UCRL-MI-134869

AMIP NEWSLETTER

No. 9 **WGNE Atmospheric Model Intercomparison Project** **July 1999**

An occasional information summary and activities description for the Atmospheric Model Intercomparison Project (AMIP) of the Working Group on Numerical Experimentation (WGNE) in support of the World Climate Research Programme. Support for AMIP is 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 Peter Gleckler, Chairman, WGNE AMIP Panel. Questions or comments concerning the Atmospheric Model Intercomparison Project should be sent by email (preferred) to amip@pcmdi.llnl.gov or addressed to: The AMIP Project Office, PCMDI, L-264, LLNL, P.O. Box 808, Livermore, CA, 94550, USA.

Comprehensive project information is regularly updated on the AMIP homepage at the following Web sites:

http: //www-pcmdi.llnl.gov/amip (USA)
http://www.lmd.jussieu.fr/pcmdi-mirror/amip (Europe)
http://www.BoM.GOV.AU/bmrc/clch/pcmdi-mirror/amip (Australia)

Contents

1. AMIP II: Status Report

1.1 Overview

Since the establishment of the AMIP II guidelines (Newsletter No. 8), project updates have been limited to the AMIP homepage. During this interim, many modeling groups have devoted substantial resources to preparing their model for AMIP II, PCMDI has solidified its infrastructure support for the project, and the WGNE AMIP Panel has worked to establish diagnostic subprojects. After much preparation, a new and more extensive phase of AMIP research is about to begin.

Some modeling groups have been actively studying their AMIP II experiments, and a few have already published results. The first release of AMIP II model output is about to be distributed to approved diagnostic subprojects. PCMDI is beginning to provide modeling groups with a ‘quick-look’ diagnosis of their AMIP II simulations, and with analysis and intercomparison intensifying, the AMIP Project Office is poised to disseminate information more regularly.

The WGNE continues to endorse AMIP, and has expressed interest in having it further established as a community-based experimental protocol that modelers revisit every few years. Increased coordination between AMIP and the Coupled Model Intercomparison Project (CMIP) has also been identified as a key strategy for the continued development of a climate modeling infrastructure.

1.2 Experimental Protocol Update

The AMIP II experimental protocol, as documented in Newsletter No. 8, resulted from several years of active discussions involving more than 100 project participants. Protocol refinements and corrections since Newsletter No. 8 have been posted on the AMIP homepage, and several are repeated here:

Experiment design

SST and Sea-Ice boundary conditions: The AMIP II SSTs and sea-ice are available via the AMIP homepage. Upon request, these boundary conditions are generated from observations at the desired model resolution. Note, these boundary conditions are not the original observations themselves, but rather a data set that preserves the observed monthly means when they are linearly interpolated to daily values, as is done in most models.

The WGNE has recommended that PCMDI routinely update these data so that modelers can run their integrations to near-present. While preparing to do this, it was discovered that beginning in 1995 the AMIP SSTs are in error, in some locations as much as 0.5C. (When the AMIP data set was constructed, 1995-1996 data was still an operational product). Problems such as this should be further reduced in the near future. NCEP and the UK Met Office are currently coordinating to develop an improved and consistent SST and sea-ice data set. This product is expected soon, and when it is ready PCMDI intends to adopt it for use in AMIP. Exactly how this data set will be used to supersede the current one will require careful study, and will best be determined when the new data set is completed and comparisons have been made. In the mean time, PCMDI will continue to offer boundary conditions to near present. This is preferable to modelers' updating the data themselves, because the observed monthly means are preserved when the data set provided by PCMDI is used. If new observations are simply added to the data set provided by PCMDI, there will be a temporal inconsistency, with a variance reduction of monthly global anomalies in the updated years of about 15%.

Additional resources: A link is available on the AMIP homepage to facilitate the exchange among climate modelers of data or code that may be useful for AMIP simulations. These resources have been offered by some modelers and requested by others. Suggestions for the Additional Resources should be sent to amip@pcmdi.llnl.gov. Currently available: 1) The CCCma sea-ice thickness climatological data set and 2) Fortran subroutines for surface-air temperature and moisture (2m), and wind (10m)[1].

Correction: Recommendation for total atmospheric mass - the observed global average surface pressure of 982.4 hPa given in the Experimental Design of AMIP Newsletter No. 8 is for dry atmospheric mass.

Standard Model Output

The AMIP standard model output represents a concerted effort to find a reasonable balance between the data needs of the diagnostic community and the practical limitations faced by modelers. Literally hundreds of recommendations made by participants were evaluated during the development of this listing. The AMIP Project Office still regularly receives suggestions for the AMIP standard model output, an inevitable state of affairs given the diverse range of interests in climate modeling and diagnostic communities. While including many climate variables at a high sampling frequency is not practical at present, a broader range of diagnostic fields may deserve further consideration in the years ahead.

It is not reasonable to expect the modeling community to adhere to a continuously evolving standard model output listing. However, given the need for the project to adapt to the advancement of climate model diagnosis, the standard output will be reviewed by the WGNE AMIP Panel on an annual basis, and recommendations will be reported to the

[1] Based on: Hess and McAvaney, 1997: Note on computing screen temperatures, humidities and anemometer height winds in large-scale models. Aust. Met. Mag., 46, 109-115

WGNE during its annual meeting (usually early November). While the intent of this review process will be to provide for future scientific needs, it is generally believed that the current AMIP standard model output listing will serve as a reasonable foundation for most diagnostic studies. Annual revisions will likely be minor, and may even include the removal of some fields. The most likely candidates for revision are cloud-related fields and land-surface quantities, both of which are deficient on the current listing. The modeling community will be notified of any output refinements following the annual meeting of the WGNE. Suggested refinements are welcome.

Corrections and minor revisions made to the AMIP Standard Model Output since its original publication (Newsletter No. 8) are documented on the AMIP homepage. In anticipation of the needs of future research interests, the AMIP Panel recommends that modeling groups save monthly "restart" files from their AMIP simulations.

1.3 Modeling group participation

Thirty-five modeling groups (see Appendix A) have indicated their intent to participate in AMIP II. About half have sent part or all of their first AMIP II simulation to PCMDI. Another third have estimated completion before the end of this year. Output from these runs will be distributed to approved diagnostic subprojects following extensive quality control and data organization done at PCMDI (Section 2.3).

1.4 Diagnostic subprojects

The AMIP Panel has reviewed nearly 50 diagnostic subproject proposals for AMIP II. To date, 25 have been approved, and many others are being revised. The expectation is that the diagnostic subprojects will provide in-depth analyses of model results that go beyond the PCMDI "quick-look" analysis that will be reported directly to modeling groups (see Section 2.5). The proposal review process is therefore more stringent than in the past. However there are more areas that the WGNE would like to see studied, so proposals are still being accepted. Proposal submission information can be obtained from the AMIP Project Office or the AMIP homepage. A current listing of approved subprojects is shown in Appendix B.

1.5 Experimental Subprojects

A small number of supplemental numerical experiments are now being organized within the framework of AMIP. In contrast to the standard experimental protocol, which involves most of the modeling community, the experimental subprojects are small scale, with only a handful of groups participating. To date, the following AMIP experimental subprojects have been established:

No. 1: Multiple realizations: To assess the statistical significance of certain simulation characteristics, it is necessary to perform an ensemble of integrations that are identical except in their initial conditions. A minimum of six simulations is requested for this exercise, plus a 20-year run with climatological SSTs and sea-ice. A specified subset of the AMIP model output has been identified for these runs.

No 2.: Resolution experimentation: No 2.: Some modelers have suggested that AMIP be used as a forum to study resolution sensitivity, an issue that continues to be a question of fundamental concern. There have been a number of resolution studies (e.g., the recent European project HIRETYCS), most focusing on horizontal resolution. Designing an effective experiment to consider both horizontal and vertical resolution is difficult. Moreover, it may be unrealistic to expect that such tests can be implemented the same way in various models. Efforts are currently underway to initiate this subproject by cataloging diagnostics observed to be sensitive to resolution in previous studies as well as additional diagnostics that have not been examined but might be sensitive to resolution.

No. 3: TOVS-HIRS/MSU model validation: The objective of this project is to simulate selected TOVS/HIRS and TOVS/MSU channels using GCM model input data. The proposal is for interested modeling groups to run specified routines that compute brightness temperatures for selected channels during their AMIP integrations. These can then be compared to radiance data now being developed under NASA/NOAA TOVS pathfinder archives. The sampling strategy for this exercise is specified as described on the project's homepage.

For additional information on these experimental subprojects see the AMIP homepage.

2. PCMDI Support

2.1 Coordination

AMIP is reviewed at the annual sessions of the WGNE every November. PCMDI continues to support AMIP, with the WGNE AMIP Panel providing scientific guidance. To the extent possible, PCMDI will support project workshops as AMIP evolves. Design and development of supporting software continues to be an important objective of the PCMDI.

2.2 Model Documentation

A template for model documentation has been constructed based on participant feedback. Existing (AMIP I) model documentation is compatible with this new template, but some additional model features have been added. Instructions for the preparation of model documentation may be accessed via the AMIP homepage.

2.3 Data management

The AMIP model database is rapidly approaching terrabyte-scale. A big challenge for PCMDI's support of AMIP and other projects is to ensure efficient quality control, organization, and distribution of AMIP data to diagnostic subprojects.

The development of the Library of AMIP data Transmission Standards (LATS[2]) has been key to the coordination of AMIP II. The LATS Fortran and C interfaces constrain the organization of model output but give the user the option of writing netCDF or GRIB data adhering to recognized data conventions (COARDS[3] and WMO GRIB[4] respectively). All AMIP II data provided to PCMDI have been LATS-generated, which has revolutionized PCMDI's capacity to manage the project. However, LATS was not designed as an all-purpose utility. While some groups are using it for various of applications, others find it is too restrictive. Regardless, LATS has helped many realize the value of data *conventions* for collaboration.

Although the COARDS convention enables scientists to use a variety of analysis software, it is not optimal for the management of climate model data. To address this widely recognized concern, an enhanced (beyond COARDS) set of metadata has been identified specifically in support of climate research. Version 1.3 of this "GDT"[5] (named after the authors Gregory, Drach and Tett) convention for climate data is rapidly gaining in popularity. GDT can be used to ensure consistency with COARDS, and thus software able to ingest COARDS data can work with GDT as well, and potentially take advantage of added features.

Proprietary formats are probably still the most common among modeling groups, but netCDF and GRIB are among several that have been firmly established. Using COARDS and GDT, those providing netCDF output to PCMDI in the future will have the choice of using LATS or simply adhering to a few key convention items. Although potentially more compact, the situation with GRIB is less desirable. Until GRIB2 standards have been firmly established, GRIB data provided to PCMDI needs to be LATS-generated.

PCMDI has developed a versatile system to efficiently organize all project data in a common file/directory structure. Data distributed to diagnostic subprojects will be quality controlled, GDT-compliant (COARDS compatible) netCDF data. Taking advantage of the COARDS convention should ensure that a wide variety of freely available software[6] can be used to read the data.

Despite advances with conventions and powerful new tools (Section 2.4), to date PCMDI has not provided feedback to modelers (Section 2.5) as quickly hoped. The problem has been data overload, and inadequate hardware to deal with it. Happily, PCMDI has just acquired a local access RAID system, with ~1 Tb available for AMIP. This will enable PCMDI to follow through on its commitment to the community.

---

[2] http://www-pcmdi.llnl.gov/software/lats
[3] http://ferret.wrc.noaa.gov/noaa_coop/coop_cdf_profile.html
[4] http://dao.gsfc.nasa.gov/data_stuff/formatPages/GRIB.html
[5] http://www-pcmdi.llnl.gov/drach/GDT_convention.html
[6] www.unidata.ucar.edu/packages/netcdf/software.html

2.4 Supporting software

PCMDI has invested considerable effort into developing software in support of AMIP and other modeling projects. These tools are available from PCMDI at no charge, including free support for projects supported by PCMDI.

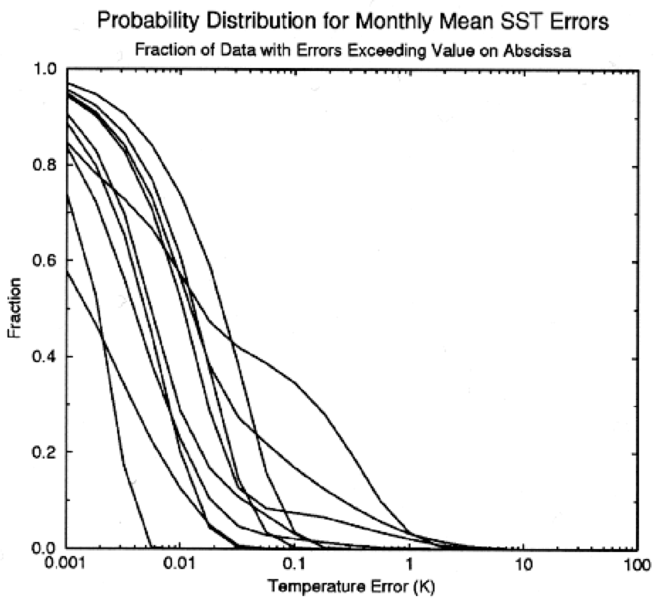
The newest PCMDI software product, the Climate Data Analysis Tool (CDAT), is an advanced computational, data organization and visualization system. CDAT is interfaced (script or interactive) with the PCMDI Visualization and Computation System (VCS, see AMIP Newsletter No. 8). CDAT uses Python, an interpreted, interactive, object-oriented scripting language, as its centralized module. The learning curve for CDAT is gradual, allowing the novice to quickly obtain useful results; yet the modular design of CDAT and the use of Python make it easy to add user-designed C, C++ subroutines to share modules and routines in collaborative projects. Fortran subroutines will be accessible in the next release.

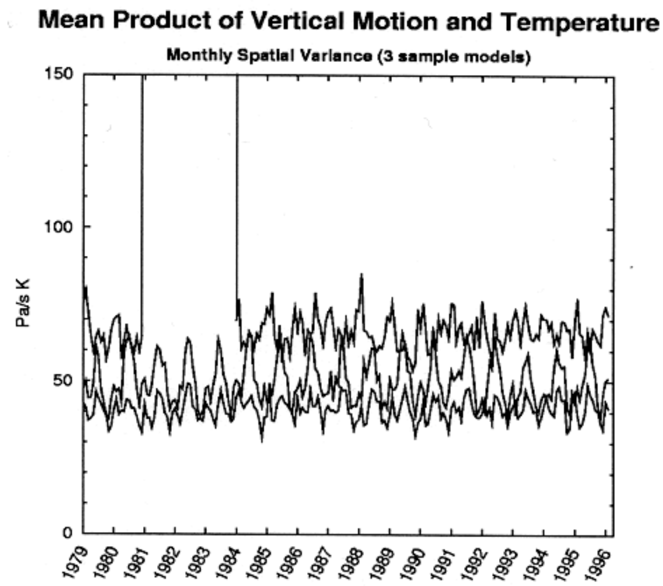
CDAT uses existing software products developed at PCMDI, with the Python programming language providing the glue to coordinate this software in a single package. Python has many built-in functions, basic mathematical operations, an import extension language for application modules, very clear scripting syntax, and powerful data structures. Orbital Python modules which were written to perform the functions of existing PCMDI software products include: the Common Data UNIform File (cdunif) reader module, which ingests large climate datasets in netCDF, HDF, DRS, and GrADS/GRIB format; the Visualization and Computation System (VCS) module visually displays and animates ingested or created data; and the Library of AMIP Data Transmission Standards (LATS) module, outputs data in the machine-independent netCDF or GrADS/GRIB file formats. In addition, the Command Line Interface (CLI) module allows CDAT to receive argument and function input via the command line and the Graphical User Interface (GUI) allows CDAT to receive argument and function input via a point-and-click environment. Additional Python modules which were modified or newly developed for climate research applications include: the Numeric module, which supplies the mathematical functions necessary for climate data manipulation; the PCMDI module, which contains important miscellaneous functions like the regridder that transforms data from one model grid to another; the CDTIME module, which includes routines for converting different time units. Future releases of CDAT will include the Climate Diagnostics Routines (CDR) module, which is a collection of climate diagnostic routines.

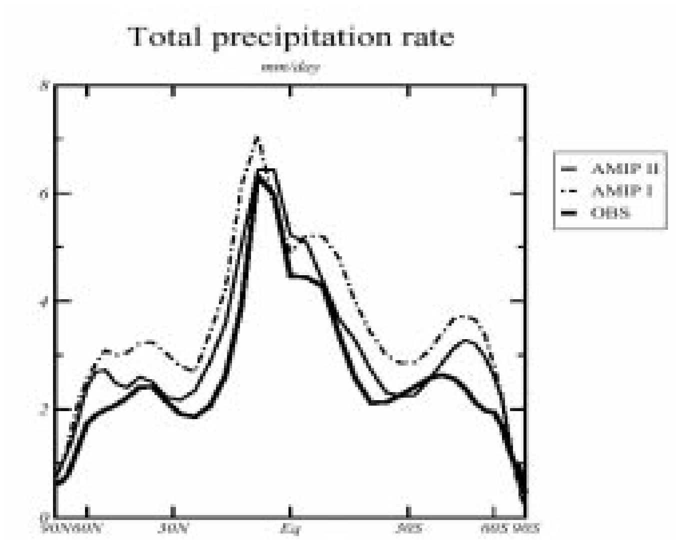
Other supporting software documented in AMIP Newsletter No. 8 (VCS, EzGET/cdunif and DDI) are available for multiple platforms. While each of these software products is fully operational alone, they are also elements of an integrated system. Contact Dean Williams (williams13@llnl.gov) for more information, or visit the PCMDI homepage.

2.5 PCMDI QC and “quick-look” analysis

As part of its continuing support of AMIP, PCMDI has agreed to provide modeling groups with a standard set of diagnostics for each officially submitted simulation. One objective of this "quick-look" diagnosis is to provide a comprehensive independent model intercomparison. Results of the analysis will be given in the context of state-of-the-art observations and previous model versions. The quick-look results will include: 1) Basic quality control statistics, 2) The WGNE standard diagnostics of the mean climate, and 3) Statistical comparison of model output at various space and time scales in order to characterize model performance. A description of the PCMDI quick-look diagnostics will be posted on the AMIP homepage in several months. Several very simple examples of the PCMDI quick-look quality control and analysis follow:







Upper left: Total space-time errors of SST boundary conditions applied in selected AMIP II integrations.

Upper right: An example of problem data frequently identified during data quality control.

Lower left: An example of how annual mean precipitation has changed in one model since AMIP I, compared to the Xie-Arkin dataset.

3. The direction of AMIP

3.1 Long-range objective

AMIP is intended to establish a community-standard protocol for AGCM simulations and their evaluation. Achieving this goal requires continuing support for systematic evaluation, intercomparison, documentation and data accessibility. To a large degree this has already been accomplished. However, it is envisaged that modeling groups will periodically revisit (every few years) the benchmark AMIP exercise as they have substantially revised their model. A key element to this ongoing activity will be an objective documentation of model improvements. It is anticipated that the AMIP II protocol can be refined as needed for the project's continuation.

3.2 Coordination with other projects

At the 14th session of the WGNE, it was recommended that the atmospheric component of every coupled model participating in CMIP be run through the AMIP protocol. Although currently a much smaller-scale project, CMIP is managed by PCMDI and benefits from the AMIP infrastructure. Many other projects continue to be coordinated to varying degrees with AMIP (e.g., via diagnostic subprojects) as identified on the AMIP homepage.

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract No. W-7405-Eng-47

AMIP II simulation status report

Last update: July 1, 1999

Institute	AMIP model designation	Institute reps(s)	Technical contact(s)	1st run
BMRC	BMRC BMRC 5.1 (T47L27)	Bryant McAvaney	Bryant McAvaney et al.	
CCCma	CCC GCM3 (T47L32)	Norm McFarlane	Mike Lazare	
CCSR	CCSR/NIES AGCM (T42L18) 1998	Atsushi Numaguti	Shen Xueshun	**Complete**
CMA	CMA CMA (T63L16) 1998	Dong Min	Ye Zhengqing Luo Yong	**Complete**
CNRM	CNRM ARPEGE Cy18 (T63L45) 1998	Michel Deque	Michel Deque Alain Braun	**Complete**
COLA	COLA COLA2.1 (R40 L18)	Adam Schlosser et al.	Adam Schlosser	
CSIRO	CSIRO CSIRO Mark 3 (T63L18)	Barrie Hunt	Martin Dix	
CSU	CSU GEODESIC	Dave Randall	Don Dazlich	
DNM	DNM A5421 (4x5 L21) 1998	Vener Galin	Vener Galin Eugeny Volodin	**Complete**
ECMWF	ECMWF ECMWFCY18R5 (T63L50) 1998	Martin Miller	Martin Miller et al	**Complete**
GFDL/DERF	DERF GFDLSM392.2 (T42 L18) 1998	Bill Stern	Bill Stern	**Complete**
GISS	GISS B295DM12 (4x5L12) 1998	Anthony Del Genio Kenneth Lo	Kenneth Lo	**Complete**
GLA	GLA GEOS-2 (4x5, L20)	William Lau Yogesh Sud	Jae-Hoon Kim	**Complete**
GSFC	GSFC GEOS-2 (2x2.5 L70)	Yehui Chang	Yehui Chang	
GSFC	NASA/NCAR Finite-Vol (2x2.5 L55)	Shian-Jiann Lin	S Nebuda and F. Verter	
IAP	IAP IAP-2L (4x5L9)	Qing-cun Zeng Hui-jun Wang	Hui-jun Wang	
JMA	JMA GSM9603 (T63 L30) 1998	Ken-ichi Kuma	Ken-ichi Kuma	**Complete**
LMD	LMD LMD6P6 (96x72L15)	Jan Polcher	Jan Polcher et al	
MGO	MGO AMIP2.01 (T42L14) 1998	Valentin P.Meleshko	Vadim A.Matyugin	**Complete**
MPI	MPI ECHAM4 (T42 L19) 1998	Erich Roeckner	Monika Esch	**Complete**
MRI	MRI-JMA98 (T42L30) 1998	Akio Kitoh	Mitsuo Ohizumi	**Complete**
NCAR	NCAR CCM3.5 (T42L18)	Dave Williamson	Erik Kluzek	**Complete**
NCEP	NCEP CLIMATE MODEL (T62L28)	Huug van den Dool	Suranjana Saha	
NCEP-REANL	NCEP REANL2 (T62L28)	Masao Kanamitsu John Roads	Masao Kanamitsu Thomas Reichler	
NIED/JMA	NIED/JMA GCM9806 (T42 L21)	Isamu Yagai	Isamu Yagai	
NRL	NRL NOGAPS 4.0 (T63l24)	Tim Hogan	Tim Hogan	
NTU	NTU NTU98 (T42L18)	Huang-Hsiung Hsu	Wen-Shung Kau	
PNNL	PNNL CCM2 (T42L18) 1997	Steve Ghan	Steve Ghan	**Complete**
RPN	RPN GEM (2x2L30)	Bernard Dugas	Bernard Dugas	
SUNYA	SUNYA CCM3 (T42L18)	Wei-Chyung Wang	Wei-Chyung Wang et al	
UCLA	UCLA AGCM6.95(2.5x2x29)	C. Roberto Mechoso	John Farrara	
UKMO	UKMO HADAM3 (3.75x2.5x19L) 1998	Vicky Pope	Rachel Stratton	**Complete**
UGAMP	UGAMP HADAM3 (3.75x2.5x58L) 1998	Julian Elliott	Jeff Cole	**Complete**
UIUC	UIUC 24-L ST-GCM (4x5 L24) 1998	Michael Schlesinger	Fanglin Yang	**Complete**
YONU	YONU ST15 (4x5 L15) 1998	Jeong-Woo Kim	Il-Ung Chung	**Complete**

APPENDIX B

AMIP II Diagnostic Subprojects

Many AMIP I diagnostic subprojects will remain active in AMIP II, and the numbering scheme will be the same for these (first 26 Diagnostic Subprojects). Some proposals are still being reviewed by the AMIP Panel or in the process of revision. There is no deadline for submitting proposals for diagnostic research, but approval will be limited to those focusing on topics not addressed by existing subprojects. Additionally, PCMDI will routinely compute many standard diagnostics with each new AMIP simulation, and it is therefore expected that the Diagnostic Subprojects will focus on increasingly advanced analysis. Refer to the AMIP homepage for more information, including submission guidelines and a status report of proposals under review.

Approved as of July 1, 1999

No. 1: Synoptic to Intraseasonal Variability (J. Slingo and K. Sperber)
No. 3: Statistics of Transient Circulation Systems (J. Boyle, K. Hodges, I. Simmonds, D. Jones)
No. 5: Ocean surface fluxes of heat, momentum, buoyancy and their implied transports (P. Gleckler and.Taylor)
No. 6: Intraseasonal to Interannual Variability of the Asian Summer Monsoon (H. Annamalai, J. Slingo and K. Sperber)
No. 7: Evaluation of hydrologic processes (W. Lau and Y. Sud)
No. 9: Polar Processes and Sea Ice (J. Walsh, D. Bromwich, H. Cattle, V. Kattsov,V. Meleshko, J. Maslanik)
No. 11: Evaluation of soil moisture and continental water budget (A. Robock, K. Y. Vinnikov, G. Srinivasan)
No. 12: Land-surface processes and parameterizations (T. Phillips, A. Henderson-Sellers, A. Hahmann, A. Pitman)
No. 13: Evaluation of global cloudiness (B. Weare)
No. 15: Angular Momentum and the Planetary Momentum Balance (D. Salstein, R. Rosen, J. Dickey and S. Marcus)
No. 16: Simulations of the stratospheric circulation (W. Lahoz, R. Swinbank, S. Pawson and G. Roff)
No. 18: Intercomparison of surface climate extremes (F. Zwiers and V. Kharin)
No. 20: Model Evaluation on the West African Monsoon (S. Janicot, J. Polcher, C. Thorncroft, H. Laurent, T. Lebel)
No. 21: Surface Climatologies (P. Jones, M. Hulme and T. Osborn)
No. 23: Variations of the centers of action (S. Hameed)
No. 25: East Asian climate (W-C. Wang, G.-X. Wu, H.-H. Hsu, X-Z. Liang)
No. 26: Monsoon precipitation (S. Gadgil, J. Srinivasan)
No. 27: Tropospheric Humidity and Meridional Moisture Fluxes (D. Gaffen, R. Rosen D. Salstein, J. Boyle, B. Soden)
No. 28: Snow Cover in General Circulation Models (D. Robinson, A. Frei, R. Brown and A. Walker)
No. 29: Diagnosis of Nonlinear Circulation Regimes (A. Hannachi, F. Molteni and T. Palmer)
No. 30: Maintenance Mechanisms of Stationary Waves in General Circulation (M. Ting and R. Joseph)
No. 31: Climatology of Maximum Potential Intensity (MPI) of Tropical Cyclones (G. Holloway and W. Qu)
No. 34: Surface and Atmospheric Radiative Fluxes (M. Wild, A. Ohmural, G. Potter, J. Hnilo)
No. 33: Atmospheric Transports and Energetics (G. Boer and S. Lambert)
No. 34: Convection and upper level links using Meteosat (R. Roca and L. Picon)