S3-1 Climate Research Directions

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Experiments in the climate system are possible via a set of mathematical relations that we call "the equations of climate". The equations of climate are very difficult mathematical problems, but they can be solved approximately by numerical methods. We can then treat very complex mathematical equations, paying the price of an enormous number of elementary operations. Each successive generation of numerical models is like new, more powerful, telescopes or particle accelerators and they allow us to look further into the working of the Earth climate more accurately, extensively and reliably.

The evolution and extension of the climate numerical models will make necessary to introduce a new paradigm for numerical simulations as numerical experiments become complex multi-institutional, transnational enterprises. A detailed process of design, planning and implementation is probably going to be used (Navarra, Tribbia and Kinter, 2010). Different phases can be identified : 1) Concept Stage (definition of idea and objective, analysis of existing skills and resources), 2) Scientific Case (definition of scientific objectives and goals, arguments for priority in terms of scientific values, relevance and impact), 3) Technical Case (definition of methods and experimental planning, organization and governance of the consortium, exploitation strategy) and 4) Detailed Multiyear Planning (detailed definition of targets and responsibilities in the consortium, phasing of experimental and analysis systems and archiving, decommissioning strategy).

The Euro Mediterranean Center for Climate Change (CMCC) will participate in this ongoing international discourse, fulfilling its mission of 1) Improve our understanding of the nature and mechanisms of climate variability, its causes and its impacts, with a special emphasis on the Mediterranean Area and its interactions with the global climate, 2) Develop high quality products that will be made available to the scientific community, with an adequate user support, documentation and training, 3) Establish a significant computational facility and 4) Produce numerical models, simulations, applications and assessments.

CMCC is already performing scenario simulations with high-resolution, short-term (decadal) prediction experiments and long scenario simulations with the Carbon Cycle.

The overall situation for the funding for the international research system is raising some concerns and there are four points that need to be considered. 1) Funding for Earth Systems research is stationary or decreasing, 2) Single investigator programs (NSF or ERC) are too small to engage global issues, 3) Research spending from defence budgets and private sector entities – is still not keyed to climate and low carbon research and 4) Investments in climate research and low carbon technologies are not growing.

Conclusion:
A new international research paradigm is required;

We need to identify new questions. What are the big scientific and technological questions that will make a real difference to policy and investment decisions in the coming decade, and that can drive the research agenda of the next generation of researchers and scientists?

We need to mobilize new sources of funding. We need to be able to articulate the scale of funding needed. What is the scale of that funding? How does it compare to other efforts to accomplish other advancements in knowledge and technology?

We need new global institutional solutions to deliver the support this research deserves. What forms of global public-private partnerships do we need to ensure the private sector invests for the long term? What institutional arrangement should we set in place?

References:
Navarra, A, J. Tribbia and J. Kinter, "Crucial Experiments in Climate Science", Bullettin of the American Meteorological Society, in press, 2010.