The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

1934-20

Fourth ICTP Workshop on the Theory and Use of Regional Climate Models: Applying RCMs to Developing Nations in Support of Climate Change Assessment and Extended-Range Prediction

3 - 14 March 2008

Outstanding issues in Regional Climate Modelling

JONES Richard Graham

UK Met Office Hadley Centre, Reading Unit, University of Reading
Meteorology Building
RG6 6BB Reading
UNITED KINGDOM

Outstanding issues in regional climate modelling

… and regional climate change

Richard Jones

Met Office Hadley Centre (Reading Unit)

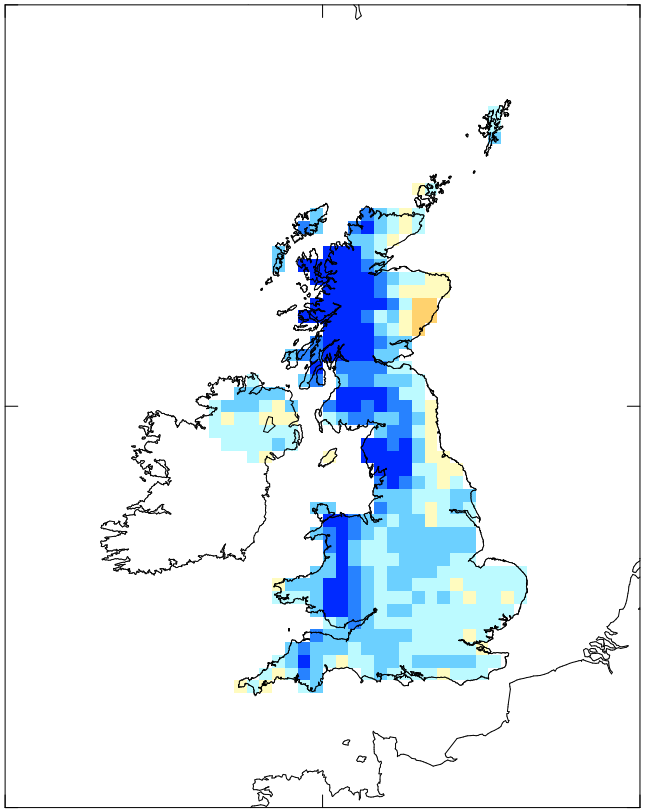
Outline

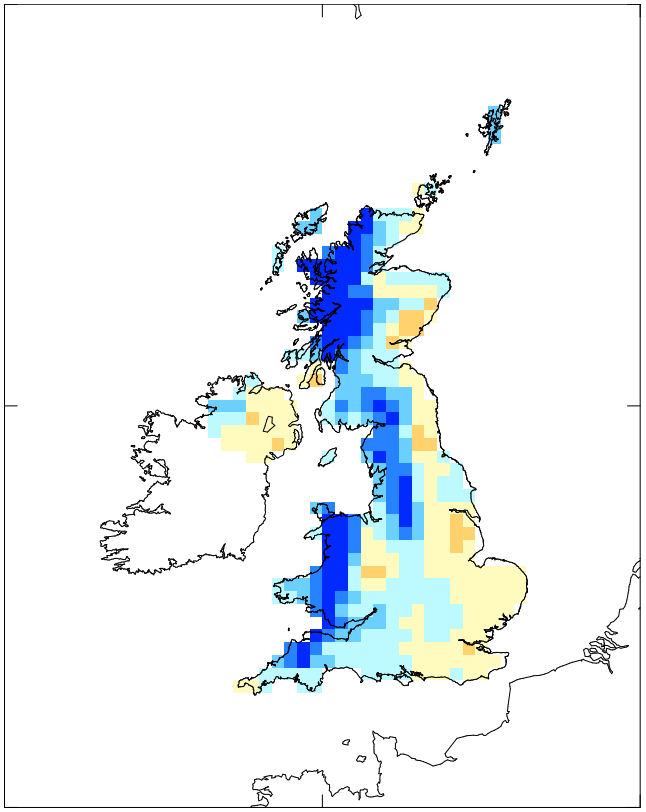
- Methodological issues
- Regional climate change research
- Awareness raising (the mitigation agenda)
- Impacts research (the adaptation agenda)
- Regional and global requirements
- In support of climate change assessments

Methodological issues – or why we are still not taken seriously

- Presenting 3 different patterns of large-scale climate change from 3 RCMs downscaling one GCM as uncertainty is wrong
  - At least two of these are wrong – we should say so
  - If we believe one is right – we must be able to explain why
    - We need to demonstrate consistency with the GCM **or**
    - We need really good physical arguments why we should believe a result inconsistent with the GCM
- RCMs can skilfully downscale those modes of climate variability represented by the GCMs/reanalyses
  - We should know how much variability (often a large amount)
  - We should understand the utility of RCM re-reanalyses

Observed and simulated trends in extreme winter precipitation



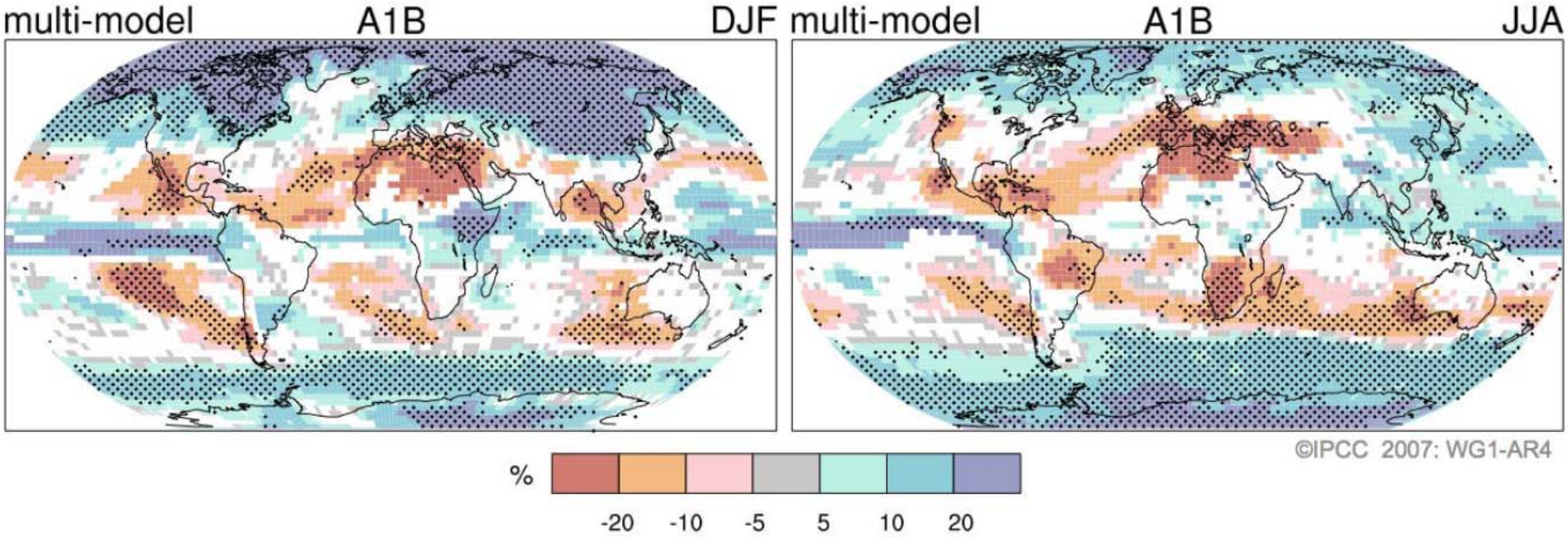


- Demonstrates skill
- Allows analysis of mechanisms e.g. for attribution
- Provides physically consistent high resolution evolution of recent climate

Regional climate change research – where we are

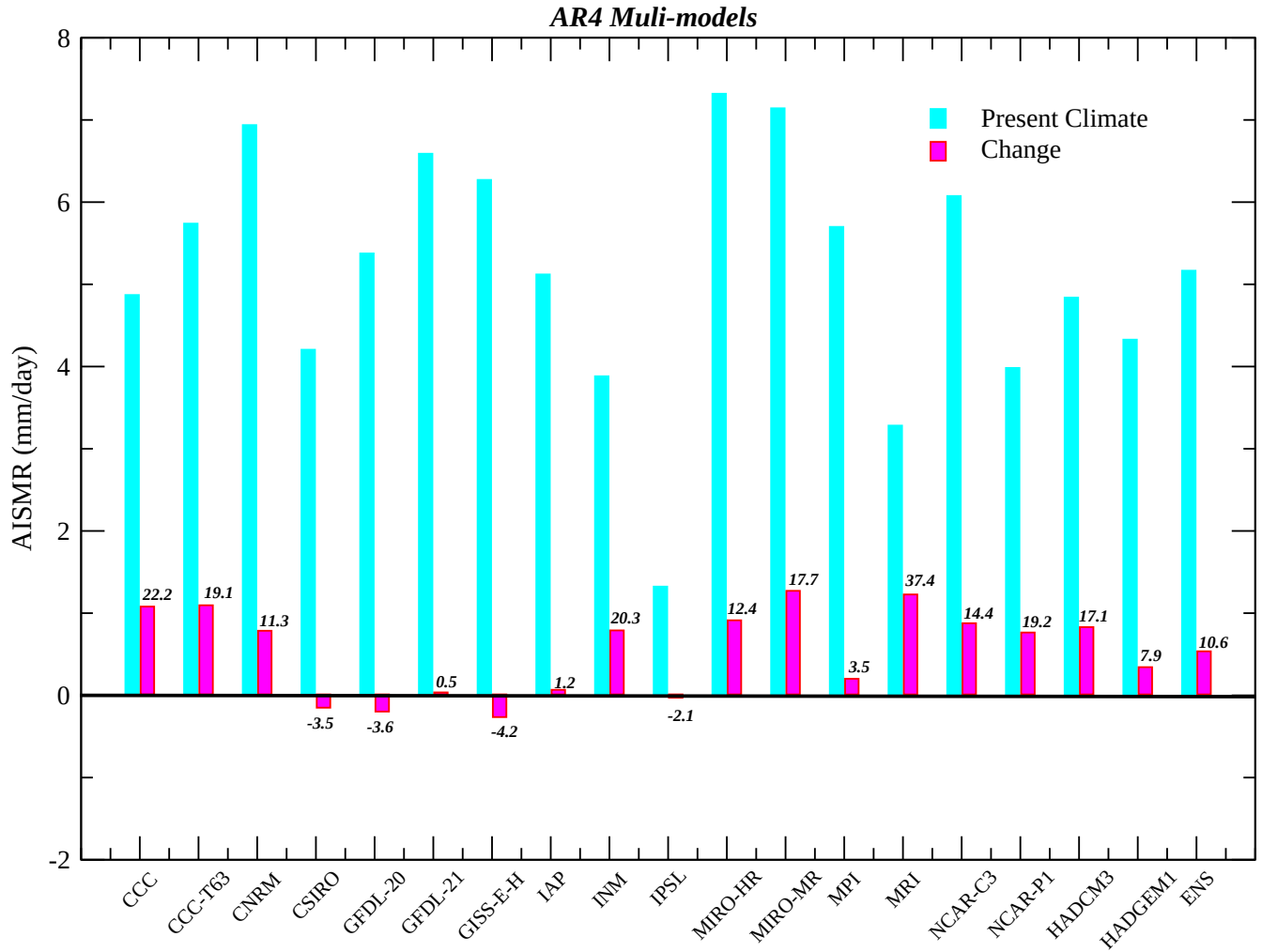
- Attributing regional-scale temperature (+ some other) changes
- Presenting regional-scale mean temperature and precipitation changes with measures of model consensus and some supporting physical insight
  - Information on emergence time of model signals
  - Temperature change information relative to transient climate sensitivity
  - Provides broad overview of likely sub-continental changes in most regions
- Some general (and a few specific) statements on changes in extremes

IPCC AR4 SPM mean precipitation change summary figure



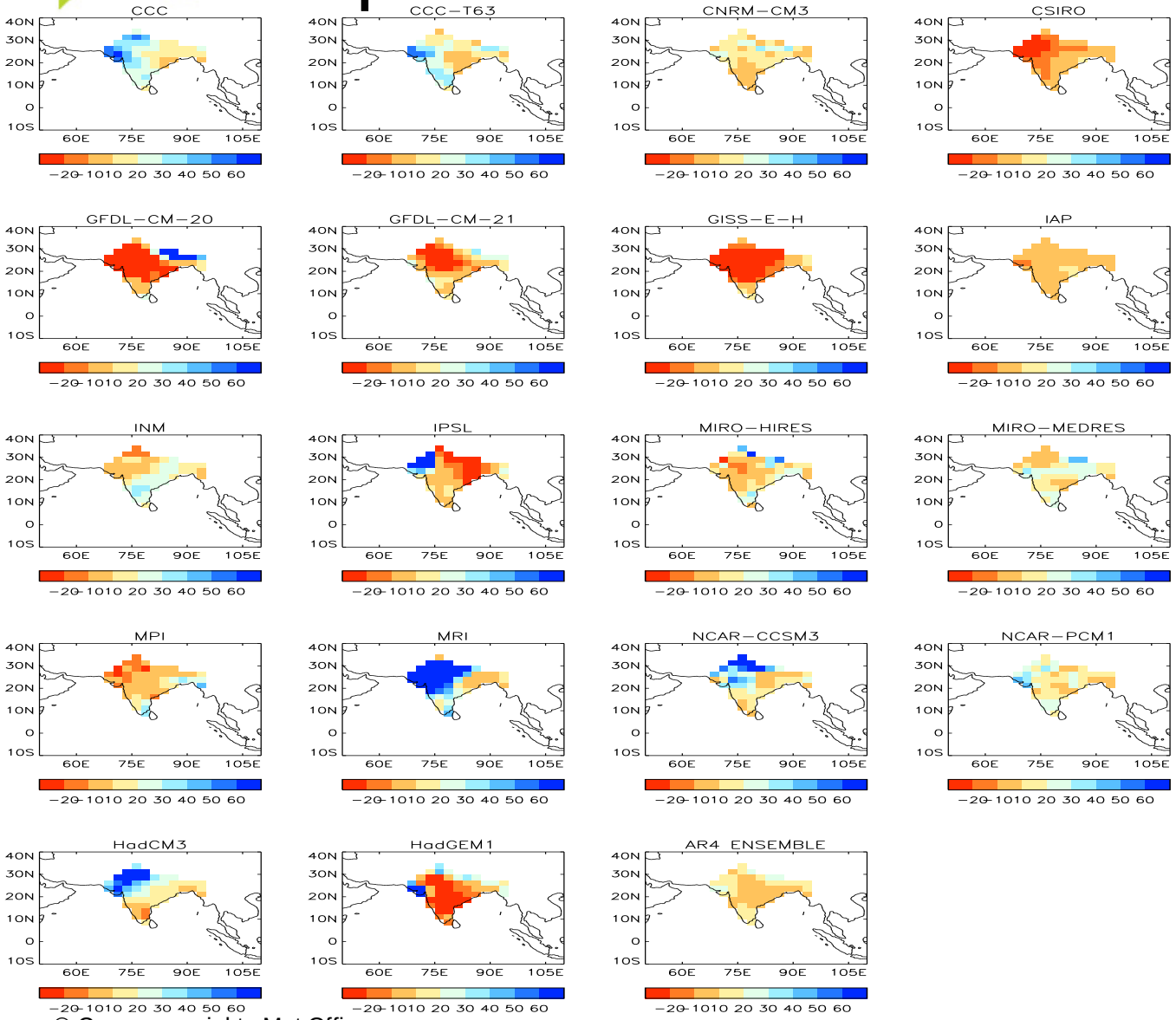
- Model consensus does not imply reliability
  - adding mechanisms provides basis for a prediction
- Lack of consensus implies no information
  - but assessed at grid-scale thus maybe misleading
- Many (sub-)tropical regions appear uncertain

Response of All India rainfall (A1B, 2080s)



- Most changes positive and large thus policy relevant
- Support from physical insight

Lack of consensus from model patterns



- Combination of pattern and some sign differences lead to lack of consensus
- Is this relevant if monsoon processes are captured in the models?

Awareness raising (the mitigation agenda)

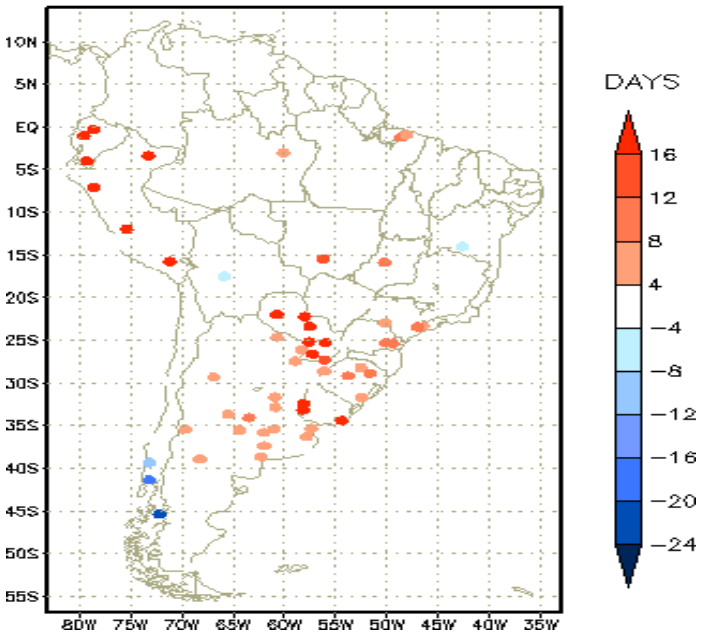
- Global and continental-scale evidence-base for climate change is sufficient for relevant policy-makers with the focus now moving to regional scales
  - More work is required on regional analysis and understanding
  - Determining reliability of regional projections is essential

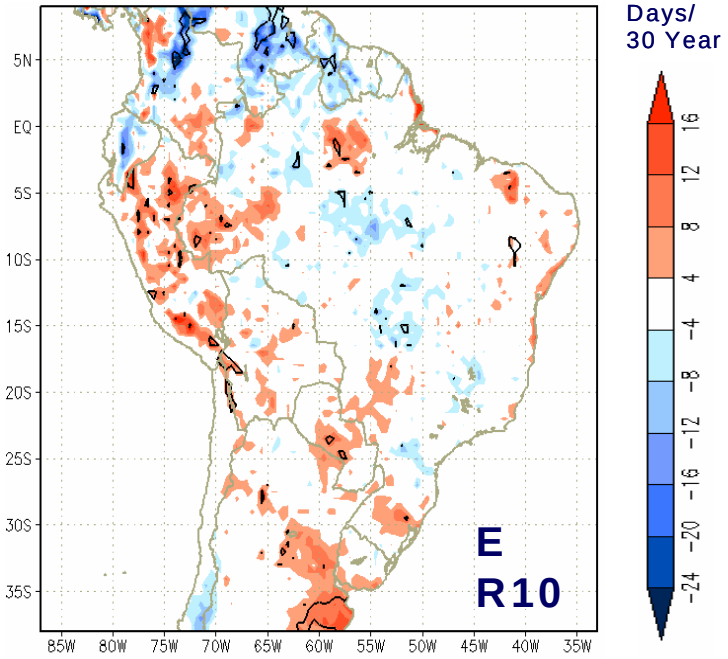
Resources available in developed countries are insufficient and unsuitable for much of this work

Significant requirement for well-resourced regional experts for this work

Observed and modelled trends in heavy precipitation over South America

Stations observations and modelled significant trends in R10
(R10=number of days in a year with precipitation above 10 mm)





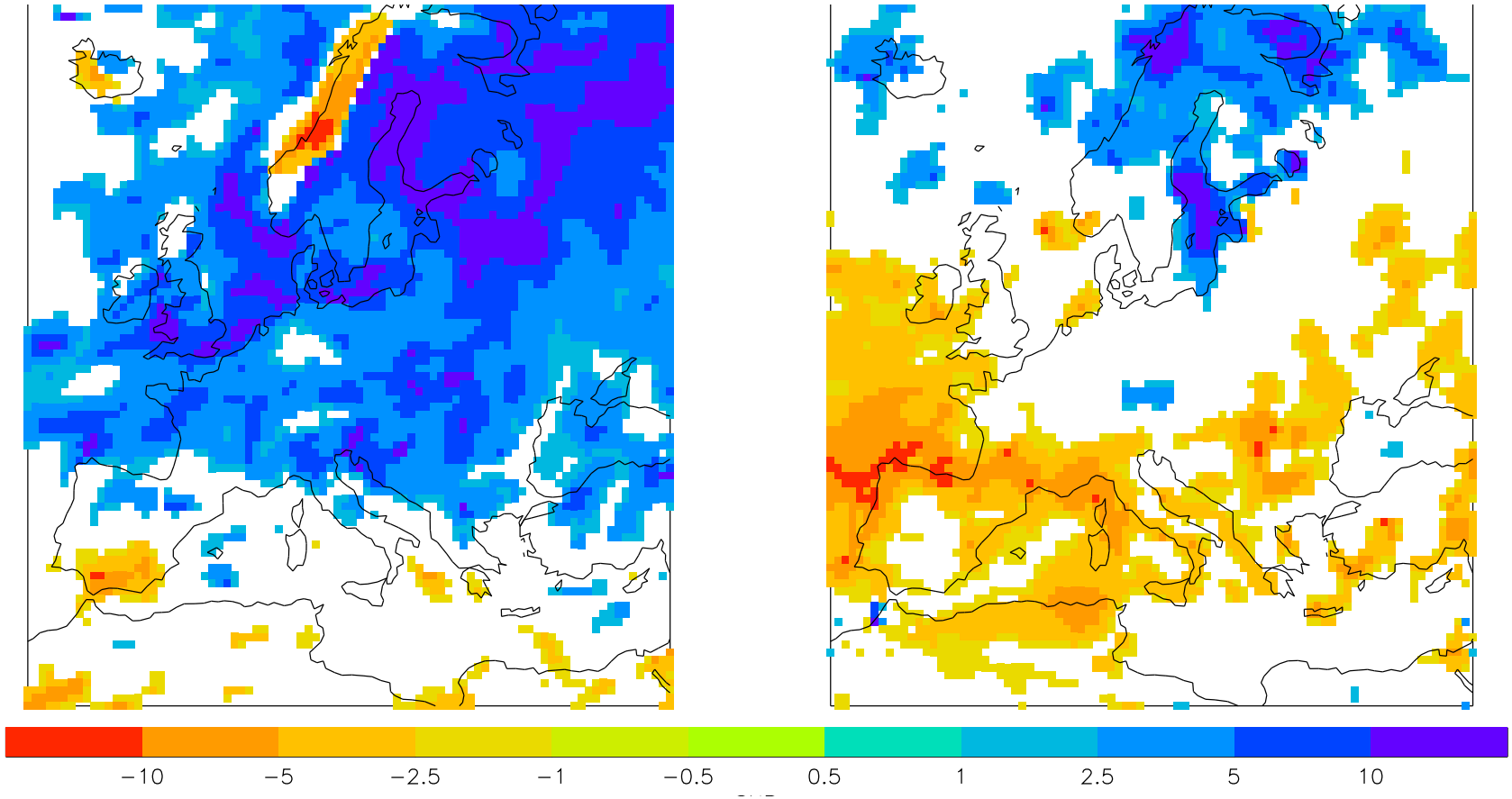
Future change of temperature and precipitation extremes in South America as derived from the PRECIS regional climate modeling system
J. A. Marengo*, R. Jones, L. M. Alves*, M. C. Valverde***
***CPTEC/INPE, **Met Office Hadley Centre (Reading Unit)**
International Journal of Climatology (to appear)

Robust changes in precipitation extremes from 3 member ensemble

Met Office Hadley Centre

Winter

Summer



Change quantified for high signal to noise ratio (>5)

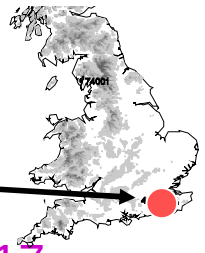
Impacts research (the adaptation agenda)

- Unavoidable climate change is an accepted reality and so again determining reliability of regional projections is essential
- So the problem seems the same until we notice that the customer has changed. Here are a few examples:
  - The manager of the River Beult, Kent, UK
  - An Indian state forestry department
  - The BP operations manager in Prudhoe Bay, Alaska, USA
  - One of Mark Tadross' maize-farmer friends

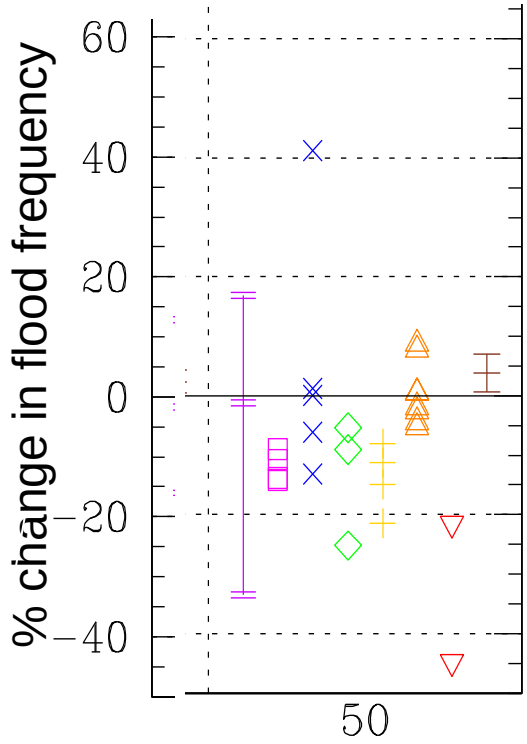
They will not be happy with a likely statement on regional seasonal–mean changes

Information for a UK river manager?

Changes in 50-year flood (%) from different drivers: River Beult in Kent



Natural variability – resampling:	-34	to	+17
Emissions – B1 to A1FI:	-14	to	- 9
GCM structure – 5 GCMs:	-13	to	+41
Natural variability – 3xGCM ICs:	-25	to	- 5
Downscaling – RCM v statistical:	-22	to	- 8
RCM structure – 8 RCMs:	-5	to	+8
Hydro' model structure – 2 models:	-45	to	- 22
Hydro' model parameters:	+1	to	+ 7



Q1: Are ranges additive?

Q2: Should model or observed climates be used as the baseline?

Q3: Are flow changes reliable enough to apply to observed flows?

Q4: Do reliable changes require full spectrum variability changes?

Regional requirements

Well-resourced regional experts for:

- Assessing and modelling of observed climate trends
- Developing climate change scenarios
- Establishing reliability in future climate projections

A climate adaptation coordination committee to:

- Understand user requirements for climate information*
- To advise on designing and implementing experiments or analyses of model or observational data to provide this

* i.e. the advanced or “backwards” (Tadross, 2008) approach

Global requirements

A Working Group on Regional Climate Research to:

- Determine priorities in regional climate change research
- Ensure liaison and dissemination of best practice between regional climate simulation and projection research projects
- Liaise with the Working Group on Coupled Models to facilitate access to GCM data for regional climate change research and downscaling
- Liaise with institutes and international agencies to promote relevant technology transfer and capacity building
- Determine standards and policy for dissemination of climate change downscaling data

International activities in support of climate change assessment

International conferences and workshops to further capacity-building and knowledge transfer

Proactive **support** for projects applying climate scenario information to support development of adaptation options and awareness raising

Dedicated **support** to build capacity in developing countries for research into climate, climate change and its impacts

Outputs in support of climate change assessment

- Climate scenarios defining ranges of likely climate changes for all regions
- Peer-reviewed papers in international journals lead by developing country authors building local capacity in climate and impacts science
- Application of state of the art climate scenarios for adaptation studies and National Communications