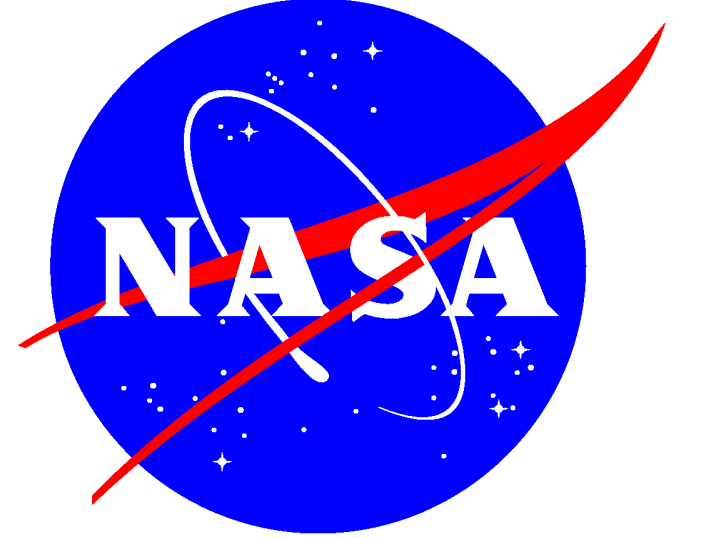# A Unified and Coherent Land Surface Emissivity Earth System Data Record

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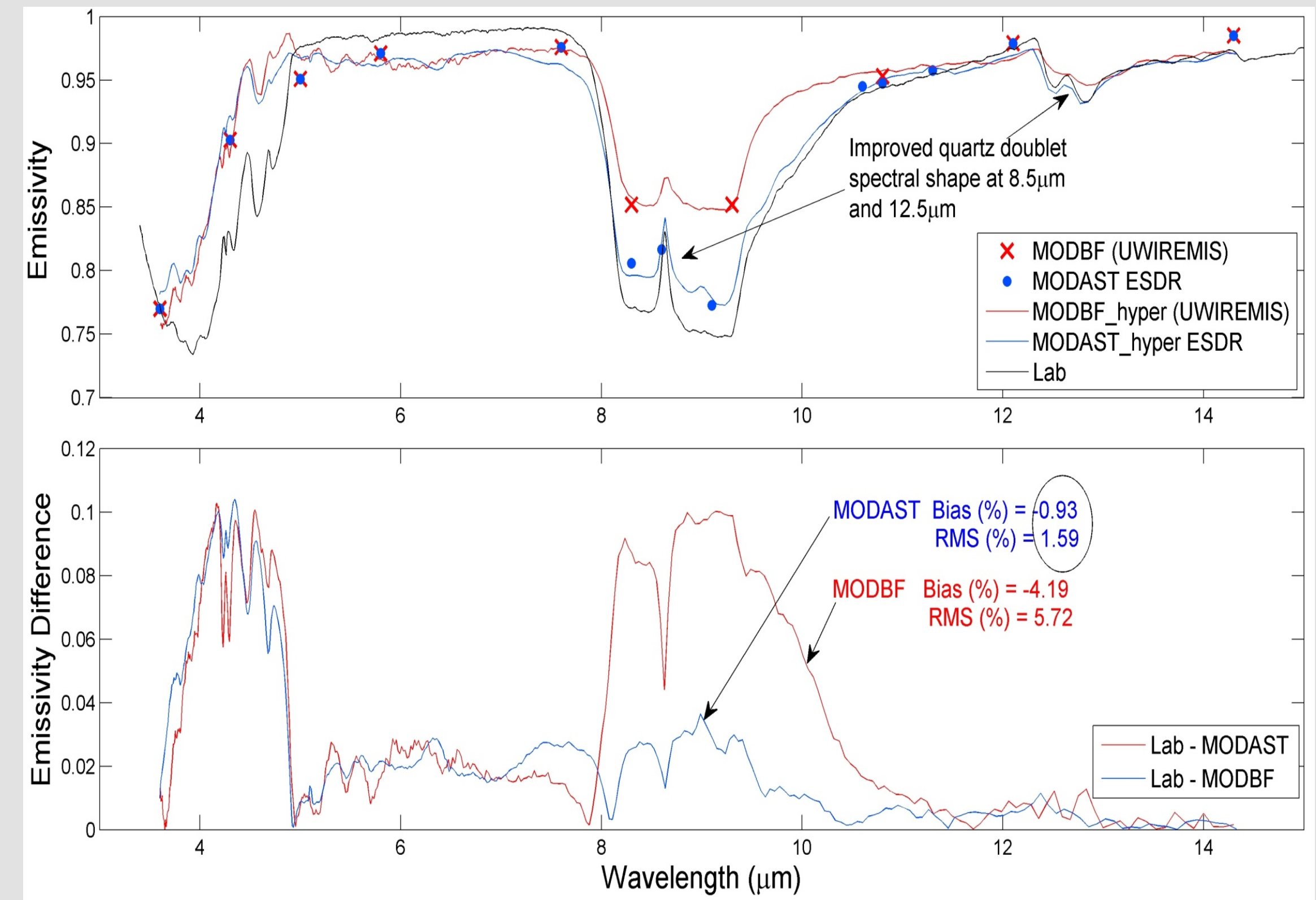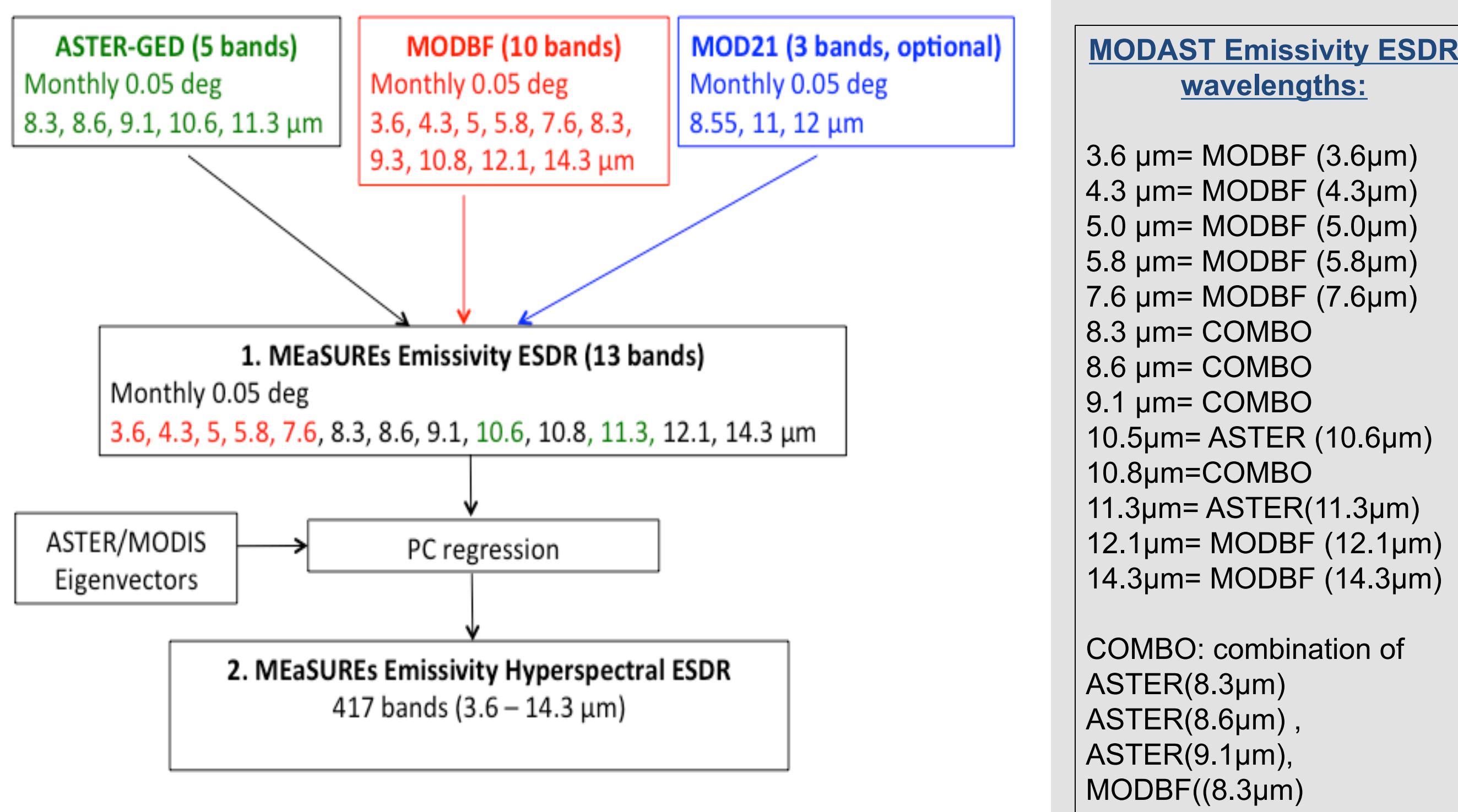** NASA Jet Propulsion Laboratory – Pasadena, CA, USA

ABSTRACT

Land surface temperture and emissivit is a critical ESDR for a wide variety of studies in particular ecosystem and climate modeling.

This poster introduces the land surface emissivity product of the NASA MEASUREs project called A Unified and Coherent Land Surface Temperature and Emissivity (LST&E) Earth System Data Record (ESDR).

To develop a unified high spectral resolution emissivity database, the MODIS baseline-fit emissivity database (MODBF) produced at the University of Wisconsin-Madison and the ASTER Global Emissivity Database (ASTER GED) produced at JPL have been merged. The unified Emissivity ESDR is produced globally at 5km in mean monthly time-steps and for 13 bands from 3.6-14.3 micron and extended to 417 bands using a PC regression approach. The poster introduces this data product.

METHOD TO COMBINE THE TWO DATABASES

ASTER-GED (5 bands)
Monthly 0.05 deg
8.3, 8.6, 9.1, 10.6, 11.3 µm

MODBF (10 bands)
Monthly 0.05 deg
3.6, 4.3, 5, 5.8, 7.6, 8.3, 9.3, 10.8, 12.1, 14.3 µm

MOD21 (3 bands, optional)
Monthly 0.05 deg
8.55, 11, 12 µm

1. MEaSUREs Emissivity ESDR (13 bands)
Monthly 0.05 deg
3.6, 4.3, 5, 5.8, 7.6, 8.3, 8.6, 9.1, 10.6, 10.8, 11.3, 12.1, 14.3 µm

ASTER/MODIS Eigenvectors → PC regression

2. MEaSUREs Emissivity Hyperspectral ESDR
417 bands (3.6 – 14.3 µm)

MODAST Emissivity ESDR wavelengths:

3.6 µm= MODBF (3.6µm)
4.3 µm= MODBF (4.3µm)
5.0 µm= MODBF (5.0µm)
5.8 µm= MODBF (5.8µm)
7.6 µm= MODBF (7.6µm)
8.3 µm= COMBO
8.6 µm= COMBO
9.1 µm= COMBO
10.5µm= ASTER (10.6µm)
10.8µm=COMBO
11.3µm= ASTER(11.3µm)
12.1µm= MODBF (12.1µm)
14.3µm= MODBF (14.3µm)

COMBO: combination of
ASTER(8.3µm)
ASTER(8.6µm),
ASTER(9.1µm),
MODBF((8.3µm)

Improved quartz doublet spectral shape at 8.5µm and 12.5µm

MODAST Bias (%) = +0.93 RMS (%) =1.59
MODBF Bias (%) = -4.19 RMS (%) = 5.72

Left: MEASURES MODAST Emissivity ESDR flowchart. **Right:** the images show a comparison of the combined MODAST emissivity ESDR (blue), the UW Baseline Fit and High Spectral Resolution Database (red), and laboratory spectra (black) of sand samples collected over the Namib desert for January 2004. The unified MODAST emissivity ESDR product results in significant improvement over the UW Baseline Fit (MODBF) product when compared to in situ measurements.
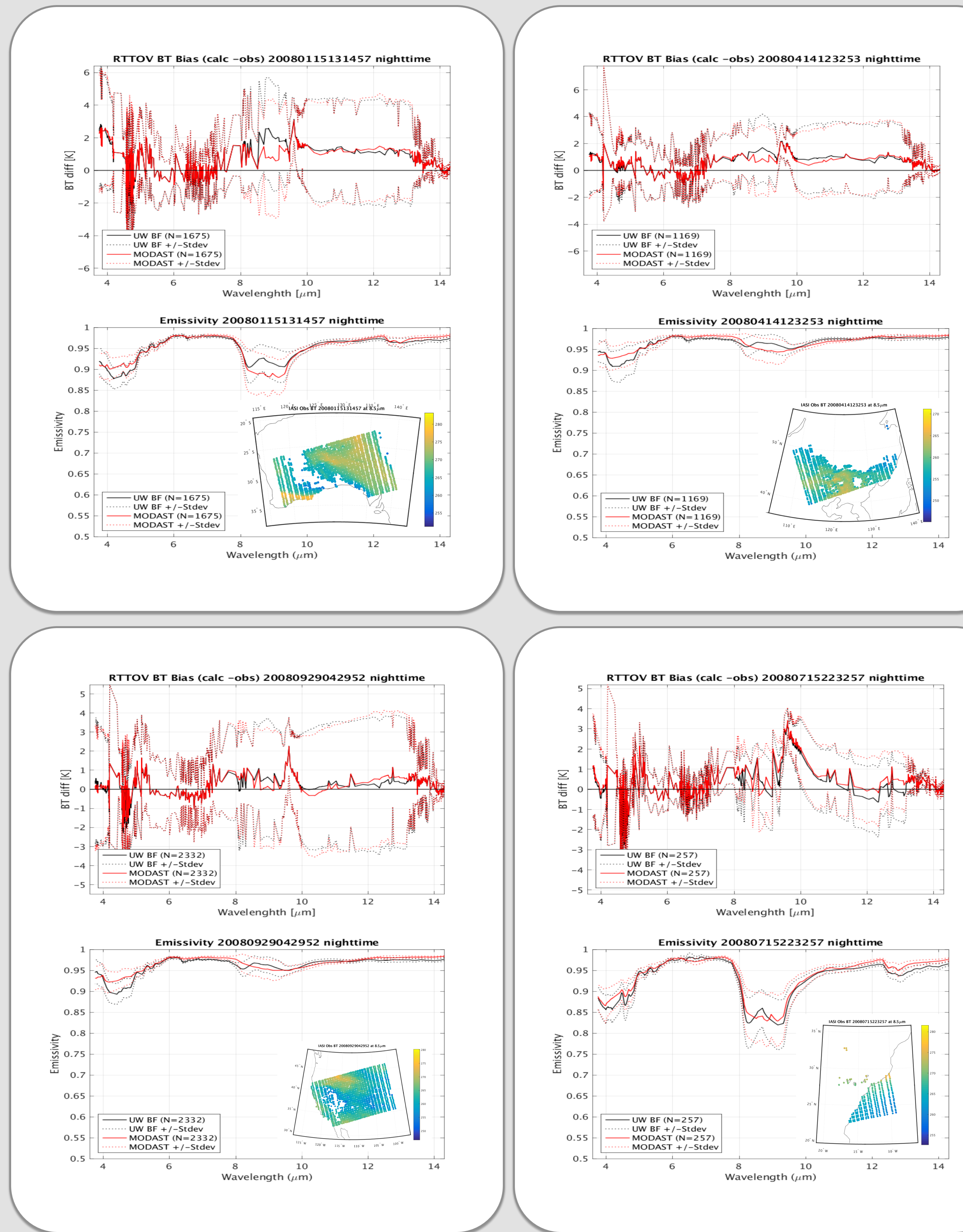
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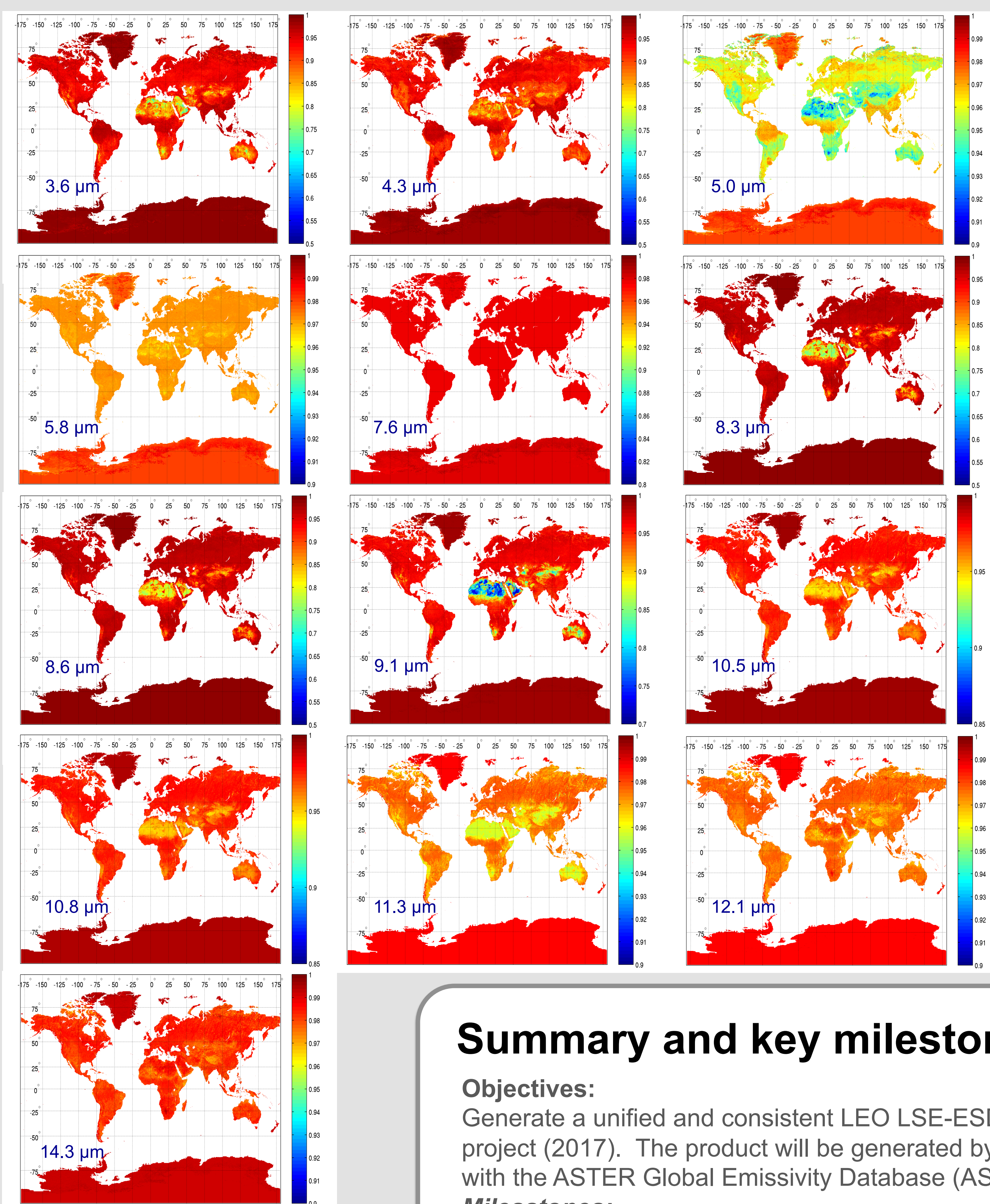
MODAST Emissivity ESDR

MODBF v4
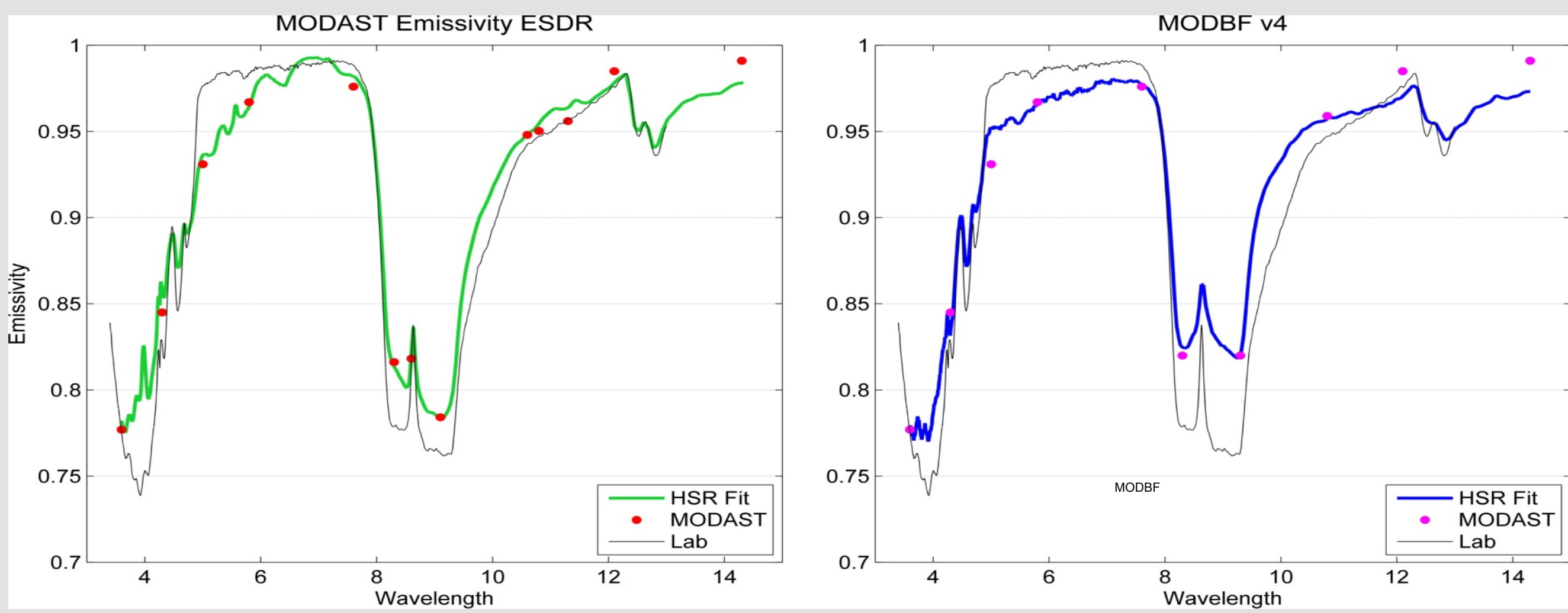
Validation of the test version of the MODAST Emissivity ESDR product with ground based measurements of emissivity at Namib desert, Dahra, Yemen.

RTTOV simulation study

IASI observed brightness temperatures were compared to the calculated ones using the RTTOV Forward Model for four selected global days representing each season: Jan 15, April 14, July 15 and Sept 29 2008. Tow sets of simulated BTs have been calculated and compared to each others: (1) using the RTTOV UW Iremissivty module based on the UW BF emissivity Database and (2) a new IRemis module based on the combined MODAST emissivity database. Four selected case studies (granules) are presented below.

RTTOV BT Bias (calc –obs) 20080115131457 nighttime
Emissivity 20080115131457 nighttime

RTTOV BT Bias (calc –obs) 20080414123253 nighttime
Emissivity 20080414123253 nighttime

RTTOV BT Bias (calc –obs) 20080929042952 nighttime
Emissivity 20080929042952 nighttime

RTTOV BT Bias (calc –obs) 20080715223257 nighttime
Emissivity 20080715223257 nighttime

The Unified and Coherent MODAST Land Surface Emissivity ESDR for July 2004

3.6 µm
4.3 µm
5.0 µm
5.8 µm
7.6 µm
8.3 µm
8.6 µm
9.1 µm
10.5 µm
10.8 µm
11.3 µm
12.1 µm
14.3 µm

Summary and key milestones of the LST&E ESDR MEASURES project

Objectives:
Generate a unified and consistent LEO LSE-ESDR product with 5 km spatial resolution on monthly time steps from 2000 through the nominal end of project (2017). The product will be generated by merging the UW Global IR Land Surface Emissivity Database produced by UW-Madison (MODBF) with the ASTER Global Emissivity Database (ASTER-GED) produced by JPL. Include a full set of uncertainty statistics.

Milesstones:
Year 1: Provide unified product samples over N. America.
Year 2: Provide global unified LSE products for 1 year only.
Year 3: Complete the unified products at their nominal spatial resolution for all years.
Year 4: Provide unified products averaged to a monthly mean product.
Year 5: Provide complete documentation for the products as well as fully documented code for use by the DAACs in continuing to generate the products.