Selected baseline prediction data for impact studies

Courtesy of NASA/Kathryn Hansen

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Blue-Action Deliverable D4.1

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Summary for publication

During the course of the project, it was realized that the data needed by the WP5 case studies can also be provided by the WP1 “Improving seasonal long range forecast skill of risks for hazardous weather and climate events” and not only by the WP4 “Enhancing the capacity of seasonal-to-decadal predictions in the Arctic and over the Northern Hemisphere”.

This was realized at the kick-off meeting, when the timescales of interest emerged. Since WP`1 focuses on the subseasonal to seasonal scale, and both of the forecast systems used in WP1 (that is the CMCCsystem and the MPI-ESM based system) offer initialized hindcast experiments from (sub)seasonal to decadal, all case studies focusing on seasonal predictability established connections to WP1 at the kick-off meeting.

That is why this deliverable has now seen the broader interaction of several teams in WP1 and WP5 as well.

This deliverable indicates how the five case studies have received data from WP1/WP4 and how these data are currently being used for the implementation of the activities in each case study.

1. Winter tourism centers in Finland
2. Temperature-related human mortality in European regions
3. Extreme weather risks to maritime activities
4. Climate services for marine fisheries
5. Russian Arctic resource extraction

More information on these case studies can be found here: http://www.blue-action.eu/index.php?id=4139

Work carried out

Case study 1 Winter tourism centers in Northern Finland

Northern Finland (Lapland and Northern Ostrobothnia) is one of the fastest warming regions in Europe with the greatest increases in temperature being seen in November, December and January. For the winter tourism sector, proper winter conditions are key to commercial success: information on future climate and specific local weather conditions is fundamental for preparing and adapting to future change.

The Arctic Center of the University of Lapland (AC UoL) started to explore in early 2017 which data the partner Rukakeskus Ltd (RUKA) needs for improved weather and climate predictions for short-term and mid-term planning of operations for ski centres owned and operated by RUKA. Located in Kuusamo area, where the climate is more continental than other parts of Finland, mean temperature is 0 degrees Celsius, RUKA is the first ski resort to open each year in Lapland for all customers, not just for the racing teams. Goal is to always be the first open and to ensure the season's longevity (October to April for tourists ending in June for racers).

RUKA general information needs:

- Winter: Both short (daily/monthly/seasonal) and long term (5 year intervals) are interesting, but especially long term. If exact data is not available, even patterns and estimates can help. Temperature, wind, humidity, cloudiness, snow fall amounts, changes in winter season length and when winter starts/ends.
- Summer: Temperature, rainfall, sunshine, humidity, how the changes in weather/climate affect nature in general.
- Scale: Ideally a 'micro-forecast', i.e. focusing on the ski resort and immediate area.
- Global trends: El Nino/La Nina and how they affect the weather and climate conditions in their area.

A first workshop with RUKA was held in Spring 2017. The results of this workshop are highlighted in the Deliverable D5.1 "CS1 End User Needs Report" and its contents won't be reported in here. Apart from the general needs listed above, RUKA staff was not entirely aware of how could they take advantage of the availability of hindcasts. The planning was thus for AC UoL to illustrate to RUKA the use of reforecasts.

Data provided by the Univ. Hamburg modellers: The modellers of the Univ. Hamburg made hindcast data available, and a manual related to the models to run the first tests.
For the time being, the data provided to the AC UoL teams were the following.

- temperature profiles include information about surface temperature and at 2 meters At a later stage, the AC UoL will access vertical profiles of the temperatures, but at a regional scale, not global.
- pressure files.

Hindcast simulations are available starting every May/Nov between 1982 - 2016 for 6 months with 30 ensemble members each, in netCDF format. As a reference data set, the Univ. Hamburg uses the ERAinterim reanalysis for the meteorological data.

The Univ. Hamburg teams suggested to start working with hindcasts for one season with relatively high temporal resolution, with daily time series 2-6 months runs.

As for long-term data: the Univ. Hamburg model system is based on MPI-ESM-MR, which is a CMIP5 model, and all the MPI-ESM-MR contributions to the CMIP5 archives are consistent with the initialized simulations. As for the CMIP5 data, a summary can be found here: http://cmip-pcmdi.llnl.gov/cmip5/data_getting_started.html

With an ESGF account via DKRZ, the AC UoL staff has access to the system in UHH and thus access to the seasonal prediction system data, after an additional registration at https://luv.dkrz.de and approval by UHH.

The Earth System Grid Federation (ESGF) http://esgf.llnl.gov maintains a global system of federated data centers that allow access to the largest archive of climate data world-wide. A ESGF Node is located at the German Climate Computing Center (DKRZ). The DKRZ is a non-profit and non-commercial limited company with four shareholders, one of them is the University Hamburg and a second one is the Max Planck Society. DKRZ provides these tools and the associated services which are needed to investigate the processes in the climate system: Computer power, data management, and guidance to use these tools efficiently. As a national service provider, DKRZ operates a supercomputer center to enable climate simulation and provides the scientific users with the technical infrastructure needed for the processing, analysis, and preservation of climate data. This also includes support for related application software, and advice and support in data processing issues.

Data provided by the meteorological services in Finland: Additionally some more data related to **real temperature** have been provided by the Finnish Meterological Institute. Data from two stations located in Northern Finland have been collected: temperature, pressure, moisture, wind. The data provided by the Finnish Meteorological Institute correspond to the interval 04.11.93 - 23.05.2017, from the stations Kuusamo Rukatuturi and Kuusamo Ruka Talvijärvi.
In the future, for this case study, it is envisioned that more data will be obtained from the Norwegian Meteorological services.

Data storage: AC UoL has some access to the CSC storage in Finland, additional storage will be negotiated with Zenodo www.zenodo.org

Case study 2 Temperature-related human mortality in European regions

The PI at ISGlobal has been interviewing many potential (both European and non-Europea) end-users including international organisations, and fitting models with observational datasets (E-OBS dataset) and climate change simulations (ISIMIP2b experiment) from outside the project.

As a first step, ISGlobal gave a general overview of the objectives and methodologies of the project to scientists from outside the climate community, and explained the main characteristics of the heat early warning system that is going to be created within the temperature-related mortality case study.

Secondly, ISGlobal have compiled information from previous and ongoing initiatives in the domain of heat stress and human health.

This point has been oriented towards three main areas:

- which are the main requirements in terms of climate observations and simulations for the development of a heat action plan,
- which are the best statistical or epidemiological methods to fit the climate and mortality data, and
- which is the best way to depict the information derived from the product so that it is easily understood by decision-makers and the general public.

ISGlobal found that the action plans in the United States, England and Germany are some of the most advanced operational systems available to date. The most sophisticated system is found in Germany, which is based on a human energy balance model of a human body used to compute the perceived temperature. Systems based on regionally-dependent temperature thresholds are however more widespread, such as in England, which uses temperature as the only climate variable. Most of the European countries have similar heat action plans, but they only provide information at the regional scale, and do not use weather or climate forecasts with lead times beyond 1 to 2 days.

Data needed from WP1 & results of the exchange with the partnership

WP1 can offer model output that covers time-scales of seasonal variability. The two groups that offer such data in WP1 are CMCC and Univ. Hamburg. Specifically, Univ. Hamburg have experiments (hindcasts) starting every Nov and May (between about 1980 to 2016) for 6 months each. We have differing spatial, temporal resolution.

In past projects, the PI at ISGlobal used seasonal and subseasonal forecasts of ECMWF System4 at lead times 1, 4, 8, 11, 15 and 18 days and 1 and 3 months before August 1st 2003 to predict the mortality excess in Europe for the 2003 heat wave (period 1-15 August 2003), expressing the prediction skill as a function of the above-mentioned 8 lead times. Optimally, at some point during the project, ISGlobal would like to expand the work done for that paper and systematically predict all summers and winters at different lead times. For ISGlobal, it is crucial that the daily time series of the forecasts are available because the ISGlobal models use the (lagged) relationships between daily climate variables and daily mortality, even if this is only used to infer at the end the overall seasonal (subseasonal) mortality.

The PI at ISGlobal normally works with the gridded E-OBS (regular grid) at a resolution of 0.25º, another possibility is to work 0.5º (e.g. ISIMIP). Coarser resolutions would not be however fine enough for some of the smaller European regions to work with. If the resolution is 1º, but still, regions to work with can be reformulated. The PI at ISGlobal has mortality data at the NUTS2 level, but can work at the NUTS1 level if necessary.[1] On this item, the discussions are still ongoing with ISGlobal and the WP1 and WP4 groups.

The essential variable we need is daily mean 2m temperature, and would appreciate to have either daily mean surface relative humidity or daily mean 2m dew point temperature. Other potentially useful variables are daily maximum and minimum 2m temperature, although they are not key if the dataset size is too big. The PI at ISGlobal is only interested in land values (need for a land-sea mask, or files could be provided with the mask already applied).

The more issuing dates of the forecasts, and the longer the time period with forecasts, the better. The PI at ISGlobal has mortality data for 1998-2010, so it would be preferable to have access to data for this

[1] https://en.wikipedia.org/wiki/Nomenclature_of_Territorial_Units_for_Statistics

period (including hindcast). There is the possibility to be open to longer periods, and work with all the target seasons, but ISGlobal has particular interest with DJF and especially JJA.

As for the size of datasets: Depending on the size, the PI at ISGlobal might need that WP1 to extract the data only for the European domain (the smallest domain would be 15ºW-25ºE, 35ºN-60ºN). And if the files are still too big, ISGlobal might need to provide partners UHH/CMCC with a R script that computes the regional averages of the main climate variables (although we would prefer to avoid that and have the original files). An easy way to download the data (e.g. linux script similar to that available to download data from CMIP, ISIMIP or EURO-CORDEX) would also be preferred.

Partners	**Univ. Hamburg**	**CMCC**
Contact names / **Questions**	Johanna Baehr johanna.baehr@uni-hamburg.de and Mikhail Dobrynin mikhail.dobrynin@uni-hamburg.de	Stefano Materia stefano.materia@cmcc.it Panos Athanasiadis <panos.athanasiadis@cmcc.it>
Main variables? Which of the variables specified in my email are available i.e. daily mean 2m temperature, daily mean surface relative humidity, daily mean 2m dew point temperature, daily maximum and minimum 2m temperature	All variables listed are available as 6-hourly data, daily data need to be calculated, except the 2m daily mean temperature	All these variables should be available
Temporal resolution?	6-hourly	Daily fields
Are daily files available?	Daily files might not be available for all variables you needed, currently I have only 2m daily mean temperature	Yes.
Do we need to access to 3h or 6h files and then make the daily averages?	Basically yes, you need an access to 6-hourly data, or we could post-process data for, depending on my time schedule it can take some time	We save daily fields.
Spatial resolution: Which is the maximum resolution?	1.875 degrees	1 degree
Temporal domain: 1980-2016	1980-2017.04, due to first initialisation in 1979 we are not analysed our data before	From 1993 onwards

	1982	
Spatial domain	Global	Global
Is it possible to have access to files showing information only for Europe?	no, we don't have any regional subdomains	Tbc
Number of ensemble members:	30	40 ensemble members for the re-forecast period (1993-2016) and 50 ensemble members for the forecasts (2017 onward).
Issuing dates:	every year in Nov 1st and May 1st	Forecast data will be issued to Copernicus on the 6th of each month. Copernicus will make the data available on the 15th.
Model integration: 6 months?	6 months	6 months
File size? Please give estimation per each 6-month model integration for each spatio-temporal resolution	About 3.8 Gb for one 6-hourly 2D field over full time (1979-2017.04) for one ensemble member about 0.9 Gb for a daily mean 2D field over full time for one ensemble member	Re-forecast data are huge: 40 members for each month (12) of the period 1993-2016 (24 years). 40 x 12 x 24 = 11520 simulations, each constituted of two tar zipped files that sum up to 16 GB. This means we stored about 190 TB of data (1° resolution for the atmosphere, 0.25° for the ocean).
Data access: ftp only? Is there any other way to access to data? e.g. CMIP scripts?	our data are not on the CMIP server, ftp would be our preference	It will be possible to access our forecast and re-forecast data through Copernicus from January 2018.

Case Study 3 Forecasts on extreme weather (polar lows) in maritime risk assessment

Sailing in the Arctic has always been attended to encountering unexpected conditions. The mere nature of the Arctic, pristine and desolate, is changing. With climate change, in all its manifestations, we witness altered weather patterns, declining ice extent, warmer polar waters, and changes in the way storms form and develop. Cold air outbreaks or polar lows are one type of weather phenomenon that are hard to predict, as they depend on a certain set of conditions being present, and can form and dissipate rapidly. As the Arctic becomes more accessible, we see a rise in commercial activity in polar waters from Russia, the U.S., Europe and Canada. This brings on new challenges and risks, not only for ships that sail them, but for the Arctic environment, and for those who depend on it.

In case study 3, DNV GL in collaboration with Unires, will look at understanding extreme weather conditions in the context of maritime operations. The aim is to investigate ways to improve our awareness towards extreme weather formations, and give notion to how the maritime industry can better utilize forecasts on severe weather impacting on safety and navigation in polar waters.

To assess applicability and value of long-term weather predictions, DNV GL has identified the following criteria:

- Critical factors for navigation, sea ice, winds, satellite coverage, visibility, precipitation.
- History of accidents in polar waters
- Patterns in formation and trajectory of polar storms

- Hotspots of polar lows, i.e. Japanese Sea
- Anticipated regions of high commercial interest
- Main fairways in Arctic shipping
- The Northern Sea Route
- Implications of the IMO polar code

In the process, we have identified and consulted the following data sources:

Source	Record/Reanalysis/Forecast	Variable/Parameter
WOAD	Historical records of offshore accidents and incidents	Chain of events, causes and consequences
ERA-INTERIM	Reanalysis data	Precipitation, Air Temperature
ECMWF	Operational forecasts, seasonal forecasts	EFI, Winds, Precipitation
ASR NCAR/UCAR	Reanalysis data	Precipitation, SST, Air Temperature, Surface Pressure, Winds
Copernicus/MEMS	Seasonal forecasts/In-Situ	Winds, Sea ice, SST
MET/BarentsWatch	BarentsWatch portal – polar lows	Polar Lows (Barents Sea)

Data is yet to be made available by WP1 and WP4 for proofing/concept development.
DNV GL need access to historical records (of polar lows) and for the case of the study, DNV GL will need a plan for model implementation (WP1) of seasonal forecasts on polar lows.

Internally, DNV GL colleagues have consulted the WOAD database, world accident database, and are in contact with representatives of the maritime industry in Japan, for feasibility and needs assessment. DNV GL will consider a wider set of scenarios than just polar lows as a phenomenon in itself and they are looking at building a case for Japan shipping, possibly involving the North-East passage, and the Japanese sea, where polar lows tend to be more frequent.

Erik Kolstad (Unires) has received all the hindcast data needed from the Univ. Hamburg colleagues temperature and pressure[2] during the course of Spring 2017, and is currently in the process of looking at the data to find out more about the predictability of cold air outbreaks using the MPI-ESM seasonal hindcasts.

Case Study 4 Climate services for marine fisheries

Based on model simulations, both existing and to be performed within the project, Blue-Action assesses predictability of and determine near-future abundance and distribution of marine species from various trophic levels, including economically important fish species. This deliverable makes existing model simulations performed at MPI-M available to the colleagues of the case study 4 at DTU Aqua.
In previous projects funded by the European Commission, such as FP7 projects THOR and NACLIM, both predictive skill of physical quantities and the relationship between physical quantities and abundance and distribution of marine species from various trophic levels has been demonstrated for the northern North Atlantic Ocean. Within Blue-Action, we combine the two approaches by using physical output from decadal prediction experiments (both retrospective and actual forecasts) to assess predictive skill

[2] Same set of data provided to AC UoL. The technical description provided above for the AC UoL/RUKA case study also fits for this case study.

of and determine near-future abundance and distribution of marine species, including economically important fish species. As initial step, temperature and salinity monthly output from existing suites of initialised decadal climate prediction ensemble experiments with the MPI-ESM earth system model over the period 1960 to 2015, namely FP7 project SPECS and German BMBF projects MiKlip, has been provided to WP5 partners.

Case study 5 Russian Arctic resource extraction

Within case study "Russian Arctic oil and gas extraction", IASS, Foresight Intelligence and IMEMO will develop scenarios of oil and gas extraction by the year 2040 in the Yamal-Nenets Autonomous Okrug, which is the leading hydrocarbon producing region of the Russian Arctic. The scenarios will be developed together with stakeholders at a total of three workshops between late 2017 and late 2018. Information about the changing climate in the Russian Arctic is one of the most important uncertainties with respect to the future of oil and gas exploration and extraction in the Arctic.

The focus of the scenario building is to delve deeply in the possible developments of oil and gas exploration and extraction in the Yamal-Nenets AO by 2040. With this timeframe in mind, the possible decadal changes of climate and weather until 2040 are of relevance (especially of hazardous climate and weather events in the Russian Arctic). However, stakeholders are also highly interested in the climatic changes on a seasonal scale, i.e. what they can expect in terms of extreme weather and climate events over a relatively short time horizon. Thus, we would like to include experts that can provide the stakeholders at the workshops with the latest data as to the capacity for seasonal-to-decadal weather and climate prediction in the Arctic (WP4) as well as about specifically seasonal forecast skills for hazardous weather and climate events (WP1). Equally important is input as to the potential innovations in the field of weather and climate prediction, so not only information as to what is possible today but also what might be possible in the future. Importantly, the climate scientists are asked to help with the interpretation of the climate data and possible innovations for the specific needs and interests of the engaged stakeholders.

The first workshop will take place on 7-8 December 2017. The following climate data are needed for the scenario exercise:

- projections of sea ice cover in the Kara sea and along the Northern Sea Route – seasonal (especially differentiated between winter and summer) and decadal (until 2040);
- projections of temperature increase for the Yamal-Nenets Autonomous Okrug – seasonal (especially differentiated between winter and summer) and decadal (until 2040);
- projections of changes in wind, cloudiness and precipitation in the Yamal-Nenets AO – seasonal (especially differentiated between winter and summer) and decadal (until 2040);
- projections of permafrost thaw in the Yamal-Nenets AO by 2040.

Further, next to providing data, the scenario process needs input as to the reliability of the models behind it, error margins of estimates, diverging expert opinions; and deviating models/projections. This information is equally important to the scenario process as existing knowledge or data.

The focus of this case study is not primarily to generate new data but rather to make existing data and data generated by WP1 and 4 usable for stakeholders on the ground. The data approach taken in this case study is thus predominantly qualitative in the sense of enabling a communication space with the workshop series between the climate scientists in Blue-Action and stakeholders engaged in oil and gas developments in the Russian Arctic.

Currently the discussion with the WP4 experts is still ongoing: The data needs of this case study consists of climate projections' output up to 2040. Such data from the multi-model simulations are available from the CMIP5, and by early-mid next year from the future CMIP6 archive. These data can be downloaded from the German ESGF node (https://esgf-data.dkrz.de/projects/esgf-dkrz/) Some of the considerations discussed:

- Horizontal resolution: CMIP5 data are relatively coarse resolution (~ 1 degree) data. In the CMIP5-based FP7 project NACLIM some user-related partners were very unhappy about that and decided to use CORDEX data instead. CORDEX is the regional downscaling of some CMIP5 simulations. The scenario simulations are probably the most user relevant ones and the Arctic is one of the strongest changing regions, so there is a good chance that CORDEX data of interest to WP5 exists. Furthermore, the regional modelling group at GERICS is strongly involved in CORDEX, so the meeting scheduled there on 10-12 July 2017 will also aim at discussing any use of CORDEX data within WP5. CMIP6 will have higher resolution compared to CMIP5 (though probably still coarser than CORDEX), but the CMIP6 scenario forcing is not available before autumn 2017 at the earliest, delaying the CMIP6 scenario simulations.
- Time series creation: The CMIP archives provide 2D (longitude, latitude) and 3D (longitude, latitude, depth / height) data, one file per variable and certain time period specified in the filename, netcdf format.WP4 staff at MPI-M will support IASS on how to download these files from the ESGF nodes.

Main results achieved

Case study 1 Winter tourism centers in Northern Finland

- A mapping of the RUKA needs has been provided in deliverable Deliverable D5.1 “CS1 End User Needs Report”: Lesser, Pamela, Toivonen, Jusu, Coath, Martin, & Contreras, Roxana. (2017). End Users Needs Report: Weather and climate data for Northern Finnish winter tourism centers (D5.1). Zenodo DOI 10.5281/zenodo.887329
- More information can be also retrieved in this presentation by Pamela Lesser: http://www.blue-action.eu/fileadmin/user_upload/blueaction/Presentations-KO-Berlin/Day2/LESSER.pdf

Case study 2 Temperature-related human mortality in European regions

- An exchange between the partners ISGlobal, CMCC and Univ. Hamburg and the WP4 teams is ongoing on the data to be used in this case study.
- Several interviews and online meetings have been conducted with relevant scientists, stakeholders and decision makers from world leading international institutions:
  - World Health Organization (WHO)
  - World Meteorological Organization (WMO)
  - Centers for Disease Control and Prevention (CDC)
  - National Oceanic and Atmospheric Administration (NOAA)
  - International Research Institute for Climate and Society (IRI)
  - Public Health England (PHE)
  - MetOffice UK
  - Deutscher Wetterdienst (DWD)
  - Almada City Council (Partner in Blue-Action)
  - Caribbean Institute for Meteorology & Hydrology (CIMH)
  - Agència de Salut Pública de Catalunya (ASPCAT)
  - Agència de Salut Pública de Barcelona (ASPB)

Case Study 3 Extreme weather risks to maritime activities

The focus of our work has been to identify possible use cases, and to assess business value. The continued work, i.e. deliverables of WP5 relate to/ depend on and deliverables from WP1 model implementation, and WP4 qualification and transfer.

Ongoing work at DNV GL:

- Workshops on needs assessment, identification of use cases
- Collaboration with H2020 project INTAROS
- Data screening on applicable and feasible supporting sources
- Contacts in Japan, NiPR
- Clarifications on impact of polar lows on maritime activities
- Risks identification: Sea ice, low temperatures, darkness, remoteness, marine icing, visibility, polar lows.

Case Study 4 Climate services for marine fisheries

This deliverable is related to the transfer of data (output from decadal prediction experiments) to WP5 partners. Results based on data analysis will be described in forthcoming WP5 deliverables.

Case study 5 Russian Arctic resource extraction

The first results from using data from WP 1 and 4 will be provided through the deliverable D5.21 in form of reporting of the outcomes of the first scenario workshop, which will take place on 7 and 8 December 2017 in Russia, with the collaboration of the Russian partner IMEMO.

Progress beyond the state of the art

Describe the advance provided beyond the state of the art (if relevant) and the extent the work has been ambitious.

Case study 1 Winter tourism centers in Northern Finland

The first deliverable, the D5.1 End User Needs Report, is just the first step in designing a climate service tailored to Rukakeskus (RUKA) that will improve their decision-making, make them more competitive, and ultimately ensure the continued health of their business. Although D5.1 is not intended to advance the state of the art as this is typically understood, it has clearly laid out the operational nature of a ski resort and some of the challenges and opportunities that are present given the type of weather and climate data that is now and can hypothetically be supplied in the future. Once the short-term and mid-term weather and climate models are improved as stated in the other Work Packages, this case study will be able to use that data to not only produce a tailored climate service for RUKA, but to also allow RUKA to assess how beneficial – or not – that information actually is for them hence providing information that is currently not available, and in the process, advancing the state of the art.

Case study 2 Temperature-related human mortality in European regions

ISGlobal has discussed possible ways of collaboration in order to coordinate current initiatives and explore potential synergies. We concluded that the next generation of heat action plans should include high-resolution climate and mortality information to derive early warning systems for European cities, which should include the exacerbation effect of the urban heat island within the context of global warming and increasing urban populations. In addition, subseasonal to seasonal climate forecasts are currently not used for heat action plans, given that it is generally believed within the public health community that there is no skill beyond the weather scale, and therefore there would a window of opportunity for the generation of new products and services if there were significant improvements in climate forecasting.

Case Study 3 Extreme weather risks to maritime activities

Understanding the impacts of a changing Arctic, weather systems, and its linkages to lower latitude climate is high on the agenda in the maritime community as well as in tourism, fisheries, and oil and gas industries. With the adoption of the IMO Polar Code*, all ships operating in the Arctic must comply with the code. This sets standards for safety of navigation and requirements for environmental protection.

IMO has adopted the international code for ships operating in polar waters (Polar Code) and related amendments to make it mandatory under both the International Convention for the Safety of Life at Sea (SOLAS) and the International Convention for the Prevention of Pollution from Ships (MARPOL). The Polar Code went into force on January 1st 2017.

Case Study 4 Climate services for marine fisheries

While assessing predictive skill of physical oceanic quantities is extensively discussed in the literature since more than a decade, assessing predictive skill of abundance and distribution of marine species has become a focus of research only very recently. WP5/CS4 partners, based on the transferred data, shall tackle the latter issue.

Case study 5 Russian Arctic resource extraction

The first scenario workshop for the case study on Russian Arctic oil and gas extraction (CS5) http://www.blue-action.eu/index.php?id=4146 will take place in December in Moscow on 7-8 December 2017.

The necessity for linking science to stakeholders and policy has been a matter of debate and urgency for a long time already. To approach this issue with the help of a rigid methodological approach (foresight analysis and scenario building) and bringing together climate scientists and stakeholders over an extended timeframe and through iterated meetings, is a rather novel approach.

Impact

The work done so far represents the basis for the development of the case studies and thus will potentially help the project in achieving the following socio-economic impacts:

- Improve stakeholders' capacity to adapt to climate change,
- Contribute to better servicing the economic sectors that rely on improved forecasting capacity (e.g. shipping, mining),
- Improve the professional skills and competences for those working and being trained to work within this subject area,
- Improving innovation capacity and the integration of new knowledge,
- Strengthening the competitiveness and growth of companies by developing innovations meeting the needs of European and global markets; and, where relevant, by delivering such innovations to the markets.

A specific impact on the **business sector** is to be foreseen in the following case studies:

Case study 1 Winter tourism centers in Northern Finland

Long-term business planning for Northern Finnish winter tourism industry therefore needs to account for the increased likelihood of the October-December season being too warm and plan for alternatives to winter sports. Forecast data is required to i) plan for the next season , especially at the beginning of the season with the need for snow making and snow storage and ii) plan mid-term operations and investments that allow their businesses to adapt to the changing and variable climate (semi-decadal scale). Furthermore, weather and climate information is required to assess the competitive position of Northern Finland relative to other major European Ski Centres.

Case Study 3 Extreme weather risks to maritime activities

With improved prediction of extreme weather in the Arctic, cold air outbreaks and polar lows, along with better understanding of how these weather phenomena origin, develop, and surface, the maritime industry can take precautionary actions to avoid or mitigate risks of extreme weather. With updated and accurate forecasts beyond the synaptic scale, navigation and routing in polar waters becomes safer, more reliable, and ultimately more economically viable.

Case Study 4 Climate services for marine fisheries

Assessing predictive skill of and determining near-future abundance and distribution of marine species, including economically important fish species, is highly beneficial for both fishing industry and conservation of marine ecosystems.

Case study 5 Russian Arctic resource extraction

At the scenario-building workshops participants representing different stakeholder groups (extractive industry, indigenous and environmental NGOs, expert community, media) will not only provide input-information for scenarios, but they will be also shown how to use these scenarios to make more information-based and unbiased decisions. Such an exercise will support the business sector to take prudent decisions concerning risky oil and gas projects in a very challenging environment, plagued by many uncertainties ranging from changing climatic, economic, political and legal conditions.

Lessons learned and Links built

- The decadal prediction experiments were performed within FP7 project SPECS [3] and the German project MiKlip[4]. Forthcoming decadal prediction experiments, which provide a possible data base for WP5 as well, will not only be performed within Blue-Action project, but also by other global coupled modelling centers as a part of the upcoming coordinated CMIP6 DCPP efforts.
- Synergies are sought with current and previous projects focussing on climate services such as FP7 EUPORIAS[5], H2020 Climateurope project[6] through a collaboration with GERICS in Hamburg and the H2020 MARCO [7] project through a collaboration with Climate-KIC France.
- Synergies are sought also with the Climate Services Partnership http://www.climate-services.org whose coordination is also based at GERICS.
- It is fundamental to have a regular exchange between WP5 and WP8 to foster exploitation. In this sense, the following meetings were organized.

[3] http://www.specs-project.eu
[4] http://www.fona-miklip.de
[5] http://www.euporias.eu
[6] http://www.climateurope.eu
[7] http://marco-h2020.eu

a) **WP5-WP8 Meeting, 16 February 2017, Copenhagen** (with leads of WP8 and WP5, coordination, project office. Scope: increase coordination between the two WPs. coordinated between the two.
b) **Monthly WPL telcos** in March, April, June 2017 with the work package leads to keep track of progress, exchange needed and interactions.
c) **WP5 workshop, 10-12 July 2017, Hamburg**: The representatives of the case studies of WP5, WP8, and in collaboration with the colleagues of GERICS http://www.climate-service-center.de/ who are involved in the H2020 CLIMATEUROPE and MARCO projects meet for 1) training on the use of the data made available by WP1 and WP4, and for an 2) exchange on end-user engagement and development of climate services, and exploitation of synergies with previous FP7 projects, e.g. EUPORIAS and SPECS and with the Climate Services Partnership http://www.climate-services.org

Contribution to the top level objectives of Blue-Action

This deliverable contributes to the achievement of the following objectives and specific goals indicated in the Description of the Action, part B, Section 1.1: http://blue-action.eu/index.php?id=4019

Objective 7 Fostering the capacity of key stakeholders to adapt and respond to climate change and boosting their economic growth

By offering better services for the specific stakeholders in the case studies and providing them with improved tools.

Objective 8 Transferring knowledge to a wide range of interested key stakeholders

Through targeted workshops organised with the end-users in the case studies and one-to-one interviews for mapping what knowledge is available and where gaps are to be filled with new knowledger and better servicing.

References

- H2020 Climateurope project http://www.climateurope.eu/
- H2020 MARCO project http://marco-h2020.eu/
- BMBF Project MiKlip https://www.fona-miklip.de/
- EU FP7 project SPECS www.specs-project.eu/
- EU FP7 project NACLIM http://naclim.cen.uni-hamburg.de/index.php?id=2226
- Rachel Lowe, Markel García-Díez, Joan Ballester, James Creswick, Jean-Marie Robine, François R. Herrmann and Xavier Rodó, Evaluation of an Early-Warning System for Heat Wave-Related Mortality in Europe: Implications for Sub-seasonal to Seasonal Forecasting and Climate Services Int. J. Environ. Res. Public Health 2016, 13, 206; doi:10.3390/ijerph13020206

Dissemination and exploitation of Blue-Action results

The updated list of the dissemination activities is published on our website:
Events: http://www.blue-action.eu/index.php?id=4011
Media and materials http://www.blue-action.eu/index.php?id=3903

Dissemination activities

Type of dissemination activity	Title	Date and Place	Estimated buget	Type of Audience	Estimated number of persons reached
Participation at a conference	Vilena Valeeva (IASS) presentation of a poster about case study 5, AMAP International Conference on Arctic Science: Bringing Knowledge to Action	24-27 April 2017m Reston (USA)	See IASS financial statement in the first progress report	Scientific community	>300
Organisation of a workshop	WP5 Worksop on climate services for exchange and training with GERICS and other EU projects (CLIMATEUROPE and MARCO) and the Climate Services Partnership	10-12 July 2017, Hamburg (DE)	See financial reports in the first progress report	Scientific community	23
Organisation of a workshop	Workshop for mapping RUKA's needs	16 March 2017, Rovaniemi (FI)	See financial reports in the first progress report	Industry	10
Organisation of a workshop	Scenario workshop for the case study on Russia	7-8 December 2017, Moscow (RU)	See IASS financial statement in the first progress report	Scientific Community (higher education, Research) Industry NGOs Policy makers	20
Participation to a conference	Raeanne Miller (SRSL) presenting a poster about the Blue-Action case studies	ECCA 2017, Glasgow (UK)	See SRSL financial statement in the first progress report	Scientific Community (higher education, Research) Industry Civil Society General Public Policy makers Medias Investors Customers Other	>300
Participation to a workshop	Elena Nikitina (IMEMO) presenting Blue-Action at the high- level expert meeting "Transfer to Green Economy in Russia: Designing Action Plan", organized by the Russian Federation Ministry on natural resources and environment; Cadaster	16-17 March 2017, Yaroslavl State Technical University, Yaroslavl (RU)	//	Research institutes, universities, business community, government, environmental organisations and local stakeholders	20

	Science and Technology Center				
Social media	Twitter account			All audiences	
Flyers	Flyer on the expected impacts of the project		See SRSL financial statement in the first progress report	Civil Society General Public Policy makers Medias	>500
Participation to a conference	Joan Ballester (ISGlobal) presenting a poster on “Forecast Scheme of Temperature-Related Mortality for Decision-Making in European Regions and Cities” http://www.climate-services.org/iccs/iccs5/	28 February- 3 March 2017, Fifth International Conference on Climate Services- Capetown	See ISGlobal financial statements in the first progress report	Scientific Community (higher education, Research) Industry Civil Society General Public Policy makers Medias Investors Customers Other	300
Participation to a conference	Joan Ballester (ISGlobal) presenting a poster on “Forecast Scheme of Temperature-Related Mortality for Decision-Making in European Regions and Cities”	Kick-off meeting of PUCS Project, 14-16 June 2017, Antwerp (BE)	See ISGlobal financial statements in the first progress report	Scientific Community (higher education, Research)	60
Participation to a conference	Joan Ballester (ISGlobal) presenting a poster on “Forecast Scheme of Temperature-Related Mortality for Decision-Making in European Regions and Cities”	annual meeting of the "Action Plan to Avoid the Effects of Heat Waves on Health, Catalan Public Health Agency, July 2017, Barcelona (ES)	See ISGlobal financial statements in the first progress report	Scientific Community (higher education, Research) Industry Civil Society General Public Policy makers Medias Investors Customers Other	100
Website	Section related to the case studies with information about players, contents and expected results: http://www.blue-action.eu/index.php?id=4139	www.blue-action.eu Case Studies	See DMI financial statements in the first progress report	Industry Civil Society General Public Policy makers Medias	

Peer reviewed articles

Full list of publications is available here: http://www.blue-action.eu/index.php?id=4120

Title	Authors	Publisher	DOI (if available)	Publication Status (in preparation, under review, accepted)	Open Access
Higher ocean wind speeds during marine cold air outbreaks	E. W. Kolstad	Q.J.R. Meteorol. Soc..	http://onlinelibrary.wiley.com/doi/10.1002/qj.3068/full	Published	Yes
End Users Needs Report: Weather and climate data for Northern Finnish winter tourism centers (D5.1)	Lesser, Pamela, Toivonen, Jusu, Coath, Martin, & Contreras, Roxana		DOI 10.5281/zenodo.887329. (2017)	Published	Yes in Zenodo
Lessons from the First Generation of Marine Ecological Forecast Products	Mark Payne et al.	Front. Mar. Sci., 12 September 2017	http://journal.frontiersin.org/article/10.3389/fmars.2017.00289/full	Published	Yes

Uptake by the targeted audiences
As indicated in the Description of the Action, the audience for this deliverable is the general public (PU) is and is made available to the world via CORDIS.

This is how we are going to ensure the uptake of the deliverables by the targeted audiences:

This deliverable will be listed in the Blue-Action website and point at a link in Zenodo.
We will pick up the news about the publicationof this deliverable with tweets, newsletter and Linkedin.

Intellectual property rights resulting from this deliverable
None.