Project: 443
Project Title: Climate Change and Impact Research: the Mediterranean Environment
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Project summary

CIRCE aims at developing for the first time an assessment of the climate change impacts in the Mediterranean area. The objectives of the project are:

- To predict and to quantify physical impacts of climate change in the Mediterranean area
- To evaluate the consequences of climate change for the society and the economy of the populations located in the Mediterranean area
- To develop an integrated approach to understand combined effects of climate change
- To identify adaptation and mitigation strategies in collaboration with regional stakeholders

CIRCE wants to understand and to explain how climate will change in the Mediterranean area. The project will investigate how global and Mediterranean climates interact, how the radiative properties of the atmosphere and the radiative fluxes vary, the interaction between cloudiness and aerosol, the modifications in the water cycle. Recent observed modifications in the climate variables and detected trends will be compared.

Project objectives

The main objectives of CIRCE are to predict and to quantify the physical impacts of climate change in the Mediterranean, and to assess the most influential consequences for the population of the region. The knowledge yielded by the different specialised investigations will then be linked in an integrated inter-disciplinary approach designed to study the total effect of climate change. CIRCE will integrate cutting-edge scientific research with the needs of end-users and communities. Thus, CIRCE will be able to quantify the impact of global warming on Mediterranean climate variables, whilst also taking into account the regional social, economic and policy aspects of the process. In this way, CIRCE will make a powerful contribution to the definition and evaluation of adaptation and mitigation strategies.

CIRCE will develop an understanding of the different needs of the European Region, and enhance and develop analysis methods, models and indicators. Under the project, the interactive effects of climate change will become better understood, and predictions of risk and the prior assessment of policy effects will be improved.

To this end, CIRCE will invite continued contributions from Mediterranean stakeholders from the outset (Researching Line 0 - RL0), whilst providing clear scientific evidence on the observed climatic trends (RL1), climate evolution scenarios for the 21st century (RL2) and radiation changes (RL3), and evaluating local processes of the Mediterranean (RL4). The potential for changes in the frequency, intensity, and duration of extreme events is of immediate importance to policy makers and will be a central question to the project (RL6). Future changes in the water cycle (RL5),

agriculture and ecosystems (RL7), air quality (RL8) and the economy (RL10) will be evaluated. Impacts on health (RL9) will also be assessed. The integration of results in a series of case studies (RL11) will be driven by stakeholder questions, geography, and temporal scale. The relevant societal strategies interacting with the climate drivers to determine impacts will be examined (RL12) and the derived induced policies will be also addressed (RL13). The project will thus provide cutting-edge scientific results that will help establish:

- The methodology for including stakeholders needs and questions in the scientific discourse,
- The information on possible climate changes for the 21st century in the Mediterranean Area
- A framework for the preparation, reviewing and dissemination of the Regional Assessment Report.
- A set of policy-specific indicators and assessments that can be used to:
- Inform environmental reporting;
- Enable international comparisons in terms of quality of life, environment, economy and health
- Define a set of objectives and targets, and to monitor trends and progress towards these targets

Our contribution to this project

The Max Planck Institute for Meteorology (MPI-M) will contribute to CIRCE project in relation of RL2 - The Mediterranean Region and the Global Climate System. The task of the MPI-M is to **perform a limited set of scenarios with regional coupled models (Mediterranean simulators), using boundary conditions from existing and new global scenarios.**

Description task: Three models of the Mediterranean region comprehensive of the atmospheric, oceanic and land-surface components will be assembled in order to make the linkage between the global climate change and impact studies. The dynamical downscaling will allow us to have a spatial resolution around 20 km. This WP will take place during the first 24 months, with model assembling and validation during the first 18 months. The next 6 months will be assigned for scenario simulations and production of statistic downscaled datasets.

For this end, Mediterranean Simulators (MS) will be composed by an atmospheric regional climate model an ocean model for the Mediterranean Basin and a land vegetation model interactively coupled by means of dedicated software. The oceanic and atmospheric models will have horizontal resolutions of about 20km. Three Mediterranean Simulators will be constructed by using three regional atmospheric models (RegCM, LMDZ-Med and REMO) and three ocean models (MITgcm, MED8 and MPIOM). The different components of each MS will interact by exchanging dynamical an thermo-dynamical fields at the ocean-atmosphere and land-atmosphere interfaces. This work will last from seventh to twelfth month.

Validation of the newly developed coupled regional MS against observations for present day climate conditions will be performed in order to asses the performance of the models and their applicability to the construction of fine scale climate change scenarios. To this purpose the models will be run with boundary conditions from ERA40 reanalysis fields and compared to actual observations for the simulated period. This

work will last from thirteenth to eighteenth month.

After their validation, the three MS will be used to perform time-slice runs for the climate evolution scenarios. The boundary forcing comes from the global coupled models (GCM). The results will be compared with those obtained with uncoupled atmospheric RCMs to assess the added value and information from the coupled Mediterranean Simulators. Data from these simulations will be provided for application to impact models. Furthermore, the effects of the dynamical downscaling will be assessed be an extensive comparison of the results obtained from the regional coupled models with those obtained with the global models.

MPI-M will perform dynamicall downscaling with the MS which consists on the coupling of the atmospheric model REMO and ocean model MPI-OM.

The planed simulations with the MS:

- **Hindcast simulation: from 1960 to 2000 driven by ERA40.**
- **Scenario simulation: from 1950 to 2050 driven by a GCM.**