HyMeX
HYdrological cycle in Mediterranean EXperiment

ICTP distributed computing experiment: building a grand ensemble of simulations of present day and projected Mediterranean and North African climate.

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Introduction.

Extreme events are intrinsically local and intermittent in nature making long simulations and large ensembles necessary to produce meaningful statistics. Even so climate models have difficulty in reproducing the statistics of extreme events correctly, let alone extreme events themselves. Moreover the discrepancy between model simulations and observations is highly dependent on parameter settings, while the spread in simulated projections of climate are highly dependent on both parameter settings and forcing uncertainty. Existing distributed computing experiments have conclusively shown that members of the public can be engaged to donate the dormant resources in their idle home computers to carry out vast numbers of climate simulations with state-of-the art models overshadowing the most powerful conventional supercomputers available to the climate community. Distributed computing resources would allow us to construct a large ensemble of simulations where not only parameter values are perturbed, but uncertainties are explored as related to varying forcings and driving global models. We refer to this as a grand ensemble.

Research outline.

We plan to build an experiment framework in which the RegCM would be driven by boundary conditions from the next generation of IPCC GCM simulations for all greenhouse gas reference concentration pathways (RCP). Individual simulations, i.e. the unit computational effort requested of each participant, will consist of a 20 year time slice, with choice of different domains and resolutions. At present we envision 4 domains, covering the Eastern, Central, Western and Whole Mediterranean Basin (fig. 1) and three resolutions, approximately 50 km, 25 km > and 10-15 km. The selected time intervals will investigate both near climate change (1980 to 2000, 2000 to 2020 and 2020 to 2040) and century scale climate change (2080 to 2100, 2100 to 2120, 2180 to 2200, 2200 to 2220, 2280 to 2300). Results from the grand ensemble of regional Mediterranean and North African climate simulations would build on the experience from established distributed computing experiments and would be used to investigate the dependence of the statistics of extreme events on model structural properties, GCM-derived boundary conditions and radiative forcing projections. Focus will be not only on constraining the changes in the statistics of extreme events but also on quantifying the uncertainties associated with statistical values, and the transfer of uncertainty from model parameters, boundary conditions and forcing scenarios.

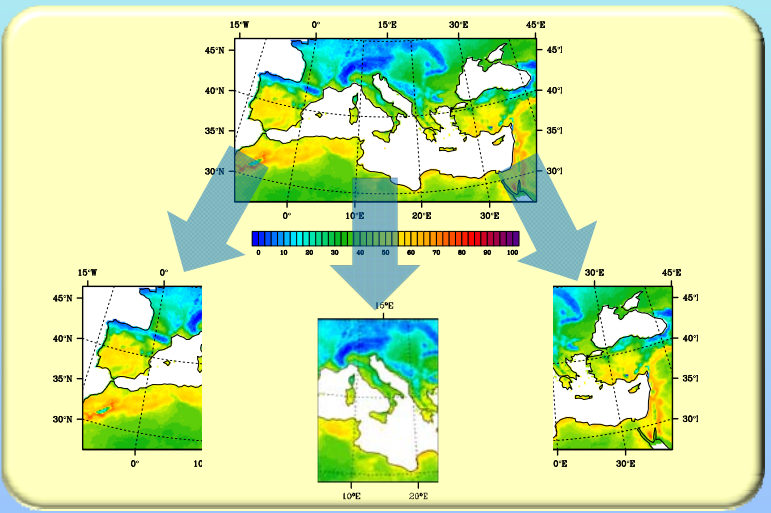

Figure.1
Suggested regional domains for single distributed computing experiments.

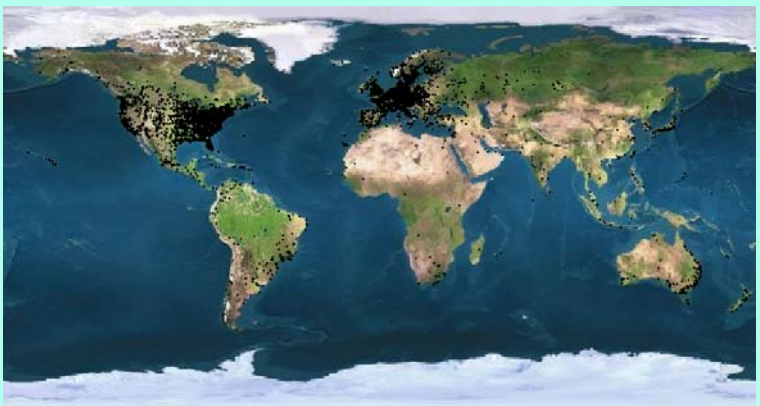

Figure.2
Location of participants in the distributed computing climate project climateprediction.net.

RegCM and distributed computing.

The RegCM, based at the ICTP, is ideally suited for a distributed computing project. The Earth System Physics section at the ICTP has established a wide regional modeling network, centered on the use of the RegCM, with a long list of countries and institutions worldwide. Hence the RegCM is already in use in many national climate research and higher education institutes worldwide while courses on the implementation and use of the RegCM are given periodically at both the ICTP and on site. This would prove a priceless resource in gaining public participation, the lifeline of a distributed computing project, in those countries. To accomplish all this the RegCM is structured with portability and userfriendliness in mind, no licensing issues exist and the system requirements are intentionally flexible.

Expected outcome.

As in previous distributed computing projects, the system would be such that participant would download from a central server located at ICTP model version and boundary conditions to carry out a climate time slice simulation with minimum technical requirements. Results would then be shipped back to ICTP, which would set up a data bank for public use. The expected outcome is a large grand ensemble of simulations of 20th and 21st century time slices over different Mediterranean regions, at different resolutions, to assess uncertainties in projected changes of extreme events and other key climatic variables, in particular as they relate to water resources, food productivity, and human health. Active participation by a broad community is envisioned, which will constitute an invaluable intellectual and capacity building product of the project.