Comparison of Outgoing Radiation During TC4: CERES versus Model Calculations

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GOAL

- Derive TOA, aircraft level and surface broadband fluxes from GOES and MODIS pixel-level retrieved cloud properties using the Fu-Liou radiative transfer model (RTM) as part of the NASA-Langley cloud and radiation products for the TC-4 IOP project.
- These Fu-Liou fluxes can then be validated with CERES, aircraft, ground based flux datasets
- The Fu-Liou fluxes can then be used to derive heating rate profiles and radiative closure in tropical convective systems of TC-4

Methodology

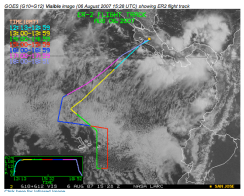
- Derive Fu-Liou RTM fluxes from CERES flashflux footprint MODIS cloud properties and GEOS-4 profiles and compare with the associated CERES broadband flux
- Apply Fu-Liou RTM to GOES (half hourly images) derived cloud properties
  - Validate with coincident CERES fluxes
- Analyze flight segments
  - Compare with aircraft level and ground fluxes
  - Assess consistency between RTM and observed fluxes - determine sources of significant differences
  - Improve cloud properties with aircraft data
    - For example ER-2 lidar for cloud tops
  - Describe profile energetics of cloud systems
    - Compute heating rates

Input to Fu-Liou RTM

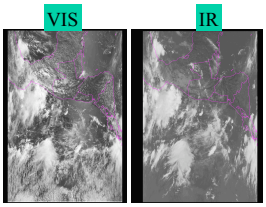
- Atmospheric profiles from GMAO GEOS-4 reanalysis
  - MODIS-land and GEOS-4-ocean skin temperatures
- MODIS (1-km) cloud property retrievals
  - Flashflux CERES SSF footprint averaged (20km nominal) cloud properties
    - Flashflux is near real-time CERES product not the official product but employs nearly the same algorithm
  - MODIS and MATCH AOTs
  - SMOBA Ozone
  - IGBP type surface albedo and emissivity
- For the GOES analysis, use GOES cloud properties, all other inputs are the same

Preliminary Results

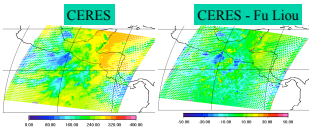
Test Case to compare with CERES fluxes
- Aug 6, 2008 at 16:40 GMT, a flight day
- Terra-CERES flashflux SSF 5 minute granule



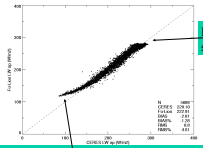
MODIS imagery



TOA LW



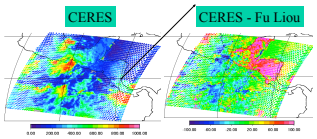
Comparison of CERES and Fu-Liou TOA LW fluxes



Limited by GEOS-4 skin temperature

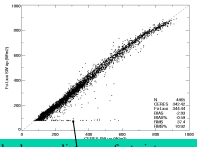
- GEOS-4 tropopause height is not as cold as what the CERES Fluxes would predict - overshooting tops?

TOA SW



- Need to get accurate land surface albedos

Comparison of CERES and Fu-Liou TOA SW fluxes



- Plotted only non-glint ocean footprints
- difficult to resolve cloud properties in glint regions

Summary of Fu-Liou and CERES flux comparison

CERES- Fu	Bias (Wm-2)	Bias (%)	RMS (Wm-2)	RMS (%)
SW	-2.0	-0.6	37.4	10.9
LW	-2.8	-1.3	8.8	4.0

- Biases are within 1.5%
- RMS error is 11% and 4% for SW and LW respectively
- Improve LW by improving cloud top and skin temperatures
- Improve SW by improving land surface albedo

Future Plans

- Analyze all CERES footprint fluxes with Fu-Liou RMT fluxes coincident with TC-4 aircraft flights
- Apply Fu-Liou algorithm with GOES derived cloud characteristics
  - Half hourly images covering the 4 weeks during TC-4
- Compare cloud retrievals and fluxes with aircraft and improve discrepancies
- Derive heating rates and assess flux closure for TC-4 convective systems