MEDSCOPE

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MEDiterranean Services Chain based On climate PrEdictions

ERA4CS Joint Call on Researching and Advancing Climate Services Development – Topic B
(GRANT AGREEMENT 689029)

European Climate Observations, Monitoring and Services initiative (2)

Milestone M4.1

Definition of case studies for testing WP3 methodologies

JPI Climate

ERA4CS European Research Area for Climate Services

Table of contents

Introduction

Overall scope of work-package 4 - Sectoral Climate Services (from the proposal)
"*This WP aims at providing **specific sectoral predictions** for the Mediterranean region at **seasonal to decadal timescales**. Identification of specific sectoral variables which may have enhanced skill for the Mediterranean region will be the main focus of this WP. The goal is to demonstrate the feasibility of climate services and **generate prototypes** for three sectors: i) **renewable energy**, ii) **hydrology** (including water resources and flood risk assessment) and iii) **agriculture and forestry**. Climate services design will benefit from previous projects results such as EUPORIAS, MOSES, CLIMRUN, etc. This WP will be fed by WP2 on sources of predictability and by WP3 on correcting, combining and synthesizing different sources of climate information*."

The project partners have planned their research activities in view of the main objectives of the WP4, whose goal is to demonstrate the feasibility of climate services and generate prototypes for the strategic sectors of renewable energy, hydrology, agriculture and forestry. A detailed description of the case studies for each Task is provided in the following.

Task 4.1: Renewable Energy

(M13-36, Lead: BSC, Partners: MF, AEMET)

For the wind energy sector, two indicators will be employed by **BSC** in the case studies. The first one is wind power density (WPD), which accounts for the amount of kinetic energy that goes through a unit of swept area, and is a first attempt at quantifying the total energy that is available for extraction with wind turbines. Generally speaking, WPD depends on the cube of wind speed at turbine hub-heights. Wind speeds at hub-heights are not readily available from seasonal prediction systems, and therefore need to be extrapolated from surface wind. A second more accurate approach is the capacity factor (CF), which takes into account the efficiency of wind turbines at different wind speeds to extract this energy from the wind and convert it into electricity. The efficiency of wind turbines varies considerably with wind speed and is highly non-linear. Both indicators rely on wind speed information but are non linear. Therefore, in order to compute those indicators from seasonal predictions, bias adjustment techniques developed in WP3 will be necessary.
The case study regions will be selected based on skill evaluation of the predictions in the Mediterranean area. Although wind speed predictions from most systems have a limited predictability in the Mediterranean, some windows of opportunity exist that need to be explored.

From the hydrological chain developed in T4.2, **MF** will compute indicators based on snow water equivalent (SWE). Previous studies conducted in the framework of EUPORIAS have shown that SWE is an important source of predictability at seasonal scale for river flow, so for the amount of water available for refilling mountain dams. At this stage, a list of basins/dams still needs to be defined.

The prototype being developed by **AEMET** for task 4.2 will also be used for decision making in dams designed for hydropower production. In particular, the dam selected for evaluation of the prototype in NW Spain is mainly used for power generation.

Task 4.2: Hydrological Products

(M13-36, Lead: AEMET, Partners: MF, CNR, RMI)

The goal of **AEMET** activities for MEDSCOPE task 4.2 is to use data provided by WP 3, as input data to a climate service in support of decision making for dams management. The starting point are two tools developed within the EUPORIAS FP7 European Project and the S-ClimWaRe national Project. An empirical seasonal forecasting system for winter water reservoir inflow and precipitation that has been tested and assessed over different basins selected by dams managers and then extended to all water reservoirs in Spain. A GIS based viewer (S-ClimWare) designed according to the final users requirements, to visualize either some indicators of the hydrological risk linked to the NAO climate driver, or the empirical seasonal forecasts (and their skill) for winter reservoir inflow and precipitation. In MEDSCOPE task 4.2, AEMET will use seasonal forecasts from ECMWF System-5 post-processed using the achievements of WP3, to improve and enhance the climate service S-ClimWaRe. In particular downscaled (using an analog method) temperatures and precipitation will be used to drive two different hydrological models: the SIMPA model, developed by Centro de Estudios Hidrográficos (CEDEX), and the SURFEX Land Surface model, which is part of the NWP model Harmonie. The rest of atmospheric forcings needed to drive SURFEX in offline mode will be provided by ECMWF System-5 fields. SIMPA is the reference model used by the Spanish DG Water to evaluate the available water resources in the Spanish River Basins. The evaluation of the prototype, using both options for hydrology, will be conducted in a hindcast period over a non-regulated basin located in Northwestern Spain that was selected by stakeholders.

MF aims to use data provided by WP3 to develop a new hydrological seasonal forecast system based on SURFEX-TRIP, forced by MF-S6 seasonal forecast model. The reanalysis chain, necessary to initiate simulations, will use the UERRA reanalysis. A similar chain had been developed and assessed over France in the framework of the EUPORIAS project (see http://riff.euporias.eu/) . The new chain would cover different regions over the Mediterranean basins. Its outputs (soil wetness, river flows, snow water equivalent over mountainous areas) would allow to compute sectorial indicators: for example for helping dam management or estimating irrigation needs. Out of France, experimental regions/basins are not totally defined yet, some discussions within the project are still necessary in the next months. Ideally some areas would be chosen to allow a comparison between SURFEX-TRIP and other models. Over France, with **INRA**, MF plans to focus on the South-East regions. The downscaled input data (and some outputs from SURFEX-TRIP) would be delivered to INRA, to be used as forcings for their impact models. MF is supporting INRA in the appropriation of SF concepts and methods, and will share its experience in EUPORIAS in the assessment of the actual value in terms of usefulness. A first workshop took place in Toulouse in March 2018. Since then, MF has provided some datasets over France (based on its French operational hydrological system) for INRA to initiate the building of its workflow.

For its contribution to task 4.2, **RMI** has selected the case study of the Aliakmon river basin in Northern Greece. Meteorological and hydrological observed time series have been gathered as well as geographical information for implementing the SCHEME water balance model to this basin. The skill of seasonal prediction over Greece has been investigated using the hindcasts of the EUROSIP multi-model seasonal prediction system. EUROSIP includes ECMWF SEAS5 and the systems of UKMO, Meteo-France, NCEP and JMA. The skill has been also estimated over Belgium and selected area in Western Europe and the Mediterranean Region for comparison. RMI is going to make the SCHEME model ready for simulating the hydrological cycle in the Aliakmon basin and set up the hydrological seasonal prediction system in order to test the output of WP3.

CNR will use the seasonal-to-decadal climate forecasts, and the related downscaled products, provided by the project to anticipate the evolution of cryosphere resources (snow and glaciers) in the Alps. Three glaciated basins have been selected for this purpose in the Italian Alps:

1. Upper reach of the Stura di Ala Valley, Balme (TO), 59 km^2 (Domain 1: top-left corner 45°20'23"N-07°05'44"E; bottom-right corner 45°16'40"N-07°12'19"E);
2. The Ciardoney Glacier Basin, Ronco Canavese (TO), 5.9 km^2 (Domain 2: top-left corner 45°31'49"N-07°22'35"E; bottom-right corner 45°30'44"N-07°24'52"E);
3. Upper reach of the Sesia Valley, Alagna (VC), 69 km^2 (Domain 3: top-left corner 45°56'02"N-07°51'12"E; bottom-right corner 45°52'08"N-07°58'40"E).

It was decided to work on a basin scale, rather than on individual glaciers because: i) the basin scale is the most relevant for application purposes (e.g. water resource forecast); ii) the basin scale allows to mediate the specificities of the single glacial bodies, considering also the grid with which the climatic simulations will be provided and the modest extent of most alpine glaciers; iii) the analysis at the basin scale allows to better evaluate the specific dynamics of glaciers and snow cover.
The case studies have been selected according to the availability of reliable and long-lasting series of glaciological data, and of high-altitude AWS (Table 1). The availability of this data is essential for the calibration of the models of glaciers and snowpack evolution, to be fed with the seasonal-to-decadal climate forecasts provided by the project.

Table 1: Case studies for estimating the evolution of snow cover and glaciers.

Study area	Upper Stura di Ala Valley	Upper Sesia Valley	Ciardoney Glacier basin
Main glaciers	Bessanese, Ciamarella	Piode, Bors, Parrot	Ciardoney
Municipality	Balme (TO)	AlagnaValsesia (VC)	Ronco Canavese (TO)
AWS	Rifugio Gastaldi (ARPA Piemonte)	Bocchetta delle Pisse (ARPA Piemonte)	Ciardoney Glacier (SMI)
AWS Elevation (m a.s.l.)	2659	2410	2850
Distance between AWS and glaciers (km)	2.9	3.5	0.5

Task 4.3: Agriculture and Forestry

(M13-36, Lead: INRA, Partners: CMCC, AEMET, MF)

From the hydrological chain developed in T4.2, **MF** will make available to INRA seasonal forecasts of soil wetness index (SWI), as well as all the downscaled variables used as input to the chain (such as temperature, snow and rainfall, wind speed, solar radiation etc., at daily and sub-daily frequency, at 5.5 km resolution). The study domain covers the South-East part of France. These datasets will be used by INRA as input data for their models (see INRA contribution).

INRA aims to evaluate performances of the use of the seasonal forecast (SF) comparing with the standard climatology on various indicators at two scales:
At the scale of the Mediterranean regions (25 km square grid) a dozen indicators will be computed using climatic variables from SF (some of those can provide information on heat and drought waves).
At the scale of the southeastern of France (5 km square grid), other indicators will be computed from deterministic models using SF as inputs: the main outputs focus on:

- Fire risk and forest hydric status of Mediterranean forest on the Promethee (www.promethee.fr),
- Assessment of water needs for agriculture on the Durance basin. Meteo-France is associated to this work and provides the hydrological information requested for the modeling (outputs from SURFEX-TRIP model) of Task 4.2.

CMCC will use the seasonal-to-decadal climate forecasts provided by the project as input to supply indices focusing on few selected pilot areas at high-resolution (~5 km or less) in Italy:
Fire risk - The study domains cover North-West Sardinia and the province of Lecce (Apulia Region). These case studies have been selected according to the availability of reliable and long-lasting series of fire activity data, provided by the Sardinia Forest Agency and the Apulia Civil Protection.
Agriculture - The pilot areas are located in Sardinia Region (Italy). The areas have been selected according to the availability of climate, soil and crop information required to initialize/parameterize indicators and/or models.
Forests - The study areas are those considered into the ISIMIP (Inter Sectoral Impact Model Intercomparison Project, Forest Sector, https://www.isimip.org/) because of the availability of stand, soil and climate (present day and scenarios) and initialization and validation data.

AEMET will evaluate some of the indicators at seasonal time scale developed by INRA over demonstration areas in Southern Spain, jointly with stakeholders from the agricultural sector.