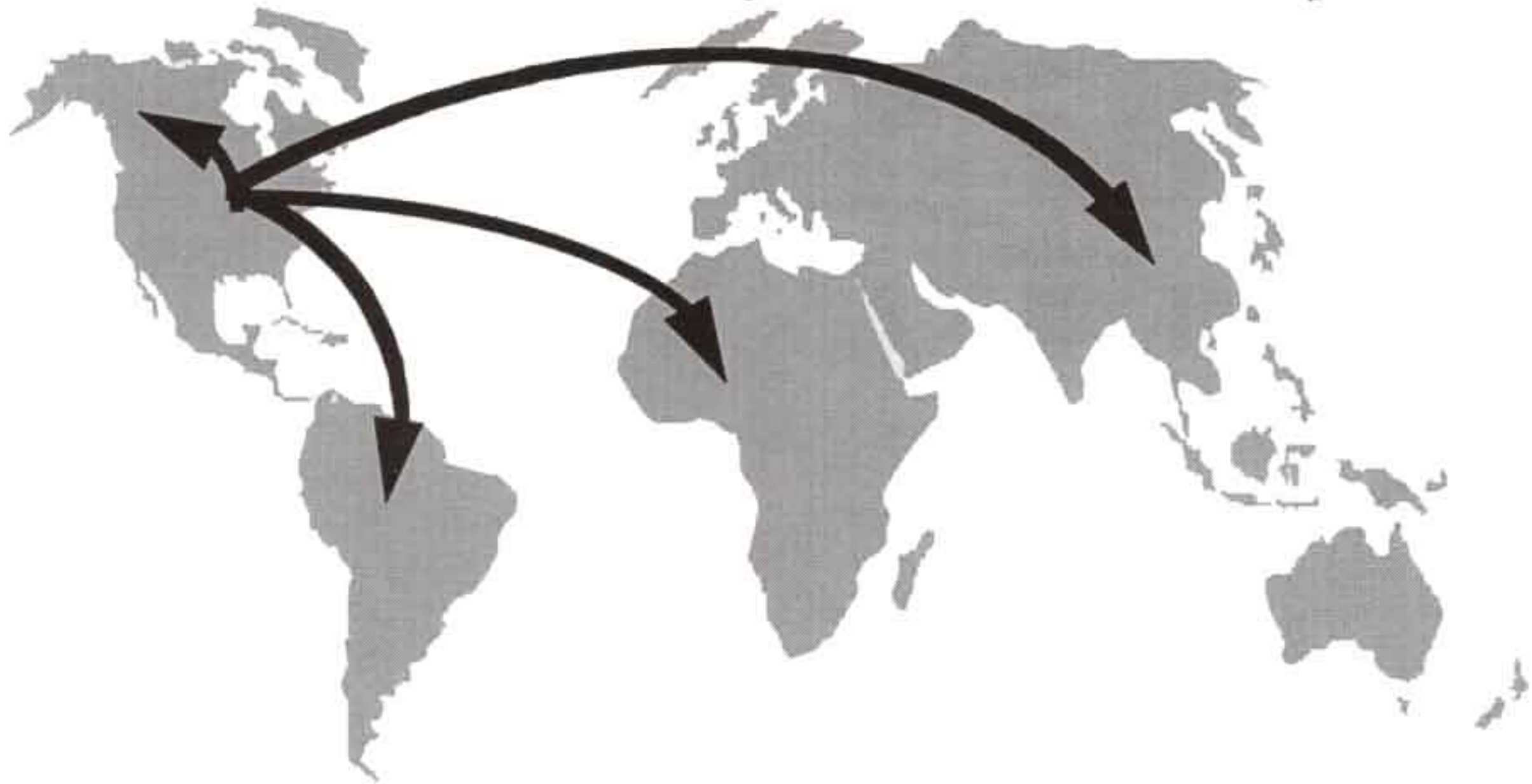


World Wide Applications of Eta Model Development



GCIP IMPROVEMENTS TO ETA MODEL BENEFIT STUDIES WORLD WIDE

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Model Improvements

A key scientific objective of the GEWEX Continental-scale International Project (GCIP) (WCRP-67, 1992) is to determine the time/space variability of the hydrological and energy budgets over a continental scale. To achieve this objective, the need for significantly improved coupling of the land-atmosphere in mesoscale models and companion data assimilation systems was identified. To move forward on coupling the Eta (atmospheric)

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WHAT'S NEW IN GEWEX

**SECOND INTERNATIONAL SCIENTIFIC
CONFERENCE ON THE GLOBAL
ENERGY AND WATER CYCLE**
17-21 June 1996

Over 250 Poster Presentations

Program Outline on Page 6

WGNE AND GEWEX COLLABORATION
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**POWER AND RESERVOIR MODEL
APPLICATION TO GCIP**
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COMMENTARY

DEVELOPING A CLOSER RELATIONSHIP BETWEEN WGNE AND GEWEX

David Williamson, Chairman, WGNE
Moustafa T. Chahine, Chairman,
GEWEX SSG

For a long time the World Climate Research Programme (WCRP) Working Group on Numerical Experimentation (WGNE) and GEWEX have conducted separate activities related to modeling and prediction. WGNE is the expert group on atmospheric modelling in WCRP, while GEWEX is improving the modelling of land-surface processes and the coupling with clouds and radiation. There is a close relationship and many similarities between these activities.

GEWEX and WGNE have developed an agreement for closer collaboration in areas of mutual interest. These ideas were discussed and well received at the GEWEX Scientific Steering Group, January 1996 meeting in Irvine, California, and the March 1996 Joint Scientific Committee of WCRP meeting in Toulouse, France. We are jointly proceeding to implement the new arrangements.

The GEWEX Numerical Experimentation Panel (GNEP) has been given the responsibility of advising WGNE on land-surface processes and hydrological modelling. This connection provides WCRP with a means to extend WGNE modelling to include land-surface/atmosphere interactions. The Chair of GNEP will become an ex-officio member of WGNE.

WGNE will provide ocean-atmosphere fluxes to GEWEX, will participate in evaluating GEWEX global data sets, and will assess the improvement in the predictive skill of GCMs as a result of progress by GEWEX modelling activities (e.g., Project for Intercomparison of Land-Surface Parameterization Schemes, GEWEX Cloud System Study, and the GEWEX Continental-scale International Project).

As a result of this closer collaboration, we anticipate demonstrating an improved predictive capability in weather forecasting and surface hydrology.

FIRST VICE-CHAIRMAN OF GEWEX SCIENTIFIC STEERING GROUP

Professor Tetsuzo Yasunari of the Institute of Geoscience at the University of Tsukuba, will serve as the first GEWEX Scientific Steering Group (SSG) Vice-Chair for the next 2 years. The primary responsibility of the Vice-Chair is to conduct the SSG meeting in the event that the Chair is unable to be present. In the future, this position will be filled from the membership of the SSG on a rotating, 2-year basis.

UPDATED LISTING OF GEWEX DATA SETS

The compilation of GEWEX data sets that was published in the February 1995 issue of *GEWEX News* has been updated and is located in the table on pages 7-10. GEWEX data sets are available to all investigators and may be obtained from many sources including World Data Centers and organizations such as those noted in the table.

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GCIP IMPROVEMENTS TO ETA MODEL BENEFIT STUDIES WORLD WIDE

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model to an improved land-surface/hydrology model, a cooperative effort was initiated between the hydrologists in the United States National Weather Service Office of Hydrology and meteorologists in the National Meteorological Center [now the National Centers for Environmental Prediction (NCEP)]. This interdisciplinary cooperation is also underway in the other GEWEX continental-scale experiments that are now in progress or planned in Canada, Africa, Asia, and South America, several building on the initial Eta model development efforts.

In just a few years there has been significant progress in coupling land-surface models to the Eta model, which is now operational at NCEP. Descriptions of the Eta model can be found in the literature (e.g., Black, 1994); also applications (e.g., Berbery et al., 1996) of the Eta model to related GCIP objectives are found in the 20 March 1996 issue of the *Journal of Geophysical Research*. The operational Eta model is continually being improved (Rogers et al., 1995) and researchers are modifying the model for specific applications.

In an important milestone for GCIP, on January 31, 1996, NCEP implemented a new land-surface scheme, including a seasonal vegetation cycle, in place of the bucket model in the operational Eta model and its associated 4-dimensional data assimilation system. This marked 3 years of accelerated development for GCIP, which began with extensive uncoupled off-line testing of four candidate land-surface schemes (Chen et al., 1996). This off-line testing benefited from utilization of data from the International Satellite Land Surface Climatology Project (ISLSCP) First ISLSCP Field Experiment (FIFE)-1987 and the Project for Intercomparison of Land-Surface Parameterization Schemes (PILPS) Phases 2a and 2b. Subsequently, two schemes were selected for follow-on coupled testing in the Eta model. In house, NCEP coupled the Oregon State University (OSU) land-surface model to the Eta model. The coupling tests included refinements to the Eta model's Mellor-Yamada level 2.5 planetary boundary scheme (Janjic, 1996) and the Paulson-based surface layer scheme. During testing, NCEP enhanced the OSU model, including new treatments of runoff,

soil moisture stress, canopy resistance, and snow-pack physics. These enhancements and the gathering of land-surface characteristics databases involved collaborations with many agencies and institutions participating in GCIP. Prior to the operational implementation, the coupled Eta/OSU model was tested retrospectively for all of June 1991 and in real time parallel runs in 1995. Validation results showed consistent improvement in precipitation forecast skill scores.

With NCEP collaboration, the Center for Ocean-Land-Atmosphere Studies (COLA) successfully coupled the Eta model to the simplified Simple Biosphere (SSiB) model (Xue et al., 1991). This effort provides an important basis of comparison with the now operational Eta/OSU coupling and an opportunity to conduct further retrospective studies of the impact of land-surface parameterization on regional simulations. In the coupled Eta/SSiB model, a U.S. Geological Survey Earth Resources Observation System Data Center vegetation map with 1-km horizontal resolution was used to prescribe the land surface vegetation types over the continental United States. A revised Mellor-Yamada level 2.5 model was implemented in the planetary boundary layer (PBL) of the coupled Eta model, in which the constraints and coefficients in this scheme are based on a comprehensive realizability analysis. The coupled Eta/SSiB model was tested for different precipitation events, including June 1993 (a wet year) and June 1991 (a relatively normal year). The simulated and observed monthly precipitation was averaged from 80°W to 120°W and from 30°N to 50°N. The simulated results from 24-hour and 48-hour forecasts produced reasonable precipitation over the central U.S., where a recent study (Xue et al., 1996) has shown that the atmosphere is sensitive to the land surface conditions. The Eta/SSiB model also produces more realistic surface energy balance, boundary layer evolution and diurnal cycle of surface temperature.

North American Applications

As part of the GCIP effort at the University of Maryland, estimates of the hydrologic cycle have been derived from the Eta model analysis and forecast products in the model's native grid (Berbery, 1996). The version being used has a horizontal resolution of about 48 km and 38 levels in the vertical. The Eta model analyses compare well

(Continued on page 13)

ECMWF IMPROVES REPRESENTATION OF OROGRAPHIC PRECIPITATION

The problem of representing orography in numerical weather prediction models and general circulation models has been studied for many years. The use of envelope orography and Gravity Wave Drag (GWD) schemes is commonplace, but it is acknowledged that there are many inadequacies remaining. For example, envelope orography distorts the precipitation distributions and leads to excessive convective activity. In addition, envelope orography raises difficulties in the data assimilation process due to the increased volume of the model mountains.

Consequently, a revision of the treatment of orography was undertaken at the European Centre for Medium-Range Weather Forecasts (ECMWF), which involved the adoption of a smoothed mean orography and a new parameterization scheme that represents both GWD and nonlinear low-level mountain drag. A dynamically-based replacement for envelope orography is used that represents the drag due to the "blocking" of the low-level flow by Sub-grid Scale Orography (SSO), which is assumed to intersect a number of model layers. This part of the scheme is formulated using recent ideas from nonlinear theories of stratified flow. Details of this new scheme are reported in the technical literature (Lott and Miller, 1996).

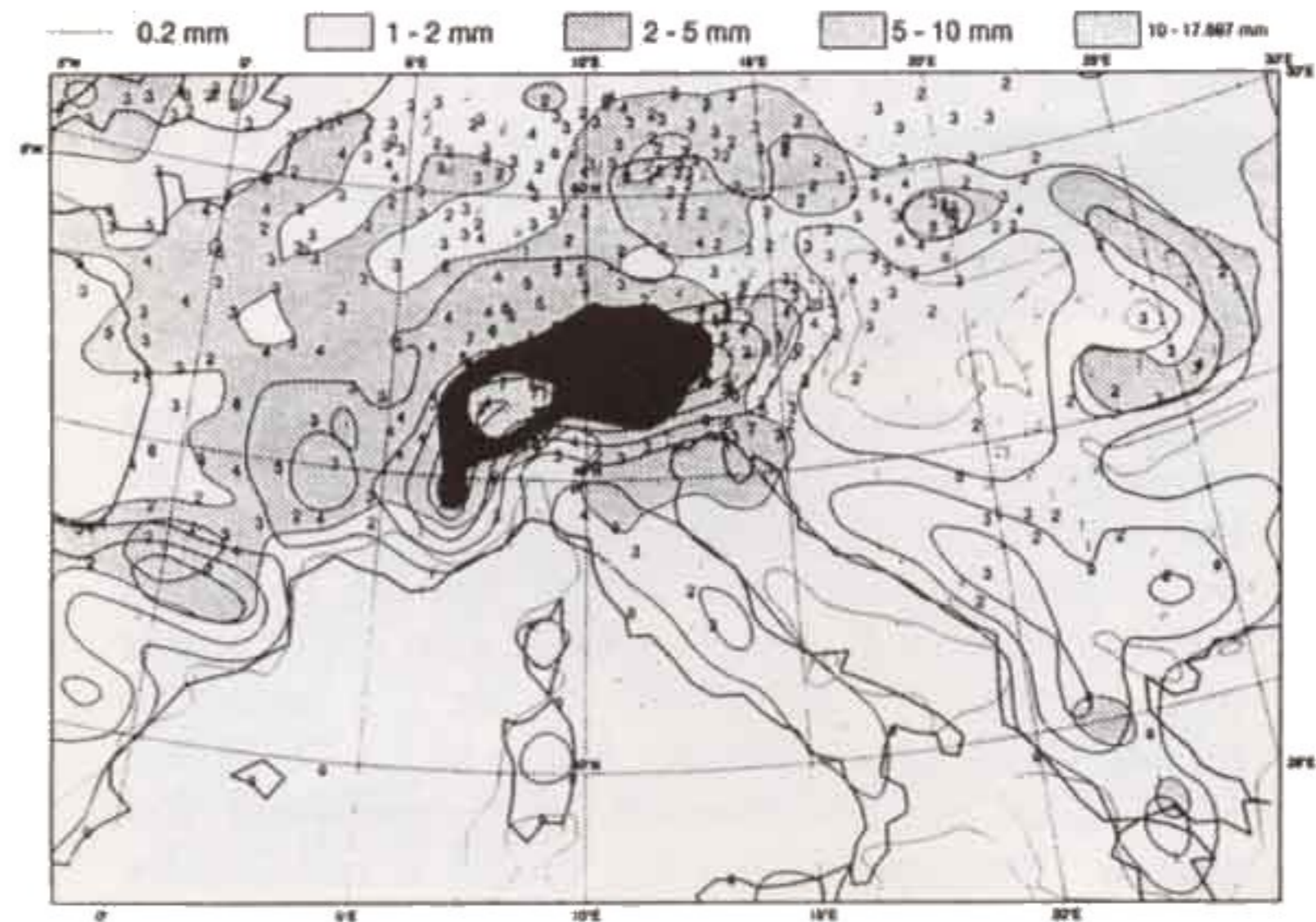
Currently the SSO fields needed for the new scheme are calculated using the U.S. Navy (10 minute by 10 minute resolution) orography data set; however, these will soon be updated based on higher resolution global data. Results from the 1990 Pyrenees Experiment (PYREX) were extensively used to help validate the scheme. These results and tests using the full ECMWF forecast system showed significant improvements, and the scheme (with the mean orography) was implemented in the ECMWF operational models in April 1995.

Experience since then has also confirmed improvements in precipitation and amount, particularly, in the vicinity of mountains, where precipitation maxima are more realistically located on the mountain flanks rather than on the highest ridges. An example of the differences in precipitation forecasts are shown in Figures 1a and 1b.

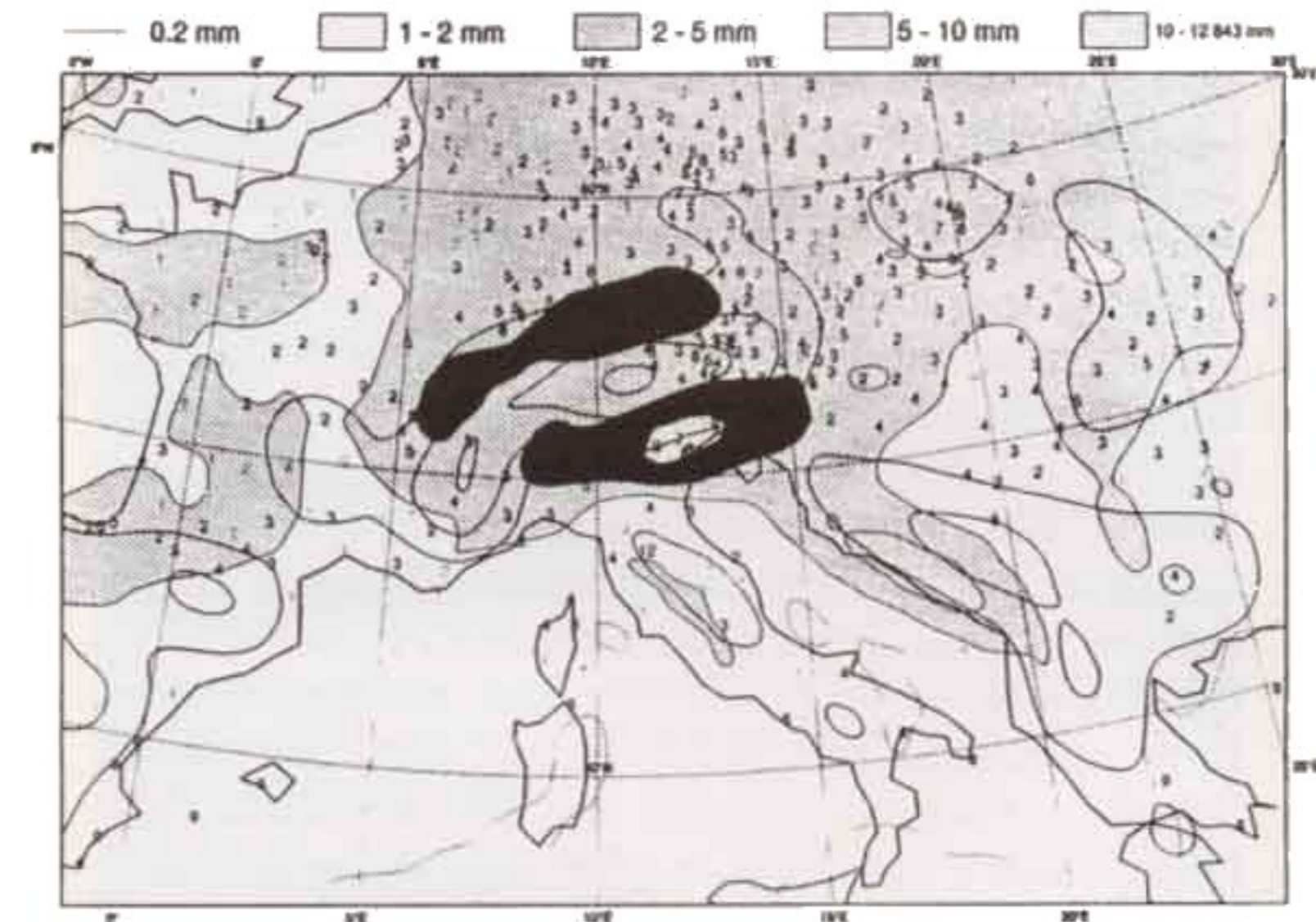
Acknowledgement: Figures 1a and 1b courtesy of Martin J. Miller, ECMWF.

Reference

Lott, F. and M. J. Miller, 1996. A new sub-grid scale orographic drag parameterization: its formulation and testing. (Accepted for publication in *Quart. J. Roy. Met. Soc.*)



(a)



(b)

Figure 1: A comparison of the monthly mean precipitation (in mm/day) for the 48–72 hour operational forecasts for (a) May 1994 and (b) May 1995. The new orographic representations locate rainfall maxima on the mountain slopes rather than peaks (integers are observations).

GCIP REFERENCE DATA SET AVAILABLE ON-LINE AND ON COMPACT DISK

Alan Rea¹, and John A. Leese²

¹U.S. Geological Survey

²GCIP Office

The GEWEX Continental-scale International Project (GCIP) activities are focused on the Mississippi River basin (see figure) to take advantage of the meteorological and hydrological networks that exist or are being upgraded with new Doppler radars, wind profilers, and automatic weather stations. The Mississippi River basin comprises a broad spectrum of different processes and conditions of cloud formation, precipitation, runoff, and land-vegetation-atmosphere interactions.

The U.S. Geological Survey, as part of its contribution to GCIP, has recently completed the compilation of 17 different data sets to serve as GCIP Reference Data Sets (GREDS). The data sets selected for inclusion are expected to have wide use among GCIP investigators. Another criterion for inclusion was that the data set was expected to change little, if any, during the next 2 to 3 years.

GREDS data sets include:

- an inventory of stream gages, reservoir gages, and meteorological stations;

- a 500-meter resolution digital elevation model;
- grid node locations for the Eta numerical weather-prediction model; and
- digital map data sets of geology, land use, streams, large reservoirs, average annual runoff, average annual precipitation, average annual temperature, average annual heating and cooling degree days, hydrologic units, and state and county boundaries.

Also included are digital index maps for Landsat scenes, and for the U.S. Geological Survey 1:250,000, 1:100,000, and 1:24,000-scale map series. All the data sets cover the Mississippi River basin, and several cover all of the continental United States. Several data sets also cover part of southern Canada. Several database retrievals were processed by state, therefore, many sites outside the Mississippi River basin are included. The data sets are designed especially for use with geographic information systems for computerized mapping and spatial analysis.

GREDS data sets are available on the World-Wide Web at:

<http://nsdi.usgs.gov/nsdi/wais/water/gcip.HTML>

A CD-ROM containing the GREDS data sets can be ordered through the International GEWEX Project Office, 1100 Wayne Avenue, Suite 1210, Silver Spring, Maryland, 20910, USA.



Hydrologic Units of the Mississippi River Basin from the GREDS CD-ROM.

SECOND INTERNATIONAL SCIENTIFIC CONFERENCE ON THE GLOBAL ENERGY AND WATER CYCLE

17-21 June 1996

U.S. National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, DC

PROGRAM OUTLINE

Monday, 17 June 1996

Opening Session - Chair: M. Chahine, GEWEX SSG

- 0900-0905 Welcome/Administrative Comments -
W. Sprigg, NAS/ P.Try, GEWEX/IGPO
0905-0915 Introduction and Scientific Overview -
M. Chahine, Chair, GEWEX SSG
0915-1000 Keynote Speaker - E. Frieman, Scripps

Session 1: Theme A - Chair: H. Grassl, Director, WCRP

Flood and Drought Prediction:

- 1000-1030 A. Hollingsworth, ECMWF
1030-1100 Break

1100-1130 R. McPherson, NOAA/NCEP

Impact of Land Surface on Weather and Climate:

- 1130-1200 A. Betts, Atmospheric Research
1200-1230 J. Shukla, COLA

Introduction to Theme A Poster Session

- 1230-1240 R. Koster, NASA/GSFC

Session 2: Posters (Key Bridge Marriott Hotel)

- 1500-1700 Theme A Posters
1800-2000 Reception at Key Bridge Marriott Hotel

Tuesday, 18 June 1996

Session 3: Theme B - Chair: P. Morel, CalTech/JPL

Regional Water Resources and Climate:

Use of climate information for managing water resources.

- 0900-0930 S. Sorooshian, University of Arizona
0930-1000 B. Wilkinson, Institute of Hydrology

Determining continental-scale water budgets, runoff, precipitation and land surface characteristics

- 1000-1030 E. Rasmusson, University of Maryland
1030-1100 Break

1100-1130 A. Henderson-Sellers, RMIT

Introduction to Theme B Poster Session

- 1130-1145 H. Lins, USGS
1145-1200 J. Roads, Scripps

Session 4: Theme B Posters (Key Bridge Marriott Hotel)

- 1330-1500 Regional Water Resource Posters
1530-1700 Water Budget and Land Sfc Char. Posters

*1215-1330 PILPS Update and Open Discussion
A. Henderson-Sellers (Chair)

Wednesday, 19 June 1996

Session 5: Theme C - Chair: R. Schiffer, NASA HQ

Cloud, Water Vapor, Aerosol and Precip. Interactions:

- 0900-0930 Clouds: G. Stephens, CSU
0930-1000 Precipitation: P. Arkin, NOAA/NCEP
1000-1030 Aerosols: M. Patrick McCormick, NASA/LaRC
1030-1100 Break
1100-1130 Water Vapor: T. VonderHaar, CSU
Introduction to Theme C Poster Session
1130-1145 R. Stewart, AES, Canada
1145-1200 P. Twitchell, GEWEX/IGPO

Session 6: Theme C Posters (Key Bridge Marriott Hotel)

- 1400-1530 Cloud, Water Vapor, Aerosol, Precip. Posters
1600-1730 Cloud, Water Vapor, Aerosol, Precip. Posters
1830-2100 Banquet in the Marriott Ballroom

Thursday, 20 June 1996

Session 7: Theme D - Chair: R. Harriss, NASA HQ

Water and Carbon Cycle Connection: Influence of precip. and radiation on the biogeochem. proc. affecting climate.

- 0900-0930 P. Sellers, NASA/GSFC
0930-1000 R. Keeling, Scripps
1000-1030 P. Tans, NOAA/CMDL
1030-1100 Break

Land Use/Change and Soil Wet/Dry Char. by SAR

1100-1130 T. Tanaka, NASDA

Introduction to Theme D Poster Session

1130-1145 P. Sellers, NASA/GSFC

Introduction to Theme E Poster Session

1145-1200 T. Yasunari, Univ. of Tsukuba

Session 8: Theme D and E Posters (Key Bridge Marriott)

- 1330-1500 Water and Carbon Cycle Connection Posters
1500-1630 Ocean-Atmosphere-Ice Exchanges Posters

Friday, 21 June 1996

Session 9: Theme E: M. Hall, NOAA/OGP (Chair)

- 0900-0930 P. Webster, Univ. of Colorado
0930-1000 J. Curry, Univ. of Colorado
1000-1030 J. O'Brien, Florida State Univ.

Session 10: Panel Discussion

- 1100-1230 The Direction of Research on the Global Energy and Water Cycle, and the Impact of Space Systems/Measurements, M. Chahine, Chair (Panel: M. Hall, NOAA/OGP; R. Harriss, NASA HQ; A. Patrinos, DOE; H. Grassl, WCRP; T. Yasunari, Univ. of Tsukuba; P. Try, Amer. Met. Society)
1230 Conference Adjourns

GEWEX DATA SETS

PROJECT NAME	DATA SET NAME/ TIME PERIOD/DESCRIPTION	MEDIA	SOURCES
International Satellite Cloud Climatology Project (ISCCP)	<p>ISCCP C2/July 1983- June 1991/Global monthly cloud products at 280-km resolution, 72 variables derived from polar orbiting and geostationary satellites.</p> <p>ISCCP C1/July 1983 - June 1991/Global cloud products at 280 km, 3-hr resolution, 132 variables, derived from polar orbiting and geostationary satellites.</p> <p>ISCCP B3/July 1983 - June 1994 (will continue through June 2000) / Satellite radiance data at 30 km, 3-hour intervals, separately from imaging radiometers on polar orbiting and geostationary satellites.</p> <p>ISCCP D2/Jan 1990 - Dec 1992(will cover July 1983 - June 2000)/ Global monthly cloud products at 280 km resolution, 130 variables derived from polar orbiting and geostationary satellites.</p> <p>ISCCP D1/Jan 1990 - Dec 1992(will cover July 1983-through 2000)/Global cloud products at 280 km, 3-hr resolution, 202 variables from polar orbiting and geostationary satellites.</p> <p>ISCCP DX/Jan 1990 - Dec 1992 (will cover July 1983 - June 2000)/ Satellite radiance and cloud retrieval data at 30 km, 3-hr intervals, separately from imaging radiometers on operational polar orbiting and geostationary satellites.</p>	<p>9-track/1600-6250 bpi tape or IBM 3480 cartridges (CD-ROM available for July 1983 - Dec 1990)</p> <p>9-track/1600-6250 bpi tape or IBM 3480 cartridges</p> <p>"</p> <p>"</p> <p>"</p> <p>"</p>	<p>ISCCP DATA IS AVAILABLE FROM THE FOLLOWING SOURCES:</p> <p>ISCCP Central Archives National Oceanic and Atmospheric Administration National Environmental Satellite Data and Information Service National Climate Data Center Climate Services Division/Satellite Services Branch FOB3, Room G233 Suitland, Maryland 20233 Tel: 301-271-4800 (option #5) Fax: 301-271-4876 E-mail: satorder@ncdc.noaa.gov</p> <p>Langley DAAC User and Data Services Mail Stop 157B NASA Langley Research Center Hampton, VA 23681-0001 Tel.: 804-864-8656 Fax: -804-864- 9807 E-mail: userserv@eosdis.larc.nasa.gov</p> <p>Telnet: eosdis.larc.nasa.gov (logon ims, password larcims)</p>
Surface Radiation Budget (SRB)	SRB Version 1.1 WCRP/SRB SW /March 1985- Dec 1988/Shortwave surface radiation parameters	CD-ROM/FTP	Langley DAAC, Mail Stop 157B, Hampton, VA 23681-0001 Tel: 804-864-8656; Fax: 804-864-8807; Email: userserv@eosdis.larc.nasa.gov; WWW: http://eosdis.larc.nasa.gov:12000/dataset_documents/srb.html
Baseline Surface Radiation Network (BSRN)	BSRN Surface Radiation Budget - surface based network (25-30 stations planned; 10-20 sites reporting by end of 1996)/1992 to Present (varies by site)/Downward components of solar and thermal irradiance from a globally distributed surface based network. Ancillary data at some sites include: upwelling irradiances, meteorological observations, aerosol optical depth, UV and PAR. Cloud based lidar may be installed at some sites in the future.	Internet, other on request.	http://www.geo.umnw.ethz.ch/wrmc/ Special requests can be made to Herman Hegner at bsrnadm@geo.umnw.ethz.ch

GEWEX DATA SETS

PROJECT NAME	DATA SET NAME/ TIME PERIOD/DESCRIPTION	MEDIA	SOURCES
GEWEX Water Vapor Project (GVaP)	<p>NVAP/1988-1992/Blended global water vapor and cloud liquid water data sets using radiosonde, microwave and infrared satellite data with 1 x 1-degree resolution, daily, pentad and monthly averages.</p> <p>Nov - Dec 1991/ Raman Lidar water vapor profiles from Coffeville Kansas Experiment .</p>	<p>CD-ROM/TAPE/FTP</p> <p>TAPE</p>	<p>NASA/Marshall Space Flight Center, 977 Explorer Boulevard Huntsville, AL, 35806, USA Tel: (205) 922-5813; Fax: (205) 922-5859 E-mail: msfc@eos.nasa.gov WWW: http://www.daac.msfc.nasa.gov</p> <p>NASA/Langley Research Center, Mail Stop 157B, Hampton, VA 23668, USA Tel: (804) 864-8656 ; Fax: (804) 864-8807 E-mail: userserv@eosdis.larc.nasa.gov WWW: http://eosdis.larc.nasa.gov</p>
Global Precipitation Climatology Project (GPCP)	<p>Global Precipitation/July 1987-Dec 1994/Monthly 2.5-degree global gridded precipitation data set produced by blending gauge, infrared and microwave satellite estimates of precipitation.</p> <p>Global Precipitation for ISLSCP Initiative I /Jan 1987 - Dec 1988/Monthly terrestrial gridded precipitation data sets on a 1-degree grid. There are two files for each month: The area-mean precipitation and the number of stations per grid.</p>	<p>FTP</p> <p>Data set was also included on the NCEP/NCAR re-analysis CD-ROM distributed in the March 1996 Bulletin of the American Meteorological Society</p> <p>CD-ROM</p>	<p>World Data Centre for Meteorology, National Climatic Data Center, Asheville, North Carolina Tel: (704) 271-4800; Fax: 704-271-4876 E-mail: orders@ncdc.noaa.gov WWW: http://www.ncdc.noaa.gov/wdcamet.html#GPCP</p> <p>ALSO AVAILABLE FROM: Global Precipitation Climatology Centre c/o Deutscher Wetterdienst, Postfach 10 04 65 D-63004 Offenbach am Main, Federal Republic of Germany Tel: +49 69 80 62 29 81; Fax: +49 69 80 62 29 93 or 2880 E-mail: rudolf@k7-wzn.za-offenbach.dwd.d400.de ftp://ftp.ncdc.noaa.gov/pub/data/gpcp/gpcc</p> <p>NASA/Goddard Space Flight Center, Mail Stop 902.2 Greenbelt, MD 20771, USA Tel: (301) 286-3209 ; Fax: (301) 286-1775 E-mail: gsfc@eos.nasa.gov ; WWW: http://daac.gsfc.nasa.gov</p>
GEWEX Cloud System Study (GCSS)	<p>Working Group I data/1995 - /Intercomparison study descriptions, instructions, observational data, and model results for WGI case studies: (1) "smoke cloud" case; and (2) ASTEX Lagrangians case study</p>	<p>WWW</p>	<p>Christopher Bretherton, Dept. of Atmospheric Sciences University of Washington, Box 351640 Seattle, Washington 98195 http://amath.washington.edu/~breth/GCSS/GCSS.html (observational data compiled from multiple published and unpublished data sets from ASTEX (NE Atlantic, June 1992)</p>
Global Runoff Data Centre (GRDC)	<p>Variable time period/ Daily and monthly discharge data for approximately 3,300 stations in 2,900 river basins (including sub-basins) from 140 countries.</p>	<p>Diskette/email/paper</p>	<p>Global Runoff Data Centre, Federal Institute of Hydrology Bundesanstalt für Gewässerkunde , Kaiserin-Augusta-Anlagen 15-17 , 56068 Koblenz, Federal Republic of Germany ; Tel.: 49 261 1306-224; Fax: 49 261 1306-280; E-mail: grdc@bfgko.bfg.bund400.de</p>

GEWEX DATA SETS

PROJECT NAME	DATA SET NAME/ TIME PERIOD/DESCRIPTION	MEDIA	SOURCES
International Satellite Land Surface Climatology Project (ISLSCP)	<p>Initiative I/1987-1988/ Vegetation, hydrometeorology, soils, snow and ice, meteorology and radiation parameters and variables required for initialization, forcing and validation of global biosphere-atmosphere models. All but the river basin runoff data and the NOAA/NESDIS snow cover provide global coverage on a common 1 x 1-degree grid. Monthly and 6-hourly forcing fields provided.</p> <p>First ISLSCP Field Experiment Data (FIFE)/ Summer 1987; 1989 (Follow-up Experiment)/FIFE was conducted on the Konza Prairie in Kansas during the summer of 1987. A follow-up experiment at the same location took place in 1989. Data includes surface observations and non-image data sets; satellite imagery; Thematic Mapper Simulator (aircraft) imagery; spectro-radiometer and microwave radiometer (aircraft) imagery; and vegetation index, soil moisture, terrain reference, surface temperature, and digitized site photographs.</p>	<p>CD-ROM</p> <p>CD-ROM</p>	<p>NASA/Goddard Space Flight Center Mail Stop 902.2, Greenbelt, MD 20771, USA Tel: (301) 286-3209; Fax: (301) 286-0268 E-mail: daacuso@daac.gsfc.nasa.gov WWW: http://daac.gsfc.nasa.gov/</p> <p>Oak Ridge National Laboratory DAAC P.O. Box 2008 Mail Stop 6407 Oak Ridge, TN 378331 - 6407 Tel: (615) 241-3952 Fax: (615) 574-4665 E-mail: ornldaac@ornl.gov WWW: http://www.eosdis.ornl.gov</p>
GEWEX Continental-scale International Project (GCIP)	<p>GCIP Initial Data Set (GIDS-1)/1 Feb - 30 April 1992/ Atmospheric, hydrologic, satellite and radar composites, and surface data for the Central Mississippi River basin.</p> <p>GCIP Reference Data Set (GREDS)/No time period/ Topography, land use and other types of data which are expected to change little, if any, during the next several years.</p> <p>GIDS-3/1 April - 31 August 1994/Consists of data collected during the GCIP Integrated Systems Test (GIST) in the Large Scale Area - SW (Arkansas Red River basin).</p> <p>GIDS-3 (subset)/1 April - 31 August 1994/Subset of GIDS-3 data which includes imagery (GOES-7 IR and Visible data, radar composites, surface/upper air maps, and vegetation index), surface meteorological composites, rawinsonde and profiler data, hydrologic data (streamflow), observing station lists and complete file documentation.</p>	<p>CD-ROM</p> <p>CD-ROM</p> <p>On-line</p> <p>CD-ROM</p>	<p>UCAR/Office of Field Projects Support P.O. Box 3000, Boulder, CO 8030 Tel: 303-497-8987; Fax: 303-497-8158 Email: sfw@ncar.ucar.edu WWW: http://www.ofps.ucar.edu/gcip/gcip_in_situ.html</p> <p>ALSO AVAILABLE FROM: GCIP Project Office, 1100 Wayne Avenue, Rm 1225, Silver Spring, MD 20910; Tel: 301-427-2089 ext 511; Fax: 301-427-2222; E-mail: gcip@ogp.noaa.gov</p> <p>UCAR/OFPS CODIAC System WWW: http://www.ofps.ucar.edu/ or http://www.ncdc.noaa.gov/gcip/gcip_home.html (select in situ data source module)</p> <p>UCAR/Office of Field Projects Support</p>

GEWEX DATA SETS

PROJECT NAME	DATA SET NAME/ TIME PERIOD/DESCRIPTION	MEDIA	SOURCES
Mackenzie GEWEX Study (MAGS)	<p>HYDAT/historical-present/Water Survey of Canada daily streamflow, lake level and sediment data for all Canadian stations.</p> <p>Canadian Daily Climate Data (CDCD) /historical-present/ Daily temperature and precipitation data for all Canadian stations.</p> <p>Canadian Weather and Engineering Data Set (CWEEDS)/ 1950-present/Hourly weather records for 143 Canadian stations.</p> <p>Related data sets/no time period/Basin monthly means; corrected precipitation archive of 78 stations; snow course and snow depth data bases, reference data, land cover.</p> <p>CMC/Sept 1995 ongoing/RFE 50 km special MAGS archive</p> <p>Beaufort and Arctic Storms Experiment (BASE)/Sept 1 - Oct 15, 1995/MC2 mesoscale model output, RFE regional model output, surface meso-network measurements, special rawinsonde launches, precipitation photography and chemistry, Doppler radar measurements at Inuvik, radar measurements at Tuktoyaktuk, Convair 580 aircraft measurements, special aircraft dropsonde data, CCGS Arctic Ivluk cruise report, ocean current and pack ice data, and US NCAR C-130 aircraft data</p>	<p>CD-ROM</p> <p>CD-ROM</p> <p>CD-ROM</p> <p>WWW</p> <p>WWW</p> <p>WWW</p>	<p>Linda M. Stirling, Director Climate Information Branch, Atmospheric Environment Service 4905 Dufferin Street Downsview, Ontario M3H 5T4 Phone: 416-739-4399 Fax: 416-739-4446 E-mail: stirling@aeastor.am.doe.ca</p> <p>Climate Information Branch, Atmospheric Environment Service</p> <p>Climate Information Branch, Atmospheric Environment Service</p> <p>Canadian GEWEX Home Page: http://www.on.doe.ca/GEWEX/gewex_homepage.html</p> <p>Canadian GEWEX Archives: http://www.cmc.doe.ca/cmc/CMOI/htmls/Gewex_archa.html</p> <p>Canadian GEWEX Home Page: http://www.on.doe.ca/GEWEX/gewex_homepage.html or BASE Home Page http://www.on.doe.ca/BASE/base_homepage.html</p>

POWER AND RESERVOIR MODEL APPLICATION TO GCIP

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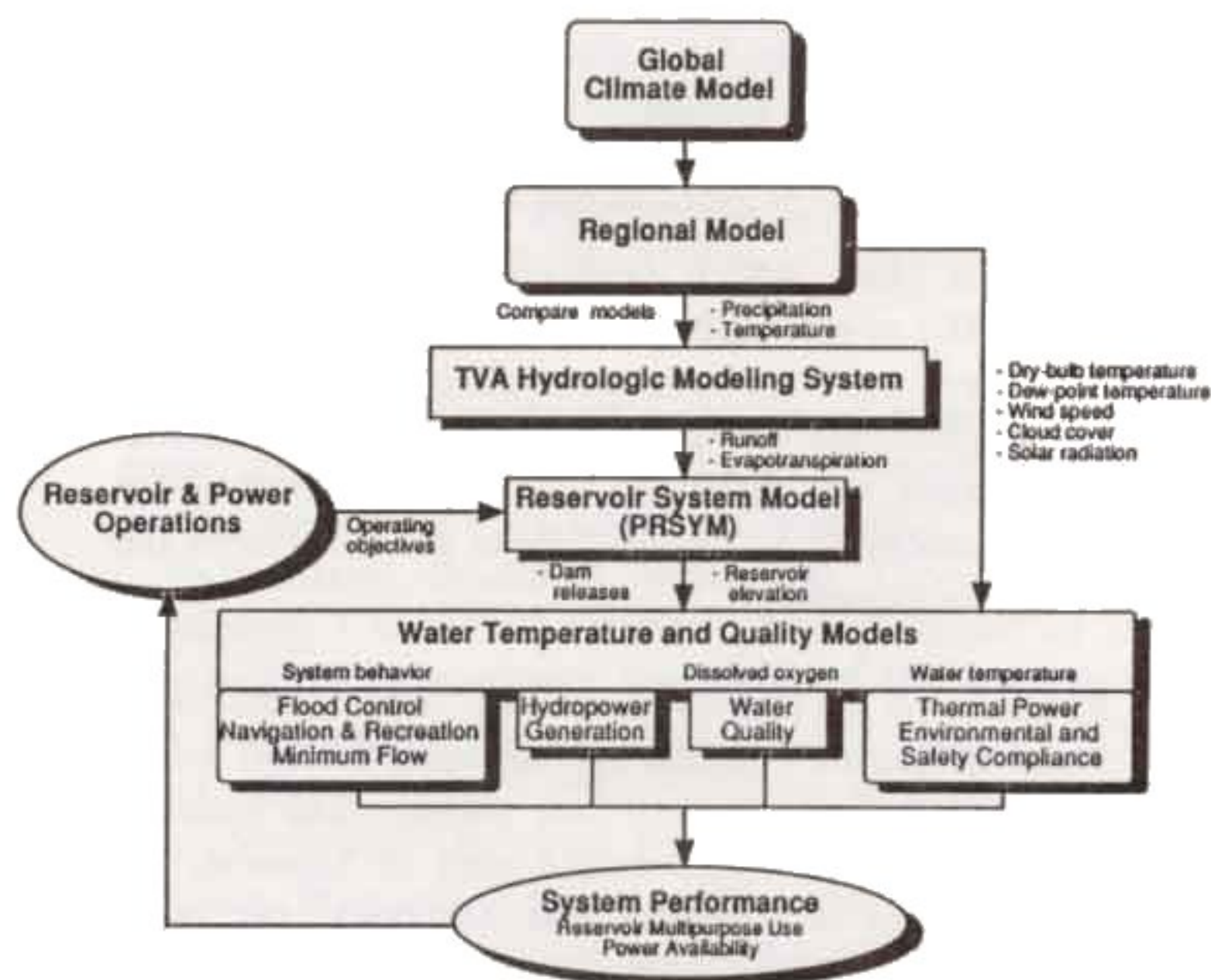
²Global Hydrology and Climate Center

The principal thrusts of the GEWEX Continental-scale International Project (GCIP) are to improve scientific understanding of the coupling of atmosphere and land surface processes and to strengthen the capability of modeling these processes at a continental scale for climate prediction purposes. One key area that will need to be addressed is how to translate the effects of climate variability into water resources management decisions at a regional or local level since human societies are most directly affected at this scale. GEWEX scientists at the Global Hydrology and Climate Center (GHCC), a partnership of NASA's Marshall Space Flight Center, the University of Alabama in Huntsville and the Universities Space Research Association, are working with the Tennessee Valley Authority (TVA) in the GCIP Eastern Large Scale Area to compute trade-offs among multipurpose reservoir operations and assess the costs of hydrologic changes using a multi-objective modeling system (see figure showing overall integrated approach). The Power and Reservoir System Model (PRSYM) is a generalized river basin modeling environment that integrates multipurpose reservoir operations, such as flood control, navigation, hydropower production, recreation, and water quality. PRSYM, therefore, provides river basin and electric utility managers with a tool for scheduling, forecasting, and planning reservoir operations. The model can be customized by a user to provide information on specific objectives, a feature that has considerable potential for addressing scientific objectives of GCIP. For example, PRSYM has capabilities that could be tailored to address GCIP objectives, such as (1) improving the utility of hydrologic predictions for water resource management; and (2) contributing to the development and evaluation of coupled hydrologic/atmospheric models at resolutions appropriate to large-scale continental river basins, particularly managed basins.

PRSYM was developed at the Center for Advanced Decision Support for Water and Environmental Systems at the University of Colorado, with assistance from planners and operators from the TVA and Bureau of Reclamation (BuRec). The application of PRSYM to GCIP could build upon

the BuRec experience of applying PRSYM to the planning and operations models in the management of the resources on the Colorado River. Closer to GCIP is the application of PRSYM by the TVA for modeling and managing more than 40 reservoirs. TVA considerations include controlling floods, maintaining desirable navigation and water-supply conditions, achieving economical hydropower generation schedules, protecting aquatic communities, and providing suitable pool-level and release schedules for recreation and hydro-energy production every 6 hours for up to 2 weeks.

Although TVA plans to use the PRSYM model for policy and planning studies, the heaviest model use will probably come from scheduling applications. TVA's current approach to reservoir scheduling is to prepare a new operating plan up to 2 weeks in daily time steps. The plan reflects immediate and long-range multiple purpose needs, including meeting power system electrical loads in an economical manner. With regard to GCIP, PRSYM when linked with the TVA's Hydrologic Modeling System or other hydrologic models has the potential to be a powerful and generic tool for water and power system impact analysis. In the upcoming years the usefulness of PRSYM will be tested and evaluated by the GHCC/TVA team for application in the GCIP eastern area.



Integrated Hydrologic Assessment System

FIRST GAME INTERNATIONAL SCIENCE PANEL MEETING

6-9 March 1996
Tokyo, Japan

Fifty participants from ten countries took part in the first meeting of the GEWEX Asian Monsoon Experiment (GAME) International Science Panel (GISP). The GISP was established as the principal group within GEWEX for considering scientific issues associated with the implementation of GAME and has responsibility for the systematic promotion of international cooperation of all of the GEWEX and GAME activities in Asia.

At the meeting, plans for the GAME Archive and Information Network (GAIN) were reviewed. It is envisioned that GAIN will be flexible enough to handle observations from the routine meteorological and hydrological networks, accept large amounts of data with varying specifications from the field and numerical experiments, and integrate satellite data into the processing streams. The system will be characterized by a centralized hub with distributed access centers for specialized data sets, and will rely as much as possible on upgrading existing networks and integrating them into a workable pattern to meet GAME's data management needs. GAIN will serve as a new centralized framework for meteorological and hydrological data coming out of GAME, especially for use among the Asian countries involved in the project.

The new criterion for GEWEX continental scale experiments (CSEs), which requires GAME and other GEWEX CSEs to establish collaborative agreements with water resource agencies to better utilize improved continental-scale information for assessing impacts on regional water resources, was discussed by the GISP. Part of the scientific strategy to accomplish these goals includes the following components.

- Reliance on an improved *in situ* Asian Automated Weather Station Monitoring Network (AAN) being deployed for at least a 10-year period. The network will include rain forest single sites in Sarawak, Sri Lanka, areas in Thailand and Malaysia, the monsoon region of China, several arid or semi-arid regions (China, Mongolia and Central Asia), and the Tibetan plateau and Siberia.
- Coordination of intensive regional field studies over four main sites covering the tropics, subtropics, pla-

teau region and cold regions. The sites include the Chao Praya River basin in Thailand and Huai He river basin in China, an experimental area on the Tibetan plateau, Siberia, and connection to an experiment in the South China Sea.

- Development of improved modeling techniques including the application of four-dimensional data assimilation and initialization of the operational limited-area models with enhanced surface and upper-air observations during the intensive observations period from March-October 1998 with a core period in May-July 1998.

Outreach of the broader scientific community was also discussed and the GISP agreed to include international teams in the GAME Intensive Observational Periods (IOPs), and to make supplementary specialized data from the IOPs available as soon as possible to the international community to promote detailed modeling, diagnostic and data interpretation studies. A full data management plan for deployment of specialized observing systems in each region (PBL towers and AAN stations) will be ready in 1996 and preliminary *in situ* observations and data collection will also begin then.

In a discussion of the modeling component of GAME, the Panel was advised that a global model that includes the application of four-dimensional data assimilation will begin operational use at JMA and that this model could be used for processing an analysis of the data collected during the GAME IOP. In addition, regional models with grid sizes of 10 to 30 km have already been developed and are undergoing testing for two field sites in China. Agreement was also reached at JMA to develop a plan for undertaking a reanalysis of the GAME/SCSMEX IOP results within a reasonable period after completion of the study phase to incorporate findings from the initial analysis and ensure assimilation of the maximum amount of available observations, many of which may be improved by reverification, correction and reformatting.

The Panel noted the establishment of a GAME International Project Office (GIPO) to assist the GISP in accomplishing its objectives. The GIPO will be located in the Institute for Hydrospheric-Atmospheric Sciences at Nagoya University. Professor K. Nakamura was confirmed as the Director of the office. GIPO will coordinate the review and update of the draft GAME Implementation Plan.

NEW VERIFICATION CENTER

**Mark Morrissey, Claude Duchon,
Scott Greene and Lee Williams
University of Oklahoma**

Scientists at the University of Oklahoma have established the Environmental Verification and Analysis Center (EVAC) to promote interdisciplinary work on data and model validation related to the investigation of environmental phenomena. EVAC is located in Sarkey's Energy Center on the Norman campus and was developed under University of Oklahoma guidelines. The goal of EVAC is to initiate new interdisciplinary collaboration among scientists and strengthen existing links between government environmental programs, especially GEWEX-related projects, such as the GEWEX Continental-scale International Project (GCIP) and the Global Precipitation Climatology Project (GPCP). The driving force behind EVAC is the need for scientists who are experts in environmental model and remote sensing algorithm development to work collaboratively with scientists who specialize in surface data analysis, particularly, spatial scale-analysis.

The location of the Center at the University of Oklahoma is very appropriate due to the vast archive of surface and radar data obtained from the extensive observational networks in Oklahoma. Within Oklahoma are numerous Department of Energy Atmospheric Radiation Measurement (ARM) sites, the USDA Agricultural Research Service's Little Washita Micronet, the Oklahoma Mesonet, and five WSR-88D radars. EVAC intends to utilize these data sources to verify model and remote sensing variable estimates.

EVAC includes a team of surface data analysis experts and maintains extensive sample databases with which to conduct a variety of verification exercises sponsored by GEWEX and other programs. The Center will serve as a natural focus for interdisciplinary work through a visiting scientist program and will conduct instructional programs aimed at teaching methods of spatial analysis, including scaling and interpolation, and problems in environmental measurements to undergraduate and graduate students.

For more information on how to participate in EVAC, contact: Mark Morrissey, Oklahoma Climatological Survey, Norman, OK 73019, Email: mmorris@uoknor.edu; Tel: (405) 325-2541; Fax: (405) 325-2550.

GCIP IMPROVEMENTS TO ETA MODEL BENEFIT STUDIES WORLD WIDE (Continued from page 3)

with estimates based only on observations. Atmospheric water balance estimates have been computed for partial periods during 1993-1994 and continuously since April 1995. Model-based estimates of different land-surface parameters are also being used to compare the budget derived estimates. Model parameterizations are changed periodically when upgrades to the system are needed. Thus, the analyses of these products at the University of Maryland are only for comparison purposes.

In addition, University of Maryland GCIP investigators are collaborating with the Canadian Mackenzie GEWEX Study (MAGS) scientists. Diagnostics similar to those over the Mississippi River basin are being computed for the Mackenzie River basin and sub-basins. The Mackenzie River basin effort will provide more knowledge about cold climate hydrology and the behavior of the Eta model at high latitudes. This knowledge may have applications in other areas such as the Labrador Sea project to study atmospheric forcing of deep ocean convection.

Comparisons of radiosonde observations and Eta model analyses during the GCIP integrated system test (July-August 1994) showed good agreement between Eta model analyzed and radiosonde observed humidity transport (Yarosh et al., 1996). In this comparison study, the results also suggest the Eta model may be useful for diurnal studies over the Mississippi basin.

At the University of Utah there is an effort to determine the forecast skill of the mesoscale Eta model in regions of complex terrain. This is a collaborative research with the Environmental Modeling Center of NCEP. The purpose of this research is to evaluate the skill of the mesoscale Eta model over the western United States. This work also involves collaboration with the Scientific Services Division of the National Weather Service Western Region. The Eta vertical coordinate helps to minimize errors across steeply-sloped terrain compared to other vertical coordinates. The sensitivity of the model's forecast to horizontal resolution is being evaluated by comparison of forecasts on 48-km, 29-km, and 10-km grids. Also

(Continued on page 14)

in planning is the application of the Eta model in the Pan American studies of climate change.

Asian Monsoon Applications

An example of applying the NCEP regional Eta model far from the North American GCIP region was pursued by Anandu Vernekar and Yimin Ji (Ji, 1995; Ji and Vernekar, 1996), University of Maryland, to improve simulation of seasonal variations of precipitation over the Asian monsoon region. In this application the Eta model region (30°E–140°E and 30°S–50°N) includes the Indian, Chinese and Southeast Asian monsoons. The Eta model used was an earlier version with 80-km horizontal resolution with 38 vertical levels. The Eta model was linked to the COLA general circulation model (GCM). The COLA GCM is a spectral model with rhomboidal truncation at 40 waves and 18 vertical levels. The Eta model was linked to the GCM such that its lateral boundary conditions and initial conditions are derived from the GCM simulations. This procedure was used to simulate the summer monsoon of 1988 from mid April to the end of September by prescribing the seasonally varying sea surface temperature both in the GCM and the Eta model. Three separate runs were made with initial conditions on April 14, 15 and 16, 1988, from the NCEP analysis. The ensemble of the three runs results were compared with GCM and Eta model results.

Mean June, July and August precipitation comparison between observations and simulations by the Eta model and the GCM showed Eta model simulations are closer to observations than that of the GCM. The Eta model accurately simulated the rainfall maxima along the west coast of India and along the coast of Burma and the minimum rainfall over Sri Lanka. The rainfall maximum along the west coast of India and the rainfall minima over Sri Lanka were missing in the GCM simulation. Those improvements in the Eta model simulations are attributed to the orographic effects and the effects of mesoscale circulations on the mean fields.

African Applications

The Eta model is also being applied over the Sahel region of Africa by Nelson D. Pyuzza (a

Ph.D candidate of Professor F. Baer at the University of Maryland) with the objective of improving our understanding of the coupling between the land-surface processes and the atmosphere for better weather forecasts in the region. The surface scheme used (Noilhan and Planton, 1989) takes into account the influence of vegetation, and is more responsive to short term variations and occurrences of precipitation and evapotranspiration forcing through moisture feedback mechanisms. These factors are essential for simulation of the surface flux exchanges, as realistically as possible, within a predominantly convectively driven atmospheric boundary layer in a region which comprises a large continental extent across the equator, characterized by heterogeneous surface conditions ranging from tropical forests to deserts, varied topography, and intense surface heating. Preliminary results show that 10-day accumulations of model rainfall simulations for the Sahel region compare reasonably with independent objective rainfall estimates based on satellite data, and surface rain gauges.

South American Applications

In Brazil, the Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) is a multi-disciplinary, multi-scale international research effort, which will study the interactions between land use and regional and global climate variations at scales ranging from the small plot to the whole basin. The basic input data will be provided by the operational meteorological network, which will be enhanced to meet the needs of LBA. The system will produce time series of surface and atmospheric data on a scale useful for validating the 4-Dimensional Data Assimilation products, and will also include modelled river flow from a coupled macro-hydrological model. The Centro de Previsao de Tempo e Estudos Climaticos will use the Eta model (with a form of SSiB) at 40-km resolution to investigate the behavior of the atmospheric boundary layer atmospheric circulations and surface conditions to produce different climates over the undisturbed and cleared forest.

Through a collaborative effort with the Environmental Modeling Center of NCEP, the University of Maryland and the Naval Weather Service of Argentina, a workstation version of the Eta model is being realized. Work has been done adapting the preprocessor and the model modules, and the

current focus now is on the postprocessor module. The two objectives in this initiative are: (1) to run the Eta model operationally for forecast purposes and (2) to develop a long term database of regional analyses for South America that would allow the performance of similar studies to those that are currently done for the Mississippi basin.

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WCRP/GEWEX MEETINGS CALENDAR

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<http://www.cais.com/gewex/gewex.html>*

10-12 June 1996—SCALING UP HYDROLOGICAL VARIABLES USING REMOTE SENSING, Wallingford, U.K. For information, contact Dr. John Stewart, Institute of Hydrology, Crowmarsh Gifford, Wallingsford, Oxfordshire, OX10 8BB, U.K.; Tel: 44-1491-838800; Fax: 44-1491-832256.

17-21 June 1996—SECOND INTERNATIONAL SCIENTIFIC CONFERENCE ON GLOBAL ENERGY AND WATER CYCLE, U.S. National Academy of Sciences, Washington, DC. For additional information, contact IGPO, 1100 Wayne Avenue, Suite 1210, Silver Spring, Maryland 20910, U.S.A., Tel: 1-301-427-2089 Ext. 521; Fax: 1-301-427-2222; E-mail: gewex@cais.com.

27-29 June 1996—SCIENCE PLANNING GROUP MEETING FOR LARGE SCALE BIOSPHERE-ATMOSPHERE EXPERIMENT IN AMAZONIA(LBA), Sao Jose dos Campos, Brazil. For information contact Dr. Carlos Nobre, CPTEC-INPE, Tel: 55 12 561 2890; Fax: 55 561 2835; E-mail: nobre@cptec.inpe.br.

22-26 July 1996—EIGHTH SESSION OF THE WORKING GROUP ON RADIATIVE FLUXES, Killiney Bay, Ireland.

29-31 July 1996—WORKING GROUP ON DATA MANAGEMENT FOR WCRP RADIATION PROJECTS FOURTH SESSION, Killiney Bay, Ireland.

12-16 August 1996—4TH INTERNATIONAL CLOUD MODELING WORKSHOP, AND THE 3RD GCSS BOUNDARY LAYER WORKSHOP, Clermont-Ferrand, France. For information contact Roy Rasmussen, NCAR, Box 3000, Boulder, Colorado, USA; Fax: (303) 497-8401; E-mail: rasmus@ucar.edu or Andrea Flossman, Laboratoire de Meteorologie Physique, Universite Blaise Pascal/CNRS, 24 Avenue des Landais, F-63177 Aubiere Cedex, France; Fax: (33) 73 27 16 57; E-mail: flossman@opgc.univ-bpclermont.fr.

19-23 August 1996—12TH INTERNATIONAL CONFERENCE ON CLOUDS AND PRECIPITATION, Zurich, Switzerland. For information, contact Prof. P.R. Jonas, Dept. of Pure and Applied Physics, UMIT, P.O. Box 88, Manchester, M60 1QD, U.K.

19-24 August 1996—INTERNATIONAL RADIATION SYMPOSIUM: CURRENT PROBLEMS IN ATMOSPHERIC RADIATION, Fairbanks, Alaska. For information contact Sharon Kessey, Geophysical Institute, University of Alaska, P.O. Box 757320, Fairbanks, Alaska 99775, U.S.A. Tel: 970-474-7360, Fax: 970-474-7290, E-mail: sharon@kaja.gi.alaska.edu.

26-29 August 1996—GEWEX HYDROMETEOROLOGY PANEL MEETING, Toronto, Canada.

9-13 September 1996—SEVENTH CONFERENCE ON MESOSCALE PROCESSES, Reading, U.K. For information, contact Bradley Smull, NOAA/NSL, 325 Broadway, Boulder, Colorado, U.S.A.; Tel: 1-303-497-6886; Fax: 1-303-497-6930; E-mail: smull@mrd3.mmm.ucar.edu, or Susan Ballard, Joint Centre for Meteorology, University of Reading, P.O. Box 240, Reading RG6 2FN, U.K.; Tel: 44-734-318794; Fax: 44-734-318791; E-mail: spballard@email.meto.govt.uk.

14-17 October 1996—GCSS EXTRA-TROPICAL LAYER CLOUDS WORKSHOP, Geesthacht, Germany. For information, contact Dr. Ronald Stewart, Climate Processes and Earth Observation Division, Atmospheric Environmental Service, 4905 Dufferin Street, Downsview, Ontario, Canada M3H 5T4; Tel: 416-739-4122; Fax: 416-739-5700; E-mail: rstewart@dow.on.doe.ca.

21-23 October 1996—GCSS PRECIPITATING CONVECTIVE CLOUD SYSTEMS MODEL INTERCOMPARISON WORKSHOP, NASA Goddard Space Flight Center, Greenbelt, Maryland, U.S.A. For information contact Mitch Moncrief, NCAR, P.O. Box 3000, Boulder, Colorado

80307; Tel: 303-497-8960; Fax: 303-497-8181; E-mail: monerief@ncar.ucar.edu.

4-8 November 1996—WGNE MEETING, Tokyo, Japan.

11-13 November 1996—CONTINENTAL-SCALE HYDROLOGICAL MODELS: Charting the Future, Institute of Hydrology, Wallingford, U.K.

13-15 November 1996—INTERNATIONAL GEWEX WATER VAPOR PROJECT (GVaP) MEETING, Geneva, Switzerland.

2-6 December 1996—FIRST STRATOSPHERIC PROCESSES AND THEIR ROLE IN CLIMATE (SPARC) GENERAL ASSEMBLY, Melbourne, Australia. For information contact SPARC96, CRC for Southern Hemisphere Meteorology, Monash University, Building 70, Clayton, VIC 3168, Australia, Fax: 61 399 05 96 89; E-mail: sparc96@vortex.shm.monash.edu.ac.

6-10 January 1997—GEWEX SCIENTIFIC STEERING GROUP MEETING, Germany.

2-7 February 1997—SEVENTY-SEVENTH ANNUAL MEETING AMERICAN METEOROLOGICAL SOCIETY, Long Beach, California. Conferences and Symposia on Atmospheric Radiation, Global Change Studies, Climate Variations, Atmospheric Chemistry, Hydrology and Integrated Observing System. For information contact American Meteorological Society, 45 Beacon Street, Boston, MA, USA, Tel: 617/427-2425; Fax: 617/742-8718.

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