Assessing Climate impacts on the Quantity and quality of WAter

Deliverable Data.2 : RCM data online - month 12

Dissemination level: Public

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MPI

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This deliverable is prepared from task 2.1 Model simulated climate baselines.

1. Introduction

1.1 Presentation of the ACQWA project

As the evidence for human induced climate change becomes clearer, so too does the realization that its effects will have impacts on socio-economic systems and terrestrial ecosystems. Some regions are more vulnerable than others, both to expected physical changes and to the consequences they will have for ways of life. Mountains are recognized as particularly sensitive physical environments with populations whose histories and current social positions often strain their capacity to accommodate intense and rapid changes to their resource base. This proposal aims to assess the impacts of a changing climate, focusing on the quantity and quality of water originating in mountain regions, particularly where snow- and ice melt represent a large, sometimes the largest, streamflow component. There, they represent a local resource (freshwater supply, hydropower generation, irrigation), but in most cases also considerably influence the runoff regime of the downstream rivers and the related water availability. Such an influence is reflected mainly in the amount of surface water available for supplying irrigated agriculture and water supply systems, but also in the amount of groundwater recharge that can take place in river–fed aquifers. An increasing number of evidences of glacier retreats, permafrost reduction and snowfall decrease have been observed in many mountainous regions, thus suggesting that climate modifications may seriously affect streamflow regimes, in turn threatening the availability of water resources, increasing the downstream landslide and flood risk, impacting hydropower generation, agriculture, forestry, tourism and, last but not least the water dependent ecosystems. As a consequence, socio-economic structures of downstream living population will be also impacted, calling for better preparedness in developed countries and strategies to avoid the exacerbation of the already conflictual situation in many developing countries, like those in Central Asia and South America.

The goal of the project is to use advanced modelling techniques to quantify the influence of climatic change on the major determinants of river discharge at various time and space scales, and analyse their impact on society and economy, also accounting for feedback mechanisms (Figure 1). The focus will be on continuous transient scenarios from the 1960s up to 2050. In comparison to many existing studies, the limitation of the modelling horizon to mid of the 21st century allows to develop more realistic assessment of the progressive impact on the social, economical and political systems, which we expect to evolve typically in an adaptive mode on shorter time scales than the centennial ones, eventually shifting to new equilibria when forced abruptly.

The data required for the multiple model applications will be managed in the form of a "data warehouse" that will begin collecting and centralizing the data for the entire ACQWA community from the start of the project. The specification of data and the data formats will be defined in collaboration with the partners within the first 2-5 months of the project, and by the end of the first year, data will be available through the Internet for use in the different Work Packages. Additional data, such as remote sensing information, will be ready by the end of the second year, while the socioeconomic data required for many of the non-physical impacts studies will be brought online from the inception of ACQWA through to the end of the project. The data warehouse will be continuously updated and maintained for the entire duration of the project.

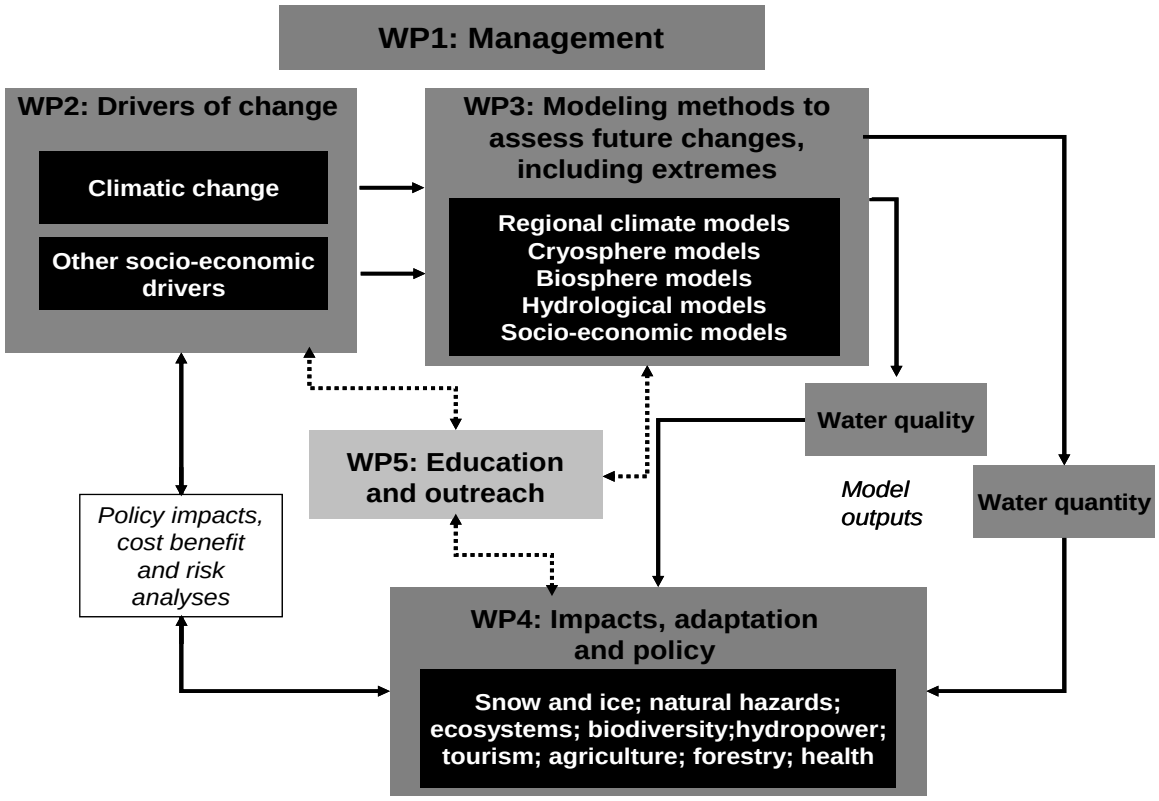

Figure 1: Flowchart illustrating the various work packages of the project.

See also Figure 2.2 in Section 2.3 of this proposal for more detailed information on interactions between the work-packages and the team members.

1.2 Presentation of Workpackage 2: Climate and Socio-Economic Drivers of Change

WP 2 will provide a quantitative description of the primary (or direct) driver, climate change (CC), and of the indirect (or secondary) driver, the socio-economic factors. Specifically:

1) the CC driver will be described by means of recent climatic scenarios for validation of models and large and regional scale scenarios respectively from GCMs and RCMs simulations according to selected IPCC emission scenarios;
2) validation of spatial and temporal extent of snow cover at global to local scale computed by spatially explicit models under different climate scenarios;
3) validation of timing and amount of runoff generated from snow pack at a fine temporal scale estimated under different climate scenarios;
4) the socio-economic factors will be quantified by means of scenarios of socio-economic developments, such as drivers of land use changes, drivers of energy demand, changes in agricultural policies, etc.

1.3 Scope and Purpose of the Task 2.1: Model simulated climate baseline

This task of WP2 will aim at setting up and managing a project data base containing climate model results carried out within the ACQWA project. Use will be made of the existing infrastructure at the World Data Center for Climate (WDCC). There is a wealth of model-generated climate data that is available at horizontal scales ranging from 25-50 km. For example, the data from the EU-FP6 "ENSEMBLES" project is regularly updating its climate data base with results from the ensembles GCM and RCM simulations. The ACQWA data base will provide links to these already existing data sources. Specific climate scenarios focusing on the near and mid-term future (in practice until 2050) carried out within the present study will be stored in the data base and shared within the consortium for the project time and to the broad scientific community at the end of it. The data will be available in a user-friendly manner, accessible through the Internet.

1.4 Scope and purpose of Deliverable Data.2

This document aims to provide an overview on how to access the database storing climate model results from the ENSEMBLES project.

This report is part of a set of guidelines and are linked with:

- D.Data.1: ACQWA Database ready for uploads
- D.Data.3: ACQWA Remote-sensing data online
- D.Data.4: ACQWA Socio-economic data online
- D.Data.5: ACQWA Data warehouse

1.5 Contributors to the deliverable

Lorenzo Tomassini:

Lorenzo Tomassini is working at the Max Planck Institute for Meteorlogy in Hamburg. Its research interests are:

- Interplay of large-scale atmospheric dynamics and regional climate
- Statistical and physical characteristics of extreme events
- Uncertainty in climate system properties and seasonal-to-decadal predictions

2. ACQWA and the EU FP6 project ENSEMBLES

In the first part of the ACQWA project, climate model simulations from the EU FP6 integrated project ENSEMBLES are used to drive hydrological discharge models. The ENSEMBLES project aimed at developing ensemble prediction systems for climate change, quantifying and reducing the uncertainty in the representation feedbacks in the Earth System, and maximising the exploitation of the results by linking the outputs of the ensemble prediction system to a range of applications.

For the ENSEMBLES project the participating climate modeling institutes performed simulations with different regional climate models at a spatial resolution of 25km for the European domain. The regional climate models were driven at the lateral boundaries by ERA40 reanalysis for the period 1951 to 2000 for the purpose of validation. Moreover, A1B scenario simulations have been performed using different global climate models to force the regional climate models. These simulations span the time period 1950 to 2050, and some of these runs have been extended to

the year 2100. The regional climate model ensemble simulations allow for quantifying various sources of model uncertainties and assessing the robustness of results.

In the ACQWA project two of those regional climate models, RegCM (Pal et al. 2007) and REMO (Jacob 2001, Jacob et al. 2007), will be used to perform the dedicated high-resolution simulations. These high-resolution simulations will use the respective ENSEMBLES 25km runs as lateral boundary conditions.

2.1 The ENSEMBLES regional climate model database

The climate model simulations are stored in a database maintained by the Danish Meteorological Institute. The climate model data are now publicly available through the Internet by accessing the page http://ensemblesrt3.dmi.dk/. The conditions of use have to be accepted and an email address provided in order to download the data. A list of all participating regional climate models and the corresponding driving global climate models is provided on the same homepage.

The regional climate model data are in NetCDF format. This is a binary format that has become a standard as an interface between climate modelers and data users. All the variables coming from the climate model simulations are stored as monthly mean and daily mean values. There are also 6-hourly values available, but these are instantaneous values that are not recommended to be used for driving hydrological models.

An example of the results of the ENSEMBLES simulations is shown in Figure 1.

The temperature change signal (difference between the means over the period 1961 to 2000 and the mean over the period 2030 to 2050) is depicted for mean winter temperature and all the regional climate models participating in ENSEMBLES.

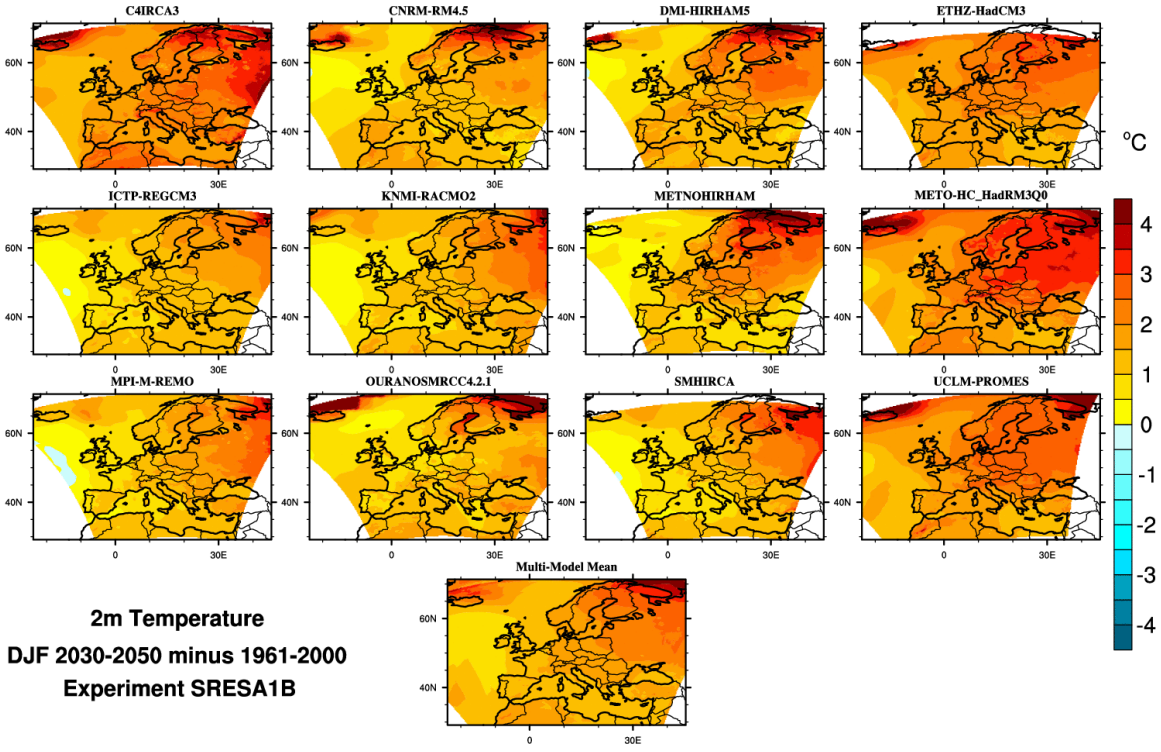

Figure 1: Winter temperature (°C) change signal of the period 1961- 2000 compared to the period 2030- 2050 for all of the ENSEMBLES models.

Since all the climate model data that have been produced in ENSEMBLES are publicly available through the ENSEMBLES data portal, there will be no separate database for these simulations in ACQWA. Researches in ACQWA who want to use these data can access them directly through the ENSEMBLES database.

In case of the two regional climate models RegCM and REMO, that are also participating in the ACQWA project, the ENSEMBLES 25km simulations can be provided in higher temporal resolution: 3-hourly in the case of RegCM, and hourly in the case of REMO. The distribution of these climate model data will organized through the ftp-servers of the corresponding institutes ICTP and MPI-M, respectively. The ACQWA partner Wegener Center of the University of Graz will apply a bias correction scheme to these data. The corrected data will be stored in the ACQWA data warehouse.

2.2 The climate model simulations performed in ACQWA

Both climate modeling institutes participating in ACQWA, ICTP and MPI-M, will provide dedicated additional high-resolution regional climate model simulations nested in the 25 km ENSEMBLES runs for the ACQWA project.

The RegCM3 high-resolution simulation will be at 15 km resolution with a sub-grid of 3 km on a domain encompassing the region in Figure 2.

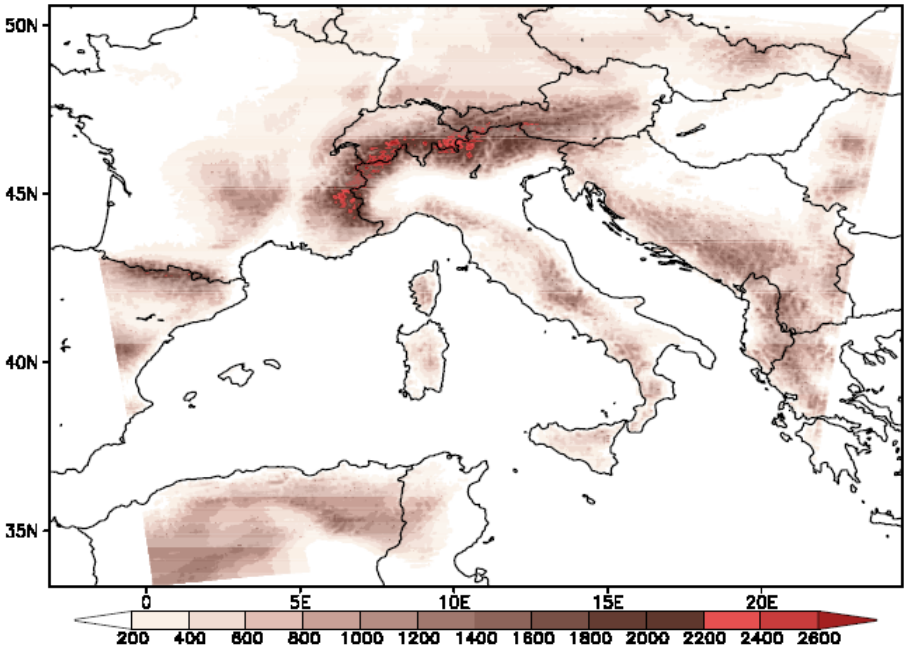

Figure2: RegCM domain for the ACQWA simulation at 3km.

MPI-M will perform regional climate model simulations using REMO at a resolution of 10km. The model domain is depicted in Figure 3.

Here as well the data will be provided through the ftp-server of the institute that performs the climate model simulations. Simulations that are post-processed by the ACQWA partner of the Wegener Center Graz will again be stored in the ACQWA data warehouse.

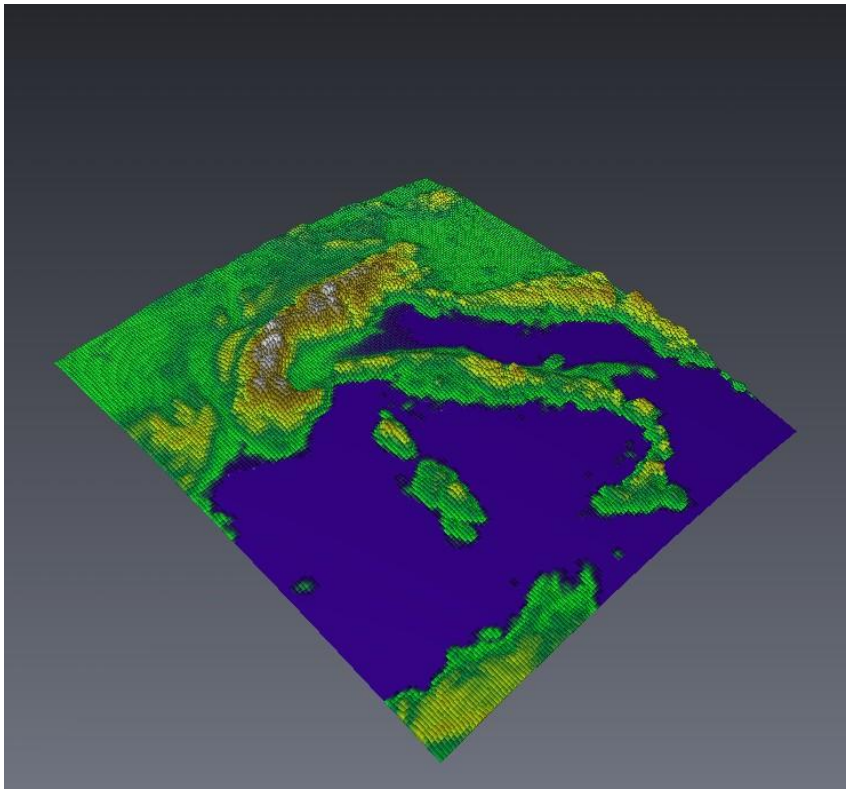

Figure 3: REMO domain for the ACQWA simulations at 10km resolution.

3. References

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