



PRECIS: Regional Climate Modelling for Adaptation and Development Planning

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Initiative Overview

The PRECIS system (Providing Regional Climates for Impacts Studies) is a package consisting of a regional climate model (RCM) and software allowing the processing and display of data on a personal computer. The system is provided free of charge to scientists in developing countries through partnerships between the UK's Meteorological Office Hadley Centre and governmental bodies at the UK and international level. The system is intended to provide developing countries with information on possible future changes in regional climate in order to facilitate adaptation and developing planning, and thus falls under both the 'strategy' and 'adaptation' domains of relation between ICTs, climate change and development (Ospina and Heeks 2010).

Application Description



Figure 1: The Main PRECIS Operating Window

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The PRECIS system comprises the Hadley Centre's regional climate model, HadRM3P, and a software package enabling the processing and display of data on any computer running the LINUX operating system (see Figure 1). HadRM3P is closely related to the Hadley Centre's global atmospheric model,

CASE STUDY

Category: ICTs and Climate Change Strategy

HadAM3P, a version of the atmospheric component of the Centre's coupled global model, HadCM3. The regional model has a maximum spatial resolution of 25km, with nineteen vertical levels in the atmosphere and four in the soil, and can be located over any region of the globe. Input data to the model are provided by the Hadley Centre, and results from other global models are increasingly being used to drive the regional simulations in addition to outputs from the Hadley Centre's own global model. Climate change projections are generated using scenarios from the Intergovernmental Panel on Climate Change's (IPCC) 'Special Report on Emission Scenarios', which provide assumptions of future economic growth, technological changes, population growth and changes in governance.

Formal Drivers and Objectives/Purpose for ICT Usage

The PRECIS project is very much motivated by concern about the possible future impacts of climate change and the need to develop adaptation policies in light of scientific predictions of the future. Many developing countries are seen as being the most vulnerable to the impacts of climate change, yet the majority of scientific knowledge concerning future changes is generated in Western nations. The project has therefore sought to begin redressing this geographical imbalance by enabling modelling work to take place within the national contexts where the simulation results will be put to political use. The simulations are intended to provide input to climate impact and vulnerability studies which in turn feed into the preparation of National Communications to the UN Framework Convention on Climate Change (UNFCCC) as required under articles 4.1, 4.8 and 12.1. The project also contributes to the UK's need to partake in technology transfer initiatives as dictated by Article 4.5.

Stakeholders

The key driver of the project is the Hadley Centre which developed the model and the user software. The Hadley Centre is a subsidiary of the UK Meteorological Office which deals with scientific issues relating to climate change. The core funding comes from the UK's Department for Environment, Food and Rural Affairs and the Department of Energy and Climate Change, and the Centre features a number of internationally renowned climate scientists making significant contributions to the assessments of the IPCC. During development of the PRECIS system, contact was made with the United Nations Development Programme (UNDP) regarding the alignment of the modelling project with the need to assist countries in planning for climate change adaptation. The UNDP's National Communications Support Unit, which assists countries in fulfilling their UNFCCC obligations, provides many of the resources necessary for training prospective PRECIS users. The project is also supported financially by the UK's Department for International Development (DFID) which assists particularly with the training exercises, and the Department for Environment, Food and Rural Affairs, reflecting the model's perceived ability to facilitate scientific capacity building and to ultimately assist in the reduction of societal vulnerabilities to natural hazards. At the user end, the model has been taken up most commonly by governmental science agencies in non-Western countries (usually meteorological institutions) that have scientists with the necessary climatological expertise to use the model productively, in addition to institutional links to climate and environmental policy makers.

Impact: Cost and Benefits

The model is made freely available to scientists in countries which fall outside of the Annex I grouping under the UNFCCC, i.e. countries which are not classed as 'industrialised'. Training is provided to prospective users by the Hadley Centre at no cost to the new users due to the financial support of DFID, UNDP, etc. Around three international training workshops are conducted each year (in addition to one UK-based workshop), with prospective users gathering at regional centres to receive instruction

CASE STUDY

Category: ICTs and Climate Change Strategy

and often building collaborative working relationships with scientists in neighbouring countries. This programme has made the system very attractive to scientists who otherwise would not have access to this kind of model which is the product of years of development at the Hadley Centre.

The benefits of this wider distribution of scientific capacity and expertise therefore include the ability of developing country scientists to develop scenarios of future climate change on spatial scales which are perceived as being highly relevant to decision making. However, in interviews with users it became clear that the main advantage of the system is not necessarily the ability to develop policies based on detailed scientific information but, rather, is the generation of awareness of possible climate change impacts in policy communities. The detail which can be provided by the model renders the issue of anthropogenic climate change 'visible' – i.e. changes can be visualised on scales of geographical familiarity – and is thus an effective means of persuading decision makers of the need to act. For example, despite work with PRECIS and the exploration of modelling uncertainties in the Caribbean being limited by a lack of computational resources, this has not precluded simulation results from use of PRECIS being used to support the Caribbean Community's calls for a 1.5°C cap on temperature rise on the international stage.

Evaluation: Failure or Success

The wide uptake of the model certainly renders the project a success in the terms of project's instigators. Over 100 countries are now running the model (see Figure 2), and results have appeared in numerous policy documents related to UNFCCC processes (e.g. Taylor *et al.* 2007; Natcom India 2008) and scientific publications (e.g. Alves and Marengo 2010). However, if the project were to be evaluated from a purely scientific standpoint, then further questions arise. For example, it is not commonly accepted within the modelling community that one global climate model can be 'downscaled' through a regional model with equal reliability in all areas of the globe. Global models always perform 'better' (i.e. they recreate elements of the observed climate with greater accuracy) in some regions than in others. It is therefore very difficult for a scientist working with just one regional model to assess the performance of the model in their area of interest against other techniques or other models.

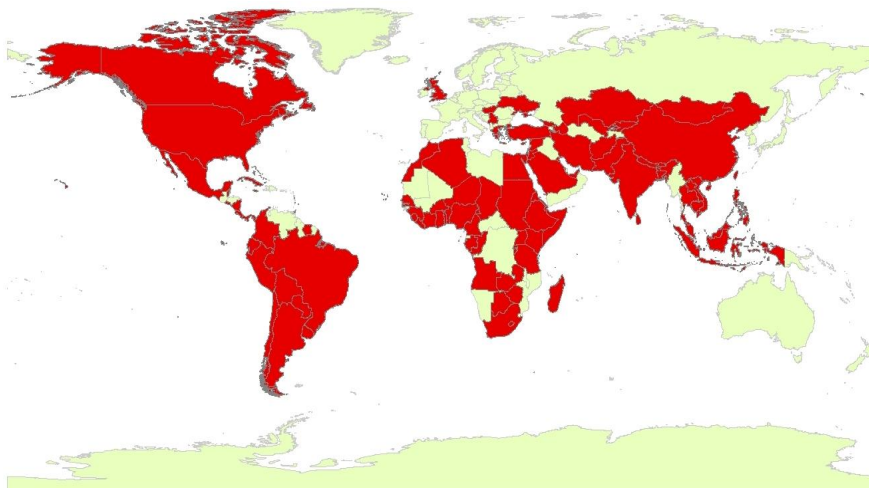


Figure 2: Map Displaying Countries with Institutions Trained in the Use of PRECIS

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It is perhaps too early to judge the substantive impact that the modelling activities have had on national policy making despite some examples of model results being used to bolster certain political decisions such as in the Caribbean, where model results have been used to inform the selection of a wind and solar-powered saltwater reverse osmosis system on the island of Bequia to ease anticipated

CASE STUDY

Category: ICTs and Climate Change Strategy

future water shortages, to give one example. In India, a country with a long-standing record of collaboration with the Hadley Centre, the model has provided the scientific basis for the Indian Network of Climate Change Assessment (INCCA) which seeks to deliver scientific assessments of the impacts of climate change on India, independently of the work of the IPCC which is seen as not serving the interests of India as best it might (see INCCA 2010). The project can therefore be judged to have been successful in providing a new level of scientific (and perhaps by extension, political) autonomy to countries running the model, but this includes a number of caveats which are discussed below.

Enablers/Critical Success Factors

The provision of the model **free of charge** and the provision of approximately ***in situ* training** has enabled a large number of institutions to take it up. It is also clear that the prominent **international reputation of the Hadley Centre** has helped the model to achieve such widespread use. Documents relating to the model position the Hadley Centre as a "pioneer" of this "most proven method for obtaining detailed predictions" (MOHC 2001:2). The **alignment of the modelling project with countries' requirements under the UNFCCC** was also important in the widespread uptake of the model, and key actors have spoken of the significance of the UNDP's 'seal of approval' in encouraging countries to obtain the model and pursue the related line of work. The successful proliferation of the model cannot be explained simply by the usefulness of it as a tool for adaptation planning. It is the authoritative institutional assemblage which surrounds the model – in the form of the scientifically influential Hadley Centre and its politically influential project partners such as UNDP – which has arguably been a key characteristic enabling it to travel so widely around the world.

Constraints/Challenges

As mentioned above, **relying on one model for projections of future climate over a particular region can be problematic**. A common way of assessing the reliability of model results is to perform multiple 'runs' of the model to test for variations and sensitivity to different initial conditions (e.g. different scenarios of future greenhouse gas emissions) and patterns of natural climate variability. This strategy was recently applied using the same atmospheric model to assess whether anthropogenic climate change had contributed to recent flooding events in the UK (Pall *et al.* 2011). The study used distributed computing (the model was run on a network of volunteer computers), allowing the researchers to draw on thousands of model runs with different model configurations in the calculation of probabilities of whether the risk of such flooding events has been raised already by climate change.

This study highlights how computationally demanding it is to develop probabilistic scenarios and to fully evaluate the uncertainties in climate simulations. Scientists running PRECIS with limited resources are restricted in their ability to employ such techniques, so **assessment of the uncertainties which are inherent to any projection of the future is a very difficult task**. Throughout the duration of the project, the Hadley Centre has given increasingly greater prominence to issues of uncertainty in regional climate modelling. This has been manifest in both accompanying documents and the training programme. However, published results from PRECIS work have demonstrated the difficulties faced in fully exploring prediction uncertainties through the use of one RCM with limited computational resources.

This therefore raises the question of the positioning of the model in relation to political decision making. Does the provision of this model potentially encourage decision makers to pursue policies which would provide 'optimal' adaptation to the future climate envisioned by the model? It is widely accepted that the most successful adaptation policies will be those that are **robust** to a whole range of possible futures and their inherent uncertainties (Dessai *et al.* 2009). By **adapting to just one possible scenario** (e.g. a certain decrease in annual rainfall), societies may leave themselves

CASE STUDY

Category: ICTs and Climate Change Strategy

vulnerable to alternative futures. Given the uncertainties of the climate system it is difficult to claim to be able to predict the future so reliably as to guarantee the success of 'optimal' adaptation strategies. There are therefore risks in placing models such as PRECIS at the centre of efforts to adapt to possible future changes.

Recommendations/Lessons Learned

How can models like PRECIS therefore play a role in the pursuit of robust adaptation policies?

Prediction must be re-conceived from a 'limit' to adaptation (i.e. the position that "you cannot adapt without precise predictions"), to **an enabler of political discussion** about present vulnerabilities and how they may be modulated by changing political and social conditions. Models can play a useful role in stimulating ideas about how our societies may cope with a changing climate, and in adjudicating over which possible futures may be more or less likely. Under such an approach, **the key 'limit' to adaptation is not our knowledge, but our institutional and societal capacities** to reduce vulnerabilities to environmental stresses. Such a re-conception of the role of climate models demands contemplation by all stakeholders of the weight they give to predictions of the future, and particularly of how models are 'sold' as packaged solutions to the problem of envisioning and adapting to an uncertain future in diverse places.

There are of course great challenges in meeting the demands of international ICT technology transfer, which could be met in the future by **increased end-user involvement in the design of such modelling systems** which may eventually lead to the emergence of more autonomous, diverse and locally-tailored approaches to studying future climates across different national or regional contexts. However, this would depend not only on greater deliberation and design flexibility (the majority of users cannot currently alter the model or software to better suit local needs), but also on tempering the emphasis which is placed on predictions as a means of driving policy by the sorts of institutions which have helped establish PRECIS as a popular tool of climate prediction.

Data Sources & Further Information

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The research informing this case study was conducted through analysis of 47 key documents relating to the PRECIS project, the majority of which are publicly available. Six semi-structured interviews were also conducted with both model developers and users, in addition to a more informal discussion with the PRECIS team at the Hadley Centre. For more information on the PRECIS project, see <http://www.metoffice.gov.uk/precis/>.

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CASE STUDY

Category: ICTs and Climate Change Strategy

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