Gender-sensitive Climate Risk Assessment of Kotor Bay, Montenegro

GEF MedProgramme – Enhancing Environmental Security
SCCF Project

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AUTHORS

Petar Raičević, Gordana Djurović, Mirjana Ivanov and Biljana Gligorić

REPORT COORDINATION AND REVIEW

Michael KARNER, Plan Bleu/RAC (UNEP/MAP).

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A. OVERVIEW OF THE GEF MEDPROGRAMME AND THE SCCF PROJECT

The Mediterranean area is particularly affected by adverse consequences of climate variability and change, coupled with existing socio-economic processes associated with growing bio-geographical vulnerability and exposure in the coastal areas of the region. As a result, Mediterranean coastal communities, ecosystems and assets are increasingly at risk.

The Global Environment Facility's "Mediterranean Sea Programme (MedProgramme): Enhancing Environmental Security" (2019-2024) is GEF's first programmatic multi-focal area initiative in the Mediterranean Sea. It aims to operationalise priority actions to reduce major transboundary environmental stresses in the Mediterranean's coastal areas, while strengthening climate resilience and water security and improving the health and livelihoods of coastal populations. The MedProgramme is currently being implemented in nine beneficiary countries: Albania, Algeria, Bosnia and Herzegovina, Egypt, Lebanon, Libya, Montenegro, Morocco and Tunisia.

Its Child Projects cut across four different GEF Focal Areas (International Waters [IW], Biodiversity [BD], Chemicals and Waste [CW], and Climate Change [CC]) and involve a wide spectrum of developmental and societal sectors, ranging from banking institutions, the private sector, governmental and non-governmental bodies, industry, research, media, and various other organisations. The eight Child Projects will deliver a set of complementary results embracing three categories of priorities identified by the Transboundary Diagnostic Analysis for the Mediterranean Sea, which are translated into three programme components:

I. Reduction of Land-Based Pollution in Priority Coastal Hotspots;
II. Enhancing Sustainability and Climate Resilience in the Coastal Zone;
III. Protecting Marine Biodiversity.

In this context, the Special Climate Change Fund (SCCF) Project "Enhancing regional climate change adaptation in the Mediterranean Marine and Coastal Areas" contributes to MedProgramme Component II). As the latter's only project devoted specifically to climate change adaptation, the SCCF seeks to build the capacity of people and institutions to adapt to the impacts of climate change in coastal areas, which are especially vulnerable to these impacts. Technical assistance in this project focuses on mainstreaming climate change adaptation strategies into coastal plans and facilitating access to climate financing to scale up adaptation measures in the region.

It is important to note that the activities of the SCCF Project are fully integrated with those of MedProgramme Child Project (CP) 2.1 "Mediterranean Coastal Zones Climate Resilience Water Security and Habitat Protection". CP 2.1's main goal is to support Mediterranean countries in the implementation of the Protocol on Integrated Coastal Zone Management (ICZM Protocol) in order to reduce major transboundary environmental stresses affecting the Mediterranean Sea and its coastal areas, taking into account climate change by building climate resilience and water security, and ultimately improving the health and livelihoods of coastal populations. Indeed, coastal planning processes represent a natural entry point for the implementation of climate change adaptation strategies in the Mediterranean. Amongst other activities, CP 2.1 is producing coastal plans in two areas identified as highly vulnerable to climate change in Montenegro (Kotor Bay) and in the Tangier-Tétouan-Al Hoceima Region, Morocco.

I. Climate Risk Assessment of Montenegro – national context

All sub-regions of the Mediterranean Basin, including Montenegro, are impacted by anthropogenic changes in the environment on land and in the sea. The main drivers of change include climate (temperature, precipitation, atmospheric circulation, extreme events, sea-level rise, sea water temperature, salinity and acidification), population increase, pollution, unsustainable land and sea use and non-indigenous invasive species, affecting both natural ecosystems and human livelihoods. These impacts will be exacerbated in the coming decades, especially if global warming exceeds 1.5 to 2°C above pre-industrial levels. Greatly enhanced efforts are needed in order to adapt to these inevitable changes and to increase resilience[1]. The diversity and uniqueness of the natural resources of Montenegro require decisive actions to preserve its tremendous natural and cultural heritage and potential, in accordance with the constitutional commitment of Montenegro as an ecological state. Indeed, the country's Constitution defines Montenegro as a civil, democratic, ecological and social welfare state, based on the rule of law[2].

A. LEGISLATIVE AND STRATEGIC FRAMEWORKS OF CLIMATE CHANGE POLICIES AND PROGRAMS IN MONTENEGRO

Immediately after restoring its independence, Montenegro initiated a process of consolidation in terms of the succession of international treaties concluded by former Yugoslavia and the State Union of Serbia and Montenegro, on the basis of the rules of international law that apply to succession. The Law on concluding and enforcing international treaties[3] stipulates that the rules of international law apply to the succession of international treaties if such treaties are not contrary to the Constitution and legal order of Montenegro. Montenegro thus acceded to most of the international conventions in the field of environmental protection and climate change:

- Montenegro became a party to the UN Framework Convention on Climate Change (UNFCCC) as a non-Annex-I Party in October 2006[4].
- Montenegro acceded to the Kyoto Protocol to the UNFCCC on 27 June 2007.
- Montenegro also ratified the Paris Agreement to the UNFCCC on 20 December 2017.

Montenegro's first contribution to the international community's efforts to combat climate change is expressed through its Intended Nationally Determined Contribution (INDC), submitted in 2015, which aims to achieve at least a 30% reduction in greenhouse gas emissions by 2030, compared to the 1990 baseline. Montenegro's emissions of greenhouse gases for from the sectors covered by the INDC was 5239 kilotons in 1990, and Montenegro pledged to reduce it by at least 1572 kilotons, to 3667 kilotons or less. This reduction is to be achieved by a general increase in energy efficiency, the improvement of industrial technologies, an increase of the share of renewables and a modernisation of the energy sector[5]. However, according to the Intergovernmental Panel on Climate Change (IPCC), if we are to limit warming to 1.5°C we will need to lower our CO_2 emissions by about 45% by 2030 compared to 2010 levels. Even limiting global warming to 2°C will require nothing less than transitioning to a carbon-neutral economy by the middle of this century. Hence, at the COP24 meeting in Katowice in 2018, the Parties to the Paris Agreement agreed to the so-called Katowice Climate Package ("Katowice Rulebook"). This package sets out the essential procedures and mechanisms which will make the Paris Agreement operational. One element of the Katowice Climate Package is the Nationally Determined Contributions (NDCs). Each party has to submit an update of its NDC every 5 years, describing its national climate goals and activities, with increasing ambitions over time. The underlying principle thus is common but differentiated responsibilities and respective capacities.

Montenegro is also obliged to regularly submit its national communications and biennial-update reports:

[1] MedECC 2020 Summary for Policymakers. In: Climate and Environmental Change in the Mediterranean Basin – Current Situation and Risks for the Future. First Mediterranean Assessment Report [Cramer W, Guiot J, Marini K (eds.)] Union for the Mediterranean, Plan Bleu, UNEP/ MAP, Marseille, France, p. 14.
[2] Constitution of Montenegro ("Official Gazette of Montenegro", no. 1/07, 38/13).
[3] Ibid., no. 77/08.
[4] https://unfccc.int/process/the-convention/what-is-the-convention/status-of-ratification-of-the-convention
[5] Government of Montenegro, 2015. Intended Nationally Determined Contribution (INDC) of Montenegro following decision 1/CP.19 and decision 1/CP.20 (https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Montenegro%20First/INDCSubmission_%20Montenegro.pdf)

- **National communications (NCs)** provide information on greenhouse gas inventories, measures to mitigate and to facilitate climate change adaptation, and any other information that the Party considers relevant to the achievement of the objective of the Convention. NCs are submitted every four years.
- **Biennial-update-reports (BURs)** are reports to be submitted by non-Annex I Parties, containing updates of national greenhouse gas inventories, including a national inventory report and information on the mitigation actions, needs and support received. Such reports provide updates on actions undertaken by a given Party to implement the Convention, including the status of its emissions and removals by sinks, as well as on the actions undertaken to reduce emissions or enhance sinks.

Montenegro submitted its revised nationally determined contribution in June 2021 - at least a 35% reduction in total national greenhouse gas emissions (excluding Land Use, Land Use Change and Forestry i.e., LULUCF) by 2030 compared to the 1990 baseline.

UNFCCC reporting obligation	Date of submission
The Initial National Communication (INC)	12 October 2010[6]
The Second National Communication (SNC)	28 May 2015[7]
The First Biennial Report on Climate Change (BUR 1)	13 January 2016[8]
The First Nationally Determined Contributions (NDC)	21 December 2017[9]
The Second Biennial Report on Climate Change (BUR 1)	3 May 2019[10]
The Third National Communication on climate change (TNC)	12 October 2020[11]
The Second Nationally Determined Contribution (NDC)	15 June 2021[12]
The Third Biennial Report on Climate Change (BUR III)	January 2022[13]

Table 1. Chronology of Montenegro's submission to the UNFCC (January 2022)

Multilateral Environmental Agreements in the Mediterranean

At the Mediterranean scale, a key international convention is the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and its Protocols (OG RM no. 64/07). The 22 Contracting Parties to the Barcelona Convention[14] (including Montenegro) pledged to take appropriate measures to prevent, abate, combat to the fullest possible extent, and eliminate pollution of the Mediterranean Sea, and to protect and enhance the marine environment so as to contribute towards its sustainable development. The Barcelona Convention and its seven Protocols adopted in the framework of the Mediterranean Action Plan (MAP) constitute the main legally-binding Multilateral Environmental Agreement in the Mediterranean. It includes the:

- **Dumping Protocol**: its main objective is for Contracting Parties to take all appropriate measures to prevent, abate and eliminate to the fullest extent possible pollution of the Mediterranean Sea by dumping of wastes or other matter. Montenegro has not ratified this Protocol.
- **Prevention and Emergency Protocol**: this Protocol concerns cooperation in preventing pollution from ships and, in case of an emergency, to combating pollution of the Mediterranean Sea. Montenegro has ratified this protocol.
- **Land-Based Sources Protocol**: its main objective is to take all appropriate measures to prevent, abate and eliminate to the fullest extent possible pollution of the Mediterranean Sea by land-based sources and activities, by the reduction and phasing out of substances that are toxic, persistent and liable to bioaccumulate, which are listed in the Protocol. Montenegro has ratified this Protocol.

[6] https://unfccc.int/sites/default/files/resource/INC_Montenegro_Eng.pdf
[7] https://unfccc.int/sites/default/files/resource/mnenc2_eng.pdf
[8] https://unfccc.int/sites/default/files/resource/MONBUR1.pdf
[9] https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx
[10] https://unfccc.int/sites/default/files/resource/SECOND%20BIENNIAL%20UPDATE%20REPORT%20ON%20CLIMATE%20CHANGE_Montenegro.pdf
[11] https://unfccc.int/sites/default/files/resource/TNC%20-%20MNE_0.pdf
[12] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Montenegro%20First/Updated%20NDC%20for%20Montenegro.pdf
[13] Adopted by the Government of Montenegro on 23 December 2021;
[14] The Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention) was adopted on 16 February 1976 in Barcelona and entered into force in 1978. The Barcelona Convention was amended in 1995 and renamed as the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean. The amendments to the Barcelona Convention entered into force in 2004. (https://www.unep.org/unepmap/who-we-are/barcelona-convention-and-protocols)

- **Specially Protected Areas and Biological Diversity Protocol**: under this Protocol, Contracting Parties are called upon to protect areas of particular natural or cultural value, through the establishment of Specially Protected Areas (SPAs) or Specially Protected Areas of Mediterranean Importance (SPAMIs), and to protect the threatened or endangered species of flora and fauna listed in the Protocol's Annexes. Montenegro has ratified this protocol.
- **Offshore Protocol**: addresses all aspects of offshore oil and gas activities in the Mediterranean, and includes measures to reduce pollution from all phases of offshore activities. Montenegro has not ratified this Protocol.
- **Hazardous Wastes Protocol**: its overall objective is to protect human health and the marine environment against the adverse effects of hazardous waste. Montenegro has not ratified this protocol.
- **Integrated Coastal Zone Management (ICZM) Protocol**: Parties are called upon to take the necessary measures to strengthen regional cooperation in order to meet the objectives of ICZM. Such measures include those aimed at protecting the characteristics of certain specific coastal ecosystems, those aimed at ensuring the sustainable use of the coastal zone, and those aimed at ensuring that the coastal and maritime economy is adapted to the fragile nature of coastal zones. Montenegro has ratified this Protocol.
- **Regional Climate Change Adaptation Framework for the Mediterranean Marine and Coastal Areas**: this Framework defines a regional strategic approach to increase the resilience of the Mediterranean marine and coastal natural and socioeconomic systems to the impacts of climate change, with a goal of assisting policy makers and stakeholders at all levels in the development and implementation of coherent and effective policies and measures[15].

Montenegro's legislative framework on climate change

- **The Law on Environment** (OGM no. 52/16, 73/19) is Montenegro's environmental umbrella Law. It lays down the principles of environmental protection and sustainable development, entities, environmental protection instruments and measures, access to information, public participation, access to justice in environmental matters, environmental financing and other issues relevant to the environment. Beside this Law, there are a large number of other laws and implementing acts regulating specific environmental issues. This Law enabled the establishment of the Environmental Protection Fund by a special Government Decision (OGM no. 81/18 and 5/20). In addition, numerous normative acts have been adopted in the area of environmental protection[16].
- **The Law on protection against the negative impacts of climate change** (OGM no. 73/19): regulates protection against the negative impacts of climate change, reducing greenhouse gas emissions, protecting the ozone layer and other issues related to climate change. It introduces the obligation to develop a Low Carbon Development Strategy, a National Climate Change Adaptation Plan, the preparation of greenhouse gas emission inventories, obtaining special permits for emissions by industrial infrastructure, monitoring reporting and verification of greenhouse gas emissions for aircraft operators and industrial and energy installations, as well as issuing permits for activities that deplete the ozone layer. The Law is designed in such a way that it does not represent an obstacle to the Montenegrin economy's competitiveness of the Montenegrin economy, while facilitating its integration into the global market. Law on the protection from negative impacts of climate change is also implemented by the set of twelve rulebooks[17].

15 https://climate-adapt.eea.europa.eu/metadata/guidances/regional-climate-change-adaptation-framework-for-the-mediterranean-marine-and-coastal-areas

16 Law on strategic environmental impact assessment (OG RM no. 80/05, OGM 73/10, 40/11, 59/11, 52/16), Law on environmental impact assessment (OGM 75/18), Law on waste management (OGM no. 64/11, 39/16), Law on Municipal Wastewater Management (OGM 2/17), Law on Nature Protection (OGM no. 54/16, 18/19), Law on Chemicals (OGM no. 51/17), Law on Air Protection (OGM no. 25/10, 40/11, 43/15, 73/19), Law on Liability for Environmental Damage (OGM no. 27/14, 55/16), Law on Protection against environmental noise (OGM no. 28/11, 01/14, 2/18), Law on protection against ionizing radiation and radiation safety (OGM, no.56/09, 58/09, 40/11, 55/16), Law on sea (OGM no. 17/07, 06/08, 40/11), Law on the protection of the maritime environment (OGM no. 73/19), Law on coastal zone (OG RM no. 14/92, 59/92, 27/94, ORM no. 51/08, 21/09, 73/10, 40/11), Law on prevention of marine pollution from vessels (OGM 12/11, 26/11, 27/14), etc.

17 Regulation on detailed manner and necessary documentation for issuance of permits for installation, maintenance and/or repair activities as well as for exclusion from use of equipment and products containing ozone-depleting substances or alternative substances (OGM no. 82/21); Rulebook on manner and necessary documentation for issuing licences for import and/or export of ozone depleting substances and alternative substances (OGM no. 69/20); Rulebook on content of the label, guides, posters, displays and promotional literature and materials on fuel consumption and carbon dioxide emissions from new passenger vehicles (OGM no, 113/20); Rulebook on detailed conditions of access to the carbon dioxide transport network, procedure and criteria for acceptance of carbon dioxide flows (OGM no. 12/21); Rulebook on the manner of preparation and content of inventory of greenhouse gas emissions (OGM no. 55/20); Rulebook on the manner of determining obligatory goals for reducing greenhouse gas emissions (OGM no. 57/20); Rulebook on the form, content and manner of verification of the greenhouse gas emissions report (OGM no. 13/21); Rulebook on the greenhouse gas permit form and the manner of keeping records (OGM no. 13/21);

- The **Decree on ozone depleting substances and alternative substances** (OGM no. 79/21) - prescribes the production, use, export and import of ozone-depleting substances and alternative substances, including equipment and products containing such substances. These rules also aim at a gradual reduction of the consumption of ozone-depleting substances.
- The **Decree on activities that emit greenhouse gases** (OGM no. 8/20) introduces a normative framework for limiting the emission of greenhouse gases from industrial and energy plants in the country. Key elements of this regulation include the specification of operators participating in the emissions trading scheme (ETS); determining the total amount and minimum price of emission credits sold at auction; the manner of recording the granted emission credits; their transfer and use as well as the purpose of the funds collected by the auction of emission credits. Finally, this regulation paves the way for the implementation of a national ETS containing an auction lowest price that could ultimately help the market to connect with the European Union's ETS. The funds will be directed to the Environmental Protection Fund, and income will be allocated to environmental protection measures, support for renewable energy production and innovation finance.
- The **Decree on aviation activities for which the plan on monitoring of greenhouse gas emissions is not delivered** (OGM no. 27/21) - determines in Annex 1 the list of aviation activities for which the plan on monitoring of greenhouse gas emissions shall not be done or delivered.
- The **Law on Industrial Emissions** (OGM no. 17/19) regulates measures for the prevention and control of emissions from industrial plants. Law on industrial emissions is also implemented by the set of ten rulebooks[18].
- The **Decree on types of activities and installations for which an integrated licence is issued** (OGM no. 68/19) - installations may start operations only on the basis of an integrated permit. The decree prescribes types of activities and facilities with capacities within each type of activity for which a permit is issued.
- The **Decree on emission limit values from combustion plants and methods of calculating emission limit values for installations using multiple types of fuel** (OGM no. 129/21) - makes provisions to reduce the emission of certain pollutants from large combustion plants.
- The **Law on protection and rescue** (OGM no. 13/07, 5/08, 86/09, 32/11, 54/16) consists of provisions related to conducting preventive, operational and recovery activities as well as measures to mitigate and reduce risks related to hazards. Plans for protection and rescue against different types of natural and man-made hazards at the national, local, and company include preventive, operational and recovery measures which have to be carried out by protection and rescue actors.

1. Responsible institutions

Table 2 summarises the key institutions and their responsibilities in terms of climate change management in Montenegro:

Organization	Acronym	Responsibilities
Ministry of Ecology, Spatial Planning and Urbanism - MESPU (Climate Change Division of the Climate Change and Mediterranean Affairs Directorate)	MESPU	In charge of climate policy adoption, implementation and monitoring. The Climate Change Division is the focal point of the UNFCCC and the Green Climate Fund (GCF).
Environmental Protection Agency	EPA	Works under the MESPU and has an important role in inventorying GHG emissions.
Institute of Hydrometeorology and Seismology	IHSM	IHSM is a state administration body responsible for numerous competencies in the fields of meteorology, climatology, hydrology, hydrography,

Rulebook on contents of the plan for monitoring of greenhouse gas emissions from aircrafts (OGM no. 102/20); Rulebook on the professional training of persons performing the installation, maintenance and repair activity and exclusion from the use of equipment and products containing ozone depleting substances (OGM no. 132/21); Rulebook on contents of the plan for monitoring of greenhouse gas emissions from stationary sources (OGM no 92/20); Rulebook on conditions regarding personnel and equipment for a legal entity that verifies the report on greenhouse gas emissions (OGM no. 12/21)

[18] Rulebook on emission limit values for pollutants, monitoring methods and operating conditions of waste incineration and co-incineration plants (OGM no. 79/20); Rulebook on limit values for emissions of pollutants, technical measures for exemption from the application of limit values and the method of monitoring (OGM no. 61/20); Rulebook on the criteria for determining the best available techniques for environmental protection and the list of pollutants from industrial plants (OGM no. 35/19); Rulebook on the manner of monitoring emissions into water and air from existence that produce titanium dioxide (OGM no. 70/20); Rulebook on the integrated permit form (OGM no. 59/19, 60/21); Rulebook on the content and manner of submitting applications for the issuance of an integrated permit (OGM no. 55/20); Rulebook on the conditions of use and release of mercury and mercury compounds (OGM no. 68/19); Rulebook on types of activities, emission limit values and the manner of monitoring in plants using organic solvents (OGM no. 30/20); Rulebook on the manner of preparation and content of the inventory of emissions of pollutants in the air (OGM no. 73/18); Rulebook on technical standards for air protection against emissions of vaporised organic compounds resulting from storage, flowing and distribution of motor gasoline (OGM 7/14, 8/19.

		oceanography and seismology, and operates meteorological and hydrological observation and forecasting systems on the entire territory of Montenegro. IHSM is also the contact institution for the Intergovernmental Panel on Climate Change (IPCC).
Environmental Protection Fund (Eco-fond)		Established in 2020, it finances the preparation, implementation and development of programs and projects in the fields of conservation, sustainable use, protection and improvement of the environment, energy efficiency and use of renewable sources and energy at the state and local levels.
Ministry of Economic Development	MED	In charge of energy and industrial policy.
Ministry of Agriculture, Forestry and Water Management	MAFWM	In charge of agricultural and forestry policy.
Ministry of Capital Investments	MCI	Plays an important role in climate change policy formulation, especially with regards to transport and energy.
Ministry of Internal Affairs (Directorate for Emergencies)	MIA	Plays an important role in climate change policy formulation.
National Council for Sustainable Development (2022)	NCSD	Responsible for the development, monitoring and implementation of national sustainable development and climate change policies. Also involved in the planning and alignment of development policies with sustainable development and climate change requirements, and the implementation of the European Union's sustainable development frameworks under the Energy and Climate Package. Its Working Groups include: ● Monitoring and implementing sustainable development policy ● Mitigation and adaptation to climate change ● Integrated coastal zone management ● Sustainable development at the local level ● Financing for sustainable development[19]
Mitigation and Adaptation Working Group (Working group of the NCSD)		Offers support and guidance to national climate policy to implement mitigation and adaptation measures to the adverse impacts of climate change. The working group is an intergovernmental body composed of representatives of all relevant authorities, civil society, business alliances and academia.

Table 2. Institutions responsible for climate change management in Montenegro

Besides the institutions mentioned, key institutions concerning Montenegro's National Monitoring, Reporting and Verification System (MRV) important institutions are the following:

- Various sectors relevant to the National Climate Change Strategy (NCCS) and the MRV are represented by Directorates under the MESPU, namely: planning (land use planning); construction (some climate change mitigation measures are related to construction standards and design); tourism (a key sector for the country's economy which is vulnerable to climate change); environment and climate change; waste management and communal development (waste management is a source of emissions that also offers opportunities to generate energy);
- Statistical Directorate of Montenegro (MONSTAT): energy mix and production, agricultural production and structure, waste statistics, industrial production, etc,
- Forestry Authority: agriculture, forestry, land use data;
- Institute for Marine Biology: marine biology data;
- Ministry of Interior: database of registered vehicles[20]

As an EU Accession country and non-Annex I Party to the UNFCCC, Montenegro has a growing number of legal reporting requirements concerning climate change. The challenge was to develop the institutional capacity and data collection and management processes to ensure a transparent and accessible flow of information for international reporting and national policy formulation. The MRV enabling Montenegro to establish a strong team of experts, committed stakeholders and robust data gathering systems to inform decision makers on climate actions[21].

[19] Decision on the establishment of the National council for sustainable development, available online at: https://www.gov.me/dokumenta/b488f201-8661-4fdf-930f-ee08fafc661d.

[20] TNC,

[21] https://www.aether-uk.com/Case-studies/Montenegro-Climate-Change-Action-MRV-System

2. Strategic frameworks

Since the adoption of the Agenda for Sustainable Development 2030 by the United Nations General Assembly in September 2015, Member States around the world have been encouraged to integrate its goals into the strategic policies and practises of their countries. The 2030 Agenda and its 17 Sustainable Development Goals (SDGs) and 169 sub-goals sets an ambitious agenda for eradicating all forms of poverty, suppressing inequalities, protecting the environment and tackling climate change.

- Montenegro integrated the UN Sustainable Development Strategy 2030 by adopting the **National Sustainable Development Strategy** (NSSD) in July 2016, together with an accompanying action plan[22]. The NSSD 2030 is defined as an umbrella, horizontal and long-term development strategy that refers not only to the environment and economy, but also to human resources, valuable social capital and recommendations for establishing a financing and management framework for sustainable development[23]. Its Action Plan is divided into six thematic areas (human, social, natural and economic capital, management and financing of sustainable development), and is an important instrument for guiding and accelerating the 2030 Agenda in the country. In addition, Montenegro was among a group of 22 United Nations member states that voluntarily conducted a national review of the planning process to enable the implementation of the 2030 Agenda at the High-level Political Forum on Sustainable Development in 2016[24]. The preparation of the first comprehensive report on the implementation of the NSSD is underway.
- **The National Strategy on Climate Change (NSCC)** was adopted in September 2015. It represents a key strategic overview of climate change in Montenegro until 2030, and provides guidelines for climate change policies as well as an analysis of mitigation measures and actions that will be implemented in this period to reduce greenhouse gas emissions. The NSCC and NSSD cannot be implemented without integrating their objectives into relevant sectoral strategies and policies, while defining market instruments and earmarking financial resources to support their implementation.
- In 2016, the Government adopted **the National Strategy with Action Plan for the Transposition, Implementation and Enforcement of the EU acquis on Environment and Climate change 2016-2020**.
- The **National Strategy for Integrated Coastal Zone Management 2015 – 2030 (NSICZM)**[25] is an integral part of the NSSD 2030. Preparation of the ICZM Strategy for Montenegro was undertaken in parallel with the preparation of the Coastal Area Spatial Plan, the most important planning document for coastal areas in Montenegro. The main goals of the ICZM strategy are:

  a. the efficient preservation of nature, landscape and cultural assets;
  b. spatial planning and sustainable spatial development;
  c. the development of infrastructure for pollution prevention and remediation;
  d. improving the performance of the coastal zone economy;
  e. improving the coastal zone management system;
  f. strengthening of human resources and social cohesion.

Bearing in mind the fact that the Montenegrin coastline is only 300 km long, but that it is experiencing high pressure from coastal urbanisation, the ICZM Strategy for Montenegro was designed to incorporate elements of the management plan as a guide for the preparation and implementation of the Coastal Area Spatial Plan, in line with the requirements of the ICZM Protocol. Specific recommendations for the plan were based on the results of a vulnerability assessment adapted for use within coastal management strategies and plans. The results of the vulnerability assessment clearly show exceptional vulnerability of the environment in the coastal zone of Montenegro where 35% of the area is highly vulnerable. The main recommendations include criteria and guidelines for determining future land uses, the key instruments enabling their implementation, and proposing an appropriate mechanism for coordinated planning and management [26].

[22] http://www.nssd2030.gov.me/
[23] Galli Alessandro, Djurovic Gordana, Hanscom Laurel and Knezevic Jelena (2018). Think Globally, Act Locally: implementing the Sustainable Development Goals in Montenegro, Environmental Science and Policy, Volume 84, June 2018, pp. 159–169, DOI 10.1016/j.envsci.2018.03.012;
[24] UN, High Level Political Forum on Sustainable Development 2016, Voluntary national reviews at the HLPF 2016 - Montenegro https://sustainabledevelopment.un.org/content/documents/10695Montenegro%20-%20HLPF%20Report.pdf
[25] https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf
[26] Integrated Coastal Zone Management Strategy in Montenegro, MedPartnership Project, 2015 (https://iwlearn.net/resolveuid/2adc054d-d6f0-405e-9aa9-c4db31cbc269);

- Disaster Risk Reduction Strategy with the Dynamic Action Plan for the Implementation of the Strategy for the period 2018-2023 (DRR): a strategic framework for reducing and combating new risks and strengthening the capacity of society in response to various types of natural and man-made disasters. According to the new legislation and the Strategy, the following plans were adopted:
  - National Plan for Protection and Rescue from Earthquakes (2018);
  - National Plan for Protection and Rescue from Fires (2018);
  - National Plan for Landslide Protection and Rescue (2021);
  - In addition, there are municipal plans for protection and rescue from floods, protection and rescue from fires, for protection and rescue from earthquakes, and entrepreneurial plans for protection and rescue from fires[27].

Name of the strategy	Period	Main foci	Remarks
Water Management Strategy of Montenegro	2018-2035[28]	Groundwater and surface water management	The Strategy includes an evaluation of the current situation in the area of water management, goals and objectives, guidelines for water management, measures to be implemented and development projections for sustainable water resources and management. Floods as a natural hazard are included in the rationale of the strategy, also the importance of risk assessment as part of the management of flood risks and flood control measures are mentioned. Floods are primarily viewed within the context of climate change and its impacts on water flows, surface and groundwater for the water supply for settlements.
National Strategy for the Development of Forests and Forestry	2014-2023[29]	Management framework in the forestry sector	Forest fires are mentioned as a threat caused by climate change, including the expected adverse impacts of climate change on certain forest species.
Smart Specialisation Strategy	2019-2023	Strategic framework for digital and smart development	Within four priority economic areas additional support will be provided under this Action within three vertical priorities: sustainable agriculture and food value chains; energy and sustainable environment; sustainable and healthy tourism, and one horizontal priority: Information and Communication Technologies.
Transport Development Strategy	2019-2035[30]	Field of transport, transport system development	The Transport Development Strategy defines five strategic goals: a) economic welfare, b) Accessibility, performance of operations and quality of services, c) Safety and security, d) EU Integration, and e) **Environmental sustainability**.
Waste Management Strategy	2015-2030[31]	Waste	Provides a timeline and defines the main instruments/measures to secure alignment with and implementation of the EU waste legislation; and Municipal wastewater Management plan 2020-2035 – plan of major investments in the area of construction or modernization of urban waste water collection and treatment system, and introduction of new water treatment and water supply technologies.
Energy Development Strategy	2014-2030	Security in the energy supply; Sustainable energy development	Securing the sustainable development of energy sector based on accelerated, but rational use of own energy resources in compliance with the principles of environment protection, increased energy efficiency (EE) and increased use of renewable energy sources (RES), as well as need for socio-economic development of Montenegro.
Energy Efficiency Action Plan	2019-2021[32]	Energy efficiency	Indicative target for improving EE on the side of final energy consumption for the period 2019 - 2021 is given in the Fourth APEE, in accordance with the EE Directive[33]which requires each country to start from 2017 achieving annual energy savings in the amount of 0.7% of total final energy consumption (4.16 ktoe per year in the period 2019-2021).[34].

[27] https://ec.europa.eu/echo/what/civil-protection/national-disaster-management-system/montenegro_en
[28] https://javnepolitike.me/wp-content/uploads/2020/07/Strategija-upravljanja-vodama-2017-2035.pdf
[29] https://www.gov.me/dokumenta/e123f7b9-669c-428f-99b6-66c6da9bf2f1
[30] https://www.gov.me/dokumenta/a080d54d-0b87-4d8c-bfbf-bdc8ae5dc8bb
[31] Plan upravljanja komunalnim otpadnim vodama (on Montenegrin); https://www.gov.me/dokumenta/0e52a4d6-e200-4e20-b721-01bec2a7eb10
[32] https://www.energy-community.org/dam/jcr:c1fa6e92-54fe-467a-9c08-53cd3fad957d/4thNEEAP_MO_201907.pdf
[33] Directive 2012/27/EU
[34] Fourth Action plan on energy efficiency of Montenegro for the period 2011-2021.

	Strategy for the development of maritime economy of Montenegro	2020-2030[35]	Development of a sustainable economic environment favourable for the blue economy	In line with components of the quintuple helix model, strategic goals are the following: 1. private sector - To increase the contribution of the maritime economy and related activities to overall economic development; 2. To strengthen capacities of the Montenegrin maritime administration and simplify administrative procedures; 3. To ensure a more intensive involvement of the civil sector, particularly professional non-government associations, in all processes that precede the adoption of strategic decisions, legislative pieces, and proposing system solutions for overcoming challenges in the maritime economy sector; 4. To ensure that the expert community becomes a driver of maritime economy development; and 5. To ensure that maritime economy growth is based on green economy principles.
	Draft air quality management strategy	2021-2029[36]	Air quality standards	The Strategy focuses on timely response of authorities in case of violation of stipulated air quality standards. This strategic document envisages measures for protection and preservation of air quality and for prevention of deterioration of air quality through careful planning of sustainable development, particularly in the sectors that significantly contribute to pollution.
	Health tourism development programme	**2021-2023[37]**	Health tourism	Key sector for the country's economy which is vulnerable to climate change
	Rural tourism development programme	**2019-2021[38]**	Rural tourism	Key sector for the country's economy which is vulnerable to climate change
	Culture tourism development programme	**2019-2021[39]**	Culture tourism	Key sector for the country's economy which is vulnerable to climate change
	Action plan for fulfilment of closing benchmarks of the negotiation chapter 27. Environment and climate changes	(18 February 2021)[40] **with costing till 2025** (23 December 2021)[41]	Environment and climate changes	Detailed plan of measures and actions to fulfil eight closing benchmarks for chapter 27. in ten sub-areas of policies (Horizontal Legislation, Air Quality, Waste Management, Water Quality, Nature Protection, Industrial Pollution, Chemicals, Noise, Civil Protection and Climate Change).
	Road map of completing the closing benchmarks for temporary closure of the negotiation chapter 27. Environment and climate change	2021	Environment and climate change	Roadmap of measures and actions to fulfil eight closing benchmarks for chapter 27. in ten sub-areas of policies (Horizontal Legislation, Air Quality, Waste Management, Water Quality, Nature Protection, Industrial Pollution, Chemicals, Noise, Civil Protection and Climate Change).
Ongoing strategies and plans on national level	**Development of the Regional development strategy (ongoing)**	**2022-2027**	Regional Development	In line with the Regional Development strategy, each municipality is obliged to prepare a local strategic development plan. Partially focuses on climate change adaptation.
	Draft Economic Reform Programme (ongoing)	**2022-2024**	Economic reforms	ERP 2022 -2024 will provide new comprehensive overview of structural reform measures for reduction or elimination of impediments to the economic growth and strengthening of the country's overall competitiveness, with project connected to climate change adaptation.
	Strategy for tourism Development by 2030 (ongoing)	**Until 2030**	Tourism development	Key sector for the country's economy which is vulnerable to climate change

[35] https://www.gov.me/en/documents/452e9a0d-305d-41a4-bd57-e5d8c0ae869d
[36] https://wapi.gov.me/download/11674b76-fe5c-4fcc-b0ac-9b3f681e633b?version=1.0
[37] https://javnepolitike.me/en/strategy-documents/
[38] https://www.gov.me/dokumenta/584397fd-ee44-4a60-b627-98ed16703978
[39] https://www.gov.me/dokumenta/79f74dbe-1fe3-4949-b8ca-395e7dcf5d1c
[40] https://www.gov.me/dokumenta/abaef2f4-d824-4d42-a05d-e6a8ad92a09d
[41] https://www.gov.me/dokumenta/3683da88-20bf-44c8-b9c5-a41e3473e80a

	Spatial plan of Montenegro till 2040 (ongoing)	**Until 2040**	Spatial planning	Land use and some climate change mitigation measures are related to construction standards and design
	NECP 2030, National Energy and Climate Plan (ongoing)	**Until 2030**	Energy and Climate	Montenegro shared draft chapters of the NECP with the Secretariat for an informal review in May 2021 and has refined the document since then[42].
	Montenegro's National Climate Change Adaptation Plan (ongoing)		Climate change adaptation	
	National Strategy for Drought Management (ongoing)		Droughts	

Table 3. Other relevant national strategies and plans related to climate change

Strategic framework of targeted municipalities

When it comes to targeted municipalities in the Boka Kotorska Bay, they have obligation to adopt Local strategic development plans. This comes from the law on Regional Development[43] which defines the duty to adopt strategic plans for the development of local self-government units, in line with the Regional Development Strategy of Montenegro.

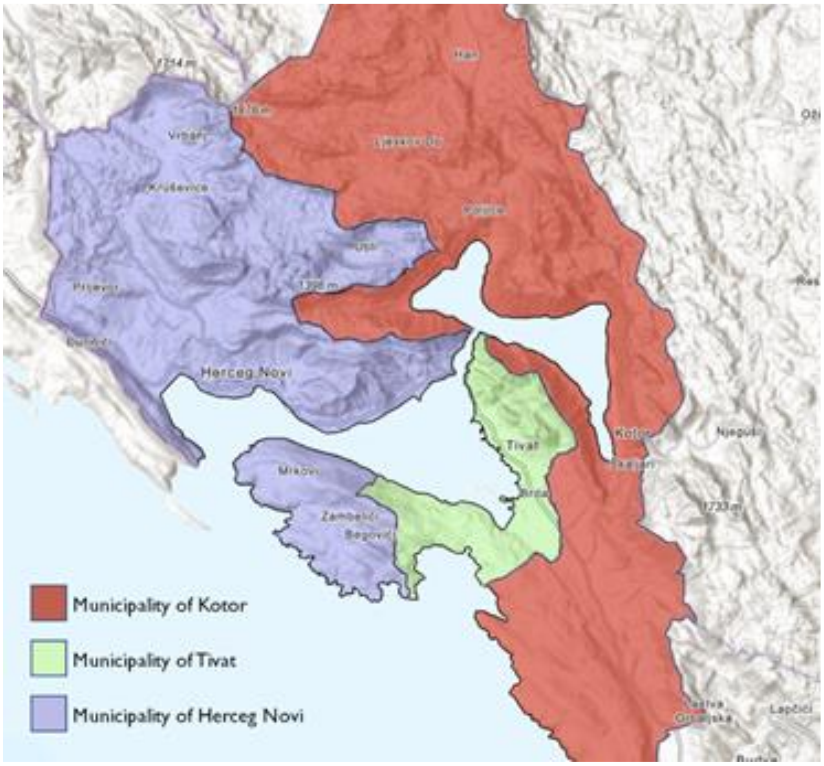


Figure 1. Targeted municipalities in Boka Kotorska Bay

[42] https://www.energy-community.org/implementation/Montenegro/CLIM.html
[43] OGM no. 20/11. Available online at: https://me.propisi.net/zakon-o-regionalnom-razvoju/

Strategic Plan for the Development of the Municipality of Kotor for the period 2020-2024	Strategic plan for the development of the municipality of Herceg Novi for the period 2020-2027	Strategic plan for the development of the municipality of Tivat for the period 2019-2022
Development of infrastructure (developing road infrastructure, water supply and sewage system improvement, developing buildings for common utilities, improving the electricity supply, developing the Port of Kotor)	Further infrastructure development	Economic development, landscaping and environmental protection;
Development of economic activities	Sustainable economic development	Construction of communal infrastructure;
Development of culture, sport, education and social protection	Development of the quaternary sector and social activities	Development of sports and culture;
Protection and valorisation of cultural and natural heritage and environment (Integral protection of cultural and natural heritage through constant control of local urban development; conservation of biodiversity, protected areas and environmental protection; Use of renewable energy sources and improvement of energy efficiency; Valorisation of cultural and natural heritage and environment)	Strengthening the administrative capacity of local self-government	Social policy;
Information and technological development of the municipality of Kotor (improving wireless internet, development of digital innovations, technological development)	Environmental protection (Better condition of communal infrastructure in 2027; Landfill till 2027; Better situation in the field of energy efficiency in 2027; Mapped potential hazards and estimated risks of pollution and natural disasters; Sustainable management and protection of the Orjen Nature Park in 2027).	International projects and energy efficiency;
Improvement of the Local self-government		

Table 4. Strategic goals and priorities in the strategies of targeted municipalities

Another relevant law that targets one of the municipalities of Boka Kotorska Bay is the **Law on the protection of the natural and cultural-historical area of Kotor** (OGM no. 56/13, 13/18 and 67/19), which regulates the protection, management and special measures for the preservation of the natural and cultural-historical area of BKB, which is inscribed on the UNESCO World Heritage List as a natural and cultural asset.

B. NATIONAL METEOROLOGICAL TRENDS

1. Observed and projected changes in temperature

Montenegro belongs to the middle part of the moderate warm belt, from 41^0 52' to 43^0 32' northern geographical latitude and 18^0 26' to 19^0 22' eastern geographical longitude. The climate is modified by large bodies of water (the Adriatic Sea and Skadar Lake) and the relief and orientation of mountain chains located near the coast. Climate monitoring and assessments show that the climate in Montenegro is changing as a result of global climate change and variability. Atmospheric and climatic variability in Montenegro is affected by:

- The North Atlantic Oscillation (NAO);
- The Genoa cyclone and Siberian anticyclone;
- Air depressions in the Adriatic;
- Cyclones across the Adriatic or Mediterranean Sea and high pressure over North Africa;
- The influence of El Nino when it is strongly developed.

Climate change refers to long-term changes of the mean state of the atmosphere. One of the clearest signals is an increase in temperature. According to the data of the Institute of Hydrometeorology and Seismology (IHMS), Montenegro's mean annual temperature from 1981-2010 shifted to a warmer climate than from 1961-1990. The

highest changes (+0.75 ^{0}C) are in the northern and north-eastern mountainous region where the climate is moderately cold[44].

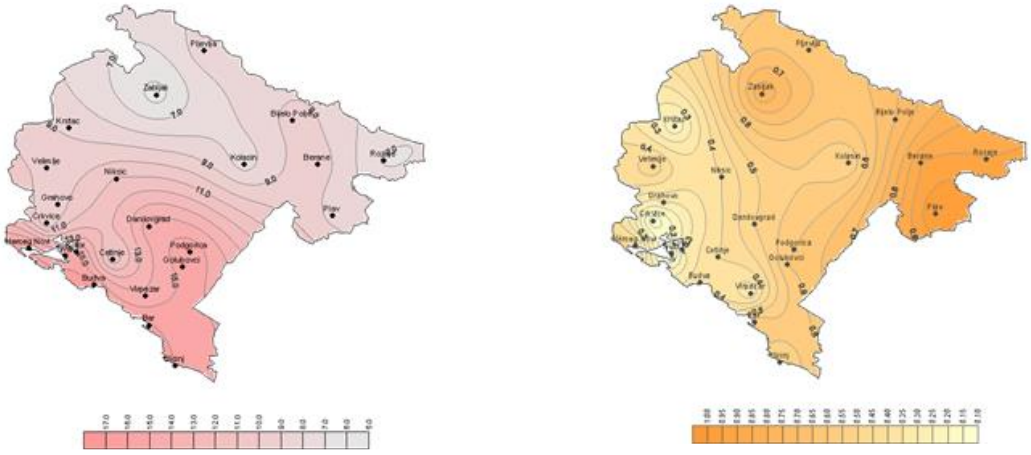


Figure 2. Spatial distribution of average annual temperature from 1981-2010 (left) and its deviation from the climatological normal from 1961-1990 (right)[45]

There is a clear trend of increasing annual temperature after the decade 1970-1980, as illustrated in Table 5.

Region	Reference period	Average annual temperature (^{0}C) per decade and its changes								
	61-90[46]	51-60	61-70	71-80	81-90	91-00	01-10	11-20	Δ1	Δ2
Northern (Žabljak)	4.6	-	4.7	4.5	4.7	5.4	6.0	6.4	+1.4	+1.8
Central (Podgorica)	15.3	15.5	15.4	15.0	15.4	15.8	16.3	17.0	+1.0	+1.8
Coastal (Bar)	15.5	15.7	15.7	15.3	15.6	15.9	16.8	17.4	+1.3	+1.9
Δ1	Deviation of the mean annual temperature for the period 2000-2010 from the climatological normal 1961–1990;									
Δ2	Deviation of the mean annual temperature for the period 2011–2020 from the climatological normal 1961-1990									

Table 5. The average annual temperature per decade and deviation from the climatological normal 1961-1990

Regarding seasonal changes, summers have become very hot, especially in the last 20 years (cf. Figure 3). The upward sloping trendline of seasonal temperature indicates a warming trend since the beginning of measurements from 1949-1958. The warming trend is highest in summer and lowest in winter, and higher in spring than in autumn. The examples are presented for two meteorological stations: Žabljak represents the coldest climate, while Podgorica's climate is Mediterranean with the hottest and very dry summer in the country. The highest temperature of 44.8^{o}C was measured in Podgorica in August, 2007, and is an absolute national record.

[44] Köppen climate classification (T of January <-3 ^{0}C and T of July > +10 ^{0}C).
[45] Institute of Hydrometeorology and Seismology of Montenegro, Second National Communication of Montenegro to UNFCCC
[46] The period 1961–1990 represents the climatological normal in relation to which climate change is observed. The period was chosen by the World Meteorological Organisation and refers to the climate described by the mean values of the meteorological elements obtained from the 30-year measurement period.

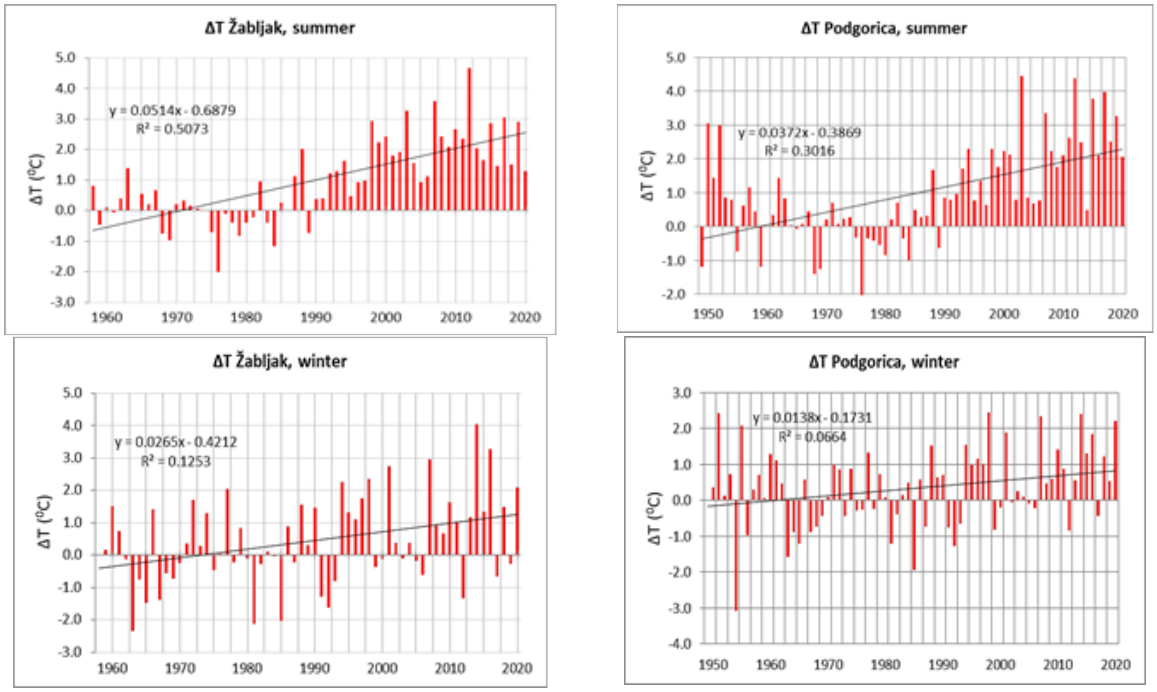


Figure 3. Deviation of average summer and winter temperature in Žabljak and Podgorica with respect to the 1961-1990 period

Projected changes of average annual and seasonal temperatures

Projections of average annual temperature[47] show that the future climate will shift towards warmer conditions, with more extreme hot weather and less extreme cold weather. The expected range of average annual temperature is from +1.5 to +2 °C over the whole country. Projections for the other two periods are presented in Figure 4 below.

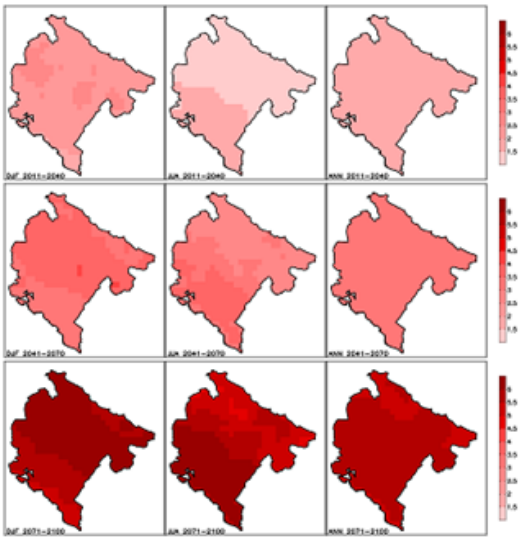


Figure 4. Changes (°C) of average winter (DJF), summer (JJA) and annual (ANN) temperatures, for the periods 2011-2040, 2041-2070 and 2071-2100 with respect to 1971-2000, for scenario RCP8.5, using the NBM (National Blend Model)

[47] To design climate projections for Montenegro, the analysis of the Third National Communication used the regional GHG emission scenario RCP8.5 established by the IPCC – AR5 (IPCC, 2014), which was done using the NMMB - regional non-hydrostatic model. RCP - Representative Concentration Pathways. RCP8.5 is the energy imbalance of 8.5 W / m^2 in the climate system that is caused by concentration of CO_2 of 900 ppm.

The expected range of winter temperature is between +2 and +2.5 °C for the first 30 years, with higher changes for some mountains of the northern region than in the rest of the country. Moreover, the northern mountainous region is expected to experience higher changes in average winter temperature in the second and third 30-year period than other regions. More warming in the summer is expected in the south than in the north: the expected range of summer temperature is around +2 °C in the first 30 years for the whole country.

1. Observed and projected changes in maximum and minimum temperature

Climate change modifies extreme weather and climate events.[48] According to the indicators recommended by the ETCCDI[49] Expert's Group of the World Meteorological Organisation, the results presented here are based on a daily maximum temperature TX, a daily minimum temperature TN (known as extreme temperatures in statistical terminology), and a daily mean temperature TM. There is an increase in maximum and minimum temperature in Montenegro with respect to climatological mean 1961-1990. The Normalized Index[50] shows that these increases are more frequent in the "warm", "very warm" and "extremely warm" categories since 2000, as shown in Figure 5.

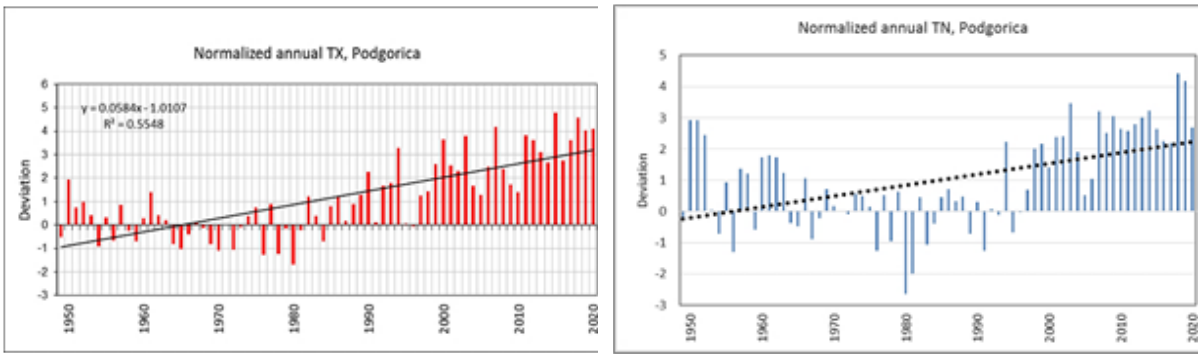


Figure 5. Normalized deviation of average TX and TN in Podgorica with respect to the 1961-1990 climatological mean

Considering specific thresholds for the TX and TN the number of summer days[51], tropical days and tropical nights increase significantly relative to the 1961-1990 reference period. Significant positive changes occur in the warm days and nights[52], the length of heat waves, and negative changes occur in the number of frosty days. Changes in the growing season length[53] are significant in Žabljak and in the number of frosty days in Bar (cf. Figure 6). Figure 7 shows the examples of increase frequency (i.e., numbers) of warm days in Žabljak, Podgorica, and Bar for the period 1950–2010.

[48] https://ane4bf-datap1.s3-eu-west-1.amazonaws.com/wmocms/s3fs-public/event/related_docs/DraftversionoftheGuidelinesontheDefinitionandMonitoringofExtremeWeatherandClimateEvents.pdf?h2Kr0f7dXp6CXZzoclQYveoEQ9FNoO5r

[49] Expert Team on Climate Change Detection and Indices.

[50] Normalised index $(Tx\text{-}Txavr_{61\text{-}90})/stdev_{61\text{-}90}$.

51 Summer days are days when TX> 25 0C; Tropical days are days when TX>30 0C; Tropical nights are days when TN >20 0C.

52 Warm days are calculated as the number of days when TX > 90th percentile; Warm night are days when TN > 90th percentile.

53 Growing season length (GSL) is annual number of days between the first occurrence of 6 consecutive days with TM > 5 °C and the first occurrence of 6 consecutive days with TM < 5 °C.

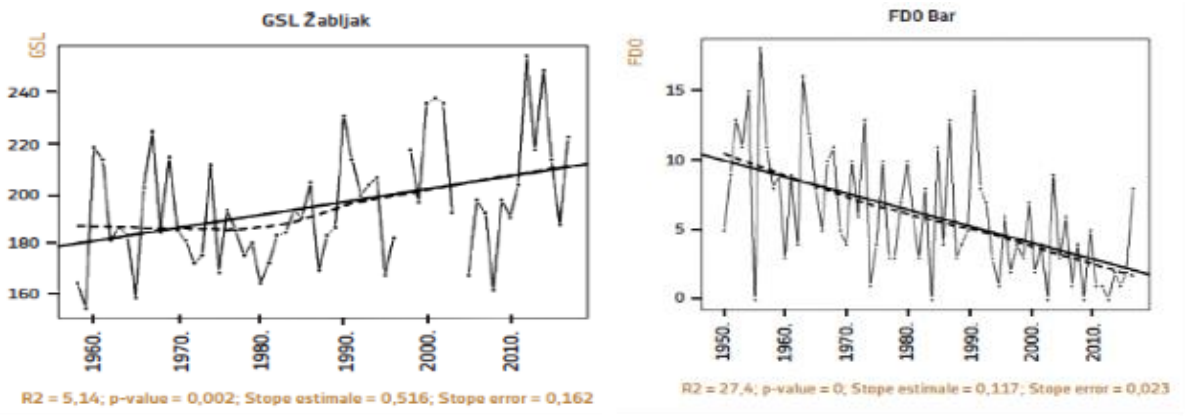


Figure 6. Changes in growing season length (GSL) in Žabljak and number of frosty days (FD0) in Bar

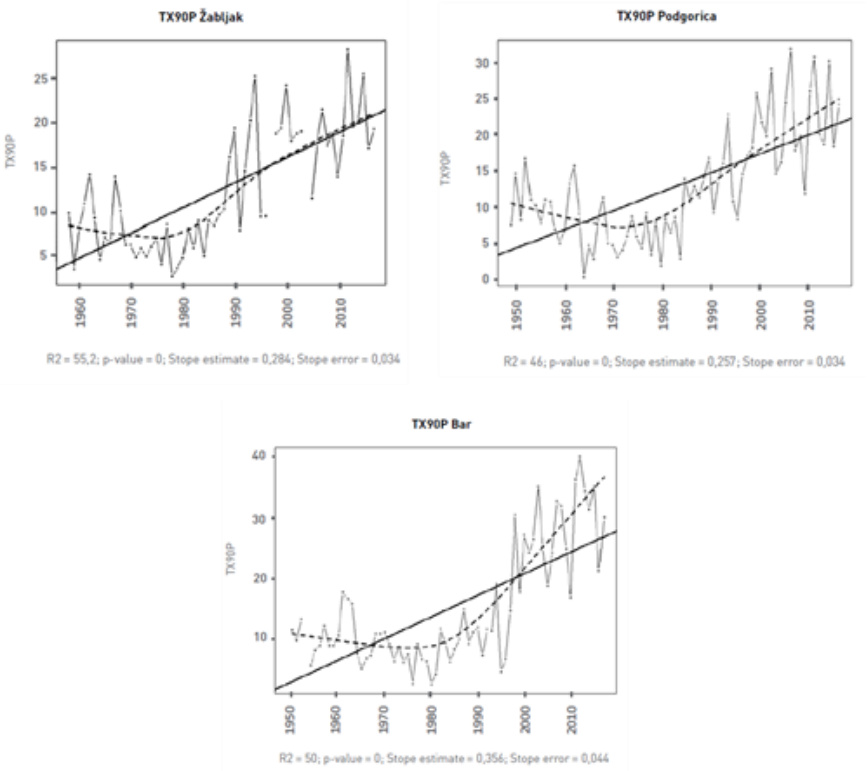


Figure 7. Number of warm days in Žabljak, Podgorica and Bar from 1950 to 2018

2. Observed and projected changes in precipitation

The rainiest area of Europe is the Krivošije littoral mountain chain located behind BKB. The annual amount of precipitation is 4600 mm. Maximum annual amount of precipitation is 7067 mm in Crkvice village (940 m altitude above mean sea level), which is a European maximum. This high amount of precipitation is due to the orographic effect, which occurs when air masses are forced to flow over high topography.

There are two main precipitation regimes: maritime and continental. The maritime regime is characterised by high precipitation in the autumn and the beginning of the winter (410-606 mm on average), and very low precipitation during the summer (117-180 mm). The continental regime is characterised by the onset of the highest precipitations in May, June and July, with a secondary maximum in October and a minimum in February. Between these two precipitation regimes (maritime in the south and continental in the north), a large part of Montenegro is located under

the modified maritime precipitation regime, which is modified by mountainous and continental precipitation regimes. The rainiest month is November while the driest is July. In the mountain regions, snow falls more frequently in spring than in autumn because autumn is rather warmer than spring.

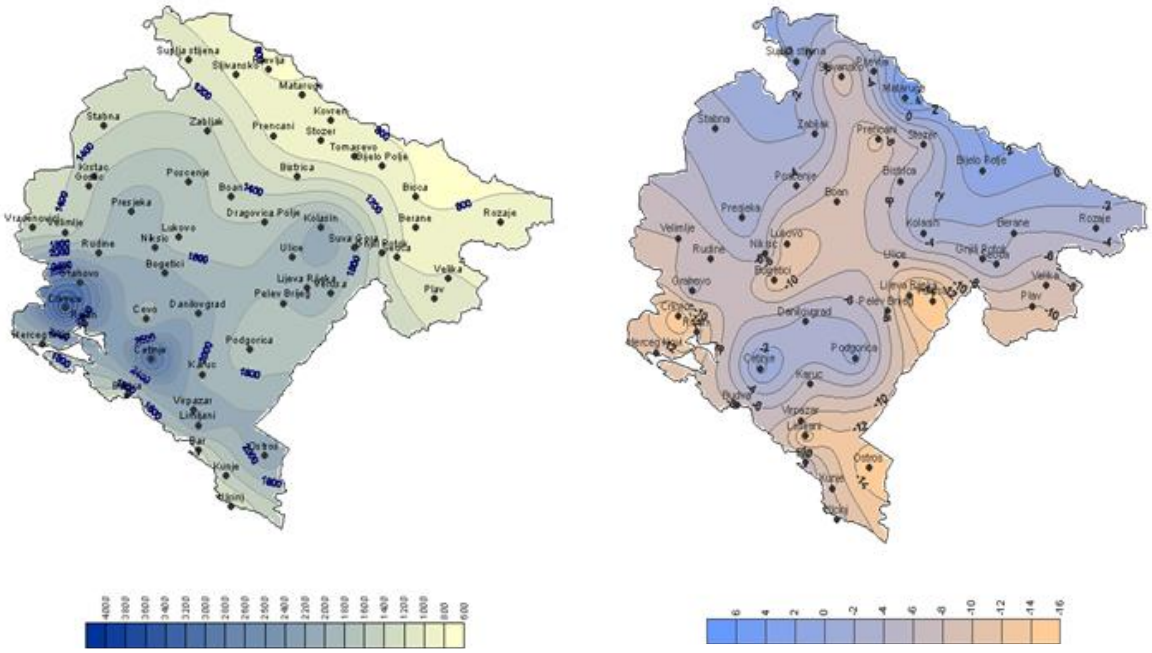


Figure 8. Spatial distribution of average annual precipitation for the period 1981-2010 (left) and its deviation in % from the climatological normal 1961-1990 (right)

The mean annual precipitation for the period 1981-2010 has changed with respect to the climatological mean 1961-1990, illustrated in Figure 8. Indeed, the rainiest part in Crkvice receives 12% less precipitation than in the 1961-1990 period. The coastal region receives less precipitation, ranging from -12% in the northwest to -10% in the southeast. The central part of the country also receives -10% less precipitation. The largest decrease of -14% is in the area of the Skadar Basin. In general, deviations are negative except in the far northeast.

Considering these long-term changes, there is no clear trend in annual precipitation, Figure 9. The nearly flat trendline indicate that there is slightly increase since 1949 and 1958 depending when the measurements started. The rectangles up and below climatological normal 1961-1990 refers to climate variability. Its range indicates how much above or below the year-to-year data differs from the normal. Very above normal were data in 2010 when heavy rains led to floods in some parts of Montenegro. For example: floods in the 2009/2010 in Skadar Lake basin made material damages and losses. Then in winter the 2012/2013 during a very intense cyclone season, snow caused a collapse in whole Montenegro. On the contrary, the driest year since the 2000 was in the 2011, Figure 9.

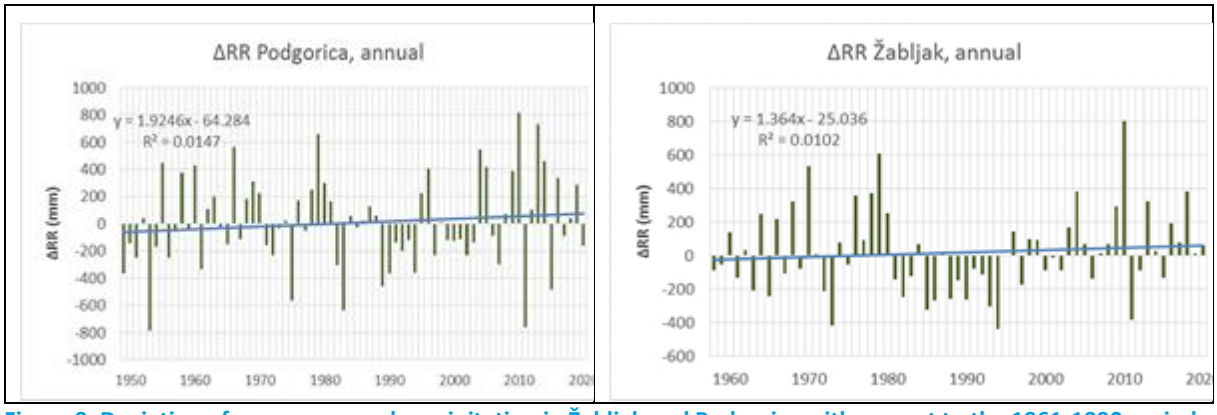


Figure 9. Deviation of average annual precipitation in Žabljak and Podgorica with respect to the 1961-1990 period

The decadal changes in mean annual precipitation were negative over the three consecutive decades: 1971-1980, 1981-1990 and 1991-2000. Due to extreme amounts of precipitation in the 2001-2010 period, changes were positive. On the contrary, the influence of hydrological droughts in the 2011, 2012, 2015, 2017, 2018, and the 2019 resulted in a decrease of precipitation in the central and southern regions (cf. Table 6).

Region	Reference period	Deviation (in %) of average decadal precipitation with respect to the 1961-1990 period						
	61-90	51-60	61-70	71-80	81-90	91-00	01-10	11-20
Northern (Žabljak)	1455.4	-	-	+ 8	-11	-6	+ 11	+4
Central (Podgorica)	1657.9	-2	+ 6	+2	-8	-4	+ 8	- 10
Southern (Bar)	1390.9	+ 2	+ 2	+6	-12	-11	+5	-12

Table 6. Percent of average decadal precipitation with respect to the 1961-1990 period

Seasonal analysis shows a slightly downward sloping trendline in summer, indicating decreasing trend of precipitation in the whole country, as shown in Figure 10. An exception is the north-eastern mountainous belt (from Pljevlja to Bijelo Polje) where it slightly increases. The trend is negative in the winter season for the central and southern regions, and positive in the north. Positive trends in precipitation occur in spring in the whole country, and in autumn in the central and north-eastern regions. In all of these cases, the rate at which precipitation changes over time is within the normal range.

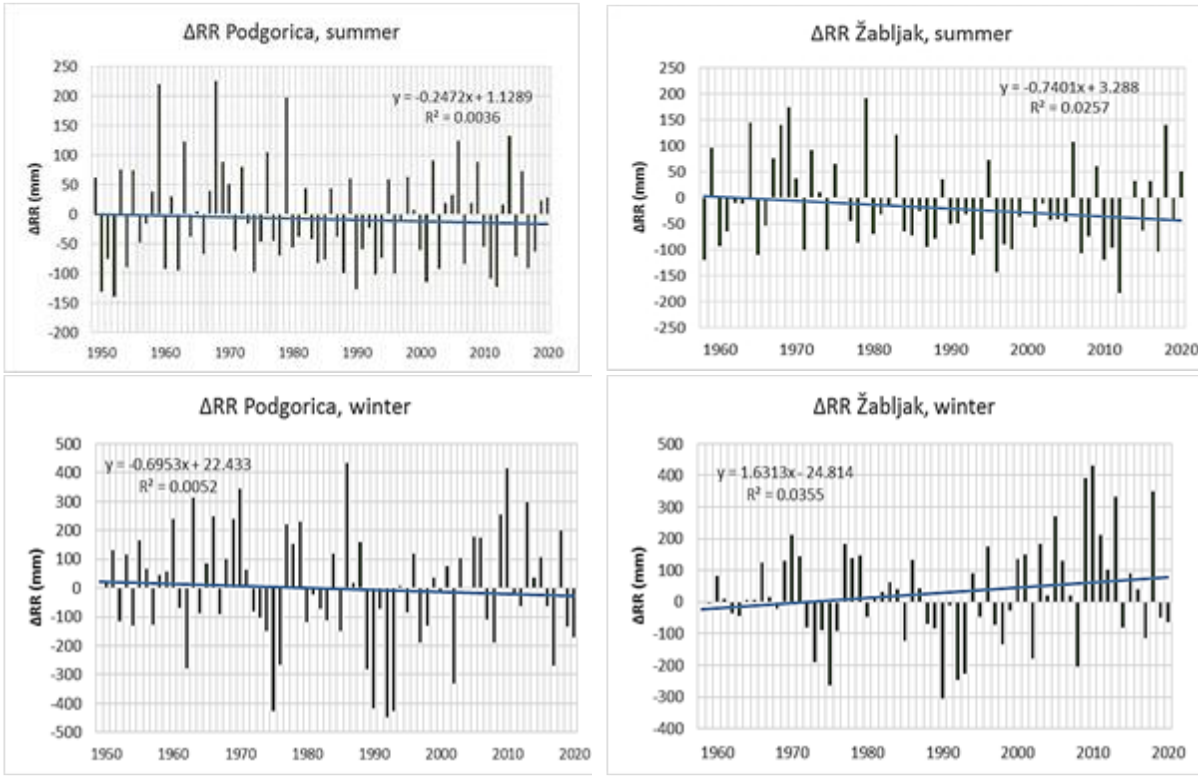


Figure 10. The deviation (mm) of average summer and winter precipitation in respect to 1961-1990

According to climate projections, the total amount of average annual precipitation is expected to decrease by -5% in the central and southern regions and increase by up to +5% in the northern mountainous region over the first 30-year period. The second and third 30-year periods are characterised by a deficit in annual precipitation throughout the entire country, which coincides with the IPCC's projections for the SEE region. Summer is expected to be drier than normal in almost the whole country with the highest decrease between -10% and -20% in the Zeta and Morača river plains (southeast region, located towards Skadar Lake), as illustrated by Figure 10 in the first 30-year period. This area is expected to be drier than normal in winter as well, with a decrease of around -10% in the first 30-year period. The central region will also be drier, with around -5 % less precipitation than normal, while the northern mountainous region is expected to be wetter by around +5% to around +10% than normal (cf. Figure 11).

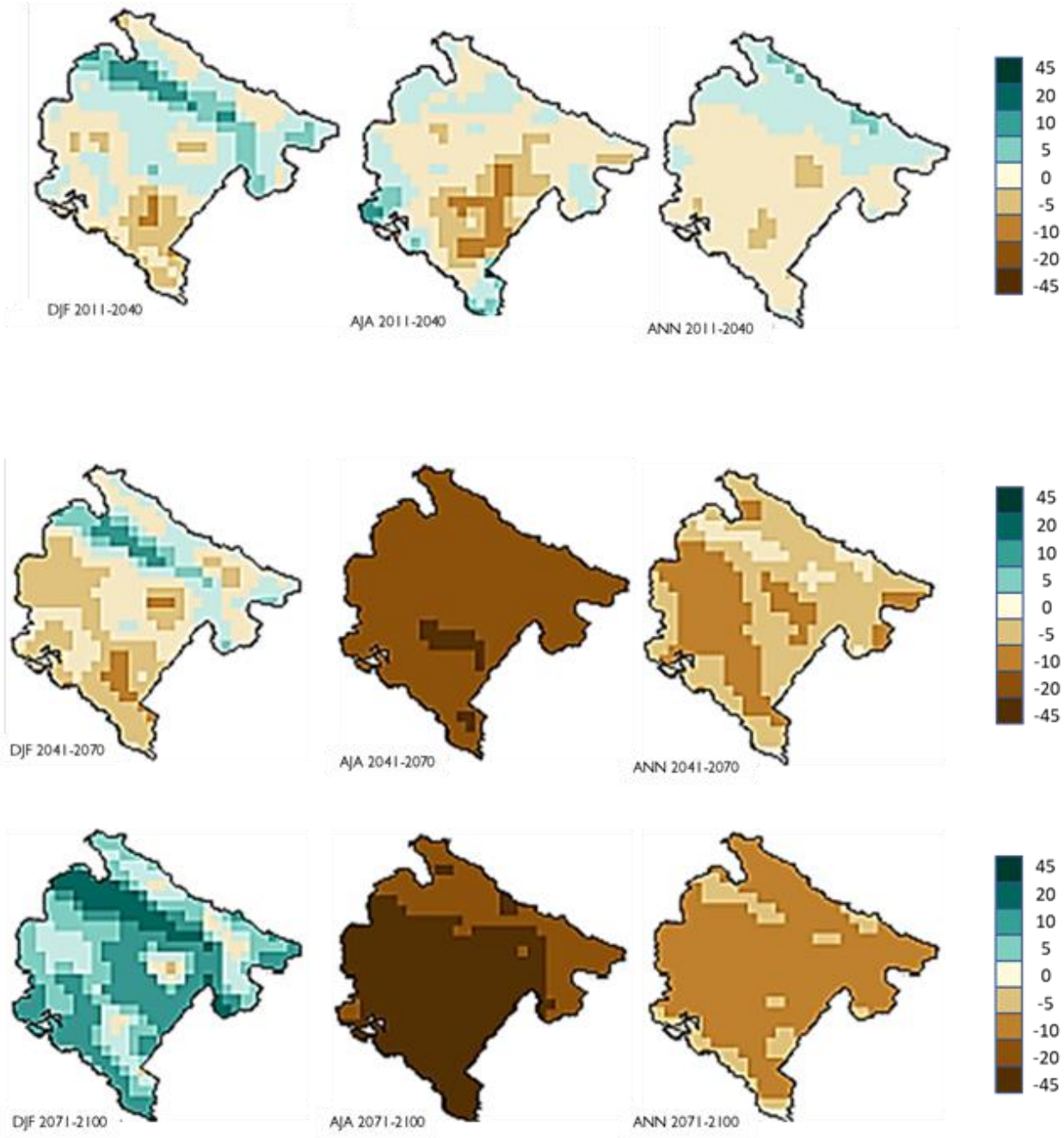


Figure 11. The deviation (%) of average winter (DJF), summer (JJA) and annual (ANN) precipitation for the 2011-2040, 2041-2070 and 2071-2100 periods with respect to the 1971-2000 period for the RCP8.5 scenario

Snowfall

Snow cover is formed at altitudes above 400 metres. A snow cover higher than 30 cm can be expected at 600 m of altitude or more, while over 800 m its height is 50 cm or more. The average number of days with snow cover higher than 50 cm is 76 days in Žabljak and 10 days in Kolašin, in the northern part of the country[54].

[54] SCM 2015, pp. 42-43.

Regions	61-90	51-60	61-70	71-80	81-90	91-00	01-10
Northern (Žabljak)	8707	-	10025	7901	8194	6400	6642*
Pljevlja	790	940	876	755	723	706	800*
Central (Podgorica)	31	59	24	30	39	7	14*
South (Bar)	-	-	-	1	2	2	0

Table 7. Total amount of snow (cm) per decade

The number of days with snowfall decreases with respect to the 1961-1990 period. Therefore, the period with snow is shorter, from December-March in the northern mountainous region (e.g., Žabljak) instead of September-June. The annual amount of snowfall in the mountainous region tends to decrease from the reference period 1961-1990. It successively decreased per decade since the 1971-1980 period. Variability is particularly pronounced from year to year during the 2001-2010 and 2011-2020 periods, when extreme snowfalls were registered. For example, in February 2005, record snowfall of 230 cm was measured in Žabljak. In 2012, a state of emergency due to snow falls and strong winds was proclaimed. According to the projections, due to higher temperatures in the colder half of the year and during the winter season, the total amount of snow and the number of days with snowfall will decrease. The highest decrease of -80% is projected for the central parts of the country during the first 30-year period. This is very important information from the hydrological aspect.

3. Observed and projected changes in extreme weather and climate extreme event / hazards

Changes in temperature and precipitation averages, increased climate vulnerability, and intensified extreme events lead to hydro meteorological hazards. Montenegro is prone to several hydro-meteorological hazards, including floods, drought, heavy rainfall or snowfall, windstorms, heat waves, landslides, and forest fires.

Drought

Drought can have multiple negative impacts on the economy, the environment, and human health. agriculture, forestry, and tourism are the most affected by droughts in Montenegro. The results in Table 7 show that droughts have been more frequent since the period 1981-1990. The analysis is based on SPI indexes[55], SPEI indexes, percentiles and percent of normal precipitation. The important difference between the decades 2000-2010 and 2011-2020 is that the deficit in precipitation was accompanied by “warm“ and “very warm“ temperatures in the country during the winter, spring, summer and the autumn. Figure 12. presents example for Standardized precipitation evapotranspiration index SPEI 12 for Podgorica meteorological station. Red colour refers to deficit in precipitation and blue colour refers to its surplus. Values of SPEI 12 are based on cumulative values of precipitation for the 12 months. The index is good to measure hydrological drought. The trend of SPEI and SPI is positive in whole country.

[55] Standardized precipitation index, https://public.wmo.int/en/resources/library/standardized-precipitation-index-user-guide.

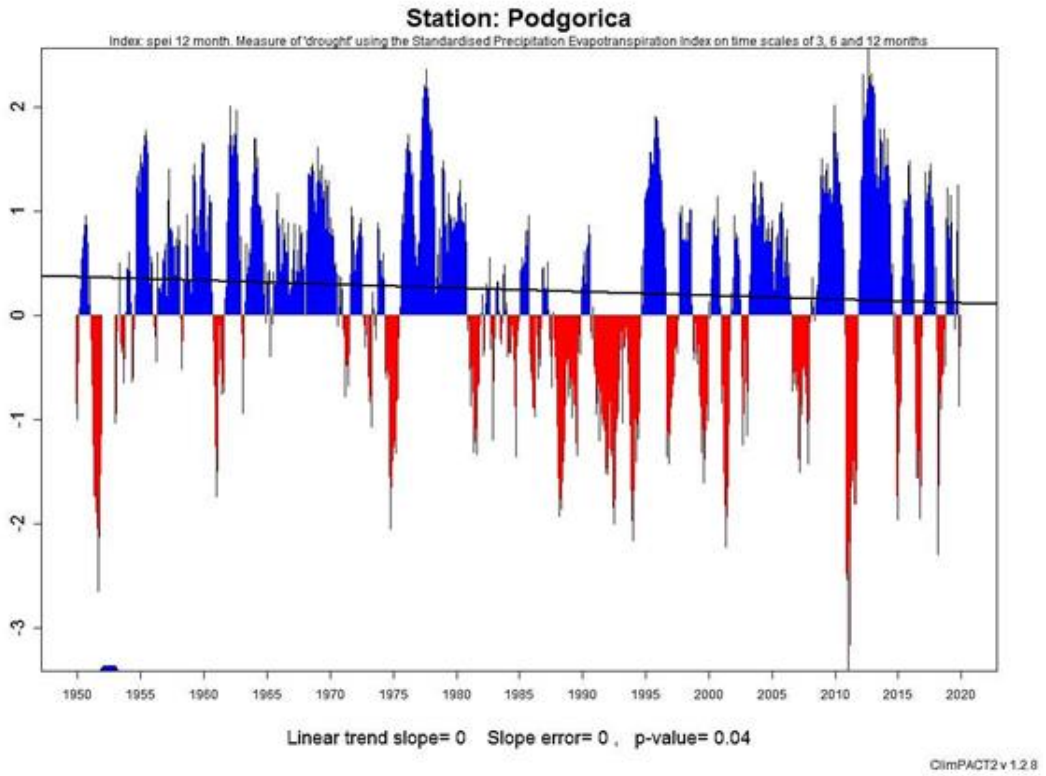


Figure 12. Standardize precipitation evapotranspiration index SPEI 12 for Podgorica meteorological station

Droughts and high temperatures in the last two decades particularly affected coastal region, Zeta-Bjelopavlic valley and northern mountain region. They affected not only agriculture and forests, but also the water level in the rivers, then Skadar Lake, what then affected fisheries, agriculture and the energy sector.

51-60	61-70	71-80	81-90	91-00	01-10	11-20
1953	1962,1967, 1969	1978	1981,1982, 1985,1988, 1989	1993,1994, 1996,1999	2000, 2003, 2005,2006, 2007, 2008, 2009	2011,2012,2013, 2017, 2018, 2019, 2020

Table 8. The frequency of drought (meteorological, agricultural and hydrological) in Montenegro per decades[56]

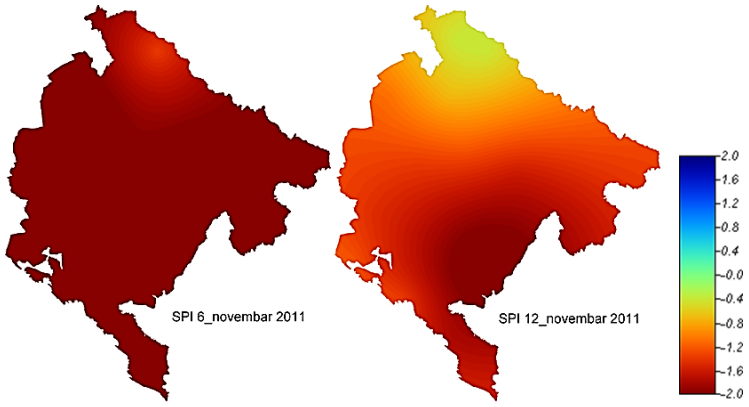


Figure 13. Maps of hydrological drought based on SPI 6 and SPI 12 index in November 2011

[56] The National Risk Assessment of Hazards in Montenegro, 2021 (Source of data IHMS).

The current stakeholder's reaction during the drought is still slow although the drought monitoring and impact assessment was improved within the EU Interreg project DriDanube, 2017-2019 (https://www.interreg-danube.eu/approved-projects/dridanube).

Figure 14. Drought monitoring in DriDanube region, in September 2018 using Drought watch tool[57]

The occurrence and magnitude of droughts is expected to increase in the future, with decrease in rainfall and increase in temperatures, especially during the summer and the autumn.

Heat waves[58]

Heat wave event HW is defined as any length of three or more consecutive days where TX>90th percentile of TX. It is calculated over extended summer season from May to September.

Analyses for Montenegro show that **longer heat waves are predominant in August**, while in **June and July** Montenegro **experiences more frequent but shorter heat waves**. Longer heat waves contribute to more frequent extreme temperatures and therefore warmer climate in Montenegro. The monitoring and assessment of the climate shows that frequency of the heat waves increase while their length has a high year-to-year variability. From a long-term perspective, the length of heat waves shows increasing trend. Figure 15 shows heatwave duration of longest heatwave event in Žabljak. It lasted almost 17 days in the 2012. Number of days contributed to that heatwave event was nearly 60 days. This example is interesting because Žabljak is located in the northern mountainous region at 1,450m above sea-level and has a predominantly snow-forest climate. There is also a small glacier, Debeli Namet, below the mountain of Šljeme (2,455 m asl) in the Durmitor massif. The linear trendline is upward indicating that the duration of the longest heatwave event increases for 0.062 per year while its frequency for 0.379. The changes are statistically significant in both cases.

[57] Drought Watch tool, https://www.droughtwatch.eu/, IPA Interreg DriDanube project.
[58] The ClimPACT2 software updates ClimPACT which was based on the RClimDEX software developed by the WMO CCl/WCRP/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI).

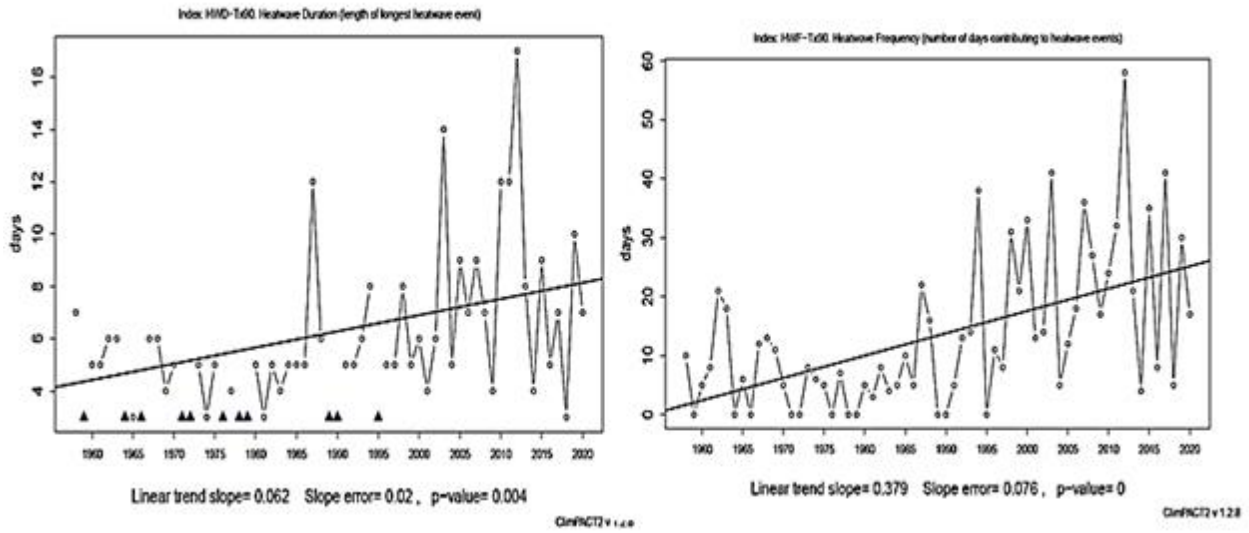


Figure 15. Heatwave duration HWD (left) and heatwave frequency HWF in Žabljak, from 1958 to 2020[59]

Duration and frequency of the heat waves is expected to increase. For the period 2011-2040, 2 times (i.e., 100%, Figure 15) longer duration is expected with the frequency of 3-5 times more than normal (i.e., 200-400% in Figure 15) in the whole country. Next figure show changes (%) in average heat wave duration and average number of heat waves, for the periods 2011-2040, 2041-2070 and 2071-2100 in relation to the period 1971-2000, for scenario RCP8.5.

[59] Ivanov M., IHMS.

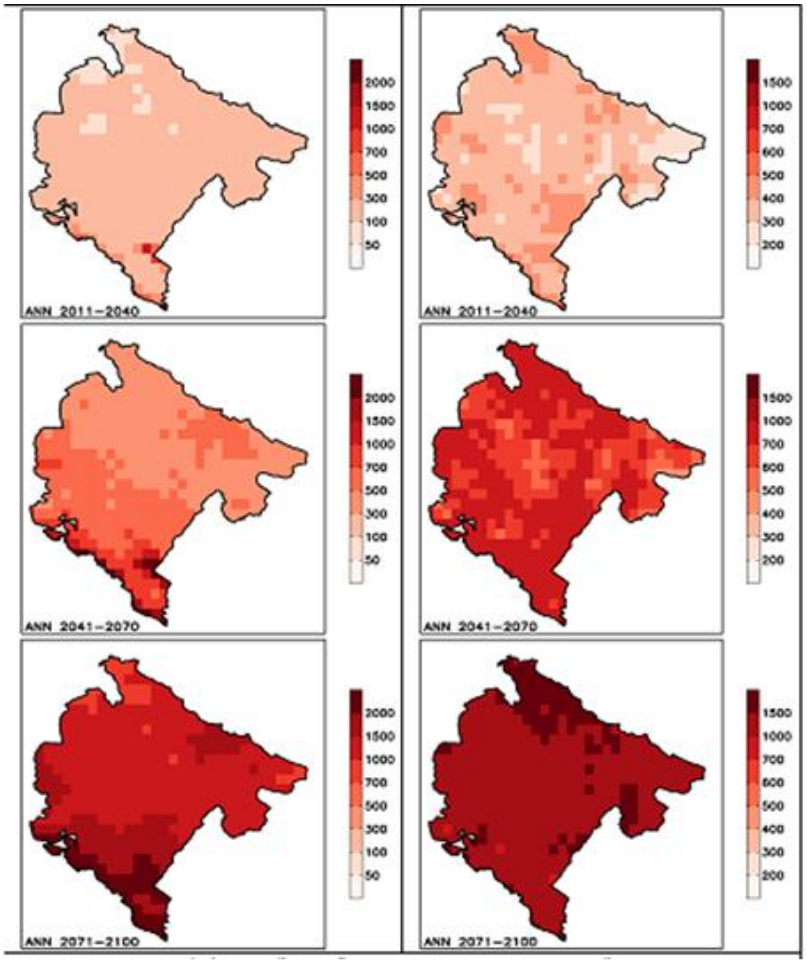


Figure 16. Changes (%) in average heatwave duration and average number of heatwaves, for the periods 2011-2040, 2041-2070 and 2071-2100 in relation to the period 1971-2000, for scenario RCP8.5.

Heavy precipitations that cause floods

Extreme rainfall episodes generally lead to significant floods. Individual daily rainfall is often linked to flash floods of limited spatial extent. Multi-day rainfall generally has a broader spatial footprint and, thus, more extensive flooding can be expected. Heavy precipitation can cause flooding, landslides, landslides, spills of streams and drainage channels, impeded traffic flow, decrease in water quality, pollution of groundwater released, and a reduction of arable land. The upward sloping trendline indicate increase in precipitation intensity SDII[60] in the northern and central region. The range of SDII above and below climatological normal indicates high variability from year-to-year. Figure 15 shows increasing trend of SDII in Žabljak and Podgorica from 1949/1958. The changes are significant ($p<0.05$) through time in Podgorica, Figure 17. Besides that, 5% maximum precipitation significantly increase in the central region.

[60] Simple Daily Intensity Index SDI is annual total precipitation divided by the number of wet days (defined as PRCP>=1.0mm) in the year

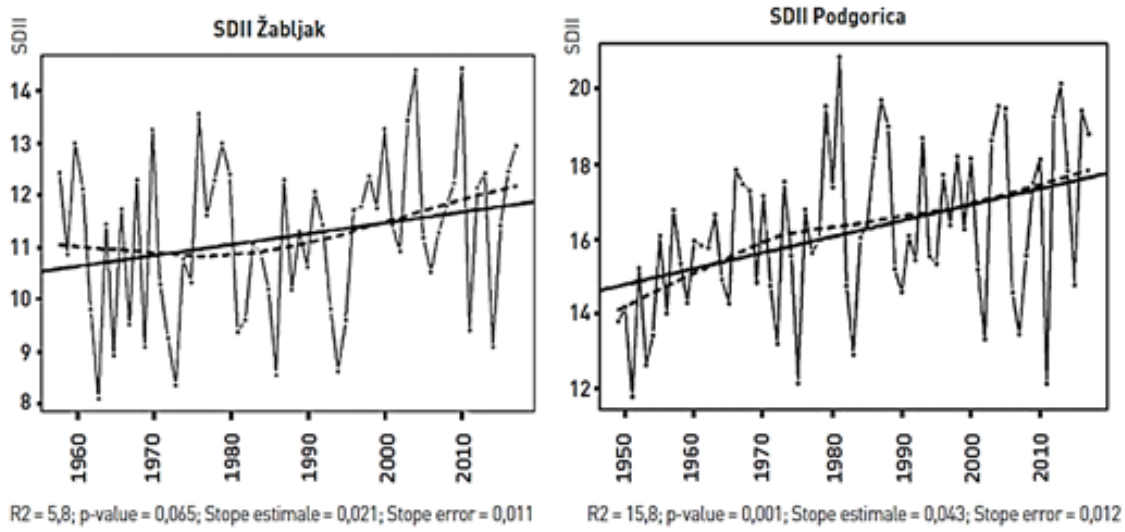


Figure 17. Daily precipitation intensities – SDII in Žabljak and Podgorica

In the coastal region the number of days with very heavy rainfall R60mm[61] decrease through time. The same is for maximum 5-days precipitation[62] amount and 5% of the highest rainfall. The nearly flat trendline for SDII indicate that there is no significant increase or decrease in precipitation intensity, Figure 18.

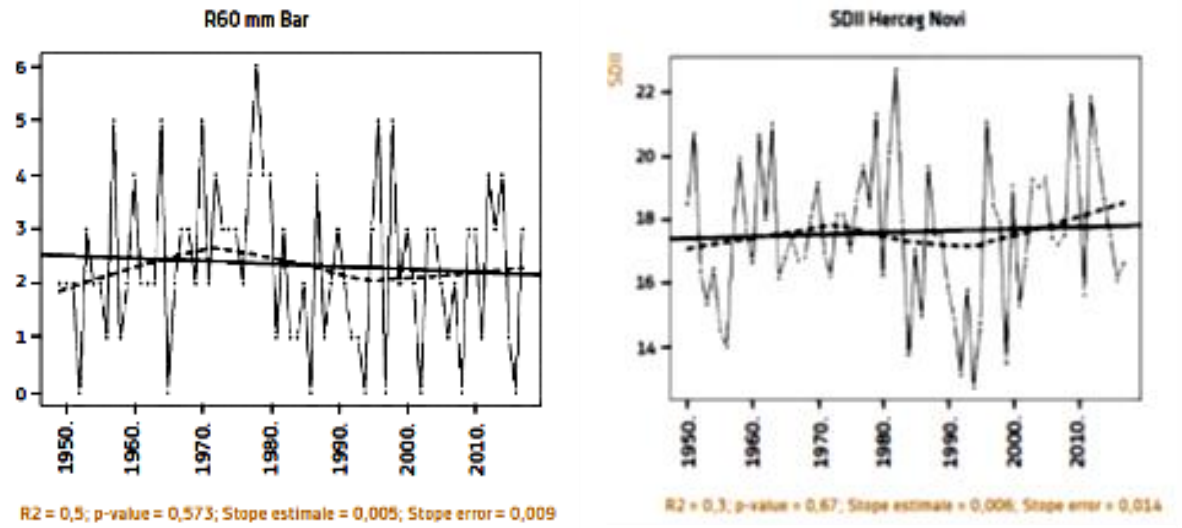


Figure 18. Very heavy rainfall R60mm and simple daily intensity index SDII in Bar and Herceg Novi

Particularly sensitive areas on heavy rainfall are: Ulcinj field, the zone from Vladimir to Veliki Ostros, and from Sutomore to Virpazar, the area of the old town of **Kotor**, **Sutorina, Herceg Novi, Crkvice,** and part of the **Luštica Peninsula** which are the areas located in our zone of study. The International Disaster Database[63] reports that Montenegro had significant consequences from three major floods (2007, 2009, and 2010).

61 Very heavy rainfall RR60mm is annual number of days when daily precipitation is >=60mm
62 Maximum 5-day precipitation amount is monthly maximum consecutive 5-day precipitation
63 www.emdat.be

The damage and losses caused by the 2010 flood amounted to around **€44 million** (1.4% of gross domestic product)[64]. The FAO estimated that this flood impacted around 30,000 hectares of agricultural land. The most affected was the area of Zeta Valley, surroundings of Skadar lake, especially municipality Golubovci, where is most of the national vegetable production. Total agricultural damages and losses were estimated at over €13 million, of which over €6 million was in damages and over €7 million was in losses[65]. The most recent significant flood was in November 2019. It had multiple impacts on people and infrastructure in the municipalities of Nikšić and Kolašin. The total estimated damage on households from this flood was around €73,000 and for infrastructure (e.g., roads, bridges) it was around €211,500[66]. But to protection from floods has not been given much attention so far in Montenegro, although the consequences are frequently significant.

The future precipitation regime in Montenegro is characterised by frequent heavy precipitation in northern and north-eastern part of the country in winter and annually. Its decrease in central and southern region is followed by higher intensity, longer dry period during the summer and over the year, Figure 17. Decrease in number of 5-day precipitation over 60mm, and increase in the amount of precipitation during individual 5-day episodes is expected in most of the country. The intensity of such precipitation will be higher per episode, what could contribute to torrential floods and landslides. On the contrary, increase in duration of consecutive dry days is expected in summer and annually in the south-eastern and western parts of the country, Figure 19.

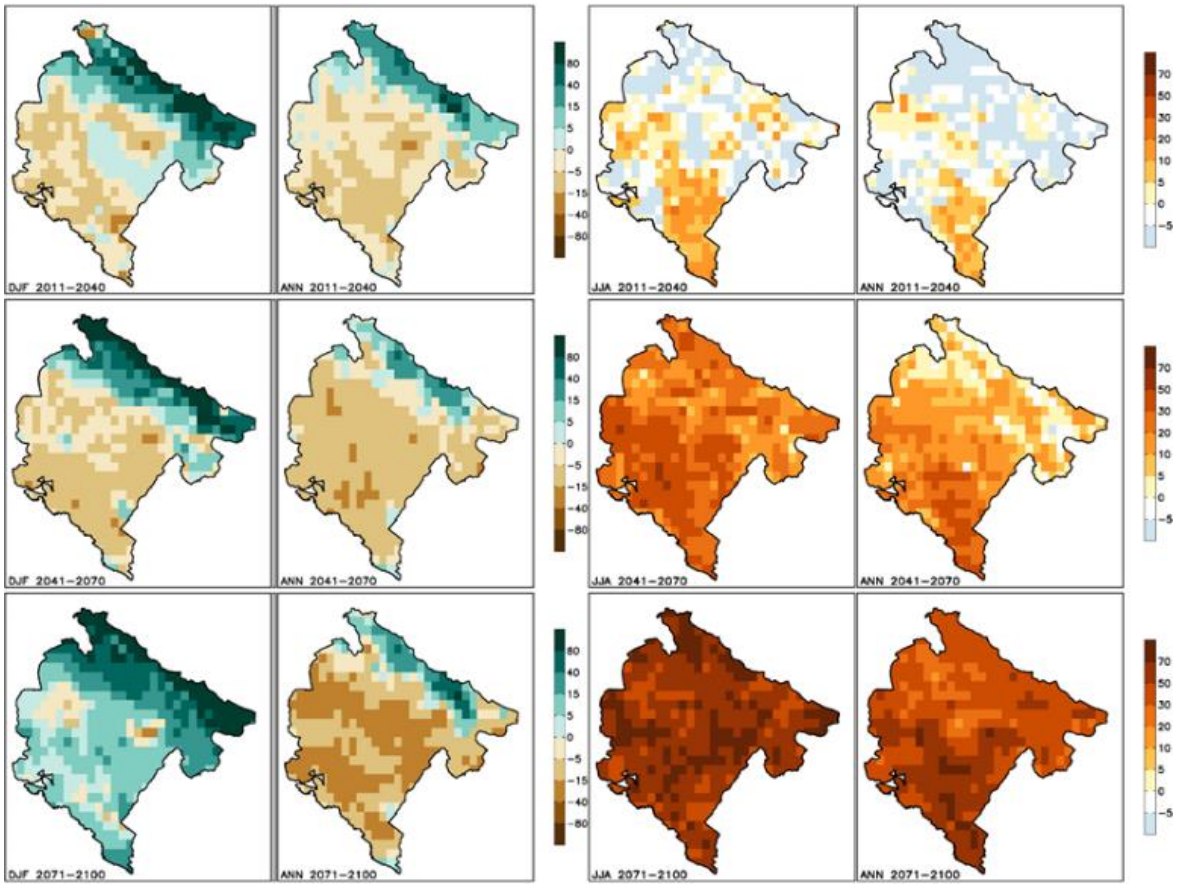


Figure 19. Changes (%) in the no. of days with precipitation higher than 20 mm during the winter (DJF) and annually (ANN) and change (%) in the number of consecutive dry days during the summer (JJA) and annually (ANN) for periods 2011-2040, 2041-2070 and 2071-2100

[64] International Disaster Database Reports for Montenegro, EM-DAT 2019.
[65] FAO (2015). Comprehensive analysis of the disaster risk reduction and management system for agriculture in Montenegro – estimation for flood 2010 (https://www.fao.org/3/i8373en/I8373EN.pdf)
[66] Ministry of Interior, Government of Montenegro.

Forest fires

Forests and forest land in Montenegro covered 69.8% (964,262 ha) of the total land area in 2013[67]. In the period 2005–2015, there were around 800 large forest fires in Montenegro, and more than 18,000 ha of forests and over 800,000 m^3 of wood mass were damaged or destroyed[68]. During the summer forest fires affect littoral mountain slopes along the coastal zone and the district between two cities Podgorica and Cetinje. The fire weather index FWI shows that the fire risk was in the classes very high-severe-extreme in the 2012, Figure 20. The most affected was: the region of the municipalities Nikšić, Pljevlja, and Žabljak, the coast, the area of Cetinje, and Podgorica.

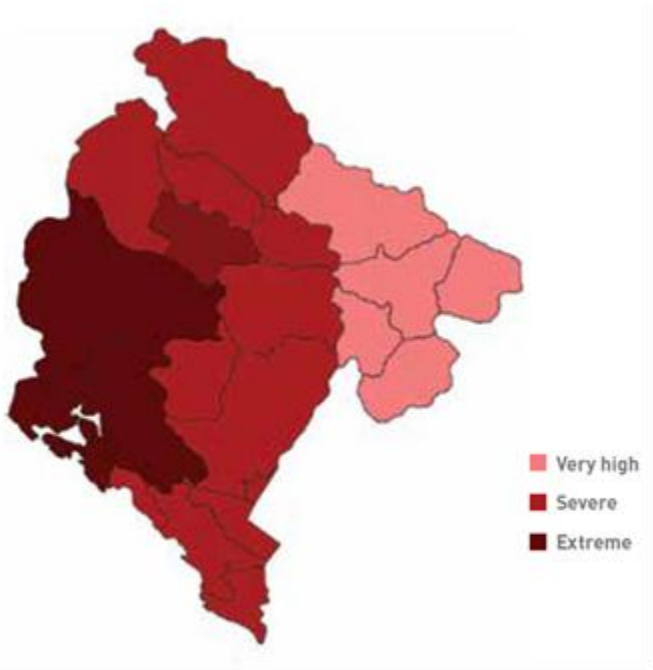


Figure 20. Areas exposed to fire risk in 2012[69]

Overview of the forest fire impacts in 2012:

- Health – watery eyes, coughing, and choking due to large amounts of dust particles in the air; More long-term impacts of smoke inhalation were recorded;
- Concentration of dust particles in the air in Podgorica was four times higher than normal.
- Forest – the loss of 6,500 hectares of forests due to fires was estimated at about €6 million according to information from the Ministry of Agriculture and Rural Development.
- Traffic – the traffic on the Podgorica–Cetinje road was periodically closed in order for fire trucks to get closer to the location of the fire in the village of Dobrsko.

The worst forest fire season in Montenegro was in 2017. There were 124 fires covering over 30 ha, affecting a total of 51,661 ha, six times the area mapped in 2016. Fires were recorded through the year from February to November, although the worst damages occurred in July and August. The largest burned area was 5,687 ha in Danilovgrad in July,

[67] Montenegro's land area is characterised by a high coverage with forest of 59.9% (826 782 ha, relative standard error 0.5%) and forestland of 9.9% (137 480 ha). Together forest and forestland cover 69.8% (964 262 ha) of the land area of 1 381200 ha (FAO. 2014, Global Forest Resource Assessment 2015, Country Report Montenegro, Rome: p.7, available at https://www.fao.org/3/az279e/az279e.pdf);
[68] REC, 2015, Montenegro – Forest fire country study, Themis network.
[69] Ivanov M., Pažin N., Drljević M.,Kuč T., IHMS, 2012.

but there were also 28 other fires larger than 500 ha[70]. Due to prolonged drought and very high temperatures water resources were affected, while the strong wind spread the fire faster than in calms. The temperature of 43.9°C in Podgorica on the 7th August 2017 was the second-highest temperature in the last 63 years.

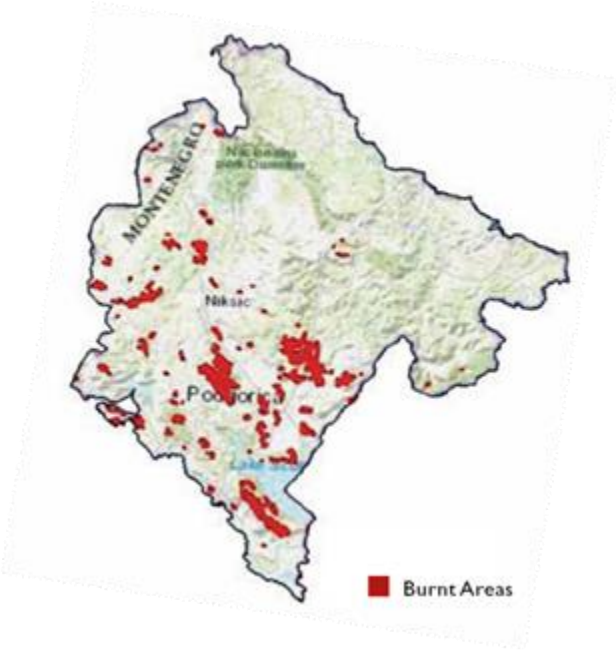


Figure 21. Map of burnt areas in Montenegro in 2017[71]

Strong winds

Two types of winds are typical, bora and sirocco. Bora is predominant wind during the winter with N – NE direction, high intensity and gust especially in the coastal zone and Podgorica – Skadar basin (central region). During bora wind temperature and humidity decrease, except of cyclonic bora when the weather is rainy and cloudy. Bora wind has high intensity and gust. Its velocity ranges between 16 and 33 m/s and doesn't create high sea surges. South wind or sirocco has S to SE direction. It brings warm and humid air, high amount of precipitation especially behind Kotor Bay. The largest amount of precipitation during colder part of the year (November to April) is due to sirocco. Its velocity and frequency increase from northern to southern part of the coastal zone reaching the highest values in Montenegro and producing high waves at the sea. Wind storm affects coastal zone and Podgorica – Skadar basin. It occurs frequently within bora wind. The average annual number of days with strong windstorms (≥ 8 Beaufort) is 18.3 days, Table 9. The frequency is highest in the coastal region, 26.7 days, then in the central region 21.3 days, and the lowest in the northern region, 6.9 days per year, Table 5. The maximum number of days with strong windstorms was recorded in Bar (69 days) in 2017 and 2019, and in Podgorica (68 days) in 1990. The windstorm in Bar in 2019, lasted 15 days in December.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annually
Southern region	3.8	3.4	3.7	1.7	0.9	0.6	1.0	0.8	1.3	2.1	3.3	4.2	26.7
Central region	2.9	2.9	3.0	1.3	1.0	0.7	0.9	0.9	0.8	1.5	2.1	3.2	21.3
Northern region	0.7	0.9	0.9	0.6	0.4	0.3	0.3	0.2	0.3	0.5	0.9	1.0	6.9
Whole territory	**2.5**	**2.4**	**2.6**	**1.2**	**0.7**	**0.5**	**0.7**	**0.6**	**0.8**	**1.4**	**2.1**	**2.8**	**18.3**

Table 9. The average number of days with windstorms strength ≥ 8 Beaufort for the period 1981-2010

[70] San-Miguel-Ayanz, J., Durrant, T., Boca, R., Liberta`, G., Branco, A., De Rigo, D., Ferrari, D., Maianti, P., Artes Vivancos, T., Pfeiffer, H., Loffler, P., Nuijten, D., Leray, T. and Jacome Felix Oom, D., Forest Fires in Europe, Middle East and North Africa 2018, EUR 29856 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-12591-4, doi:10.2760/561734, JRC117883.
[71] Ibid.

During the summer windstorms last shortly about 5-20 minutes on the local scale. They are very strong and followed by: wind gusts from different directions, hail, heavy precipitation and decrease in air pressure. In the winter time, windstorms develop over the whole country. It lasts longer, and the direction is predominantly N and S with extremely strong wind gusts of 40 m/s and more. In combination with snow fall in 2012, it caused problems in air, railway and road traffic, increase energy consumption and affect human life. Windstorms cause an increase of sea level of +69 cm (according to the measurements in Bar), i.e., +96 cm in respect to zero in Trst which is on 27 cm. The wind regime is highly non-uniform in Montenegro, even in its coastal strip. For example, percent of calms fluctuate from 4.5 % in Ulcinj and Bar, between 55 and 60 % in Herceg Novi and Budva, to over 70 % in Cetinje and Pljevlja. Average maximum wind velocities fluctuate from 11 m/s in Pljevlja to over 30 m/s in Herceg Novi.

			TREND	
			OBSERVED	PROJECTED
ELEMENT		Temperature	INCREASE	INCREASE
INDICES		NAME		
	GSL	Growing season length	INCREASE	INCREASE
EXTREME EVENTS	SU25	Summer days	INCREASE	INCREASE
	SU30	Tropical days	INCREASE	INCREASE
	TR20	Tropical nights	INCREASE	INCREASE
	FD0	Frosty days	DECREASE	DECREASE
	TX90p	Warm days	INCREASE	INCREASE
	TN90p	Warm nights	INCREASE	INCREASE
	HWD	Heatwave duration	INCREASE	INCREASE
	HWN	Heatwave frequency	INCREASE	INCREASE

Table 10. Summary of observed and projected meteorological trend in temperature

			TREND	
			OBSERVED	PROJECTED 2011-2040
ELEMENT		Precipitation	ANN: slightly increase JJA: increase DJF: Southern, Central-Decrease; Northern - Increase	ANN: Central, Southern- Decrease Northern – Increase; JJA: Central – Decrease, North – Increase; NW and SE coast- Increase. DJF: South, Central-Decrease; Northern region and NW coast - Increase
INDICES		NAME		
EXTREME EVENTS	R20mm	Number of days with heavy precipitation	ANN: Coastal region: slightly decrease, Northern, Central: increase	ANN: Northern – increase, Central, Southern - decrease DJF: Southern – decrease, Northern, Central - Increase
	R60mm	Number of days with very heavy precipitation	ANN: Coastal: decrease in Bar, no increase no decrease in Herceg Novi and Ulcinj. Central, Northern - Increase	ANN: Northern – increase, Central, Southern - decrease DJF: Southern – decrease, Northern, Central - Increase
	Rx5day	Maximum 5-days precipitation amount	ANN: Coastal: no increase no decrease; Northern, Central – increase.	ANN: Central, Coastal region – decrease, Northern-increase.
	SDII	Simple daily intensity index	ANN: Northern, Central-increase; Southern-slightly decrease	INCREASE
	CDD[72]	Consecutive dry days	**Coastal region:** INCREASE **Northern region:** DECREASE slightly **Central region:** NO INCREAS NO DECREASE	ANN: Central region and coastal southward – increase; JJA: Central region and coastal southward and its northern part – increase; Northern region and part of Central – slightly decrease

[72] Consecutive dry days CDD is calculated as maximum number of consecutive days when the daily RR < 1 mm.

SPI, SPEI	Standardize precipitation index; Standardize precipitation evapotranspiration index	INCREASE	It is not projected

Table 11. Summary of observed and projected meteorological trend in precipitation

C. CLIMATE RISK: NATIONAL CLIMATE BASELINE IN MONTENEGRO

A national climate risk assessment was accomplished within the EU project "Risk assessment of hazards in Montenegro" in December, 2021. The methodology used more targeted UNDRR[73] terminology on disaster risk reduction. Single and multi – hazard risk was analysed on the national level. For both single-risk and multi-risk assessment two scenarios were considered: (1) for most probable event and (2) for event with the worst probable consequences. For each scenario, the methodology comprised 10 following steps:

(1) Risk identification	(6) Developing matrices
(2) Scenarios	(7) Multi risk
(3) Impact	(8) Risk treatment
(4) Probability estimation	(9) Risk level
(5) Estimation of consequences	(10) Mapping hazard / risk

The national level of climate risk assessment recognized storms, droughts and heatwaves, cold waves and snowfall as climate related hazards of high importance. For the multi-hazard risk assessment, drought and forest fires as well as storms and floods were analysed. Floods were analysed separately from meteorological hazards. More results about it will be presented later on the regional level. Sea floods were not analysed in the "Risk assessment of hazards in Montenegro" except in the CAMP project[74]. Table 11 presents overview of geographical location in relation to scenarios, hazards and multi hazards. Results of risk analysis and assessment are presented in the Table 12, Table 13, Table 14, Table 15.

Geographical location	HAZARD
Scenario 1: Southern region (Herceg Novi – Zelnika-Bijela, and part of Tivat airport); **Scenario II:** Central region (Podgorica, Danilovgrad, Nikšić, Cetinje) and coastal region (H. Novi, Kotor, Tivat, Budva, Bar and Ulcinj).	Storms
All regions	Droughts
Northern mountainous region	Cold wave and snowfall
Scenario 1: Northern mountainous region: Tara canyon ((Municipalities Pljevlja, Zabljak and Kolasin); **Scenario II:** Northern mountainous region: Tara river canyon and forest land in the National Park Durmitor (protected by UNESCO).	Drought and forest fires
Scenario I: Southern region: Boka Kotorska, Cetinje and coastal part of Skadar lake and some parts along the coast. **Scenario II:** Središnji (Podgorica, Danilovgrad, Nikšić, Cetinje) i Primorski region (H. Novi, Kotor, Tivat, Budva, Bar i Ulcinj).	Storms and floods

Table 12. Selected geographical locations related to meteorological hazards and multi hazards according to the National climate risk assessment

D. GENDER SENSITIVE CLIMATE RISK ASSESSMENT – NATIONAL CONTEXT

The IPCC Glossary[75] defines **risk** as "the potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability or likelihood of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur". The uncertainty

[73] United Nations Office for Disaster Risk Reduction.
[74] National strategy for integrated coastal zone management, CAMP Montenegro, 2015; available online at: https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf
[75] Intergovernmental Panel on Climate Change, IPCC User Guide, Annexe – Glossary of terms, 2018. (https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FINAL_Annexes.pdf)

of this probability increases considerably with climate change. In short, **climate risk assessments** identify "the likelihood of future climate hazards and their potential impacts on cities and their communities."[76]

Gender refers to the "economic, social and cultural attributes and opportunities associated with being male or female. It encompasses the roles, behaviours and activities that are deemed acceptable for people of different genders and influences the relationships between the people who fall within these groups. These attributes and relationships are socially constructed"[77]. Gender determines what is expected, allowed and valued in a particular context at a given time, recognizing that this is changeable. In most societies, there are **differences and inequalities** between women and men in the responsibilities they are expected to take up, the activities that are considered normal or acceptable, access to and control over resources, and participation in decision-making. The following explanations are important for this chapter:

- **Gender equality** between men and women, or gender equality, refers to the equal rights, responsibilities and opportunities of women and men, boys and girls. Equality does not mean that women and men will become the same but that their rights and opportunities will not depend on their biological sex at their time of birth. Gender equality implies that the interests, needs and priorities of both women and men are taken into consideration, recognizing the diversity of different groups of women and men. Gender equality is not a women's issue as it provides benefits for both men and women and is a key human right. Gender equality is also a precondition for, and indicator of, sustainable development.
- **Gender inclusiveness** is a process and refers to how well women and men are included as equally valued players in initiatives.
- **Gender mainstreaming** is the (re)organisation, improvement, development and evaluation of policy processes, so that a gender equality perspective is incorporated in all policies at all levels and all stages, by the actors normally involved in policy-making.[78]

In the era of **climate change**, having access to resources is key to building climate resilience. However, in many countries, significant socio-economic inequalities between men and women still limit or prevent women's access to education, property, financial assets, technology, political decision-making, ownership of land and natural resources and other valuable resources. These gender discriminatory norms hamper women's adaptive capacity and put women and girls at a high risk of suffering loss and damage from climate change. Some recent analysis shows the following: Extreme Weather Events (EWEs) cause higher mortality rates for women and girls; Women's and girls' health are projected to be disproportionally affected by the impacts of climate change; Women and girls have restricted access to certain adaptation strategies (e.g. migration); In the aftermath of an EWE, women and girls face a higher risk of experiencing gender based violence, human trafficking and sexual exploitation; Women and girls face higher loads of care work, resulting in various long-term effects on their education and income generation[79]. Having in mind all the above mentioned, it is of utmost importance to **integrate gender considerations** into comprehensive Climate Risk Management in order to avert, minimise and address loss and damage of climate changes.

The initial focus of UN and EU climate policy was climate change mitigation, i.e., reduction of GHG emissions. However, in the case of small developing countries, like Montenegro, what is more important is adaptation to climate change, taking into consideration its size and the amount of emissions it produces. For Montenegro, adaptation should be a focus, because even if it were to reduce its emissions to zero today, it would continue to suffer significantly from the consequences of climate change due to larger countries' impacts. In recent decades, a body of important empirical work has uncovered the ways in which the impacts of climate change differentially affect individuals and communities based on gender[80], racial, and economic inequalities[81]. As a result, climate policy started to edge away from an exclusive focus on technological solutions towards a recognition that climate change affects people, acknowledging the social and environmental aspect of climate change. It is important to recognize that women and men are differently

[76] C40 Cities. (2018). Climate change risk assessment guidance. (https://cdn.locomotive.works/sites/5ab410c8a2f42204838f797e/content_entry5ab410fb74c4833febe6c81a/5b17dd2614ad660612c5dc54/files/C40_Cities_Climate_Change_Risk_Assessment_Guidance.pdf?1541689629)

[77] UNFPA, UN Population Fund, 2005 Report (https://www.unfpa.org/publications/unfpa-annual-report-2005).

[78] UN Woman training centre, e-learning campus (https://trainingcentre.unwomen.org/mod/glossary/view.php?id=36)

[79] GIZ, 2021. Diving into the gap: Gender dimensions of Climate Risk Management (https://www.giz.de/en/downloads/GIZ-GP-(2021)_Diving%20into%20the%20gap_Genderdimensions%20of%20Climate%20RiskManagement.pdf)

[80].. „Gender determines what is expected, allowed and valued in a particular context at a given time, recognizing that this is changeable. In most societies there are differences and inequalities between women and men in the responsibilities they are expected to take up, the activities that are considered normal or acceptable, access to and control over resources, and participation in decision-making ".

[81] See Denton 2002; Masika 2002; Dankelman 2010; Moosa 2014;

affected by climate change, which mainly stems from fundamental inequalities in socio-economic status. Namely, the degree of equality of women's and men's rights in national legislation; degree of law enforcement; traditions and customs that define the role of men and women in society (so-called gender roles).

In order to build climate resilience and better adapt to climate change, it is important to address gender inequality in climate change responses. Since renewing its independence in 2006, Montenegro has put significant effort into achieving gender equality. It has ratified international treaties such as the **UN Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)**[82] and the **UN Framework Convention on Climate Change (UNFCC)**[83], which promote a gender-sensitive approach and encourage signatories to integrate gender into national sustainable development and climate change policies. On the other hand, with the adoption of the **Constitution**, the **Law on Gender Equality** and the **Law on the Protector of Human Rights**, as well as the **Law on Prohibition of Discrimination**[84] Montenegro established a legislative framework for gender equality and created a basis for promoting and protecting women's rights and rights of different genders and gender identities. However, despite good institutional and legislative frameworks for the protection and promotion of human rights and freedoms in Montenegro, numerous international organizations in their reports still recognize shortcomings in the field of gender equality and continuously recommend Montenegro to improve institutional protection against discrimination based on sex and gender, as well as to work on reducing stereotypes and intensifying programs to support women and people of different genders[85].

1. International and national legal and strategic framework

Having re-entered a number of international organisations as an independent country, Montenegro set out its grounds for the implementation of a number of international instruments for the achievement of gender equality. Furthermore, as a candidate country for EU membership, Montenegro has committed itself to achieving goals that reduce gender discrimination, which are set out in legislative and strategic documents adopted by the European Commission and the Council of Europe. Montenegro strives to implement all conventions and measures that the United Nations, European Union, and Council of Europe recommends to member states (cf. Annex 1 for a detailed list of those relevant international documents.

When analysing the interrelations between gender equality and climate change, it is also important to look at national policies for gender equality and sector-level policies (energy, transport, agriculture, waste management, financing of businesses, disaster risk reduction, etc.) to assess which policies are gender-sensitive and include considerations regarding vulnerable social groups. It is also important to understand how these measures can contribute to the gender-responsiveness of mitigation and adaptation policies. As previously mentioned, the **Law on Gender Equality** (OGM no. 46/07, OGM no. 73/10, 40/11 and 35/15)[86], along with the **Action Plan for Gender Equality** (2007–2010, 2011–2016 and 2017–2021)[87] constitute a foundation for legal and institutional protection against gender-based discrimination. It represents an overarching gender equality policy, stipulating the full and effective participation of women and equal opportunities for leadership at all levels of decision making in the political, economic and public life. It also obliges all institutions to collect sex-disaggregated data.

In July 2021. Montenegro adopted a **National Gender Equality Strategy** 2021-2025 and its Action Plan 2021-2022[88]. The low level of gender equality in Montenegro is recognized as a central problem. It also encompasses, namely through Measure 3.8, an assessment of the impact and implementation of prevention measures to reduce the negative impacts of climate change and natural disasters on the health of women, men, people of different gender and gender identities, as well as marginalised and particularly vulnerable people and groups. There still is no research in

[82] See CEDAW. Available online at: https://www.unwomen.org/en/digital-library/publications/2016/12/cedaw-for-youth
[83] See UNFCC. Available online at: https://unfccc.int/
[84] Constitution (OGM no. 1/07, 38/13); Law on Prohibition of Discrimination (OGM no. 46/10, 40/11, 18/14 and 42/17); Law on Gender Equality (OG RM no. 46/07, OGM no. 73/10, 40/11 and 35/15); Law on the Protector of Human Rights (OGM no. 42/11, 32/14 and 21/17);
[85] See CEDAW report on Montenegro from 2017. Available online at: http://docstore.ohchr.org/SelfServices/FilesHandler.ashx?enc=6QkG1d%2FPPRiCAqhKb7yhsgOTxO5cLIZ0CwAvhyns%2ByJkiEj7TvkpzpCWIaw%2FXo5zI6Qpj9bMmh8y7A8ieXBJtxM8baOhnToMqMn5d4ngDsz828dhdfR8T%2BsR8uNG2UYs
See GREVIO report on Montenegro from 2018. Available online at: https://rm.coe.int/grevio-report-montenegro/16808e5614
See ECRI report on Montenegro from 2017. Available online at: https://rm.coe.int/second-report-on-montenegro/16808b5942
See UPR report on Montenegro from 2017. Available online at: https://documents-dds-ny.un.org/doc/UNDOC/GEN/G17/333/59/PDF/G1733359.pdf?OpenElement
[86] Law on Gender Equality, http://www.minmanj.gov.me/biblioteka/zakoni
[87] Action Plan on Gender Equality 2016-2021, https://www.gov.me/dokumenta/77dce535-ea50-438d-8968-25aa4ce62257
[88] See: https://www.gov.me/en/documents/41e3ee6a-757a-4684-9763-9fee5e933afd

Montenegro on the impact of climate change on women's and men's health, so it is very difficult to plan national policies for adaptation to climate change, which would ensure more effective protection of public health in conditions of rapidly changing climate.

National Strategy for Sustainable Development until 2030 (NSSD)[89], through measure for SDG 5 - "Eliminate gender discrimination", focuses on reforms to give women equal rights to natural resources, including access to ownership and control over land and other forms of property, as well as to economic opportunities, such as entrepreneurship and financial services. Among other things, the strategy precisely defines the weaknesses, problems and disadvantages in policies to reduce disaster risk and mitigate the consequences, but also the measures to strengthen these policies. The Strategy supports the prevention of new risk hazards and the reduction of existing ones as a priority objective of the sustainable development of Montenegro by 2030. The goal thus set is in line with the global disaster risk reduction framework for the period 2015–2030.

On the other hand, the **National Strategy for Climate Change until 2030 (NSCC)** indicates that a gender-sensitive approach is important for the fight against climate change, but this is not further elaborated on in the goals or the Action Plan.

Strategy for Development of Agriculture and Rural Areas 2015–2020[90] aimed at improving basic services while taking account of the different needs of women and men in these areas (road infrastructure, water supply and electricity, health, social and cultural facilities, etc.). Furthermore, it included the diversification of economic activities and opportunities, for both women and men, provided by economic and social cohesion between urban and rural areas. **The Programme for Development of Agriculture and Rural Areas of Montenegro** within **IPARD II 2014–2020** continuously implements incentive measures for women from rural areas. The measures have enabled the modernization of holdings, strengthening of production competitiveness, increasing the productivity of holdings, reducing costs, increasing product quality, hygiene and food safety[91].

The **National Strategy for Women's Entrepreneurship (2021-2024)** with action plan 2021-2022[92] can be fully implemented in all climate change policies related to economic activities, entrepreneurship and equal distribution of economic power and resources. Following the UN 2030 Agenda and UNDP Gender Equality Strategy 2018-2021[93], the Strategy recognises as one of the priorities “strengthening gender strategies in crisis prevention, preparedness and recovery, including climate change”.

Another two gender-sensitive public policy strategic documents are the **Montenegro Fiscal Strategy 2021–2024**[94] and the **Montenegro Development Directions 2018–2021**[95]**.** Both policy documents include several incentives, such as government-funded short-term and long-term loans for investments and liquidity, particularly to support entrepreneurial activity among traditionally disadvantaged applicants, e.g. unemployed graduates, young entrepreneurs, women and start-ups. Furthermore, the Investment Development Fund of Montenegro provides finance through banks and directly to small and medium businesses led by women through several support programmes[96].

In December 2019, **the Law on Protection from the Negative Impacts of Climate Change** was adopted, which did not emphasise the gender aspect. This Law envisages the adoption of two strategic documents that will practically replace the existing National Strategy for Climate Change. Notably, the Low Carbon Development Strategy of Montenegro and National Adaptation Plan. It is of the utmost importance that in the process of drafting these two strategic documents, the gender aspect is taken into account and included horizontally in all objectives. Article 9 of the Law on Protection against the Negative Impacts of Climate Change calls for the adoption of a 10-year Climate Change Adaptation Plan. This plan provides an opportunity to integrate gender aspects.

[89] See: http://www.nssd2030.gov.me/
[90] See: https://www.gov.me/dokumenta/8d4d0d4c-7d01-4e5d-b328-598862ebe753
[91] See: https://ipard.gov.me/IPARD_program
[92] Adopted on 7 October 2021. See: https://www.gov.me/dokumenta/0a95b4be-c3f4-4f9b-8c36-964d9684c885
[93] UNDP Gender Equality Strategy 2018-2021: Women's economic empowerment. (https://www.undp.org/publications/undp-gender-equality-strategy-2018-2021).
[94] See: https://www.gov.me/dokumenta/02f8c410-f87b-4004-96fa-a8eb7eb20b32
[95] See: http://roads.meteo.co.me/practices/Montenegro%20Development%20Directions%202018-2021-1.pdf
[96] See: https://www.irfcg.me/en/2016-03-01-09-03-19/women-in-business-support-programme-start-up.html
https://www.irfcg.me/en/2016-03-01-09-03-19/women-in-business-support-programme.html
https://www.irfcg.me/en/2016-03-01-09-03-19/support-to-women-in-business-programm-undp.html

When it comes to reporting, the process of drafting the **Third Biennial Update Report on Climate Change** included drafting the concept of the National Monitoring, Reporting and Verification System (MRV). In addition, an MRV portal was created for the exchange of the most important information on current activities and projects in the field of climate change, which includes updated information on gender equality[97]. Some of the main recommendations of the Third Biennial Update Report on Climate Change, adopted on 23 December 2021, were the following:

- **Continuous collection of data disaggregated by gender**: Focusing on collection and documentation of gender-disaggregated statistics as a basis for planning gender-sensitive programs and projects, and as an instrument for monitoring their implementation;
- **Strengthening the capacity of key actors in the field of gender and climate change**: By focusing on capacity building of institutions and capacities of civil society organisations, for creation and implementation of gender sensitive programs and projects at all levels;
- **Gender equality in policy making**: Participation of equal numbers of women and men in policy making, decision making and implementation of climate change measures, taking into account different vulnerabilities and adaptation capacities;
- **Strengthening institutional mechanisms**: Strengthening gender-sensitive mechanisms through the National Council for Sustainable Development, Climate Change and Integrated Coastal Zone Management in order to integrate the gender dimension into all policies related to climate change;
- **Effective implementation, monitoring and evaluation of performance (gender indicators);**
- **Introduction of a gender perspective in the financing of climate policies** - adequate financial resources for policy implementation (gender responsive budgeting);

Given the above mentioned, in Montenegro, gender equality is recognized as a significant aspect in only two sectoral policies - agriculture and entrepreneurship, while other sectoral policies are currently “blind” to the issue of gender equality.

2. Integrating the gender dimension into activities in the field of climate change in Montenegro - Assessment of institutional arrangements and capacity

Integrating the gender dimension into climate change policies and activities in Montenegro is an important prerequisite for ensuring effective results. A gender lens is both necessary and relevant in order to achieve climate targets and contribute to the MedProgramme’s regional Gender Mainstreaming Strategy, through mainstreaming gender-responsive actions in the regional climate change adaptation strategy, creating the impetus towards formulating gender data-driven policy to manage climate risks and environmental resources in the region, and engaging stakeholders on gender and socioeconomic aspects within adaptation solutions, the project can ensure both environmental and social co-benefits in its results framework.

Montenegro does not have a dedicated policy on or a decision related to **the balanced participation** of women and men in climate policies. This is mainly due to the lack of institutional awareness and capacity to intersect the two policies, while the institutions do not have a sufficient number of employees with knowledge in this area or their funds planned in the annual budget are insufficient. Therefore, additional training and financial assistance are needed. The system of functional mechanisms for monitoring and evaluation of climate policies and gender equality horizontally across institutions is still not sufficiently developed, and it is necessary to work on improvement both at the national and local level. Annex II contains detailed breakdown of gender-disaggregated data on all professionals working on **transposition of EU Directives under Chapter 27**, where the underrepresentation of women participating in climate policies is presented. Some positive developments happened in the period 2017–2020, when Montenegro participated in the UNDP/UNEP Global Support Programme (GSP) pilot for five Balkan countries and Lebanon. Most notably, a **gender focal point for UNFCCC** has been nominated and the Gender and Climate Change Action Plan, as a framework for intersecting the two policies, has been developed[98].

Within this project, Montenegro defined three objectives for its national **Gender Action Plan**:

[97] See: https://www.gov.me/dokumenta/3b8af3ba-368b-45a9-8180-d48fb62c8e90

[98] See: Gender Mainstreaming into Climate Transparency and MRV: Results of GSP Pilot in Western Balkan Countries, 2017-2020. https://www.ndcs.undp.org/content/ndc-support-programme/en/home/impact-and-learning/library/gender-mainstreaming-into-climate-transparency-and-measurement--.html

- **to improve climate change legislation and policy documents (strategies and by-laws) by introducing a gender perspective**, as well as to introduce climate change perspective in policy documents related to gender equality;
- **to strengthen national institutions to mainstream gender into the climate change transparency framework** by assessing the capacities of institutions to interlink gender and climate change as a first step. A set of training sessions were also proposed. It was also proposed to nominate gender representative into Working Group on Climate Change within the National Council for Sustainable Development, and
- **to improve the system of collection and analysis** of sex-disaggregated data and gender data relevant for MRV and transparency[99].

Other important **recommendations** from this project are the following:

- Creating awareness of the importance of sex-disaggregated data, analysis of data and development of gender indicators
- More structured thinking about the interconnection between gender and climate change policies and development of strategic framework for cross-sectorial approach
- Improve gender sensitive monitoring framework (indicators)
- Better understanding of gender dimension of NDCs
- Promotion of communication tools to effectively cooperate with stakeholders and to raise awareness of the public about interdependence of gender and climate change
    - Encouraging countries to nominate UNFCCC gender focal points and enabling experience sharing and peer-to-peer learning between involved countries.

The next steps could include the following activities:

- Identify various tools that would help countries to collect sex disaggregated data and gender information
- Encourage youth leadership in mainstreaming gender into climate action and transparency
- Support cooperation among women parliamentary networks from the region in exchanging experiences related to ensuring women's participation and recognition of women's needs and perspectives in the design of climate policy and action
- Support cooperation of NGOs, research institutions and private sector in the region in the area of gender and climate change
- Produce video and other communication material about correlation between gender and climate change and communicate it through social networks; it is important to use case studies and simple language to communicate the massages and to provide the platform for grassroots groups to tell their stories
- Introduce budget allocations for gender specific activities within all climate change related initiatives[100].

3. Indicators to assess gender and social equality

Employment

Of the total labour force (active population) in 2020, around 148.6 thousand of 55.6% were men and 118.6 thousand or 44.4% were women[101]. Similar situation is with the III quarter of 2021, where of the total active population, 152.9 thousand or 55.9% are men, and 120.4 thousand or 44.1% are women[102]. The unemployment rate for women in Montenegro remains high, with large regional variations. Unemployment rates in 2020, among women in the north are seven times as high as in the south and three times as large as in the central region[103]. If we consider Table 33 in Annex III, which contains labour statistics for Montenegrin women, we can see a clear trend of increase in women participation in the workforce, as well as decrease in unemployment rate for the period 2006-2021. However, there is still a significant number of women not participating and for those who chose to enter the workforce, unemployment remains a pressing issue. Although the unemployment rate halved in the last 10 years, the unemployment rate remained still twice as high as the Millennium Development Goals.

[99] Gender Mainstreaming into Climate Transparency and MRV: Results of GSP Pilot in Western Balkan Countries, 16 July 2020. https://www.ndcs.undp.org/content/ndc-support-programme/en/home/impact-and-learning/library/gender-mainstreaming-into-climate-transparency-and-measurement--.html

[100] https://www.un-gsp.org/sites/default/files/documents/thirdmeeting_report_final.pdf

[101] https://monstat.org/uploads/files/ARS/2020/ARS%20saopstenje_2020_en.pdf

[102] https://monstat.org/uploads/files/ARS/2021/3/ARS%20saopstenje_2021_Q3_en.pdf

[103] https://monstat.org/eng/page.php?id=1615&pageid=22

Youth unemployment remains an issue in Montenegro, however we can see that within the youth, there is a significant gap between men and women unemployment. According to the **ILO Labour Force Survey of 2020**, the highest unemployment rate in Montenegro is within the age group 15–24 years and that is 39.7% for women and 33.6% for men. On the other hand, the highest activity rates are in the age group 25–49 years and amount to 82.8% for men and 70.5% for women. Men make up a significant majority in the sectors of transport, storage and communication, while some professions continue to be typically female-dominated: healthcare and social protection, education, other social and personal services; financial and insurance activities; wholesale and retail; and professional, scientific and technical activities. Women also constitute 60% of the total number of family workers.

Women on average earn 86.4% of the average man's salary, and as one of the consequences of the gender gap in wages, women later have lower pensions, which consequently increases the risk of poverty. The causes of the gender gap in earnings include: 1) direct discrimination; 2) indirect discrimination; 3) lower valuation of women's work; 4) segregation in the labour market; 5) stereotypes and tradition; and 6) an increased need for women to balance work and private life, which is probably related to taking additional responsibilities as care providers (not only to children but also the elderly and disabled members of the household)[104]. The gender gap in access to economic opportunities is huge and women are self-employed less and have lower rates of firm ownership and management. Only 9.5% of total women in the workforce are self-employed in 2021.

Education

When it comes to primary education, a much smaller number of female students enrol in primary school, compared to male students, and finish primary school in approximately the same ratio. However, in 2018, in the segment of the population that had no education at all (the total of 11,324 citizens), women also represented a significant majority (80.8%)[105]. Similarly, within the segment of the population with incomplete primary school, women comprise the majority of 73%[106]. The huge gap that is evident here, however, can probably be ascribed to older generations when it was less common for women to receive any kind of education. Times have changed and today, women represent the majority of those who complete bachelor studies according to the new reformed educational system. The completion rate for women in primary education is 96% and in secondary education 90%[107], where around 5% of girls and 8% of boys of secondary school age are out of school. In Montenegro, women outnumber men within the highly educated population. Women are more likely to enrol and finish studies. For the entire observed period (2007-2021) we can see that women make up the majority of people who enrol and finish higher education. Only the PhD varies through the observed period because of a small sample, usually less than 10 people enrol in one academic year. There is a concentration of women in so-called "female areas" – education, social science, arts and humanities. According to MONSTAT, women constitute a majority of master's graduates in the fields of education, social sciences, business and law, arts and humanities. Women with masters' degrees make up around 50% in the fields of mathematics and computer sciences, as well as the agriculture and veterinary medicine, while the make up less than 50% in the fields of health and welfare and in the field of services[108].

Resource Ownership

In Montenegro, men make up a significant majority of property owners. According to agricultural data from the 2010 census, **the holders of family farms** are mostly men (87.13%), while women make up 66% of the family workers on farms[109]. Without property, their chances for self-employment and economic empowerment are at a minimum, due to the inability to provide guarantees for loan repayment in the form of mortgages. Most rural women have no pension insurance, due to lack in earnings or cash, or because they are working on their own property[110]. Some of these women have never worked and, as such, do not have a pension plan. In addition, women in Montenegro own only **4% of all real-estate properties, 8% of land and 14% of vacation homes**[111]. Although the law gives the same inheritance rights to women and men, due to tradition, women often give up their rights to their property in favour of males in their families. This information provides a valuable context for the factors that influence the risk of poverty. Namely, not

[104] http://extwprlegs1.fao.org/docs/pdf/mne180375.pdf
[105] MONSTAT & Ministry for Human and Minority Rights, Men and Women in Montenegro, 2018, p. 43, available online at: https://www.monstat.org/userfiles/file/publikacije/Zene%20i%20muskarci%20u%20Crnoj%20Gori%202019%20preview%20FINAL.pdf
[106] Ibid.
[107] https://www.unicef.org/montenegro/en/media/8486/file#:~:text=The%20completion%20rate%20for%20primary,and%20stands%20at%2086%20percent.&text=3%20percent%20of%20children%20of%20primary%20school%20age%20are%20out%20of%20schooll.
[108] https://monstat.org/eng/page.php?id=295&pageid=75
[109] https://www.monstat.org/cg/page.php?id=380&pageid=58
[110] http://extwprlegs1.fao.org/docs/pdf/mne180375.pdf
[111] http://extwprlegs1.fao.org/docs/pdf/mne180375.pdf

owning property increases financial insecurity and dependency; this could later be translated into a number of deprivations, from not being able to escape an abusive relationship to not being able to start up a business because most business loans require real-estate security. However, according to the National Strategy for Women's Entrepreneurship (2021-2024), the framework conditions for the development of women's entrepreneurship have **gradually improved** in recent years by improving the operation and implementation of various institutions responsible for regulating the business environment of SMEs and entrepreneurship, as well as those that provide various forms of support and integrate measures and policies to promote women's entrepreneurship and entrepreneurship in general. According to the Tax Administration data (see Annex III, table 4), approximately 23% of companies are owned by women, which was difficult to imagine ten years ago. Data from 2011 show that in Montenegro only 3,021 companies were predominantly female-owned, while in 2020 the number was 7,584, which is a result of the implementation of women's entrepreneurship policy and specific program support in the previous period. However, no matter how significant these increases are, these indicators still do not speak in favour of women's entrepreneurial potential and the expected level of development of women's entrepreneurship in Montenegro.

Gender equality index for Montenegro (2019)

The Gender equality index (GEI) was calculated for the first time in Montenegro in 2019, and the report calls for stronger leadership for institutional transformation, coupled with adequate financial resources, in order to bridge the gap between men and women. The GEI was developed by the European Institute for Gender Equality (EIGE) and is used to measure inequalities in all EU member states and pre-accession countries. The Gender Equality Index is a composite indicator that measures gender equality in the spheres of work, knowledge, money, health, time and power. Based on the EIGE methodology, the index was measured by the National Statistical Office of Montenegro. The report was produced within the EU-funded project "Support to Anti-discrimination and Gender Equality Policies" implemented by UNDP, in partnership with the Ministry of Human and Minority Rights[112]. The GEI 2019 value for Montenegro is 55.

At the national level, women in Montenegro are least equal when it comes to Power, followed sequentially by Time, Knowledge, Money and Work. Highest equality was observed in the domain of Health. Greatest differences between the EU countries and Montenegro were recorded in the domains of Money and Power. In order to see a broader picture, the figure calculated for Montenegro can be compared to the 2019 Gender Equality Index for EU-28 which was 67.4. With the index value of 55 (out of maximum 100 points), Montenegro scored lower than the EU average. Thus, Montenegro was seen to lag-behind most of the developed EU countries. Top of the ladder is held by Sweden, Denmark, France, Finland and the UK, while four EU member states scored lower or equal as Montenegro - Romania, Hungary, Greece and Slovakia. Serbia, Albania and North Macedonia are 56, 60 and 62 respectively.

Gender inequality index 2019

One of three basic dimensions of UNDP HDI report is the **Gender Inequality Index (GII)**[113]. The GII measures gender inequalities in three important aspects of human development:

a. **Reproductive health**, measured by maternal mortality ratio and adolescent birth rates;
b. **Empowerment**, measured by proportion of parliamentary seats occupied by females and proportion of adult females and males aged 25 years and older with at least some secondary education; and
c. **Economic status**, expressed as labour market participation and measured by labour force participation rate of female and male populations aged 15 years and older. It measures the human development costs of gender inequality. Thus, the higher the GII value the more disparities between females and males and the more loss to human development.

The GII measures the human development costs of gender inequality. The GII shows the loss in potential human development due to inequality between female and male achievements in these dimensions. It ranges from 0, where women and men fare equally, to 1, where one gender fares as poorly as possible in all measured dimensions, Thus the higher the GII value the more disparities between females and males and the more loss to human development. GII 2019 for selected countries is presented in the Annex III, Table 37. The Value of the Gender Inequality Index 2019 for Montenegro is 0.109 (rank 26 out of 162 countries included). This position is better than other Western Balkans countries but worse than the position of Slovenia and Croatia.

[112] UNDP, Gender Equality Index for Montenegro. 2019.
https://www.me.undp.org/content/montenegro/en/home/library/womens_empowerment/GEI2019.html
[113] http://hdr.undp.org/en/content/gender-inequality-index-gii

Vulnerability assessment

Given the above mentioned, the climate change factors that most impact vulnerable groups are **heat waves, droughts, snowfall and wildfires.** As mentioned before in Chapter 2.5, **long heat waves** predominate in August, and they lead to an increase in demand for electrical power, leading to an increase in the price of electricity. This can lead to **energy poverty** and especially exposed are older women and women living in rural areas. Research on energy consumption in households in North Macedonia[114] showed that older women (65+) are most vulnerable to energy poverty. In Macedonia, women make up the majority of older citizens and have lower incomes, due to the gender pay gap. Although Montenegro has not developed such a study, it could expect similar findings, given that in Montenegro, just as in North Macedonia, women form the majority of the older population and suffer from a gender pay gap of a similar percentage (on average, women earn 13.6% less than men[115]) and have therefore lower pensions. Similarly, **heavy snowfall** can put a pressure on the electricity price, thus increasing risk of poverty for vulnerable groups. Furthermore, it puts additional pressure on rural populations, especially women since it becomes more difficult to provide food and medical supplies to rural populations. As 34.5% of women live in **rural areas**, and the fact that some of these women have never worked and, as such, do not have pension insurance, they are more exposed to poverty risk due to the abovementioned factors. Furthermore, as the demographic depopulation and ageing in villages represent the main trends in the development of the population, that leaves intersection of older rural women as an extremely exposed group.

[114] https://www.skopjesezagreva.mk/.
[115] https://www.gov.me/en/documents/75eb5b10-d38e-43ad-8ab3-185080f0c3e4

II. Climate Risk Assessment of Boka Kotorska Bay

A. INTRODUCTION

One of the most precious national treasures of Montenegro is Boka Kotorska Bay. The area has a significant growth potential, which is critical for development of Montenegrin society. It is, nonetheless, characterized by complex relationships between human activities and the natural environment, which frequently results in significant pressures on natural resources. Boka Kotorska Bay covers an area of 616 km^2, or 4,5% of Montenegrin territory. In the geographic sense, the Bay is naturally divided into four smaller parts - Herceg Novi Bay, Risan Bay, Kotor Bay and Tivat Bay. The outermost part of the bay is the Herceg Novi Bay which narrows into the Kumbor Strait, through which it is connected to the Tivat Bay. The inner bays are the Risan Bay to the northwest and the Kotor Bay to the southeast, connected with the outer bays through the Verige Strait which is the bay's narrowest section and is located between Cape St. Nedjelja and Cape Opatovo. The entrance to the bay is defined by two peninsulas, Luštica on the southeast and Prevlaka on the northwest. Boka cuts 29 kilometres inland with a shoreline extending 107.3 kilometres. It is surrounded by two massifs of the Dinaric Alps, Orjen mountain (1895 m) to the west, and the Lovćen mountain (1749 m) to the east, which is one of five national parks in Montenegro. In geological terms, Boka Kotorska Bay is a ria of the vanished Bokelj River, which used to flow from the high mountain plateaus of Mount Orjen. Tectonic and karstification processes led to the disintegration of this river. Due to its morphological characteristics, especially due to the specific vertical ruggedness, it is a unique bay of the Mediterranean.

Montenegro has still not carried out a national vulnerability study. Only the capital Podgorica developed a study[116] in 2015, which did not focus on gender. However, it is used as a proxy for understanding of climate vulnerability at the national level. It concluded that particularly vulnerable groups (young and old, sick, workers who work outdoors...), as well as the majority of socially vulnerable groups (Roma, displaced persons...), have a high vulnerability to heat waves (especially in city centre) as well as a heavy precipitation (accompanied by floods)[117].

In Chapter 4 of the next part of the study, while mapping vulnerabilities in the Boka Bay, the gender aspect were taken into consideration. In order to take into account the climate-gender nexus, and in particular the need to understand the differentiated impact of hazards, we identified natural hazards (hydro-meteorological and geophysical) as a result of diverse climate-related stimuli, and tried to explain why these natural hazards could amplify existing gender inequalities in the Boka Kotorska Bay region and potentially increase the multifaceted socio-economic vulnerability gap between women and men. We tried to analyse key-areas in which a “gendered” differential hazard could be potentially highlighted like Health Status, participation in the labour market, participation in the educational and training system, family dynamics, in terms, for example, of marriage and reproductive behaviours, territorial placement of resident population between city and countryside, internal and coastal areas, etc. Furthermore, we took into consideration “resilience indicators”, suggested by Swarna Bintay Kadir[118], which considered key areas as education and knowledge, information access, intra-household relations, community engagement behaviour, etc. However, the main problem was the available data. Montenegro Statistical Office of Montenegro, doesn’t have publicly available disaggregated data by gender and withing municipalities, and majority of available data on national level stemmed from 2011 Census. Detailed list of considered indicators and available data is available in Annex V – Considered Gender Indicators.

[116] Climate Change Adaptation Vulnerability Assessment and Adaptation Action Plan in 2015. Capital City Podgorica, 2015. Available online at https://www.giz.de/en/downloads/Report%20%E2%80%93%20Vulnerability%20Assessment%20and%20Adaptation%20Action%20Plan%20for%20Podgorica%20Montenegro%20(2015).pdf.

[117] Ibid.

[118] Kadir, S. B. (2021). Viewing disaster resilience through gender sensitive lens: A composite indicator-based assessment. International Journal of Disaster Risk Reduction, 62, 102398. doi:10.1016/j.ijdrr.2021.102398

Figure 22. The Boka Kotorska Bay

The region consists of three municipalities, namely, Kotor, Tivat and Herceg Novi. The rapid development of the municipalities, industrialization (before) and urbanization (continuously before and now), have led to pollution, primarily of the sea, but also of air and soil. The location of the area, its unique cultural heritage and UNESCO World Heritage Site status and proximity to Tivat airport, also give impetus to the development of tourism in the region. Today, Boka Kotorska Bay counts around 67,000 inhabitants, with around 37% living in rural areas and 63% in urban areas, according to the 2011 census.

B. RISK PROFILE OF BOKA KOTORSKA BAY

For the risk profile in Boka Kotorska Bay, the IPCC approach was used. The risk is extrapolated from the overlap/interaction of climate hazards, vulnerability and exposure of human system, ecosystems and biodiversity (Figure 23.). Natural climate variability and anthropogenic climate change influence the frequency and intensity of extreme events that can contribute to disaster. Vulnerability and exposure determine impacts and the likelihood of disaster (disaster risk). Increasing vulnerability, exposure, or severity and frequency of climate events will increase disaster risk.

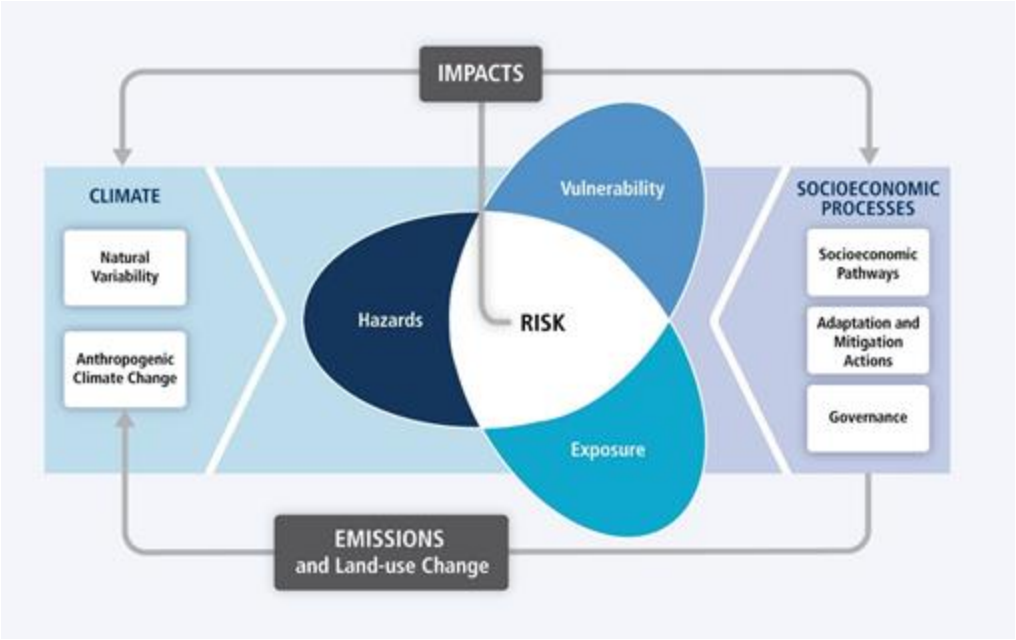


Figure 23. Illustration of the core concept of SREX

The Boka Kotorska Bay is one of the most vulnerable parts of the sea area of Montenegro. The main stressors are anthropogenic factors (due to high population in the narrow coastal zone), tourism development and accompanying urbanization, limited impact of industry (shipbuilding), maritime activities and recent growth of nautical tourism and cruising ships. Considering non-climatic factors, the exceptional diversity of flora and fauna is endangered by human activities on land and at sea and by pollution.

Based on available information from the newspapers, electronic media, protection and rescue plans, expert judgement and reports of Institute of Hydrometeorology and Seismology of Montenegro (IHMS) to WMO, it could be concluded (Figure 24) that the main hazards in Boka Kotorska Bay are mostly compound in multihazards (MH), i.e.:

- Storms – compound heavy rainfall and strong southern wind, causing river flooding and erosion
- Drought followed by heatwaves (HW), extreme temperature and forest fires (FF).

Collected information about the past effects of climate hazards, are listed in the Table of local vulnerability and exposure in Annex 1.

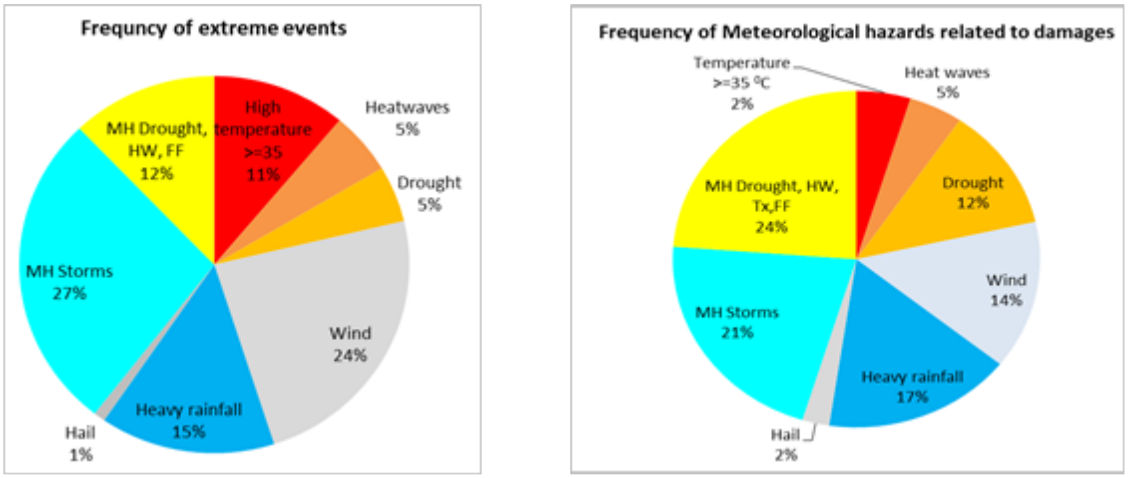


Figure 24. Frequency of extreme events and meteorological hazards that contribute to damages and losses

(Source: M. Ivanov, IHMS)

Analysis in the study "National risk assessment of hazards in Montenegro"[119] shows that the risk is "moderate" for most probable adverse consequences of storms as well as for the worst. It means that some actions have to be implemented. The risk is "medium" for most probable drought consequences and "high" for the worst probable drought consequences.

C. METEOROLOGICAL TRENDS OF BOKA KOTORSKA BAY

1. Changes in temperature

The average annual maximum temperature in Boka Kotorska Bay is around 21 ^{0}C. August is the warmest month where the average maximum temperature ranges from 30.7^{0}C (in Herceg Novi) to 31.3 ^{0}C (in Tivat). The average minimum temperature is in January from 12.4^{0}C (in Tivat) to 13^{0}C (in Herceg Novi). The highest maximum daily temperature is 42 ^{0}C recorded in Herceg Novi in August 1981. After that, only two values higher than 40 ^{0}C were observed in the last two decades. The most frequent maximum daily temperature is in the range 15^{0}C - 19^{0}C (26%) and from the 25^{0}C - 34^{0}C (22%) in the warmer part of the year, Figure 25.

[119] Disaster Risk Assessment of Montenegro, 2021, Montenegro, Government of Montenegro, Ministry of Internal Affairs, Directorate for Protection and Rescue, Available online at: https://media.gov.me/media/gov/2021/mup/nacionalna-procjena-rizika-elektronska-publikacija.pdf

	Average annual maximum temperature	Average maximum temperature in August	Average minimum temperature in January
The Boka Kotorska Bay	21 ^{0}C		
Herceg Novi		30.7 ^{0}C	13.0 ^{0}C
Tivat		31.3 ^{0}C	12.4 ^{0}C

Table 13. Average temperatures in the Boka Kotorska Bay and municipalities Herceg Novi and Tivat

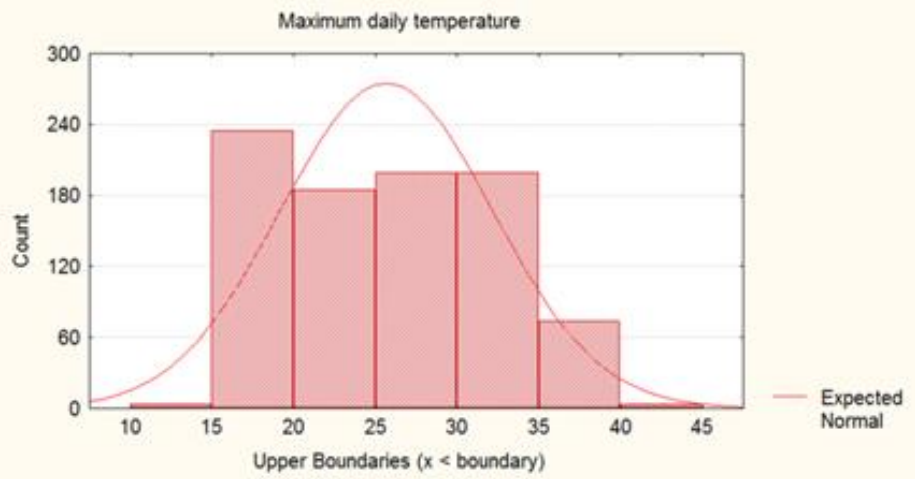


Figure 25. The number of maxim daily temperature Tx within defined interval

(Source: M. Ivanov, IHMS)

The climate in Boka Kotorska Bay is for the period 1981-2020 warmer for +0.7 ^{0}C per year compared to 1961-1990 period. The difference from climatological normal is the highest in August +1.3 ^{0}C, indicating that warming is higher in summer than in other seasons. The last decade 2011-2021 is the warmest, +2 ^{0}C compared to 1961-1990. period (Table 16).

Region	Reference period	Average annual temperature (^{0}C) per decade and its changes								
	61-90[120]	51-60	61-70	71-80	81-90	91-00	01-10	11-20	Δ1	Δ2
Herceg Novi	*20.3*	*20.2*	*20.4*	*20.2*	*20.4*	*20.4*	*20.8*	*22.3*	*+0.5*	*+2.0*
Tivat	*20.4*	-	*20.3*	*20.3*	*20.4*	*20.7*	*21.4*	*21.7*	*+1.0*	*+1.3*
Source: Calculation based on data from IHMS statistical year book										
Δ1	Deviation of the mean annual temperature for the period 2000-2010 from the climatological normal 1961–1990;									
Δ2	Deviation of the mean annual temperature for the period 2011–2020 from the climatological normal 1961-1990									

Table 14. The average annual temperature per decade and deviation from the climatological normal 1961-1990

(Source: M. Ivanov, IHMS)

Significant increase of maximum and minimum temperature during the year contribute to such an increase. Contribution is also from the consecutive days when both maximum Tx and minimum Tn daily temperatures are >95% (i.e., in the highest 5%), Figure 26. It is obvious that such days were more frequent during the two last decades.

[120] The period 1961–1990 represents the climatological normal in relation to which climate change is observed. The period was chosen by the WMO and refers to the climate described by the mean values of the meteorological elements obtained from the 30-year measurement period.

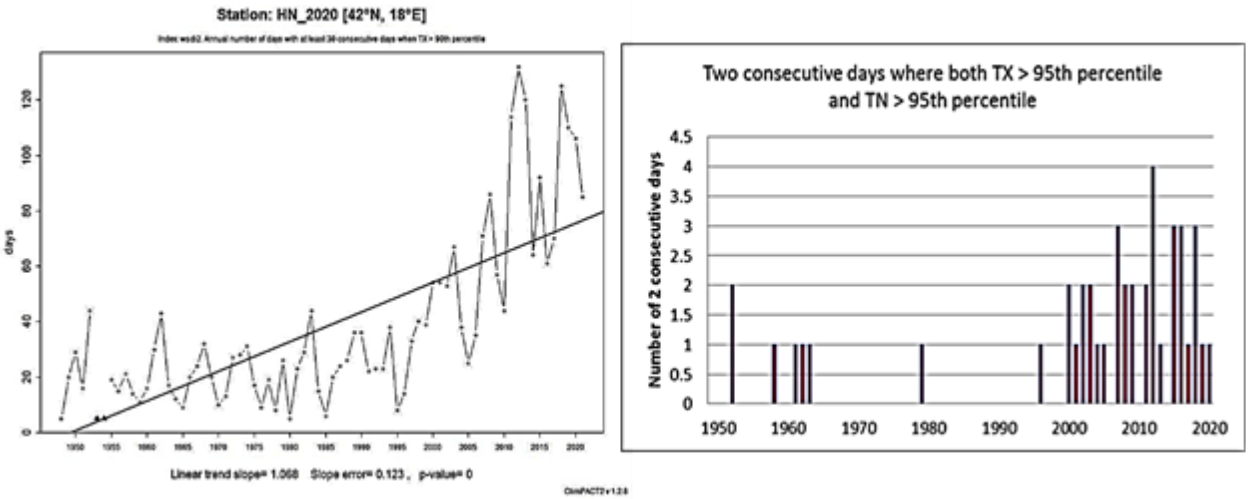


Figure 26. Annual number of days with at least 30 consecutive days when TX > 90th percentile (right) and two consecutive days with TX>95th and TN>95th percentile

(Source: M. Ivanov, IHMS)

The analysis of the observed and the projected changes in extreme temperatures is based on the following indices: the number of summer days (SU25), the number of tropical days (TR30), the number of tropical nights (TR20), the heatwave duration index (HWDI), the number of heatwaves in analysing period (HWDN), the number of days with frost (FD0) and the growing seasonal length (GSL). The linear trend is positive and statistically significant for all of these indices except number of frost days (FD0). The trend line shows that FD0 decreases in Herceg Novi for -0.02 days within period 1961-2020, Figure 27. It has positive trend in Tivat. Projections of extreme temperature show that they will increase 2 times more with respect to 1971-2020 and decrease in the number of frost days.

	SU25 observed (linear trend slope)	**SU25 projected (RCP 8.5) 2011-2040**	**TD30 observed (linear trend slope)**	**TD30 30projected (RCP 8.5) 2011-2040**	**TR20 observed (linear trend slope)**	**TR20 projected (RCP 8.5) 2011-2040**
Herceg Novi	**+0.4**	Two times more in 2011-2040 than in 1971-2000. Continues increase until the end of the century	**+0.6**	2 times more in 2011-2040 than in 1971-2000. Continues increase until the end of the century	**+0.5**	Increase of 50% with respect to the 1971-2000. Continues increase until the end of the century. Negative impact on human health.
Tivat	**+0.4**		**+0.9**		**+0.2**	

Table 15. Trend of climate indices SU25, TD30 and TR20

(Source: M.I vanov, IHMS)

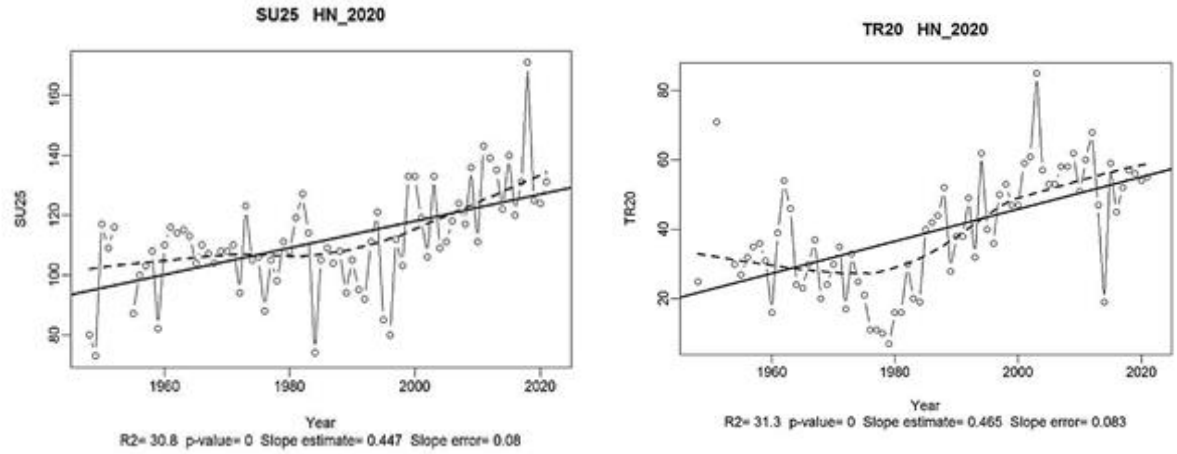


Figure 27. Summer days (SU25) and tropical night (TR20) in Herceg Novi from 1949 to 2020

(Source: M. Ivanov, IHMS)

	HWDI observed (linear trend slope)	HWDDI projected (RCP 8.5) 2011-2040	HWDN observed (linear trend slope)	HWDN 30projected (RCP 8.5) 2011-2040	FD0 observed (linear trend slope)	FD projected (RCP 8.5) 2011-2040
Herceg Novi	**+0.11**[121]	2 times longer duration than in 1971-2000. Continues increase until the end of the 21st century	**+0.07**	3-5 times more heatwaves than in 1971-2000. Continues increase util the end of the 21st century	-0.02	- 50% decrease with respect to 1971-2000. Until the end of the 21st century frost days very rare (-95% decrease)
Tivat	**+0.19**		**+0.11**			

Table 16. Trend of climate indices HWDI, HWDN and FD0

(Source: M. Ivanov, IHMS)

[121] Bold numbers refer to statistically significant changes of index.

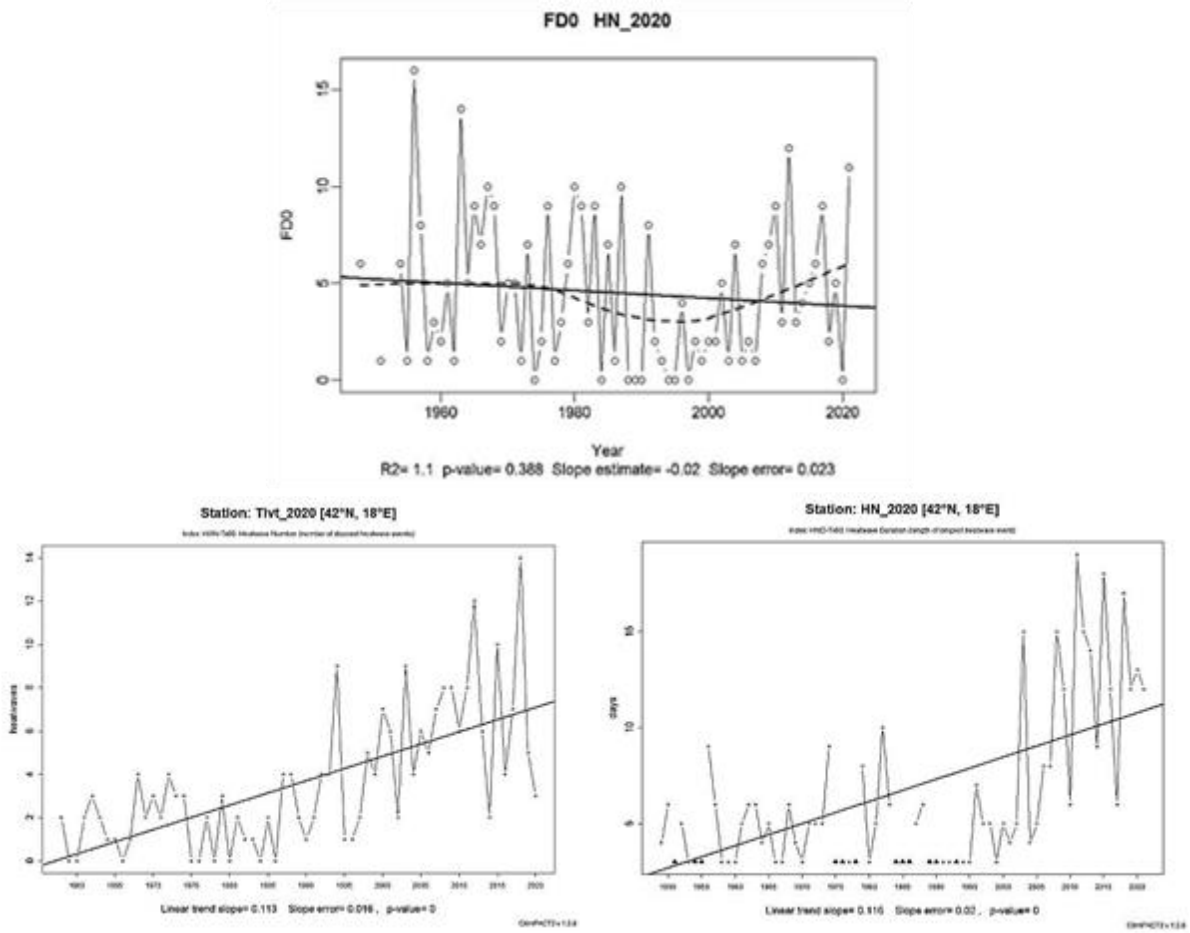


Figure 28. Number of frost days (FD0) and heatwaves (HWN) in Herceg Novi and Tivat from 1949-2020

(Source: M. Ivanov, IHMS)

There are no significant changes in growing season length (GSL). Linear trend slope is +0.006 days, indicating that duration of vegetation period changes for +0.006 days every year within the period 1961-2020. According to projected changes, GSL will be +20% longer for the period 2011-2040 compared to the normal 1971-2000. Continuous increase between 20-30% is expected until the end of the 21st century.

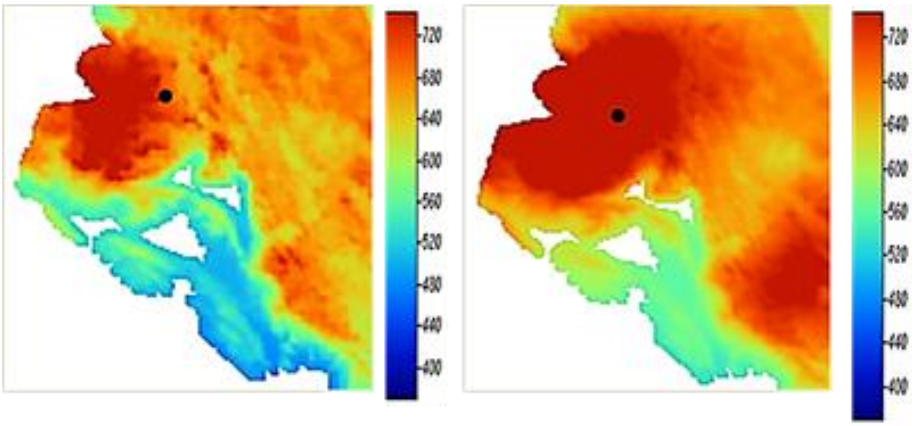
2. Changes in extreme precipitation

Figure 29. (a) shows the spatial distribution of average precipitation in the warm season (April-September) and in the cold season (October-March) for the period 1981-2010. The rainiest region in Boka Kotorska is in its hinterland, in Crkvice (cf. Figure 29). The spatial distribution of precipitation shows that cold season is rainier. Herceg Novi and in Kotor are experiencing higher precipitations rates in both seasons than Tivat. Furthermore, according to CAMP Montenegro, heavy rains have the highest impact in the parts of the municipality of Kotor and in Budva hinterland[122].

The rainiest month in Boka Kotorska Bay is November. Maximum intensity of precipitation is in September, October and November, Figure 29. (b). Maximum probability of precipitation is in November and December, followed by February and March.

[122] National strategy for integrated coastal zone management, CAMP Montenegro, 2015; available online at: https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf

a)



b)

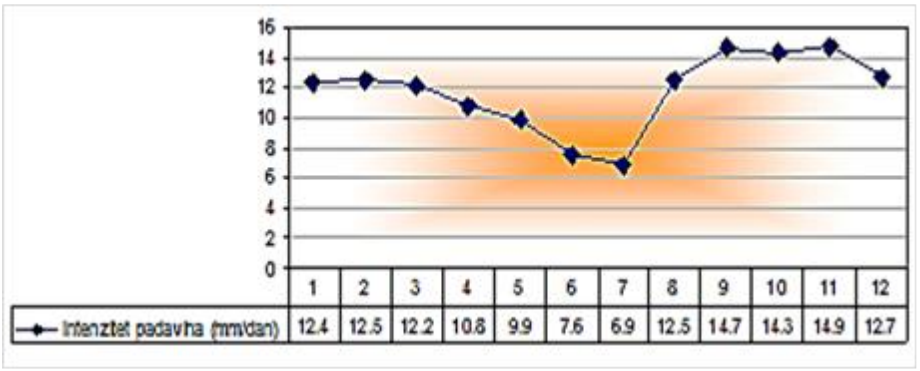


Figure 29. a) Spatial distribution of average annual precipitation in warm (left) and in cold season (right) for the period 1981-2010. The black dot is presented location of Crkvice the rainiest area in Montenegro and Europe; b) The average intensity of precipitation

(Source: M. Ivanov, IHMS)

According to long term period of measurements, average annual maximum 1-day precipitation total in Herceg Novi is 131mm, 106.5 mm in Tivat and 279.7 in Crkvice. Maximum and minimum daily value during the year is higher in Herceg Novi than in Tivat. Along the slope of Orjen, maximum 1-day precipitation ranges from 150 mm to 500 mm, presented in the table below.

	Mean	Minimum	Maximum
TVX1DAY	106.5	60	200.1
HNX1DAY	130.6	60.3	327.1
CRX1DAY	279.7	150	500

In the long-term measurements, the most frequent maximum daily precipitation in Herceg Novi is from the 100 mm – 149 mm (47%, Figure 30.). Its highest 5% of the observed values are in the range from 200 mm to 249 mm, while highest 1% are in the range 250 mm – 349 mm.

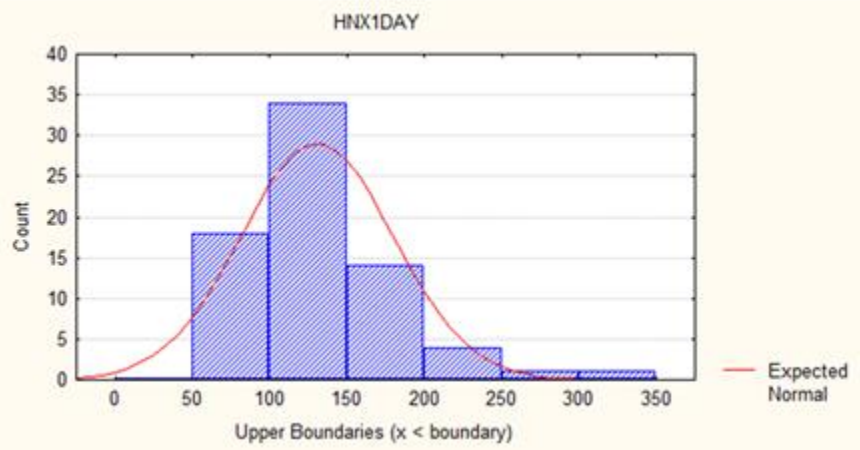


Figure 30. The number of maxim daily precipitation in Herceg Novi within defined interval

(Source: M. Ivanov, IHMS)

The observed and projected changes in extreme precipitation are based on the analysis of the following indices: annual sum of daily precipitation > 95th percentile (R95p), the number of days with precipitation >95 percentile (RR95p), maximum annual 5-day precipitation total (RX5day), simple daily intensity index (SDII) and consecutive wet days (CWD).

Analysis of indices of the observed precipitation and its extremes, shows that there are no significant changes during the year compared to climatological mean 1961-1990. There is statistically significant decrease in the maximum monthly number of consecutive wet days (CWD) in Tivat. Furthermore, there is a slight positive trend in the highest 5% of the observed precipitation values (R95p) and it is negative for the number of days with 5% highest values (RR95p). Therefore, its intensity slightly increases, as well. Maximum annual 5-day precipitation total slightly decrease.

Very similar trends to observational shows climate projections. Positive changes are expected for the highest 5% precipitation (R95) and decrease in the number of days with 5% of highest amount of precipitation (RR95p). Intensifying precipitation due to temperature increase is most expectable for the winter and autumn seasons.

	R95p observed (linear trend slope)	**R95p projected (RCP 8.5) 2011-2040**	**RR95p observed (linear trend slope)**	**RR95p projected (RCP 8.5) 2011-2040**	**RX5day observed (linear trend slope)**	**RX5day projected (RCP 8.5) 2011-2040**
Herceg Novi	+0.18	Positive changes for all seasons and annually for all three projected period 2011-2040, 2041-2070 i 2071-2100	-0.06	-5% during the year in Herceg Novi and Kotor municipality, and +5% in Lustica.	-0.2	expected widening the period with low precipitation and reduction with heavy precipitation.
Tivat	+0.38		-0.04		+0.7	

Table 17. Trend of climate indices R95, RR95p and RX5day

(Source: M. Ivanov, IHMS)

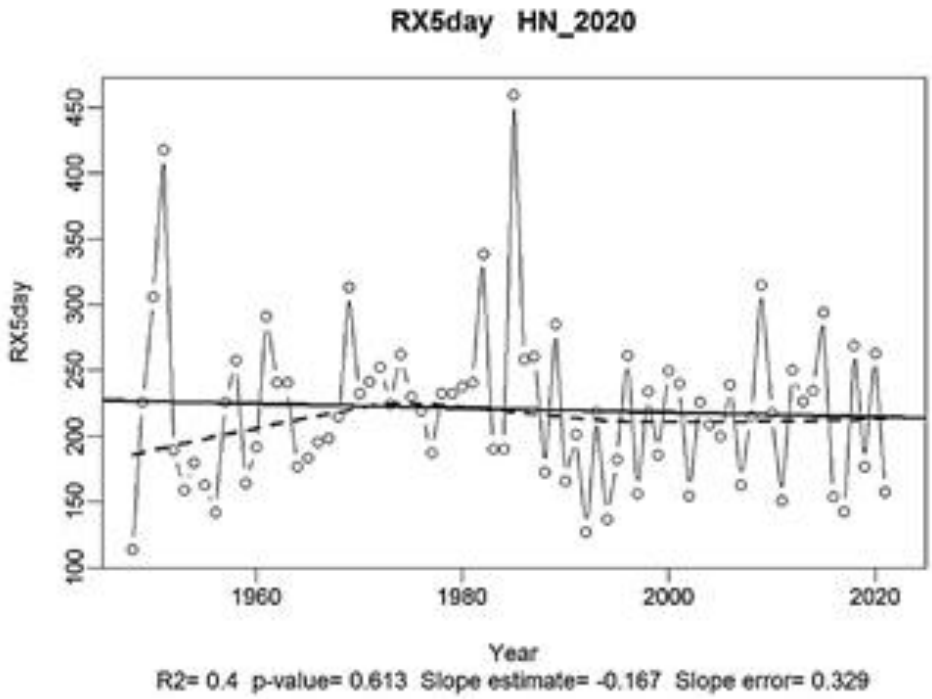


Figure 31. Maximum annual 5-day precipitation total (RX5day) in Herceg Novi

(Source: M. Ivanov, IHMS)

The trend of CWD is negative, as shown in Table 18. It corresponds to decrease in days with more significant precipitation. Given the available data, it is reasonable to expect a widening of the period with low precipitation and a reduction of the period with heavy precipitation in the future.

	SDII observed (linear trend slope) mm/day	SDII projected (RCP 8.5) 2011-2040	CWD observed (linear trend slope) days/year, days/month	CWD		
				Projected (A1B) 2001-2030	Projected (A1B) 2071-2100	Projected (A2) 2071-2100
Herceg Novi	+0.012	Annual total precipitation: -5%	Annually: -0.017 Monthly: -0.001	-0.3	-0.6	-0.9
Tivat	+0.004		Annually: -0.013 **Monthly[123] : -0.001**			

Table 18. Trend of climate indices SWDII and CWD

(Source: M. Ivanov, IHMS)

3. Drought

Drought is a natural phenomenon defined as sustained and extensive occurrence of below average water availability. Drought is not aridity, which is a permanent climate characteristic. It is also distinct from water scarcity, which is an imbalance between water availability and demand. Drought can be monitored in several ways. The analysis here is based on the Standardized Precipitation Index (SPI) and the Standardized Precipitation Evapotranspiration Index (SPEI) for 6, 12 and 24 months cumulative. These timescales reflect the impacts of drought on streamflow, reservoirs, and groundwater (SPI, WMO). The 6-month SPI compares precipitation for that period with the same 6-month period over

[123] Maximum monthly number of consecutive wet day when precipitation is >=1mm

the historical record. For example, a 6-month SPI at the end of September compares the precipitation total for the April–September period with all the past totals for that same period. The 6-month SPI indicates seasonal to medium-term trends in precipitation and is still considered to be more sensitive to conditions at this scale than the Palmer Index. A 6-month SPI can be very effective in showing the precipitation over distinct seasons. For example, a 6-month SPI at the end of March would give a very good indication of the amount of precipitation during period from October through March for certain Mediterranean locales. Information from a 6-month SPI may also be associated with anomalous of stream flows, reservoir levels and ground water depending on the region and time of year (SPI, WMO).

Trend analysis shows that there are significant changes in those indexes on all timescales except in Herceg Novi for SPI-6month where there is no trend.

Drought	Trend of SPEI and SPI					
	SPEI-6 month	SPEI-12 month	SPI-6 month	SPI-12 month	SPEI-24 month	SPI-24 month
Herceg Novi	**-0.001**	**-0.001**	No trend	**-0.001**	**-0.002**	**-0.001**
Tivat	**-0.001**	**-0.002**	**-0.001**	**-0.001**	**-0.002**	**-0.001**

Table 19. Trend of drought using the Standardise Precipitation Evapotranspiration index (SPEI) and Standardise Precipitation Index for 3, 6 and 12 months

(Source: M. Ivanov, IHMS)

Figures below indicate that there is high drought impact on surface and ground water in Boka Kotorska Bay. Due to predicted lengthy droughts and their consequences on water supplies, this knowledge is crucial and requires more analysis and research in practice.

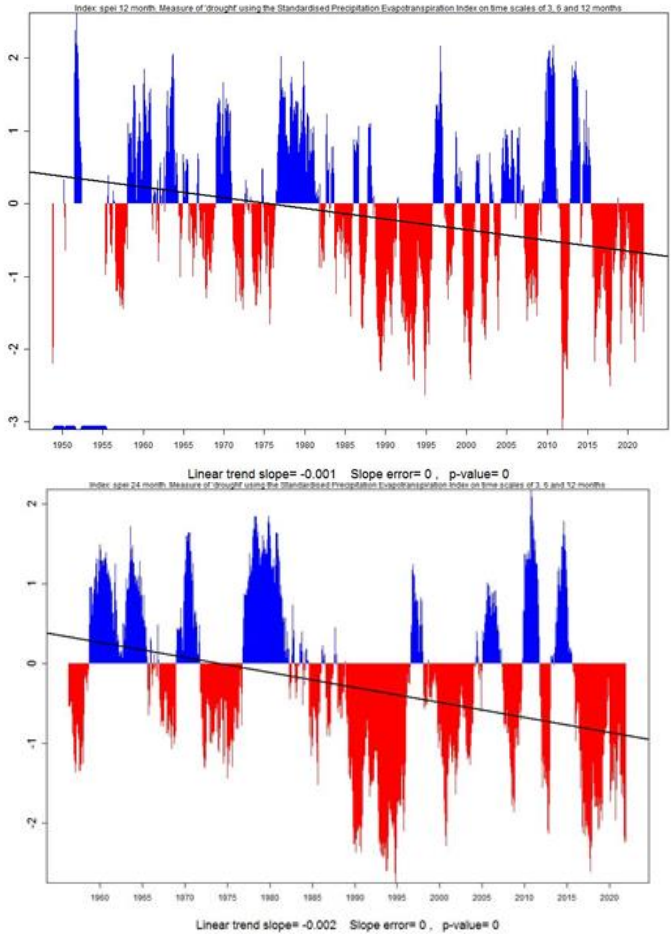


Figure 32. SPEI-12 month and SPEI-24 month

(Source: M. Ivanov, IHMS)

The maximum duration of a period without rainfall in the growing season, based on the ZT[124] methodology, is from 77 to 82 consecutive days, and it is likely that it could repeat in 100 years, which corresponds to moderate to very rainless conditions.

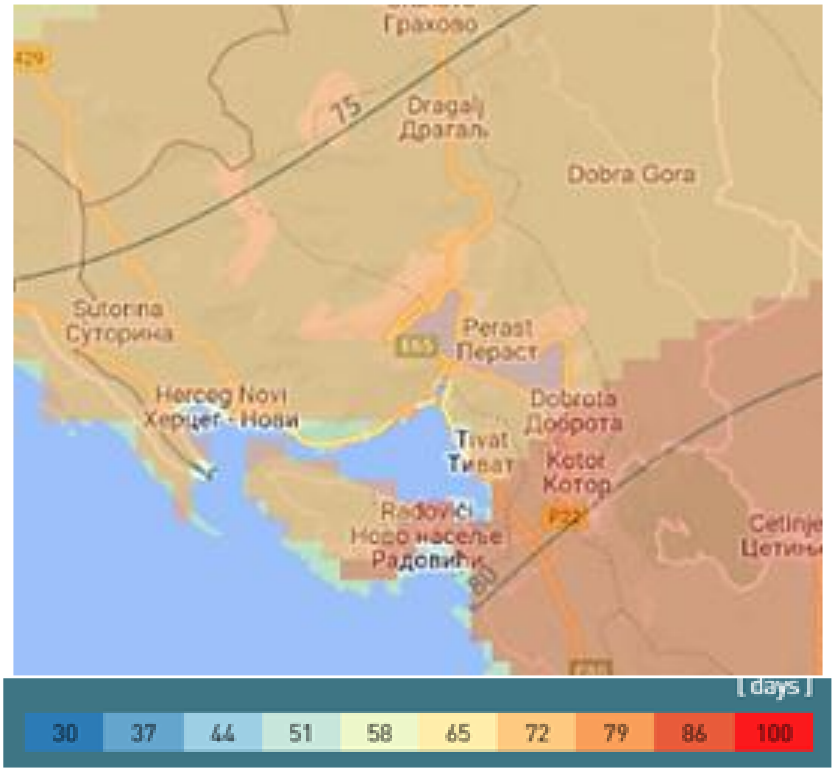


Figure 33. The maximum rainless period in vegetation season for the return period of 100 years

The longest maximum number of consecutive dry days (CDD) was 60 days in 2013 and 2017 in Herceg Novi, while Tivat experienced 90 days in 2008 and 99 in 2017.

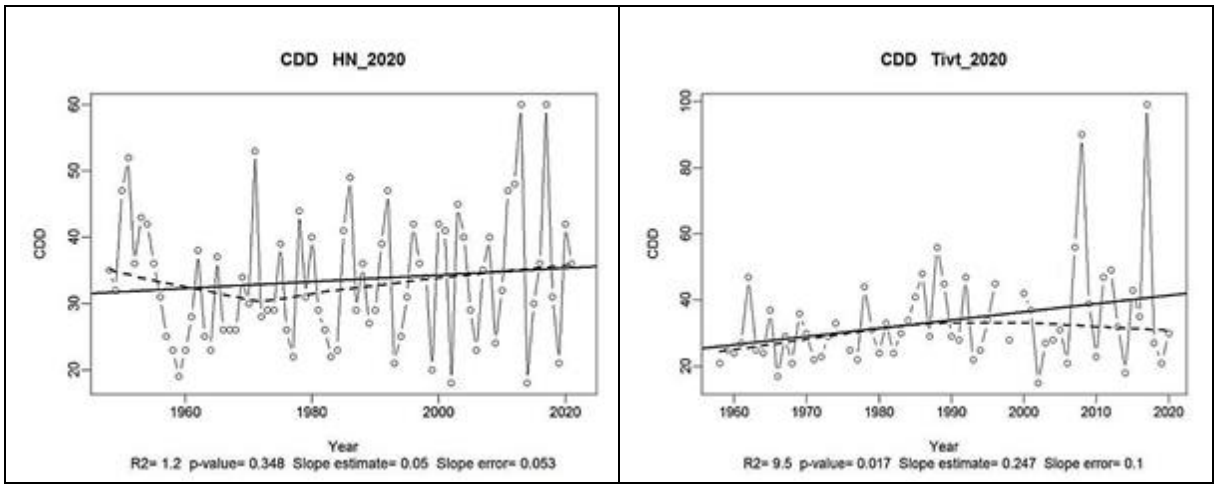


Figure 34. The maximum annual number of consecutive dry days (CDD)

(Source: M. Ivanov, IHMS)

[124] The **ZT method** (after Zelenhasic and Todorovic, CSU in Fort Collins - USA). Aplication of the ZT method in the growing season - from the 1st April and ending on the 30ty September relevant for the agriculture. It considers drought duration more than 20 days long, with less than 3 mm of daily rainfall, time of occurrence, number of droughts in a given time interval [0,t], and the longest drought in a given time interval [0,t]. INTERREG DriDanube, https://www.droughtwatch.eu/

	CDD[125] observed (linear trend slope) mm/day	CDD projected (RCP 8.5) 2011-2040
Herceg Novi	+0.05	JUNE-JULY-AUGUST: 5%-10% increase in Luštica, Tivat and Kotor surroundings; No changes in Herceg Novi and its surroundings; 5% decrease in the hinterland (Crkvice); ANNUAL: Around 5% decrease in Boka Kotorska bay; 5%-10% decrease in the hinterland (Crkvice); JUNE-JULY_AUGUST Maximum 30% increase from 2041-2071 and 50% till the end of the century. ANNUAL Maximum 20% increase from 2041-2070, and 30% at the end of the century.
Tivat	**+0.2**	

Table 20. Observed and projected changes of maximum annual number of consecutive dry day (CDD)

(Source: M. Ivanov, IHMS and IPA INTERREG Drought Watch Tool)

Thus, in the case of the RCP8.5 scenario, it can be expected that the number of consecutive days without precipitation will increase in the future, and at the end of this century it could be up to 70% in average. This change in the CDD index clearly indicates that droughts will intensify in the future. This is in line with the scenario A1B/2001-2030 in the CAMP, where average annual grades show that **droughts, fires** and **stormy winds** in the area of **Herceg Novi**, Budva and southern part of the coast have the highest impact[126].

4. Storms

Storms occur in strong and relatively large atmospheric systems - cyclones. The main risks that accompany them are: storm waves and their combination with astronomical tide, so called storm tide, followed by heavy rain, wind and flooding.

Storms in Montenegrin coastal region were analysed within the CAMP project[127]. Analysis was focused on well-developed cyclones i.e., storms of maximum wind gust and maximum amount of rainfall. Storms were classified according to intensity into 5 categories, from strong to extremely strong, with corresponding relative frequency.

Interval of maximum wind speed (m/s)	Storm intensity index	Relative frequency (%)		Interval of maximum daily precipitation (mm)	Storm intensity index	Relative frequency (%)
10 – 20	1	4		0 – 100	1	32
21 – 30	2	40		101 – 150	2	47
31 – 40	3	36		151 – 200	3	12
41 – 50	4	16		201 – 250	4	5
51 – 60	5	4		251 – 350	5	4

Table 21. Intervals of maximum wind speed (left) and maximum daily precipitation (right), corresponding storm intensity index and percentage of such storms in relation to its total number for Herceg Novi

[125] Maximum annual number of consecutive dry days when precipitation < 1.0 mm)

126 National strategy for integrated coastal zone management, CAMP Montenegro, 2015; available online at: https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf

127 National strategy for integrated coastal zone management, CAMP Montenegro, 2015; available online at: https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf

The key findings:

Based on meteorological measurements of wind and rain	Based on observation from the ship and instrumental measurements of waves
Analysis of storms based on the data from meteorological station in Herceg Novi indicate frequent winds from the 2nd and 3rd category, with maximum gusts of gale to hurricane speed. Most of the time they appear within cyclone in cold part of the year from October to April. Observed impacts: • Damages to the buildings, houses, construction sites, airport, transmission lines; • Storm surges, coastal flooding and erosion, damages on coastal infrastructure Regarding the precipitation, category 1 and 2 are usually present indicating heavy rain between 101-150 mm in one day. Therefore, loads on heavy rainfall must be taken into account, especially when designing rainwater drainage. Observed impacts: • Torrents, overflow of the river, damages on infrastructure.	Analysis of waves generated by the wind indicates that the open sea of Montenegro does not have natural protection from waves such as island chains of reefs. Therefore, it is entirely exposed to destructive waves. The influence of waves in larger part of Boka Kotorska bay is moderate. Exception is the gulf of Herceg Novi and a few locations exposed to the wind (fetch). All of these locations have a low coastline, and thus greater vulnerability to floods due to storm surges. Comparison of the observational data from the ship and those measured by instruments show that observational data are significantly underestimated. However, observational data may well serve to determine frequency of waves' progression in some wave's models. It should be noted that during sirocco (south wind) the maximum wave height could reach 10.8 m on the open part of Adriatic Sea.

Two current areas[128] vulnerable to sea floods, i.e., the floods induced by the sea are:

- The estuary of the river Sutorina (Municipality of Herceg Novi)
- Area of Solila (Municipality of Tivat).

Figure 35 shows the areas that could be inundated by water in any given category 4 hurricane (Table 8).

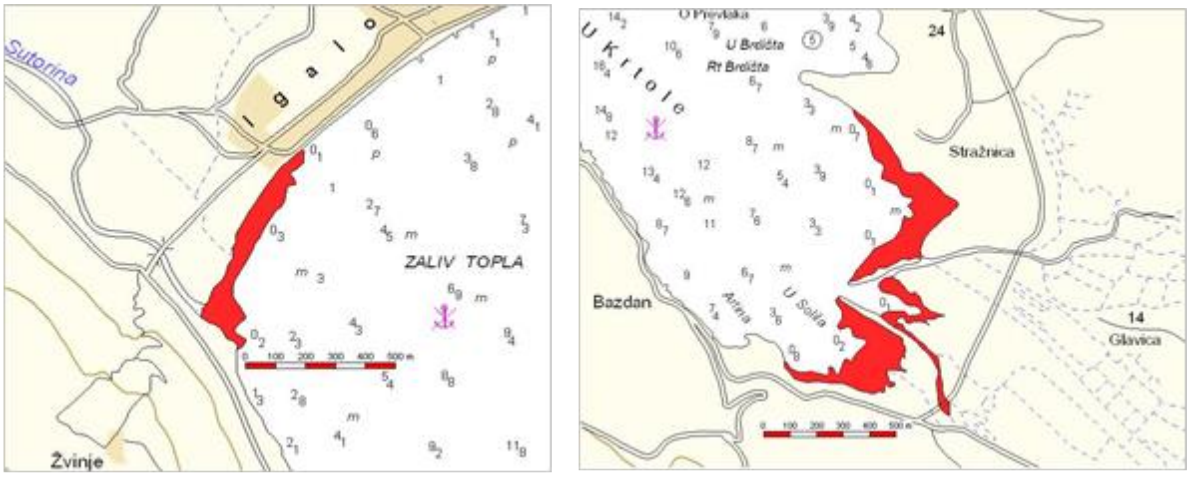


Figure 35. Flooded areas (red polygons): The estuary of the river Sutorina (left) and Solila area (right)

[128] Current areas of flooding are digitized from nautical map of Boka Kotorska Bay with the scale 1:25 000

Although the Sutorina River estuary is within Boka Kotorska Bay, it is exposed to high storm surges southern direction from the open sea. The coast at the mouth is low, partly flooded. In the case of cumulative impact of the sea level, the flooded area may be bigger.

The Solila area, (Figure 35), is a salty and occasionally flooded wetland. Although the bay is located in the protected Bay of Kotor, it has a windward side towards northwest 9.5 km long. Strong and long-lasting winds from that direction can develop waves that cause flooding of the coastal belt in the bay.

The potential areas of flooding are those based on estimates of possible flooding by storms. The surfaces of delineated areas are presented in the table below. Those areas need to be further explored in order to collect new, and update existing data, using modern technology such as satellite data, DTM and reanalysis of the wind field.

Location	Surface (m^2)
Mouth of the river Sutorina	51 936.2
Solila	147 183.5

Sea level rise due to the its thermal expansion and in combination with meteorological and oceanographic factors, could lead to major flooding in these areas in the future.

Figure 36. Flooded city's area in Kotor (left), 20th November 2018 and torrent in Bijela (right)

Figure 37. Storm category 4: Flooded city's area in Herceg Novi, 5th March, 2015

(Source; Mondo.me)

Figure 38. Floods due to storm tide in Djenovici (Municipality of Herceg Novi)

(Source; National strategy for integrated coastal zone management, CAMP Montenegro, 2015; available online at: https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf)

D. IMPACTS OF CLIMATE HAZARDS ON KEY SECTORS IN BOKA KOTORSKA BAY

The starting point for checking the observed impacts of climate hazards were local physical features and socio-economic conditions, i.e., receptors (e.g., population or infrastructure). The table "Former events" lists extreme climate and weather events - hazards in the past (2000-2020), with description of meteorological situation, corresponding consequences, affected receptors and locations (see Annex 1). Based on that information, the summary table of climate hazards' impacts on each of key sectors in Boka Kotorska was made.

The key sectors in Boka Kotorska Bay relevant to climate hazard impact assessment are:

- Tourism
- Small and Medium Enterprises (SMEs)
- Construction
- Infrastructure (transport, water supply, electricity service)
- Industry
- Agriculture, fisheries and mariculture
- Forests.

Our analysis will start with the overview of the Boka Kotorska population, then we are going to focus on the economy of the region, taking into consideration all of the key sector. Finally, we are going to analyse climate change impacts on the biodiversity of the region.

1. Population

According to the Monstat data from 2020, it was estimated that there were 68,478 inhabitants of Boka Kotorska Bay. In Montenegro, the processes of concentration and centralization of the population have significantly intensified since the first half of the 1990s, and the region of Boka Kotorska bay has significantly felt these trends. Furthermore, a significant impact on the entire coastal region is reflected through the departure of the population from the northern region of Montenegro to primarily the coastal region. As a result of the above, we have, among other things, coastal areas that take on urban features and become zones of concentration of population with a predominantly tourist function.

In the demographic analysis, the division into urban, coastal and rural settlements in the hinterland can be made for Boka Kotorska Bay. Coastal settlements, as demographically more vital and suitable for development, include settlements on the coast or in the immediate hinterland of cities, which have a large number (more than 500) and a constant growth of population in the last 20 years. Rural settlements in the hinterland that have significantly different demographic characteristics than coastal settlements (small number and mostly declining population, unfavourable age structure, elderly households and unfavourable workforce structure). Boka Kotorska Bay was in the past farmers bay, but after the rapid urbanization many agricultural fields were abandoned. Today, agricultural population accounts for only around 1.6% of the overall population in Boka Kotorska, with 46% of population living in urban centres. The

average density is about 110 inhabitants per square km. Spatial distribution shows that the coast is exposed to high pressure from population.

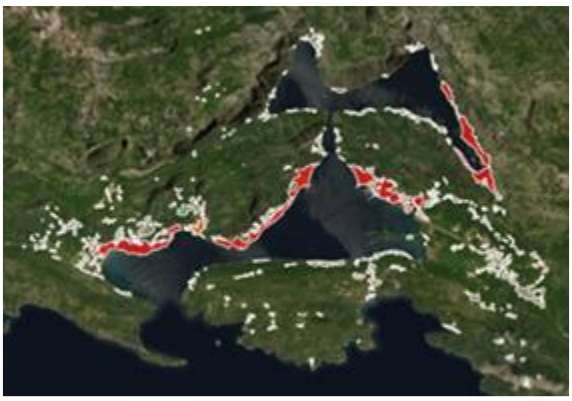


Figure 39. Population distribution in the Boka Kotorska Bay

Figure 40 compares the population in 3 municipalities and within the city centres. Most populated municipality is Herceg Novi, followed by Kotor and Tivat respectively. However, if we are looking at the city centres Herceg Novi is still the most populated, but city of Tivat is more populated than Kotor.

Figure 40. Population in Boka Kotorska Bay

The main demographic problems of the Boka Kotorska region are:

- High pressure of the immigrant population, especially on urban and coastal settlements and the immediate hinterland, which led to the creation of agglomerations and caused overcrowding, which is very evident in the coastal area;
- Despite the significant influx of population through immigration, the rates of natural population growth in rural settlements in the wider hinterland are very low or even negative, which negatively affects the renewal of the labour force, resulting in labour shortages in these settlements;
- Rural settlements without inhabitants follow the decades-long trend of emigration

If we look at the population growth through the years, abovementioned demographic problems become evident.

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
HERCEG NOVI	31,711	30,866	30,861	30,824	30,763	30,755	30,690	30,690	30,647	30,597
	-2.66%	**-2.68%**	**-2.80%**	**-2.99%**	**-3.01%**	**-3.22%**	**-3.22%**	**-3.35%**	**-3.51%**	**-3.88%**
KOTOR	22,435	22,603	22,622	22,627	22,618	22,640	22,634	22,651	22,683	22,753
	0.75%	**0.83%**	**0.86%**	**0.82%**	**0.92%**	**0.89%**	**0.96%**	**1.11%**	**1.42%**	**1.60%**
TIVAT	13,758	14,032	14,129	14,185	14,286	14,386	14,572	14,774	14,923	15,069
	1.99%	**2.70%**	**3.10%**	**3.84%**	**4.56%**	**5.92%**	**7.39%**	**8.47%**	**9.53%**	**10.52%**

Table 22. Population growth in Boka Kotorska Bay (2010 as a baseline)

As we can see, the only municipality with significant increase of population was Tivat, mainly because of the historically small population and new investments. Population ageing is also evident in the region, % of population over 65 years went from 14,10% in 2011 when the census was done, to estimated 17,84% in 2020. Regarding gender statistics, there is no data available for the municipalities in Montenegro. Unfortunately, our Statistical office of Montenegro – Monstat, doesn't collect data by gender form municipalities, and the municipalities don't have incentive to collect gender disaggregated data themselves. In annex V there is detailed list of "resilience indicators", suggested by Swarna Bintay Kadir (2021), where the all of the available gender data for the level of municipalities in Montenegro is available. Majority of data stems from census data which was conducted in 2011. After that, no major gender study was conducted on the municipality level in Montenegro and there is no available data.

2. Economy

Economy of the coastal region makes a significant share of the national economy, as for the tourism sector, the share is predominant. The period of transition totally changed the economic picture of the Boka Kotorska Bay. The former industrially developed environment with developed maritime affairs has been replaced by tertiary activities, primarily tourism, followed by trade and services in the field of construction.

A similar structure applies to employment: the largest number of employed works in the services sector – over 83%. Non-agricultural sectors employ 13.5% while 2.7% of population of the coastal zone is engaged in agriculture[129]. According to MONSTAT, in three municipalities of Boka Kotorska Bay in 2020 there were 5,594 registered companies or 17.15% of total registered companies in Montenegro[130], while around 99% of them are micro or small companies.

The coastal zone is economically the most developed part of Montenegro. In last quarter of 2021, a somewhat higher activity rate (54.9% higher than the national average) and a lower unemployment rate (6.1% or 9.3% below the national average)[131] was reported.

In the recent decades, a major share of investment (especially between 2006 and 2009) was linked to real estate transactions. Aside from the economic effects, this has put significant pressure on space and other coastal zone resources, and has, to some extent, harmed the possibility for sustainable tourism development with greater economic and social advantages.

a) Tourism

The geographical position of the region, a great variety of cultural, historical and natural sites such as high steep mountains, deep valleys, diverse flora and fauna, airport, make Boka Kotorska very attractive for the tourism industry. The coastal municipalities (Herceg Novi, Kotor, Tivat, Budva, Bar and Ulcinj) altogether account for the 93% of the tourists, and represent the most attractive area for the tourism. The most developed municipality in Boka Kotorska is Herceg Novi. It has more hotels, restaurants and employees than other two municipalities. According to data of the Administration for the Protection of Cultural Heritage, within the area of coastal municipalities there are in total 735 immovable cultural assets; out of which 83% are in the Boka Kotorska Bay (namely, Tivat 26, Kotor 459, and Herceg Novi 127)[132].

129 National strategy for integrated coastal zone management, CAMP Montenegro, 2015; available online at: https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf
130 http://www.monstat.org/uploads/files/biznis%20registar/saopstenja/Broj%20i%20struktura%20poslovnih%20subjekata2020.pdf
131 https://www.monstat.org/cg/page.php?id=1897&pageid=22
132 National strategy for integrated coastal zone management, CAMP Montenegro, 2015; available online at: https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf

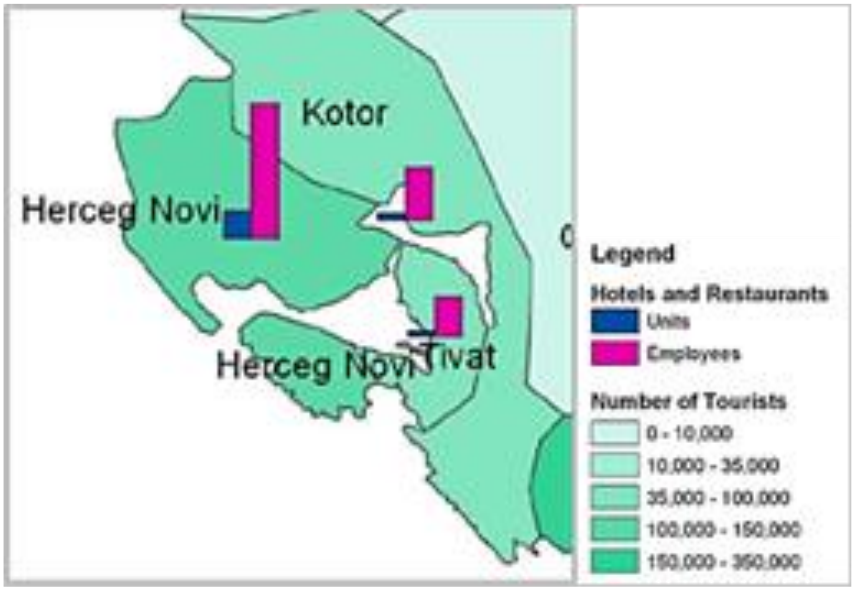


Figure 41. Tourism sector in Boka Kotorska

(Source: Cetma, Study on Renewable energy in Montenegro)

Tourism is weather-dependent and therefore susceptible to climate hazards. It encompasses many activities, some of which are more sensitive to weather and climate than others: compare sunbathing to angling, business seminars, family visits, and pilgrimage. Therefore, climate should be considered in the Strategic plans when developing diverse touristic activities. Climate hazards have a negative effect on tourism because natural beauty deteriorates with frequent forest fires and storms. A summary of potential impacts is presented in the Table 23.

Receptors	Climate hazards	Potential impacts	Who/What is affected
Tourism	Heat wave & Drought	- Altered high / low seasons - Landscape changes (e.g., due to forest fires) -Increasing costs, e.g., for cooling - Higher water demand	Tourists, touristic infrastructure, historical & cultural buildings, tourist economy
	Heavy precipitation/ Floods	- Damages on touristic infrastructure - Higher costs for maintenance and repair	Tourists, touristic infrastructure, historical & cultural buildings, tourist economy
	Storms	- Damages on touristic infrastructure - Higher costs for maintenance and repair	Tourists, touristic infrastructure, historical & cultural buildings, tourist economy
	Strong wind	- Damages on touristic infrastructure - Higher costs for maintenance and repair	Tourists, touristic infrastructure, historical & cultural buildings, tourist economy

Table 23. Summary of potential impacts of climate hazards on tourism

b) SME enterprises

Receptors	Climate hazards	Potential impacts	Who/What is affected
SME	Heat wave & Drought	-Lower efficiency -Cooling problems and higher costs -Shortfall of workers -Changes in buying behaviour -Sales boost / shortfall -Water scarcity / cooling problems -Supply problems due to limited bulk transport	Consumer (access & price level), shop owners, enterprises with need for cooling, shop owners, enterprises with need for water
	Heavy precipitation/ Floods	-Damages / failures -Sales shortfall	Consumer (access & price level), shop owners, enterprises in the affected areas
	Storms	-Damages / failures - Sales shortfall	Consumer (access & price level), shop owners, enterprises in the affected areas
	Strong wind	-Damages / failures - Sales shortfall	Consumer (access & price level), shop owners, enterprises in the affected areas

Table 24. Summary of potential impacts of climate change on SME enterprises

c) Construction sector

Summary of the potential impacts of climate hazards is based on analysis of former extreme events and most affected receptors, Table 25.

Receptors	Climate hazards	Potential impacts	Who/What is affected
Building stock and materials	Heat wave & Drought	-Greater need for air conditioning -Heat island effect -Shorter life span of elements of objects exposed to the sun, e.g., water proofing of flat roofs - Higher water demand -Damages e.g., on asphalt -Higher maintenance costs	-Technical & urban infrastructure, especially in densely built areas, dark surfaces, asphalt, concrete, etc. -Collective residential buildings and commercial buildings in urban parts of the cities surrounded by big concrete and asphalt surfaces
	Heavy precipitation/ Floods	-Surface runoff, rainwater installation clogging, increase of roads flooding -Clogging and damage to the rainwater installations of facilities, damage to water proofing, water leak into residential and business premises	-City centre and suburbs -Particular vulnerable buildings with basements; building with damages on facades and roofs
	Storms	-Surface runoff, rainwater installation clogging, increase of roads flooding -Clogging and damage to the rainwater installations of facilities, damage to water proofing, water leak into residential and business premises -Damages	-City centre and suburbs -Particular vulnerable buildings with basements; building with damages on facades and roofs
	Strong wind	-Damages	-City centre and suburbs -Building with damages on facades and roofs

Table 25. Potential impacts of climate hazards on building stock and material

d) Industry

According to the document "Industrial policy of Montenegro 2019-2023[133]", diversification of industry is very important part of further development with focus on production of ecological food and drinks, constructions, financial services, manufacturing industry.

Deindustrialization changed the economic picture in Boka Kotorska Bay. Instead of large socially owned business systems there are many small and medium enterprises with light industry compatible with tourism and the service sector. For example, industrial production in the municipality of Herceg Novi from 2011-2018 increased mostly due to the manufacturing industry. SWOT[134] analysis shows a relatively small market for the placement of final products and the seasonal character of individual industries. Lack of clusters is also one of the industry's weaknesses.

e) Agriculture

Agriculture in Montenegro, together with the tourism sector, is a development and economic priority of the national economy, and therefore agriculture is being developed as an activity complementary to tourism. According to the 2010 census of agriculture, out of a total of 620,029 citizens of Montenegro, 98,341 performed agricultural activity on family farms[135]. The municipalities in the Boka Kotorska Bay are among the municipalities with the least developed agriculture in Montenegro, located in a coastal region with small amount of arable land, relatively good fertility, which consists of deep alluvial-deluvial soils in fields and bays as well as brown anthropogenic soils on terraces and plains[136]. Some of the main problems faced by municipalities in the Boka Kotorska bay are the small size of farms with small average plot sizes, low level of education of the farmers, low productivity, as well as high share of part-time farmers, insufficient promotion of agricultural products, lack of agricultural advices needed for rural management, etc[137].

Despite the small amount of land utilized, agriculture in the Boka Kotorska Bay is very diversified. The representation of several agricultural branches is conditioned, above all, by different natural preconditions for production. This region is especially suitable for fruit (southern fruits and olives) and vegetable production, hilly terrains are rich in honey, aromatic and medicinal plants, as well as wild fruits (pomegranate, fig, etc.)[138]. Considering the above-mentioned spatial specificities, tradition and market demands, the three key agricultural sectors in the coastal zone are olive and citruses growing and viniculture[139]. Areas with the potential for development of more intensive agriculture in Boka Kotorska Bay are Sutorinsko, Kutsko, and Tivatsko fields followed by Grbalj (Zagora, Krimovica, Kovači, Bigova) and Luštica (Klinci and its surrounding, Gošići, Radovanići, Merdari), which have lower potential for agriculture development due to natural limitations such as flysch and karst terrain as well as usage and organization of space[140].

According to the Ministry of Agriculture, Forestry and Water Management in 2021 there were 352 registered agricultural producers in the municipalities of Boka Kotorska Bay, namely 146 in Herceg Novi, 124 in Kotor and 82 in Tivat[141]. However, for most farmers, agricultural activity is complementary and as such is an additional source of income to basic income from the non-agricultural sector[142]. In the last decade, A significant part of the urban population (which here makes up more than 70% of the total population of the Boka Kotorska Bay area) is returning to the villages, not so much to ensure their livelihood but, above all, in search of alternative lifestyles with the production of smaller quantities of organic food[143]. Investing in agriculture also means investing in rural development because it is impossible to preserve rural areas from depopulation without active agriculture.

133 Industrial Policy 2019-2023, (2019), Ministry of Economic Development and Tourism, available online at: https://www.gov.me/dokumenta/af22514f-712a-4fb8-8ab5-acfa8e083c4c
134 Industrial Policy 2019-2023, (2019), Ministry of Economic Development and Tourism, available online at: https://www.gov.me/dokumenta/af22514f-712a-4fb8-8ab5-acfa8e083c4c
135 https://www.monstat.org/cg/page.php?id=380&pageid=58
136 https://opstinativat.fra1.digitaloceanspaces.com/documents/REVIZIJA/Strateski%20plan%20razvoja%20Tivta_CG_finalno.pdf
137 https://www.hercegnovi.me/downloads/Nacrt04082020.pdf
138 National strategy for integrated coastal zone management, CAMP Montenegro, 2015; available online at: https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf
139 National strategy for integrated coastal zone management, CAMP Montenegro, 2015; available online at: https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf
140 National strategy for integrated coastal zone management, CAMP Montenegro, 2015; available online at: https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf
141 https://www.gov.me/dokumenta/bb20e217-c9b4-454b-8db5-e96f03c25164
142 https://opstinativat.fra1.digitaloceanspaces.com/documents/REVIZIJA/Strateski%20plan%20razvoja%20Tivta_CG_finalno.pdf
143 https://opstinativat.fra1.digitaloceanspaces.com/documents/REVIZIJA/Strateski%20plan%20razvoja%20Tivta_CG_finalno.pdf

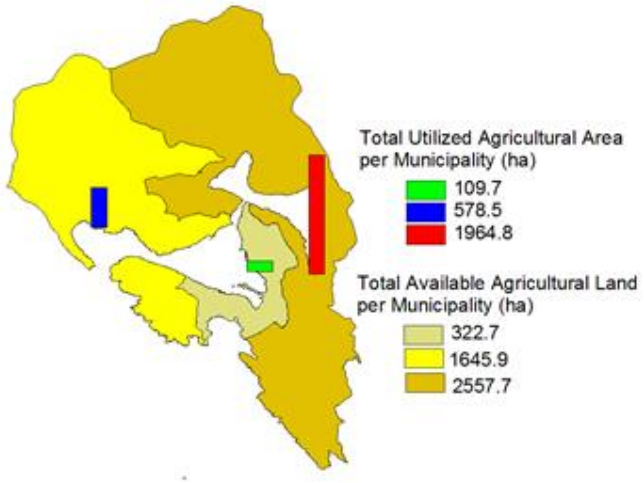


Figure 42. The total available and utilized agricultural land (ha) per municipality

(Source: M. Ivanov, IHMS)

The production of orchards (citrus and olives) and vineyards is dominant in Herceg Novi and Kotor, Figure 43. Permanent meadows and pastures have the highest contribution in overall utilization of the agricultural land. The least developed agriculture is in the municipality of Tivat.

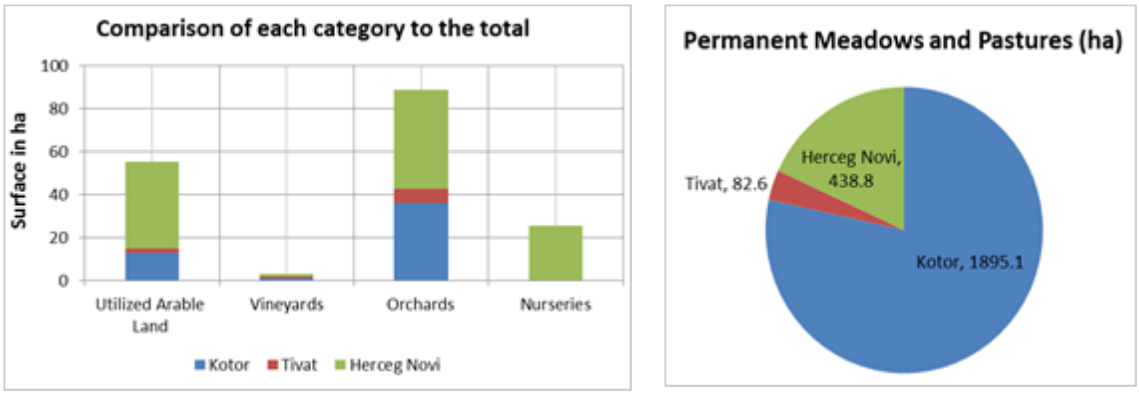


Figure 43. Comparison of each category of utilized agricultural land to the total

(Source: M. Ivanov, IHMS)

Agriculture is highly vulnerable to climate change due to its dependence on water conditions, temperatures and consequent sensitivity to extreme weather events. Combined with more intense short rainfall events, flash floods, and more frequent and intense droughts, yields and revenues are expected to decrease while costs for irrigation, disease and pest control increase. For example, the drought in 2012 reduced milk production due to reduced fodder production and new livestock diseases from heat stress (M. Ivanov, IHMS). According to the results of IPA DMCSEE projects, vulnerability of agriculture to drought is in category “moderate” to “vulnerable” in Boka Kotorska.

Receptors	Climate hazards	Potential impacts	Who/What is affected
Agriculture	Heat wave & Drought	-Changes in growth cycle -Enhanced dehydration -Failure in orchards yield -Direct impact on livestock by reducing productivity of livestock products -Indirect impact on livestock by harvest deterioration -Lack of water for irrigation in rural areas; Wide spread impact on crops; -Drought-induced pest infestations or diseases	Agricultural producers, food industry and consumers
	Heavy precipitation/	-Changes in the cycle of plant growth, death, decay and the impact on yield and quality	Agricultural producers, food industry, consumers

	Floods		
	Storms	-Physical damages on orchards, vegetables and olive groves -Large damages to the crops -Changes in the growth cycle in terms of plant productivity	Agricultural producers, food industry, consumers
	Strong wind	-Physical damages on the orchards, vegetables and olive groves - Accelerated erosion, reduction of available land surface and decreasing content of organic matter in soil	Agricultural producers, food industry, consumers

Table 26. Summary of the potential impacts of climate change on the agricultural sector

f) Forestry

The region of Boka Kotorska Bay has the smallest surface of the forest cover compared to the other regions of the country. Due to the intense anthropogenic influence in the past, various forms of macchia and shrubs are located in Boka Kotorska instead of forest communities. Still, there are evergreen Mediterranean forest and sub-Mediterranean deciduous forest. Cutting of deciduous trees is mostly for the heating purposes. An arid climate in June compounded with drought and heatwaves create favourable conditions for forest fires in July, August and September. Increased temperatures and variability of rainfall contribute to the increase of pests and disease in the forests (SNC, 2010). The data of the National Monitoring of the Health Condition of Forests shows that there are negative trends in lower resistance to forest pests, although the general condition of forests is deemed to be at a satisfactory level. The process of inspecting trees identified the common insects and fungi that cause degradation. Pests and diseases are very sensitive to any changes in the environment. Increased temperatures and variability of rainfall will likely increase populations and their impacts on forests.

Next table summarizes the extensive tree loss in the Boka Kotorska Bay municipalities. It shows how much three cover three municipalities had in 2010, and the losses of three cover in the period from 2001 to 2021. Due to rapid urbanization and extensive forest fires, especially in 2016 and 2017, Tivat lost 14% of its tree cover. Unfortunately, Herceg Novi and Kotor are not far behind. Figure 43 shows the geographic locations of tree cover loss in the targeted municipalities, while Figure 44 compares tree cover loss in Kotor, Tivat and Herceg Novi through last two decades.

	Tree cover in 2010 (in ha)	% of municipal land area	Losses of tree cover in the period 2001-2021 in ha	% of tree cover loss
Herceg Novi	8,530 ha	35%	846 ha	8.7%
Tivat	2,530 ha	50%	379 ha	14%
Kotor	9,350 ha	37%	437 ha	4,4%

Table 27. Tree cover in targeted municipalities and losses of tree cover in the period 2001-2021

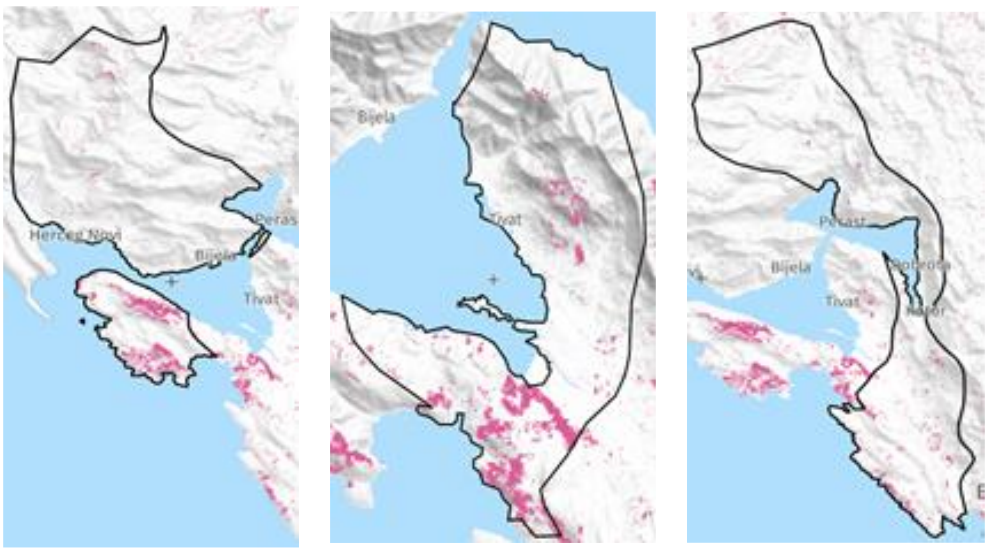


Figure 44. Tree cover loss in Municipalities of Herceg Novi, Tivat and Kotor

(Source: Global Forest Watch)

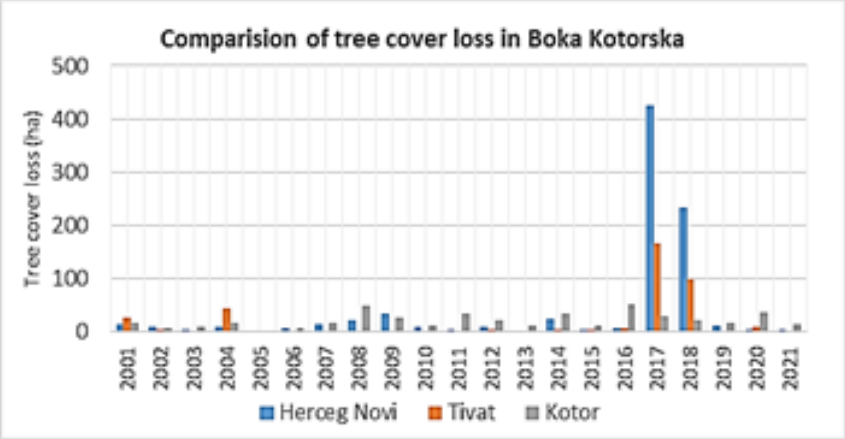


Figure 45. Comparison of tree cover loss in municipalities of Boka Kotorska Bay though the last two decades

(Author: M. Ivanov; graphic is based on data from Global Forest Watch)

	Receptors	Climate hazards	Potential impacts	Who/What is affected
Natural resources	Forest	Heat wave & Drought	-Changes in growth cycle (decrease in growth, drying of wood) - Possibility of fire - Fires - increasing risk of erosion - Differential species impacts could impact the competition and succession, particularly in mixed forests - Insects and fungi	Low vegetation and macchia Mixed forests Ecosystem Consumer
		Heavy precipitation/ Floods	-Damages / dying of trees -Violation of water bodies and soil quality -Damage to the root system -Erosion of forest land	Ecosystem Consumer
		Storms	- Damages to the woods	Ecosystem Consumer
		Strong wind	-Damages and dying of trees -Erosion of forest land	Ecosystem Consumer

Table 28. Summary of the potential impacts of climate change on the forest sector

g) Fisheries

Fisheries are not developed in Montenegro. In 2015, 128 fishing vessels were registered at sea, where almost 84% are vessels smaller than 12 meters. The main characteristic of the fishing fleet is that it is old, not modernized and insecure. Fisheries in the coastal area rely on mariculture. In 2017, 116 tons of fish and 214 tons of shellfish (MONSTAT) were farmed. Most of the primary production served for the needs of restaurants and hotel complexes in the coastal area, while a small percentage was exported.

3. Impacts of climate hazards on marine and coastal ecosystems in Boka Kotorska Bay

The diversity of the geologic base, landscape, climate and land, as well as the geographical position of Montenegro in the Balkan peninsula provided for development of high-value biological diversity[144]. Similarly, the coastal zone of Montenegro is also characterised by a high degree of diversity and specific habitats and species.

On the rocky coast of Boka Kotorska Bay, several natural sand beaches, and (nine) tiny islands, typical coastal and seaside ecosystems may be found. The characteristic Mediterranean vegetation of macchia and garrigue has developed

144 National strategy for integrated coastal zone management, CAMP Montenegro, 2015; available online at: https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf

on the southern slopes of coastal mountains Lovćen and Orijen, while halophyte vegetation has formed on lower terrains and along the shore itself (Arthrocnemum, Sarcocornia, Salicornia, Limonium etc. in Tivat Salinas[145]).

The ecological conditions in Boka Bay differ considerably from the open part of the south-east coast of the Adriatic Sea. The presence of a large number of underwater springs and the inflow of large quantities of fresh water from land affect the physical and chemical characteristics of the seawater[146]. Because of these specific abiotic conditions, marine life in the Bay is specific as well. Since the middle of the 20th century a number of researchers have begun to study its fauna and have contributed greatly to improving

knowledge of the Boka Kotorska. However, more intensive scientific research of the malacofauna in the Bay began with the establishment of the Institute of Marine Biology in Kotor. The marine bottom of the Bay is covered by layers of sand, mud, clay, algae, *Posidonia* and *Cymodocea* fields, submarine springs, rocks, coastal sandy beaches, coastal springs, mouths of short rivers, interstitial fauna (meiobenthos) at beaches, and all these types of bottoms are settled by various species of amphipods. The freshwater input is from the sides of the surrounding mountains by numerous springs, caves, small torrents with their subterranean and epigean fauna of Amphipoda. This input has strong influence on the salinity, temperature and many other ecological conditions of the seawater in the Bay[147]. As one of the examples of marine biodiversity, when comprehensive study on all available data of marine molluscs from Montenegrin coast check-list was created, 304 species were counted for the area of the Boka Kotorska Bay [148]. Since that research conducted from 2016-2018 show presence of eight new species[149].

Tivat Salinas is a locality of great importance with halophytic vegetation on muddy-clay grounds. This type of vegetation has almost disappeared from the eastern coast of the Adriatic, and in Montenegro it can only be found in Boka Kotorska Bay and in Ulcinj. Specific fauna, particularly rich birdlife, is also typical for this vegetation. 111 species of birds have been registered in Tivatska Salinas so far. However, the list is not complete, since every year several new species are registered. Given that 526 bird species have been registered in Europe so far, the number of birds present in this lagoon makes up more than 20% of the total number of European species, which is not negligible[150]. Due to the importance for the survival of flora that can rarely be found today on the eastern Adriatic coast, as well as due to the fact that this area is home to many endangered species of amphibians, reptiles and birds, Tivat Salinas was protected in 2008 as a Special Nature Reserve[151]. Additionally, in 2021, Montenegro has declared as Marine Protected Areas "Platamuni"[152], which is located in Kotor municipality, and "Katič"[153] located in Budva. The Platamuni area is characterized by its main marine cave at the south of Bigova, with at its entrance an extraordinary development of bio-constructions. It also hosts a vast Posidonia oceanica meadow on rock at the western side of Greben Kalafat, continuing by deep coralligenous assemblages on rock. However, numerous problems have been identified in the area and its surroundings, such as wastewater, solid waste, fishing, including illegal fishing, anchoring, maritime traffic, invasive species, illegal construction, proliferation in infrastructure construction, tourism, fires, and the afforestation with non-indigenous plant species. This particular area has benefited in recent years from the support of UNEP/MAP-SPA/RAC, notably through regional projects on marine and coastal protected areas and key habitats mapping in the Mediterranean. The declaration of the Platamuni area as an MPA is an important step for the conservation of biodiversity in the Mediterranean. Additionally, in August of 2021, two preventive marine protected areas "Sopot" and "Dražin vrt" have been declared due to the exceptional value of biodiversity[154], and especially the coralliferous community of the golden corral Savalia savaglia[155]. Two areas are located in the inner part of Boka Kotorska bay and

145 Petrović, D., Hadžiablahović, S., Vuksanović, S., Mačić, V., Lakušić, D, (2014), Catalogue of habitat types of EU importance of Montenegro, available online at: file:///C:/Users/Petar/OneDrive/Desktop/1_Final_version_of_the_Catalogue_of_Habitat_Types_for_Montenegro_pp2.pdf

146 Regner, D., Vuksanović, N., Stjepčević, B., Dutina, M. & D. Joksimović (2002): Sea water quality and the level of eutrophication in the Montenegrin Coastal Sea. Studia Marina 23(1): 71-79

147 Karaman, Gordan (2019): Diversity of Amphipoda (Crustacea) in Boka Kotorska Bay (Montenegro, Adriatic sea) (Contribution to the knowledge of the Amphipoda 308), Studia Marina 2019, 32 (1): 5-13 DOI: 10.5281/zenodo.3274490

148 See: Petović, S., Gvozdenović, S. & Z. Ikica (2017): An Annotated Checklist of the Marine Molluscs of the South Adriatic Sea (Montenegro) and a Comparison with Those of Neighbouring Areas. Turk J of Fish Aquat Sci, 17: 921-934.

149 Petović, Slavica. (2018). Additions to the checklist of the malacofauna of the Boka Kotorska Bay (south-east Adriatic Sea). Studia Marina, 31(1), 23–36. https://doi.org/10.5281/zenodo.1321703

150 https://web.archive.org/web/20190624202508/http://czip.me/podrucja-za-ptice/obala/tivatska-solila

151 https://www.gov.me/dokumenta/b78904cf-7e20-4ee7-ae99-8adb4edeff9d

152 https://www.gov.me/clanak/park-prirode-platamuni-proglasen-kao-prvo-zasticeno-morsko-podrucje-u-crnoj-gori https://www.gov.me/dokumenta/32a19644-440c-440f-977d-b243de5afa68

153 https://www.gov.me/clanak/crna-gora-dobila-drugo-zasticeno-morsko-i-obalno-podrucje-park-prirode-katic

154 https://www.gov.me/clanak/vlada-crne-gore-donijela-odluku-o-stavljanju-pod-preventivnu-zastitu-lokalitete-sopot-i-drazin-vrt

155 Gvozdenović Nikolić, Slađana & Mandic, Milica & Macic, Vesna & Petovic, Slavica & Djordjevic, Nikola. (2021). Seafloor litter in two protected areas (Sopot and Dražin vrt) in the Boka Kotorska Bay (Montenegro, southeast Adriatic Sea). 34. 23-33. 10.5281/zenodo.5795255.

belong to the Municipality of Kotor, Sopot belongs to the local community Risan, while Dražin vrt is located within Perast.

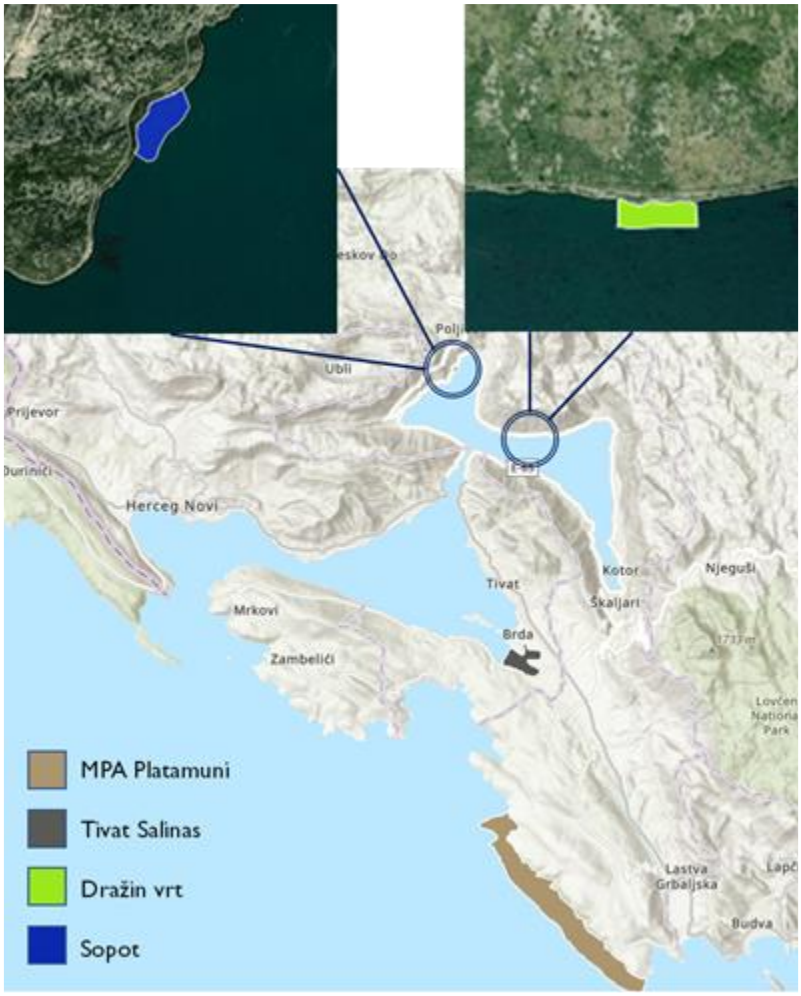


Figure 46. Protected marine areas in three targeted municipalities (Herceg Novi, Kotor and Tivat)

Available national statistics and monitoring schemes do not provide adequate data directly addressed to consequences of climate changes on natural habitats, animal and plant communities (biocenosis) and ecosystems. Existing data on habitats / ecosystems destruction and fragmentation are directly linked to the local human activities (urbanization, tourism facilities, infrastructure etc.).

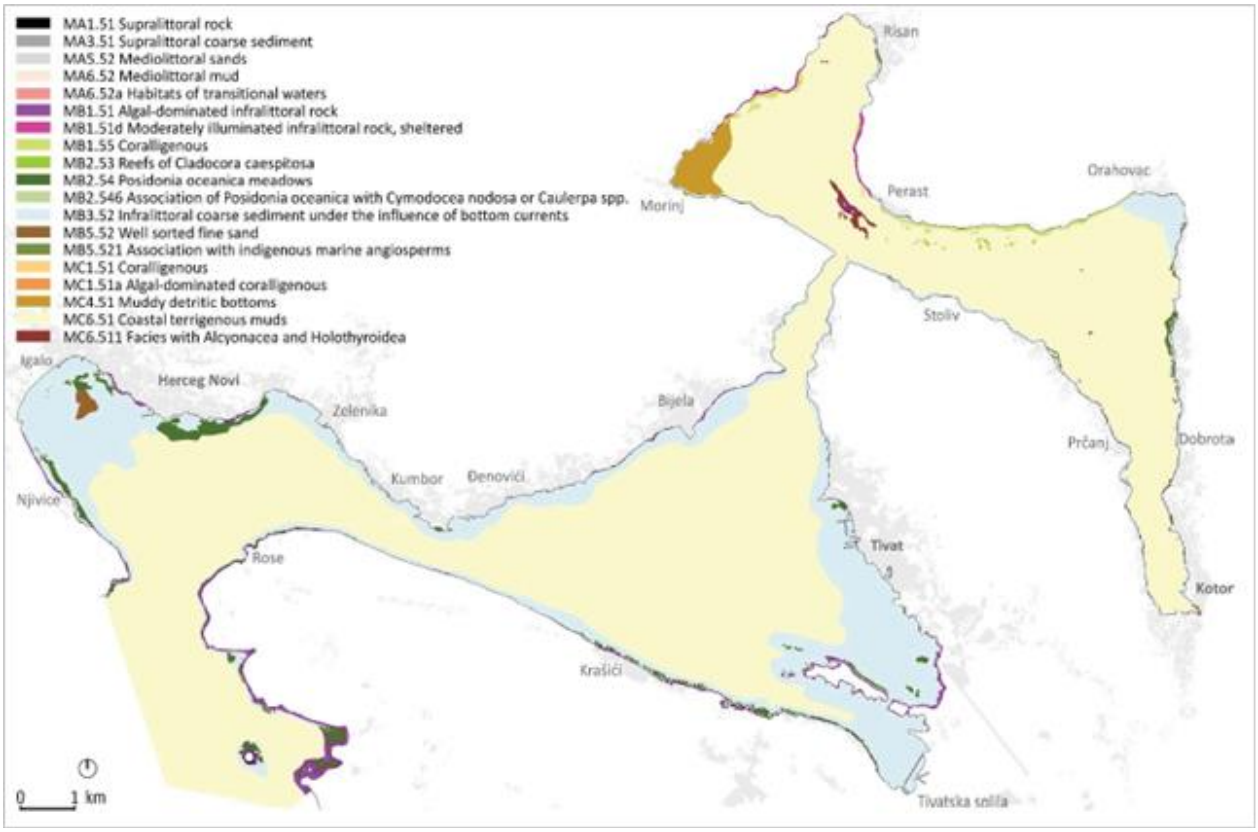


Figure 47. Habitat type distribution in the Boka Kotorska Bay

Some key habitats may be critically affected by exposure to climate change, owed to different drivers:

- **Wetlands:** submersion by sea-level rise, changing sediment flux, less water to wetlands, human impacts in the form of excessive construction and blockage of canals which feed the wetlands
- **Sea grass beds**: changing sediment flux
- Significant impact of the sea on the **water aquifer** of the coast is observed. In the summer time, water from many aquifers is not usable for drinking because of the increase concentration of chlorine ions.
- **Mediterranean animal and plant** species become more threatened, particularly those in or near to wetlands as well as species in karstic habitats. It is noted reductions in the populations of some amphibian (newts, frogs) and reptile (lizards, snakes) species that are dependent on surface waters in karstic area of the country.

The estimated increase in temperature of the Adriatic Sea up to 2.5 °C for the period until 2071 will result in a decrease or disappearance of domestic fish species and an increase in invasive species (3rd NC). Changes in water circulation due to thermohaline will negatively affect fish (blue fish) in the pelagic zone (includes all waters that are not near the bottom or shore), what will reflect on the sustainability of fishing.

Potential impacts of climate change in the fisheries area are:

- increase in the number of invasive species and their impact on domestic species due to increasing sea temperature[156]
- migration of part or all of the animal species due to rising sea temperatures,
- reduction in the number of pelagic (blue) fish due to changes in water circulation because of thermohaline.

[156] The Third National Communication on climate change (TNC), 2020, Government of Montenegro, GEF, UNDP; available online at: https://unfccc.int/sites/default/files/resource/TNC%20-%20MNE_0.pdf

Figure 48. Indigenous species Potamomus saltatrix (left), Fistularia commersonii (middle) and Caranx crysos (right)

Figure 49. Female (left) and male (right) of Callinectes sapidus

Figure 49 shows compound model that is consisted of:

- Flora and Fauna (wetland[157] and protected plant species),
- Surface of high seismic vulnerability,
- surface water and
- surface of flooded area in Solila (Tivat);

Compound model of expected sea level rise and flooded areas due to storm surges are presented on a Figure 47 b as well. In both cases black border line presents enlargement of the coast.

[157] Wetland and protected species surface of high seismic vulnerability

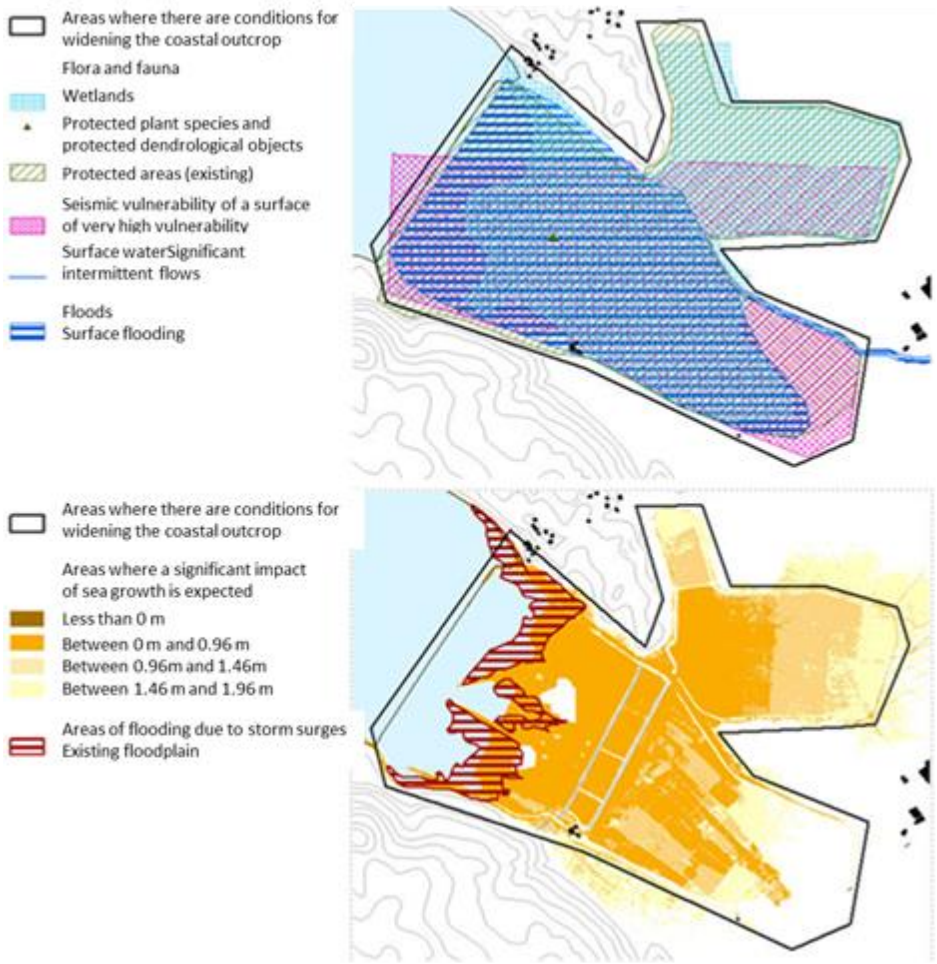


Figure 50. Compound model of Tivat Salinas

Receptors	Climate hazards	Potential impacts	Who/What is affected
Biodiversity/Eco-systems	Heat wave & Drought	-Altered flora and fauna, new & invasive species -Loss of species -Dying of flora and fauna -Migrations -Fires	All flora and fauna with low adaptive capacity, ecosystem
	Heavy precipitation/ Floods	-Altered flora and fauna, new & invasive species -Loss of species -Torrential streams	All flora and fauna with low adaptive capacity, ecosystem
	Storms	-Loss of natural resources -Altered flora and fauna, new & invasive species -Loss of species -Torrential streams	All flora and fauna with low adaptive capacity, ecosystem

Table 29. Summary of potential impacts of climate hazards on Biodiversity / Eco-Systems

Based on previous research on the impact of climate change on sea surface temperature (SST), it can be concluded that such researches are rare, and it is necessary to start with the analysis of the impact of climate change on temperature change in the coastal area. It is also necessary to continuously monitor and measure the surface temperature of water at several positions in the Boka Kotorska Bay.

The projections of SST refer to the open sea of the coastal area. But the surface temperature of the sea in the Boka Kotorska Bay is more exposed to temperature changes due to the influence of underwater water sources and karst structure of the Bay, especially during the rainy season, when certain water sources such as Sopot and Ljuta emit up to 200 m^3/s.

E. COASTAL ZONES IN BOKA KOTORSKA BAY AND THE POTENTIAL IMPACTS OF SEA LEVEL RISE

The Boka Kotorska Bay is separated from the inland by Dinaric Alps parallel to the coast. The coastal area is narrow 28,125 km long, but provides different facilities for swimming, diving and other water sports activities.

The terrain is rugged and steep with several valleys (Zanjica, Miriste, Bratorastica, Mala Gora and towards open sea: Zlatna Luka, Dobra Luka) and extensive bay Traste. Boka Kotorska Bay is an enclosed basin with specific hydrographic and dynamic processes. The communication with open part of Adriatic Sea is through the entrance in the bay, i.e., junction Cape Ostra – Cape Miriste. According to its geographic-hydrographic features the entire Boka Kotorska Bay consisted of three separate units:

- The Bay of Kotor-Risan with the Verige Strait;
- The Bay of Tivat with the Kumbor Strait;
- The Bay of Herceg - Novi up to the junction Cape Ostra – Cape Miriste.

Main bathymetric characteristic of whole Boka Kotorska bay is relatively high depth in a bay and toward the open sea. From the data it is evident that the maximum depth is 60 m at the mouth of the bay. Then it decreases toward inside and fluctuates between 40 and 45 m in large portion of the bay. Regarding to sea dynamics during the tide and ebb, the average daily amplitude in Herceg Novi bay is 22 cm while maximum annual amplitude is 106.3 cm.

General morphometric data of Boka Kotorska Bay:

Total surface	87,344 km^2
Total volume	2,412,306,000 km^3
Max depth	60 m
Mean depth	27,3 m
Length of the bay	28,125 km
Coast line length	105.7 km
Coast sinuosity	Coefficient 3.07
Width of the bay's mouth	2,950 m

Boka Kotorska is most critical area for safety of navigation in Montenegro because of:

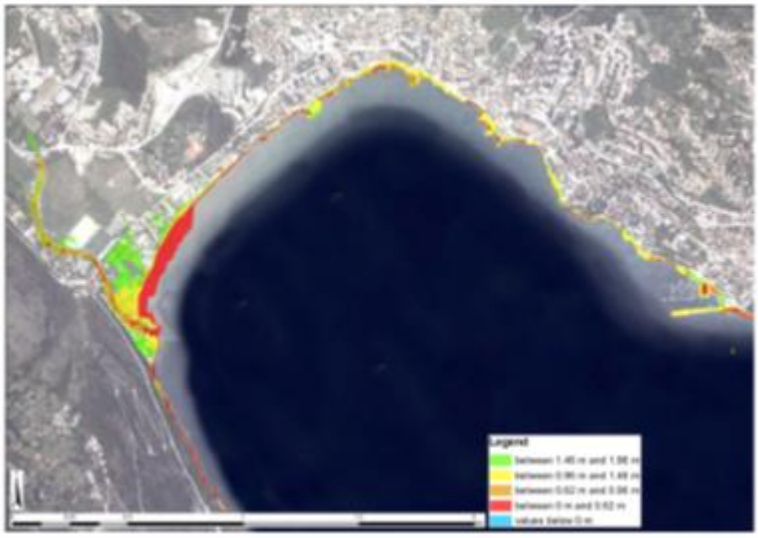
- Three ports for international traffic - Zelenika, Risan and Kotor
- Three marinas – Porto Montenegro, Klimanj in Tivat and marina Kotor
- Large oil reservoirs in Lipci and
- Dense traffic especially during touristic season.

The bay is semi closed with very limited water exchange with the open. It means that any maritime accident such as with oil spill would be disaster for this area. For these reasons it is of vital interest to have good bathymetry, and information on currents and tides in the bay in order to be able to produce updated nautical charts and plans for ports and marinas.

Six bays are recognized as vulnerable to sea level rise:

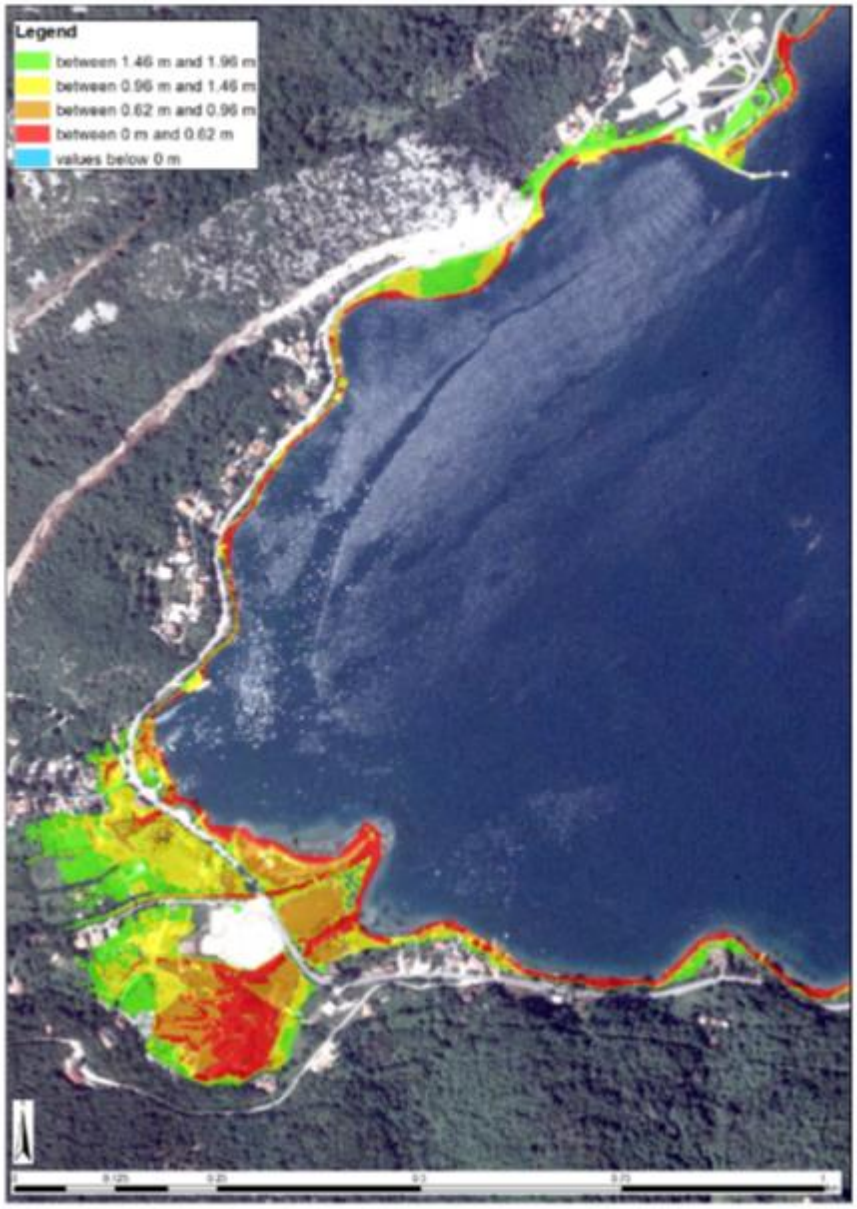
- Igalo, Morinj, Tivat, Kotor, Krtole and Bigova.

Map 2: Igalo area



Igalo bay could be problematic in western part where the water could progress through the channel and should be therefore considered from hydrotechnical side.

Map 3: Morinj area



This area would be significantly endangered already in the case of first scenario. In case of second scenario, the endangered area would progress further to west and east. The water would also cover almost entire part of the land on the sea-ward side of the road, except of the elevated residencial area.

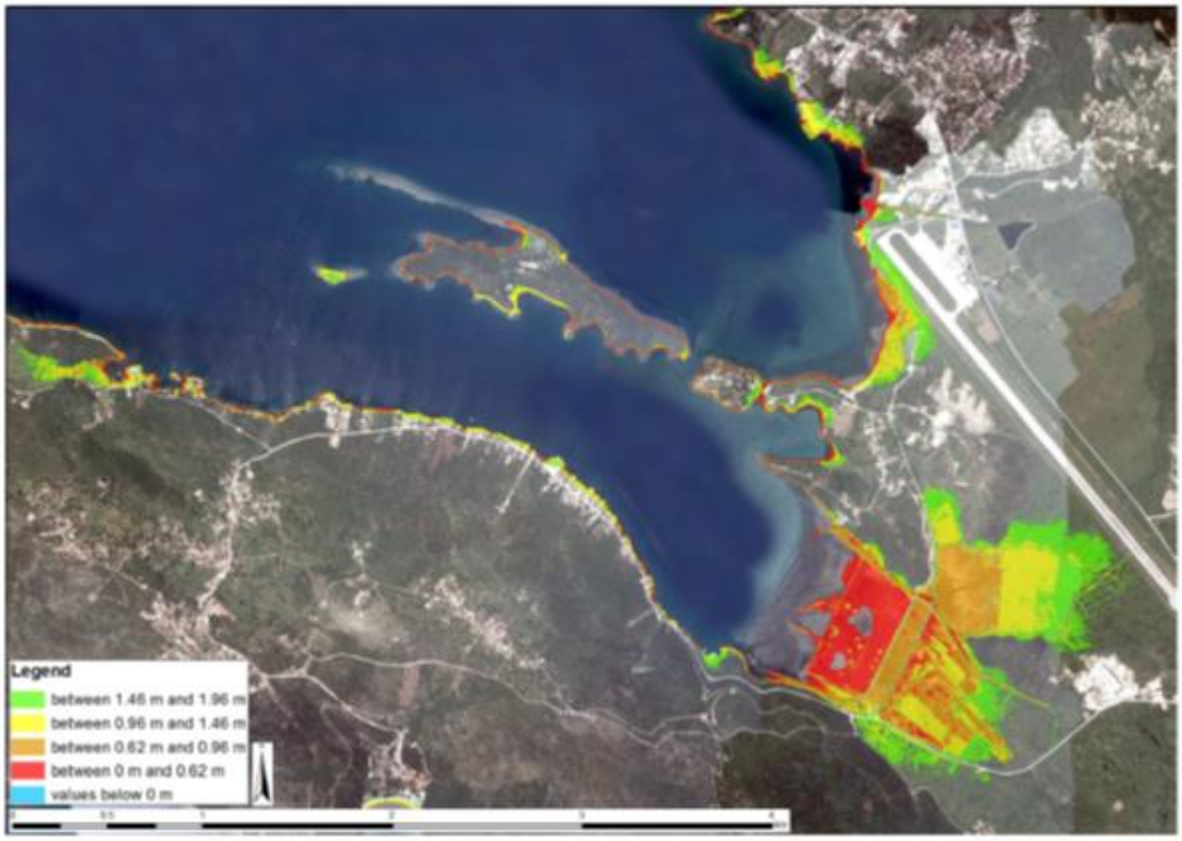
Map 4: Tivat area

In Tivat, only areas directly to the sea has elevations below 62 cm. Therefore, the town is well protected in case of first scenario. In case of second scenario, Tivat seems to be relatively safe, except of some parts around Kalimanjska road and Ribarski put, where elevations are lower than 96 cm. The significantly worse situation is in case of third and fourth scenario as water would, in some parts of the city, progress as far as to the Jadranska magistrala road on the south-eastern part and far exceed the Obala Filipa Miloševića road on north-western part of map.

Map 5: Kotor area

Similarly to Tivat, Kotor is also well protected in case of first scenario. The lower area around Knežev Dvor seems to be well protected with higher seaside pavement in case of second scenario, but only until in front of Manastir Svetog Francisa, where the pavement lowers again. In case of third and fourth scenario, the higher pavement probably wouldn't protect the old town from flooding. Park Svobode would be under water already in the case of second scenario as well as the triangle area around the Consulate of Croatia.

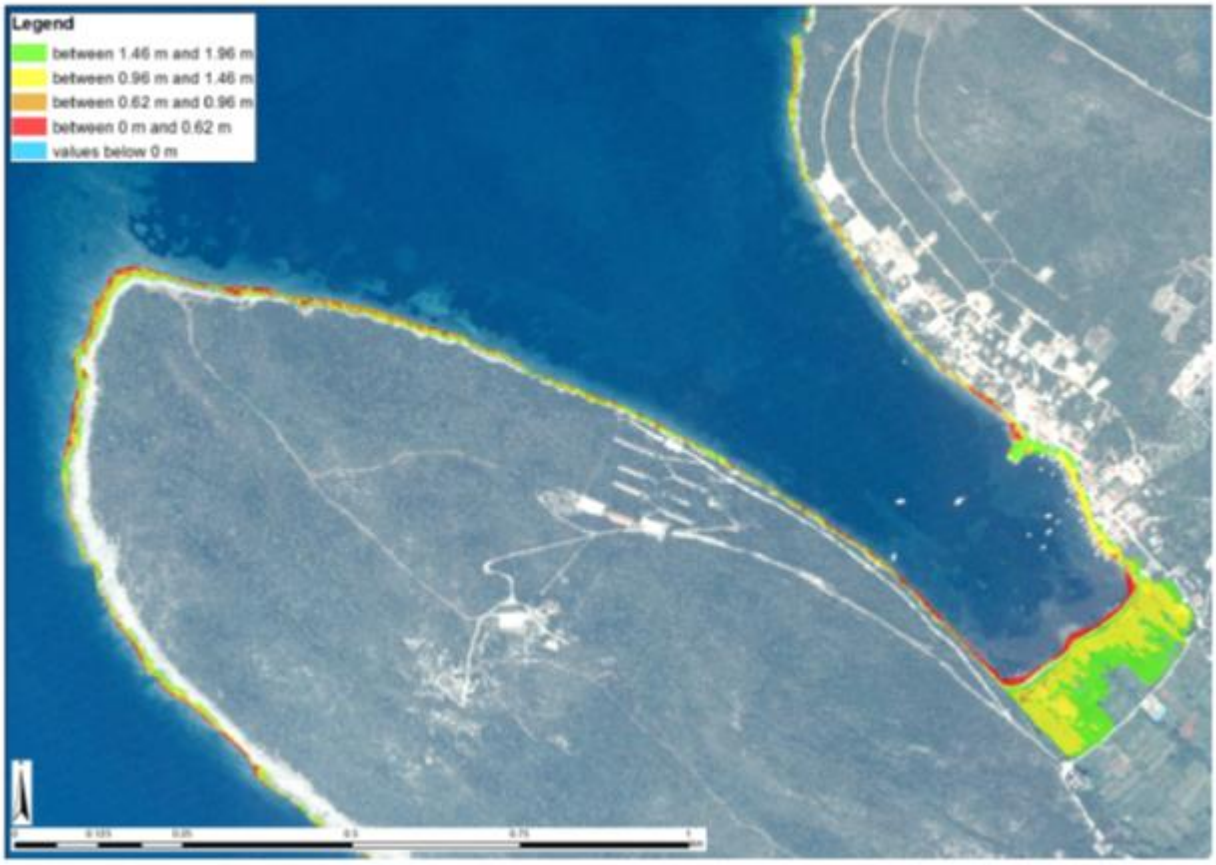
Map 6: Krtole/Polje bays area



The saltpans natural reserve would be significantly flooded already in the first scenario (west-wards to the first crossing road). In case of second scenario the water would flood also the area between the two crossing roads and progress significantly more to the east and north (towards the airport).

The airport of Tivat would, however, stay above the water in all four scenarios.

Map 7: Bigova area



The rising sea would not significantly affect the area according to first and second scenario. In third and fourth scenario water would progress inlands but would not exceed the coast-parallel road on south-east.

Potential impacts of sea level rise due to climate change will have several physical and ecological effects on coastal area:

- Coastal erosion (especially sandy beaches like Morinj and Igalo, as well as Tivatska Solila within Boka Kotorska Bay, and beaches Plavi horizonti, Velja Špilja and Arza on the Luštica peninsula)
- Flooding due to storm surge
- Inundation
- Salt water intrusion to ground water resources (This is already a case due to prolonged periods of drought, there is a disturbance of the equilibrium border zone between salt and fresh water and salinization of springs. Such is the case with the karst source of **Škurda**, included in the water supply system of Kotor, **Spilje**, included in the water supply system of Risan and Plavda, included in the water supply system of Tivat. These effects, combined with sea level rise are going to become even more common)
- Salt water intrusion to rivers/estuaries.

Two scenarios out of four are marked as most important:

- First scenario +62 cm on DTM as the most probable. CAMP project recommends to use it for assessing vulnerability in terms of enlarging the coast in the future[158]. It should be applied in all current and future short-term coastal planning;
- Second scenario +96 cm on DTM similar to current maximum sea level that is recorded on tide station in Bar. CAMP project recommends it in terms of the extent of flood zones.

[158] National strategy for integrated coastal zone management, CAMP Montenegro, 2015; available online at: https://iczmplatform.org/storage/documents/3eEc3KDWJT6syBfo6HJih8uLcesMGWrrnh6Emp09.pdf

The IPCC also concluded that rising sea levels along with the impact of storms would lead to a potentially more destructive scenario than it is today.

F. THE POTENTIAL FUTURE EVOLUTION OF VULNERABILITY AND ITS DRIVERS IN BOKA KOTORSKA

The climate in Boka Kotorska became **significantly warmer** compared to the period 1961-1990 (maximum and minimum temperature significant increase, and number of frost days decrease). **Heat wave** duration and frequency have **positive trend**. Therefore, positive changes in the temperature and its extremes will be reinforced in the future. Period without frost will be longer than in 1961-1990 period. GSL will shift towards beginning of the year earlier in the spring. Although earlier vegetation development will have positive side effect, there is still probability of frost occurrence and severe impact on plants and their yield. Such probability is higher in 2011-2040 period. CDD has positive trend what gives additional confirmation for **reduction of precipitation and drier climate in the future**. The results of the climate model show intensification of extreme weather phenomena followed by intense precipitation and strong winds. It indicates a high vulnerability on human, ecosystem and biodiversity and from damages caused by strong winds and increased chances of flood waves.

Slow onset hazard:

- Sea level rise includes **more regular flooding** in the coastal area (densely populated), coastal erosion and land loss.
- **Salinization**, changes in rainfall patterns as well as an **increase in drought and desertification** will lead to **decreases in agricultural productivity**.

Summary of projected impacts are presented on the Table 30for extreme events / hazards.

Extreme events	Future trends based on projections for 21st century using RCP8.5 scenarios and 2011-2040 period	Water resources	Agriculture and Food production	Forestry	Energy	Transport and road infrastructure	Human health
Heat wave /Drought	Increase	Increased water demand; Decrease in water supply; water quality problems (e.g., Mixture of salty and fresh water); decreased annual river flow	Reduced yields, fodder; reduce food production; Increased irrigation; Increased water demand -Increased risk of land degradation; -increased livestock death, reduce in fodder and food production; -Increased risk of soil erosion in	Increased danger of forest fires; movement of forest species towards higher latitudes; increase of pests; Increased negative impact on distribution of spruce, fir and white pine.	Changes in energy demands Higher overall energy demand Reduced hydropower potential		Increased mortality due to heat waves;

			the coastal area				
Heavy precipitation/Floods	Increase	- increasing the risk of flash floods; Increased adverse effects on surface and ground water quality; contamination of water supply by sewerage systems	Increased damages to crops; waterlogging of soils; food reduced production; increasing the risk of water erosion, especially in the area of torrents			Landslides and flooding interrupt the transport and roads; Increased financial external cost of network interruption; lower the reliability of the transport system	Increase risk of deaths, injuries
Storms	Increase	More wide spread decrease of water level and river flow					Increased risk of water and food shortage; increased risk of water and food borne disease

Table 30. Example of projected extreme impacts by sectors. Adaptive capacity is not taken in consideration

III. Concluding Remarks and Recommendations

Climate change presents a wide and complex range of risks to human safety and welfare. However, these risks are disproportionately spread across regions, social groups, and genders, and risk management planning must also consider this variability in order to be effective and equitable. As climate change intensifies the probability of climate-related disasters, population living in vulnerable areas, whose livelihoods are dependent on the weather, are more exposed and vulnerable to risk. In the mentioned context, this analysis is focused on a gender-sensitive climate risk assessment of Montenegro (national context) and climate risk assessment of the Boka Kotorska Bay (as a coastal hot spot area). The analysis should provide a platform for building coastal resilience to climate change in a sustainable and inclusive manner in the Boka Kotorska Bay. Furthermore, this assessment provides a starting point for considering, prioritizing, and coordinating risk management activities in the Boka Kotorska Bay. It demonstrates the wide range of risks that climate change poses to region and targeted municipalities, as well as their complexity across different social groups, municipalities, sectors, and domains of both state and municipal responsibilities. As such, these risks will require a coordinated effort to manage.

In addition, the assessment has highlighted important knowledge and data gaps (especially related to climate-gender nexus and the gender sensitive climate risk assessment) and process improvements that would further enhance understanding of climate risks.

Some of the key takeaways and conclusion from gender sensitive climate risk assessment of the Boka Kotorska Bay are:

- There is a clear trend of increases in the annual temperature after the decade 1970-1980. Each decade was warmer than previous. The expected range of increases in temperature is from +2 °C in the summer months to +2.5°C in the winter months within the next 30 years for the whole country. Human health and wellbeing will be under pressure (increased summer mortality and morbidity due to higher temperatures and heatwaves). Impact will be more significant on the older population, especially older women, who make up around 58%[159] of the older generation. The Country and municipalities of Boka Kotorska Bay should increase its resilience to these phenomena by improving health care structures (infrastructure & organisation) and existing building stock. Furthermore, the green and blue infrastructure should be increased, especially in city centres where, due to rapid urbanisation, it is not available.
- According to the climate projections, the total amount of average annual precipitation is expected to decrease for -5% in the southern region, consecutive days with rain are expected to decrease also, while occurrence of the flash floods is expected to increase in the future. Therefore, better sewage infrastructure is required, especially in city centres of Herceg Novi and Tivat, along with better water supply infrastructure, resilient to the occurrence of these events.
- The occurrence and magnitude of droughts is expected to increase in the future. In combined with rising population of the Boka Kotorska Bay, number of foreign tourist and the fact that the municipalities heavily rely on the limited local water sources, it is expected that there will be problems with water supply. Better water supply infrastructure is necessary in order to reduce network losses and preserve water. Furthermore, water conservation measures are needed, along with awareness raising campaigns in three municipalities of Boka Kotorska Bay.
- Further changes in forest management practises are likely to be required in the future in order to reduce drought effects and to enhance growth and quality of the forest stands. Some of the proposed management options include: better forest fire early warning systems, modification of tending and thinning practises, use of more drought resistant trees in reforestation and plantation actions etc. Generally, existing mechanisms of fire prevention and detection should be further enhanced.
- There are a number of risks related to the marine environment. Regional plans on protection of marine life in the Boka Kotorska Bay is needed, and ending practice of cruise ships entering Boka Kotorska Bay should be seriously

[159] Monstat, 2011, Census data

considered. Furthermore, invasive species, pest outbreaks and diseases form an important risk for the natural environment (but also for other productive sectors such as agriculture and fisheries) that has to be addressed in time thought adaptation strategies. Finally, grater investments in waste water infrastructure are needed in order to protect marine environment in the upcoming years. Implementation of conservation projects in time could moderate the risk of biodiversity loss.

- Region of Boka Kotorska Bay should focus on sustainable tourism development. Favourable climate conditions are projected for tourism industry. However, unsustainable tourism can lead to increased energy and water consumption, waste production and further losses of natural habitats especially in the coastal zone. Loss of beach assets can be further increased by coastal erosion and it could adversely affect the tourism industry of the Boka Kotorska Bay. Municipalities in Boka Kotorska Bay should increase the resilience of the energy supply system in order to meet the increasing demands for cooling and drinking water supply.
- Agriculture will suffer from production losses due to irrigation water deficits, while livestock production and welfare will also be impacted. Mitigation measures in indoors farming will also increase energy consumption.
- Detailed plan on protection of areas in easily affected by sea level rise should be prepared. We already have a very clear locations where higher seaside pavement could be implemented in order to protect cities and infrastructure from sea level rise.
- Montenegro has still not carried out a national vulnerability study. Only the capital Podgorica developed a study in 2015, which did not focus on gender. Municipalities in Boka Kotorska Bay should carry out vulnerability studies with inclusion of climate-gender nexus.

Considering that in Montenegro gender equality is recognized as a significant aspect in only two sectoral policies - agriculture and entrepreneurship, other sectoral policies remain “blind” to the issue of gender equality. Gender continues to be identified as an ‘add on’ aspect, rather than an integral component. This stems from the lack of knowledge and understanding of government and municipal of how gender and social inclusion is relevant to climate change vulnerabilities and impacts and climate action. They need further targeted training in this respect.

Furthermore, focus should be put on collection of gender disaggregated data. Statistical Office of Montenegro in its regular reports doesn’t include gender disaggregated data, meanwhile in their reports Gender Statistics, they only report data on the national level. Government should also establish gender specific data and statistics on impact of disasters, carry out gender-sensitive vulnerability, risk and capacity assessments and develop gender-sensitive indicators to monitor and measure progress

Additional takeaways and lessons learned from gender sensitive climate risks assessment are:

- There is low level of gender mainstreaming in the **sectoral policies** (water, health, tourism, etc.) in Montenegro, while **gender policies** do not cover the above listed sectors.
- Gender perspective (relevant representatives) should be providing into the work of other bodies related to climate change
- National policies on gender equality should be revised and upgraded with inclusion of the climate change aspects into them
- Design of the gender responsive sectoral policies can be reached through practicing and implementing the legal provisions on including the gender mainstreaming process defined by the Gender Equality Law (Article 3)
- Further sectoral definition of the gender based vulnerable groups has to be strongly addressed, as well as the process of design of the adaptation and mitigation policies and measures must address the intersecting inequalities.
- Government must commit to gender analysis and gender mainstreaming through enhanced cooperation and collaboration between Ministries responsible for disaster risk reduction, climate change, poverty reduction and gender issues;
- Awareness of the public and media should be raised on the gender sensitive vulnerabilities and capacities in climate change adaptation and gender specific needs and concerns in disaster risk reduction and management.

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Annex I - Overview of the International legal framework

United Nations standards for achieving gender equality		
1.	Universal Declaration of Human Rights (1948)[160]	
2.	Convention on the Political Rights of Women (1952)[161]	
3.	International Covenant on Civil and Political Rights (1966)[162]	
4.	International Covenant on Economic, Social and Cultural Rights (1966)[163]	
5.	Declarations on the Elimination of All Forms of Discrimination against Women (1967)[164]	
6.	Declarations on the Protection of Women and Children in Emergencies and Armed Conflict (1974)[165]	
7.	Convention on the Elimination of All Forms of Discrimination against Women[166]	
8.	Declaration on the Elimination of Violence against Women[167]	
9.	Beijing Declaration and Platform for Action (1995)[168]	
10.	Universal Declaration on Democracy (1997)[169]	
11.	Optional Protocol to the Convention on the Elimination of All Forms of Discrimination against Women (1999)[170]	
12.	Security Council resolution 1325 (2000) on Women and peace and security[171]	
13.	United Nations Resolutions on sexual orientation, gender identity and sex characteristics (2003)[172]	
14.	Resolution 66/129 on the advancement of women in rural areas (2011)[173]	
15.	**The 2030 Agenda for Sustainable Development** (2015)[174]	
European Union standards for achieving gender equality		
1.	Treaty of Rome (1957)[175]	
2.	Treaty of Amsterdam (1997)[176]	
3.	A Roadmap for Equality Between Women and Men 2006-2010 (2006)[177]	
4.	Women's Charter Declaration (2010)[178]	
5.	Council conclusions on the European Pact for gender equality for the period 2011 – 2020 (2011)[179]	
6.	Directive 2010/41/EU[180]	On the application of the principle of equal treatment between men and women engaged in an activity in a self-employed capacity.
7.	Directive 2010/18/EU[181]	Implementing the revised Framework Agreement on parental leave.
8.	Directive 2006/54/EC[182]	On the implementation of the principle of equal opportunities and equal treatment of men and women in matters of employment and occupation.
9.	Directive 2004/113/EC[183]	Implementing the principle of equal treatment between men and women in the access to and supply of goods and services.

[160] See: https://www.un.org/en/about-us/universal-declaration-of-human-rights
[161] See: https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XVI-1&chapter=16
[162] See: https://www.ohchr.org/en/professionalinterest/pages/ccpr.aspx
[163] See: https://www.ohchr.org/en/professionalinterest/pages/cescr.aspx
[164] See: https://www.ohchr.org/en/professionalinterest/pages/cedaw.aspx
[165] See: https://www.un.org/ruleoflaw/blog/document/declaration-on-the-protection-of-women-and-children-in-emergency-and-armed-conflict/
[166] See: https://www.ohchr.org/en/professionalinterest/pages/cedaw.aspx#:~:text=Introduction,twentieth%20country%20had%20ratified%20it.
[167] See: https://undocs.org/en/A/RES/48/104
[168] See: https://www.unwomen.org/en/digital-library/publications/2015/01/beijing-declaration
[169] See: http://archive.ipu.org/cnl-e/161-dem.htm
[170] See: https://www.un.org/womenwatch/daw/cedaw/protocol/#:~:text=In%20a%20landmark%20decision%20for,new%20instrument%20as%20soon%20as
[171] See: https://www.un.org/ruleoflaw/blog/document/security-council-resolution-1325-2000-on-women-and-peace-and-security/
[172] See: https://ohchr.org/EN/Issues/LGBTI/Pages/UNResolutions.aspx
[173] See: https://www.un.org/womenwatch/daw/documents/ga66.htm
[174] See: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf
[175] See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Axy0023
[176] See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A11997D%2FTXT
[177] See: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52006DC0092
[178] See: https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A52010DC0078
[179] See: https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/lsa/119628.pdf
[180] See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32010L0041
[181] See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32010L0018
[182] See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32006L0054
[183] See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32004L0113

10.	Directive 92/85/EEC[184]	On the introduction of measures to encourage improvements in the safety and health at work of pregnant workers and workers who have recently given birth or are breastfeeding.
11.	Directive 79/7/EEC[185]	On the progressive implementation of the principle of equal treatment for men and women in matters of social security.
12.	Directive 2001/51/EC[186]	Launching a program on the Framework Strategy on Gender Equality (2001-2005);
13.	Council Resolution of 27 March 1995 on the balanced participation of men and women in decision-making[187]	
14.	European Parliament resolution of 12 March 2008 on the situation of women in rural areas of the EU[188]	
15.	Guidelines on the application of Council Directive 2004/113/EC to insurance, in the light of the judgment of the Court of Justice of the European Union in Case C-236/09 (Test-Achats) Text with EEA relevance[189]	
16.	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A better work-life balance: strong support for reconciling professional, private and family life - 2008[190]	
17.	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Addressing the pay gap between women and men - 2007[191]	
18.	European Commission Recommendation on strengthening the principle of equal pay for men and women through transparency - 2014[192]	
Council of Europe standards for achieving gender equality		
1.	European Convention on Human Rights (1950)[193]	Is Europe's basic human rights treaty, and guarantees civil and political human rights.
2.	European Social Charter (1961)[194]	Counterpart to the European Convention on Human Rights in the field of economic and social rights. The Charter guarantees the enjoyment of rights in the areas of housing, health, education, employment, legal and social protection and the movement of persons.
3.	Council of Europe Convention on Action against Trafficking in Human Beings (2005)[195]	Aims to prevent and combat trafficking in women, men and children for the purpose of sexual, labour or other exploitation, as well as to protect victims and prosecute traffickers. This includes the non-discriminatory provision of Article 3 and the obligation of states to promote gender equality and use the gender perspective in the development, implementation and evaluation of measures to implement the Convention.
4.	Council of Europe Convention on the Protection of Children against Sexual Exploitation and Sexual Abuse (2007)[196] (Lanzarote Convention, 2007)	The first agreement that criminalizes all forms of sexual offenses against children. The convention specifically criminalizes engaging in sexual activities with a child, child prostitution, child pornography and "sex tourism". The Convention stipulates that individual be prosecuted for certain crimes, even when the crime was committed abroad.
5.	Council of Europe Convention on preventing and combating violence against women and domestic violence (2011)[197] (Istanbul Convention)	The most far-reaching international agreement to combat violence against women and domestic violence. It aims at zero tolerance for such violence and represents a major step forward in making Europe safer for women.
6.	Recommendation R (79) 10 concerning migrant women[198]	Calls on the Member States to ensure that national legislation and regulations concerning migrant women are fully in line with international standards.
7.	Recommendation R (85) 2 on legal protection against gender discrimination[199]	Advises Member States to take or strengthen measures to promote equality between women and men, including through legislation in the fields of employment, social security and pensions, taxes, civil law, the acquisition and loss of citizenship and political rights.
8.	Recommendation R (90) 4 on the elimination of sexism from language[200]	Calls on the Member States to promote the use of languages that reflect the principle of equality between women and men, and to take appropriate measures to encourage the

[184] See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31992L0085
[185] See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31979L0007
[186] See: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32001L0051
[187] See: https://op.europa.eu/en/publication-detail/-/publication/dd2dbe96-6dbe-4db1-b769-fc592a60a5ba/language-en
[188] See: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52008IP0094
[189] See: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:52012XC0113(01)
[190] See: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0491:FIN:en:HTML
[191] See: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0424:FIN:EN:HTML
[192] See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014H0124
[193] See: https://www.echr.coe.int/Pages/home.aspx?p=basictexts&c#:~:text=The%20Convention%20for%20the%20Protection,force%20on%203%20September%201953.
[194] See: https://www.coe.int/en/web/european-social-charter
[195] See: https://www.coe.int/en/web/conventions/full-list?module=treaty-detail&treatynum=197
[196] See: https://rm.coe.int/1680084822
[197] See: https://rm.coe.int/168008482e
[198] See: https://rm.coe.int/native/0900001680506f32
[199] See: https://rm.coe.int/168058ff43
[200] See: https://rm.coe.int/1680505480

		use of non-swine and non-sexist languages, taking into account the presence, position and role of women in society.
9.	Recommendation R (96) 51 on the reconciliation of work and family life[201]	Calls on member states to take measures to enable women and men to better reconcile their work and family lives. Proposed measures include the organization of working time (flexible employment practices, maternity and parental leave); elimination of discrimination between women and men in the labour market; development of adequately funded services for the benefit of families; adaptation of social security systems and tax systems to increase the diversity of work patterns, as well as organizing school hours and curricula.
10.	Recommendation R (98) 14 on gender mainstreaming	Calls on the member states to create a favourable environment and facilitate the conditions for the implementation of gender equality in the public sector on the basis of the Council of Europe Report on Gender Equality.
11.	Recommendation Rec (2002) 5 and documents concerning violence against women[202]	Sets out a series of measures to end all forms of violence against women, including legal and policy measures to prevent but also measures to investigate violence against women, help victims, raise public awareness, collect relevant data, work on education, etc.
12.	Recommendation Rec (2003) 3 on the balanced participation of women and men in political and public decision-making[203]	Sets a standard that has meanwhile been followed by other organizations and countries: a balanced representation of women and men is defined as a minimum of 40% representation of each sex in any decision-making body in political and public life.
13.	Recommendation Rec (2007) 13 on gender mainstreaming[204]	In education, calls on member states to promote and encourage measures aimed at integrating a gender perspective at all levels of the education system and in the education of teaching staff. It highlights a range of comprehensive measures, including the legal framework, school organisations and school curricula.
14.	Recommendation Rec (2007) 17 on gender equality[205]	Provides a broad list of measures to achieve gender equality in practice, taking into account human rights and gender mainstreaming in legislation in all sectors.
15.	Recommendation CM/Rec(2008)1 on the inclusion of gender differences in health policy[206]	Calls on the Member States to take into account the gender perspective in health, paying attention to the specific health needs of men and women and including the integration of the gender perspective into their health policies and strategies.
16.	Recommendation CM/Rec(2010)10 on the role of women and men in conflict prevention and resolution and in peace building[207]	Provides guidance on how to respond to the different roles attributed to women and men in conflict prevention, conflict resolution and peacebuilding activities.
17.	Recommendation CM/Rec(2012)6 on the protection and promotion of the rights of women and girls with disabilities[208]	Calls on the Member States to adopt appropriate legal measures and take other positive actions that could encourage the participation of women and girls with disabilities in all areas of life.
18.	Recommendation CM/Rec(2013)1 on gender equality and media[209]	Includes guidelines and proposals for measures to combat gender stereotypes in the media and applies equally to Member States and media organisations.
19.	Recommendation CM/Rec(2015)2 on gender mainstreaming in sport[210]	Calls on the Member States to promote and encourage policies and practises aimed at introducing, implementing and ensuring gender mainstreaming in all areas and at all levels of sport, including: legislation, policies and programs, data collection and research on women and girls in sport; and women's sport, as well as raising awareness and training on gender equality issues for civil servants and other staff involved in the field of sport.
20.	Recommendation CM/Rec(2017)9 on gender equality in the audio-visual sector[211]	
21.	Recommendation CM/Rec (2019)1 on preventing and combating sexism[212]	
22.	Make Gender Equality in Law A Reality in fact: Compilation of recommendations of the Committee of Ministers of the Council of Europe in the field of gender equality (2021)[213]	

[201] See: https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDCTMContent?documentId=09000016804d4ea1
[202] See: https://www.coe.int/en/web/genderequality/recommendation-rec-2002-5-and-other-tools-of-the-council-of-europe-concerning-violence-against-women
[203] See: https://rm.coe.int/1680519084
[204] See: https://rm.coe.int/recommendation-cm-rec-2013-1-of-the-committee-of-ministers-to-member-s/1680982c06
[205] See:https://rm.coe.int/recommendation-cm-rec-2013-1-of-the-committee-of-ministers-to-member-s/1680982c06#:~:text=In%20its%20Recommendation%20CM%2FRec,social%20responsibility%20that%20is%20linked
[206] See: https://search.coe.int/cm/Pages/result_details.aspx?ObjectID=09000016805d4212
[207] See: https://search.coe.int/cm/Pages/result_details.aspx?ObjectId=09000016805cea74
[208] See: https://search.coe.int/cm/Pages/result_details.aspx?ObjectID=09000016805caaf7
[209] See: https://search.coe.int/cm/Pages/result_details.aspx?ObjectID=09000016805caaf7
[210] See: https://search.coe.int/cm/Pages/result_details.aspx?ObjectID=09000016805c4721
[211] See: https://search.coe.int/cm/Pages/result_details.aspx?ObjectID=09000016807509e6
[212] See: https://rm.coe.int/prems-055519-gbr-2573-cmrec-2019-1-web-a5/168093e08c
[213] See: https://rm.coe.int/prems-013421-gbr-2573-make-gender-equality-couv-texte-a4-web-2778-0010/1680a1d3de

Annex II - Participation of women and men in climate policies

In 2017 the Ministry of Sustainable development and tourism collected gender-disaggregated data on all professionals working on **transposition of EU Directives under Chapter 27**, for the purpose of developing a reorganisation plan and capacity building for the sectors of the environment and climate change in Montenegro for the period 2017–2020. The target group included the following professional profiles: high management, mid-management and experts. Administrative and support staff were not taken into account. The results show that women make up 33% of professionals. The data from this research activity is presented below:

Institution	Woman	Men	Total
1. Ministry of Sustainable development and tourism	24	4	28
- Environmental Protection Agency	21	19	40
- Institute of Hydrometeorology and Seismology	30	43	73
- Administration for Inspection Affairs of Montenegro	17	18	35
2. Ministry of Agriculture and Rural Development	6	8	14
- Forest Administration	38	249	287
- Water Directorate	1	0	1
- Administration for Food Safety, Veterinary and Phytosanitary Affairs	1	0	1
3. Ministry of Transport and Marine time Affairs	3	6	9
4. Ministry of Interior	4	4	8
5. Ministry of Finance – Real Estate Directorate	1	2	3
6. Ministry of Health – Institute of Public Health	7	4	11
7. Statistical Office of Montenegro (MONSTAT)	1	0	1
TOTAL	154	357	511

Table 31. Number of people working on transposition or implementation of the EU Directives under Chapter 27

Source: Ministry of Sustainable development and tourism, data collected the purpose of developing a reorganization plan and capacity building for the environmental and climate change sectors in Montenegro for the period 2017-2020.

Furthermore, within all **the managerial structures**, (ministers, deputies, directors, state secretaries and independent advisers – 86 people in total), there were 39 women (45%) and 47 men (55%). However, when it comes to the high-level managerial structures (ministers and deputies), there were 13 men (87%) and two women (13%)[214]. Unfortunately, the same statistical breakdown for the new Government structure isn't yet available. The new government was elected on 4 December 2020, and with it the structure of the ministries and people change. The cabinet includes 4 women, and the number of ministries has been reduced to 12 from 18. The change of government in August 2020 did not bring about significant changes in the representation of women in the Montenegrin parliament. Of the 81st seats in the highest legislature, 22 went to women, which is below the legal quota of 30 percent. There are no women in key decision-making positions in the state and there are still none at the head of parties. Even if we look at the participation of women in Montenegrin delegations in the climate negotiation[215], in the last 12 years it was uneven. In other years, the participation of women was 35% on average. However, when it comes to the leaders of delegations, men headed COP delegations in 10 out of the 12 meetings, while women have had this opportunity only twice, in 2011 and 2013.

COP	Percentage of women	Women at head of delegation
COP14 Poznan, 2008	66.7%	No
COP15 Copenhagen, 2009	41.6%	No
COP16 Cancun, 2010	60%	No
COP17, Durban, 2011	83.3%	Yes
COP18 Doha, 2012	33.3%	No

[214] See: Sanja Elezovic, Women and Climate Change in Montenegro. UNDP, 2018.

[215] In 2001 at COP 7, the parties agreed on the first decision related to "Improving the participation of women in the representation of Parties in bodies established under the UNFCC and the Kyoto Protocol '' (1 Decision 36/CP.7). The Lima Work Programme on Gender adopted by COP20 in 2014 invited parties to advance on gender balance, promote gender sensitivity in developing and implementing climate policy, and achieve gender responsive climate policy in all relevant activities under the Convention (Decision 18/CP.20).

COP19 Warsaw, 2013	80%	Yes
COP20 Lima, 2014	0%	No
COP21 Paris, 2015	40%	No
COP22 Marrakesh, 2016	33.3%	No
COP23 Bonn, 2017	33.3%	No
COP24 Katowice, 2018	38.9%	No
COP25 Madrid, 2019	33.3%	No
COP26 Glasgow, 2021[216]	47%	No

Table 32. Participation of women in COP meetings

Source: WEDO Gender Climate Tracker[217]

[216] https://unfccc.int/sites/default/files/resource/PLOP_COP26.pdf
[217] https://wedo.org/tool-gender-climate-tracker-app/

Annex III – Tables and graphs on Indicators to assess social equality

Year	Unemployment rate		% of women participating in labour force	Employment rate	Self-employed women/Self-employed population	Self-employed women/women working population
	Total	**Women**				
2006	29.6	30.1	41.0	28.7	31.7	12
2007	19.4	20.9	43.9	34.8	32.2	14.4
2008	16.8	17.9	43.9	36.1	32.3	11.6
2009	19.1	20.4	43.3	34.4	26.2	9.6
2010	19.7	20.7	42.6	33.8	24.9	8.8
2011	19.7	20.0	42.1	33.7	29.7	10.4
2012	19.7	20.3	43.4	34.6	27.7	10.1
2013	19.5	18.8	43.6	35.4	28.4	9.3
2014	18.0	18.2	46.2	37.8	30.1	11.3
2015	17.6	17.3	47.7	39.4	30.3	12.3
2016	17.7	17.1	47.6	39.4	29.5	12.6
2017	16.1	17.0	47.4	39.4	26.4	11.4
2018	15.2	15.1	48.1	40.8	23.4	10.2
2019	15.1	15.7	49.9	42.1	24	9.8
2020	17.9	18.4	46.4	37.9	26.3	11.4
2021*	14.8	(12.9)	47.0	40.9	25	9.5

Table 33. Women in the Montenegrin workforce

* For 2021 data from the III quarter was used

( ) Less accurate estimation

Source: Own table based on Labour Force Surveys, Statistical Office of Montenegro (MONSTAT)

School year	**Started primary education**			**Finished primary education**		
	Total	Women	% of girls that started primary education	Total	Women	% of girls that finished primary education
2006/2007	10,005	4,811	48%	8,834	4,264	48%
2007/2008	9,629	4,690	49%	8,903	4,336	49%
2008/2009	8,183	3,885	47%	9,893	4,740	48%
2009/2010	7,811	3,715	48%	9,188	4,461	49%
2010/2011	7,355	3,622	49%	8,426	4,104	49%
2011/2012	7,369	3,501	48%	8,216	3,982	48%
2012/2013	7,460	3,515	47%	7,562	3,589	47%
2013/2014	7,715	3,648	47%	7,192	3,436	48%
2014/2015	7,876	3,746	48%	7,421	3,578	48%
2015/2016	8,172	3,809	47%	7,701	3,754	49%
2016/2017	7,922	3,824	48%	7,747	3,696	48%
2017/2018	7,710	3,259	42%	7,350	3,540	48%
2018/2019	7,563	3,672	49%	6,978	3,447	49%
2019/2020	7,508	3,570	48%	6,985	3,303	47%
2020/2021	7,811	3,747	48%	-	-	-

Table 34. Students who enrol and complete primary education

Source: Own table based on data available at Monstat, Department of Education, Culture and Justice Statistics

Women who enrol in the higher education compared to total number of students				
Academic year	Undergraduate studies	Postgraduate studies		PhD
		Specialist studies	Master studies	
2007/2008	54%	76%	61%	55%
2008/2009	54%	71%	64%	52%
2009/2010	53%	65%	61%	58%
2010/2011	53%	62%	59%	49%
2011/2012	54%	61%	64%	53%
2012/2013	53%	58%	59%	44%
2013/2014	53%	57%	61%	53%
2014/2015	53%	60%	57%	48%
2015/2016	54%	55%	56%	53%
2016/2017	54%	55%	60%	25%
2017/2018	55%	58%	56%	40%
2018/2019	55%	55%	55%	51%
2019/2020	55%	56%	60%	44%
2020/2021	55%	55%	63%	51%
Women who finish the higher education compared to total number of students				
Academic year	Undergraduate studies	Postgraduate studies		PhD
		Specialist studies	Master studies	
2007/2008	71%	80%	56%	100%
2008/2009	64%	76%	49%	21%
2009/2010	61%	73%	57%	67%
2010/2011	61%	67%	57%	40%
2011/2012	59%	62%	55%	36%
2012/2013	60%	64%	63%	100%
2013/2014	59%	60%	60%	31%
2014/2015	60%	59%	62%	60%
2015/2016	62%	62%	63%	63%
2016/2017	58%	63%	59%	68%
2017/2018	58%	60%	56%	44%
2018/2019	56%	63%	55%	54%
2019/2020	57%	59%	65%	40%
2020/2021	60%	61%	65%	57%

Table 35. Women in higher education in Montenegro

Source: Own table based on Monstat, Department of Education, Culture and Justice Statistics

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Number of Micro and SMEs	**18,571**	**19,829**	**21,525**	**23,138**	**24,455**	**25,440**	**26,755**	**29,534**	**32,084**	**33,157**
Women owners of SMEs	3,021	3,281	3,595	3,925	4,599	5,233	5,820	6,460	6,996	7,584
% of women owners	**16.27**	**16.55**	**16.70**	**16.96**	**18.81**	**20.57**	**21.75**	**21.87**	**21.81**	**22.87**

Table 36. Number of women owners of Micro and SMEs in relation to the total number of Micro and SMEs in Montenegro - changes in the period from 2011 to 2020

Source: Tax Administration, January 2021.

GEI	Domain	Subdomain	Indicators
Gender Equality Index for Montenegro in 2019 - 55 out of 100	**WORK (still paying a higher price for "having it all") 65.2**	Participation	FTE employment rate (%)
			Duration of working life (years)
		Segregation and quality of work	Employed people in education, human health and social work activities (%)
			Ability to take one hour or two off during working hours to take care of personal or family matters (%)
			Career Prospects Index (points, 0-100)
	MONEY 59.7	Financial resources	Mean monthly earnings (PPS - Purchasing Power Standard)
			Mean equalized net income (PPS)
		Economic situation	Not at-risk-of-poverty (%)
			Income distribution S20/80
	KNOWLEDGE 55.1	Attainment and participation	Graduates of tertiary education (%)
			People participating in formal or non-formal education (%)
		Segregation	Tertiary students in education, health and welfare, humanities and arts (%)

	TIME (management of free time) 52.7	Care activities	People caring for and educating their children or grandchildren, elderly or people with disabilities, every day (%)
			People doing cooking and/or household, every day (%)
		Social activities	Workers doing sporting, cultural or leisure activities outside of their home, at least daily or several times a week (%)
			Workers involved in voluntary or charitable activities, at least once a month (%)
	POWER 35.1	Political	Share of ministers (%)
			Share of members of parliament (%)
			Share of members of regional (local) assemblies (%)
		Economic	Share of members of boards in largest quoted companies, supervisory board or board of directors (%)
			Share of board members of central bank (%)
		Social	Share of board members of research funding organisations (%)
			Share of board members of publicly owned broadcasting organisations (%)
			Share of members of highest decision-making body of the national Olympic sport organisations (%)
	HEALTH 86.9	Status	Self-perceived health, good or very good (%)
			Life expectancy at birth (years)
			Healthy life years at birth (years)
		Behaviour	People who don't smoke and are not involved in harmful drinking (%)
			People doing physical activities and/or consuming fruits and vegetables (%)
		Access	Population without unmet needs for medical examination (%)
			Population without unmet needs for dental examination (%)

Table 37. Gender equality index for Montenegro in 2019

Source: EIGE, Gender Statistics Database https://eige.europa.eu/gender-statistics/dgs/indicator/index_data__index_scores

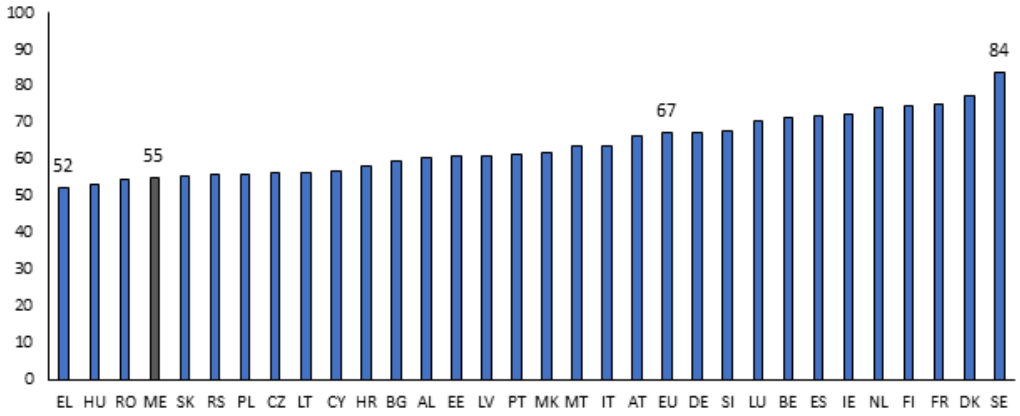

Figure 51. EIGE Gender Equality Index 2019 – EU Member States and available data for Western Balkans countries

GII DIMENSIONS:				HEALTH		EMPOWERMENT			LABOUR MARKET	
HDI rank	Country	GENDER INEQUALITY INDEX		Maternal mortality ratio (SDG3.1)	Adolescent birth rate (SDG3.7)	Share of seats in parliament (SDG3.5)	Population with at least some secondary education (SDG4.4)		Labour force participation rate	
		Value 2019	Rank 2019	(deaths per 100,000 live births)	(births per 1,000 women ages 15–19)	(% held by women)	(% ages 25 and older)		(% ages 15 and older)	
							Female	Male	Female	Male
		2019	2019	2017	2015-2020	2019	2015–2019	2015–19	2019	2019
1	**Norway**	0.045	6	2	5.1	40.8	95.4	94.9	60.4	67.2
2	**Ireland**	0.093	23	5	7.5	24.3	81.9	79.9	56.0	68.4
22	**Slovenia**	0.063	10	7	3.8	22.3	97.2	98.3	53.4	63.4
43	**Croatia**	0.116	29	8	8.7	20.5	94.6	97.4	45.4	57.5
48	**Montenegro**	0.109	26	6	9.3	28.4	88.0	98.2	46.5	62.8
49	**Romania**	0.276	61	19	36.2	19.6	88.2	93.6	45.3	64.7

54	**Turkey**	0.306	68	17	26.6	17.4	50.2	72.2	34.0	72.6
56	**Bulgaria**	0.206	48	10	39.9	25.8	94.4	96.4	49.2	62.0
64	**Serbia**	0.132	35	12	14.7	37.7	86.3	93.6	47.4	62.8
69	**Albania**	0.181	42	15	19.6	29.5	93.7	92.5	46.7	64.6
73	**BiH**	0.149	38	10	9.6	21.1	74.0	89.3	35.4	58.1
82	**North Macedonia**	0.143	37	7	15.7	39.2	41.8	57.7	43.0	67.3
	World	0.436	—	204	43.3	24.6	61.0	68.3	47.2	74.2

Table 38. UNDP Human Development Report 2019: Gender Inequality Index

Source: Human Development Report 2020 (http://hdr.undp.org/en/composite/GII)

Annex IV – Local vulnerability and exposure based on the past events

Climate and weather disaster	Extreme weather	Consequences (indirect impacts)	Most affected receptors	Location/area
Heat wave				
2003 **2007-2011** **2012** **2013, 2015,** **2017,** **2018- 2020**	39.7 40.1, 39.8 40.2	- inability to execute works on building structures in the open - more electric power consumption for cooling - Direct and indirect impact (total and partial drying of plants) - Occurrence of plant diseases - Reduced vitality and decorativeness of plant material -Impact on human health	-Ecosystems -Entire plant stock - Public company / local self-government budget The central city core is especially affected, including a lot of buildings, large asphalt and concrete surfaces Vulnerable groups (children, pregnant women, the elderly, chronically ill, socially endangered groups, outdoor workers ...)	- Urban areas - City parks - Park forests -- Block and Linear greenery
Drought				
June-August 2000 Jun-September 2003 June -September 2005 July – October 2007 August-September 2009 2011, 2012, 2017, 2018, 2019	consecutive dry days the number of tropical days higher than normal heat waves drought developed from the agricultural to the hydrological	Increased number of forest fires; Increased severity of forest fires; increased costs / economic losses in 2000 Forest fires in the coastal region - olives in Kotor and HN in flame in 2003 Forest fires in 2005 Increased water consumption and water restriction Lack of water for irrigation in rural areas; Wide spread impact on crops; Drought-induced pest infestations or diseases. Increased number of forest fires in September 2009 Water level in the rivers near minimum Increased number of forest fires in 2017; increased burnt area Danger for or actual violation of minimum flow or environmental flow requirements	Low vegetation and macchia Forests Cultural heritage Fishery Water and Electrical supply; There will be less 650 million kilowatts of electricity.	TIVAT: Area under the *machia* and low vegetation HERCEG NOVI- hills of Bijela, Djenovići, Zelenika and above Kumbor. Fire near the houses TIVAT: Church from the 14th century Fisheries village Bigovo and complex of blue horizons coast KOTOR, HERCEG NOVI, TIVAT
Heavy precipitation/Floods				
14-15.10.2012 04-05.03.2015 12- 13.06.2016 21.-22.12.2011 25-28.09.2020	Series of intensive cyclonic activities followed by heavy rainfall	Large dump of excavated material, formed a landslide. It blocked the entire course of the river Sutorina and it overflowed; Estimated costs	Rivers Public utility infrastructure Road infrastructure Tivat airport Traffic	HERCEG NOVI: on the border with Croatia Municipality of Herceg Novi...etc, Kotor, Tivat, Igalo,

30-31.03.2022	220 mm of rainfall fell in Herceg Novi	for reparation of landslide 200,000 EUR Big damages on infrastructure, private houses and properties near to the river Sutorina. 50 houses were flooded Sewage canals cannot accept such amounts of water, so the streets and squares were mostly flooded, and parts of the highway. Overflow of the rivers Sutorina and Opačica from the riverbeds Large amount of deposited waste; Flooded houses in Igalo Njivice, Bijela and Kamenari, Skaljari, in the settlement of Glavatsko Traffic on the road from Herceg Novi to Kamenari was difficult Landslide near Veriga, Torrents flooded the highway near Lepetani, Opatov, Donja Lastva, Seljanov, Kalimanja and Dumidran. Coast in Dobrota several hours under water; torrents in the streets, flooded basements and ancillary facilities; flooded technical rooms at Tivat airport	Sewage system; Hindered operation of the waste water treatment facility All categories of the local population in flooded settlements were affected Private houses, buildings with flat roofs; buildings with basement premises; buildings with worn facades material goods	NJivice, Bijela, Kamenari, Verige Lepetan, Opatov, Donja Lastva, Seljanov, Kalimanja and Dumidran. Municipality of Kotor: Most endangered settlement of Glavatske Coast in Dobrota Evacuation Centre was established in Kotor
Storms (compound of heavy precipitation and strong wind				
21-22.11.2018 21-22.12.2019 25-28.09.2020 18.09.2021	In Herceg Novi, 200 mm of rain, south wind gust up to 90 km/h Strong gusts of southwest wind, rain and hail size of small egg	Large torrents along the coast in Herceg Novi, Flooded buildings along the coast Flooded main road M1 High tidal wave hinders the entry in the port of Novi A large part of Kotor under water Many cars were trapped in torrents Sea level rise Large part of Lustica Bay under water Torrents and mud in Seljanovo Large damages to the crops in Grbalj settlement; Damages to orchards, vegetables and olive groves; Damages to the cars, windows and the house facades	Coast, rivers Buildings, houses, business facilities, schools, markets, restaurants Overflowed sewerage canals for precipitation Highway and local roads traffic, sea traffic 77 houses damaged, losses - 94,903.2 $ in Zelenika, Meljine218 (municipality of Herceg Novi) Damaged water supply network and electrical installation in Tivat 190 cubic meters of various materials in torrent channels, on the roads and on the sidewalks in Tivat	Herceg Novi, Kotor, Tivat The port of Novi Municipality of Herceg Novi: Zelenika, Meljine Sutorina, Meljine, Zelenica, Bijela Road from Kotor to Radovici
Strong wind				
09.06.2018 23-24.02.2019	Short lasting strong wind	Damages to the Airport in Tivat and smaller planes Damaged hospital in Meljine	Electricity network Greenery	Herceg Novi, Sutorina, Kamenari, Igalo, Meljine

[218] Desinventar http://desinventar.cimafoundation.org/

	Strong northern wind (borra) with the gust over 100 km/h	People security were endangered Damages to the electricity network, greenery, roofs of the houses from Sutorina to Kamenar, doors and windows of houses, Ruined roof of the Igalo Institute, above the pool; Interventions were also on 4 fires	Houses: roofs, windows and doors Ruined roof of the Igalo Institute Human life	Airport in Tivat and surroundings

Annex V – Considered Gender Indicators

	Montenegro			Year	Source
	Total	Female	Male		
Mortality Rate at birth by gender	0.7			2019	https://www.hzjz.hr/wp-content/uploads/2021/10/Dojenacke_smrti_2020.pdf
Infant mortality rate (under one year of age) by gender	1.42	1.48	1.37	2021	MONSTAT
Child mortality (under 5 years of age) by gender	2.4	2.2	2.5	2020	https://databank.worldbank.org/source/world-development-indicators
Child mortality (between 5-14 years of age) by gender					No data available at all
Teen Mortality Rate (between 10-19 years of age) by gender					No data available at all
Young Adults Mortality Rate (between 15-24 years of age) by gender					No data available at all
Elderly mortality Rate (65 years and older) by gender	58.71	51.29	68.42	2020	MONSTAT Population estimates and basic demographic indicators 2020 and table of deaths per 1000 people
General Mortality Rate by gender	11.74	10.75	12.75	2020	MONSTAT Population estimates and basic demographic indicators 2020 and table of deaths per 1000 people
Average Life Expectancy at birth by gender	75.9	78.8	73.2	2020	MONSTAT - basic demographic indicators
Maternal Mortality Ratio (number of deaths per 100.000 live births) by age		6		2017	https://data.unicef.org/country/mne/
Death Rate for Malnutrition by gender and age	0.09			2019	https://ourworldindata.org/grapher/malnutrition-death-rates?tab=table
Epidemic/Viral Infection(s) Fatality Rate by gender and age					No data available at all
Mortality Rate for Respiratory Disease by gender and age					No data available at all
Proportion of people with disability by gender and age	11%	12%	10%	2016	68,064 people in the strategy listed and of these, 46% were men and 54% were women. On the link: https://www.csrcg.me/images/Dokumenti/Strateska%20dokumenta/STRATEGIJA%20ZA%20INTEGRACIJU%20LICA%20SA%20INVALIDITETOM%20U%20CRNOJ%20GORI%202016-2020.pdf
Activity Rate by Gender and Age	50.9	44.4	57.7	2021	Monstat - labour force surveys
Employment Rate by Gender and Age	42.4	37.3	47.8	2021	Monstat - labour force surveys
Unemployment Rate by Gender and Age	16.6	15.8	17.1	2021	Monstat - ankete o radnoj snazi - Municipalities https://www.zzzcg.me/wp-content/uploads/2021/04/3-Mart-BILTEN-03.2021..pdf
Youth Unemployment Rate (15-24-year-olds) by gender	22.5	18.3	25.7	2021	Monstat - labour force surveys
Gender pay/wage gap (Average difference between the remuneration for men and women who are working)					No data available at all
Proportion of employed females in primary sector (e.g., agriculture, fishing, etc.) to total employment in this sector	100.0	38.6	61.4	2021	Monstat - labour force surveys

Proportion of employed females in primary sector (e.g., agriculture, fishing, etc.) to total female employment	6.4	5.5	7.1	2021	Monstat - labour force surveys
Proportion of employed females in secondary sector (e.g., manufacturing) to total employment in this sector	100.0	16.6	83.4	2021	Monstat - labour force surveys
Proportion of employed females in secondary sector (e.g., manufacturing) to total female employment	16.9	6.2	25.7	2021	Monstat - labour force surveys
Proportion of employed females in tertiary sector (e.g., services, commerce, etc) to total employment in this sector	100.0	51.9	48.1	2021	Monstat - labour force surveys
Proportion of employed females in primary sector (e.g., e.g., services, commerce, etc) to total female employment	76.7	88.3	67.2	2021	Monstat - labour force surveys
Proportion of female entrepreneurs to total entrepreneurial population	100.0	26.5	73.5	2021	Monstat - labour force surveys
Average proportion of retired people by gender and type of retirement scheme (e.g., minimum social welfare benefit or contributory pension)	18.53			2021	Pension and Disability Insurance Fund, by gender they only have from 2016
Literacy rate by gender and age	98.8	98.5	99.5	2018	https://databank.worldbank.org/source/world-development-indicators
Youth female literacy rate (15-24 years)	99.1	99	99.2	2018	https://databank.worldbank.org/source/world-development-indicators
Net attendance rate of primary school by gender	96.1	96.6		2017	https://databank.worldbank.org/source/world-development-indicators
Share of population with primary education as highest education level by gender	28%	60%	40%	2011	Monstat - 2011 - https://monstat.org/userfiles/file/popis2011/Saop_obraz%2014_06_2012_%20konacno%20PDF.pdf
Out-of-school population among lower secondary education by gender					No data available at all
Net enrolment rate in secondary school by gender	89.9	90.5	89.3	2018	https://databank.worldbank.org/source/world-development-indicators
Share of population with secondary education as highest education level by gender	52%	46%	54%	2011	Monstat - 2011 - https://monstat.org/userfiles/file/popis2011/Saop_obraz%2014_06_2012_%20konacno%20PDF.pdf
Gender Ratio among people enrolled in higher/academic education	100%	61%	39%	2020	Own calculation for the academic year 2020/2021 based on Monstat data available at: https://monstat.org/cg/page.php?id=437&pageid=76
Share of population with tertiary education by gender (bachelor's degree, master's degree, Ph.D.)	55.5	64.4	47.4	2020	https://databank.worldbank.org/source/world-development-indicators
Total fertility rate per woman	1.8	1.8		2020	https://databank.worldbank.org/source/world-development-indicators
Mean age of women at birth of first child	26.3	26.3		2010	https://w3.unece.org/PXWeb2015/pxweb/en/STAT/STAT__30-GE__02-Families_households/04_en_GEFHAge1stChild_r.px/table/tableViewLayout1/
Total marriage (and civil union) rate by age of spouses	6.29			2021	Monstat broj skloljenih brakova/procjena broja stanovništva 15+ * 1000 - https://monstat.org/uploads/files/demografija/brakovi/2021/Sklopljeni%20i%20razvedeni%20brakovi

					%20u%20Crnoj%20Gori%20u%202021.%20godini_.pdf
Mean age of women at birth of first child	26.3	26.3		2010	https://w3.unece.org/PXWeb2015/pxweb/en/STAT/STAT__30-GE__02-Families_households/04_en_GEFHAge1stChild_r.px/table/tableViewLayout1/
Separation and divorce rate by gender / 1000 marriages	240.3			2021	Na 1000 brakova - Monstat - https://monstat.org/uploads/files/demografija/brakovi/2021/Sklopljeni%20i%20razvedeni%20brakovi%20u%20Crnoj%20Gori%20u%202021.%20godini_.pdf
Widowhood rate by gender and age	9.30%	#####	3.20%	2011	Monstat popis - **Imamo i za opštine** https://www.monstat.org/userfiles/file/popis2011/saopstenje/bracni%20status%2014%2010%20MNE-ENG.pdf
Single-parent families' proportion by householder's gender	18%	15%	3%	2011	Monstat popis - **Imamo i za opštine** https://www.monstat.org/userfiles/file/popis2011/saopstenje/Structure%20of%20family%2020.pdf
Proportion of neolocal households (located apart from the families of both spouses) out of the total number of households					No data available at all
Share of family households with children under age 15	#####			2011	Diferent methodology, with children under 25 - Monstat popis https://www.monstat.org/userfiles/file/popis2011/saopstenje/Saop%20%20struktura%20porodica%2020.pdf
Share of family households with one or more members with disability					No data available at all
Population size and density by gender and age					We have data by municipalities in the 2011 census
Average age of the resident population by gender	37.2	38.4	36.0	2011	
Population growth rate by gender					
Population size and density between urban and rural areas (disaggregated by gender and age)					
Population size and density between coastal and inner areas (disaggregated by gender and age)					
Population size and density between areas potentially "at risk" and areas perceived as potentially safer (disaggregated by gender and age)					No data available at all