Calibration Trend Analysis of Digital Globe Imagers

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Purpose: Analyze the radiometric stability of commercial imagers for time series and trend analyses in support of Earth science research and applications

Study Objective: Using ancillary MAIAC MODIS atmospheric and surface BRDF data, characterize the radiometric calibration trends for DigitalGlobe images over Libya-4 quasi-stable desert CEOS calibration site
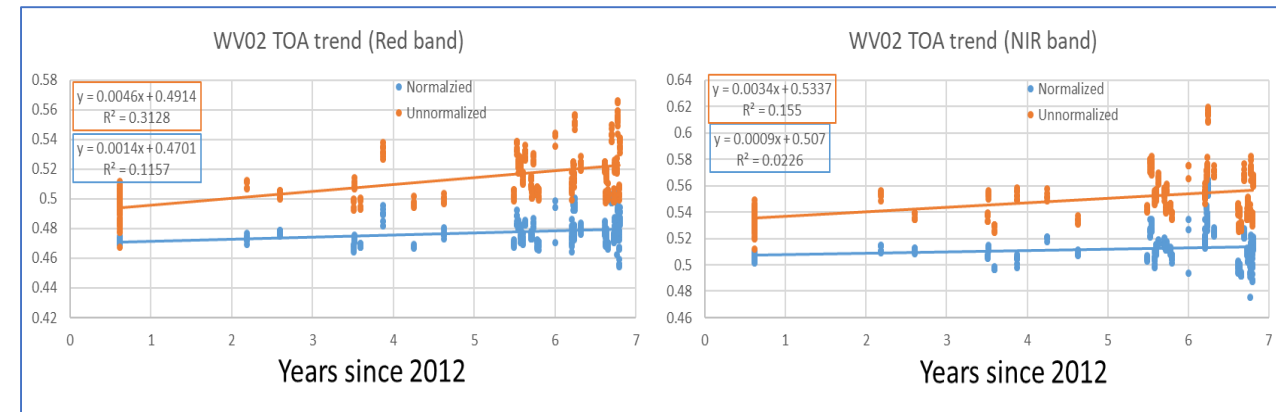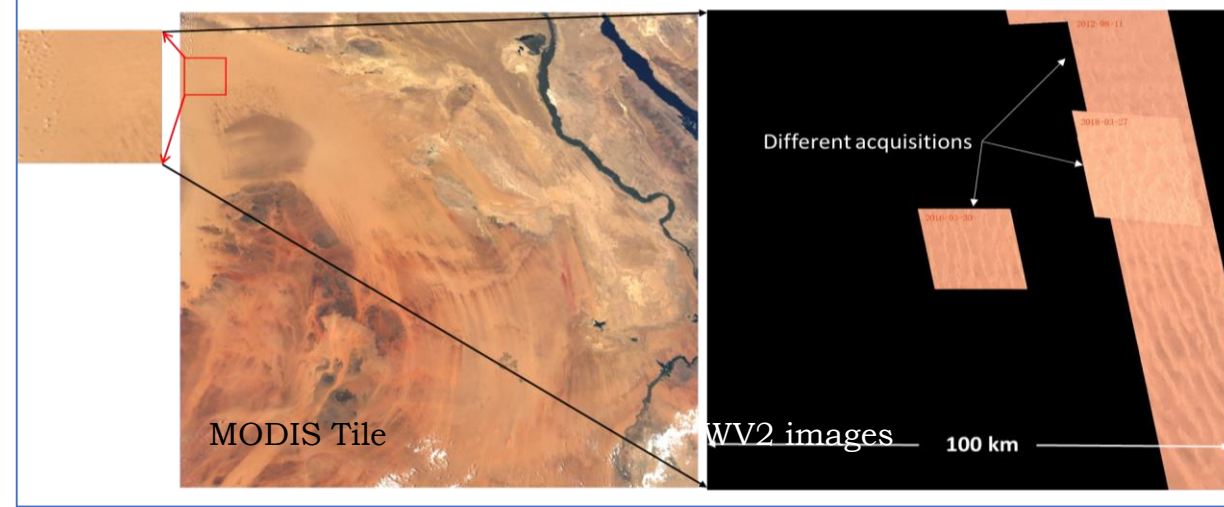
Imagery: MODIS, WorldView-2, WorldView-3

Findings: Both satellites show radiometric calibration trends, with WorldView-3 the more stable. Trends in WorldView-2 were approximately twice as large as the calibration trends in MODIS Collection 5 data. Use of MODIS calibration coefficients removes calibration trends, bringing the three sensors in close agreement, i.e., within ± 3%.

Top: Data acquisition for WV-2 over Libya4 site. The left image shows the larger MODIS tile and location of the Libya4 site. The left image illustrates different WV-2 acquisitions over the years.

Middle: An example of trend characterization for the WV-2 Red and NIR bands.

Bottom: Summary Table of calibration trend analysis for the common bands of MODIS, WV-2, and WV-3. The derived trends per year per unit of reflectance) are compared with MODIS Collection 5 calibration trends which were recognized significant for the science data analysis. The reflectance in RGB and NIR bands agree well among the WV-2 and WV-3 imagers over a reference point (column 5).

MODIS Tile — WV2 images — Different acquisitions — 100 km

WV02 TOA trend (Red band)

$y = 0.0046x + 0.4914$
$R^2 = 0.3128$

$y = 0.0014x + 0.4701$
$R^2 = 0.1157$

- Normalzied
- Unnormalized

Years since 2012

WV02 TOA trend (NIR band)

$y = 0.0034x + 0.5337$
$R^2 = 0.155$

$y = 0.0009x + 0.507$
$R^2 = 0.0226$

- Normalized
- Unnormalized

Years since 2012

Bands	Reference Surface Reflectance	Trend per year, per unit reflectance (MODIS) x 10-4	Trend per year, per unit reflectance (WorldView-2) x 10-4	Bands	Reference Surface Reflectance	Trend per year, per unit reflectance (MODIS) x 10-4	Trend per year, unit per unit reflectance (WorldView-3) x 10-4
Blue	0.244	-8.900	-0.139	Blue	0.238	-8.900	-9.290
Green	0.323	-5.700	0.238	Green	0.325	-5.700	-0.284
Red	0.471	-0.170	0.289	Red	0.474	-0.170	-0.169
NIR	0.507	7.800	0.188	NIR	0.513	7.800	-0.124