EUPORIAS

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EUPORIAS

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EUPORIAS

European Provision Of Regional Impact Assessment on a

Seasonal-to-decadal timescale

Deliverable D42.1

Report summarising the (expected) usefulness of selected prototypes

Date Submitted: 31st October 2014

Deliverable Title	*Report summarising usefulness of each prototype*	
Brief Description	*This report is summarizing the (expected) usefulness of each prototype, the communication strategy and the strategy to manage the flow of information from producers to decision makers.*	
WP number	42	
Lead Beneficiary		
Contributors	*Prototype Leads : S. Calmanti, JP. Céron, M. Davis, P. Falloon, K. Foster, E. Palin, E. Pope, P Newton* *WP leader : C. Buontempo*	
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Vf	31/10/14	JPC & CB	Final version

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1. Executive Summary

The EUPORIAS prototype climate services represent one of the main outcomes of the project. As expressed in the DOW, the prototypes are intended *to be a way of demonstrating how climate information can be made relevant and useful by tailoring it to the needs of well-identified decisions of specific users. To ensure that such a tailoring takes place; EUPORIAS has adopted a non-standard approach and selected the prototypes through an internal competition based on a set of well-defined criteria and the advice of an external panel of experts. The selection process took several months to complete and has resulted in the selection of five prototypes covering sectors as diverse as freshwater management for Paris, and international food aid. In parallel, EUPORIAS has decided to support a series of case-studies covering some of the proposals that did not get selected as prototypes and also to explore the possibility of a prototype in support of WMO Regional Climate Centres (RCCs) for Europe.*

This report summarises the aim of the five prototypes whose development will be supported by EUPORIAS, plus an extra prototype, which is being funded by ELFORSK (http://www.elforsk.se/In-English1/). This extra prototype is being developed within the same framework as the five EUPORIAS prototypes.

- *EUPORIAS identified a set of criteria for the selection of the prototypes. These criteria were then used by a panel of independent experts to rank the prototypes, and then select which prototypes to develop;*
- *Six prototypes will be developed as part of the project. Five of them will be funded by EUPORIAS directly and one by a Swedish stakeholder ELFORSK (Swedish Electrical Utilities' R & D Company);*
- *The prototypes focus on: winter transport in the UK, water resources in France, hydroelectric production in Sweden, livelihood in Ethiopia, wind power production in the north Sea and winter land management in Devon.*

2. Overall objectives of the project and Work Package 42

2.1. Project Objective

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.		
3	Develop a set of standard tools tailored to the needs of stakeholders for calibrating, downscaling, and modelling sector-specific impacts on S2D timescales.		
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**	

2.2. Work Package 42 Objective

The main objective of the WP 42 is to develop a set of experimental semi-operational prototypes of climate services operating on the climate prediction time-scales. Most of the other WPs are contributing to this WP which to some extent concentrates most of the results and knowledge gained within the other WPs.

3. Detailed Report

3.1. Introduction

- General presentation of the prototypes

Whatever the performance of a forecasting suite, a climate forecast which is unable to inform an action or a decision is of a very limited practical use. The main objective of EUPORIAS prototypes is to go beyond the provision of atmospheric forecasts and move toward the provision of impact forecasts which better fit the needs of stakeholders. Special attention has been devoted to the interface with specific Decision Making Processes. The prototypes that are being developed are targeting some key sectors within Europe and beyond: such as water resources, energy, health, agriculture and food security and transport. Whilst the selection of the prototypes has been based on the comments of a panel of independent advisors the final selection aligns quite nicely with the priority sectors by the Global Framework for Climate Services (GFCS in the following). The original approach of EUPORIAS is to keep the stakeholders at the core part of prototype developments and thus they are being developed in close collaboration with the specific stakeholders.

- Selection procedure, selection committee and result.
- The principles behind the prototype selection were identified during the 2013 General Assembly and then further elaborated via emails. Whilst the principle address different aspects which control the potential success of a prototypes two main dimension were given higher weight in the selection. They were:

- The identification of at least one decision of one specific stakeholder that the prototype aims to address; and

- An assessment of the overall expected value of the prototype to the stakeholder (a combination of skill and exposure).

- Having decided on the selection criteria WP42 identified a panel of independent experts who could help the project select the most promising prototypes. The experts selected were: Dr Steve Zebiak (IRI, Columbia University, USA), Dr Roger Street (UKCIP, UK) and Prof Roger Stone (University of Southern Queensland, Australia). Each of them was given a scoring matrix and set of rules on how to score the prototypes. EUPORIAS picked the highest scoring prototypes in the ranked list. The ranking was a result of taking the averaging of the inputs from the three experts. Whist there were significant differences among the experts in the exact score of each prototype, the overall ranking was very similar among the three.

3.2. Overview of the selected prototypes

All the prototypes are targeting specific stakeholders and consequently their specific Decision Making Processes (DMP). So the usefulness of the prototypes is very obvious as they are developed in close liaison with each of the stakeholders. But beyond these specific utilisations, there is strong evidence that the usability and usefulness attached to each specific stakeholder DMP should be largely transferable to other stakeholders of the same sector. Each prototype is described in more detail in the sections below.

Table 1: Potential usefulness of the prototypes

Sector	Prototype	Potential usefulness	Additional comments
Water	Météo-France	1) Anticipation of possible deficit in the water stocks leading to fresh water supply, cooling station or irrigation management concerns or risk of over filling leading to flood mitigation concerns 2) Awareness of the water managers in France and Europe of possible products relevant to their stakes 3) Potential extension of products and services to Energy, Agriculture or River Inland transport domain	Evaluation of the impact of the use of the information onto the decision made
Energy	SMHI	1) Better power production strategies and water magazine management 2) Friendly visualiser for Hydro-Power management purposes 3) Potential extension to Hydro-Power management across Europe	
Energy	IC3	1) Better logistical and strategic decision for Energy Operators, Wind Farm producers and Wind Farm Financers 2) Friendly visualisation of wind power-related energy supply and temperature-related energy demand at EU and international locations.	
Agriculture	Met Office and Clinton Devon Estates	1) Better management of soil fertility, carbon storage, soil quality, water, weeds, pests, diseases, biodiversity and wildlife 2) Awareness of similar stakeholders of potential available products and strategies. 3) Developments relevant for a sustainable agriculture	
Transport	UK Met Office and DfT	1) Optimal communication of risk-based forecasts to transport stakeholders 2) Better management of logistics, maintenance, and safety 3) Potential extension across Europe and to other sectors	
Food security	LEAP	1) Better Disaster Risk Management and Food Security Early Warning 2) Potential extension across Africa	Cost/Benefit analysis developed

3.2.1. Water Resource Sector

3.2.1.1. Météo-France prototype:

Stakeholder of reference:

EPTB Seine Grands Lacs (Seine river catchment) and SMEAG (Adour-Garonne river catchment)

Decision(s) to be informed:

Decision related to the management of reservoirs (refilling and low flow periods

Refilling strategies, water stock release strategies and water volumes

Description of work (i.e. how the prototype will make climate information useful to inform the decision):

Downscaled near surface temperature and precipitation coming from the Météo-France operational system for seasonal forecasting will feed the SIM suit (a refined Soil Vegetation Atmosphere Transfer (SVAT) model at an 8-km resolution coupled with a river flow routing module) to produce a probabilistic forecast of river flows at different lead-times and for specific stations along the rivers (Céron et al. 2010, Singla et al. 2012). River flow forecasts are tailored to fit critical thresholds, for crucial seasons for which decision making processes are established. Additional parameters like the number of days or the integrated water volume under or above critical thresholds are also considered. Some possibility of using long lead-time information will be explored (e.g. end of spring up to the end of the autumn).

Flow of information and communication strategy:

As presented in figure 1, the basic information is provided by the hydrological seasonal forecasting suite (pre-operational). This information is then post-processed and tailored at Météo-France to fit the needs of the Decision Making Processes (DMPs) of the stakeholders. These products contain both information on the relevant hydrological variables (River Flow, Water Volumes, number of days below –or above- relevant thresholds, Soil Wetness Index –SWI-) and on the related uncertainty (climagrams, different scenarios related to the probability density function distribution of the forecasts). Also, a specific communication related to the level of risk (transformation of the probabilities into odds or relative odds as proposed by Murphy) is scheduled. In addition, digital data (mostly forecasted daily river flow information at specific points) are to be provided to feed into stakeholders' models. The mode of communication is a push mode to start with. At a later stage, we will study the possibility for the stakeholder to interactively use the products. A Hot-Line like structure is put in place at Météo-France to support the stakeholder in the product interpretation and use. The impact of the use of the climate information in the decision will be assessed using the Placebo protocol.

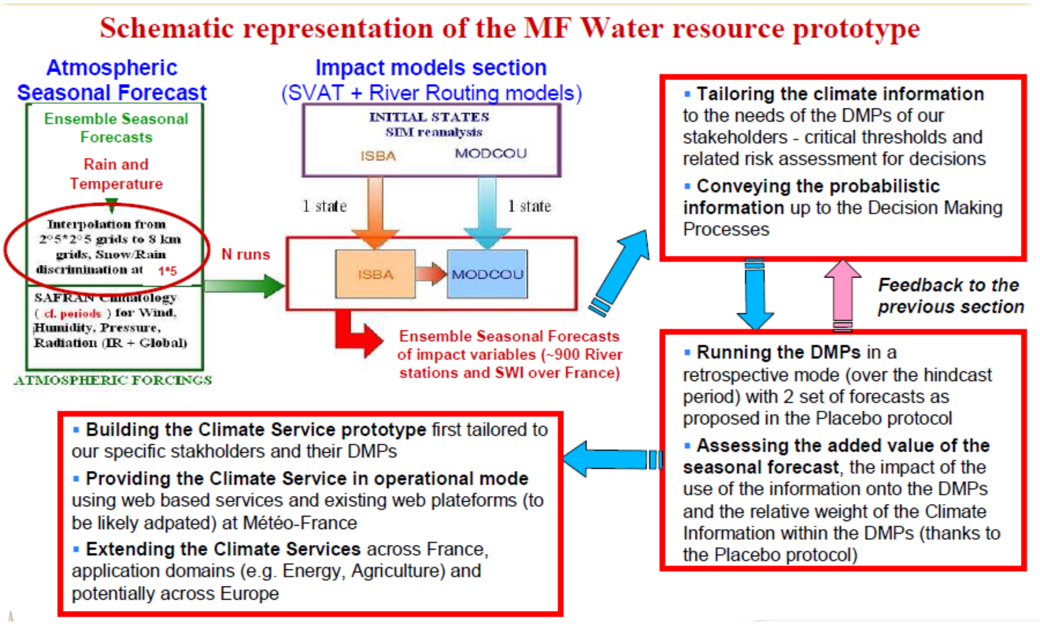

Figure 1: Schematic representation of the Météo-France water resource prototype

Progress so far:

Thanks to specific stakeholder meetings, the stations and critical thresholds (warning or crisis thresholds or near wet or dry quintile or decile ...) have been defined. The crucial decisional periods have been identified. These are:
late May/beginning of June for the low flow period and the end of Winter/beginning of Spring for the reservoir refilling periods.

It should be noted that the same periods are also relevant to the energy suppliers. A first set of products has been prepared and discussed with the stakeholders; these will be tested in a learning-like phase on a set of specific years (stakeholder choice) during the autumn of 2014.

The usefulness of the provided information will be assessed using a specific protocol so call Placebo Protocol. The aim of this protocol is to provide two set of impact forecasts, one issued with the seasonal forecast; one issued using the impact model forced by random atmospheric forcing. These two sets will be used in a blinded-like mode over the hindcast period to made decisions. The comparison, between the two sets of information, of the quality of the decisions should give some insight into the impact of the use of the information on the DMPs and to some extend the relative weight of the climate information into the DMPs. A document (Céron, 2014) describing this protocol has been prepared and the stakeholders are willing to apply.

3.2.2. Energy Sector

3.2.2.1. SMHI prototype:

Stakeholder of reference:

ELFORSK

Decision(s) to be informed:

Decisions related to power production strategies and water magazine management. Operators need: (1) forecasts of the spring flood volume to estimate how low they can run the magazines prior to the flood without negatively affecting later production; and (2) they need a forecast for the timing of the spring flood's onset to set a timeframe for the planned operational strategy

Description of work:

The Ångerman River basin is Sweden's third largest by area, 31864 km², and the second largest by hydropower production with an average annual production of 6900 GWh.
Knowledge and methods developed in a recent project funded by the stakeholder, "A multi-model system for spring flood forecasts" (Olsson et al. 2011), will be used as a base to develop a multi-model forecast prototype. The system will use the state-of-the-art forecast system at SMHI as a template and employ hydrological models based on the HBV model (Lindström et al. 1997) and statistical downscaling models to produce a probabilistic forecast of river flows and accumulated seasonal discharge at different lead-times and for specific stations. The multi-model system performance will be evaluated together with the stakeholder against the state of the art forecasts using cross-validated hindcasts for a 30 year period, 1982-2011. These hindcasts will also be used to develop an index that estimates the skill of the forecast system for each forecast. The system will be tested under both simulated and operational conditions for the period 2012-2015.

Flow of information:

There will be two streams of information. One will follow the current operational practice where a historical ensemble of meteorological observations and seasonal meteorological the forecast data are used to force the HBV model and the resulting forecast is post processed and distributed to the stakeholder via the SMHI forecast infrastructure. The second is to develop a user interface visualiser to address how information is provided to the end user; the aim is to make the forecast information more actionable. Once the initial prototype is complete, development will continue iteratively together with the stakeholder.

Progress so far:

The test catchment, the Ångerman River, has been selected together with the stakeholder and the relevant stations are defined by the current forecast system. The primary period of focus, the spring flood May-June-July, has been identified and if time and resources allow additional periods such as the summer and autumn periods will be included. A new setup of the HBV model has been completed for the Ångerman River system and improvements to the statistical model chain are complete.

3.2.2.2. Resilience IC3:

Stakeholder of reference:

Energy management companies who have operations in wind power production and/or financing e.g. E.ON, EDP, EDF, Natural Power, Iberdrola, Acciona (contact has been made and specific contacts identified for All)

Decision(s) to be informed:

Monthly to seasonal predictions will be used to potentially inform the following logistical and strategic decisions that are taken regularly by each stakeholder:

- Energy producers (e.g. EDF, www.edf.com) take a decision on how to adjust their resource management strategies based on a foreseen total wind power capacity of several wind farms;
- Wind farm operators (e.g. EDP, www.edp.com) take a decision to plan for costly maintenance works during optimal wind conditions; and
- Wind farm financers (e.g. Iberdrola, www.iberdrola.com) take a decision that can optimise the return on their investments, based on a foreseen wind power capacity of an individual wind farm.

These are examples of relevant decisions, although the prototype will likely address the first in more depth.

Description of work:

The primary aim of the REsilience prototype is to facilitate and strengthen energy management by having a more robust knowledge of the future variability of wind power and temperature.

The highest priority for the energy network is to maintain a balanced system to avoid black-outs. However, the rapidly evolving energy system is in an increasingly vulnerable position due to the growth of highly variable wind power contributing to the total energy supply, and unusual temperatures affecting demand.

REsilience will firstly visualise the skill of monthly to seasonal predictions globally, for a specific climate variable (wind power or temperature), at specific lead times. Several different climate forecast systems will be used, as well as a multi-system skill assessment.

Secondly, REsilience will provide a future prediction for the coming months and seasons for each climate variable, forecast system and lead time. A small number of global wind farm sites will be chosen, based on where there is identified skill.

This information will provide an insight into how wind power could change for specific wind farm locations in the future, affecting the overall power supply. Pending support from Meteoswiss, temperature-related Heating Degree Days (HDD) will also be looked at for larger regions, to provide an insight into how overall demand could vary over the same period of interest. This information can be used by the identified stakeholders to inform their logistical and strategic decisions described above.

Flow of information and communication strategy:

A visualiser will be sub-contracted to address how information provided reaches the end user. Once a first version of this information is available, this will be tested with the stakeholders, either via direct meeting and/or via workshops organised within SPECS with the project partner VORTEX. An energy microsite will also be set up on the EUPORIAS website to host the visual tool and provide background information. A multi-model approach will be taken to produce the climate forecasts, pending the availability of the necessary data in time. The target forecast systems are: ECMWF S4, GloSea5, Meteo France as a European multi-model, and the NMME as the US multi model. Each forecast will undergo the following stages of post-processing: first wind power predictions will be created from wind speed and temperature, which have been bias corrected and translated over “impact surfaces”. The impact surfaces will be used to generate a PDF of the wind power probabilities, and the results will be verified.

Progress so far:

A call for tender for the visualiser has been developed by IC3 and FutureEverything and was launched in early summer 2014:
https://euporias.wikidot.com/local--files/euporias-general-assembly-2014/ClimateServiceVisualisation-InvitationtoTender.pdf

After some consultation with EUPORIAS partners, Future Everything chose the visualiser of choice in August 2014

IC3 is currently working on creating the wind power skill assessment and prediction data needed for the visualiser. At the same time, they have put together a document for the visualiser, with an example of a seasonal prediction and describes some of the information related to these predictions that is relevant to the story behind the prototype. The latest version of this document can be found here:
https://euporias.wikidot.com/local--files/euporias-general-assembly-2014/20140605_ClimateServiceVisualisation_background.docx

Following feedback on this document, an initial kick off meeting between FutureEverything and IC3 will be organised, and the visualiser will be involved when appropriate. It is envisaged that the development of the prototype visualisation will be carried out in two-stages: the first will be related to an example of the data as already provided:
https://euporias.wikidot.com/local--files/euporias-general-assembly-2014/EXAMPLE_WindMod1DJF1leadLocalForecast.nc

https://euporias.wikidot.com/local--files/euporias-general-assembly 2014/EXAMPLE_WindMod1DJF1leadGlobalSkill.nc

This will enable the visualiser to start the development process, with a focus on the visual and communication concepts. The second stage will be once all the data is available, where the visualiser will focus on the information content of the prototype leading up to its official launch.

3.2.3. Agriculture sector

3.2.3.1. Land Management Tool prototype:

Stakeholder of reference:

Clinton Devon Estate

Decision(s) to be informed:

Cover crop planning

Description of work:

Clinton Devon Estates (CDE) is a major regional land owner in the South West of the UK, with responsibility for 25,000 acres of land. Its areas of business cover farming, sustainable forestry, conservation management, deer management, and commercial and residential property and businesses including the region's premier equestrian venue. CDE's decision making depends critically on land and weather conditions, covering timescales from hours to decades.

The aim is to develop a specific working tool for one application which can later be extended to other uses, while also serving as a blueprint for a weather-decision making tool for land managers and farmers in general.

The specific decision is cover crop planting. A cover crop is a crop planted primarily to manage soil fertility, carbon storage, soil quality, water, weeds, pests, diseases, biodiversity and wildlife. Advance knowledge of a very wet winter would enable the farm manager to choose an appropriate summer/autumn sown cover crop which will protect soils that would otherwise be left bare and susceptible to run-off and erosion.

The farm is in a Water Framework Directive (WFD) valley catchment. This will also strongly relate to Nitrate Vulnerable Zone (NVZ) regulations, cross compliance for Single Farm Payment (SFP) in terms of Soil Protection Review, both of which look at run off appropriate cultivations and timings of such as well as the application of fertilizers.

The prototype builds on the recent improvement in winter seasonal forecast skill for Northern Europe, linked to the need to make advance decisions on over-winter cover crop planting.

Benefits to CDE also include prevention of loss of its main farming resource, soil, and prevention of potential negative impact on the environment and communities with nutrient leaching and soil on roads. CDE have historically used cover cropping on a limited basis since it involves additional cost (seed, fuel, labour) and partly because it is not viewed as "normal practice". Therefore predictions indicating high rainfall, nutrient loss, and soil erosion would make the decision making process much easier, and help to justify the additional expenditure.

The impact of the prototype on the decision made will be assessed using retrospective validation. We will assess a series of decisions made from previous years (e.g. past crop rotations), and compare them with the decision which would have been made if the prototype had been available. Consideration will be given to using another suitable estate or group of farms as a control.

Both cases will then be evaluated in terms of their economic, environmental (and other) impacts, which will then be compared to derive the overall impact of the prototype.

The information needed to assess the benefits of cover crop decisions will be gathered through the farmer engagement process, including:

- *previous decisions made and how they relate to weather*
- *actions farmers would take, given a set of historical forecasts*
- *financial costs of planting and managing cover crops*
- *farmer perceptions of the "losses" from not planting cover crops in a wet season* (e.g. environmental, social/reputation etc)

Where relevant, we will also make use of information from literature/other projects – for instance on the value of ecosystem services.

Flow of information and communication strategy:

The tool is being developed iteratively with the Clinton Devon Estates farming community (see Figures 2 and 3) and so the content and flow of information to them will be largely be determined by their needs, which will be assessed via the interview process.

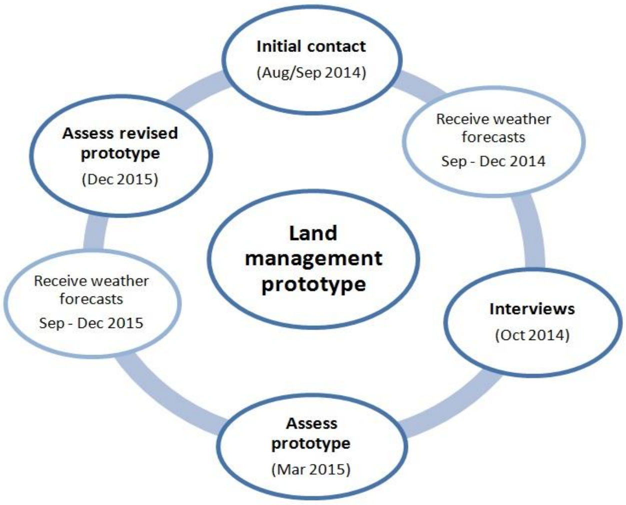

Figure 2: Stakeholder pathway and flow of information in the land management tool

We aim to provide rolling monthly updates to the farmers if possible, during the main decision-making period. The project holds fortnightly teleconferences and minutes will be placed on the EUPORIAS wiki pages. KOR Communications are Clinton Devon Estates PR agency, and they are developing an external communications plan for the project, based around the following goals:

To promote the prototype through a range of targeted communications activities, and develop a brief communications plan to be agreed with KOR Communications. Potential activities could include:

- Early project announcement to highlight the innovative, local nature of the project combining cutting-edge science and land management decisions (e.g in Western Morning News); noting the need for careful expectation management to avoid overselling the project;
- Mid-project announcement on project findings and successes;
- End-of-project announcement on project findings and future outlook;
- Twitter feeds/postings;
- Presence at agricultural/county shows (note the potential to link with existing Met Office Public Weather Service activities);
- Relevant trade conferences (e.g. 2015 Institute of Chartered Forestry); and
- Met Office and CDE website articles.

The initial prototype forecasts for winter 2014 are being based on an existing Contingency Planners forecast, which is produced by the Met Office and based on the GloSea5 seasonal prediction system. Additional work in the project has provided a simple means of downscaling these UK-wide forecasts to the county of Devon, using the relationships between the key variables (temperature and precipitation) for the UK and Devon.

Progress so far:

Clinton Devon Estates joined EUPORIAS as stakeholders in November 2013, following a workshop in November 2013 to develop the prototype proposal; which was accepted in February 2014. Since then, team members attended the visualisation workshop in March 2014, which helped build the team and shape ideas for presenting results. Monthly partner teleconferences have been held since April 2014 to coordinate work on the prototype and maintain progress. The prototype has a very active wikidot site, and additionally we have held several discussion meetings to investigate potential delivery options, agree the initial set of farmers to work with, make plans for farmer interviews, agreed needs for assessing past land management decisions with respect to seasonal weather, and begin to assess potential links to other ongoing projects. A launch workshop was held in Exeter in July 2014, providing an opportunity for project partners and stakeholders to get to know each other, and to refine requirements for the tool, land management decisions to focus on, weather events, the look and feel of the tool, and finally agree a top-level work plan to deliver the tool.

We have developed a project outline and timeline, and first drafts of letters/information sheets for farmers (sent out in mid September 2014), and a mock-up to illustrate potential delivery options (Figure 3), plus an interview protocol and consent forms. Initial external communications activities are being planned with KOR Communications. The initial interviews are planned for the first week of November 2014, and the first forecasts to farmers will also be delivered then (see Figure 4). An earlier draft forecast for October-December 2014 has already been used by Clinton Devon Estates to decide to postpone forestry operations on wet soil, avoiding soil damage, loss of access and associated costs.

Figure 3: Mock-up of delivery channels for the land management tool

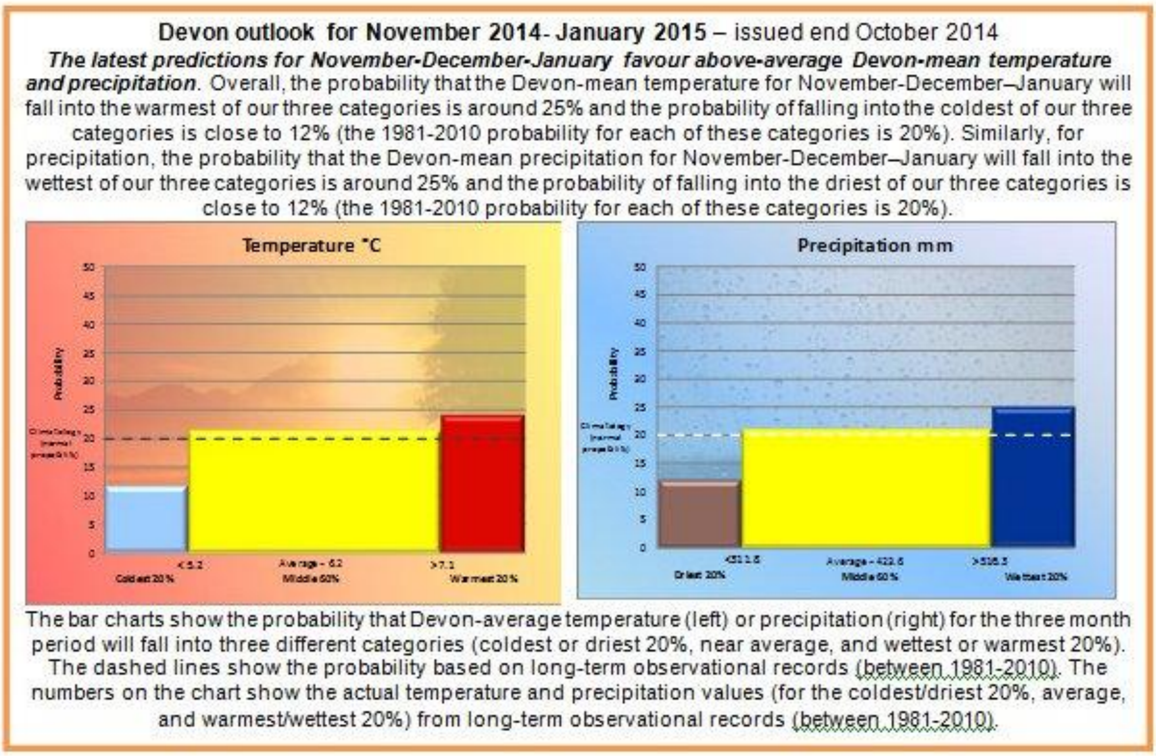

Figure 4: Draft forecast format used in the land management tool. The forecast delivered to farmers includes information on the project background, general information on seasonal forecasting, and what we expect from the farmers as well as the forecast box shown here

3.2.4. Transport sector

3.2.4.1. Winter conditions Influence on UK Transport:

Stakeholder of reference:

UK Government Department for Transport (DfT)

Decision(s) to be informed:

The development of this prototype has arisen through a slightly different process than for the other prototypes. This is primarily due to the existing stakeholder relationship with a DfT-led stakeholder group, which includes (amongst others) representative from the rail, highways and aviation sectors.

Given the breadth of interests of these stakeholders, we have chosen to focus our initial work on assessing the extent to which the underlying science can feasibly support the desired goal of providing information to stakeholders. We have some promising results in this regard and will now focus more strongly on identifying a specific user decision (or decisions) on which our onward development will focus.

The types of stakeholder decisions which *could* be supported by our work include those related to:

- Procurement of de-icing materials, and levels of stocks;
- Procurement and location of snow-clearing equipment (e.g. snowploughs);
- Planning and publicity of public safety campaigns (e.g. Highways Agency's "Make time for winter" campaign);
- Planning of maintenance during periods of suitable weather (so-called weather windows); and
- Development of extreme weather management plans (e.g. emergency timetables for public transport).

(see below under "flow of information and communication strategy" for details of planned next steps)

Description of work:

As recent years have demonstrated, winter weather conditions can have a significant impact on most forms of transport in the UK and Northern Europe. Airport closures, road accidents and delays/cancellations of train services are just some examples of the possible consequences of widespread snowfall over the British Isles. The exceptional winter of 2013/14, in which a series of storms crossed the UK, also resulted in widespread impacts - with severe flooding affecting the rail and road networks. Long-range forecast information is, therefore, of significant value to the transport sector, alongside its current use of weather forecast products to inform operational planning, and its increasing knowledge of impacts at the climate change timescale.

Until recently, there has not been sufficient skill in seasonal forecasts to make it feasible to use them in the transport sector. Now, using the fifth generation of the Met Office's Global

Seasonal forecast system, GloSea5, we have begun to explore the potential for using the North Atlantic Oscillation (NAO) to predict impacts on the UK transport sector, at lead times of 1-3 months. We have capitalised on existing engagement by Professor Adam Scaife (Head of Monthly to Decadal Prediction at the Met Office) with a transport stakeholder group coordinated by DfT, in order to assess the possibility of providing risk-based forecasts to transport stakeholders to enhance their winter preparedness and resilience.

This prototype will interact with UK transport stakeholders, to develop a method for optimal communication of risk-based forecasts to the UK's main transport stakeholder group (as coordinated by DfT), and subsequent provision and evaluation of these forecasts.

Flow of information and communication strategy:

We plan to use the existing stakeholder communication channel (namely, an annual meeting at DfT in November) to discuss the outcomes of our work to date, with a view to obtaining stakeholder feedback. For Winter 2014/15, the focus is still on communicating the *meteorological* forecast to stakeholders (i.e. not the impacts forecast) on a monthly basis, providing a rolling one-month and three-month outlook. We aim to develop a prototype impact forecast product in time for trialling in Winter 2015/16.

Progress so far:

A key milestone in developing the prototype has been a meeting of a stakeholder group representing the UK transport networks, held at the Met Office headquarters in Exeter on July 21, 2014. The group included representatives from the UK government Department for Transport, local government authorities, as well as aircraft and train operators. The primary aims were to demonstrate the information in a probabilistic seasonal forecast, and to understand how this information would influence decisions made by the stakeholders, specific to their activities and operations. From this workshop, we have gained a much better understanding of the key considerations influencing decision-making for the transport sector as a whole, as well as understanding the different requirements for individual organisations, For example, the cost of dealing with snowfall is generally considered to be the greatest winter expense, although flooding can also incur significant costs, as seen in the winter of 2013/14. In addition, through this workshop, the stakeholders identified a potential benefit to their operations through identifying windows of weather suitable for bringing forward maintenance planned for later in the year.

Alongside the workshop, we have drafted a research paper for submission to a peer-reviewed journal, illustrating links between the NAO and a range of impacts affecting the transport networks, including weather-related accidents, delays and road salt usage. This research paper represents an important "proof of concept" stage regarding the scientific content of the prototype.

3.2.5. Food-security sector

3.2.5.1. Leap Ethiopia prototype:

Stakeholder of reference:

WFP, Disaster Risk Management and Food Security Sector (DRMFSS) of the Ethiopian Ministry of Agriculture

Decision(s) to be informed:

Integrating seasonal forecasts into the LEAP platform can influence decision-making in Ethiopia at three levels:

1. For **WFP**, earlier and more accurate estimates of needs based on seasonal forecasts will be used by the Vulnerability, Assessment and Mapping (VAM) unit to raise awareness of an impending crisis and advocate for initiating an early response within the Disaster Risk Management Technical Working Group (the national working group which brings together the government, donors, the humanitarian and development actors, and which plans and carries out response to food crises);
2. In parallel to – or as a result of – the above "advocacy" process, forecasts can be used by the **Ethiopian government** (Ministry of Agriculture and other Ministries) in the following way:
   - Identify and prioritise areas and sectors that require closer monitoring throughout the rest of the season; and
   - Update regional and district-level contingency plans.
3. Implement sector-specific "low-regrets" interventions, including advance purchase and prepositioning of food; or advance purchase of seeds and livestock supplementary feeding/medicine, in preparation for potential emergency seeds distribution and livestock interventions.

Description of work:

LEAP is the Government of Ethiopia's national food security early warning system, established with the support of WFP and the World Bank in 2008. LEAP uses precipitation monitoring data to estimate the number of people who will be in need of food assistance due to drought. By providing early and objective estimates of the expected magnitude of needs, LEAP helps increase both the speed and transparency with which a humanitarian response can be triggered.

Currently, LEAP uses monitoring data to calculate future needs. Through EUPORIAS, a seasonal forecast element will be added into LEAP. The potential for rainfall predictability in East Africa has been known for a relatively long-time (Ogallo, 1989, Black et al., 2003). Concerning Ethiopia, Diro et al. (2008) have analysed the Kiremt rainfall (JJAS) showing how global SST exert an influence on the summer rainfall in different areas of the country. The onset and duration of the main rainy season in Ethiopia have also been linked to patterns of global SST (Segele and Lamb, 2005). Nowadays, SST-based statistical seasonal forecasting algorithms (Korecha and Barnston 2007) are of common use at the National Meteorological Agency (NMA) of Ethiopia.

The aim of the LEAP prototype is to assess the value of integrating seasonal precipitation forecasts into the calculations, by seeing to what extent this improves the timeliness and accuracy of LEAP's beneficiary projections. At the same time, the prototype will also create the capability to view seasonal forecasts as "standalone" products in the LEAP software (i.e. not integrated in the beneficiary calculations), alongside the other agro-climatic information already provided by LEAP.

The prototype will therefore make seasonal precipitation forecasts useful for decision making in two main ways:

- **By integrating forecasts into food security impact models (post processing):**

  The prototype will integrate seasonal forecasts into the two impact models which LEAP results are based on: the Water Requirement Satisfaction Index (WRSI), and the Index of Potential Food Assistance Beneficiaries. Both of these indices are currently based on rainfall monitoring data. The assumption is that this integration of seasonal forecasts will make LEAP results more accurate and timelier, thereby helping the government, WFP and other humanitarian decision-makers take faster and more appropriate action in case of drought.

- **By developing tailored visualisation interfaces to display LEAP results and forecasts:**

  A key aim of the prototype is to ensure that the beneficiary information produced by LEAP is displayed in an easily understandable and eye-catching manner. The aim is to ensure that LEAP results : (a) can be quickly and accurately understood by a non-scientific audience (humanitarian workers, government officials, donors), including regarding the uncertainty associated with the results ; and (b) catch the attention of decision makers/ donors, so that they can be used for advocacy purposes.

  In addition, the prototype will also create an interface in the LEAP software to view forecasts as "stand-alone" products. Again, this will require the forecasts and associated uncertainty information to be displayed in an easily understandable way, tailored to a non-scientific audience.

However, in addition to its practical value for decision-making, the prototype will also be valuable to WFP's broader policy/ advocacy efforts around the benefits of climate services for food security, and on improving the effectiveness of food security early warning systems. In addition to evaluating the technical/ scientific added-value of integrating seasonal forecasts into LEAP, the prototype also aims to assess the socio-economic value of doing so. A cost benefit analysis of the LEAP prototype will seek to evaluate the benefits of using seasonal forecast to trigger early humanitarian assistance in response to drought. The analysis will use hindcasts for past years to assess the socio-economic gains that would have been incurred, had these forecasts been available at that time and been used to trigger early response.

Finally, in addition to its value for the food security/ humanitarian sector (practical decision making and policy/ advocacy), the LEAP prototype will also enable the cross comparison of the LEAP crop model (WRSI) with other crop models implemented for the same region (LPJml, WOFOST, GLAM, JULES). This will provide a preliminary test bed for a Multi Model Ensemble based crop forecasts for the area. This is an important complementary activity to this prototype, which will be conducted through EUPORIAS' other work packages.

Progress so far:

The key milestone in the implementation of the prototype has been a meeting of the prototype team held at WFP Headquarters in Rome on June 27, 2014. The programme officer who currently oversees LEAP in WFP's Ethiopia Country Office came to Rome for the meeting.

During the meeting, the team agreed on a work plan and timeline for the implementation of the prototype within the first half of 2015. Roles and responsibilities have been assigned to all partners. The team that will work on this prototype includes food security experts from WFP, climate experts from ENEA, Meteo Swiss and University of Cantabria, climate impact experts from MeteoSwiss and ENEA, and the LEAP software developer.

Work is currently in progress in three lines of activity:

1. **Data processing**: surrogate data that reproduce the archive structure of a seasonal forecast ensemble have been provided to the LEAP developers in order to implement the necessary changes in the algorithm that produces the climate impact index. An interface of the LEAP software platform to R-packages has been tested to ensure a smooth data flow and to enhance LEAP with an interface to external plug-ins;
2. **Evaluation of forecast skill**: Preliminary analysis of the skill of System4 on seasonal cumulated rainfall has been completed. Literature review of the forecasting skills of different methods over Ethiopia is ongoing; and
3. **Assessment of value of the prototype for decision-making**: Literature documentation review on the impacts of past El Nino events on food security in Ethiopia is ongoing.

Flow of information:

a. Seasonal hindcasts/ forecasts will be provided through the portal developed by the University of Cantabria;

b. The LEAP server will directly access the forecasts on the University of Cantabria's web portal. The LEAP user will therefore be able to import the forecasts directly from the LEAP software (i.e. without having to go into the University of Cantabria portal);

c. The LEAP user will then be able to:
   - Run the LEAP beneficiary needs calculations using rainfall forecast (instead of rainfall monitoring data). This will be done by using the gridded forecast data as

input data into the two impact models used in LEAP to calculate projected beneficiary numbers: the Water Requirement Satisfaction Index (WRSI) and the beneficiary needs index;
- View the hindcasts/ forecasts as "standalone" products;

d. LEAP beneficiary results can then be:
- Viewed on a regular basis by WFP and government disaster risk management staff as part of their routine disaster risk management and food security monitoring activities;
- Presented at DRMTWG meetings to inform official humanitarian appeals documents and preparedness efforts;
- Used by WFP, the government and other humanitarian actors on an ad-hoc basis, as needed, for advocacy purposes in case of a major impending crisis;

LEAP's "standalone" forecasts can be:
- Viewed on a regular basis by various government officers (including from the National Meteorological Agency and the Ministry of Water);
- Used to inform the annual Greater Horn of Africa Climate Outlook Forum (GHACOF).

Note that the above description of how forecasts will be used by stakeholders in Ethiopia applies to a hypothetical, fully operational situation in which actual forecasts are provided on a regular basis into LEAP. However, within the timeframe of the EUPORIAS project, the focus will be on using hindcasts to evaluate the skill and added-value of using such forecasts in LEAP.

Communications strategy:

For WFP, communications efforts on the LEAP prototype inscribe themselves within WFP's broader advocacy and messaging efforts around improving the effectiveness of food security early warning systems; harnessing the power of climate services for food security; and supporting innovative financing mechanism for climate disasters (including forecast-based financing).

WFP is therefore committed to documenting and widely sharing the LEAP prototype experience, in Ethiopia and at the global level. For example, a guidelines document is currently being produced outlining how LEAP works and how it supports decision-making within the government's disaster risk management framework. As the prototype progresses, the role of seasonal forecasts in LEAP, and how they supports better food security risk management at the national level in Ethiopia, can be added to this document.

In addition, the cost-benefit analysis of the LEAP prototype, mentioned above, will provide quantitative evidence to support WFP's wider policy engagement on the value of climate services for food security, and on the benefits of early humanitarian response to drought.

From a scientific communications perspective, ENEA and other prototype partners will present the prototype at relevant conferences.

3.3. Communication strategies

The communication strategies will take into account the different faces of communicating the climate information up to the stakeholders, including the uncertainty issues. At this stage it is noted that the communication strategies should be finely tuned to the specific problem to address, so to the specific stakeholders and related DMPs. Among different aspects, one can quote:

- the communication of the risk, mostly using probabilistic aspects (possibly after some post-processing);
- the level of education, competencies of the stakeholders (especially referring to probabilities but not only);
- the level of confidence into the forecast (with possibly some additional information to use like the current predictability into the climate system);
- the acceptability of the level of risk on the stakeholder side;
- the current vulnerabilities and exposures; and
- the available decisional options for the stakeholders.

3.4. Management of the flow of information

The aim of the EUPORIAS project is to develop climate services providing more actionable climate information. As a consequence, the corresponding vision of the Climate Services can be schematically represented as in figure 5. The first part of the flow of information corresponds to the preparation of the relevant information, and relies on the impact forecast and its associated uncertainty. A tailoring process is then performed in order to adapt the information to the needs of the targeted DMPs (thanks to an efficient User/Provider dialogue). This stage could be seen as the main component of the Climate Service Information System (CSIS) in the GFCS framework. The second stage is more related to GFCS User Interface Platform (UIP) and corresponds to the provision of the information (through relevant mechanisms e.g. dedicated web site or web services). One important component here is related to the organisation of the user support; including the user feedback accounting for a strong and efficient User/Provider liaison.

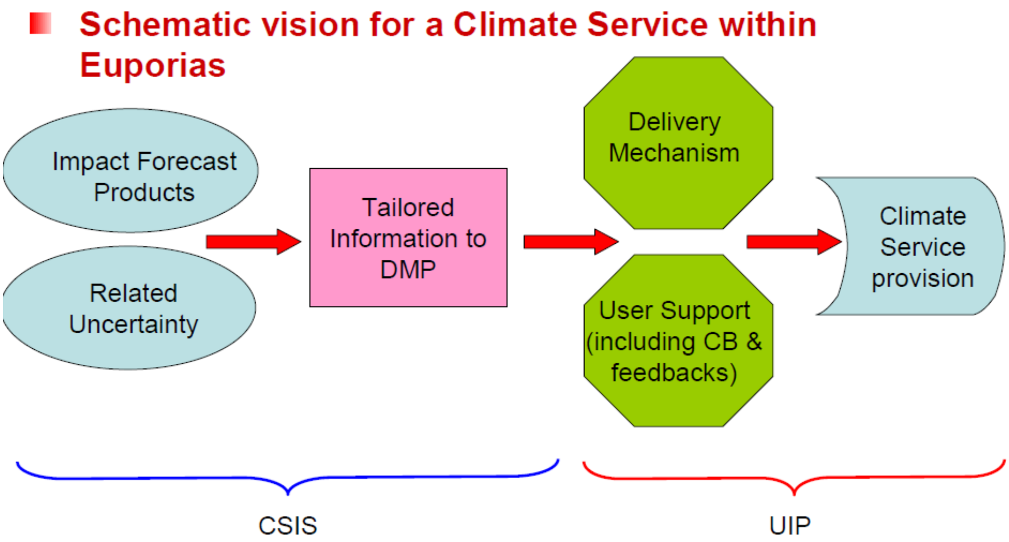

Figure 5: Schematic representation of the flow of information in the Euporias prototypes

3.5. Implications for future work

The work already achieved with the prototypes is, and will be, crucial for the success of the whole project. Strong linkages to all other Research Theme 4 WPs have been established. The stakeholder engagement, beyond the specific stakeholders already engaged in the prototypes, will be very likely strongly influenced by the operational perspectives proposed with respect of prototype outcomes (see WP43). In addition to that, the lessons learnt in the user/provider relationship development will be of major interest in extending such prototypes to a broader set of stakeholders. In this respect, it is recommended that a comprehensive record is kept of the “story” behind the development of each prototype. Obviously, the publicity and dissemination of the prototypes results and lessons learnt are of primary interest in future stakeholder engagements. The potential analysis (including when possible economical analysis) related to these specific DMPs and their improvement, will be of major interest for the demonstration of the usefulness and value of such climate services.

3.6. References

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