CERES Terra-Aqua Edition4A SSF Spatial Matching of Imager Properties and Broadband Radiation Accuracy and Validation

Data Accuracy

The SSF contains point spread function (PSF) weighted estimates of surface, cloud properties, and radiances obtained from the higher- resolution, coincident, imager pixels over CERES footprints. The imager pixels must be correctly located within the footprint and properly weighted to correctly determine their contribution to the scene the CERES footprint is viewing. This step is accomplished by dividing that portion of the viewed area which has an integral PSF weight of 95% of the theoretical total into uniform angular bins, averaging the pixel parameters within each bin, and then using a PSF weighted average of the bin parameters to determine the footprint parameter values.

To evaluate the accuracy of the PSF weighting, the broadband unfiltered radiances will be compared with the averaged PSF weighted MODIS narrowband radiances. There should be strong agreement in the linear relationship between the two. In addition to errors in location accuracy, this method will also contain errors caused by the nonlinear relationship between broadband and narrowband radiances. For more loosely matched SW broadband and narrowband radiances, errors are on the order of 8 to 10 percent using a nonlinear fit. Similar nonlinear regression of Outgoing Longwave Radiance (OLR) has errors between 2.5 and 3 percent. Any errors in spatial matching and weighting are masked by variations in broadband and narrowband radiances. The most representative spatial error will be the window spectral band since coverage there is nearly coincident. Only crosstrack footprints for all sky conditions over ocean will be used to minimize viewing geometry, surface, and atmospheric path differences.

The above described comparison was made using the Aqua CERES instrument (FM3) and the MODIS imager. Table 1 shows the uncertainty of the MODIS imager convolution within the CERES-FM3 footprint. For Terra, very high correlation coefficients and representative RMS errors to nonlinear studies were obtained for shortwave and window, as shown in Table 1. The longwave values are high, because our regression forced the intercept through zero where when unconstrained the intercept was 30 W $m^{-2}sr^{-1}$ with a RMS error of 3 percent. Over the year of Aqua data, no statistically significant trends could be identified in the regression slope coefficient. Any drift in the calibration of the CERES- FM3 and MODIS instruments is in the same direction.

Table 1. Uncertainty of MODIS Convolution within CERES-FM3 Footprint

Spectral Band	Typical Value W $m^{-2}sr^{-1}$	Regression RMS Error W $m^{-2}sr^{-1}$	Regression Percent RMS Error	Correlation Coefficient
SW	73	6.44	8.78%	0.996
LW-day	79	8.70	10.9%	0.984
LW-night	78	8.88	11.4%	0.982
WN	22	0.62	2.8%	0.996
a. July 1, 2002 through June 30, 2003				

Validation Study Results

The following validation study results are for the TRMM satellite. They will be replaced with Aqua results when the Aqua validation study has concluded.

Imager-Based Cloud Fraction: On nine days, the CERES-PFM instrument was placed in along-track scan mode. This mode allows the same nadir scenes to be viewed at all viewing angles from 0 to 75 degrees. Since the VIRS imager pixels used are basically the same for all these footprints (neglecting some crosstrack expansion), the mean cloud fraction percent by viewing zenith bins should not have a viewing zenith dependence. Our results show that this is true within 0.5% based on a mean of 53%.

Aerosol Optical Thickness: As part of the aerosol validation, the mean VIRS imager radiances and viewing zenith were used to obtain the AOT through look-up tables. There were never errors larger than 0.01 for either channel between the values calculated using SSF variables and the mean AOT on the SSF.

Quality Checks:

1. All imager-derived parameters are rejected if they are outside the range specified in the data product catalog. Parameters are almost never rejected for this reason.
2. When the ratio of weighted area of unknown to known cloud parameters exceeds 10:1, the cloud layer area and cloud properties are rejected. About 0.73% of these parameters are rejected.

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