

POLDER-2 and PARASOL Reflected Flux: Comparison with CERES

**Jean-Claude Buriez ⁽¹⁾, Frédéric Parol ⁽¹⁾, Zegbeu Poussi ⁽²⁾, and
Michel Viollier ⁽³⁾**

**⁽¹⁾ Laboratoire d'Optique Atmosphérique UMR CNRS 8518,
Université des Sciences et Technologies de Lille, Villeneuve d'Ascq,
France**

**⁽²⁾ ICARE CGTD, Université des Sciences et Technologies de Lille,
Villeneuve d'Ascq, France**

**⁽³⁾ Laboratoire de Météorologie Dynamique, CNRS, Ecole
Polytechnique, Palaiseau, France**

Outline

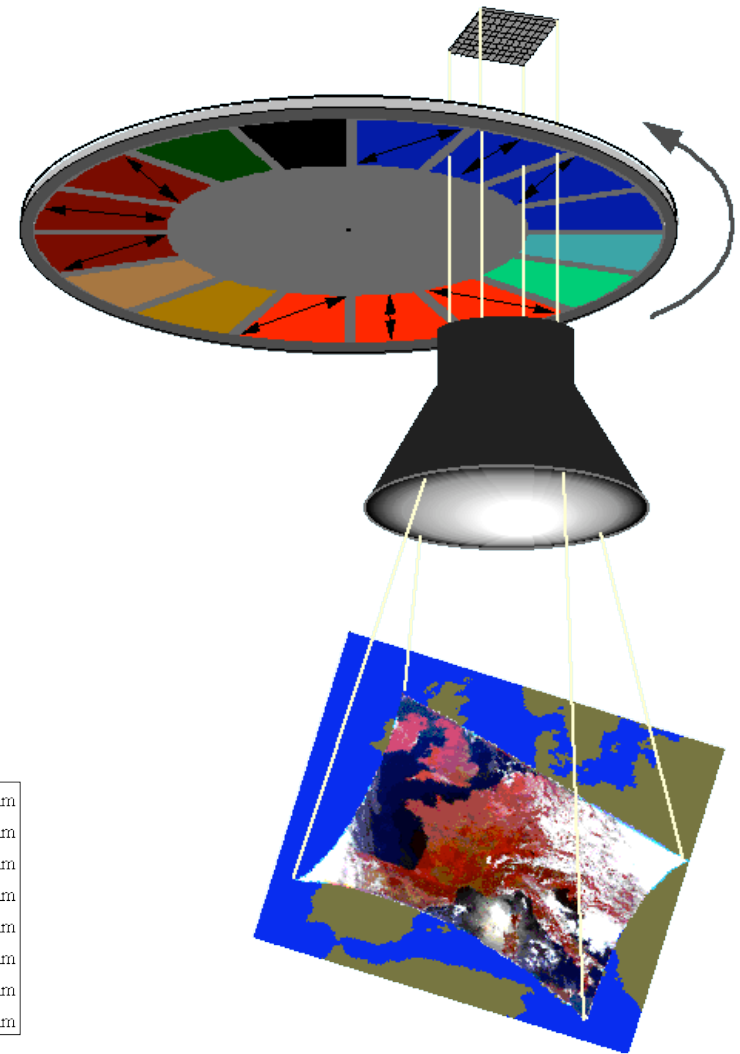
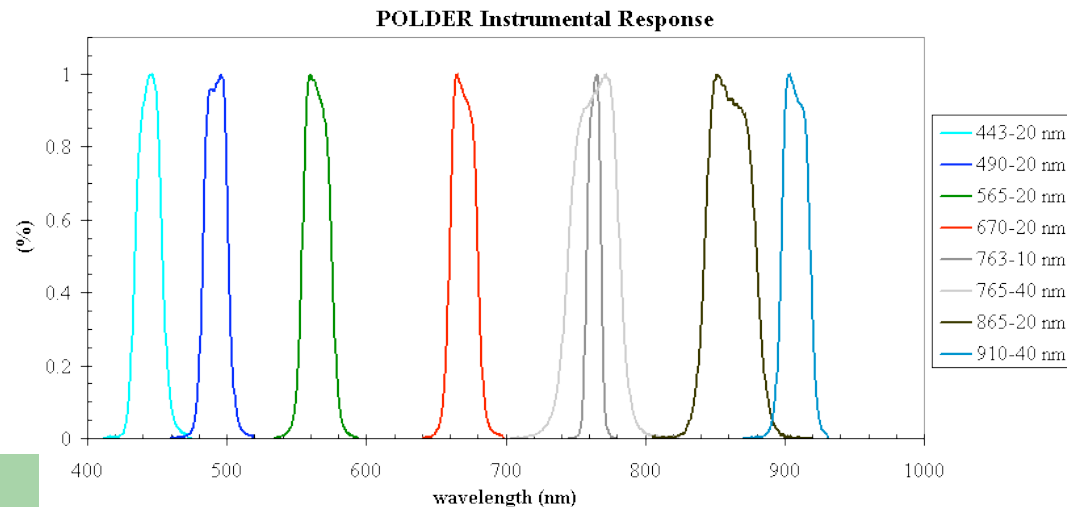
- latest comparisons between POLDER-2 and CERES-SSF instantaneous SW flux
- 22 monthly means of SW flux from POLDER/PARASOL: comparison with CERES ES4

POLDER= POLarization and Directionality of the Earth's Reflectances

<http://parasol-polder.cnes.fr/>

POLDER Characteristics

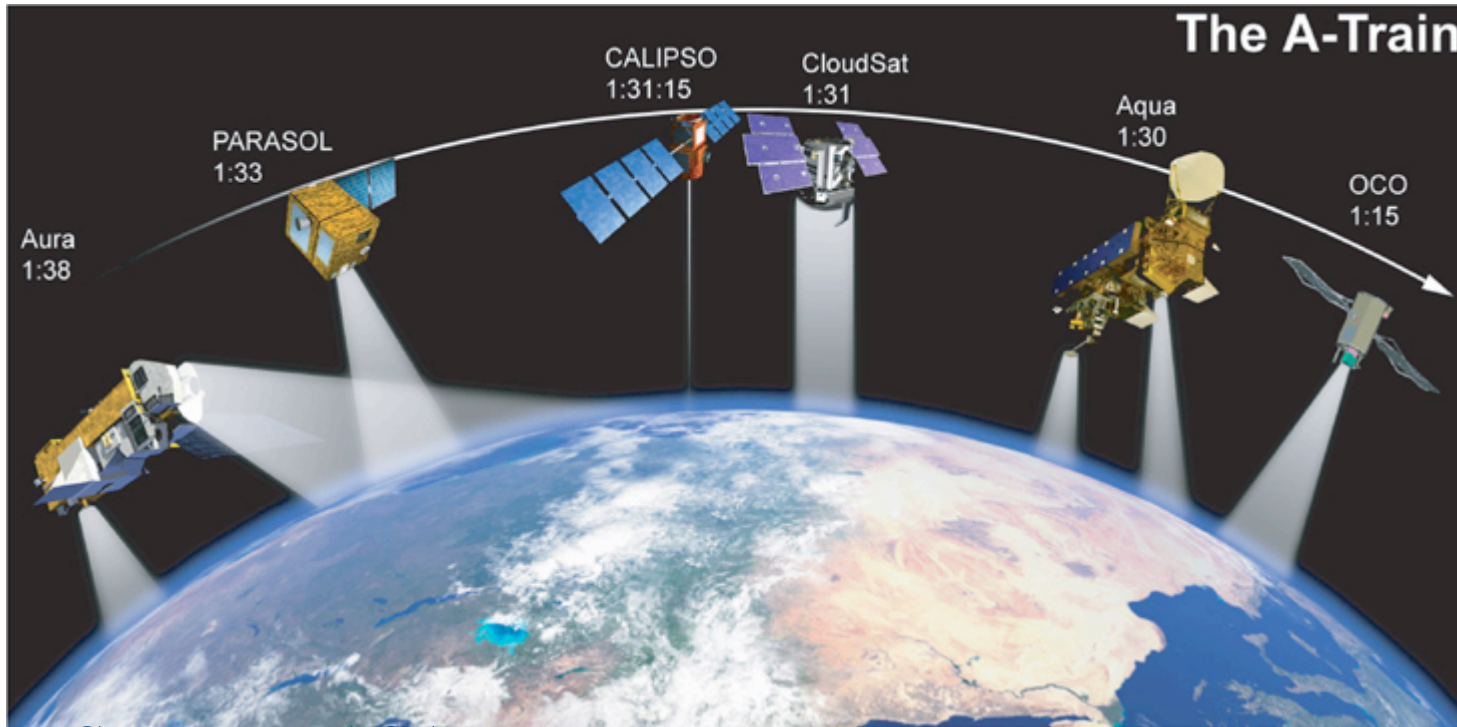
- narrow bands between 443 and 910 nm
- vicarious calibration
- 6 km resolution
- 242x288 pixel CCD matrix
- TFOV -60° to 60°
- up to 14 viewing directions



POLDER HISTORY

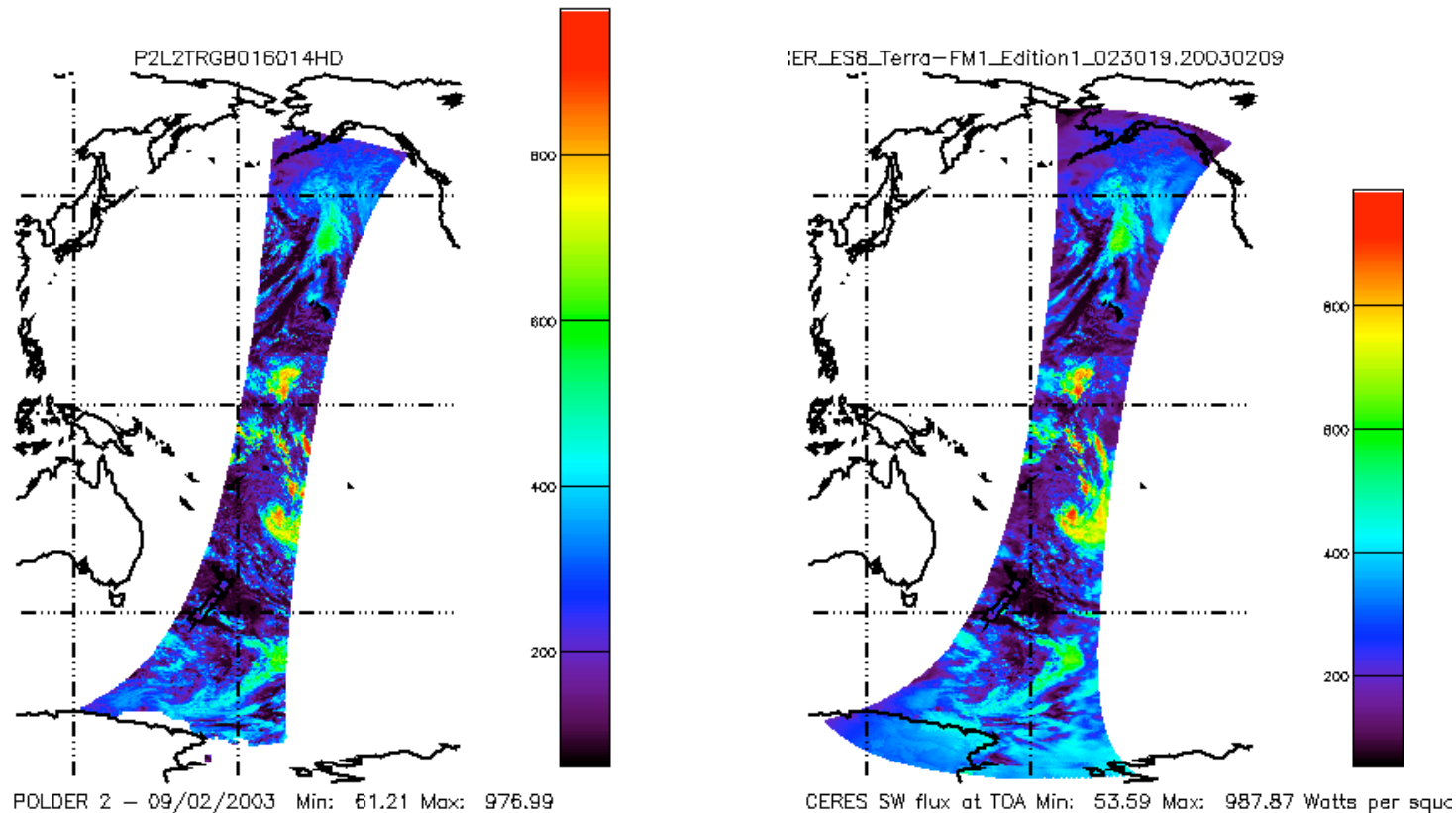
| | Operating period | Concurrent ERB |
|---------------------|----------------------|---|
| POLDER-1 ADEOS-1 | Nov 1996 Jun 1997 | WFOV-ERBS |
| POLDER-2 ADEOS-2 | Apr 2003 Oct 2003 | CERES/TERRA FM1 FM2 |
| PARASOL A-Train | Mar 2005 present | CERES/AQUA FM3 FM4 CERES/TERRA FM1 FM2 |

The A-Train



Source: NASA

almost coincident POLDER-2 CERES/Terra observations (<5 mn) for certain orbits

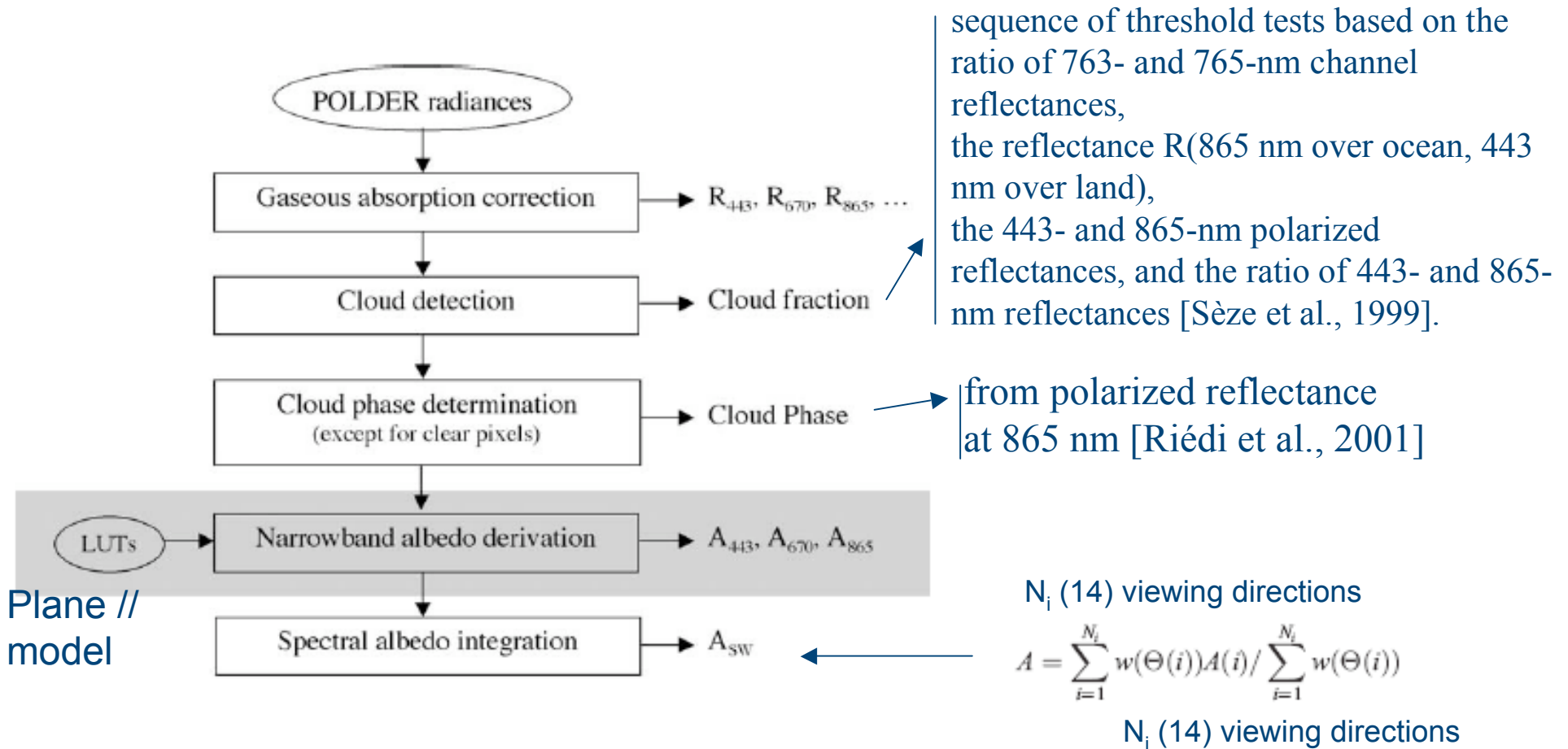


POLDER-2 and CERES, 9 February 2003

6

- ADEOS-2 ascending node : 22:20 (Terra:22:30)
- Altitude ADEOS-2: 803 km (Terra:705 km)
- Ground track repeat cycle ADEOS-2= 4 days ; Terra=16 days CERES STM - April 2007

From nb radiances to nb and bb albedo



From Buriez, J. C., F. Parol, C. Cornet, and M. Doutriaux-Boucher, 2005: An improved derivation of the top-of-atmosphere albedo from POLDER/ADEOS-2: Narrowband albedos. *J. Geophys. Res.*, **110**, D05202, doi:10.1029/2004JD005243.

NB to BB

443 and 670 nm: representative of the UV-visible range
865 nm : representative of the near infrared
except the gaseous absorption, estimated from TOMS data
and from the POLDER 910nm to 865 nm reflectance ratio

REFLECTANCE

$$R_{sw}(\mu_s, \mu_v, \varphi) = [C1 R_{443}(\mu_s, \mu_v, \varphi) + C2 R_{670}(\mu_s, \mu_v, \varphi)] T_{vis}(mU03) + c3 R_{865}(\mu_s, \mu_v, \varphi) T_{nir}$$

→

$$R_{sw}(\mu_s, \mu_v, \varphi) = [C1 R_{443}(\mu_s, \mu_v, \varphi) + C2 R_{670}(\mu_s, \mu_v, \varphi)] T_{vis}(mU03) + C3 R_{865}(\mu_s, \mu_v, \varphi) + C4 \rho_{H2O}(\mu_s, \mu_v, \varphi) R_{865}(\mu_s, \mu_v, \varphi) + C5$$

where $\rho_{H2O}(\mu_s, \mu_v, \varphi) = R_{910}(\mu_s, \mu_v, \varphi) / R_{865}(\mu_s, \mu_v, \varphi)$

ALBEDO

$$A_{sw}(\mu_s, \mu_v, \varphi) = [C1 A_{443}(\mu_s, \mu_v, \varphi) + C2 A_{670}(\mu_s, \mu_v, \varphi)] T_{vis}(M1U03) + C3 A_{865}(\mu_s, \mu_v, \varphi) + C4 [\rho_{H2O}(\mu_s, \mu_v, \varphi)]^{\zeta(\mu_s, \mu_v, \varphi)} A_{865}(\mu_s, \mu_v, \varphi) + C5$$

equivalent air-mass factor taking into account the integration over viewing directions

$C1, C2, C3, C4, C5$: coefficients from multi-regression analysis from radiances

Step 1 : based on theoretical models

Step 2 : based on simultaneous collocated comparisons with CERES (once for all)

For Albedo:

The coefficients $C1, C2, \dots, C5$ are the same as determined for radiances.

Multi-regression coefficients

| | C_1 | C_2 | C_3 | C_4 | C_5 |
|--------|-------|-------|-------|-------|-------|
| STEP 1 | 0.241 | 0.173 | 0.105 | 0.288 | 0.015 |
| STEP 2 | 0.193 | 0.260 | 0.129 | 0.244 | 0.020 |

STEP 2: derived from the 94,871 coincident CERES-POLDER data from April, July and October 2003 (cells of 1 degree , covered at least by 80 percent of a cell area by both POLDER and CERES footprints)

(time lag < 10 min; angle between viewing directions < 5°; no snow; no sunglint).

$$R^2 = 0.994$$

«An improved derivation of the top-of atmosphere albedo from POLDER/ADEOS-2: part 2. Broadband albedo»
Jean-Claude Buriez, Frédéric Parol, Zegbeu Poussi, and Michel Viollier,
2007, under revision for JGR

POLDER minus CERES co-directional reflectances and albedos (relative difference %)

| REFLECTANCE | | STEP 1 | | STEP 2 | |
|--------------------------|------------------------|---------|-------|---------|-------|
| Scene | Mean CERES reflectance | BIAS | RMS | BIAS | RMS |
| All | 0.270 | - 3.9 % | 6.2 % | 0.0 % | 4.3 % |
| Clear-sky over continent | 0.178 | - 5.4 % | 7.5 % | - 0.1 % | 3.0 % |
| Overcast over ocean | 0.433 | - 4.0 % | 5.1 % | - 0.4 % | 3.2 % |

| ALBEDO | | STEP 1 | | STEP 2 | |
|--------------------------|-------------------|---------|-------|---------|-------|
| Scene | Mean CERES albedo | BIAS | RMS | BIAS | RMS |
| All | 0.288 | - 1.7 % | 5.7 % | + 2.3 % | 5.6 % |
| Clear-sky over continent | 0.186 | - 5.3 % | 7.1 % | - 0.4 % | 3.0 % |
| Overcast over ocean | 0.451 | - 2.7 % | 4.4 % | + 1.0 % | 3.7 % |

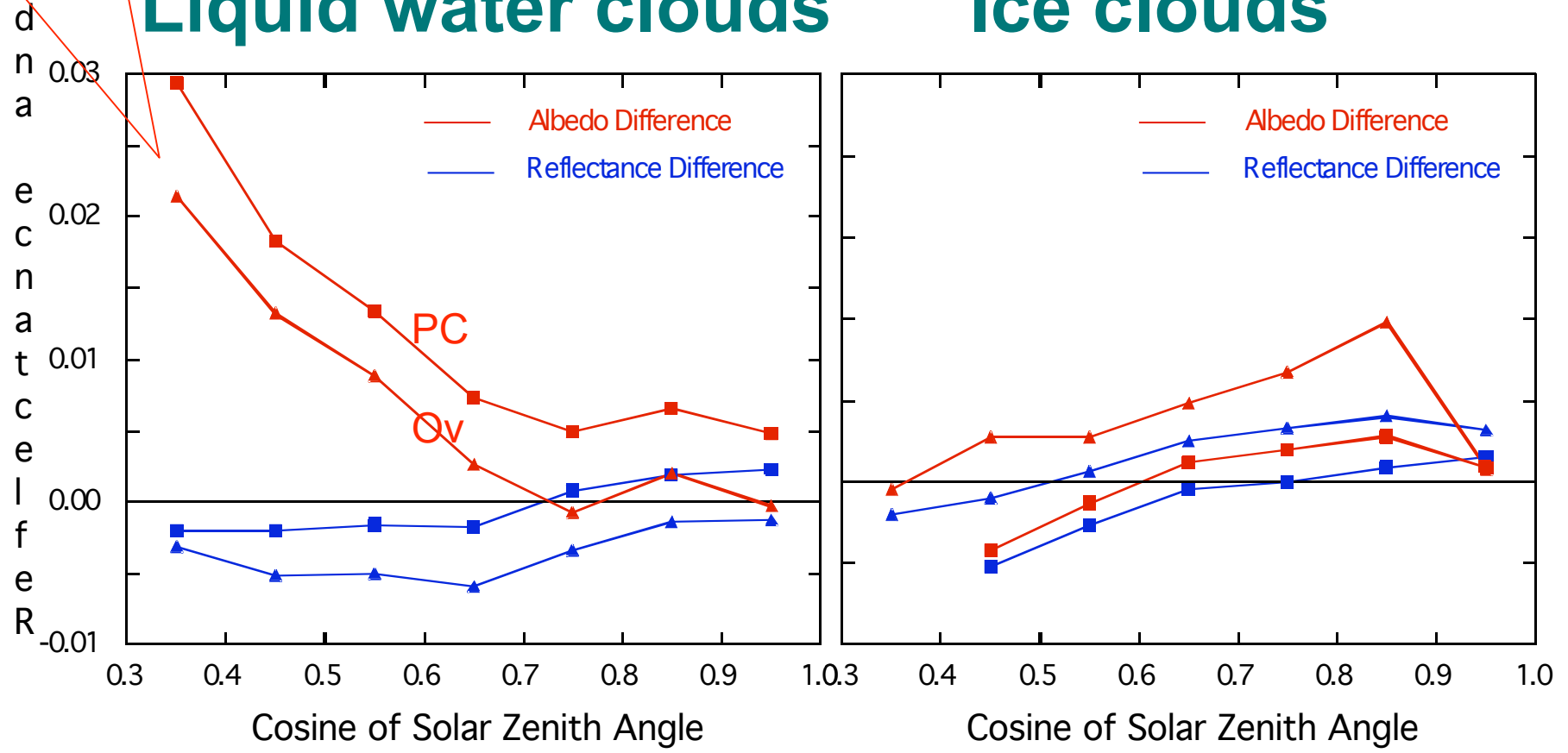
1 Multiple updates since 2003: ES8/SSF flux, ED2-rev1, POLDER updates, sampling, ..

Error probably due to the planar assumption

co-directional reflectances and albedos

Liquid water clouds

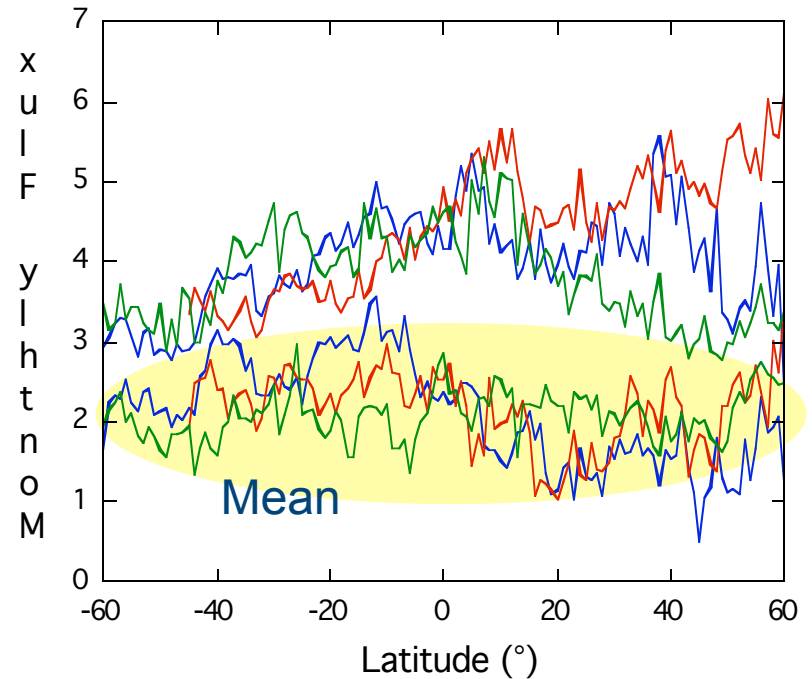
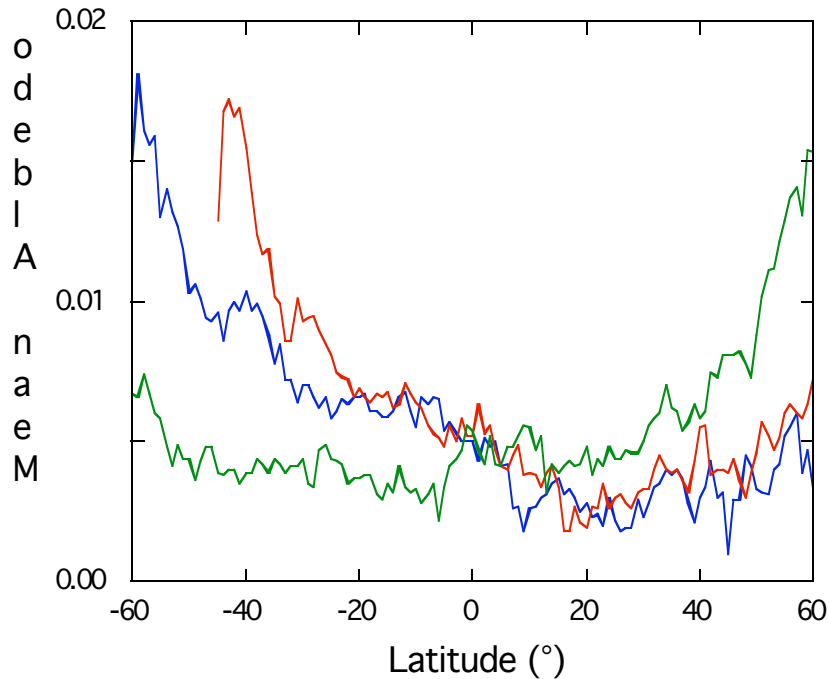
Ice clouds



for partly cloudy (squares) and overcast (triangles) conditions

'weighted averaged' albedo.

Albedo Flux Difference / Latitude



April 2003 (blue), July 2003 (red) and October 2003 (green).

Right: lower and upper curves represent respectively mean and rms differences.

mean SW flux bias roughly comparable to the predicted value by *Loeb et al.* [2006a, Terra Part II] on a global average, but with zonal variations noticeably less marked.

Second part : Monthly means

- 22 months of Parasol (March 2005-Dec 2006)
- Levels 2 and 3 available at <http://www-icare.univ-lille1.fr/>
- Level 3: monthly means, algorithms close to ERBE-like but with extrapolation based on regional diurnal albedo climatology (Standfuss et al., J. Climate, 2001
Viollier et al. ,GRL, 2002)
- Also available: monthly means from POLDER 1 and 2.
- provisional results so far: different versions have been used for each dataset; homogeneous re-processing to be planned

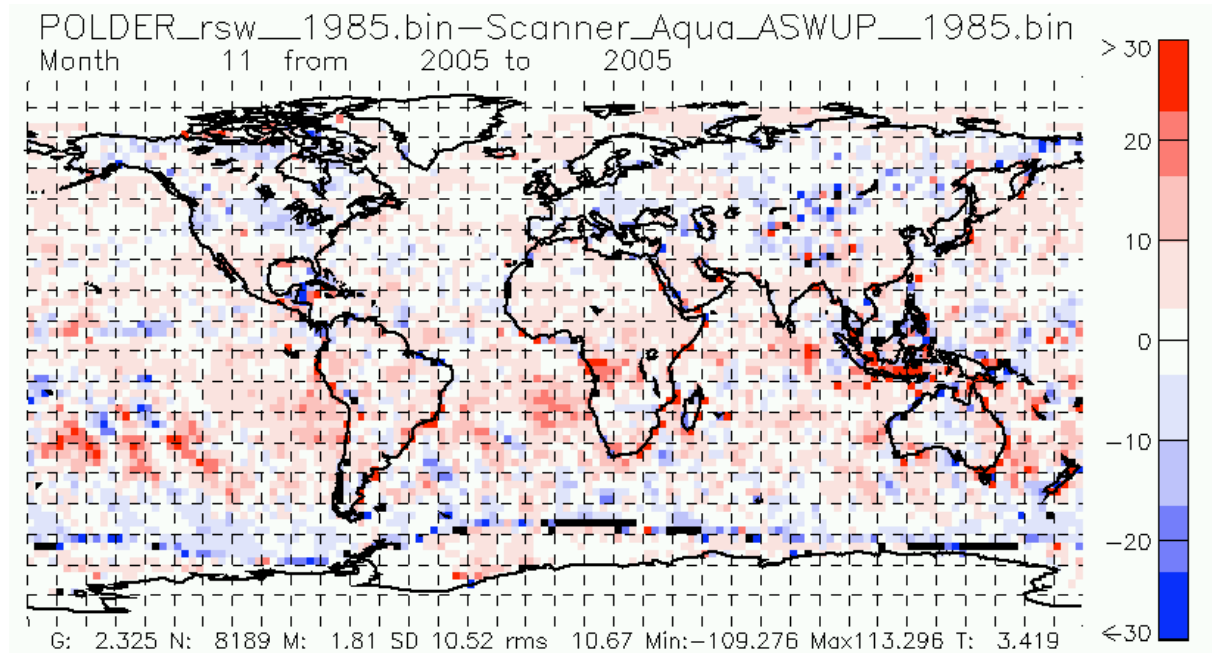
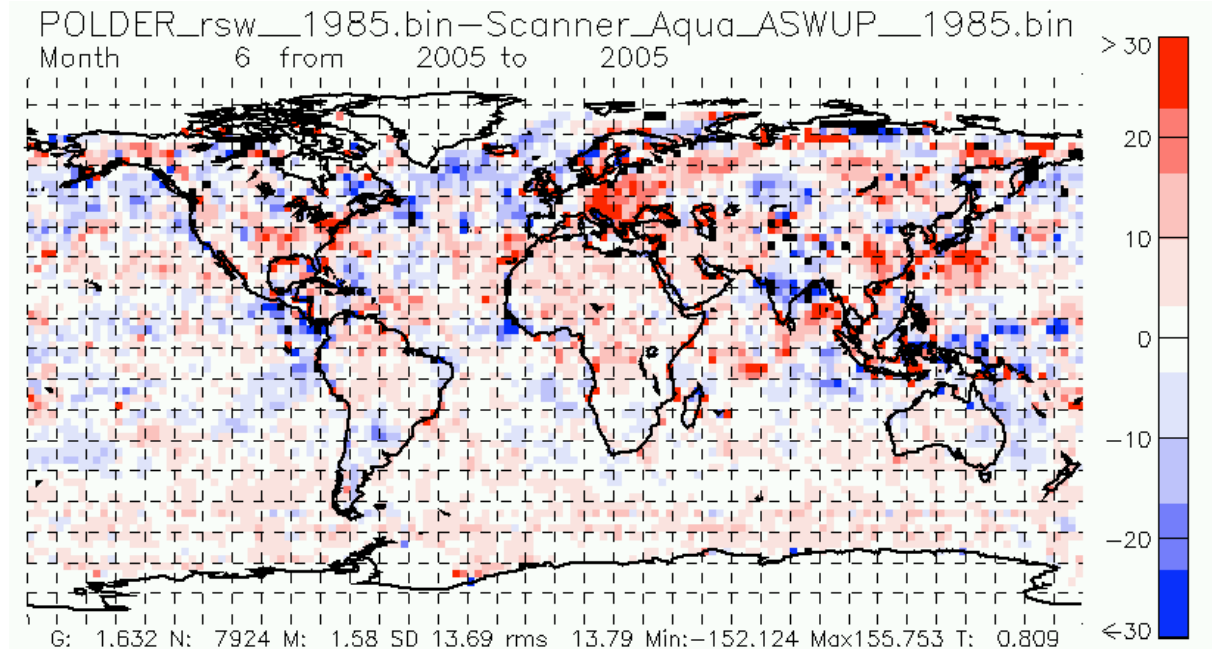
Flux Wm^{-2}

Difference
Parasol
minus
ES4 CERES
/Aqua

Examples:
June 2005
Nov 2005

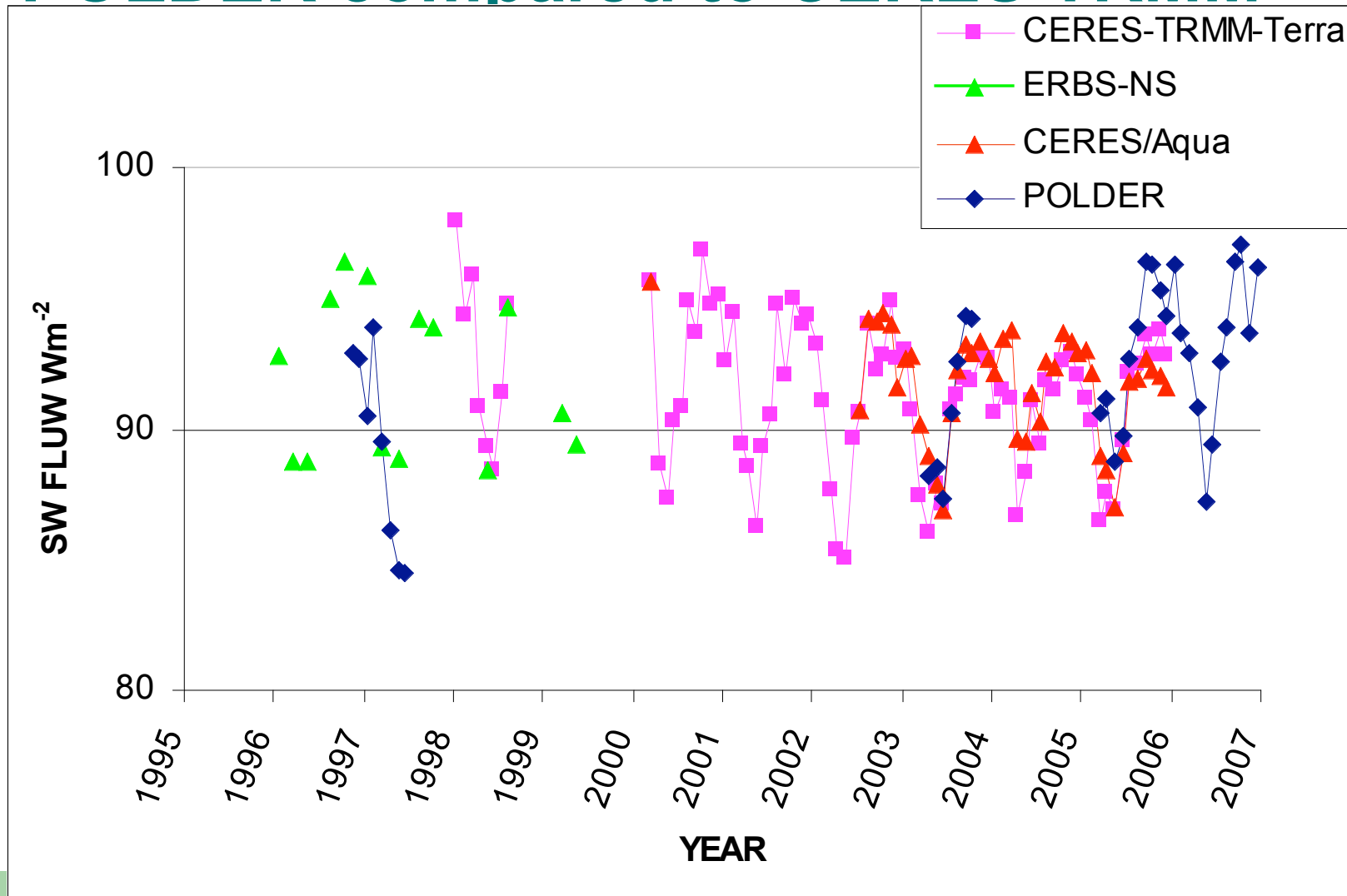
(Differences may partly due to the diurnal extrapolations)

15

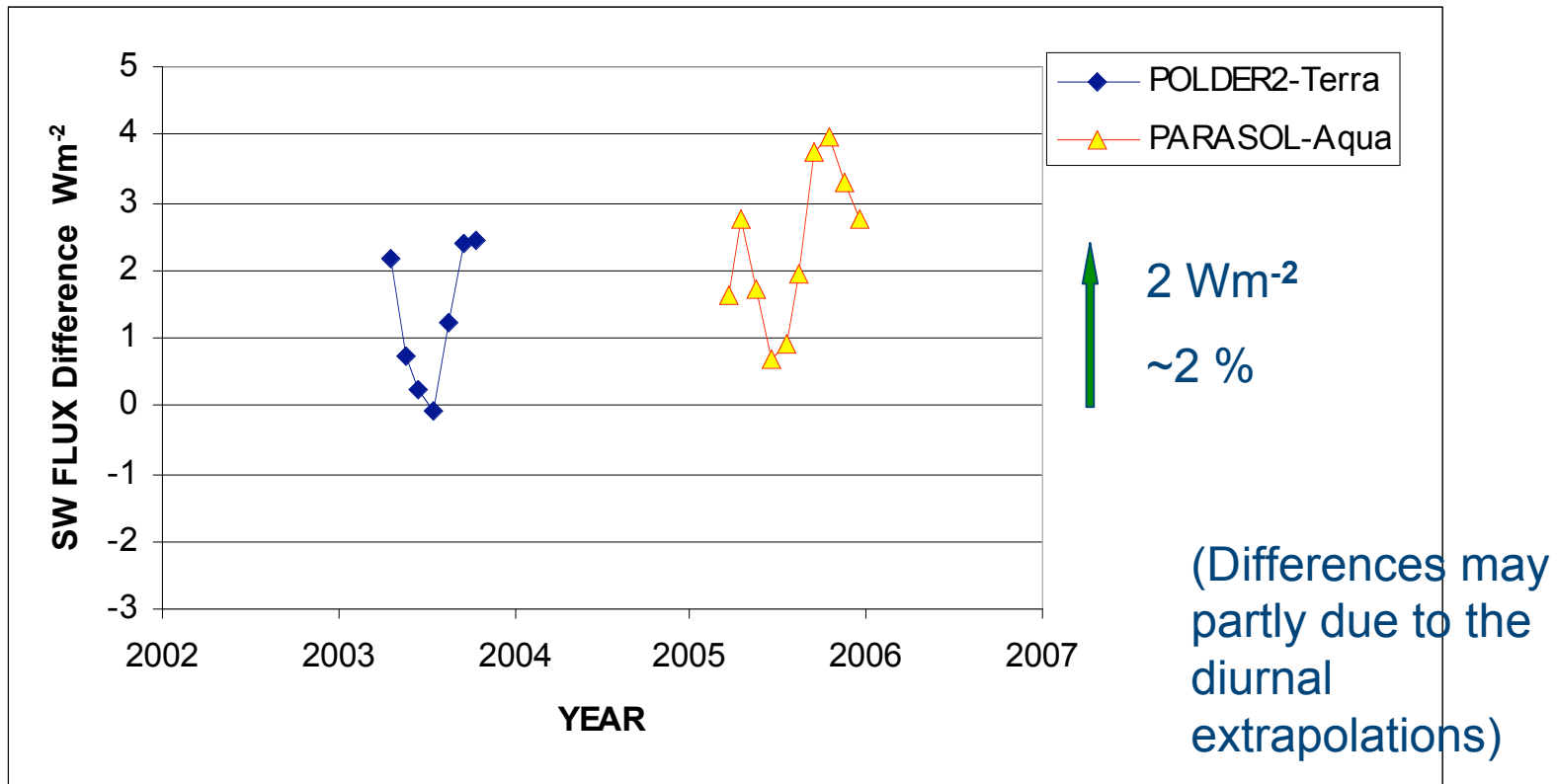


CERES STM - April 2007

Tropical Means (20°S-20°N): SW FLUX POLDER compared to CERES TRMM



Tropical Means (20°S-20°N): differences between POLDER-2, PARASOL, and CERES Aqua and Terra



Summary and Conclusion

All % values are relative, not absolute albedo deviations.

Instantaneous Flux (POLDER2/CERES-Terra SSF Ed2rev1)

- Mean reflectance difference for step 1 = -3.9% consistent with the nominal POLDER (~2-3%) and CERES (1%) radiometric uncertainties, and nb-bb theoretical conversion errors
- Step2: nb-to-bb conversion adjusted to CERES (one unique formula for all the months)
- Moderated 2% albedo overestimation / CERES
- Increase of the 'co-directional' albedo difference with SZA in case of liquid water clouds
- In large part, these both last statements are consistent with the plane-parallel assumption errors (Loeb et al., 2006)

2 years of Monthly Means: PARASOL/CERES-Aqua

- An independent and long-established "Cloud, WV and ERB" dataset, especially the PARASOL series (> 26 months)
- Preliminary PARASOL/CERES-ES4 comparisons for the tropical means: $\sim +2\% \pm 1.2\%$, requires further analysis