Meeting summary: Project to Intercompare Regional Climate Simulations

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Abstract
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Disciplines
Atmospheric Sciences | Climate | Meteorology

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FULL TEXT

Headnote
William J. Gutowski Jr.,* Eugene S. Takle,+ and Raymond W. Arritt#

1. Introduction
The Project to Intercompare Regional Climate Simulations (PIRCS) held its second modelers workshop 5- June 1997 at Iowa State University, Ames, Iowa. Twenty-five scientists representing 16 modeling groups attended. The overall goal of PIRCS is to advance the status of regional climate simulation using atmospheric mesoscale models. In accordance with this goal, active participants convened several months after the release of the boundary conditions for the first PIRCS simulation experiment (Takle 1995) to discuss several topics:
* technical problems with performing the simulation;
* initial results from some models;
* strengths and limitations of the PIRCS boundary conditions;
* output archive requested from participating models; and
* observational data needs.
An underlying theme of these discussions was the challenge presented to PIRCS and the mesoscale climate-modeling community by the Working Group on Numerical Experimentation (WGNE) to evaluate thoroughly the feasibility of using mesoscale models for climate simulation.
PIRCS Experiment 1 was established during the first PIRCS workshop in November 1994 (Takle 1995). Participants at that workshop determined that the initial experiment should focus on the central U.S. drought of 1988 (Experiment la) and the floods of 1993 (Experiment lb), two periods offering strong signals of climate variability for the models to reproduce. These choices were motivated also by the substantial observational record available for evaluating simulations and the interest of the GEWEX ContinentalScale International Project in these episodes. A prominent mesoscale feature of this region is a nocturnal, low-level jet that plays a central role in the region's hydrologic cycle. Participants in the November 1994 workshop and follow-up discussions developed a standard output archive for participating models for diagnosing this feature and its interaction with regional energy and water cycles.
Workshop II was supported by the International Institute of Theoretical and Applied Physics (IITAP) at Iowa State and the Electric Power Research Institute (EPRI). Early in the workshop, J. Vary, acting director of IITAP, reviewed IITAP's support of PIRCS in the context part of IITAP's goal as a UNESCO (United Nations Educational, Scientific,
Cultural Organization)-sponsored institution to promote forefront research by scientists in developing countries. He also surveyed participants later in the workshop for their involvement with developing country scientists, stating that IITAP may be able to sponsor such interaction. C. Hakkarinen (EPRI) noted that EPRI has supported substantially efforts to understand climate change on the regional scale, partly to aid the Intergovernmental Panel on Climate Change in its periodic review of the science of climate change and its impacts on human society. Comments by Vary and Hakkarinen provided a broad context for the ensuing discussions.

2. Initial and boundary conditions
The initial and boundary conditions for Experiment 1 generated substantial discussion, particularly soil moisture. The relatively short lengths of Experiments 1a and 1b (60 days) prevent models from spinning up their own soil moisture field, so their simulations may be sensitive to the initial condition, which is poorly observed. (Informal discussion at the workshop suggested that about 90 days of simulation is necessary to spin up soil moisture.) The experiment’s initial soil moisture and atmospheric boundary conditions come from the reanalysis (Kalnay et al. 1996) produced by the U.S. National Centers for Environmental Prediction (NCEP) and National Center for Atmospheric Research (NCAR). J. Roads (Scripps Institution of Oceanography) presented analyses showing how the damping of the NCEPNCAR reanalysis soil moisture toward a specified climatology may not capture fully the climatological extremes of Experiment 1. A. Seth (The University of Arizona) relayed a suggestion from F. Giorgi (NCAR) that PIRCS provide multiple sets of initial soil moisture for a suite of simulations that would reveal sensitivity to this specification. No definitive conclusion was reached at the workshop, but the PIRCS organizers will continue to discuss this suggestion by electronic mail with participants and possibly prepare alternative initial soil-moisture conditions. W. Gutowski (Iowa State University) noted that one of the intents of PIRCS is to provide a common framework for sensitivity studies, such as the one suggested here, so that such simulation would be encouraged even if not formally part of Experiment 1. Finally, J. McGregor (Commonwealth Scientific and Industrial Research Organization, Australia) pointed out that deep-soil temperature also needs to be included in the initial conditions.

The original PIRCS Experiment 1 boundary conditions specified monthly mean SST. M. Botzet (Max Planck Institute for Meteorology) presented results showing how regional simulations could be sensitive to temporal evolution of SST, suggesting that SST should be updated from observations more frequently than monthly. S.-Y. Hong (NCEP) stated that the NCEP-NCAR reanalysis updates SST to daily intervals by interpolating weekly observed values. Participants generally agreed that while the simulation domain for Experiment 1 does not contain substantial ocean, PIRCS should nonetheless specify SST more frequently than monthly, in part to maintain consistency with the NCEP-NCAR atmospheric reanalysis output used for boundary conditions.

Further discussion of boundary conditions focused on specified surface properties. There was substantial disagreement over whether or not standards should be enforced for these and other specified features such as surface roughness and albedo. One group felt that adherence to such standards would reduce uncertainty over the causes of intermodel differences. Another felt that model surface specifications are determined in part for compatibility among all model parameterizations present and that the greater value of PIRCS simulations lies in comparing model performance with observations. Participants agreed, however, that PIRCS organizers should give maps of standard vegetation distributions and topography on the PIRCS Web site, both as references and to establish map contouring and coloring standards.

3. Archive of model output and observations
Another area of substantial discussion was the standard output archive that PIRCS organizers will collect from participating modelers and maintain for potential use by the climate-research community. The workshop gave the modelers an opportunity to review this archive after some had run initial simulations. Special attention focused on output for comparison with observations and output for intermodel diagnosis of mesoscale behavior. Participants recommended that the standard archive continue to emphasize diurnal cycles of energy and moisture fluxes at the surface. However, several consensus modifications emerged:
* Surface and top-of-the-atmosphere fluxes should be archived as 3-h accumulated values (eight values per day) at
all points on each model’s PIRCS domain to accommodate output storage restrictions faced by some.
* Surface wind stress should be similarly accumulated and saved.
* Surface pressure, sea level pressure, precipitable water, air temperature, and skin temperature should be sampled every 3 h.
* Convective and stable precipitation should be saved separately.
* Soil (surface) heat flux is defined as the net heat flux from the atmosphere into the model domain below the atmosphere.
* Runoff, accumulated over 24 h from 0000 UTC, should be archived.
* Archived soil moisture is the total amount of water in a grid box’s soil, sampled daily at 1200 UTC.
* Each model should give temperature, horizontal wind, specific humidity, geopotential height, and pressure at all levels on its grid at 0000, 0600, 1200, and 1800 UTC. (This will allow diagnosis of the region’s nocturnal, low-level jet without having to estimate a priori the location of its maximum strength.)
* Each modeling group should provide the latitude and longitude of their model’s grid points so that PIRCS can interpolate all output to a common 0.0 lat-long grid.
Modeling groups are encouraged to submit a supplemental dataset:
* hourly precipitation
* hourly atmospheric mixed-layer depth
* vertical “ sounding” profiles at selected locations
All participants agreed that having a variety of observations available would be of great benefit to individual as well as collective efforts to understand model behavior. Comparison with observations will also be necessary for addressing the WGNE challenge described above. These observations will be collected by PIRCS. Summary plots of observations will be displayed on the PIRCS Web site (http://www.pircs.iastate.edu) to allow modelers an initial check of their output with observations and also to establish map contouring and coloring standards for comparative study. Observations will emphasize diurnal variations, especially those like precipitation that are closely linked to mesoscale behavior such as the nocturnal, low-level jet. Some specific observational fields include hourly precipitation from first-order stations, four-times daily NCEP and European Centre for Medium-Range Weather Forecasts analyses, daily maximum/minimum temperatures, and satellite observations of radiative fluxes.
Several models performed Experiment la before the workshop and participants informally compared their preliminary output with several noteworthy features emerging. Models generally showed agreement with the observed time-average, large-scale circulation, though there were differences in details that were rather large at some points. Low-level jet output showed a diurnal variation with maximum strength at night. The degree of agreement in simulated precipitation between models and with observations varied greatly. Additional simulations and further diagnosis are clearly needed.
4. Conclusions
Final discussions considered potential follow-up PIRCS experiments. J. Hesselbjerg Christensen (Danish Meteorological Institute) advocated a suite of simulations at additional sites outside North America with relevant observations and model output that any person with a new model might run to assess model performance. Observations would include precipitation and surface air temperature at subdaily frequency and, ideally, observations of local mesoscale processes considered important for a site’s climate. Potential sites discussed included southeast Asia, southern Africa, and South America. In this light, C. Tanajura (National Institute for Space Research, Brazil) presented some results from mesoscale simulation of the South American low-level jet. Further information on PIRCS appears at http://www.pircs.iastate.edu.
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