

Simulation of Interannual Variability in Solar Benchmark Reflectance And Comparison With Observations

Z. Jin, C. Lukachin, and Y. Roberts

SSAI, Inc. / NASA Langley research Center

CLARREO SDT Meeting

October 15-17, 2013

Objectives:

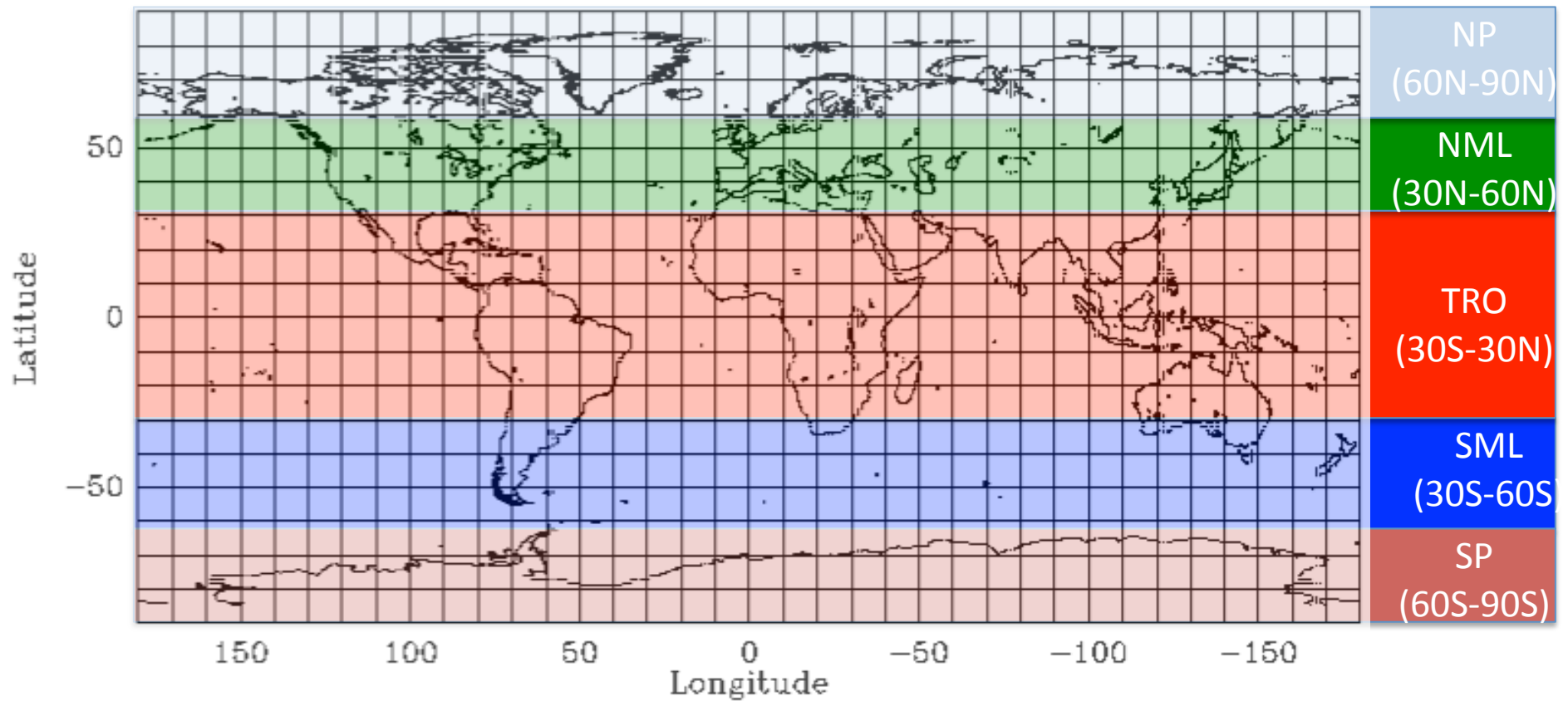
- 1) Understand the interannual variability expected in the CLARREO solar benchmark reflectance spectra.
- 2) Evaluate the modeling ability to simulate the spectral reflectance and its variability in large climate domains.
- 3) Cross check the results from observations, RT model, and climate OSSE for consistence.

Observation data: SCIAMACHY radiance and solar irradiance (2003-2010).
Spectral range: 300-1750 nm; resolution: 1 nm.

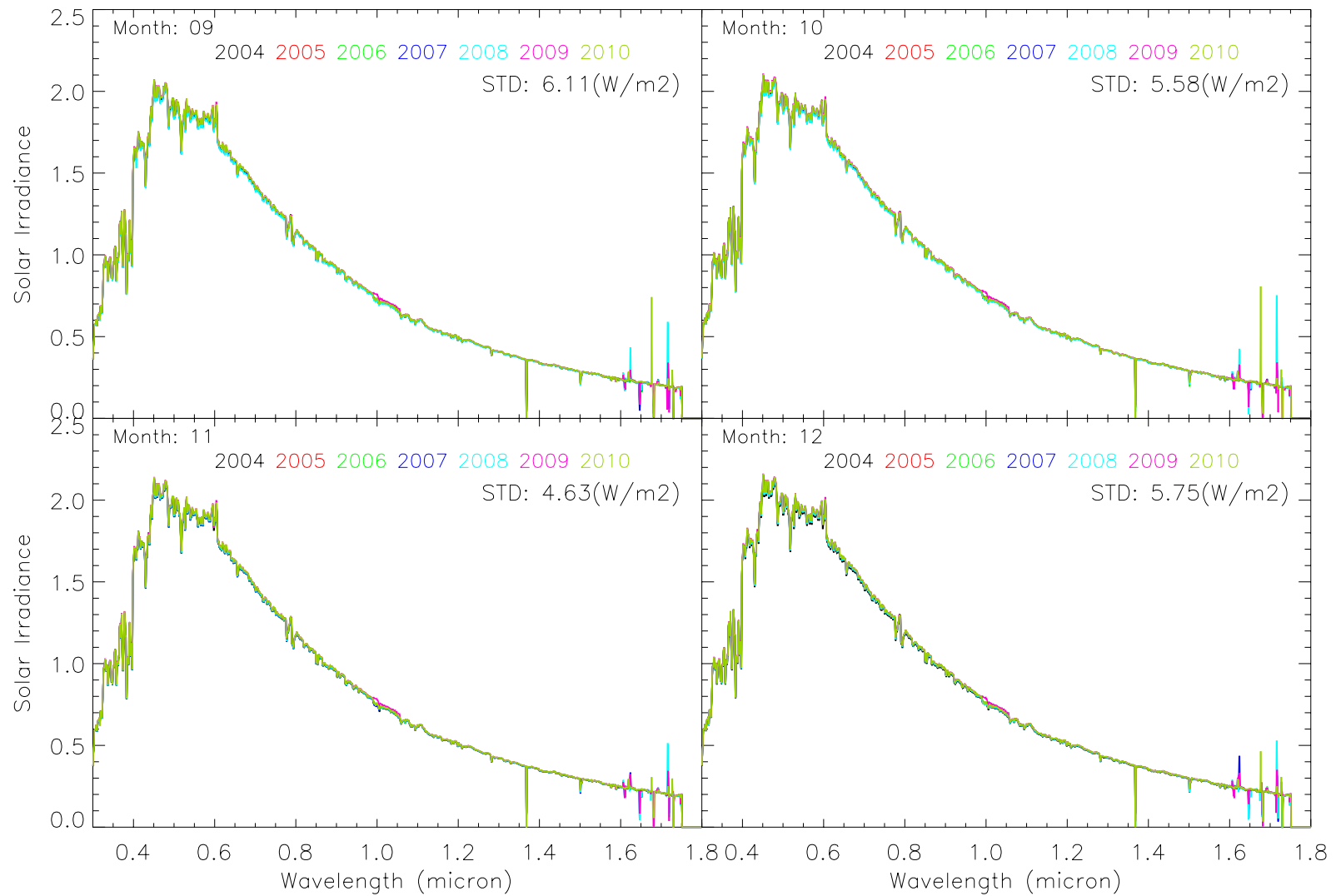
RT model: MODTRAN with input parameters from CERES SSF, MODIS and SMOBA.

Climate OSSE: MODTRAN with input parameters from climate model simulations.

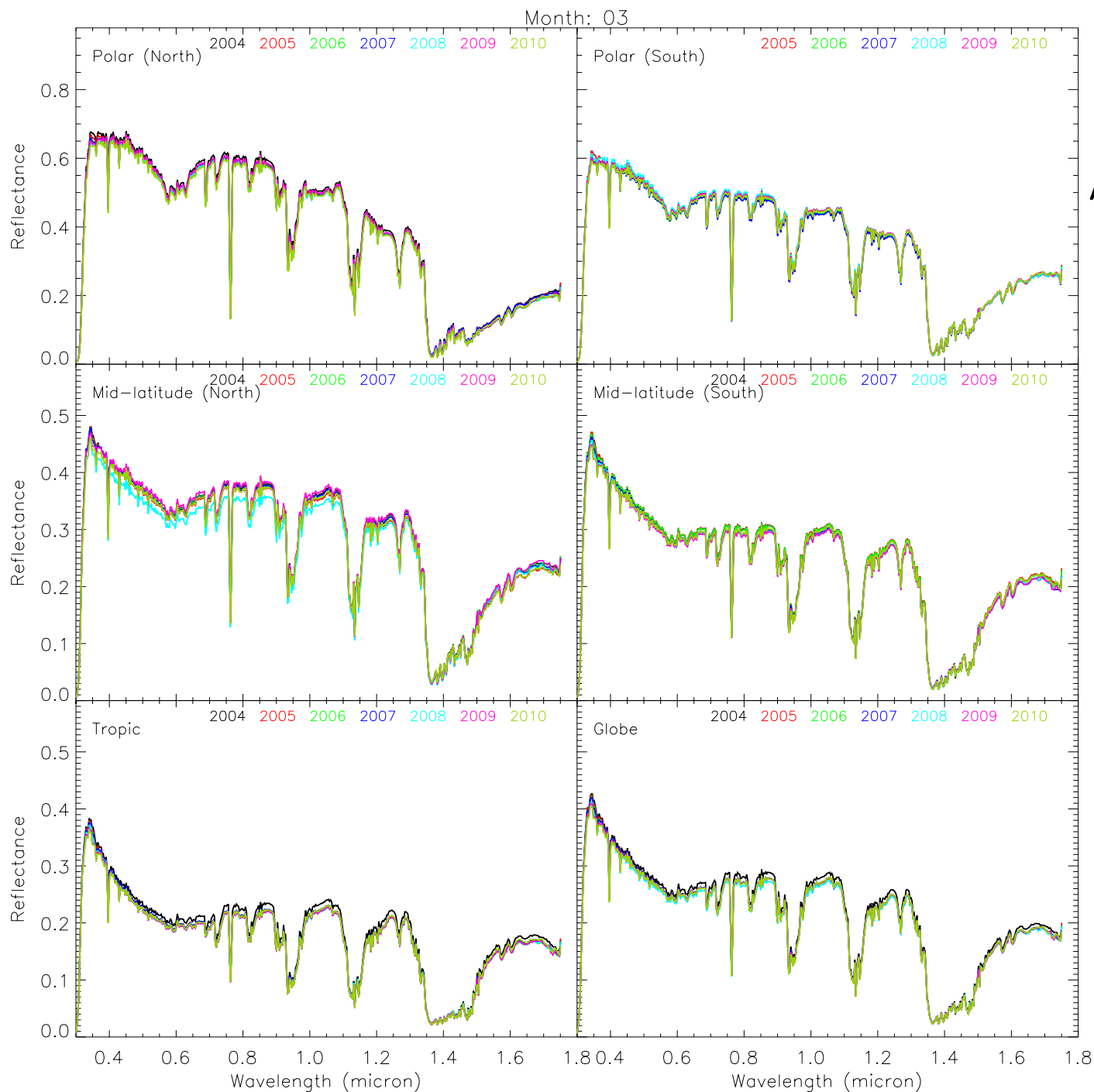
Five latitude regions



Data are first averaged to 10 deg latitude zones in each month.
Reflectance is averaged over 5 large latitude regions and globe.



A sample of SCIAM measured solar irradiance over 7 years (2004-2010).
(Each colored line is for a different year)



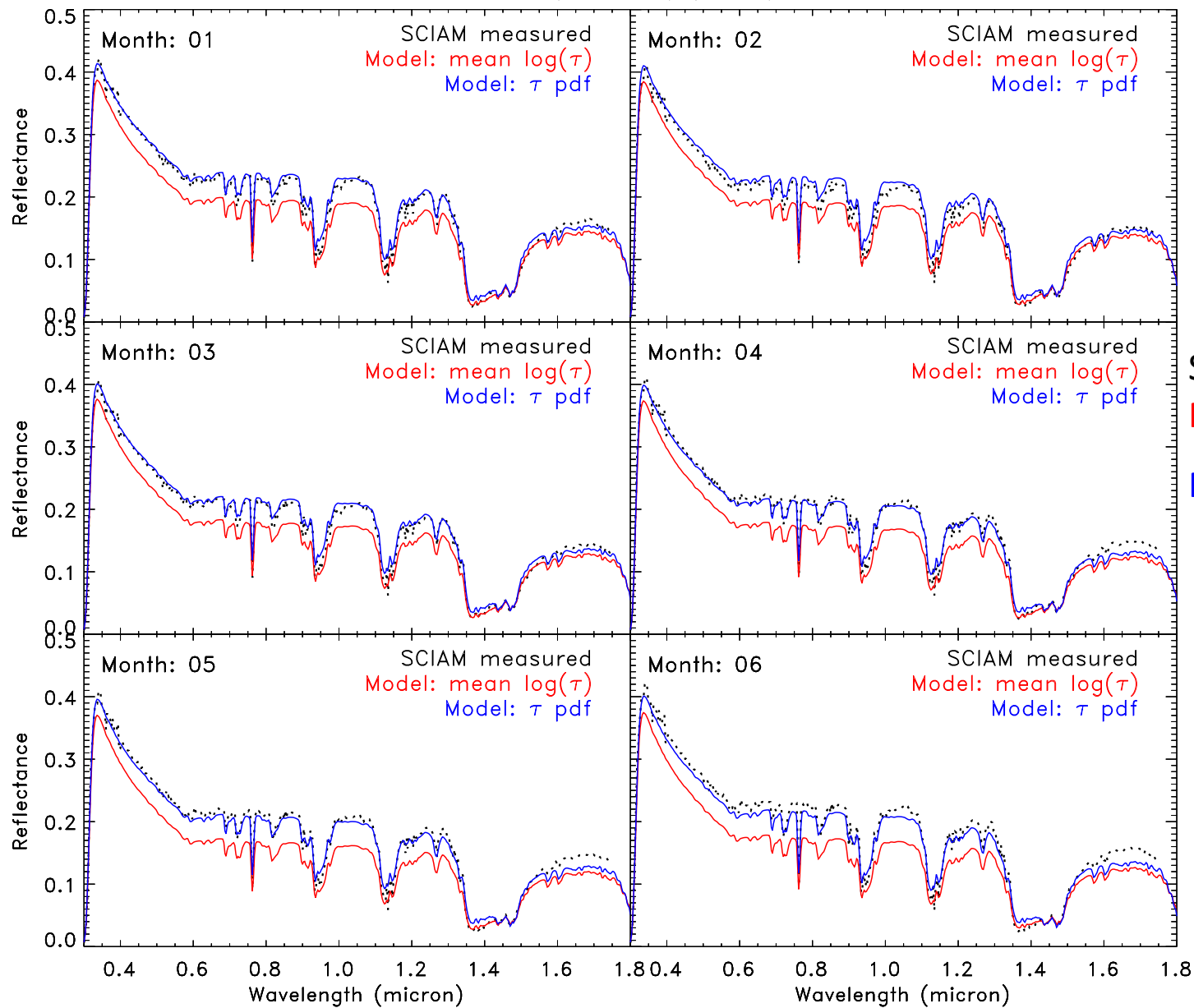
An example of SCIAM
measured solar
reflectance averaged
to the 5 latitude
regions and globe.

(Each panel is for a
different region,
each color is for a
different year.)

CLARREO's climate benchmark concerns radiation averaged over large space and time scales.

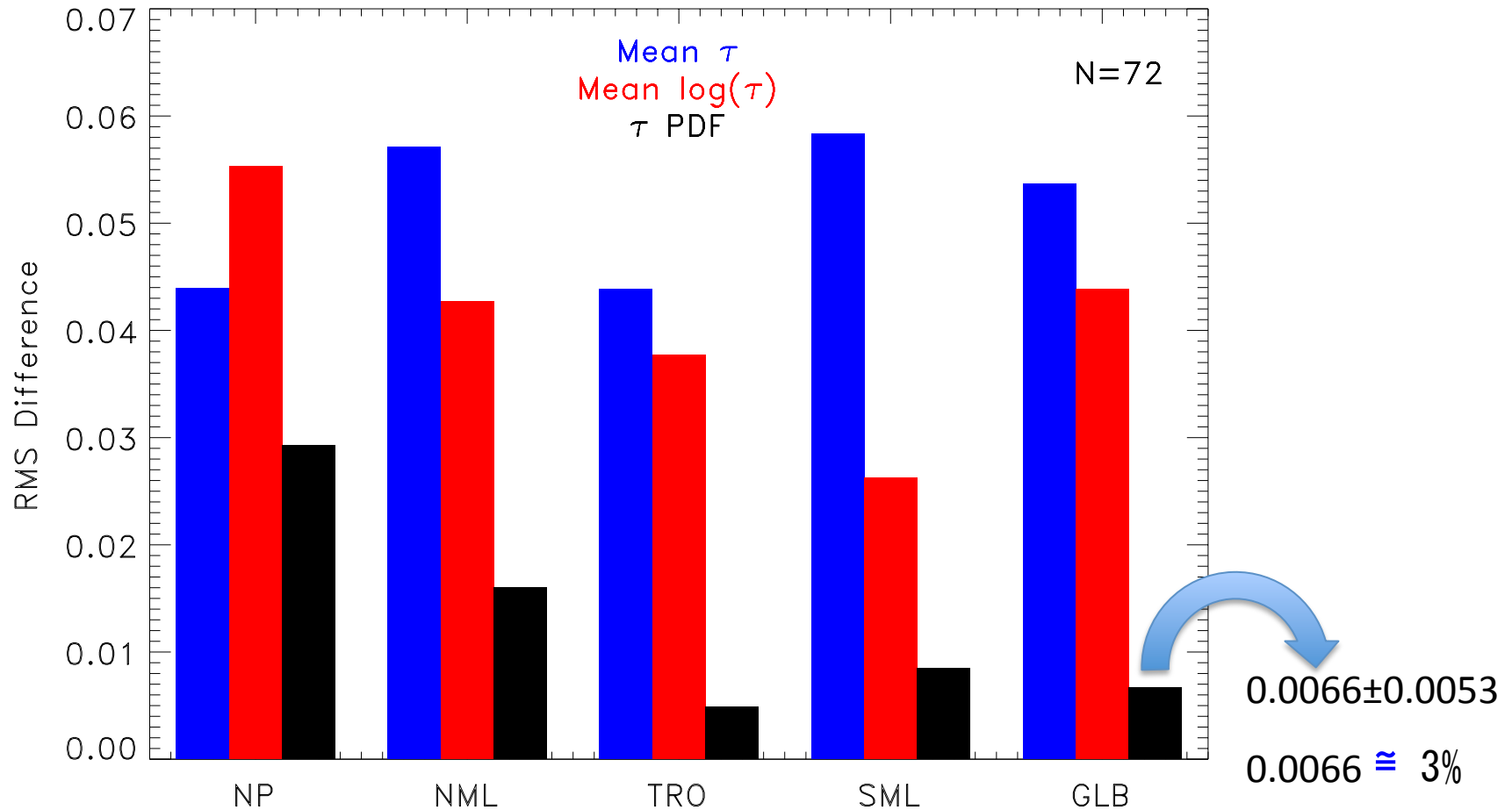
Spaceborne sensors have measured the atmospheric and surface properties over globe for decades and have accumulated a large volume of instantaneous measurement data. It is impractical, if not impossible, to simulate the mean spectral radiance over large climate domains by explicit RT computations for each satellite footprint individually.

The simplifying approach based the cloud probability distribution function (PDF) was recently developed to efficiently and accurately calculate the large domain-averaged radiance/reflectance using a large volume of instantaneous satellite data.

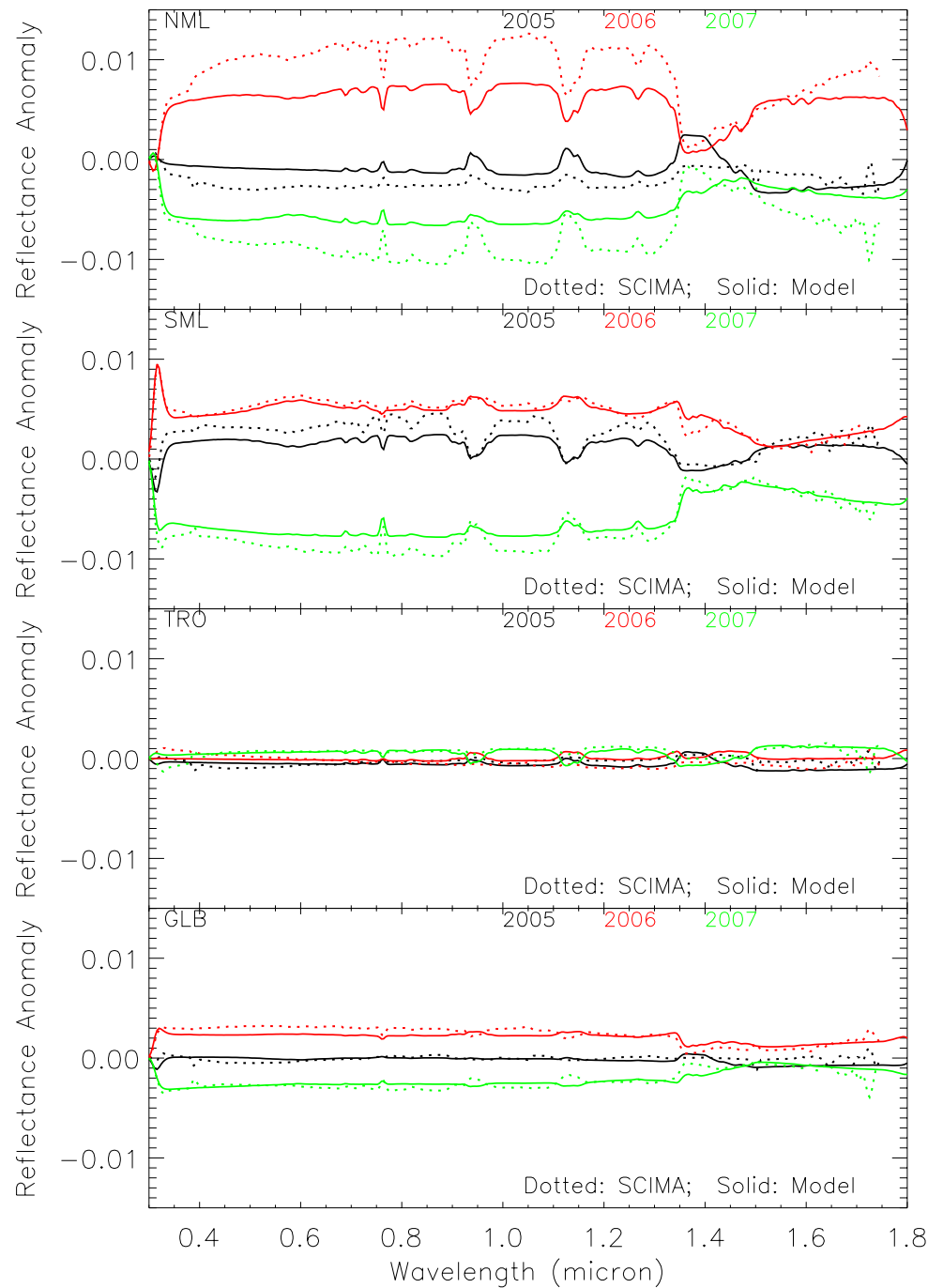


SCIAM measured
 Model with mean τ
 Model with τ PDF

Comparison of observed and calculated monthly and globally averaged spectral nadir reflectance (ocean only).

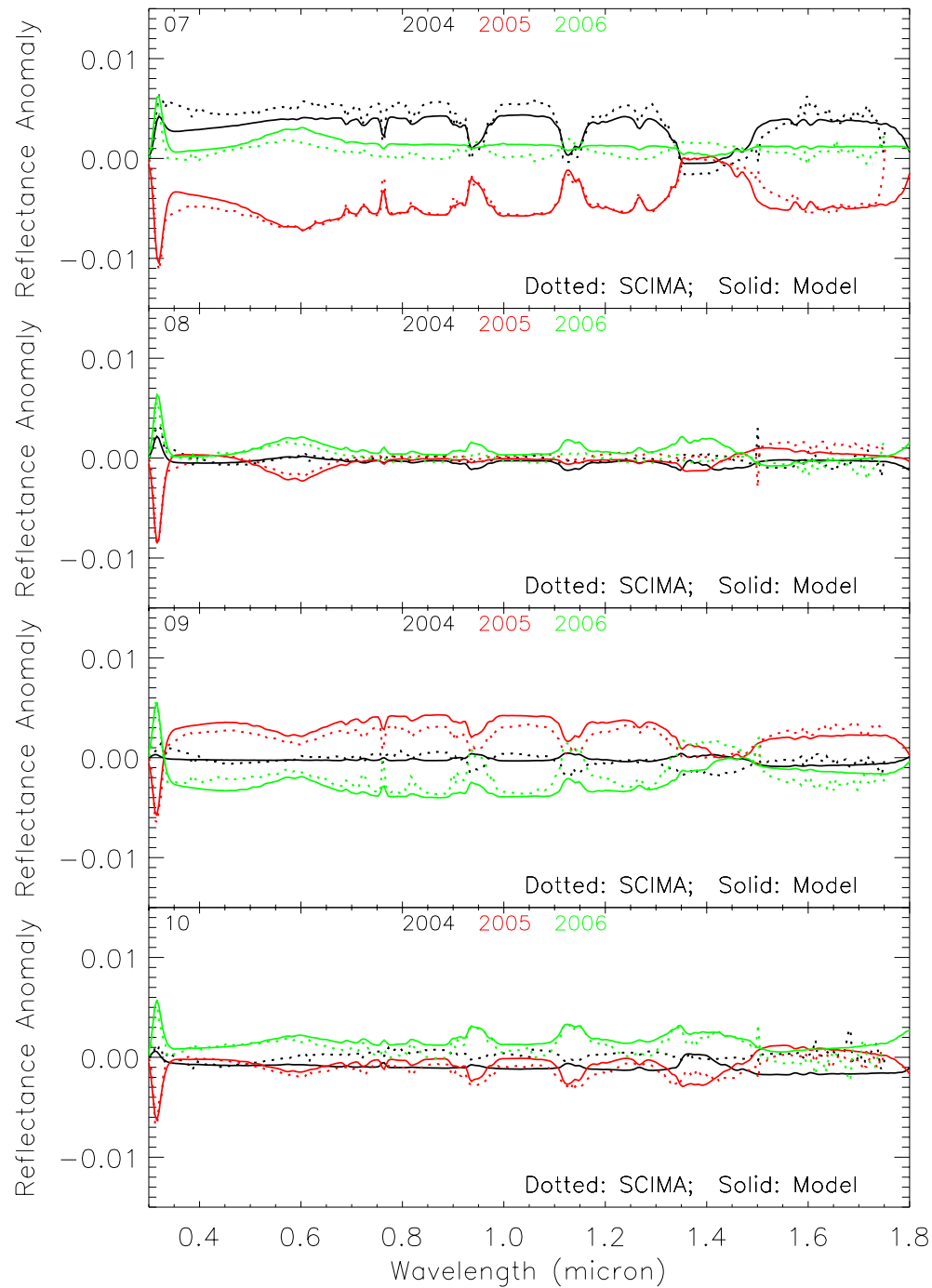


The RMS model discrepancy in the monthly mean reflectance in the five latitude regions (based on the results in the 72 months from 2004 to 2009). Each color bar represents a RMS error for a different modeling approach.



Comparison of the monthly mean reflectance anomalies between SCIAM measurements and model.
(In the same month but different regions. One panel for one region and one color for one year.)

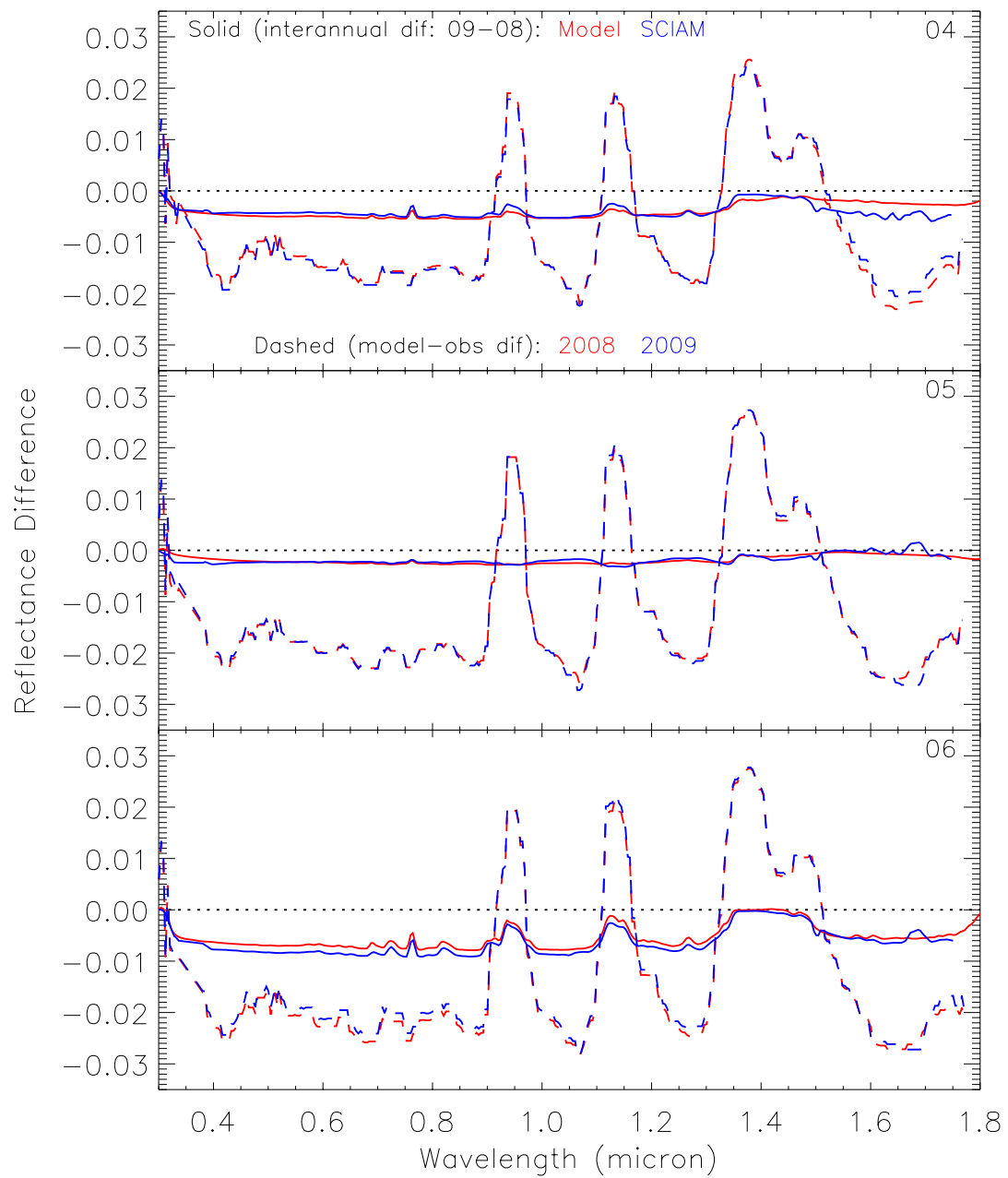
Dotted: SCIAM
Solid: Model

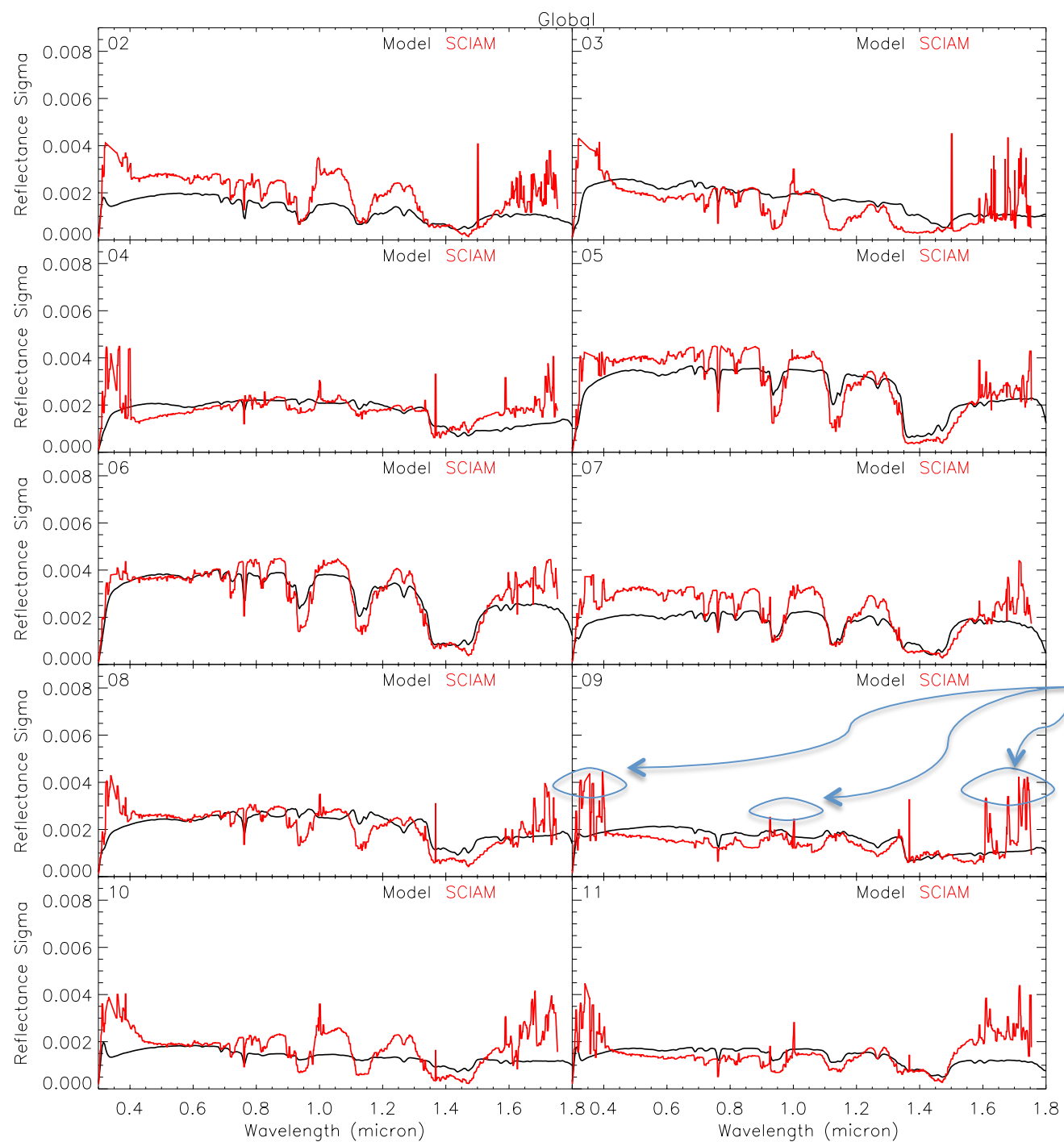


Comparison of the monthly mean reflectance anomalies between SCIAM measurements and model.

(In the same region but different months. One panel for one month and one color for one year.)

Dotted: SCIAM
Solid: Model

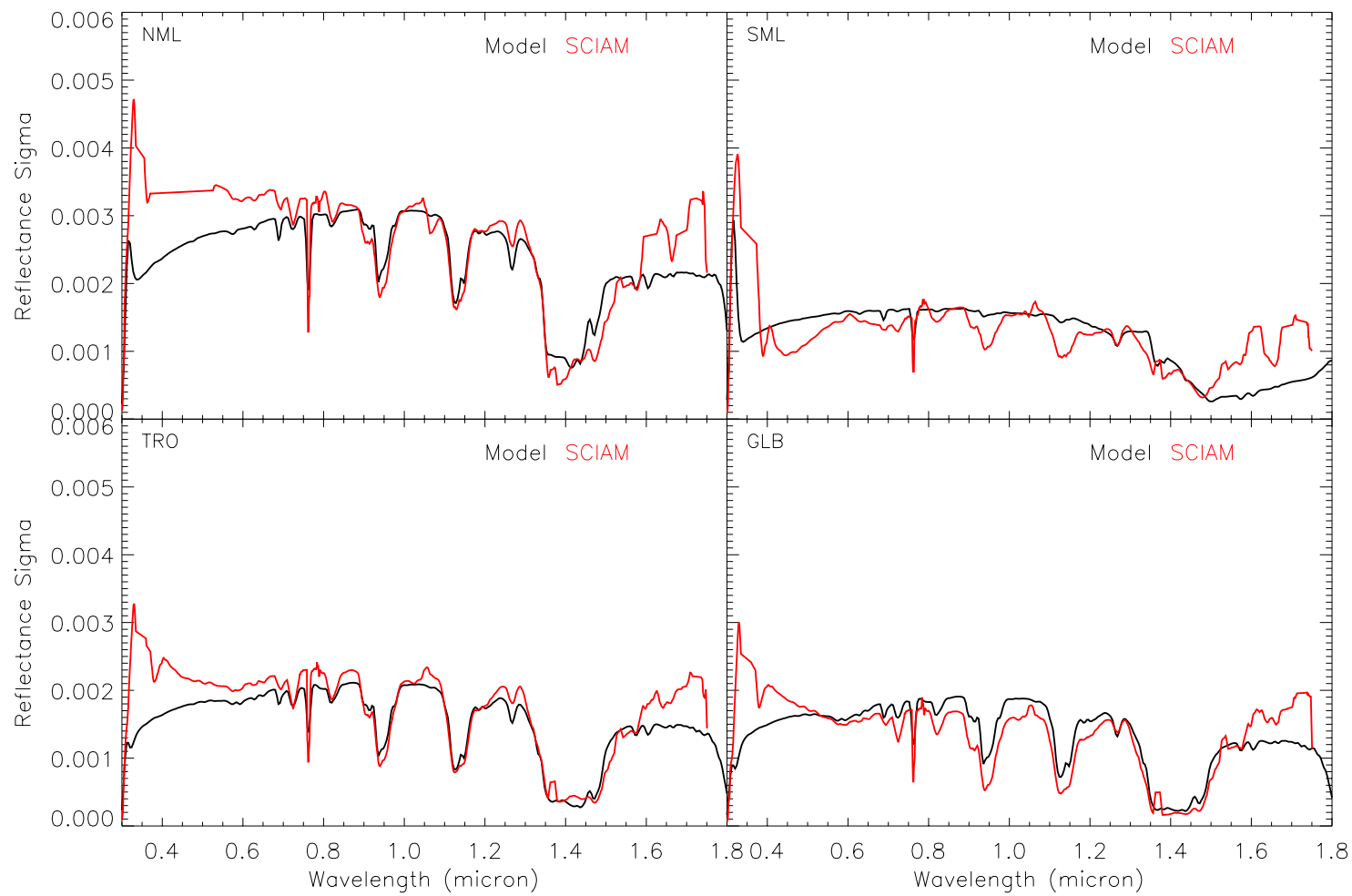




1 σ of the monthly mean global reflectance across all years from SCIAM and model.

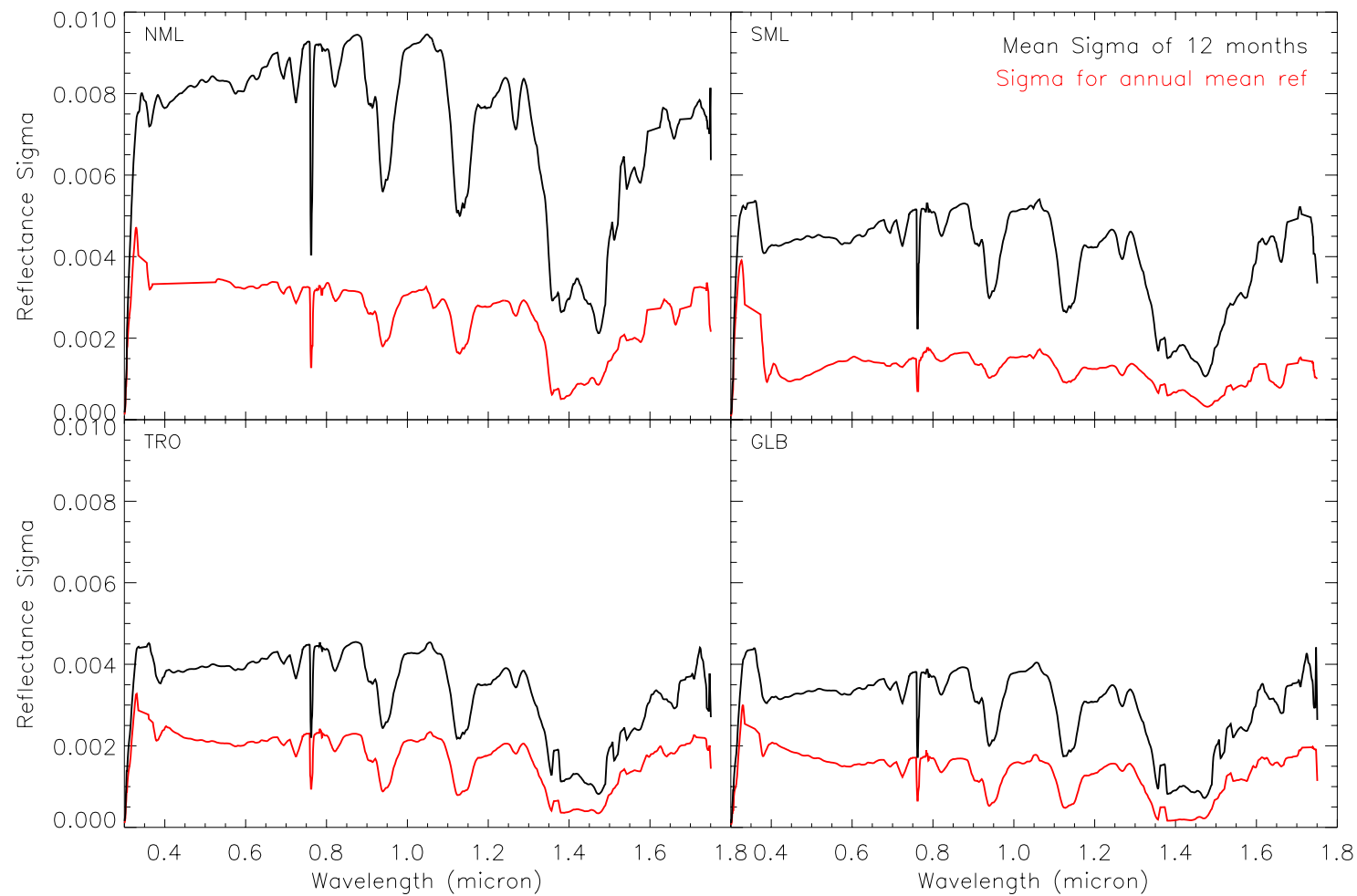
One panel for one month.

Spectral ranges with large measurement uncertainty.



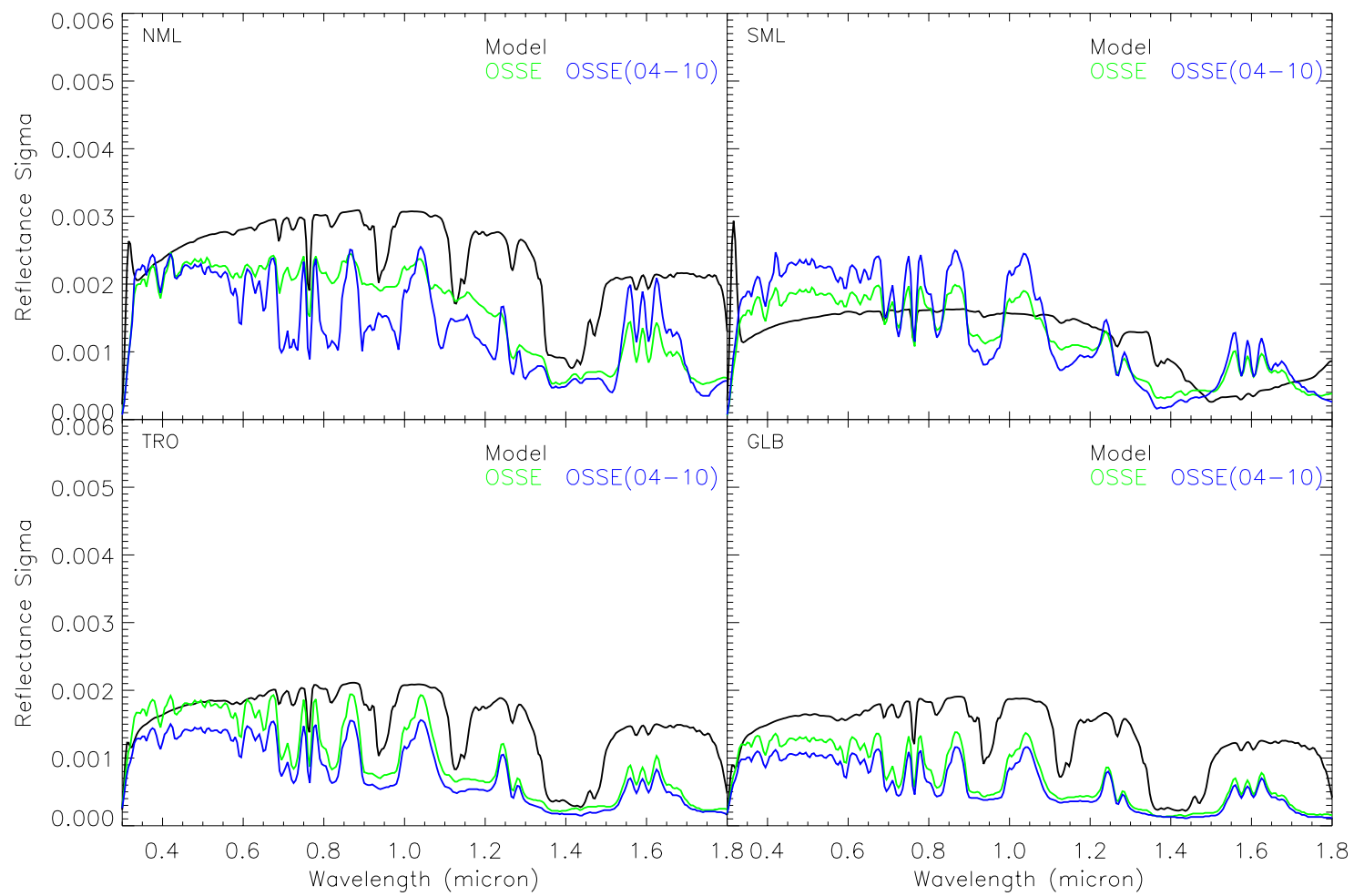
The annual mean reflectance σ from SCIAM and model.

Each panel shows a different region.

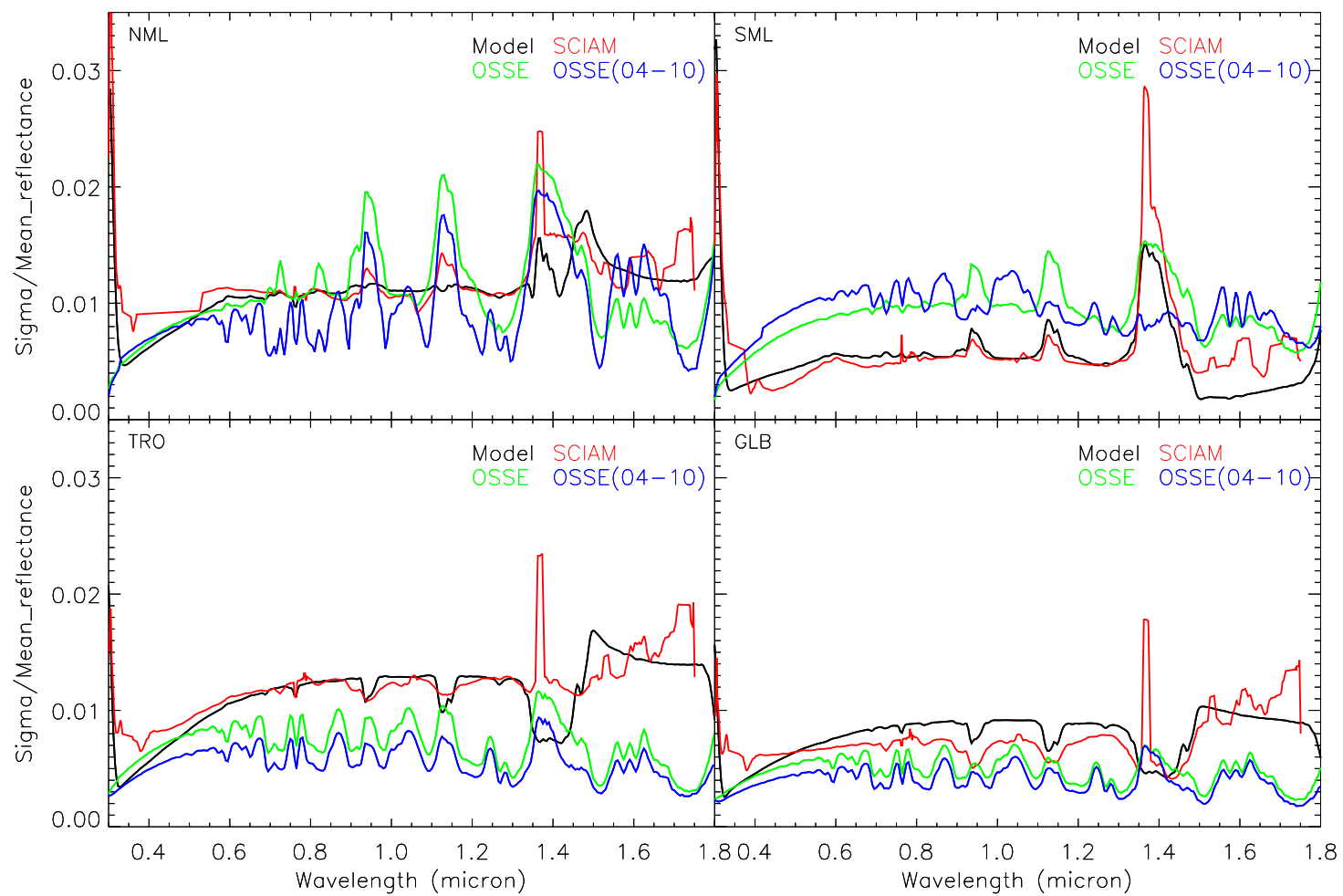


Comparison of the spectral reflectance σ between the monthly mean and the annual mean in different regions.

Each panel shows a different region.



Comparison between model and OSSE.



Comparison between model, OSSE and hyperspectral observation.