

Evaluating the Relative Stability of CERES, MISR and MODIS Radiances Over the Terra Record



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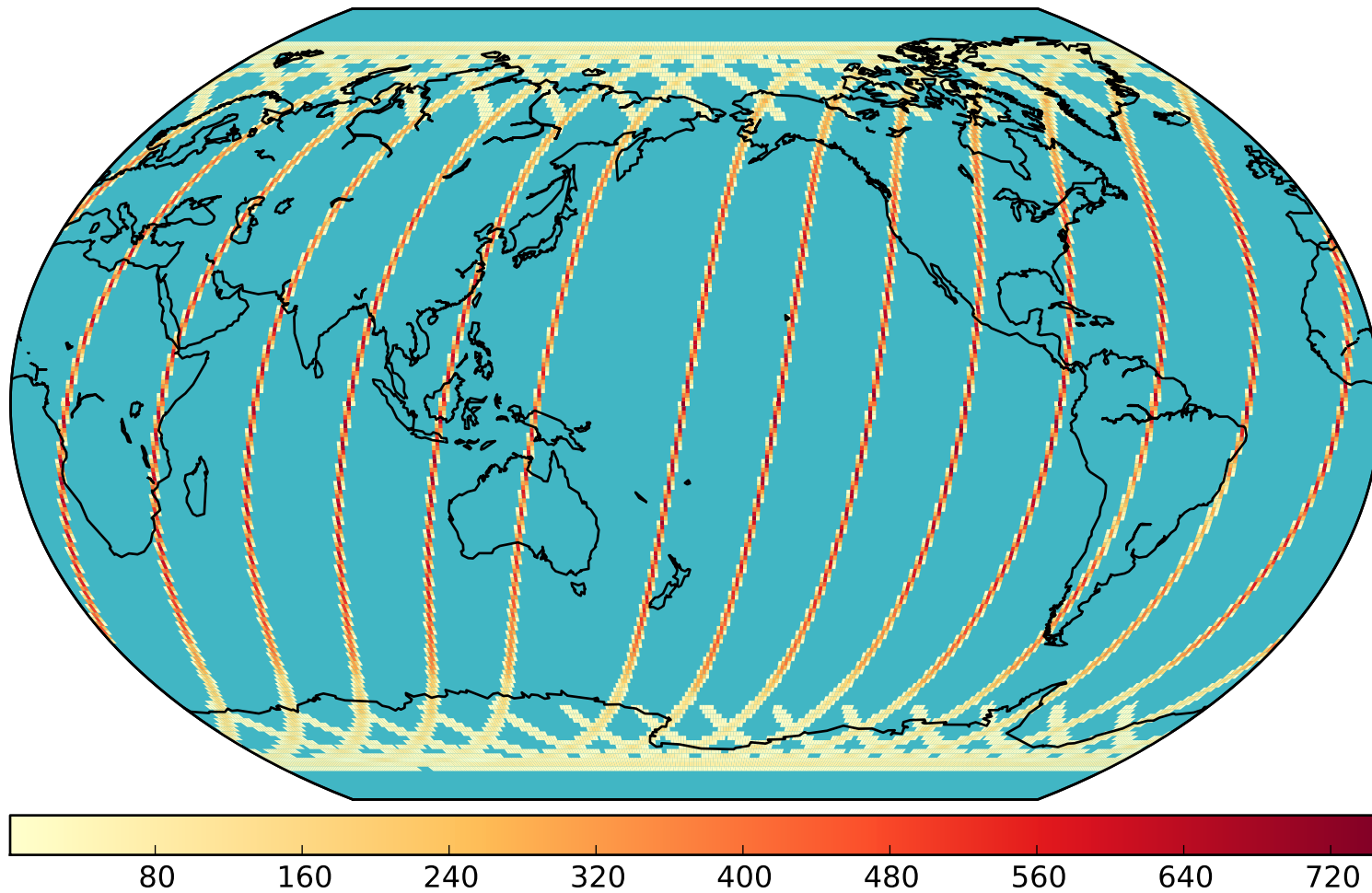
Introduction

- 14 year record of Terra allows us to compare the long-term relative stability of the radiances from the different instruments.
- We can use this to get a sense of the robustness of trends (or lack of trends as the case may be) in the reflected radiation.
- CERES, MISR and MODIS all have independent calibration techniques so comparing them is a good test of each instruments calibration.
- We use the Single Scanner Footprint - MISR (SSFm) dataset.
 - Combines CERES, MODIS and MISR radiances and scene information into a single dataset.

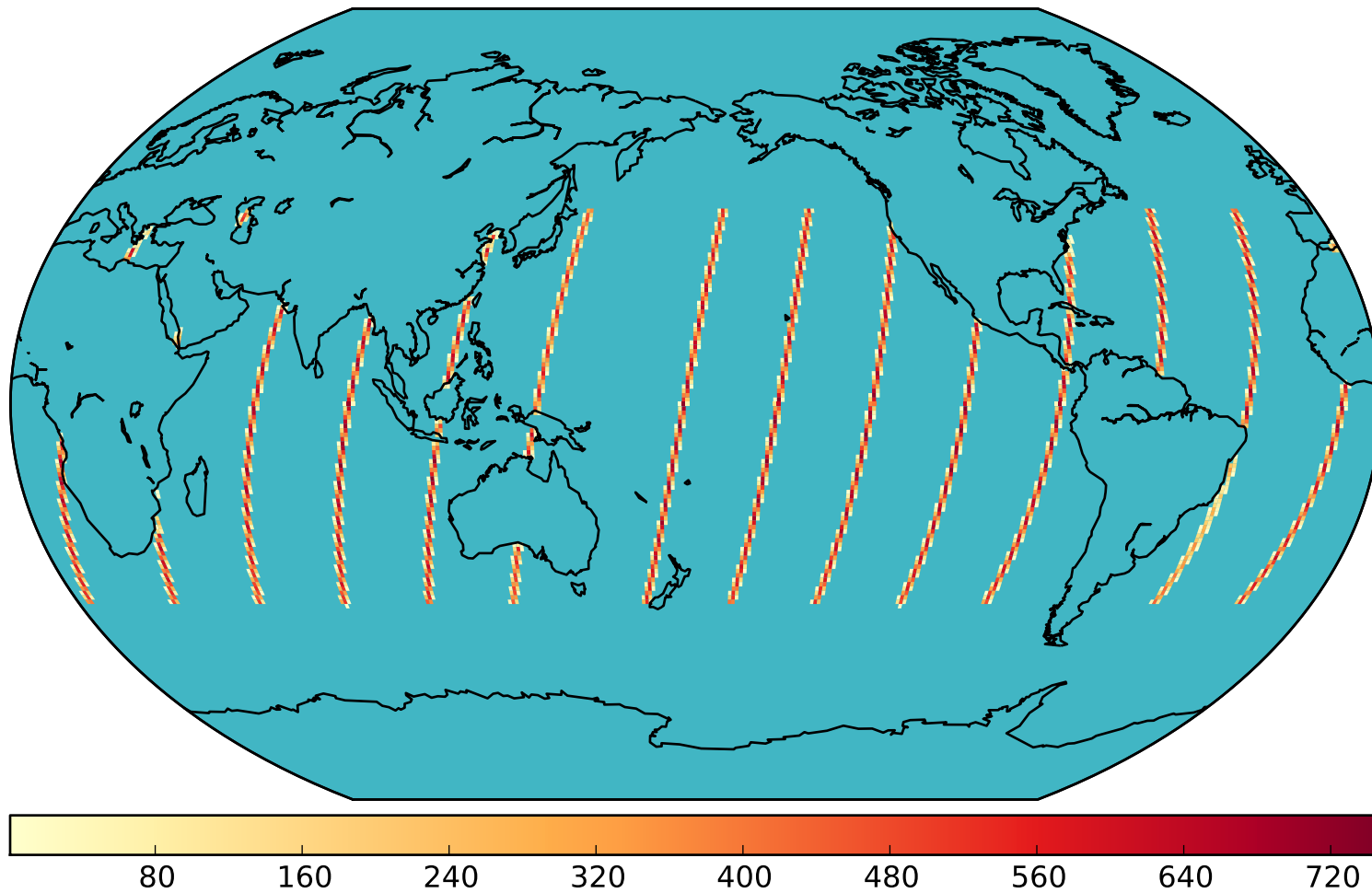
SSFM Dataset

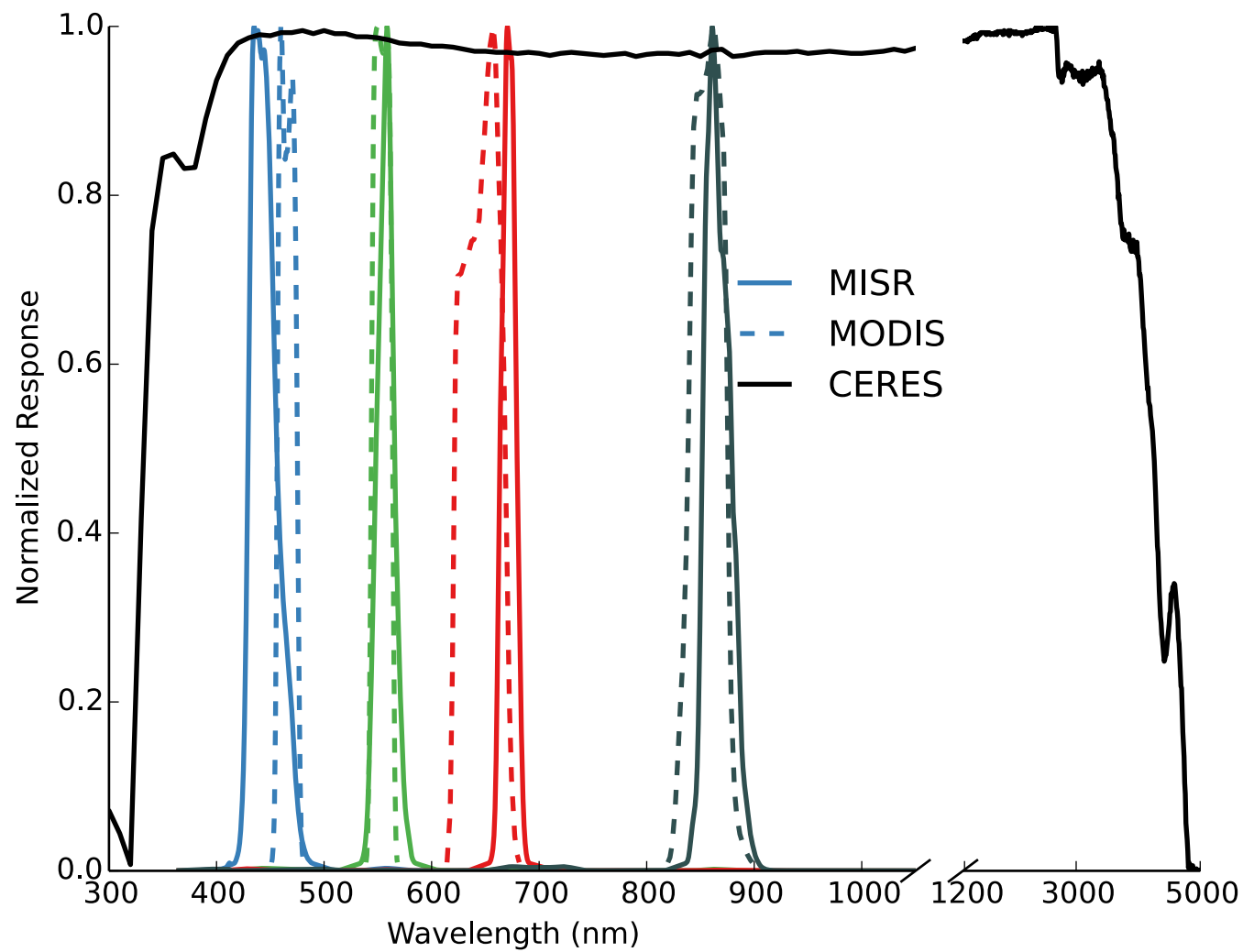
- Takes the existing SSF dataset - CERES radiance, flux and MODIS radiances, CERES team cloud information and adds the MISR radiances from the different angles.
- Narrowband radiances consist of the 4 MISR bands (446nm, 557nm, 672nm and 868 nm) and 4 MODIS bands (470nm, 555nm, 650nm and 858nm, bands 3, 4, 1, and 2)
- Narrowband radiances are matched in time and space and averaged over the CERES footprint using the CERES point spread function.
- We have extended it from March 2000 to February 2014 using the CERES FM1 Edition 3A, MODIS Collection 6 and MISR Level1 Ellipsoid F03_0024 datasets.
- Processed every 16th day of data in order to get the orbit repeat cycle but limit the processing time and dataset size.
- This version is limited to CERES cross track viewing angles of $<5^\circ$.

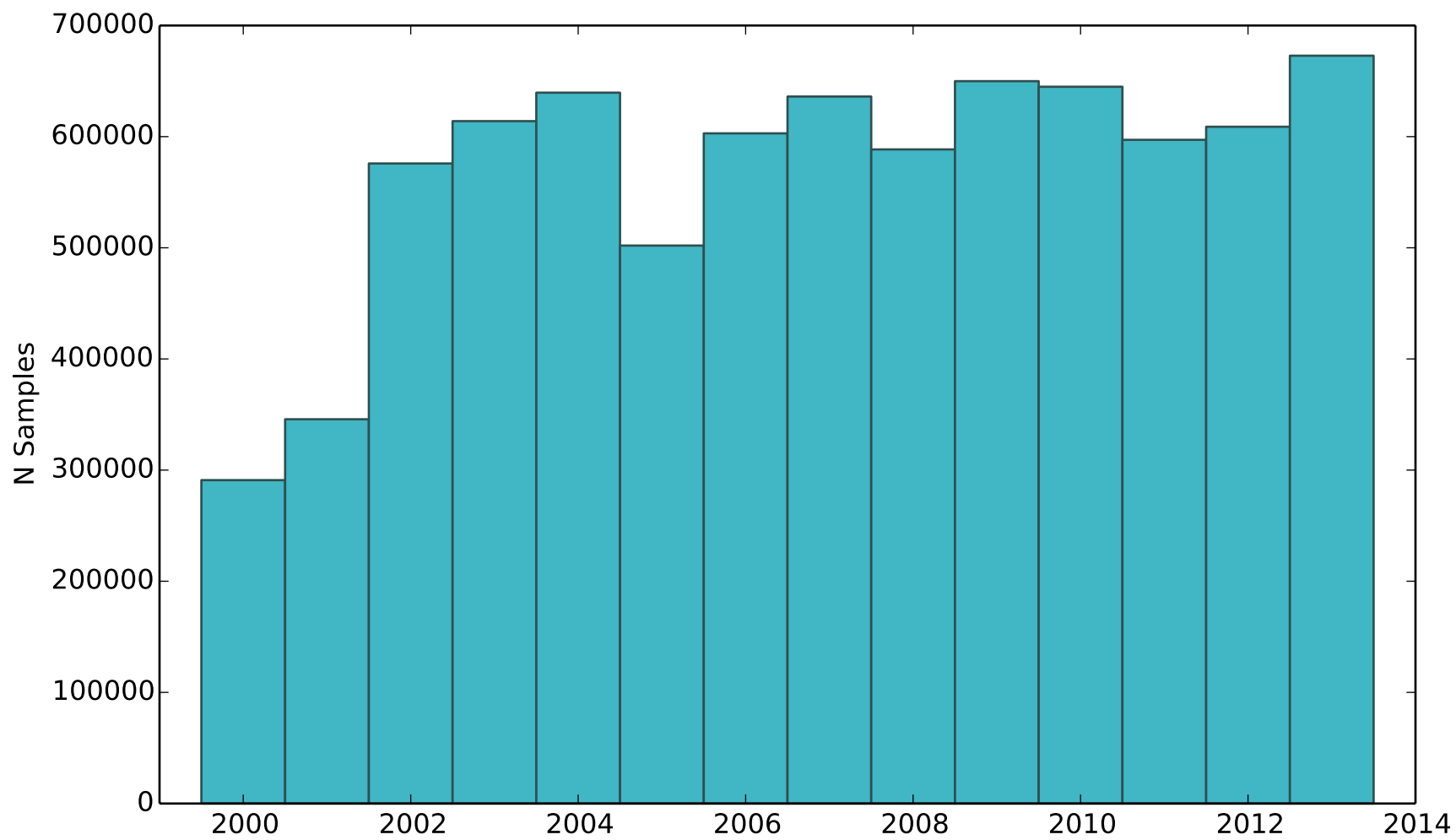
2013

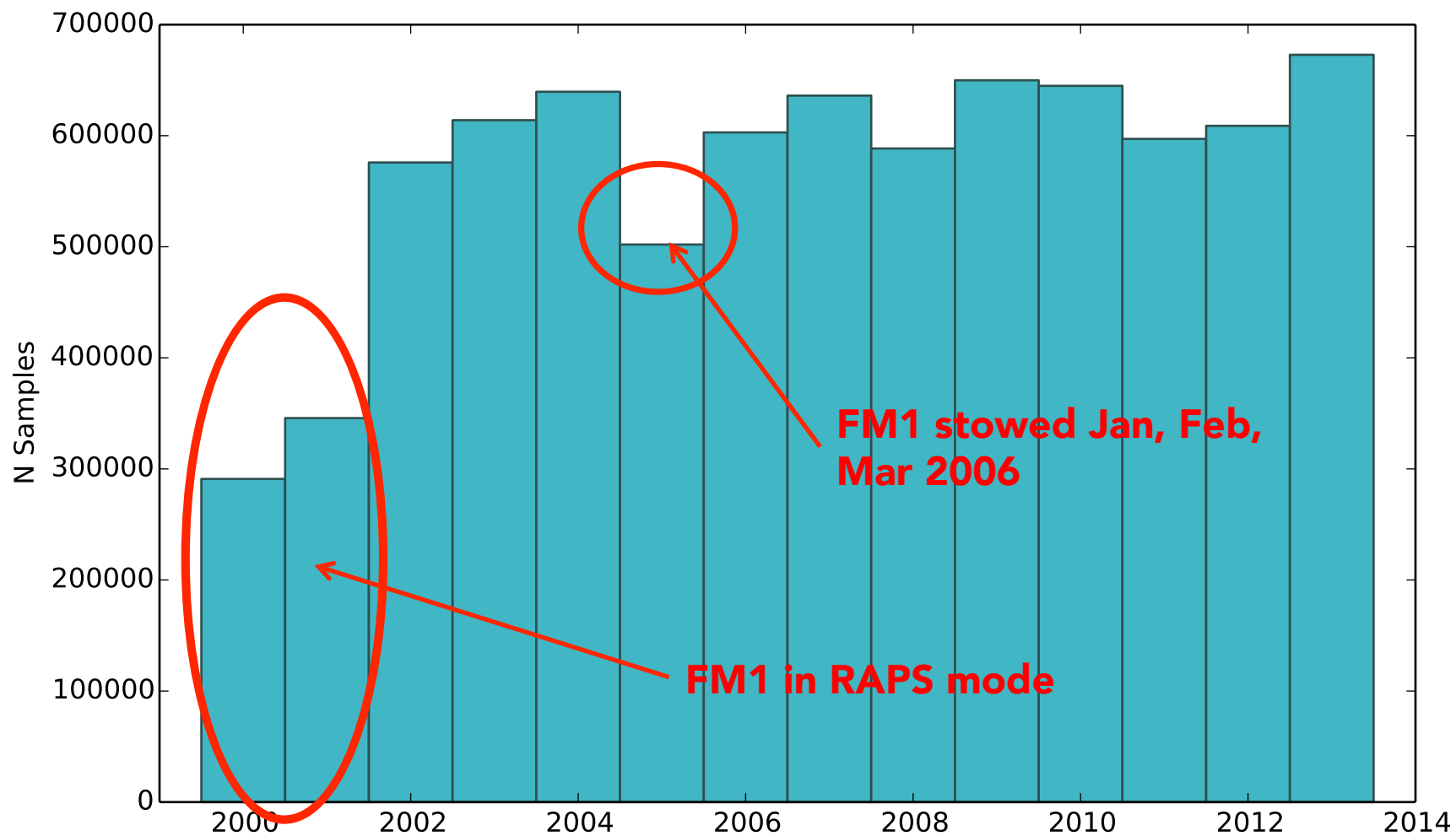


2013

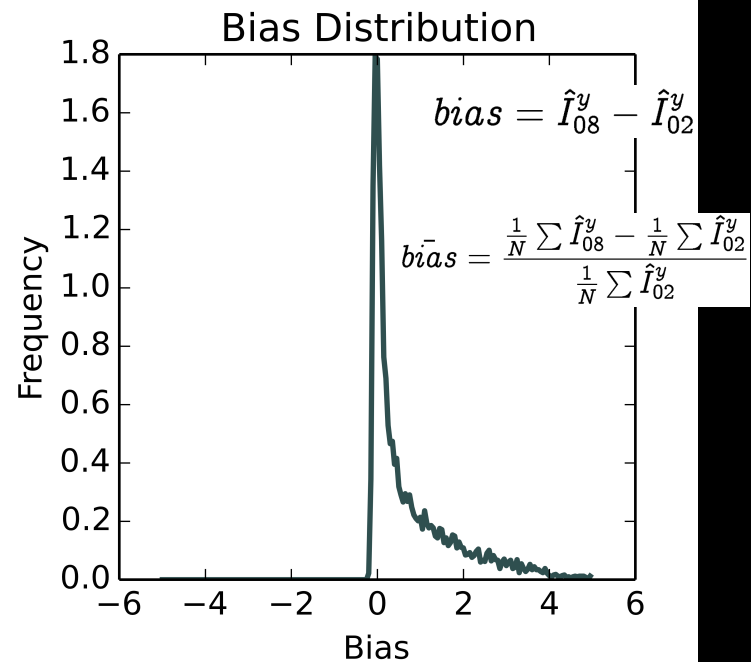
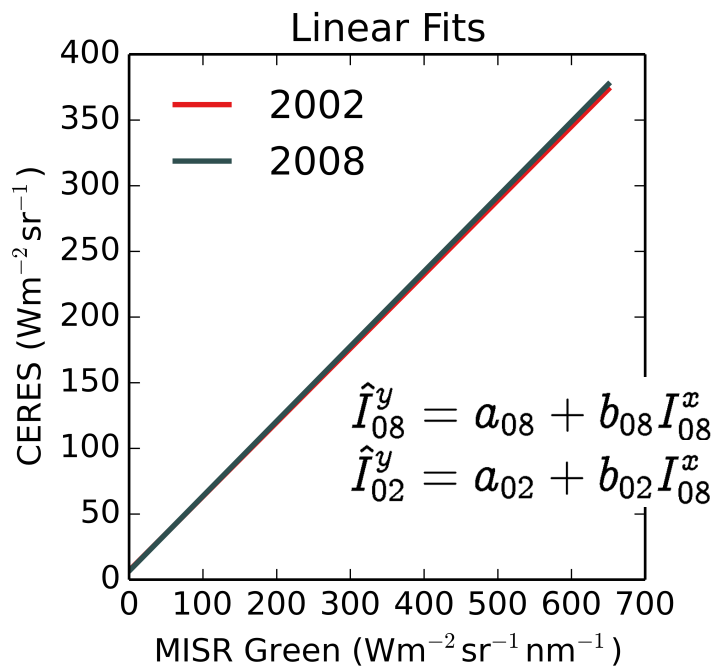
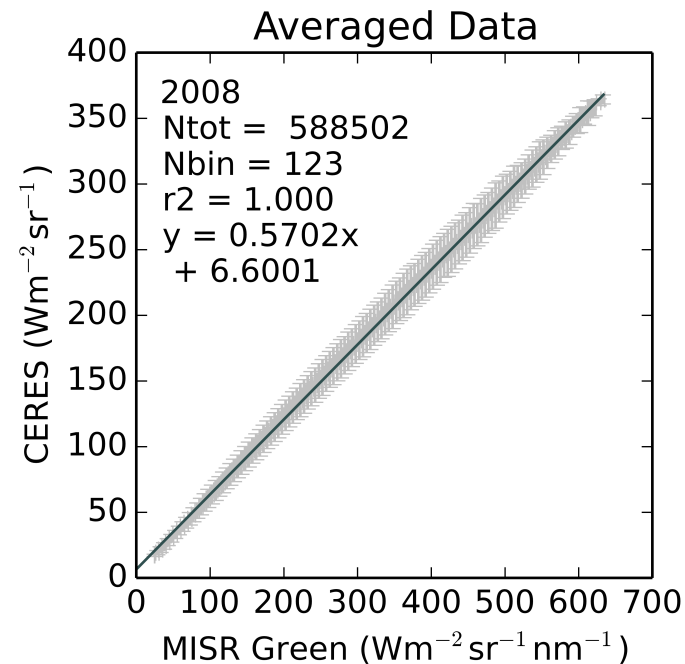
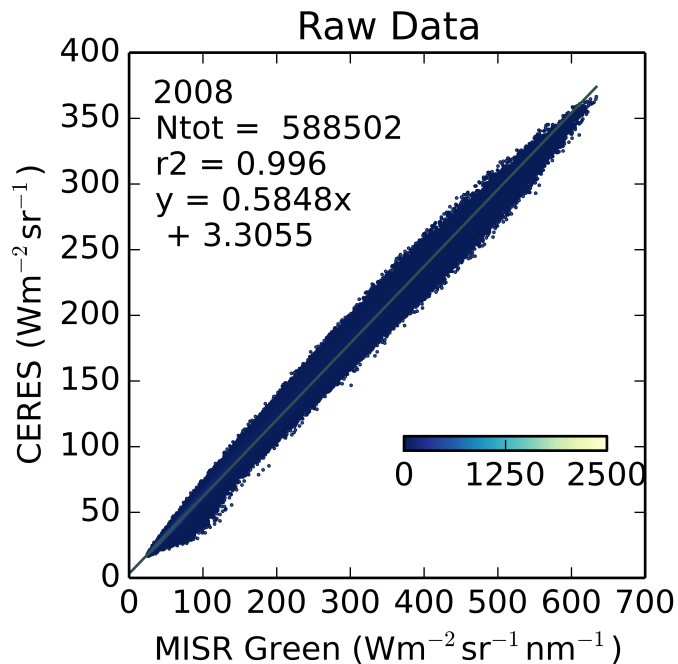


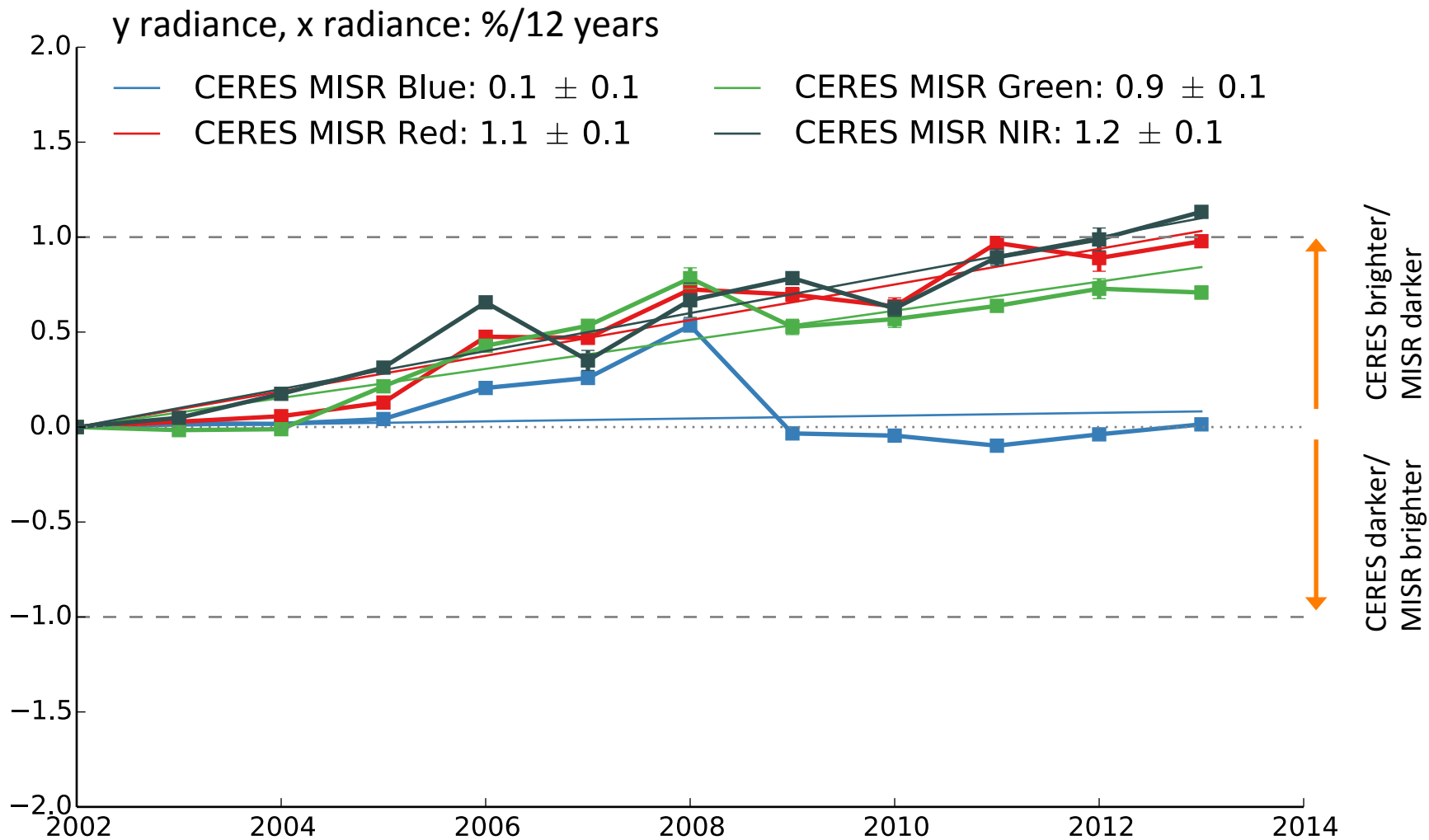


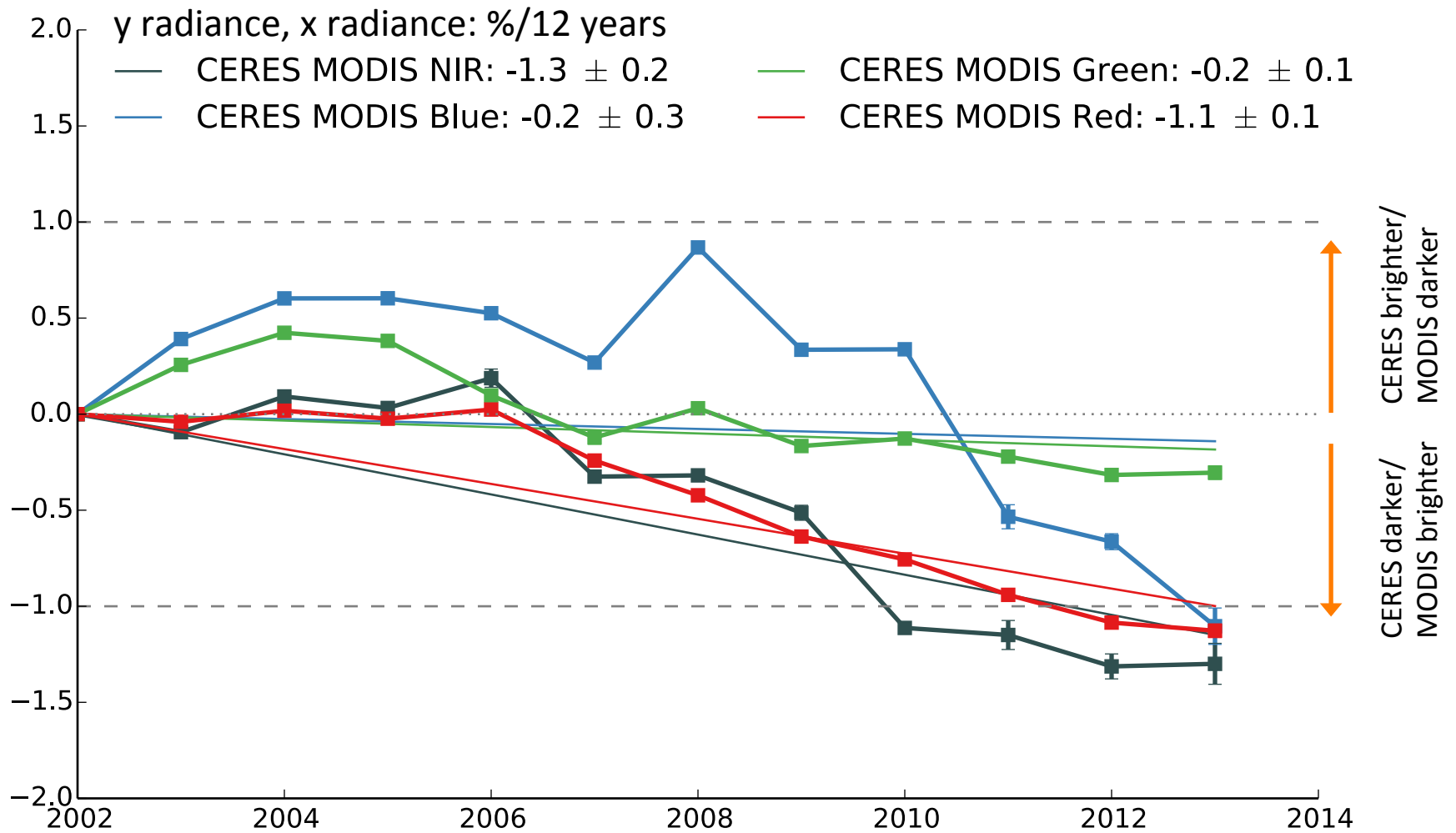


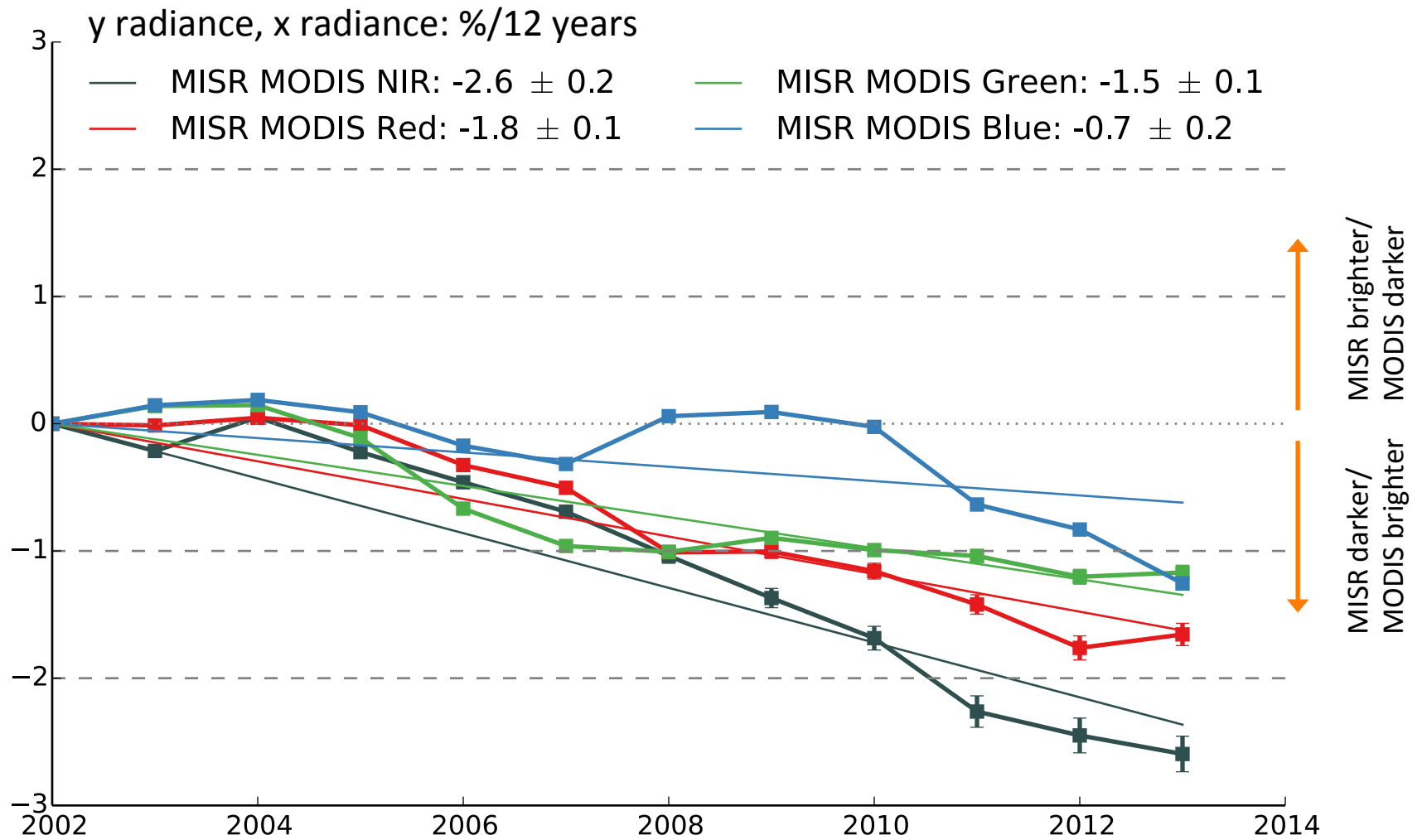


Method

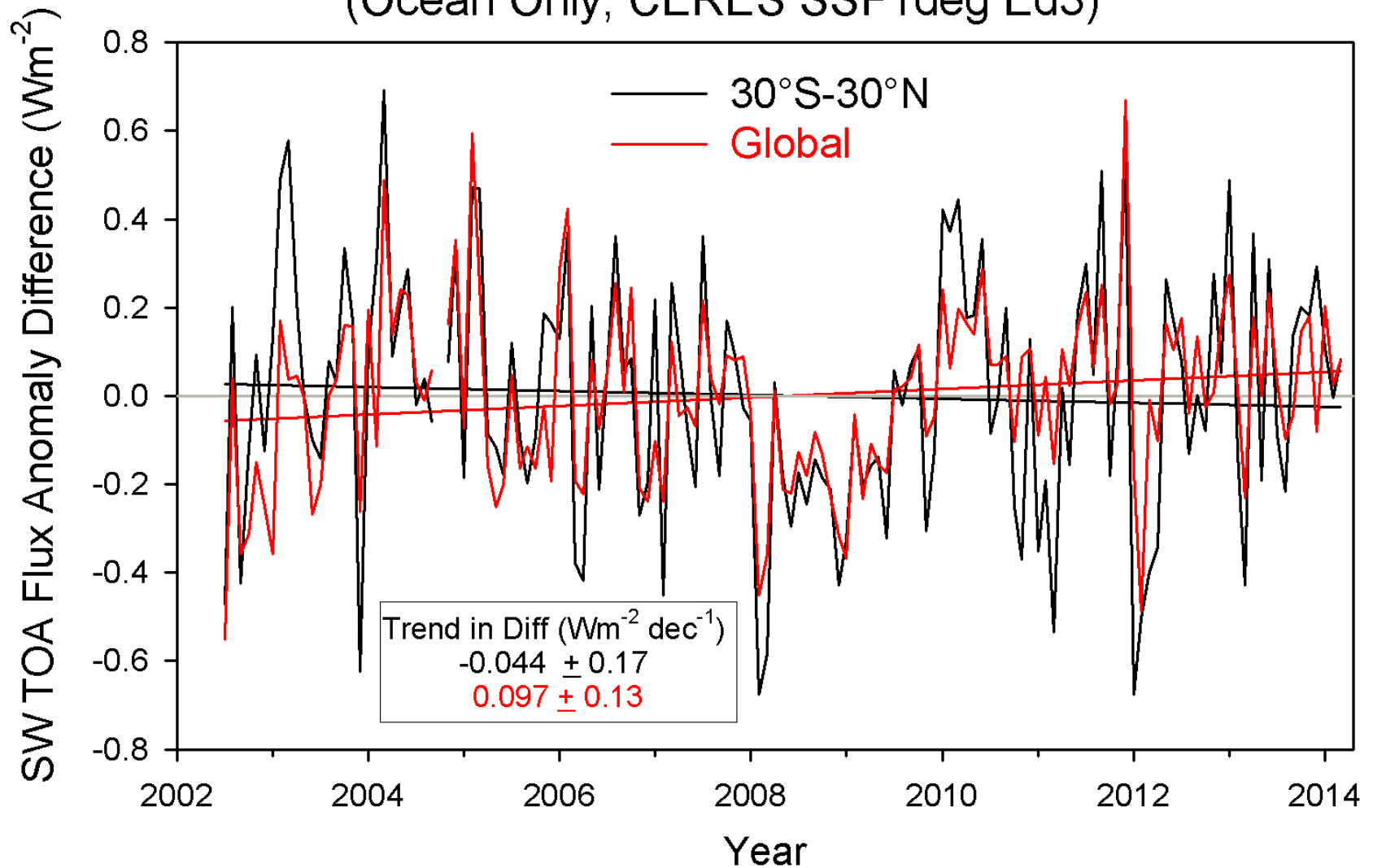








Terra minus Aqua SW TOA Flux Anomaly Difference (Ocean Only; CERES SSF1deg Ed3)

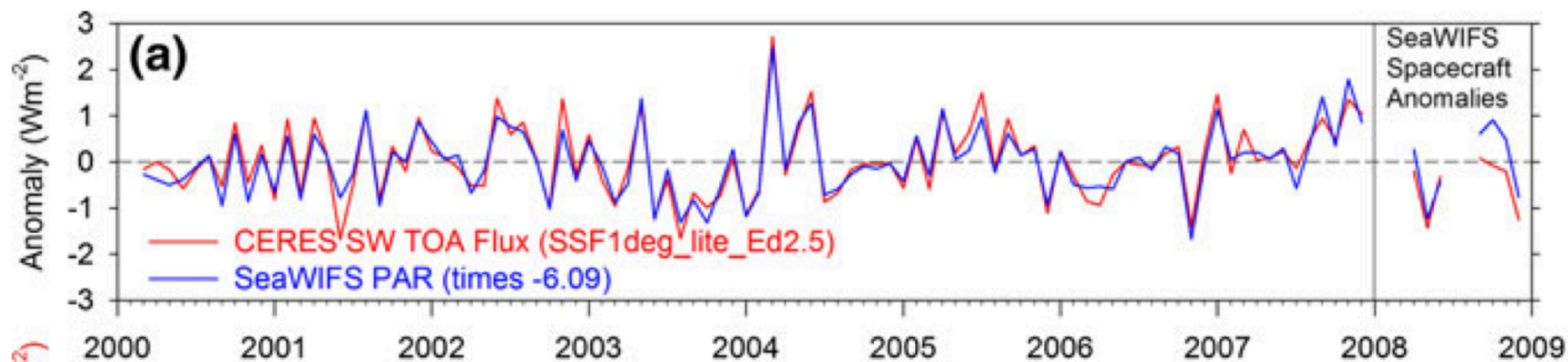


Conclusions

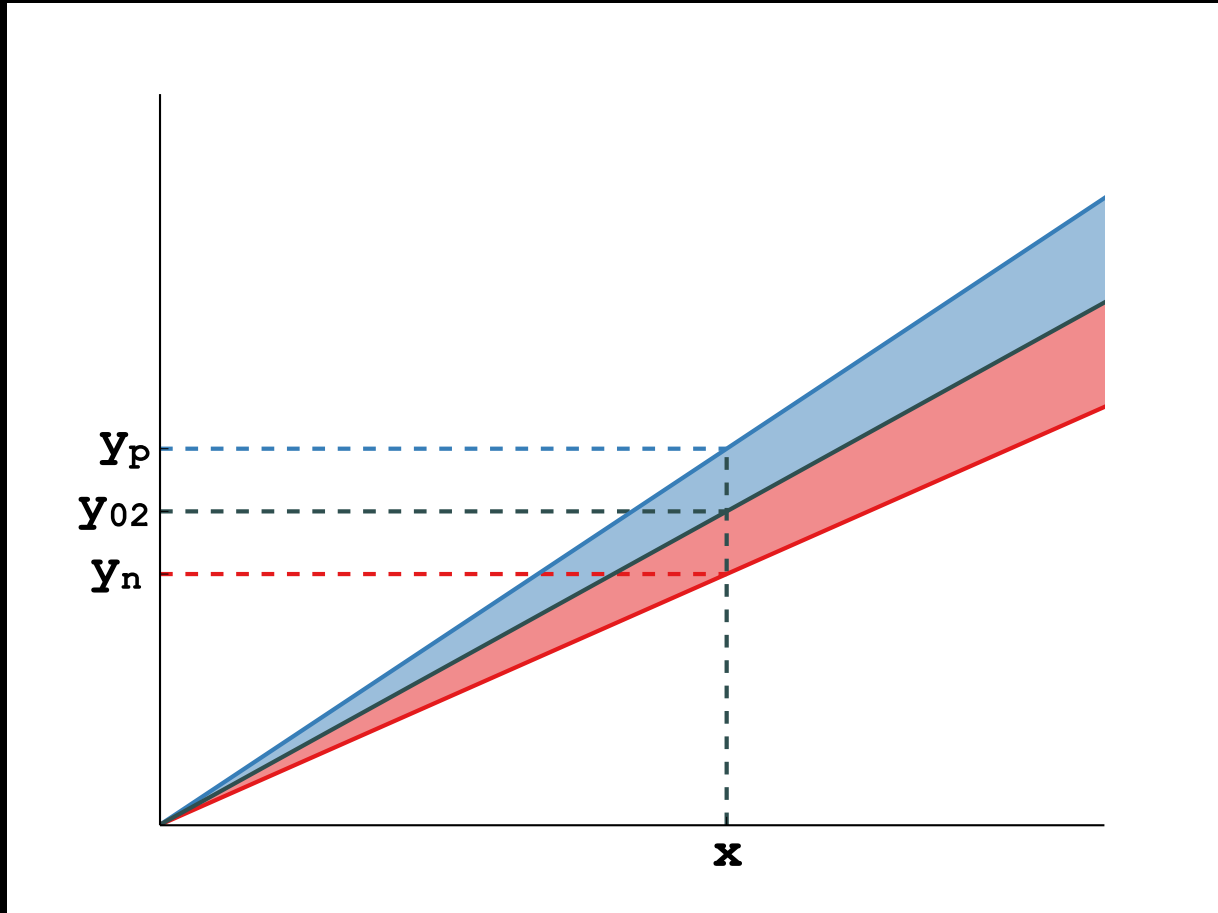
- Combining the CERES, MISR and MODIS products gives us a unique dataset that we can use to examine the relative stability of the instruments over time.
- Overall the changes in the relative calibration between the CERES, MISR and MODIS radiances are low, less than $\pm 3\%$ since 2002.
- Trends between CERES and MISR and MODIS are between $\pm 1.3\%$ since 2002.
- Largest trends occur between the NIR bands of MISR and MODIS, with MODIS brightening by 2.6% relative to MISR.
- Remains hard to determine which, if any, of the instruments have greater absolute stability (but we have confidence in CERES).

Method

- Average the 'y' and 'x' radiance in 5 $\text{Wm}^{-2}\text{sr}^{-1}$ (3 $\text{Wm}^{-2}\text{sr}^{-1}$ if 'x' is a NIR band) bins of the 'x' radiance $\rightarrow \mu_x, \mu_y$
- Perform linear regressions between μ_x and μ_y for each year.
- Use that to estimate a 'Y' radiance as a function of the μ_x radiance.
- Repeat using the regression coefficients from the reference year (2002).
- Calculate the mean relative bias $\rightarrow (Y - Y_{2002})/Y_{2002}$.
- Tells us how the 'y' radiance has changed with respect to the 'x' radiance over time.



Method



- A positive bias indicates increase in the 'y' radiance relative to the 'x' radiance and negative bias indicates a decrease in the 'y' radiance relative to the 'x' radiance.
- Important to note that as these are relative biases we can't use them to say which instrument is the more stable.

Terra SW TOA Flux Anomaly (Ocean Only; CERES SSF1deg Ed3)

