GERB LW radiance-to-flux conversion

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Content:

- Description of the unfiltered thermal radiance,
- Radiance-to-flux models: *Non-spectral* and *spectral*,
- Note on the *Spectral Model*,
- Comparison of these models wrt CERES-TRMM LW ADMs,
- Note on the azimuthal anisotropy,
- *GERB-like* versus *CER_SSF_TRMM-PFM-VIRS_Edition2A* fluxes.

Input : Unfiltered Thermal Radiance

Basically, L is derived from SEVIRI (NB-to-BB process) and "renormalized" using the GERB LW measurement.

- Footprints $=$ boxes of 3 by 3 SEVIRI pixels,
- Footprint size similar to TRMM: 10.6 km * 10.6 km at sub-satellite point, increases with θ.
- PSF: $+/$- constant within the footprint,
- Timing : each 15', local time from 0 to 24h
- For each footprint : constant geolocation (rectified grid), constant viewing zenith and viewing azimuth angles.

RMIB Models

1. Non-spectral model:

$$R = R(\theta, L_{th}) \; = \; c_0(\theta) \; + \; c_1(\theta)\, L$$

2. Spectral model:

$$R = R(\theta, L_{th}, L_{6.2\mu}, L_{7.3\mu}, L_{8.8\mu}, L_{9.7\mu}, L_{10.8\mu}, L_{12\mu}, L_{13.4\mu})$$

To date: all models parameterized using the SBDART radiative transfer model (plane-parallel).

Current status : use the non-spectral model for *GERB-like* data generation using Meteosat-[5,7] and the spectral model once SEVIRI data available.

Note on the Spectral Model

Paper submitted to RSE*: "Estimation of TOA Broadband Flux Errors Using a Coupled Radiometer-Imager. Part II: Longwave Radiation"*, December 2001.

Analysis of the exploitation of the correlation between angular and spectral behavior of the LW radiation field at the TOA to improve the radiance-to-flux conversion.

Conclusions (for plane-parallel system):

- The use of SEVIRI spectral signature allows to reduce the angular conversion error (for nadir view) for about 50% (spectral model *wrt* Non-spectral model). Same improvement using MODIS channels.
- If the entire thermal spectrum $L(\lambda)$ is known: error reduction of about 66%.
- No specific improvement for the cirrus clouds.

Comparison Non-spectral model wrt CERES-TRMM ADMs

Bias of about 2% on R for nadir view and clear sky scenes (see graph).

Suspected reasons:

1. SBDART generates too anisotropy TOA radiance fields,
2. As input, we use too large difference of temperature between the surface and the atmosphere.

As the MODTRAN anisotropy is closer to the observations, we will use it in models parameterization. See graph SBDART/MODTRAN.

Note on the Azimuthal anisotropy

Problem: GERB observes the target "from the South" in the Northern hemisphere and "from the North" in the Southern. -> possible overestimation of the flux using ADMs with are not dependent on the azimuth.

Preliminary investigation

Based on 78 days of CER_ES8_Terra-FM1_Edition1 data in RAPS mode (Aug.-Sept.-Oct. 2001). Local time 10h30'.

-> zonal and regional difference of the averaged WIN and LW radiances between "North" and "South" views (graphs).

Plan (future activity):

1. Quantify the azimuthal anisotropy according to: geotype, topography, cloud cover, local time and viewing zenith angle,

2. Quantify the error (instantaneous and bias) introduced on the GERB LW flux,

3. If needed: design of a correction method for the GERB LW flux.

GERB-like versus CER_SSF_TRMM-PFM-VIRS_Edition2A Fluxes

Goal : to analyze the systematic error introduced during the radiance-to-flux conversion according to the CERES and Meteosat viewing zenith angle (see Steven presentation).

Data description:

- 53 hours of RAPS data during July and August 1998,
- *GERB-like* fluxes from Meteosat-7 and Meteosat-5 (Indian ocean)
- Non-spectral model used for the radiance-to-flux conversion: $R = R(\theta, L)$
- Colocation of the CERES footprints in the MS-[5,7] FOV -> scatter plots (see graphs). Number of colocated footprints: 3.1 Million (MS7) and 2.5 Million (MS5).