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Towards Developing Weather and Climate Prediction for Sri Lanka

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Abstract - *Advances in satellite technology, computing technology and geophysical databases have led to the development of numerical weather and climate prediction. Officials of the Sri Lanka Department of Meteorology have identified the need for the development of such prediction tools. Here, it is argued that an indigenous capacity in numerical weather and climate prediction can be established in several years given modest investment, high-level coordination, sustained follow-up, support for research and the efforts of the scientists. The development of prediction capacity will be of little benefit unless the climate information is well communicated and used appropriately. Hence, early attention is needed to foster research and development that leads to applications of climate information and predictions. Developing such technology should be done in the context of a national level strategic plan for weather and climate research. The development of such a strategic plan needs the input of a professional society of meteorologists, oceanographers and users of climate information, which needs to be established in some form. Hence, a national effort is proposed to develop weather and climate prediction technology, which is supported by relevant Ministries and professional bodies, which involves the Department of Meteorology, research groups in Universities, Research Institutes and International Agencies that are willing to help.*

Key Words: Weather, Climate, Impacts, Applications, Technology Development

Running Title: Weather and Climate Prediction for Sri Lanka

1. The need for weather and climate prediction

Weather and climate services if appropriately provided could lead to improvements and savings across many sectors whether it be plantation or subsistence farming, hydro-electricity planning and production, cropping decisions, fisheries, infrastructure construction, disaster management and so on. From the national viewpoint, there is considerable importance of such services, given the severe impacts of weather and climate on energy (Ministry of Environment, 2001). Government officials and meteorologists see the need for better understanding of climate. For example, the then Secretary of the Ministry of Science & Technology wrote "Studies to understand climate change and climate variability and weather forecasting for longer periods are some of the challenges that the Department (of Meteorology) will have to face in the very near future" (Department of Meteorology, 1998). There have been 14 severe storms and 4 cyclones over the last 100 years that have left a trail of destruction. Predictive capacity related to cyclones is urgently needed (Zubair, 2002, unpublished). In addition, the research capacity will enable us to understand the precise local long-term implications of climate change. Indeed, research on climate conditions around Sri Lanka is of global and regional scientific importance given its equatorial location commanding the Indian Ocean.

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In early 2002, the Ministry of Science, Technology and Economic Reform invited me to visit the Department of Meteorology and University of Colombo for lectures, interaction and the development of research. During various discussions, officials of the Department of Meteorology identified the need for the development of numerical weather and climate prediction tools. Here, I sketch out conceptually ideas to develop such tools.

At present, weather forecasts are issued based on synoptic analyses a day in advance. Users of weather and climate information will benefit from predictions that have a high spatial resolution and extend from a few-days to possibly a year in advance. Indeed, such predictions are already available for Sri Lanka on the Internet. Examples for such predictions are the Indian National Centre for Medium Range Weather Forecasting (http://www.ncmrwf.gov.in/) British Broadcasting Corporation (http://www.bbc.co.uk/weather/) and the Weather Underground (http://www.wunderground.com/global/SB.html). All of these sites were visited on 14 August 2004.The reliability of these predictions is in question. Thus it is all the more urgent that an indigenous prediction capacity is developed. While, the potential benefits from having climate predictions are considerable, the resources needed for it – personnel, computing environment, technological transfer and development - is modest in comparison.

2. Planning for the use of weather and climate services

The development of prediction capacity is of little societal benefit if it cannot be communicated well and used appropriately. Indeed, communication is needed not only from the weather and climate service providers to users but also in the reverse direction as well, so that research and development can be appropriately tailored. Therefore, it is crucial to ensure early participation of agricultural scientists, water engineers, public health officials, disaster managers and fisheries experts. Indeed, several organizations that have developed a prediction capacity are devoting resources towards catering climate services for applications in water resources, agriculture, health, fisheries and disaster management.

3. The development of numerical weather and climate prediction

Computer models of Sri Lanka weather may be either statistical or dynamical. The statistical model uses the historical record to anticipate climate by analogy in relation to sea and land surface conditions. On the other hand, dynamical models calculate in advance the variations in atmospheric and land conditions based on the laws of physics. Both of these techniques should be developed.

At present, there are about a dozen computer programs for modelling weather and climate at the scale that is appropriate for Sri Lanka such as Mesoscale Model (MM5), the Eta Model, the Regional Spectral Model (RSM) and the Regional Climate Model (RegCM). However, the customisation of these programs for Sri Lanka needs considerable research. One may obtain high skill in weather predictions made a few days in advance, while such predictions at longer advance periods is more daunting.

4. The need for strategic planning for weather and climate services

The development of computational weather and climate prediction will be best done in the context of a national level plan for climate research and services. Such planning should involve the

Ministries concerned with Science, Technology, Environment, Fisheries, Ocean Resources, Agriculture, Education and Social Services, the Department of Meteorology, National Science and Technology Commission (NASTEC), Universities, Research Institutes and representatives of the user organizations and educators.

5. The need for a professional society for weather, climate and related areas

Such planning and other activities that set agenda and foster research could be aided by fostering the development of a professional society of meteorologists, climatologists, oceanographers and users of climate information. Note that the Ceylon (subsequently Sri Lanka) Meteorological Society functioned in the early 1970s' produced a valuable series of journals (Zubair, 2002). This effort could not be sustained due to lack of resources. For the last four years, the authour and other scientists have been instrumental in maintaining communications among scientists in the fields of meteorology, oceanography and hydrology related to Sri Lanka through a series of 11 newsletters. However, what is really required is a full professional society that can engage authoritatively in national development related to earth sciences.

In the absence of such a body, the role of many local scientists, particularly in the outstations, continues to be overlooked. For example, several conferences related to climate change have taken place in Sri Lanka without the participation of local climate scientists. In addition, the needs and problems of the researchers are inadequately articulated (National Science Foundation, Findings of Survey of Climate Researchers in Sri Lanka, 1999, unpublished). There is a clear but ill-articulated need for better support for researchers in terms of literature, software, information retrieval and data (Zubair, 1999). There is also really little professional contact between climate scientists, oceanographers, hydrologists, disaster managers and so on.

6. Requirements for establishing numerical modelling

The particular resources needed for research and development work in numerical weather and climate prediction are:

1. A few lead scientists with competence in Meteorology, Atmospheric Physics, numerical modelling, fluid mechanics, thermodynamics and ample work time to be substantially devoted to the purpose.
2. A suitable cadre of numerical and computationally competent research assistants.
3. Suitable working conditions for these scientists
4. Access to real-time global data products (available through Internet) and high-resolution regional climate information from satellite information
5. Robust computer environment (workstation computers and high-end personal computers)
6. International partnerships (to access software, training and consultation)

Even after the models are developed, continuous research and development will be needed to improve its performance.

The primary bottleneck for developing numerical prediction is the lack of senior level expertise. Thus it may be premature and cumbersome to initiate an institute devoted to this task. Given the need to harness all the available human resources and recognizing the need for authoritativeness in information, research should be developed based on a three-way partnership between the Department of Meteorology, several research groups in Universities or Research Institutes and International Agencies. The development of the prediction capacity and the application of these

predictions work should be overseen and coordinated by an umbrella organization or agency.

7. Developing numerical modelling in the Department of Meteorology

Developing computational tools for weather and climate prediction requires a dedicated research group in this topic. For example, an ongoing program to develop prediction capacity at the Brazilian Climate and Water Resources service, in collaboration with the International Research Institute for Climate Prediction, involved one lead scientist, 5 full time meteorologists, an applied mathematicians, and one computer scientist.

As senior officials of the Department have suggested, perhaps a separate Division of Numerical Weather and Climate Prediction should be established with a few lead scientists and a proportionate number of research assistants and support staff who are freed of operational duties.

Two recent positive developments are the establishment of the library in more spacious quarters and the initiation of links between the Department and various universities and research institutes through the new Centre for Climate Change Studies.

8. Developing Weather, Climate and Applications Research in Universities and Research Institutes

At present, there are a number of competent scientists in the Universities and Research Institutes who unfortunately have many other commitments. As a result, the actual research and development in weather and climate modelling has been limited. Hence, a concerted effort is needed to encourage research through the provision of funding for research. It is preferable that modest funding is made available initially to a dozen or so scientists. Thereafter the funding levels can be increased based on their output.

In the national Universities, a few individuals in departments such as Geography and Agricultural Engineering have carried the burden of climate applications research for many decades. Their services should be harnessed particularly in understanding the impacts of climate. Researchers in computer sciences, statistics, physics, public health, agricultural engineering, and engineering departments need to be induced towards climate related research. Indeed, there is a need for building networks on climate and water, within large universities such as Colombo and Peradeniya and even at a district level. Such institutes will be in a good position to develop multi-disciplinary and regional perspectives on weather and climate services.

An important development is the M.Sc. course in Atmospheric Physics and Dynamical Meteorology that was started in 2001 at the University of Colombo. Some of these 18 students from the first batch may be tapped to promote research into numerical weather prediction.

It is now well recognized that Oceans have a profound influence on weather and climate and thus the M.Sc. course in Oceanography that has been initiated by the Post-Graduate Institute of Science at the University of Peradeniya in 2002 would provide valuable research and staff for climate research in the years to come.

The Natural Resources Management Centre of the Department of Agriculture has built up considerable expertise in obtaining data and providing climate services of particular relevance for agriculture. In addition, the Hydrological Division of the Irrigation Department, Water Management Secretariat, Environment and Forest Conservation Division and the Natural Resources Management Services Unit of the Mahaweli Authority too have built up climate related

expertise. The Arthur C. Clarke Institute for Modern Technologies has sought to foster meteorological applications by conducting a special panel of Meteorology at its conference on space applications.

9. Harnessing International Partnerships

The resources of the various agencies whose missions include supporting capacity building in third world countries e.g. International Research Institute for climate prediction (IRI), International Centre for Theoretical Physics (ICTP), World Meteorological Organization (WMO) and "global change SysTem for Analysis Research and Training" (START) should be harnessed. In addition, services of individual expatriate and foreign scientists too could be made use of.

10. Suggested Action Steps

1. Establish priority for weather and climate prediction at the highest government level. A senior government official could coordinate the effort.
2. Establish a planning group involving Ministry of Science and Technology, Ministry of Environment and Natural Resources, Ministry of Fisheries and Ocean Resources, Department of Meteorology, research scientists and representatives of user agencies of climate prediction such as the Department of Agriculture, Electricity Board, Irrigation Department and Public Health and Disaster Management agencies.
3. Develop a strategic plan for research leading to enhanced weather and climate services in consultation with user agencies.
4. Develop research support services such as access to relevant journal article services, a union list of climate related books available already in Sri Lanka, additional relevant books, relevant data bases, collection of books. The access to these services should be enhanced through timely information and development of regional information centres.
5. Develop government level links with relevant international agencies. This can be based on initial contacts followed by either exchange of letters and two-way visits of senior officials.
6. Induce research through funding of research in multiple sites. Support the operation of climate prediction models in a few institutes.
7. Develop a user focus in climate prediction from the outset. In addition, as soon as feasible, the climate prediction system should be coupled to system models to provide predictions for droughts, floods, river flow, risk of hazards, malaria and dengue, fisheries and hydropower potential.

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Biographical Sketch

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