AHI Navigation and Radiometric Performance Assessment using VIIRS and Landsat 8
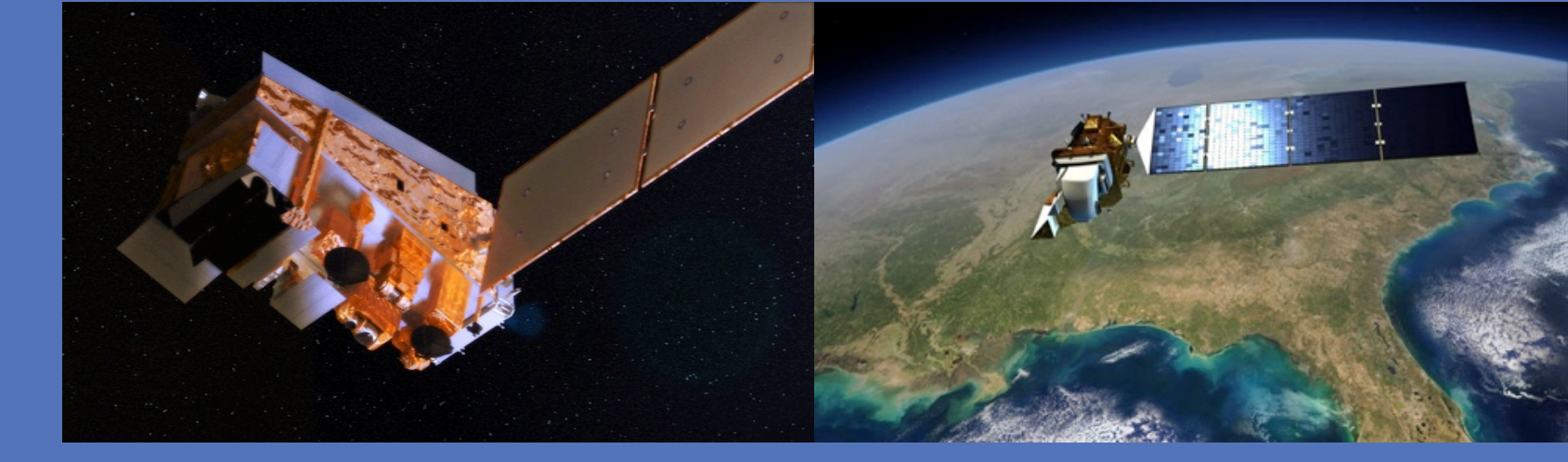
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Introduction

The Advanced Himawari Imager (AHI) is the next-generation geostationary follow-on for the Japanese Meteorological Agency launched on October 7th, 2014. The instrument is a 16-band suite with 6 of the bands in the visible and near-infrared (VNIR) range. We use the matching moderate bands of the Visible Infrared Imaging Radiometer Suite (VIIRS) [1] to assess the multi-month radiometric response of the AHI VNIR bands from February to August, 2015 using deep convective clouds (DCC) near AHI sub-satellite point. To assess navigation accuracy we make Imagery comparisons of landmarks, both visual and quantitative, against VIIRS. We also present a preliminary high-accuracy comparison analysis against the 30m-resolution Landsat 8 imageries to quantify sub-100m AHI navigation deviations.

| AHI			VIIRS		
Band Designation	Wavelength (μm)	Resolution (km)	Band Designation	Wavelength (μm)	Resolution (km)
1	0.47	1.0	M3	0.48	0.75
2	0.51	1.0	M3	0.48	0.75
3	0.64	0.5	M5	0.67	0.75
4	0.86	1.0	M7	0.87	0.75
5	1.60	2.0	M10	1.61	0.75
6	2.25	2.0	M11	2.25	0.75

The wavelengths and the resolutions of the AHI VNIR bands and the corresponding VIIRS moderate bands are well-matched
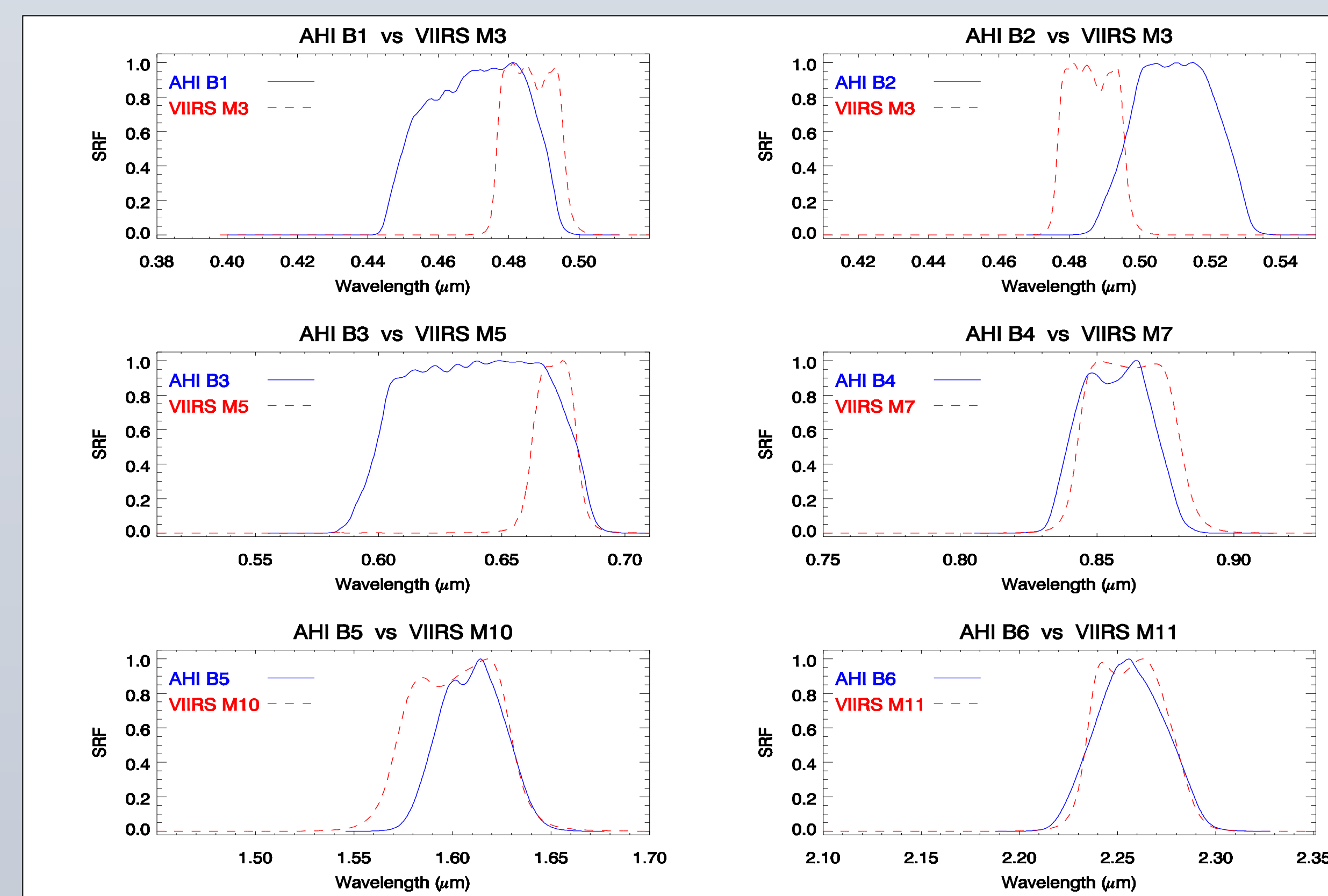
The spectral response functions of the AHI VNIR bands and the matching VIIRS bands.

Co-Registration, Frame-to-Frame Registration and Navigation Accuracy

The assessment of the AHI radiometric response against VIIRS is conducted at the single-pixel level, thus establishing both inter- and intra-bands pixel matching is necessary. Landmarks are used in examinations below.
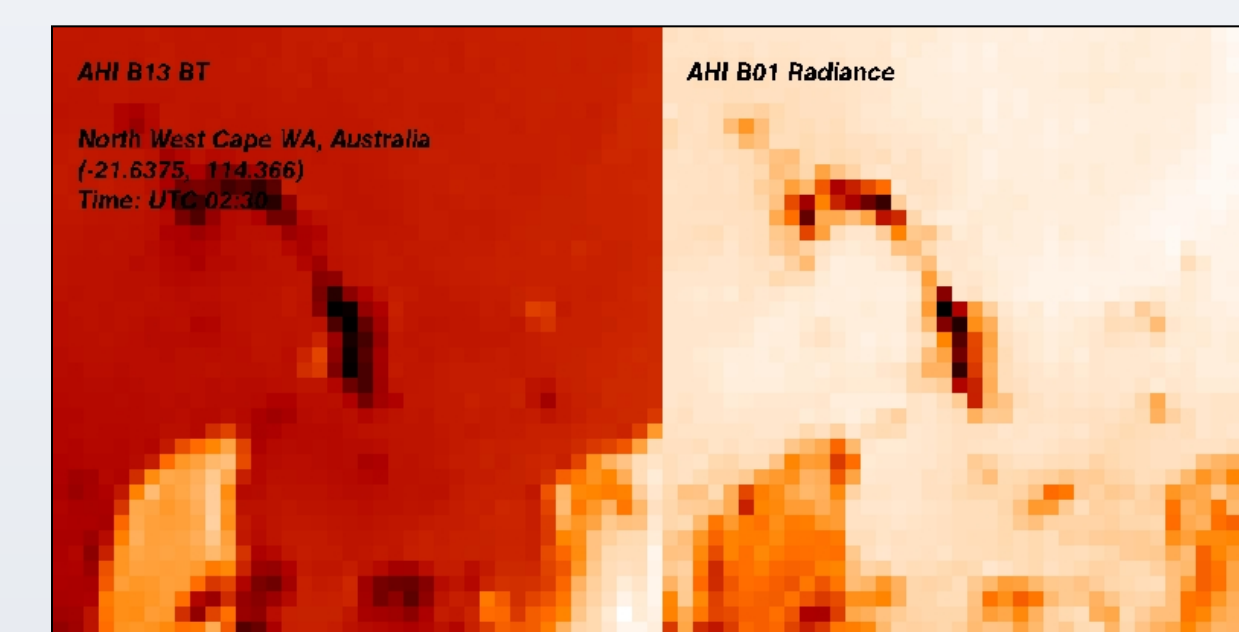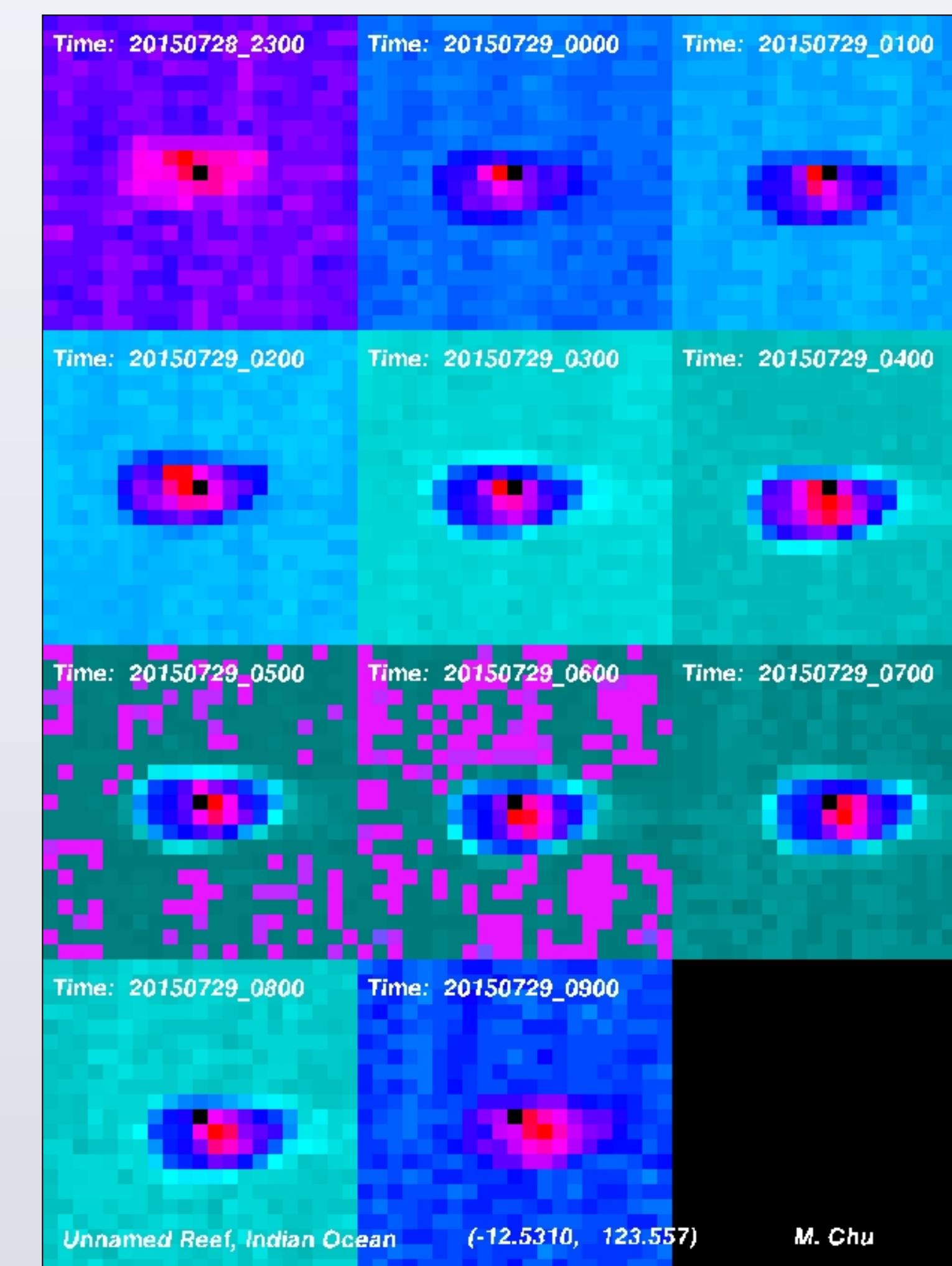

AHI Intra-band co-registration
- B13 (10.35μm) and VNIR bands match at sub-pixel (< .5 pixel)
- DCC pixels found by B13 and the corresponding VNIR bands radiance will correctly match
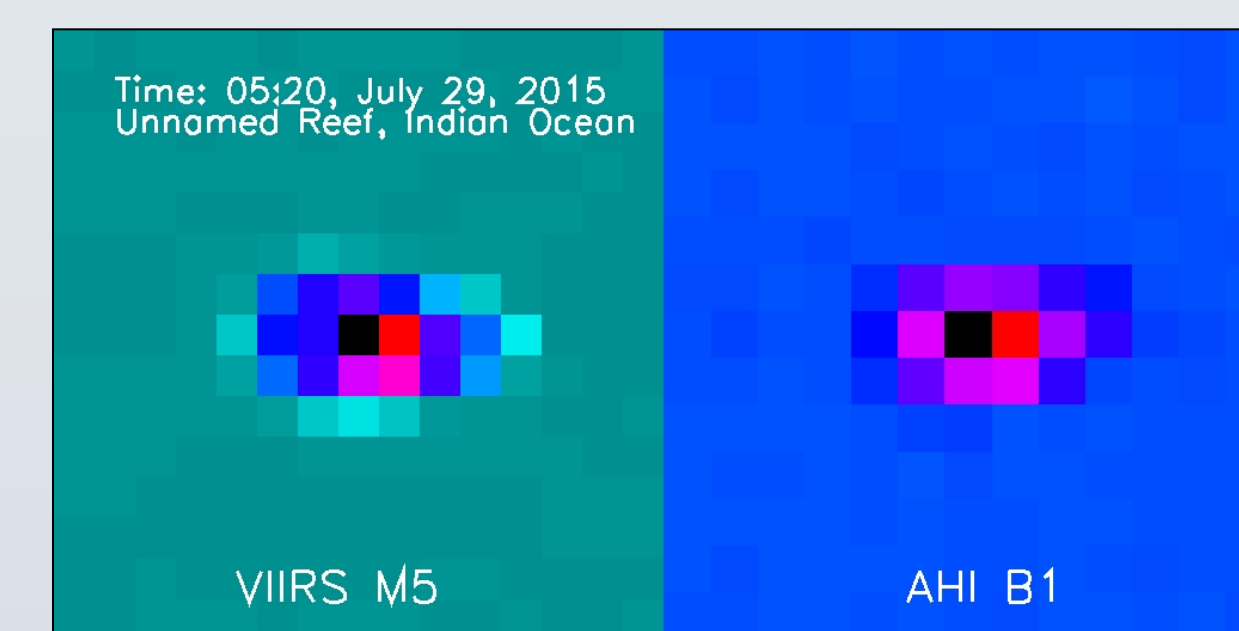
AHI navigation against VIIRS
- VIIRS navigation is accurate
- AHI B3 shows similar accuracy at UTC-0520

AHI frame-to-frame registration
- Up to 2 pixels (1km) deviation in B3
- Accuracy has improved since February, 2015 [2]

* Pixel shifts in each AHI radiance imagery used in the radiometric analysis have been examined and corrected

High-Resolution Navigation Analysis of AHI using Landsat 8

A new effort has begun on the development of a high-accuracy quantitative analysis of AHI navigation accuracy using high-resolution Landsat 8 imageries (30m) to quantify low fractional-pixel deviations (<100m). The methodology is based on the NASA Geolocation Team's "landmark chips" approach. Recent preliminary result using Landsat 8 B4 against AHI B3 (red bands) demonstrates clear daily trends with deviations up to 1km.
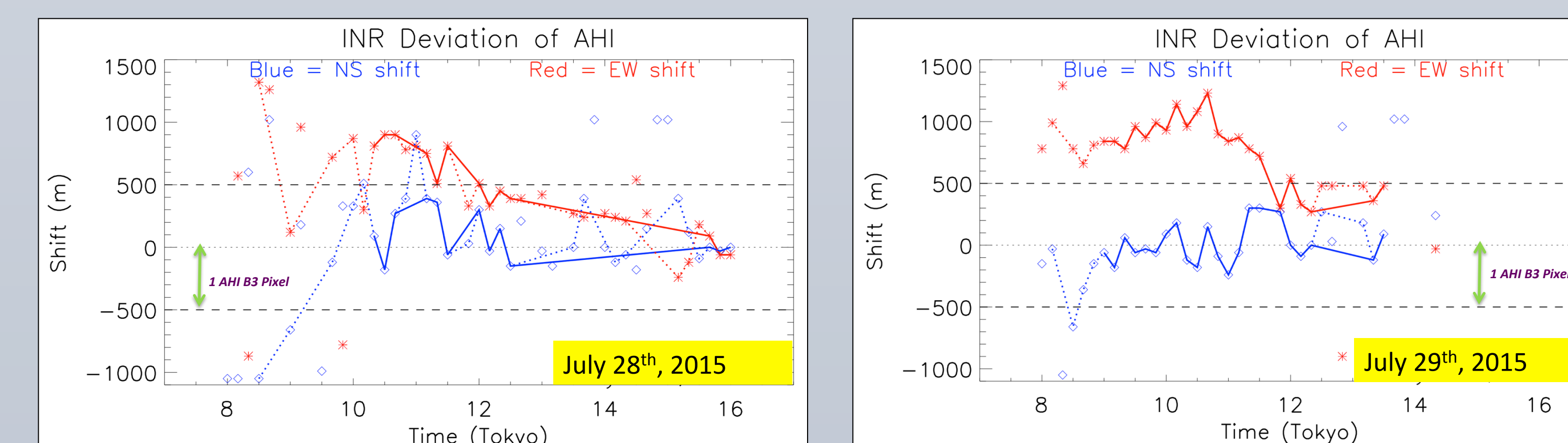
AHI-VIIRS Radiance Comparison Trend

DCC pixels are identified by AHI B13 (10.35μm). The corresponding radiance of the AHI and VIIRS VNIR bands for the identified DCC pixels is compared at the individual pixels level. Each monthly update, up to mid-August, combines 7 days worth of data. The spectral band adjustment factor (SBAF) for the first 4 matching band pairs are directly obtained from the web-calculator based on SCHIAMACHY visible hyper-spectral data [3] and the SBAF for the bottom 2 matching band pairs is an estimation to within 1% accuracy.
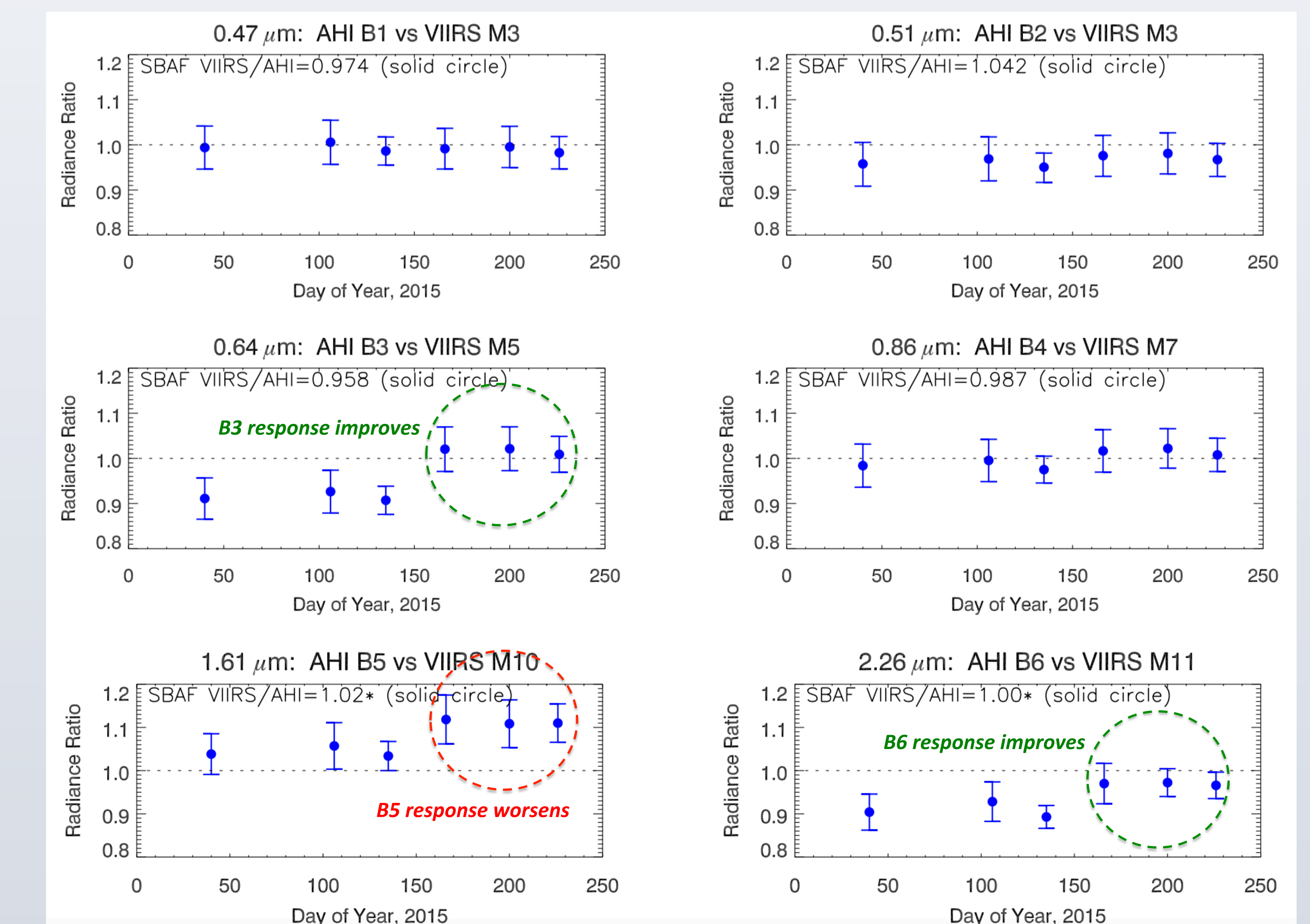
- JMA has made calibration adjustments between May and June
- B1 (0.47μm) the blue channel remains very accurate and stable
- B3 (0.64μm) and B6 (2.26μm), showing 10% dark bias earlier as was reported in April, 2015 [2], have been improved to within **3%** accuracy
- B5 (1.61μm) bias worsens up to **11%** higher (relative to VIIRS)

Summary

- AHI radiometric response versus VIIRS up to *11%* difference at 1.61μm
- Radiometric response monitor using DCC readied as operational tool
- AHI navigation deviations up to *1 km* using VIIRS and Landsat 8
- Methodologies applicable to GOES-R Advanced Baseline Imager

REFERENCES

[1] Uprety, S. and Cao, C. "Suomi NPP VIIRS reflective solar band on-orbit radiometric stability and accuracy assessment using desert and Antarctica Dome C", Remote Sensing of Environment. http://dx.doi.org/10.1016/j.rse.2015.05.021

[2] Chu, M., Wu, X., Yu, F., "Early Inter-sensor comparison result of Himawari-8 Advanced Baseline Imager with the Visible Infrared Imaging Radiometer Suite", Poster 3-44, 2015 NOAA Satellite Conference, Greenbelt, Maryland, April 27th - May 1st, 2015.

[3] Scarino, B., Doelling, D. R., P. Minnis, A. Gopalan, T. Chee, R. Bhatt, C. Lukashin, and C. O. Haney, "A Web-based Tool for Calculating Spectral Band Difference Adjustment Factors Derived from SCHIAMACHY Hyper-spectral Data," Submitted to IEEE Trans. Geosci. Remote Sens., 2014.