Collaborative Project

CLIM-RUN

Climate Local Information in the Mediterranean region Responding to User Needs

WP 8 – Integrated case studies
Task 8.4

D8.4 Cross-cutting conclusions

Project No. 265192– CLIM-RUN

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Summary

According to the CLIM-RUN "Description of Work" the Deliverable D8.4 (Cross-cutting conclusions) describes how the CLIM-RUN protocol was applied to the North Adriatic case study, highlighting some examples of good practices and key recommendations.
Following the common structure and scope proposed by WP1 and WP4 for the cross-cutting reports, D8.4 addresses several topics of the CLIM-RUN protocol, describing the direct experience of the integrated case study in the overall process of climate products development (e.g. from stakeholder analysis and involvement to the identification of priority needs and the assessment/refinement of products). Finally, some general conclusions about the products developed and some future recommendations for the development of climate services at the Mediterranean scale are also provided.

1.Introduction

Nowadays climate change is posing significant challenges to coastal managers that very often have to deal with multiple types of climate-related hazards (e.g. sea-level rise, extreme weather and ocean events, changes in water quality parameters) that can affect different natural and human systems and sectors (e.g. health, tourism, agriculture, industry, energy). Moreover, increasing exposure and vulnerability patterns are posing additional pressures on coastal assets and ecosystems in these fragile environments (IPCC 2012).
The development of climate services tailored to coastal zone managers' needs is therefore essential to mainstream climate change adaptation in the definition of sustainable plans, policies and programs.
The main aim of WP8 was to develop a range of climate products (including climate risk and adaptation products) for local stakeholders of the North Adriatic region. The overall activities followed the CLIM-RUN bottom-up approach (D1.1), in order to involve and elicit stakeholders' needs and develop products more tailored to their real requests.
Key objectives and questions addressed by WP8 were: 1. to understand how climate and climate impact information can be used by different categories of stakeholders working in different coastal sectors (e.g. natural resources management, civil protection, regional planning and development, tourism and energy) and at different administrative levels (i.e. from local to national and supra-national); 2. to evaluate how this information can effectively answer to the stakeholders' data needs and therefore be used in mainstreaming climate change adaptation in the development of plans, programs and policies.

For this purpose, two relevant case studies were developed within the WP8:1. the Italian case study, represented by the coastal zone of Veneto and Friuli-Venezia Giulia Regions and considering various systems and sectors of interest for coastal management (e.g. natural habitats and ecosystems, water resources, population and infrastructure, agriculture, urban areas); 2.the Croatian case study, which includes the whole country and analyzes especially the energy and tourism sectors.
Teams of different researchers were involved in the process of development of climate services, including the Stakeholder Expert Team (SET), applying the overall participative process; the Climate Expert Team (CET), providing information about climate variations, trends and extremes by means of tailored climate products. Moreover, for the specific purposes of the Italian case study, a Risk Expert Team (RET) was set-up, producing information about the potential consequences of climate change on selected natural and human coastal systems (i.e. climate risk and adaptation services).
D8.4 aims at presenting how the CLIM-RUN protocol was applied in the North Adriatic region, describing specific methods and tools used in the Italian case study and providing some examples of lessons learned and good practices. Specific considerations about the tourism and energy sectors for the Croatian case study are presented in D5.4 and D7.4. However, in the conclusions of this report some general considerations concerning climate services in coastal zones from both case studies (i.e. Italy and Croatia) are provided.
D.8.4 is structured in five mains sections. Section 2 presents the main phases performed for the application of the CLIM-RUN protocol to the Italian case study; Section 3 highlights the common users' needs identified for the Italian case study and how they were been met by developed products; Section 4 gives some recommendations for the implementation of a Mediterranean climate service network; finally, Section 5 summarizes conclusions and lessons learnt providing some suggestions for further development.
More specific information about the contents and results of the two workshops held for the Italian case study can be found in D8.1 and D8.2 (Giannini et al., 2011 and 2013). The process used for the definition of key climate variables for the case study is described in D8.3 (Branković et al., 2012).

2. Developing the CLIM-RUN protocol

In the North Adriatic case study all stakeholders involved were quite familiar with climate information and services and used climate/weather information in their activities. Moreover, some of them (i.e. regional meteorological office, tidal forecast centre) were also providers of weather or tidal services.

For this reason all of them showed great interest in the theme of climate services and willingness to cooperate with climate and risk experts in order to learn more about future climate change scenarios, tools and models for their assessment. Their expectations and needs were to improve their climate service user capacity and uptake and to learn how to use climate data in their own activity mostly related to the public sector. In the next sections main phases of application of the CLIM-RUN protocol to the case study are discussed, focusing on specific methods and tools applied for stakeholder involvement and communication and for the identification of their priority needs.

2.1 Overall process

The overall process of the CLIM-RUN protocol applied in the North Adriatic coastal area followed an integrated and iterative approach composed of three main tiers represented in Figure 1: 1) the participative process, aimed at understanding the needs and requests of the stakeholders; 2) climate information, providing forecasts and projections about climate variability and climate change; 3) climate impacts and vulnerability information, integrating climate data and stakeholders' requests in order to evaluate climate-related risks for several natural and human systems. Each tier involved different experts (i.e. stakeholder, climate and risk experts) working in synergy and in a continuous communication with the aim to deliver timely and sound climate information to coastal stakeholders.

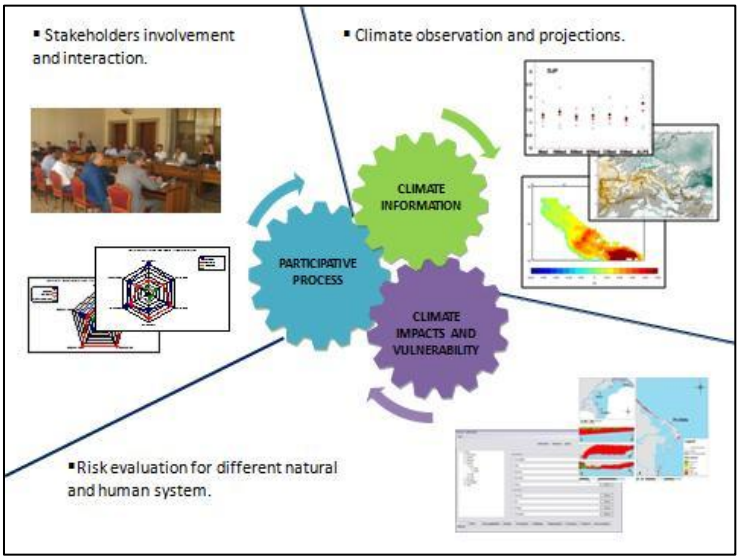

Figure 1. Integrated approach applied in the North Adriatic case study for the development of climate products, including risk and adaptation services.

The participative process was applied by a stakeholder expert since the beginning of the project in order to identify and select more relevant stakeholders and involve them in a continuous dialogue with climate and risk experts, by means of targeted workshops, questionnaires and thematic groups. The climate information tier is represented by climate experts producing tailored climate products relevant and usable directly by stakeholders and risk experts (e.g. analysis of climate observations, improved modeling and downscaling techniques). Finally, the intermediary climate impacts and vulnerability tier is represented by risk experts allowing to bridge the gap between basic climate information produced by climate experts (e.g. extreme precipitation, sea-level rise projections, temperature) with territorial information about exposure and vulnerability, in order to produce climate risk and adaptation services for stakeholders.
As described in more detail in the next paragraphs, the overall process of WP8 followed the general CLIM-RUN protocol adopting a bottom up and iterative approach based on a first workshop - focusing on the comparison between data demand and supply - and on a second workshop in which products were presented and discussed with stakeholders, in order to obtain feedbacks and suggestion for their refinement and improvements.
Specifically, the CLIM-RUN general protocol was adapted to WP8 objectives and stakeholders' groups, involving three teams of experts (i.e. Stakeholders Expert Team (SET), Climate Expert Team (CET) and Risk Experts Team (RET)) to better communicate information about climate change and related impacts and risks to public authorities involved in coastal zone management of the North Adriatic region.
In particular, the involvement of impact researchers (i.e. SET) played a key role forWP8 in order to use climate modelling information, analyse policy-relevant potential impacts; and transfer the results to decision-makers and practitioners in the area of climate adaptation. In this way they helped to bridge the gap between the climate projections of the earth system modellers and the political reality of short term policy making, as well as between the global and local and regional scale.

2.2 Identification and selection of stakeholders

According to the WP8 aims, the stakeholders involved in the integrated case study were identified and selected among those public institutions which have a mandate for Integrated Coastal Zone Management (ICZM) or a mandate with respect to the goals of the WP8 (see also D8.1).

In order to identify and select the more relevant stakeholders to be involved in the participative process, a comprehensive list of 63 offices was compiled at the beginning of the project and used to perform a stakeholder analysis (Table 1).

Macro

Micro

Level	Veneto	Friuli Venezia Giulia
National	▪ Civil Protection, regional office	▪ Civil Protection, regional office
Inter-regional	▪ Autorità di bacino delle Alpi Orientali ▪ Autorità di bacino dell'Alto Adriatico ▪ Autorità di bacino del Po	
Regional	▪ ARPAV ▪ Segreteria regionale per l'ambiente ▪ Segreteria regionale per le infrastrutture e l'urbanistica ▪ Genio Civile (Regione Veneto) ▪ Segreteria regionale per la cultura e turismo ▪ Pesca ed acquacoltura ▪ Servizio idrico integrato: ATO ▪ Industria ▪ Energia	▪ ARPA FVG ▪ Sviluppo sostenibile ▪ Urbanistica e pianificazione territoriale (incluso infrastrutture) ▪ Aree naturali e biodiversità ▪ Ente tutela pesca ▪ Servizio idrico integrato ▪ Industria ▪ Energia ▪ Turismo
Independent Authorities	▪ Port Authoritiy of Venice ▪ ASPO Chioggia ▪ Magistrato delle acque di Venezia ▪ Consorzio di Bonifica Adige Po ▪ Consorzio di Bonifica Delta Po Adige ▪ Consorzio di Bonifica Adige Euganeo ▪ Consorzio di Bonifica Bacchiglione ▪ Consorzio di Bonifica Acque Risorgive ▪ Consorzio di bonifica Piave ▪ Consorzio di Bonifica Veneto Orientale	▪ Port Authoritiy of Trieste ▪ ASPO Monfalcone ▪ Consorzio di Bonifica Bassa Friulana ▪ Consorzio di Bonifica Cellina Meduna ▪ Consorzio di Bonifica Ledra Tagliamento ▪ Consorzio di Bonifica Pianura Isontina
Parks and reserves	▪ Parco Regionale Veneto del Delta del Po ▪ Riserva Naturale Bocche di Po ▪ Riserva Naturale Integrale Bosco Nordio	▪ Area Marina Protetta di Miramare ▪ Riserva Naturale della Foce dell'Isonzo ▪ Riserva Naturale Foci dello Stella ▪ Riserva Naturale della Valle Canal Novo ▪ Riserva Naturale della Valle Cavanata ▪ Riserva Naturale delle Falesie di Duino ▪ Riserva Naturale regionale laghi di Doberdò e Pietrarossa ▪ Riserva Naturale della Val Rosandra ▪ Biotopo Magredi di San Canciano
Provinces	▪ Venezia ▪ Rovigo	▪ Trieste ▪ Gorizia ▪ Udine
Municipalities	▪ San Michele al Tagliamento ▪ Caorle, Eraclea ▪ Jesolo ▪ Cavallino-Treporti ▪ Venezia ▪ Chioggia ▪ Rosolina ▪ Porto Viro ▪ Porto Tolle	▪ Muggia ▪ Trieste ▪ Duino Aurisina ▪ Monfalcone ▪ Staranzano ▪ Grado ▪ Marano Lagunare ▪ Lignano Sabbiadoro

Table 1. Typology of stakeholders on a macro to micro continuum

To reduce the number of offices to involve and to ensure the choice of the most representative and significant authorities for each level (i.e. from macro to micro) a rank was performed by a team of experts of the North Adriatic case study (i.e. social and environmental scientists) giving a score from 1 to 5 considering five specific attributes (i.e. importance, influence, effects, relevance, attitude) defined by the WP1.
The ranking methodology applied in the North Adriatic case allowed to reduce the number of participants to the process, reaching the most representative stakeholders to be involved for different sectors of interest for Integrated Coastal Zone Management (ICZM), both for Veneto and Friuli Venezia Giulia regions. Based on the final rank, 40 offices were selected and invited to attend to the first workshop, through an e-mail invitation.

2.3 Communication with stakeholders

The communication with stakeholders of the North Adriatic case study was performed in different stages of the project adopting different methods and tools (i.e. workshops, questionnaire, discussions, focus group).
A strong effort was made to keep all the participants engaged during the process. E-mails were mainly used in order to ensure an easy communication with CET and RET but also between stakeholders and to exchange informative material (i.e. newsletter, questionnaire, informative brochure) useful for the project development.
The CLIM-RUN website (www.climrun.eu) was also used to share informative and formative material developed by expert teams (i.e. presentations, brochure, publications) in order to make it available for stakeholders interested in learning more about the proposed issues.

Specifically, the communication process between CLIM-RUN expert teams (i.e. CET and RET) and local stakeholders for the North Adriatic case study was coordinated by the SET and can be summarized in three main steps (Figure 2):

1. First workshop held in Venice on 13th of September 2011 aimed at comparing stakeholders' needs and data supply (D8.1), this step included interaction carried out through email exchanges as a follow-up to workshop discussion (October 2011 – May 2012), the aim of this activity was to facilitate interaction and exchange between stakeholders and CET and RET;

2. Second workshop organized in Trieste on 28th May 2013 aimed at presenting and discussing the preliminary climate services developed by RET (D8.2);

3. Focus group held in Venice on 26th September 2013 aimed at presenting final products developed and to define cross cutting conclusions (D8.2).

Moreover, two questionnaires (i.e. perception and feedback questionnaire) were administered to stakeholders after the two workshops, with the aim to assess specific stakeholders' needs for the development and refinement of the products.

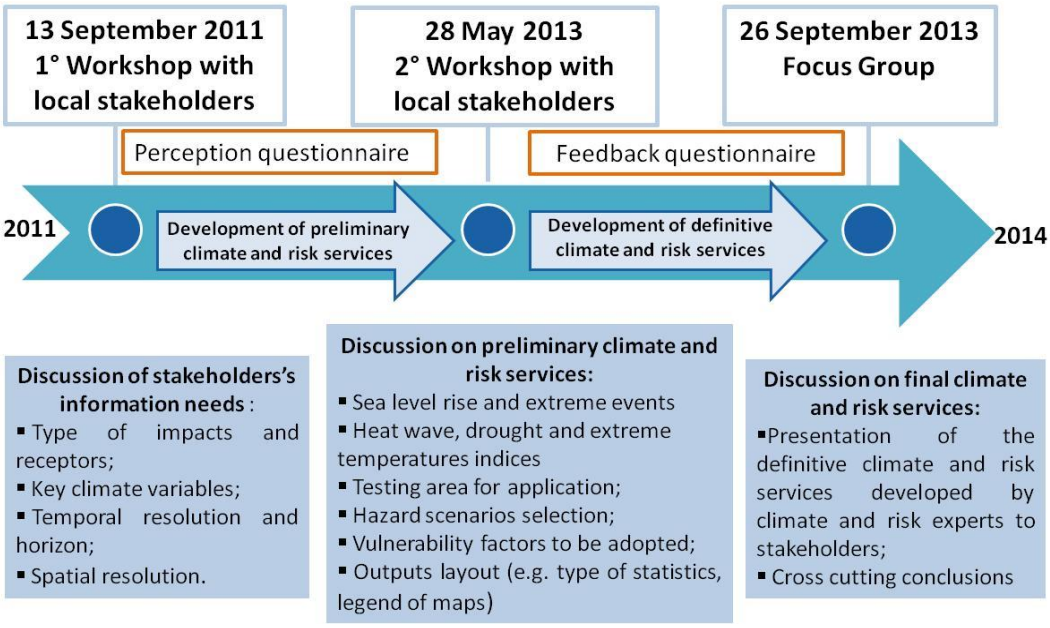

Figure 2. Main steps of the participative process applied in the North Adriatic case study for the development of climate products.

The first workshop and the following questionnaire allowed to elicit key stakeholders' needs in terms of climate variables, impacts, priority receptors, temporal and spatial resolution and scale (Giannini et al., 2011). Based on stakeholders' requests, after the first workshop, CET and RET developed preliminary climate products (including climate risk and adaptation products) which were presented and discussed in the second workshop. The second workshop allowed to assess and refine these preliminary products, evaluating their relevance for local stakeholders, and to improve their final format. For what concerns specifically climate risk and adaptation products, feedbacks and suggestion outlined in the second workshop and in the feedback questionnaire were used to improve preliminary climate products and to better answer to

stakeholders needs regarding case study area for the risk assessment, hazard scenarios to be considered and output data. On the whole, 5 climate products were completed and discussed with local stakeholders of the North Adriatic region: three regarding basic climate parameters (precipitation, sea-level rise, air temperature); and two regarding derived risk parameters (sea-level inundation risk and pluvial flood inundation risk).Final products were presented and discussed with interested stakeholders in a focus group held in Venice on 26th September 2013 in order to get final feedbacks about the usefulness of the products and recommendations for further developments.

2.3.1 Workshops

Considering the interaction process between the two workshops, a strong effort was made in order to keep all the participants engaged and to facilitate their participation to both the workshops. A first step was to organize one workshop in each of the two regions involved in the case study (i.e. Veneto and Friuli Venezia Giulia). Despite of this, the stakeholder participation decreased during the process. Looking at the first workshop held in Venice in 2011 out of the 40 offices invited only 20 definitely participate (Figure.3).

Level	Institutions
Supranational	Adriatic Euroregion
National	Institute for Environmental Protection and Research
	Civil Protection Regional Office Friuli Venezia Giulia
Veneto	Public works office Rovigo
	Soil conservation service
	Integrated hyrdric service
	Regional Metereological service Teolo
Indipendent authorities	Venice Water autority
	Venezia Nuova Consortium
	Po river irrigation consortium
	Veneto Orientale irrigation consortium
	Venice port autority
Provinicies	Geologic service Venice
Municipalities	Venice municipality
	Tidal Forecasting Centre Venice
Friuli Venezia Giulia Region	Regional Agency for the Protection of the Environment
	Regional Metereological service Friuli Venezia Giulia
	Geologic service
Parks	Marine protected area of Miramare

Figure 3. Participants to the first CLIM-RUN workshop.

The same 40 office were also invited to the second workshop in Trieste in 2013 but in this case only 11 participated (Figure 4).

Level	Institutions
Veneto	Regional Met Office
	Municipality of Venice: urban sustainability
	Municipality of Venice: PAES and C40
	Municipality of Venice: energy agency
Friuli Venezia Giulia	Regional geologic service
	Regional environmental agency
	Regional Met Office
	Ledra Tagliamento irrigation consortium
	Marine protected area of Miramare
PAES piano d'azione per l'energia sostenibile (action plan for sustainable energy) The C40 Cities Climate Leadership Group is a network of the world's megacities committed to addressing climate change http://www.c40cities.org/	

Figure4. Participants to the second CLIM-RUN workshop.

This decrease can be mainly attributed to the difficulty to attend the workshops and meetings due to others work constraints. Stakeholders who participated, in fact, demonstrated a great interest and involvement. In order to engage also those who could not participate in the second workshop (mainly Veneto stakeholders),but expressed interest to learn more about what CLIM-RUN has produced,an additional meeting was organized in Venice in September 2013, four stakeholders participated to this meeting.

2.3.2 Perception and risk assessment questionnaires

During the participative process and after each workshop two questionnaires were compiled by stakeholders in order to facilitate the expression of their needs and requests in terms of specific climate information, services and climate adaptation products.

A first perception questionnaire was developed within the WP4 in English, and then translated into Italian and made available to stakeholders online through a

Google platform. Some questions were added to the original format of the questionnaire in order to collect opinions about derived climate parameters (i.e. climate impact and risk assessments) according to the specific objectives of the North Adriatic case study. The questionnaire was divided into five main sections: 1) your institution/organization, 2) risk perception and current use, 3) your perspectives on climate services,4) data requirements, 5) handling uncertainties.
Thirteen out of the twenty stakeholders who participated to the first workshop answered the questionnaire. As described in more detail in D8.1, the results were collected by SET and elaborated trough tables and graphs. This way of synthesizing information allowed to better identify and communicate stakeholders' needs in terms of climate change impacts (i.e. coastal flooding, coastal erosion, drought, salinization and water quality, hydro geological disturbance) and priority receptors (i.e. beaches, deltas and estuaries, wetlands, hydrological systems, agricultural areas, keystone species habitats, lakes, infrastructures for tertiary sector).The first questionnaire also allowed to obtain information about the scale and the resolution of the climate data needs: high resolution climate data with local/regional scale ranging from a medium (50 km) to a fine (1 km) and all possible temporal resolutions were required (annual, seasonal, monthly, daily, sub-daily), while the time scale mainly required ranges from last 10 years to last 50+ years. Looking at the time horizon stakeholders asked projections for the next 10 or 20 and by 30 to 50 years. Only few asked for projection over 50 years.
The results of the first workshop were considered by the CET in order to provide adequate climate information at regional and local scale, and by the RET in the choice of receptors, impacts, temporal and spatial resolution to be used for the development of risk and adaptation products.
A second questionnaire was developed by the RET and proposed to stakeholders during the second workshop held in Trieste. The main aim of the questionnaire was to collect stakeholders' feedbacks about preliminary products presented during the workshop and to obtain some suggestions for their improvement. The proposed questions were focused on: testing areas for product's application; input data (i.e. receptors, vulnerability factors, dataset and timescale of the analysis); output data (i.e. typology of risk maps and statistics). Due to time constraints of the event the questionnaire was sent to all the participants after the workshop but only 5 out of 11 fulfilled it. Generally speaking the questionnaire highlighted an overall satisfaction about the study areas, receptors and input data used. However some suggestion were provided for what concern vulnerability factors and the layout of the products (see also D.8.2 for specific results).

The results of the questionnaire were considered by RET to improve the preliminary risk and adaptation products and to make them more suitable to answer stakeholders' needs.

2.4 Identification of user-needs: priority ranking

After the survey of climate data needs from stakeholders (questionnaire and workshops), it was necessary to define a priority list for the development of climate products.

After the identification of the 3 thematic areas of interest during the first workshop (i.e. hydro climatic regime, management of coastal and marine ecosystem and agriculture), key climate variables were defined by CET in table format (D8.3) replying to very specific user needs. Each table was composed of two major fields: stakeholders and researchers. The stakeholders' column highlights the major needs and interests emerged during the first workshop and questionnaire in relation to each selected theme; the researchers' columns provide preliminary answers of WP8 the CET concerning key climate variables and their spatial and temporal scales.

These tables are the result of interaction between CLIM-RUN scientists and experts, which was kept alive to fine tune stakeholders requests. In fact, some discussion was specifically needed to clarify what could be produced by the CLIM-RUN project to address stakeholders' needs. Three tables listing the possible climate parameters which would be useful to satisfy stakeholders' needs were produced synthesizing the first workshop results. Climate experts reacted to this identifying what climate information could be produced with respect to this. Then stakeholders were asked to finalize and validate this list of climate variables. Finally the list was passed to climate modellers.

Based on these tables, a priority ranking was performed by climate and risk experts who decided to focus their analysis on three key variables (i.e. extreme events, sea-level rise and drought) for the development of preliminary products. Accordingly, the following preliminary climate products were produced:

- Intense events projections and associated uncertainty;
- Surface temperature, precipitation, wind speed projections and associated uncertainty;
- Sea-level rise projections;

Moreover, after the second consultation with stakeholders (i.e. second workshop) and based on the results of the second questionnaire, another priority ranking was performed by CET and RET. The final products that were selected and completed are sea-level rise inundation and pluvial flood risk assessment (see information sheets in D1.3).

2.5 Functioning of the SET/CET/RET

During all the phases leading to the product development a continuous interaction process was organized between the three expert teams involved in the North Adriatic case study. Communication between Stakeholder Expert Team (SET), Climate Expert Team (CET) and Risk Expert Team (RET) was carried on by means of email, newsletters, phone discussions during each phase of the project and this allowed to keep all the experts constantly involved and to take maximum advantage of their expertise and suggestion in the products development.
Moreover, during the second project meeting held in Barcelona in 2011, a discussion between CET and RET was started in order to identify the appropriate hazard metrics and stressors to adopt in the risk assessment procedure. Specifically the discussion was focused on the identification of the most appropriate spatial and temporal resolution to adopt for the study of climate change impacts at the coastal/regional scale and on how to deal with the uncertainty of the projections provided by models for the Adriatic area.

3. The case study user need and products

Stakeholders' involvement and discussion allowed, since the preliminary phases of the process, to highlight which were the common users' needs for climate services in the North Adriatic area. Most of the stakeholders asked for climate information to describe sea-level rise, tides, and precipitation, especially when relative to those extreme events that cause flooding or other damages. Great importance was given to the extreme events issues. All the stakeholders, in fact, selected extreme climate/weather events (e.g., heavy rainfall, high temperature, heat waves, low temperature, drought, flood, hail) as the most important climate-related impact and specifically they required heavy rain forecasts as they are necessary for the development of effective early warning flood systems.
Most stakeholders highlighted that the climate change impacts should be taken into account in the urban planning and in the Integrated Coastal Zone Management by the development of policies, plans and programs. For this purpose detailed climate information at the regional/local scale with spatial resolution ranging from 50 km to 1 km are requested by majority of stakeholders.
Based on these common needs the priority ranking was performed and several climate products, including climate risk and adaptation services, were finalized for the North Adriatic case study.

For what concerns the basic climate parameters (i.e. precipitation, sea-level rise, air temperature) the participants to the meeting expressed a great interest for the climate products presented by climate experts.
The following discussion highlighted the difficulty of prediction of specific climate variables (i.e. sea-level rise, precipitation) due to the great quantity of components involved in the analysis and the consequent climate projections uncertainties. Moreover, for some relevant variables (precipitation) the numerical future climate simulations do not completely agree in the foreseen changes over the North Adriatic region. In fact, such results could suggest that the North Adriatic would lie in a 'transition' zone between those regions projected to become drier (i.e. the southern Mediterranean) and those projected to become wetter (Central-Northern Europe).
For this reason there is the need to developed flexible and adaptive policy and plans able to efficiently address climate variability and uncertainty considering different projected climate changes. Ultimately there is the need to design policy and plans to account for the range of values climate parameters might assume, e.g. the drier and the wetter precipitation conditions.
Climate risk and adaptation services proved to bridge the gap between climate impact science and coastal zone policy/planning in order to support decision making and climate proofing in a wide range of situations (e.g. shoreline planning, land use and water resource management, flood risk reduction, strategic environmental assessment). However, not all the stakeholders' starting needs were satisfied due to the lack of data and appropriate tools to perform the analysis (e.g. the product related to the assessment of water deficit for agricultural areas was not finalized). Some stakeholders also asked to concentrate the analysis to some specific hotspots of climate change risk already considered by the Civil Protection emergency plans (e.g. hospitals, strategic infrastructures, people).

Early stakeholders' involvement in the risk assessment process allowed to: 1) get the right questions - according to stakeholders' expertise and expectations - in terms of time scenarios, geographical scale and resolution, choice of receptors, vulnerability factors and thresholds; 2) develop products more tailored to the stakeholder information needs.
A limit in the development of risk products was due to data gaps (e.g. lack of detailed and homogeneous information about coastal artificial protection, LIDAR, DEM, presence and structure of urban drainage systems).
Accordingly, the products delivered to stakeholders by the risk experts' team should be considered as screening risk products that are useful as first-pass assessment of critical vulnerabilities. A more detailed analysis is required to respond to very specific needs of stakeholders (e.g. how to improve urban

drainage systems, when and where plan irrigations systems). Moreover, from the dialogue between risk experts and stakeholders, it emerged that it is necessary to go beyond the traditional impact by impact approach and to implement multi-risk assessment considering that the same area would be potentially affected by several climate-related hazards (i.e. drought, risk of flood, groundwater salinization).
Finally, a lesson learned from the case study is that there is a high level of uncertainty due both to unavoidable climate variability and to uncertain model projections and therefore it is necessary to develop adaptive policies and strategies to cope with future climate situations that can be very different for the same region (e.g. dry years followed by rainy years).

4. Moving toward Mediterranean-wide climate services

A strategy toward the establishment of a Mediterranean climate services network should employ an integrated approach including members from climate service users, researchers, developers, providers and those providing funds in the public and private sector.
To ensure an efficient use of climate information in the Mediterranean region it is desirable to set up common guidelines for the implementation of climate services, responding to a wide range of end users needs in different sectors (e.g. energy, tourism natural resources management, civil protection). Moreover, it is advisable to refer not only to basic climate information but also to climate impacts services, which provide information about expected impacts and risks on human and natural systems. An important role in this direction can be played by climate risk experts that facilitate the transfer of scientific-based information in terms of impact and risk information that can be easily understood also by no technicians (e.g. local and regional authorities, private stakeholders).
Finally, according to the strategy adopted in the North Adriatic case study, a comprehensive Mediterranean-wide climate services network should involve different institutions at different levels (i.e. from local to the European scale) in order to cover all the political, social and economic spheres involved in the climate change issue.

5. Concluding remarks

A key message from the WP8 integrated case study is that climate services should be considered not only as climate projections but also as projections on impacts that climate change could have on natural and natural and human coastal systems (e.g. beaches, wetlands, urban and agricultural areas, tourism, energy production). This is already assumed in the Italian case study where

climate risk and adaptation services were developed for the assessment of several climate change impacts (i.e. sea level rise, pluvial floods inundation risk). However, also in the Croatian case study stakeholders highlighted the need to know how climate change will affected renewable energy production, in particular from hydro, and consequently the need of a cost-benefits assessment of climate change impacts on energy sectors. For the tourism sector, the climate change issue has been included in the first ever Strategy of tourism in Croatia. This could be considered as an important achievement at the institutional level in the sector where otherwise the lack of interest or the lack of conviction on the need for climate change information is prevalent.

Generally speaking, the bottom up approach, applied in the development of climate services for the North Adriatic case study, resulted in a successful approach for the development of climate and risk services oriented to user needs. Moreover, for what concerns the Croatian case study, the cooperation with a large number of stakeholders allowed to create a wide network including different types of organization involved in the energy sector at the national and international level that will continue beyond the CLIM-RUN Project.

The involvement of stakeholders during each phase of products' development helped to build North Adriatic users capacity to use climate information and services. The knowledge acquired by the users helped them in increasing awareness about the need to start planning adaptation strategies for coastal zone management. Moreover, the activities carried out in the project, allowed to address the main requests made by stakeholders during the consultation, including the need to learn more about future climate scenarios, models and tools and about the level of uncertainty of climate projections and risk assessments' results. Despite the very high interest demonstrated in trainings from both the case studies, one of the major weaknesses, especially for what concerns the Croatian case study, remains the difficulty to get stakeholders constantly engaged. The rate of participation in workshops and training remained very low and this can be due to the fact that stakeholders were not convinced by the contents and the design of trainings and meetings. For this purpose, it will be crucial to find in the future new and more effective formats and tools to interact with stakeholders. One recommendation in this regard can be the development of targeted training sessions and seminars about climate products, risk and adaptation services tailored directly to different stakeholders preferences and needs. On the other hand, the lack of the stakeholders' interest or assertion for the need of climate change information could have been alleviated by an overall more persuasive approach.

Finally, as far as the Croatian case study is concerned, for the dissemination of climate information to renewable energy stakeholders, it was suggested to implement a public web portal where all climatic data should be accessible,

reliable and clear as far as possible also for stakeholders with a non-climate background. Last but not least, great effort has to be devoted to communicate climate and risk information in an understandable and usable manner. Stakeholders, in fact, asked for climate products that would enable them to make more stringent requests to the governance sphere: this would improve policy and decision making to best address climate change impacts.

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