Deriving Fast Global Radiative Fluxes from CERES Measurements: The FLASHFlux Project

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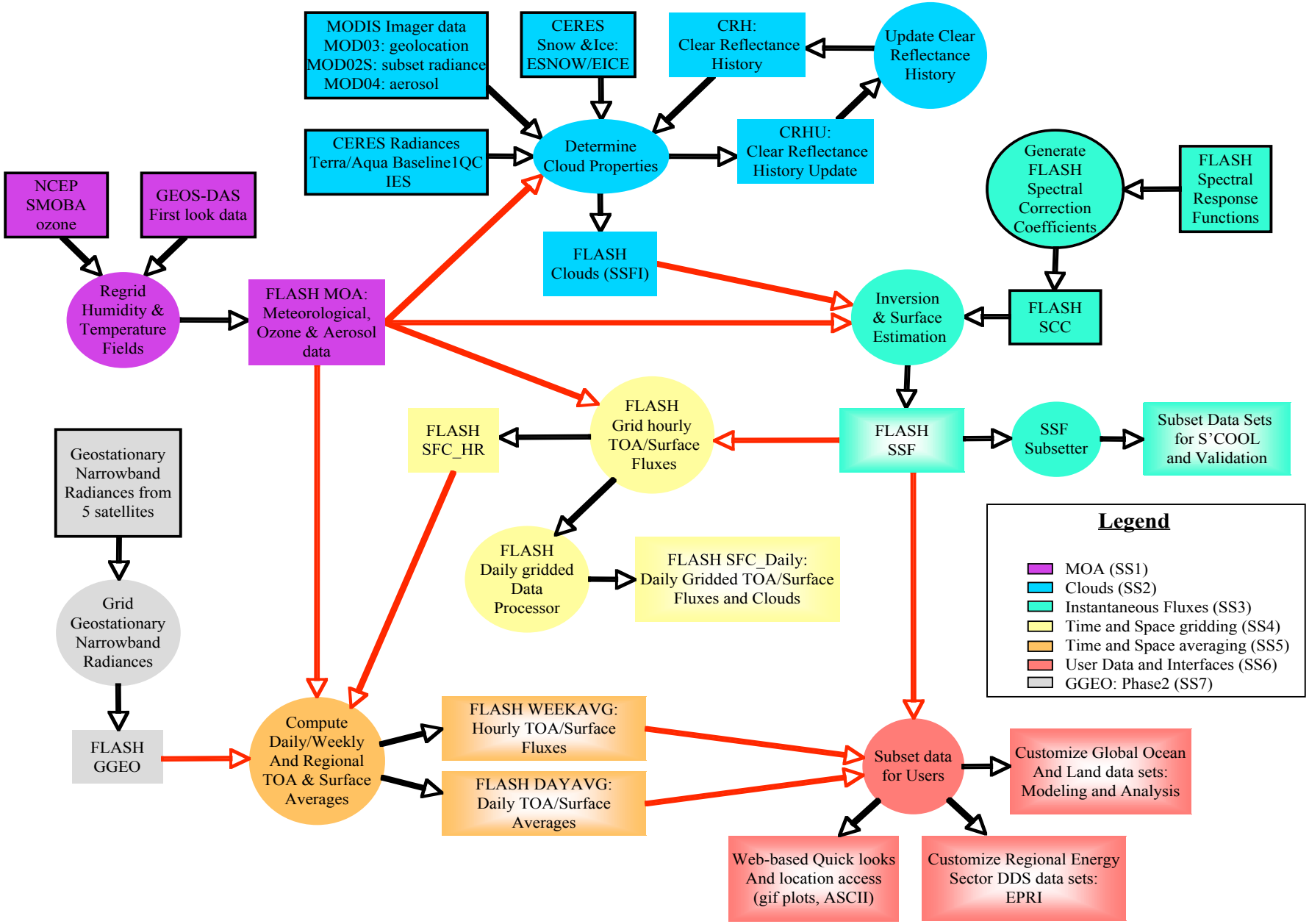
ASDC Team (Data processing)
and CERES Team

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.

FLASHFlux Processing System Overview



FLASHFlux Status: FLASH SSF

1. **Subsystems MOA, Clouds, and Inversion**
   a. MOA uses GMAO GEOS-4 First-Look, snow maps
   b. Clouds: used as delivered by CERES Terra/Aqua (MODIS 4)
   c. Inversion and surface:
      - specialized coefficients for Terra/Aqua calibration and spectral correction; most recent used
      - Includes SOFA algorithms used for surface fluxes
2. **Data Processed to date (FLASH SSF):**

   a. INTEX period August 1-15, 2004
   b. Mid-seasonal months 10/04, 1/05, 4/05, 7/05
   c. Oct. 2005 being processed in near-real time mode; available now in 4 days after overpass
3. **Validation and Assessment of FLASH SSF**
   a. Compared GEOS-4 FL and LL
   b. Global maps of SSF composite averages being evaluated
   c. Instantaneous validation against BSRN/SURFRAD/ARM surface measurements and CERES SSF products

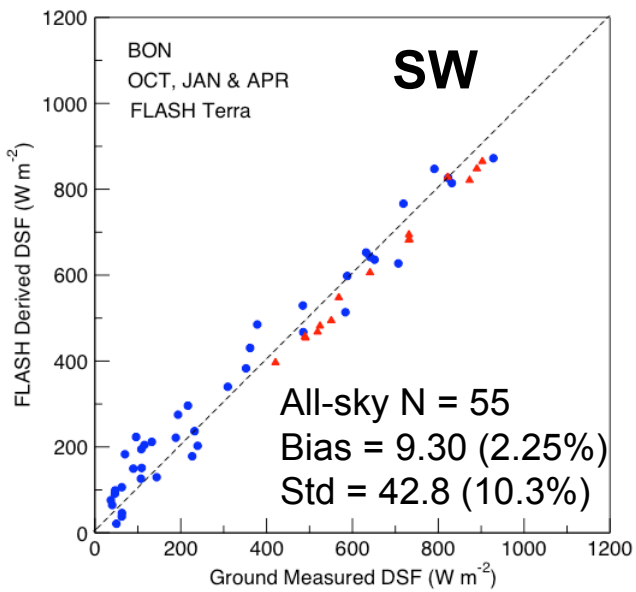
FLASHFlux SSF: Surface Flux Validation

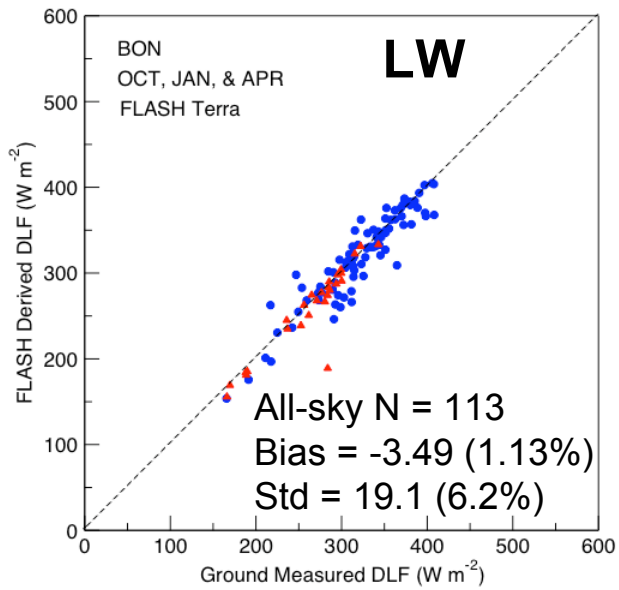
FLASH

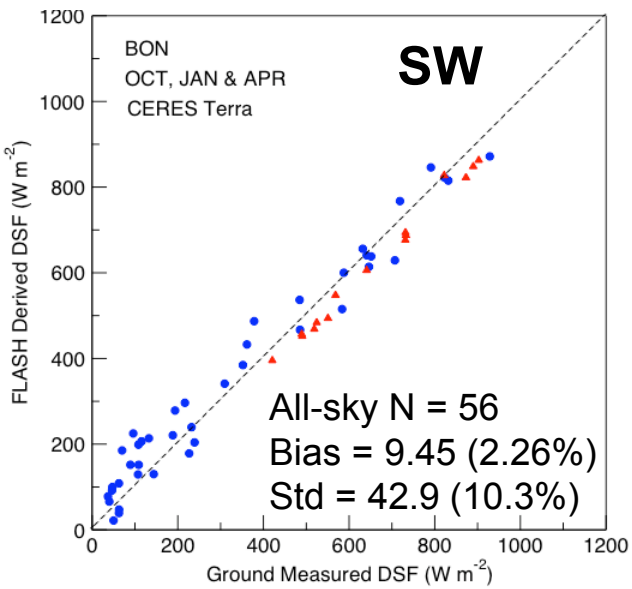
CERES

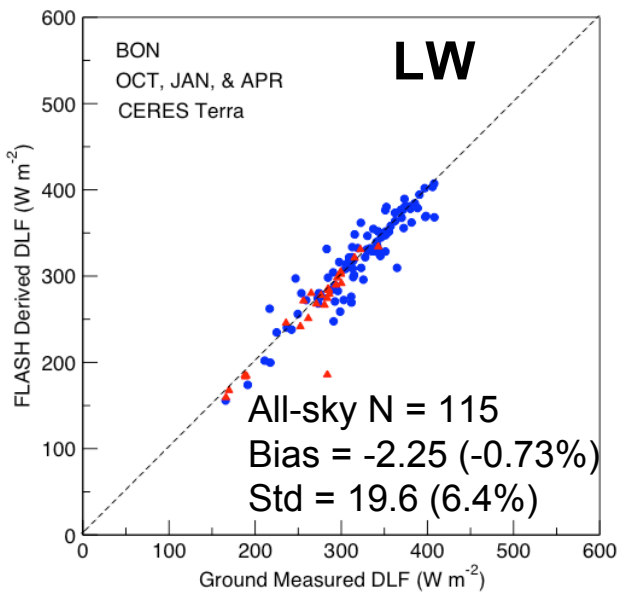
Red: Clear-sky

Blue: Cloudy-sky









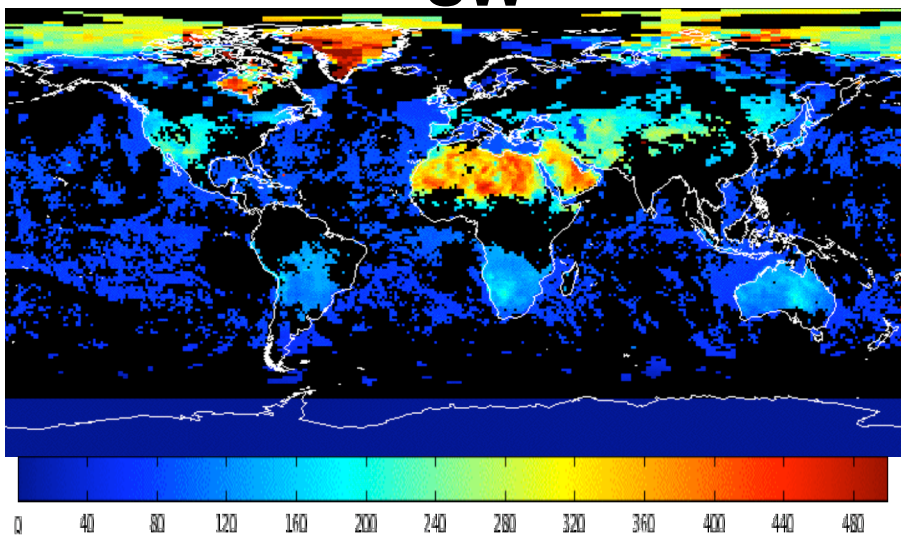
FLASHFlux Status: TISA Products

4. **Spatial Gridding Subsystem**
   a. Terra/Aqua FLASH SSF gridded to $1^o x 1^o$
   b. Capability to grid to $1/2^o x 1/2^o$ added
   c. Limited processing for testing in June 2004
5. **Temporal Interpolation Subsystem**
   a. ERBE TISA algorithms implemented with flexible processing window; 3-day being test against larger windows
   b. Terra and Aqua processed separately and together
   c. Limited processing for testing in June 2004; limited validation
   d. Main data products: hourly maps (both local and UT) and daily averaged maps
6. **Space and Time Averaged Products for Users**
   a. Designed for user needs
   b. Propose to add weekly and monthly averages; zonal and global

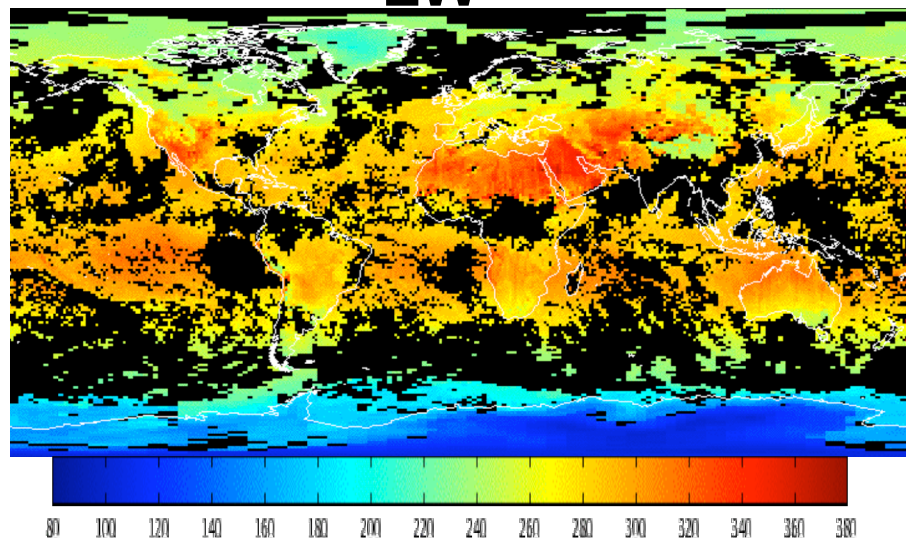
Gridded FLASH SSF: TOA Clear-Sky Fluxes

(3-day composite average, centered on June 15, 2004, Aqua FM4)

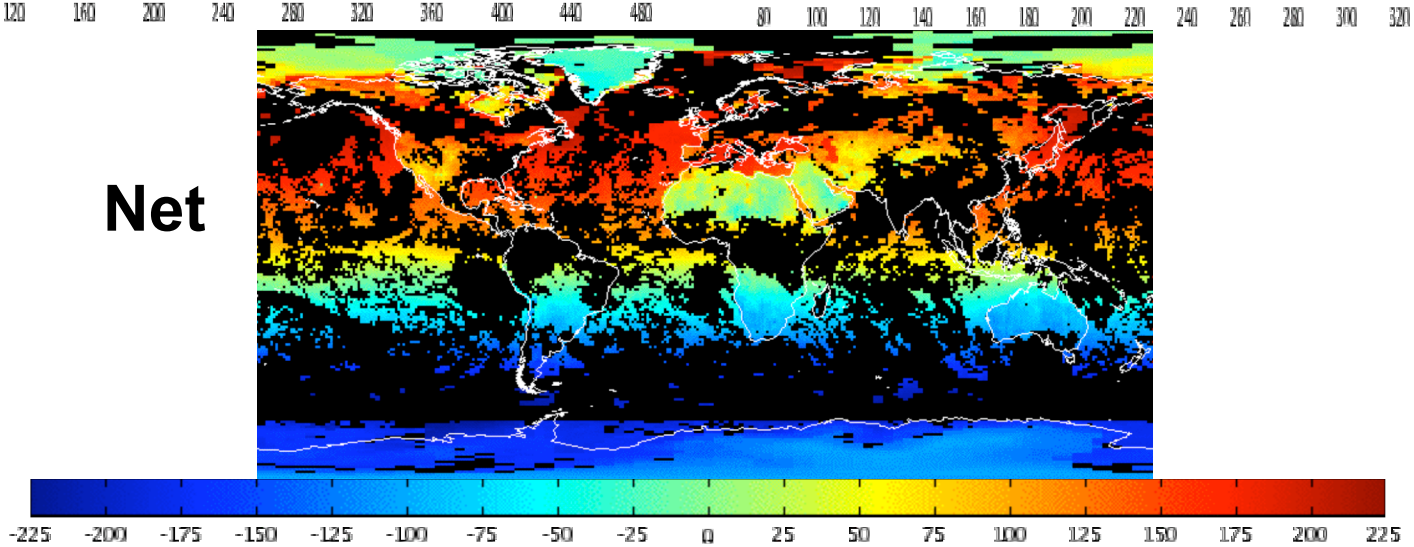
SW



LW



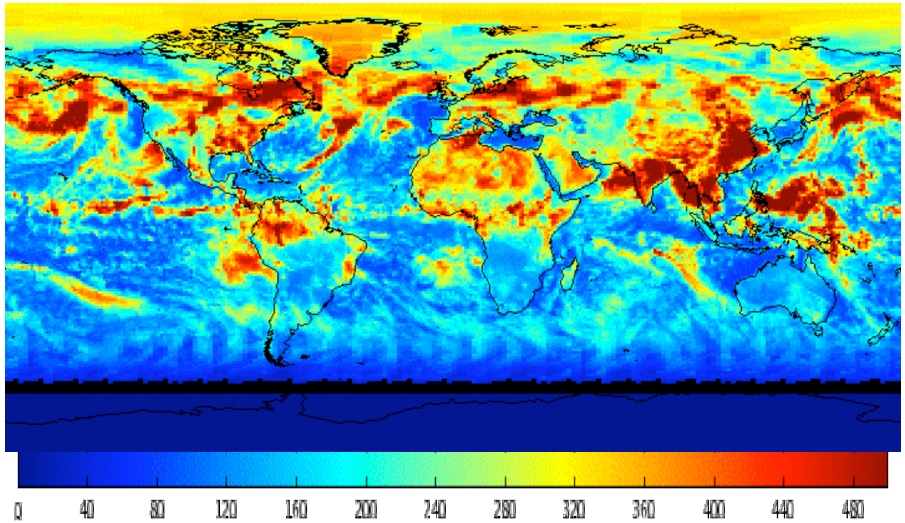
Net



Gridded FLASH SSF: TOA All-Sky Fluxes

(3-day composite average, June 14-16, 2004, Aqua FM4)

SW



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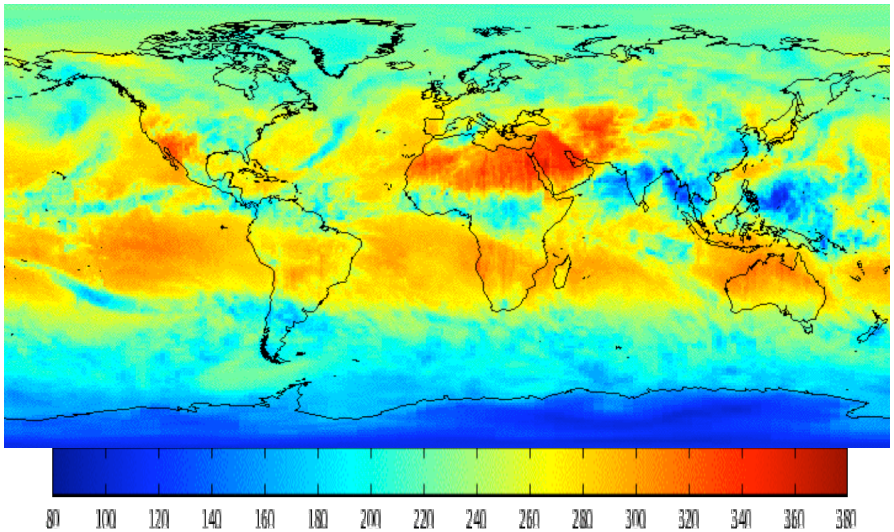

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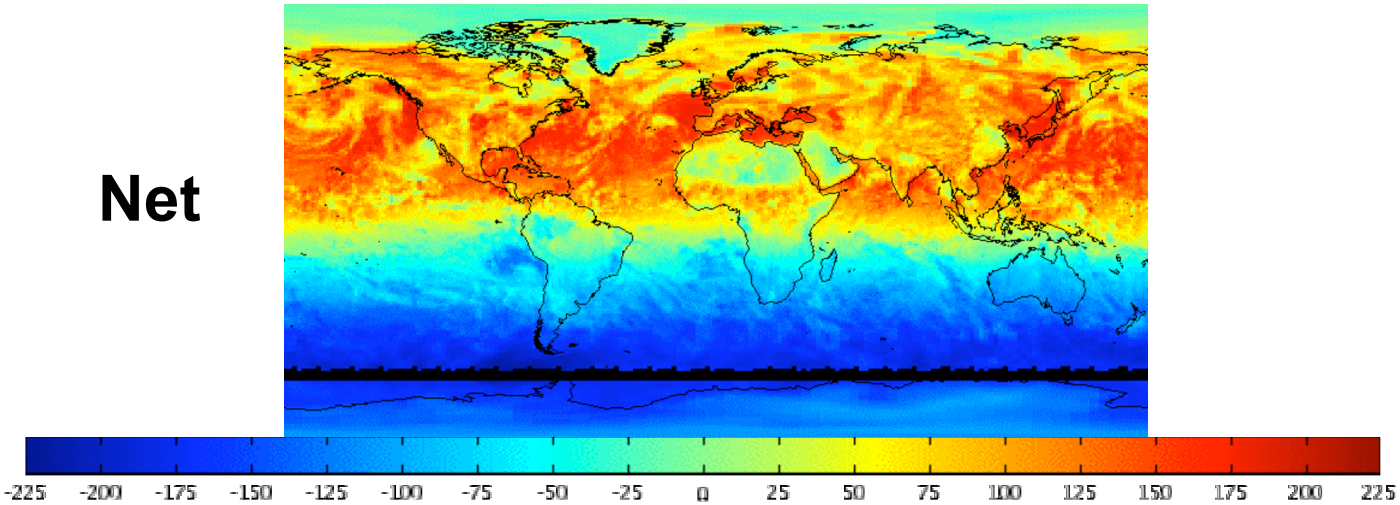
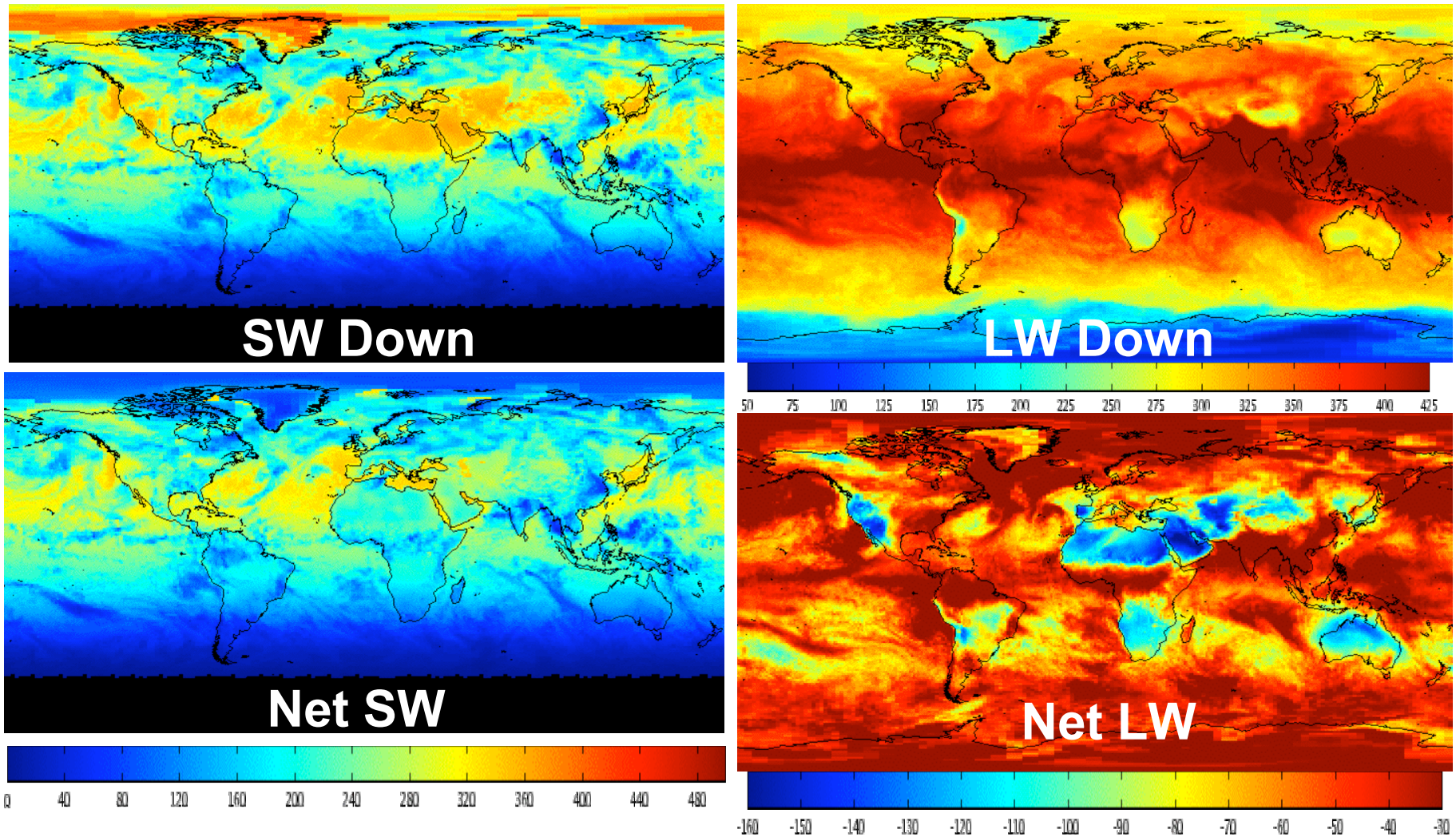


Gridded FLASH SSF: Surface All-Sky Fluxes

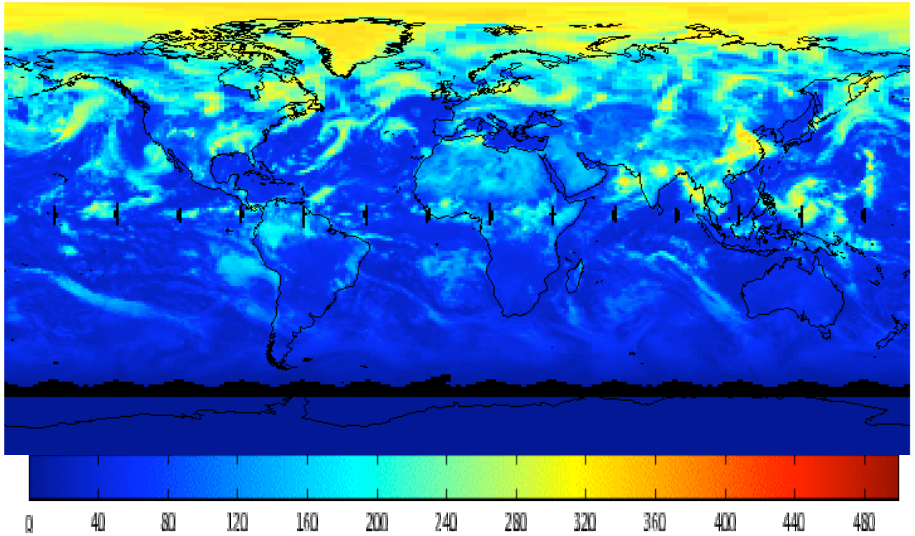
(3-day composite average, June 14-16, 2004, Aqua FM4)



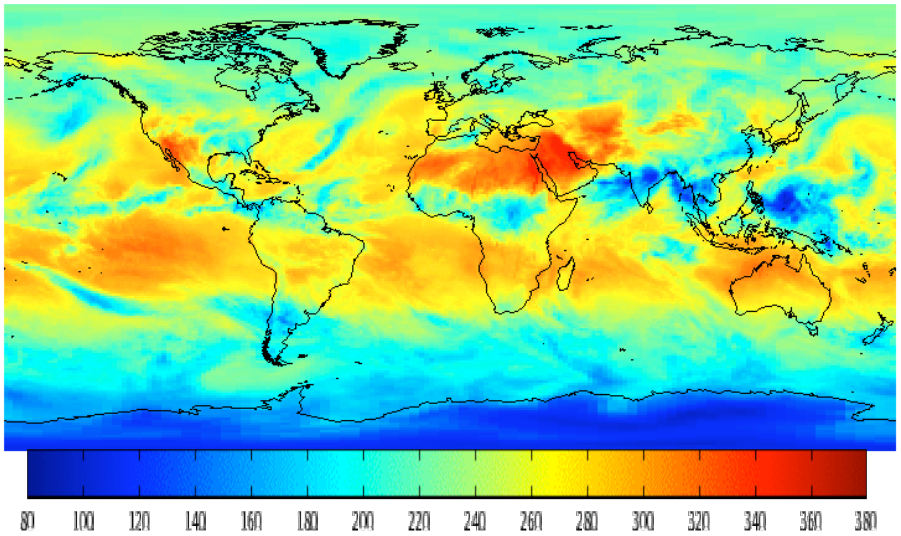
TISA FLASHFlux: TOA All-sky Fluxes

(*Daily averaged June 15, 2004, Aqua+Terra*)

SW



LW



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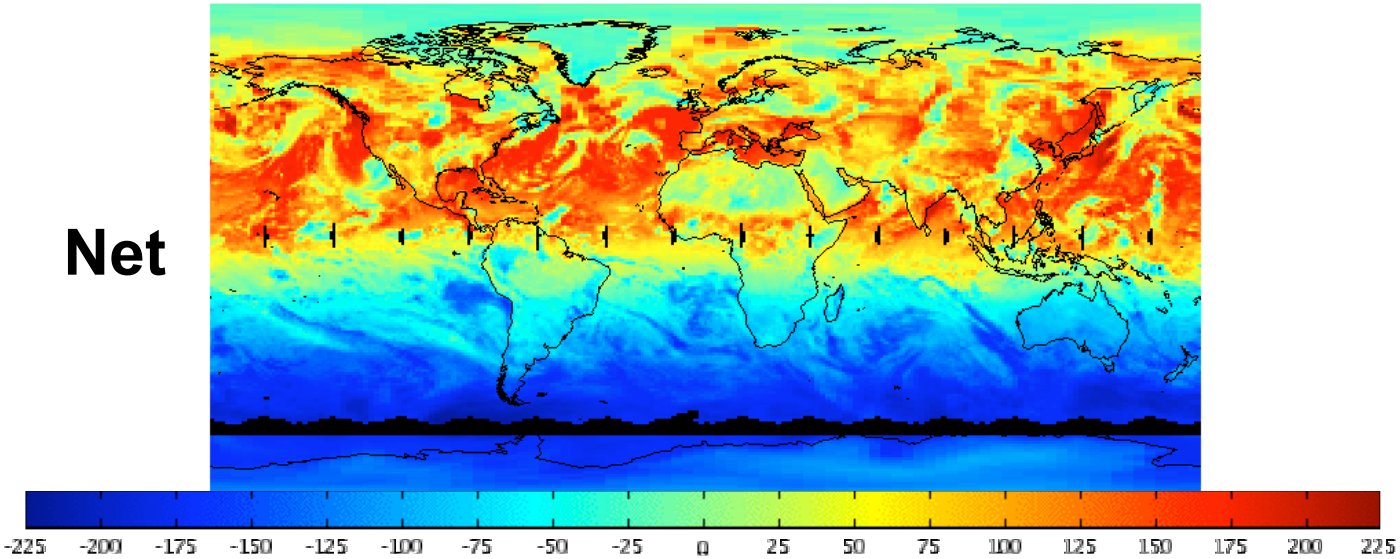
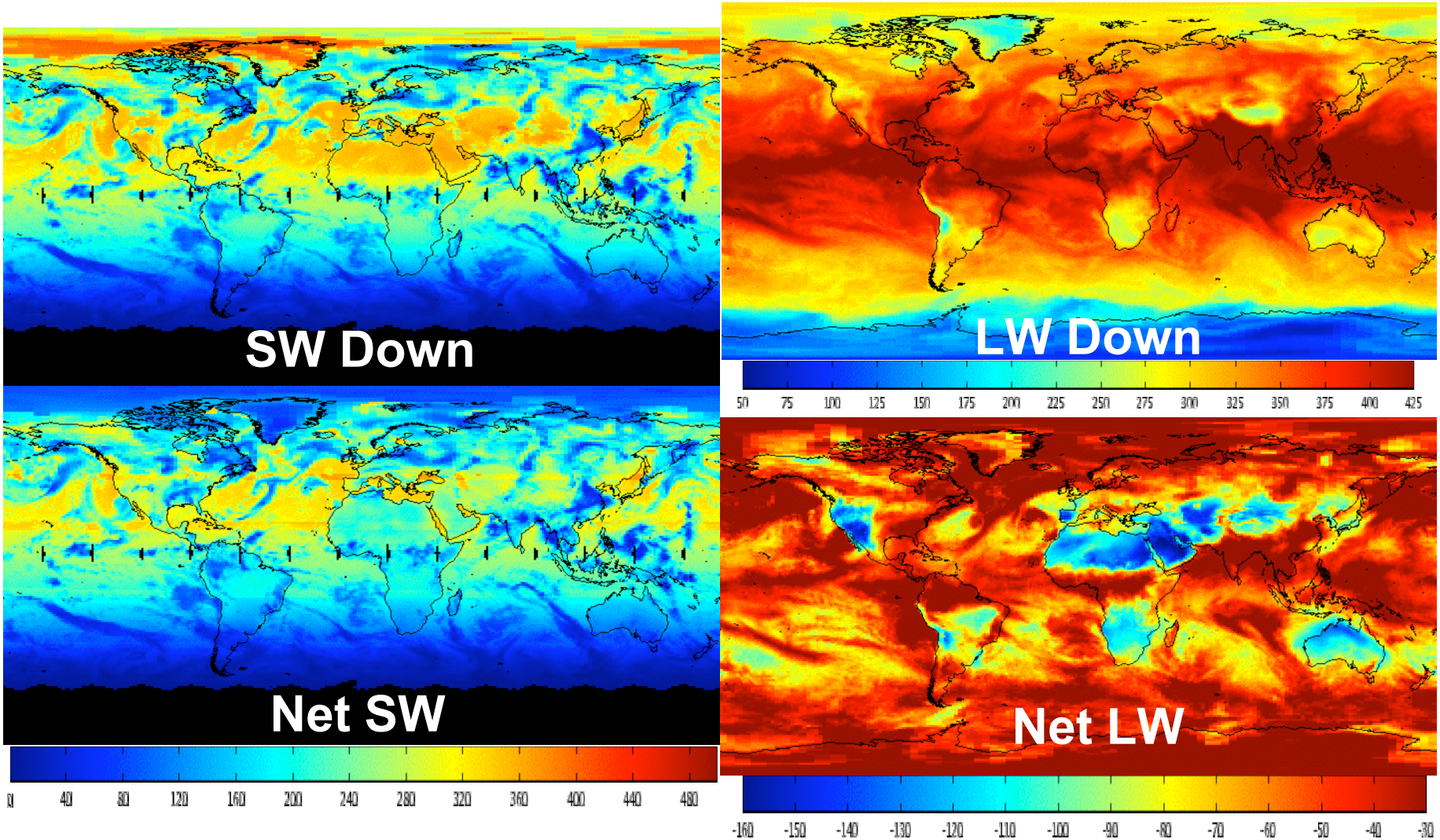
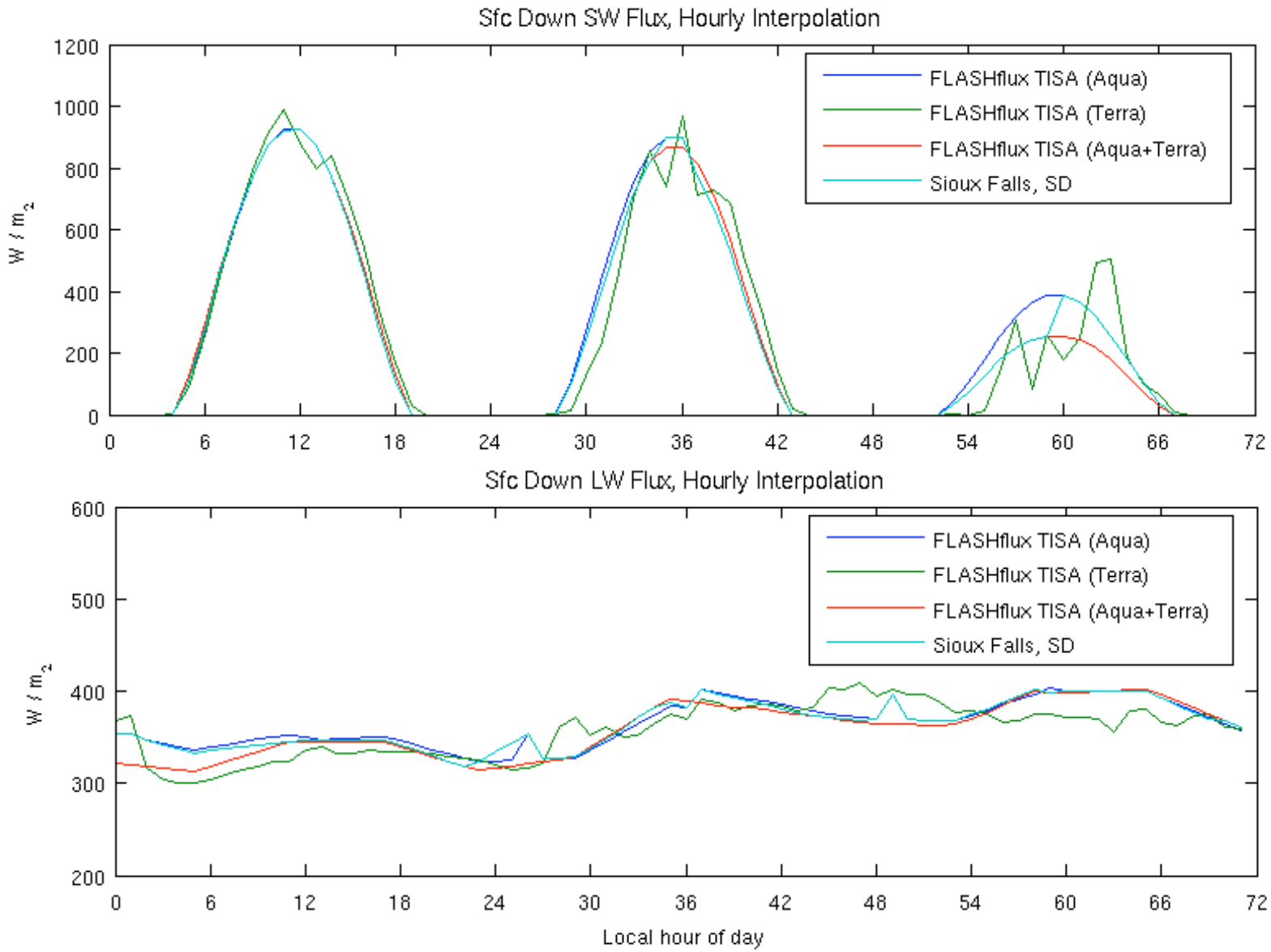


TISA FLASHFlux SSF: Surface All-Sky Fluxes

(Daily average, June 14-16, 2004, Aqua+Terra)



TISA FLASHFlux Surface Validation



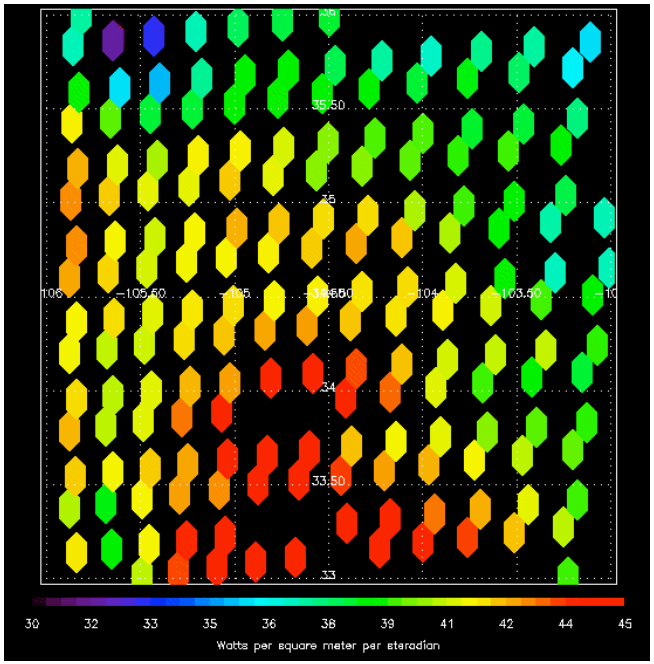
FLASHFlux Data Users

1) CLOUDSAT Operations: Graeme Stephens (CSU), SSF.
2) CERES Groups:
    a. Calibration/Spectral Correction (SSF)
    b. Clouds (SSF)
    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)

- 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



FLASHFlux SSF

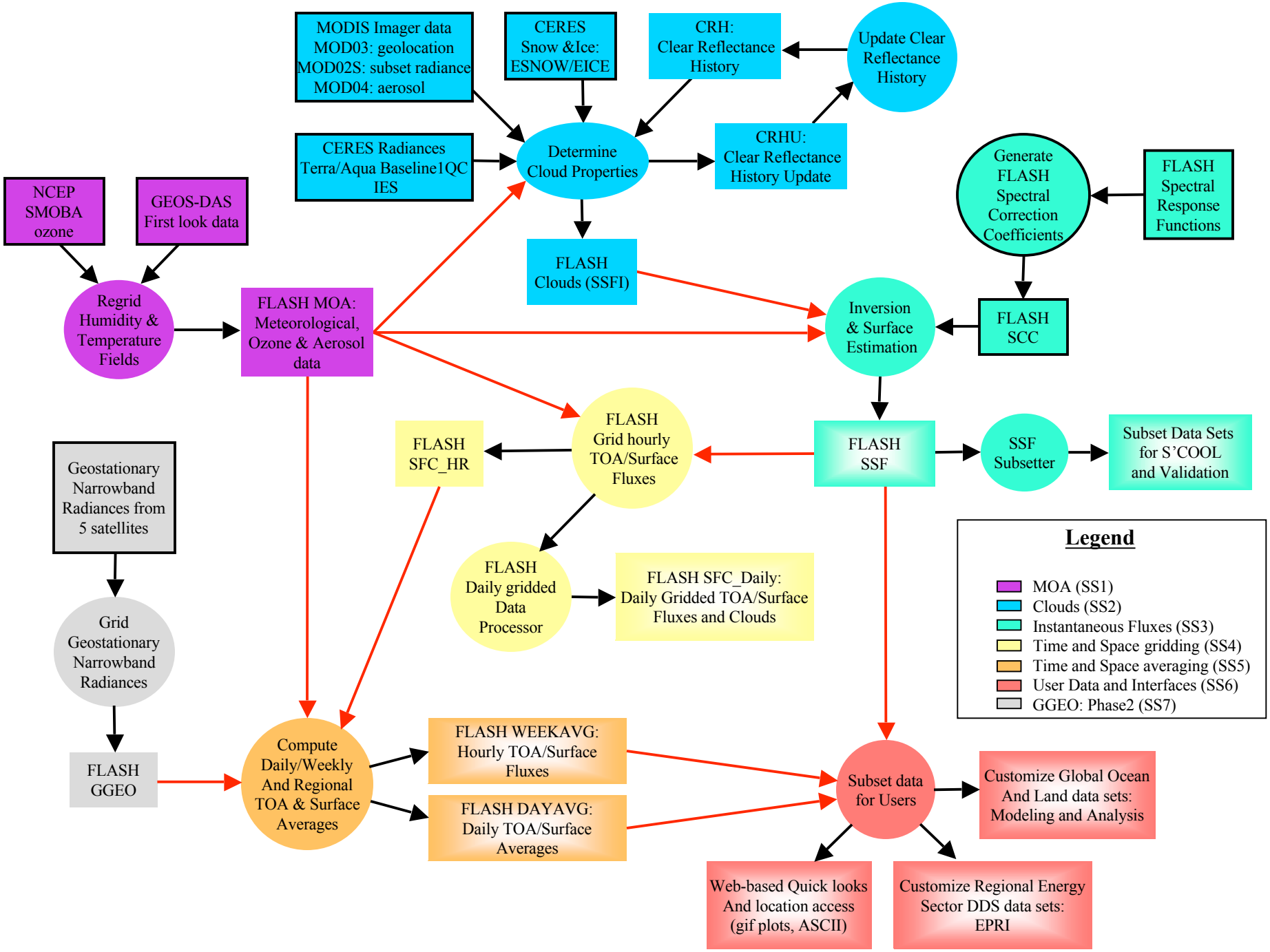
- AIRS skin temperature closest to FIRST is 318.5 K
- CERES Window Channel (844 to 1227 cm^{-1})
  - FLASH-CERES measured radiance is 41.66 W m^2 sr^{-1} closest to FIRST
  - Computed radiance using ABQ sonde, 318 K skin Temp is 41.83 W m^2 sr^{-1}
  - Computed radiance for 297 K skin temp is 30.76 W 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 Conclusions

- FLASHFlux SSF
  - Operational; global fluxes within 4 days
  - 4 Seasonal Months already processed; instantaneous validation on par with CERES-SOFA fluxes
  - Supports S'Cool and CLOUDSAT to date
- FLASHFlux TISA fluxes
  - Global gridded fluxes at 1x1 degree
  - Time Interpolation algorithms being tested and benchmarked
  - Comparison to surface observations and CERES underway
- FLASHFlux Output Products
  - Customized data sets for users being devised
  - Scientific studies of variability to be developed
- FLASHFlux Future
  - GEOS-5 and MODIS-5 to be processed
  - GEO data to be included?
  - 1/2 x 1/2 degree??

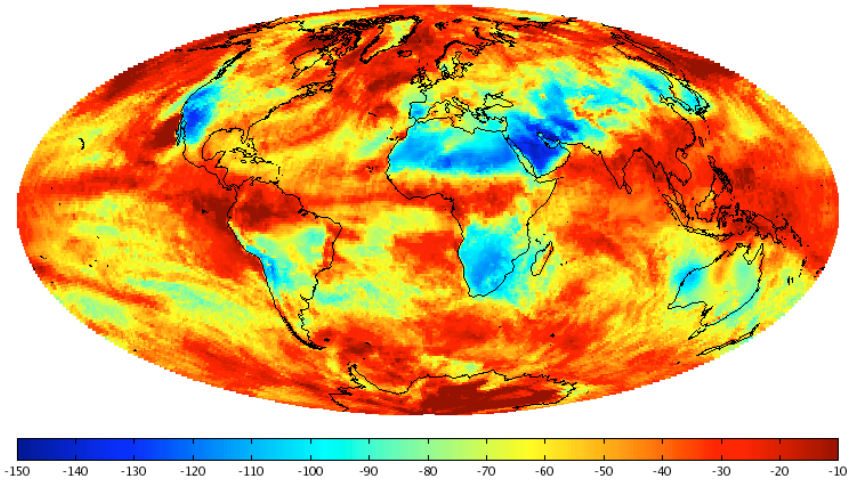
Backup slides


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
Daily/Weekly
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

Global Surface Fluxes for Near Real-Time Applications

Paul Stackhouse, David Kratz, the CERES Team and ASDC

Total-sky Surface Net LW Flux: Aqua+Terra:
(June 15, 2004)



Fast Longwave and SHortwave Radiative Fluxes (FLASHFlux) from CERES and MODIS

- Compute global surface fluxes from CERES observations within one week of measurement
- Provide near real-time surface fluxes to ocean and land assimilation teams
- Provide datasets to CALIPSO and CloudSat
- Use datasets for scientific evaluation of seasonal variability of climate parameters
- Provide datasets to energy sector applications project POWER including agriculture

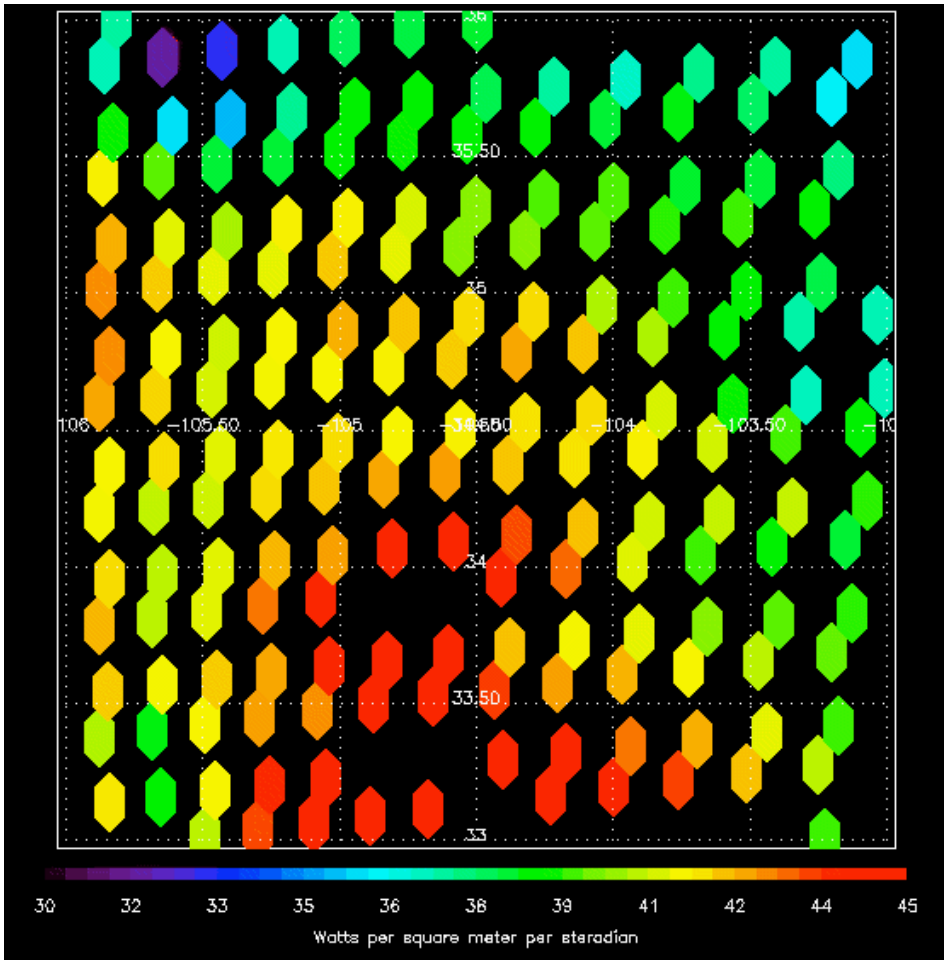
Issues and Requirements

- Provide data products within one week of observation for land/ocean assimilation and agricultural use
- Design system to incorporate future processing upgrades (e.g., higher resolution reanalysis, geosynchronous data)
- Design the processing system to be transitioned to operational status

Future Results

- Prototype operational system for production of near real-time surface and atmospheric fluxes for scientific (seasonal prediction) and applied uses (agriculture and energy
- Method transferable to NPP, NPOESS
- Satisfies USGEO and GEOSS targets for development and dissemination of global environmental data

Measured FIRST and Calculated LbL Infrared Spectra



Lat 34° 29.4' N
Lon 104° 13.13' W
Time = 20:25 UT
Date = June 7, 2005

Radiances in
W m^{-2} sr^{-1} $(cm^{-1})^{-1}$
R_{CERES} = 41.66
R_{LBL} = 41.83, T = 318K
R_{LBL} = 30.76, T = 297K