# AMIP NEWSLETTER

No. 2 WGNE Atmospheric Model Intercomparison Project February 1992

An information summary and activities description for the Atmospheric Model Intercomparison Project (AMIP) of the World Climate Research Programme's Working Group on Numerical Experimentation (WGNE). Technical and computational support for AMIP is being provided by the Environmental Sciences Division of the U. S. Department of Energy through the Program for Climate Model Diagnosis and Intercomparison (PCMDI) at the Lawrence Livermore National Laboratory (LLNL) where this Newsletter is edited by Larry Gates. (Address: PCMDI, L-264, LLNL, P.O. Box 808, Livermore, CA 94550)

## Second AMIP Meeting

The second meeting of AMIP participants is being held 20-21 February 1992 at the Claremont Hotel in Berkeley, California (the same place as the first AMIP meeting in April 1991). More than 60 scientists are expected to attend, including representatives of 28 of the 30 AMIP participating groups, as well as observers from these and other organizations interested in atmospheric modeling and climate research. The meeting will feature reports on preliminary results from a number of groups, an update on PCMDI support, and plans for the implementation of diagnostic subprojects.

The decision to hold the AMIP meeting in conjunction with the meeting of the FANGIO (Feedback Analysis for GCM Intercomparison and Observations) group led by Bob Cess was made since both efforts are being supported by the Environmental Sciences Division of the U.S. Department of Energy, and since all of the modeling groups participating in FANGIO are also participants in AMIP. The meeting was also enriched by the special one-day session on Climate Model Intercomparison that was organized by the WCRP Steering Group on Global Climate Modelling, at which other intercomparison activities for atmospheric, oceanic and coupled climate models were described.

## AMIP Participation Update

Since September 1991 three new atmospheric modelling groups have joined AMIP, bringing the total number of participants to 30; AMIP now includes virtually the entire global atmospheric modeling community. The three new participants are the Argonne National Laboratory (ANL, Argonne, Illinois), the Hydrometeorological Center (HMC, Moscow) and the Japan Meteorological Agency (JMA, Tokyo). An update on the status of these and other AMIP model simulations is given in the table on page 2.

In view of the arrangements necessary in many cases to ready model codes for execution on the CRAY 2 at NERSC/Livermore, it has proven more efficient to run the entire 10-year simulation rather than just the first 5 years as originally envisaged. While this has delayed the start of some simulations, sufficient time has been allocated to PCMDI by the DOE in 1992 to complete those simulations now in progress at LLNL, and time is expected to be available in 1993 to complete those remaining.

According to the latest available information (see table), four groups have now completed the AMIP simulation, while another thirteen groups have the simulation in progress. Of those groups computing at LLNL, several have sent representatives to PCMDI for periods of one or two weeks in order to ready their model codes for execution on the NERSC CRAY 2(s), while other groups have been able to access NERSC remotely. All groups, whether computing at LLNL or elsewhere, are urged to make arrangements for the submission of the monthly averaged AMIP Standard Output and the experiment's history of state to PCMDI for archival storage as soon as possible after the completion of the simulation.

## AMIP Participation Status

| Group | Contact(s) | Model | Computing @LLNL | Computing Elsewhere |
|---|---|---|---|---|
| ANL | Oh | 4°x5° L7 | - - - | |
| BMRC | McAvaney | R31 L19 | in progress | |
| CCC | Boer | T32 L10 | | in progress |
| CNRM | Mahfouf/Cariolle | T42 L30 | | in progress |
| COLA | Straus | R40 L18 | in progress | |
| CSIRO | Hunt | R21 L9 | | in progress |
| CSU | Randall | 4°x5° L17 | completed | |
| DNM | Galin/Dymnikov | 4°x5° L7 | completed | |
| ECMWF | Ferranti/Burridge | T42 L19 | completed | |
| GFDL | Wetherald | R30 L9 | | - - - |
| GFDL/DERF | Miyakoda | T42 L18 | | completed |
| GISS | Lo/Del Genio | 8°x10° L9 | | - - - |
| GLA | Lau/Fiorino | 4°x5° L17 | in progress | |
| HMC | Trosnikov | T21 L15 | - - - | |
| IAP | Zhang/Zeng | 4°x5° L2 | in progress | |
| JMA | Sato | T42 L21 | | - - - |
| LANL | Kao | R15 L20 | - - - | |
| LMD | Le Treut | 3.6°x5.6° L11 | | in progress |
| MGO | Meleshko | T30 L14 | in progress | |
| MPI | Dümenil/Schlese | T 42 L19 | completed | |
| MRI | Kitoh/Tokioka | 4°x5° L15 | - - - | |
| MSFC | Fitzjarrald | T42 L12 | - - - | |
| NCAR | Williamson | T42 L18 | completed | |
| NMC | van den Dool/Kalnay | T 40 L18 | | - - - |
| NRL | Rosmond | T42 L18 | | in progress |
| SUNYA | Wang/Liang | R15 L12 | - - - | |
| UCLA | Mechoso | 4°x5° L17 | in progress | |
| UGAMP | Blackburn/Slingo | T42 L19 | in progress | |
| UILL | Schlesinger | 4°x5° L7 | - - - | |
| UKMO | Rowell | 2.5°x3.75° L20 | | in progress |

## Properties of New AMIP Models

The acquisition of documentation on the AMIP models has continued, and their principal properties are being comprehensively summarized in both printed and electronic format. In the meantime, in order to update the abbreviated listing of model properties given in the AMIP Newsletter No.1, summary information is given below for the three new participating groups.

| | ANL | HMC | JMA |
|---|---|---|---|
| Horizontal Resolution | 4x5 | T21 | T42 |
| Vertical Coord./Levels | $\sigma$/7 | $\sigma$/15 | Hybrid/21 |
| Diurnal Cycle | Yes | No | Yes |
| Radiation Scheme | Oh-Schlesinger | Geleyn-Hollingsworth | Lacis-Hansen, Sugi et al. |
| Cloud Scheme | Oh-Schlesinger | Geleyn-Tiedtke | Saito and Baba |
| Prognostic Cloud Water | Yes | No | No |
| Convection Scheme | A-S | Kuo | Kuo |
| Horizontal Diffusion | No | 4th-order | 4th-order |
| Gravity-Wave Drag | No | Pichugin | Iwasaki et al. |
| Number Soil Layers for Temp./Moisture | 1/1 | 2/2 | 4/3 |

## AMIP Model Documentation

The PCMDI is developing computerized database summaries of the principal properties of all of the models participating in AMIP. These summaries comprise a subset of a more comprehensive database of the major historical versions of extant GCMs which we are developing as part of our mission to facilitate model intercomparison studies by the international climate community. PCMDI is implementing these model summaries both in Macintosh Hypercard and in Oracle relational database formats because of their complementary capabilities. Hypercard, for example, is widely distributed and can be used without any knowledge of a computer language, while Oracle permits logical queries to be made on selected models or properties and can generate corresponding printed tables. The Hypercard database now includes detailed summaries of the properties of about a dozen of the AMIP models and citations to documents on their numerical, dynamical and physical properties. The Oracle relational database presently includes only brief initial summaries of each AMIP model, such as those appearing in the table above; as more detailed information on each AMIP model is acquired, PCMDI will extend the properties that are tracked by the Oracle database. By the end of 1992 we anticipate completion of the detailed Hypercard and Oracle summaries of all AMIP models and publication of a users guide to the databases. However, achieving this goal is contingent on receiving the necessary documentation from AMIP participants and their cooperation in verifying the accuracy of the database entries.

## AMIP Standard Output (Revised)

Although no additional variables have been added to the list of monthly-averaged Standard Output quantities given in the AMIP Newsletter No.1 (September 1991), there have been a number of revisions in the contours recommended for use in the display of these data. (These changes should not effect participants, since it is anticipated that each group will transmit their model's calculations of the Standard Output to PCMDI, who will then be able to make figures of the data in the defined format on request.) For the record, a reorganized listing of the required Standard Output is given in the table below, to which we have also explicitly added information on the requested variances (defined as the monthly variance of the daily averages about the monthly mean).

In addition to the production of the standard output described above, each AMIP participating group is expected to prepare a daily history of state (i.e., the distributions of the variables needed for restart, such as velocity, geopotential, temperature, humidity, surface pressure, soil moisture and snow mass) for archival storage at PCMDI. In order to be compatible with the standard output, these history variables should be in the same units as indicated below.

## AMIP Standard Output (Revised)
(Monthly means for each month of 1979-88)

| No. | Variable | Units | Contour Interval (Reference Contour) |
|---|---|---|---|
| Set 1 | Global distribution of means of surface and 2-D variables | | |
| 1 | Sea-level pressure | hPa | 5 (1020) |
| 2 | Variance | $(hPa)^2$ | 25 (100) |
| 3 | Temperature (ground) | C | 5 (0) |
| 4 | Variance | $C^2$ | 10 (10) |
| 5 | Surface air temperature | C | 5 (0) |
| 6 | Variance | $C^2$ | 10 (10) |
| 7 | Total cloudiness | percent | 20 (20) |
| 8 | Total precipitable water | mm | 5 (5) |
| 9 | Soil moisture | cm | 2.5, 5, 10, 20 |
| 10 | Snow mass | $kgm^{-2}$ | 2000 (2000) |
| 11 | Precipitation (accumulated) | mm/day | 2.5, 5, 10, 20, 40 |
| 12 | Evaporation (accumulated) | mm/day | 2.5, 5, 10, 20 |
| 13 | Eastward wind stress (accumulated) | $Nm^{-2}$ | 0.1 (0) |
| 14 | Northward wind stress (accumulated) | $Nm^{-2}$ | 0.1 (0) |
| 15 | Sensible heat flux (accumulated) | $Wm^{-2}$ | 40 (0) |
| 16 | Net surface short-wave flux (accumulated) | $Wm^{-2}$ | 50 (0) |
| 17 | Net surface long-wave flux (accumulated) | $Wm^{-2}$ | 50 (0) |
| 18 | Top-of-atmosphere net short-wave flux (accumulated) | $WM^{-2}$ | 50 (0) |
| 19 | OLR (accumulated) | $Wm^{-2}$ | 50 (0) |
| 20 | Cloud radiative forcing (METHOD II) | $Wm^{-2}$ | 25 (0) |

## AMIP Standard Output (Revised)
(Monthly means for each month of 1979-1988)

| No. | Variable | Units | Contour Interval (Reference Contour) |
|---|---|---|---|
| Set 2 | Global distribution of means of 3-D variables | | |
| 21 | Temperature at 200 hPa | C | 2 (0) |
| 22 | Variance | $C^2$ | 2 (0) |
| 23 | Temperature at 850 hPa | C | 5 (0) |
| 24 | Variance | $C^2$ | 5 (5) |
| 25 | Geopotential height at 200 hPa | m | 160 (1200) |
| 26 | Variance | $m^2$ | 6000 |
| 27 | Geopotential height at 500 hPa | m | 80 (5500) |
| 28 | Variance | $m^2$ | 3000 (5500) |
| 29 | Geopotential height at 850 hPa | m | 40 (1500) |
| 30 | Variance | $m^2$ | 2000 (6000) |
| 31 | Specific humidity at 200 hPa | g/kg | 0.025 (2) |
| 32 | Variance | $(g/kg)^2$ | 0.0002 (0.0002) |
| 33 | Specific humidity at 850 hPa | g/kg | 2 (2) |
| 34 | Variance | $(g/kg)^2$ | 1 (2) |
| 35 | Zonal wind at 200 hPa | $ms^{-1}$ | 10 (0) |
| 36 | Variance | $(ms^{-1})^2$ | 40 (40) |
| 37 | Zonal wind at 850 hPa | $ms^{-1}$ | 5 (0) |
| 38 | Variance | $(ms^{-1})^2$ | 20 (40) |
| 39 | Meridional wind at 200 hPa | $ms^{-1}$ | 5 (0) |
| 40 | Variance | $(ms^{-1})^2$ | 40 (40) |
| 41 | Meridional wind at 850 hPa | $ms^{-1}$ | 5 (0) |
| 42 | Variance | $(ms^{-1})^2$ | 10 (40) |
| 43 | Streamfunction at 200 hPa | $10^6 m^2 s^{-1}$ | 4 (0) |
| 44 | Variance | $(10^6 m^2 s^{-1})^2$ | 1 (1) |
| 45 | Streamfunction at 850 hPa | $10^6 m^2 s^{-1}$ | 1 (0) |
| 46 | Variance | $(10^6 m^2 s^{-1})^2$ | 0.5 (0.5) |
| 47 | Velocity potential at 200 hPa | $10^6 m^2 s^{-1}$ | 0.5 (0) |
| 48 | Variance | $(10^6 m^2 s^{-1})^2$ | 0.05 (0.05) |
| 49 | Velocity potential at 850 hPa | $10^6 m^2 s^{-1}$ | 0.5 (0) |
| 50 | Variance | $(10^6 m^2 s^{-1})^2$ | 0.05 (0.05) |
| Set 3 | Meridional-vertical distribution of zonal means | | |
| 51 | Temperature | C | 0.5 (0) |
| 52 | Specific humidity | g/kg | 1 (1) |
| 53 | Relative humidity | percent | 10 (10) |
| 54 | Cloudiness | percent | 10 (50) |
| 55 | Zonal wind | $ms^{-1}$ | 5 (0) |
| 56 | Meridional wind | $ms^{-1}$ | 1 (0) |
| 57 | Meridional streamfunction | $10^9$ kg $s^{-1}$ | 20 (0) |

## AMIP Diagnostic Subprojects

Although a wealth of important information on the models' individual and collective performance will be provided by the Standard Output statistics, deeper insight into the models' portrayal of specific physical mechanisms or their performance from regional or phenomenological viewpoints requires a more focussed diagnosis of the results.

To promote the orderly establishment of such Diagnostic Subprojects, the following procedures should be followed.

*Subproject proposal*. A brief proposal should be submitted to the WGNE AMIP Panel (W.L. Gates, Chairman) containing the following information: The title and purpose of the subproject, the subproject leader and the anticipated participants, the simulated data needed (variable(s), time(s), region(s) and level(s)), a description of the diagnostic calculations to be made, and identification of the data envisaged for validation. Indication should also be given of your agreement to provide a set of your diagnostic results for archival storage at PCMDI, your willingness to work in cooperation with PCMDI and representatives of the modeling groups whose data is used, and your agreement to submit a report as outlined below.

*Implementation.* After review and approval by the Panel, the PCMDI will asist the subproject leader and participants in the generation of the necessary data from those models whose AMIP output is available at Livermore. If the model data requirements can be met from the monthly-averaged Standard Output (which is expected to be available in a defined format at PCMDI for all models), then PCMDI should be able to provide as much of these data as requested and may also be able to assist in the calculation and display of the results. If the diagnoses require data that can be generated only from the model history-of-state files (which may not be available at PCMDI for all models), then PCMDI will assist in the data acquisition and calculations to the extent possible.

*Report* After completion of the subproject (or at a suitable point during its implementation), a scientific report should be submitted to the AMIP Panel for inclusion in the WGNE/WCRP report series (whose publication does not preclude publication of results in a peer-reviewed journal). In due course it is planned to convene an international scientific conference on AMIP, at which a comprehensive report could be made.

At the present time, planning is underway for AMIP Diagnostic Subprojects in the following areas:

| | |
|---|---|
| Surface boundary fluxes | (Dave Randall)<br>(Peter Gleckler) |
| Stratospheric phenomena | (Carlos Mechoso) |
| Polar phenomena and sea ice | (John Walsh)<br>(HowardCattle)<br>(Carlos Mechoso) |
| MSU validation | (John Christy)<br>(Richard McNider) |
| Monsoons | (Tim Palmer)<br>(Mike Fennessy) |
| 30-60 day oscillations | (Julia Slingo)<br>(Ken Sperber) |
| Cloud radiative forcing | (Bob Cess)<br>(Jerry Potter) |
| High southern latitude phenomena | (Bryant McAvaney)<br>(Ian James)<br>(Ian Simmonds) |
| Angular momentum and LOD | (Raymond Hide) |

Here the individuals named are the projects' provisional organizers who have indicated their intention to submit a subproject proposal. Other diagnostic subproject areas that have been informally discussed are blocking, three-dimensional cloud distribution, storm tracks, the energetics of the atmospheric circulation, and the global heat and hydrologic budgets. AMIP participants are urged to participate in these projects and to propose others according to their interests.

## AMIP Validation Data

The availability of observational datasets that will serve to validate model performance is essential to meeting the goals of AMIP. To this end PCMDI has acquired a number of major climate datasets that are generally global in extent, gridded, and temporally averaged to monthly time scales covering the AMIP period (Jan 1979 to Dec 1988). (To meet other requirements, data for other variables and periods not specifically related to AMIP have also been added to the PCMDI data inventory.) These uniformly-formatted files are now available in a single directory stored on optical disk that permits ready access. Over and above conventional climatological datasets that do not address specific AMIP months, the major datasets now in the AMIP data archive are given in the table below. All AMIP participants are invited to identify other observational data that they feel would be useful.

| Variable | Source | Period | Status |
|---|---|---|---|
| Temperature | ECMWF analyses | 1980-1988 | All in DRS |
| | NMC analyses | 1979-1988 | " |
| Geopotential | ECMWF analyses | 1980-1988 | " |
| | NMC analyses | 1979-1988 | " |
| Wind | ECMWF analyses | 1980-1988 | " |
| | NMC analyses | 1979-1988 | " |
| Relative humidity | ECMWF analyses | 1980-1988 | " |
| Cloudiness | ISCCP | 1983-1986 | Partly in DRS |
| Precipitation | GPCP | 1987-1988 | Being acquired |
| Radiation at TOA | ERBE | 1985-1986 | All in DRS |

## DRS and PCMDI Graphics Software

PCMDI has developed the DRS (Data Retrieval and Storage) management system for storing and visualizing model-generated and observational data. DRS is a file-oriented system of libraries and utilities that support a machine-independent data file format.

- The *DRS library* is the programming interface to DRS, and supports both C and Fortran languages. It is supported both on Sun/SunOS and Cray/Unicos systems. Files may be transferred between systems, and accessed without explicit translation; I/O is direct access. The fundamental data structure supported by DRS is arrays of up to four dimensions. Descriptive information about the array and its dimensions may be stored. Routines are available in the library for extracting data slices in any number and combination of dimensions, as well as reversing dimension directions, transposing dimensions, and wrapping longitudinal dimensions.

- The *PCMDI graphics package* is a menu-driven, point-and-click utility that allows the user to interactively select data from DRS files, and create, modify, and manipulate graphic displays to produce two-dimensional plots and three-dimensional animations. The software runs within the SunOS (v.4.0.3 or higher) environment, under Sunview and Open Windows v .2.0.

Supporting this software is an interactive utility currently available on Sun and Cray systems for browsing DRS files, and a utility that supports translation of non-DRS files into DRS format, as well as the merging and extraction of DRS files.

## Future AMIP Plans

As the AMIP simulations are completed and as the models' Standard Output and history-of-state files are accumulated at Livermore during 1992 and 1993, PCMDI will place these data in archival storage in DRS format. During this period and beyond it is anticipated that emphasis in AMIP will progressively shift to the analysis and intercomparison of the results. To these ends PCMDI will use the AMIP results for the preparation of summary reports for WGNE on mean seasonal model performance and associated systematic errors in cooperation with the participants. PCMDI will also use the Standard Output and history data in support of AMIP Diagnostic Subprojects as noted on page 6.

The current versions of both the DRS and associated PCMDI Graphics software described on page 7 are available for use by AMIP participants upon request. (Inquiries should be addressed to Bob Mobley.) These software permit the efficient storage, retrieval and display of large model (and observed) data sets, and PCMDI is continuing to enhance the capabilities of the DRS system. An improved (and more portable) version of PCMDI Graphics is expected to be available in the Spring of 1992.

The next AMIP meeting is planned for mid-1993 at a location yet to be determined; the possibility of holding the meeting outside the United States is under consideration.

## AMIP Contacts

Questions, suggestions and comments on AMIP are welcome, and may be directed to the following:

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