Collaborative Project

CLIM-RUN

Climate Local Information in the Mediterranean region Responding to User Needs

WP 8 – Integrated case studies
Task 8.2 Collection of local information on the north Adriatic coastal case studies, and Croatia's tourism and energy sectors

D8.3 Protocol definition

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Summary

The D8.3 deliverable presented here is based upon the definition of the WP8 deliverables in the Clim-Run "Description of Work": D8.3) Protocol definition: Report on the protocol definition: a set of critical climatic variables will be defined, and the relevant time and spatial scales, key criteria for downscaling, analysis and simulations to WP2 and 3. (Task 8.2) [month 12]

It covers stakeholders' needs and expectations, in view of climate, climate variability and projected climate change, for the integrated case study of the Italian northern Adriatic coastal zone and for the case studies of the Croatian energy and tourism sectors. Various methods of the stakeholders' involvement, their responses and the problems encountered are described and discussed. The end products are summarised in the form of tables listing various climatic and climate-related variables, and the time and spatial scales required.

1. Introduction

Coastal areas represent vulnerable environmental systems highly threatened by the potential impacts of global climate change. The major expected impacts include more frequent inundation of low-lying areas, increased rates of coastal erosion, saltwater intrusion in surface and groundwater, intensification of extreme temperature and precipitation events. These bio-physical impacts in turn could lead to a range of socio-economic impacts including increased flood risk of people, impacts on agriculture and aquaculture, damages on tourism and energy sectors. Moreover, rapidly growing population, urbanization, tourism and associated land use changes in coastal areas would exacerbate these issues and could potentially increase the environmental and anthropogenic risks calling for new integrated management challenges and adaptation strategies.

The main aim of WP8 is to analyse the need of climate information and the effectiveness of climate services for the integrated assessment of climate change impacts on coastal zones at the regional to local scale. For this purpose, two relevant case studies were developed on the western and eastern coast of the North Adriatic Sea: the Italian case study, represented by the coastal zone of the Veneto and Friuli-Venezia Giulia Regions; the Croatian case study, which includes the whole country.

The Italian case study comprises various fragile ecosystems such as coastal wetlands and lagoons, and high cultural and socio-economic locations (e.g. the city of Venice). Moreover, the Italian North Adriatic coast is considered particularly vulnerable to climate change impacts (such as increase in flood risk, increase in erosion and permanent submersion of low-lying areas, saltwater intrusion).

Accordingly, the analysis performed in the CLIM-RUN project considered various systems and sectors of interest for coastal managers that have a mandate for Integrated Coastal Zone Management (ICZM) (e.g. natural habitats and ecosystems, water resources, population and infrastructures, agriculture, urban areas) (see Deliverable 8.1). In particular, according to the results of the first Workshop held in Venice the 13th September 2011 (Deliverable 8.1), three major themes were identified as key topics for the Italian integrated case study: 1) "hydroclimatic

regime", particularly related to the impacts caused by extreme climate/weather events (e.g. heavy rainfall/snow events, drought, floods etc.); 2) "coastal and marine environment", basically related to shoreline and marine issues e.g. storm surge flooding, sea-level rise, saltwater intrusion, marine biodiversity and protected areas; 3) "agriculture" that is focused on specific issues such as droughts and irrigation.

As far as the Croatian case study is concerned, two major economy sectors were analyzed: energy and tourism. Croatia has a long tradition of utilising the renewable energy, primarily hydro power which makes approximately 50% of the total installed energy-generating capacity (the other being oil, gas, coal and nuclear shared with Slovenia). Most of hydro power plants are located at or close to the Adriatic Sea (northern Mediterranean) where climate change in the first half of the 21st century is projected to be pronounced. Of other renewable energies (wind, solar), the installed capacities are much smaller in comparison to hydro, but the interest of increasing their utilisation is growing rapidly.

Tourism is one of the most important economic sectors in Croatia, contributing to around 15% of the total GDP. It is most developed at the Adriatic (coast and islands) during summer. There are the two major groups of the tourism sub-sectors with different adaptive capacity to the projected climate change: the first group, with high adaptive capacity, are tourists, tour operators and transport providers and the second group, with low adaptive capacity, is the tourism infrastructure (local hotels and resorts) and local communities.

The main objective of this deliverable is to identify potential users of climate information, the methods how to approach them, to identify users' needs in terms of climate information and to bring them closer to those who possess this kind of information. For this purpose several steps, described in the following sections, were applied in both integrated and sectorial case studies. First, potential stakeholders (both local and regional) must be identified and approached. This is described in the next section - for example, the regional workshops that were organised and conducted represent one way to initiate the contacts with stakeholders and to convey the main objectives of the project. Since the subject of climate and climate change covers various complex scientific issues, an appropriate, often simplified, way to involve stakeholders must be developed. This could be attained in various ways, but conducting questionnaires on climate issues and user needs seems to be the most effective – the methods of engagement are discussed in section 3. Finally, section 4 deals with the outcomes of the contacts between stakeholders and the climate data "holders". This is summarised in the form of tables whereby users' needs/expectations related to climate issues, climatic (as well as meteorological, hydrological, oceanographic, etc.) variables, time and spatial scales are listed and commented.

2. Stakeholders

Participants invited to the Italian workshop for the integrated case study were chosen among a list, where all local public offices with mandate on Integrated Coastal Zone Management (ICZM) have been identified according to EU "Protocol on Integrated Coastal Zone Management in

the Mediterranean" (2009). All the participants were considered as stakeholders who can be potential end-users of climate services. Out of the forty offices selected, twenty six responded positively to the invitation, showing interest and willingness to participate and appointed a person to participate to the workshop. Unfortunately six of these could not attend the workshop, because of prior commitments. Nevertheless, they gave availability and should therefore be contacted in future phases of the project.

After the workshop all participants were invited to compile the questionnaire designed in WP4 translated into Italian and made available online. A total of thirteen questionnaires were compiled. Stakeholders were also asked to send additional comments using a spreadsheet where the main results of the workshop were organized. This information was also integrated by comments from the climate experts providing a preliminary list of key climate variables for WP2 and WP3 experts (Tables 1, 2, 3). A total of eleven stakeholders responded to this invitation, eight of which added comments, the rest only validating the information of the table.

The identification of potential stakeholders from the energy and tourism sectors in Croatia, which would eventually take part in the Clim-Run initial workshops, was attained by opening contacts with known individuals employed within those two economy sectors. In the case of energy, the response was relatively satisfactory since representatives from the main organisations and companies involved in the energy business in Croatia, state owned and private, took part in the first talks and discussions. In total, 12 participants responded to the questionnaire on renewable energy. From the tourism sector the response was poor (7 participants who responded to the questionnaire on tourism), and the new initiative is underway to identify potential stakeholders, with the emphasis now on the quality of communication and the genuine interest in climate and climate change rather than "en masse" contacts. Few individuals were approached and asked to help improving the process of the stakeholder identification.

3. Methods of engagements

Having selected the offices that should be involved in the Clim-Run project for the Italian North Adriatic Sea, invitations were sent by email to people working in each office. The list of people was compiled first including previously known people, and then by searching on the internet to complete the list. Follow up phone calls were made to all offices to make sure the most appropriate person was invited, and that the email was received. Some changes in invitations were made according to content of phone calls, e.g. somebody else from the office was more appropriate or showed more interest, or because the first person selected could not attend because of prior commitments. Remainder emails and phone calls were also made as the date of the workshop was approaching.

The two interactions after the workshop, i.e. the questionnaire and the table described above, were carried out over the internet, additionally e-mail reminders and follow-up phone calls were also made for both.

It can be noticed that the number of stakeholders decreased along the process, even if an effort was made to reach out to stakeholders by means of personal interactions, e.g. dedicated phone calls to understand whether there were misunderstandings or problems.

In Croatia, in order to facilitate a list of potential stakeholders, some individuals from both energy and tourism sectors were contacted before the workshops were actually organised. For each workshop, invitations to more than 60 possible participants were sent via e-mail; however, some individuals were also contacted by phone or in person. At the workshops the questionnaires and their contents were presented and explained to the participants. No problems were encountered by participants while replying to the questions.

The method of contacting potential participants by e-mail or phone worked satisfactory for the Energy workshop, but this was not the case for the Tourism workshop. Therefore, in order to get them involved with the Clim-Run project we have to revise our approach by contacting potential stakeholders individually and conducting one-to-one interviews. [However, this is a more time-consuming method with no guarantee of final success.] With this aim we have already approached certain individuals and got their approval for cooperation. At the time of writing the meetings were arranged and the revision (broadening) of the questionnaire is underway.

4. Key criteria for analysis, simulation and downscaling of climatic variables

The analysis of climatic data of any sort should be performed primarily at those temporal and spatial scales at which observations and the outputs from climate models are available. A degree of quality control of source data might be necessary in order to ascertain their suitability for further use. This kind of data manipulation is already well developed at National Meteorological (and Hydrological) Services that are in charge of collecting meteorological (and climatic) data in their respective countries.

If model output is compared with observations some sort of spatial interpolation should be performed. Preferably observations, normally available at irregular spacing, are interpolated to model grid (regular, latitude/longitude or similar). However, this may involve smoothing and consequently some misrepresentation of data, in particular extremes. In such a case, a *caveat* should be issued in order to draw attention to a potential source of error.

Although past and present climates, based on collection of reliable observations, can be fairly well described and explained, each analysis of climate and climatic variables should include an estimate of uncertainties. This is particularly important for analysis of model outputs (either from global or regional models) of future climate where sources of uncertainties are various. Uncertainties in climate projections must be clearly stated and an effort should be made by climatologists to understand them. This should be an important part of the protocol, because it enables a responsible approach to potential stakeholders.

When spatial and/or temporal scales of available climatic data are insufficient to describe processes on even smaller scales, a downscaling technique may be applied. Downscaling is *not* an interpolation from a coarser resolution to a finer resolution. It involves either complex physical/dynamical models that describes (parts of) climate system or complex mathematical

relations that links coarse scales with the finer ones. Downscaling techniques have become indispensable when climate data are describe at the scales that are largely influenced by small variations in orography or are defined over a complex coastal configuration. Although downscaled results enable an insight into the details of a climatic variable, one should avoid a trap of becoming too confident in such results. Here too uncertainties do exist and should be clearly identified.

Tables 1, 2 and 3 collect information emerged from the stakeholder survey of the Italian North Adriatic case study with the aim to identify relevant climate variables and metrics useful to represent climate change information for each theme of interest (i.e. hydroclimatic regime, management of coastal and marine environment, agriculture) and to provide key criteria for downscaling, analysis and simulations to WP2 and WP3.

Each table is composed of two major fields: stakeholders and researchers. The column with stakeholder needs highlights the major interests of stakeholders emerged during the first workshop of September in relation to each selected theme; the stakeholder comments highlight needs of interviewed stakeholders regarding each issue of concern; the researchers columns provide preliminary answers of WP8 climate experts involved in the Italian case study concerning key climate variables and their spatial and temporal scales.

In order to provide climate services not only related to climate models and basic climate parameters but also to risks and impacts induced by climate change (i.e. derived parameters), within the Italian case study, the key climate variables will be used by risk experts within a climate change risk assessment procedure.

Tables 4 and 5 summarise the questionnaire responses of the Croatian energy and tourism sectors. For the tourism sector, all respondents agree that air temperature is considered as an essential piece of information, and most agree this is precipitation as well. However, additional several variables are included in our tables which have not been identified by stakeholders as potentially valuable (e.g. UV radiation for outdoor activities, visibility for nautical tourism, freezing rain for solar renewable, etc.). On the other hand, there is number of derived indices from basic climatic variables, particularly related to biometeorology, which were proven as very useful for outside activities (e.g. the so-called comfort index). No attempt was made to partition between observation and modelled variables.

ANNEX I

HYDROCLIMATIC REGIME				
STAKEHOLDERS		RESEARCHERS		
Needs identified in the workshop (13 sept 2011)	**Summary of stakeholders' comments**	**Variable**	**Spatial scale**	**Time scale**
Extreme events forecasts (e.g. those that cause floods and hydrogeological risk, including return periods).	Monthly, seasonal, yearly precipitation; Extreme events: percentiles, return periods; Extreme events duration: short (1-3-6-12 hours) or longer (1-5 consecutive days); Storms, hailstorms, tornadoes, etc.: differences in equivalent potential Temperature, CAPE (Convective Available Potential Energy), Lifted Index to understand possible tendencies affecting the atmospheric stability and their influences on the occurrence of extreme events; General trend (up tp 2100), decadal trends (2010-2010, etc.), multidecadal (2010-2030, etc.) and all the processing outputs; Pressure.	Precipitations; Winds.	15-50 km from models, local scale from downscaling.	1-3 hours, daily, seasonal, decadal, multidecadal.
How trends of climate parameters will vary (temperature, precipitation, etc).	Fog; Snow cover variation.	Temperature; Precipitations.	15-50 km from models, local scale from downscaling.	Daily, seasonal, decadal, multidecadal.
Design and management of structural defense measures, sizing of pumps and levees.	Description of weather events as modified by climate change to improve structural defenses.	Extreme events of precipitations.	15-50 km from models, local scale from downscaling.	1-3 hours, daily, seasonal, decadal, multidecadal.
Extreme events monitoring for civil protection intervention and issue of alerts.		Precipitations; Winds.	15-50 km from models, local scale from downscaling.	1-3 hours, daily, seasonal.
Improve knowledge of climate change scenarios, of models used, and of uncertainty.	Mean sea level.	Temperature; Precipitations.	Global and regiona model ensambles, possible downscaling.	Decadal, multidecadal.
Possibility of using data from ARPA Veneto and ARPA Friuli Venezia Giulia (i.e. the two involved regions) to run models in CLIM-RUN, also to understand errors and uncertainties in model themselves.	For all data: identify uncertainty and confidentiality levels at regional scale.	Precipitations; Winds; Temperature.	Local data coming from stations.	Daily, seasonal, decadal, multidecadal.
Weather forecast for 10 days (a year?).				
Establish a collaboration among institutions participating in this workshop and climate experts.	Establish ongoing collaboration among climate experts and institutions (e.g. civil protection agency, etc.).			
Monitoring can be improved, e.g. the monitoring of surface waters, of aquifers, and of sea level (especially in the Po delta) could be improved or set up.				
Improvement of weather forecast, e.g. longer forecasts (10 days) could help Civil Protection better plan in advance and move its vehicles where necessary, also Water Reclamation Boards could programme irrigation as a consequence of drought periods.				
Need to establish link between extreme event and corresponding risk, as of today, databases are separate, they could be integrated.	An inventory of landslides can be made available by the Veneto Region (Inventario Fenomeni Franosi Italia, IFFI).			
Distinguish between effects of climate variability and of climate change.				
Information on return periods of extreme events to improve timely prevention measures.				

Table 1. Information need and key climate variables emerged from the WP8 Italian case study in relation with the theme group "Hydroclimatic regime".

COASTAL - MARINE ENVIRONMENT				
STAKEHOLDERS		RESEARCHERS		
Needs identified in the workshop (13 sept 2011)	**Summary of stakeholders' comments**	**Variable**	**Spatial scale**	**Time scale**
Environmental sustainability: beach erosion, salt water intrusion, forest fires, drinking water availability.	Continuous monitoring of: hydrometric levels, piezometric levels, electrical conductivity.	Sea level; Wind; Precipitation;	15-50 km from models, local scale from downscaling.	Daily, seasonal till multidecadal.
Fishery resources and variation in species present.	Seasonal cycles: water temperature at different depths, heavy precipitations.	Precipitation; Runoff;	15-50 km from models, local scale	Daily, seasonal till multidecadal.
Longer duration of storm surges destroy defenses (e.g. sand dunes): improvement of forecast needed.		Sea level; Wind;	15-50 km from models, local scale	Daily, seasonal till multidecadal.
Return periods to forecast how many time the MOSE will be raised, and have useful information for marine transport.		Sea level; Wind; Precipitation; Sea level pressure.	15-50 km from models, local scale from downscaling.	Daily, seasonal till multidecadal.
Climatic information for urban planning.		Sea level; Wind; Precipitation; Sea level pressure.	15-50 km from models, local scale from downscaling.	Daily, seasonal till multidecadal.
Climatic information for coasts: which are the most likely sea leve rise scenarios?		Sea level; Wind; Precipitation; Sea level pressure.	Global and regional model for the North Adriatic area.	Daily, seasonal till multidecadal.

Table 2. Information need and key climate variables emerged from the WP8 Italian case study in relation with the theme group "Coastal and marine environment".

AGRICULTURE				
STAKEHOLDERS		RESEARCHERS		
Needs identified in the workshop (13 sept 2011)	**Summary of stakeholders' comments**	**Variable**	**Spatial scale**	**Time scale**
Drought and irrigation.	Potential evapotranspiration; Hydroclimatic balance; Extreme temperatures; Heat waves; General trend (up tp 2100), decadal trends (2010-2010, etc.), multidecadal (2010-2030, etc.).	Precipitation; Temperature; Drought indicators.	15-50 km from models, local scale from downscaling.	Daily, seasonal till multidecadal.

Table 3. Information need and key climate variables emerged from the WP8 Italian case study in relation with the theme group "Agriculture".

Variable	Time scale	Spatial scale	Comment	Comment 2
	a. sub-daily	A. local (1-50 km; municipality, borough, district)		
	b. daily	B. regional (50-250 km; county, province)		
	c. week	C. basin (250-1000 km; one or more states)		
	d. month	D. sub-continental (1000-3000 km; parts of the Mediterranean – west, north, etc.)		
	e. season	E. continental (3000-10000 km; Europe)		
	f. year			
	g. multi year			
	h. climate change			
Air temperature at 2m				
Hydro	c. to h.	A. to C.	via evaporation from storages	
Wind	a., b.	A.		
Solar	b. to h.	A. to D.		
Maximum temperature (2m)				
Hydro	c. to h.	A. to C.	via evaporation from storages	
Wind	a., b.	A.		
Solar	b. to h.	A. to D.		
Minimum temperature (2m)				
Hydro	c. to h.	A. to C.	via evaporation from storages	
Wind	a., b.	A.		
Solar	b. to h.	A. to D.		
Precipitation				
Hydro	all scales	A. to C.	depends on intensity	
Wind	-	-		
Solar	a., b.	A.		
Snowfall				
Hydro	c. to e. and h.	A., B.		
Wind	-	-		
Solar	b., c.	A.		
Snowmelt				
Hydro	c., d. (e.?)	A. to C.		
Wind	-	-		
Solar	a., b.	A.	if snow melts in few days	

Snow depth				
Hydro	c. to e.	A., B.		
Wind	-	-		
Solar	a. to c.	A.		
Hail			rare event	
Hydro	-	-		
Wind	-	-		
Solar	a.	A.	could cause damage	
Freezing rain			rare event	
Hydro	a.	A.		
Wind	-	-		
Solar	a., b.	A.		
Surface runoff				
Hydro	d., e.	A. to C.	river catchments	
Wind	-	-		
Solar	-	-		
Evaporation				
Hydro	c., d. and h.	A., B.		
Wind	-	-		
Solar	-	-		
Surface pressure				
Hydro	-	-		
Wind	b., c.	A. to C.	synoptic-scale weather systems	
Solar	-	-		
Wind magnitude (at 10 m)				
Hydro	-	-		
Wind	a. to e. and h.	A., B.		
Solar	b., c.	A.	maintenance cost in strong winds	
Wind direction (at 10 m)				
Hydro	-	-		
Wind	g., h.	A., B.	depends upon terrain configuration	
Solar	-	-		
Wind gusts (at 10 m)				

Hydro	-	-		
Wind	a., b.	A.		
Solar	a., b.	A.	aerosols	
Maximum wind speed (10m)				
Hydro	-	-		
Wind	b. to h.	A. to C.		
Solar				
Wind magnitude (at 100 m)			the 80-m data would be preferable	
Hydro	-	-		
Wind	b., c.	A., B.		
Solar				
Total cloud cover (cloudiness)				
Hydro	b., c.	A.	affects evaporation from storages	
Wind	-	-		
Solar	a. to c. and h.	A., B.		
Sunshine duration				
Hydro	b., c.	A.	affects evaporation from storages	
Wind	a., b.	A.	linked with temperature	
Solar	a., b. and h.	A., B.		
Global horizontal irradiance				
Hydro	-	-		
Wind	-	-		
Solar	a. to e. and h.	A., B.		

Table 4. Climatic variables required for the Croatia's renewable energy case study

Variable	Time scale	Spatial scale	Comment	Comment 2	
	a. sub-daily	A. local (1-50 km; municipality, borough, district)			
	b. daily	B. regional (50-250 km; county, province)			
	c. week	C. basin (250-1000 km; one or more states)			
	d. month	D. sub-continental (1000-3000 km; parts of the Mediterranean – west, north, etc.)			
	e. season	E. continental (3000-10000 km; Europe)			
	f. year				
	g. multi year				
	h. climate change				
Air temperature at 2m	a. to h.	A. to C.			
Maximum temperature (2m)	a. to h.	A. to C.			
Minimum temperature (2m)	a. to h.	A. to C.			
Sea (surface) temperature	a. to h.	A. to C.			
Humidity/evaporation	a. to h.	A. to C.			
Precipitation	a. to h.	A. to C.			
Snowfall	a. to h.	A. to C.			
Snow depth	a. to h.	A. to C.	winter tourism		
Hail	a.	A.	rare event		
Freezing rain	a.	A.	rare event		
Fog	a., b.	A.	nautical tourism, outdoor activities		
Visibility	a., b.	A.	nautical tourism, outdoor activities		
UV radiation	a. to e.	A. to C.	outdoor activities		
Surface pressure	a. to h.	A. to C.	a (deep) low with adverse weather may affect outdoor activi		
Wind speed (at 10 m)	a. to h.	A. to C.			
Wind direction (at 10 m)	a. to h.	A. to C.			
Wind gusts	a., b.	A.	nautical tourism		
Total cloud cover (cloudiness)	a. to h.	A. to C.			
Sunshine duration	a. to h.	A. to C.			

Table 5. Climatic variables required for the Croatia's tourism case study