Implementation of Geostationary Surface Albedo (GSA) Algorithm with GOES data

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Task Code	NC-CDR-08-NCICS-JM
Main CICS Research Topic	Climate Data and Information Records and Scientific Data Stewardship
Percent contribution to CICS Themes	Theme 2:100%
Percent contribution to NOAA Goals	Goal 1:100%

Highlight: The GSA algorithm is being implemented as the American contribution of an international collaboration between Europe, Japan, and the US to produce a joint Climate Data Record

BACKGROUND

Surface albedo is the fraction of incoming solar radiation reflected by the land surface, and therefore is a sensitive indicator of environmental changes. To this end, surface albedo is identified as an Essential Climate Variable (ECV) by the Global Climate Observing System (GCOS). In support of the Sustained, Coordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM), we are implementing the GSA algorithm for GOES data on behalf of NOAA to contribute to an international effort in collaboration with EUMETSAT and JMA. This effort signifies the first such attempt to use the same core algorithm across internationally operated geostationary satellites to produce a climate data record for this variable. Currently, the GSA algorithm generates products operationally at EUMETSAT using geostationary data from satellites at 0° and 63°E and at JMA using 140°E geostationary data. To create the stitched global Level 3 product as illustrated in Figure 1, NCDC is tasked with implementing the algorithm for GOES-E (75°W) and GOES-W (135°W).

Previously the GSA algorithm was run with GOES data only for viability studies with 10 days of data. To effectively and efficiently generate products with this algorithm over large time periods, much effort was extended to understand the application to GOES data specifically. The effort may be divided into two general categories: Operations and Science. Examples of Operations tasks include: porting code developed in the EUMETSAT computing environment to be functional in the NCDC computing environment, code development to work with GOES data format imagery, code development for ancillary NWP input data, etc. Examples of Science tasks include: evaluation of the effect of different spatial and temporal resolutions of GOES as compared to the resolutions of EUMETSAT and JMA satellites, validation of the algorithm as applied to GOES data with external data sets, development of uncertainty bounds for the product, etc.

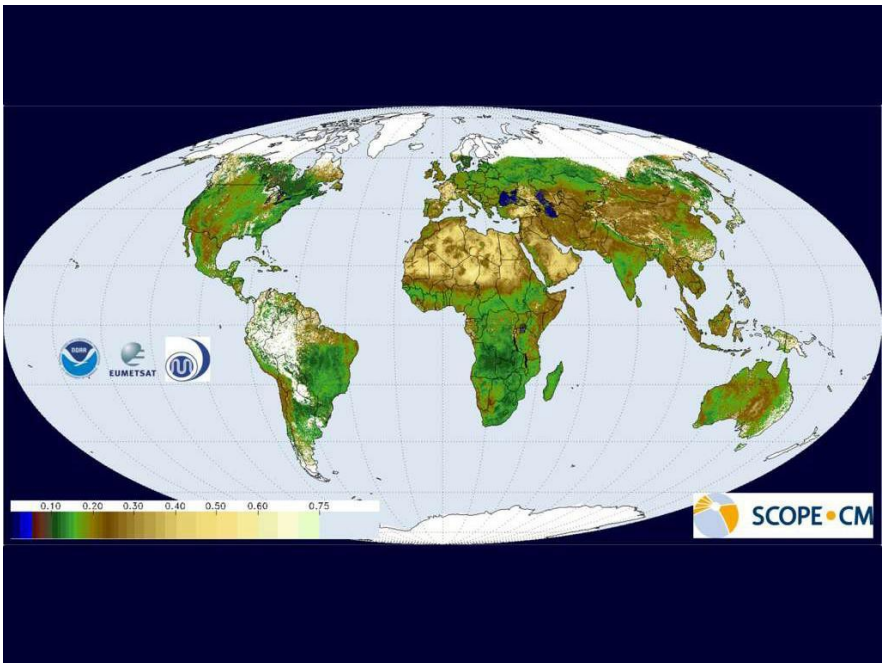

Figure 1: Broadband black sky albedo spatial composite product for the period 1-10 May 2001.

ACCOMPLISHMENTS

To date, much of the effort for this project has been directed towards implementation of an operational algorithm at NCDC. The 32-bit core algorithm has been successfully ported to the 64-bit computing environment at NCDC. We have developed a code package to convert GOES formatted imagery into the required binary input for the core algorithm, to accept NCEP inputs for total column water vapor and ozone, and to process in parallel on the computer cluster infrastructure. And, we have developed a preliminary code package to convert the binary product output into netCDF4 format for archival.

In April and August 2012 Jöerg Schulz, of the team of collaborators from EUMETSAT, visited NCDC. During these visits a number of items were discussed. We updated on the status of Level 2 processing at NCDC, discussed future plans for joint Level 3 product generation, and begin initial discussions about the future of GSA in Phase-2 of SCOPE-CM.

In September 2012, we delivered all products for GOES-E and GOES-W for the SCOPE-CM requested period of 2000-2003. This is the largest reprocessing of GOES data undertaken at NCDC, working with 45 TB of input data. The work made use of the CICS computing facility, processing in only weeks, using nearly 70 parallel streams. We are currently analyzing the resultant products.

A letter of intent was submitted to SCOPE-CM in January 2013 to continue and extend the international collaboration of the GSA project into Phase 2. This second phase is planned to last 5 years and includes activities such as: a common cloud mask approach, a common intercalibration method, exploration of different temporal resolutions and formats of output, and validation of Level 2 products.

Performance Metrics	FY12
# of new or improved products developed	1
# of products or techniques transitioned from research to ops	1
# of peer reviewed papers	1
# of non-peered reviewed papers	
# of invited presentations	3
# of graduate students supported by a CICS task	
# of undergraduate students supported by a CICS task	

PLANNED WORK

* Submit full proposal to SCOPE-CM for Phase 2 work.
* Validation of GSA products with MODIS and in situ observational data.
* Pending validation, the algorithm will be implemented for the entire historical record of GOES data (1979-present).
* Evaluate and extend the uncertainty analysis technique implemented by the GSA algorithm.
* Research possible angular and seasonal patterns in RPV parameters.

PUBLICATIONS

Lattanzio, A., Schulz, J., Matthews, J., Okuyama, A., Theodore, B., Bates, J.J., Knapp, K.R., Kosaka, Y., Schueller, L. (2012) Land surface albedo from geostationary satellites: a multi-agency collaboration within SCOPE-CM. Bulletin of the American Meteorological Society, doi:10.1175/BAMS-D-11-00230.1.

PRESENTATIONS

- Matthews, J.L., Lattanzio, A., Hankins, W., Knapp, K., and Privette, J. (2012), Land surface albedo based on GOES geostationary satellite observations. Poster presented at AGU Annual Meeting, December 3-7, 2012, San Francisco, CA.

- Matthews, J.L. (2012), A SCOPE-CM Initiative: Surface albedo from the geostationary constellation. Presented at NOAA's Annual Climate Data Record Conference, July 31-August 2, 2012, Asheville, NC.
- Lattanzio, A., Theodore, B., Schulz J., Scheuller, L., Matthews, J., Knapp, K., Okuyama, A., Kosaka, Y. (2012), Land surface albedo retrieval within the SCOPE-CM initiative. Presented at IGARSS, July 22-27, 2012, Munich, Germany.

OTHER

- The products from GOES-E and GOES-W for 2000-2003 were delivered to EUMETSAT in September 2012.