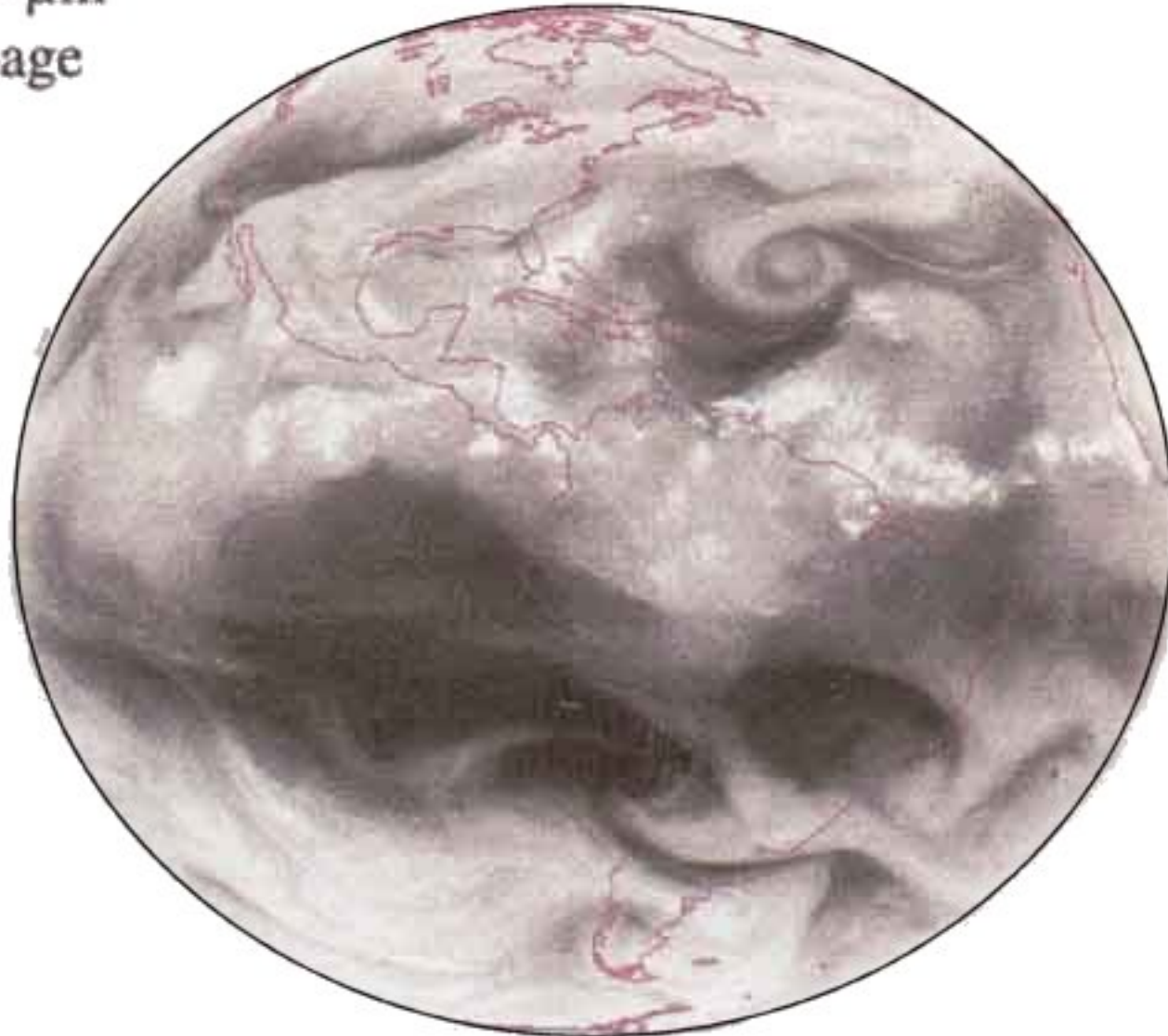
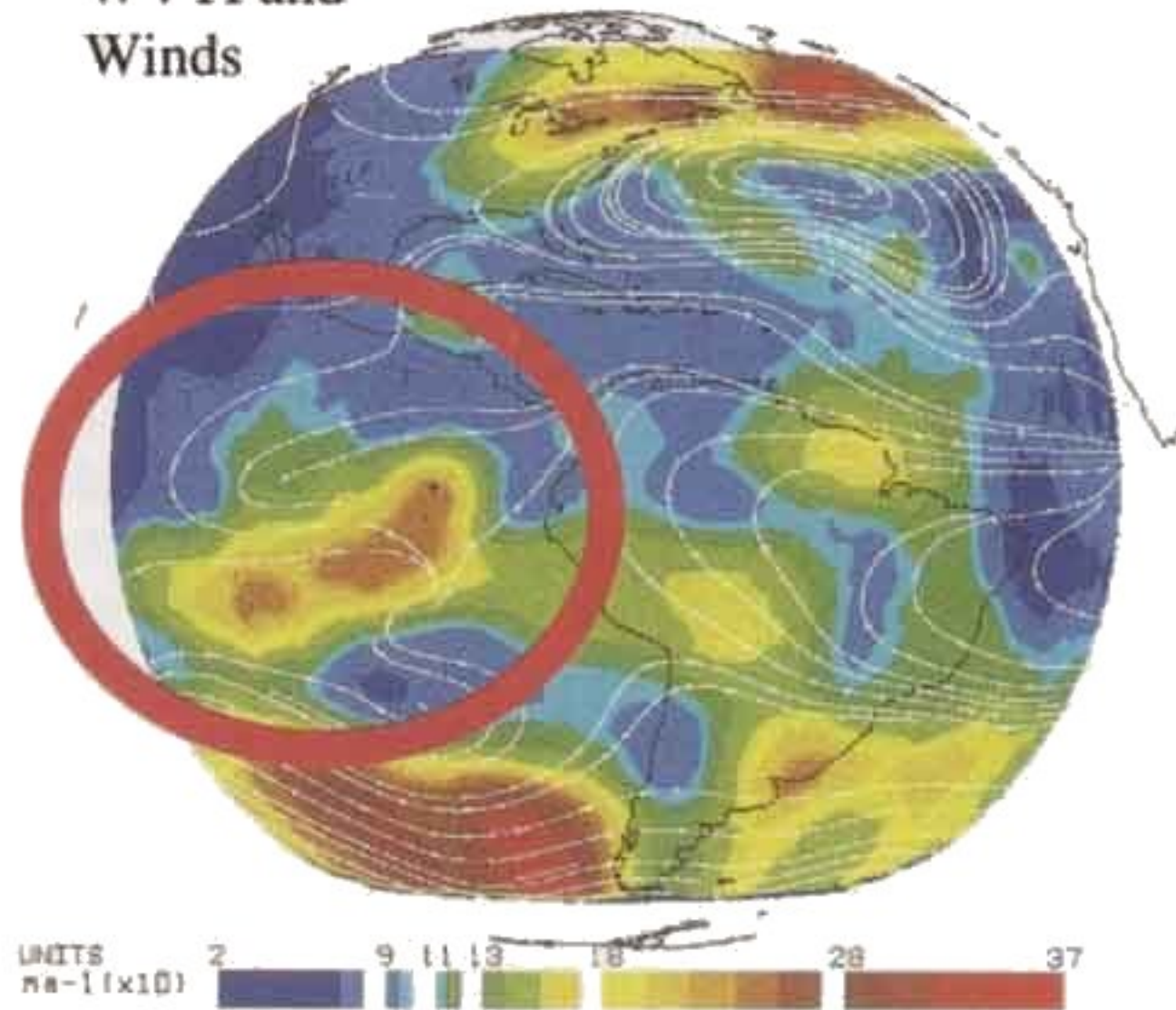


6.7 μm
Image



WVTI and
Winds



The new Water Vapor Transport Index (WVTI) is explained below. In the circled region, note the high altitude westerly flow (see white streamlines) over the Intertropical Convergence Zone (bright on 6.7 μm image), which turns south and east, descending into the high pressure subsidence zone (dark on 6.7 μm image) of the subtropical Eastern Pacific and producing a WVTI transport maximum (high to low altitude) in this region. The high to low altitude transport illustrates how tropical convection outflow may be studied over extended periods.

UPPER-LEVEL WATER VAPOR TRANSPORT INDEX FOR CLIMATE RESEARCH

¹Gary J. Jedlovec, ¹Franklin R. Robertson
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Despite the attention focused on anthropogenic trace-gas emission, water vapor is the most important greenhouse gas. In particular, upper-level water vapor is extremely important in climate processes because it controls the amount of energy lost to space by infrared emission. Very little is known about the variability of water vapor in the upper troposphere because radiosondes and even operational satellite sounders do a poor

(Continued on page 11)

WHAT'S NEW IN GEWEX

New
Aircraft Cloud Profiling Radar Data
(see back page)

Over 300 attend
Second International Scientific
Conference

Increased focus on Water Vapor
(see articles pages 1 and 13)

International GVAP Workshop
Planned

GPCP Pilot Study with
Higher Resolution

INCREASING THE USEFULNESS OF GEWEX RESEARCH

Moustafa T. Chahine
Chairman, GEWEX Scientific Steering Group

The Second International Scientific Conference on the Global Energy and Water Cycle (17-21 June 1996) brought together scientists, administrators and students involved in the study of measurements, modeling and the theory of processes affecting the energy and water cycle from small to global scales. Over 300 people from 20 countries attended the conference and 250 posters were presented. The conference sessions focused on GEWEX scientific activities involving the climate feedback associated with clouds, radiation, and hydrologic processes. The papers and posters presented clearly show that GEWEX research is making rapid progress in supporting up to seasonal-to-interannual forecasts and in developing the data sets to understand decadal-to-century climate change.

The final day of the Conference was highlighted by a panel discussion involving J. Michael Hall, Office of Global Programs, National Oceanic and Atmospheric Administration; Hartmut Grassl, World Climate Research Programme; Tetsuzo Yasunari, Institute of Geoscience, University of Tsukuba; Robert Harriss, Office of Mission to Planet Earth, National Aeronautics and Space Administration; Ari N. Patrinos, Environmental Sciences Division, U.S. Department of Energy; and Paul Try, American Meteorological Society. Briefly, I will convey the focus of their discussion and the collective recommendation:

It is clear that the research GEWEX has undertaken is not only scientifically important, but also has significant applicability to numerous societal activities. This usefulness is appreciated by many, but can be more effectively communicated to end users and to the general public. Translating research into tangible benefit to society is not an easy task; in our case the greatest payoff can be achieved by working directly with researchers in other associated fields (e.g. agriculture, fisheries, forestry, insurance, etc.). We must involve more of these colleagues in our activities and work together on their problems. We must look at the problems from their

point of view to understand how to best apply the knowledge and information that GEWEX has collected.

As we move forward to develop improved regional assessments of climate-related problems we will be finding ways to involve the end users of GEWEX research results to implement this recommendation.

GEWEX PROJECT SCIENTIST SHUTTLE BOUND



Piers Sellers (center), former International Satellite Land-Surface Climatology Project (ISLSCP) Science Panel Chair, was honored at the Second International Scientific Conference on the Global Energy and Water Cycle for his outstanding leadership and contributions to GEWEX. In recognition of his accomplishments, a plaque was presented at the Conference by Hartmut Grassl, Director WCRP (left) and Moustafa Chahine, Conference Chairman. Piers has moved to Houston, Texas, to become a mission specialist on the space shuttle.

Contents	
Upper-Level Water Vapor Transport	
Index for Climate Research	1
Commentary	2
ARM Ships ARCS-1 to Tropical	
Western Pacific	3
River Routing in the Global Water Cycle	4
Parameterization for Lateral Discharge	
on a Global Scale	6
Using Cloud Resolving Models for	
Parameterizations of Precipitating	
Cloud Systems	7
Conference Photos	8-9
ARM to Characterize Water Vapor Over	
Southern Great Plains Site	13
International Workshop on Research Uses	
of ISCCP Data Sets	13
GPCP WGDM Tenth Session	14
WCRP/GEWEX Meeting Calendar	15
New Airborne Cloud Radar Data	16

ARM SHIPS ARCS-1 TO TROPICAL WESTERN PACIFIC

On 22 May 1996, a new meteorological instrument station was shipped from Long Beach, California, bound for Manus Island in Papua New Guinea. The Atmospheric Radiation and Cloud Station-1 (ARCS-1) is the first of five ARCSs scheduled to be deployed in the Tropical Western Pacific locale (10° N and 10° S of the equator from 120° E to 150° W longitude) between now and the year 2002. ARCS-1 is scheduled to be operational in September 1996. It is equipped with instruments that measure solar and terrestrial radiation, cloud properties, and other meteorological parameters; computer systems for data collection and storage; a satellite communications system, and support equipment. Developed by the U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) Program, ARCSs form the technological cornerstone for the ARM Tropical Western Pacific Cloud and Radiation Testbed sites.

The ARCS instruments complement measures cloud properties, solar and terrestrial radiation, water vapor, surface meteorology, and boundary layer structure. The instruments require minimal day-to-day operating attention, and each has been hardened and tested for long-term operation in

the tropical marine environment. A user interface to the data system displays real-time and stored scientific and operational data for use by on-site personnel. Using the Geostationary Operational Environmental Satellite (GOES) system, the data system sends periodic transmissions of summary scientific data and of the health and status of instruments and support systems to operations personnel in the United States.

The siting and operations of ARCS-1 is a cooperative effort between ARM and the Papua New Guinea National Weather Service, which helped obtain and prepare a site for ARCS-1 at the Momote Airport on Manus. National Weather Service personnel will provide daily operational support, collaborate in the interpretation of regional data, participate in local education programs, and provide an interface for the use of ARCS data within Papua New Guinea.

For more information, contact Bill Clements, Tropical Western Pacific Site Program Manager, (505) 667-1186, (clements@lanl.gov). For general information about the program, explore the ARM home page at <http://www.arm.gov/>.

ARCS Measurements and Instruments

MEASUREMENTS	INSTRUMENTS
Cloud properties	Whole sky imager* 905-nm ceilometer 523-nm vertical pointing lidar 35-Ghz vertical pointing cloud radar*
Surface-level solar and terrestrial radiation properties	Up- and down-looking pyranometers, pyrgeometers, and narrow field of view 10-micron radiometers Normal incidence tracking pyrheliometer Shaded pyranometer and pyrgeometer on solar tracker Net radiometer UVB radiometer
Aerosol optical depth	Multifilter rotating shadowband radiometer
Column water vapor and liquid water	Microwave radiometer Rawinsonde (operated in cooperation with the National Oceanic and Atmospheric Administration [NOAA] Aeronomy Lab)
Surface meteorology	Meteorology station with 10-m mast: temperature, humidity, precipitation, pressure, wind speed and direction
Boundary layer structure	915-MHz wind profiler with radar-acoustic sounding system for temperatures (operated in collaboration with NOAA's Aeronomy Lab)
	*to be added in 1997

RIVER ROUTING IN THE GLOBAL WATER CYCLE

Taikan Oki*, Shinjiro Kanae and
Katumi Musiake
Institute of Industrial Science
University of Tokyo

River discharge returns water to the ocean that may have been carried deep into continents in a vapor phase by atmospheric winds. The global water cycle is not complete without considering the river discharge process. However, this process is not well defined in global climatological studies. Recently, it has been proposed that river discharge can be used for validating general circulation model (GCM) simulations. A river routing model is required in order to compare the runoff from GCMs with observations. This is due to a lag between runoff generated by a GCM grid using a land surface parameterization (LSP) and runoff observed at gauging stations.

The runoff routing model of Miller et al. (1994) was used off-line in this report (Kanae et al., 1995), for the runoff generated by the modified bucket model of Kondo (1993). The Kondo scheme is embedded in the atmospheric GCM of the Center for Climate System Research (CCSR), University of Tokyo and the National Institute for Environmental Studies (NIES). In the case of this bucket model, some portion of precipitation becomes runoff even before the bucket is "full". A numerical experiment was performed using the climatological mean sea surface temperature with its seasonal change and the seasonal runoff of major river basins (Oki et al., 1995).

The river channel network was built from digital elevation maps and manually modified to a $5.6^\circ \times 5.6^\circ$ grid corresponding to the T21 GCM resolution. The velocity of the water in the river channel is a tuning parameter in the runoff routing model, and it was found that the velocity of 0.3 m/s gives good seasonal cycles of river discharge for the Amazon, Ob, and Amur river basins (see Figure 1).

One advantage of this research is that total water storage in each river basin can be compared with independent estimates by the atmospheric water balance (AWB) method (Oki et al., 1995a, b).

The total water storage estimated by the AWB method and by the atmospheric GCM (AGCM) compared reasonably well (solid lines with open stars in Figures 2 and 3). Total water storage in river basins is estimated by the AWB method that includes the changes of surface soil moisture, snow accumulation, ground water, water in lakes and river channels. This estimation is only a relative value. The minimum value was set to zero in Figure 3. It is important to examine not only the flux (discharge) from the model but also the state variable (storage) in the model with observations.

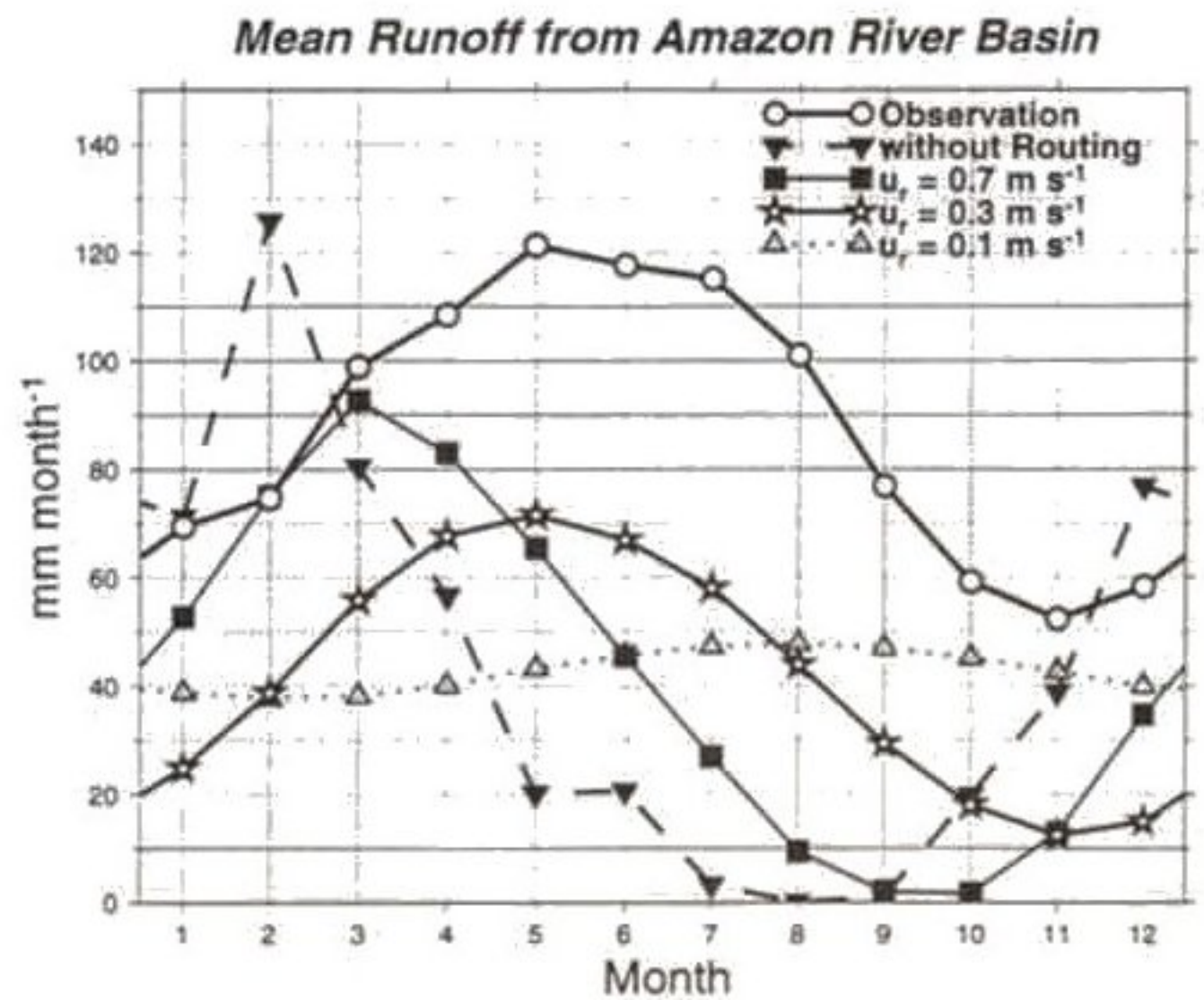


Figure 1: Effect of introducing routing model to the Amazon River Basin.

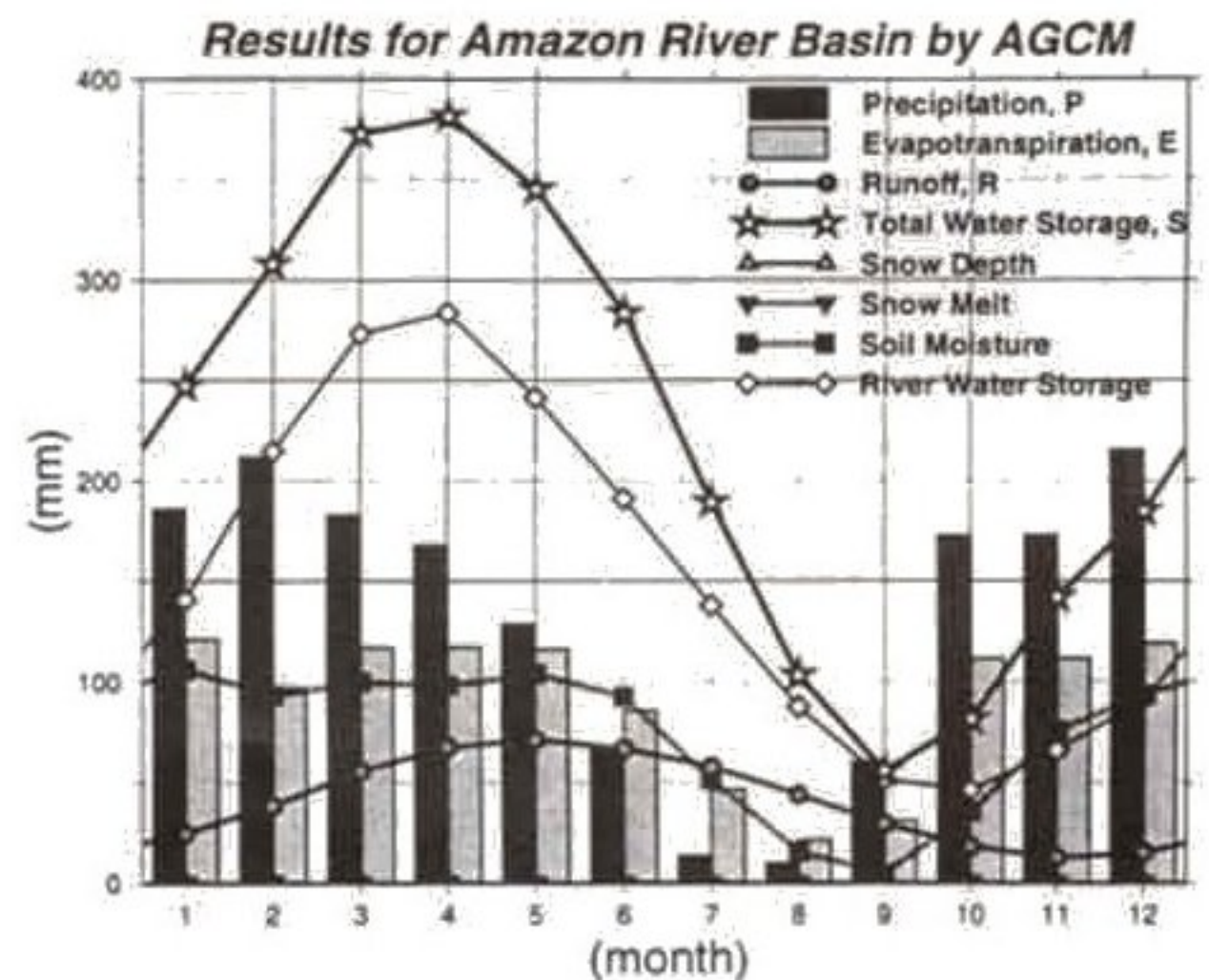


Figure 2: Water balance of the Amazon River Basin by the AGCM and the routing model.

* Visiting scientist, NASA, Goddard Space Flight Center, Greenbelt, Maryland.

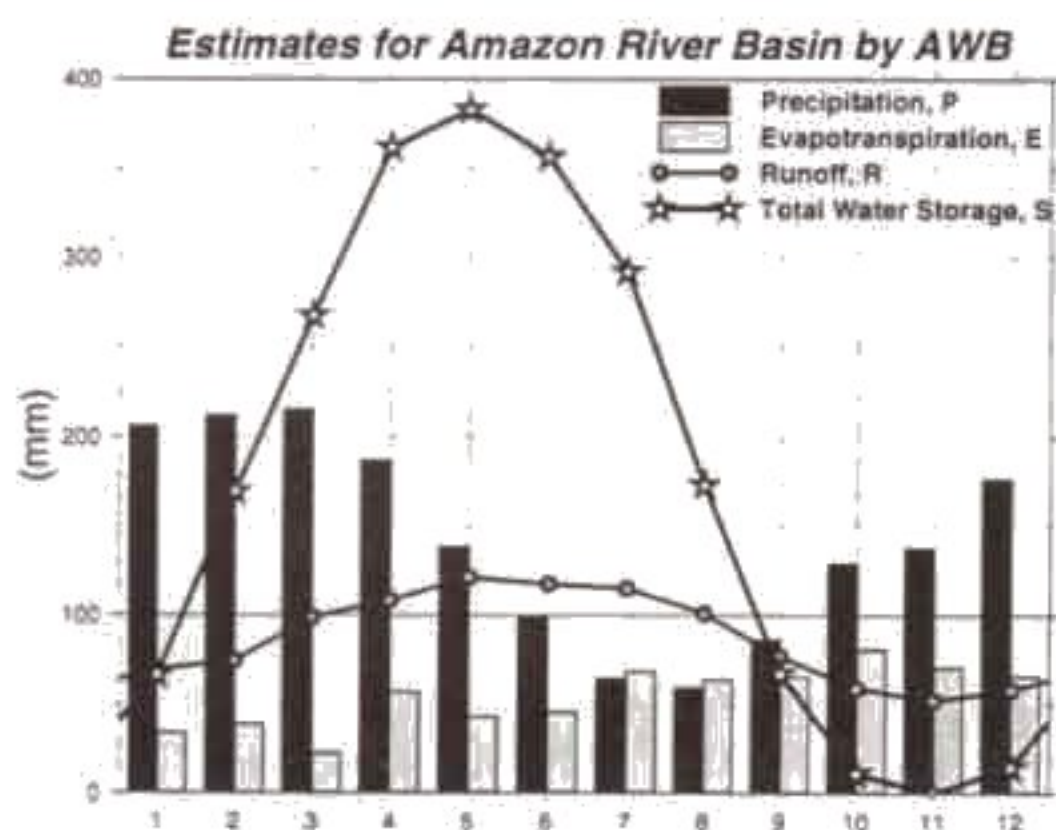


Figure 3: Hydrologic cycle of the Amazon River Basin estimated by atmospheric water balance.

Actually, 0.3 m/s seems slower than the flow speed in a channel of large rivers. The use of a bucket model in a GCM (Manabe, 1969) generates runoff, which has no relation to evaporation at the grid either by surface runoff or by percolation into deep soil layers. Therefore, the effective velocity should be regarded as an integrated mean velocity of rainwater traveling from the surface soil layer to the river mouth through various paths. The routing model in this study includes the ground water process, and river channel storage also consists of ground water storage.

The river routing model is currently included in a coupled atmosphere-ocean GCM of CCSR/NIES, and will be used to investigate how the inclusion of river routing affects the thermohaline circulation of the ocean. The irrigation effect on the soil moisture at a downstream grid by the runoff water from upstream soil moisture should be expressed in a coupled atmosphere-ocean-river GCM in the near future.

GCMs generally use more robust forcings and boundary conditions compared to traditional rainfall-runoff models in hydrology. Simulating river discharge by GCMs will realize the hydrograph estimation of *ungauged river basins*, which is a goal of some hydrologists. Therefore, river routing with a LSP in GCMs can be one of the most challenging issues for them.

For studies on the global water cycle, the river channel network for major basins of the globe (nearly 300) was recently constructed on a $1^\circ \times 1^\circ$ global mesh. Figure 4 is an example for South America. This global product can be used in studies such as the International Satellite Land-Surface Climatology Project (ISLSCP) Global Soil Wetness Project.



Figure 4: South America river basins in a $1^\circ \times 1^\circ$ mesh.

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PARAMETERIZATION FOR LATERAL DISCHARGE ON A GLOBAL SCALE

Stefan Hagemann and Lydia Dümenil
Max-Planck-Institute (MPI) for
Meteorology, Hamburg

The representation of hydrologic land-surface-processes is still not adequate in atmospheric General Circulation Models (GCM). In particular, the lateral waterflows are described insufficiently. The goal of this study is to develop a model for the lateral flows on a global scale which describes, independent of the spatially distributed land surface characteristics, the translation and retention of the lateral discharge. In this case global scale refers to the resolution of 0.5° and lower, which corresponds to a typical average gridbox area of about 2500 km^2 . The operational resolution of GCMs is usually lower than that.

Several model approaches exist for the description of discharge processes, but these do not fit our purposes. Apart from the fact that only a few investigations have been carried out on a global scale, most of the existing discharge models are only applicable on gauged watersheds. This means that hydrologic time series must exist for each given catchment or gridbox, respectively, so that the model parameters can be derived from those, but the majority of the gridboxes of a GCM are ungauged. At MPI the model of Sausen et al. (1994) is currently operational, but it has several errors.

In order to test what level of accuracy and which processes are required on the global scale, a catchment-based model was developed for two catchments, approximately the size of a 0.5° gridbox. The discharge from a given catchment was simulated using several types of models and parameterizations. The results of this development phase show that a separation between several flow processes such as overland flow, baseflow and riverflow is necessary to yield good discharge simulations. To simulate processes that include both retention and translation, it is necessary to use two-parameter models. Based on these results the following model structure is chosen for the new HD (Hydrological Discharge)-Model:

- Overland flow is modeled by a cascade of n_o equal linear reservoirs, input is surface runoff.

- Baseflow is modeled by a linear reservoir, input is drainage from the soil.
- Riverflow is modeled by a cascade of n_r equal linear reservoirs, input is gridbox inflow.

A special model topography was created to cause good agreements of the model and the real catchments of large rivers that are taken from a data set. For a first parameterization approach, the retention time of the baseflow reservoir is globally set to 300 days. The numbers of linear reservoirs n_o and n_r are global constants for overland flow and riverflow. The retention coefficients of the linear reservoirs are a function of the topography gradient Δh and the gridbox length Δx . The gridbox length is defined as the distance between the centers of two adjacent gridboxes in the direction of the flow. These functional relationships for the HD-Model are based on optimized parameter sets in the test catchments.

For some large rivers the simulated discharges of the model of Sausen et al. (1994) and the HD-Model are compared with observed discharge data provided by the Global Runoff Data Centre (GRDC) (Dümenil et al., 1993). As input, 5 years of daily values of runoff and drainage are taken from an ECHAM3-T42 (Rockner et al., 1992) simulation using climatological sea surface temperature.

The graphs in the figure (next page) show a considerable improvement of the simulated discharge comparing the HD-Model to the model of Sausen et al. For the Amazon and the Mississippi this improvement is primarily based on the separation of flow processes. For the Danube it is based on the improved model topography. For the Jenissei, the model of Sausen et al. (1994) appears to be better than the HD-Model, but this is only a deception. We know that in ECHAM3-T42 the snowmelt is computed about one month too late. Therefore, a correct discharge simulation must simulate a snowmelt-induced discharge also one month too late which is the case for the HD-Model at the Jenissei catchment (located in South Siberia).

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USING CLOUD RESOLVING MODELS FOR PARAMETERIZATIONS OF PRECIPITATING CLOUD SYSTEMS

Mitchell Moncrieff
National Center for Atmospheric Research

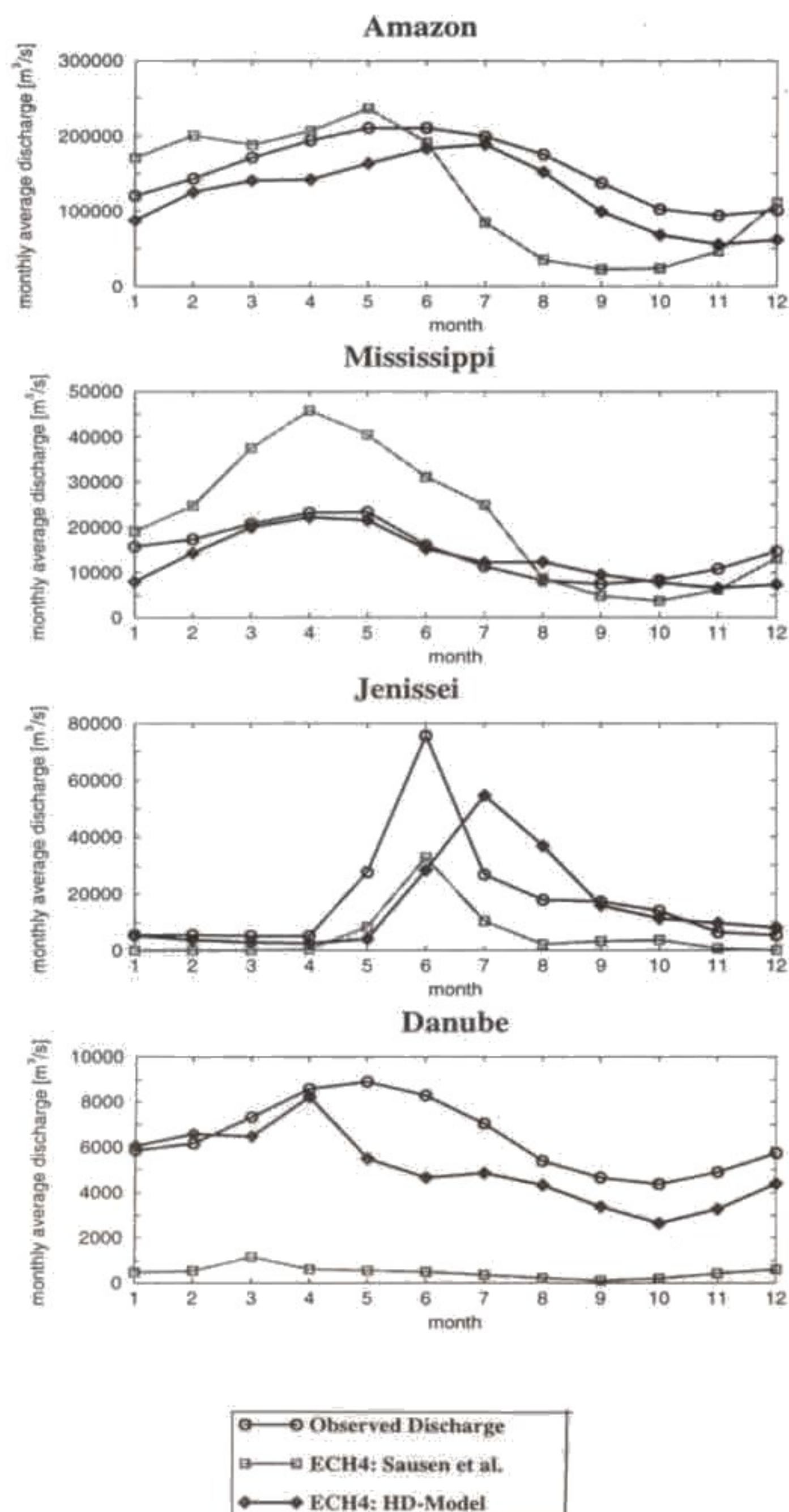
The dearth of comprehensive and physically based parameterizations in both numerical weather prediction models and general circulation models used for climate research is a well-known bottleneck to progress. The GEWEX Cloud System Study (GCSS) was established with this strategic problem in mind.

Tropical convective cloud systems are the top priority of the GCSS Working Group 4 and the recently established Clouds in Climate Program (CCP) at NCAR. The cornerstone of the GCSS/CCP approach is the use of cloud-resolving models (CRM), evaluated against observations. In addition, theoretical paradigms are also needed to establish fundamental principles and to formulate cloud processes properly and efficiently in parameterization schemes. CRMs are based on the nonhydrostatic equations of motion and accurately resolved cloud-scale and mesoscale circulations that couple cloud-related processes (microphysics, boundary and surface layer, radiation and small-scale turbulence). This is in contrast to general circulation models (GCM) that must parameterize the effects of these circulations (e.g., as mass fluxes) as well as the processes themselves. Two spatial dimension CRMs are capable of simulating the evolution of precipitating cloud systems in domains up to several thousand kilometers in size and up to interseasonal time scales. Three-dimensional models naturally have smaller domains (a few 100 km on a side) and can be run for a week or so, but are still compatible with climate model grid-scales and the time scales of the primary convection-related processes.

A key question remains regarding the degree of detail necessary to realistically estimate the large-scale effects of convective cloud systems. To this end, good progress has been made. Grabowski, Wu and Moncrieff (1996) used large-scale forcing derived from the Global Atmosphere Research Programme (GARP) Atlantic Tropical Experiment (GATE) as an *integral control* over

Rockner, E. K. Arpe, L. Bengtsson, S. Brinkop, L. Dumenil, M. Esch, E. Kirk, F. Lunkeit, M. Ponater, B. Rockel, R. Sausen, U. Schlese, S. Schubert and M. Windelband, 1992: Simulation of the present-day climate with the ECHAM Model: Impact of model physics and resolution. MPI Report No. 93, Max-Planck-Institute for Meteorology, Hamburg.

Sausen, R., S. Schubert and L. Dumenil, 1994: A Model of the River Runoff for use in coupled Atmosphere-Ocean Models. *J. of Hydro.* 155, S. 337-352.



Observed and simulated discharge of some large rivers.

(Continued on page 10)

Second International Scientific Conference on



CONFERENCE HIGHLIGHTS

Over 300 people from more than 20 countries attended the conference, and 250 posters were presented. Highlights of some of the conference presentations included:

- Examples of medium-range forecasts for extreme flooding events in Europe, North America, and the tropics demonstrated that successful medium-range forecasting requires accurate modeling of key land-atmosphere interactions.

- Examples from three climatic regions underscored the fact that in water resources engineering, a variety of water management techniques, modeling schemes and tools are needed in the planning and implementation of global change studies within GEWEX to be useful to water resource management.

- A review of the influences of clouds on the radiation budget of the Earth and its atmosphere, including their effects on the top-of-atmosphere radiation budget illustrated the shortcomings of global models

the Global Energy and Water Cycle, June 1996



Photos courtesy of Beth Laakso, U.S. Dept. of Commerce

in dealing with this effect. Our current understanding of absorption of both solar and infrared radiation in the atmosphere was described and included plans for GEWEX projects to improve on the current base of knowledge in this field.

- Progress in the study of the Earth's rainforests indicated the need for GEWEX to follow up on recent studies and global observational initiatives, which are greatly advancing the understanding of the close connections between the physical climate system and the global biosphere.

- An overview of both ocean and high-latitude exchanges of energy and water indicated that strong interaction among the components of WCRP are needed to ensure that ocean-atmosphere-ice exchange research is most productive.

Several of the articles in this newsletter, such as the water vapor article by Jedlovec (page 1) and the articles on routing models by Oki (page 4) and Dümenil (page 6), are examples of results presented in posters. The high quality posters stimulated scientific exchange and discussions on applications.

**USING CLOUD RESOLVING MODELS
FOR PARAMETERIZATIONS OF
PRECIPITATING CLOUD SYSTEMS**

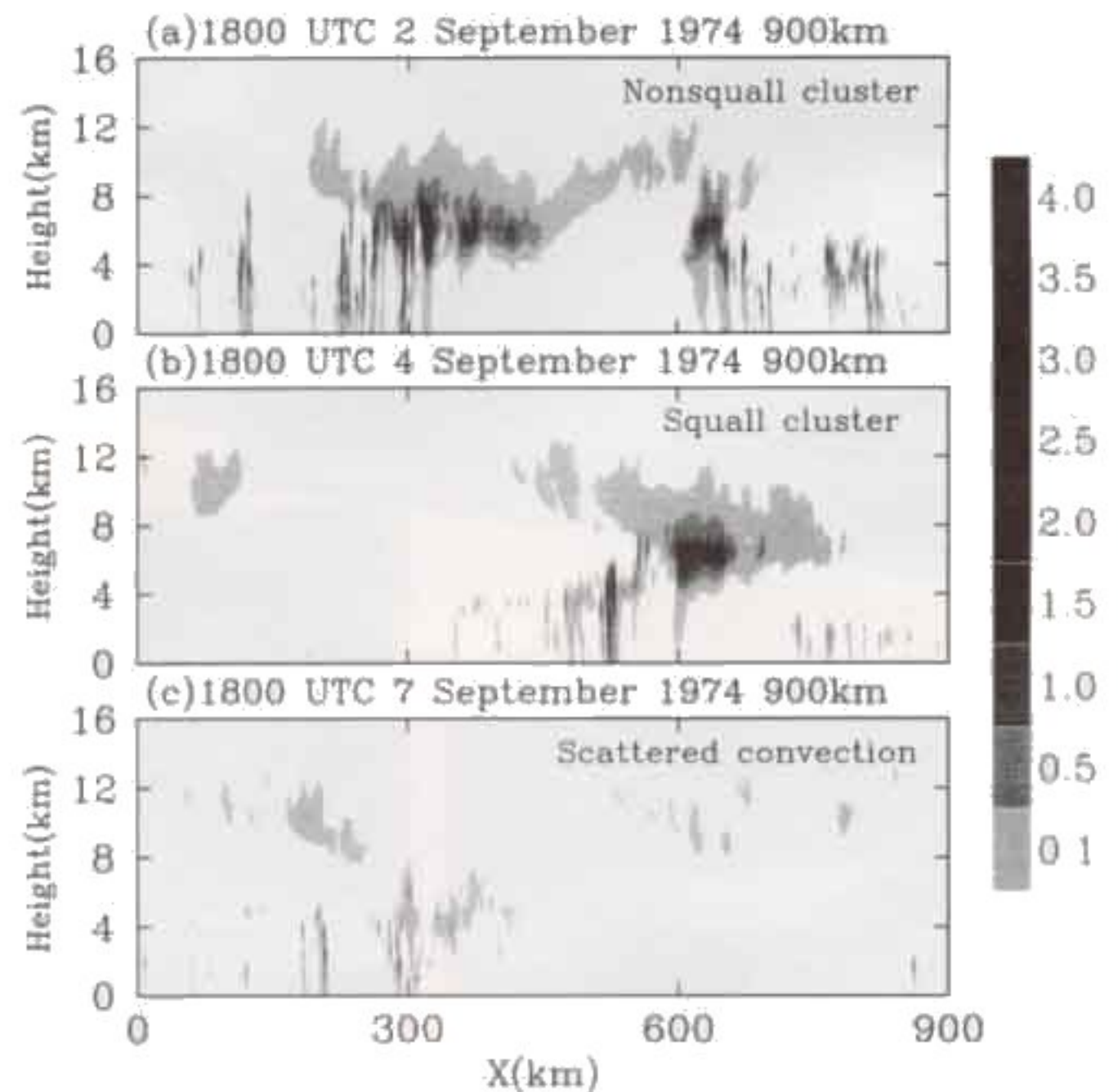
(Continued from page 7)

the bulk properties of the numerical simulation. In a CRM based on the Clark et al. (1996) model, existing and not particularly sophisticated microphysical, radiative, surface and boundary layer parameterizations, simple periodic boundary conditions and a 1-km resolution result in realistic cloud life cycles and transitions among different cloud systems. For example, the progression from scattered convection, through non-squall clusters to squall lines, and back to scattered convection is seen in the figure. On-going three-dimensional numerical experiments, and higher (200 m) horizontal resolution experiments, as well as other sensitivity tests further confirm this key finding. Moreover, this is the first time squall systems have been shown to evolve from a field of clouds (as opposed to being initiated by artificially imposed cloud-scale forcing) in a numerical model. This highly-organized type of cloud system has been shown to have a simple dynamical paradigm (Moncrieff, 1992) that verifies well against observational and model datasets. Similarly encouraging results are being obtained for convection in a 39-day two-dimensional simulation of tropical convection in TOGA COARE.

Bulk measures of convective effects on the large scale, such as heating and drying, agree well with observations. This is a necessary condition for their use in parameterization development and can only be achieved if the correct life cycle of cloud systems is simulated. The CRM data sets are much more detailed than observations, and explicitly give quantities impossible to obtain accurately from observations (e.g., mass fluxes, momentum fluxes and scale dependence). By design, they can be made to satisfy the integral control (which is on scales resolved in GCMs). It is clear, therefore, that the CRM is an excellent tool not only to evaluate different parameterization schemes but also to formulate new approaches.

What of the future? State-of-the-art CRMs will soon be well enough tested against large field experiment data sets to enable them to be applied to progressively broader and more complex aspects involving the role of clouds and water in the climate system. This is commensurate with

GEWEX objectives and is of key importance to other climate-related goals in which the water cycle is the paramount, albeit poorly understood, uncertainty.



The total condensate (g/kg) in the 900-km computational domain for 1800 UTC. (a) Non-squall clusters (September 2), (b) Squall lines (September 4), and (c) Scattered convection (September 7).

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CORRECTION

In the May 1996 issue of *GEWEX News*, F. Chen, NOAA/NCEP, was inadvertently dropped from the authors in the article "GCIP Improvements to Eta Model Benefit Studies Worldwide."

UPPER-LEVEL WATER VAPOR TRANSPORT INDEX FOR CLIMATE RESEARCH

(Continued from Page 1)

job of measuring it. Even less is known about the transport of water vapor in the upper troposphere because our knowledge of upper-level winds is poor, especially over the oceans where there are few radiosondes.

Currently, 6.7 μm satellite images from geostationary satellites are being used to study upper-level water vapor transport. The parameters used include upper-level humidity and corresponding water vapor winds derived from sequences of hourly satellite imagery. The winds and humidity fields are combined to form an upper level Water Vapor Transport Index (WVTI) which is then used to diagnose moisture transport in the atmosphere. A 3-month period (June–August 1988) from the GOES pathfinder data set is used to demonstrate these capabilities. The humidity fields are derived using a modified version of the Soden and Bretherton (1993) technique where the relative humidity is converted to specific humidity with *a priori* temperature information. Root Mean Square (RMS) error for the relative humidity from the Soden and Bretherton method is about 10 percent. The winds are derived from the Marshall Automated Wind (MAW) algorithm (Atkinson, 1984, 1987) which uses minimum-difference template matching for feature tracking. Rigorous quality and control parameters are employed to minimize wind errors. The current quality and control approach used with the MAW reduces RMS errors in GOES Vertical Atmospheric Sounder (VAS) data to less than 4 m/s (Jedlovec and Atkinson, 1996).

The development of the WVTI comes from the atmospheric water vapor budget equation,

$$Q_t = E - P - D,$$

where Q_t is the time derivative of precipitable water (the vertically integrated specific humidity) or the water vapor tendency, E is a source of atmospheric moisture due to evaporation, P is a sink of moisture as a result of condensation and precipitation, and D is the moisture flux divergence (can be either a source or sink of moisture). The flux-divergence term is expressed as

$$D = \nabla \cdot (qV)$$

where qV is the moisture flux or transport of water vapor. If we consider a layer (L) of the atmosphere represented by the water vapor channel weighting function and consider the transport of water vapor in this layer, then $(qV)_L$ becomes the water vapor transport of the two-dimensional (layer) flux divergence of water vapor,

$$\nabla_L \cdot (qV)_L$$

This transport and two-dimensional flux divergence occurs exclusively over the layer represented by the water vapor weighting function. Variations in the height of the peak of the weighting function describe the spatial variation in the height of the water vapor transport layer. Quantifying $(qV)_L$ with the use of satellite-derived moisture and winds yields the WVTI. The WVTI is considered to be a good indicator of upper-level water vapor transport. If it is derived from a long-term data set, such as that of the GOES Pathfinder, it should be a reliable indicator of the seasonal variability of upper level moisture. Among the processes that can be studied with this approach are the transport of upper-level moisture from the tropics, moisture outflow from intense convective systems, and the diurnal variation of water vapor in the upper troposphere.

The illustrations on the first page show an example of this product for July 20, 1988. The 6.7 μm water vapor image (left) is one of three used to derive the WVTI (right). The scale at the bottom indicates the magnitude of the water vapor transport. The streamline analysis of upper-tropospheric wind derived from the water vapor tracking method is also shown. Significant water vapor transport is associated with synoptic features in both hemispheres. Additionally, transport from the tropical convective regions to subtropical high pressure regions is apparent. Analysis of the height of the transport layer in this region indicates transport from low to high pressure, which is consistent with the subsidence patterns observed in the satellite image.

The validity of the upper-level WVTI is currently being established by comparing it with cloud data, polar-orbiter water vapor data, diagnostic and prognostic models, synoptic-scale reanalysis fields, and with itself for various climate regimes.



Meridional transport of upper-level moisture (thick lines) (left) are derived from the Vertical Atmospheric Sounder (VAS) and National Centers for Environmental Prediction (NCEP)/National Center for Atmospheric Research (NCAR) reanalysis data on the right.

The figures above present the meridional transport of upper-level moisture, vq , on July 20, 1988 from the VAS and the NCEP/NCAR reanalysis data set (Kalnay et al., 1996). The VAS data (left) valid at 1500 UTC show transport in the layer (approximately 300-500 mb) given by the $6.7 \mu\text{m}$ weighting function and are compared to values of meridional moisture transport at 400 mb from the reanalysis fields (right) for the same day (1800 UTC). Good consistency in the spatial patterns exists between the two independent data sets. Differences in the magnitude and positions of the transport centers can be explained by the way each product portrays moisture and winds in their respective layers.

More information can be found on the web at <http://wwwghcc.msfc.nasa.gov/irgrp/irgroup.html>.

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DATA SET UPDATE

NVaP data sets are no longer archived at the MSFC DAAC. All requests for NVaP data should be directed to the Langley DAAC.

Langley DAAC
 NASA/Langley Research Center
 Mail Stop 157D
 Hampton, VA 23681-0001 USA
 Telephone: 757-864-8656
 Facsimile: 757-864-8807
 E-mail: larc@eos.nasa.gov
 URL: <http://eosdis.larc.nasa.gov/>

ARM TO CHARACTERIZE WATER VAPOR OVER SOUTHERN GREAT PLAINS SITE

In September, a series of intensive observational periods focusing on moisture characterization will begin at the Department of Energy (DOE) Atmospheric Radiation Measurement Program's (ARM) Southern Great Plains site. The Intensive Observing Periods (IOP) are designed to improve the state of the art in measuring water vapor in a vertical column, both range-resolved and column-integrated, under all clear/cloudy and day/night conditions.

The goal of the September IOP is to improve the ability of the site's instrumentation to characterize moisture in the lowest kilometer of the atmosphere with a focus on the area below 200 m. In addition to the instruments used for routine data collection, collaborators will bring instruments to the site to collect data. The first water vapor campaign includes the NASA/GSFC Scanning Raman lidar, which will provide vertical profiles of water vapor mixing ratios from 100 m to greater than 1 km in primarily cloud-free conditions.

The event also will provide an opportunity to calibrate the site's new Raman lidar. Chilled mirror hygrometers placed on tethersondes, and the ground and towers will furnish the accurate point measurements needed to calibrate the instrument and the balloon borne sounding system used at the site. According to Pat Crowley, ARM Science Director, the first campaign should provide valuable insights for conducting subsequent intensive observational periods in the series.

For more information, contact Hank Revercomb, Water Vapor IOP Chief Scientist at (608) 263-6785, e-mail: hankr@ssec.wisc.edu, or Doug Sisterson, SFG Site Program Manager at (708) 252-5836, e-mail: sisterson@anler.gov. Or see the ARM Home page at <http://www.arm.gov>.

CHECK OUT THE ISCCP HOME PAGE:

<http://haboob.giss.nasa.gov/>

MEETINGS

INTERNATIONAL WORKSHOP ON RESEARCH USES OF ISCCP DATA SETS

**William Rossow
NASA Goddard Institute for
Space Studies (GISS)**

Over 50 scientists from ten countries participated in the workshop, which was held at NASA GISS in New York on 15-18 April 1996. A total of 46 papers were presented in three topic areas: (1) Validation or improved interpretation of ISCCP data, (2) Determination of cloud properties or diagnosis of other climate processes, and (3) Improving climate model representations of cloud processes.

Key areas that need increased research effort are (1) analyses of the effects of cloud vertical structure on the radiation balance and its forcing of the general atmospheric circulation; (2) examining the connection between water transport and cloud properties, and between cloud properties and precipitation; and (3) re-organizing observations to determine the lifecycles of various cloud systems. Comparisons of GCM output with observations confirm the validity of the original impetus for ISCCP by showing the importance of extending such comparisons beyond mean cloud cover amounts and/or top-of-atmosphere fluxes to the time and space variations of other cloud properties such as optical thickness, top heights, and particle sizes. Analyses to extend measurements beyond radiative properties to those quantities involved in the cloud physical processes were welcomed as a critical new direction. Continuing problems with upper tropospheric (especially cirrus) and polar clouds were highlighted.

RECOMMENDATIONS

- Further development of new retrieved cloud quantities, especially with emphasis on those that figure in cloud physical processes and precipitation.
- The unique ability of satellites to follow cloud systems through their whole lifecycle is highlighted as an exciting new capability and there was general agreement that surveys are needed because the detailed phenomenology of different cloud types is still poorly known.

- ISCCP and other global data sets should be sampled to provide ensembles of "case studies" detailed enough for comparison with higher resolution "process" models and numerous enough to provide adequate statistics for GCM parameterizations.
- A specific suggestion is to perform special ISCCP analyses of higher resolution data sets from geostationary satellites to examine cloud system evolution and to allow for more detailed comparison with surface and aircraft observations.
- Improvements of model-data comparison methods are recommended to better target problems.
- A very strong recommendation is that the GCSS strategy should focus on coordinating four activities: (1) highly detailed "field" observations for core case studies, (2) global (mostly satellite) data sets to provide ensemble statistics, (3) detailed process studies, and (4) both "single-column" experiments and full GCM studies.

GPCP WGDM TENTH SESSION

The purpose of the GEWEX Global Precipitation Climatology Project (GPCP), Working Group on Data Management (WGDM), Tenth Session Working Group was to review the status of implementation of the project with respect to the operations of its various data centers and the research issues surrounding continued progress in development of a global precipitation climatology. The Tenth Session was held in Iowa City, Iowa, USA, 28-31 May 1996.

The meeting provided several conclusions and recommendations which highlight the future direction of GPCP.

- *GPCP Products With Higher Spatial and Temporal Scales.* The station operators and related data processing centers agreed to begin a pilot study on 1 October 1996 to produce 1° histograms at 3-hourly intervals, daily, in parallel with the existing procedure. The Geostationary Satellite Precipitation Data Center at NOAA/Climate Prediction Center agreed to provide a quantitative evaluation of this 3 hourly, daily product, presented on a 1°x1° spatial scale for presentation to the WGDM at its next session in May 1997. Additionally, the station

operators agreed to produce new GPCP IR histograms sampled at every 1° within the brightness temperature range of 230 to 240 K, as opposed to the 5-degree temperature class interval currently employed.

- *Improvement of the GPCP Rain gauge Data Product and Related Global Precipitation Climatology Centre (GPCC) Activities.* Additional priority will be placed on quality checking of the database of gauges of 25,000–30,000 stations it has obtained in order to develop a larger database for more accurate GPCP analyses. Agreement was reached to have sample months (seasonal) produced from the expanded database available for review by the end of 1996 and then to proceed to have a 5-year (1987-93) enhanced data set ready for use in 1997. GPCC has agreed to participate in the pilot study for the higher resolution GPCP product by preparing to provide monthly mean 1x1 degree gauge data and assisting with techniques for scaling current values as a means of obtaining higher space and time resolution data on a routine basis. Additionally, GPCC has agreed to collect and evaluate all available synoptic data from the World Meteorological Organization's (WMO) Global Telecommunications System (GTS) and from national sources, with priority given to the Arctic Ocean catchment area. Development of this new database will support the GPCP goal related to determination of precipitation type (stratiform, convective and solid) and rate as well as contributing to the Arctic Climate System Project within WCRP.
- *Requirements for GPCP Products From Data Available Before 1986.* The WGDM endorsed a proof of concept study that could lead to appending to the suite of existing GPCP products global monthly precipitation estimations for the period 1979-95. The estimations have been produced by a new merging process.
- *GPCP Reference Data Coordination.* The WGDM endorsed the development of the Environmental Verification and Analysis Center (EVAC) which is supported by the University of Oklahoma. It was formed in response to the request made by the WGDM at its ninth session for a center to specifically address the archival and analysis of surface reference data using state-of-the-art geostatistical methods over a range of scales.



The Sixth SSG meeting was held in Irvine, California, January 1996, and was well attended. The next meeting will be in Hamburg, Germany on 6-10 January 1997.

WCRP/GEWEX MEETINGS CALENDAR

*For calendar updates,
consult the GEWEX Home Page*

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

22-27 September 1996—THIRD JOINT CONFERENCE ON ENVIRONMENTAL HYDROLOGY AND HYDROGEOLOGY, Tashkent, Uzbekistan. For details contact the American Institute of Hydrology, Third USA/CIS Conference, 2499 Rice Street, Suite 135, St. Paul, Minnesota 55113, U.S.A.; Tel: 1-612-484-8169; Fax: 1-612-484-8357; E-mail: AIHydro@aol.com.

21-23 October 1996—GCSS PRECIPITATING CONVECTIVE CLOUD SYSTEMS MODEL INTERCOMPARISON WORKSHOP, NASA Goddard Space Flight Center, Greenbelt, Maryland, USA. For information contact Mitch Moncrieff, NCAR, P.O. Box 3000, Boulder, Colorado 80307; Tel: 303-497-8960; Fax: 303-497-8181; E-mail: moncrieff@ncar.ucar.edu.

28 October - 01 November 1996—WORKING GROUP ON NUMERICAL EXPERIMENTATION, Twelfth Session, Tokyo, Japan.

11-13 November 1996—CONTINENTAL-SCALE HYDROLOGICAL MODELS: CHARTING THE FUTURE, Institute of Hydrology, Wallingford, United Kingdom.

12-15 November 1996—INTERNATIONAL WORKSHOP ON THE GEWEX WATER VAPOR PROJECT (GVaP), Geneva, Switzerland.

18-20 November 1996—THE THIRD PRECIPITATION INTERCOMPARISON PROJECT (PIP-3), University of Maryland Conference Center, College Park, Maryland. For information contact Robert Adler, NASA Goddard Space Flight Center, Code 912, Greenbelt, Maryland, 20771, U.S.A.; Tel: 301-286-9086; Fax: 301-286-1762; E-mail: adler@agnes.gsfc.nasa.gov.

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.

9-13 December 1996—GCSS SCIENCE PANEL MEETING, Toulouse, France.

6-10 January 1997—GEWEX SCIENTIFIC STEERING GROUP MEETING, Hamburg, 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 Systems. For information contact American Meteorological Society, 45 Beacon Street, Boston, Massachusetts, U.S.A., Tel: 617/427-2425; Fax: 617/742-8718.

6-7 February 1997—GLOBAL SOIL WETNESS PROJECT WORKSHOP at AMS Annual Meeting.

10-14 February 1997—LAND SURFACE PARAMETERIZATION/SOIL VEGETATION ATMOSPHERE TRANSFER WORKSHOP, Scripps Institution of Oceanography, LaJolla, California, U.S.A.

23 April - 3 May 1997—THE FIFTH SCIENTIFIC ASSEMBLY OF THE INTERNATIONAL ASSOCIATION OF HYDROLOGICAL SCIENCES. Rabat, Morocco, Convener A. Becker, Potsdam Institute for Climatic Impact Research, Postfach 601203, Potsdam D-14412, Germany. Tel: 49 331 2882 500; Fax: 49 33 2882 600; E-mail: becker@pik-potsdam.gr.

1-9 July 1997—EARTH-OCEAN-ATMOSPHERE FORCES FOR CHANGE, Melbourne, Australia. For details contact IAMAS/IAPSO Secretariat, Convention Network, 224 Rouse Street, Port Melbourne, Victoria 3207, Australia; Tel: +61-3-9646-4122; Fax: +61-3-9646-7737; E-mail: mscarlett@peg.apc.org.

26-29 August 1997—WMO/ICSU/IOC CONFERENCE ON THE WORLD CLIMATE RESEARCH PROGRAMME, Geneva, Switzerland.

28-31 October 1997—WCRP REANALYSIS WORKSHOP, Washington, D.C.

GEWEX DOCUMENTS

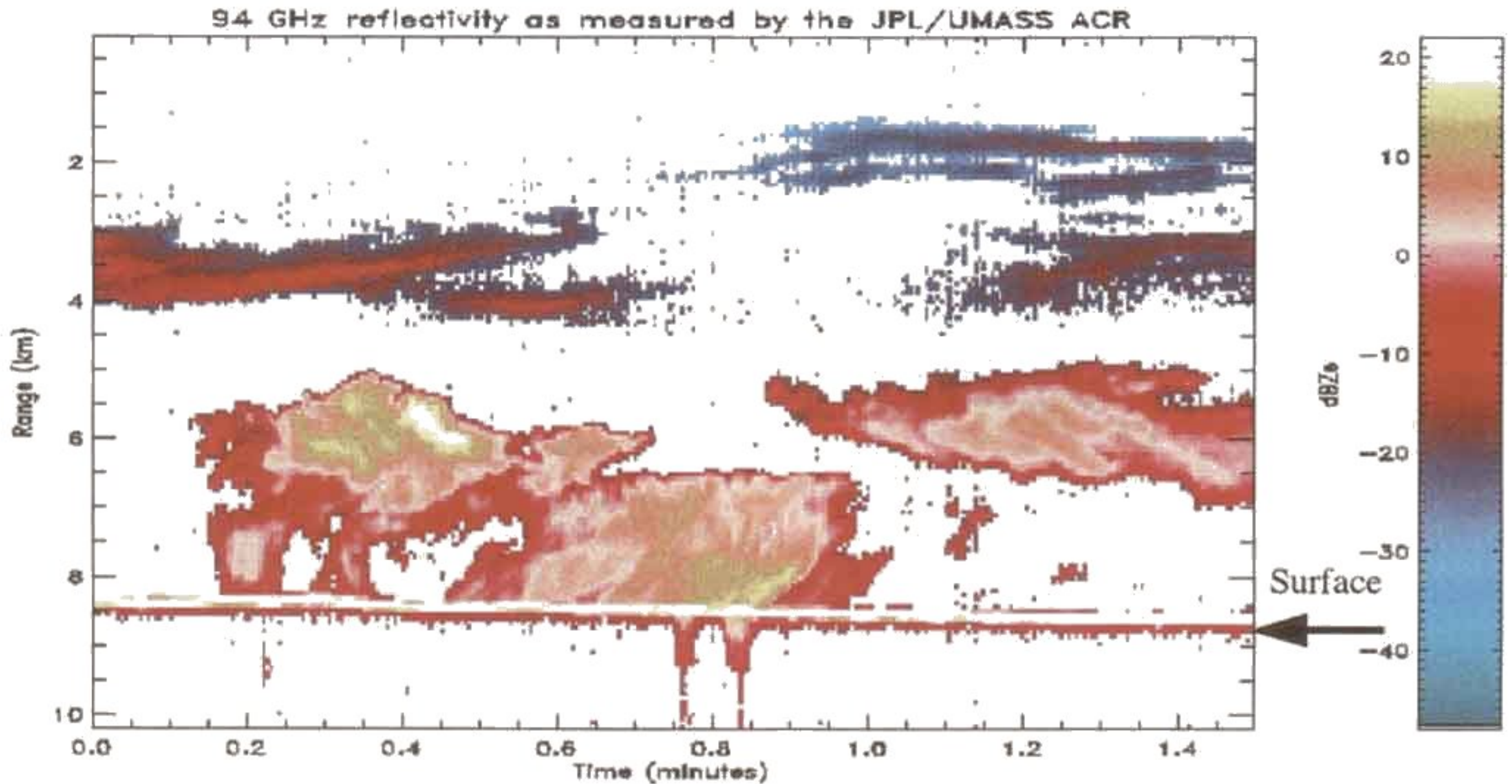
A complete listing of GEWEX documents is available on the GEWEX Home Page.

GEWEX NEWS

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NEW AIRBORNE CLOUD RADAR DATA

GEWEX has established the need to measure globally the vertical structure of cloud systems as one of its highest priorities and, as of yet, an unmet observational need. Cloud radars have the potential to meet this need. Cloud radars, with wavelengths on the order of millimeters, are sensitive to cloud particles, and, as active systems, they are able to penetrate multiple layers of clouds to resolve the internal structure of clouds and cloud boundaries.

The NASA Airborne Cloud Radar (ACR), recently developed by the Jet Propulsion Laboratory and the University of Massachusetts, was tested extensively in June 1996 on the NASA DC-8 aircraft. Nearly 50 hours of in-flight data were acquired in many varied and complex cloud systems ranging from marine boundary layer clouds to convective systems, as well as isolated and layered mid- to upper-level stratiform clouds. These data were collected over large geographic regions extending from California up the west coast to Alaska and around the south central United States; from coastal Texas north into Oklahoma and Kansas and eastward into Arkansas.

ACR operates at 94 GHz measuring reflectivity, doppler, and dual-polarization parameters. The image above shows the radar reflectivity measured at nadir

by ACR for a multi-layer cloud system over the Wrangell Mountains in Alaska on 12 June 1996. The horizontal scale corresponds to the distance along the aircraft flight track approximately 20 km, while the vertical scale corresponds to the distance below the aircraft. The range resolution was 75 m with a 60 m spacing. At right, four distinct cloud layers can be seen: cirrus at 1-2 km range, cirrus at 4 km range, middle level stratiform clouds at 6 km range, and cumulus at 7 km range. The melting level is apparent at a range of 7.6 km near-time 0.8 minutes. Also near this time, mirror image return can be seen just below the surface. The mirror image return is caused by multiple reflections between the surface and the precipitation. The extra time required for the signal to return to the radar is recorded as a subsurface signal.

In collaboration with scientists at Colorado State University and the Pennsylvania State University, the ACR was developed to profile cloud properties for use in studies of the hydrologic processes and energetics of the Earth's atmosphere. NASA plans additional flights of the ACR in the near future to carry out these objectives. The ACR also serves as a prototype for future space-based radar systems which will enable global measurements in accordance with the needs identified by GEWEX.