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Cooperative Institute for Climate & Satellites
UNIVERSITY OF MARYLAND

Cooperative Institute for Climate and Satellites-Maryland

Circular JUNE 2014

DIRECTOR'S MESSAGE

As you might expect, there are more eventful stories to report than what we can include in this short message. However, two major events deserve to be emphasized. First, four CICS-MD scientists and three students were recognized for their work and given different awards. Two of them (Likun Wang and Mike Natoli) received two awards each. Congratulations to all for your dedication! Award winners are pictured below, and details of each person's citation for the award is presented at http://cicsmd.umd.edu/award-winners-at-cics-md/.

The second event is the launch of the Second CICS-MD Summer Initiative. This year we are training and supporting 22 undergraduate and graduate students, many on-site and others at NOAA facilities. Each student has a mentor to maximize the experience. Their studies cover a broad range of activities, including the development of climate displays on a sphere, lightning detection, climate diagnostics, satellite calibration and an analysis of the use of rangeland health indicators by government agencies and stakeholder groups. They are a good representation of the broad activities being carried out at CICS-MD.

We welcome suggestions and contributions for the CICS-MD Circular. Please let us know if you would want to contribute to it. Best wishes,

Hugo Berbery, CICS-MD Director

AWARD RECIPIENTS


Likun Wang


Yong Chen


Ralph Ferraro


Huan Meng


Kate O'Brien


Mike Natoli


Katie Lukens

NOAA SPONSORS

- Center for Satellite Applications and Research (STAR)/National Environmental Satellite, Data and Information Service (NESDIS)
- Climate Prediction Center/National Centers for Environmental Prediction/National Weather Service
- National Climatic Data Center/NESDIS
- National Oceanographic Data Center/NESDIS
- Air Resources Laboratory/Office of Oceanic and Atmospheric Research

CICS-MD BACKGROUND

CICS is a partnership led by the Earth System Science Interdisciplinary Center of the University of Maryland at College Park engaged in collaborative research with several NOAA Centers and Laboratories. CICS comprises two main research centers, CICS-MD at the University of Maryland, and CICS-NC in Asheville, NC, which is administered by North Carolina State University. The CICS Consortium includes another 15 institutions as partners, including academic, non-governmental, and private research enterprises.

CICS-MD consists of about 60 scientists that implement the Institute's mission of supporting NOAA's ability to use satellite observations and Earth System models to advance the national climate mission.

RESEARCH TOPICS

CICS-MD research strengths focus in the following topic areas:

Data Fusion and Algorithm Development. This is research focused on the use of satellite and complementary observations to create geophysical data sets related to various aspects of the global climate system.

Calibration/Validation. This area of research is aimed at calibration and validation of satellite radiance data as well as products of algorithms that derive geophysical parameters to best represent the state of the Earth System.

Future Satellite Programs. Activities under this topic are directed at developing and implementing new NOAA meteorological satellite systems, particularly GOES-R and JPSS.

Climate Research, Data Assimilation and Modeling. This research topic aims at improving the understanding of the physics of climate through integration of information by data assimilation, particularly satellite-derived data sets, with models of the Earth System and its components.

Land and Hydrology. The focus of this topic area is on the enhancement, refinement and validation of algorithms that derive land surface products from satellite observations with the purpose of improving global land-atmosphere feedback mechanisms that impact all living forms on the planet.

Earth System Monitoring from Satellites. Research in this topic area focuses on the derivation and curation of data sets that describe crucial aspects of the Earth System (Atmosphere, Land, Ocean, Cryosphere) and the application of those data sets in the detection and monitoring of significant climate events.

Education, Climate Literacy, and Outreach. Activities include mentoring of undergraduate and graduate students on themes of relevance for NOAA, increasing awareness of climate science and changes in the climate system, and raising the understanding of how climate data is collected, observed, analyzed, and used in research purposes.

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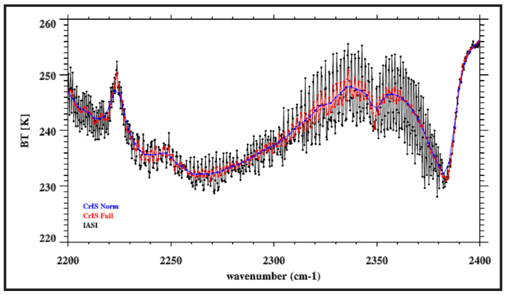
Inter-Comparison of CrIS, AIRS, and IASI Spectral Radiances

(Contributed by Likun Wang)

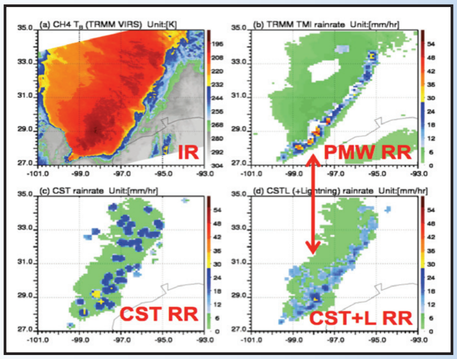


Hyperspectral infrared (IR) radiance measurements from satellite sensor contain valuable information on atmospheric profiles, greenhouse gases, clouds, and surface characteristics. These measurements are used not only to retrieve atmospheric profiles, but more importantly, to be directly assimilated into numerical weather prediction (NWP) models as inputs. Moreover, owing to the hyperspectral nature and accurate radiometric and spectral calibration, hyperspectral IR radiances have been used as a reference to independently assess spectral and radiometric calibration accuracy of broad- or narrow-band IR instruments as well as for long-term climate change monitoring. Therefore, it is fundamental to evaluate radiometric and spectral consistency among hyperspectral sounders, i.e., newly-launched Cross-track Infrared Sounder (CrIS) on the Suomi National Polar-Orbiting Partnership satellite (SNPP), Atmospheric Infrared Sounder (AIRS) on NASA Aqua, and Infrared Atmospheric Sounding Interferometer (IASI) on MetOp-A and –B. CICS scientist Likun Wang recently directly compares the SNPP CrIS radiance measurements with the AIRS and IASI at a finest spectral scale at orbital crossing points of satellites occurring over high latitudes through one year of the data. It is found that CrIS well agrees with AIRS and IASI and their brightness difference is within 0.1-0.2K. Given the fact that SNPP CrIS combined with the AIRS on Aqua and IASI on Metop-A and –B will accumulate decades of hyperspectral spectral infrared measurements, the radiometric and spectral consistency among AIRS, IASI, and CrIS is fundamental for creation of long-term IR hyperspectral radiance benchmark dataset for both inter-calibration and climate-related studies.

Figure: Inter-comparison of CrIS and IASI spectra at the spectral range from 2200 to 2400 cm^{-1}.

Improving Geosynchronous Rainfall Estimates With GOES-R Lightning Data

(Contributed by Robert Adler)

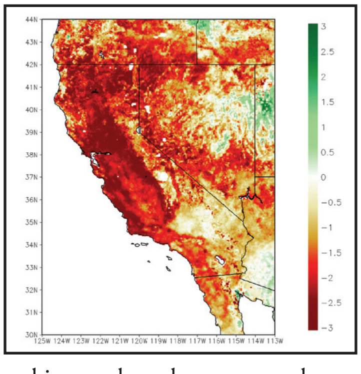


CICS scientists have successfully developed a new satellite rainfall estimation technique for the use with the upcoming GOES-R, which would use a combination of IR data [Advanced Baseline Imager (ABI)] and optical lightning information [Geostationary Lightning Monitor (GLM)]. The study utilized data from instruments on the Tropical Rainfall Measuring Mission (TRMM) as proxies for the ABI and GLM data and for instantaneous comparison/validation with rain estimates based on the TRMM radar and passive microwave instruments. Lightning information, in the form of flash rates, are used to define areas of convective cores and associated rain rates through empirical relations. This type of information is coupled with a modified IR-based Convective/Stratiform Technique (CST) to produce a lightning-enhanced CST (CSTL). As shown in the figure, the CSTL identifies convective areas that are missed by the CST and removes convective cores that are incorrectly defined by CST, with results being a CSTL rain estimate much closer to the passive microwave estimate than the IR-based estimate, with significantly improved statistics over a large number of cases. This type of approach should lead to improved rain estimates with GOES-R for flood detection and other applications.

Figure: Instantaneous rainfall estimates (10 km resolution) of a convective system: (a) IR T_b *map from TRMM IR sensor (b) rainrates estimated by TRMM passive microwave instrument (c) CST rainrate estimates, and (d) CSTL rainrate estimates. Rainfall rates are indicated by the color bar with units of mm hr*$^{-1}$.

Evapotranspiration and Drought Monitoring Using GOES-R Products for NIDIS

(Contributed by Chris Hains)



Observations of land surface temperature (LST) retrieved from thermal infrared (TIR) sensors, such as GOES, can convey extremely valuable information related to monitoring drought and evapotranspiration (ET). CICS scientist Christopher Hain, along with colleagues at the USDA and NOAA/NESDIS have developed the Evaporative Stress Index (ESI), based on surface flux estimates from the Atmosphere Land Exchange Inverse (ALEXI) model, describing the departure of modelled flux estimates of ET from the potential rate expected under non-moisture limiting conditions. The ESI is computed as standardized temporal anomalies in the ET/PET ratio, and shows good correspondence with standard drought metrics and with patterns of antecedent precipitation, but at significantly higher spatial resolution and without the need for knowledge of antecedent precipitation. With the launch of GOES-R, our capabilities will be significantly enhanced due to substantial improvements in spatiotemporal resolution, radiometric accuracy, and cloud-clearing capabilities. This will significantly improve utility to the drought community and action agencies served by NIDIS, who are demanding drought information at increasingly higher spatial resolution to support decision making at the sub-county scale.

Figure: ESI for 27 March 2014 for the GOES-R proxy (MODIS-based) at 2 km. Red shaded pixels denote evaporative stress associated with drought conditions.