

Guidelines for climate change monitoring in the cooperation area

Final Version of 30/11/2021

Deliverable Number D.4.4.2.



Project Acronym	CHANGE WE CARE
Project ID Number	10043385
Project Title	Climate cHallenges on coAstal and traNsitional chanGing arEas: WEaving a Cross-Adriatic REsponse
Priority Axis	2
Specific objective	2.1
Work Package Number	4
Work Package Title	Evolution dynamics in Pilot Sites and Northern/Central Adriatic under climate change
Activity Number	4.4
Activity Title	Definition of common monitoring and observation system on identified significant parameters
Partner in Charge	PP8 (IZOR)
Partners involved	LP (CNR-ISMAR)
Status	Final
Distribution	Public

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1. Foreword

This document has been produced in the framework of the INTERREG Italy – Croatia CHANGE WE CARE Project. CHANGE WE CARE fosters concerted and coordinated climate adaptation actions at transboundary level, tested in specific and representative pilot sites, exploring climate risks faced by coastal and transitional areas contributing to a better understanding of the impact of climate variability and change on water regimes, salt intrusion, tourism, biodiversity and agro-ecosystems affecting the cooperation area. The main goal of the Project is to deliver integrated, ecosystem-based and shared planning options for different problems related to climate change (CC), together with adaptation measures for vulnerable areas, to decision makers and coastal communities. Additional information and updates on the CHANGE WE CARE can be found at <https://www.italy-croatia.eu/web/changewecare>.

Within the activities defined by the work plan of the Interreg Italy-Croatia project “Climate cHallenges on coAstal and traNsitional chanGing arEas: WEaving a Cross-Project Adriatic REsponse” (CHANGE WE CARE), this deliverable aims to define a guidelines for monitoring of climate changes in the Adriatic Sea, as a set of activities that would maintain the monitoring activities at the satisfactorily level.

The report is a companion report of D4.4.1 (Long-term strategic plan for site-specific operating of monitoring and observation system at Pilot Sites), which is providing the detailed strategy for specific monitoring at five Pilot Sites. The report will mainly list the recommendations specifically targeting the key activities that would assure the sustainability of the climate monitoring on the long term. The recommendations span over various activities, related to the monitoring programmes itself, tools for more efficient management, securing long-term finances, opening the data and the data products to all potential users and products, fostering collaborations between scientists, managers and policy-makers, and on educational activities. Each recommendation contains: the aim of the recommendation, the description, the timeframe of the recommendation (short-term, 1-2 years, middle-term, 3-5 years, long-term, 6-10 years), and funding programmes and instruments that may be consumed to get a financial framework for the activity.

2. Recommendations for climate monitoring in the Adriatic Sea

2.1 Integrating and standardising the monitoring programmes and observational networks

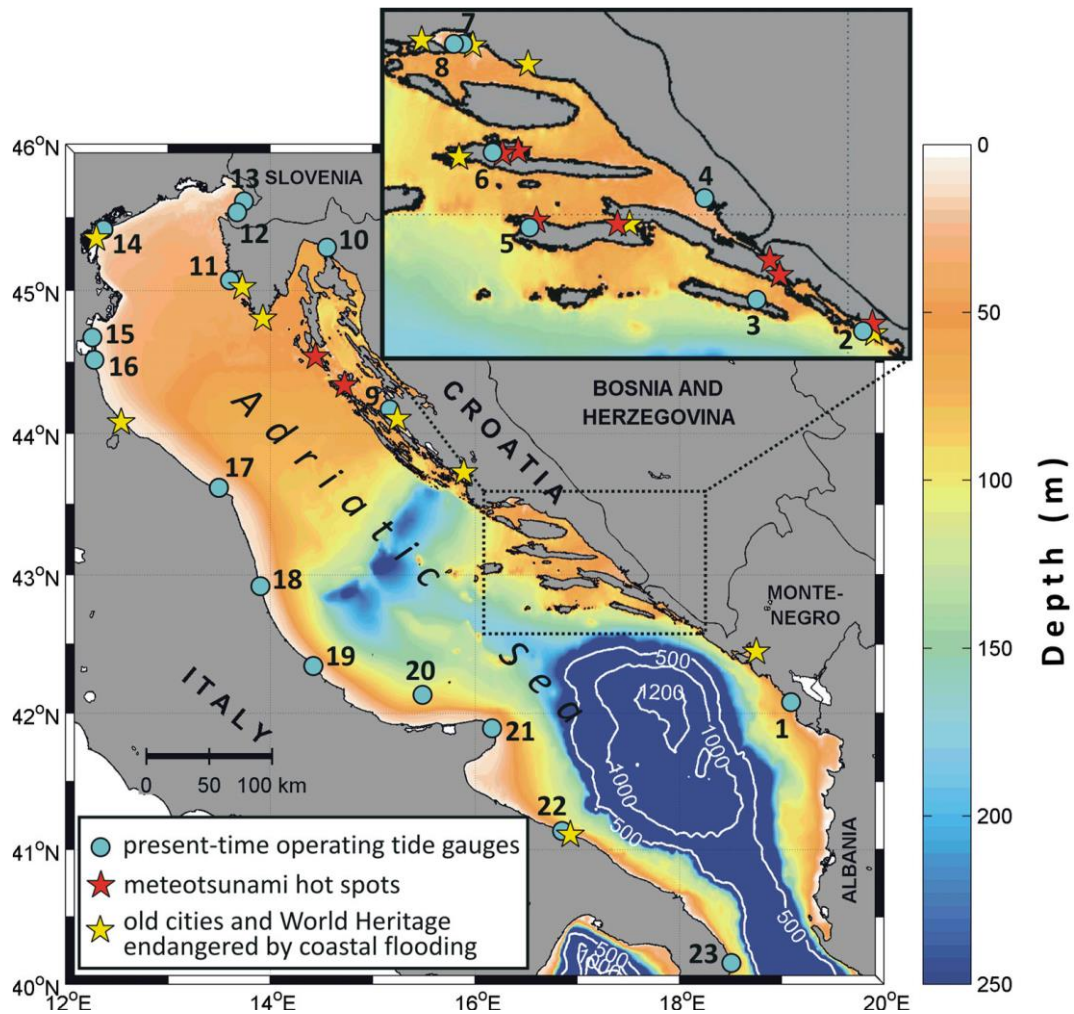
Aim: To integrate and standardize sampling strategies and procedures within the climate monitoring programmes and observational systems.

Description: As presented by the D3.1.1. of the project ECOSS (ECOLOGical observing System in the Adriatic Sea: oceanographic observations for biodiversity), which reviewed existing observing monitoring programs and observing systems in the Adriatic Sea, enlightens their variability originated from different background, 22 observational programmes and observational systems that act on a long term has been active, more or less, in the Adriatic Sea. Here we provide the statistics of all presented monitoring programs and observing systems:

Geographical coverage	Local or regional (80%), whole or most of the Adriatic (20%)
Monitoring MFSD (Marine Strategy Framework Directive) parameters	Yes (68%), No (32%)
Monitoring WFD (Water Framework Directive) parameters	Yes (72%), No (28%)
Monitoring HD (Habitat Directive) parameters	Yes (40%), No (60%)
Monitoring MSP (Marine Spatial Planning) parameters	Yes (60%), No (40%)
Types of monitored parameters	Physical parameters (64%), Chemical parameters (56%), Biological parameters (88%)
Data accessibility	Fully available (34%), Partially (with a condition) available (26%), Not available (40%)

Reported information indicated an obvious lack of observation and data for some group of parameters demanded by certain directives probably as consequence of underfinancing of monitoring activities. Yet, they concluded that the diversity between existing monitoring programs, number of observing systems, duration of observations, lack of data for certain parameters, might be used for providing added value to the management and maintenance of the Adriatic networks and marine-related infrastructure, potentially ending with the increased level of managements of the Adriatic living resources and biodiversity.

Most the presented networks can be used and adapted to the monitoring of climate changes in the Adriatic Sea. Tide gauge network is one of examples, which cover both Croatian and Italian coastlines and being maintained by a variety of institutions (national and regional agencies, universities, public research institutes):



Geographical location of present-day operating tide gauges

Another example is the Acqua Alta oceanographic tower located 15 km offshore of Venice in the northern Adriatic Sea, at a bottom depth of 16 m. The platform is fully equipped with a large set of autonomous instrumentations that acquire atmospheric, hydrological and oceanographic data with several meteorological stations and sensors, including different measurement systems of waves and currents and providing one of the longest directional wave time series presently available). At the site, biological and chemical measurements are routinely acquired, with periodic sampling of the water column.



Photo of the Aqua Alta Tower

Therefore, all of the monitoring programmes should be (i) appropriate in the term of spatial and temporal sampling, covering a wide range of physical and biogeochemical processes in the Adriatic Sea, (ii) self-sustainable, in terms of financial resources, coming mostly from national and regional sources, but being supported and advanced through the European or regional projects and programmes, (iii) adequately managed, i.e. having in operations and management enough high-quality trained personnel and professionals, and (iv) providing the high-quality data, that are supervised by specialist and not by data managers.

Timeframe and milestones: 3-5 years (2024-2026).

Funding programmes and instruments: National funding, Horizon Europe, Interreg programmes, Research Infrastructures programmes

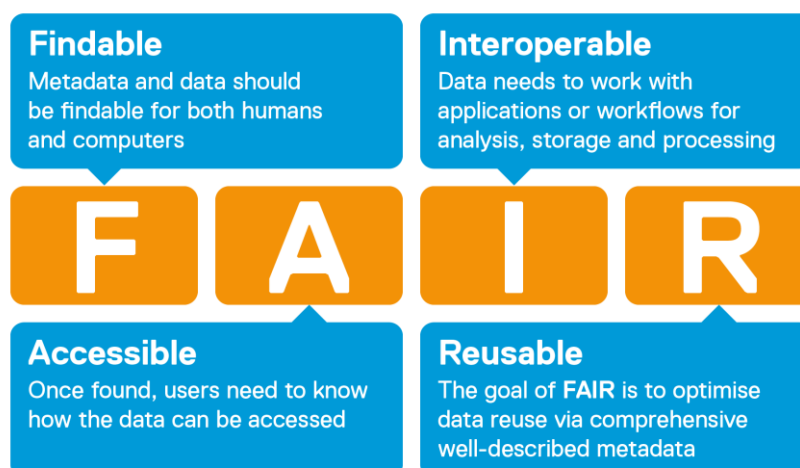
Key players involved: research performing institutions, environmental agencies, policy-making institutions

2.2 Creating tools for easy management with data and products

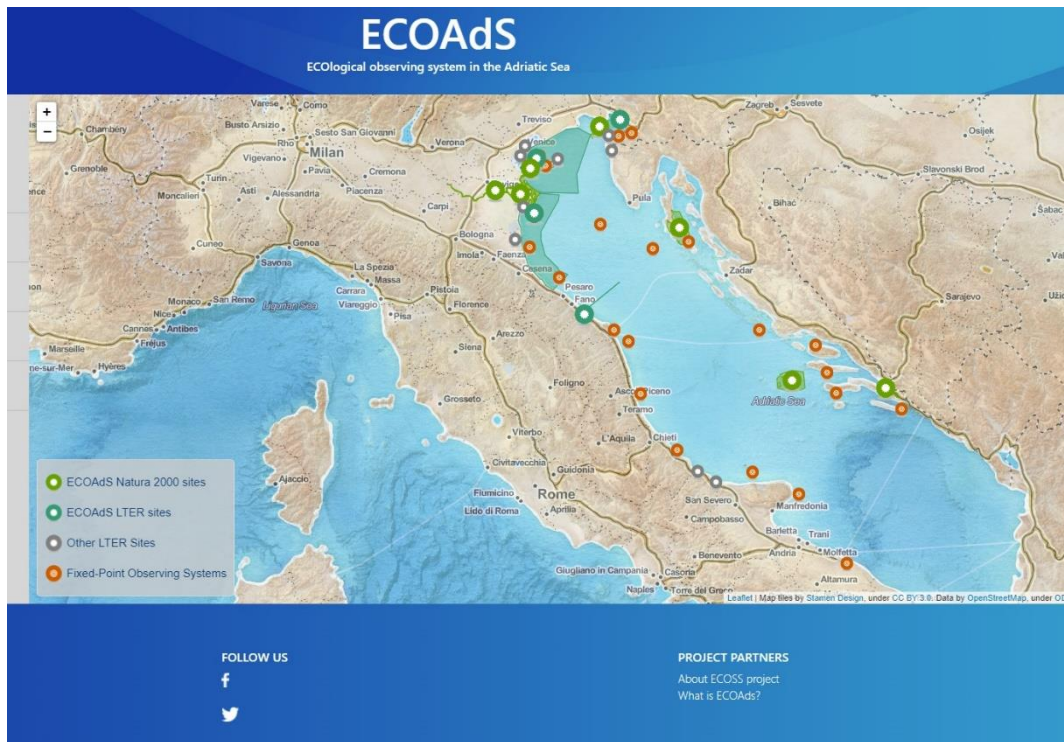
Aim: To develop state-of-the-art data access, data management, product management and for assessing and forecasting climate changes and processes.

Description: Projections of climate conditions in the near future (e.g. a few decades) and on climate scales is an important tool for proper management of eventual hazards and eventual deterioration of the physical system, chemical and biological relations. To provide a tool for proper and easy management of climate changes and climate hazards, the data coming from both observations and modelling simulations should follow so-called FAIR principles (Wilkinson et al., 2016).

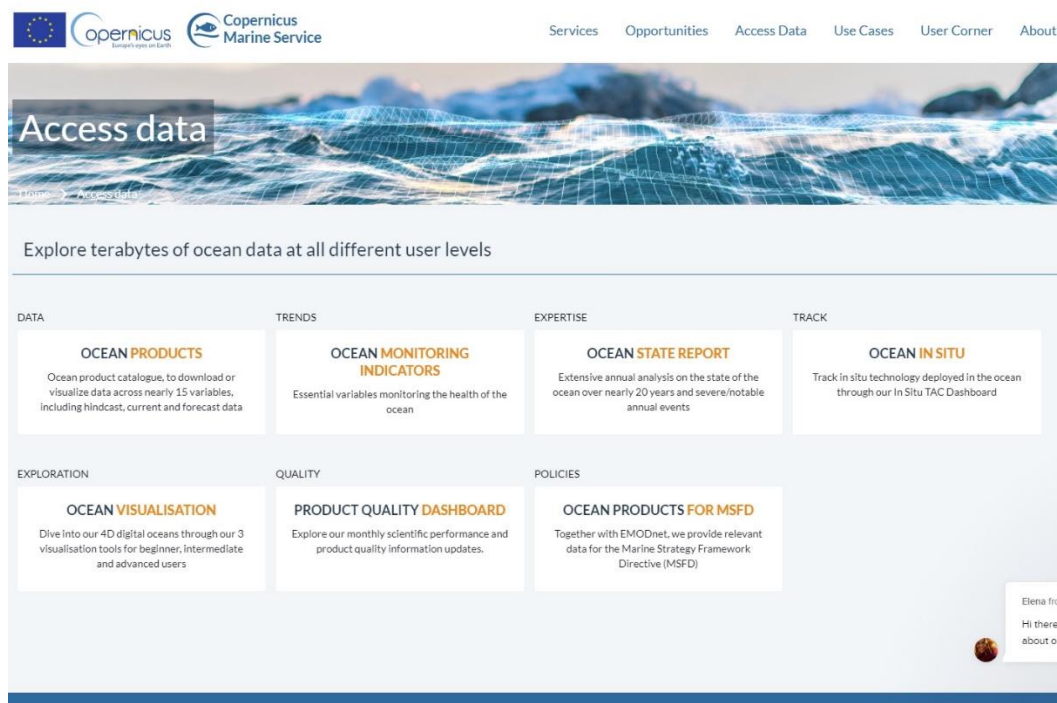
The 'FAIR Guiding Principles for scientific data management and stewardship' are providing guidelines to improve the Findability, Accessibility, Interoperability, and Reuse of digital assets. The principles emphasise machine-actionability (i.e., the capacity of computational systems to find, access, interoperate, and reuse data with none or minimal human intervention) because humans increasingly rely on computational support to deal with data as a result of the increase in volume, complexity, and creation speed of data.



To follow these principles, data repositories, existing and future ones, should be adapted. However, this is just the first item allowing for easy management of the Adriatic atmospheric and ocean data usable in research and management. The next goal should be harmonising the data policies and the data management over different observing platforms and data types, i.e. by creating the central one-stop-shop point for accessing all Adriatic data and products. An example is the ECOAdS website, which is a hub for all ecological data in the Adriatic:



Another example is Marine Copernicus system (<https://marine.copernicus.eu/access-data>), which is the most robust system developed for management of all European seas, but some of the solution might be adapted to the Adriatic regional needs:



Timeframe and milestones: 3-5 years (2024-2026).

Funding programmes and instruments: National funding, Horizon Europe, Interreg programmes, private foundations

Key players involved: research performing institutions

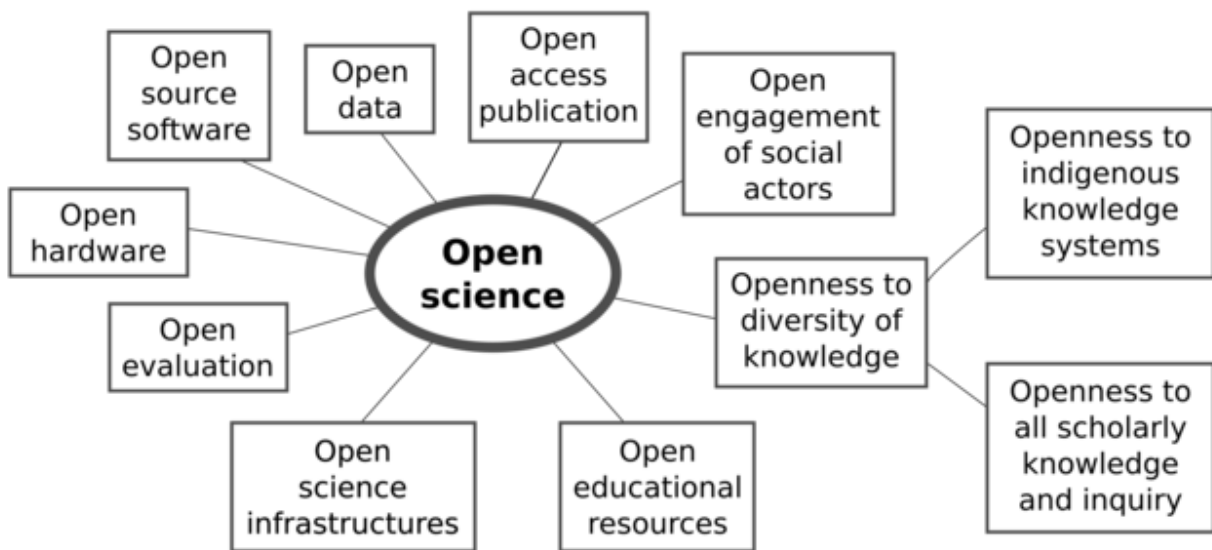
2.3 Implementing open data and science principles

Aim: To develop data policies based on open data, open science and FAIR principles.

Description: Open science is transparent and accessible knowledge that is shared and developed through collaborative networks. It encompasses practices such as publishing open research, campaigning for open access, encouraging scientists to practice open-notebook science, and generally making it easier to publish and communicate scientific knowledge. The six principles of open science are: (i) Open methodology, (ii) Open source, (iii) Open data, (iv) Open access, (v) Open peer review, and (vi) Open educational resources. Open science aims to make scientific research (including publications, data,

physical samples, and software) and its dissemination accessible to all levels of an inquiring society, amateur or professional, following the FAIR principles.

Open Data is the idea that some data should be freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control. Opening government data is only a way-point on the road to improving research, education, and governance.



Following these principles, the data policies for usage of the observed and modelled data, in particular of these that is of high-quality for climate studies, should be developed for the climate data in the Adriatic Sea.

Timeframe and milestones: 1-3 years (2022-2024).

Funding programmes and instruments: National funding, Horizon Europe, Interreg programmes, Research Infrastructures

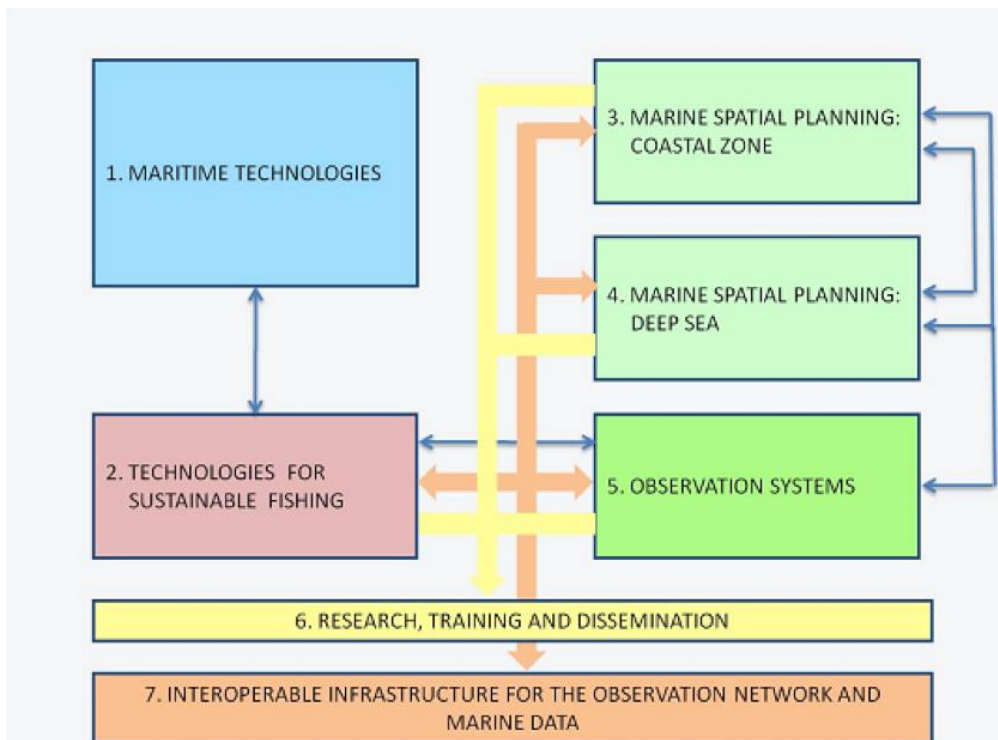
Key players involved: national policy-makers, research performing institutions, environmental agencies

2.4 Securing long-term financing of the monitoring programmes and observational networks


Aim: To secure financial sustainability of long term observations and infrastructure needed for climate simulations on the long term.

Description: The cost of sampling at the sea and obtaining the ecological marine data is quite high, in particular compared to similar activities at land. For this reason, a long-term basin-wide monitoring programme should be agreed between Croatia and Italy and set up on the long term, including its financial framework. All the quoted measures will easily fall down if an appropriate level of financial support is not secured at national and basin level.

Financial support for the climate monitoring in the Adriatic should be primarily set up by through national funding, preferably through a national monitoring programmes. For Italy, such a monitoring programmes has been operational in the last decade, e.g. RITMARE Flagship Project which was one of the National Research Programmes funded by the Italian Ministry of University and Research. RITMARE was the leading national marine research project for the period 2012-2016; the overall project budget amount to 250 million euros, co-funded by public and private resources. It is coordinated by the National Research Council and involves an integrated effort of most of the scientific community working on marine and maritime issues, as well as some major industrial groups, with the structure plotted below:



In the Croatian waters, there were several attempts to create national long term monitoring programmes, of which the long lasting was Project Adriatic running from 1998 to 2008. However, the financial crisis in 2008 resulted in no money attached to the project activities and therefore with a deterioration of the programme itself. Such program, coordinated at the national level, harmonising all activities assessing climate changes in the Adriatic Sea, should be restored in a certain way.

PROJEKT

JADRAN

Projekt Jadran
Hrvatski nacionalni monitoring program

Sažetak
 Program
 Sudionici
 AMOS
 Oceanografska plutača

Meteorološko - oceanografska postaja i modeli


Kritarije u sklopu projekta

Meteorografske prognoze i mjerenja

Korisne poveznice:
 Baza pokazatelja
 Projekt NASCUM
 Mikrobarograf

webmaster

Sustavno istraživanje Jadranskog mora kao osnova održivog razvitka Republike Hrvatske



Timeframe and milestones: 3-5 years (2024-2026).

Funding programmes and instruments: National funding, EU funding, Research Infrastructures

Key players involved: national policy-makers, research performing institutions, environmental agencies

2.5 Fostering collaborations between scientists, managers and policy-makers

Aim: To establish a permanent platform for exchanging ideas about climate monitoring, assessment and governance in the Adriatic Sea.

Description: Collaborations and exchange of ideas between key players are a key to a success of any long-term action related to proper functioning of the Adriatic observing systems. For this reason, a permanent platform might be established as a body that will direct and maintain the functioning of the climate change monitoring, assessment and governance after the end of the CHANGE WE CARE project. This platform might be composed of all relevant research performing institutions, environmental agencies and policy-making organisations, like these – but restricted to – involved in the CHANGE WE CARE consortium. The platform might meet once a year and monitor the performance and sustainability of the climate change

monitoring, assessment and governance, including the creation of specific documents and actions that might push the activities in the right direction.



Timeframe and milestones: 1-2 years (2021-2022).

Funding programmes and instruments: National funding, in kind contributions

Key players involved: national policy-makers, research performing institutions, environmental agencies


2.6 Educating professionals and managers for climate monitoring

Aim: To increase the education of researchers, engineers and technicians who will be engaged in climate monitoring, assessment and governance.

Description: Considering a multi-level organisation which are involved in climate monitoring, assessment and governance in all countries around the Adriatic Sea, for the proper functioning of which different experts should be engaged (marine researchers, policy-makers, decision-makers, local and national managers, IT experts), education in all of these aspects and gaining the competences and skills necessary for proper enrolment in climate-oriented activities should be carried out.

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Master of Science (MSc) in Climate Change



PROFILE AND CAREER

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The programme is offered in English.

With an MSc in Climate Change you will be equipped to take up job functions associated with local, national and international efforts to deal with climate change, one of the currently greatest challenges to modern society.

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For achieving that, the communication with universities that have marine-related activities should be established, upgrading already existing courses and creating new ones relevant to climate monitoring, assessment and governance. This is particularly relevant for the graduate and postgraduate student levels, and life-long learning programmes, to be created to serve the increasing number of professionals dealing with different aspects of climate changes. Even though, a new M.Sc. study might be established (an example may be found at <https://studies.ku.dk/masters/climate-change>), targeted to different level of professionals that are engaged in climate change-related activities.

Timeframe and milestones: 3-5 years (2024-2026).

Funding programmes and instruments: National funding, Interreg programmes

Key players involved: universities, research performing institutions, environmental agencies

3. Summary and conclusions

In this deliverable we have developed the framework for long term sustainability of the climate observations in the Adriatic Sea. Development of such a framework, with specific recommendations, is of utmost importance in the present era of climate changes, as quantifying the effects of climate changes on the physical, biogeochemical and biological systems is a prerequisite for proper assessment of climate changes and is allowing for definition of measures that might mitigate the impacts of climate changes.

The recommendations are defined on the Adriatic level, as all surrounding countries, their key players (research institutions, managers, policy-makers, decision-makers, on the national and local scales) should be involved in such activities. At first, a variety of monitoring programmes should be more harmonized and better exploited, which is also due to unavailability of lots of data to researchers, which then cannot properly quantify the level of changes. Another important component of the proposed recommendations is establishing or improving of a framework for education of all players related to climate changes, which is presently lacking even on national levels. This should be done on graduate and postgraduate levels, and such education should be a prerequisite for being included in managing and defining of policies at all scales related to environmental issues in the Adriatic Sea. Hopefully, the proposed recommendations will be included where appropriate and further developed in details by the respective key players, leading to more sustainable and healthier Adriatic Sea and the Mediterranean as a whole.