THEME ENV.2012.6.1-1

EUPORIAS

(Grant Agreement 308291)

EUPORIAS

European Provision Of Regional Impact Assessment on a

Seasonal-to-decadal timescale

Deliverable D12.3.

Report summarising users' needs for S2D predictions

Date Submitted: 30/01/2015

Deliverable Title	*Report summarising users' needs for S2D predictions*	
Brief Description	*Report summarising users' needs for S2D predictions, post expert interviews with key stakeholders from targeted sectors*	
WP number	WP12	
Lead Beneficiary	*Suraje Dessai, University of Leeds* *Marta Bruno Soares, University of Leeds*	
Contributors		
Creation Date Version Number Version Date	08/07/14 V2 30/01/15	
Deliverable Due Date Actual Delivery Date	30/10/14 30/01/15	
Nature of the Deliverable	X	*R - Report*
		P - Prototype
		D - Demonstrator
		O - Other
Dissemination Level/ Audience	X	*PP - Public*
		PU - Restricted to other programme participants, including the Commission services
		RE - Restricted to a group specified by the consortium, including the Commission services
		CO - Confidential, only for members of the consortium, including the Commission services

Version	**Date**	**Modified by**	**Comments**
V1	15/08/2014	Marta Bruno Soares	Suraje Dessai, Laurent Pouget, Anna Maria Jönsson, Christoph Spirig, Maria Magarino, Ghislain Dubois.
V2	30/01/2015	Marta Bruno Soares	Suraje Dessai, Felicity Liggins, Ghislain Dubois, Anna Maria Jönsson, Maria Magarino.

Table of Contents

List of Figures

List of Tables

List of abbreviations

- DMP – Decision-making processes
- ECMWF – European Centre for Medium-Range Weather Forecasts
- NMHS – National Meteorological and Hydrological Services
- S2DCP – Seasonal to decadal climate predictions
- WP12 – EUPORIAS work package 12

1. Executive Summary

The aim of work package 12 (WP12) is to assess users' needs with regard to seasonal to decadal climate predictions (S2DCP) across European sectors. To achieve that, a range of tasks were pursued including a systematic literature review, an expert elicitation workshop with European climate services providers, in-depth interviews with EUPORIAS stakeholders and other users, and an European survey of users' needs. This final report draws on findings from the interviews and survey.

A total of 80 interviews were conducted with European organisations spanned across various sectors although the energy, transport and emergency services, agriculture, and water sectors were better represented. The majority were private companies and government organisations, many of which were large organisations operating at the national level.

Understanding the decision-making processes within these organisations was complex at times as the responses provided by the interviewees were influenced not only by the role of the interviewee in it (e.g. head of department, modeller) but also by the size of the organisation (and the multiplicity of activities) and the type of organisation (i.e. end-user *versus* intermediary organisations). Timescales for planning and decision-making differ across sectors and organisations but in general, shorter timescales (up to 1 year) tend to be related to operational day-to-day activities within organisations; whilst mid-term (1 up to 5 years) are mainly associated with business strategies or maintenance activities within the organisations; and long-term timescales (5 up to 30 years) tend to be linked to wider strategies and financial and resources investment in the organisation (this was mainly highlighted in energy, transport, and water sectors). Those organisations acting as intermediaries (e.g. consultancies) tend to plan their activities based on contracts/projects and therefore their timescales vary; whilst those delivering emergency response services tend to plan their activities ad hoc.

These organisations are sensitive to weather and climate conditions although some are more concerned with the impacts of extreme weather (e.g. drought, floods) whilst others are more interested in weather variables such as temperature and precipitation. Many use weather/climate information with weather forecasts being the type of information mostly used closely followed by historical data/past observations. This information is used to either develop/feed operational models, understand future weather conditions, and/or forecast seasonal variability based on past data all of which are used to inform how future weather/climate conditions may affect their (or their clients') activities and operations.

Many perform some kind of post-processing or tailoring of the weather information many of which pursue this in-house although a few also outsource this service. Some of the organisations interviewed use climate information indices mainly those associated with temperature and precipitation. The main sources of weather and climate information are the National Meteorological and Hydrological Services (NMHS).

Many of the interviewees were aware (to different levels of detail) of what a seasonal forecast is whilst decadal predictions are considerably less known. Those organisations using seasonal forecasts are spread across the energy, water, transport and emergency services, agriculture, insurance, health, and food security sectors. These tend to be mainly used as an additional source of qualitative information to help them plan activities (e.g. maintenance work) or to help them form an opinion of future conditions and how that may affect their operations.

Reasons for not using seasonal forecasts were mainly associated to their lack of reliability, the difficulties in integrating such information into existing operational models and structures, existing traditions of performing historical analyses whilst others simply do not need this type of information.

Although many of the organisations interviewed do not use seasonal forecasts there is a general understanding that information on uncertainty is a fundamental component of S2DCP. However, the approach for dealing with uncertainty from those using seasonal forecasts differs. Many of the organisations would prefer information on the uncertainty of forecasts to be provided using a deterministic approach. Their preferred method for representing uncertainty is numerical (e.g. one figure, percentages) as it would facilitate the quantification and integration of uncertainty into models.

From the 489 survey responses collected the energy, agriculture, water, and transport sectors were the most represented whilst finance and insurance, tourism, and health sectors were the least represented. However, the majority of the respondents felt that their organisation was not directly related to any of the sectors listed and many associated their organisation with activities related to the environment, conservation, and heritage; weather and climate change; and industry, construction, and materials.

There was a significant representation by organisations based in Germany compared to other European countries. The majority of the organisations were private companies and government agencies/state companies many of which operating at the national level. These tend to be large organisations (with more than 1,000 employees) although there was also a considerable number of small to medium size organisations.

The timescales for planning activities within these organisations tend to vary depending on the type of activity. Short-term timescales (i.e. up to 1 month) tend to be related to operational and maintenance activities whilst medium-term timescales (i.e. every month up to every year planning) are mainly associated to activities based on business plans/strategies and corporate investment.

The main type of data used on a daily base was weather forecasts and the main sources for weather and climate data are the internet and web portals followed by statistical data, reports, and professional databases.

The organisations' activities were most negatively sensitive to floods, high rainfall, and storm surge followed by landslides, high wind, and forest fires. Snow, ice, and high rainfall followed by high temperatures, lightning, and high winds were also considered as events with negative impacts on their activities. A positive sensitivity to high temperatures, snow, and rainfall (low and high) was also noted. Some events did not seem to affect the organisations' activities including low wind, fog, low rainfall, and low temperatures.

The most used weather and climate data were weather forecasts which tend to be used daily; all other types of data are considerably less used.

Similarly to the interviews, the NMHS were also identified as the main providers of all types of weather and climate information including weather forecasts, past/historical data, and climate predictions and projections. The most used type of weather/climate information was weather forecasts closely followed by seasonal forecasts, past weather data, and past climate data. These tend to be used to integrate existing operational models (mainly past weather data, weather forecasts, past climate data and to a lesser extent seasonal forecasts), to manage their every day operational activities (mainly weather forecasts), and to inform their strategic planning (largely climate change projections and inter-annual climate predictions).

Many of the organisations agreed that they tended to deal with uncertainty by focusing on those risks most likely to occur and that in general they need to know what will happen (rather than what might happen). Many organisations seem to use numerical estimates, maps, text descriptions, and graphics on a daily basis when dealing with uncertainty in the climate information.

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

3. Methodological framework to asses users' needs

The EUPORIAS work package 12 (WP12) aims to assess users' needs with regard to seasonal to decadal climate predictions (S2DCP) and impacts across European sectors. To achieve this, a methodological framework was developed and a multi-methods approach was implemented in order to gather as much knowledge as possible but also to allow us to triangulate these various sources of information.

The first step was to conduct a systematic literature review on the use of S2DCP across Europe in order to help us gather any existing knowledge on this subject area (see point 3.1. below). Given the paucity of knowledge in the systematic literature we then organised a workshop with European climate services providers to elicit their knowledge and experiences regarding users' needs of S2DCP across Europe (see point 3.2. below).

Following the workshop we then conducted in-depth interviews with the EUPORIAS stakeholders as well as other potential users of S2DCP across Europe (see point 4. below). However, as these interviews only represented a small sample of the users' needs in Europe we then develop a survey in order to expand our knowledge base (see point 5. below).

This final report on users' needs presents the main findings from the activities pursued throughout WP12 with a particular focus on the interviews (T12.3) and the survey (T12.5).

3.1. Main findings from the systematic literature review

The systematic literature review performed focused on the use of S2DCP and climate impacts predictions across European sectors. This analysis consisted of two distinct reviews: one based on peer-review literature and another focusing on grey literature (Dessai and Bruno Soares, 2013a).

Main findings from the systematic literature reviews include:

- The development of seasonal climate predictions has been evolving in recent years although skill and predictability differ across different regions.
- A recent endeavour, decadal predictions are now emerging although a number of challenges remain regarding the development of the science.
- In Europe, S2DCP are still taking the first steps particularly regarding the practical use of this climate information to inform decision-making.
- The only example found in the literature of the use of S2DCP in practice was the case of Eletricité de France (EDF).

- The adoption and proliferation of seasonal predictions by other sectors and organisations is still far from reality.
- Decadal predictions are still in their infancy so there were no examples of their use in decision-making.
- In other regions where seasonal forecasts have a longer history (e.g. Brazil, Australia, USA) past experiences have led users, in some instances, to doubt the credibility, saliency, and legitimacy of this type of climate information. Irrelevant and non-tailored information, mis-communication, and mis-use of seasonal climate predictions are some of the factors that have led to disbelief in their usefulness.

The systematic literature review can be accessed at: http://euporias-test2.wdfiles.com/local--files/events-meetings/D12.1.pdf

3.2. Main findings from the workshop with European climate services providers

The workshop was attended by 26 climate service providers and purveyors from across Europe representing 11 countries and two European organisations and numerous sectors including water, energy, tourism and health (Dessai and Bruno Soares, 2013b).

Main findings from the workshop include:

- Little use of seasonal forecasts in Europe;
- Those using seasonal forecasts (to different extents) are mainly in the energy, water, transport, & insurance sectors;
- The majority of these organisations use predictions lead time of a month up to a season and energy sector organisations were identified particularly for seasonal forecasts;
- The majority of organisations/users identified use this type of climate information to improve the management of their activities, products and outputs with a view to improve efficiency and, for those in the private sector, increase profitability;
- No use of decadal predictions – unchartered territory;
- Central role of the European Centre for Medium-Range Weather Forecasts (ECMWF) and NMHS as providers of seasonal forecasts;

- Barriers to the use linked to low skill and reliability[1]; but also with usability & accessibility to S2D predictions by the end-users;
- Substantial knowledge and experience in using seasonal forecasts can be learned from other regions of the world (e.g. USA, Brazil, and Australia) including the range of barriers and limitations to the use of this type of forecasts;
- Interactions between climate services providers and users varied: those providing climate services (e.g. NMHS) tended to have some kind of relationship with users although these tended to be more interactive and iterative in some cases (e.g. MeteoSwiss, KNMI) than in others (IPMA);
- Chains of provision of S2DCP mainly focused on the seasonal or sub-seasonal timescale.
- These chains consistently started with data provided by ECMWF to NMHS and in some cases directly from ECMWF to certain organisations (e.g. EDF, ENEA).
- NMHS tend to act as purveyors by performing post-processing of information which they translate to generic products (and in many cases are freely available) and/or products tailored to users' needs (which tend to be a paid service).

To access the full workshop report go to: http://www.euporias.eu/euporias-workshop-on-climate-service-providers-and-users-nee

4. The interviews with the EUPORIAS stakeholders and other European users

4.1. Conducting the interviews

The interviews with the EUPORIAS stakeholders and other users aimed to provide a better understanding of users' needs with regard to S2DCP and climate impacts. An interview protocol was developed covering themes such as general characteristics of the organisations, processes of decision-making, the use of weather and climate information including seasonal to decadal climate predictions, and how organisations deal with uncertainty (Appendix 1). In addition to the general interview protocol, a few sectors - energy, tourism, agriculture, and forestry - developed additional questions to address specific issues in these sectors (Appendix 2).

The interviews were conducted between June 2013 and June 2014 by a total of 19 people from various partner organisations. Many of the organisations interviewed are part of the

[1] The term *Reliability* is used here as a synonym of trustworthiness and, as a result, it can be mapped onto a number of other technical concepts such as *skill*, *reliability*, and *sharpness*.

EUPORIAS stakeholders' consortium and therefore, have accepted to be involved in the project from the outset. Other organisations were identified and approached by project partners and accepted to be interviewed for the project.

In some cases, during the interviews the interviewees would also suggest other contacts/organisations that could be of interest to the remit of the project (i.e. snowball effect).

For some organisations more than one person was interviewed (or present at the time of the interview) in order to provide information regarding different areas of activities within the organisation (e.g. working with weather information; working at a more strategic level within the organisation).

Following the initial batch of interviews with the stakeholders and other European organisations the WP12 team assessed the representation (geographical and sectoral) of the interviews to date and identified specific areas and sectors that were underrepresented. Further interviews were then pursued aiming to address some of that representativeness across Europe.

The map below shows the distribution of the interviews conducted per country and main sector of activity (Figure 1).

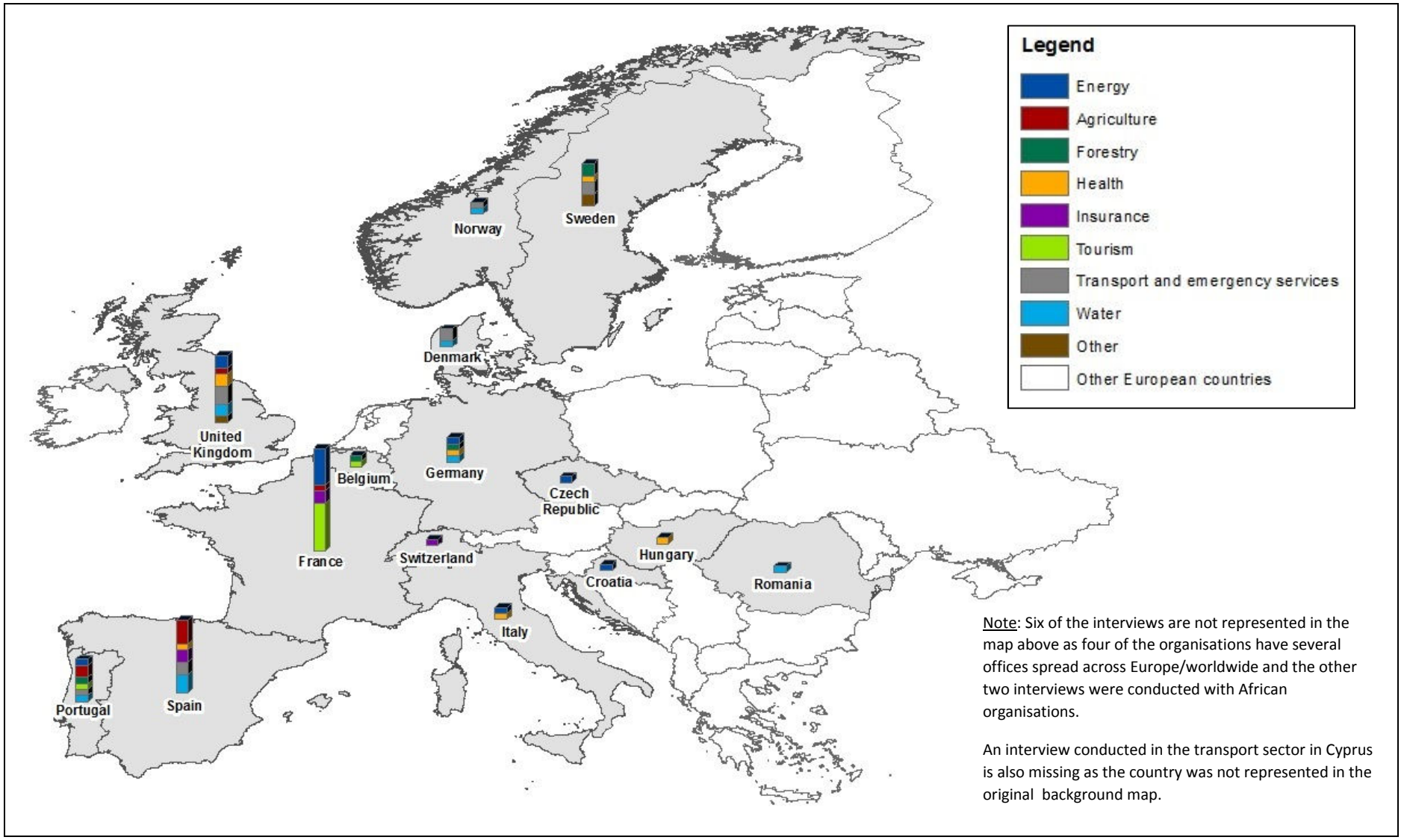


Figure 1 – Interviews conducted and analysed per country and sector of activity.
(Copyright © 1999-2010 ESRI Inc.).

The table below presents the total number of interviews conducted and analysed per sector of activity.

Table 1 – Number of interviews conducted and analysed per sector of activity.

Sector	Interviews conducted	Interviews analysed
Energy	14	14
Agriculture	12	11
Forestry	5	5
Health	8	8
Tourism	10	9
Insurance	5	5
Water	10	10
Transport & emergency services	12	12
Other[2]	4	4
Total interviews	**80**	**78**

The findings from the interviews conducted are structured around the themes from the interview protocol: general characteristics of the organisations; decision-making processes; use of weather and climate information in the organisations; use of seasonal to decadal climate predictions; and dealing with uncertainty (see Appendix 1).

The following sections provide a cross-sectoral analysis of the information collected during the interviews (section 4.2.) and more detailed information for each of the sectors represented in the EUPORIAS project (section 4.3.). These sections are based on the 78 interviews analysed (see Table 1). In some sections however, the total number of responses do not sum up to this total as, in some instances, a clear response was not provided by the interviewee.

[2] Three of the interviews were conducted with environmental organisations and one in the food security sector.

4.2. Cross-sectoral analysis of the organisations interviewed

4.2.1. General characteristics

The organisations interviewed varied in the sector of activities and the nature of the organisation. The majority of these organisations were private companies (n=25) or government organisations (n=23) (Figure 2). The remaining organisations were public funded or state owned organisations (n=10), research organisations (n=7), international organisations (n=6), professional organisations or associations (n=5), and organisations pursuing research and consultancy activities (n=2).

Certain sectors are also better represented by particular types of organisations. For example, the energy sector is mainly represented by private companies and research organisations whilst the transport and emergency services and health are mainly represented by government organisations. Agriculture, tourism, water, and forestry are the best represented in terms of spread across the different categories of organisations (Figure 2).

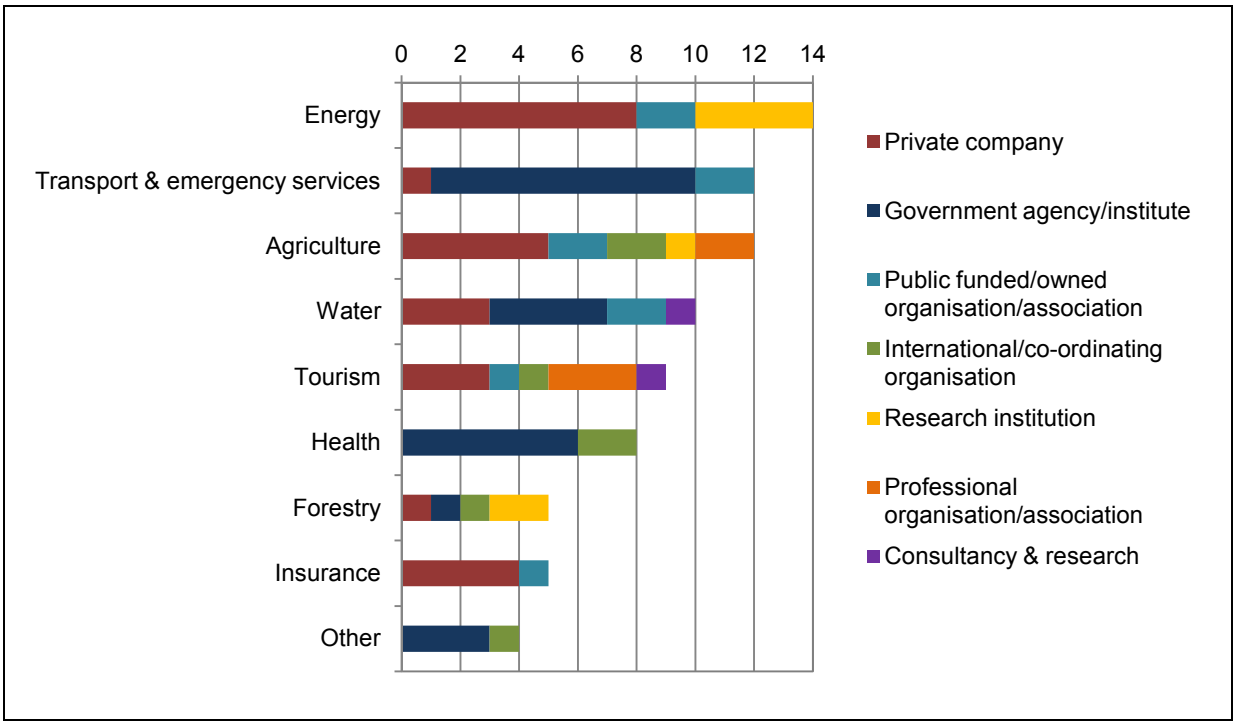


Figure 2 - Number of organisations interviewed per type and sector.

Some of the organisations interviewed (n=16) play an intermediary role in terms of centralising and/or providing information to others (e.g. consultancies, research organisations, professional associations) which is then used to make decisions. In such instances, the responses provided were mainly based on the interviewees' role and perceptions of how their clients operate and need.

Almost half of these organisations pursue activities at a national level (n=32) (Figure 3). Other relevant geographical scope were organisations with activities at the regional (i.e. sub-national) (n=15) and international level (n=15). The remaining organisations pursue activities at the European (=7) and local levels (n=2). It is important to stress however that this was the main geographical scope of their activities and in many cases it does not exclude other scales of activities (e.g. those working at the European level also pursuing activities at the national level).

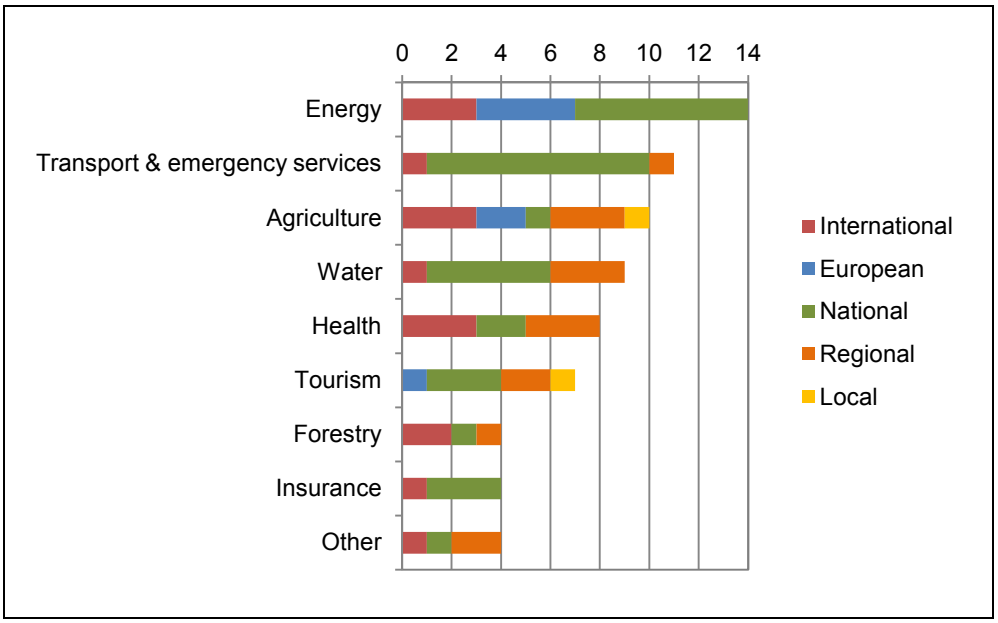


Figure 3 – Main geographical scope of the organisations' activities.

The size of the organisations was considered in relation to the total number of employees. As we can see from Figure 4, the biggest organisations (i.e. more than 1,000 employees) were associated with the energy sector and transport and emergency services (n=9 and n=7, respectively). Conversely, the tourism sector included the smallest organisations (i.e. below 50 employees) (n=8).

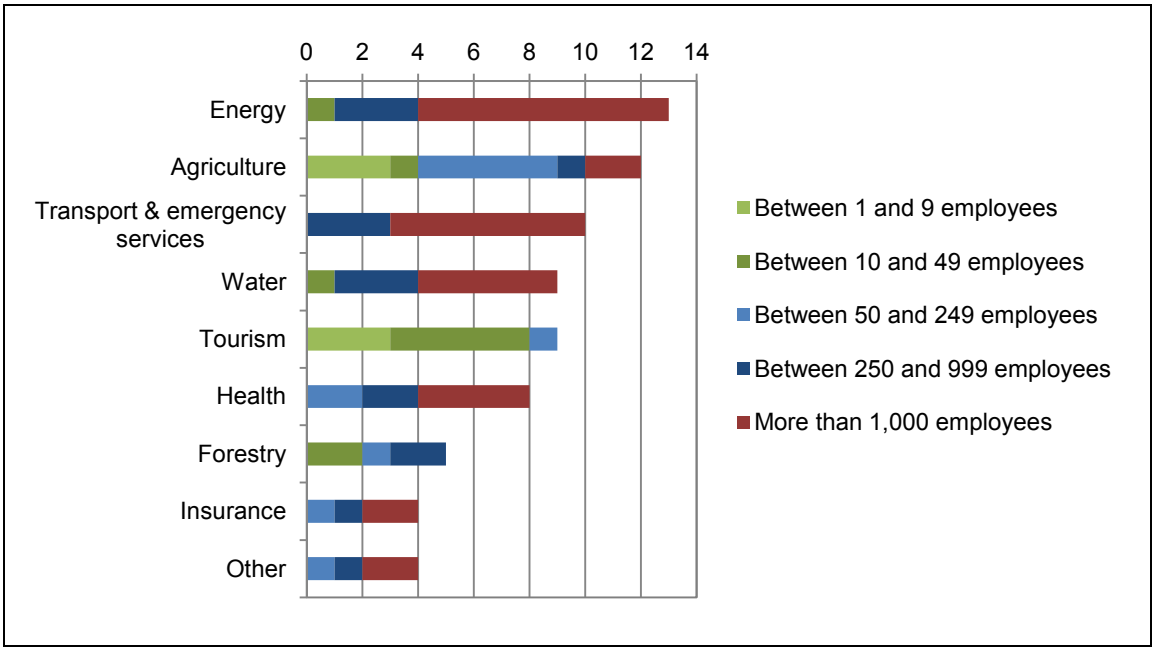


Figure 4 – Size of the organisations per sector and number of employees.

These organisations tend to be mainly governed by government policies and regulations (n=35), internal standards and guidelines (n=22), industry standards and regulations (n=21), and European directives (n=20) (Table 2). It should be stressed however that these categories are not mutually exclusive as organisations can be (and are normally) influenced by more than one source of regulation. In some interviews the regulatory context in which the organisation operates was not clear due to the absence of a clear response by the interviewee(s).

Table 2 – Main regulatory context

Government regulations/policies	35
Internal standards/guidelines	22
Industry standards	21
European directives	20
United Nations protocols	4
Independent regulator	4
Other	1
Don't know	1

The majority of the interviewees have leading roles within their organisations with many acting as the head or manager of a particular department or unit (n=32) closely followed by technical experts or officers in particular areas within their organisation (n=29). Of the remaining interviewees seven were directors or CEO of the organisation, five were

researchers, one scientist and one consultant. In the remaining interviews (n=4) the role of the interviewee was not clear.

4.2.2. Planning and decision-making processes

The organisations interviewed differ greatly not only in terms of size, nature, and geographical scope but also their sector of activity, the planning of activities, and the type of decision-making processes within them. Larger organisations have more complex structures encompassing different departments and units where various planning of activities and decision-making processes take place. In addition, organisations playing an intermediary role (between the end-user and the producer) tend to have their activities planned on an ad-hoc basis depending on the project/contract besides the organisation's own planning (e.g. corporate strategy). Such factors influence the responses provided by the interviewees which varied substantially in its nature partly due to the size and type of organisation (i.e. end-user or intermediary) but also the role of the interviewee in it and his/her experience and knowledge of the overall organisation.

In some cases, when asked about the planning activities within the organisation, respondents referred to the organisation corporate/strategic planning but also to the day-to-day operations and activities in the organisation, the planning of activities of the interviewee, and the planning of activities of their client(s) organisation(s) (i.e. corporate planning but also the planning of activities within a specific department/unit). The disparity of the responses provided made it difficult to match timescales with the type of planning described by respondents. In addition, the complexity and spread of the activities and operations in many of these (large) organisations was difficult to fully capture.

Nonetheless, in general terms the planning of activities tended to be associated with the following timescales:

- Shorter timescales tend to be associated with day-to-day operations and activities (i.e. implementation, maintenance, monitoring, and assessment) that either occurs daily or within the month.
- There are also activities that are more seasonal in their nature (months up to a year) which were mainly related to agriculture, energy, tourism, and health sectors. These are also longer maintenance activities that normally take longer to perform.
- Mid-term planning of activities (from 1 year up to 5 years) tends to be related with business strategies (often linked to annual capital investment plans) which tend to be reviewed at some point during that period and, in many cases, act as the strategic

framework for more specific plans within the organisations. Others also plan maintenance activities and asset management planning within this timeframe.

- Long-term planning (from 5 years up to 30 years) are mainly associated to wider vision and strategy (and associated resources and capital investment) for the whole organisation. Such long-term planning was mainly referred to in the energy, transport, and water sectors.
- For those organisations acting as intermediaries (i.e. consultancy or research institute) the timescales for planning their activities was heavily dependent on specific contracts/projects and also requests from customers.
- A couple of the organisations also deliver emergency response operations which are planned ad hoc.

Figure 5 below graphically illustrates these timescales and provides examples retrieved from some of the interviews conducted.

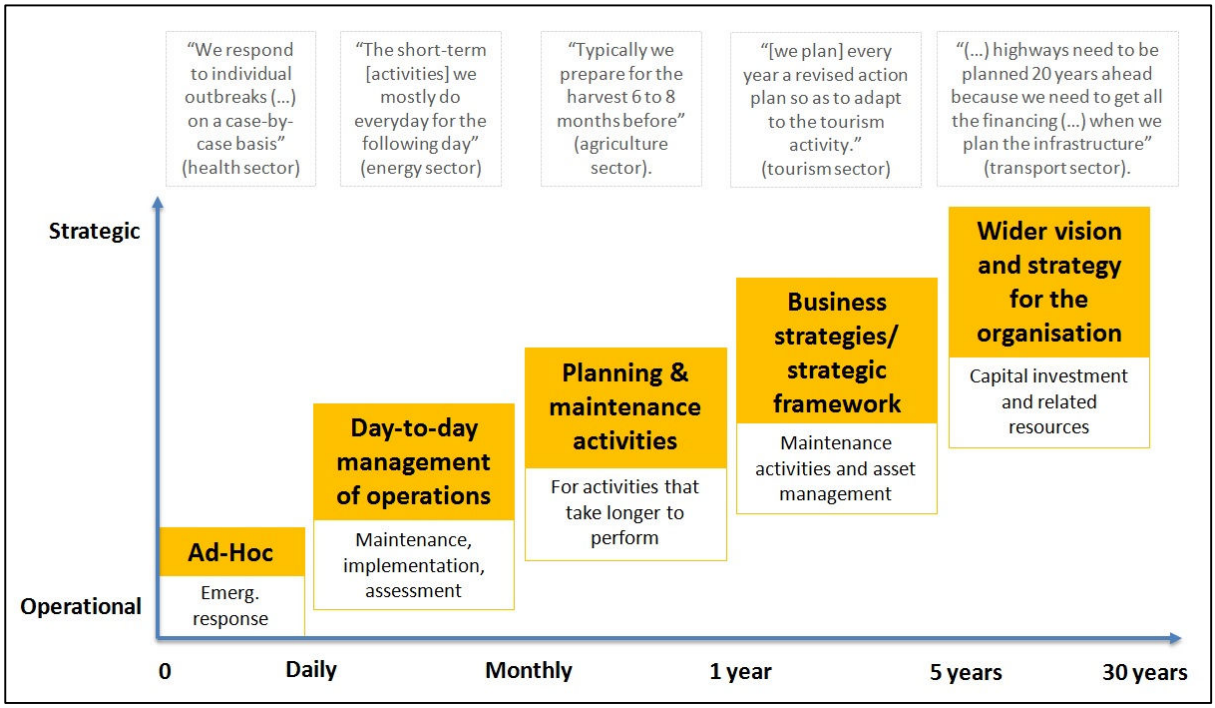


Figure 5 – Examples of planning and decision-making across the sectors interviewed.

4.2.3. Sensitivity to weather events and impacts

The majority of organisations interviewed are sensitive to some kind of weather conditions and/or events. However, sensitivity to weather depends on the sector, and the geographical scale of their operations as some weather events and impacts are more local (e.g. storms) than others (e.g. drought). In addition, knowledge and understanding of such sensitivities is also linked to the nature of the organisation being interviewed (e.g. organisation with an intermediary role, end-user organisation) and the role of the interviewee in it.

Some organisations/sectors tend to be more concerned with the impacts of extreme weather whilst others focus more on variables such as temperature and precipitation.

For example, the health and food security sectors tend to be more concerned about the impacts of floods and droughts (as well as temperature in the health sector); whilst in the energy sector the main concern lies on variations in temperature, wind, solar radiation, and precipitation as these affect both energy production and consumers' demand.

In the agriculture sector sensitivity to weather varied due to the nature of the organisation and the activities it pursues. Temperature, rainfall, and drought were the most important weather events and impacts affecting these organisations although relative humidity, solar radiation, wind, hail, frost, snow, and floods were also considered as parameters relevant to the success of their activities. Similarly, the forestry sector is also sensitive to an array of weather events and impacts (e.g. rainfall, drought, temperature, wind, lightning, forest fires, snow breakage, and storms) although the ways in which these affect their organisations depend on the activities, the time of the year, and the geographical location.

The tourism sector is aware of their sensitivity to weather conditions but some, particularly those acting as intermediary organisations, can't articulate how such sensitivities affect operational activities. Some organisations are sensitive (both negatively and positively) to precipitation and snowfall.

The organisations working in transport and emergency services were generally sensitive to precipitation (i.e. rainfall and snow) and floods, particularly during winter months. Some were also sensitive to cold temperatures and freezing conditions as well as high winds all of which can affect their infrastructure (e.g. roads). High flows, lightning, coastal storms, avalanches, and landslides were also mentioned particularly by organisations based in Scandinavia.

The main source of sensitivity in the water sector is floods and drought although some organisations were also sensitive to temperature as it can affect consumers' demand for water resources.

4.2.4. The use of weather and climate information

The large majority of the organisations interviewed used (to different extents) weather or climate information although many used it to develop specific products and not necessarily to make decisions within the organisation (particularly those organisations with an intermediary role). Table 3 presents the main type of weather and climate information currently used in the organisations per sector of activity.

Table 3 – Use of weather and climate information across interviewed organisations by sector.

Sector	**Historical data/past observations**	**Weather forecasts** (up to 1 month)	**Seasonal forecasts**	**Climate change projections/ scenarios**
Energy (n=14)	71%	36%	43%	14%
Agriculture (n=11)	45%	73%	36%	27%
Transport & emergency services (n=12)	58%	92%	25%	50%
Water (n=10)	60%	90%	60%	70%
Tourism (n=9)	11%	22%	0%	0%
Health (n=8)	38%	75%	25%	63%
Forestry (n=5)	40%	80%	0%	20%
Insurance (n=5)	40%	60%	60%	20%
Other (n=4)	50%	75%	25%	100%

Note: Decadal predictions are not shown since they are not currently used.

In the table above, historical data also encompasses data collected by the organisation such as their own meteorological stations as well as satellite and radar data.

Weather forecasts are the most used type of information across the various organisations interviewed (51 organisations). These tend to be used to understand future weather conditions and plan activities. This information is generally provided either in the form of model outputs (i.e. to feed a specific model(s) in the organisation) or as weather warnings which are then translated into potential impacts (e.g. health sector).

Historical data/past observations are also largely used across all sectors (38 organisations) particularly in the energy, transport and emergency services, water, and agriculture sectors.

This type of information tends to be used to help organisations understand the potential weather variability and its impacts which is normally pursued by either developing or feeding information into existing operational models or by performing historical variability analysis to forecast future weather conditions (weeks/seasons/years). In some cases, these forecasts are used to assess the potential impacts on production and consumption (mainly in the energy sector). Three of the organisations interviewed also used historical data but to analyse how their resources and infrastructure has coped with when facing particular weather conditions in the past (…) *So we use historical data to do our asset analysis (…) on days where the system has struggled we'll look at if there's any correlation to what the weather was that day*" (Interview in the transport sector).

The main parameters used included precipitation (mainly rainfall), temperature, and wind. Other parameters also used included solar radiation, snowfall, frost, and humidity.

Climate change projections or scenarios are also used mainly to help organisations plan ahead in terms of climate change impacts (e.g. on health) or to help them decide on future capital investment and develop wider strategies for the organisation.

Comparatively, seasonal forecasts are the least used type of information and tourism is the sector that uses the least weather/climate information (see below for more on the use of seasonal forecasts).

Use of climate information indices

Some organisations (n=30) currently use climate information indices in their organisations, including:

- Temperature-related indices: Heating degree days (n=6); Growing degree days (n=5); Number of days with minimum temperature below 0 Celsius (n=2); cooling degree days (n=1); cumulative degree days (n=1); number of days with temperature below\above x (n=1); cold waves index (n=1); Universal thermal climate index (n=1); Thermal stress index (n=1);
- Precipitation-related indices: Heavy precipitation/rainfall index (n=4); standardized precipitation index (n=2); accumulated precipitation percentage (n=1); number of days with precipitation (n=1);
- Drought-related indices: Water requirement satisfaction index (n=1); Palmer drought index (n=1);
- Agriculture-related indices: Huglin index (n=1); Winkler index (n=1); Greenness index (n=1);
- Storm indices (n=4);

- Forest fire index (n=2);
- Freeze/thawing index (n=1);
- Number of days with frost (n=1);
- Anomalies indices (n=1).

The potential to use climate indices was also identified in particular sectors:

- Forestry sector: on the relationship between forest growth and forest health; reaction of soil parameters to climate; ground-frost and snow breakage; storing winter timber until summer;
- Health sector: temperature/humidity index in the context of infectious diseases; wind and its relationship with respiratory diseases; indices related to tick-borne diseases.
- Insurance: drought-related indices; heavy rainfall indices;
- Transport sector: freeze-thaw ratio; number of days when temperature is around zero;
- Water sector: number of days with heavy precipitation, number of days without precipitation; temperature-related indices.

Post-processing of weather information

Many of the organisations interviewed perform some kind of post-processing or tailoring of the weather information they use in their activities (n=45). Of these, 21 organisations perform some kind of post-processing in-house; 11 outsource this service; and 13 organisations do both in-house and outsourced post-processing.

Some organisations (n=10) only use 'digested' information directly provided either in the form of a weather forecast or as translated impacts (e.g. for health) based on weather forecasts.

For those organisations tailoring the information in-house the main methods applied include: statistical modelling and reanalysis (n= 10); data aggregation and interpolation (n=6); quality control (n=3); statistical downscaling (n=3); bias correction (n=1); and validation of dynamical seasonal model (n=1).

Many organisations use this information to feed existing operational models. However, in many of the interviews this was not clearly stated by the interviewee and therefore it was not possible to ascertain the total number of organisations using operational models. In addition, given the size and complexity of these organisations it was also difficult, in some cases, to

capture all the weather and climate information used and the types of post-processing applied in each case.

Sources of weather and climate information

The majority of organisations use weather and climate information provided by the National Meteorological and Hydrological Services (NMHS) based on their countries (and also other European NMHS when relevant) (Table 4). Other sources of information used by these organisations interviewed included the British Atmospheric Data Centre, Climatic Research Unit (based at University of East Anglia); Famine Early Warning Systems Network (FEWS Net); National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA); Catalonia Public Health Agency; Climate Research Centre in Potsdam, Romanian Water Administration, and the UK's National Centre for Atmospheric Science (based at the University of Leeds).

Table 4 – Sources of weather and climate information

NMHS	56
Other sources	14
Online information	14
Private companies/services	12
Own data (e.g. weather stations)	12
ECMWF	4

Many of the organisations (n=28) provide weather-related information to others outside the organisation. In the transport sector (n=7) this information is passed on to others in order to help with the maintenance of roads (e.g. snow ploughing, track accidents), traffic control, or prevention. In the health sector (n=5) organisations mainly provide warnings related to potential impacts of weather on health (e.g. heat waves warnings); whilst in the water sector (n=5) this provision can take the form of weather forecasts, weather-related impacts on hydrological resources, or guidelines/advise on flood and development. In the energy sector (n=3) weather information and its potential impacts on the sector is provided to their clients.

4.2.5. Awareness and perceptions of S2DCP

The majority of interviewees were generally aware of seasonal forecasts although differences in how they perceive it varies. Many associate seasonal forecasts with those produced by the national met services and available online or simply as a forecast of future

conditions; whilst others have a more intricate understanding of these types of forecasts e.g. "*It's an uncertain look in the future where we hope that we get more information out of it than long term climatological mean*" (interview in the water sector).

There is also a wide spectrum of understandings regarding the predictions lead time of a seasonal forecast: from 1 up to 3 months; a 3 or 4 months forecast; up to 6 months; more than a 1 month and less than a decade. The majority of the interviewees however, associated these forecasts specifically with the potential changes in seasons (even those less aware of seasonal forecasts).

Decadal predictions are significantly less known comparatively to seasonal forecasts and generally regarded as unchartered territory. Very few interviewees were aware of this type of climate predictions and those who did understood these as covering the period of 10 or 20 years from now, suggesting that inter-annual may be a better description of these types of predictions.

4.2.6. The use of S2DCP in the organisations

Organisations using seasonal forecasts are spread across sectors (n=26): energy (n=6); water (n=6); agriculture (n=4); transport and emergency services (n=4); insurance (n=3); health (n=2); food security (n=1). These forecasts are mainly used as an additional source of qualitative information, i.e. as something they 'keep on the back of their minds' as the reliability of such forecasts is generally perceived as relatively low. "(…) *the forecast never seems to be able to tell us… you know, last year was a classic. We were really planning for drought up until 1 May and then we had the wettest summer on record it just wasn't seen to be coming*." (Interview in the transport sector).

However, the extent to which these organisations use it differs from those using the information to help them plan their activities (e.g. maintenance work, external contracts, emergency planning, etc) from those using it simply to inform a more general opinion on how future conditions may affect their organisation's (or their clients) operations.

Only one of the organisations (in the water sector) was in the process of integrating seasonal forecasts into their operational model although this was still at an experimental phase.

In some cases, although the organisation uses seasonal forecasts as qualitative information, there are still issues on how the information is provided and used within the organisation:

- The forecast is provided too late for the information to be used effectively in the planning of operations;

- The forecasts are temporally coarse i.e. preference for the forecast to be provided monthly rather than as 3 month outlooks (energy sector);
- Preference for 2 or 3 month prediction with daily data so information can be used in crop models (agriculture sector);
- Preference for seasonal forecasts to be translated into potential floods (water sector).

Many of the organisations interviewed however do not use seasonal forecasts (n=39). None of the organisations interviewed in the forestry and tourism sectors currently use this type of forecasts. The main reasons for no using seasonal forecasts included:

- Lack of reliability[3] in the forecasts and reputational risk (n=20).

  "*We try not to make relevant decisions based on this information. It's a direction to go but afterwards we will not justify that the generation was made based on this information*" (interview in the energy sector).

  "(…) *as I mentioned earlier seasonal predictions are not always reliable concerning parameters other than temperature like precipitation*." (interview in the health sector).

  "(…) *We do not believe that it [a seasonal forecast] is yet accurate enough to even use it as an indicative value and even less to draw conclusions about how the flood volumes will be in the coming months*" (interview in the water sector).

- Tradition of performing historical variability analysis to look at trends (n=14).
  "*So the reason [for not using seasonal forecasts], I suppose, would be that at this kind of timescale, not looking that far into the future, historic data is probably a reasonable representation of what's going to be happening in a few years' time*" (interview in the energy sector).

  "*We also use historical information as a substitute for seasonal projections because if we can't get any seasonal projections that are good enough (…) then the traditional approach we have used is to look at the historical series* (…)" (interview in the water sector).

- Difficulty in integrating information into existing operational models and decision-making processes (n=7).

  "(…) *the information today is not adequate for being integrated into [our] models, because the timescale and the time step on the information, basically we're talking*

[3] The term *reliability* is used here as a synonym of trustworthiness and, as a result, it can be mapped onto a number of other technical concepts such as *skill*, *reliability*, and *sharpness*.

about three months averages and so on, is really not possible to introduce into our tools (…)" (interview in the energy sector).

"*Because we plan a lot of our work about a year and a half out so even if we planned out […] a seasonal forecast that we receive two months before isn't going to be particularly of use*" (interview in the transport sector).

"(…) *what we would like is that this […] seasonal information on rainfall and temperature be transferred to floods*" (interview in the water sector).

- No need for this type of information in the organisation (e.g. does not fit with the *modus operandi*, reactive response to weather/climate, no demand from clients) (n=7).

  "I'm not sure we would use them [seasonal forecasts] anyway because (…) it's the contractors that have to be aware of seasonal variations when they are planning the work on the roads (…)" (interview in the transport sector).

- Not aware of what is available (n=5).

  "Because we don't know what is available, simple as that" (interview in the health sector).

  "*No because I didn't know that [seasonal forecasts] existed. No really I didn't know." (interview in the tourism sector).*

None of the organisations interviewed used annual or decadal climate predictions. Those aware of decadal climate predictions "(…) *think it is not well-known yet. It's not really available and I don't think we understand well the added value of using this kind of decadal climate information and the associated uncertainties.* (…) *I think that many people are not aware of their existence and even if they do know about it, they have doubts about their value.*" (Interview in the agriculture sector).

One reference was made in the agricultural sector regarding the use of decadal variability information where it is used qualitatively to aid seasonal forecasting (i.e. phase of the pacific decadal oscillation which affects the probability of occurrence of El Niño/La Niña). In some instances there was also some confusion regarding the difference between decadal predictions and climate change projections or using historical data to forecast changes for the next decade.

Sources of seasonal forecasts and responsibility for developing S2DCP

The main sources of seasonal forecasts to the organisations interviewed are the NMHS (n=8), ECMWF (n=4), Meteogroup (n=1), WSI (n=1), World Climate Service (n=1), International Research Institute (n=1), and CFS (n=1).

Four of the organisations also use other available sources of seasonal forecasts (e.g. online websites) in addition to their main provider of seasonal forecasts.

In general terms, the production and dissemination of S2DCP was perceived by many as a responsibility of the state operationalised by the NMHS (n=37) given their perceived scientific transparency, institutional credibility, and legitimacy as well as continuous resources to develop the predictions. Only three of the organisations viewed this as a responsibility of the ECMWF.

The European Union was also identified as a potential centralising source of information for S2DCP across Europe (n=4) whilst the potential role of intermediary organisations in communicating existing data to users as well as translating and tailoring the information to specific user needs was also emphasised (n=2). One organisation defended the need for academic research to underpin the development of the predictions (n=1).

For some organisations the source of S2DCP was not so relevant providing:

- The forecasts have the best skill possible (n=1);
- The quality of the predictions and delivery of the products (at an affordable cost) is successful (n=2);
- "The one that does it better, that's okay" (n=1).
- The information is centralised and well disseminated "*I don't know where, but everything together. If you have some information that doesn't agree with the information provided in other places, you have an uncertainty*" (Interview in the Insurance sector).

Potential for using S2DCP

Although the majority of organisations interviewed do not use S2DCP the potential to use these types of forecasts was identified. Many of the interviewees said that seasonal forecasts would be useful to improve the planning of activities and decision-making (either the organisation or the client) (see section 4.3. below for more details).

For some organisations inter-annual/decadal predictions would also be useful if they become available. There was some interest in these types of climate predictions particularly in the transport, energy, and forestry sectors (n=21) (see section 4.3. below).

Two organisations said they would be particularly interested in decadal predictions given the influence such information could have i.e. influence European policy in the next 10-15 years and predict forest growth and health and also soil development in a 10-20 year horizon.

A particular case is the health sector whose concerns lie in the potential impacts of weather/climate conditions and although generally interested on the potential to use S2DCP, the sector requires higher levels of probabilities attached to the forecasts before being able to take action (i.e. the correlation between future climate conditions and health impacts needs to be strong).

"*We would have to construct the models to see what the relationship is between health and weather*." (interview in the health sector).

"I'm sure that this [seasonal forecasts] could certainly be useful information but there's no clear cause and effect for us and if we can't prove that, although there could be sometimes not explaining everything but could explain something that could happen in the future, I think that will be giving more and more attention to climate predictions in terms of health services." (interview in the health sector).

In terms of parameters (for both seasonal and decadal climate predictions) these were largely related to temperature, precipitation (i.e. rainfall and snowfall), wind, humidity, and solar radiation. Another important aspect to some was the spatial resolution of the forecasts which, ideally would be provided at the finest resolution possible either to allow the planning of activities in areas were physical conditions are very different (e.g. in the water sector) or to allow focusing on local urban areas in terms of health impacts (e.g. in the health sector). See section 4.3. below for further details for each of the sectors and organisations interviewed.

S2DCP as public *versus* private services

Provision of raw data (model data) of S2DCP was largely perceived as something that should be available as a public service (i.e. publicly available and free of charge) (n=26) as many view these new forecasts being developed under the auspices of NMHS and therefore largely funded by the taxpayer. However, some also argued that as soon as value is added to this publicly available data (e.g. through post-processing or tailoring of the data for a specific application) that it should be provided as a private service with a cost attached (n=13). This overall approach, was described by an interviewee in the energy sector, as

having "(…) *all the observational data and model outputs continued as public because they are being paid by the tax payers and (…) then let's say you have tailored products, for instance post processing, moderate statistics and so on, could be part of the private service and so be paid for (…) I think the US model is quite good and I think (…) this could be the future model for Europe.*"

Other concerns regarding the provision of S2DCP (particularly as a public service) included the potential for misusing or misinterpreting the information provided and the need to ensure the quality and reliability of the information. A few organisations also recognised that S2DCP could be provided with a cost attached or as a public/private partnership (n=3).

4.2.7. Dealing with uncertainty

Many organisations perceive information on uncertainty as an essential component to better understand the data being provided (n=35). *"I think it will certainly be challenging but I think it's absolutely essential and it is part of that transformation process. You have to have that uncertainty, it's unavoidable"* (interview in the energy sector).

Only three of the organisations admitted looking at the skill of the forecasts (n=3) whilst a couple of the organisations in the energy sector compare seasonal forecasts from different sources as a way of reducing/sampling uncertainty: "(…) *we compare the forecasts issued by different suppliers (…) and then, if this information is contradictory, that is one type of information and, if they are both pointing in the same direction, that is also a type of information*."

Some respondents considered that at least 70-75% of probability (also referred to as confidence/certainty) if not more was needed to make use of the information (n=8). One particular organisation in the agriculture sector had an exact threshold for considering such forecasts: "*As a rule of thumb, in order to take into account such a forecast I need to have at least 67% reliability, that's my threshold*" (interview in the agriculture sector).

Conversely, probabilities equal or below the 50% probability were not regarded as useful information by others (n=5). "*If the uncertainty is very high, we won't obviously consider the climate information to make any decision. For instance, according to my experience, if it is said that it is going to rain with a 40% probability, then I don't consider that information at all, it is worthless in a drought period*." (interview in the insurance sector).

Regarding the preferred methods for representing the uncertainty attached to climate information many organisations (n=31) would prefer to receive this information as numerical estimates (e.g. one figure number, percentages, confidence intervals). This preference is mainly due to the ability to quantify uncertainty, integrate this information in existing models

or the ability to produce their own graphics from numerical estimates, and avoid misinterpreting the information.

Graphics were also a preferred method by some of the organisations (n=26) but in many cases interviewees felt the need for these to be accompanied by explanatory or descriptive text particularly for less experienced audiences and as a way of avoiding misinterpretations. This preference was mainly associated with the easiness in using this method "(…) *Graphics would be easily readable but sometimes more information would be needed, especially with people with less experience.*" (Interview in the energy sector).

A few interviewees (n=6) also mentioned maps as their preferred method for representing uncertainty given their readability and the ability to link information on uncertainty with particular geographical areas.

Some interviewees felt that the method for representing uncertainty needed, above all, to match the needs of who is using that information:

"*It depends on who uses it. Traders who permanently must make quick decisions like visual displays or one-sentence messages. They like very clear, simple graphics, which allow them to capture immediately and understandably all relevant information. Crop analysts on the other hand really need numbers and more detail, but they also appreciate a bit more general context on what is happening*." (Interview in the agriculture sector).

"(…) *we scientists can understand and interpret these findings and results but for us it's necessary to learn how to explain the results to the decision-makers. So we also need education about communication with lay people and decision-makers (…) and they [decision-makers] also need some special training on how to incorporate these things into their decisions*." (interview in the health sector).

Other methods of representing uncertainty mentioned included the provision of data in an easy format and already interpreted for non-specialists; information on uncertainty provided according to a reliability scale or index of confidence; and adopting a more probabilistic approach to uncertainty (i.e. moving away from deterministic approaches to uncertainty).

4.3. Sector-specific information

This section provides further detail about each sector including the general characteristics of the organisations, their area of work and activities, the current use of weather and climate information, and the potential for using S2DCP in these organisations. Note that organisations are complex systems where a range of decisions and processes occur every day. The data collected is therefore limited by, and a result of, the people interviewed, their role in the organisation, and their own experience and knowledge. As a result, the data described below (and in the rest of the report) should be regarded as an overview of the context and needs of these organisations/sectors by the people interviewed.

4.3.1. The energy sector

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
A private energy company operating around the world. The organisation has around 30,000 employees.	The company operates in most areas of energy: generation, distribution, transmission and is an energy supplier in some countries. They operate primarily with fossil fuel technologies and all types of renewables but not with nuclear.	The company uses historical observations from MERRA (Modern-Era Retrospective Analysis for Research and Applications) for e.g. understanding future wind variability and the potential value of generation mix.	Seasonal forecasts could be useful to help plan and maintain gas turbines but not particularly relevant for the interviewee's own research. Decadal predictions (if reliable enough) could be helpful in terms of understanding the future wind generation.
A centre of Expertise in Economic Studies and Modelling. The centre is part of an energy company working across Europe (the company is part of a larger group). The company has approximately 147,000 employees and the centre around 85 employees.	This centre is responsible carrying out a number of economic studies for the group, mainly energy economics but also on climate and sustainable development related issues.	The centre uses historical data and observations (aggregate, reprocessed data) as well as weather forecasts to feed their operational models. They also use seasonal forecasts (1 to 6 months) as qualitative information. The information is used to help them understand potential supply and demand needs for gas and electricity for Europe as well as understand the potential risks to their assets from extreme events.	There is a potential to use seasonal forecasts in a more automated way although for them the reliability has not yet been achieved and there is also the need to better understand the decision-making to be implemented. "*We say that there is a matter of reliability and there is a matter of the capacity to assimilate or process that data and, therefore, of automated processes which, despite everything, require an expert's view on the output of the models. The models produce very different data and scenarios and, therefore, if the scenarios in the 3 coming months are concentrated on 2 very different atmospheric situations, we need a human view and an expert's view on this type of results. These are the things we want to be automated, but not completely automated, and therefore there is a chain of decision-making that is yet to be understood and implemented*."
A transmission system operator (partially	The organisation is responsible for the	The organisation uses historical data to forecast seasonal variability (based on	Although they are interested in historical data to understand future seasonal variability it was not clear from the interview

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
public-owned) working at the national level and with around 8,000 employees.	national high-voltage transmission system (the largest in Europe).	past data). Every year (and even twice a year) they take into account the last five years to estimate the parameters of their model and use those parameters for the next six months. They also use weather forecasts in their operational models. Their main parameter is temperature to help them understand energy demand. Other parameters of interest include wind, solar radiation and cloud cover. Precipitation is used for hydraulic forecast.	what would be the potential to use S2DCP in this particular organisation.
A stated owned electric power company which is part of a larger group working across Europe (mainly Eastern Europe). It has around 12,000 employees.	The organisation is responsible for electricity production (mainly hydro-power) and trading.	They currently use weather forecasts (next day and 2 weeks forecasts) as well as past observations to help them manage their hydro-power plants (based in rivers and small basins) and plan potential demand. They also use seasonal forecasts (precipitation and temperature) but only as qualitative information.	Seasonal forecasts would be useful to help them understand future conditions in the in next 1 to 3, even to 6 months in terms of precipitation (rainfall) and temperature. Precipitation is the most important parameter for their hydro-power plants production. Temperature is very important for electricity (and recently gas) consumption prediction and in combination with precipitation makes good input understanding about cooling / heating needs and artificial light needs. They are already trying to explore seasonal forecasts in terms of precipitation and temperature in terms of above, below or mean (with indicator of confidence -percentage). However, they would like to know daily distribution of precipitation for the first month of the half year period. They would also like to have seasonal forecasts showing the type of precipitation during winter (i.e. rain or snow) and its distribution (e.g. evenly distributed during those 1 to 3/6)

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
			months, or there would be changing periods with excessive precipitation and periods of drought?) They would like a spatial resolution of approximately 3,000 km2 or higher due to the geographical location of their rivers and basins (mountainous region).
A private energy company working at the international level and with more than 1,000 employees.	Working on a range of issues from the generation of energy, distribution, down to the customer.	They use historical observations and climatology (averages and tendencies of particular months) to help them understand potential demand and improve optimisation.	Potential for using seasonal and inter-annual forecasts (focus on precipitation) to help manage their reservoirs including decisions about the transfer of water between their two inter-annual reservoirs. *"For us to have more reliable information for the next 3-4 months will be very important to help to manage the water in a better way, considering those two situations that I mentioned previously: optimizing the electric generation, and obviously putting all the social conditions and all the social restrictions, so from the water supply to the other usages of water, in an optimal way."*
A private energy company (largely government owned) working worldwide but with main activities in Europe. It has around 165,000 employees.	Working on the production and distribution of electricity (with some smaller activity in gas).	They use weather forecasts (days up to 2 weeks looking at a range of parameters including temperature, precipitation, wind), historical data and climate change projections.	Potential to use seasonal forecasts focusing on same variables as those already used for short-term forecasting (e.g. temperature, precipitation, wind) and use it to better understand power demand and production (and improve optimisation) and inform decision-making.
A transmission system operator (private company but largely government owned) working at the national level and with around 3,000 employees.	The organisation is responsible for the transmission electricity network.	Historical records are used to forecast the peak load of a particular day (based on a similar day in the past) and define generation pattern.	There is a potential for using seasonal forecasts in operational planning but no perceived use for decadal predictions in the organisation as these timescales do not fit their *modus operandi*.

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
A private energy company (but largely government owned) working worldwide but with main activities in Europe. It has around 165,000 employees.	The organisation works on the production and distribution of electricity (with some smaller activity in gas).	The organisation uses historical observations and climatology mainly for production plans and development of new facilities. They also use weather forecasts (up to 2 weeks) in their operational models to e.g. help them understand electricity demand and compute wind and solar outputs. They also use climate change scenarios to help them estimate the potential evolution of climate particularly extreme events; and seasonal forecasts (temperature) but only as qualitative information (although efforts have been made recently to try and integrate this into their operational models). They use different sources of information in order to triangulate the data and reduce uncertainty. Main parameters of interest are temperature and cloud cover as these affect the demand for electricity. On the production side the parameters of interest include precipitation and snowfall, wind (up to 200m), and solar radiation.	There is potential to integrate seasonal forecasts into their operational models. However, current barriers to achieving that include "(…) *the format of the [seasonal] forecast [that] is not compatible with the application, (…) the scale is not good at the moment and there's no useful information in it (…) even when you take information as it should be taken, so for large scale areas with three months already and so on, so of course the first bit is the scale."* Nonetheless, it would be useful for them to have several months to one year prediction lead time to give them an idea of how their system will behave in the coming months. With regards to inter-annual and decadal predictions: "*For instance if you have let's say a one year forecast, which was due at precipitation would be [above] the normal, for the next year or for the next years, winter and spring for instance, it would give some more flexibility for our energy systems because it will have more water and some more hydro potential capacity and so on, so this would be useful at these time scales."*
A private consultancy company working at national level with around 18 employees.	The organisation helps companies take into account the impact of weather on their	They use past observations and weather forecasts (up to one or 2 weeks ahead) to provide their clients with activity forecast (for the energy sector) and	There is potential to use seasonal forecasts more widely in the organisation providing the reliability over Europe increases. If that was the case, they would like to have monthly temperature forecasts at the national scale.

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
	operational activities.	weather impact forecast (for the consumer produced goods sector). They also use seasonal forecasts for some customers (situated in the tropical belt) to help them plan their activities for the coming months.	Such information *"(…) could reduce the cost for our customers (…) [by] improving the decision making" (…) They [the consumer produced goods] have very expensive actions, communication action operations, and if it happens when the weather is very poor (…) the effect of this expensive operation will be very negative for them".* To be able to use this information they would have to first "(…) *prove that using this kind of forecast will have some value added for our customers."*
A transmission network (private company) working at the national level with approximately 27,000 employees.	Responsible for the transmission electricity network and gas distribution network.	The organisation uses probabilistic weather forecasts to help them forecast wind power. The company providing them with these forecasts provide them at an hourly resolution from the current day up to 10 days ahead. They also use weather observation data to calculate their own indices for forecasting demand (e.g. average temperature over the last 4 hours). They also consider seasonal forecasts. They also take into account long-term climate change when managing their assets for the future.	Seasonal forecasts could be useful for their long-term planning but these would have to be more reliable. *"We're very interested in whether it's going to be an unusually cold winter or an unusually mild winter, if there's information that can be gathered on that information, on that possibility six months ahead of time, then that's really useful to us for our longer term planning. But again, I know enough about climate prediction that that's quite difficult to achieve."*
A research institute working at the national level with approximately 1,000 employees.	Working on bioenergy technologies and the assessment of bioenergy pathways.	The organisation uses weather and climate change information for making predictions on future energy crop systems (but they don't use any operational models).	They are not interested in seasonal forecasts but "(…) *I think it would be helpful to have, let's say, more seasonal forecast on agricultural yield in general*".
A government research institute working on a	Working on resource assessment (mainly	The organisation uses weather and climate information to provide	They're not planning to use seasonal forecasts as they don't seem to need it.

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
range of different contracts and projects. The organisation has around 300/400 employees.	solar energy); determining the environmental impact of energy, in the energy system; and dissemination of information.	information to their clients as they are interested in current weather and future climate to install wind farms or photovoltaic systems. The clients use past data to help them understand inter-seasonal values. For solar energy they use aggregated values for a typical meteorological year (TMY) where they aggregate temperature, humidity, solar radiation.	They don't currently use decadal predictions as their clients do not request this type of information but they are planning to use it in the future to provide an evolution of resources.
A research institute working on a range of different contracts and projects. The organisation has around 200/300 employees.	Research on what kind of information energy industries need and how to provide it to them, so that they can use the information in different industry applications.	Their clients tend to use historical data to try and quantify uncertainty.	It would depend on the client and what their particular concerns are but they would possibly be interested in wind and temperature (above, below, mean). Regarding decadal predictions this would relate more to the timescales for investment or financing. Hence, the potential for using seasonal or decadal predictions would lead to different questions "(…) *depending on how close you are to the operations versus the investment".*
A research institute working nationally (and in some international projects).	The organisation works in different areas of research including engineering, energy, and mechanics.	They use historical data to forecast the probability of something extreme happening.	The interviewee would be more interested in working with seasonal and inter-annual predictions. "*For me it's interesting to know whether the next six months would be dry or wet because what happens very often in [the country], we use water as much as possible and then, just when it's nearly too late, everyone says, "Be careful. We have to use less water because there's no water in the reservoir." Now for me I think it would be useful to know one year beforehand [if] next year is going to be dry and then to save water a year rather than just one month before.* "

4.3.2. The water sector

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
A private company operating at the international level (e.g. America, Asia, Europe) but business is mostly carried out at a local level in Spain. The organisation has around 10,000 employees.	The organisation offers services in the area of integrated water cycles. It offers services around drinking water supply, sanitation and filtration of water.	The organisation uses weather forecasts to make basic operational decisions (i.e. depending if it's going to rain or not influences certain operations). They use monthly and seasonal forecasts but only as qualitative information to help them have a general idea on how dry/wet the seasons will be and how that may affect their operations.	"*(…) when we talk about this type of forecast, whether it be monthly or seasonal. We are discussing something qualitative which is used to inform your opinion about, in our case, factors that influence demand and availability of resources, but of a qualitative type* (…) [and so] *there isn't enough confidence in these kinds of forecast for there to be someone behind them selling you a service.* They are not interested in decadal predictions as they don't work with these timescales.
A government organisation working at the river basin level and with approximately 1,000 employees.	The organisation manages the water in a Spanish river basin. Its various tasks include managing the use of water by private individuals, the operation of reservoirs and canals, and the quality control and conservation of aquatic environments.	The organisation use weather forecasts (rainfall) to help them forecast water levels and maximum flood volumes at the water gauge points. They have their own network of rainfall and temperature weather stations. They also use climate change projections/scenarios for future planning. They don't use seasonal forecasts due to the lack of confidence in the information.	They would be interested in seasonal and annual forecasts and decadal predictions. For example "*If we plan for 2021 and we know what the water supplies are going to be in those years, well it would be ideal. Hypothetically, if I could know what the rates of river discharge will be over the next ten years that would be perfect. What's more is that this is a real possibility now."*
A research and consultancy organisation working in Europe (having different offices across Europe) but also working at a global level. Organisation with more than 1,000 employees.	Organisation working in all aspects of water including sea water, ground water, sewerage systems, water supply and its hydrology and water resources.	The organisation uses historical data to feed their models of flooding forecasting. They also use historical series to forecast seasonal variability using Monte Carlo simulations. They also use satellite information when ground information is lacking. They also use climate change projections to help them understand	They would be interested in seasonal forecasts for rainfall and temperature (mean and extremes; and wind speed to a lesser extent) with 1 to 12 months prediction lead time. These would be as high resolution as possible both temporally and spatially (i.e. 5 km2 or finer, although coarser resolution would also be useful). If possible, they would like to have daily values. They work globally so their needs for information can vary but all year round forecasts and/or information on wet

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
		water availability in the future.	season/dry season or winter/summer months would be valuable to them. They would also be interested in forecasts with more than 1 year predictions lead time provided these were reliable. This information would help them develop their consultancy/research projects.
A public company owned by the state and working at the regional level. Organisation with approximately 700 employees.	The organisation is responsible for the supply and distribution of water in a region of Portugal.	The organisation uses weather forecasts for the next 7 days (temperature and precipitation). They also use historical information for the previous year to help them understand the periods of higher demand. They also use climate change projections for their projects.	They would be interested in annual forecasts to help them predict potential drought conditions and enable anticipatory action.
A government organisation working at the national level with around 400 employees.	The organisation is responsible for advising other government organisations and agencies with regard to the country's waterways.	The organisation uses meteorological observations particularly precipitation and temperature from NMHS (also from information from neighbouring countries). This is hourly data (sum and mean) that is integrated into their hydrological model. They also use ECMWF 10 day forecast (ISS model) and are adapting their operational model to use the 14 days forecast. They also use historical data from their own meteorological stations and use it to update hydrological and hydrodynamic models. They also use climate change projections in a research project to analyse the potential impacts of climate change on water ways and	The organisation is planning to integrate the ECMWF System 4 forecasts to generate stream flow forecast for the water ways.

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
		navigation and develop adaptations strategies. It's also used to calculate climate run-offs or stream flow projections and assess potential impacts on navigation.	
A government organisation working at the national level with approximately 550 employees.	Manages the national water resources including hydropower development and electricity distribution.	The organisation uses observation data for precipitation and temperature as well as weather forecasts (six or 10 days forecasts) to feed their hydrological models in the national flood forecasting system. They have been looking into the ECMWF 4 week forecast but are not using it operationally. Their distributed rainfall-runoff model is now moving into a 1x1 km grid for spatial calculations. They also use climate change scenarios for 2050, 2070, and 2100. They are also developing scenarios of the future based on historical data i.e. taking the present snow status and then using historical observations of precipitation and temperature run a simulation for the spring season.	The organisation would potentially be interested in seasonal information for precipitation (rain, snow), temperature and wind. The impacts of such events will depend on the country's region and they all contribute to flood events which is a major concern all year around. For example, extensive rain during summer may cause floods whilst in the autumn the combination of snowmelt and rain may also cause floods. In the coastal region, there is a more all-year-around flood regime, though for the major rivers, snowfall further up country will also play a role. Temperature is also important (particularly the maximum extreme) as this can predict the speed of the snowmelt (particularly in spring) and consequently floods. During winter temperature can also be relevant to help them understand if precipitation will fall as rain or snow. During the snowmelt period wind can also be important as it can accelerate the melt. During the winter, the wind will also influence the snow distribution and models for this are under development for a better accuracy of the modelled snow situation. Temporal resolution of these forecasts would be ideally 4 months prediction lead time. However, the spatial resolution would have to fit their needs as there are significant differences in physical and geographical conditions e.g. 5km2 grid would be sufficient for large basins but a higher resolution would be better for smaller basins (particularly for extreme events).

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
			This information would help them e.g. plan flood projects in particular rivers.
A government organisation working at the national level with more than 250 employees.	Water management planning at national, regional and basin level.	The organisation uses weather forecasts and historical data for precipitation, temperature and wind. They also use radar information for precipitation and climate change scenarios regarding (evolution of) snow pack. Seasonal and monthly information is also used to inform River Basin Agencies. This information is used as additional information for River Basin Agencies to make decision on dam management rules and other issues.	Seasonal forecasts would be useful for updating the hydrological indicators currently used by river basin agency for decision making (as in some parts of the country the reserve in dams could be enough to guarantee the supply for 4 years, while in other parts reserves cannot supply the demand for more than a year).
A private company working at the regional level and with approximately 2,200 employees.	Provides water and sewerage services to a region in the UK.	The organisation uses weather forecasts and some radar information to manage their water resources. The main variables of interest are precipitation, temperature, wind, and evapotranspiration. Seasonal forecasts are used as additional information (e.g. in 2011 some maintenance works were done in advance of the predicted cold winter. In the end, the winter was not especially cold but this didn't cause operational problems).	Decadal predictions could be useful for the maintenance of their sewerage network.
A public organisation (with a % of funding coming from consultancy). The	Research on hydrology water management as well as preparing	The organisation uses weather forecast (precipitation and temperature) to prepare monthly hydrological forecasts for the next 3 months. They also use the	Seasonal forecasts could be of interest to them even if only as qualitative information as it "(…) *could offer some information about what is the solution with different associated probability let's say, so it will be very important*

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
organisation works at the national level and it has around 20 employees working in the forecasting centre.	hydrological forecast warnings.	ECMWF Flood Awareness System and they also look into the 7-month forecast by ECMWF (for precipitation and temperature). They also use climate change projections.	*to [understand] (…) what [is the] probability [with] respect to drought period, not drought, very low precipitation level for this month, what is the probability to have medium level of precipitation or normal climate".*
A private company working at the regional level with approximately 5,000 employees.	Provide water and sewerage services to a region in the UK.	The organisation uses weather forecasts including rainfall (daily) data to help them manage wastewater. Daily and longer-term weather forecasts of temperature and rainfall are also used to manage their reservoirs and water resources (clean water). They also use seasonal forecasts to help them plan the production for water supply and their plant budgets for maintenance They also use climate change projections for both the wastewater and clean water services to help them with future trend and developing policy.	"*We still look at them [seasonal forecasts] because the information's there, especially if we can get it for free, why wouldn't you look at it? But because of the limited accuracy in them and the amount of uncertainty associated with them, as I said, we treat them with due respect."*

4.3.3. The agriculture sector

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
A non-governmental organisation working at the regional level with around 10 employees.	The organisation provides technical support advisement to their members in the viticulture sector in Portugal.	The organisation uses weather forecasts, historical data, and they also collect information from their own weather stations. The parameters they look at are precipitation, temperature, humidity, solar radiation and wind. They analyse the information and pass it on to their members so they can use it to inform consumers and the media on how weather and climate has impacted on the wind production and quality.	Both seasonal and inter-annual predictions could be useful to this organisation: *"We think that this kind of information would be very helpful for us if this was available. However we are not aware enough of this kind of tool to give you a correct answer. It would be useful to define the projects that we will develop within the next year or 5 or 10 years. Even for our members it would be useful to make decisions to, I don't know, for example to decide which variety should be planted in which local. (…) If they will need more or less water to be supplied."*
An organisation working at both regional and national levels and with around 5 employees.	The organisation represents the interest of all farmers and stock-breeders in Spain at the regional and national level. Their role is to help their members in all kind of transactions, farm management, appeals, and everything else related to everyday farming needs.	The organisation does not use but they provide a link to the NMHS website where their members go to check the weather forecast.	The interviewee does not think that seasonal forecasts could be of use in the region given that "*Here, there is what there is, there is nothing else. So, if it is drought, pasture will dry and if it is rain... but it is what it is. There is no possibility to plant new crops. Well, there is no possibility...well this is not exactly like that because it is true that we have not tried different things. However, there is a traditional system and there is no [alternative]..."*
A private company working at regional and national levels and with approximately 70 employees.	Production of wine in different designation areas in Spain.	The organisation uses weather forecasts (rainfall) to make short-term decisions regarding harvest and treatments on a day-to-day basis.	Seasonal forecasts could potentially be of interest to them given if "(…) *for example, you have a reliable report that states that the summer will be one of the driest of the last 100 years we could install grip irrigation to a vineyard that does not have this type of irrigation. Or if is going to be very rainy you could avoid tilling and leave a vegetation cover. Having this type of information could be fundamental in*

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
			order to determine the viticulture treatments to be applied. Prune in this way or the other. Another thing would be if there is stated that there is going to rain, I leave a vegetation cover and then it does not rain."
A government organisation working at the national level (with 8 employees in the department where interviewee is based).	Organisation working on agricultural land and rural development, farmland preservation, and management of agricultural funding as well as support in the field of water development.	The organisation uses agro-meteorological information.	They are aware of the seasonal forecast available from the NMHS website but don't use it "(…) *because this is not enough reliable and predictable*".
A private company working at the regional level with approximately 75 employees.	The company works in different activities including farming, forestry, commercial property, housing, and conservation areas.	The organisation uses weather forecasts (up to a month) and flood forecasts.	S2DCP are not relevant to the interviewee as he works at the more strategic level within the organisation (where weather and climate information are not considered). However, seasonal forecasts may be of interest to the farmers.
An international organisation working at the international level with approximately 10,000 employees.	The organisation works towards eradicating hunger and malnutrition across the world's population, including food security.	The organisation uses daily, weekly and seasonal forecasts to help them monitor and plan their projects. They also use weather and climate information after an emergency response event to help them understand what happened. The organisation also uses climate change information in some of their projects.	They already "(…) *monitor current climate and climate forecasts at seasonal scale, for better understanding the crop growth in varying areas, like in Africa, to make an early warning if we foresee any major crop failure due to insufficient rainfall received in particular areas.*" They use various sources of seasonal forecasts depending on the region and availability of data.
A private company working at the international level with approximately 140,000	The organisation provides a number of services in the agricultural sector and	The organisation uses weather forecasts (up to 2 weeks), past observations and seasonal climate forecasts. The parameters of interest are precipitation,	They already use seasonal forecasts from different sources depending on the region they are working. Regarding decadal information (i.e. decadal variability) this is "(…) *used when it helps for seasonal forecasting. For*

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
employees.	food chains including distribution, marketing, products supply, farm services, and financial solutions.	temperature (max, min) and soil moisture (if available). The information is used to forecast future weather conditions and assess current and future state of the crops. They occasionally use climate change impact scenarios to answer specific questions from their clients.	*example, the phase of the pacific decadal oscillation affects the probability for the occurrence of El Niño and La Niña. In that sense we use decadal information. However, we do not use decadal forecasts at this stage." (…) "There are indeed some examples where decadal forecasts are of interest, but with the low skill they have at the moment it is not reasonable to base decisions on them, particularly since the cost-lost ratio can be high. Really, when it comes to big investments, you don't want to rely your decision on a shaky forecast."*
A public organisation working at regional level with around 230 employees.	Organisation working on and researching irrigation-related topics and providing support to farmers in this area.	They use weather forecasts and they also collect information from their weather stations (precipitation and evapotranspiration). They also developed a climatological atlas (for frost) to make farmers aware of the recommended dates for sowing in each area.	Seasonal forecasts could be useful as it would help them provide support to the farmers in relation to times for planting and harvesting as well as understanding potential water scarcity in the region. They would be interested in seasonal forecasts for rainfall (mean) covering the autumn months with a prediction lead time of 3 months. They would also like to have forecasts for hail (total) for the months of April/May with a prediction lead time of 6 months. There is a preference for forecasts with daily data and with a spatial resolution of 7,000km^2 but higher resolution would be preferable. They would also be interested in seasonal forecasts to help them plan against potential pests and see when the peak is going to take place: "*It is interesting to know the environmental conditions to predict if the peak is going to be as big as last year, or on the contrary, if it is going to be a manageable peak*."
A research institute working at the European scale with around 2,500	Research organisation working on environment, sustainability and agricultural issues. In	The organisation uses a range of observation data and weather forecasts (10, 14 days, up to a month) including model outputs from ERA reanalysis,	They are aware and have access to the ECMWF 7-month seasonal forecast but do not exploit it properly mainly due to lack of reliability but also lack of resources to investigate it. *"We have them [seasonal forecasts], we have access to*

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
employees.	the agricultural component the work relates to the monitoring and forecasting.	ECMWF and other providers' forecasts. They also use climate change projections in certain projects.	*them, and we haven't made much use of them. As you know, our main focus on the operational activities of Europe (…) so it is not obvious how to use that in our forecasting or operational systems to add value, because the long range ahead influence on these estimates is not so obvious, but I do feel that's something to be explored actually".* *They would also be interested in decadal predictions* as in "(…) *the policy range there is quite a strong demand of what is happening in the next ten, fifteen years. And this is where we focus our models on the climate change scenarios, and there is more noise than real information for Europe, and that is of course something where decadal forecasts could be an interesting project in principle."* In general they would be interested in parameters such as temperature, humidity, radiation (i.e. "*everything that lets the plants grow"*).
A private company working at the national and international level with more than 250 employees.	Production of wine in Portugal although the company also owns other production companies in other countries including Spain, Argentina, Chile and New Zealand.	They use weather forecasts (3 to 10 day) to help them manage their farming operations. They also look at seasonal forecasts trends when they are available mostly to plan marketing and selling campaigns.	Seasonal forecasts would be useful to help them manage the grapevine's growth cycle, input needs (labour, resources, etc), and marketing campaigns. Main parameters are temperature (mean and extreme) and rainfall (mean). The ideal spatial resolution would be 9km^2 (but ideally 1km^2) across continental Portugal. Temporal resolutions of interest included: From <u>January to June</u> (start of growth cycle): - Monthly forecasts with a prediction lead time (PLT) of 18 months to assess production potential; - Monthly forecasts with 6 months PLT to assess input needs; From <u>July to October</u> (end of growth cycle): - Weekly forecasts with 12 months PLT to assess irrigation needs;

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
			- Weekly forecasts with 6 months PLT to forecast production potential; - Monthly forecasts with 3 months PLT to evaluate ripening & quality potential; - Daily forecasts with 3 months PLT to help them plan the harvesting.
A private company working at the national level with 14 employees.	Production of wine in a specific designation area in Spain.	They use past data from local weather stations.	Seasonal forecasts could be useful for them "*Especially for irrigation, for its planning. Identifying irrigation needs in advance and choosing the best moment to irrigate. Decide if we apply drop irrigation on a vineyard or not. Depending of the zone it is critical to apply proper irrigation. Then, considering possible treatments. If we knew how the harvesting time looks like we could apply treatments before: leave more or less leafs, remove more load. If we know that ripening is going to be difficult you can take the production in April instead of September and obtain more quality. There are things you can do.*"

4.3.4. The forestry sector

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
A government organisation working at the regional level with around 50 employees.	Organisation responsible for all aspects concerning environment and energy in a region in Belgium. The interviewee works in the unit responsible for forests and woodland areas.	The organisation uses climatology to justify evolving changes in climate and future changes in support of their technical proposals. They also use extreme event warnings (windstorms and heavy rain) to help them manage and decide on their activities and operations.	They could potentially use seasonal forecasts if these were to become more reliable in the future. They would be interested in seasonal information on rainfall and cold spells to help them plan their work particularly during the planting period. For example, "(…) *this winter, which is highly humid, is severely disrupting planting work that needs to be done in the forest. And so, if we had been informed in advance of this kind of weather, in this case we would not have placed our orders at the nurseries (...) as we did in November*." They would also be interested in decadal predictions to help them understand if the trends on estimated climate change projections are being confirmed or not.
A private company working mainly in Europe and with approximately 4,000 employees.	Integrated forestry company which owns its forests and factories in Sweden and other countries in Europe. They manage their forests and buy and sell timber.	The organisation acquired a special service to predict wind and temperatures. Another very important parameter for their operations is ground frost and snow-breakage so they can plan the lumber and removal of timber from the forests as well as storing timber.	There is potential interest to use seasonal but especially decadal predictions if these were to be more reliable in the future to help them make their operations more efficient.
An international organisation working at international level with approximately 500 members.	A network of different countries in Europe working on the monitoring and assessment of forests.	The organisation uses their own observations (250 monitoring plots across Europe) and Global Climate Model ECHAM which is scaled down to grid cell sizes of 12x12 km (to match their plots) by the Regional Climate Model CLM. They also use meteorological data provided by the Climate Research Unit at the University of East Anglia. These are mean monthly	The organisation would be interested in decadal predictions to predict and evaluate potential forest ecosystem analyses, modelling, and forest soil development in the future. Parameters of interest include temperature (maximum and minimum), precipitation (maximum and minimum), and wind speed (maximum). Temporal resolution of 3 month seasonal forecasts for the next 10 years. Spatial resolution of 50x50km for continental Europe as this is the resolution they already use for the atmospheric data (e.g. on air pollutant concentrations and

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
		temperature and monthly sums of precipitation. Their resolution is 0.5° x 0.5° in latitude and longitude. They also use IPCC scenarios for future scenario analyses.	deposition) they use.
A research institute (non-profit organisation owned by a private company) working from international to local level and with less than 50 employees.	The organisation develops a wide range of applied research activities in industrial processes, environment and eucalypt plantation forest. It also provides specialized consultancy and training to the community.	The organisation uses weather forecasts for planning field work planning and to model productivity by process-based models. They also correlate past observations to biometric data in same conditions to predict yield productivity. They use climate change information to predict future changes.	They are interested in annual precipitation and its distribution over the year to help them determine the productivity at the regional level, and determine the choice of adequate genetic materials and silvicultural practices. Drought, floods and strong winds also have negative effects in the forest. Moreover, summer temperatures and rainfall affect nursery (clonal propagation) yields.
A research institute working nationally but with some working collaborations in Europe. The organisation has around 120 employees.	Their research focuses on forest production including forest tree grafting and forest management, as well as environmental initiatives. It also conducts research in the area of lumber provision, which includes technique and lumber, fuel, and planning.	They use weather forecasts (rainfall, temperature, wind and frost; ground saturation is also a very important issue) to help them plan the planting but also the removal and transportation of timber from the forests.	There is potential interest in seasonal forecasts providing these were reliable. They would be interested in freezing and thawing conditions not only to help them understand growing seasons but also the conditions for driving through the forests. For example, *"(…) If there's a thick frost, the ground can sustain some heat before anything happens, in comparison to if the frost is thin. So it would be good to have more information about the relation between air temperature and ground temperature."*

4.3.5. The health sector

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
An international organisation working at international level and with around 8,500 employees (the European region office, where the interviewee is based, has around 550/600 employees).	The organisation works on health-related issues across the world. The unit where the interviewee is based looks at infectious diseases and resilient environments focusing on its links to a changing climate.	The organisation does not use weather or climate information per se. However, if available, they would use health scenarios regarding potential risks related to climate.	They could potentially be interested in seasonal forecast information "(…) d*epending on its accuracy. I mean if it would say there is a 60% probability of a heat wave occurring in the next summer, in June, when you are in May, I mean, this wouldn't mean anything to me. I would need to have a high probability."*
A government department working at national level and with approximately 850 employees.	The organisation is responsible for preparing policies in a range of areas including environment, nature conservation, and building. The interviewee unit focuses on health adaptation to climate change and food security.	The organisation uses weather forecasts and warnings (e.g. storms and droughts) and past observations are also taken into consideration.	They could potentially be interested in having seasonal forecasts.
A government institute working mainly at national level (although also involved in some international projects) with 82 employees.	The organisation works on health protection and impacts to human health (including from climate change) through monitoring, preparation of legislation and conducting research.	The organisation uses meteorological data and climate change scenarios to study the health impacts of climate change and help prepare the national climate strategy.	They would be interested in seasonal forecasts if these were more reliable. For example, in terms of precipitation data "(…) *it would be interesting because our second task is to deal with invasive plants and allergic plants, and these seasonal forecasts would help predict the change in the pollen production of these plants for example, so could help us a lot."*
An international organisation	The organisation is responsible for identifying,	The organisation uses historic data (i.e. precipitation) to try and link it to	They already use seasonal forecasts "*To predict disease rates. So we are trying to use Spring temperature for*

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
operating at the European level and with 280 employees.	assessing and communicating current and emerging threats to human health posed by infectious diseases.	outbreaks. Their interest lies on heavy precipitation or the aftermaths of a drought events for water-borne diseases; and temperature (particularly cold temperatures) for vector-borne diseases.	*example to predict the risk of a disease in the fall, or seasonal data that will help us come up with an overall risk for the coming season."* *"Of course more short-term data [weather forecasts] tend to be more accurate, but we would love to have highly accurate long-term data as well if it is available."*
A public organisation working at the sub-national level (i.e. and with approximately 4,800 employees.	The organisation provides healthcare services to the public and conducts research on infectious diseases namely epidemics and public health.	The organisation receives weather warnings and weather forecasts for their day-to-day operations. They also consider climate information to take into account potential future changes and their impacts on health.	They are not aware of seasonal predictions although the interviewee suggested that there may be some potential to use this type of forecasts in the organisation (possibly monthly forecasts): "(…) *maybe we can be better prepared to something that could happen to us in the next six months, although I think maybe the main difficulties are trying to understand what the likelihood of some health events related to the climate conditions*."
A government organisation mainly operating at the regional level but also with activities at the national level and some involvement in European and international projects. It has around 60 employees.	The unit where the interviewee is based focus on environmental epidemiology in particular the effect of temperature on health. They are also responsible for the national heatwave warning system.	The unit uses past observations (historical time series) to construct their models and to carry out epidemiological studies (regarding the effects of temperature) and air pollution studies. They also use weather forecasts (3 day weather forecasts – temperature, relative humidity, wind speed and atmospheric pressure). They also receive seasonal forecasts for the next season which they use as qualitative information. They also used climate change scenarios (descriptive information) to	Although the organisation already uses seasonal forecasts as qualitative information they would potentially use it to manage their warning system if the reliability was higher. They would be interested in monthly temperature forecasts for summer months with a prediction lead time of 3 to 6 months. Regarding spatial resolution they would be interested in urban areas (at the highest possible resolution).

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
		assess the potential effects of climate change on health.	
A government organisation working at the national level and with approximately 5,000 employees.	The organisation is responsible for health protection, health and wellbeing, and knowledge management.	They receive weather warnings regarding e.g. cold weather, heat waves, and floods. They use weather and climate information provided by others to develop their plans and strategies.	The organisation already plans for the next seasons (e.g. winter, summer) but they tend to use information provided by others (see current use of weather/climate information).
A government organisation working at the regional level and with approximately 4,500 employees.	The organisation is responsible for the ambulance services in the region.	The organisation uses 10-day weather forecasts. They also use some national alert scheme regarding different events (e.g. storms, storm surge, flooding).	Although somewhat uncertain about the potential use of S2DP in the organisation the interviewee thought that "(…) *there would be a use [for seasonal forecasts] because we know on an annual basis that we're going to have a winter, we know on an annual basis we're going to have a summer, how it's going to be in between and whether it's going to be a wet summer or a dry winter (…) And if it's going to be a particularly snowy Christmas you need to stop as many people going on holiday, so you need to make sure that they're on shift, you've got more staff available because there is going to be more calls for your service*." They would potentially be interested in temperature, precipitation, storms although it would require a "(…) *a joined up collaborative viewpoint on the way you assess the information [as] these different elements combine together to dictate the amount of calls we're going to get and assess the calls and access through roads and access to the hospitals"*

4.3.6. The insurance sector

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
A private company working at the national level and with 247 employees.	The organisation does co-insurance management related to the agriculture sector.	The organisation uses weather forecasts (up to 10 days) and occasionally 1-month forecasts. They also use seasonal forecasts. They also have their own weather stations to collect data regarding temperature and humidity. Their parameters of interest are precipitation, temperature and wind as they look into risks coming from frost, drought, and hail. They are also interested in knowing if winter temperatures are going to be below 1ºC. They also use a pasture index to help them understand the risk of drought. They receive this index every 10 days with a spatial resolution of $1km^2$	There is an interest in seasonal forecasts particularly for cereals although the parameters of interest and temporal resolution would vary depending on the crop. There is also potential interest for decadal predictions to help them understand how risk conditions and crops may evolve in 10 years time.
A public entity working at the national level.	The organisation provides insurance against risk and damages (e.g. floods, extreme winds, tornadoes, earthquakes) to property and people. It also provides reinsurance against risks in agricultural, livestock, forestry and aquatic farming activities.	The organisation receives reports of accumulated precipitation and intensity of precipitation as well as reports on areas where there have been severe wind events or winds combined with precipitation. They also use weather forecasts to help them prepare for potential imminent accidents.	If seasonal forecasts become more reliable in the future the organisation could use this information in their annual budgets or actuarial studies. They would be interested in seasonal and annual forecasts for precipitation and wind particularly focusing on the autumn months.
A private company (a subsidiary of a larger group) and working at the	The organisation provides insurance products i.e. life insurance and damage and liability.	They use past data to feed their models. They also use reports on the potential impacts of climate change and severe weather events on the financial impacts on the insurers.	Seasonal forecast could potentially be of interest in terms of prevention although it is difficult to determine how exactly this information would be used. *"For example an extremely dry summer in the*

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
national level. It has around 7,000 employees.			*Mediterranean South, we could take a number of initiatives with our insured customers who own property. But I want to say that prevention is a long-term matter and for us insurers, seasonal prevention is still difficult to take into account. Well, if we are told about a particularly stormy winter, what are we going to say, what are we going to tell our customers?"*
An international private company working internationally with more than 250 employees.	The group where the interviewee is based works on weather derivatives (insurance for weather).	The organisation uses weather forecasts (4-weekly forecasts – monthly). The parameters of interest may vary depending on the contract but some include precipitation, temperature, drought, and flooding. They also use historical data.	The organisation already uses forecasts up to 6 months prediction lead time and "*If there was skill we would use 20year forecasts. But that is simply not possible.*" They would like wind information for wind farms which tend to be long-term projects that are financed over the course of 10/20 years. In such cases, "(…) *customers wish to put details in the contracts that last as long as the investment.* [Hence] *If you could forecast the wind with a reasonable skill for the next 20 years that would be fantastic*!"
A private company (a subsidiary of a larger group) and working at the national level. It has around 7,000 employees.	The organisation provides insurance products i.e. life insurance and damage and liability.	They use past data to feed their models. They also use reports on the potential impacts of climate change and severe weather events on the financial impacts on the insurers.	The interviewee was unsure to whether S2DCP could potentially be of use to the organisation.

4.3.7. The tourism sector

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
A federation of chambers of commerce and industry working at the national level but also with some work at the European level. It has around 175 employees.	The organisation advises and supports tourism organisations regarding regulations, strategy, sustainable development, etc.	The organisation does not currently use weather or climate information as they react to events *à posteriori*.	There is no potential for using S2DCP in the organisation as they do not use weather/climate information.
An international organisation working at the European level and with approximately 10 employees.	The organisation runs a network of European partners working on sustainable tourism and is responsible for disseminating information on European project and news, organise events and create new partnerships.	The organisation does not currently use weather or climate information as their role is based on networking and their work is more of a conceptual nature.	The organisation is not interested in this type of information. However, it "(…) *may be useful (…) for the members (…) We may relay the information and propose it to our members who will decide to pay for it or not according to their needs."*
An association working at the national level with a part-time employee.	The association is for all professional working on canyoning and climbing.	The interviewee uses weather forecasts of 2 to 4 days ahead.	Seasonal (or even sub-seasonal) forecasts could be interesting as qualitative information although it would probably not directly affect their decisions as changes tend to occur only a few days before. However, it could be of interest to be aware of the "(…) *tendency of snow depth on winter.* (…) *Very hot summer such as 2003 could [also] be interesting for falling rock but only as guide [information].* "
A consultancy working at the national level with 4 employees.	The organisation helps local authorities to manage their tourism activities including development, organisation and marketing.	The organisation alerts their clients on general issues such as extreme events, increasing temperature and its impact on biodiversity or landscape. But they don't actively use any available data with	They're potentially interested in decadal predictions for supporting specific long-term decisions such as "*For example, a ski resort buying snow-blower should know that snowfall will reduce*."

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
		exception for the occasional illustrative map.	
A public funded association working at the international level to promote activities in a particular region. It has around 46 employees.	The organisation promotes tourism activities from this particular region though communication, engineering and development activities.	The organisation uses future scenarios although they also analyse ex-post the weather factors (amongst others) that influenced the overall balance of a season. They use this information to understand the situation and alert other tourism organisations and help them integrate this information.	If seasonal forecasts were more reliable and available with 6 months prediction lead time they could potentially use this type of forecasts for communication purposes. "*For instance to insist on the possibility of indoor activity in case of bad weather forecast. Activities independent on the context could be promoted. (…) in case of a seasonal prediction announcing a heat wave, we could inform professionals in advance, so that they can prepare in April or May some alternatives (e.g. using water) in that scenario. In winter, we could imagine [and promote] activities anticipating a lack of snow, so that clients are not too disappointed: social programs, etc."*
A private company working at the local level and with approximately 50 employees.	They manage the ski areas and activities in the resort.	The organisation receives "*statistics on the season, the last months and the detail of these months. Thus, we will read it at the end of the season but, once again, I observe it but I have never drawn up a board that synthesises these statistics in relation with other past seasons and present the results on a graphic*." They mainly use their experience from previous years to manage their day-to-day operations.	According to the interviewee there's some potential for decadal predictions in relation to precipitation if these were reliable. *"It would be great to have a tool able to provide 10-year predictions, and this should be relatively easy to access for different professionals. And, yes we would use it."* However, their operations are largely based on their knowledge and experience.
A public funded association working at the local level with around 10 to 20 employees.	They manage the activities of the resort (focusing on winter and summer activities).	The interviewee looks at weather and climate information but this information is not integrated in any specific decision-making.	The interviewee is aware of seasonal predictions but the lack of reliability makes it too risky for the organisation to use it as their credibility with their elected representatives could be lost.

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
A private organisation working at the international level to promote activities in a particular region. It has approximately 46 employees.	The organisation promotes the tourism activities of the region (focusing on winter and summer activities).	The organisation uses weather forecasts to help them react to weather conditions.	They access various sources of seasonal forecasts but they do not use it due to the lack of reliability: "(…) *this* [seasonal forecast] *is not reliable, so we don't use it. We would need a reliability guarantee. (…) So we don't integrate them in our decision process. We look at them, but just in order to be informed. This is not precise enough so, it is pretty useless for us. If the information was more adapted and precise, we could pay for it*." They are not interested in decadal predictions as they only" (…) *work one year or two ahead*."
A private organisation working at the international level to promote activities in a particular region. It has approximately 46 employees.	The organisation promotes the tourism activities of the region (focusing on winter and summer activities).	The organisation uses weather forecasts to help them react to weather conditions.	They could be potentially interested in seasonal forecasts to integrate in an observational system they are currently setting up which analyses tourists' consumption patterns and behaviours. They would be interested in temperature, rainfall, and sunshine forecasts during summer months and temperature, rainfall, sunshine and snowfall for winter months.

4.3.8. The transport and emergency services sector

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
A private company providing services to public sectors organisations and working mainly at the national level (with a few international projects). They have around 500 employees.	The organisation provides maintenance services for roads.	The organisation uses data collected from their own weather stations. Occasionally (when there is a bad weather alert) they also look at observations from other nearby stations.	No potential to use S2DCP - their activities and operations do not use weather forecasts or longer timescale forecasts.
A government organisation working at the national level with approximately 2,000 employees.	The organisation is responsible for maintenance and development of the rail infrastructure.	The organisation uses weather forecasts (up to 10 days for rain and wind) to feed their operational models. They also receive rain and wind warnings for certain areas and rail stations across the country. They have a system of 150 weather stations to measure temperature on the tracks and surrounding temperature (information which they share with their NMHS). The information is used to help them manage their level of preparedness within the organisation and local contractors.	They don't use seasonal forecasts due to the level of uncertainty. They would be potentially interested in decadal predictions to help them "(…) *make risk assessment on how to plan our large-scale renewal projects* (…)" in terms of for example, planning and investments. They would be mainly interested in rainfall and wind (and possibly temperature).
A government organisation working at the national level with around 1,500 employees.	The organisation is responsible for the design, construction, supervision and maintenance of the motorways and roads, as well as coastal protection works.	The organisation uses (descriptive) weather forecasts to manage their day-to-day operations or to plan activities such as routine maintenance, installing traffic signals. The main parameter of interest is rainfall.	Seasonal forecasts would be useful for them to help them manage traffic and roads particularly for summer months (for temperature) and November to February (for rainfall). These would ideally be monthly forecasts with 2-3 months prediction lead time with a spatial resolution covering the whole country (around 9,000 km^2) or, ideally, each of its districts.

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
A government organisation working at the national level and with approximately 800 employees.	The organisation is responsible for the state road network including motorways and main roads.	The organisation looks at weather forecasts (up to 9-days forecasts) mainly in the winter months to help them prepare for their operations. They're mostly concerned with rainfall, snowfall, temperature, wind, and storm surge. They also have their own weather stations along the road network which collects precipitation and temperature data. They also use the IPCC climate change scenarios (which are then modelled to provide more specific scenarios to their country) to help them manage and design their future assets.	The interviewee is not entirely sure if seasonal forecasts would be of interest to the organisation as "(…) *it's the contractors that have to be aware of seasonal variations when they are planning the work on the roads* (…)". However, the interviewee felt that decadal predictions would be of greater potential to the organisation if these were more reliable in the future as "(…) *there would be some short term adaptations that we could do if we knew what would happen within five or 10 years, that's a more interesting timeframe to adapt to then a 100 years."* At these timescales they would be interested in precipitation i.e. differences in patterns such as heavy rain (particularly in summer) and also coupled with extreme events and with storms (particularly in winter) as well as wind. They would like to have 5 to 10 year climate predictions for all parameters at the highest spatial resolution possible. This information would help them develop more accurate plans on asset management (e.g. what would be the best time to replace the pavement or to make repairs on the drainage system).
A government organisation working at the national level with around 3,200 employees.	The organisation is responsible for the strategic road network (i.e. motorways and main roads) including maintenance and monitoring.	The organisation uses weather forecasts and observation data. They also have temperature sensors along the road system as well as wind speed detection equipment. They're interested in routine procedures in terms of gritting and ploughing the roads in winter or road closure and diversions due to high wind. They also consider climate change projections for structures such as roads, pavements, drainage, tunnels, culverts,	They don't currently use seasonal forecasts due to the lack of reliability but also is the timing of when they are made available to them: "*When the* [NMHS] *presented* [the seasonal forecast for winter] *to us I think this was November and it was talking about the immediate winter coming. And at that point in time, and indeed at any time for the foreseeable climate we're not going to change the equipment we have available to deploy gritting and ploughing and we're not going to change, significantly change anyway, the stockpiling of salt for saline treatment. We just can't take that risk because I suppose it then becomes an uncertainty issue, doesn't it?"*

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
		etc.	There is a potential to use seasonal forecasts to help them better plan their works e.g. "(…) *it might not be the ideal night time temperature to be resurfacing the road but it's going to get a lot colder in the next month or two so let's make sure we get it done now*." However, according to the interviewee this would not lead to a change in procedures or standards as a consequence of that seasonal prediction.
A government organisation working at the national level.	The organisation is responsible for the maintenance of the road system network.	The organisation uses meteorological information for winter road maintenance. They use the alert bulletins emitted by the NMHS regarding snow and ice.	They would potentially use seasonal forecasts if these were more reliable in the future particularly to help them in rehabilitation tasks as such activities cannot be stopped once started. It could also help them plan other activities as they "(…) usually operate in summer. Everything related to the soil has to be extended in the top conditions it needs high temperatures and the atmosphere is heavily involved in this."
A state company publicly and privately funded working at the national level and with around 30,000 employees.	The organisation is responsible for operating, maintaining, and developing the railway infrastructure.	The organisation uses real time weather forecasts (up to 5-days ahead) for rainfall, snowfall, wind speed, temperature. They use it to inform their operational response on a day-to-day basis (it should be noted however, that this organisation makes use of different weather forecasts and providers depending on the various regions in which they operate). They also use historical data to perform asset analysis *"(…) on days where the system has struggled we'll look at if there's any correlation to what the weather was that day."* They also have their own weather	They receive seasonal forecasts but they only use it as qualitative information to give them a sense of future conditions: " [We] Look at it and consider it but a lot of the responses that we put in we probably put them in a few days before any sort of weather event we expect to happen. Obviously just because of the nature of the industry and the business (…) we have contingency plans so they kind of cover us for seasons, if you like, and then it would only be two or three days before the event perhaps that we would start to look at those contingency plans to decide what we're going to do, essentially, when the day arrives." The main reasons for them not to use seasonal information in their decision-making is "*Because we plan a lot of our work about a year and a half out so even if we planned out work a year and a half out then a seasonal*

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
		stations. They also use climate change projections to help them plan and manage their assets in the longer-term.	*forecast that we receive two months before isn't going to be particularly of use."* as well as "*It's not that it's not relevant, it's just that we would never make a decision that far out as to putting in different strategies or train plans, etc."*
A government organisation working at the national level and with around 9,000 employees.	The organisation is responsible for the development and maintenance for the road system and for supporting smaller roads.	The organisation uses weather forecasts for their day-to-day operations. They are particularly interested in "(…) the number of days where the temperatures are around zero because that is a safety issue on the roads and that is also a kind of a temperature load that is not really wanted. We are also interested in the number of days where the road is wet, number of days where precipitation over a certain minimum level." "(…) the number of days with snow is also a parameter we are looking for, it's not only rain and wind and short term rain but all of this as well. They also have their own weather stations for measuring temperature and precipitation and use that information in their decision-making. They use climate change information to help them plan their contracts.	Seasonal forecasts would them manage road operations (i.e. ensuring the functioning and safety of roads) which are performed by contractors. In situations where a contract already exists, seasonal predictions could help them tailor the effort; distribute machines and personnel between different contracts, etc. They would also be potentially interested in inter-annual predictions in situations where they are to sign a new contract (normally for 5 to 7 years) they would be interested in knowing how the seasonal predictions could change from year to year, throughout the contract period. They would be interested in data on precipitation combined with temperature (knowing if it is rain or snow when it hits the road). Ideally, both would be provided as daily averages and information about intense and heavy rain/snowfall would also be interesting. In addition, information on temperature variations around 0^{o}C would also be of interest because they would require action from our part (i.e. ensuring friction by salting or laying out sand). Information such as for example: *"The first winter of the contract period, there will not be much snow. The temperatures will vary a lot, we might have many +/- zero days, bringing about the need to salt or clean or manage traffic. However, the next two winters are expected to bring heavy snow. They will be stable and cold, from approximately October to March."* They would prefer seasonal forecasts with a 3 months prediciton lead time and for decadal predictions with a 6

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
			months predcitions lead time; both with a spatial resolution of up to 10km.
A government organisation working at the national level with around 6,000 employees.	The organisation is responsible for the construction, operation and maintenance of roads and railways.	The organisation has their own weather stations spread all over the country and these are mainly used to help them with winter maintenance (to monitor precipitation, wind speed, humidity). They also use weather forecasts to help them plan their day-to-day operations and their contracts (e.g. ploughing of roads). They also use climate change projections to do long-term planning investments in terms of infrastructure.	They would like seasonal forecasts for precipitation information combined with temperature (i.e. knowing if it's going to hit the roads as snow or rain) as well as knowing how many days around zero are expected (freeze and thawing). This information would help them manage their road operations as well as their external contracts (particularly during winter months). The temporal resolution would likely be forecasts with 3 months prediction lead time for winter with a spatial resolution of 10 km^2 as winter maintenance varies substantially across different geographical areas.
A public body publicly and privately funded working at the regional level and with approximately 28,000 employees.	The organisation is responsible for the development, maintenance and policy regarding the integrated public transport system of a region including buses, coaches, underground, cycling, and walking.	They use live weather information to help them plan their day-to-day operations. However, the organisation is quite complex and they do not have an integrated system (i.e. different modes of transport can use different weather/climate information). However, in general terms they all seem to use weather forecasts (for tomorrow or next few days) and some have real time monitoring systems (e.g. underground).	They use seasonal forecasts from the NMHS to help them prepare "(…) *for the summer and (…) winter I suppose ... ideally four times a year, but it doesn't always happen. We would try and get a seasonal trend forecast that says, you know, largely this winter what's it going to be like? Is it going to be a cold one? Is it going to be a wet one*?" They use these forecasts as qualitative information to help them "(…) *review our readiness plans, review our emergency preparedness plans."*
A government organisation working at the national level and with approximately 900 employees.	The organisation is responsible for civil protection, public safety, emergency management and civil defence before, during and after an emergency	The organisation uses the warning service provided by the NMHS regarding fire risk forecasts. They also use the hydrological warning service as a basis for flooding maps.	*"I'm not sure if we have a use as an authority…the counties probably do. It's hard to see…well, that's true, when it comes to our reinforcement resources, it would be good to for example to know if the spring was going to bring a lot of rain in northern Sweden…we could direct the resources to the north. Seeing details for an upcoming spring or whatever would be useful."*

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
	or crisis.		The interviewee also suggested that the counties could potentially be interested in decadal predictions although he was not clear as to how these could be helpful to them.
A government organisation working at the national level and with more than 250 employees.	The organisation coordinates all national civil protection actions	The organisation uses 3-day weather forecasts and integrates this into their models. They also use hydrological information. The parameters of interest include precipitation, temperature (very high or low), wind speed and direction, snow, and relative humidity. They are also interested in extreme events such as tornados and explosive cyclogenesis. They use IPCC climate change scenarios to develop their own studies and also in their involvement in the national strategy for alerts on climatic changes.	They occasionally use seasonal information but only to help them predict drought: "(…) *we have information for the three following weeks in terms of droughts, let's imagine, and we get information from the seasonal information that we get, which tells us the drought period is going to continue."*

4.3.9. Other

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
A government organisation working at the national level and with around 10,500 employees.	The organisation is responsible for water environment and flood risk and flood management activities including flood defences, forecasting and implementation of policy and regulation.	The organisation uses real weather information, historical data and weather forecasts (rainfall and storm surge and wave models for coastal areas) in their operational models for flood forecasting to help them understand the immediate flood risk (this is done over a 5 day period). They also use climate change projections (change in extreme rainfall) to help them understand the range of what the flood risk may be in the future and help them develop and manage flood defences.	They currently don't use seasonal forecasts as "(…) *there's a lack of confidence in the existing products [and] (…) what it would mean for our business planning and processes. And, then there's an expectation I think that we don't yet know what customers would (…) do with it, but I think there's certainly the potential to explore some customer sectors."* However, if these were to become more reliable in the future there would be a potential to use this information to help them understand the total winter and summer rainfall. If possible, they would also like to have seasonal information on the increase in rates of convective storms during summer months.
A government organisation working at the regional level and with approximately 250 employees.	The organisation implements national policy at the regional level in areas such as planning, environmental protection, and nature conservation.	The organisation uses information from weather forecasts and warnings to help them manage any potential weather-related event. They also use climate change scenarios to develop their regional work on climate change adaptation.	Seasonal forecasts could be useful to help them understand potential flooding and storms particularly from a vulnerability perspective.
A government organisation working at the regional level and with approximately 450 employees.	The organisation implements national policy at the regional level in areas such as planning, environmental protection, and nature conservation.	The organisation uses climate change scenarios to review their plans and address climate change issues in the region as well as enforce climate change regulations in the municipalities.	The interviewee is not aware of seasonal forecasts and is not sure how/if this type of information could be of any use within the organisation.
An international organisation working worldwide and with	The organisation carriers out humanitarian	The organisation uses historical data and weather forecasts (up to a month) of rainfall to feed their operational model which, in	The organisation is currently in the process of trying to integrate seasonal forecasts for rainfall into their operational model. This information will hopefully help

Organisation	Area of work	Current use of weather/climate information	Potential for using S2DCP
approximately 11,800 employees.	emergency assistance and long-term development work with regards to food security.	conjunction with other data (socio-economic, demographic, political), provides different information on the number of beneficiaries with regard to food security issues in parts of Africa. They also use climate change projections to help them plan their activities in the next 10, 20 years.	them to understand if "(…) *the season is going to be particularly bad, but it's not yet very certain, we can prepare emergency operation funding requests in advance, and then as the season progresses we can actually submit those requests."*

5. The survey of users' needs

5.1. Developing and disseminating the survey

The aim of the survey was to expand the existing sample of S2DCP users (beyond those interviewed) and further understand the need for S2DCP across European sectors.

The main body of the survey was developed based on the interview protocol used to conduct the WP12 interviews with the stakeholders (Task 12.3.) in order to ensure a degree of consistency across the data being collected. In addition, the survey questions were also developed based on our experience of which questions best worked during the interviews conducted with the EUPORIAS stakeholders and other European users.

The survey included sections covering questions related to the organisations' general characteristics (section A), their decision-making processes (section B), the use of weather and climate information (section C), the use of S2DCP (section D), and dealing with uncertainty (section D) (see Appendix 3). However, not all of the questions in the survey were mandatory.

In addition, to accommodate sector-specific questions, the survey was branched out into different sections to include questions regarding forestry, agriculture, and tourism sectors (see Appendix 3, section E). Specific sectors for the remaining sectors (i.e. energy, water, emergency services, transport, and health) were not considered necessary by the partners as it was thought that the general sections of the survey would cover all the issues relevant to these sectors.

The survey was translated into four other European languages besides English – French, Spanish, German, and Italian – in order to facilitate the access to the online survey by respondents across Europe. The survey was also made anonymous to safeguard the confidentiality of the respondents. The survey was launched online in April 2014 and was accessible until mid-July 2014.

The target of this survey was European organisations (public, private, and/or third sectors) whose operations and activities are sensitive to weather and climate events and impacts. The focus was on the energy, water, agriculture, forestry, transport, emergency services, insurance, tourism, and health sectors; although engaging with other sectors did also occurred naturally.

The dissemination of the survey across Europe was a joint effort by the EUPORIAS partners and pursued through different means, including:

- Through the EUPORIAS partners (e.g. via their internal and external contacts, Website/News pages, Newsletters, Twitter, Facebook);
- Through other European projects, initiatives, and industry organisations (e.g. through contacts from the EEA, CIRCLE II, ECLISE, EUCLEIA, Light2CAT, Insurance Europe, Brewers Europe);
- Via UK and other European Climate Change networks (e.g. Adaptation Scotland, Climate Northern Ireland, UKCIP, Climate UK);
- Acquisition of over 4000 email contacts from 44 European countries across sectors relevant to EUPORIAS;
- News pages and Newsletters (e.g. EUPORIAS, SPECS, CETaqua, UKCIP, LWEC, Farming Futures);
- Twitter (e.g. WMO, AEMET, EUPORIAS, ICAD, LWEC, Met Office, Climate NI, UNESPA);
- Facebook (e.g. DWD, Climate Geek);
- Linkedin articles.

5.2. Analysis of the survey' responses

A total of 489 survey responses were received. However, the number of responses across the different sections of the surveys tends to fluctuate given the types of questions (i.e. mandatory/non-mandatory and single/multiple choice). The following sections provide the main findings from the responses received from the WP12 surveys.

5.2.1. General characteristics

The main sectors represented in the responses collected were the energy sector (14%) closely followed by agriculture (12%), water (11%), and transport (10%). Other sectors such as emergency services, health, forestry, tourism, and finance and insurance were less represented (Figure 6).

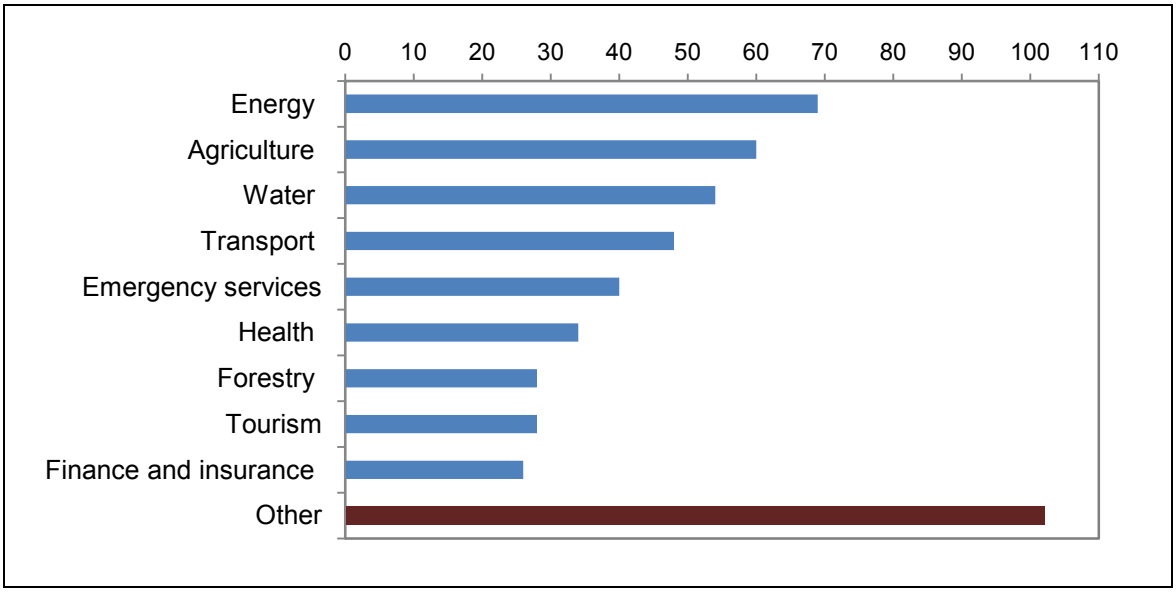


Figure 6 – Number of responses per sector of activity.

Many respondents (21%) however felt that their organisations were not directly associated with any of the sectors listed in the survey and opted for the option “other”. The responses provided under this option encompassed a range of different areas including environment, conservation and heritage (n=20); weather and climate change (n=14); industry, construction and material (n=14); miscellaneous (n=14); and research and science (n=13) (Figure 7).

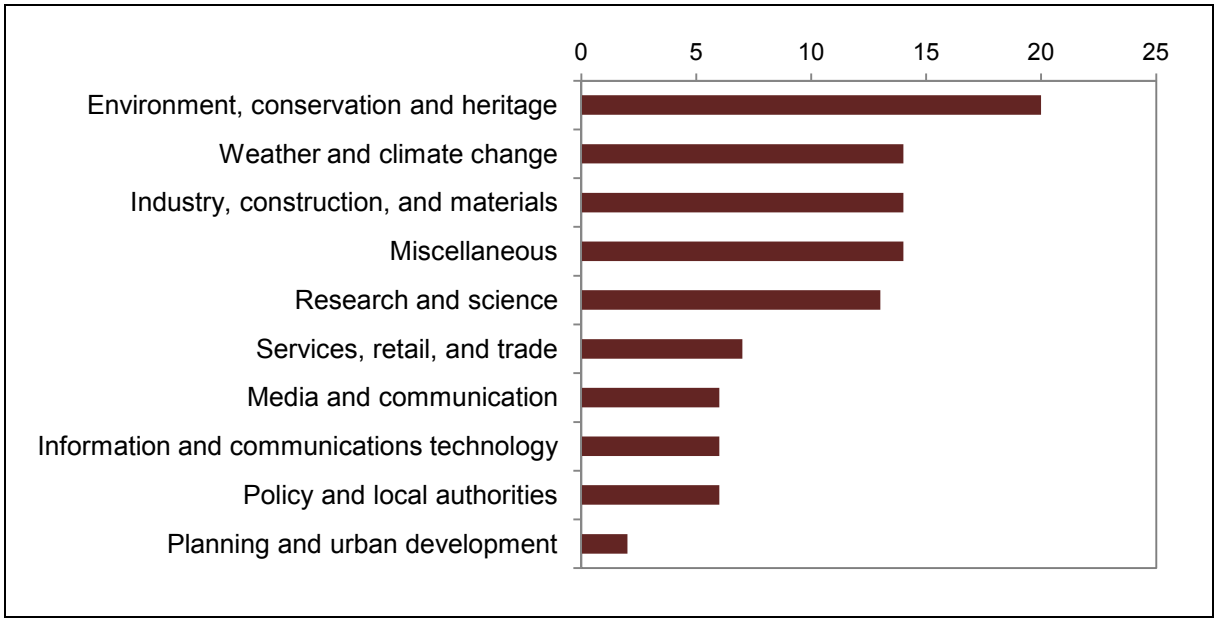


Figure 7 – Other sectors of activities.

Regarding the distribution of survey responses per country there was a significant representation of organisations based in Germany (n=98) and, to less extent the UK (n=60),

compared to other European countries (Figure 8). Other European countries fairly represented included France (n=28), Switzerland (n=25), Spain (n=22), and Italy (n=19). The rest of European countries had a low response rate.

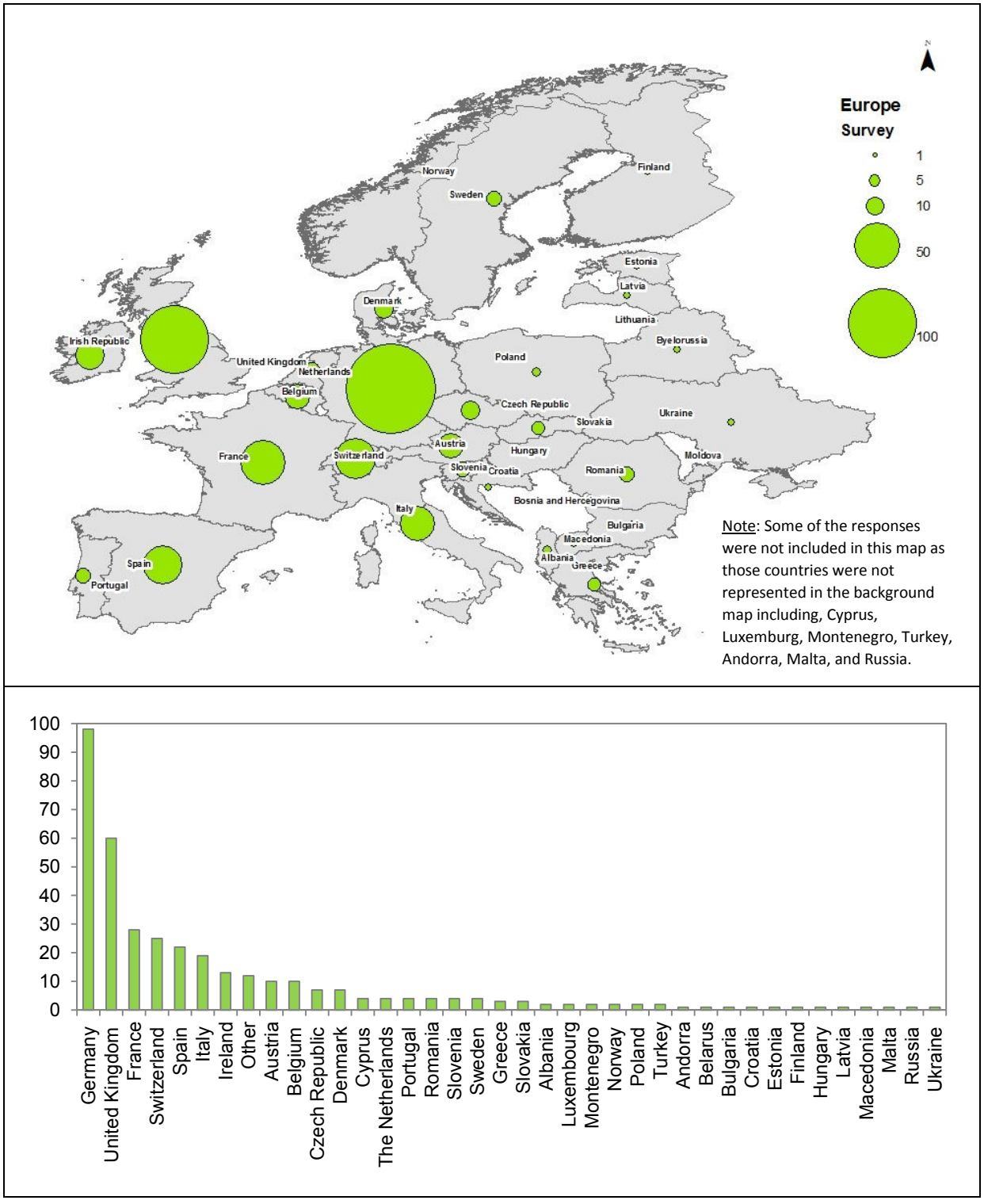


Figure 8 – Number of responses per country.

(Copyright © 1999-2010 ESRI Inc.).

The majority of the organisations who responded to the survey were private companies (37%; n=134) and government agencies or state owned companies (33%; n=118). The remaining were research institutes (10%; n=37), non-governmental organisations (8%; n=30), and international organisations (2%; n=5). Some of the respondents (10%; n=35) opted for the option "other" which included organisations such as professional unions, associations, and utilities companies.

The majority of these organisations operate at the national level (33%). The remaining organisations operate at the international level (23%), local level (21%), and European level (15%). Only 8% of the organisations operate at the sub-national level (Figure 9).

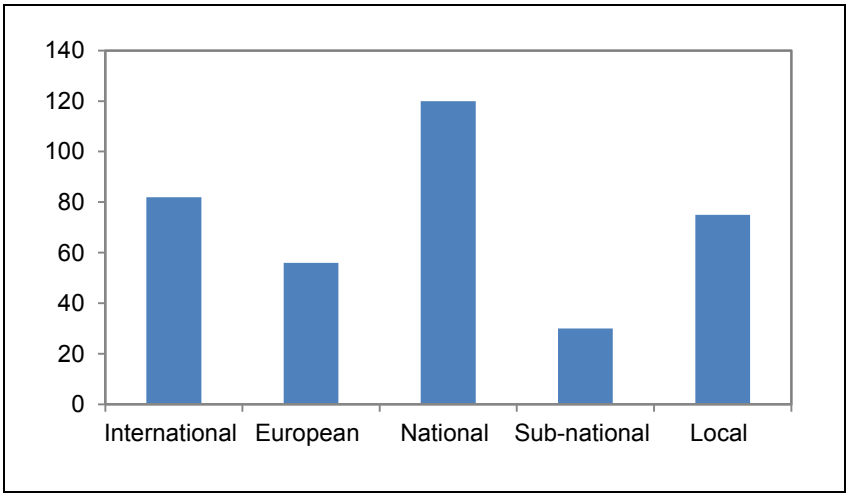


Figure 9 – Main geographical scope of the organisations' activities.

Those organisations operating at the European level (see Figure 8) many operate in Western Europe including Germany (n=32), France (n=26), Belgium and Italy (n=23), The Netherlands (n=21), Spain (n=20), and Austria and UK (n=19) (Figure 10).

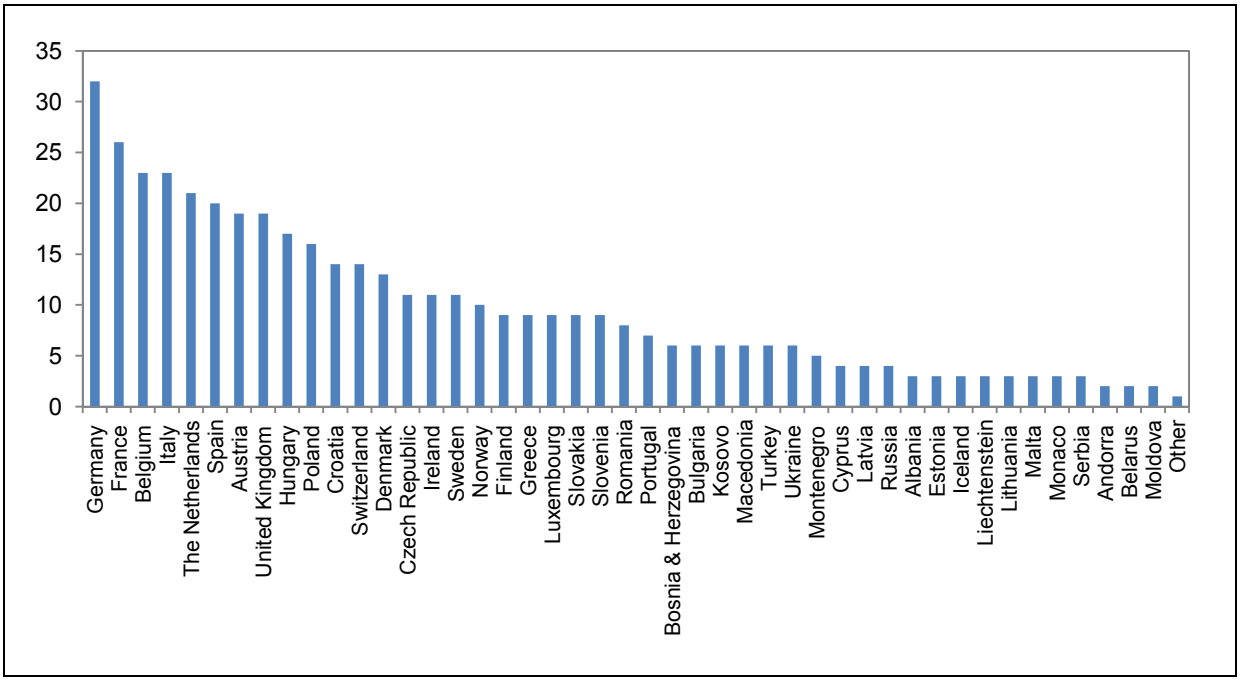


Figure 10 – Other European countries where organisations also operate.

Those operating at the international level (see Figure 9) mainly work in Europe (n=76; 23%), Asia (17%; n=49), North America (16%; n=45), South America (15%; n=42), Africa (13%; n=37), Australasia (11%; n=30), and other (1%; n=3).

Many of these are large organisations with more than 1.000 employees (34%) although a considerable number of smaller organisations with less than 10 employees (17%), between 50 and 249 employees (17%), and between 10 and 49 employees (14%) were also represented. Mid-sized organisations (i.e. between 250 and 499 employees and between 500 and 999 employees) were less represented (9% each category).

The majority of the respondents had a management role in the organisation either as a head or manager of a department (32%), the CEO/Director of the organisation (15%), technical experts (13%), and scientists (10%) (Figure 11). The remaining respondents were spread across a variety of roles including officer (8%), researcher (6%), owner of the business (4%), and adviser or consultant (3%).

Figure 11 – Role of the respondent in the organisation.

5.2.2. Decision-making processes

The timescales for planning the organisations' activities vary considerably depending on the type of activity. For example, whilst operational and maintenance activities tend to be planned in the very short-term (i.e. every day and every week) those activities that are a result of business plans/strategies and corporate/capital investment tend to be planned in the medium-term (i.e. every month up to a year). In fact, these typologies of activities seem to be negatively correlated in terms of their timescales.

Activities based on external funding such as government and European funding tend also to be planned in similar timescales to those activities based on business plans and corporate/capital investment (i.e. one month up to a year). The planning of the various types of activities tends to decrease substantially after the one to two years planning mark suggesting that many of these organisations do not tend to plan much beyond the 2 years (Figure 12).

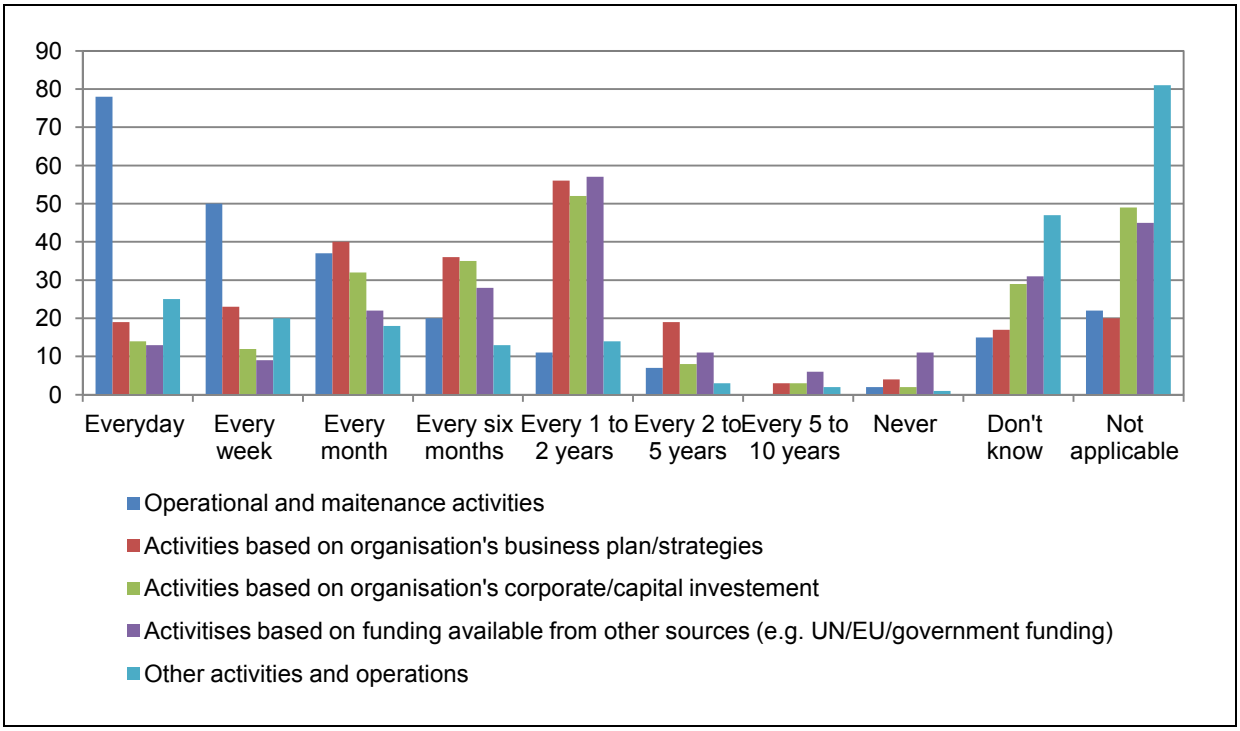


Figure 12 – Types of activities being planned in the organisations.

From the various types of information used in the organisations meteorological data was the most prominent type of data used in everyday activities (n=126). Climate, environmental, and economic data are used with a similar frequency across the various timescales although these tend to be used more often on the daily, monthly, and yearly timescales (Figure 13).

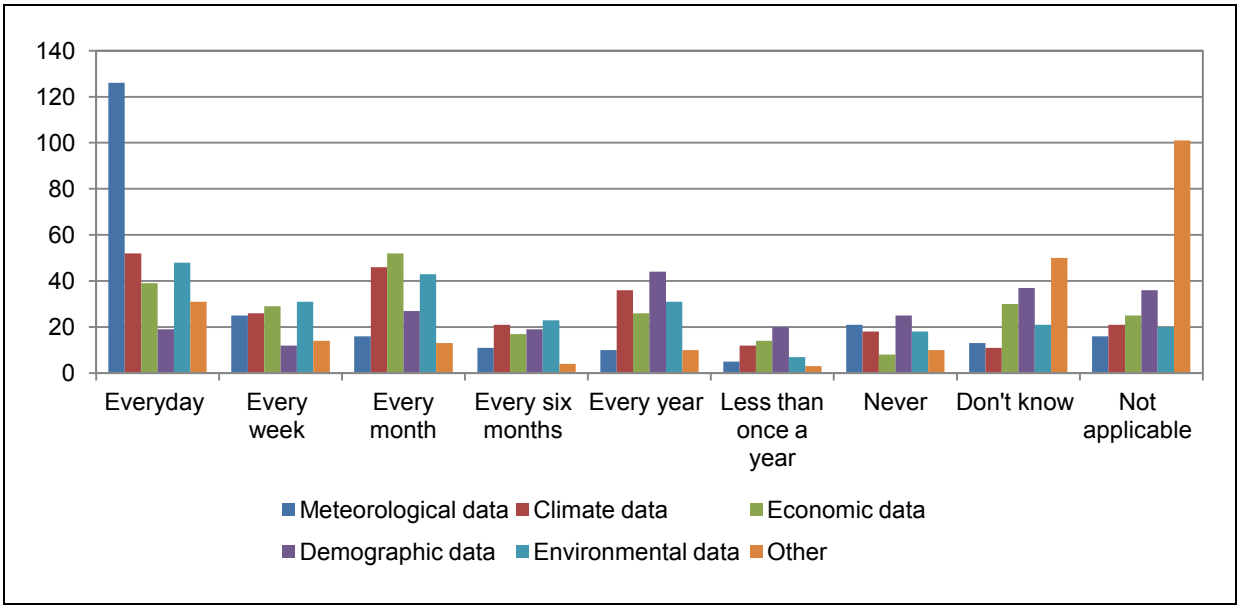


Figure 13 – Types of information used in the organisations.

The main sources of weather and climate information are the internet and web portals (n=141) followed by statistical data (n=125), reports (n=101), and professional databases (n=96). Government literature (n=63) and specialist publications and journals (n=55) also seem to be well used sources of this type of information in the organisations (Figure 14).

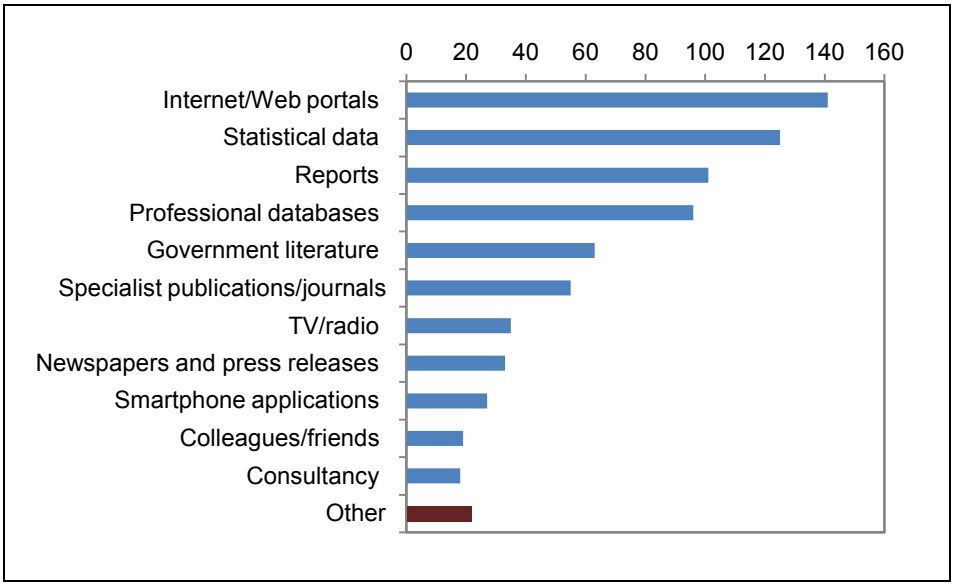


Figure 14 - Sources of weather and climate information.

'Other' sources of weather and climate information (n=22; see Figure 14) include organisations that collect their own data (e.g. monitoring system, weather stations), information obtained from National Hydrological and Meteorological Services, radar and satellite observations, and the World Meteorological Organisation Global Observing System.

5.2.3. Sensitivity to weather events and its impacts

In general terms, the organisations' activities tended to be more negatively affected by weather events and its impacts than positively affected.

There were some differences across the different sectors regarding their sensitivities to weather events and its impacts. The table bellow describes the main weather events and impacts to which organisations are negatively and/or positively sensitive to. Please note that this table is not exhaustive as it only includes those events and impacts to which the organisations are most sensitive. In addition, as this question was not mandatory the total number of responses is lower than for some of the other survey questions.

In general terms, all sectors tend to be more negatively sensitive to weather events and impacts than positively sensitive particularly in the case of the agriculture, forestry, health,

transport and emergency services and water sectors (Table 5). The energy sector is an interesting case as it does not seem extremely sensitive (either positively or negatively) to most of the weather events and its impacts listed in the survey.

Floods are the most common impact affecting many of these sectors in a negative way (with exception for the tourism sector), followed by high rainfall (with exception for the energy and forestry sectors) and high winds (with the exception for the insurance and water sectors).

Conversely, snow is the weather event that seems to affect most of the sectors in a positive way (with the exception for the tourism sector). In addition, most sectors are neither positively or negatively sensitive to low wind (with exception for the insurance sector).

However, it is clear from the table below that there is a large diversity in terms of the sensitivity of these organisations to weather events and its impacts across and within sectors. For example, in the health sector both snow and high rainfall seem to affect some organisations (although these may not be the same organisations) in both a negative and positive way.

Table 5 – Weather events and impacts to which the organisations are (negatively, positively and neither positively or negatively) sensitive by sector.

Sector	Negatively sensitive*	Neither positively or negatively sensitive	Positively sensitive*
Agriculture (n=28)	Floods (68%), droughts and high rainfall (both 57%) and high winds (50%)	Low wind (50%), fog (46%) and lightning (36%)	Snow (32%), high temperatures (29%) and low wind and frost (both 25%)
Energy (n=30)	High wind (20%), floods, droughts, landslides and storm surge (all 17%)	Low wind (63%), Lightning (60%), high temperatures, high rainfall, ice and forest fires (all 57%)	Low temperature (43%) and snow (23%) and high temperature and low rainfall (both 20%)
Forestry (n=14)	High wind, forest fires, and droughts (all 71%), floods (64%), high temperature and low rainfall (both 57%)	Low wind (57%), fog (50%) and frost (36%)	High rainfall and low temperature (both 36%), high temperature, snow and frost (all 29%)
Insurance (n=11)	Floods and landslides (both 36%), high rainfall and lightning (both 27%)	Low rainfall, droughts and storm surge (all 36%)	Low temperature, snow, ice and high wind (all 36%)
Health (n=15)	Snow and ice (both 53%), floods and lightning (both 47%), storm surge, high wind and high rainfall (all 40%)	Low wind (67%), low temperature (60%) and low rainfall (53%)	Snow (33%), high rainfall, ice, forest fires and floods (all 27%)
Tourism (n=10)	Ice (70%), high rainfall, snow, high wind, lightning and fog (all 60%)	Droughts (30%), low temperature, low wind and fog (all 20%)	High temperature (40%) and low rainfall (30%)
Transport and emergency	Floods and high winds (56%), snow, ice and high	Low wind (68%), low rainfall (61%) and fog	Snow (27%), high temperatures (24%), low

Sector	Negatively sensitive*	Neither positively or negatively sensitive	Positively sensitive*
services (n=41)	rainfall (all 54%), frost and lightning (both 49%)	(49%)	temperatures, high rainfall, low rainfall and forest fires (all 20%)
Water (n=27)	Floods (44%), high rainfall and snow (both 41%), high temperature and drought (both 37%)	Fog and low wind (both 63%), high wind (41%), and low temperature, forest fires and avalanches (all 37%)	High rainfall (33%), snow (30%), low rainfall, high temperatures, and floods (all 26%)

*The categories 'Negatively sensitive' and 'Positively sensitive' include the weather events affecting the organisations either in a very negative way or just in a negative way and in a very positive way or just in a positive way, respectively.

5.2.4. The use of weather and climate information

In terms of weather and climate data the most used form of data are weather forecasts, which are largely used on a daily basis (n=92) (Figure 15). Comparing to this, all the other types of data are significantly less used across the various timescales. Nonetheless, seasonal forecasts tend to be mainly used on a monthly (n=41) or weekly (n=30) basis whilst inter-annual predictions (n=39) and climate change projections (n=38) are mainly used on an annual base. Past weather data tend to be mostly used on a daily basis (n=39) whilst past climate data (n=28) tends to be utilised on a monthly and annual basis.

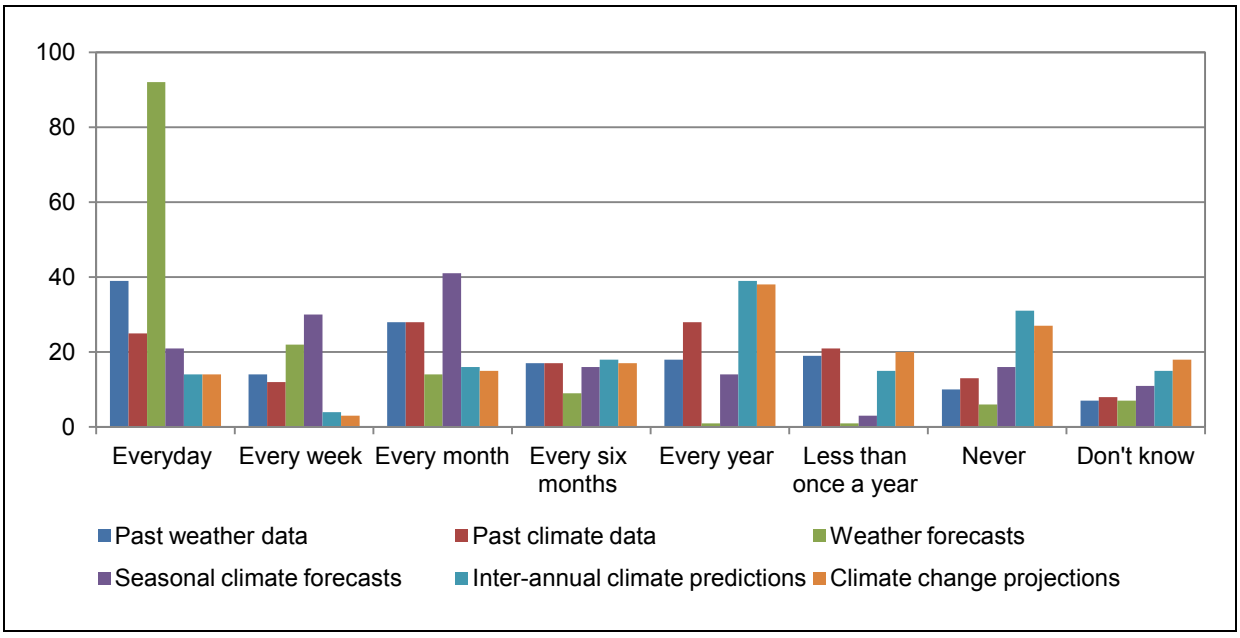


Figure 15 - Frequency in using weather and climate data in the organisations.

The use of weather and climate information in the different sectors also takes a similar pattern with weather forecasts being the type of information most used everyday across all

sectors. Past weather and climate data also tend to be used everyday but less that weather forecasts. Seasonal forecasts tend also to be used on a monthly (or weekly basis for the agriculture and tourism sector) basis whilst climate change projections/scenarios tend to be used on longer timescales such as every six months or every year.

The main providers of weather and climate data to these organisations are the National Meteorological and Hydrological Services (Figure 16). Their main provision is weather forecasts followed by past weather and climate data; they are also the main providers of seasonal forecasts, inter-annual predictions, and climate change projections. Research institutes and ECMWF also play a role (although to a much lesser extent) in the provision of climate change projections and seasonal forecasts, respectively. With a less prominent role are Government agencies, private companies, and other sources of information that provide a range of different weather and climate data to these organisations. Some organisations also collect their own weather and climate data.

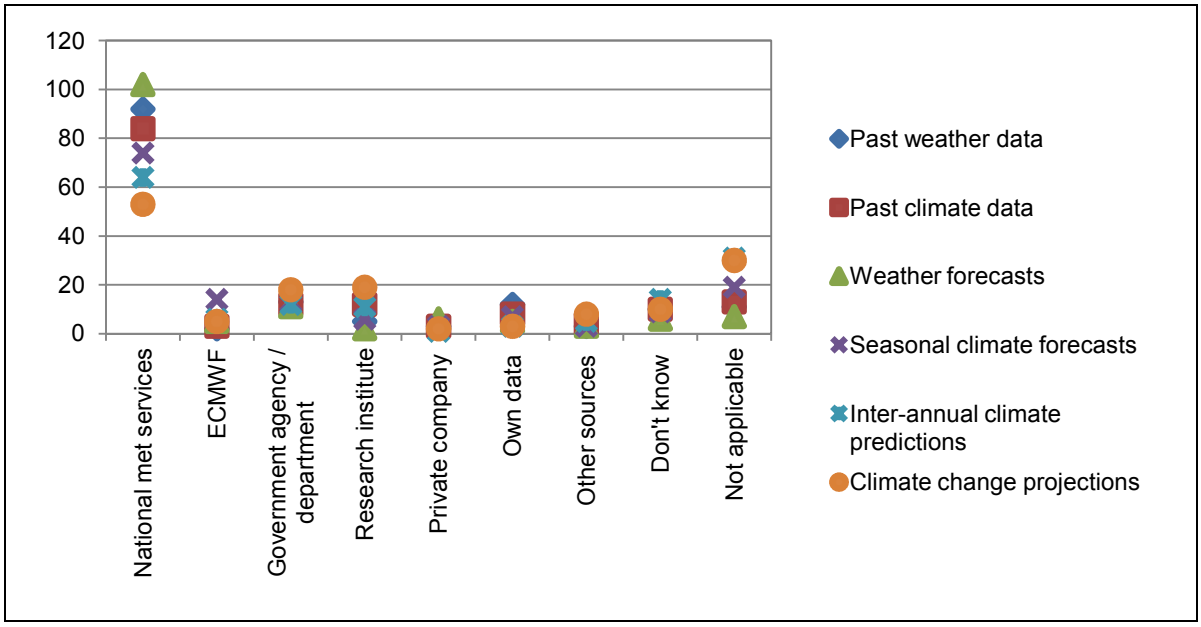


Figure 16 - Sources of weather and climate information.

The most used weather and climate information are weather forecasts (n=130) closely followed by seasonal forecasts (n=119), past weather data (n=118), and past climate data (n=113); whilst inter-annual predictions and climate change projections are relatively less used (n=101 and n=100, respectively) (Figure 17). Weather forecasts are mainly used to inform and help manage the day-to-day operational activities (n=58) whilst climate change projections (n=47) and inter-annual predictions (n=46) are mainly used to inform the

strategic planning within organisations. Most of the weather and climate information used in these organisations is analysed in house before being used in existing operational models.

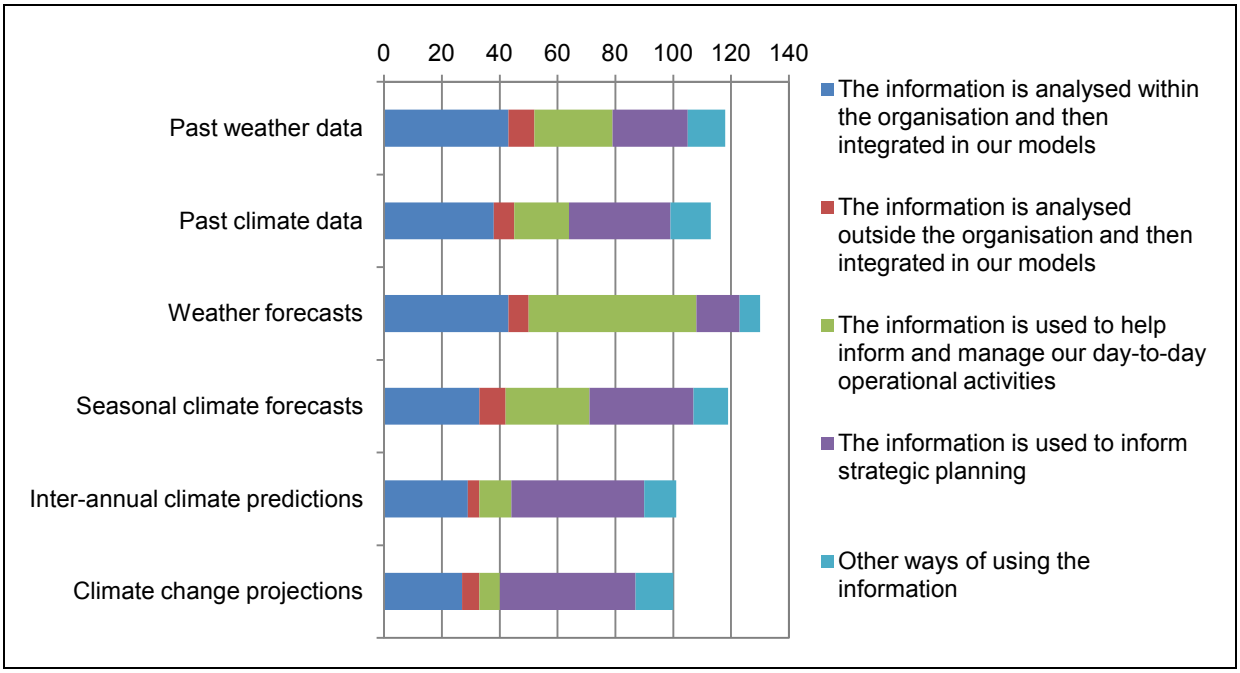


Figure 17 – Use of the weather and climate information in the organisations.

Respondents were also asked if there was any other weather or climate information that they would find useful to have. Weather forecasts were the type of information that respondents would find useful to have in their organisations (n=61). Other useful types of information to have would be seasonal forecasts (n=35), past weather data (n=29), climate change projections (n=28), inter-annual climate predictions (n=26), and past climate data (n=24). Eight of the respondents felt that they did not need more weather or climate information.

Of the organisations that currently do not use weather or climate information (n=43) the main reasons presented for not using it was due to the lack of usefulness that weather or climate information in their organisation (n=16), the lack of in-house expertise to use this information (n=11), and the lack of suitability of existing information to match their needs (n=10).

5.2.5. Dealing with uncertainty

In terms of how organisations deal with the uncertainty attached to climate information the majority of respondents agreed that their organisation is mainly concerned with those risks that are most likely to occur (n=91). Many also agreed that they need some degree of certainty in what is going to happen (as opposed to what might happen) (n=86). Time

pressures to make decisions is another factor influencing the way they deal with uncertainty (n=80) although many plan for rare but severe weather events (n=79). Less prominent factors influencing the way in which these organsiations deal with uncertainty relate to the format in which they receive the information in order to help them to make Yes/No decisions (n=68) and having clear guidelines on the level of confidence in the information provided in order for them to make a decision (n=43) (Figure 18).

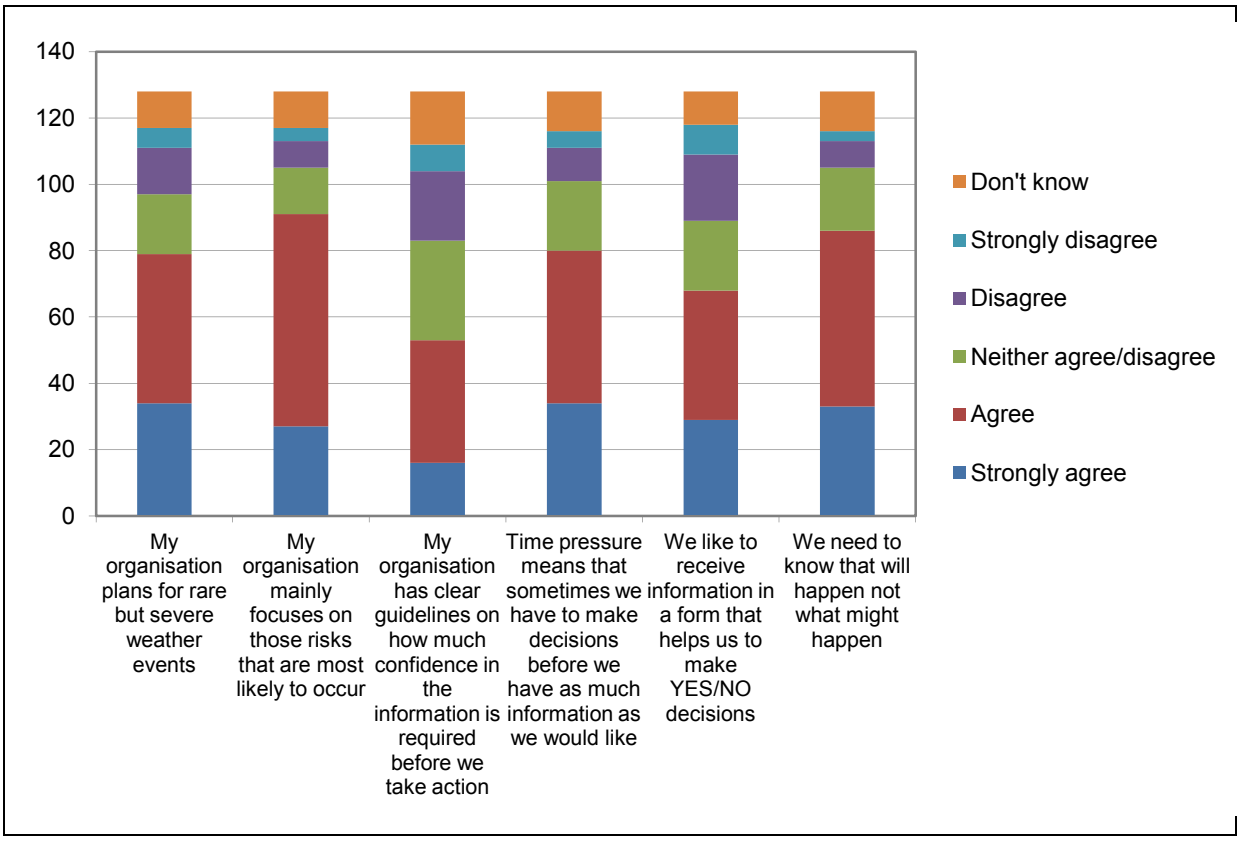


Figure 18 - How organizations deal with uncertainty in climate information.

In terms of the methods used for representing the uncertainty in climate information all different formats –numerical estimates (n=39), maps (n=38), text descriptions (n=37), and graphics (n=36) – all seem to be used frequently every day. However, all of these different formats tend to be considerably less used on longer timescales (i.e. weekly, monthly, and yearly basis).

5.2.6. Sector-specific findings

Specific questions for the forestry, agriculture, and tourism sectors were included in the survey. These questions were only made visible for those respondents who, in the first section of the survey, associated their organisation's activities to one or more of these

sectors. As a result, the total number of responses is considerable lower than in the other sections of the survey.

In total, the agriculture sector received 49 responses whilst the forestry and tourism sector received 28 responses each. Of these, 11 organisations worked in both the agriculture and forestry sector, 4 organisations worked in the agriculture and tourism sector, and 3 organisations worked in all three sectors.

In the agricultural sector, the majority of the meteorological variables presented in the survey were considered, to different extents, as having some usability to help organisations manage their activities. Variables associated to minimum/maximum temperature, rainfall, evapotranspiration, and humidity were regarded as the most usable variables (Figure 19). Mean temperature, snowfall, and wind were also regarded as usable variables.

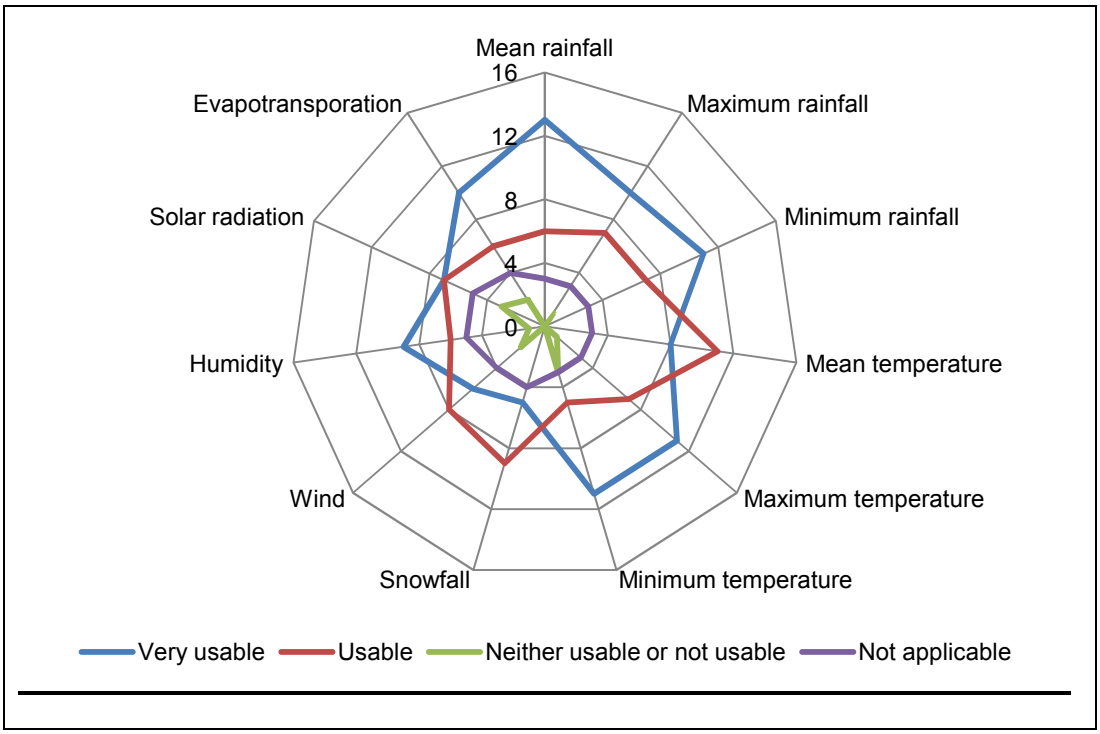


Figure 19 - Usability of meteorological variables in the agriculture sector.

The weather and climate events considered most harmful to agricultural activities were drought (n=10) whilst floods (n=12), hail (n=10), and frost (n=9) were mostly considered as harmful events.

Drought and hail tend to occur during the summer months whilst frost tends to occur during spring and winter months and floods during winter (Figure 20).

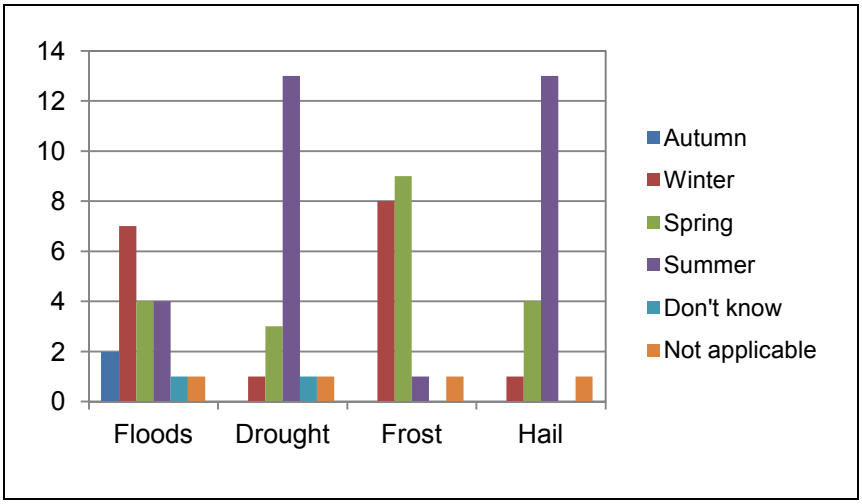


Figure 20 - Seasons when harmful events to agricultural activities tend to occur.

In the forestry sector, the risk of forest fire (n=9) and risk of drought (n=7) were the indices considered as the most usable by organisations whilst the timing of pest activity, the risk of frost damage, and the probability of frozen ground were considered usable by some of the organisations (n=5, n=4, and n=4, respectively).

In the tourism sector, the main types of tourism activities represented were rural and urban tourism (n=4 in both cases) and the seasons of most interest for these organisations are summer (n=6) and spring months (n=5).

6. Discussion and final remarks

A total of 80 interviews were conducted and 489 survey responses collected by WP12. The figure below shows the geographical distribution and the number of interviews conducted and survey responses received per European country.

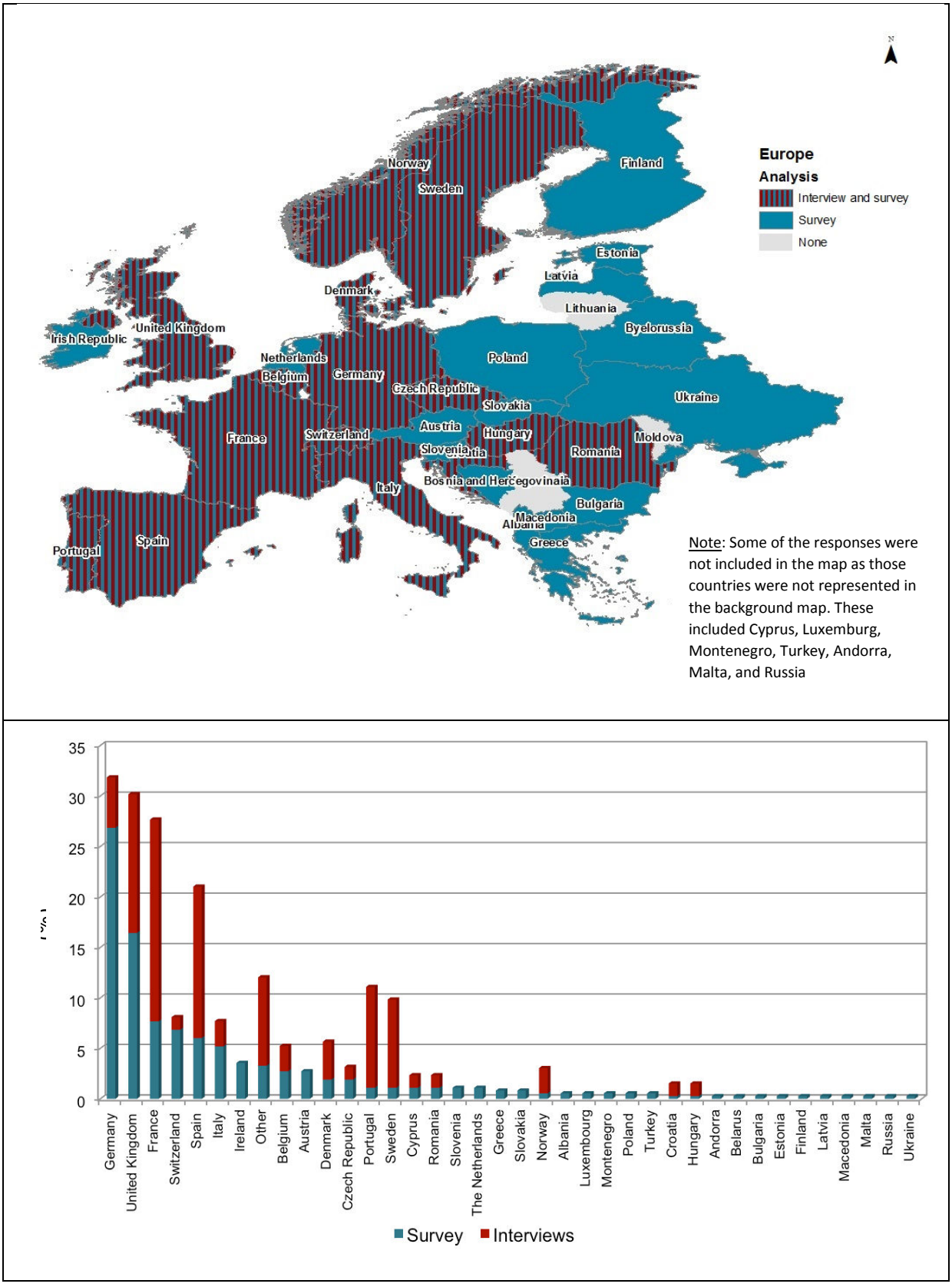


Figure 21- Distribution of interviews and survey responses across Europe.
(Copyright © 1999-2010 ESRI Inc.).

The data collection allowed us to gather a considerable amount of information regarding these organisations such as how they use weather and climate information (including S2DCP) in their operational activities, the providers and sources of information, and the potential to use S2DCP if these become more reliable in the future. However, this knowledge base is not without its limitations. These include for example a higher representation from organisations in Western Europe of which, in the case of the survey responses, a bias towards Germany and the UK were noted (Figure 21). In addition, particular sectors such as energy (17.5% and 14%), transport and emergency services (15% and 18%), agriculture (15% and 12%), and water (12.5% and 11%) were also better represented in both the interviews and survey, respectively. Many of these were also larger organisations with more than 1,000 employees (42% and 34%) working as private companies (33% and 37%) or government/publicly funded organisations (44% and 33%) according to the interviews and survey, respectively.

The majority of the organisations were sensitive (either positively or negatively) to some kind of weather conditions and/or events. Some organisations and sectors tend to be more sensitive to weather events or their impacts. However, whilst the information collected during the interviews provide us a clearer idea of the sensitivity of the sectors to particular weather events and impacts and how these affected their activities; the information collected from the survey was more limited in the sense of only providing us with a snapshot of the main events and impacts affecting the organisations/sectors in either a positive or negative way. The results from the survey also varied across sectors and within sectors in the ways in which those events and impacts affected them (see table 5). Nonetheless, in general terms floods and high rainfall were the events and impacts to which the majority of sectors are (negatively) sensitive. In terms of the weather events and its impacts to which these organisations/sectors were positively sensitive these varied across the range of the data collected. It is also important to note that the sensitivities of the organisations to those weather events and impacts also depended on a number of factors including the types of activities pursued by the organisation (which vary within organisations from the same sector), the time of the year, and the geographical location.

Weather forecasts are the most used type of weather/climate information across the various organisations interviewed and surveyed. These tend to be used to understand future weather conditions and help inform and plan their day-to-day operations and activities. This information is generally used to integrate operational model(s) in the organisation or as weather warnings.

Similarly, but to a lesser extent, past weather and climate data are also used across all sectors and organisations. This type of information tends to be used to help organisations

understand the potential weather variability and its impacts (e.g. production and consumption in the energy sector; or assess potential impacts in their assets) by either developing or feeding information into existing operational models or by performing historical variability analysis to forecast future weather conditions. This information can also be used to inform the strategic planning within organisations

From the interview data, we found that seasonal forecasts were the least used type of weather/climate information (particularly in the tourism sector) and this tended to be used as descriptive information to help them have a sense of future conditions. However, from the survey responses more organisations (across all sectors) seem to be using this type of forecasts either on a weekly or monthly basis. These organisations use the forecasts to either inform their strategic planning or to integrate it into their operational models.

The organisations interviewed used climate change projections or scenarios to help them plan ahead in terms of climate change impacts (e.g. on health) or to help them decide on future capital investment and develop wider strategies for the organisation. The sectors that most use this type of information were the transport and emergency services, water and health. However, from the survey responses the use of climate change projections/scenarios varied across sectors. Nonetheless, those using this type of climate information tend to use it less regularly (every month, six months or every year) and mainly to inform their strategic planning and longer-term operations.

Overall, in terms of the use of weather and climate information, these organisations seem to prefer using weather forecasts and historical weather and climate data than future or modelled data.

The main providers of weather and climate data to these organisations are the NMHS. From the interviews other main sources of information included online information, other sources as well as information obtained from their own meteorological stations and private services. From the survey other sources of information but to a much lesser extent than the NMHS included research institutes and ECMWF. The main sources of this information came from internet and web portals followed by statistical data, reports and professional databases (see figure 14 above).

Many of the organisations interviewed do not use seasonal forecasts and those that do, tend to use it as qualitative information i.e. to give them a sense of the trend in terms of future conditions. However, the ways in which seasonal forecasts are used in practice by these organisations and how these are accounted for in decision-making was not fully capture by the interviews.

None of these organisations use decadal climate predictions. However, the potential to use S2DCP, particularly seasonal forecasts, was noted as more than 70% of the interviewees suggested that this type of information could be useful to their organisation However, the current lack of reliability was the main factor for not using these predictions (particularly seasonal forecasts). Decadal predictions were also of particular interest to those in the transport, energy and forestry sectors, provided the necessary reliability is in place when these become more widely available. Although many of the interviewees recognised the potential to use S2DCP in their organisations, many were unsure on how this information could be used and integrated in their operations and activities. This in part, reflects the still emergent use of seasonal forecasts across Europe. Those interviewees who were able to identify the S2DCP information needs tended to be from larger organisations working very closely with weather and climate information. Unfortunately, we were not able to enquire the survey respondents on the potential to use S2DCP in their organisations. However, they were asked what type of weather and climate information they would find useful to have and seasonal forecasts as well as inter-annual climate predictions were identified by some of the respondents (n=35 and n=26, respectively).

7. References

DESSAI, S. & BRUNO SOARES, M. 2013a. Systematic literature review on the use of seasonal to decadal climate and climate impacts predictions across European sectors. *European Provision Of Regional Impact Assessment on a Seasonal-to-decadal timescale, Deliverable D12.1.* University of Leeds. Report available at: www.euporias.eu

DESSAI, S. & BRUNO SOARES, M. 2013b. Climate services providers and users' needs - Workshop report. *European Provision Of Regional Impact Assessment on a Seasonal-to-decadal timescale, Deliverable D12.2.* University of Leeds. Report available at: www.euporias.eu

8. Lessons Learnt

Working with partners from very different organisations and backgrounds (e.g. met services, universities, private companies) meant that, at times, such differences had to be acknowledged, addressed, and reconciled in order to allow us to work as a group and deliver the tasks at hand.

Some difficulties were also felt in terms of reaching enough interviewees (in task 12.3) in order to allow us to perform around 100 interviews expected in the project's Description of Work. This was due to a number of reasons including the fact that the 'snowball effect' (whereby interviewees provide us with further contacts) did not occur as expected. As a result, we had to find alternative ways of contacting other organisations of interest across Europe (e.g. by contacting organisations working in the sectors of interest and involved in other European projects).

Some technical difficulties also occurred when developing the survey of users' needs (task 12.5) mainly in terms of the translation of the survey into five different European languages and the careful co-ordination that that entailed.

9. Links Built

The information collated and analysed in WP12 has been used to inform other EUPORIAS work packages, including:

- Information on sectors' vulnerabilities (WP11);
- Information on the use of climate information indices (WP22);
- Dealing with uncertainty (WP33);
- Understanding decision-making processes in organisations (WP41);
- Information for prototype selection (WP42).

Further collaborations with other projects have also occurred including:

- Dissemination of the WP12 surveys to other European projects and initiatives e.g. SPECS, CLIMRUN, ECLISE, EUCLEIA, EEA, CIRCLE II, Light2CAT.
- Collaboration and sharing of experiences regarding the development of the WP12 interview protocol and surveys with the European projects CLIPC and EUCLEIA.

Appendices

Appendix 1 – Interview protocol Part 1: General questions

1. General information

1.1. Can you tell me a bit about your organisation and the work it does? (Including sector and type of activities it performs).

1.2. How would you classify your organisation? (e.g. government, international organisation, private company, consultancy, research institution, non-governmental organisation, other).

1.3. At what geographical scale does your organisation operate? (e.g. international, European, national, regional, local level).

1.4. How many employees does your organisation have?

- Up to 10 employees;
- Up to 50 employees;
- Up to 250 employees;
- More than 250 employees.

1.5. What is your role in the organisation?

1.6. How is your organisation and sector governed? E.g., by government, independent regulators, industry standards, EU directives, consumers, other.

2. Decision-making processes in the organisation

This section includes questions regarding decision-making in the organisation namely timescales for decisions, the type of information used to make decisions, and how the organisation plans for the future.

2.1. How does your organisation plan for the future? What are the main activities that need to be planned beyond a month?

2.2. Are there activities that need to be planned at longer timescales? For example, 3 months, 6 months, 1 year, 5 years, 10 years, more than 10 years?

2.3. What are the critical factors that need to be considered or accounted for when you plan for those activities? (e.g., consumer demand, weather, commodity price, regulatory approval, other)

2.4. When planning for the future how do you account for uncertainty? Do you use any tools or information that help you account for that uncertainty in your decision-making such as scenario analysis, probabilistic risk assessment, etc.?

2.5. What are the main challenges in accounting for that uncertainty in your decision-making processes?

2.6. What type of information does your organisation use to make decisions (e.g. social data, economic data, etc.)? What are the main channels through which that information is obtained e.g. reports, TV, colleagues, smartphone applications, radio?

3. Use of weather and climate information

This section covers questions on the organisation's sensitivity to weather and climate and the use and provision of climate information in the organisation. Interviewer: you can use the diagram provided at the end of this protocol to briefly explain the differences between weather and climate change and related types of forecasts if needed.

3.1. Is your organisation sensitive to weather (e.g., high/low rainfall, temperature, wind, snow) and its impacts (e.g., droughts, floods)? Please describe how your organisation's activities are affected (positively and negatively) by such events.

3.2. Does your organisation use weather/climate information to make decisions?

- If yes, please describe the information used (e.g. weather forecasts; past observations; seasonal climate forecasts, climate change projections, climate impacts) and the type of activities and decisions being planned;
- If no, please describe why your organisation doesn't use weather/climate information (go to question 3.8 below).

3.3. Climate information can also be provided in the form of indices describing the potential impacts of climate. Examples of this type of indices include:

- Heating Degree Days which corresponds to a sum of cold temperature days and therefore indicates the effort required to heat buildings;

- Growing Degree Days which corresponds to temperature sum above a given threshold and can be used as an index for plant productivity;
- Heavy precipitation indices which give an indication for possible flooding;
- Storm indices which summarize information on wind strength and give an estimation of possible damages.

Does your organization use this type of indices?

- If yes, how is this information used to make decisions?
- If not, could you think of any helpful measures or indices that could be useful to your organization?

3.4. How important is weather/climate information compared to other types of information that influence decisions in your organisation?

3.5. Where does your organisation obtain its weather/climate information (including information on climate impacts)? Does your organisation pay for this information?

3.6. What sort of relationship does your organisation have with the weather/climate information provider(s) of that information e.g., client relationship, collaborative relationship, etc.?

3.7. Is this weather/climate information processed/tailored before being used?

- If yes, please describe how and by whom (e.g. climate service provider, consultancy, someone in your organisation?)
- If no, would it be helpful to have particular climate information tailored? What kind of climate information?

3.8. Does your organisation provide climate information to others?

- If yes, please describe the type of information provided, the user, and the purpose of such provision;
- Is this a new or long-established activity?

3.9. Is there climate information that is currently not available and that would be useful to have in your organisation or sector? Please describe it and how it would help your organisation or sector.

3.10. In your opinion, which weather/climate products should be provided as a public service (and therefore freely available) and which should be a private service (i.e. with a cost attached)?

4. Use of seasonal to decadal climate information

This section includes questions on the use of S2D climate information in the organisation and their expectations of what this information can provide.

4.1. Are you aware of seasonal climate information? If so, can you describe what seasonal climate information is in your own words?

Interviewer: you can use the example of a seasonal forecast available on the Content Management System if you need to explain it to the interviewee.

4.2. Does your organisation use seasonal climate information such as seasonal or monthly forecasts?

- If yes, please describe the type of information used with regard to:
    - o Activities and decision-making processes it informs;
    - o Who provides that information;
    - oThe reasons why that information is used in your organisation e.g. availability, usefulness.
- If no, please describe the reasons for not using this type of information (e.g. lack of predictability, inadequacy of information provided, costs for accessing such data, not aware).
    - o If this information was available to you, how would your organisation use this information?
    - o Which type of seasonal/monthly information would be useful to your organisation? (e.g. 3-month temperature forecast)
    - o Would your organisation be willing to pay for this information?

4.3. Does your organisation use annual/decadal climate information?

- If yes, please describe the type of information used with regard to:
    - o Activities and decision-making processes it informs;
    - o Who provides that information;
    - o The reasons why that information is used in your organisation e.g. availability, usefulness.

- If no, please describe the reasons for not using this type of information (e.g. lack of predictability, inadequacy of information provided, costs for accessing such data, not aware).

    o If this information becomes more widely available, what conditions would have to be in place for your organisation to start using this climate information in its decision-making?

    o If so, which type of information would be useful to your organisation? If known, please describe the required climate variable(s) and the spatial/time resolution.

    o And why would you use this information? (e.g., credibility, improve decision-making, cost);

    o Would your organisation be willing to pay for this information if it becomes more widely and readily available?

4.4. Who do you think should be responsible for producing and disseminating seasonal and decadal climate information?

4.5. Based on your past experience or your perception, how reliable are these predictions?

4.6. If seasonal and decadal forecasts become more widely available in the future, which do you think should be provided as a public service (i.e. available free of charge) and which should be a private service (i.e. with a cost attached)?

4.7. Are you aware of any other organisations that are using or should be using S2D climate information? If so, can you describe how and why they are using this information. Can you please provide me with their contact details?

5. Dealing with uncertainty

This section covers issues regarding the uncertainty of climate information and how the organisation deals with it.

5.1. S2D forecasts usually come with information about the degree of uncertainty in the forecast.

- If not a current user of S2D forecasts: How useful would this information be to you? How would you use it in your decision-making?

- If a current user of S2D forecasts: How do you deal with uncertainty in S2D forecasts? Do you only use them given a certain signal strength (or confidence level...)? When using such forecasts, do you check their skill assessment?

5.2. There are different ways of representing the uncertainty in forecasts such as using verbal descriptions, numerical estimates and/or graphics. How would you like to receive information about forecast uncertainty? And why would you prefer this method of representation?

Appendix 2 – Interview protocol Part 2: Sector-specific questions

Agriculture sector questions

1. Which meteorological variables are the most interesting for your organization? (Precipitation, temperature, wind, humidity, radiation...) Why? Do you measure them?

2. Which weather/climate events are more harmful to your activities? Do these events tend to occur in a particular month/season of the year?

3. Would seasonal forecast provide support to your activities? If so, how much time in advance would be useful for your decision-making processes to know the forecasts?

4. Do you think that climate indices, e.g.: growing degree days, Huglin index, number of frost days, would bring added value to the forecast? Do you already use these indices? If yes, which ones and with what temporal and spatial resolution?

5. Are decadal forecasts useful to your organisation?

Energy sector questions

1. If a climate forecasting service tailored to your needs was available, what information would it provide (and how often) in order to satisfy your decision-making needs? *(Check that the following information is included in the answer: the climate variable, spatial scale, temporal scale, frequency of information).*

2. What do you see as the main barrier to using climate forecasts in your decision-making at seasonal timescales/inter-annual timescales/decadal timescales?

3. Do you have any suggestions on how to overcome such barriers?

4. Do you see climate forecasting services as an extension of other services or processes already active within the energy sector (if so, which) or as a stand alone entity? *(Can prompt by providing example of weather forecasting service, insurance services, risk management procedures etc.)*

5. What is your definition of a low, medium and high skill climate forecast? Are all climate forecasts useful? *(Forecast skill is measured from 1 to 0, where 1 corresponds to a climate forecast that can perfectly represent the past "observations" and 0 to -1 corresponds to a climate forecast that provides no additional information when compared to the average of the past climate "observations".)*

Forestry sector questions

1. Which weather events or climate extremes are most harmful to the forest?

2. Which weather and climate situations are most risky when carrying out different kinds of forest management actions, such as planting and harvesting?

3. Can seasonal to decadal prognosis provide any support for planning of regular forest management actions?

4. Different kinds of impact indices can be calculated from seasonal to decadal weather prognosis, expressing the risk of e.g. drought stress, frost damage, forest fire and insect activity. Would any kind of information on the risk of biotic and abiotic damage be useful?

5. What spatial and temporal accuracy of the impact indices is needed (Q3, Q4)?

Tourism sector questions

1. What are the most important seasons (e.g. summer, winter, etc.), type of tourism (e.g. beach, skiing, adventure, sailing, etc.) and location (e.g. mountains, sea coasts, natural parks, etc.) for your organisation activities?

2. How do tourists use the climate information they get from the main touristic destination? Is this a decisive criterion? Does the clients' daily climate context influence the choice of the touristic destination? (e.g. Is a person who lives in a rainy town less climate sensitive in its destination choice?)

3. Are there differences between your clients in terms of their activities and sensitivity to climate? What about differences in the way they use climate information?

4. Do you provide climate information to your customers? If yes, what type of information do you provide and how? Which departments in your organisation would use S2D climate information? (e.g. marketing department, human resources, etc.)

Appendix 3 – Survey of users' needs

Seasonal to Decadal climate predictions (from a month up to 10 years into the future) can provide information on potential future conditions to organisations whose activities and operations are affected by weather and climate.

By taking part on this short and anonymous survey, organisations like yours will be actively helping us to understand users' needs in Europe with regard to seasonal to decadal climate predictions. Such findings will help advance existing knowledge of users' needs and potentially improve the provision of seasonal to decadal climate predictions in Europe and for organisations such as yours.

This survey is part of the EUPORIAS project funded by the European Commission.

*** Mandatory questions**

This survey is multi-lingual - please select your language from the various options listed above. Thank you!

Esta encuesta se presenta en various idiomas - por favor escoja el suyo de entre las opciones que se muestran a continuación. Gracias!

Cette enquête est polyglotte - merci de sélectionner votre langue dans les options proposées ci-dessus. Merci!

Questo questionario è multi-lingue - per favore seleziona la tua lingua tra le opzioni qui sotto elencate. Grazie!

Bitte wählen Sie lhre Sprache aus den oben aufgführten Optionen aus. Danke!

Section A: General information on the organisation

A1. 1. What is your organisation's main sector of activitiy?

- [ ] Agriculture
- [ ] Energy
- [ ] Forestry
- [ ] Finance and insurance
- [ ] Health
- [ ] Tourism

Transport ☐

Water ☐

Emergency services ☐

Other ☐

Other

A2. 2. Which country is your organisation located?

Albania ☐

Andorra ☐

Austria ☐

Belarus ☐

Belgium ☐

Bosnia & Herzegovina ☐

Bulgaria ☐

Croatia ☐

Cyprus ☐

Czech Republic ☐

Denmark ☐

Estonia ☐

Finland ☐

France ☐

Germany ☐

Greece ☐

Hungary ☐

Iceland ☐

Ireland ☐

Italy ☐

Kosovo ☐

Latvia ☐

Liechtenstein ☐

Lithuania ☐

Luxembourg ☐

Macedonia ☐

Malta ☐

Moldova ☐

Monaco ☐

Montenegro ☐

The Netherlands ☐

Norway ☐

Poland ☐

Portugal ☐

Romania ☐

Russia ☐

Serbia ☐

Slovakia ☐

Slovenia ☐

Spain ☐

Sweden ☐

Switzerland ☐

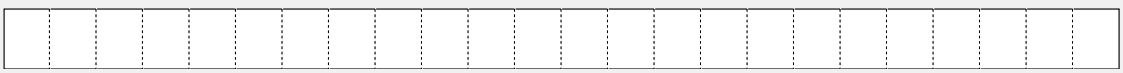
Turkey ☐

Ukraine ☐

United Kingdom ☐

Other ☐

Other



A3. 3. How would you classify your organisation?

- [ ] Government agency/department
- [ ] Private company
- [ ] Research institution
- [ ] Non-governmental organisation
- [ ] International organisation (e.g. UN agency)
- [ ] Other

Other

A4. 4. What is the main geographical scope of your organisation's operations?

- [ ] International
- [ ] European
- [ ] National
- [ ] Sub-national
- [ ] Local

A5. 4.1. In which of the following European countries does your organisation operates?

- [ ] Albania
- [ ] Andorra
- [ ] Austria
- [ ] Belarus
- [ ] Belgium
- [ ] Bosnia & Herzegovina
- [ ] Bulgaria
- [ ] Croatia
- [ ] Cyprus
- [ ] Czech Republic
- [ ] Denmark
- [ ] Estonia
- [ ] Finland

- [ ] France
- [ ] Germany
- [ ] Greece
- [ ] Hungary
- [ ] Iceland
- [ ] Ireland
- [ ] Italy
- [ ] Kosovo
- [ ] Latvia
- [ ] Liechtenstein
- [ ] Lithuania
- [ ] Luxembourg
- [ ] Macedonia
- [ ] Malta
- [ ] Moldova
- [ ] Monaco
- [ ] Montenegro
- [ ] The Netherlands
- [ ] Norway
- [ ] Poland
- [ ] Portugal
- [ ] Romania
- [ ] Russia
- [ ] Serbia
- [ ] Slovakia
- [ ] Slovenia
- [ ] Spain
- [ ] Sweden
- [ ] Switzerland

Turkey ☐

Ukraine ☐

United Kingdom ☐

Other ☐

Other

A6. 4.1. In which of the following continents does your organisation operates?

Europe ☐

Asia ☐

Africa ☐

Australasia ☐

North America ☐

South America ☐

Other ☐

Other

A7. 5. How many employees does your organisation have?

Less than 10 employees ☐

Between 10 and 49 employees ☐

Between 50 and 249 employees ☐

Between 250 and 499 employees ☐

Between 500 and 999 employees ☐

More than a 1.000 employees ☐

A8. 6. What is your position in the organisation (e.g. Director, head of deparment, scientist, technical expert, etc)?

Section B: Decision-making processes in your organisation

B1. 1. How often does your organisation plan for its activities?

	Everyday	Every week	Every month	Every six months	Every 1 to 2 years	Every 2 to 5 years	Every 5 to 10 years	Never	Don't know	Not applicable
Operational and maintenance activities	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Activities based on the business plan/strategies developed for the whole organisation	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Activities based on the corporate/capital investment available to the organisation	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Activities based on funding available from other sources (e.g. UN/EU/Government funding)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other activities and operations	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

B2. 1.1. Please specify what <u>other</u> activities and operations are planned in your organisation:

B3. 2. How often does your organisation use the types of information listed below to plan its activities?

	Everyday	Every week	Every month	Every six months	Every year	Less than once a year	Never	Don't know	Not applicable
Meteorological data	☐	☐	☐	☐	☐	☐	☐	☐	☐
Climate data	☐	☐	☐	☐	☐	☐	☐	☐	☐
Economic data	☐	☐	☐	☐	☐	☐	☐	☐	☐
Demographic data	☐	☐	☐	☐	☐	☐	☐	☐	☐
Environmental data	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐	☐	☐	☐

B4. **2.1. Please specify what <u>other</u> types of information are used to plan for your organisation's activities:**

B5. **3. How is this weather/climate information obtained?**

- Statistical data ☐
- Reports ☐
- Government literature ☐
- Professional databases ☐
- Internet/Web portals ☐
- Newspapers and press releases ☐
- Specialist publications/journals ☐
- TV/radio ☐
- Colleagues/friends ☐
- Smartphone applications ☐
- Consultancy ☐
- Other ☐

Other

Section C: Use of weather and climate information

C1. **1. Are your organisation's activities sensitive (either positively or negatively) to any of the following weather events and impacts?**

For exampe, during a heatwave a company selling ice-cream may benefit from higher temperatures (positively sensitive) whilst a transport company may have to interrupt its services during a flooding event (negatively sensitive).

	5 - Very positively sensitive	4 - Positively sensitive	3 - Neither positively or negatively sensitive	2 - Negatively sensitive	1 - Very negatively sensitive	Don't know	Not applicable
High temperatures	☐	☐	☐	☐	☐	☐	☐
Low temperatures	☐	☐	☐	☐	☐	☐	☐
High rainfall	☐	☐	☐	☐	☐	☐	☐
Low rainfall	☐	☐	☐	☐	☐	☐	☐

	5 - Very positively sensitive	4 - Positively sensitive	3 - Neither positively or negatively sensitive	2 - Negatively sensitive	1 - Very negatively sensitive	Don't know	Not applicable
Snow	☐	☐	☐	☐	☐	☐	☐
Ice	☐	☐	☐	☐	☐	☐	☐
Frost	☐	☐	☐	☐	☐	☐	☐
High wind	☐	☐	☐	☐	☐	☐	☐
Low wind	☐	☐	☐	☐	☐	☐	☐
Storm surge	☐	☐	☐	☐	☐	☐	☐
Fog	☐	☐	☐	☐	☐	☐	☐
Lightning	☐	☐	☐	☐	☐	☐	☐
Droughts	☐	☐	☐	☐	☐	☐	☐
Floods	☐	☐	☐	☐	☐	☐	☐
Landslides	☐	☐	☐	☐	☐	☐	☐
Avalanches	☐	☐	☐	☐	☐	☐	☐
Forest fires	☐	☐	☐	☐	☐	☐	☐
Other weather events and impacts	☐	☐	☐	☐	☐	☐	☐

C2. **1.1. Please specify what <u>other</u> weather events and impacts is your organisation sensitive to:**

C3. **2. Please describe below how each of these weather events and impacts affect your organisation's activities.**

C4. **3. How often does your organisation use the following weather/climate information?**

	Everyday	Every week	Every month	Every six months	Every year	Less than once a year	Never	Don't know
Past weather data (such as historical weather observations)	☐	☐	☐	☐	☐	☐	☐	☐

	Everyday	Every week	Every month	Every six months	Every year	Less than once a year	Never	Don't know
Past climate data (such as historical climate averages)	☐	☐	☐	☐	☐	☐	☐	☐
Weather forecasts (forecasts from hours up to 4 weeks into the future)	☐	☐	☐	☐	☐	☐	☐	☐
Seasonal climate forecasts (forecasts for next month up to a year into the future)	☐	☐	☐	☐	☐	☐	☐	☐
Inter-annual climate predictions (predictions for next year up to 10 years into the future)	☐	☐	☐	☐	☐	☐	☐	☐
Climate change projections (more than 10 years into the future)	☐	☐	☐	☐	☐	☐	☐	☐

C5. 4. Where does your organisation obtains this weather/climate information?

	National Meteorological and Hydrometeorological Services	European Centre for Medium Range Weather Forecast (ECMWF)	Government agency/department	Research institute	Private company	Own data (e.g. weather stations)	Other sources of information	Don't know	Not applicable
Past weather data (such as historical weather observations)	☐	☐	☐	☐	☐	☐	☐	☐	☐
Past climate data (such as historical climate averages)	☐	☐	☐	☐	☐	☐	☐	☐	☐
Weather forecasts (forecasts from hours up to 4 weeks into the future)	☐	☐	☐	☐	☐	☐	☐	☐	☐
Seasonal climate forecasts (forecasts for next month up to a year into the future)	☐	☐	☐	☐	☐	☐	☐	☐	☐
Inter-annual climate predictions (predictions for next year up to 10 years into the future)	☐	☐	☐	☐	☐	☐	☐	☐	☐
Climate change projections (more than 10 years into the future)	☐	☐	☐	☐	☐	☐	☐	☐	☐

C6. 4.1. Please describe what <u>other</u> sources of weather/climate information does your organisation uses:

C7. 5. How is this weather/climate information used in the organisation?

	The information is analysed within the organisation and then integrated in our models	The information is analysed outside the organisation and then integrated in our models	The information is used to help inform and manage our day-to-day operational activities	The information is used to inform strategic planning	Other ways of using the information	Don't know	Not applicable
Past weather data (such as historical weather observations)	☐	☐	☐	☐	☐	☐	☐
Past climate data (such as historical climate averages)	☐	☐	☐	☐	☐	☐	☐
Weather forecasts (forecasts from hours up to 4 weeks into the future)	☐	☐	☐	☐	☐	☐	☐

	The information is analysed within the organisation and then integrated in our models	The information is analysed outside the organisation and then integrated in our models	The information is used to help inform and manage our day-to-day operational activities	The information is used to inform strategic planning	Other ways of using the information	Don't know	Not applicable
Seasonal climate forecasts (forecasts for next month up to a year into the future)	☐	☐	☐	☐	☐	☐	☐
Inter-annual climate predictions (predictions for next year up to 10 years into the future)	☐	☐	☐	☐	☐	☐	☐
Climate change projections (more than 10 years into the future)	☐	☐	☐	☐	☐	☐	☐

C8. 5.1. Please describe in what <u>other</u> ways is this weather/climate information used in your organisation.

C9. 6. Why does your organisation not use weather and/or climate information?

Please rate your level of agreement with the statements below.

	Strongly agree	Agree	Neither agree/disagree	Disagree	Strongly disagree	Don't know
This type of information is not useful to the organisation	☐	☐	☐	☐	☐	☐
The information available does not suit our needs	☐	☐	☐	☐	☐	☐
The information available is too expensive	☐	☐	☐	☐	☐	☐
The information available is too complex	☐	☐	☐	☐	☐	☐
We don't know what information is available	☐	☐	☐	☐	☐	☐
We don't have in-house expertise to use this information	☐	☐	☐	☐	☐	☐

C10. 7. What other weather and/or climate information would be useful for your organisation to have in order to manage its operations and activities (both in the short and long-term timescales)?

Please specify in the comments box the type of weather variables that would be useful to have (e.g. maximum rainfall, 3-month outlook of temperature, average precipitation) and, if possible, the spatial resolution (e.g. data required at local/regional/national/European level).

Past weather data (such as historical weather observations) ☐

Past climate data (such as historical climate averages) ☐

Weather forecasts (forecasts from hours up to 4 weeks into the future) ☐

Seasonal climate forecasts (forecasts for next month up to a year into the future) ☐

Inter-annual climate predictions (predictions for next year up to 10 years into the future) ☐

Climate change projections (more than 10 years into the future) ☐

Other weather/climate information ☐

We don't need more weather/climate information ☐

Don't know (x) ☐

Don't know (x)

Section D: Dealing with uncertainty

D1. 1. How does your organisation deals with the uncertainty in climate information?

Please state your level of agreement with the statements below.

	Strongly agree	Agree	Neither agree/disagree	Disagree	Strongly disagree	Don't know
My organisation plans for rare but severe weather events	☐	☐	☐	☐	☐	☐
My organisation mainly focuses on thos risks that are most likely to occur	☐	☐	☐	☐	☐	☐
My organisation has clear guidelines on how much confidence in the information is required before we take action	☐	☐	☐	☐	☐	☐
Time pressure means that sometimes we have to make decisions before we have as much information as we would like	☐	☐	☐	☐	☐	☐
We need to know that will happen not what might happen	☐	☐	☐	☐	☐	☐
We like to receive information in a form that helps us to make YES/NO decisions	☐	☐	☐	☐	☐	☐

D2. 2. How often do you use the following formats of representing uncertainty in climate information?

	Everyday	Every week	Every month	Every six months	Every year	Less than once a year	Never	Don't know
Text descriptions	☐	☐	☐	☐	☐	☐	☐	☐
Numerical estimates	☐	☐	☐	☐	☐	☐	☐	☐
Maps	☐	☐	☐	☐	☐	☐	☐	☐
Graphics	☐	☐	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐	☐	☐

D3. 2.1. Please specify what <u>other</u> formats of representing uncertainty in climate information do you use:

Section E: Sector specific questions

E1. Forestry sector

1. How usable would the following indices be for planning forest management actions?

	Very usable	Usable	Neither usable or not usable	Not usable	Not usable at all	Don't know	Not applicable
Risk of drought	☐	☐	☐	☐	☐	☐	☐
Risk of frost damage	☐	☐	☐	☐	☐	☐	☐
Risk of forest fire	☐	☐	☐	☐	☐	☐	☐
Timing of insect pest activity	☐	☐	☐	☐	☐	☐	☐
Probability of frozen ground	☐	☐	☐	☐	☐	☐	☐

E2. Agriculture sector

1. How usable would the following meteorological variables be in managing your organsiation's activities?

	Very usable	Usable	Neither usable or not usable	Not usable	Not usable at all	Don't know	Not applicable
Mean rainfall	☐	☐	☐	☐	☐	☐	☐
Maximum rainfall	☐	☐	☐	☐	☐	☐	☐
Minimum rainfall	☐	☐	☐	☐	☐	☐	☐
Mean temperature	☐	☐	☐	☐	☐	☐	☐
Maximum temperature	☐	☐	☐	☐	☐	☐	☐
Minimum temperature	☐	☐	☐	☐	☐	☐	☐
Snowfall	☐	☐	☐	☐	☐	☐	☐
Wind	☐	☐	☐	☐	☐	☐	☐
Humidity	☐	☐	☐	☐	☐	☐	☐
Solar radiation	☐	☐	☐	☐	☐	☐	☐

	Very usable	Usable	Neither usable or not usable	Not usable	Not usable at all	Don't know	Not applicable
Evapotranspiration	☐	☐	☐	☐	☐	☐	☐

E3. Agriculture sector

2. Which weather/climate events are most harmful to your agricultural activities?

	5 - Most harmful	4 - Harmful	3 - Neither harmful or unharmful	2 - Unharmful	1 - Not harmful at all	Don't know	Not applicable
Floods	☐	☐	☐	☐	☐	☐	☐
Drought	☐	☐	☐	☐	☐	☐	☐
Frost	☐	☐	☐	☐	☐	☐	☐
Hail	☐	☐	☐	☐	☐	☐	☐

E4. 2.1. In which seasons do these harmful events tend to occur?

	Autumn	Winter	Spring	Summer	Don't know	Not applicable
Floods	☐	☐	☐	☐	☐	☐
Drought	☐	☐	☐	☐	☐	☐
Frost	☐	☐	☐	☐	☐	☐
Hail	☐	☐	☐	☐	☐	☐

E5. Tourism sector

1. What type of tourism activities does your organisation promote?

- Seaside tourism ☐
- Mountain tourism ☐
- Urban tourism ☐
- Rural tourism ☐
- Sport tourism ☐
- Winter sports (e.g. skiing, snowboarding) ☐
- Summer sports (e.g. sailing, surfing, rafting) ☐
- Cultural tourism (e.g. historical sites) ☐
- Health tourism (e.g. Spa, relaxation activities) ☐

Other

Other

Other

E6. Tourism sector

2. What are the most important seasons for your organisation's tourism activities?

Autumn

Winter

Spring

Summer

Don't know

Not applicable

Section F: General questions on climate change

F1. 1. Do you think the climate is changing where your organisation is based?

Yes

No

Not sure

Don't know

F2. 2. Would it be useful to know to what extent climate has changed due to human influences (e.g. burning of fossil fuels)?

Yes

No

Not sure

Don't know

Section G: EUPORIAS mailing list

G1. If you would like to receive further information on the findings of this research project or would like to join the EUPORIAS mailing list please leave your email address:

Thank you!

For more information on the EUPORIAS project or to see the outputs from this project: www.euporias.eu