MOD09CMG for a systematic consistency assessment of any Land Surface Reflectance data: Case study with Landsat-5/7, SPOT-4 and Formosat-2

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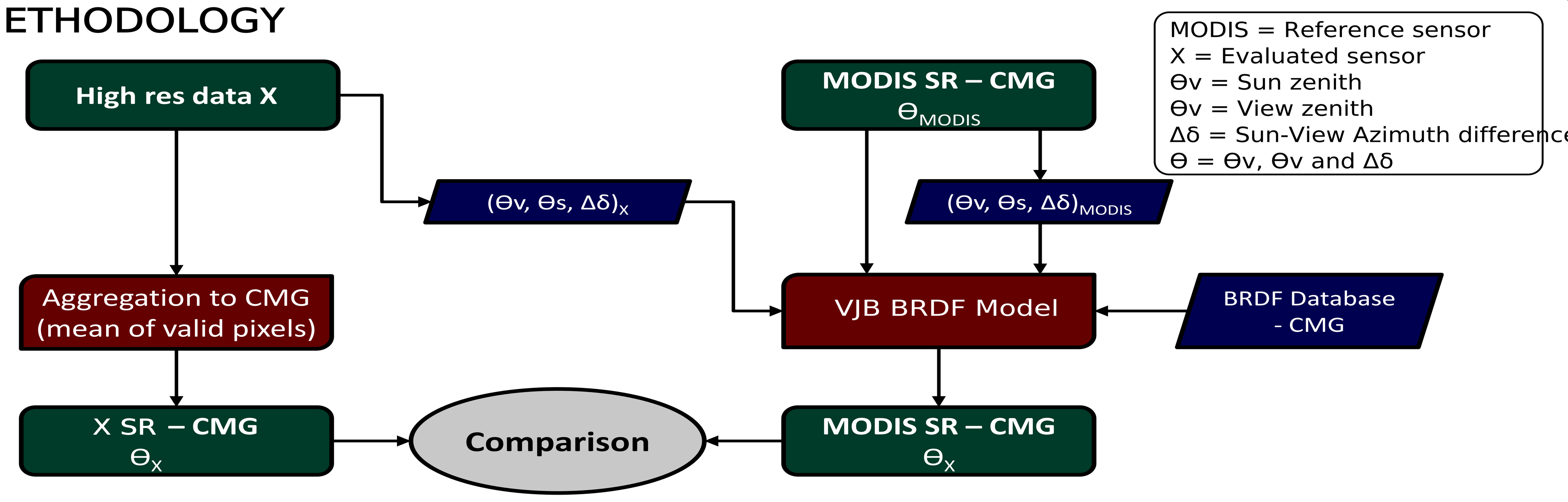
INTRODUCTION

Maintaining consistent dataset of Surface Reflectance (SR) data derived from the large panel of in-orbit sensors is an important challenge to ensure long term analysis of earth observation data. Sensors data cross-comparison is as a valuable tool to maintain a long term consistency of the data. However, satellite data are acquired at various times of the day (i.e., variation of the atmosphere content) and within a relative large range of geometry (view and sun angles).

In this study, we suggest a new systematic method to assess land optical SR data from high to medium resolution sensors. We used MODIS SR products (MO/YD09CMG) which benefit from a long term calibration/validation process, to assess SR from 3 satellite datasets: Landsat-5/7, SPOT-4 and Formosat-2. SPOT-4 and Formosat-2 atmospheric correction is done with MACC and Landsat-5/7 with LEDAPS.

The main issue concerns the difference in term of geometry acquisition between MODIS and compared sensors data. We used the VJB model (Vermote et al. 2009, TGRS) to correct MODIS SR from BRDF effects and to simulate SR at the corresponding geometry (view and sun angles) of each pixel of the compared sensor data. The comparison is done at the CMG spatial resolution (0.05°) which ensures a constant field-of-view and

METHODOLOGY



METRICS

3 metrics are used to assess the comparison between MODIS (the reference) and high resolution sensors (X in the diagram):
(i) Accuracy (A), (ii) Precision (P), (iii) Uncertainty (U).

The Uncertainty represents the overall deviation and is compared to the Specification (S).

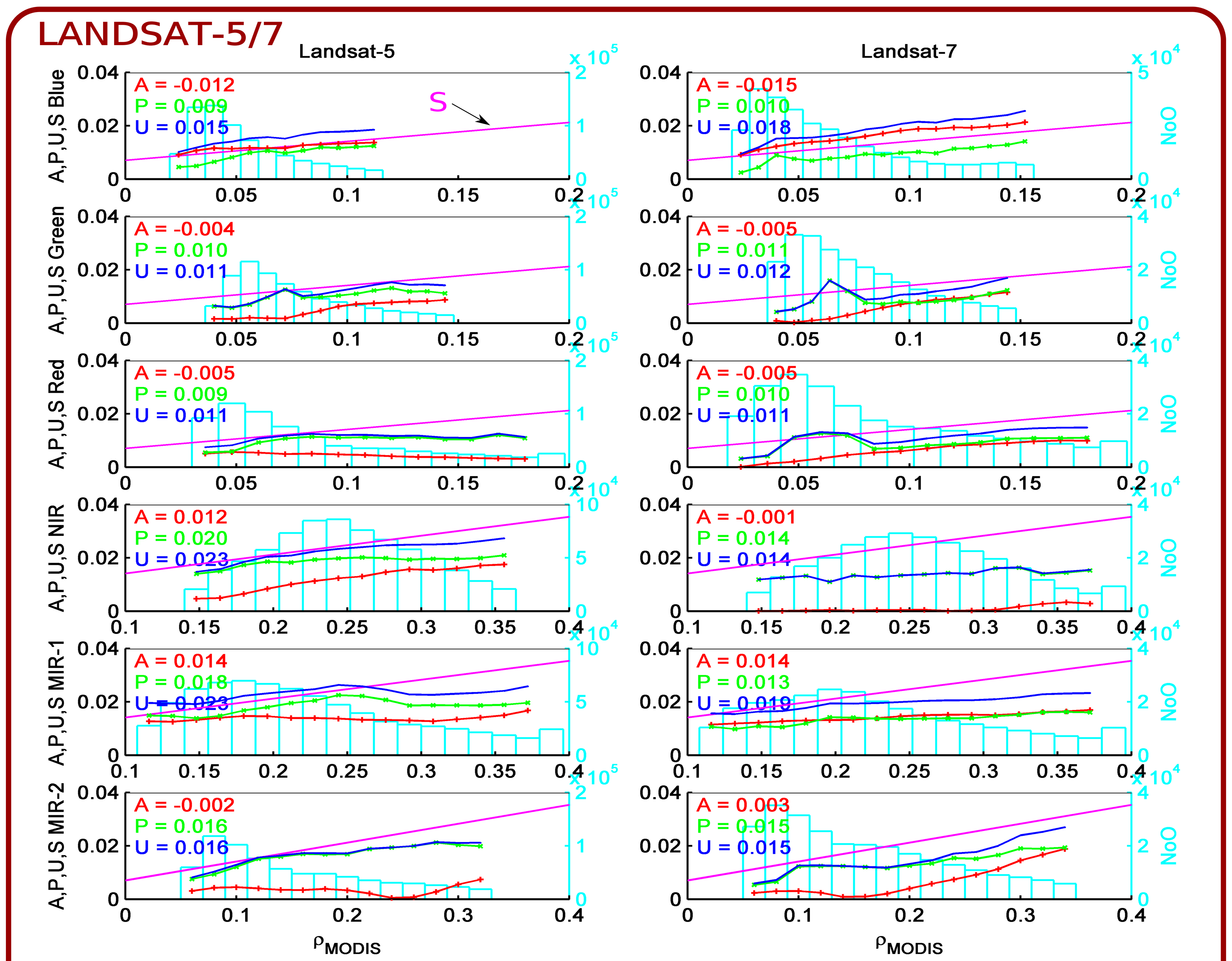
$$A = \frac{1}{N} \times \sum_{i=1}^{N} \varepsilon_i$$

$$P = \sqrt{\frac{1}{N-1} \times \sum_{i=1}^{N} (\varepsilon_i - A)^2}$$

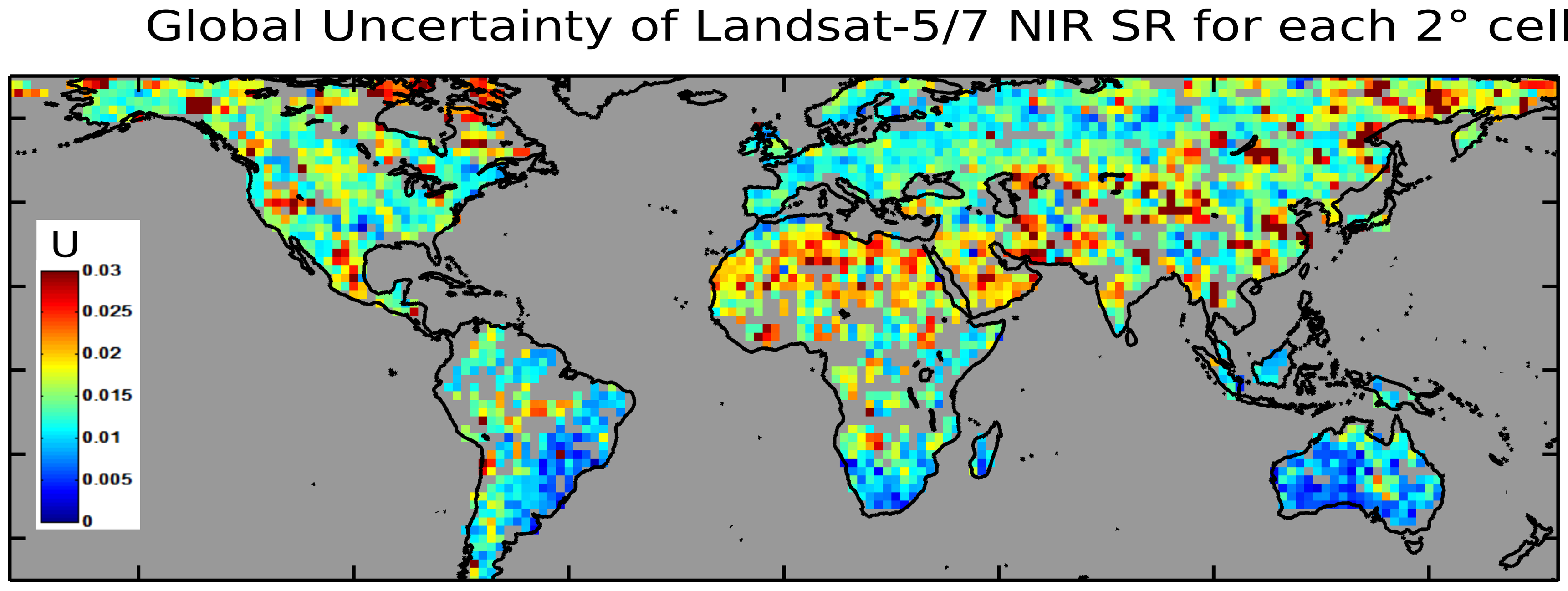
$$U = \sqrt{\frac{1}{N} \times \sum_{i=1}^{N} {\varepsilon_i}^2}$$

$$S = \sqrt{2 \times (0.05\rho + 0.005)^2}$$

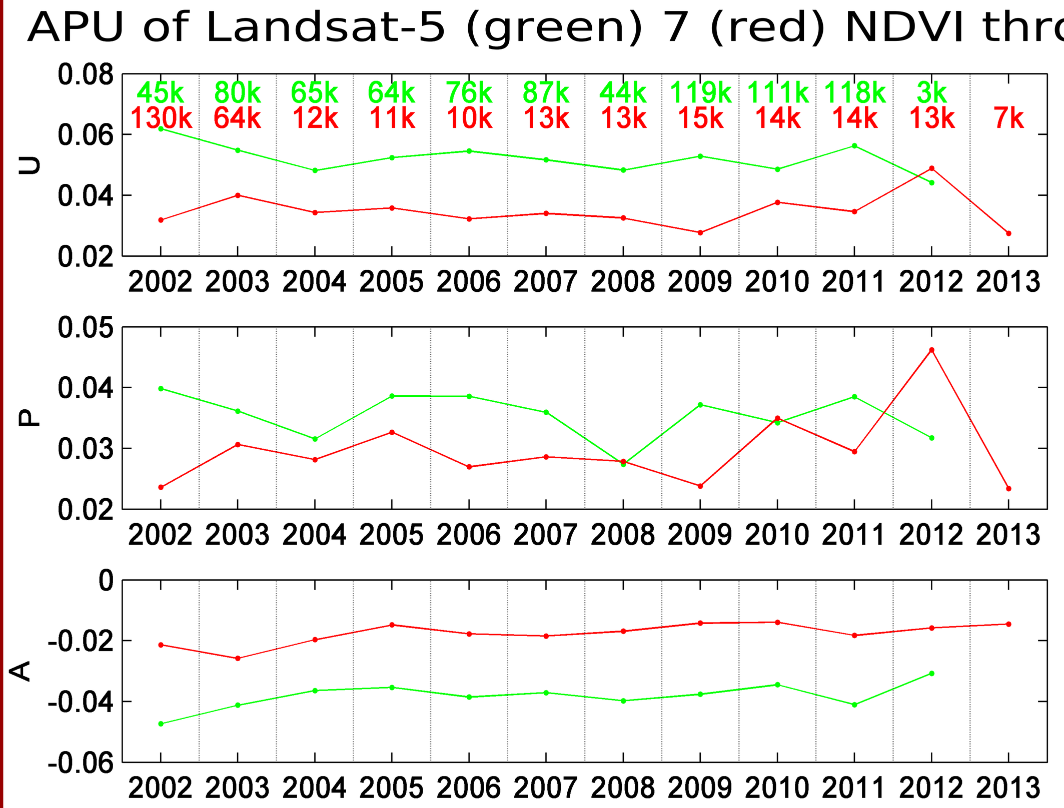
LANDSAT-5/7



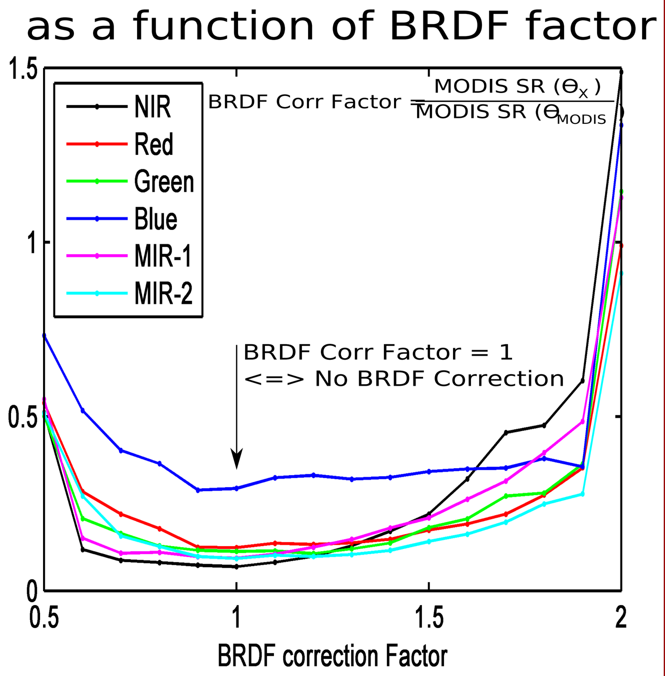
Global Uncertainty of Landsat-5/7 NIR SR for each 2° cell



APU of Landsat-5 (green) 7 (red) NDVI through time

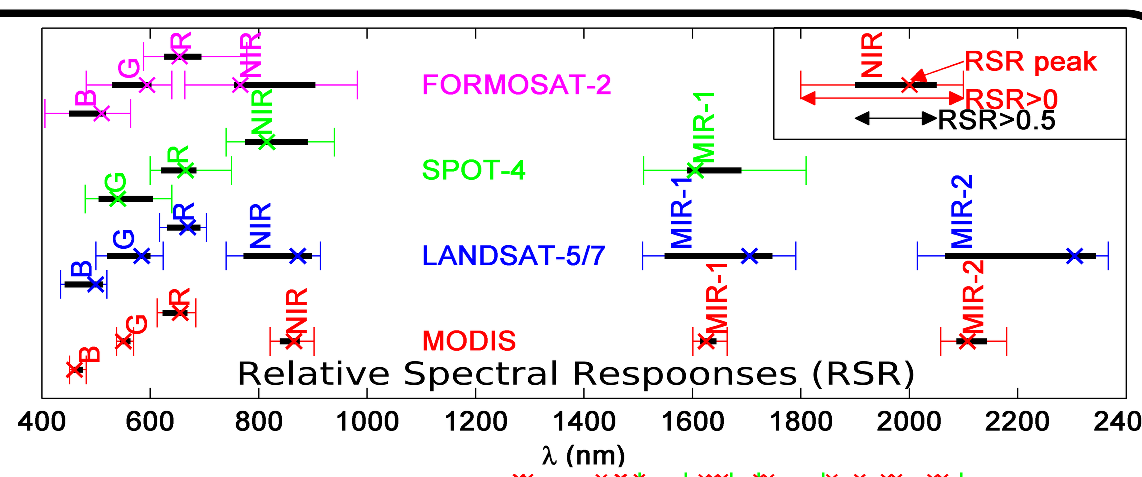


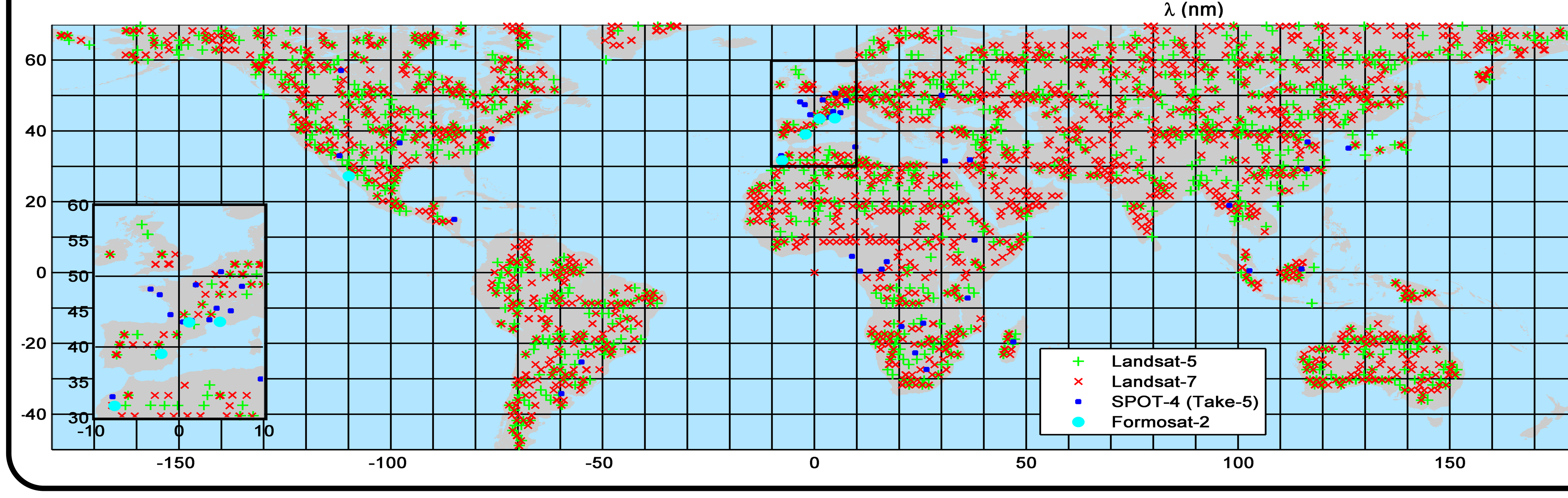
Uncertainty of Landsat-5/7 as a function of BRDF factor



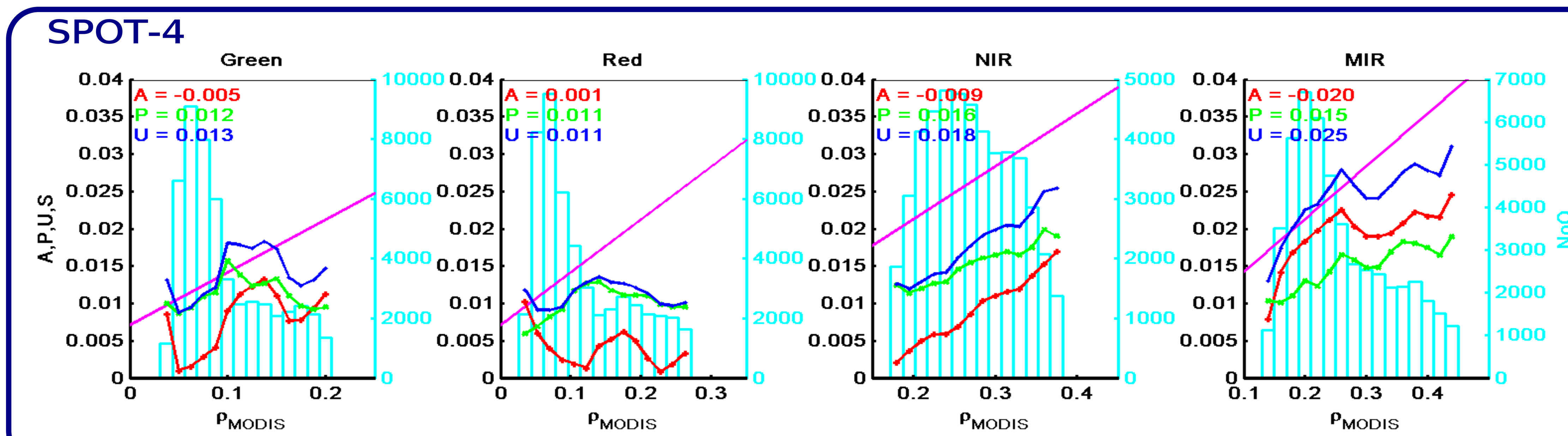
DATASETS

	Number of Scenes	number of Sites	Number of valid CMG pixels
Landsat 5 TM	1450	1100	940 k
Landsat 7 ETM+	2100	1450	325 k
SPOT-4 HRV (Take-5)	745	42	38 k
Formosat-2	280	5	2.5 k

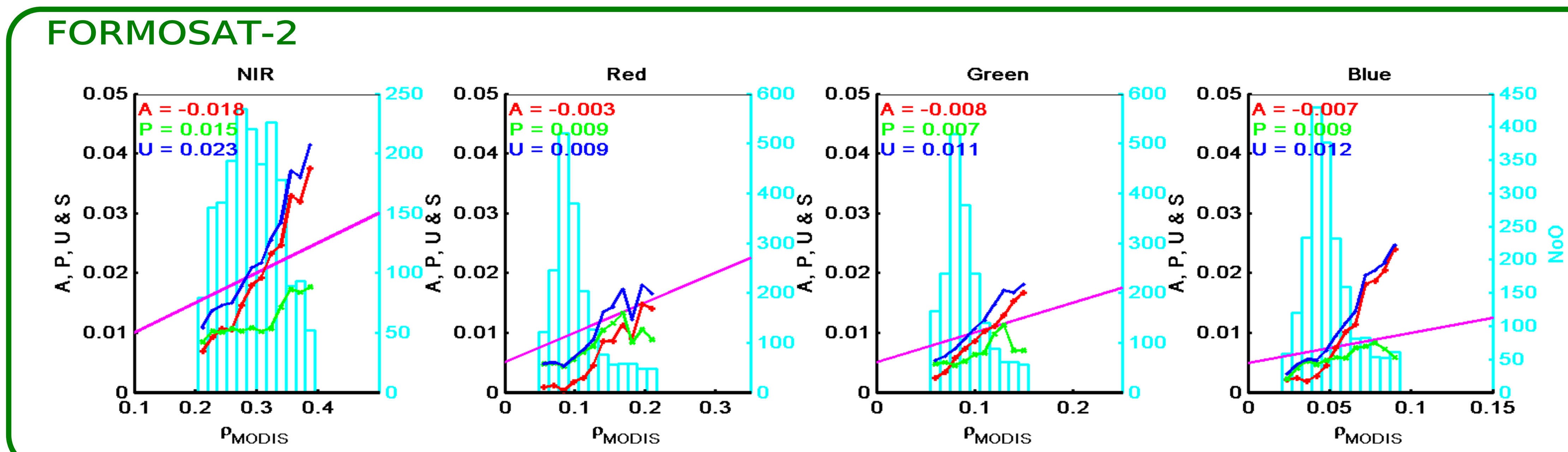




SPOT-4



FORMOSAT-2



CONCLUSION

We presented a new tool to aggregate the high resolution dataset, adjust the BRDF of MODIS, and compute consistency metrics. This tool will be useful to maintain a consistent multi-sensor dataset.

This study enhances the good performance of LEDAPS (Landsat atmospheric correction chain) and MACC (SPOT-4 and Formosat-2 atmospheric correction chain) for most of the spectral bands except the blue one, which is often used as a proxy of the atmospheric condition. Currently no adjustment for the spectral differences was taken into account. This needs to be implemented

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