13TH AMS CONFERENCE ON SATELLITE METEOROLOGY AND OCEANOGRAPHY

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The American Meteorological Society (AMS) 13th Conference on Satellite Meteorology and Oceanography was held at the Norfolk Waterside Marriott in Norfolk, Virginia, from 20 to 23 September 2004. The special theme for this conference was as follows: "Next Generation Environmental Sensors and Emerging Applications in Satellite Meteorology and Oceanography." Over the next 10–20 years environmental satellite monitoring will undergo major advancements in both passive and active remote sensing capabilities with significant improvements in spatial, spectral, and temporal resolution, providing unprecedented insights into the Earth system sciences. In choosing the theme for this satellite conference, the AMS Committee on Satellite Meteorology and Oceanography recognized the importance of preparing for the future to facilitate maximum utilization of these new datasets.

The more than 200 submitted abstracts strongly reflected the continued application of research and operational environmental satellites in a variety of disciplines and suggested exciting new opportunities for monitoring Earth with future sensors.

The opening session focused on new and future sensors and applications, highlighting the special theme of the conference. The keynote address by

SATELLITE METEOROLOGY AND OCEANOGRAPHY CONFERENCE

WHAT: The environmental satellite monitoring community shared insights on innovative research activities and applications with a focus on next-generation environmental sensors and emerging applications in satellite meteorology and oceanography.
WHEN: 20–23 September 2004
WHERE: Norfolk, Virginia

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Dr. T. Adang of Aerospace Corporation [on behalf of Gregory Withee, National Oceanic and Atmospheric Administration (NOAA)/National Environmental Satellite, Data, and Information Service (NESDIS) Administrator] discussed the international Group on Earth Observations (GEO), which is developing a 10-year implementation plan for a comprehensive, coordinated, and sustained Earth observation system with minimal data gaps, engaging developing countries in this effort, and exchanging observations recorded from in situ, aircraft, and satellite networks with minimum time delay and cost (see information online at http://earthobservations.org).

The need for planned rather than inadvertent transition of research data/products to operations was a recurrent topic throughout the conference. Furthermore, with research and development satellites operating past their expected life spans, multiagency coordination is needed on a national and international level to budget for and effectively utilize these unique research capabilities for operational applications and climate studies.

A new World Meteorological Organization (WMO) Space Programme has been established to coordinate environmental satellite issues throughout all WMO programs. One important activity involves regional seminars and workshops to identify research and development data streams that should transition to operational satellites.

Over the next 20 years there will be unprecedented improvements in global Earth observing with high spatial and spectral resolutions from the ultraviolet to the microwave and a five order of magnitude increase in data volume/content. J. Purdom (Colorado State University) emphasized the need for global partnerships and intrasatellite [e.g., Geostationary Operational Environmental Satellite (GOES-R) and National Polar-Orbiting Operational Environmental Satellite System (NPOESS)], intrasystem (e.g., GOES-East and -West), and intersystem (e.g., research and operational satellite applications) synergies to fully exploit near-term and future remote sensing capabilities. Dr. Purdom conceptualized a future composite-observing system where distinctions between geostationary, polar, and low-Earth-orbiting satellites, research and operational satellites, and sensors are minimized.

Other presentations in this session focused on new and future platforms and sensor-specific advancements in environmental remote sensing. The European *Meteosat-8* Spinning Enhanced Visible and Infrared Imager (SEVIRI) is providing new information in 12 spectral bands for both atmospheric and surface applications from an operational imager. Although the mission life of the Japanese *Midori-II* was cut short, it showed the advantages of combined active (Sea Winds) and passive [Advanced Microwave Scanning Radiometer (ASMR)] remote sensing for wind and sea surface temperature (SST) retrievals. Early results from the Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave Imager/Sounder (SSMIS) are encouraging, with improved imaging and sounding capabilities.

Clearly, the impact of research instruments on the current understanding of the Earth–atmosphere system is phenomenal. Research instruments such as those flown on the National Aeronautics and Space Administration's (NASA's) Earth-Observing System (EOS) platforms are providing new insights into land, ocean, and atmospheric constituents, and atmospheric chemistry. Furthermore, they are being used in the design of next-generation operational meteorological systems as demonstrated by the large number of poster presentations at this conference that utilized EOS satellite instrument data [e.g., Moderate-Resolution Imaging Spectroradiometer (MODIS) and Atmospheric Infrared Sounder (AIRS)] to simulate future operational capabilities[e.g., NPOESS Visible/Infrared Imager and Radiometer Suite (VIIRS), GOES-R Advanced Baseline Imager (ABI), and Hyperspectral Environmental Suite (HES)]. This next generation of operational geostationary and polar-orbiting satellites will offer a continuation of the current products and services and will allow for improved or new capabilities to monitor a wide range of phenomena related to weather, climate, ocean, coastal zones, land, hazards, solar activity, and space.

The second day of the conference was divided into two sessions: data assimilation and environmental applications. Dr. J. F. Le Marshall [Joint Center for Satellite Data Assimilation (JCSDA)] opened the data assimilation session with an overview of this recently established multiagency [NOAA, NASA, Department of Defense (DoD)] center. The primary mission of the JCSDA is to accelerate and improve the quantitative use of both research and operational satellite data in weather and climate analysis and prediction models. Early successes include major advances in the development of a Community Radiative Transfer Model (CRTM), EOS *Aqua* AIRS data thinning and distribution to numerical weather prediction (NWP) centers, impact studies of polar winds derived from MODIS, and advancements in assimilation of precipitation and cloud data derived from microwave instruments [e.g., Special Sensor Microwave Imager (SSM/I) and

the Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI)]. Several presentations highlighted the significant impact of MODIS polar winds on forecast skill at global modeling centers. A number of posters in this session also addressed advances in the use of microwave data for modeling applications.

A rapidly growing area involves assimilation of satellite-derived products for aerosol and air quality modeling in the United States. Initial studies show that satellite-derived surface and atmospheric products can provide valuable input on the point sources and long-range transport of pollutants. This is just one example of how the model data assimilation community is becoming a driving force in the development of new datasets, retrieval methodologies, and applications.

The afternoon session focused on environmental applications and featured a number of innovative environmental applications of research and operational satellite data. The Infusing Satellite Data into Environmental Applications (IDEA) program is a multiagency partnership [NASA, Environmental Protection Agency (EPA), NOAA, University of Wisconsin (UW)—Madison] to improve air quality assessment, management, and prediction by infusing satellite data and products into analyses for the EPA's AIRNow PM2.5 Air Quality Index (AQI) forecast. Satellite observations and modeling are being incorporated into the Prediction of Worldwide Energy Resource (POWER) project, providing improved long-term datasets for applications in the renewable energy industry and regional building design/architecture. Multiple satellite-derived products (TRMM precipitation radar and SSM/I), along with conventional ground observations, are being used to investigate the possible impact of urbanization on precipitation over and downwind of large cities. Operational satellite-derived products such as SST anomalies, bleaching HotSpot anomalies, degree heating weeks (DHW), and tropical ocean coral bleaching indices have become an integral part of NOAA's Coral Reef Watch Program, providing early warnings of possible coral bleaching to the global user community.

The sessions on the third day focused on operational products and climatology and long-term satellite studies. The morning sessions on operational products featured a wide variety of satellite products for applications in the ocean, land, and atmosphere and demonstrated the advancement in moving research products into operations with a diverse user community. Currently the Sea–viewing Wide Field of View Sensor (SeaWiFS) on *SeaStar* and the MODIS instruments on *Terra* and *Aqua* are providing valuable optical property information for many operational ocean applications. The most critical satellite observations for ocean models are those relating to sea surface height and temperature. In the next few years the Wide Swath Ocean Altimeter (WSOA) on *Jason-2*; the Aquarius, a Soil Moisture and Ocean Salinity mission; and hyperspectral observations will offer exciting, new opportunities for operational ocean observation and modeling of tides, salinity, and the dynamic state.

A unique operational land application of multisensor [GOES, Advanced Very High Resolution Radiometer (AVHRR), MODIS] data is the NOAA/NESDIS Hazards Mapping System (HMS) Geographic Information System (GIS) Web site, providing quality-controlled fire detection for North and Central America in near–real time. Plans include expanding this capability to include global fire monitoring. Although not yet operational, a new and interesting technique was presented for enhancing satellite imagery using morphing techniques developed in the computer graphics and digital imaging industries. Morphing allows for simulating images at a higher temporal resolution than is available from the satellite. Features apparent in two images are warped in time from one to the other by advecting, stretching, or rotating. The method shows particular promise when applied to the tropical cyclone inner core structure evolution viewed by irregularly spaced passive microwave imagery.

Dr. J. Bates [NOAA/NESDIS/National Geophysical Data Center (NGDC)] opened the afternoon session on climatology and long-term studies by focusing on NOAA's role in the newly established Climate Change Science Program (CCSP) and plans to create climate data records (CDR) from existing and upcoming operational satellites. The goal is to provide scientifically defensible datasets that are accessible to the user community in near–real time to diagnose and predict climate variation and change. In addition, plans include reprocessing data records using the best available algorithms and software to generate accurate and consistent long-term datasets.

Applications of multisatellite observations and derived products for climate change analyses require an understanding of and appropriate corrections for calibration errors. This was highlighted in several presentations in this session. One study showed that nonlinear adjustments of the 25-yr Microwave Sounding Unit (MSU)/Advanced Microwave Sounder Unit (AMSU) temperature observations from

14 polar-orbiting satellites result in satellite-observed temperature trends that are consistent with surface observations. In another study, comparisons of measurements from satellite radiation budget instruments over the past 25 years from three different types of radiometers highlighted the differences between the instruments and the traceability of the calibration. This direct characterization of measurement differences is very useful for generating higher-level data products from multiple satellites.

The final day of the conference was devoted to the session on retrievals and cloud products. This was the largest session in the conference. It was exciting to see the various passive and active instruments and combinations of multisatellite data that are being used to retrieve atmosphere, land, and ocean products. There has been a tremendous increase in the sophistication of data fusion methods to create improved products from both operational and research satellites. Improved and more efficient retrieval techniques are being developed to handle the variety of data sources and exponential increase in data volume.

Dr. S. Ackerman [UW—Madison, Cooperative Institute for Meteorological Satellite Studies (CIMSS)] noted that a key to improving climate prediction includes the treatment of clouds. Although significant advancements have been made in this area, many questions regarding the amount and distribution of ice in the atmosphere remain unanswered. Dr. G. Stephen (Colorado State University) continued this discussion with an overview on the retrieval of clouds and precipitation properties from space. The use of different radiometric sensors and algorithms for mapping clouds often results in very different summaries of global cloud distributions and properties. The launch of CloudSat (cloud radar) and the Cloud–Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) will offer new possibilities for observing and retrieving cloud properties using a combination of information from these active sensors and conventional radiometric data.

Validation of cloud products and retrievals was the focus of several posters in this session. There is a noticeable trend toward more sophisticated characterization of satellite-based retrievals with more complete validation schemes and thorough error and bias analyses. Much of this is in response to explicit user community requirements. An interesting education and outreach validation project was presented by Dr. L. Chambers (NASA Hampton). The online Students' Cloud Observations On-Line (S'Cool) project uses a network of students as ground observers for the Clouds and the Earth's Radiant Energy System (CERES) cloud retrieval validation. The S'Cool online database includes more than 32,000 student observations for the past 7 years. In addition to providing useful ground truth information, the S'Cool program and associated student data analysis activities are having a positive impact on test scores at all grade levels.

There were a number of posters and two invited presentations regarding retrievals of various products from MODIS and AIRS, ranging from polar winds to surface spectral emissivity. The synergistic use of MODIS and AIRS results in improved retrievals of cloud-top pressure, effective cloud amount, cloud particle size, and cloud optical thickness. A presentation on the use of superchannels for AIRS retrievals showed how highly correlated channels can be used to reduce the large volume of data provided by AIRS without losing valuable information. The use of superchannels provides for the speed and accuracy needed in numerical models where the number of channel calculations are reduced by a factor of 10 with an error under 0.015 K.

ACKNOWLEDGMENTS. This conference was organized by the AMS Committee on Satellite Meteorology

STUDENT POSTER AWARD WINNERS

The following student poster award winners were announced at the conference:

1st place: Angela Maharaj, Macquarie University: The influence of bottom topography on long Rossby wave propagation in the South Pacific Ocean.

2nd place: Robert Holz, CIMSS/University of Wisconsin—Madison: Comparison of high spectral resolution infrared cloud top pressure algorithms using S-HIS measurements.

3rd place: Chelle L. Gentemann, University of Miami: Near real time global optimum interpolated AMSR-E SSTs—Applications to hurricane intensity forecasting.

4th place: Jun Wang, University of Alabama–Huntsville: An integrated system for studying the effects of Central American smoke aerosols on air quality and climate over the southeastern United States.

5th place: Brian Kahn, University of California, Los Angeles: Cloud detection using a combination of hyperspectral infrared channels and microwave-derived precipitable water.

and Oceanography, under the leadership of Christopher S. Velden. The program committee for this conference consisted of Elaine M. Prins (chair), Ralph Ferraro, Jeffrey D. Hawkins, Robbie E. Hood, Arlene G. Laing, J. Marshall Shepherd, and Christopher S. Velden. The short course was organized by Jeffrey Puschell, with assistance from Gerrald Dittberner, Jaime Daniels, and Elaine Prins. A special thanks is extended to all the short-course instructors for their excellent presentations and material. We also extend our thanks to the AMS for their continuing support of the student awards programs, and to John Zapotocny for coordinating the student award contest and the panel of judges: Jaime Daniels, Shaima Nasiri, Jeffrey Puschell, F. Joseph Turk, and John Zapotcny. We gratefully acknowledge the excellent support we received from the AMS staff: Henry Regis, Cara Christensen, and Chris Pagliccia.