Fast Longwave and Shortwave Flux (FLASHFlux) products derived from CERES and MODIS measurements

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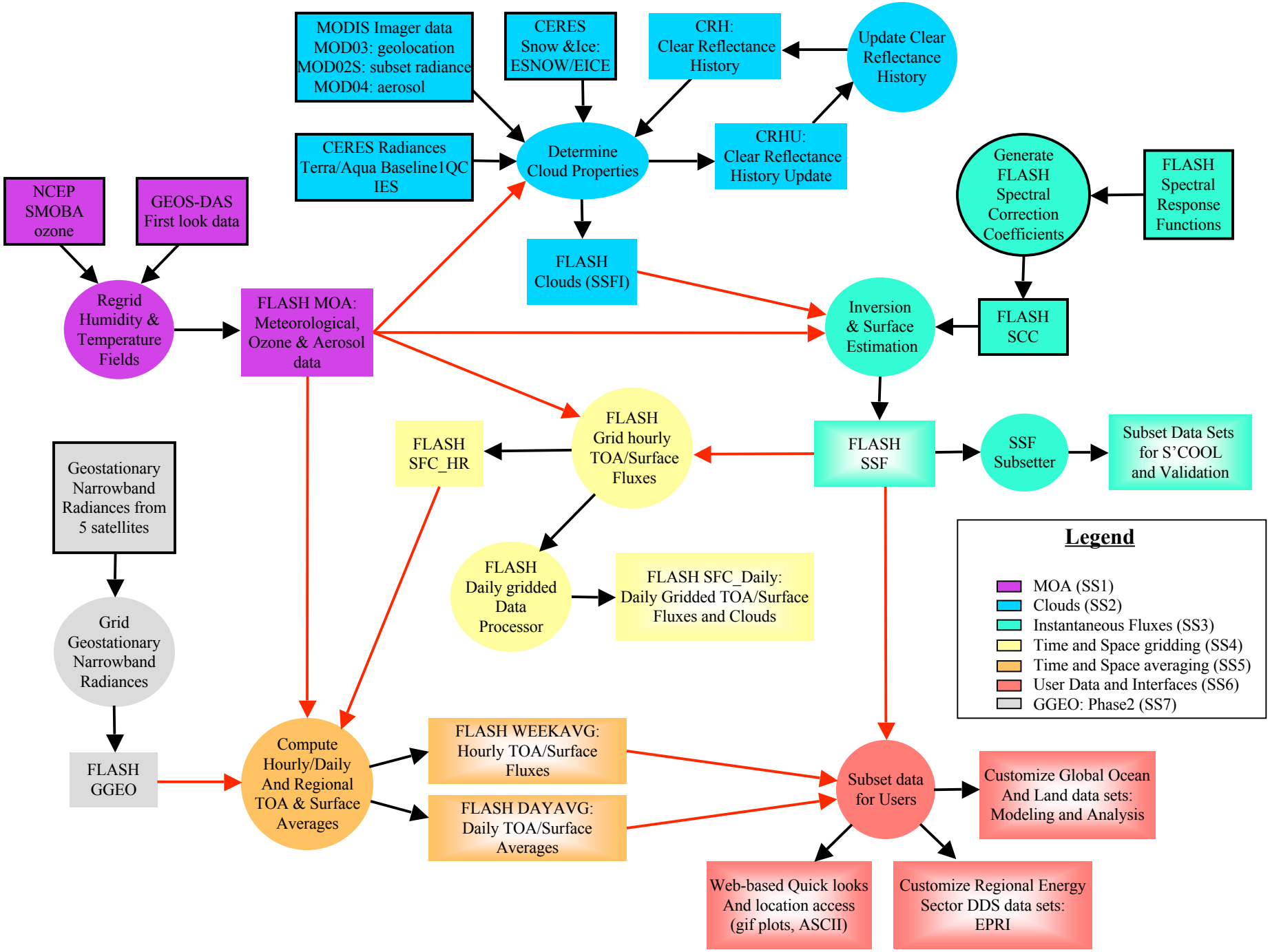
FLASHFlux Objectives

- **Objectives:**
  - Compute radiative fluxes from CERES observations within one week of measurement (for time averaged data within 1 week of last measurement)
    => *fill gap between overpass and official climate quality CERES products*
  - Provide these datasets to:
    - ocean (WHOI) & land (GSFC) assimilation teams
    - Instrument teams like CERES, CALIPSO and CloudSat
    - societal applications such as to energy and agriculture sectors
  - Use datasets for scientific evaluation of flux variability and extremes relative to climatological means
- **Requirements:**
  - Design processing system for operational data production within 1 week of observation
  - Design system flexibility to accommodate upgrades of input quantities (i.e., higher resolution reanalysis - GEOS-5, GEO data)
  - System must include data pipelines for dissemination of products to partners and general public.


MODIS Imager data
MOD03: geolocation
MOD02S: subset radiance
MOD04: aerosol
CERES
Snow &Ice:
ESNOW/EICE
CRH:
Clear Reflectance
History
Update Clear
Reflectance
History
CERES Radiances
Terra/Aqua Baseline1QC
IES
Determine
Cloud Properties
CRHU:
Clear Reflectance
History Update
Generate
FLASH
Spectral
Correction
Coefficients
FLASH
Spectral
Response
Functions
NCEP
SMOBA
ozone
GEOS-DAS
First look data
FLASH
Clouds (SSFI)
Regrid
Humidity &
Temperature
Fields
FLASH MOA:
Meteorological,
Ozone & Aerosol
data
Inversion
& Surface
Estimation
FLASH
SCC
FLASH
Grid hourly
TOA/Surface
Fluxes
FLASH
SFC_HR
FLASH
SSF
SSF
Subsetter
Subset Data Sets
for S'COOL
and Validation
Geostationary
Narrowband
Radiances from
5 satellites
FLASH
Daily gridded
Data
Processor
FLASH SFC_Daily:
Daily Gridded TOA/Surface
Fluxes and Clouds
Legend
MOA (SS1)
Clouds (SS2)
Instantaneous Fluxes (SS3)
Time and Space gridding (SS4)
Time and Space averaging (SS5)
User Data and Interfaces (SS6)
GGEO: Phase2 (SS7)
Grid
Geostationary
Narrowband
Radiances
FLASH
GGEO
Compute
Hourly/Daily
And Regional
TOA & Surface
Averages
FLASH WEEKAVG:
Hourly TOA/Surface
Fluxes
FLASH DAYAVG:
Daily TOA/Surface
Averages
Subset data
for Users
Customize Global Ocean
And Land data sets:
Modeling and Analysis
Web-based Quick looks
And location access
(gif plots, ASCII)
Customize Regional Energy
Sector DDS data sets:
EPRI

FLASH MOA

- The purpose of FLASH MOA is to assimilate information concerning the basic state of the atmosphere, e.g., water vapor amount, ozone amount and surface temperature, and make that information available to other subsystems.
- The meteorological data is assimilated through NASA's Goddard Earth Observing System (GEOS) Global Modeling and Analysis Office (GMAO) with GEOS Version 4.0.3 FLK being used through October 2006, and GEOS Version 5 being used after October 2006 (CERES only processes with GEOS Version 4.03).
- Ozone is provided through SMOBA with a climatological map acting as a backup.

FLASH Clouds (SSFI)

- The purpose of FLASH Clouds is to assimilate CERES Radiances, MODIS Imager data, CERES snow & ice maps, as well as, other information to determine cloud properties, and thus, ultimately to calculate the SSFI dataset which can then be read into FLASH Inversion.
- The FLASH Clouds Algorithm is virtually identical to the CERES Clouds Algorithm.
- FLASH incorporates the most recent MODIS Collection data (CERES incorporates the MODIS Collection 4 data)
- FLASH will use MODIS Collection 5 aerosols for Aqua.

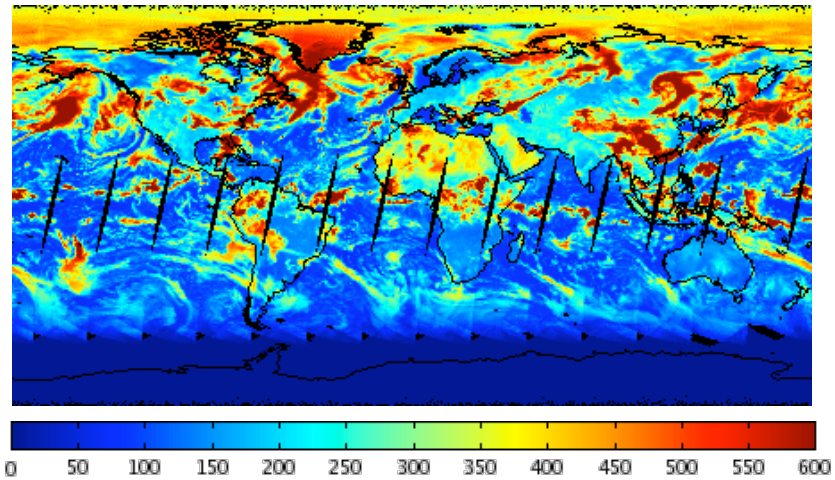
FLASH Inversion

- The purpose of FLASH Inversion is to use the FLASH MOA and SSFI data, as well as FLASH spectral response functions and gain coefficients, to produce the FLASH Single Scanner Footprints (SSF). The most critical SSF output data are the instantaneous surface and TOA fluxes.
- The CERES Instrument WG provides estimated values for the combined CERES spectral response functions (SRF) and gain coefficients (GC), which are used to generate the FLASH Spectral Correction Coefficients (SCC). CERES SCC generated only after best possible SRF and GC become available.
- The FLASH SSF is an instantaneous output data product available for use by the community, but is characterized by swaths of footprint data (Useful for specific locations but not necessarily useful for regional of global coverage).

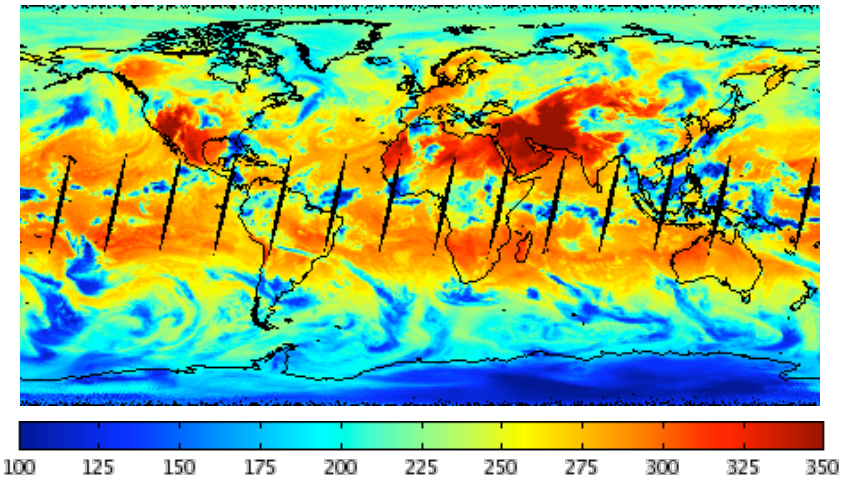
SSF TOA and Surface Fluxes (Wm^{-2})

(Daily Composite Terra Overpass, June 12, 2006)

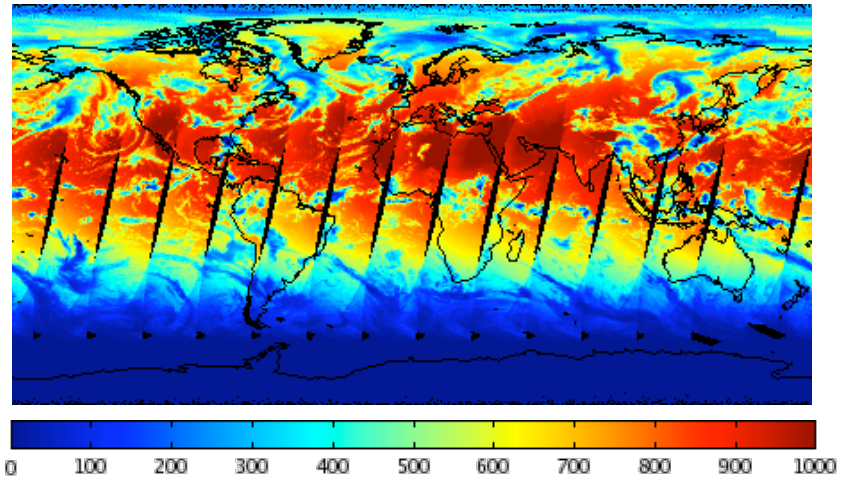
TOA SW Up



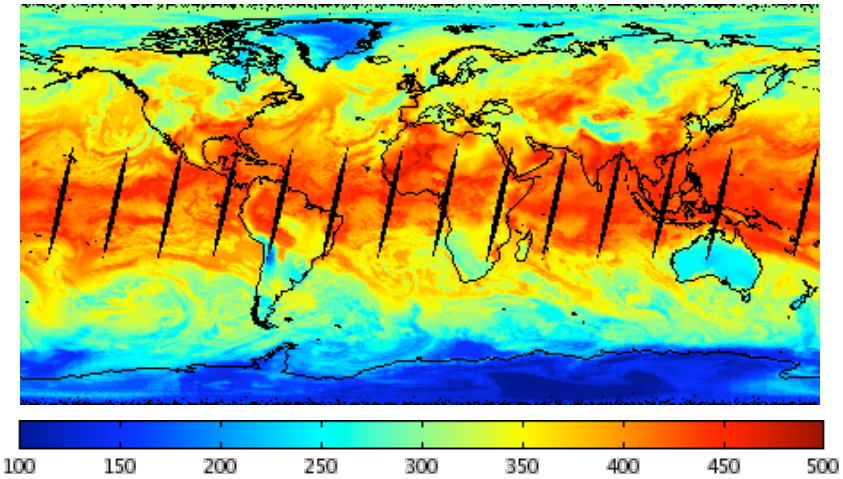
TOA LW Up



Surface SW Down



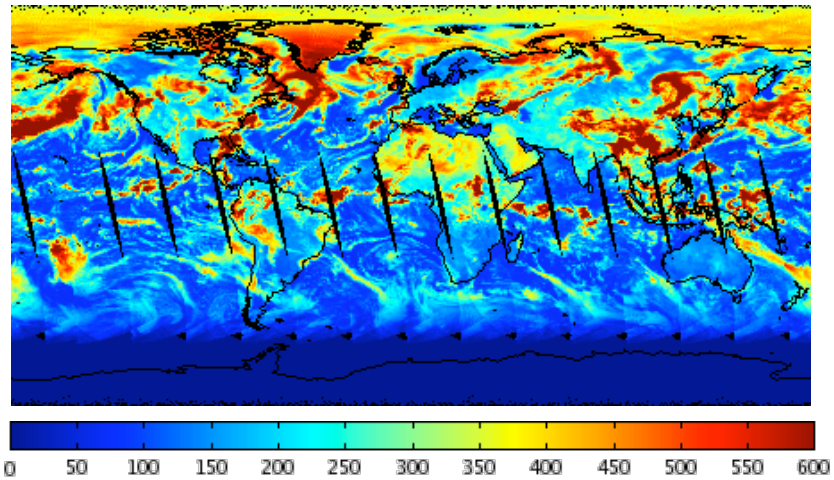
Surface LW Down



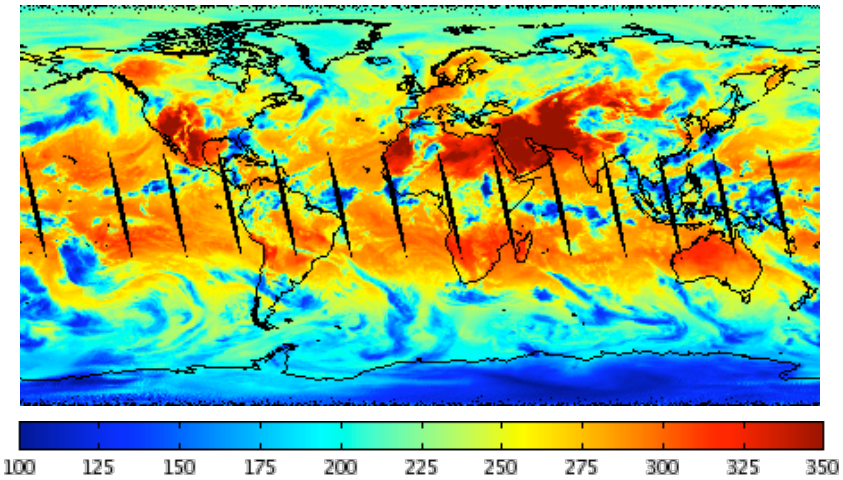
SSF TOA and Surface Fluxes (Wm^{-2})

(Daily Composite Aqua Overpass, June 12, 2006)

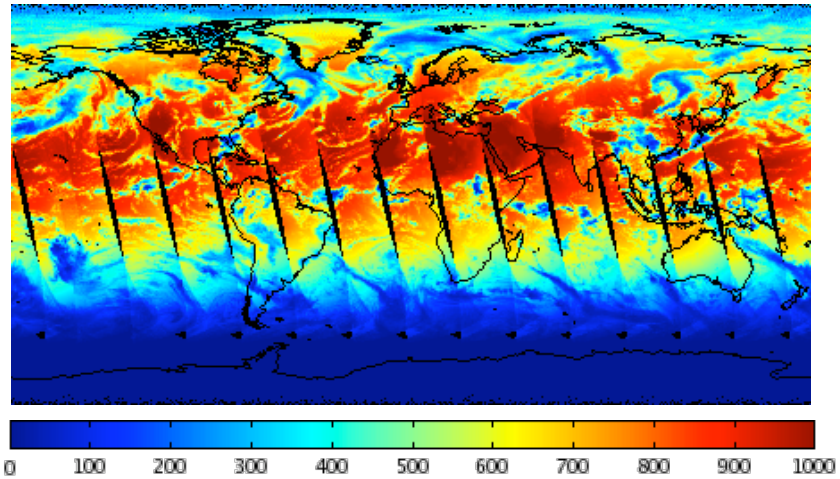
TOA SW Up



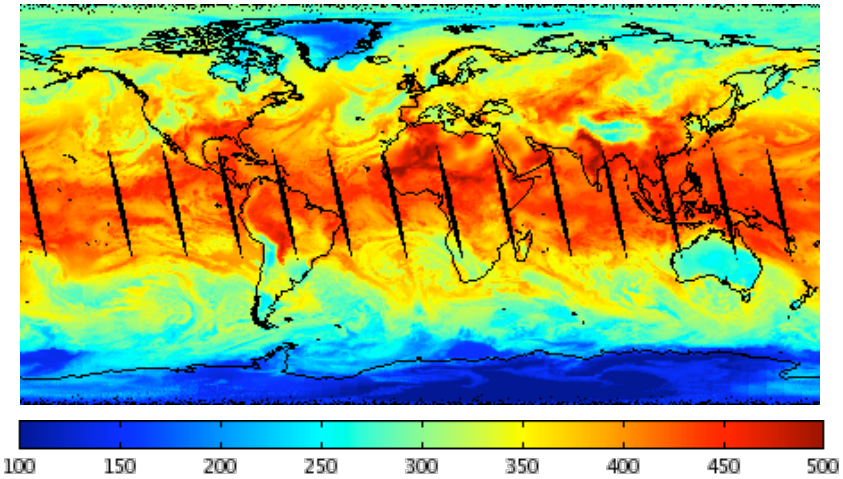
TOA LW Up



Surface SW Down



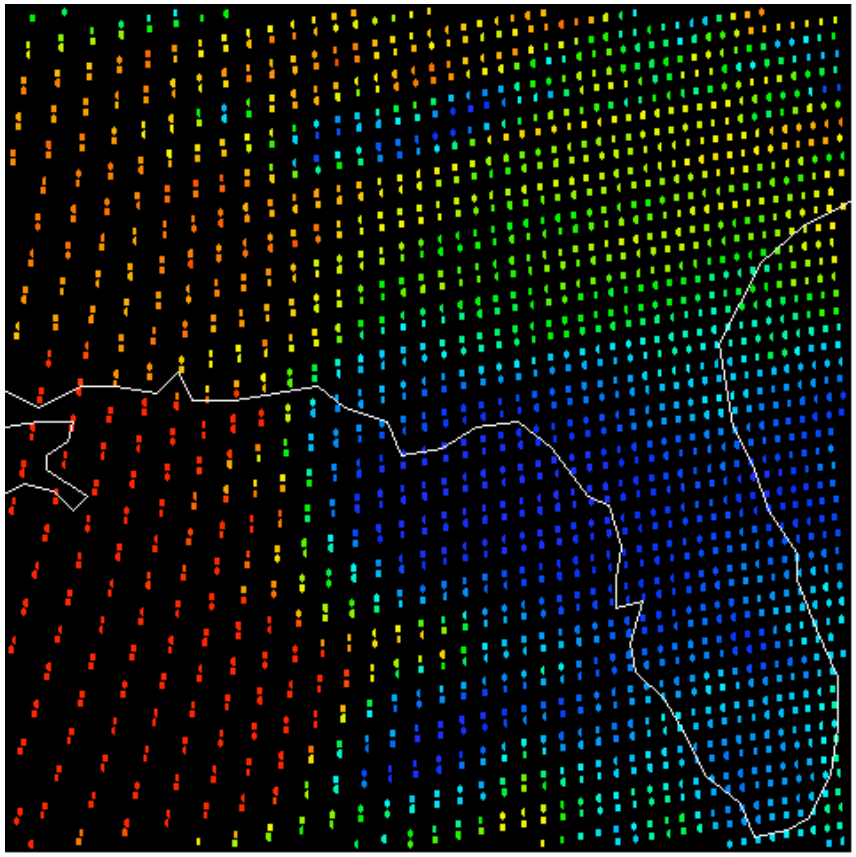
Surface LW Down

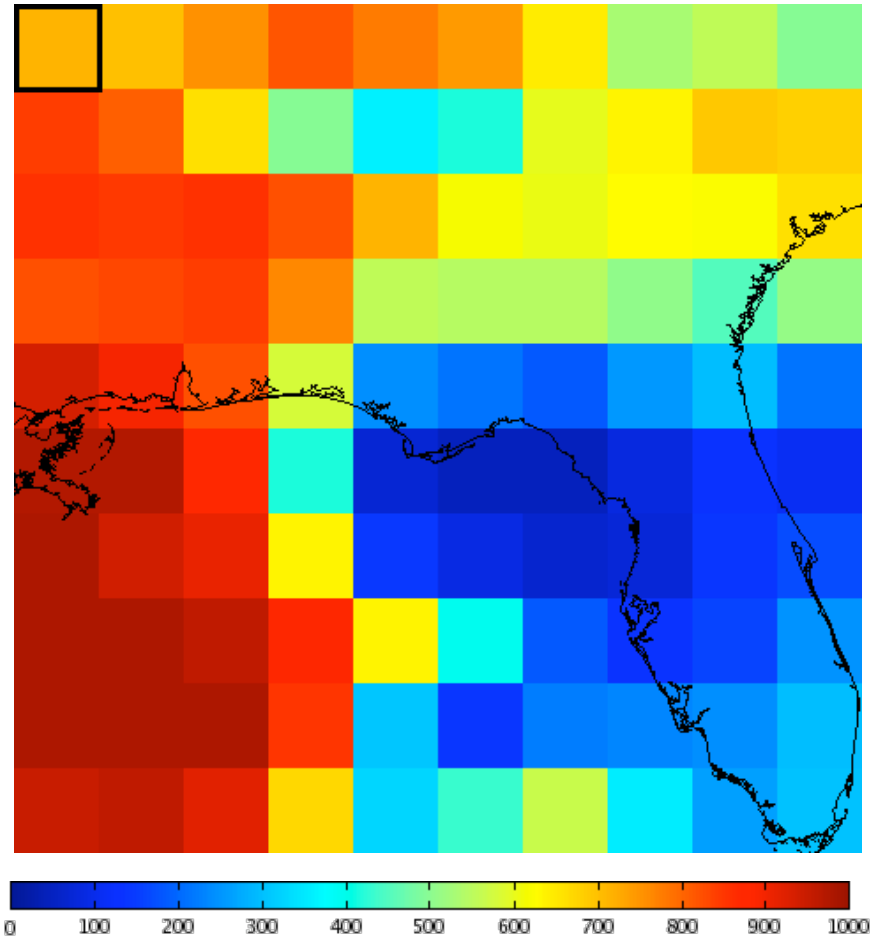


FLASH Spatial Gridding

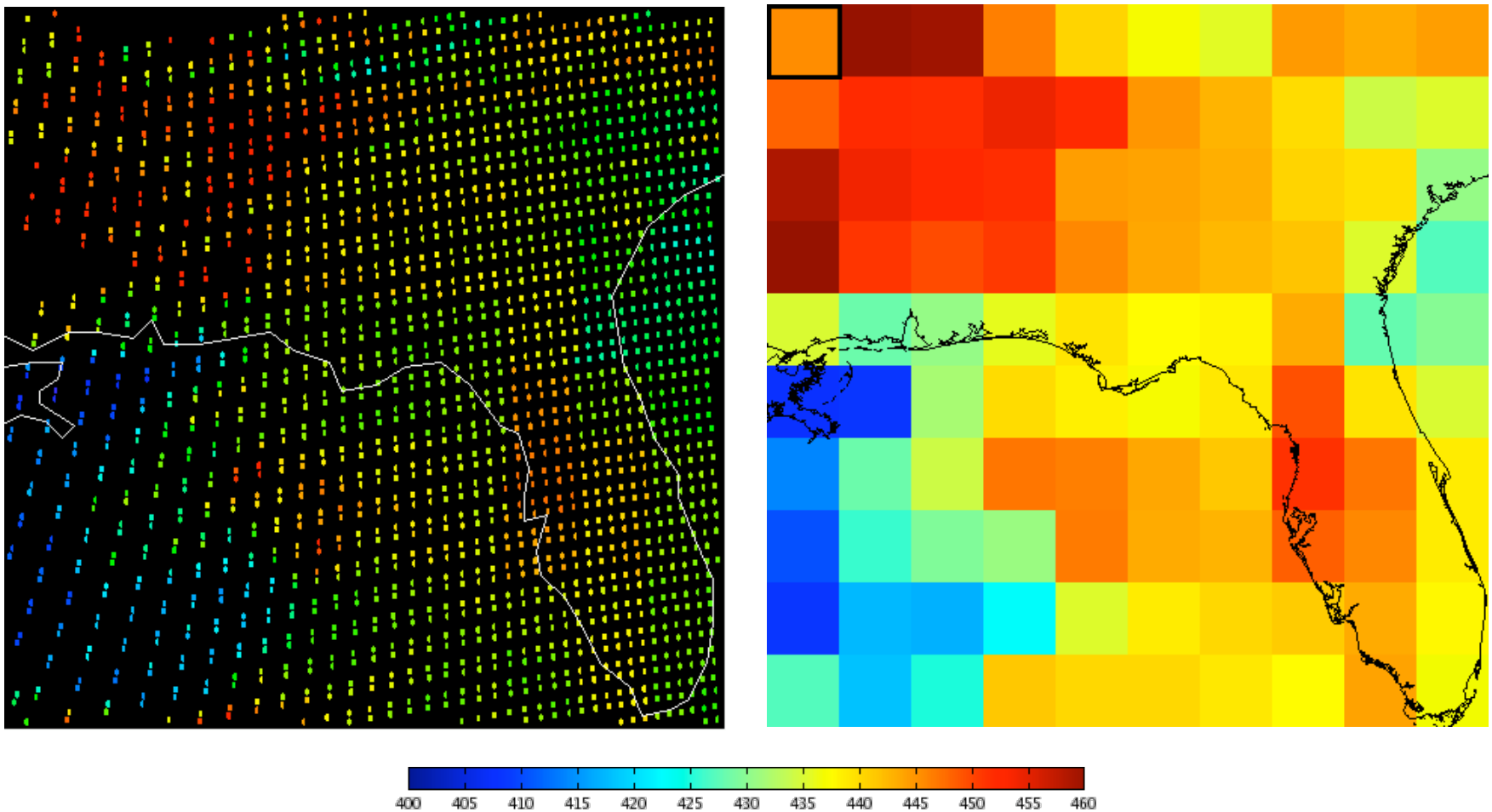
- FLASH Spatial Gridding takes the FLASH SSF instantaneous fluxes and produces hourly and daily products on a 1° x 1° grid.
- Future plans include improving the spatial resolution of the data to a ½° x ½° grid.
- The FLASH SFC daily gridded cloud products and gridded TOA and surface fluxes will be made available for use by the community.
- The FLASH SFC hourly gridded data are the primary input into the FLASH TISA.

Comparison of Surface Downward SSF and Gridded Shortwave Fluxes (Wm^{-2})

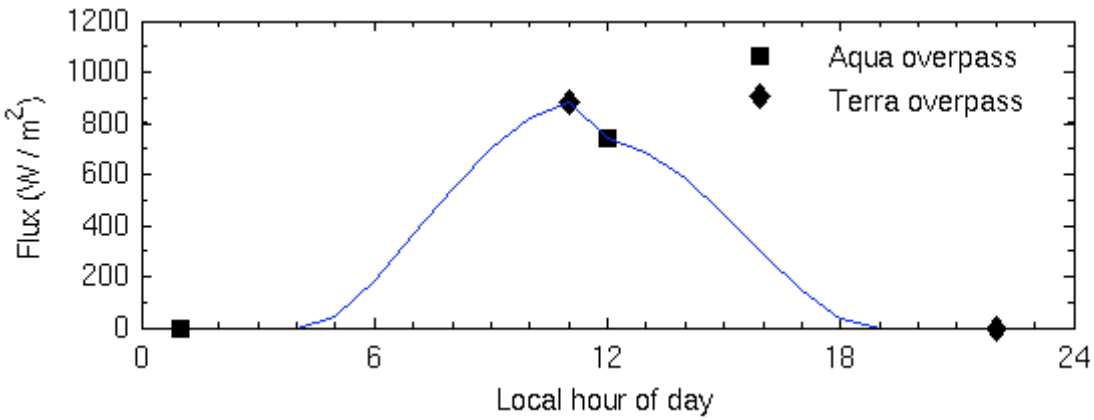




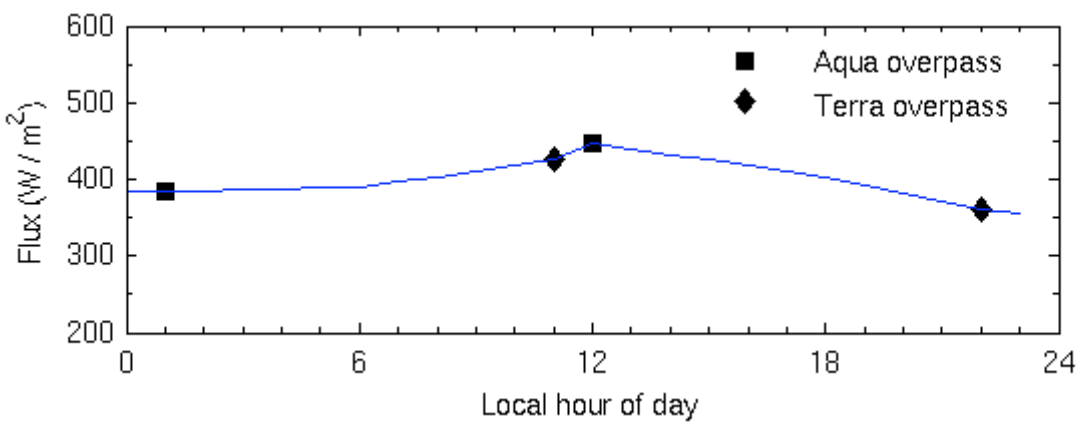
Comparison of Surface Downward SSF and Gridded Longwave Fluxes (Wm^{-2})



SW & LW Down Hourly Interpolation, 34.5°N , 89.5°W, Goodwin Creek, MS



SW



LW

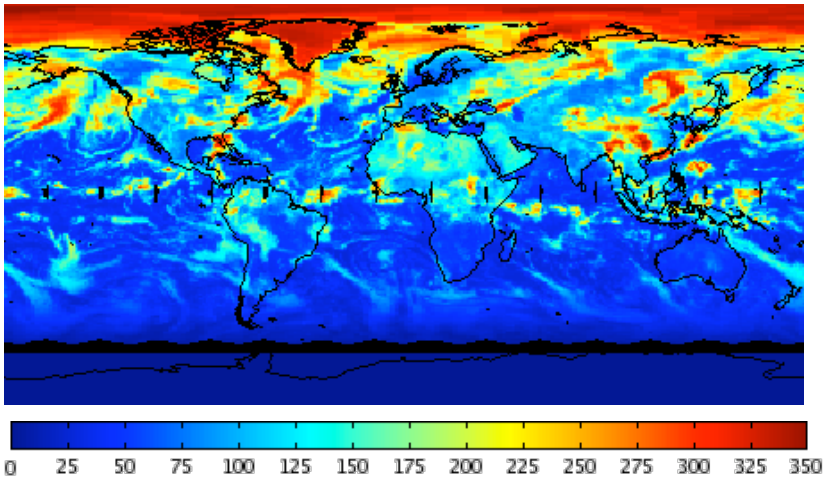
FLASH Time & Space Interpolation

- FLASH TISA incorporates FLASH MOA and the SFC hourly gridded data to compute hourly and daily averages for the TOA and surface fluxes.
- ERBE TISA algorithms implemented with 3-day window.
- Terra & Aqua data processed separately and together.
- The FLASH TISA results are available to the community as both an hourly product and a daily product.
- To improve the accuracy of the hourly and daily products throughout the day, we intend to incorporate Geostationary narrow-band radiances as a next step.

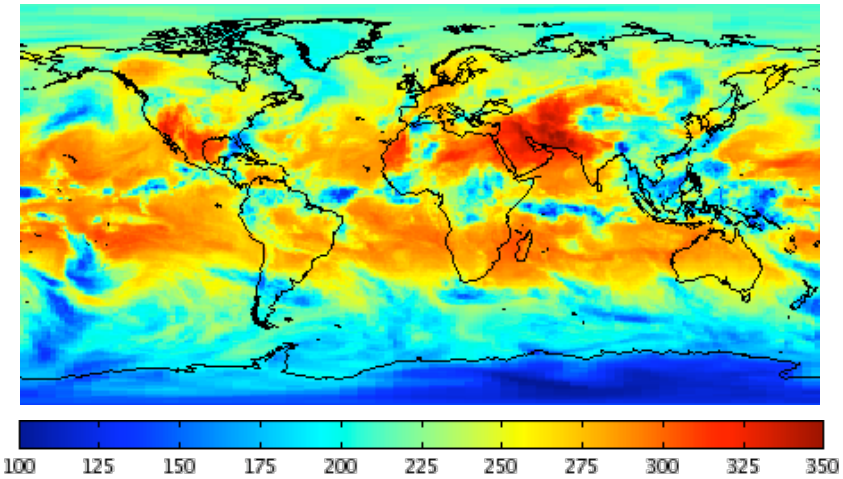
TISA TOA and Surface Fluxes (Wm^{-2})

(Daily Composite Terra + Aqua, June 12, 2006)

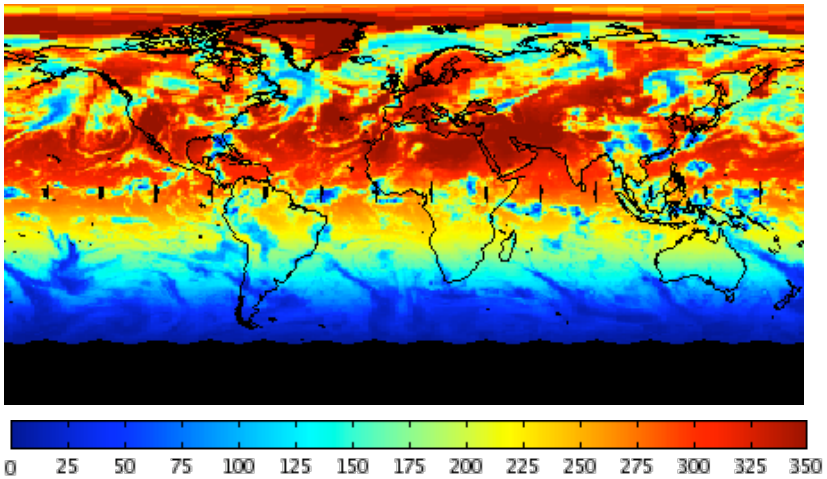
TOA SW Up



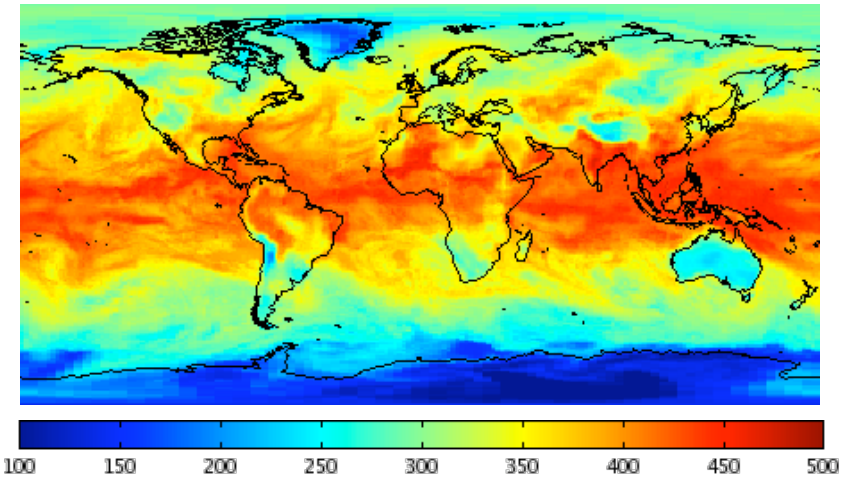
TOA LW Up



Surface SW Down



Surface LW Down



FLASH Data Interface

- The FLASH Data Interface is envisioned as a process to facilitate use of the FLASHFlux data.
- Information about the FLASHFlux products, including product availability documentation, relevant links, sample software, tools for working with the data, etc. can be found at the FLASHFlux data site: http://eosweb.larc.nasa.gov/PRODOCS/flashflux/table_flashflux.html
- Still under development, the goal is to work with data users to create a web-based data interface tool that will provide easy access to the FLASHFlux data products.
- Create subsetted and customized data sets for specific data users as required.
- For additional information concerning data acquisition or data management contact: larc@eos.nasa.gov

FLASH Gridded Geostationary

- Since the Aqua and Terra satellites are in sun-synchronous orbits, the temporal sampling for most of the Earth is limited to two times per day for each satellite. To improve the accuracy of the hourly and daily products throughout the day, we intend to incorporate Geostationary narrow-band radiances. This will allow for temporal sampling throughout the day, but will retain much of the higher precision afforded by the EOS instruments since those instruments will anchor the Geostationary measurements twice per day.

FLASHFlux Data Users

1) CLOUDSAT Operations: Graeme Stephens (CSU), SSF.

2) CERES Groups:

   a. Calibration/Spectral Correction (SSF)

   b. Clouds (SSF): Daily and Monthly QC

   c. S'Cool (SSF): over participating schools

3) Aqua/CALIPSO/CLOUDSAT Fusion: Bruce Wielicki (NASA LaRC), SSF (maybe?).

4) Seasonal Predictions: Randy Koster (GSFC - NSIPP), 3-hourly data.

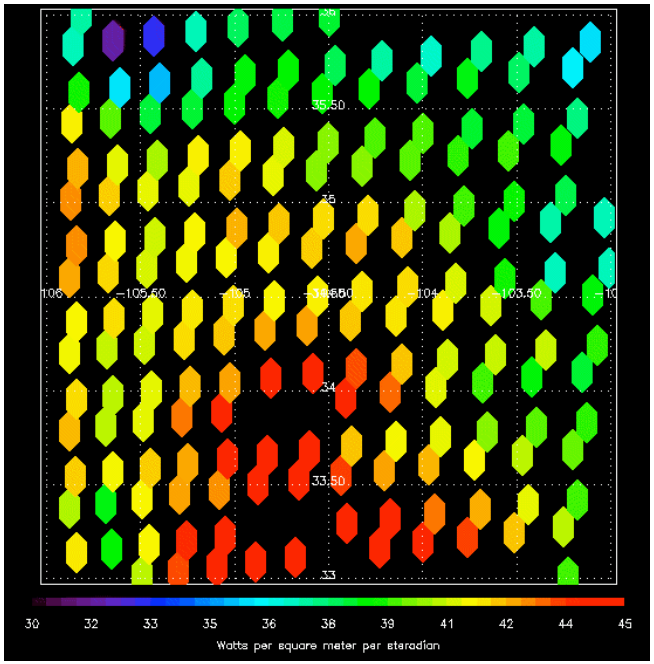
5) Ocean Assimilation: Bob Weller (Woods Hole), Daily data.

6) Agriculture: Ted Wilson (TAMU-Beaumont), Jim Jones (UF), Gerritt Hoogenboom (UG), Daytime Average Irradiance.

7) Support for field campaigns: Marty Mlynczak & Dave Kratz (NASA LaRC), SSF footprint data for FIRST balloon flight of 6/7/2005.

FLASHFlux Field Mission Support: FIRST Validation with AIRS and FLASH-CERES Window Radiance Comparisons

FIRST Balloon Flight (June 7, 2005)



FLASHFlux SSF

- Four AIRS footprints very close to FIRST
- FLASH-CERES Window channel footprints close to FIRST
- FIRST Radiance at 900 cm^{-1} is 0.15 W m^{-2} sr cm^{-1}
  - Corresponds to a skin temperature of 317.7 K
  - Air temperature at Ft. Sumner ~ 90 F or 305 K
- AIRS skin temperature closest to FIRST is 318.5 K
- CERES Window Channel (844 to 1227 cm^{-1})
  - FLASH-CERES measured radiance is 41.66 W m^2 sr^{-1} closest to FIRST
  - Computed radiance using ABQ sonde, 318 K skin Temp is 41.83 W m^2 sr^{-1}
  - Computed radiance for 297 K skin temp is 30.76 W m^{-2} sr^{-1}

Conclude that within 1 K both FLASH-CERES and AIRS support FIRST skin temperature, and hence, absolute calibration of the FIRST instrument

FLASHFlux Status

- FLASHFlux SSF
  - Operational; global fluxes at a footprint level within 4 days
  - Validation using 4 Mid-seasonal months (10/04, 1/05, 4/05, 7/05) showed results that were comparable to the CERES-SOFA results
  - SSF fluxes being provided to S'Cool and CLOUDSAT
- FLASHFlux TISA fluxes
  - Operational; global gridded fluxes are available within 5 days and time interpolated fluxes are available within 6 days
  - Global Terra & Aqua data fluxes gridded to 1° x 1°
  - Test month (4/04) processed for comparison between FLASH and CERES TISA results, operational results available 6/06 forward
- FLASHFlux Output Products
  - Customized data sets are being formulated for individual users
  - Scientific studies of variability are being developed
- FLASHFlux Future
  - Process with improved GEOS-5 and MODIS-5 data products
  - Include Gridded Geostationary data to improve temporal sampling
  - Improve resolution of gridded fluxes to ½° x ½°

Final Thoughts

- FLASHFlux derives surface fluxes for scientific purposes (seasonal predictions) and applied uses (agriculture and energy), thereby filling the gap between measurements of weather phenomena and production of climate data.
- FLASHFlux intends to process only the CERES crosstrack data.
- FLASHFlux processes CERES and MODIS data to derive time and space interpolated surface fluxes within one week of the initial measurements.
- Because of the rapid turn-around time, FLASHFlux will have more data gaps than CERES, but does not intend to reprocess the measurements to fill these data gaps.
- FLASHFlux will implement algorithm improvements as required but does not intend to reprocessing the measurements to compensate for changes.
- FLASHFlux and CERES datasets are complementary but are not meant to be combined.