Comparison of TOA Fluxes from CERES FLASHFlux and EBAF

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Eighteenth CERES Science Team Meeting
Geophysical Fluid Dynamics Laboratory
Princeton, New Jersey
22-25 October 2012

Outline

- Product Introduction
- Data Available
- Objective
- Methodology
- Results
- Summary

Product Introduction

EBAF: Energy Balanced and Filled

- Geostationary-enhanced CERES fluxes adjusted for energy balance at the TOA within the ocean heat storage value.

  Loeb et al. (2009): *J. Climate*, **22**, 748-766 (doi: 10.1175/JCLI2637.1)
- Produced to meet the needs of the climate modeling community.
- Climate quality fluxes which take upward of six months to prepare.
- Many applications require CERES-like data much sooner while their accuracy requirements are not as stringent.

Product Introduction

•*FLASHFlux*: Fast Longwave and Shortwave Radiative Fluxes

•*Purpose*: Provide CERES-like TOA and surface fluxes on a near real-time basis for use until formal CERES data become available.

- Devised a speedy stream of the CERES processing system.
- Produced CERES-like fluxes within 1 week of satellite observations.
- Accomplished by relaxing some stringent accuracy requirements.
- Used the first data stream from the instruments (Baseline-1 QC).
- Processed only cross-track scanner data from both satellites.
- Used calibration coefficients from the previous CERES processing.
- *Overarching goal:* Capture variability of CERES fluxes even when there are systematic differences so that it can be used to project CERES EBAF fluxes for early applications.
- Scientific, educational and commercial applications: Field experiments, Earth Observatory, S'COOL, Solar Energy and Building industries.
- Compare FLASHFlux with EBAF to assess the quality of the former.

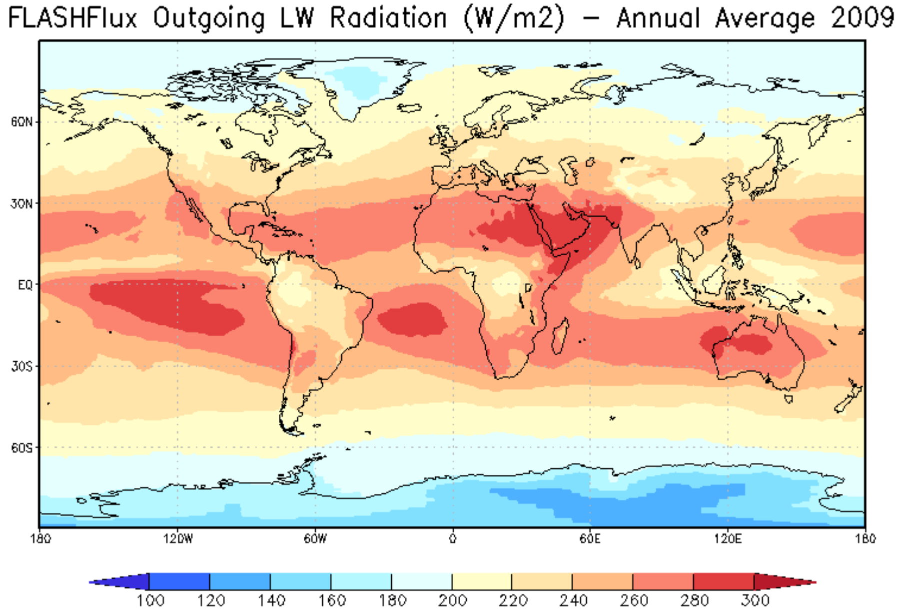
Data Available

- EBAF Edition-2.6r data available as monthly 1°x1° gridded for the March 2000 to December 2011 period.

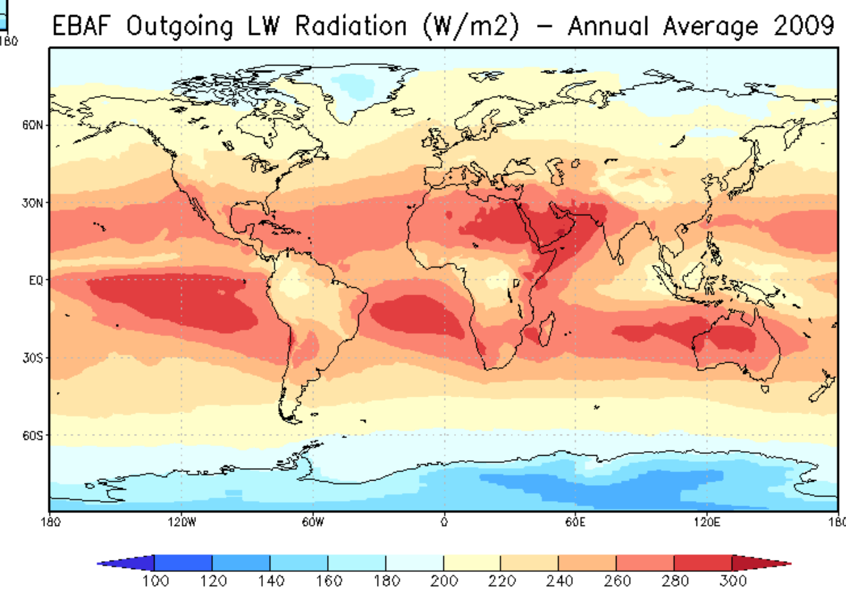
- FLASHFlux Version-2G data available as daily 1°x1° gridded for January 2009 to December 2011. Averaged to monthly to match EBAF.

- Comparisons made on a monthly average basis for a 36-month period (Jan 2009 – Dec 2011).

Objective



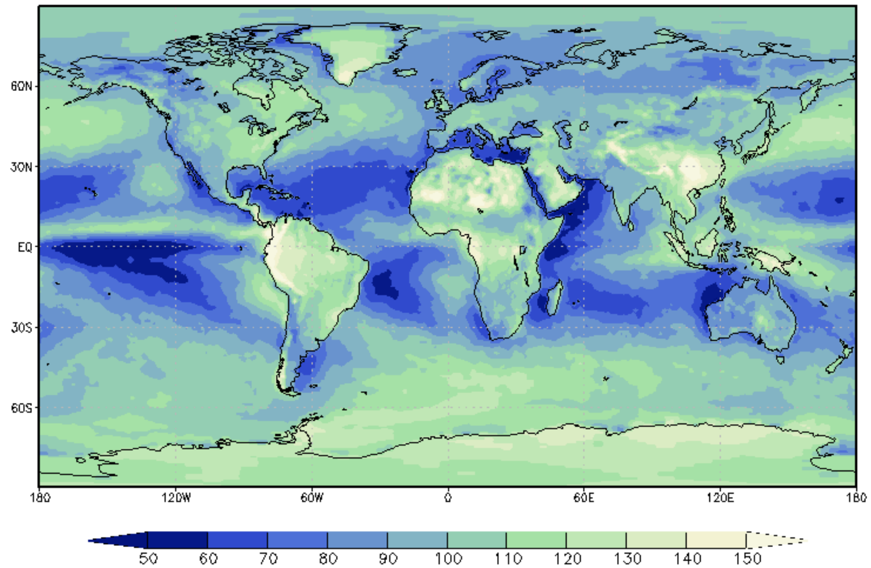
Compare FLASHFlux with EBAF:
Quantify the agreement between them



The two fields look very similar
but there are small differences.

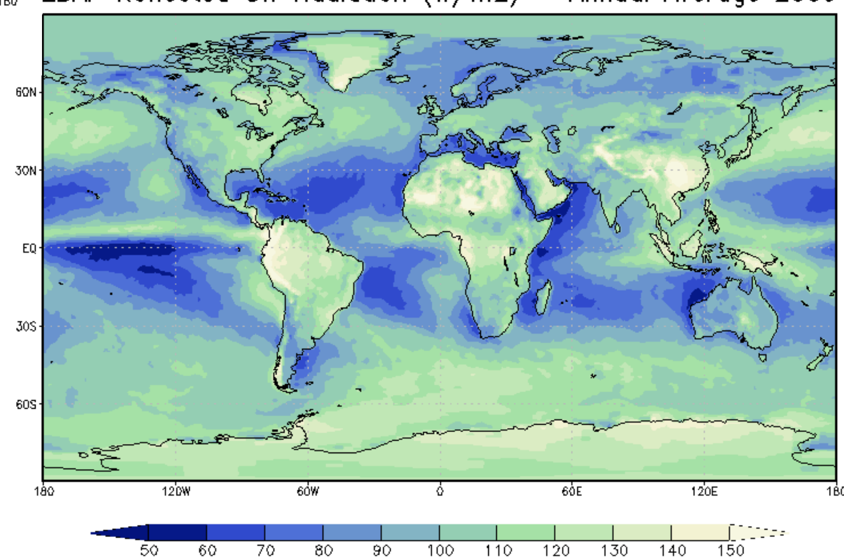
Objective (continued)

FLASHFlux Reflected SW Radiation (W/m2) – Annual Average 2009



EBAF is the reference field
FLASHFlux is the test field

EBAF Reflected SW Radiation (W/m2) – Annual Average 2009



Methodology

- Comparison of Statistics (The same 3 used in Taylor diagrams):
  (Taylor, K. E. (2001): *JGR*, **106**, 7183-7193.)

1. Correlation Coefficient *(R)* between the fields:

$$R = \frac{1}{N}\sum \frac{(f_n - \bar{f})(r_n - \bar{r})}{\sigma_f \, \sigma_r}$$

where *f* represents the test variable and *r* the reference variable. σ_f and σ_r are their standard deviations. High correlation coeff. demonstrates a correspondence between the spatial patterns.

2. Standard Deviations *(σ)* of the two fields:

$$\sigma_f^{\,2} = \frac{1}{N}\Sigma(f_n - \bar{f})^2 \quad \text{and} \quad \sigma_r^{\,2} = \frac{1}{N}\Sigma(r_n - \bar{r})^2$$

comparable values of standard deviations indicates that range of values in the two fields are comparable.

Methodology (contd.)

3. RMS Difference *(E)*:

$$E^2 = \frac{1}{N}\Sigma(f_n - r_n)^2$$

quantifies the difference between the corresponding values in the two datasets but includes the bias between them.

Centered RMS Difference *(E')*:

$$E'^2 = \frac{1}{N}\Sigma\left[(f_n - \bar{f}) - (r_n - \bar{r})\right]^2$$

The two are related as

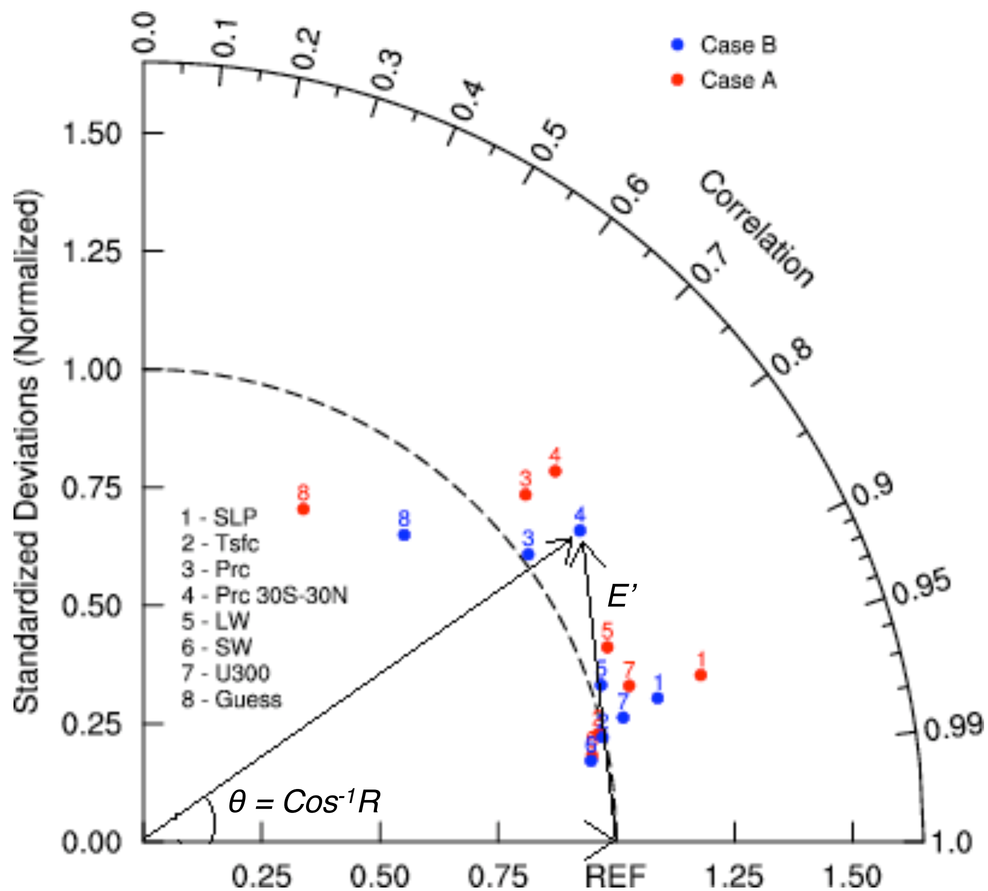
$E'^2 = E^2 - \bar{E}^2$ where $\bar{E} = (\bar{f} - \bar{r})$ is the mean bias

centered RMS removes the effect of mean bias from the RMS.

This can also be represented as:

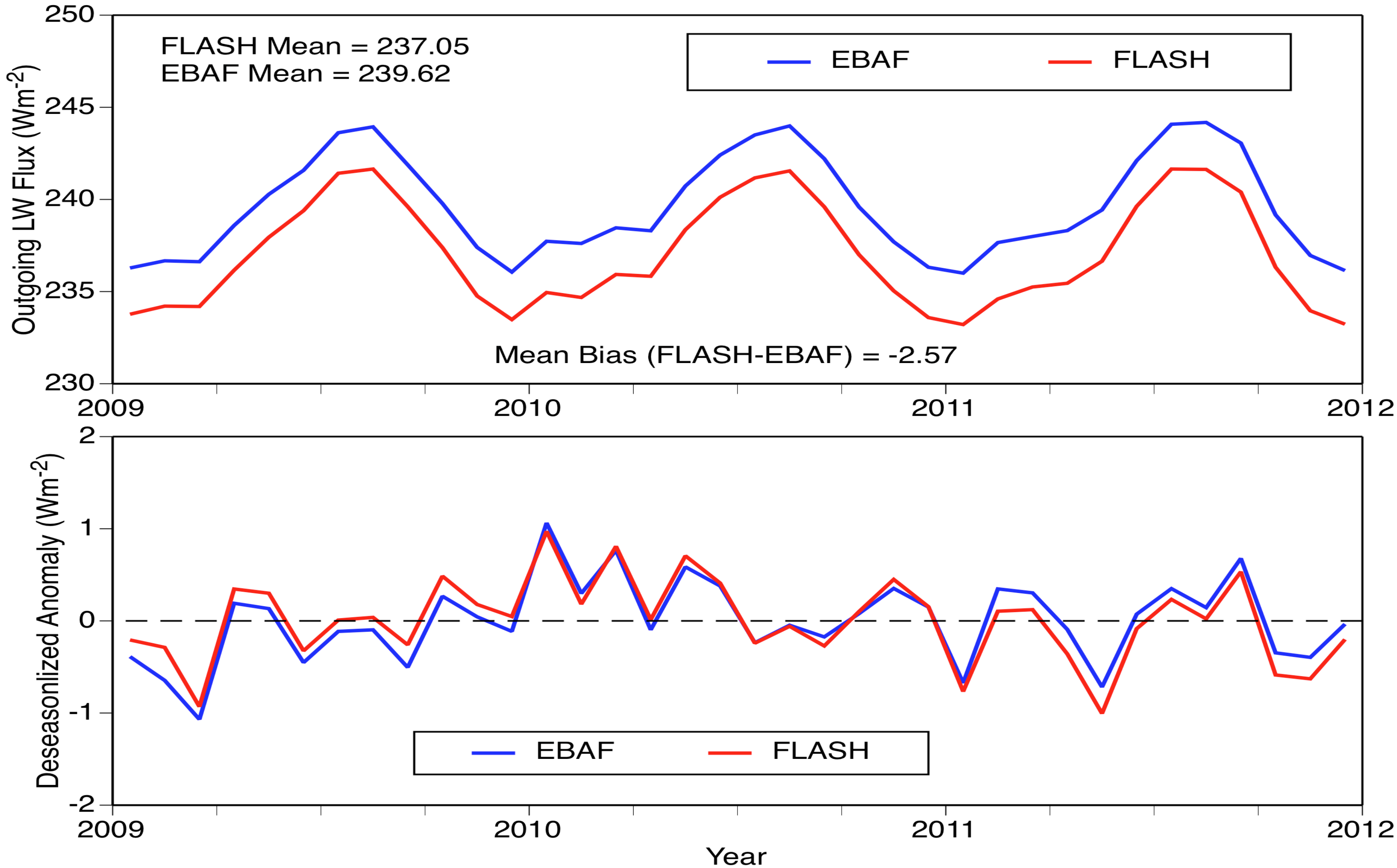
$$E'^2 = \sigma_f^{\ 2} + \sigma_r^{\ 2} - 2\sigma_f\sigma_r R$$

Example Taylor Diagram



$$E'^2 = \sigma_f^2 + \sigma_r^2 - 2\sigma_f \sigma_r R$$

All-Sky Outgoing Longwave Radiation – 2009-2011



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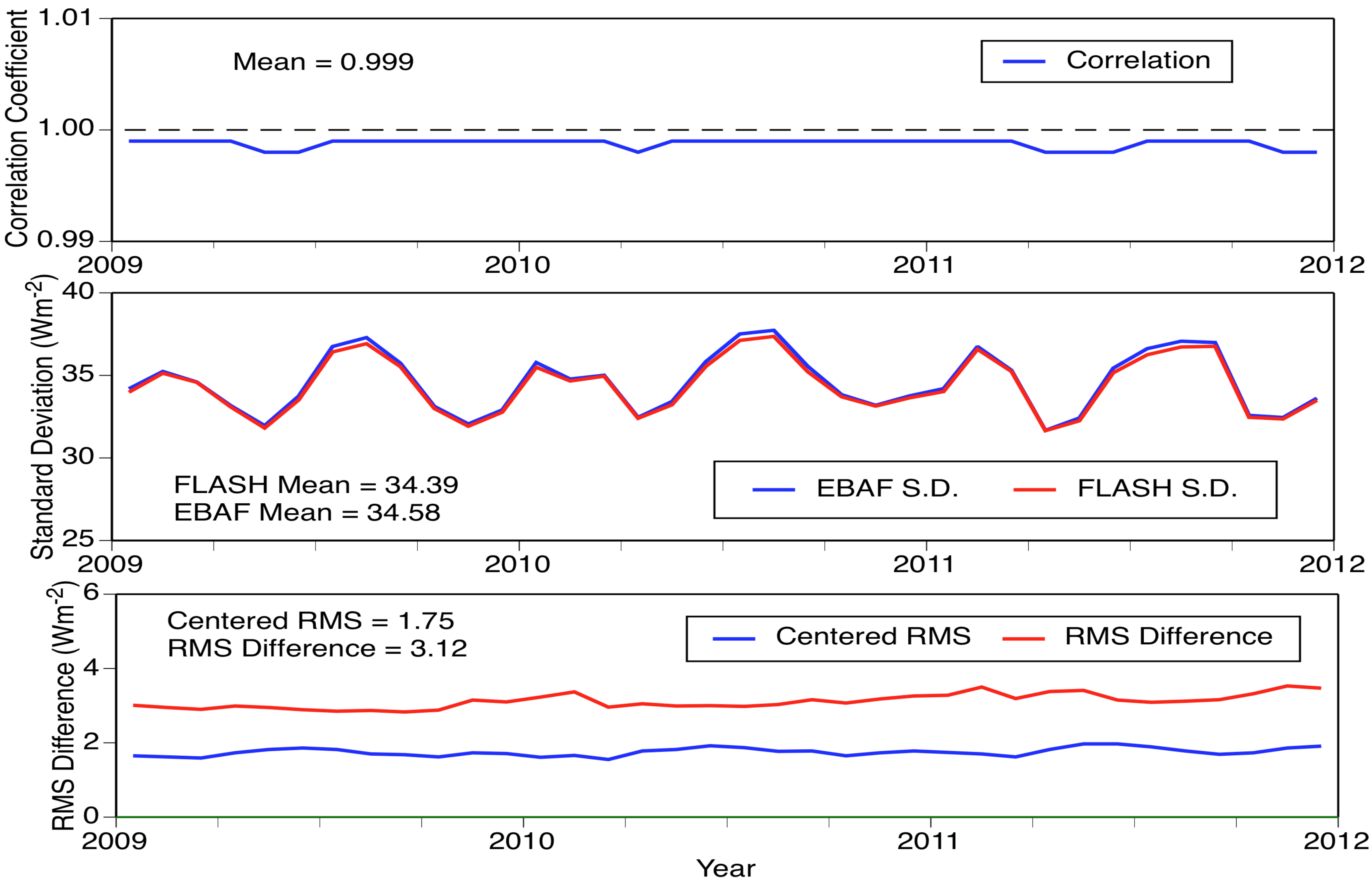
All-Sky OLR Statistics – 2009-2011



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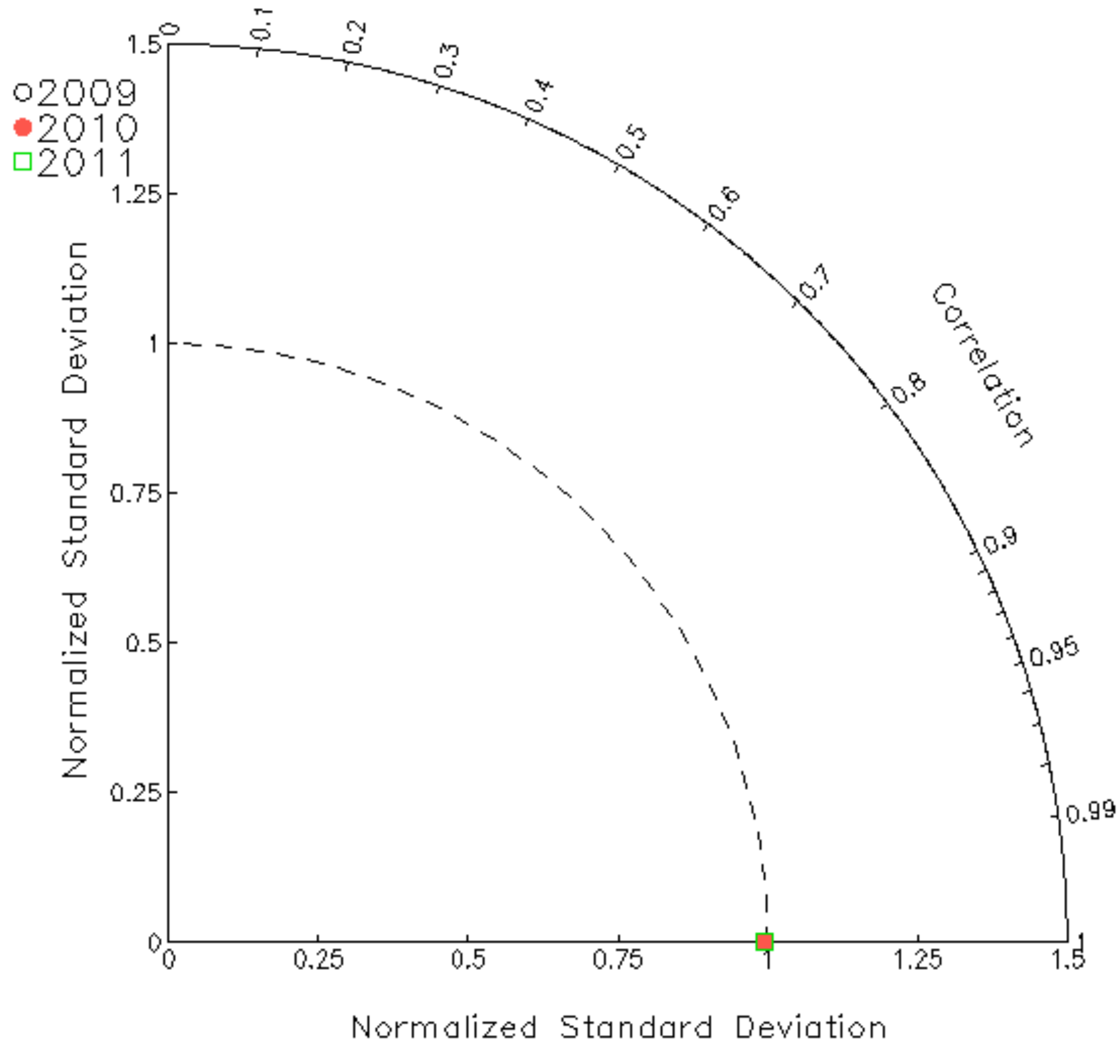
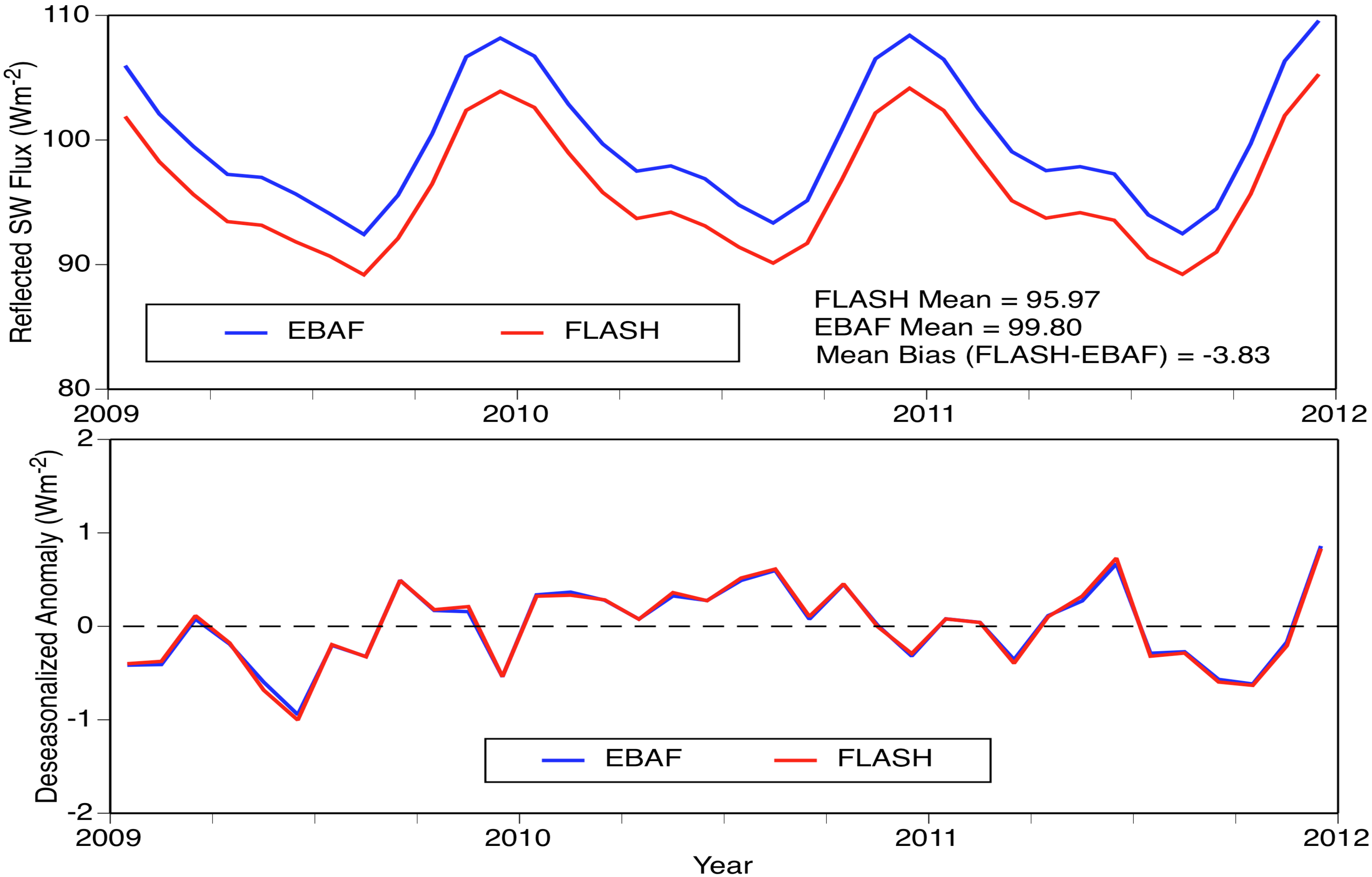
All-Sky Outgoing Longwave Radiation

Taylor Diagram for Annual Averages



All-Sky Reflected Shortwave Radiation – 2009-2011



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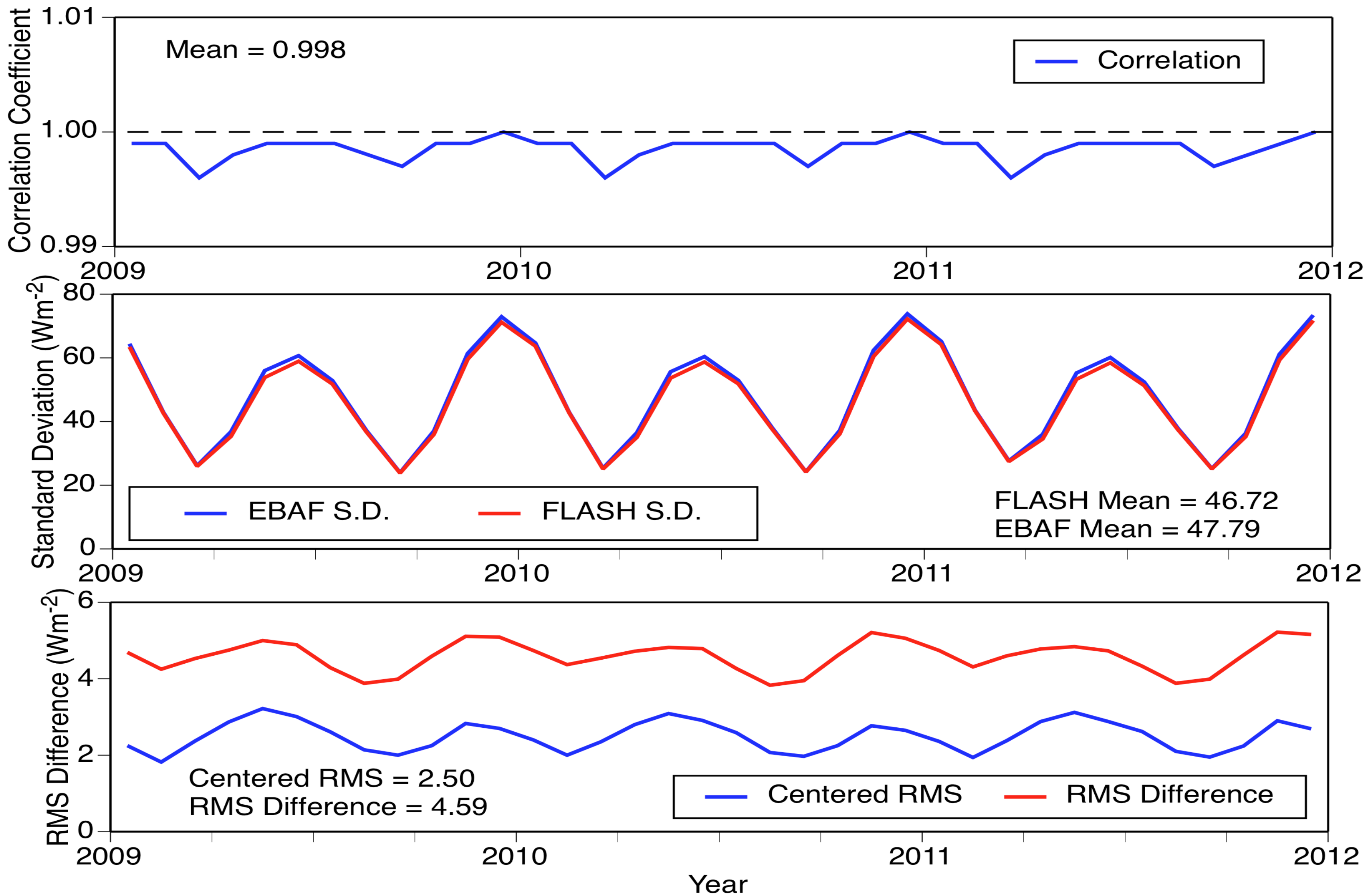
All-Sky RSR Statistics – 2009-2011



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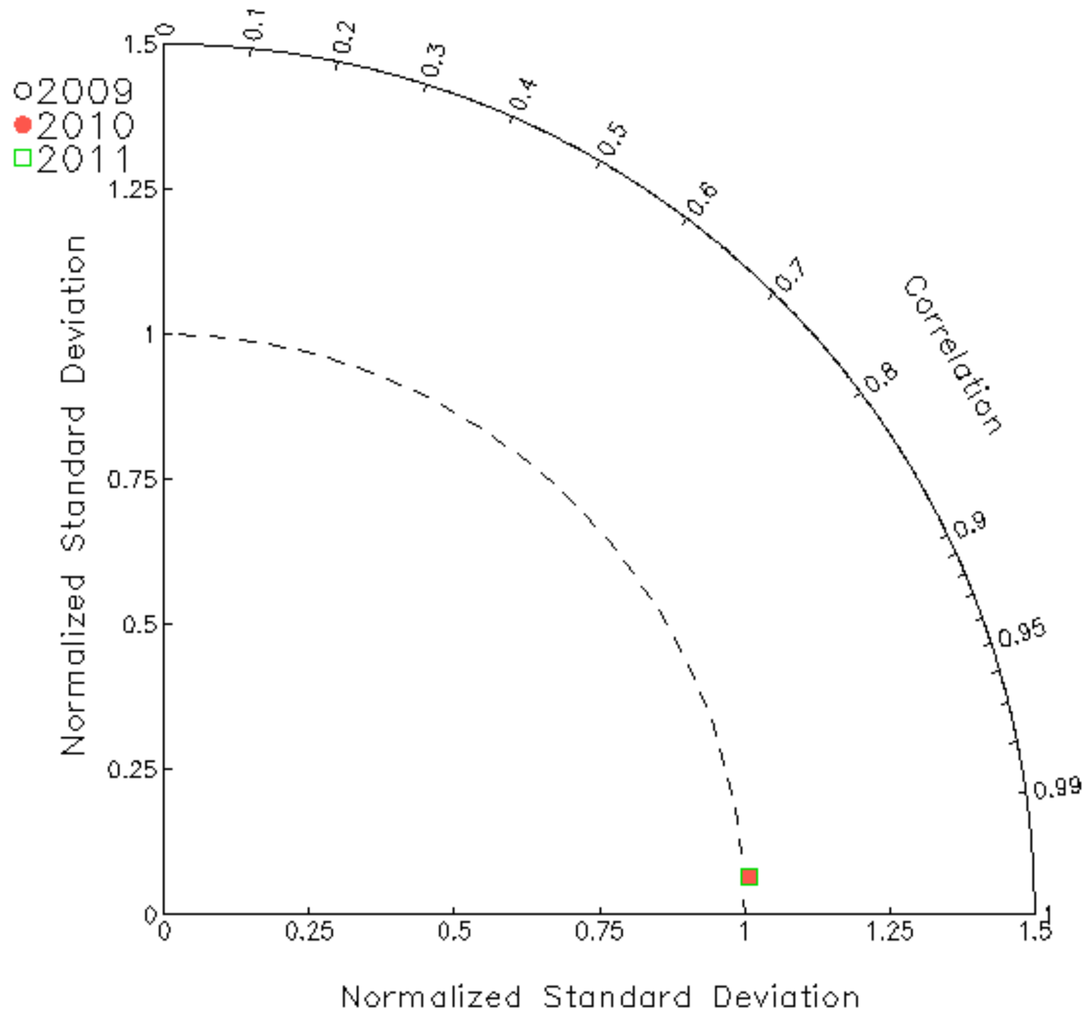
All-Sky Reflected Shortwave Radiation

Taylor Diagram for Annual Averages



Summary and Concluding Remarks

- CERES-like fluxes available on a near real-time basis.
- Closely capture the variability of the final CERES product.
- Small differences result from the use of older calibration coefficients for FLASHFlux and adjustments made to EBAF.
- Biases:

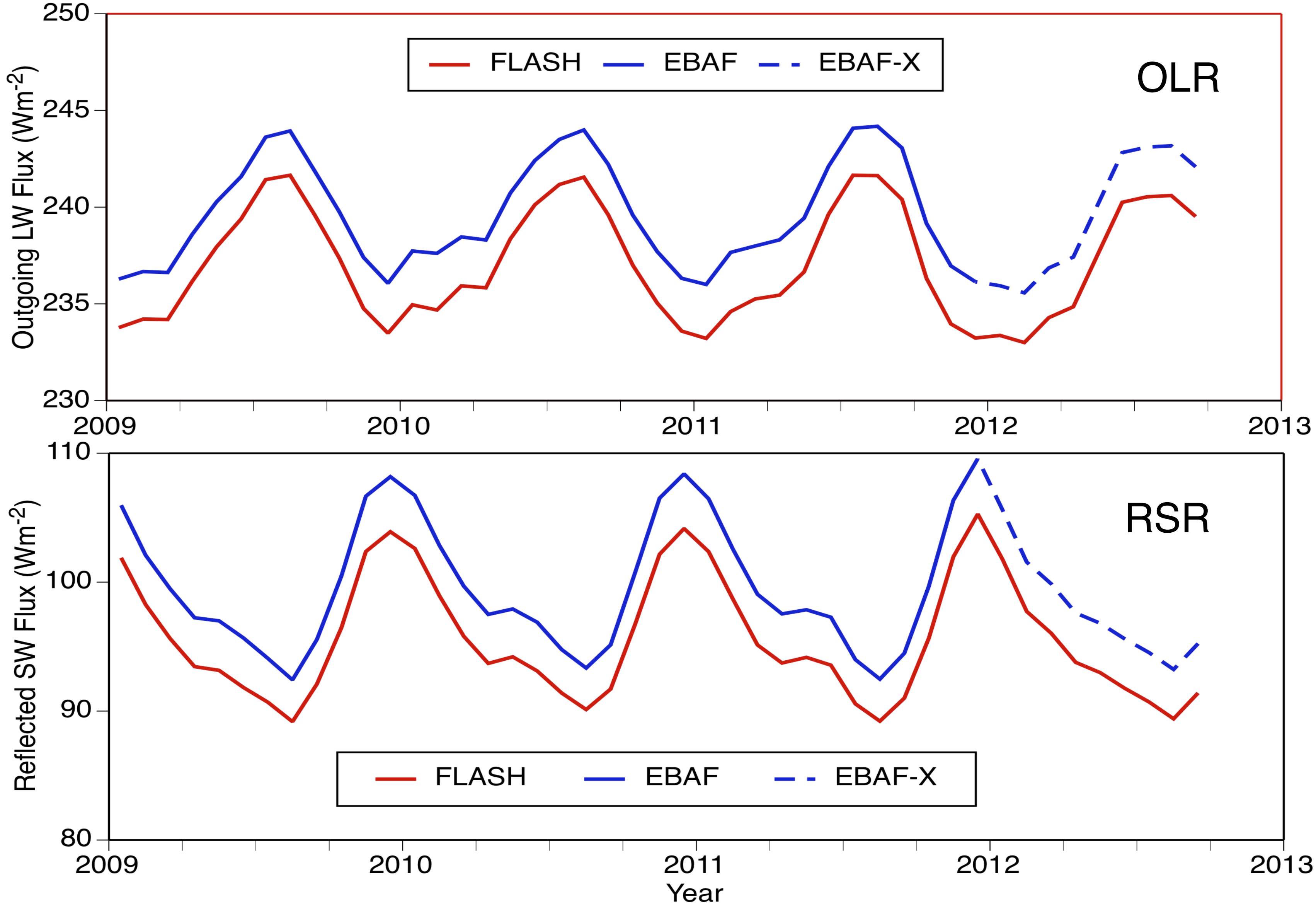
  Outgoing LW = -2.57 Wm^{-2} (-1.1%)

  Reflected SW = -3.83 Wm^{-2} (-3.8%)
- Centered RMS Differences:

  Outgoing LW = ±1.75 Wm^{-2} (0.7%)

  Reflected SW = ±2.50 Wm^{-2} (2.5%)
- Along with other applications these can be used to project CERES fluxes before those become formally available. Done to contribute to the State of the Climate Report.

Extrapolation of EBAF Fluxes Using FLASHFlux



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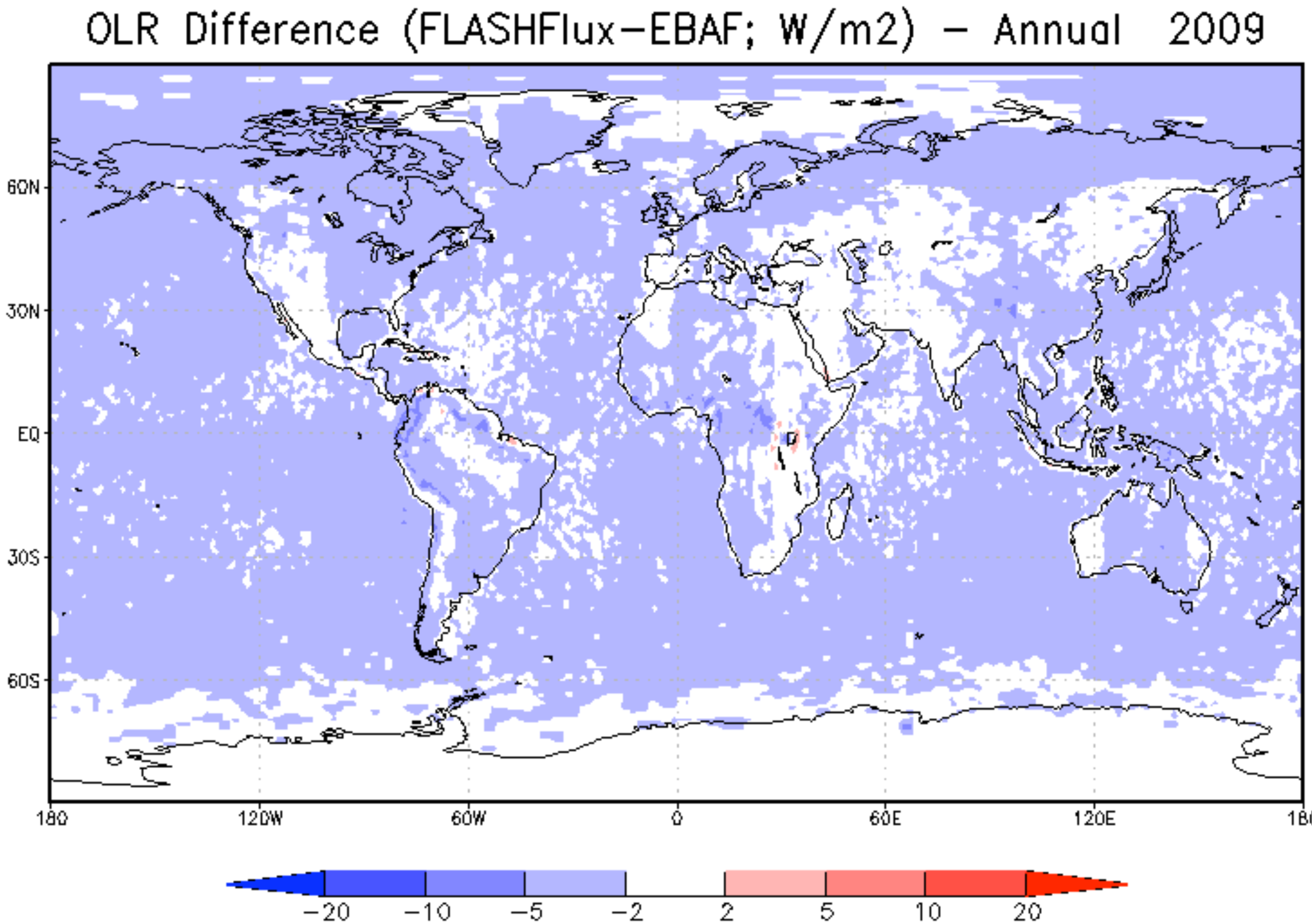
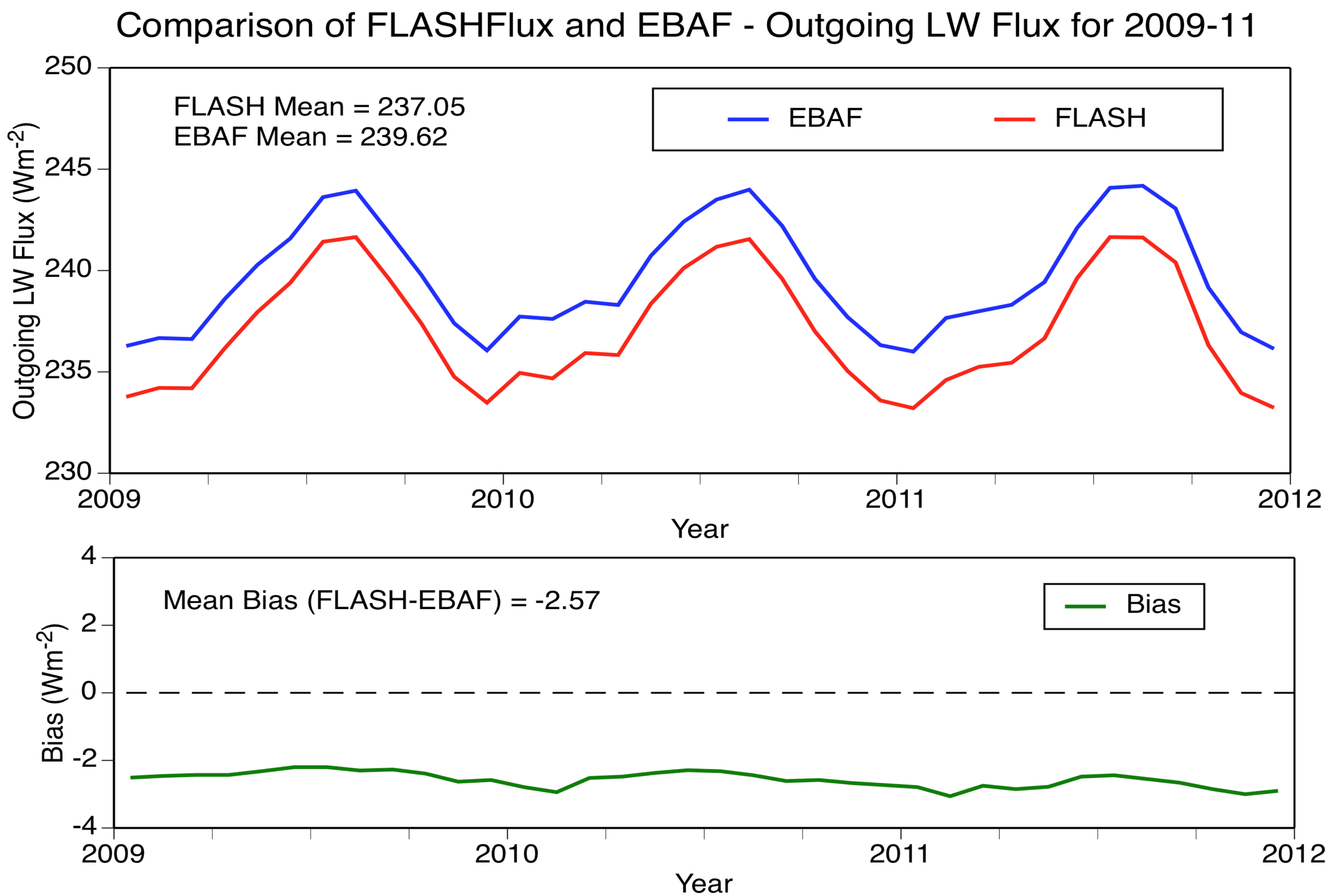
Back-up Slides



OLR Difference (FLASHFlux−EBAF; W/m2) − Annual 2009
60N
30N
EQ
30S
60S
180
120W
60W
0
60E
120E
180
−20
−10
−5
−2
2
5
10
20



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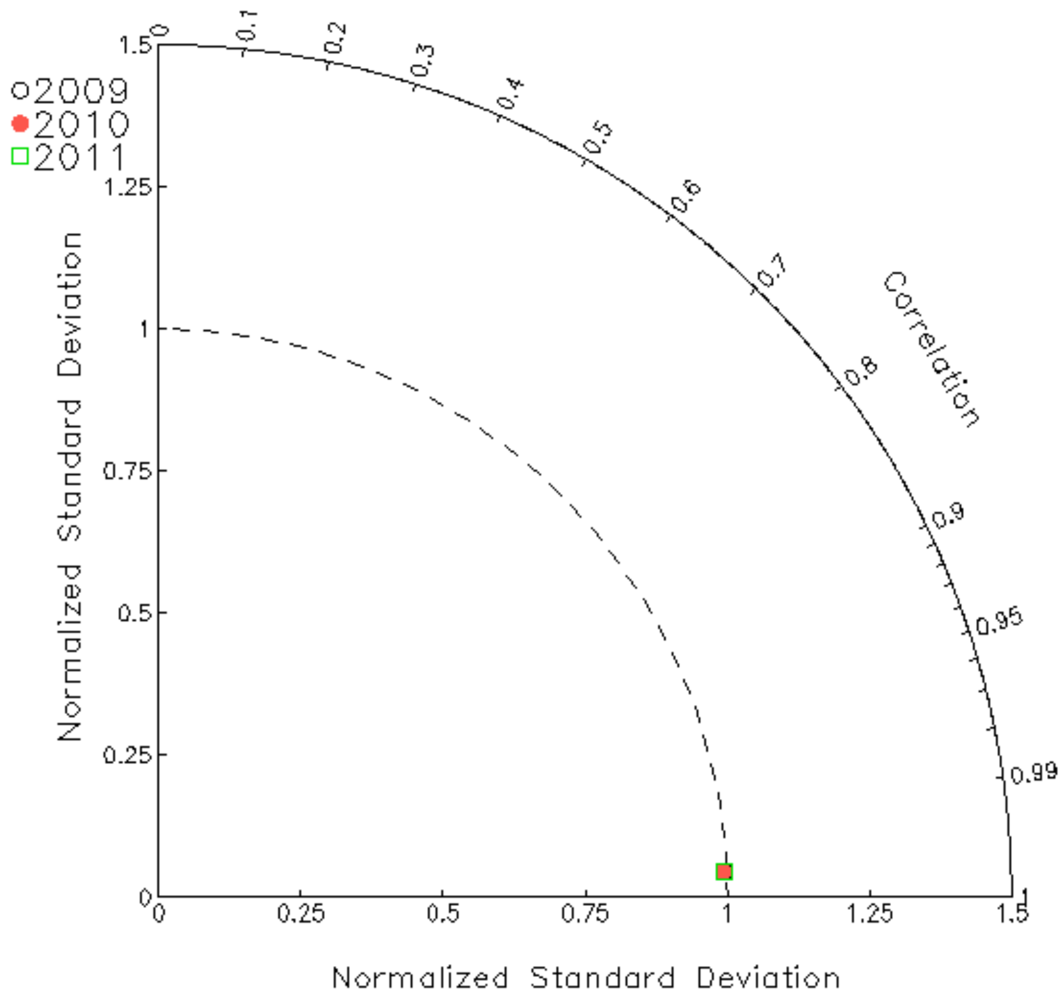
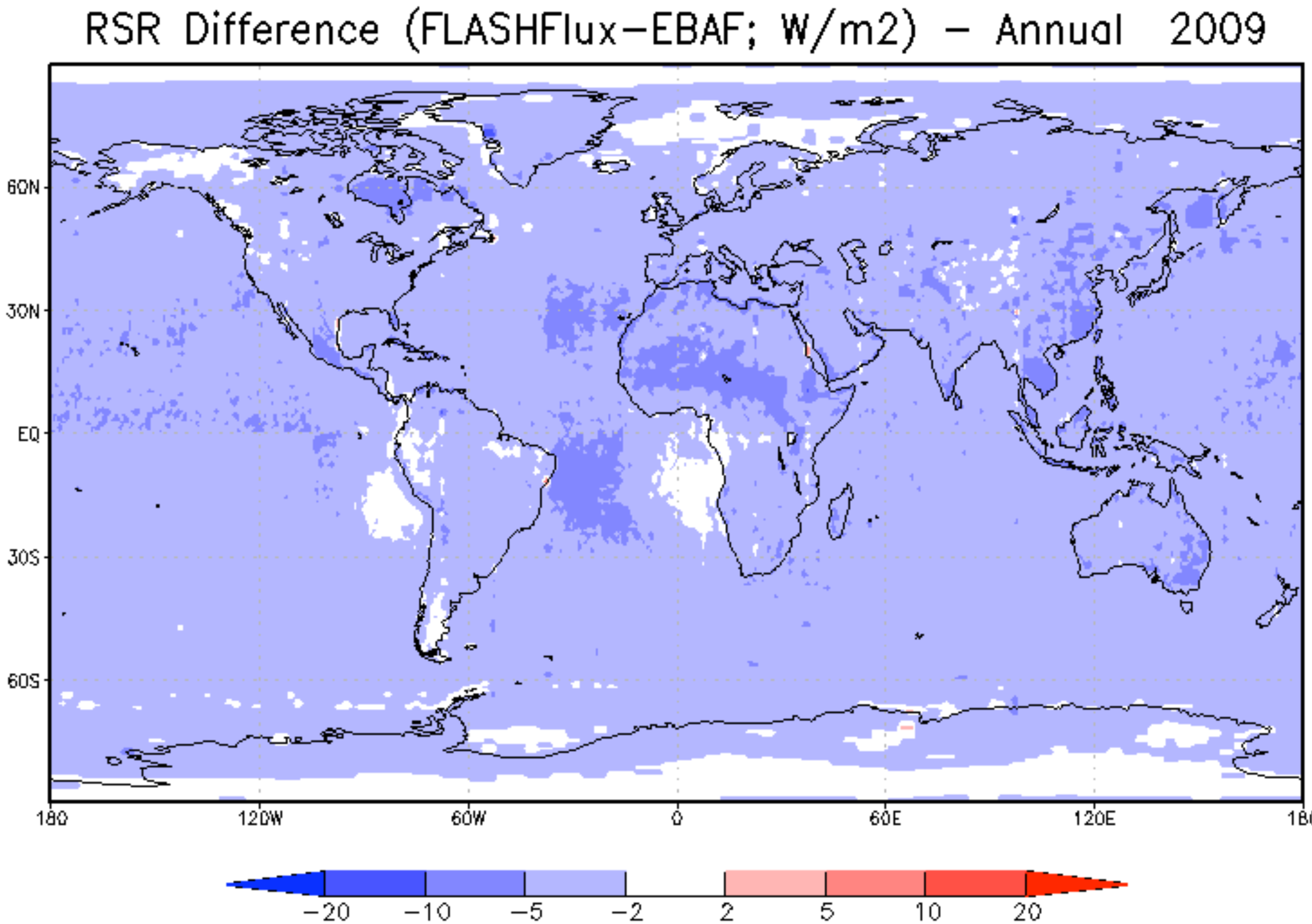
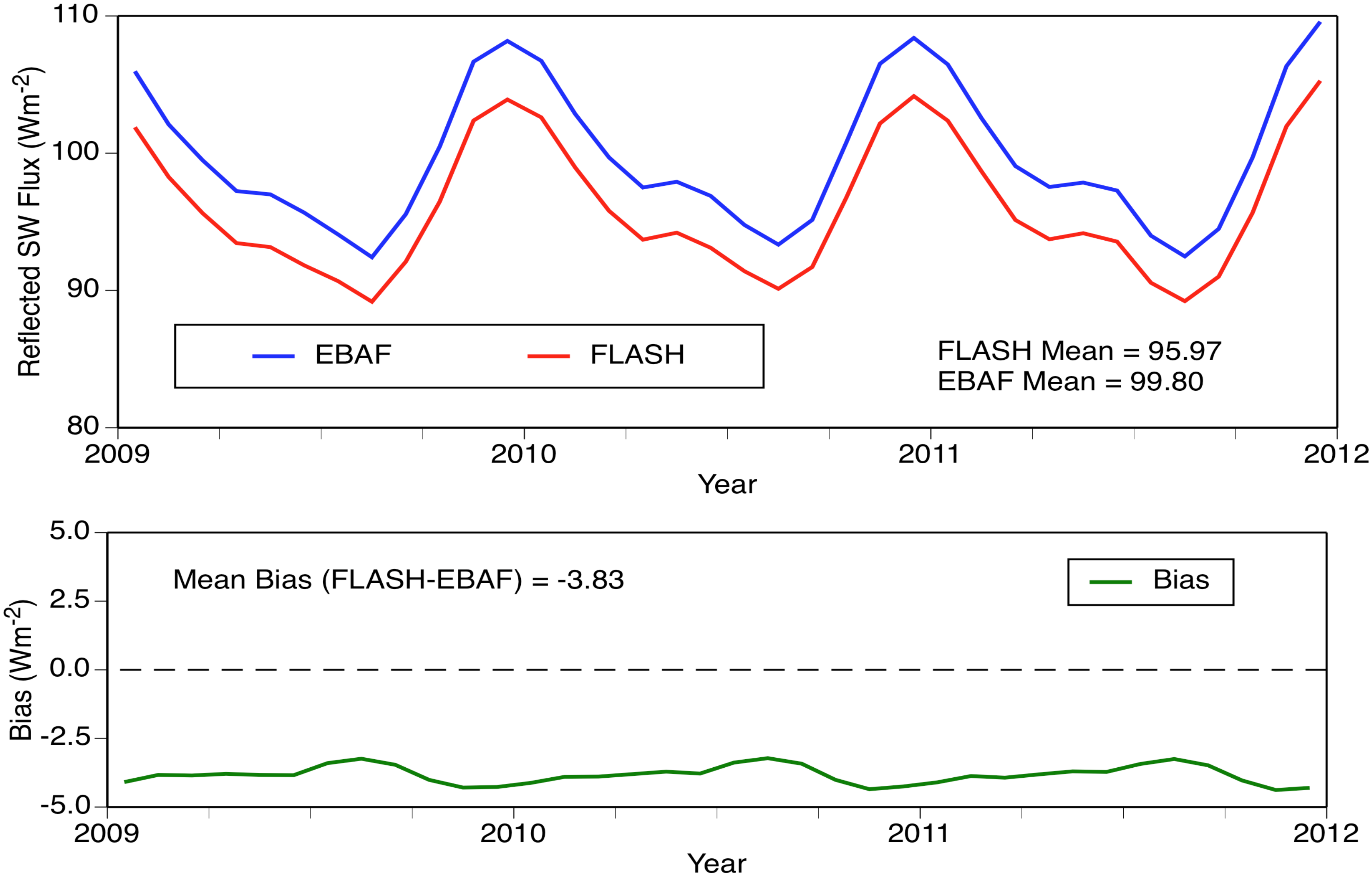
All-Sky Outgoing Longwave Radiation

Taylor Diagram for Monthly Averages




RSR Difference (FLASHFlux-EBAF; W/m2) - Annual 2009
60N
30N
EQ
30S
60S
180
120W
60W
0
60E
120E
180
-20
-10
-5
-2
2
5
10
20

Comparison of FLASHFlux and EBAF - Reflected SW Flux for 2009-11



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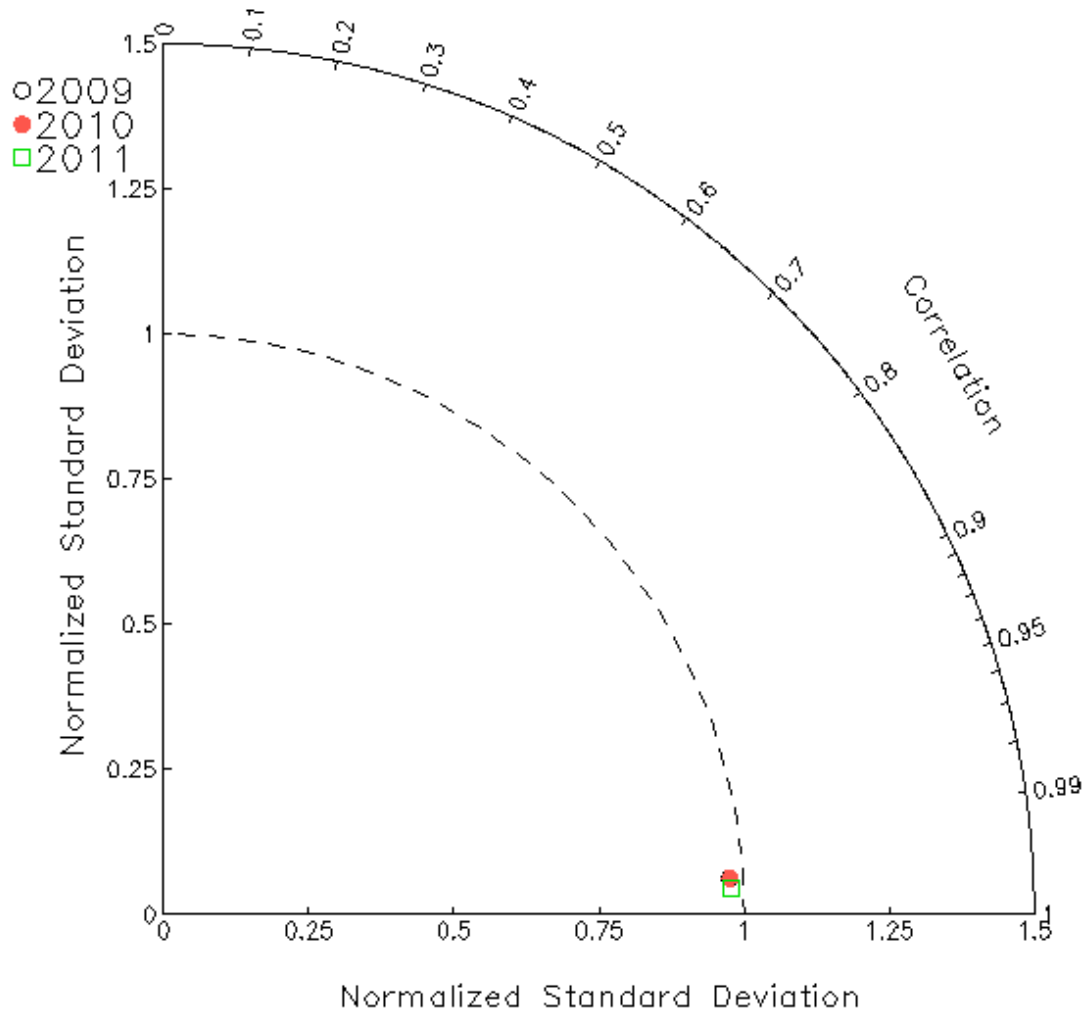
All-Sky Reflected Shortwave Radiation

Taylor Diagram for Annual Averages



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