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EUPORIAS

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European Provision Of Regional Impact Assessment on a

Seasonal-to-decadal timescale

Deliverable D11.1

Outlook of sector specific vulnerabilities for Europe S2D horizon

Deliverable Title	*Outlook of sector specific vulnerabilities for Europe S2D horizon*	
Brief Description	*Outlook of sector specific vulnerabilities for Europe D2H horizon; based on the first European Stakeholders Services Conference, held in Rome, in July 2013. The workshop initiated a dialogue between experienced climate information providers and those who currently use or wish to use such information, specifically on seasonal and decadal time scales. The objective of the conference was to establish a climate services network at European level, by piloting the service delivery in key sectors: energy, tourism, water, forestry, health, transport, agriculture and European support for developing countries.*	
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1. Executive Summary

EUPORIAS's project vision is that by developing end-to-end impact prediction services, operating on seasonal to decadal (S2D) timescales, and clearly demonstrating their value in informing decision–making, a market for these new tools will be stimulated. The goal is to increase the competitiveness of EU businesses and the ability of EU regional and national authorities to make effective decisions in climate-sensitive sectors. A close collaboration with project stakeholders is therefore crucial, to:

- Develop and deliver a reliable and trusted impact prediction system for two or three semi-operational prototypes.
- Assess and document key knowledge gaps and vulnerabilities of important sectors (e.g. Water, Energy, Transport, Food security, Health, etc.) along with the needs of specific user within these sectors.
- Develop a set of standard tools and techniques tailored to the needs of stakeholders for calibrating, downscaling, and modelling sector-specific impacts on S2D timescales.
- Develop a knowledge-sharing protocol necessary to promote the use of these technologies.
- Assess and document the current marketability of climate services in Europe.

During the last week of January 2013 the first EUPORIAS Stakeholder Meeting took place at ENEA Headquarters in Rome. Forty-three people from across Europe in representation of 10 different sectors registered for the workshop. The main objective of the workshop, in line with all EUPORIAS activities, was to start to bridge the gap between the producers and users of S2D information.

A preliminary questionnaire at the moment of stakeholders' registration, and another on line questionnaire during and after the workshops, were also used as means to activate a dialogue with stakeholders.

The main results of these stakeholders' activities can be summarised as follows:

1.1 Climate parameters:

- In general, during the workshop it emerged that temperature and precipitation are the most relevant climate parameters requested by stakeholders. This is especially so in the *water, energy, health* and *agriculture* sectors;
- The most valuable parameters for the *surface-transport* sector are ground temperature (influenced by air temperature, wind, soil moisture) and the number of marginal nights (zero-crossing);
- Important parameters for the *insurance* sector include the number of land-falling tropical storms, extreme precipitation, river runoff over threshold "x",

insurance specific drought indices, weather profile of the year including lack of snow and late frosts, general “crop failure indices” with a focus on drought lengths of dry spells.

The questionnaire results (which do not distinguish among the different sectors) confirm that precipitation and temperature are priorities for stakeholders, followed by: wind speed, run off, solar radiation and surface pressure. Moreover, stakeholders suggested other parameters, such as: humidity, sea-surface temperature, wet days, thresholds, drought, severe event, etc.

1.2 Needs

The business-critical decisions that can be informed by weather *tend to cluster in spring (for the summer outlook) and autumn (for the winter outlook).* The exceptions are the agricultural sector which would benefit from seasonal predictions throughout the year, and the insurance sector for which the beginning of January and the beginning of April are crucial dates.

While downscaling is seen as a crucial step for most stakeholders, they appeared to be keen to prioritise resource-investment in improving the large scale drivers rather than increasing the granularity of the data.

While climate predictions (seasonal and decadal) are an interesting and potentially useful area for the stakeholders, and while many sectors use them, there is still a huge need for *education and training*. This was one of the priorities identified by all users. Direct access to expertise, for instance via sector specific workshops or seminars, is seen as a vital way of providing this education and training.

Despite the fact that a significant fraction of the audience was aware of climate predictions and whilst some of the participants were using these predictions, there was a clear language barrier on a series of crucial definitions. The primary example of this was around the communication of risk and uncertainty. A number of stakeholders stated that they would not have used the predictive information unless its level of confidence (no definition provided) exceed 95%.

It is important to notice that some *gaps* indicated by stakeholders are only *perceived gaps*; as the information is in fact already available, such as: high frequency information, daily time series to feed impact models; interpretation of confidence levels, model outputs not bias-corrected. This highlights a need for better communication of what information is actually available. This aspect indicates a lack of visibility and usability of some of the tools that the S2D community has been developing over the years.

While improving the accessibility to the existing data can help the stakeholders, it is clear that some genuine gaps do exist. Some of those gaps can be easily taken into account within the EUPORIAS project, such as: tailored products and parameters at important stages of crop development, four-six month seasonal forecasts, statistical and dynamical downscaling to local level taking into account fine scale topography differences, integration with other food security relevant information for decision making, customised forecasts for user or business application, interface with existing (early warning) systems, etc.

2. Workshop's Objectives

The primary **objective** of the workshop was to *inform* stakeholders and *capture* information on their current knowledge and usage of S2D data; the critical/relevant choices in their business that could be affected by climate; how climate influences their business choices; and how climate information enters into their decision making procedures. Secondary objectives were to create a community of users of climate information; develop climate user champions; share knowledge and learning among peers (peer-to-peer, P2P); and provide a good experience for attendees.

Means and method

Preliminary questionnaire

A preliminary questionnaire was distributed to the stakeholders at the moment of their on line workshop registration, with the aim of capturing their attitudes toward seasonal or decadal climate predictions and then organising an appropriate workshop. The following questions were posed:

1. Do you use seasonal or decadal climate predictions in your organisation?
2. How do you use them?
3. What are the barriers in using seasonal or decadal climate predictions in your organisation?

Stakeholder's Workshop

The meeting consisted of an *opening session*, a *talk over dinner* and a number of *interactive sessions*. The interactive sessions applied design methods to generate knowledge exchange and capture. Face-to-face interviews will be carried out in light of the results achieved in this workshop.

The interactive session on the first day had the scope to create connections between participants. On the second day a session with a more rigorous, scientific approach had the scope to ensure that questions were answered more comprehensively and consistently.

The format used for the interactive sessions involved two parts.

1. *Breakout Groups*
   Participants were divided into groups of four or five. Groups included people from different sectors, one experienced user, and a facilitator. Groups were asked to discuss and produce notes on post-it notes on each of the questions that they were given within the landscape established in the opening presentations. Each group produced at least two badges containing answers or comments.

2. *Feedback*
   In turn, a nominee from each group placed the badges from their group on a landscape board. They were asked to speak for 10-30 seconds about each badge they placed. Groupings or links were drawn on the board by the moderator/team members. Clusters of ideas that related to most of the participants were identified. These clusters highlighted many recurring themes across the sectors. This exercise enabled insight and applications to be shared across disparate sectors. Peer-to-peer dialogue and engagement across stakeholders and partners have been built.

Questions for interactive session

An online questionnaire was prepared to generate discussion during the workshop. It was also used to further investigate stakeholders' attitudes towards S2D forecasts and their present and/or potential needs. This would allow them to share their information, and generate new ideas. The questions asked were:

1. **What are the critical activities or decisions in your business that are affected by climate?** (e.g., communication, operational management, long term adaptation strategies, pure research);
2. **How are these affected**? (e.g., financial risks);
3. **What are near term benefits or future opportunities can you envision through access to S2D information** (e.g., improving operational efficiency, diversification, new climate services);
4. **Mapping the gaps – what is the information we are not supplying?** (e.g., level of confidence, temporal or geographical resolution); and
5. **What are the barriers in using S2D climate sectors**? (e.g., lack of information, complexity, financial constraints, uncertainty).

With this deliverable, the project has contributed to the achievement of the following objectives (DOW, Section B1.1):

No.	Objective	Yes	No
1	Develop and deliver reliable and trusted impact prediction systems for a number of carefully selected case studies. These will provide working examples of end to end climate-to-impacts-decision making services operation on S2D timescales.		X

2	Assess and document key knowledge gaps and vulnerabilities of important sectors (e.g., water, energy, health, transport, agriculture, tourism), along with the needs of specific users within these sectors, through close collaboration with project stakeholders.	X	
3	Develop a set of standard tools tailored to the needs of stakeholders for calibrating, downscaling, and modelling sector-specific impacts on S2D timescales.		X
4	Develop techniques to map the meteorological variables from the prediction systems provided by the WMO GPCs (two of which (Met Office and MeteoFrance) are partners in the project) into variables which are directly relevant to the needs of specific stakeholders.	X	
5	Develop a knowledge-sharing protocol necessary to promote the use of these technologies. This will include making uncertain information fit into the decision support systems used by stakeholders to take decisions on the S2D horizon. This objective will place Europe at the forefront of the implementation of the GFCS, through the GFCS's ambitions to develop climate services research, a climate services information system and a user interface platform.	X	
6	Assess and document the current marketability of climate services in Europe and demonstrate how climate services on S2D time horizons can be made useful to end users.	X	

3. Detailed Report

3.1 Preliminary registration questionnaire

Forty one people provided a response to the stakeholder workshop's registration questionnaire.

Although some of the respondents could not make the workshop in person, their answers are still included in the following analysis. Furthermore, there were some attendees to the workshop who did not fill in the registration questionnaire and hence are not included in this analysis.

The answers from eight of the initial respondents have been removed as they are organiser, facilitators or moderators (EUPORIAS workshop's staff); therefore there were then 33 respondents.

All participants (total 33):

3.1.1 Do you use seasonal or decadal climate predictions in your organisation?

Yes – 26
No – 7

There was no clear distinction across sectors between those answering 'Yes' and those answering 'No'. However, all of the respondents from the energy, insurance and food aid sectors use such predictions.

Of those that answered 'yes' to above:

3.1.2 How do you use it?

Respondents could give multiple uses

Use for operations/planning	17
Use for research	10
Develop seasonal/decadal predictions	3

Of those that answered 'no' to above:

Six/seven said that seasonal or decadal predictions would be of use to their organisation (one specifying that they would need to be tailored; one not answering).

All participants:

3.1.3 What are the barriers in using seasonal or decadal climate predictions in your organisation?

(Respondents could give multiple barriers)

Value of the predictions to the sector(s)	9
Technical complexity/data availability	7
Difficulties in communicating uncertainties/probabilities	7
Cost (in terms of time, money and knowledge needed)	7
Perceived skill of predictions	5
Lead time not fitting with decision making	4
No barriers specified	1
Not answered	8

In conclusion, the preliminary registration questionnaire shows that the majority of the stakeholders use seasonal or decadal climate predictions mainly for operation/planning and for research. A small group indicate that they use them to develop seasonal/decadal predictions. Among the minority that do not use seasonal or decadal climate predications, most of them indicate that it *may* be useful for their organisation. This means that in future EUPORIAS stakeholders' activities, **attention is to be devoted, not only to refining tools for those stakeholders that already use them but also, to identify "potential" future uses of these tools**.

Stakeholders expressed concern over the technical barriers, data availability and difficulties in communicating uncertainties and costs.

3.2 Sector specific summary of the Stakeholder's Workshop

In this section a summary of the main results of the workshop is reported for each sector. **The complete results of the discussions are reported in the web links listed.**

3.2.1 Water

Stakeholders:

- *Philippe Verjus, DRIEE France (Direction Régionale et Interdépartementale de l'Energie et de l'Environnement)*
- *Dr Bastien Klein, Germany, FIH (Federal Institute of Hydrology)*
- *Creus Rodriguez Ramon, AGBAR, Spain*

Stakeholder Expert (water resources)*: Laurent Pouget, CETaqua*
Climate Expert*: Jean Pierre Ceron, Météo-France*
Moderator*: Adeline Cauchy, TEC*
Link to water spreadsheet: http://bit.ly/matrix_water

3.2.1.1 Climate parameters

Two relevant climate parameters are requested by the stakeholders in the field of water resources management: *temperature* and *rainfall*. These two indicators are highly correlated with hydrological processes studied and/or controlled by the stakeholder; i.e., changes in river flows and groundwater recharges.
It is worth highlighting that this is not obvious as a-priori, since other parameters such as evaporation or soil moisture could have been of interest.

3.2.1.2 Potential applications of seasonal climate forecasts in water management

Several applications of seasonal forecasts have been discussed between stakeholders:

- Water resources management at the river basin scale (water allocation);
- Seasonal forecasts could be used for planning drought management strategies at different scales and could support various types of activities: control and monitoring of water resources availability, operational decisions on water supply or demand (restriction on agricultural withdrawals in groundwater/dams management);
- Operational management of material and human resources: teams' management and organisation (for rivers measurement, maintenance of dams etc) according to future hydrological conditions; and
- Ship traffic management: predict river low flow and ice in the river.

3.2.1.3 Levels of uncertainty and confidence

At this stage there are no specific recommendations from stakeholders about the level of confidence or uncertainty that would allow, or not allow, them to use this information. However, a high level of uncertainty can of course be an important barrier for communication and decision making.

3.2.1.4 Communication and capacity building

A significant need for training has been identified by stakeholders, in the form of workshops or courses. Three groups with different needs have been identified: (1) climate data provider (e.g., those providing data on future temperature and rainfall); (2) impacts data provider (e.g., those providing data on future water availability); and (3) end-user (e.g., those managing / operating the resources). The training could encompass all three groups, or could be organised between groups (1) and (2) (exchange of information regarding the use of climate information, model skills) and between groups (2) and (3) (exchange of information regarding the integration of the forecast in operational processes).

3.2.2 Energy

***Stakeholders**:*

- *Niglio Gennaro, Italy, GSE SpA (Gestore Sistema Elettrico)*
- *Pestana Rui, Spain, REN – Rede Eléctrica Nacional, S.A.,*

***Climate Expert**: Laurent Dubus, EDF R&D*
***Moderator**: Melanie Davis, IC3*
Link to energy spreadsheet: http://bit.ly/matrix_energy

Operations and planning for the energy sector rely on the balance of energy supply to demand. Variation in demand is primarily determined by above or below average temperatures, whereas supply depends on the energy mix available over different geographical areas (e.g., wind, hydro, solar, nuclear, coal etc.). The energy companies involved in the EUPORIAS project represent both energy supply managers (e.g., EDF) and grid managers (e.g., TERNA).

3.2.2.1 Climate parameters and potential application

In hydro resource management, precipitation was identified as the most valuable climate variable, due to the fact that hydro energy resources can be stored, their operations are highly flexible and can therefore respond quickly to the demand. Temperature and pressure variables are also key, in order to evaluate variations in energy demand. Over seasonal and interannual timescales, summer and winter periods are the most vulnerable times to the energy system. Climate forecast (or outlook) information provided during the periods leading up to these seasons could therefore play an important role in helping the energy sector to prepare for, and manage, such high-risk periods. Therefore, climate forecasts should, as a minimum, be provided in autumn (October) for a winter outlook, and in spring (April) for a summer outlook. Over longer decadal timescales, a wider range of climate information could be useful to guide decisions related to energy generation sites, infrastructure planning, interconnectivity of the energy network etc. For these timescales, variation in the climate extremes is most useful.

European regions where there are inter-country grid connections are also most vulnerable to energy supply and demand. Central Europe is therefore a key region to improve the provision of climate information all year round, whilst southern Europe is a priority in the summer and northern Europe in the winter.

3.2.2.2 Level of uncertainty and future challenge

The skill of climate forecasts needs to be compared to, and improve upon, current practices. An on-going validation exercise to benchmark the different approaches could therefore be a good starting point. One of the key challenges will be the introduction of climate forecast information into the existing operational tools of the energy management sector - for example, a temporal resolution of daily means is requested by the energy community, although climate forecast skill has, to date, only shown to be useful when using monthly means.

Hydro power management and demand forecasts are the key issues on seasonal/annual time scales. Current practises generally use a climatological approach: use of historical time series of precipitation and temperature in hydrological model, to make projections of how the initial water stocks (dams, snow pack in mountains...) may evolve in the future. Hence, forecasts of temperature and precipitation are valuable if they are more skilful than this climatological approach.

The relevant spatial scale is the watershed for hydro, and the aggregation of watershed up to the national scale. The ideal temporal scale is daily (for demand in particular), but weekly information is enough for hydro power management.

Longer term projections/forecasts are important as well:

- How the annual water cycle will evolve (more/less precipitation over the year, or a shift in the rainy/dry seasons inside the year)?
- Will the interannual variability increase/decrease?
- How will the key variables evolve (mean, variability, distributions, extremes) – temperature, precipitation, soil wetness indices?

Seasonal forecasts of wind and solar energy are not considered as a primary issue, but they may rapidly become so, due to their fast developing ratio.

3.2.3 Health

Stakeholders:

World Health Organisation (WHO), Regional Office for Europe
Department of Epidemiology, Lazio Region, Italy
Germany, Ministry of Environment and Health

***Climate Expert**:*
***Moderator**:*
Link to health spreadsheet: http://bit.ly/matrix_health

3.2.3.1 Climate parameters and potential application

Temperature is one of the most important parameters requested for decisions concerning:

- Prediction of possible temperature anomalies in the *winter season* (October to March) and in the *summer season* (May to September), in order to plan prevention activities and alert health services. For the winter season the decision time is around August and for the summer season, the decision time is April; with a monthly frequency. For winter, a forecast length of three months, from August and then monthly thereafter until March is used. For the summer season, a forecast length of three months is used from April and then monthly thereafter until September;
- Mean temperature (useful to have longer range forecast to help fill the information gap between seasonal forecasts and long-term projections), with a forecast length from five to 10 years.

As for other *parameters*:

- Sea surface temperature (SST), for *decisions* concerning the knowledge of SST for summer season (starting in February) in terms of the overall change and trend in SST;
- Precipitation and temperature for *decisions* related to severe flooding events in Europe (e.g., August and during winter time due to snow melt), with a monthly frequency and an all-year monthly forecast;
- Wind storms.

The spatial resolution for all the parameters is European level (EU state members, plus Russia, central Asia, Caucasus, and Southeast Europe).

3.2.3.2 Level of uncertainty and confidence

The seasonal predictions systems should be able to provide the probability of exceeding a particular threshold. This information is used if the probability is exceeding at least 70%. The level of confidence needed is an area that requires further investigation.

3.2.3.3 Communication

Clear key messages to the media on what people need to do, is required; as is closer collaboration between producers and users (e.g., defining specific roles, workshops).

3.2.4 Surface-Transport

Stakeholders:

- *Max Tuni , Predictia, Spain*

SH Expert:
Climate Expert:
Moderator:
Link to transport spreadsheet: http://bit.ly/matrix_transport

3.2.4.1 Parameters and potential applications

The *parameters* indicated by the stakeholder are:

1. Ground temperature (influenced by air temperature, wind, soil moisture) with objectives or decisions of interest regarding road management, with a forecast required in a, currently, uncertain time and one month before the period, a monthly frequency, a forecast length of monthly forecasts for winter months (November, December, January), with a very high resolution (sub 1km). A forecast required in September/October, with an annual frequency, a seasonal forecast length and a seasonal spatial resolution and a very high resolution (sub 1km); and

2. Number of marginal nights (zero-crossing), with objectives or decisions of interest regarding understanding risks to bridge stability, frost heave, etc., with a decadal forecast required (probably relevant for southern Europe). Characteristic timescale needed to implement forecast decision is monthly to seasonal with very high spatial resolution of up to 1 km.

3.2.4.2 Level of uncertainty

As high resolution data as possible; with a quantified level of certainty.

3.2.4.3 Communication

Decision makers may require data; good communication about the level and range of confidence; and the format that the data is presented in needs to integrate into existing applications.

3.2.5 Insurance

Stakeholders:
- *Allianz RE, Germany*

Climate Expert:
Moderator:
Link to insurance spreadsheet: *http://bit.ly/matrix_insurance*

3.2.5.1 Parameters

Important *parameters* that were indicated during the meeting include:

- Number of land-falling tropical storms;
- Extreme precipitation; river runoff over threshold 'x' in Asia and Europe;
- Insurance specific drought indices; weather profile of year including lack of snow and late frosts; and
- General "crop failure indices" with focus on the USA and China; drought; length of dry spells (soil moisture?).

As a second priority the following *parameters* are indicated:

- European windstorms above a defined wind speed. Number of severe convective storms; Australia, USA;
- Frost in Europe: number of frost days below a certain temperature threshold in a row (freezing pipes);
- Snow load on roofs: amount of accumulated snow over x number of days with little or no melting; snow and rain combined; and
- Precipitation extremes leading to surface water flooding; hourly maximum precipitation.

3.2.5.2 Potential applications

The most important *objectives/decisions* indicated are:

1) Annual insurance profile; provide information to customers;
2) Five-year/decadal overview for reinsurance; and
3) Plan ahead for claims; provide advice to customers.

All the parameters of the above indicated objectives/decisions have an annual *frequency*, with a strong need for accurate seasonal forecasts.
Key regions have been identified: Asia and Europe, Ocean basin (Atlantic, WNP) plus more regional breakdown, such as the Gulf of Mexico.

Example of complementary actions were given; such as; investigations of anti-/correlation between basins, any cross-country correlation/anti-correlation, and what is the most reliable "crop failure index" which can be predicted with high-skill.

3.2.5.3 Level of uncertainty and confidence

The level of uncertainty in this sector is due to the fact that two different audiences are receiving information:

1. Communication with customers advising adaptation and mitigation actions; e.g., clear drains, keeping an eye on snow load etc. Level of confidence in projections needs to be relatively high (>70%) but if these are 'wrong', there are reputational issues but no great financial risk; and
2. Buying reinsurance needs forecasts with a high degree of skill. Generally short timeframes involved means that decisions can be tested and evaluated.

3.2.5.4 Communication and capacity building

Communications to customers will always be filtered and it is likely emphasis will be put on actions, not on the forecast itself.

Messages about risks need to be “backed up” by the scientific community providing clear examples and using an appropriate language.

3.2.6 Agriculture and Forestry

Stakeholders*:*
- *Stefan Niemeyer, JRC*
- *Philip Amingo, IGAD-ICPAC, Kenya*
- *Andreas Weigel, Cargil International, SA*
- *Graça Antonio, Sogrape Vinos SA*
- *Lars Barring, SMHI, Sweden*

Climate Expert*: Paolo Ruti, ENEA*
Moderator*:*
Link to agriculture spreadsheet: 3. http://bit.ly/matrix_agriculture

3.2.6.1. Climate parameters

The main requested climate parameters are:

- Temperature;
- Total precipitation and its probability density function;
- Number of rainy days, dry spells, drought and Standardised Precipitation Index (SPI) (parameters can be derived from main variables);
- Low temperature (minimum);
- Sea Surface Temperature;
- Number of frost days; and
- Snow cover.

3.2.6.2 Potential applications

The most important objectives/decisions indicated are:

- Crops management (logistic, harvesting, protection during flowering period, irrigation management);
- Water management; and
- Forestry management.

All the parameters associated with the above indicated objectives/decisions have an annual frequency, with a forecast length going from one month to a season. Key regions have been identified: Mediterranean, Northern Europe, Eastern Africa. The spatial resolutions should be 50 Km.

3.2.6.3 Levels of uncertainty and confidence

The level of reliability depends on the organisation that uses this information. For example the World Food Programme (WFP) can manage risk, but governments cannot.
Increasing the frequency of production of seasonal predictions (e.g., twice a month) can be very useful for tailoring decisions and managing the associated risk.
It would be very important to initiate an internal discussion in EUPORIAS about the link between high reliability and high probability and how reliability varies in relation to space and time (seasonality).

3.2.6.4 Communication and capacity building

Concerning communication, here is a short list of relevant issues:

- The involvement of stakeholders in discussing forecast results is considered important;
- Basic communication action should be devoted to teenagers;
- A handbook with few definitions, eight page guides with graphs and pictures (including comics) and a training video, have been indicated as important ways to disseminate information; and
- The training of new professionals and the choice of communication champions.

3.3 Analysis of the online questionnaire

An on line questionnaire was prepared by the EUPORIAS staff, with the technical support of ENEA (ENEA server: address http://utmea.enea.it/surveys/index.php, password: xyok). The questionnaire had the aim to further investigate the stakeholders' attitude towards S2D forecasts and the present and/or potential users' needs. In addition to the stakeholders participating in the workshop, the questionnaire was also allowed to reach those stakeholders who were not able to participate in it. It was completed by 16 key stakeholders.

In addition to the information concerning the stakeholders themselves (name, surname, institution, e-mail), simple and direct unstructured questions were used (see below).

3.3.1 QUESTION 1-2: What are the critical activities or decisions in your business that are affected by climate? QUESTION 2: How are these [activities] affected?

These questions in their open structure, had the aim of leaving the stakeholders free to express the critical decisions they have to face in their activity in relation to climate, without any direct reference to S2D. Of course the typology of replies depends on the sectors identified for the selected workshop participants. For this reason the number of replies for each category is irrelevant for an analysis. The replies are listed and commented sector by sector.
(The complete list of replies for question 1-2 is here enclosed)

3.3.1.1 Agriculture/food security/forest

In the agriculture sector, among the replies, the respondents indicated as their critical activities and decisions: crop yields in Europe and beyond, early crop estimates, irrigation plan, grape and wine production, drought, water use. Seasonal-scale climatological factors could impose a risk or an opportunity for crop yields in a specific region. The commodity prices are influenced by weather variability.

Agriculture is directly dependent on weather and climate on a daily to seasonal time scale. The water levels availability in the next days/weeks is of extreme importance for the agriculture sector.

In the wine sector, considering that vineyards are meant to have a productive average life of 40 to 50 years, the critical decisions related to climate concern the choice of grape varieties, rootstocks, irrigation systems design and sizing, cultural practices and so on are all affected. Wineries, storage and bottling facilities, water treatment plants, and offices are also affected. Planning for grape and wine procurement is greatly affected by weather. The price of wine is dependant on the quality of crops. Sales and marketing campaigns can also be greatly affected. Wines are seasonal: reds and Port in cool weather; white and rosé wine in warm weather. They way spirits are promoted also changes: straight liquor in cool weather, cocktails and mixers in warm weather.

In the food security activity prevention is crucial to support food assistance intervention design, including preparedness (contingency plans, corporate, community levels, etc.) and to support decision making processes for short-term planning (prepositioning of food stocks and logistical services), and long term planning (resilience building activities and creation of livelihood assets).

A regional drought could trigger a humanitarian crisis which would affect decisions about where to preposition food, how many beneficiaries to assist, and how to support governments.

Above normal, or well below normal, temperature and/or precipitation at specific phases in a plant's growth cycle, can reduce (or also enhance) expected yields.

In the forest sector the following activities have been indicated: operation planning - logging, transport, forestry, choosing the suitable table reforestation material (varieties, species) and forecast pest outbreaks. The needed indices indicated are:

- Temperature e.g., frost;
- Soil moisture (precipitation, evaporation);
- Biological threshold values; and
- Extreme values (maximum, minimum).

Together with drought stress, flooding, temperature backlashes (frost damage), wind storms; the financial crisis is also indicated as important in agriculture.

3.3.1.2 Energy

Most of the replies concern renewable energy (solar, wind, hydro). The activities that have been indicated are:

- Site planning of wind or solar project and operational planning of wind or solar project.;
- Balancing grid, ensuring risk;
- Estimation of renewable energy quantity;
- Operational management for hydro production in dry years, especially if they are consecutive. Very hot days and the impact of water temperature at rivers (example: greater than 28ºC – water, 40ºC – air temperature). Number of days with very extreme wind (example: greater than 120 km/hr). Energy prices and commodities prices;
- Operational management of the power system, from day +1 to 3.

Renewables are directly dependent on weather and climate on a daily to seasonal time scale. City planning is more interested up to the decadal climate scale. Climate has an effect on financial risk (profit and losses), and energy supply.

Power demand and production are affected by climate variability. The conjunction of several parameters/impacts can have very negative effects, for instance: low temperature (high demand) + low level of water available for hydro power production.

Poor site selection results in poor Return on Investment (ROI) and vice versa. Poor planning results in inefficient use of energy resources, which equates to a loss of money and the risk of blackout.

3.3.1.3 Health

Decision on education campaigns; spraying programmes to eradicate mosquitos; and insecticide treated bed net distribution in tropical countries have been indicated among the critical decisions stakeholders have to face. Climate is indicated as having an effect on the loss of life; the economic cost loss of working days and the cost of hospitalisation.

3.3.1.4. Other sectors: transportation, insurance, research

For transportation, stakeholders have indicated the decisions on maximum possible loading capacity based on forecasted water levels at critical locations, planning of shipping and transportation capacities.

As regards insurance, the following activities have been indicated: buying of retrocession insurance cover, providing (re)-insurance and providing primary insurance cover (property and crop).

As far as research is concerned, the modelling of climate impact on the risk of damage to forest ecosystems has been indicated.

3.3.2 QUESTION 3: What near term benefits or future opportunities can you envision through access to S2D information?

This unstructured question had the aim of receiving immediate opinion and replies by stakeholders on the use of S2D information. In general respondents indicate better and more efficient operational management activities in the use of resources, in security levels, planning, etc. as benefits/opportunities deriving from S2D information.

Some respondents stressed the importance of management on monthly to seasonal timescales. Others indicated reducing risks in general from short to long term would be a benefit. Moving from the management of disasters to the management of risks has been indicated by many respondents in order to ensure cost-effective decision making. Adaptation is a first cost-effective action which helps to improve resilience.
(The complete list of replies is shown below)

3.3.2.1 Agriculture/forest – food security

In agriculture, respondents indicate the need to improve crop yield forecasts (one-three monthly forecasts), anticipated sowing conditions and frost kill risk. Reliable seasonal forecasts could help to obtain more reliable yield estimates, and more reliable yield estimates would allow the better anticipation of supply and demand of a crop and thus to obtain better estimates of food availability, food need, and food prices.

Improving planning of management actions (harvesting, planting) and early warning systems - countermeasures of forest pests, have also been indicated as future opportunities deriving from S2D research.

3.3.2.2 Energy

One opportunity identified was an improving confidence in the decision making process (DMP). Potential business opportunities in operational climate services to expand current weather forecasting for solar and wind energy, and insurance covers were also identified.

3.3.2.3 Insurance

Risk management is fundamental in this sector. Respondents envisaged receiving the following benefits through S2D information:

- Moving from managing disasters to managing risk;
- Help understand risks in the short to long term;
- Help reduce basis risk in index insurance design;
- Improve cost-efficiency and effectiveness - convincing donors to invest in preparedness and prevention rather than response only;
- Help building resilience;
- Optimisation of reinsurance protection (mid-term); and
- Optimisation of insurance risk portfolio (mainly strategic, decadal).

3.3.2.4 Mixed

Estimation of future water levels/runoff situations for decision making; planning of ship capacities; optimising stock management; and be prepared for extreme low flow events (reducing economic risks).

3.3.3 QUESTION 4. Mapping the gaps - what is the information we are not supplying?

This unstructured question aims to catch the gaps in the information which, according to the respondents, is not supplied. This then provides an indication of the associated gaps in the S2D forecast information.

The replies are listed according to the four following categories: (1) information already available; (2) information that is not available that can be achieved with some affordable work within EUPORIAS project life span; (3) real gaps; and (4) non applicable.

3.3.3.1 Information already available but not always received by users

- High frequency information: for example, daily time series to feed impact models, which then will be aggregated/averaged;
- Interpretation of confidence levels;
- Model outputs not bias-corrected compared to the observation data;
- Communication on uncertainty/skill/predictability/windows of predictability/future improvements to all.

3.3.3.2 Information that is not available but can be achieved with some affordable work within EUPORIAS project life span

- Tailored products and parameters at important stages of crop development (e.g., probability to reach critical threshold of precipitation during grain filling stage of maize in Spain);
- Four-six months forecasts, seasonal;
- Overview of climate products, guidelines to using them, tailored products;
- Downscaling to local level taking into account fine scale topological differences;
- Challenge of integration with other food security relevant information for decision making;
- Customised forecasts for user or business applications;
- Interface with existing (early warning) systems;
- Downscaling (temporal and spatial), model skill, timing of making data/forecast available;
- High spatial resolution for impact models, statistical downscaling is required by the users who probably don't have experience in statistical downscaling;
- Reliable rainfall forecast (improvement required);
- We need relationship between: - prediction period (length), - accuracy, - spatial resolution;
- Skilful tailor-made products for loss relevant quantities (e.g,. land-falling hurricane number versus Atlantic basin activity, activity of European winter storms);
- Higher temporal resolution (e.g., seasonal forecasts in monthly or even two-weekly resolution rather than three-month-averages). This could perhaps be achieved by more spatial aggregation (cf we do not need information in grid-point resolution);
- Precipitation frequency (at the moment typically only precipitation means are supplied) and higher moments of the precipitation statistics;
- Reliable confidence intervals for each forecast; and
- Impact specific measures.

3.3.3.3 Real Gaps

- Representation of extreme weather events; and
- The wine sector needs greater resolution both at the geographical (down to 1km ideally, at least down to 10 km level) and temporal dimensions (in some cases down to weekly periods, in other cases at yearly periods).

3.3.3.4 Raised issues out of scope

- Sharing the financial risks among scientists and businesses in case of errors;
- “Validation / proof of benefit of use of monthly to seasonal forecasts, requires long(er) commitment of us as users to convince us and our customers";
- Format/metric(s) of data/forecasts;
- This only works with a parallel/complementary capacity building effort at all user levels; and
- Overall challenge of political intervention.

3.3.4 QUESTION 5: If you were to invest 10 coins into S2D research, how many of them would you spend on (you have a total of 10 coins to distribute across these four questions):

(1) the overall skill of the predictions on the large scale - 33%
(2) improving spatial resolution of the prediction – 20%
(3) the representation of the extreme events – 26%
(4) tailoring the forecast and communicating its skill and uncertainty – 21%

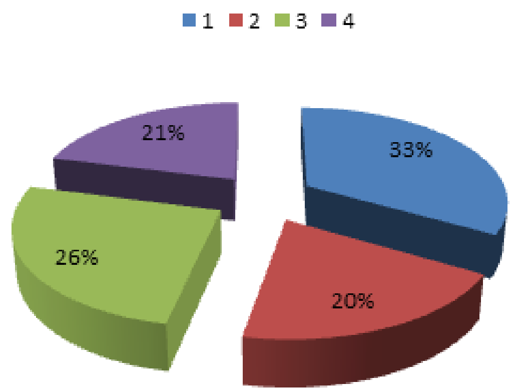

Figure 1: Distribution of ’10 coins’ across the four proposed areas of S2D research

The distribution across the four categories is rather homogenous in terms of financial resources that the respondents would allocate to S2D research. The “overall skill of the prediction on the large scale” shows the largest value (33%), followed by “the representation of the extreme events” (26%). “Tailoring the forecast and communicating its skill and uncertainty" (21%) and "improving spatial resolution" (20%) receive smaller values (*Figure 1*).

This analysis has to be completed also with the distribution of "value" and its frequency as reported in *Table 1*. In *Table 1*, respondents have used eight values (from 0 to 7). Values 8 to 10 were offered to them, but these values were not used. At the same time respondents used the zero ("0") value, which was not expressly offered to them.

The highest value, 7, has been indicated only once and for statement 4, which is the question that received the second lowest percentage in the total ("tailoring the forecast and communicating its skill and uncertainty, 21%"). This mitigates the negative results that come out from the total percentage of the above indicated analysis. Statements 2, 3 and 4 receive two "0" values. This diminishes the importance of statement 3 "the representation of the extreme events" as a second priority, and confirms the position of the other statements, as indicated in *Figure 1*.

The "0" value was never used against statement 1; which is the statement with the highest percentage (33%). This confirms that "the overall skill of the predictions on the large scale" is the research that respondents consider most important and are most keen to invest money in. All the others are more or less at the same level of importance.

On the whole, it can be concluded that respondents are not very keen to finance the categories of research offered in this question, since the frequency of low votes (from 0 to 5) is very high, while votes from 6 to 7 have a very low frequency.

Table 1: Vote distribution and its frequency

Vote	Questions	Frequency
7	1	-
	2	-
	3	-
	4	1
6	1	-
	2	-
	3	1
	4	-
5	1	3
	2	-
	3	-
	4	-
4	1	5
	2	2
	3	3
	4	2
3	1	5
	2	4
	3	5
	4	2
2	1	1
	2	4
	3	3
	4	4
1	1	2
	2	3
	3	1
	4	5
0	1	-
	2	2
	3	2
	4	2

3.3.5 QUESTION 6: Put the following variables in order of importance for your business: temperature, precipitation, wind speed, solar radiation, surface pressure, runoff, others

Precipitation, temperature and wind speed are the variables which receive the highest frequency of top priorities. These were followed by: run off, solar radiation and surface pressure. However this list has to be completed with “others”: humidity, SST, wet days, thresholds, drought, severe events, followed by: fog index, pollution, rainfall distribution, start of season, waster retention structure inspection (WRSI), Normalised Difference Vegetation Index (NDVI), potential evapotranspiration, geo-potential (700 and 500 hPa), soil moisture, water level, active degree-days (Winkler), evapotranspiration (Penman-Monteith), dryness index, cool-night index, grape colour index (Crespy).
Table 2 details the order of priority of the variables.

Table 2: Order of priority of the variables as expressed by respondents

Respondent / Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
T.	1	-	1	3	2	2	2	2	-	1		2	3	2	2	1
P.	2	-	-	2	-	1	1	1	-	2	4	1	4	1	4	2
W.S.	3	1	-	-	.-	-	-	-		3	2	4	1	-	1	3
S.R.	3	2	-	-	-	3	-	-		-	-	5	2	3	3	-
S.P.	4	-	-	-	-	-	-	-		-	-	-	5	-	5	-
Ro	5	.	2	1	-	-	-	-	1	-	3	3	6	-	6	-
O.		Fog index, pollution	Geo-potential (700 and 500 hPa		Extreme events (droughts, floods), rainfall distribution, start of season, WRSI, NDVI, potential evapotranspiration		Humidity SST, wet days, thresholds	Humidity SST, wet days, thresholds	Water level	Maximum/mean of the above variables	Number of extremes storms, Drought, Severe convection	Active degree-days (Winkler), evapotranspiration (Penman-Monteith), dryness index, cool-night index, grape colour index (Crespy)	Soil moisture			

Legend:
T.= Temperature
P. = Precipitation
S.R. = Solar Radiation
W.S. = Wind Speed
S.P. = Surface Pressure
Ro. = Runoff
O. = Others

4 Conclusions and lessons learnt

The first phase of the EUPORIAS project's activity with its stakeholders can be considered very satisfactory since all the objectives have been reached. Questionnaires were distributed to relevant stakeholders and a two day workshop was held during January 2013 in Rome.

Stakeholders have been informed, and at the same time information about their knowledge and use of S2D data have been acquired on: (1) the critical/relevant choices in their business that could be affected by climate; (2) how climate influences their business choices; and (3) how climate information enters in decision making procedure. The first steps to reach the objective to create a community of users of climate information and develop climate user champions have been made. The workshop was an occasion for stakeholders and partners to learn from each other, providing a positive experience for participants.

The *preliminary registration questionnaire* shows that the majority of the identified stakeholders use seasonal or decadal climate predictions mainly for operations/planning and for research. A small group indicate that they use them to develop seasonal/decadal applications. Among the minority that do not use seasonal or decadal climate predications, most of them indicate that they may be useful for their organisation. As a consequence in future EUPORIAS stakeholders' activities, attention is to be devoted not only to refining tools for those stakeholders that already use them, but also identify "potential" future uses of these tools. In this questionnaire stakeholders expressed concern over technical barriers, data availability and difficulties in communicating uncertainties and costs.

The *first Stakeholder Workshop* in Rome enabled a deepening understanding of the stakeholders' needs in the different sectors: water, energy, agriculture, transport, health and insurance. Some of the information gathered thanks to the *online questionnaires* further investigated the stakeholders' attitudes towards S2D forecasts and the present and/or potential users' needs.

With the exclusion of the *agricultural* sector which would benefit from seasonal predictions throughout the year, and the insurance sector (for which the start of January and the start of April are crucial dates); the requirements of the other sectors tend to cluster in spring (for the summer outlook) and autumn (for the winter outlook).

In general, during the workshop it emerged that temperature and precipitation are the most relevant climate parameters requested by stakeholders. This is especially so in the *water, energy, health* and *agriculture* sectors. The most valuable parameters for the *surface-transport* sector are ground temperature (influenced by air temperature, wind, soil moisture) and the number of marginal nights (zero-crossing). Important parameters for the *insurance* sector include the number of land-falling tropical storms, extreme precipitation, river runoff over threshold "x", insurance specific drought indices, weather profile of the year including lack of snow and late frosts, general "crop failure indices" with a focus on drought lengths of dry spells.

The results of the online questionnaire (which do not distinguish among the different sectors) suggest that precipitation and temperature are priorities for stakeholders, followed by: wind speed, run off, solar radiation and surface pressure. Moreover, stakeholders suggested other parameters, such as: humidity, sea-surface temperature, wet days, thresholds, drought and severe events.

For the *water* sector, stakeholders indicate many applications of seasonal climate forecasts, such as: water resources management at the river basin scale, strategies to manage drought periods, and operational decisions on water supply or demand.

For the *energy* sector, the workshop was attended by both the energy supply managers (e.g., EDF) and grid managers (e.g., TERNA). This gave the chance to analyse the stakeholders' needs from the two perspectives. *Precipitation* was identified as the most valuable climate variable, due to the fact that hydro energy resources can be stored, and their operations are highly flexible and can therefore respond quickly to demand. *Temperature* and *pressure* variables are also indicated as important to evaluate variation in energy demand. If the stakeholder's sample size was enlarged, then other parameters could be identified as relevant.

The skill of climate forecasts need to be compared to, and improved upon, current practices. An on-going validation exercise to benchmark the different approaches could therefore be a good starting point. One of the key challenges will be the introduction of climate forecast information into the existing operational tools of the energy management sector - for example, a temporal resolution of daily means is requested by the energy community, although climate forecast skill has, to date, only shown to be useful when using monthly means.

Hydro power management and demand forecasts are the key issues on seasonal/annual time scales. Current practises generally use a climatological approach: use of historical time series of precipitation and temperature in hydrological model, to make projections of how the initial water stocks (dams, snow pack in mountains) may evolve in the future. Hence, forecasts of temperature and precipitation are valuable if they are more skilful than this climatological approach.

The relevant spatial scale is the watershed for hydro but also the regional (sub-country)/national scale. The ideal temporal scale is daily (for demand in particular), but weekly information is enough for hydro power management.

Longer term projections/forecasts are important as well:

- How the annual water cycle will evolve? (More/less precipitation over the year, or a shift in the rainy/dry seasons inside the year).
- Will the interannual variability increase/decrease?
- How will the key variables evolve (mean, variability, distributions, extremes)? => temperature, precipitation, soil wetness indices.

Seasonal forecasts of wind and solar energy are not considered a primary issue, but they may become rapidly so, due to their fast developing ratio.

Temperature, mean temperature, precipitation, *sea surface temperature* and *wind storms* are the variables that are most important to the health sector. As confirmed also in the on-line questionnaire, stakeholders express high interest in capacity building activities, not just activities directly linked with climate parameters. For instance, they indicate education campaigns, spraying programmes to eradicate mosquito, and so on. In this sector, the seasonal forecast information should have a good level of certainty, allowing users to know the probability of exceeding a particular threshold and hence make the most appropriate decisions. In this regard, the role of media is considered important, as they can convey the right messages on what people need to do. Also a better collaboration between producers and users was considered crucial.

Contrary to the initial expectation, *downscaling* was not the first priority on the stakeholders' agendas. Stakeholders would prefer to invest resources in improving the large scale drivers rather than increasing the granularity of the data.

While climate predictions appear to be a potentially useful tool and while many sectors use them, the stakeholders expressed a huge need for education and training. This was one of the priorities identified by all stakeholders. Direct access to expertise through, for instance, sector specific workshops or seminars, is seen as a vital way of providing this basic training. Three groups requiring training were identified: (1) climate data providers; (2) impacts data providers; and (3) end-users (e.g., those managing/operating resources).

Despite the fact that a significant fraction of the audience was aware of the availability of climate predictions, and whilst some of the participants were using these predictions, there was a clear language barrier on a series of crucial definitions. The primary example of this was around the communication of risk and uncertainty. A number of stakeholders stated that they would not use the predictive information unless its level of confidence (not definition provided) exceeded 95%.

It is important to notice that some *gaps* indicated by stakeholders are only *perceived gaps*, as the information, unknown to them, is in fact already available. Examples of this include:

- Interpretation of confidence levels;
- Model outputs not bias-corrected compared to the observation data; and
- Communication on uncertainty/skill/predictability/windows of predictability/future improvements to all.

While improving the accessibility to the existing data can help the stakeholders, it is clear that some genuine gaps do exist. Some of those gaps can be easily taken into account within the EUPORIAS project, such as:

- tailored products and parameters at important stages of crop development;
- four-six month seasonal forecasts;
- statistical and dynamical downscaling to local level taking into account fine scale topography differences;

- integration with other food security relevant information for decision making;
- customised forecasts for user or business application; and
- interfaces with existing (early warning) systems, etc.