

# **Summary of the PRECIS workshop, Havana, Cuba, 8-12 September 2003**

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## **Contents**

### **Introduction**

### **List of participants**

### **Workshop programme**

### **Design and plans for initial PRECIS**

### **Initial tasks and their status and follow-up activities**

### **Brief summary of sessions including questions and answers**

## **Introduction**

The aim of the workshop was to explain the scientific background and provide technical instructions necessary for productive and informed use of the PRECIS regional climate model (RCM) to construct climate scenarios for impacts assessments. The workshop comprised three activities, formal presentations by Hadley Centre staff, presentations by participants and project representatives and discussions on their workplans and use of PRECIS and hands-on sessions allowing participants to gain experience in using PRECIS.

The formal presentations were based around the PRECIS workbook and an accompanying technical manual supplemented by lectures on the science of climate change, construction and use of climate scenarios and practical sessions on installing, configuring and using PRECIS. The technical presentations involved the demonstration of an installation of the PRECIS system, the use of the PRECIS interface to set up and run RCM experiments and software supplied with PRECIS to monitor experiments and analyse results. The participants were then given the opportunity, in several sessions, to experiment with all of these aspects of the system on a network of 10 PCs provided by the host institute on which PRECIS was installed. During these sessions the Hadley Centre staff were available to provide specific assistance to individuals or groups on the use of PRECIS or to explain aspects of the system, the RCM and its use.

In the middle of the workshop the participants were given the opportunity to make presentations on aspects of their work relevant to PRECIS. This provided background for discussions on how PRECIS could contribute to their work and feedback to the Hadley Centre on the applicability of PRECIS. Based on this, several small and whole group sessions were held over the last three days to discuss how work with PRECIS would be taken forward. This resulted in a plan for an initial series of PRECIS experiments to be undertaken by institutes represented at the workshop and the completion of some of the essential preliminary tasks before running these experiments. A summary of these experiments, tasks and follow-up actions is given below.

In addition to providing an overview of these initial actions with PRECIS, this document aims to summarise the main activities within the workshop and the interactions between the participants. The primary aim of this document is then to act as a resource, alongside the materials provided, recording the additional information and feedback resulting from these activities and interactions.

## **Participants**

### **Central America**

Tom Bakkum	UNDP – CATHALAC, Panama
Darysbeth Martínez	CATHALAC, Panama
Jose Luís Pérez	Inst. Mexicano de Tecnología del Agua, Jiutepec Morelos Paseo Cuauhnahuac, Mexico
Rosendo Pichinte	University of El Salvador
Jorge Barrantes	Instituto Meteorológico Nacional, Costa Rica

### **Caribbean Islands**

Neville Trotz	Caricom/ACCC Regional Project Implementation Unit, Barbados
Ian King	Caricom/ACCC Regional Project Implementation Unit, Barbados
Michael Taylor	University of the West Indies, Mona, Jamaica
Albert Owino	University of the West Indies, Mona, Jamaica
John Charlery	University West Indies. Barbados
Adrian Trotman	Caribbean Institute for Meteorology and Hydrology, Barbados
Everson Peters	University of the West Indies, St Augustine, Trinidad
Gyan Shrivastava	University of the West Indies, St Augustine, Trinidad

### **South America**

Gabriela Rosas	Servicio Nacional de Meteorología e Hidrología del Perú (SENAMHI) Lima, Perú
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### **Workshop hosts (INSMET, Cuba)**

Alfredo Roque	Instituto de Meteorología, Cuba
Israel Borrajero	Instituto de Meteorología, Cuba
Lourdes Alvarez	Instituto de Meteorología, Cuba
Miriam Limia	Instituto de Meteorología, Cuba
Daniel Martínez	Instituto de Meteorología, Cuba
Arnoldo Bezanilla	Instituto de Meteorología, Cuba
Jesús Dole	Instituto de Meteorología, Cuba
Abel Centella	Instituto de Meteorología, Cuba

### **Workshop organisers/training providers (Hadley Centre, UK)**

David Hassell	Met Office Hadley Centre, UK
Ruth Taylor	Met Office Hadley Centre, UK
Richard Jones	Met Office Hadley Centre, UK

## **Workshop programme (modified from original following workshop developments)**

### **Monday 8<sup>th</sup> September**

A.M.: Welcome (Abel Centella, Tomas Gutierrez, Richard Jones)  
Introduction to the PRECIS system (Richard Jones)  
Regionalisation techniques and regional climate modelling (Ruth Taylor)

P.M.: Demonstration of PRECIS (David Hassell)  
Hands-on session using the PRECIS user interface to set up and run experiments.

### **Tuesday 9<sup>th</sup> September**

A.M.: Modelling the climate system and climate change (Ruth Taylor)  
The PRECIS regional model (David Hassell)

P.M.: Demonstration of PRECIS data storage system and data processing/display (Ruth Taylor)  
Hands-on session on processing and analysing results from PRECIS.

### **Wednesday 10<sup>th</sup> September**

A.M.: Uncertainties in the development of climate scenarios (Richard Jones)  
Designing RCM experiments (David Hassell)

P.M.: In depth demonstration of PRECIS functionality: Lampos (David Hassell)  
Presentations from participants on plans for the projects where PRECIS is to be used  
Hands-on session continuing experimenting with the PRECIS interface and analysing results of experiments.

### **Thursday 11<sup>th</sup> September**

A.M.: Scenario construction for impacts assessment (Richard Jones)  
Installation of PRECIS (David Hassell)

P.M.: In depth demonstration of PRECIS functionality: Stopping and re-starting (David Hassell)  
Initial discussions with participants on design of their PRECIS experiments  
Hands-on session – more work with the user interface, reviewing aspects of installation, analysing results of experiments.

### **Friday 12<sup>th</sup> September**

A.M.: Participant work-plans and follow-up activities including publications (Richard Jones)  
Detailed set-up of the 50km common domain land-sea mask

P.M.: In depth demonstration of PRECIS functionality: Import/Export regions (David Hassell)  
Domains and masks set-up for domains for other 50km and 25km experiments  
Formal close: Presentation of workshop certificates and closing remarks (Abel Centella, Jose Luis Perez, Neville Trotz, Tomas Gutierrez, Richard Jones)

## **Experimental design for initial use of PRECIS over central America/the Caribbean**

1. Common area including all relevant countries chosen for 50km simulations
2. Daily data to be output from all experiments as standard to enable analysis and impacts work
3. 50km sensitivity studies to be performed
  - Over the eastern Caribbean and the tropical Atlantic to see if more ocean affects the simulation of tropical cyclones
  - Over the eastern tropical Pacific and Mexico to see if resolving more of the interaction between cold fronts and the warm ocean in winter at high resolution affects precipitation
4. 25km simulations to be performed over a region including the small islands of the eastern Caribbean

## **PRECIS experiments planned by regional partners**

1. Cuba: 4 experiments over the common domain
  - using ECMWF analyses for validation and comparison with the sensitivity experiments - 15 years
  - using GCM control (one ensemble member #1 addfa) data - 31 years
  - using GCM A2 (one ensemble member #1 addja) data - 31 years
  - using GCM B2 boundary data - 31 years
2. Mexico: 2 experiments over the common domain + 1 sensitivity experiment
  - using ECMWF analyses for Pacific sensitivity experiments
  - using GCM control (one ensemble member #2 addfb) data - 31 years
  - using GCM A2 (one ensemble member #2 addje) data - 31 years
3. U. West Indies: 3 experiments over the 25km domain, 1 sensitivity experiment (at 50km)
  - using ECMWF analyses for validation - 15 years
  - using GCM control (one ensemble member #1 addfa) data - 31 years
  - using GCM A2 (one ensemble member #1 addja) data - 31 years
  - using ECMWF analyses for Atlantic sensitivity experiment - 15years
4. Panama/El Salvador/Costa Rica: common domain experiments including:
  - using GCM control (one ensemble member #3 addfc) data - 31 years
  - using GCM A2 (one ensemble member #3 addjf) data - 31 years

## **Initial tasks and status**

- 1 Agree on a land-sea mask for the common domain and set orography of any land areas introduced

Status: Land-sea mask agreed upon at workshop, orography for island points to be checked

- 2 Choose the domains for the sensitivity studies

Status: Domains agreed upon at the workshop

- 3 For the 25km region, choose the domain and edit the land sea-mask and orography

Status: Possible domain discussed at the workshop

- 4 Distribute boundary data

Status: Boundary conditions for the 8 common domain experiments and the 25km eastern Caribbean experiments available at INSMET with a 60Gbyte hard disk for transfer to other institutes. Three years of global ERA data available on the PRECIS DVDs for the start of the sensitivity experiments, more to be supplied by the Hadley Centre.

- 5 Run initial simulations for a year and check carefully for boundary effects over important regions

Status: Awaiting running of initial experiments.

## **Collaborative and follow-up activities**

- 1 Organise efficient methods of data transfer
- 2 Provide information about progress on experiments and provide results when available
- 3 Organise a workshop to present and discuss results and further plans and liaise with users of the data
- 4 Produce a short publication to present the climate scenarios developed with PRECIS to potential users and other interested parties

## **Brief summary of sessions including questions and answers**

### **Monday 8th September**

#### **Introduction (Richard or RGJ)**

Jorge Barrantes: Can you use Precis for a week's forecast?

RGJ: PRECIS is designed for simulating climate thus to produce long simulations of present and future climate states.

Tom Bakkum: Does PRECIS run under Linux only? Will we get a Windows version?

RGJ: We have discussed this with the climateprediction.net project based at Oxford University and they have expressed an interest in doing this and if they do it will probably happen within the year.

John Charlery: Can we alter the land-sea mask to reflect sea-level rise?

RGJ: Effectively yes. We can edit the land-sea mask and give heights to land points, this is a possible way of doing this.

John Charlery: Is introducing RCM island grid-boxes for small real islands reasonable?

RGJ: Yes because it will provide more realistic temperature responses (as the thermal inertia effects of the introduced land surface in the gridbox will be more realistic and have a large impact), provide more realistic surface fluxes to the atmosphere and, if it has significant height, will interact with the atmospheric circulation.

Everson Peters: Can one do analysis part way through a long experiment e.g. after 5 years?

RGJ: Yes, one can access data from the start of the experiment up until the current model time.

Albert Owino: How do (RCM) model SSTs compare with observation?

RGJ: Observed SSTs (as in a time-series of monthly averages) are used for present day simulations. For the future, changes predicted from HadCM3 are added to these observed values. It was emphasised that the PRECIS RCM is atmos/land-surface model and does not include representations of the oceans and sea-ice.

#### **Regionalisation techniques (Ruth or RBET)**

Jorge Barrantes: Do you need to download the boundary conditions each time you run the model?

RBET: No, supplied in advance and available for sensitivity experiments/reruns etc.

Jorge Barrantes: How well does the model validate in terms of tropical cyclones?

RGJ/DCH: Well but a tendency to produce too many in some regions.

Gyan Shrivastava: What is the frequency of updating the boundary conditions?

RBET: Every timestep (interpolated from 6 hourly values) for the lateral boundary conditions and daily (interpolated from monthly values) for the surface boundary conditions.

Daniel Martinez: Is there a reference with details on the evaluation of twelve as an upper limit for the difference in resolution between driving and regional model?

RGJ: Denis et al (2003), Climate Dynamics 20: 107-126.

Daniel Martinez: Should you increase rim size as the difference in resolution between the RCM and its driving GCM increases?

RGJ: Good question, it may be an issue but we have not investigated.

Daniel Martinez: What is acceptable RCM deviation from the driving data?

DCH: These should not happen on the scale of the driving GCM but should happen on the scale resolved only by the RCM.

## **Demonstration of PRECIS (David or DCH)**

Jorges Barrantes: What happens to PRECIS if it is running and the power goes off?

DCH: The model saves data at monthly intervals to be able to restart in the event of unplanned loss of power.

Albert Owino: Can you use the PRECIS monitoring software to display derived variables (e.g. pmsl gradients)?

DCH: No, monitoring is to allow a simple overview of simulation progress not for serious model analysis.

Abel Centella: Can you get results for different periods other than 2080s?

DCH/RGJ: Yes by interpolation (or pattern scaling) but not direct model results (consequence of a choice about how best to apply scarce computing resources).

## **Tuesday 9th September**

### **Modelling the climate system (Ruth)**

#### **The PRECIS RCM (David)**

*Questions after the dynamics section:*

Gyan Shrivastava: Are there problems with solving the equations governing the behaviour of the state variables because they are coupled?

RGJ: No more so than in any non-linear coupled system. The simplified versions of the full partial differential equations and their source terms and the numerical techniques used to solve them, when carefully chosen, lead to stable solutions.

Michael Taylor: Are the rotated grids used standard?

DCH: Many RCMs use these sorts of grids and the grid (non-rotated) is used in many GCMs.

Michael Taylor: Is there documentation on the model components?

DCH/RGJ: Yes in the workbook and technical manual but also in depth in the UM documentation on the DVDs.

Albert Owino: Please explain whether the lack of explicit resolving of vertical motions implied by the hydrostatic approximation affects the simulation of e.g. hurricanes.

DCH: Vertical velocities and accelerations are second order with respect to those in the horizontal and thus can be ignored but are derived from horizontal convergence. Also, the impact of up/downdrafts in convective cells is represented.

Israel Borrajero: Is the model stable in the long-term (i.e. is there any drift)?

DCH: Yes. In the case of the RCM it is constrained to follow the evolution of the GCM and conservation of relevant quantities is ensured within the GCM.

*Questions after the physics section:*

Michael Taylor: Are there other parameterisation schemes available. e.g. ones which are more applicable for particular regions.

DCH/RGJ: No but the schemes are built to work globally both in the forecast and climate context.

*Questions after the boundary conditions section:*

John Charlery: What happens when you insert land point in the mask editing in terms of ancillary data?

DCH: It is interpolated from the nearest adjacent points where data is available. This may not be realistic in some places and soon we will make available (via the website) the ability to insert relevant values.

Israel Borrajero: Is the vegetation data global and at what resolution?

DCH: Yes and one degree (but a more detailed dataset will be made available soon).

Israel Borrajero: How frequently is the model updated?

DCH: The model timestep is five minutes.

Tom Bakkum: Can we look at the source data?

DCH/RGJ: Yes, using xconv and relevant points can easily be identified if the land-sea mask editing is run alongside.

Daniel Martinez: What are the boundary condition update intervals?

DCH: Lateral boundary conditions are updated every timestep, interpolated from 6 hourly GCM values. Sea surface boundary conditions are updated every day from monthly observed or observed+model values.

### **Demonstration of PRECIS data storage system and data processing/display (Ruth)**

The subsequent hands-on session associated with this generated much discussion about what the maps displayed represented as the default behaviour of the relevant software plotted a non-rotated map over the data. Work since at the Hadley Centre (by Simon Wilson) has since remedied this with the provision of facilities in Grads and VCDAT to plot maps consistent with the data fields.

## **Wednesday 10th September**

### **Uncertainties in the development of climate scenarios (Richard)**

Adrian Trotman: Aren't near-future effects more credible?

Yes because the uncertainty due to emissions will be less (generally insignificant until 2040) but there may be so much intermodel variation that any one (or some ensemble) may not have any useful information. Also, if the near-term signal is within the noise then essentially there will be no discernable change and thus natural variability will important process to be considered in the impacts or adaptation study.

Adrian Trotman: Has any work been done using pattern-scaling to get e.g. early 21st century effects?

Yes in the sense of the 2020s but no in the case of present day (i.e. around 2000) where for all but some very large regions the signal would not be seen above the noise of climate variability.

### **Designing RCM experiments (David)**

Michael Taylor: Are A2 and B2 the only scenarios available?

DCH: Currently yes from the Hadley Centre but there will be new experiments from us and other centres made available.

RGJ: More on other HadCM3/Echam etc lbc's ...

Michael Taylor: Do we get driving GCM data to compare with the RCM results.

DCH: Yes, for all experiments we supply lbc's for.

John Charlery: How do you generate coastlines for your RCM maps.

DCH/RGJ: This is software we have written and in the case of the PRECIS monitoring software this is written in python/CDAT and is available as part of the PRECIS installation.

### **In depth demonstration of PRECIS functionality: LAMPOS (David)**

## **Presentations from participants on plans for the projects where PRECIS is to be used**

### **Cathalac project - Rosendo Pichinte**

This project is to focus on future vulnerability over the central American/Caribbean region and will use PRECIS to provide climate change information as input to vulnerability studies. It is working with several central American countries and Cuba. Each country has its particular interest but it is regionally coordinated and similarly it is keen to see PRECIS experiments coordinated.

### **Work in Cuba - Abel Centella, Daniel Martinez**

Cuba is keen to run several PRECIS experiments and share results and will be able to run in parallel. It would like to see PRECIS being run for all of Mexico to the Antilles and from the US Gulf coast to Venezuela but not to include too much of the Atlantic. This is to ensure full country coverage whilst keeping integration times to manageable levels. The work in Cuba should produce climate scenario information in under 1 year.

### **Work in Mexico - Jose Luis Perez**

Mexico will run PRECIS experiments including using ERA driving data to compare with observations. Important issues are summer droughts and low-level jets from the Caribbean.

### **Work in Costa Rica - Jorge Barrantes**

A PC will be procured for running PRECIS and Costa Rica are keen to collaborate on running experiments.

### **Work in Panama/Cathalac - Derysbeth Martinez**

The project will procure a PC for running PRECIS and Panama will also take part in a coordinated set of PRECIS experiments. Results from PRECIS will be applied to vulnerability studies.

### **MACC project - Ian King**

MACC was preceded by two projects, CPACC and ACCC involving twelve Caribbean countries, mainly islands except Belize. CPACC established monitoring stations to record climate and sea-level rise. ACCC aimed to build capacity in the region with a focus on the University of the West Indies (UWI) three campuses and the Caribbean Institute for Meteorology and Hydrology. For climate applications statistical downscaling techniques were developed at the Mona campus and agriculture, water and health impacts were studied. MACC aims to add dynamical downscaling as another tool to provide data for these studies.

### **Work at UWI in Jamaica - Michael Taylor**

Part of an AIACC project on dengue fever which requires climate scenarios and would like to use PRECIS for this. Also, looks to provide high resolution climate scenarios generally for the region and is looking at other RCMs as well for this. There is some capacity for running models but MACC will provide more support.

### **Work at UWI in Trinidad - Everson Peters**

Keen to use climate scenarios but not interested in running models immediately (interested in building capacity slowly). Initially will use output from other institutes but eventually will aim at running 25km RCMs.

### **Work at UWI/ Caribbean Institute for Meteorology and Hydrology in Barbados - John Charlery/Albert Owino/Adrian Trotman**

Pointed out that there are very small islands in the Caribbean which are taking climate change very seriously. Keen to run experiments but do not have the capacity at present. The tropical Atlantic is important for cyclones. Interested in impacts, especially on crops, and looking specifically at precipitation.

### **Work in Peru - Gabriela Rosas (SEMANHI)**

Using CCM3/RAMS for seasonal (ENSO) forecasts and are responsible for providing climate scenarios and looking at GCM/RCM combinations for these. Interested also in impacts on glaciers and thus water supply.

## Thursday 11th September

### Climate scenario development (Richard)

#### *Types of climate scenarios*

Neville Trotz: What does "direct GCM or interpolated" box in diagram mean?

RGJ: Either using GCM grid-box data directly or interpolating them onto either a point or a finer spatial grid.

John Charlery: on the same diagram, why is the shaded area significant?

RGJ: An example of the procedure when applying MAGICC/SCENGEN

Abel: Can pattern scaling be used for regional climate model? What is the procedure? (do you still use global temperature change from simple climate model etc as for scaling global models?)

RGJ: Yes and yes. The boundary conditions for the RCM experiments come from the GCM for the 2080s and then use the RCM results to get patterns for other periods and scale (see the procedure used in the UKCIP 2002 scenarios provided for UK impacts modellers).

Albert Owino: Can you still justify using an RCM if the GCM projections aren't very credible?

RGJ: Yes there will probably still be some value, for example changes in precipitation extremes may well be driven mainly by higher moisture loadings in the atmosphere which would then be largely insensitive to different regional patterns derived from different projected changes in circulation.

Abel (experimental design slide): What is the cost ratio for running the different models?

RGJ/DCH: A factor of 1.5 when going from 50 to 25km when using the same number of grid-points and thus a factor of 6 if using the same area.

#### *Case-study on the use of climate scenarios in an impacts study*

Adrian Trotman: Were the modelled runoffs validated?

RGJ: Insufficient observations; runoff model relatively simple and has no routing. (The Arnell et al. paper is a sensitivity study to see the impact of using different precipitation scenarios.)

Gyan Shrivastava: What if you wanted to do e.g. 2005-2060?

RGJ: In this instance one could use the pattern scalings described above and apply this to the monthly precipitation evolutions from the different A2 ensemble members.

### PRECIS installation (David)

Ian King: Is the PRECIS documentation on DVDs.

DCH: Yes.

Jorge: What do we do about installing Linux.

DCH: This should be done by the supplier of the PC or by the system administrator.

### In depth demonstration of PRECIS functionality: Stopping and re-starting (David Hassell)

#### Initial discussions with participants on design of their PRECIS experiments

## Friday 12<sup>th</sup> September

### Participant work-plans and follow-up activities including publications (Richard Jones)

#### Detailed set-up of the 50km common domain land-sea mask

### In depth demonstration of PRECIS functionality: Import/Export regions (David Hassell)

#### Domains and masks set-up for domains for other 50km and 25km experiments