

COOPERATIVE INSTITUTE FOR MESOSCALE METEOROLOGICAL STUDIES (CIMMS)

ACCOMPLISHMENTS DURING CALENDAR YEAR 1999

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INFRASTRUCTURAL ACCOMPLISHMENTS

- During 1999, CIMMS continued to play a national leadership role for the NOAA Joint Institutes (JIs). This resulted from the CIMMS Director being Chair of the JI Directors during 1998-99, and involved planning and conducting two JI Directors' Meetings that took place in January and April 1999. These activities enhanced CIMMS' familiarity with NOAA's Office of Oceanic and Atmospheric Research (OAR) and the ten other JIs that extend across the U.S., including in Hawaii and Alaska.
- The high level of CIMMS scientific activity during 1999 continued to involve increased research and development within the National Oceanic and Atmospheric Administration (NOAA) units participating in CIMMS. In particular, much research and development took place within the research themes of (1) Forecast Improvements and (2) Doppler Weather Radar Research and Development. This research involved collaborations between CIMMS and federal employees at the OAR National Severe Storms Laboratory (NSSL) and the three National Weather Service (NWS) units on the University of Oklahoma (OU) campus (Weather Forecast Office, WFO; WSR-88D Operational Support Facility, OSF; and Storm Prediction Center, SPC).
- Consistent with the above, 1999 saw a continuation of the recently increased involvement of CIMMS scientists, engineers, and support personnel in the programs of the NSSL (93 individuals, who now substantially outnumber the Laboratory's 52 federal employees), WSR-88D OSF (12), and SPC (3). This level of activity constitutes a ten-fold increase over five years ago. The resulting infrastructural challenges are being successfully addressed, including through a day-long "NOAA-OU Directors' and Administrators' Workshop" that was held in January at the Oklahoma Memorial Union.

INTERNATIONAL ACTIVITIES

- Probably the most important international activity undertaken by CIMMS in 1999 was the staging of the "First Workshop on Regional Climate Prediction and Applications -- Tropical Atlantic Basin" at the OU College for Continuing Education during October 11-November 12. The Workshop goal was to improve the capabilities of national meteorological and hydrological services (NMHSs) around the Tropical Atlantic to understand global climate system behavior, to use such knowledge to develop seasonal precipitation prediction schemes, and to collaborate with other national agencies to apply such prediction schemes in the management of agricultural production, water resources, energy generation, and public health. This first Workshop had 12 NMHS participants, equally divided between Latin America (representing 4 nations) and Africa (6 nations). This first Workshop was judged to be very successful by its NOAA financial sponsors (NWS International Activities Office, \$84,000; OAR Office of Global Programs, \$30,000), which are now encouraging us to embark on a series of about 5 more such Workshops -- that will span the developing world -- on a twice per year basis. We are now organizing the Second Workshop (also on the Tropical Atlantic Basin) for mid-2000.

- A high level of collaboration and cooperation continued between CIMMS and the African Centre of Meteorological Applications for Development (ACMAD, Niamey, Niger) during 1999. These activities are funded by an ongoing grant from the International Activities Office of the U.S. National Weather Service. The 1999 interactions included the following -- initiation of a 5-year project entitled "New Radio and Internet Technology for Communication of Weather and Climate Information to Rural Communities for Sustainable Development in Africa" (RANET), that is funded by the U.S. Agency for International Development; a 1-week visit by the CIMMS Director to ACMAD in August, which included a field trip to Benin as part of the RANET project; and continued full-time research at CIMMS on East African rainfall variability and predictability by Mr. Charles Mutai (Kenya Meteorological Department Drought Monitoring Centre-Nairobi) for a University of Nairobi Ph.D. Dissertation that will be submitted in mid-2000.
- CIMMS scientists participated in several Regional Climate Outlook Forums in West Africa, and Southern Africa, and a Training Workshop at ACMAD prior to the West African Forum. This Workshop led to national meteorological services from that region developing seasonal prediction schemes for their countries, using tropical Atlantic and Pacific sea surface temperature predictors. CIMMS scientists also collaborated with ACMAD in the preparation of a manual for the above Pre-Forum training, and with the Drought Monitoring Center-Harare to develop the first system for verifying the forecast maps from the Regional Climate Outlook Forums.
- Collaboration between CIMMS and the Kingdom of Morocco continued to investigate the climate system causation of the interannual-to-decadal variability of Moroccan winter precipitation, and to use the resulting knowledge to develop a seasonal prediction capability. One Meteorological Engineer from the Moroccan Direction de la Météorologie Nationale (DMN) was in residence at CIMMS for all of 1999 as a Ph.D. student. The principal DMN-CIMMS collaborative activities were -- development and issuance of "Experimental Precipitation Predictions for Morocco" for 1998-99 and 1999-2000, the first of which verified extremely well and the second partially so; publication of a book chapter that summarize the results obtained to date; and a 1-week visit by the CIMMS Director to DMN in May to help prepare for the continuation of the project and the associated transfer of the funding responsibility from USAID to the Moroccan government. Further information on the research component of this collaboration appears below.
- In addition to the above collaborations, CIMMS Scientists are actively working with counterparts at Ben-Gurion University (Israel), the Istituto per lo studio delle Metodologie Geofisiche Ambientali (IMGA, Italy), the National Climate Center and Institute of Atmospheric Physics (P. R. China), the Institute of Atmospheric Physics (Russia), and the Canadian Atmospheric Environmental Service.

NATIONAL FIELD PROGRAM LEADERSHIP

- As part of its Atmospheric Radiation Measurement (ARM) Program Site Scientist role, CIMMS scientists continued to provide essential day-to-day scientific guidance for the development and continuous operation of the Southern Great Plains ARM Cloud and Radiation Testbed (CART) site. This is the World's first comprehensive climate observatory, and now generates ~300 continuous data streams from 30 locations spread over 50,000 square miles in southern Kansas and northern and central Oklahoma. During 1999, the Site Scientist Team continued its increased responsibilities with respect to the quality assurance of the above data streams, and in the planning, execution, and participation of several Intensive Operational Periods (IOPs). Among the 1999 IOPs conducted were the Mesoscale Convective Systems Campaign (May-September), the Southern Great Plains '99 Soil Moisture Campaign (July), and the International Pyrgeometer Intercomparison (September).

- Planning for the Intermountain Precipitation Experiment (IPEX) took place in 1999. The field phase of IPEX will be conducted in February 2000 in northern Utah. IPEX is a field and research program designed to improve the understanding, analysis, and prediction of precipitation and precipitation processes in complex terrain. The project is led by a CIMMS scientist at NSSL, and involves scientists from the University of Utah, the Desert Research Institute (DRI) of the University of Nevada-Reno, and the NWS Forecast Office in Salt Lake City. Students from the Universities of Utah, Nevada and Oklahoma will also participate. The major scientific objectives of IPEX are to: (1) advance fundamental knowledge of orographic precipitation, with an emphasis on the narrow, steeply sloped Wasatch Mountains of northern Utah; (2) improve knowledge of lake-effect precipitation of the Great Salt Lake; (3) validate and improve high-resolution data-assimilation systems, mesoscale model performance, and quantitative-precipitation forecasts over complex terrain; and (4) validate and improve quantitative-precipitation estimates produced by WSR-88D's located at high elevation.

SCIENTIFIC HONORS, INNOVATION, AND ACTIVITY

- NSSL's Stormscale Research and Applications Division, staffed by more than 70 CIMMS employees (scientists, computer specialists, technicians) was awarded the 1999 U.S. Department of Commerce Silver Medal "for making significant enhancements to the National Weather Service warning program through developing, testing and transferring tools from a prototype Warning Decision Support System to NWS operational systems".
- Three research thrusts during 1999 are highlighted here:

"Al Moubarak" and Moroccan Precipitation. Over the last five years, there has been a strong collaborative effort between CIMMS and the Kingdom of Morocco to increase our understanding of the interannual-to-decadal variability of Moroccan winter precipitation, particularly within the context of the North Atlantic Oscillation (known as "Al Moubarak" in Morocco). This effort has also included the wider global climate system (tropical Pacific sea surface temperatures) as it relates to the late rainy season. The project was motivated by a predominance of extremely poor Moroccan winter precipitation seasons since the late 1970s. This understanding is being used to develop a seasonal precipitation prediction capability for Morocco. The work has been done in direct collaboration with the Moroccan Direction de la Météorologie Nationale (DMN) with the financial support of the U.S. Agency for International Development, including through DMN scientists being in residence at CIMMS. During this calendar year, the development and issuance to Moroccan government officials of "Experimental Precipitation Predictions for Morocco" continued, with the prediction for 1998-99 verifying extremely well. Also, a book chapter, "Climate Variability in Northern Africa: Understanding Droughts in the Sahel and the Maghreb", was published in *Beyond El Niño: Decadal and Interdecadal Climate Variability* (Antonio Navarra, ed., Springer Verlag, 1999). Among supporting sub-projects now being undertaken are the development of (1) a climatology of the intensity and paths of weather systems in the North Atlantic since 1958 and (2) an 18-year (1979-96) daily precipitation data set for Morocco.

Warning Decision Support System (WDSS). For six years, CIMMS and NSSL personnel have been developing and testing the Warning Decision Support System (WDSS). The WDSS includes enhanced Doppler-radar algorithms, data integration and imaging techniques, innovative algorithm product display capabilities, and a severe-weather warning generation system. It has been tested at 18 NWS forecast offices since 1994. Many of the concepts developed in the WDSS have received very favorable comments from the operational forecasting community. During this calendar year, CIMMS and NSSL personnel worked closely with the NWS Techniques Development Laboratory to implement WDSS functionality in the NWS Advanced Weather Interactive Processing System (AWIPS). Many of the best performing features of WDSS were implemented into AWIPS and are

slated for release in 2000. The WDSS is now being enhanced to WDSS-Integrated Information (WDSS-II). The WDSS-II will support multiple data types to allow for easier inclusion of new algorithms, and will provide a new user interface for making more informed warning decisions. Version 1.0 of WDSS-II is expected to be ready for field testing during spring 2000.

Improved Quantitative Precipitation Forecasting (QPF) using Numerical Weather Prediction Models. Techniques for improving quantitative precipitation forecasting (QPF) using the NCEP Environmental Modeling Center's (EMC) Eta model have been investigated by CIMMS and NSSL scientists. An experimental configuration of the model was run in forecast mode at NSSL in parallel with the operational model at EMC, and in collaboration with EMC scientists. It was configured with the Kain-Fritsch convective parameterization and higher-order numerical diffusion than the operational model contains, both of which are designed to allow the model to produce and retain mesoscale structures. After a series of refinements, the experimental configuration of the model achieved comparable scores on traditional measures of skill for QPF, while providing higher resolution mesoscale guidance than the operational model. New verification techniques are being developed so that the accuracy of the model in producing finer-scale features can be better evaluated. Further model refinements are likely to be concentrated in the parameterizations of turbulent mixing, microphysics, and moist convection, all of which have been shown to have a significant impact on QPF. Forecasters from the Storm Prediction Center (SPC) will be involved in the identification of relevant model output fields as well as the development and implementation of new verification techniques. Daily numerical predictions, comparisons with operational EMC models, and verification statistics have been made available on the World Wide Web.

- Finally, during 1999, the external funding for CIMMS totaled more than \$7 million and supported research that was reported in more than 35 refereed journal articles (published or accepted for publication) and many other articles that appeared in conference and workshop *Proceedings*.