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LARGE SCALE SURFACE RADIATION BUDGET FROM SATELLITE OBSERVATION

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During the current reporting period, the focus of our work was on preparing and testing an improved version of our Surface Radiation Budget algorithm for processing the ISCCP D1 data routinely at the SRB Satellite Data Analysis Center (SDAC) at NASA Langley Research Center. The major issues addressed are related to gap filling and to testing whether observations made from ERBE could be used to improve current procedures of converting narrowband observations, as available from ISCCP, into broadband observations at the TOA. The criteria for selecting the optimal version are to be based on results of intercomparison with ground truth. The following was accomplished:

o Empirical corrections to the narrow to broadband conversions were derived by regressing TOA albedos from ERBE to those derived from the D1 data for the months for which D1 data were available, namely: October 1986, January 1987, June 1987, and July 1987. Separate corrections were developed for clear and cloudy skies. Since the ERBE data do not contain cloudy-sky albedos, the correction for cloudy sky was obtained in three ways:

a) ERBE "cloudy-sky" albedo was first obtained from the clear and all-sky ERBE albedos, using cloud cover information in the ISCCP D1 data. The cloudy-sky correction was then determined by a regression between the D1 cloudy albedos and the derived ERBE "cloudy" albedos.

b) ERBE "cloudy-sky" albedo and cloud cover were obtained from the assumption that in the expression of the all-sky albedo, the two terms (the cloud-cover weighted clear-sky and cloudy-sky albedos) should be the same from both ERBE and ISCCP D1. The cloudy-sky correction was then determined by a regression between the D1 cloudy albedos and the derived ERBE" cloudy" albedos.

c) Cloudy-sky correction was determined from the all-sky TOA albedos.

Empirical corrections were determined and analyzed for each contributing satellite (GOES-6, METEOSAT-2, GMS-3, NOAA-9, NOAA-10) separately, and all satellites combined.

Corrections were also obtained and analyzed for different clear scene-types (water, vegetation, desert, snow) separately, and combined. The transformation for all satellites and surface types combined were then adopted.

SRB parameters obtained from the ISCCP C1 and D1 data for October 1986, January 1987, June 1987 and July 1987 were compared in a series of experiment to assess the differences in the surface fluxes due to the change in satellite input, and change in the narrow to broadband transformations. Surface fluxes from both C1 and D1 were compared to ground measurements from GEBA. Three experiments were

conducted. The experiments applied different empirical corrections to the narrow to broadband transformation:

a) To avoid the influence of different empirical corrections applied to the narrow to broadband transformation in C1 and D1, no empirical corrections were used.

b) The cloudy-sky empirical correction derived from the "cloudy" ERBE and D1 albedos were used.

c) The cloudy-sky empirical correction derived from the all-sky albedos were used.

In all experiments, both C1 and D1 estimates yielded similar RMS errors when compared to the GEBA values. In general, somewhat lower RMS errors were obtained in the last experiment.

The satellite estimated surface fluxes were compared to the measured values at two different time scales (monthly and four months combined), and spatial scales (global, hemispheric, tropical).

o Prepared a data base of TOA and surface SRB parameters for Oct. 1986, Jan, April and July of 1987 derived from C1 and D1, and provided this information to users, for evaluation.

o Compared C1 estimates with data from FIFE.

o Implemented a new gap filling procedure. Filling is done in one or more of three ways. These are:

1) filling from observations for the same cell and closest in time on the same day;

2) if no daytime observations are available, filling is done from observations of a cell closest to the missing cell in the same latitude band, and of the same surface type on the same day;

3) if for the current day no observations are available in a latitude band, filling is attempted from the monthly averages.

Filled fluxes are now obtained from the filled values of the atmospheric constituents (water vapor, ozone amount, aerosol an cloud optical depth), and not by interpolation on the available fluxes. (Significant modification of the original code was necessary to introduce the above filling procedure.). In addition, the fluxes are normalized to the three hourly average value of the solar zenith angle, and not to the one corresponding to the center of the time interval.

Diffuse surface downward flux, global PAR and diffuse PAR, aerosol and cloud optical depth are now saved in the output. Several diagnostic parameters (total

number of possible daytime observations, number of missing satellite observations, number of filled flux values, etc.) are now also provided.

o Started the evaluation of the new code with comparing the retrievals from D1 data to fluxes from GEBA.