

**Analysis of Climate Change Simulations of Southeast Asia
(APN 99011)**

Project Leader:

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APN Funding

US\$ 51,486

List of participating countries

Australia, Cambodia, Fiji, India, Indonesia, Malaysia, Papua New Guinea, Philippines, Samoa, Singapore, Thailand, Vietnam

Introduction/Background

CSIRO Atmospheric Research has carried out large climate simulations for SARCS using the DARLAM regional climate model at 44 km resolution. These were for a domain 93°E to 152°E and 25°S to 22°N for:

- a) 1990 (an El Nino year), nesting within ECMWF analyses;
- b) 10-years for present CO₂ conditions nesting within the CSIRO transient atmosphere-ocean GCM;
- c) 10-years nesting in the GCM for CO₂ conditions 50 years from now;
- d) 10-years nesting in the GCM for CO₂ conditions 100 years from now.

Full model output was saved 12-hourly, and surface fields 3-hourly. Most features of the tropical climate system were captured in the simulations.

The present APN project was a 5-week workshop in Melbourne, starting 10 January 2000. The aim of the workshop was to assist climate scientists of the region to understand and make good use of the output from the SARCS simulations. Fifteen scientists were invited to participate. Melbourne was chosen as the venue to facilitate access to the large data sets and computing facilities, with ready provision and application of the analysis and graphics tools used at CSIRO. Valuable discussions were expected between the participants and between CSIRO staff from both the Regional Modelling and Climate Impacts projects. It was intended that the visiting scientists should become well equipped to carry out further analyses on return to their own countries.

During the visit, the objectives included giving assistance to:

- analysing the SARCS climate-change simulations in detail for Indonesia, Malaysia, Philippines, Singapore, Vietnam, and a Pacific Island State;
- examining rainfall and temperature changes, expected 50 and 100 years from now;
- examining rainfall variability within 10-year periods for selected places for
 - present conditions
 - 50 years from now
 - 100 years from now;
- examining the modelled variability, relating it to ENSO effects;
- examining diurnal and seasonal characteristics within the simulations, comparing with observations;
- comparing aspects of the simulations nested within analyses for both an El Nino and La Nina period, and relate to observed climate data and (where possible) agricultural production. To aid this objective, extra simulations were performed prior to the workshop for 1982 (El Nino) and 1988 (La Nina).

Outline of activities conducted

An extended lecture was given each morning on a topic relevant to climate change simulations or their analysis, as follows:

1. "Introduction to the workshop" J. McGregor, J. Katzfey and K. Nguyen
2. "Regional climate modelling and SARCS" J. Katzfey
3. "Use of statistics in climate research" K. Walsh
4. "Perspectives on global climate modelling" H. Gordon
5. "Tropical cyclones: structure and variability" K. Walsh
6. "The Southeast Asian Monsoon" R. Suppiah
7. "Seasonal predictability in the Australian Region" I. Smith
8. "Model intercomparisons: results from AMIP II" M. Dix
9. "Regional intercomparison of GCM results" P. Whetton
10. "Convective parameterizations" J. Katzfey
11. "ENSO and climate variability" R. Allan
12. "Observations and simulated changes in extreme temperatures and rainfall" K. Hennessy
13. "Climate change modelling" M. Dix
14. "Climate change detection and attribution: IPCC the Third Assessment Report" D. Karoly
15. "Comparison of different sensors for fire assessment in tropical rainforests" F. Siegertry
16. "Dynamical formulation of models" J. McGregor
17. "Coastal modelling and impacts for climate change" K. McInnes
18. "Description of a soil/canopy scheme in DARLAM" E. Kowalczyk
19. "Meeting supply and demand: reconciling climate model output with impact needs" R. Jones
20. "The Air Pollution Model (TAPM)" P. Hurley
21. "Aerosols" J. Jensen and M. Keywood
22. "New grid formulations" J. McGregor

Each afternoon, intensive tutorials were given to teach the participants (both for unix computers and PCs):

- how to access the output files of the CSIRO SARCS simulations;
- proficiency in manipulating netcdf files;
- proficiency with the Grads and Gnuplot computer graphics packages.

Each day the participants worked on their projects (one project per country) analysing selected aspects of the simulations, with ongoing guidance from the workshop tutors.

During the workshop the participants gave three short presentations on their projects covering: (a) background, (b) preliminary results, (c) concluding results. The final presentations were of a high standard, providing interesting and varied approaches. The participants demonstrated a great increase in their computer and analysis skills, and also produced short written reports.

During the final two weeks participants were also given the opportunity to carry out one-month regional climate simulations for their own country using DARLAM.

Outcomes/Products

- a) A 5-week workshop was carried out, successfully accomplishing all the intended objectives.
- b) The 15 participants sponsored by APN were trained in the analysis of large data sets produced by regional climate simulations.

- c) Three CD-ROMs were produced by CSIRO for the workshop. These contain monthly climatologies of all the prescribed simulations. All participants have been given copies of the CD-ROMs for use on return to their own countries.
- d) The participants brought a selection of station data, and learned how to compare them with the archived model grid-point data.
- e) Most participants learned how to run DARLAM for a 1-month simulation on a 44x44x18 grid over their own country and to graphically examine the output.
- f) A very high resolution (10 km) 12-month simulation was performed over Samoa.
- g) It was found that the DARLAM simulations for SARCS over Southeast Asia generally represent well the present-day climate for the region, with regard to rainfall and maximum/minimum temperatures. These results and others are described in the following draft country reports:
 - "Climate change modelling simulation for Cambodia" Pak Sokharavuth and Sum Thy
 - "Primary investigation and some initial climatic applications of the CSIRO model for Vietnam" Hoang Minh Hien
 - "Results of the DARLAM climatological simulations over Fiji: is there a signal for climate change over this region?" Nilesh Kumar
 - "Climatological model simulations for small islands (Samoa): 10 km resolution nesting the DARLAM model in a GCM" Sagato Tuiafiso
 - "Selected comparisons of model and observations for Indonesia" Mezak A. Ratag, Bambang Siswanto and Eddy Suaydhi
 - "DARLAM climate change simulations: rainfall analysis for the Philippine region" Felicidad Villareal
 - "Changes in wind patterns for the next 50 years over the area 5°S - 20°N and 95°E - 150°E " Zabani B. Md. Zuki
 - "Verification of DARLAM by comparing rainfall using observed and measured data with special emphasis on topographic effects " Kasis Inape
 - "Verification of precipitation simulated by DARLAM for Southeast Asia" Hu Yihong
 - "Comparison of various AOGCM runs for the Southeast Asian region with observations" Suruchi Bhadwal
 - "Comparison of climate model data and observation data: Thailand" Dararat Disbunchong, Anuchit Ratanasuwan and Wira Smalhe

Future directions/follow-up work

- The country reports are being revised, and after being reviewed they will be combined into a single technical report.
- The participants have been encouraged to continue their analyses by making use of the CD-ROMs on their own PCs.
- Future collaborations and projects
 - a number of participants wish to use DARLAM for climate research within their own institutions;
 - Vietnam, Cambodia, Laos and Australia are keen to formulate a regional climate modelling proposal for the 2001 APN round of proposals;
 - the present-day rainfall patterns from the Samoa run are very encouraging, and it is hoped to extend significantly the duration of this simulation.
- The contacts formed between the participants will be very valuable in future climate change activities.

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