Measurement of the Earth Radiation Imbalance

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Earth Radiation Imbalance (W/m\(^2\))
\[ 341 - 102 - 238 = 1 \]
Challenges in the measurement of the Earth Radiation Imbalance

• CALIBRATION: UNDERESTIMATED PROBLEM

• Sampling
  – Spatial -> use of scanners instead of non-scanners
  – Temporal -> GERB
  – Angular -> ADM improvements
  – Spectral -> spectral response, unfiltering
Independent Total Solar Irradiance measurements
Incoming solar

• For period 03/2000-02/2005 (CERES EBAF):
  • Min=TIM, Max=DIARAD/VIRGO
  • TSI = 1364.12 +/- 2.5 W/m² (0.2%)
  • Incoming solar: 341.3 +/- 0.63 W/m²
GERB2/CERES SW Radiance Ratio

• June + Dec 2004:
  • GERB 2 / CERES : 1.059
  • GERB 2 / CERES FM1: 1.045
  • GERB 2 / CERES FM2: 1.054
  • GERB 2 / CERES FM3: 1.071
  • GERB 2 / CERES FM4: 1.067

• Preliminary: GERB 2 / GERB 1 ~ 1.03
Reflected solar

• Min = CERES FM3
• Max = GERB2
• For period 03/2000-02/2005 (CERES EBAF):
  • Reflected solar = 98.71 +/- 3.38 W/m² (3.4%)
GERB2/CERES LW Radiance Ratio

- June + Dec 2004:
  - GERB 2 / CERES: 0.987
  - GERB 2 / CERES FM1: 0.989
  - GERB 2 / CERES FM2: 0.993
  - GERB 2 / CERES FM3: 0.983
  - GERB 2 / CERES FM4: 0.981

- Preliminary: GERB 2 / GERB 1 ~ 0.995
Emitted thermal

- Min = GERB2
- Max = CERES FM4
- For period 03/2000-02/2005 (CERES EBAF):
- Emitted thermal: 236.76 +/- 2.27 W/m² (1%)
Earth Radiation Imbalance

• Measured = 5.55 +/- 6.28 W/m²
• Expected = 0.85 W/m²

• Insufficient accuracy
• Only possibility for significant improvement: measure Sun and Earth radiation with single instrument
ERBE wide field of view radiometers

- Spectrally flat and true flux measurement
- Separate measurements of Sun and Earth
- See presentation Nancy Vermeulen @ GIST meeting
WFOV Results 1985-1991

- Earth radiation imbalance = 8.27 W/m² ± 0.35 W/m²
- Uncertainty due to sampling
- Missing instrument uncertainty
- Still not satisfactory
- Instrument design improvements are possible
Proposal for building new instrument

• Build new Wide Field of View cavity radiometer as reference for the true measurement of the Earth Radiation Imbalance

• We have the know-how based on the experience with the DIARAD TSI radiometers

• We are interested in Clarreo flight opportunity
Conclusions

• For a true measurement of the Earth Radiation Imbalance we should focus on CALIBRATION.

• The only possibility is to measure the Earth and Sun fluxes WITH ONE INSTRUMENT.

• Adding spatial and spectral resolution will not help …