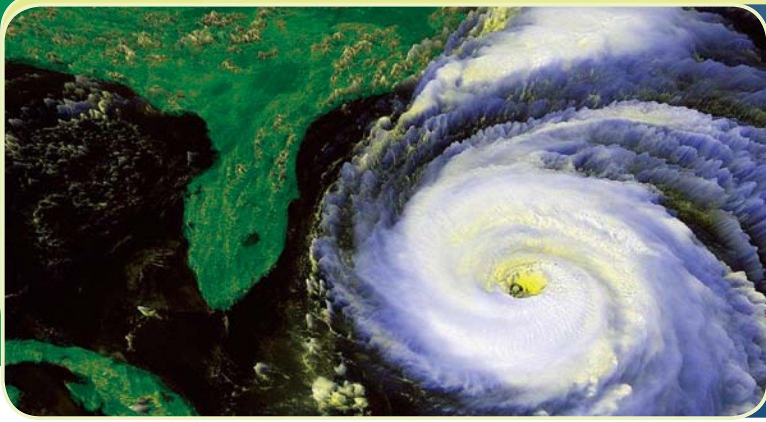
ACCC
Adapting to Climate Change in China
Sharing Knowledge Globally

Key Research Findings

October 2012



Policy-ready projections: making climate models more useful to planners

About the ACCC Project

The Adapting to Climate Change in China Project (ACCC) is an innovative policy research project, supporting China's response to the impacts of climate change and evidence-based adaptation planning. ACCC provides decision-makers with the policy –relevant information they require, taking into account current and future climate change and variability. ACCC aims to improve understanding and assessment of impacts, vulnerability and risk in key sectors in China by bringing together policy and research, national and subnational planning, social and physical science for an integrated response. The project shares this experience and lessons learnt with other developing countries in order to reduce their vulnerability to the impacts of climate.

ACCC does this by:

- supporting evidence-based adaptation planning through access to relevant and robust data, tools and information.
- mainstreaming climate change adaptation policies into development planning.
- producing comprehensive impact, vulnerability and risk assessments at the national and subnational level.
- building capacity and providing technical support on adaptation responses at the subnational level.
- sharing China's experience with other developing countries to enhance their own resilience to the impacts of climate change.

For more information, please visit our website at www.ccadaptation.org.cn.

Key messages

- Decision-makers need specific information about the range of climate futures we should prepare for. Since climate models agree on global trends, but disagree on just how fast and intense the changes will be, combining multiple models gives a fuller picture, deals with uncertainty and enables adaptation responses.

- Vulnerability assessments and adaptation planning also require spatially detailed data — which means 'downscaling' global climate models to show future changes at higher resolution.

- Downscaling doesn't come cheap. But by using a carefully chosen sample of available models, researchers can produce detailed climate projections covering a wide range of scenarios while keeping computing costs relatively low.

This briefing was prepared by Carol McSweeney and Richard Jones from the PRECIS regional modelling team at the Met Office Hadley Centre, UK, based on ongoing research as part of the Adapting to Climate Change in China project. Roger Street of the UK Climate Impacts Programme (UKCIP) also contributed.

The multi-model advantage

For government planners and other decision-makers, model simulations of future climate change pose a dilemma. Climate projections are consistent and unambiguous about coming stresses and the need to take adaptive action — but often do not provide enough detail to allow them to work out what action is needed.

Global climate models are the basis of much of the current scientific understanding about how and why the climate is changing. And they send very clear messages that the planet will continue to warm, sea levels will continue to rise and that rainfall and other climate parameters will change significantly in many places.

In short, increasing climate disruption is on the way, and major adaptations will be needed in sectors from agriculture and economic development to public health and disaster response. But to plan these responses, decision-makers need more specific information. Climate models agree on global trends, but disagree on just how fast and intense the changes will be, and sometimes on the patterns of change — which areas will become wetter or dryer, for instance. Taken together, the models suggest differing levels of confidence about different climate variables. And currently there is no objective way to tell which models are more trustworthy.

Because these models cannot be shown to be wrong and thus their projections can be considered as plausible future scenarios, results from multiple models must be combined to understand the range of possible climate futures we should prepare for. At the same time, adaptation planners need detailed projections of the likely changes in local areas — at a higher resolution than global climate models provide. Similarly, efforts to assess the likely impacts of climate change on factors such as water availability, ecological balance and food security also require high-resolution data. It is possible to 'downscale' global models to yield detailed local projections, but downscaling many global models and making the results available requires significant computing and human resources.

As part of the Adapting to Climate Change in China research programme, partners at the UK Met Office Hadley Centre have used a novel method to try to get the best of both worlds — multi-model climate projections at high resolution — using fewer resources. The new approach meets decision-makers' need for specific local scenarios, at lower cost. This method was applied to characterise the range of plausible changes within China, and the same technique can be transferred to any other country and has been applied for Vietnam and in Africa.

Modelling China's future

The approach relies on sampling from a large group of models. We started with projections of China's climate in 2100 from 18 global climate models (Fig. 1). All 18 saw the country overall becoming warmer and wetter, but differed on the magnitude of the changes. We looked at how well these models simulated the current climate over China and from those that represented well important feataures of the climate in different regions of China we selected six whose projections spanned a range similar to the whole group. So the six projections included some of the largest and smallest increases in temperature and precipitation, as well as some scenarios in the middle.

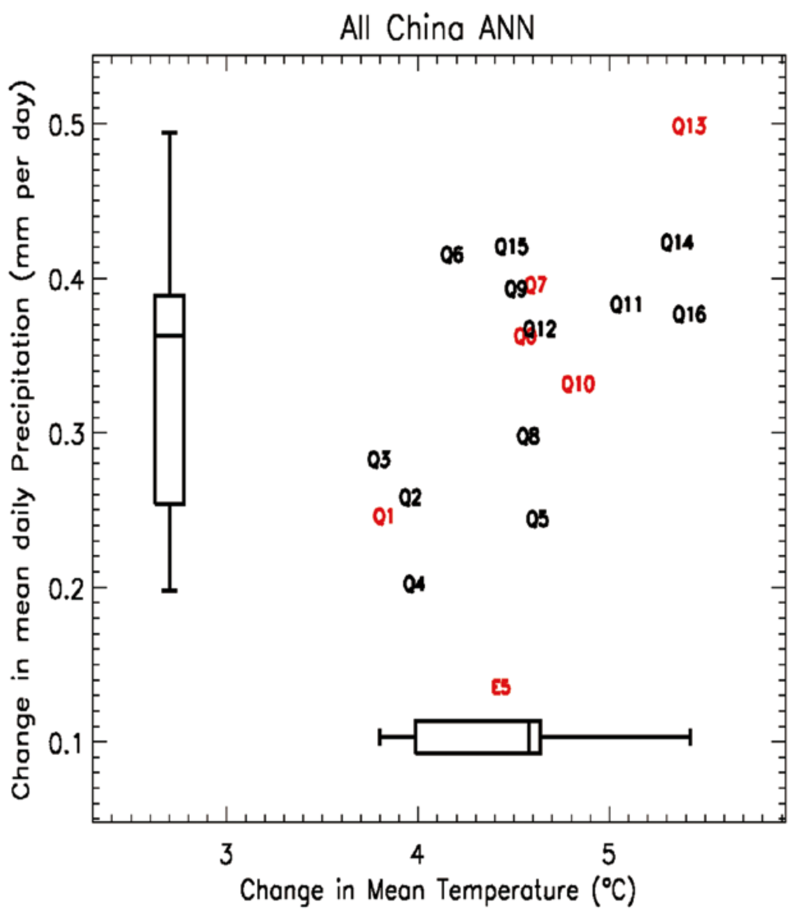


Figure 1:
Projected future climate change by 2100 for China, under one emissions scenario in a 17-member climate model ensemble (Q1-Q17) from the Hadley Centre at the UK Met Office, and in the model ECHAM5 (E5) from the Max Planck Institute for Meteorology. Models highlighted in red were selected to sample the range of outcomes.

Furthermore, we looked at rainfall across China in each model. Rainfall was a particular challenge for modelling: in certain regions, the models disagreed about not only the magnitude of change, but whether precipitation would actually decrease or increase (Fig. 2). We made sure our sample covered this diversity as well.

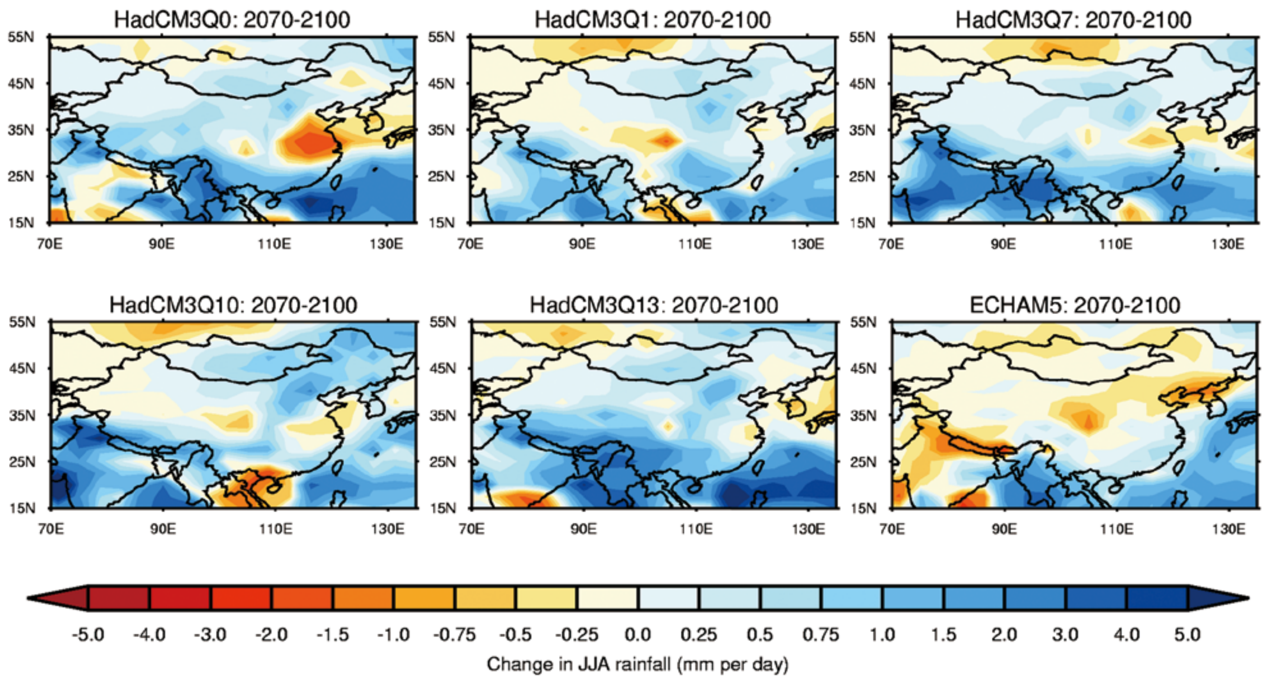


Figure 2:

Projected future changes in wet-season rainfall by 2100 for China in the six models highlighted in Figure 1, under one emissions scenario. These models were selected to represent a range of different spatial patterns of precipitation changes.

The six models were then downscaled to provide high-resolution, multi-model scenarios. These provide six detailed sets of data describing how the varied aspects of climate, e.g. from average summer temperatures to the frequency of hot days or heavy rainfall that can be used to assess the spectrum of possible climate impacts which decision-makers need to be aware of when formulating adaptation plans[1].

Managing a data deluge

The amount of data from global climate models is growing every year, and accelerating in the run-up to the next report of the Intergovernmental Panel on Climate Change in 2013-14. Approaches like the one described here are increasingly important as a way to represent the range of possible futures revealed in this data, without incurring unmanageable costs for number-crunching and the subsequent storage and distribution of the data. Governments must not base climate impact assessments and adaptation plans on just one model, because none is reliable enough. But neither can they afford to compute detailed projections from all the models.

Choosing which scenarios to consider requires understanding the system(s) for which climate threats are being explored — such as agricultural crops, water resources, or disease and healthcare — including how these systems react to changes in different climate variables. Researchers should select scenarios that allow for a range of possible outcomes, especially if they enable testing of sensitivities and possible tipping points.

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[1]*For more detail on this, refer to the Journal of Climate paper on the application of this technique in SE Asia. C.F. McSweeney, R.G Jones and B.B.B. Booth, 2012: Selecting a sub-set of perturbed physics ensemble members for downscaling experiments with PRECIS in south-east Asia. J. Clim. doi:10.1175/JCLI-D-11-00526.1*

Implications for adaptation planning

For those using climate data to assess impacts, vulnerabilities and risks, the availability of multiple future scenarios presents both challenges and opportunities. They will have to judge which models to use and work to understand the implications of a range of results. But having multiple climate scenarios allows a better grasp of uncertainties, sensitivities and thresholds, and leads to planning for a range of outcomes. These are building blocks in a robust adaptation strategy.

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Project web site:
www.ccadaptation.org.cn
You can contact us by writing to:
info@ccadaptation.org.cn

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