Collaborative Project

CLIM-RUN

Climate Local Information in the Mediterranean region Responding to User Needs

WP 4 – Climate Services Pilot Case Studies
Task 4.2 Case Study Implementation

Synthesis of common messages report

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1. Introduction

The CLIM-RUN case studies focused on tourism (Savoie, Tunisia, Croatia, Cyprus – co-ordinated by WP5), wild fires (Greece – co-ordinated by WP6) and renewable energy (Morocco, Spain, Croatia, Cyprus – co-ordinated by WP7) as well as one cross-cutting case study (North Adriatic – co-ordinated by WP8). They have been essential in implementing and evaluating the bottom-up approach to the development of Mediterranean climate services pioneered in CLIM-RUN. WP4 has striven to provide overall co-ordination of these case studies through a common framework and methodological approach while at the same time allowing flexibility in the context of local and sectoral considerations. It is also the role of WP4 to draw out common messages from the case-study experiences to inform development of the CLIM-RUN protocol for climate services (see deliverable D1.1). These common messages are the focus of this deliverable D4.4.

One of the early achievements of WP4 was the identification of the five key CLIM-RUN stages:

- Stage setting
  - First stakeholder workshops (May-December 2011)
- Mapping the issues
  - Perception and data needs questionnaires
- Iterative consultation and collaboration
- Consolidation and collective review-assessment
  - Second stakeholders workshops (May-October 2013)
- Going forward: synthesis and recommendations
  - Final workshop and end of project (February 2014)

The two rounds of stakeholder workshops held in each of the case-study locations have played a major and critical role in CLIM-RUN. A synthesis of the first round workshops is provided in Deliverable D4.2 and of the second round workshops in Deliverable D4.3. These two documents provide important background material for producing D4.4.

While implementation of the local case studies has been time consuming, CLIM-RUN partners have all contributed to the evolution of the CLIM-RUN protocol for the development of Mediterranean climate services. Appendix 1 outlines the draft general structure of the CLIM-RUN protocol as agreed by CLIM-RUN partners attending the annual project (governing board) meeting in July 2013. The topics listed in Appendix 2 provide a basis for the common messages presented in Sections 2 to 4 of this deliverable.

Following the second round workshops, the case study WPs were asked to review and reflect on all stages of implementing the case studies, particularly addressing the CLIM-RUN protocol. Appendix 2 lists the questions and issues that partners were asked to consider in producing a set of cross-cutting conclusions deliverables (D5.4, D7.4 and D8.4). These cross-cutting deliverables assist in 'fleshing-out' the structure of the protocol and provide supporting evidence and examples including examples of good practice. The cross-cutting deliverables address the majority, but not all, of the protocol topics and are firmly based on the direct case-study experience. These cross-cutting conclusions deliverables have provided essential input to D4.4.

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In order to provide some preliminary context with respect to the case-study stakeholders, it is noted here that the availability and uptake of and capacity to use climate information was generally very low at the start of CLIM-RUN, particularly with respect to forecasts and projections. In the case of the renewable energy private sector stakeholders involved in the wind industry, for example, use of weather or climate information was typically limited to one or two years of weather data for individual sites. The major exception was the North Adriatic case study, where all stakeholders were quite familiar with climate information and services and already used climate/weather information in their activities.

Section 2 focuses on development of the CLIM-RUN protocol, particularly considering the identification and selection of stakeholders and communication with them. Section 3 considers the case-study user needs and products including the identification and translation of needs, and the production, assessment and refinement of products. Section 4 makes some recommendations for moving towards Mediterranean-wide climate services. Section 5 provides some concluding remarks particularly considering the main priority issues that should be addressed over the next five years or so.

2. Developing the CLIM-RUN Protocol

2.1. Introduction

A major challenge in implementing the CLIM-RUN case studies is that this was essentially a process of 'learning by doing'. Thus the methodological details had to be developed and amended as work progressed. This meant, for example, that while the key stages (see Section 1) were identified and some guidance on methods and tools for the involvement of stakeholders were produced by WP1 (see Deliverable 1.1) quite early on, the desire to hold the first stakeholder workshops relatively close to the start of the project, meant that there was little time for discussion and the overall objectives were not always as clear as they could have been to partners. Nonetheless, the case studies provided a valuable testing ground for some of the methods and tools proposed by WP1 and WP4.

2.2. Identification and selection of stakeholders

One of the main objectives of the first round workshops (see D4.2) was to identify the 'who' and the 'what', i.e., who are the stakeholders and what do they need from climate services?

The first step, however, was to identify and invite stakeholders to be involved. A number of different approaches were used to identify potential stakeholders. For the North Adriatic case study, the typological analysis approach proposed by WP1 (see D1.1) was used in which stakeholders were placed on a macro (national level) to micro (municipalities) continuum and then ranked using a score from 1 to 5 considering five specific attributes (i.e., importance, influence, effects, relevance and attitude) (see D7.4). A systematic ranking of stakeholders was also undertaken for the Savoie and Tunisia tourism case studies (see D5.4).

The value of undertaking this type of analysis or mapping was not recognised by all case-study partners at the outset but in general, appreciation of the utility of such a step increased over the

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course of the project. Prior to the second round workshops, for example, surveys of the energy and tourism sectors were undertaken in Cyprus in an attempt to improve on the very low stakeholder involvement in the first round workshops.

For many of the case-studies, existing contacts with stakeholders were an important starting point. WP7 also found expert opinion (i.e., seeking the advice of sectoral experts) and conference participation lists very useful (see D7.4).

It is concluded that, overall, stakeholder analysis or mapping is extremely useful, and should be considered as an essential step. Benefits include:

- Understanding of the range of organisations involved in the particular sector
- Easier to assess the representativeness of stakeholders involved in the project
- Assists in the identification of un-represented groups or interests
- Helps in understanding the decision-making context
- Helps in adjusting communication 'language' and strategies

However, this step was found to be quite time consuming and didn't help to identify the most appropriate communication mechanisms. For WP7, clustering stakeholders was somewhat unexpectedly found to be not very helpful due to the specific case-study context, i.e., the existence of international actors with stakes in several of the local case studies.

Some of the case-study teams found it useful to also categorise stakeholders according to their interest or level of involvement in the project. WP7, for example, identified primary and secondary groups of stakeholders – though warned against making these assignments too early in the relationship. D7.4 also discusses the advantages and disadvantages of focusing on the most influential and representative people or on key experts and/or 'champions'. In conclusion, it is considered better to focus, at least initially, on willingness rather than influence and importance when selecting stakeholders. Savoie tourism stakeholders were classified as: very interested in CLIM-RUN; interested; a bit interested; or, not interested.

2.3. Communication with stakeholders

Effective two-way communication between the CLIM-RUN partners lies at the heart of the bottom-up approach taken by CLIM-RUN. Although not explicitly framed as part of the CLIM-RUN methodology or protocol, three questions can be identified:

- 'Who' should lead the communication process?
- 'What' should be communicated?
- 'How' should it be communicated?

Members of the CLIM-RUN research team were allocated to the Climate Expert Team (CET) or the Stakeholder Expert Team (SET) – with specific experts named for each case study. The named SET experts (with the exception of some of the renewable energy case studies) were locally-based in the case-study locations and took the lead role in communication with stakeholders (as well as in their identification and selection – see Section 2.2). The role of these individuals was also to facilitate communication between the local stakeholders and the relevant CET member. The latter

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person in turn was responsible for wider communication with other CLIM-RUN experts on climate modelling and observations.

The 'what' depended on the particular stage of the project and the local context. In terms of background information and capacity building, it encompassed a range of issues, including:

- The aims and objectives of the CLIM-RUN project
- The benefits of participation
- What are climate services?
- What does climate services have to offer?
- The state-of-the-art in climate modelling, forecasting, prediction and projection
- What are the limits to climate information that can currently be provided?
- Uncertainty in forecasts, predictions and projections

While all these topics provided scope for discussion with stakeholders, the main focus for two-way communication with stakeholders related to:

- Identification of user needs (see Section 3.1)
- Assessment and refinement of products (see Section 3.4)

In order to facilitate the identification of user needs, WP4 developed a perception and user needs questionnaire (discussed in Section 3.1). The process of translating these needs into specific tailored products and the mechanisms for producing them are discussed in Sections 3.2 and 3.3 respectively.

During the course of the project, it was decided to present a number of these products in the form of two-page information sheets following a standard format with sections on: Relevance to the case-study requirements; Target groups; The approach; The product; and, Making the product usable. The process of writing, reviewing and assessing these information sheets was a more time consuming and complex task than originally envisaged and highlighted many of the key issues in successful communication. While these sheets could be further improved (and do not provide sufficient technical details for all users), they are considered to reflect the general principles for effective stakeholder communication identified by CLIM-RUN, i.e., communication should be:

- Precise
- Concise
- Clear about goals
- Clear about the benefits of the information communicated
- Clear about the limitations of the information communicated

In so far as the 'how' to communicate is concerned, CLIM-RUN used a number of different methods, all of which are considered to have a useful role:

- Email (particularly for inviting stakeholders to workshops and events)
- Telephone (for reminders about workshops and events, and setting up interviews)
- Newsletters (circulated electronically – including the general CLIM-RUN newsletter and tailored newsletters produced by WP7 for the renewable energy sector)

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- Project workshops (see D4.2 and D4.3)
- Presentations during sectoral conferences (see D7.4)
- Face-to-face interviews (held during sectoral conferences – see D7.4 – and at stakeholder organisations or other convenient local locations)
- Hard copy questionnaires (and in a few cases, electronic versions)
- Shared wiki (set up for the Savoie case study at the request of tourism stakeholders)
- Project web site (www.climrun.eu)
- Videos (e.g., Climate forecasting for renewable energy produced by IC3 and The uncertainties in climate change projections produced by CNRM – see www.climrun.eu)

While the majority of communication has occurred in English, local languages (including French, Italian, Croatian and Greek) were used for a number of the workshops and interviews.

In the final stages of CLIM-RUN, a number of partners are discussing the possibilities of disseminating information through stakeholder and other sectoral websites and distributing brochures through stakeholder organisations. Discussions are also being held with a number of national weather services.

Finally, it is noted that the duration of the relationship and the degree of trust established were considered to be very important in terms of building effective two-way communication. Another major conclusion was that the framing of the communication is more important than the communication method or tool. Thus an underlying understanding of the sector and its actors is essential. Nonetheless, there was a general consensus that improved visualisation methods should be explored and that there is a role for communication experts (as well as climate and stakeholder experts).

3. The case-study user needs and products

3.1. Introduction

As noted above (Section 2.2) one of the main objectives of the first round of stakeholder workshops was to identify the 'who' and the 'what', i.e., who are the stakeholders and what do they need from climate services? The CLIM-RUN perception and data needs questionnaire (shown in full in Appendix 3) was designed as a principal tool in eliciting this information.

The 'who' information was considered very relevant to the CLIM-RUN protocol (see D1.1) - informing the stakeholder and institutional analysis, and helping to categorise and characterise stakeholders. It was also seen as important for understanding the types of decisions for which climate information was requested and the policy, legal and risk frameworks in which these decisions are made. It was also intended to provide contextual and background information for the 'what' questions – so allowing checking of understanding and whether responses to more technical questions were consistent and meaningful. The first three sections of the questionnaire were intended to address the 'who' part:

- Your institution/organisation

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- Risk perception and current use of climate and weather information
- Your perspective on climate services

Subsequent sections of the questionnaire address the 'what' part:

- Data requirements
- Handling uncertainties

An overview of how the questionnaire was used in practice and a first assessment of its utility is provided in Section 4 of D4.2, while the cross-cutting conclusions documents (see Section 1) provide a more recent and detailed assessment by the case-study partners. Here, the key messages are summarised:

- The information sought through the questionnaire was desirable for project partners (both climate and stakeholder experts) to have and all the questions are considered to have potential utility
- However, the optimal method(s) for seeking the information from stakeholders requires great care and thought
- Using the questions as the basis for semi-structured interviews is generally seen as the optimal method though is very time consuming compared with paper or online surveys (and involves going to the stakeholders, e.g. to their office or sectoral conferences)
- Ideally interviews should be conducted by two people – a sectoral/stakeholder expert (ideally somebody who the stakeholder already knows and trusts) and a climate expert
- It should not be assumed that users know their needs *a priori* – or at least that they can express them in a technical way (e.g., as lain out in the Data requirements section of the CLIM-RUN questionnaire – see Appendix 3)
- Even if stakeholders know that they are vulnerable to climate change and variability, it can be difficult for them to specify their needs without some awareness or knowledge of climate science – or there is a danger of being unrealistic in their requests
- The questionnaire was designed to be used flexibly (although some partners found it cumbersome and inflexible) – but this made it impossible to undertake quantitative and comparative analyses particularly across case studies
- Pilot surveys should have been undertaken and the involvement of survey experts would have helped with issues such as getting the length and level of technicality right as well as avoiding questions which are potentially open to misinterpretation. These issues are particularly important to get right when questionnaires are required to be filled in remotely (either as hard copy or online) by stakeholders

The information obtained from the questionnaires, stakeholder interviews and discussions during the first round workshops is presented in the case-study workshop reports and synthesised in D4.2.

According to D4.2, the most common requests were for temperature and precipitation and indices calculated from these variables, together with other meteorological variables such as wind (speed, direction and 'consistency'), snow, humidity and cloud cover. Radiation (in particular, DNI – direct normal irradiance) was identified as important for the renewable energy (solar – PV and CSP) sector. Extremes of temperature, rainfall and wind were also requested for all case studies, though the particular indices or types of extreme were not always specified in detail. For the coastal

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tourism case studies of Tunisia and Croatia, information about sea bathing water temperature was requested, and for the Tunisian and Venice case studies, information about sea level rise, storm surge and wave heights. Information about local winds (Bora and Scirocco) was requested for Croatia (tourism and energy) and there was an interest in dust storms for the renewable energy case studies and the Tunisian tourism case study. The tourism case studies expressed an interest in biometeorological comfort indices (based on temperature and/or humidity), as did some of the renewable energy case studies (in the context of electricity demand for cooling). In general, the requests and needs related to climate information, rather than to wider environmental or socio-economic data (though the importance of non-climate issues in decision making was raised in all first round workshops). This may, however, reflect the general 'steer' given by the workshops and questionnaires. One exception is the Veneto case study which worked with a risk-based decision support system for coastal impact assessment from the beginning.

3.2. Translation of needs

The next step was to 'translate' the expressed user needs into specific products, information and tools. In particular to allow:

- Production of new examples of products and outputs (maps, figures, datasets etc)
- Identification of key data/output gaps and strategies for tackling them
- Identification of priorities
- Identification of requests which were 'out of scope' of CLIM-RUN or impossible to meet
- Definition of new modelling tools required

The process was led by the CET members assigned to each case study in consultation with the climate modelling partners (WP2) and experts in climate observations (WP3) and with the relevant SET member. Initially a summary of user needs and how these could be met was produced for each case study. These documents took a number of different formats, in part reflecting the different issues and level of technical detail that emerged from each case study. An example, for the Croatian tourism study, is provided in Figure 8 of D5.4. Regardless of how the information was recorded, for each specified product, the underlying data set (e.g., ENSEMBLES RCM output, E-OBS gridded data), variables (e.g., temperature, precipitation, wind, radiation) or indices (e.g., extremes, Tourism Comfort Index, Fire Weather Index) and climate group responsible were identified.

In terms of the geographical location of information, the majority of requests were for the local case study. However, the spatial focus of renewable energy stakeholders was on four levels: the Mediterranean as a whole, the case-study level (i.e., Morocco, Spain, Cyprus and Croatia); geographical regions within the case studies; and, specific renewable energy production sites (see Figure 4 in D7.4). Some of the tourism stakeholders, for example in Cyprus, requested information about climate change in the 'source' regions of tourists as well as in potential rival destination regions.

CET members were asked to define each particular request according to the following categories:

0 – not possible to provide
1 – already available
2 – easy to provide

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3 – able to provide, but with a lot of work

This categorisation was seen as important for subsequent communication with stakeholders. Rather than apparently ignoring an 'impossible' or 'too difficult' request, it was considered important to provide feedback to stakeholders as to why particular requests could not be met at least within the limited scope and timeframe of the CLIM-RUN project. However, in practice, this reporting back did not happen in all case studies.

For operational climate services, it would be preferable to use a more standardized and transparent system for managing and recording this translation process. All information should be held centrally, with a clearly identified system for monitoring progress and ensuring reporting back to users.

From the CLIM-RUN case-study experience, user needs can be very complex and/or specific, but equally requests may be weakly defined or at other times too ambitious. The process of asking about user needs inevitably raises users' expectations thus it is important to be honest and open in communicating what can be provided and when. The latter is, however, more difficult to specify when a new or experimental product is being developed.

Throughout the process it is important to prioritise. In CLIM-RUN users were asked to categorise their needs as essential, desirable or nice to have. From the providers' perspective, the process of prioritising needs was perhaps rather too ad hoc. WP4 did suggest some possible criteria for defining priorities at the project level (considering the requests from all the case studies):

- greatest number of requests/potential users
- greatest 'shortage' of information
- things currently not provided at all
- things currently provided but with very limited reliability
- where climate experts think there is greatest chance of 'improvement'
- advancement of the 'science'
- things that can be 'operationalised'

These criteria are clearly somewhat conflicting and in the end a more pragmatic approach was taken with the main aim being to ensure that at least one product would be available for each of the case studies by the time of the second round workshops. For the renewable energy case study, a deliberate decision was made to focus primarily on wind during the second round of industry events (for the reasons outlined in D4.3 and D7.4). Thus the CLIM-RUN strategy was to be representative rather than comprehensive in meeting needs.

While the focus was primarily on the case-study level, some attempt was also made to identify common needs or requests that could be combined. For a number of the tourism case studies, for example, information was produced on sea surface temperature by the same climate team. Most of the tourism case studies were also interested in Tourism Comfort Indices. These were produced for a number of the case studies, but generally using slightly different methods in each case. For Tunisia, the index was locally tailored based on a survey of local tourists.

Another area where it was decided to consolidate needs was with respect to extreme events. Although the stakeholders' comments from the first round workshops ranged from a general

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interest in extremes to clear and specific requests, there was also considerable overlap in the requirements from many groups. As a result a common set of indices was identified, based primarily on the requirements of the stakeholders but also on the body of research concerned with the development of indices of extremes based on daily temperature and precipitation data. The definitions were based on indices developed by the ETCCDI (http://etccdi.pacificclimate.org/) and STARDEX (http://www.cru.uea.ac.uk/cru/research/stardex/) projects. The indices were split into a core set (of most interest to stakeholders) and a supplementary set of indices (of additional importance to the climate experts for model evaluation). Further details of the indices and the analyses of extremes undertaken are provided in the Milestone 12 report and D3.7.

Some new modelling was undertaken in order to meet specific user needs, for example, innovative work on lake modelling for the Savoie tourism case study. Nonetheless there are examples from all case studies where needs could not be met or where more detailed information is still required. These examples include: sea bathing water temperature and quality, very high mountain conditions, alpine lakes and rivers, dust storms, storm surges and jelly fish blooms. Over the course of the project there was a growing demand for economic information and assessments which could not be met within the limited resources allocated to this type of work within the project. D4.5 does, however, provide three worked examples of the potential for providing such information – for tourism flows to the Mediterranean, the cost of wildfires in Greece and Spain, and changes in heating and cooling demand.

The major constraints in terms of meeting needs were both scientific and logistical:

- Availability of appropriate simulated and observed data (particularly in terms of variables and spatial resolution)
- Lack of or low predictability (particularly in the context of seasonal forecasting)
- Human resources
- Time
- The need to identify priorities

3.3. Producing products

Following the first round workshops, it was agreed that the first examples of products and outputs should be presented in the form of two-page briefing notes or information sheets following a standard format with sections on: Relevance to the case-study requirements; The approach; Product example; and, Making the product usable.

The information sheets were intended to be accessible, understandable and relevant for the decision-making process, and to provide meaning to the underlying data. Thus the different sections were aimed at addressing the following questions:

- What is the target group?
- What problem is it for?
- What is the underlying approach?
- How reliable are the results?

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The intention was that the climate input should be provided by the WP2 (climate modelling) and WP3 (observed climate) partners, and that the information sheets should be reviewed at the case-study level by the relevant SET members and stakeholders, before being submitted to a five-member project-wide review panel. In practice, the case-study review did not always happen (at least in terms of the written information sheet), though a number of the draft information sheets did provide the basis for discussion at many of the second round workshops. This discussion and feedback process is discussed in Section 3.4.

Producing these information sheets required considerable effort and expertise beyond the scientific production of the underlying data. While most of them were written by the climate experts providing the input data, perhaps the most successful or accessible ones, are those written by stakeholder experts or jointly by stakeholder and climate experts.

CLIM-RUN was more concerned to produce demonstration products and to understand the process of production rather than to produce operational products. Thus the information sheets include the following 'disclaimer': *This information sheet was developed in the framework of the CLIM-RUN FP7 EU project. The product it describes should not be used without acknowledging the project and, particularly for any operational use, interaction with the authors is welcome and strongly encouraged.* Nonetheless, a number of the products move towards operational ones and at least two can be considered as operational: the short-term fire risk forecast for Greece (see http://cirrus.meteo.noa.gr/forecast/bolam/index.htm) and the Croatian wind atlas (see http://meteo.hr).

The information sheets that have been accepted by the review panel are being published on the CLIM-RUN case-studies web portal. They were originally intended as the principal, but not the only way of presenting CLIM-RUN products. Thus it was envisioned that they would be supported by more material on the CLIM-RUN portal whilst being 'free-standing' for those who don't want or need lots of technical details and data. In practice, it has been difficult to make the supporting data and information available due to time constraints and because the necessary infrastructure (the CLIM-RUN case study and data portals) only became available in the closing stages of the project. Nonetheless, some examples are being made available including Google Earth and fixed image maps and figures on temperature and rainfall extremes for the Mediterranean as a whole and selected case studies (Greece, Cyprus and North Adriatic).

In order to give an indication of the range of issues covered by the information sheets, the titles of those initially accepted for publication by the review panel are listed here:

- Advanced wind resource risk management: wind speed forecasting over seasonal time scales
- Advanced wind resource risk management: wind speed long-term scenarios
- Advanced resource risk management: solar radiation long-term scenarios
- Decadal prediction for SST near the Tunisian coast
- Sea level rise issues
- Seasonal predictability of heavy precipitation events using the CMCC-SPS system
- Educational software for Fire Weather Index
- Future fire risk in Greece and its sub-regions
- Short-term fire risk forecast for Greece
- Thermal component of climate potential for tourism in Croatia

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- The Tourism Climate Comfort Index in Tunisia
- Projections of precipitation climate change for hydro energy in Croatia
- Applications of the UC portal for wild fire and tourism studies
- Croatia Climate Index
- Wind Atlas Croatia

3.4. Assessing and refining products

A key objective of the second round of stakeholder workshops and events (see D4.3) was to present and obtain feedback on CLIM-RUN products. WP4 outlined the particular feedback that was sought:

- Is the information clearly presented – in language that is meaningful and understandable for you?
- Could the presentation/description be improved?
    - If so, how?
- Is the information relevant (and useful and/or usable) for you?
    - If so, how might you use it?
    - If not, why not?
- What additional information would you like?

For most workshops, the feedback was obtained through general discussion with stakeholders following presentations on the products. More structured approaches were used in some cases. A set of ten guiding questions was used in face-to-face interviews with renewable energy stakeholders. A short product feedback questionnaire was sent to the Athens wild fire workshop attendees and a longer questionnaire on the DEYSCO risk assessment tool was circulated to attendees of the Trieste workshop on the Veneto case study. All three documents are provided in the Appendix of D4.3 with further details provided in Section 4 of that deliverable.

In general, the two-page information sheets were welcomed by stakeholders as a useful way of presenting information in an accessible way and demonstrating the types of information that climate services can provide. However, stakeholders also suggested a number of ways in which the information content and/or its presentation could be improved in order to enhance accessibility and usability. Comments encompassed a number of different aspects including:

- The clarity and understandability of figures and maps, including comments on units and axis labelling
- The desirability of having information at higher spatial resolution
- The need for better guidance on the robustness of the information for decision making, including discussion of uncertainties and model calibration and validation
- Missing information – including additional variables and more impacts focused information

The specific feedback obtained on each information sheet is reported in the relevant individual workshop report and some of the main comments are summarised in Section 5 of D4.3. From the case-study perspective some additional general comments and issues emerge:

- It is important to use the right level of information and language

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- The format in which information is presented is crucial
- Predominantly visual information is preferred, with not too much text
- Experts in communication and visualisation are required to devise simpler ways to visualise complex information (whilst not avoiding the uncertainty issue)
- Different people react differently to maps and histograms, but in general people do not like having too many maps
- Choice of units, scales and colour schemes are all important – and getting this right takes time

A number of general comments and issues have also emerged from the perspective of the CLIM-RUN information sheet review panel (on which WP4 was represented by Clare Goodess):

- It is difficult to break away from the process and mind set of producing scientific papers where the focus is on producing figures and writing the methodological description, i.e., on technical detail and processes
- It is harder for climate experts to provide interpretation in terms that are most relevant for stakeholders, i.e., what do the figures show and why/how is this information meaningful, relevant and useful for decision making? Particularly where uncertainty is high or reliability/predictability is low, what usable information content is there?
- It was ambitious to attempt to provide all this in two pages and it is often more challenging to produce short documents than longer ones.
- The whole process of writing and reviewing these information sheets was more time consuming than envisaged. Ideally it should be an iterative process with plenty of time for discussion between all those involved (climate and stakeholder experts and stakeholders) and for multiple revisions.
- Greater attention should have been paid to ensuring rigorous and defensible scientific standards particularly with respect to the treatment of uncertainty and the use of multi-model ensembles. WP2 recommended that the latter should always be used (e.g., in the case of longer-term climate change projections the RCM ensembles produced by ENSEMBLES, CIRCE or MED-CORDEX) unless a new methodology or specialised model (e.g., the lake model used in the Savoie case study) was being demonstrated.
- It is important to consider the overall consistency of information and messages across all products.

4. Moving towards Mediterranean-wide climate services

The case studies have been central to CLIM-RUN and as illustrated in previous sections have provided the opportunity for hands-on learning about what works in the context of the development of climate services, what doesn't work so well and what could be improved. There are clearly some common messages identified in the previous sections particularly with respect to the interface between climate service providers (both climate and stakeholder experts) and stakeholders. How relevant are these messages and experiences in the wider context of the Global Framework for Climate Services (GFCS) and in moving towards Mediterranean-wide climate services?

It could be argued that a fixed-term research project such as CLIM-RUN is not an appropriate model for operational climate services. In particular, there may be a concern that the non-

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operational setup of CLIM-RUN with partners going out to seek stakeholders and potential users was somewhat artificial. However, the CLIM-RUN experience strongly indicates that it is very important to be proactive in identifying and engaging with users and potential users. Even for those case study stakeholders who were already aware of their sensitivity and vulnerability to climate variability and change, with the exception of the Veneto case study, there was generally less awareness of climate forecasts, predictions and projections and how these might be used in decision making processes. In some cases, stakeholders did not consider themselves vulnerable to climate variability and change and engagement was particularly difficult.

Identifying the barriers to engagement is a necessary first step before developing strategies to overcome them. Within CLIM-RUN, the tourism and renewable energy case studies in particular faced a number of barriers which are discussed in the relevant cross-cutting conclusion reports (D5.4 and D7.4 respectively) and summarised here:

- The value of climate services (or participation in the project) is not perceived
- Dominance of political and economic events
- A link between climate change and variability and impacts is not perceived because of the complexity of these links
- Dominance of SMEs in the sector
- Low innovation within the sector
- Climate is dwarfed by political, regulatory, technological and market issues and risks
- Stakeholders are already involved in other projects (and go where the rewards are greatest)
- Language challenges and understanding (level of technicality)
- Talking to the right organisation but the wrong person within the organisation
- Perceived lack of skill of forecasts, predictions and projections

Since the current use of weather and climate information is generally very limited in many sectors across the Mediterranean, there is clearly a need to introduce Mediterranean stakeholders to the concept of climate services rather than to just ask ‘what do you want from them?’. The so-called ‘unfamiliarity gap’ (see discussion in D7.4) is a major challenge in increasing awareness of the potential of climate services. Examples are needed of information actually being used for making specific decisions in order to demonstrate the benefits of climate services to organisations. Thus it is important to understand which parts of the decision making process can be influenced by climate information (see D5.4 and D7.4 for some examples). Understanding timescale dependencies is also important. Weather and seasonal forecasts are more relevant for operational decision making, while decadal predictions and climate change projections are more important for strategic planning. Demonstrating the potential economic advantages of using climate services is also desirable though methodologically difficult particularly in the case of longer-term climate change projections (see D4.5).

To be successful, climate services need to be ‘taken to the people’. The processes of identifying, analysing and mapping stakeholders such as used in CLIM-RUN (see Section 2.2) should help to attain a balanced portfolio of users and sectors or at least to identify gaps in the user community. Thus it should be possible to obtain a wider picture of needs rather than just focusing on those who are already engaged or who ‘shout loudest’.

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One clear message from the CLIM-RUN case studies is that engagement works best at the sectoral level and this is where the focus of the climate expert/stakeholder interface should be. Thus the stakeholder experts involved in the interface tier should have expertise of the specific sector. Working at the sectoral level should also facilitate the development of more sustainable relationships and wider uptake of climate services within the sector by taking advantage of stakeholder focal points or champions within organisations and eventually embedding climate change into industry strategies. The sectoral level also offers possibilities for wider dissemination of climate services and products both at the national and regional level. In CLIM-RUN, for example, a brochure on tourism comfort indices, produced in collaboration with the national meteorological service, is being distributed through national tourism agencies. Linkages established between WP7 and the Advancing Renewable Energy with Climate Services (ARECS) initiative have provided the basis for ongoing work aimed ultimately at developing an operational climate service focused on seasonal to decadal wind and solar forecasts for the renewable energy sector.

CLIM-RUN has also demonstrated the value of collaborative working between climate and stakeholder experts, in particular through the CET and SET. The process of identifying, translating and meeting user needs worked best when people had clearly defined roles appropriate to their particular expertise and was less successful when people had multiple roles (such as trying to fulfil the function of both climate and stakeholder expert). Communication with stakeholders was generally most effective when led by the stakeholder experts (i.e., those involved in the interface tier) rather than the climate experts. Communication would however be improved by the involvement of experts in communication, visualisation and participatory methods, together with social scientists particularly those expert in decision making. At the same time, it is considered important to provide opportunities for direct dialogue between climate experts and stakeholders, for example in workshops and interviews. This should happen at various stages of the iterative process of identifying user needs, and developing and reviewing/revising products. The climate experts also have an important role to play in explaining and discussing the current capabilities of climate science, particularly in the context of uncertainty and how the nature of uncertainty/model reliability varies from seasonal forecasting to decadal prediction to climate projection timescales.

Whilst CLIM-RUN has emphasised the importance of a bottom-up approach and of working with individual stakeholders, it is acknowledged that this is very time consuming. Within an operational climate service it will not be possible to engage directly at length with all individual users. Thus while the optimal method for using the CLIM-RUN questionnaire is considered to be in face-to-face interviews (see Section 3.1), it is recognised that at times hard-copy or online questionnaires and surveys will be needed. Regardless of the implementation method, social scientists have a role to play in the processes of questionnaire/survey design, evaluation and analysis.

CLIM-RUN followed a network production process which is considered to provide an appropriate model for operational climate services. While the climate expert allocated to each case study had the main responsibility for translating user needs (see Section 3.2), they were able to draw on the wider expertise of the project partners when it came to developing and providing individual products. In this context, the register of climate modelling skills (of partners and individuals) developed by WP2 was very useful. The production process worked best when the right climate expert could be brought in. As well as producing specialised products, this facilitated the transfer of know-how and capacity building across the teams. National meteorological services also had an important role to play in the network production process for a number of the case studies.

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Another relevant key message emerging from the CLIM-RUN case studies is the need for training and capacity building for all actors involved, i.e., climate experts, stakeholder experts and others involved in the interface tier, and stakeholders and users. The need for training is discussed further in the CLIM-RUN protocol (see deliverable D1.1). Here, we note that a very high interest in training was expressed by renewable energy stakeholders involved in CLIM-RUN and WP7 has, for example, proposed the idea of a climate service academy where tailored training and seminars are offered for such stakeholders (see D7.4, Section 4.2).

The importance of developing trust in the stakeholder relationship was stressed by many of the CLIM-RUN case studies. This raises the potentially sensitive issue of the need for standards and accreditation which is discussed further in the CLIM-RUN protocol (see D1.1). In this context, we note the issues relating to the treatment of uncertainty and the use of multi-model ensembles associated with the CLIM-RUN information sheets (see Section 3.4). Other relevant issues concern the extent to which users' expressed needs for very high spatial resolution information can be met and the onus on providers to accurately and responsibly indicate the true spatial scale of information. The use of automated mapping and contouring packages may, for example, inadvertently give the impression of higher spatial resolution than is justified by the underlying data. Similarly, care is needed when interpolating data to higher spatial resolutions.

One other issue that needs to be considered in developing Mediterranean climate services is the extent to which these services should focus primarily on the delivery of climate information itself or whether climate services should be defined more broadly to include impacts and adaptation information. A key message from the WP8 integrated case study on coastal risk management is that climate services should also include projections on impacts of climate change on natural and human coastal systems (e.g., beaches, wetlands, urban and agricultural areas) (see D8.4). The inclusion of risk management experts within this particular case-study team and the use of the DEYSCO decision making tool facilitated the consideration of impacts (e.g., sea level rise inundation risk maps and pluvial flood inundation risk maps in urban areas were shown to stakeholders during the final workshop). The case-study team considered that this more integrated approach together with the emphasis on risk very much helped to 'bridge the gap' between the climate science and users. An assessment of the vulnerability of the Mediterranean and specific target locations (focusing on Greece) to fire risk occurrence within the context of climate change, together with possible adaptation measures, was undertaken by WP6 (see D6.4).

In addition, CLIM-RUN developed a number of impact relevant indices – notably various tourism comfort indices (including physiologically equivalent temperature (PET)) and the Fire Weather Index (FWI). The statistical downscaling portal developed by the University of Cantabria was used to explore the potential for directly downscaling PET and FWI rather than having to downscale the individual climate input variables (see D3.5). The common set of indices of extremes (see Section 3.2) was chosen considering, in part, the impacts relevance of potential indices. The selected set included, for example, cooling and heating degree days from which were calculated cooling/heating load and load ratio. This information was used as input to the analysis of projected changes in energy demand for heating and cooling (see D4.5). The impacts application was also an important consideration in translating user needs into specific climate variables and products. For wind energy, for example, it is more useful to have wind speed at 100 m rather than at the usual 10 m, and for winter tourism, snow cover and depth are more useful than snowfall.

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Since the scope of CLIM-RUN, including the range of partner expertise, was limited by the available resources and the fixed-term nature of the project, it was important to outline this scope to stakeholders from the outset. This did not preclude discussion of impacts related issues. At times, however, it was hard to define the boundary between 'climate' and 'impacts' issues.

Finally, the importance of overall co-ordination and management is stressed, encompassing:

- Clear objectives and scope
- Methodologies for selecting and engaging stakeholders
- Communication channels
- Planning and implementation of the engagement and production process
- Transparency at all stages of the engagement and production process
- Development of common toolkits and infrastructure (e.g., web portals)

Given the necessity to ensure that, having raised them, stakeholder expectations are, so far as possible, met, it is also important to have in place a management system to ensure monitoring, checking and chasing up of the whole production process. Wherever possible, deadlines notified to users need to be met and the whole process should move forward dynamically.

5. Summary and concluding remarks

This deliverable provides an overall synthesis of the common messages emerging from the various CLIM-RUN case studies, focusing on issues that feed into the CLIM-RUN protocol for the development of Mediterranean climate services (see D1.1) particularly relating to engagement with stakeholders (Section 2). The processes of identifying and translating user needs and subsequently producing, assessing and refining climate products have also been assessed (Section 3). Finally, common messages relevant to the development of sustainable and operational Mediterranean climate services have been identified (Section 4).

The project timeline has meant that implementation of the case studies has required 'learning by doing' and the CLIM-RUN protocol has been continually evolving rather than being available at the start of the project. Because of this, the final stages of the project have provided a valuable opportunity for reflection and for identifying what has been learnt and what we would do differently next time.

The common messages have emerged despite the recognition that every case study and every stakeholder and user or potential user is different. These differences are reflected in the cross-cutting conclusions documents produced by the case-study teams (see D5.4, D7.4 and D8.4) which along with the various workshop reports have provided the basis for the common messages identified here. Some of the common messages presented in the earlier sections and below may seem rather obvious but they are based on the real-world experiences of the CLIM-RUN case studies and, for example, direct contacts with around 160 stakeholders during the second round workshops.

Overall, the bottom-up, stakeholder-focused approach adopted by CLIM-RUN is considered to have been successful and some element of this type of engagement is essential if climate services

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are to deliver useful and usable information for decision making. At the same time, it is recognised that within the context of operational climate services it is not practical to engage in depth with every individual user. And while users and user needs (together with an understanding of their decision making context) should be central, there is a necessity to ensure that climate products and information provided by climate services are scientifically robust, defensible and credible. Thus effective climate services need to achieve an appropriate balance between a bottom-up user led approach and a top-down climate science led approach.

In terms of developing products, CLIM-RUN has benefitted from the work of previous national, European and international research projects, programmes and initiatives focused on both climate modelling and the development of observational datasets. Many of the products on climate change projection timescales are, for example, based on ENSEMBLES RCM simulations. Some preliminary work has also been done using the emerging high-resolution MED-CORDEX simulations and these will provide the basis for much future work on Mediterranean climate services.

Perhaps the overarching message emerging from the CLIM-RUN case studies is the importance of communication between the various actors that are considered essential for effective climate services. This encompasses communication within the project team – between the climate and stakeholder/sectoral experts as well as external communication with case study stakeholders. Successful interaction requires transparency, feedback, targeted and two-way communication, with plenty of time for discussion. The development of product information sheets within CLIM-RUN, for example, would have benefitted from more discussion and communication – including discussion between the climate experts themselves on how to present and interpret information and appropriate standards and methods for using multi-model ensembles and presenting uncertainty.

The starting point was different for each case study, for example, in terms of stakeholder knowledge and understanding of their sensitivity to climate variability and change, their current use of weather and climate information, and their understanding of climate science. Each sector is diverse and complex, thus it is considered essential to involve sectoral experts in the interface tier. One thing that is hard to gauge is the extent to which involvement with CLIM-RUN changed the perception of stakeholders towards climate change and/or climate services. A number of stakeholders did however stay engaged throughout the project, and have expressed interest in continuing engagement. They provided valuable feedback on the products developed within CLIM-RUN, generally considering them useful. However, it is difficult to identify examples of these products actually being used as part of the decision making process (though this may be a matter of time). Demonstrating the value of climate services through such practical examples of usability is considered important both by CLIM-RUN partners and the stakeholders with whom they engaged. Such examples will be particularly valuable for future training and capacity building activities which are also seen as vital by all those involved in the CLIM-RUN case studies.

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Appendix 1: Draft general structure of the CLIM-RUN protocol

- ✓ Overall process – the methodological key stages
  - The business model (three tiers) for climate services
    - Climate tier
    - Intermediary (e.g.,SME) tier
    - Stakeholder tier
  - Life cycle of Climate Services
  - List of existing skills (data, model tools) and networks
  - Need for coordination at national and European level. Climate Services beyond the local Meteorological Services
- ✓ Identification and selection of stakeholders
- ✓ Communication with stakeholders
  - Involvement of social science & impact experts
  - Expectations and risks
- ✓ Identification of user needs
  - Priority ranking
- ✓ Translation of needs
  - Defining new research developments to answer the needs
  - Defining products
  - Defining impacts transfer functions
- ✓ Producing products
- ✓ Assessing and refining products
  - Feedbacks from stakeholder's and intermediary levels to government /funding agencies to develop new products and research
- ✓ Methodologies for evaluating the economic value of Climate Services
  - Cost/benefit ratios and analysis

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- Quality control and Certification?

✓ Beyond CLIM-RUN: the lessons learnt

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Appendix 2: Self-reflective questions addressed in preparing the case-study cross-cutting conclusions and to be addressed in the CLIM-RUN protocol

These are the specific CLIM-RUN 'tools' and 'methods' that should be reviewed and for which specific examples of good practice should be provided:

- Stakeholder mapping etc. (e.g., see D1.1)
    - What kind of methods and tools have you used to identify and select stakeholders? Have these methods and tools allowed you to reach a representative team of stakeholders?
    - What kind of methods and tools have you used to communicate with stakeholders? Have you used different methods and tools depending on the different stakeholder types? Has the preliminary stakeholder analysis (specific climate risks, degree of knowledge and awareness, decision-making process of stakeholders) helped you to define communication strategies? Have these methods and tools evolved during the process of interaction? Are there some good practices that have emerged from the interaction process?
- Perception questionnaire
    - Please review both the questions themselves and the process of implementing the questionnaire
- Functioning of the CET/SET
    - Can you describe the interaction process between Stakeholders – WP case study team – and WP2-3 (climate scientists) that has permitted definition of the products to be developed? Has the demand been expressed spontaneously? Did the ClimRun questionnaire for stakeholder consultation help in expressing this demand? Did the preliminary stakeholder analysis help you to facilitate the expression of needs? Were there difficulties in understanding the demand, (for example in translating the demand in to the language of climatologists, or vice-versa; or to communicate the limits of research and of what can be delivered or not)?
- Workshops (e.g., see D4.2)
    - As well as considering the two workshops, consider the process of interaction between the two workshops. Have some stakeholders left the process? If so, why? Are there any examples of good practice to keep them engaged in the process?
- Product information sheets

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- Were the delivered products sufficiently/appropriately adapted to the stakeholder needs? Why? Were there data and/or research constraints in developing the products (and/or in the choice of the products to be developed)?

For each of the 'tools and methods' here are some generic questions to help you think about the issues, in addition to the more specific questions above:

- Which 'tools'/'methods' did we say we would use?
  - Which did we actually use? Why?
  - Which didn't we use? Why?
- Are there others that we could/should have used?
- For those that we did use:
  - Which worked well? And why?
  - Which didn't work so well? And why?
  - How could both groups of 'tools'/'methods' be improved?

Finally, we made a number of assumptions in developing our methodological approach (e.g., it was assumed that understanding 'who' the stakeholders are would help in understanding 'what' they wanted). Please try to identify any specific assumptions which were made for your case studies/sector and comment on the extent to which they were borne out (or not) in practice.
While this Appendix provides an extensive list of questions and issues to be addressed, feel free to structure the content of this section as you feel most appropriate. Do not worry if it is not possible to address all these issues in the deliverable. Please remember that specific examples of good practice are particularly welcome.

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Appendix 3: The CLIM-RUN perception questionnaire

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Background

The CLIM-RUN perception and data needs questionnaire(s): rationale and background

- Aims to provide the 'who' information for WP1 (see draft document on protocol development methodology, Section 2 – stakeholder and institutional analysis), i.e., basic information for (i) identification and classification and preliminary information for (ii) categorizing and (iii) characteristics. From the questionnaires and more generic literature review, an institutional analysis can be constructed for each sector and case study.

- Aims to provide the 'what' information for WP2 and WP3, i.e., what data and related information do stakeholders need?

- Links with 'Mapping the issues' CLIM-RUN key stage (May-September 2011)

- Provides contextual/background information for the 'what' questions – and so allows checking of understanding and whether responses to more technical questions are consistent.

- It is aimed at the institutional/organisational level rather than at the individual stakeholder, but this does not preclude it being used in interviews with individual stakeholders.

- Can be self-completed by stakeholders or used by researchers as part of structured (possibly more detailed) interviews. Data requirements section could also be completed by researchers on behalf of stakeholders following iterative discussion and interaction.

- Parts can be completed at different times (and/or in different ways – see above). E.g., first parts could be sent out prior to first workshops to get people thinking and to provide a starting point for workshop discussions. Other parts could be completed during or after the first workshop, with further help/guidance from researchers if needed. Part numbers have been removed to increase flexibility – some groups may prefer institutional information to be collected last.

- Comments in margin indicate where case-study teams need to provide tailored text.

- The data requirements part currently has common questions on scale etc. for all variables. You may wish to tailor this to ask separately about scales for each variable or group of variables.

- The uncertainty part ideally needs updating. Although I don't think this will be completed by respondents before they have attended a workshop, it needs examples adding (perhaps a 1 page briefing note?) and generally more work/thought.

- The glossary (terms included and definitions) needs to be agreed by all relevant teams.

- Various parts of the questionnaire have been piloted in WP7 and WP5 workshops.

Clare Goodess
29 July 2011

Your institution/organisation

This information will be used only by the CLIM-RUN research team and only for project purposes. Individual respondents will not be identifiable in any synthesis reports/analyses made available outside the CLIM-RUN consortium of researchers and stakeholders.

1. Name of your institution:

2. Your job title:

3. Type of institution/organization (please tick one)

Public agency/body	
Private company	
University or research organisation	
Professional/trade association/group (farmers, industrial, etc..)	
NGO	
Other (please specify	

4. What is the level of operation of the institution/organisation? (please tick one)

International/transnational	
National	
Regional	
Local	
Other	

5. What is the <u>main</u> sector of interest of your institution/organisation? (e.g., tourism, agriculture, energy, water, health)

6. Does your institution/organisation have autonomy in taking decisions relating to the following?

	Yes	No	Some	Don't know/unsure
Research-related decisions				
Use of operational data				
Communication/marketing related to environmental actions				
Other (please specify):				

If No, what are the major constraints?

7. Are climate-related and/or other comparable decisions taken within a context of

- Informal custom and practice Yes/No
- A formal legal system Yes/No
- A formal technical framework Yes/No

8. Are external opinions considered in the decision-making process related to climate and other comparable issues? Yes/No

If Yes, whose opinion(s)? Tick all that apply, and specify who/which if possible.

Consultants	
Experts	
Stakeholders	
NGO	
Government officials (local/regional/national)	
Media	
Local community	
Other (please specify	

9. What type(s) of data do you currently collect/archive/use in you operations and climate-envrionmental-related decision making? Please tick all that apply and give details if desired.

Economic data	
Climate/weather data	
Social trends data	
Other (please specify)	

10. What level of involvement would you/your organization like to have with the CLIM-RUN project (which will run to February 2014)? Please tick relevant boxes.

	Yes	No	Maybe	Unsure
Take part in further workshops				
Attend training workshops				
Take part in more in-depth interviews with research team				
Testing of data sets				
Testing of data analysis/presentation tools				
Data provision				
Review project material (guidelines, presentations etc)				
Other (please specify)				

Please return to:
By this date:

Risk perception and current use

Weather and climate variability and change: risk perception and current use of weather/climate information

1a. On a scale of 1 to 10, would you describe your organisation as extremely risk tolerant (1) or extremely risk adverse (10)?

1b. What is the usual Return on Capital time horizon in a broader context?

1c. What is the annual cost for operating your business?

1d. Do you cover specific risks with insurance?

2. What are the environmental problems/issues of greatest concern in relation to your activity (please tick all that apply):

Coastal/river flooding	
Drought	
Storms (snow, ice, sand, wind etc)	
Heatwaves	
Coastal erosion	
Salinisation	
Desertification	
Atmospheric pollution	
Water quality	
Loss of biodiversity	
Soil erosion	
Other (please specify)	

3. What is your definition of climate?

4. What kind of climate and weather-related events and their impacts do you consider are important for your sector? Please tick all that apply.

Extreme climate/weather events (e.g., heavy rainfall, high temperature, heatwaves, low temperature, drought, flood, hail – please specify all that apply)	
Intra-season (within season) variability	
Inter-annual (year-to-year) variability	
Variations in the start/end/length of seasons	
Increasing/decreasing trends extending over a few years	
Increasing/decreasing trends extending over decades	
Other (please specify)	

5. How are you informed on climate and weather issues? Tick all that apply and specify who/which if possible.

Media (newspapers, TV, internet, …)	
Personal contact	
Seminars and conferences	
Professional bodies	
Direct contact with meteorologists/climatologists	
Other (please specify)	

6. What kind of weather/climate information is important for your activity? Tick all that apply

Technical/scientific information on understanding past climatic variability	
Technical/scientific information on future climatic variability	
Policy information (e.g. white/green papers, legislation)	
Physical environment information	
Socio-economic information (e.g. population/economic projections)	
NGO campaigns	
International debate	
Other (please specify)	

7. Compared to other environmental issues/problems, what is your organizations perception of risk(s) for your activity from climate variability in the long term (i.e., next 1-50 years)?
Most important/Very important/Important/Of secondary importance/Not important

8. Compared to other environmental issues/problems, what is your organizations perception of risk(s) for your activity from climate variability in next 50+ years?
Most important/Very important/Important/Of secondary importance/Not important

9. What types of meteorological/climate information do you currently use in your activity? Tick all that apply.

None	
Daily weather forecasts (next 1-10 days)	
Severe weather forecasts and advisory notices	
Seasonal forecasts (next few months)	
Future climate projections (next decades or beyond)	
Historical observations (from weather stations, satellites, etc)	
Other (please specify)	

10. Does your institution currently employ climate experts/analysts? Yes/No

Risk perception and current use

11. Does your institution currently have access to regional or national seasonal forecasts (i.e., for next few months)? Yes/No

If Yes:

From which source? Please specify if possible.

Do you find this information useful? Yes/No/Unsure

How do you use it [i.e., qualitatively (e.g., for general guidance)/quantitatively (e.g., for predicting demand/output)]?

If No, why not (please tick one):

- Not aware of them
- Aware, but unsure where to find them
- Not reliable enough
- Difficult to access

12. Does your institution currently have access to local or regional climate change projections (i.e., for next decades or beyond? Yes/No

If Yes:

From which source? Please specify if possible.

Do you find this information useful? Yes/No/Unsure

How do you use it [i.e., qualitatively (e.g., for general guidance)/quantitatively (e.g., for predicting demand/output)]?

If No, why not (please tick one):

- Not aware of them
- Aware, but unsure where to find them
- Not reliable enough
- Difficult to access

13. Which of your activities or services are affected by <u>current</u> variability in weather and climate and its impacts - and briefly, why/how?

- …..
- …..
- Other (please specify)

Risk perception and current use

14. Which of your activities or services are likely to be affected by <u>future</u> climate change and its impacts – and briefly, why/how?

- …..
- …..
- Other (please specify)

15. Which of your activities or services could be improved with greater knowledge/understanding of climate variability and change – and briefly why/how?

16. What future timeframes are currently addressed in your organization when considering weather and climate-related issues? Please tick all that apply

	For operational issues	For decision making: Key (k) or Secondary (s)	For strategic planning
Daily (next 1-10 days)			
Seasonal (next few months)			
'Short-term' (next 1-2 years)			
'Mid-term' (to 2020s)			
'Long-term' (to 2050s)			
'Centennial' (to 2100)			
None			

Please return to:
By this date:

Your perspective on climate services

1. **What do you consider to be the most important roles of climate services? Please tick the relevant box for each aspect. Note that the data requirements questionnaire asks for more information with respect to the first four aspects.**

Aspect	Essential	Desirable	Not important	Don't know / unsure
Provision of observed climate and weather data				
Provision of seasonal forecasts				
Provision of decadal predictions				
Provision of climate change projections (next decades and beyond)				
Tools for displaying climate data				
Tools for analyzing climate data				
Guidance (e.g., guidelines and other written material) in using climate data/tools				
Training (e.g., workshops and E-learning courses) in using climate data/tools				
Education and awareness raising within your profession				
Other (please specify)				
The focus of CLIM-RUN is climate information. Do you think that climate services should extend beyond this to cover data and tools for: • Climate impacts assessment • Adaptation assessments • Other applications issues (please specify)				

2. **Would you use climate services for:**

	Yes	Maybe	No	Don't know
Assessing the impacts of climate variability and change on your energy operations or yield/fire risk/tourist numbers				
Assessing the vulnerability of your energy operations or yield/fire risk/tourist numbers to climate variability & change				
Developing mitigation strategies (i.e., reducing greenhouse gas emissions)				
Developing adaptation strategies (i.e., coping with climate variability and change)				
Education and raising awareness within your professional field				

3. How would you describe your knowledge and understanding of the different types of climate model?

	I know quite a lot	I know a little	I don't really know anything
Global models			
Regional models			
Statistical models			

Are you interested in increasing your knowledge? Yes/No

If Yes, do you have any ideas on how/where to start?

4. How would you describe your knowledge and understanding of methods for constructing:

	I know quite a lot	I know a little	I don't really know anything
Seasonal forecasts			
Decadal predictions			
Climate change projections			

Are you interested in increasing your knowledge? Yes/No

If Yes, do you have any ideas on how/where to start?

Please return to:
By this date:

Data requirements

Specification of climate data needs: please fill out the table to the extent that you are able at the current time by ticking one of the boxes (Essential, Desirable etc..) and indicating your confidence in the final column on each row.

	Essential	*Desirable*	*Nice to have*	*Don't know / Unsure*	*Confidence*[1]
Region(s) required:					
Geographical region(s), e.g., city/town, catchment, county/province, larger sub-national region – please specify					
Spatial scale required:					
Gridded (200/100/50/25/10/1 km resolution) – please specify: Station/point scale: What is the coarsest acceptable scale?					
Temporal resolution required:					
At what temporal resolution do you need data: annual (A), seasonal (S), monthly (M), daily (D), sub-daily (SD) What is the coarsest acceptable resolution?					
Timescale required:					
Do you need observed (e.g., station, gridded, satellite) data? If Yes, for how many years (last 10/20/30/50/50+ years)? Please specify.					
Do you want seasonal forecasts (i.e., for next few months)?					
Do you want decadal predictions? If yes: for next 10/20/30 years – please specify					
Do you want climate change projections? If yes: for next 10/20/30/40/50/100 years – please specify.					

[1] Please indicate your level of confidence in answering these questions:
1: Confident
2: Not very confident - I would prefer to have more information (or consultation within my organisation) before giving a final response
3: Not at all confident – I need more information (or consultation within my organisation) before answering

Data requirements

	Essential	*Desirable*	*Nice to have*	*Don't know / Unsure*	*Confidence*[1]
Parameters/variables required:					
Temperature					
Rainfall					
Wind speed					
Wind direction					
Wind consistency					
Extreme events, e.g., heavy rainfall, frosts, heatwaves, very hot days/nights – please specify here:					
Other weather variables, e.g., radiation (more specifically if relevant: DNI, GHI etc), sunshine, humidity, sea level pressure – please specify here:					
Marine and coastal variables, e.g., sea level, sea surface temperature, salinity, storm surge, wave height – please specify here:					
Weather-related indices and events, e.g., fire risk, dust storms, snow – please specify here:					

[1] Please indicate your level of confidence in answering these questions:
1: Confident
2: Not very confident - I would prefer to have more information (or consultation within my organisation) before giving a final response
3: Not at all confident – I need more information (or consultation within my organisation) before answering

Data requirements

Data formats required:	*Essential*	*Desirable*	*Nice to have*	*Don't know / Unsure*	*No preference*
Time series (i.e., a value for each timestep – comparable format to weather station data, rather than a 30-year or other average)					
Statistical distributions: • mean and variance • Percentiles (e.g., 5^{th}/95^{th}, 10^{th}/90^{th}) • Probability distribution/density function (PDF) • Cumulative distribution/density function (CDF) • Other (please specify)					
Maps					
Preferred formats for numerical (e.g., time series) data: • text files • .xls • .csv • ASCII • GRIB • NetCDF • GIS • Other (please specify)					
What data volumes can you handle: Mb, Gb, Tb?					

Please return to:
By this date:

Handling uncertainties

All climate forecasts/projections/scenarios are subject to inherent uncertainties due to underlying assumptions about future human activity (which affect the emissions and atmospheric concentrations of greenhouse gases) together with structural and statistical uncertainties in climate model simulations.

If possible, please indicate the ways of representing these uncertainties that would be useful/informative for you:

	Useful/informative	Maybe useful/informative	Don't know
Multi-model means			
Uncertainty ranges			
Confidence estimates			
Probability distributions			
Other – please specify here:			

Glossary

Climate
Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation (rainfall and snow) and wind. Climate in a wider sense is the state, including a statistical description, of the climate system.

Climate change
A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or variability of its properties, and that persists for an extended period of time, typically decades or longer. Climate change may be due to natural internal processes or external forcings (such as volcanic eruptions and solar variations), or to persistent anthropogenic (resulting from or produced by human beings) changes in the composition of the atmosphere (particularly with respect to concentrations of greenhouse gases, such as carbon dioxide and ozone, and aerosols) or in land use.

Climate model
A numerical representation of the climate system based on the physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties. The climate system can be represented by models of varying complexity and spatial coverage/scale (including global and regional climate models). Climate models are applied as a research tool to study and simulate the climate, and for operational purposes, including monthly, seasonal, and interannual climate forecasts and predictions.

Climate projection
A projection of the response of the climate system to emissions or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, based upon simulations by climate models. Climate projections are distinguished from climate predictions in order to emphasize that climate projections depend upon the emission/concentration/radiative forcing scenario used, which are based on assumptions concerning, for example, future socioeconomic and technological developments that may or may be realized and are therefore subject to substantial uncertainty.

Climate variability
Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). See also Climate change.

Cumulative Distribution Function (CDF)
The CDF is a monotonically non-decreasing distribution function which allows estimation of the probability of (or the proportion of the population) having a value less than a particular threshold. It can be considered as the "area so far" function of the probability distribution (see also PDF).

Decadal prediction
A prediction is the result of an attempt to produce an estimate of the actual evolution of the climate in the future – in the case of decadal prediction, for the next two or three decades. Since the future

evolution of the climate system may be highly sensitive to initial conditions, these need to be well represented in the climate models used.

Extreme weather event
An extreme weather event is an event that is rare at a particular place and time of year. Thus by definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. An extreme weather event is generally defined as the occurrence of a value of a weather or climate variable (such as temperature, precipitation, wind) above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.

Probability Density Function (PDF)
A PDF is a function that indicates the relative chances of occurrence of different outcomes of a variable. The function integrates to unity over the domain for which it is defined and has the property that the integral over a sub-domain equals the probability that the outcome of the variable lies within that sub-domain.

Percentile
A percentile is a value on a scale of one hundred that indicates the percentage of the data set values that is equal to or below it. The percentile is often used to estimate the extremes of a distribution. For example, the 90^{th} (10^{th}) percentile may be used to refer to the threshold for the upper (lower) extremes.

Seasonal forecast
A seasonal forecast is the result of an attempt to produce an estimate of the actual evolution of the climate over the coming season(s). Since the future of the evolution of the climate system may he highly sensitive to initial conditions, such forecasts are usually probabilistic in nature.

Uncertainty
An expression of the degree to which a value (e.g., the futures state of the climate system) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain projections of human behaviour. Uncertainty can therefore be represented by quantitative measures, for example, a range of values calculated by various models, or by qualitative statements, for example, reflecting the judgement of a team of experts.

Weather
Weather is typically associated with changes in weather patterns over short periods of time, i.e., less than a day to a few weeks. It is distinct from climate, which is the long-term average of daily weather (see Climate).