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EUPORIAS

(Grant Agreement 308291)

European Provision Of Regional Impact Assessment on a

Seasonal-to-decadal timescale

Deliverable 11.*3*

Online European User Interface Platform

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3	25/02/2016	Carlo Buontempo	Added further contribution and editing.

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1. Executive Summary

One of the most important and yet least developed component of the GFCS is the Climate Users Interface Platform. At front of its centrality in the structure of the framework, the development of this component has suffered from the existence of a series of pre-conceived ideas of what a users interface should look like. In an attempt to go beyond the state of the art, EUPORIAS promised in its description of work to develop and deliver an online users interface platform. Over the last few years it became more and more evident that an online tool that is not supported by a close interaction with the users tends to be of limited utility for the end users. For this reason EUPORIAS developed a CUIP that consists of two distinct pars. On the one hand there are the microsites, a collection of users' specific webpage describing the climate service prototypes that have been developed. On the other hand EUPORIAS also developed a series of workshop with the users which have played a pivotal role in scoping out the prototypes, their functionalities and interfaces. This paper summarises the process EUPORIAS has been through to define and deliver the CUIP. The paper also highlights a series of lessons we learnt through the process which we believe could be of value for those people who want to embark in a similar journey.

2. Project Objectives

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 operating on S2D timescales.	X	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. Introduction

EUPORIAS and the CUIP

The User Interface Platform as described by the GFCS provides the structure for users, researchers and providers to interact. It enables interactions to define user needs and provider capabilities, to reconcile the needs with the capabilities, and to promote effective decisions based on climate information. The User Interface Platform can facilitate the generation and delivery of what is needed for climate-sensitive decision making. It operates using a wide-range of methods designed to promote mutual understanding, including formally established committees, working groups, internship programmes, one-on-one discussions, workshops, conferences, and inter-agency interactions. There are opportunities to build upon dialogues such as the Regional Climate Outlook Forums and community liaison working groups. The GFCS states that the User Interface Platform should develop the following:

- *Feedback* from user communities;
- *Dialogue* between climate service users and those responsible for climate observations, research and information systems;
- *Outreach* to improve climate literacy in the user community through a range of public education initiatives and on-line training programmes;
- *Monitoring and evaluation* of progress made in improving climate services according to agreements between users and providers.

The development in recent years of IT systems has meant that a widely used way to disseminate the results of a project or to present new ideas is through an online platform. All research projects funded by FP7 and H2020 programmes of the European Commission are asked to develop and deliver a project website containing information about their activities, point of contacts, public deliverables etc. Webpages offer a very effective way to provide information from a provider to a diverse and distributed audience. Such characteristics have made webpages a

common delivery mechanism to provide weather related information to the general public. Think about how you usually access your favourite weather service providers and chances are you will be thinking about a web-based application.

For these characteristics web-portals have often been used to distribute climate data to users. There are a number of portals operating in or accessible from Europe which provide climate relevant datasets. These portals range from a simple collection on model outputs to an online toolkit able to process, annotate and plot datasets to meet specific needs. But climate data per se does not represent information, nor does it represent a climate service. To become informative and actionable the data needs to be put in the context of the users who will use it to inform decisions and/or policies. To make such a transformation it is often necessary to gain an in-depth understanding of the users, their planning and decision horizon and their environment. Such an understanding can seldom be gained solely through web interfaces. Face to face meetings and ongoing dialogue are often required. It has been recognised that person-to-person meetings help build trust, legitimacy and saliency into the service being developed.

This is an important point as it clearly goes against one of the premises of EUPORIAS deliverable namely the possibility to develop an online climate user interface platform able to address a number of defined sectors. Such a deliverable is also undermined, in its definition, by one of the results emerging from the project which is that is much harder to develop meaningful interfaces and services if the end-users and their decision are not well characterised. In a nutshell a generic portal of information is a useful way to address a variety of different users but it is not necessarily the best way to engage in depth with any of them.

EUPORIAS CUIP

In this short section we will explain the motivation behind our decision to develop a CUIP in a way that differ from what was originally written in the DOW. Deliverable 11.3 is described as an online European Climate User Interface Platform (CUIP) tailored for energy, tourism, water, forestry, health, transport, food security & agriculture, disaster risk reduction, and European support to developing countries.

As part of this deliverable we defined and developed a number of user-specific web-pages called microsites and collectively accessible through EUPORIAS website. At the same time we felt this only represented one of the many sub-components of the interface. In facts alongside the microsites we had a number of user-specific workshops. These had two main functions: on the one hand they served as co-design hubs where new service ideas could be developed and tested on the other hand they represented a way to engage with the users, understand their needs beyond those addressed by the prototypes and explore with them new opportunities whilst, at the same time, building capacity. In that sense EUPORIAS CUIP should be seen as the opposite of a generic climate information portal as it provides, through a series of channels, information which is only relevant to the users it targets.

It is not possible within a project of limited duration in time to deliver a climate user interface platform that can be considered operational. At the same time we feel it is not only possible but also fully within the scope of the project to describe what we learnt from the user interface experience.

The document is organised as follows. Section 4 describes the structure of the online component of the CUIP. Section 5 goes through all the climate service prototypes that have been developed as part of the project and describe the ways in which they interacted with the users and used the online component of the service. Section 6 goes through the case studies and describes how they interacted with the end-users. Section 6 summarises the lessons we learnt from the experience. Finally section 7 tries to draw some general conclusions and recommendations and section 8 lists the link we build in the process.

4. The online tool: the microsites

According to Wikipedia, a microsite is “an individual web page or a small cluster of pages which are meant to function as a discrete entity within an existing website or to complement an offline activity”. Besides, “the microsite's main landing page can have its own domain name or subdomain. The main distinction of a microsite versus its parent site is its purpose and specific cohesiveness as compared to the microsite's broader overall parent website.” Under these premises, a collection of microsites have been created and delivered under the EUPORIAS domain. In particular, all of them are gathered under the online component of the CUIP developed within the project, which can be reached here at http://www.euporias.eu/cuip

The five (six) microsites corresponding to the different EUPORIAS prototypes (case-studies) can be accessed by clicking on the blue (gray) icons displayed either on the map or in the table located below. These microsites are though as user friendly interfaces for demonstration and promotion of the services developed within the project to both general public and relevant decision makers.

Although each microsite has been developed to a different extent (depending on the status of the corresponding prototype/case-study), all of them share a common design and appearance, inheriting the visual identity previously created for EUPORIAS. Moreover, all of them have the same general structure, formed by the following four main sections (four corresponding tabs can be found on the upper right-hand side of the page), which fundamentally intend to:

- ABOUT: Provide a general overview of the prototype/case-study and present the institutions/people involved in its development.
- BENEFITS: Show the risks addressed by the prototype/case-study, the decision making process followed, its plausible business opportunities and

some vulnerability information.

- OUTCOMES: Disseminates the results from the prototype/case-study.
- RESOURCES: Announce the dissemination activities related to the prototype/case-study as well as other auxiliary information (FAQs, glossary, etc.)

In addition to the microsites, an API (Application Programming Interface) has been developed to ensure both data and results emerging from EUPORIAS can be shared and, whenever appropriate, used by others. This could really help to promote the project beyond its natural reach. This API can be used by the prototypes/case-studies in order to deliver their outcomes, both via the corresponding microsites or via external platforms. Additionally, this tool can also help the prototypes/case-studies developers to access the end-users' feedback by using the Eusurvey (https://ec.europa.eu/eusurvey) service. However, only the LMTool prototype is using so far this API in order to provide private access to short-time and seasonal forecasts to a number of farmers in SW England.

5. Climate service prototypes

LMTOOL*

http://lmtool.euporias.eu/

A short description of the prototype

The Met Office, the University of Leeds, KNMI (Netherlands) and other partners have worked closely with Clinton Devon Estates (CDE) and the National Farmers Union (NFU) to develop prototype seasonal weather forecasts for UK land managers. Seasonal weather forecasts (typically for 1-3 months ahead) are currently only skilful during the wintertime, so initial work on the prototype has focused on providing winter forecasts.

Production of the first draft forecasts during winter 2014/2015 was based around the UK contingency planners forecasts (CPF), which provide 3 month outlooks for temperature and precipitation for the UK as a whole each month, and we used a simple downscaling method to scale the UK forecasts to Devon. We provided these outlooks for the county of Devon, working with a small representative user group of farmers (4-5) from CDE, and collected feedback on them via email and post. The outlooks were provided each month from October to March.

During winter 2015/2016, we have been using the microsite to provide 14 day site-specific forecasts for temperature and precipitation alongside three month outlooks, across the wider area of South West England, working with a larger stakeholder group (about 20, covering both CDE and NFU).

Further work is continuing to develop a mobile app based on this service, and to further develop the forecasts based on feedback from the farmers, including:

a) additional weather variables (Tmin, Tmax, windspeed and direction)
b) improved presentation and
c) information on county-scale climatology and tercile categories to improve understanding.

The prototype has benefitted from considerable interaction with the users throughout the project.

The online component of the prototype and how it was used by the users

As described above, we did not use an online component for the prototype during the first winter for simplicity and because we were working with a small user group (4-5). However, we made, and continue to make extensive use of a collaborative wikidot site for project team communications such as meeting minutes and working documents.

During winter 2015/2016, we have moved to providing our forecasts (14 day and 3 month) via a web microsite http://lmtool.euporias.eu . Initially this was via a static page for the 3 month outlooks, updated manually on a monthly basis, following the Met Office seasonal forecast meetings. 14 day forecasts are provided via an interactive map (and updated every 6 hours), with forecasts run at the Met Office producing archive files which are retrieved and processed to produce graphics files, transferred to the microsite via ftp.

The 14 day forecasts are now provided via an API (Application Programme Interface), and hence the Met Office transmits data to the API in JSON format (currently via ftp). Ongoing work will include the 3 month outlooks into the API.

Ongoing work is also developing a mobile app based on the prototype services. The users received a login to access the website, which was also used to gather feedback on forecast content, relevance (use) and understanding via SurveyMonkey, which will probably move to EC-survey once the API is fully implemented. Initial statistics show the website has been accessed up to 400 times a day (given about 20 users). The users interact with the website both on mobile devices and via desktop PCs.

Interactions with users

Figure 1 illustrates how we interacted with users in the project.

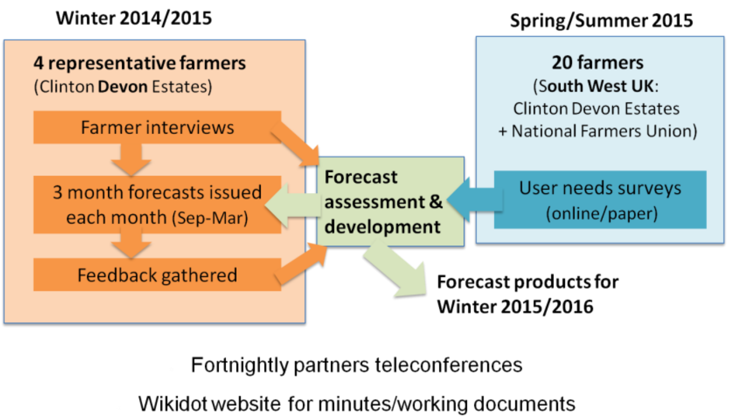

Figure 1: Summary of approach and progress in the land management prototype

In brief, we:

- interviewed a representative subset of CDE farmers on their needs for weather information
- developed a draft three month forecast and sent this to the farmer subset each month during winter 2014/2015
- provided background information on our prototype for the microsite (http://lmtool.predictia.es/en/)

- surveyed a wider group of farmers from CDE and NFU on their needs for long-term weather information to support decision making, and on their preferences for visualisation, and held a workshop to then
- Built on findings from stakeholder engagement and feedback on our draft forecasts to develop a second version of the forecast for winter 2015/2016.
- Begun to provide 14 day forecasts and three month outlooks via our microsite (http://lmtool.predictia.es/en/content/euporias-lmtool-forecasts-south-west-england - login required)

As noted above, feedback was gathered via workshops and hard copy/email forms, and later by online surveys in SurveyMonkey.
CDE were chosen as an initial stakeholder due to their proximity to the lead partner, making interaction easier, and their wide-ranging interest in land management activities. Several scoping meetings were held initially with CDE, with high-level management contacts, leading to CDE identifying a representative group of farmers for the project team to work with, and a lead contact at CDE. We agreed with CDE to extend the focus of the project during the second winter, to both include a wider range of CDE contacts (voluntary invitation from the project team) and from NFU (approximately 12 contacts provided by a central NFU colleague).

In general, the stakeholder engagement work (feedback forms, interviews and survey) found the following:

Interest in more specific variables (temperature, rainfall, rain/dry days/spells, heavy rain events, wind speed and direction)

Interest in more local, shorter-term forecasts alongside three month outlooks

Requirement for delivery via a website, and/or app

Poor understanding of the three month outlooks, if unfamiliar with them, and not explained in detail

LEAP
http://leap.euporias.eu/

A very short description of the prototypes

The LEAP-Ethiopia prototype uses seasonal hindcast simulations to assess the added-value of using seasonal predictions in food security drought early warning systems. The Livelihoods, Early Assessment and Protection (LEAP) system is the Government of Ethiopia's national food security early warning system, established with the support of the World Food Programme and the World Bank in 2008. LEAP was designed to increase the predictability and timeliness of response to drought-related food crises in Ethiopia. It combines early warning with contingency planning and contingency funding, to allow the government, WFP and other partners to provide early assistance in anticipation of an impending drought.

The LEAP early warning tool uses crop and weather information to monitor crop conditions and estimate the number of people, by region, projected to be in need of early livelihood protection in the face of an impending drought. Resources can then be disbursed, in a timely and transparent manner, from a contingent fund. This enables the immediate scale-up of Ethiopia's national Productive Safety Net Programme (the PSNP) to provide early assistance to the additional people at risk of food insecurity this year, as well as to existing safety-net beneficiaries requiring additional months of assistance. By providing early and objective estimates of the expected magnitude of humanitarian needs, LEAP helps increase both the speed and the transparency with which food assistance can be provided to people in need.

A description of the online component of the prototype and how this was used by the users

Being a tool used by the Government of Ethiopia, which provides politically sensitive information on the food security and humanitarian needs of the population, the online component of the prototype is not well suited to cater the needs of a wider public, by providing them access to such data. Currently, the plan is to provide online the hindcast validation results, not the actual beneficiary needs data. Such hindcasts validation result will provide an indication on the accuracy of using the LEAP forecasts.

A short description of the interactions you had with your users

A series of meetings and workshops were held in the first year of the LEAP EUPORIAS prototype to present the idea of seasonal forecasts to the major stakeholder of the tool: the Ethiopian Government. During the first year, positive feedback was obtained from the Disaster Risk Management and Food Security Sector of the Ministry of Agriculture, on the potential of LEAP seasonal forecast in improving the time of response to drought emergencies in Ethiopia. Another major workshop has been scheduled a series of time to be held in Addis Ababa to dig in

more details the specific activities, besides the prepositioning of food assistance and the earlier procurement, that could be positively influenced by seasonal forecasts. These activities can be wide ranging, and might include activities such as changing cropping patterns, investing in soil and water conservation measures, or installing water infrastructure. Unfortunately, due to the current emergency humanitarian situation, it has currently been impossible to hold such workshop so far.

RIFF

http://riff.euporias.eu/

A short description of the prototype

By providing river-flow forecasts at key period to anticipate the evolution of water-stocks, RIFF aims to help stakeholders manage water resource better and reduce both drought and flood risks.

RIFF is based on a forecasting system, built on a refined hydrological suite, forced by seasonal forecasts. It produces probability forecast of river flows at different lead-times and for specific stations along the rivers. River flow forecasts are tailored to fit critical thresholds, during the crucial seasons when decision making processes are established.

Thanks to specific stakeholder meetings, the stations and critical thresholds have been defined in liaison with stakeholder warning system and decision making processes (warning or crisis thresholds). The crucial decisional periods are typically May/beginning of June for the low flow period and the end of Winter/beginning of Spring for the reservoir refilling periods.

See microsite for more explanations or illustrations: http://riff.euporias.eu/en

A description of the online component of the prototype and how this was used by the users

At this stage of the development, tailored products was only provided to stakeholders in a replay mode using hindcast dataset of the seasonal forecast models. Stakeholders have worked on past situations, using different graphical documents adapted to their decision making protocol and procedures. As they do not use impact model for decision making, they don't really need dedicated tools for disseminating data. During the last year of the project, we will be mainly working on the implementation and the real- time use of RIFF prototype with our stakeholders.

To diffuse them RIFF products, we think to use our dedicated seasonal forecast website (http://elaboration.seasonal.meteo.fr/), having functions available to configure specific interface for one user (list of menu and products)

Our main idea is to develop online seasonal climate services from the model of climate change services as French portal DRIAS (http://www.drias-climat.fr/) including in a same website, areas for education (e.g. “what is seasonal forecast ?”), discover (i.e. our products and their reliability) and data dissemination (i.e. real time products but also maybe current bulletin on seasonal forecast).

As operational seasonal forecast producer, we are convinced it is very important to think about the way to "accompany" stakeholders for using seasonal forecast products in real time.

A short description of the interactions with the users

For RIFF prototype, we are mainly working with two stakeholders (Seine Gd Lacs and SMEAG) with monthly meetings (or conference call). Their identification was done at the start of the project both for the DMP sensibility to climate impacts at seasonal scale time and availability to devote time with us to experiment new methods and products. Meetings had used first to understand in details their DMP and explain what SF could bring them. Later, we defined together tailored products adapted for their use and calculated specific scores. We provided them products for past situations and evaluated their feedbacks. Currently, we are preparing the implementation of real time experiment both in terms of products, update frequency, documentation avaliability and training need. The evaluation of this stage will be achieved in next September.

SPRINT

http://sprint.euporias.eu/

A short description of the prototype

As recent years have demonstrated, wintry conditions have a significant impact on most forms of transport in the UK and Northern Europe.

Recently it has been discovered that skilful predictions of the likelihood of occurrence of cold air outbreaks in winter can be made at lead times of weeks to months. Met Office scientists have been engaging with a transport stakeholder group coordinated by the UK Government's Department for Transport (DfT) about the predictability of winter conditions at seasonal timescales, and providing risk-based forecasts to these transport stakeholders with the aim of enhancing their winter preparedness and resilience.

A key element of winter operations for many transport stakeholders is the de-icing of vehicles and surfaces. The information in this prototype is intended to assist stakeholders with pre-season decisions around de-icing, including stock levels, training and availability of personnel, and availability and condition of de-icing equipment. In-season updates to forecasts could also potentially support in-season decision making. As well as de-icing, information is also provided to support users who are interested other relevant transport impacts such as incidents and delays/cancellations.

A description of the online component of the prototype and how this was used by the users

The online component of the prototype summarises its aim and the primary decision-making process it is designed to support, plus relevant links to past high-impact winter weather events. Users have not seen the online part of the prototype yet – we have communicated with them primarily via workshops, email and teleconferences (see below). We intend to show the users the website at a workshop we are having in March (also see below).

A short description of the interactions with the users

The user group is coordinated by DfT. All members are invited to participate in monthly update teleconferences, are provided with briefing material beforehand in case they cannot attend (or wish to read in advance), and then are issued with a short survey after each teleconference. It is difficult or impossible to act upon some elements of feedback (e.g. "the uncertainty on the forecast needs to be smaller"); however, other feedback can be taken into account (e.g. offering them two formats for the forecast and issuing the one they prefer).

In July 2014 we held a workshop with the users to familiarise them with seasonal forecasting and encourage them to think about how it might be of use to them. In March 2016 we expect to hold a further workshop, where we will review the prototype service that we have developed and trialled with them, and ask them to evaluate the service they have received and suggest possible ways to improve it.

RESILIENCE

http://resilience.euporias.eu/

A short description of the prototype

Predicting the future variability of energy resources beyond the first two weeks can allow end users to take justified, precautionary actions with potential cost savings. Current energy practices use an approach based on a retrospective climatology. Recent advances in global climate models that simulate the physical processes that govern the whole climate system demonstrate that probabilistic forecasting can improve upon the current methodology at some spatial and temporal scales (Doblas-Reyes et al. 2013).

RESILIENCE is a semi-operational prototype that aims to provide robust information of the future variability in wind power resources based on probabilistic climate predictions. To reach this objective the RESILIENCE prototype will operate at seasonal time scales providing seasonal wind speed predictions for the energy sector.

RESILIENCE's predictions are based on the calibrated seasonal near-surface wind speed from on the ECMWF Forecast Prediction System-4 data. These predictions have 51 ensemble members. The semi-operational launch of the prototype includes the predictions for the boreal winter in 2015 (December 2015- February 2016) that have been initialized on the first of November.

To evaluate if RESILIENCE is able to provide better information than climatology, the simultaneous predicted and observed values are compared over the entire period (1981-2014) with a skill score: the Ranked Probability Skill Score (RPSS). This skill score is very useful in order to assess how was the performance of RESILIENCE predictions in the past and guide users about the performance of the future forecasts.

By developing this semi-operational prototype, the EU-funded project EUPORIAS wants all interested parts in the wind energy sector to visualize how this novel methodology could impact in their decision-making processes and ultimately encourage them to use it.

A description of the online component of the prototype and how this was used by the users

The seasonal prediction addresses a long list of challenges to produce climate information that responds to the expectations of the users. One of the objectives of the prototype is to develop a user-friendly interface to show seasonal predictions tailored to users' needs.

The operational wind speed prediction for winter 2015/2016 (Dec 2015 - Feb 2016) is available on-line in a visualization interface called Project Ukko:

http://www.project-ukko.net

Project Ukko is the product of the close collaboration between cutting-edge science and big data graphic designer. It is an interactive visualisation interface for wind industry users to explore probabilistic wind speed predictions for the coming season provided by the RESILIENCE prototype. The aim is to support users to better understand the future variability in wind power resources and bridge the gap between energy practitioners and the climate science community.

Figure 2 a web capture of project ukko interface

Project Ukko is designed for energy users, in particular for energy traders, who need to understand how wind will change in the coming months. The web application at http://project-ukko.net allows to spot global patterns and trends in future wind conditions through the World map with data overlay, and drill into detailed prediction breakdowns on a regional level in the Detail Panel. The characteristics of the information shown in the interface are detailed below.

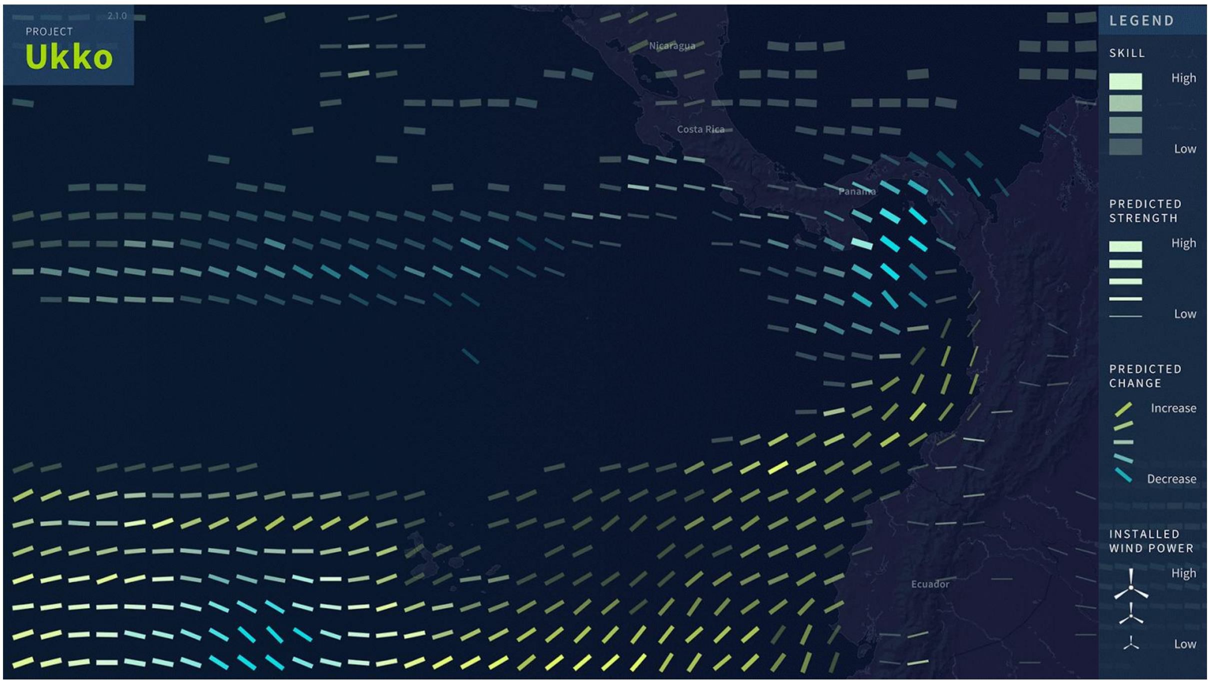

Figure 3 a world's map with the overlay used in project UKKO

World map with data overlay

The user interface presents a thematic map with wind prediction data visualized in line symbols (multi-dimensional glyphs) for around 100,000 regions of the world.

These encode a number of dimensions in parallel:

- Prediction skill (i.e., how well the prediction model performed on historic data in that region) is expressed through opacity. Regions with higher skill values are more opaque, regions with lower values more transparent. in order to facilitate readability, the opacity values are binned into 4 discrete steps based on the quartiles of the skill distribution. Only lines that represent areas with skillful forecasts are visible at all.
- Predicted wind speed is encoded through line thickness. The line strength is directly proportional to the average predicted wind speed.
- Predicted category of wind speed in line tilt and color. Yellow lines pointing to the top right indicate a high probability of increased winds, blue lines pointing bottom right, a high probability of reduced winds. Encoding trend in line tilt and color (a so-called redundant encoding) has the benefit that in zoomed out view, the colors provide a good overview of the trend situation, while in closer views, the tilt is readable more precisely.

This combined data display allows drawing the viewer’s attention immediately to spots with strong indications of significant changes in wind speed.

In addition, the available wind power production capacities can be visualized on the map, in order to compare future wind conditions with the presence of wind farms. Turbine icons of varying size show the location of wind farms and the overall installed power facilities according to the database provided by [windpower.net.](windpower.net)

Selecting a region opens a panel with additional information, such as the past 30 years of wind observations in the region, the full distribution of 51 prediction results computed, the detailed skill level as well as the wind power capacity installed.

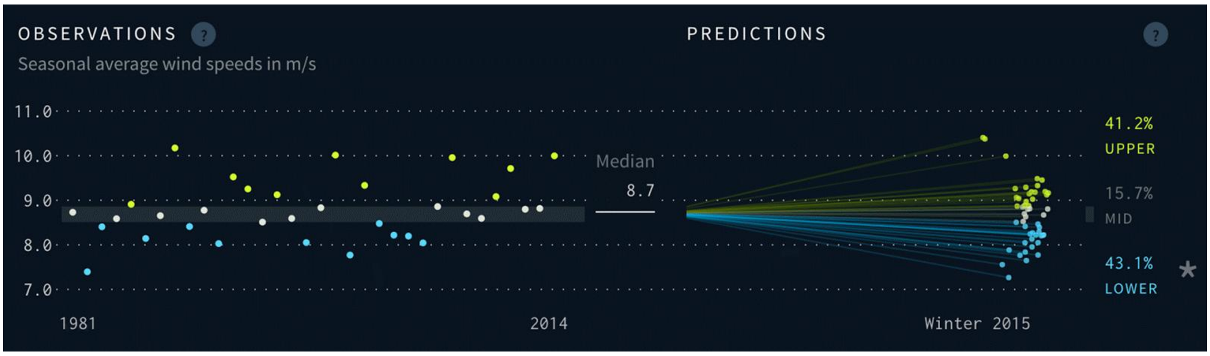

Figure 4 the plot that appears in the detail panel of project UKKO

Detail panel

Selecting a region opens a panel with additional information, such as the past 30 years of wind observations in the region, the full distribution of 51 prediction results computed, the detailed skill level as well as the wind power capacity installed.

Observations plot

The observations plot summarises the mean wind speed observations in the selected geographic region over the last 30 years, in the respective season. Each observation is color coded and split into three categories of equal size (terciles) that indicate if that year had low (blue), medium (grey) or high (yellow) wind speeds.

Prediction plot

This diagram presents the predicted values of the 51 ensemble members obtained by the RESILIENCE prototype. These values comprise the calibrated probabilistic prediction for the selected region. The ensemble predictions are displayed as a cone of rays emanating from the typical (median) value of the historic data, allowing a quick judgement of variance among the predictions, and the central tendency.

Skill

Skill is also numerically represented in the chart as a percentage.. A (hypothetical) score of 100% would indicate a perfect prediction and a score of 0% would indicate that the prediction is no better than just making a guess based on historic data.

User interactions

Understanding and quantifying wind resources is a key element to multiple user profiles in the wind energy sector both in pre and post-construction with requirements at different temporal scales. Manufacturers, O&M teams, project developers, project investors, consultants and energy trading companies are some of the types of users that already have shown their interest in seasonal to decadal prediction products and particularly in the outcomes of the RESILIENCE prototype on wind speeds.

Identification of users:

Throughout the EUPORIAS project many types of energy stakeholders have been involved in providing information for the development of the prototype. One of the most effective methods to identify and interact with users has been face-to-face meetings.

In order to design and later assess the usability of the RESILIENCE prototype we have contacted, met and interviewed representatives of a range of companies and organizations involved in the Spanish and European energy network operations (EDPR, EDF, Alstom, Iberdrola, EnBW, MeteoLogica, AWS Truewind or Vortex among others). All the stakeholders contacted were willing to provide information on their climate information needs, test the prototype and provide feedback although some were more proactive in providing feedback and requesting additional information.

Most of the interviewed agreed in the diversity of user profiles and information needs in the energy sector, even within the same company, which led to new contacts and meetings with other departments that had a different perspective regarding the relevant temporal and spatial resolution and climate variables.

Workshops and presentations in professional conferences:

The RESILIENCE prototype and the online visualisation platform (Project Ukko) have been presented to energy users in a number of industry-led conferences (e.g. EWEA annual events or workshops on resource assessment). Besides oral presentations or posters, a number of workshops were carried during these events. Organizing meetings during relevant external events or initiatives organized by the wind energy industry maximises the probabilities of engaging users not usually linked to the weather and climate research communities.

User Interface Platform Evaluation:

To evaluate Project Ukko, the first approach was the direct interaction and demonstrations to users to hear their comments and feedbacks that later could be

included in the development of the platform. However, a systematic approach for evaluation is highly advisable. When a stable almost definitive version was ready (v.2.1.0) a specialist evaluator from the City University London carried out Project Ukko evaluation based in the interaction with 5 potential users and reported the results in a “User Evaluation Report”. Each of these users was asked to explore the interface while thinking-aloud performing realistic tasks. The questions aimed at probing their understanding of the prototype.

HSFS

http://hsfs.euporias.eu

A short description of the prototype

The Hydrological Seasonal Forecast System (HSFS) is a climate service prototype aimed primarily at the hydropower industry in Sweden. Hydropower accounts for approximately 45% of the country's annual energy production, however the natural availability of the water resources necessary for operations are not only asymmetrically distributed through the year but and also they are out of phase with demand. During the colder winter months, when the energy demand is higher, reservoir recharge is limited due to any precipitation being stored in the catchments in the form of a snowpack. This stored water is later released in a relatively short and intense flood during the spring. The task of reservoir operators is to sequester water from these spring floods for later use when resources would normally be limiting. The key stakeholder decisions targeted by the prototype are how much reservoir capacity needs to be made available to receive the coming flood and by when.

The HSFS prototype was developed to provide ensemble forecasts of the spring flood volume (SFV) and spring flood onset-timing (SFT). The prototype is a multi-model system that employs both traditional rainfall-runoff modelling and the downscaling of large scale climate variables to forecast the SFV (figure 1). There are three model-chains,

1) A rainfall-runoff model driven by bias corrected seasonal forecasts of precipitation and temperature data from a numerical weather predictor or climate model.
2) A rainfall-runoff model driven by analogue precipitation and temperature data selected from historical data. The analogues are selected from a historical time series of precipitation and temperature for the region and season. The selection is done by comparing the phase and persistence of selected climate indices in the months leading up to the forecast date with the corresponding period in the historical data set.
3) A statistical model that uses large-scale climate variables, such as geopotential, heat flux and precipitation fields, and regional snowpack data as predictors to forecast spring flood volumes.

The outputs of the three models are pooled together to make the final multi-model ensemble forecast of the SFV. The daily values from the first two model chains are used to estimate the SFT ensemble; the statistical model chain does not forecast SFT information.

Forecasts are provided in two different formats. A boxplot of the SFV forecast ensemble plotted together with the climatological tercile thresholds and the

percentages of the ensemble members that fall into the different terciles (figure 2). The second is the 'Onset-Volume Box', a two-dimensional boxplot relating SFT information on the x-axis and SFV on the y-axis, plotted together with the individual hydrograph 'spaghetti-plots' (figure 3).

A description of the online component of the prototype and how this was used by the users

As the HSFS is aimed at the hydropower industry there are limitations to what can be published publically. Due to this there has not been an online aspect to the operational forecasts issued to the end users. However, a large unregulated tributary to one of the hydropower rivers has been selected to show case the HSFS online. Operational forecasts as well as hindcasts for the period 1981-2015 will be published online starting in April this year.

A short description of the interactions you had with your users

SMHI has had a long working relationship with the project stakeholder Energiforsk (formally ELFORSK. Research into improving hydrological forecasts for hydropower has been an ongoing cooperation for many years. Due to this historical relationship SMHI invited Energiforsk to be a stakeholder partner within EUPORIAS. Energiforsk decided to financially support the development of the HSFS based on results from previous studies and the opportunities offered within the EUPORIAS project. Contact between SMHI and Energiforsk has been regular during the project. This contact has been in the form of progress meetings and annual workshops where research results are presented to both the stakeholders and other members of the hydropower industry. The Water Regulation Authority, a company who are responsible for the management of the reservoirs in the seven of the largest hydropower producing river systems, will test the HSFS operationally parallel with the current seasonal forecast system. To this end SMHI will be incorporating the HSFS into the operational forecasting environment during the 2016. It is anticipated that the HSFS will become a standard product to compliment and possibly even replace some of the existing forecast products aimed at the hydropower industry.

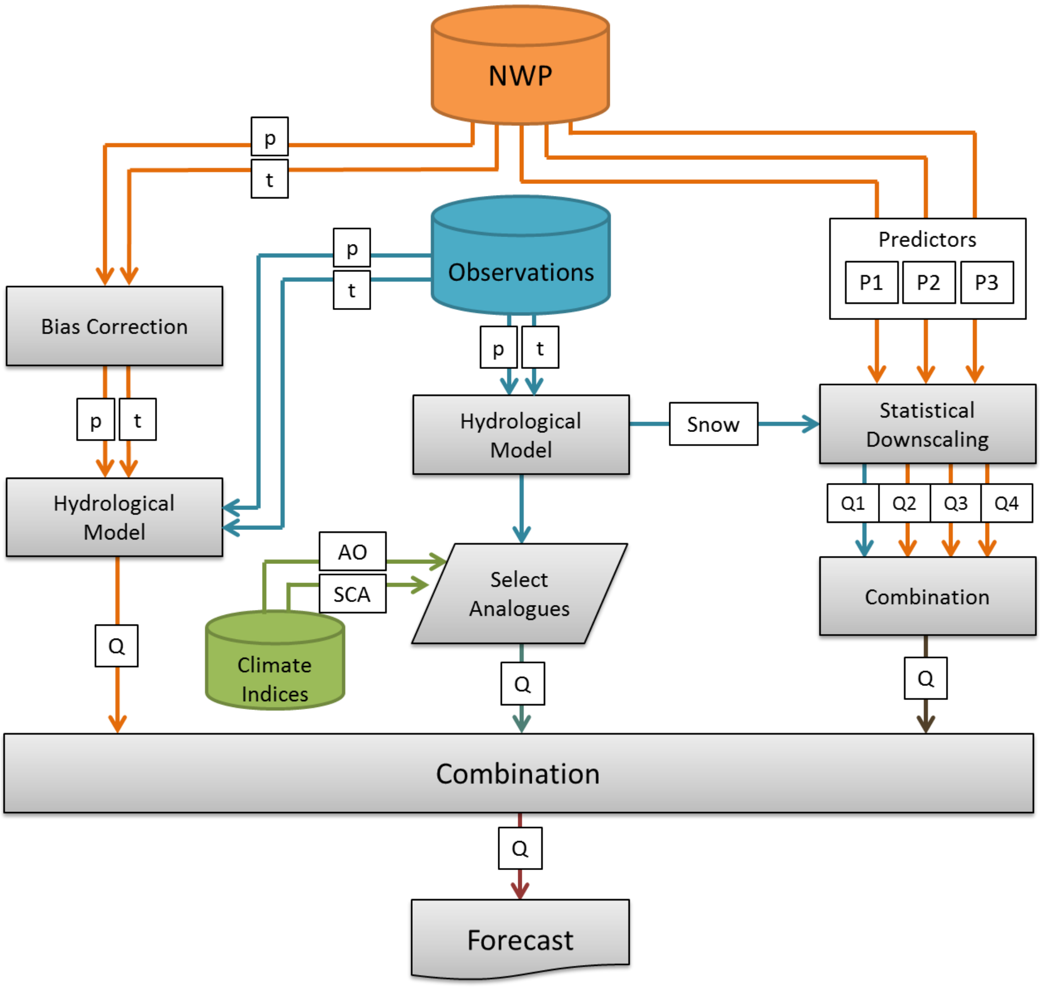

Figure 5. A schematic diagram of the HSFS modelling chains.

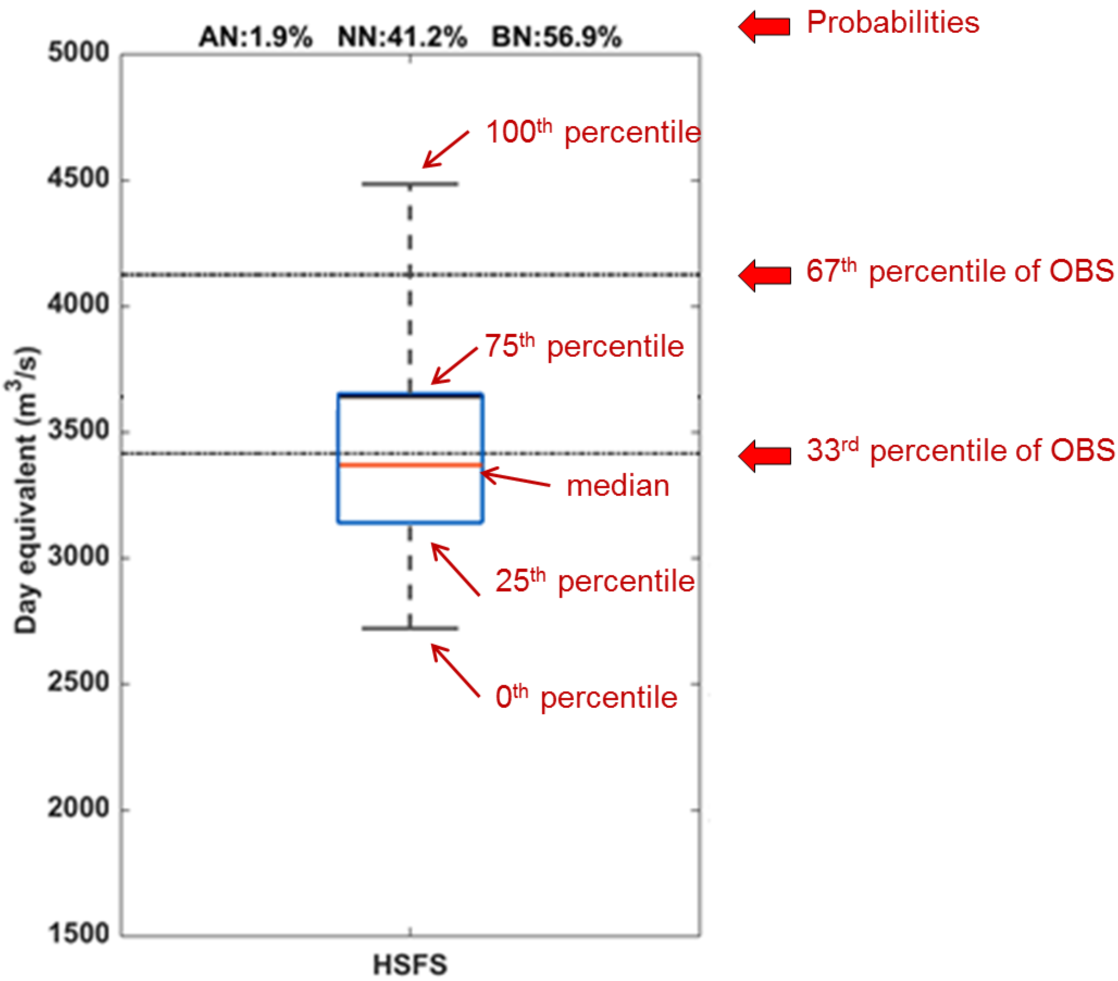

Figure 6. The SFV boxplot forecast presented with the climatological tercile thresholds. The probabilities for a Below Normal (BN), Near Normal (NN), and Above Normal (AN) SFV based on the forecast ensemble are given above the boxplot.

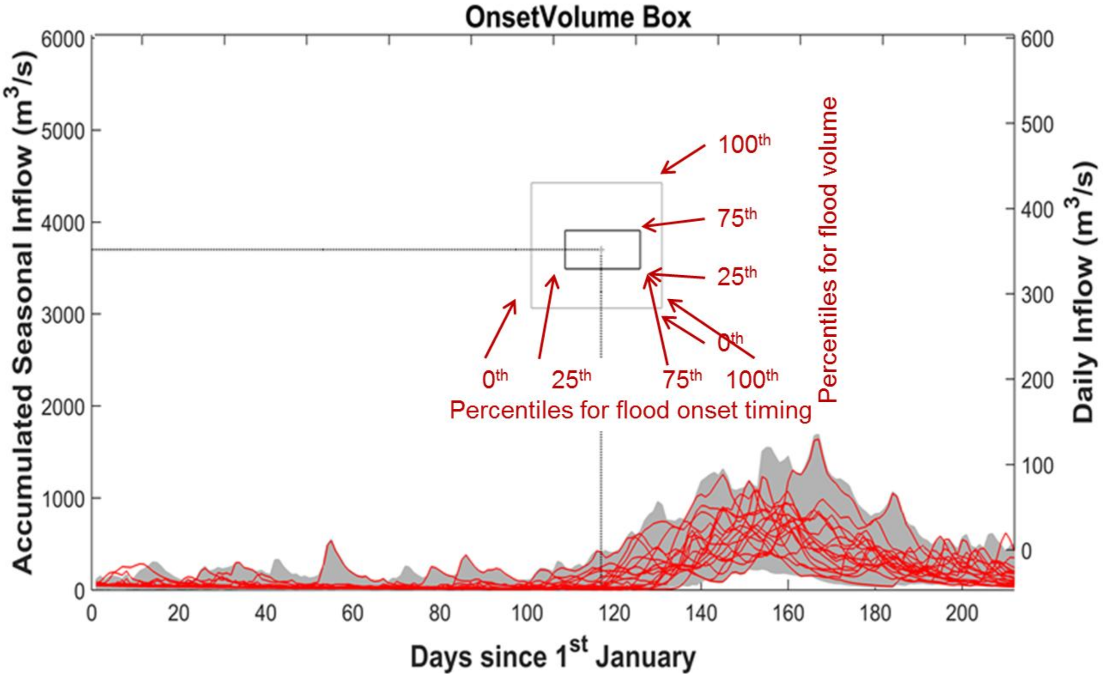

Figure 7. The Onset-Volume Box forecast. The box above the 'spaghetti-plots' give the two-dimensional boxplots relating SFT information along the x-axis and SFV information along the y-axis. The 'spaghetti-plots' are the individual ensemble seasonal hydrographs from the two rainfall-runoff modelling chains. The SFT information is derived from these 'spaghetti-plots'.

6. Case studies

CMTOOL

http://cmtool.euporias.eu

A short description of the case study

The CMTOOL case study illustrates the potential for climate services for health in Europe by offering probabilistic mortality forecasts over Europe. It is the result of the collaboration between the Catalan Institute for Climate Sciences (IC3) and the World Health Organization (WHO). The predictions are based on temperature forecasts (1–3 months ahead) to support decision making for the preparedness of health services and protection of vulnerable communities ahead of future extreme temperature events. We believe that better information on future extreme temperature related mortality will support public health agencies in making better decisions on health care provisions and therefore help to justify the additional resources involved (medical staff, beds) and avoid unnecessary loss of human life.

To formulate the prediction model, daily mortality data corresponding to 187 regions across 16 countries in Europe were obtained from 1998–2003. Data were aggregated to 54 larger regions in Europe, defined according to similarities in population structure and climate. Location-specific average mortality rates, at given temperature intervals over the time period, were modelled to account for the increased mortality observed during both high and low temperature extremes and differing comfort temperatures between regions. Model parameters are estimated in a Bayesian framework, in order to generate probabilistic simulations of mortality across Europe for time periods of interest. By replacing observed temperature data in the model with forecast temperature from state-of-the-art European forecasting systems, which are being developed in the EUPORIAS project, probabilistic mortality predictions could potentially be made several months ahead of imminent heat waves and cold spells.

Via interviews and participation in high level policy meetings we have engaged with stakeholders from the national level (head of department of health) to the local level (medical doctors) to establish their needs and preferred format for visualising probabilistic predictions of mortality risk. Ultimately, we hope to extend this climate-mortality prediction tool to a wider geographical domain, beyond Europe and to extend the model to account for heat and cold stress in animals, as part of a integrated 'one health' approach.

PROSNOW

http://prosnow.euporias.eu/

A short description of the case study

Snow falls and snow level seasonal forecast system for ski resorts in the French Alpine area

The level of activity, employment, turnover and profit of hundreds of ski resorts around the Alps depend on snow falls and associated snow levels, highly variable in space and time. By nature seasonal, winter tourism is also affected by a high inter-annual variability, which makes all the more important the improvement of seasonal forecasts.

PROSNOW service delivers a seamless sub-seasonal to seasonal snow prediction system specifically tailored for the ski industry in the Alpine area. This service contributes to a better management of ski resorts and overall better anticipation capabilities of stakeholders at play.

PROSNOW covers time ranges not addressed by operational weather forecast information, which is already widely used by mountain professionals. Two main types of information are delivered: information about the future meteorological conditions, and information about snow conditions on the ground (natural or accounting for snow managements techniques such as grooming and snowmaking). In both case, long-term in-situ observations is used to carry out statistical adaptations of the raw forecast model. Due to potential misuse of such forecasts by individual customers, the access to the system is limited to tourism professionals.

Interactions with the users

As a first step, in the process of selection to study the tourism sector, it was decided to try and capture a diversity of actors, issues and intervention scales, without claiming any representativeness. The selection was made using networks, experiences and previous involvement of stakeholders in others research projects. 8 interviews have been conducted:

- NGO (1) operating at a European level (federation of tour operators and associations for the promotion of sustainable tourism);
- National consular chamber (1);
- Private actor (accommodation chain) (1);
- Regional and departmental public operators (engineering, promotion and communication of destination) (3);
- Local public operators (ski resorts) (2).

We interviewed key contacts of the organizations that can have a direct influence on the decision-making processes. All interviewees were directors of the structure or in a management-level position with a very good technical background.

For the PROSNOW case study, we contacted again the stakeholders that were involved in mountain tourism, as they had already been informed of the EUPORIAS project and had expressed their interest.

In a second step, we identified two reference stakeholders, (Rhône-Alpes Regional Tourism Agency and Savoie Mont Blanc Tourisme), both public operators (regional and departmental) for engineering, promotion and communication of alpine destinations. They contributed on the first draft of the PROSNOW prototype.

In a last step, we organised a 1-day workshop in Grenoble, gathering those reference stakeholders and a ski resort manager that had already been interviewed with climate and weather experts (researchers) in order to discuss the needs of the sector, the technical, scientific and economical feasibility of such a service and the details of the PROSNOW prototype. The minutes of this workshop has been the basis of the case study.

SCLIMWARE

http://sclimware.euporias.eu

A short description of the case study

This water management system to help the decision making processes in the water sector has been developed by a team headed by AEMET (the Spanish Meteorological Agency), CETaqua and the DGA (the General Directorate for Water of Spain) making use of the predictability of the winter precipitation in Spain at seasonal scales and new water management and modeling tools.
A probabilistic forecasting statistical model has been implemented to forecast the reservoir inflow in winter. In the first days of November, a probabilistic seasonal forecast of the inflow for the period December-January-February is issued for each reservoir in the project. This forecast is then ingested by SIMRISK, the water management tool to simulate and analyze different possible scenarios. This tool produces a risk evaluation for each reservoir based on its initial situation, the forecasts and the historical demands. Finally, the water managers, based on this risk evaluation, can take different actions to mitigate the risks.
With this system a detailed analysis of the past situations has been carried out on the Cuerda del Pozo reservoir and the results show that this methodology could help in the management of the reservoir and the reduction of drought risks.

The different agents in the prototype keep regular online meetings to coordinate the activities of the project. At them, the users and the project team interchange their views and thoughts about the outcomes and processes in the project.

To identify the different users interested in the project, a workshop on water management took place in Madrid on March 2014 and the main actors involved in water management in Spain were invited to attend. Then a first work group leaded by AEMET, CETaqua and the DGA started the project and some water managers joined it as users. Since then, the interaction with the users is carried out by regular online meetings in which the course of the project is decided.
Once a year a workshop is carried out to show the achievements of the project, invite new users and stakeholders and design the new project guidelines.

SOSRHINE

http://sosrhine.euporias.eu/

Short description of the case study

Periods of critical high or low water-levels of major waterways significantly affect their navigability and thus the logistic capacity of waterway transport systems. Especially for the River Rhine as one of the most important waterways in Europe the potential economic damage due to extreme low flow conditions can be immense. Early information on periods of extreme streamflow conditions offers the possibility to optimize the fleet structure of shippers as well as the stock management of enterprises. This refers to a timely rescheduling of the transport-timing or the arrangement of multiple smaller ships in times of lower water-levels to execute the transport efficiently.

Reliable seasonal streamflow forecasts have therefore great potential to become a valuable tool for medium-term to long-term waterway-management and the planning and optimization of the water bound logistic transportation chain. The hydro-climate service products will be seasonal streamflow forecasts which are calculated using downscaled and bias-/drift-corrected hydro-meteorological seasonal forecasts as input for the hydrological model HBV. The skill of the seasonal streamflow forecasts is systematically analyzed for relevant gauges representing different hydro-climatological regions and relevant hydrological parameters with special focus on the needs of the inland waterway transport. The results of the climate service will be user-specific information and warnings on critical water-levels for the coming months provided by the Federal Institute of Hydrology (BfG) and the German Meteorological Service (DWD) to advice the ministries of transport and environment as well as the Water and Shipping Administration.

7. LESSONS LEARNT

There are a number of lessons we have learnt through the experience of the CUIP that we feel it is important to capture so that others can build upon our experience. EUPORIAS, as any other research project, had some constraints and thus within the great flexibility we had throughout the project we faced some limitations. One of the most evident contraints was related to the time-scales of relevance. By design, EUPORIAS was built around the seasonal and the decadal time-scale. This decision was taken prior to any discussion with the user and thus represented a constraint the users could not modify. Within this hard constraint we realised it was important to build ways to bridge the different timescales. In particular within the LMTOOLS the feedback from the users suggested to link the seasonal predictions with the 15 days forecasts as these proved to be, unsurprisingly, much more relevant to the farmers than the climate predictions and thus increased the relevance of these latter.

Within climate services it is often said that there is a need to work with the users to listen and understand their needs. Whilst this probably represents a good starting point the experience of the CUIP suggested it is not only a question of listening to the users and giving a feedback to the developers, but to gather them around the same table and discuss about what is useful, likable, feasible. This helps the developers to go a little further than what they initially had in mind and it helps the users to understand why some of their needs cannot be fulfilled.

Although to develop a service there is a need to have a well identified user on the one side and a technical capabilities on the provider side it is also fruitful to involve in the development people who are neither directly involved in the sector nor climate experts, as these can bring new disruptive ideas, question the decision-making process and help to integrate new information.

While Europe is moving towards a market of climate services it is important to understand and account for the needs of the markets. For example, we developed the microsites and the API but some of the users were worried about sharing sensitive information on these platforms as they felt some of their competitors could have used them to gain commercial advantages. Developing tools that allow users to upload their data and get the answer they need without sharing their data with third parties could be a possible way forward.

8. Links Built

Building links between users and stakeholders is a key component of the CUIP rather than a by-product. For this reason we are not presenting here the links each team developed with the users they were specifically targeting. In developing the prototypes and the CUIP a number of new collaboration have emerged. For example Moritz Stefaner worked with BSC, Met Office and FE to develop the visualisation used in project UKKO. Similarly Stephann Makri worked on the evaluation of the usability of project UKKO as a user interface.

Links have also been build with WMO RCOF (SEECOF, PRESANORD, and MEDCOF) where the concepts behind the CUIP and the prototypes were had been presented by Carlo Buontempo.