Submission to the House of Representatives Industry, Science and Innovation Committee *Inquiry into Long-term Meteorological Forecasting in Australia*

from
Prof. Christian Jakob[*]
Chair of Climate Modelling
School of Mathematical Sciences
Monash University

Background to this submission

In this section I summarize my experience as it pertains to commenting on this submission. The main purpose of the section is therefore to put the comments that follow below into the appropriate context. I have been a researcher in the development of weather and climate prediction models for more than 15 years. I am currently holding the Chair of Climate Modelling at Monash University. I am a co-chair of the World Climate Research Program's and the World Meteorological Organization's Commission of Atmospheric Science Working Group on Numerical Experimentation, WMO's prime body for modeling of the atmosphere and Numerical Weather Prediction. In this role I frequently interact with the international research and prediction community. It is this interaction as well as my own research that provide the main background to the views expressed in this submission.

Scope of this submission

This submission focuses on a small selection of the Terms of Inquiry.

Responses to the Terms of Inquiry

The efficacy of current climate modelling methods and techniques and long-term meteorological prediction systems

Computer models of the atmosphere, ocean, land, cryosphere and increasingly the biosphere are the prime tools for making predictions of weather and climate. Modern weather prediction relies on computer models like never before and the skill in predicting the weather using such models has increased tremendously over the past two decades. Forecasts five days ahead are now as good as those two days ahead twenty years ago. In that time it has also been realized, that the prediction of longer time-scales can be achieved with such models, provided that the parts of the Earth system in which the long-term memory resides, most prominently the oceans, ice and the land surface, are properly included in the models. Such so-called coupled Models (as they couple different components of the Earth system) have been successfully applied to the projection of

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[*] This submission is expressing my personal views and does not necessarily reflect the views of Monash University.

future global climates, as evinced by the series of reports by the Intergovernmental Panel of Climate Change (IPCC), as well as more recently to the prediction of the "weather" several months ahead. It is important to note that while these seasonal and climate predictions differ significantly in their character from weather prediction, as they do not attempt to predict the weather of a particular day but rather the statistical distribution of future weather, they are based on the same fundamental physical principles and the representation of such principles in computer models.

Given the link between weather, seasonal and climate prediction there is now a strong trend in the international community to design so-called seamless prediction systems, i.e., use the same computer models applied with varying degree of complexity to make predictions on all time-scales. There are a significant number of scientific and technical challenges that need to be overcome before seamless prediction can be achieved, but it is evident that both scientifically and technically the approach is both viable and desirable. One advantage of the seamless prediction approach is that only one model infrastructure, a significant expense in any modeling enterprise, needs to be maintained. Another advantage is that products produced by the prediction system can be designed to be seamless so that the users of the predictions are provided with a more coherent set of products across the various time-scales of prediction. It is evident from the above discussion that to make progress in long-range forecasting requires to stay abreast of these international developments and to design a seamless prediction system for Australia. Such a system must naturally reside in our nation's weather and climate service, i.e., the Bureau of Meteorology, but requires the research support of the entire scientific community.

The international community recently held a World Modeling Summit for Climate Prediction to discuss the future of modeling for climate (and long-range) prediction. The Summit united the world's leading modelers and its conclusions are summarized in a report, which is available from:

http://wcrp.ipsl.jussieu.fr/Workshops/ModellingSummit/index.html.

The main conclusion of the report is that the key to improved climate predictions lies in improved computer models achieved in three ways:

i) Through improved understanding of the underlying science,
ii) Through increased investment in human resources for model development and
iii) Through the exploitation of the most advanced supercomputing facilities.

The summit suggests that both national and international efforts be brought to bear on the problem. The main conclusions that can be drawn from the Summit pertaining to this inquiry are:

i) Only a national effort that unites the key government organizations, i.e., the Bureau of Meteorology and the CSIRO, and the Academic sector under a national strategy will have the necessary critical mass to successfully build a unified and seamless prediction system for the nation.

ii) This effort requires significant human and computational resources for it to be successful.

iii) The national effort needs to be well integrated with and needs to contribute to international activities as envisaged by the Modeling Summit.

Through the Australian Community Climate and Earth System Simulator (ACCESS) project the Australian community has recently laid the foundations for such a national effort. However, current support of this effort in both human and computational resources falls well behind that in other nations and in its current form may well fall short of what is required to be successful. It is evident from the discussion above that achieving high-quality long-term predictions for Australia is intimately intertwined with achieving success in the ACCESS project. The latter is dependent on a significant increase of both the human and computational resources available to this all-important national project.

Potential benefits and applications for emergency response to natural disasters, such as bushfire, flood, cyclone, hail, and tsunami, in Australia and in neighbouring countries

The societal benefits of successful weather predictions for days ahead are under no doubt and are estimated to be billions if not trillions of dollars per annum worldwide. There is little doubt that skilful predictions of the "weather" for seasons, decades and centuries ahead will have similar if not greater societal benefits. A relatively small investment today is therefore likely to reap tremendous rewards in the future. It is likely that the role of predictions for Australia of seasons or decades ahead will increase under climate change. This is so, since conditions on our continent are likely to become more difficult to sustain our activities, in particular in the agricultural and water resources sectors. If under current climate a farmer or water manger experiences eight "good seasons/years" out of ten, but this number reduces to five out of ten in a future climate, the prediction of which of the future seasons/years is going to be a "good one" is naturally going to increase in importance and hence, if successful, in effect. There is little doubt in my mind that making progress in long-range prediction, and hence making progress in developing computer models as the main tools for such predictions, will have a profound impacts on our nation.

Conclusions

Predictions of the weather for days, seasons, decades and centuries ahead are based on computer models of the physical and biogeochemical systems that are relevant to the time-scales of interest. These models are applied with varying degrees of complexity adequate to each of the time-scales of prediction. As a consequence, carrying out long-term predictions and improving their quality is intricately linked to establishing and continuously improving a prediction system based on such computer models. Because of the similarity in design of the prediction systems for the various time-scales of interest (days, seasons, decades, millennia) a seamless approach to prediction at various time-scales is the most promising approach. The complexity of a seamless prediction requires it to be built through a well-organized strategic national effort that is well supported by the entire research community both in government-based laboratories as well as academia and is well connected to international efforts, such as the Climate Prediction Project envisaged by the recent World Modeling Summit. Through the ACCESS project Australia is well placed in principle to develop a prediction system for all time-scales that can serve the nation well. However, for this project to be successful requires a significant increase in both the human as well as computational resources devoted to it. Here, investments in an improved scientific basis for predictions for Australia as well as in the technologies to convert scientific best practice into usable systems and products for the end-user are of equal importance. These necessary investments are likely to provide a huge return through more reliable predictions at ranges from seasons to decades to millennia for all sectors of Australian society.

Digitally signed by Christian Jakob
DN: cn=Christian Jakob, o=Monash University, ou=School of Mathematical Sciences, email=christian.jakob@sci.monash.edu.au, c=AU
Date: 2009.04.24 16:29:24 +10'00'

Prof. Christian Jakob   Melbourne, 24 April 2009