Composite TOA clearsky solar fluxes for the GERB processing

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Overview

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Motivations

- Comparisons with GCMs output
- Surface albedos through inversion
- Estimation of cloud radiative forcing
- Diurnal cycle of clouds
- Monitoring for decadal changes

- ▶ Instantaneous L20 clear–sky solar fluxes
- ▶ Time–averaged L30 clear–sky solar fluxes

Literature

Futyan & Russel (2005) developped a clear–sky scheme to be applied to ARG, BARG (50 km):

- Use of sceneID & MPEF cloud mask to detect clear GERB footprints
- HR (10 km) GERB, sceneID & MPEF cloud mask used to estimate clear–sky fluxes within partially cloudy ARG, BARG footprints

▶ Instantaneous L20 clear–sky solar fluxes unavailable over regions with persistent cloudiness

Dataset

- V003 L20 GERB products (baseline for ED01):
  - without data in sunglint (to be filled soon)
  - large gaps in sun avoidance seasons
  - corrected with GERB measurements
- ▶ V003 L20 GERB–*like* products:
  - less accurate: only relying on NB–to–BB
  - higher availability
  - sunglint estimates, even if inaccurate
- Development on HR format: native GERB processing resolution (10 km) → ARG & BARG
- Use of sceneID information within the products

Limitations

V003 L20 products:

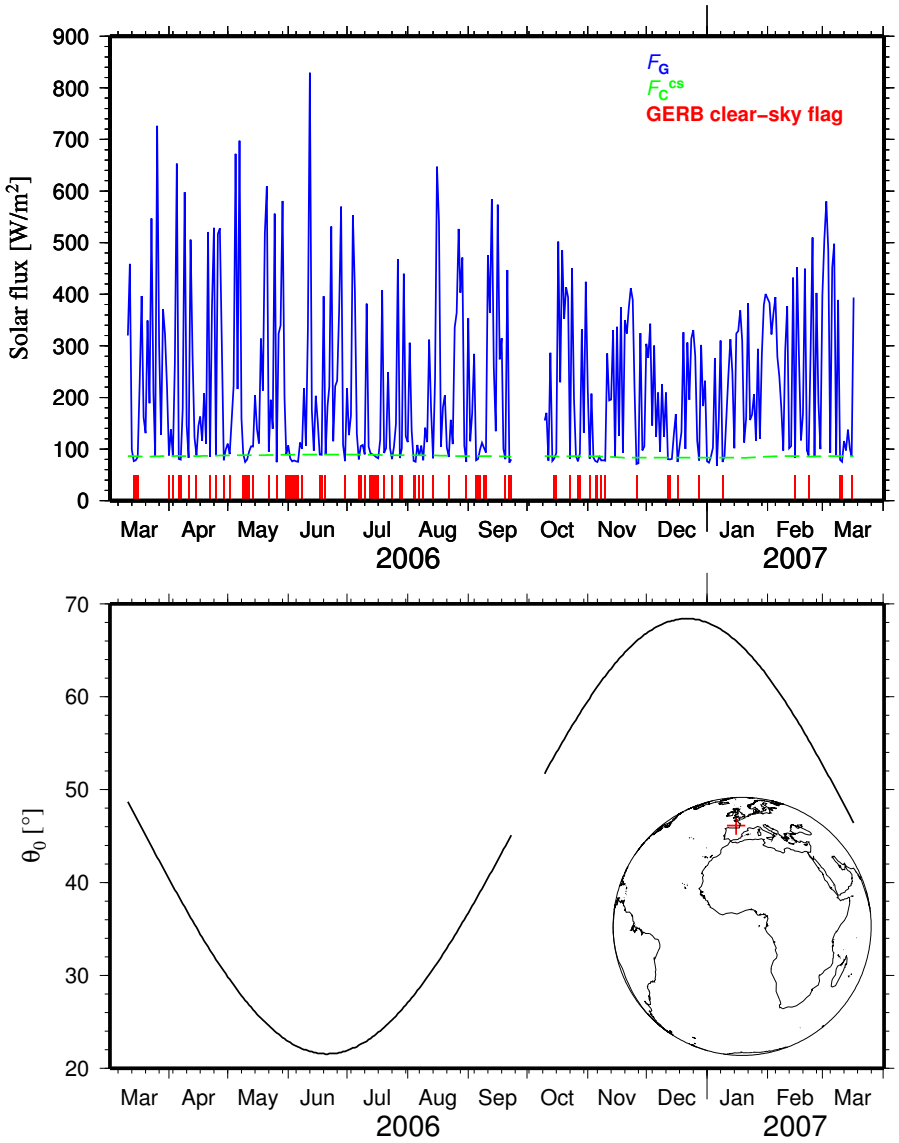
- No fresh snow detection in SEVIRI sceneID
- No snow ADMs for static snow/sea–ice covers

Scheme

Similar to sceneID for clear–sky reflectances:

- Time–series of fluxes F_G at given time of day t and location (x, y) upto Δ previous days
- Assuming clear–sky fluxes is base–curve and additive transient contribution (clouds, aerosols, dust, ...)
- Slow solar zenith angle θ_0 dependency of clear–sky fluxes according to CERES TRMM SW clear–sky ADMs
  $\alpha(x, y, d, t) = \frac{F_G(x,y,d,t)}{F_C^{cs}(x,y,d,t)}$ for $d = d^\star - \Delta, \ldots, d^\star$
- Use of sceneID information $\longrightarrow \{\alpha_i^{cs} = \alpha(d')\}$
- Select $\tilde{\alpha}^{cs}$ to estimate $F_G^{cs}(d^\star) = \tilde{\alpha}^{cs} \cdot F_C^{cs}(d^\star)$

Scheme



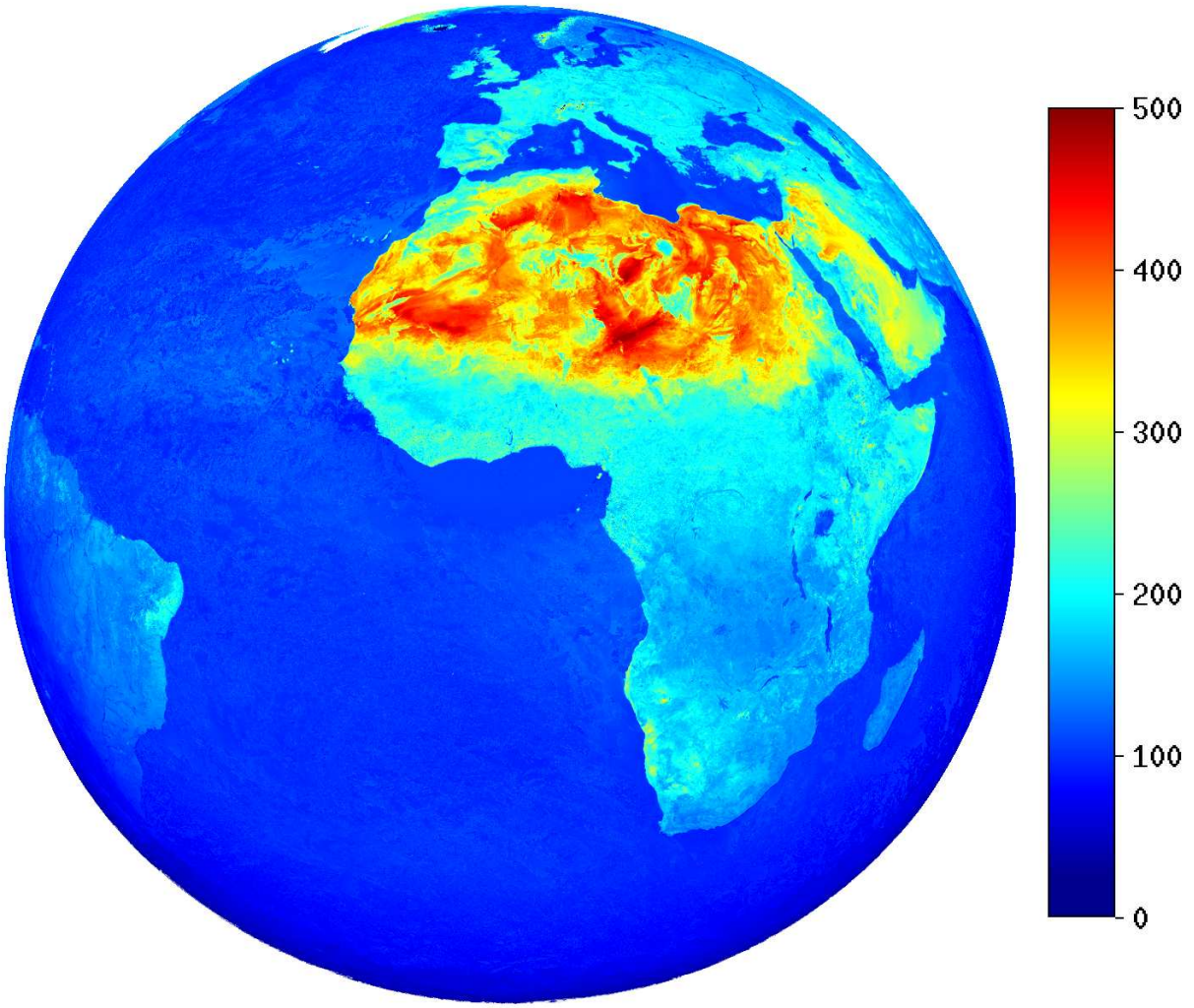
Scheme

Selection of $\tilde{\alpha}^{cs}$ within $\{\alpha_i^{cs}\}$

- SEVIRI sceneID:
  - cloud–conservative cloud mask
  - cloud fraction
  - ocean dust flag
  - ~~MPEF cloud mask~~ (updates)
- Flagged clear–sky contains spurious:
  - thin clouds (over ocean & land)
  - aerosols and dust (only over land)

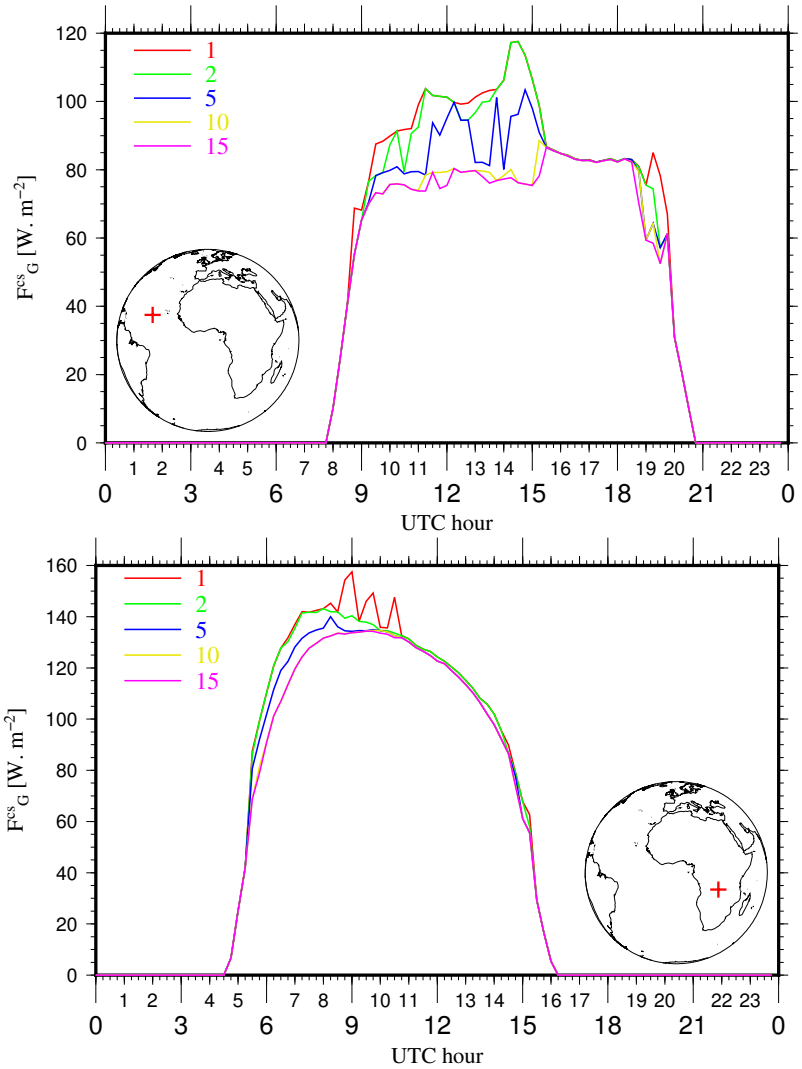
▶ $\tilde{\alpha}^{cs} = \min_{i=1,\ldots,n_{cs}} \{\alpha_i^{cs}\}$ with $n_{cs} = \{1, 2, 5, 10, 15, 20\}$ and $\Delta = 120$ days

Results



GERB–*like* fluxes F_G^{cs} $[W \cdot m^{-2}]$ for July 15 2010 at 12:00 UTC ($n_{cs} = 1$)

Results



GERB–*like* fluxes for July 15 2010 and various n_{cs}

- Thin clouds, aerosols & dust contamination on clear–sky fluxes
- Mitigation by selecting adequate n_{cs}
- ▶ Strategy for selecting $n_{cs}(x, y)$

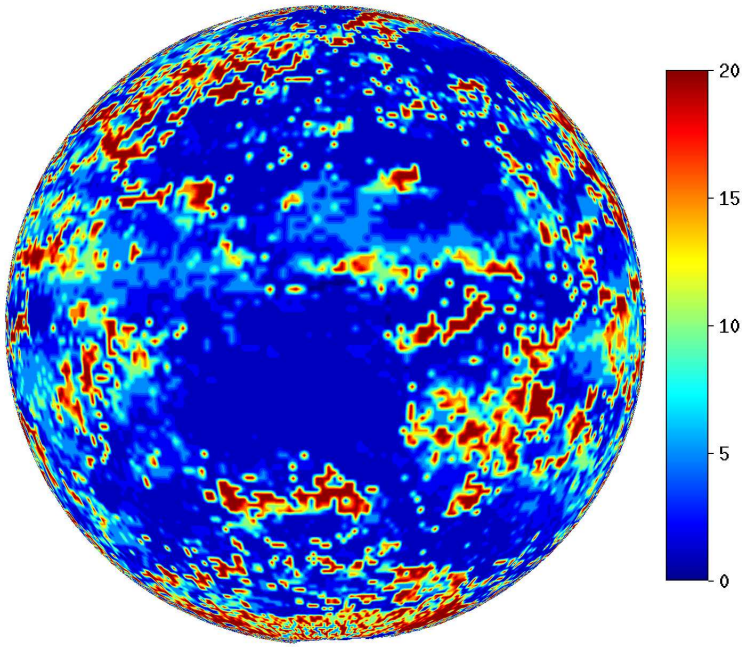
Datasets

- GERB–*like* L20 HR V003 products:
  - Solar clear–sky flux products computed for 2010 and $n_{cs} = \{1, 2, 5, 10, 15, 20\}$
  - Computation of associated monthly means
- CERES EBAF TOA solar monthly clear–sky fluxes for 2010 (Ed2.6r)

Scheme

For each pixel (x, y):

- we compute a "normalized" annual cycle from monthly means $F^{cs}_{...}(t)$ as $\frac{F^{cs}_{...}(t) - \langle F^{cs}_{...}(t) \rangle}{\sigma_{F^{cs}_{...}(t)}}$ for $\{n_{cs}\}$ and GERB & CERES
- we select n_{cs} associated to highest correlation of GERB & CERES "normalized" annual cycles



n_{cs}

Further work

- Consider another year (e.g. 2011) to check consistency of n_{cs} image
- Consider several years to build monthly climatological n_{cs} images
- Estimate clear–sky fluxes on GERB sunglint–filled products
- Compare monthly clear–sky fluxes between GERB sunglint–filled & CERES EBAF products (gaps due sun avoidance seasons ?)