LIFETIME INTRA-CONSTELLATION CALIBRATION OF THE RAPIDEYE SENSORS OVER PICS

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Calcon 2013

RapidEye
Delivering the World

BLACKBRIDGE

OUTLINE

- Background

- Procedure

  - Individual Tile

  - Cumulative Site

  - Complete Satellite-Band

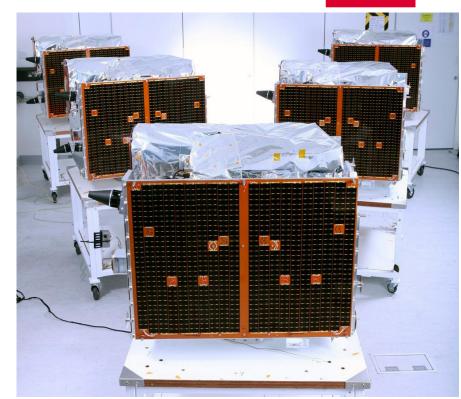- Full Constellation Satellite-Band Comparison

- Conclusions

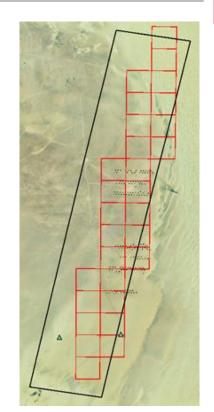# BACKGROUND

THE RAPIDEYE CONSTELLATION

- 5 optical satellites.

- 5 spectral bands.

- 6.5 m GSD, 77km swathwidth.

- >5 million sq km/day imaging capacity.

- Daily revisit of any target possible!!
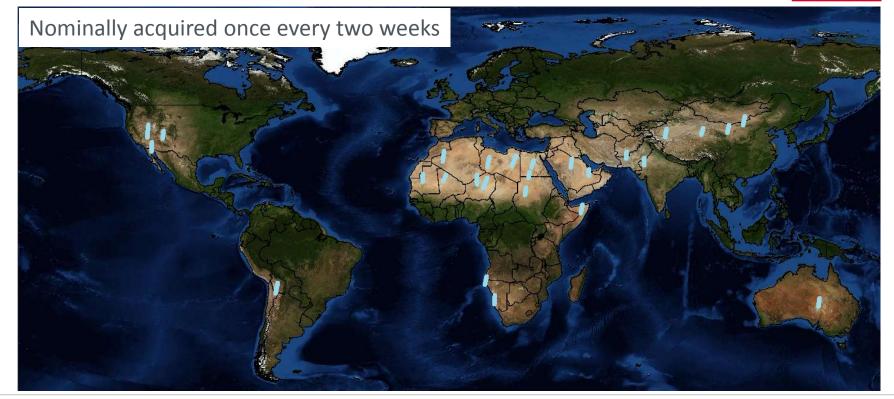
RAPIDEYE'S TILE CONCEPT

- RapidEye uses a 25km x 25km tile reference system.

- RapidEye's Pseudo-Invariant Calibration Sites (PICS) are defined using these tiles.

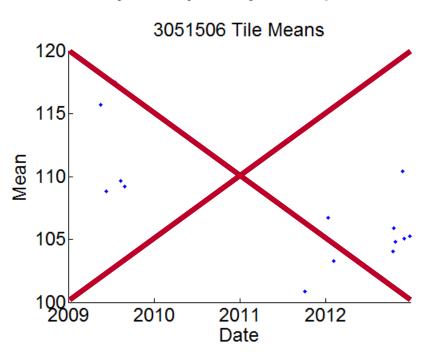- An image take may not cover an entire cal-site.

RAPIDEYE'S 26 PICS
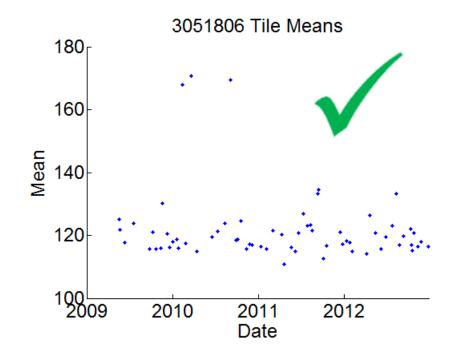
Nominally acquired once every two weeks

PROCEDURE

Individual Tile

(Preformed for each satellite and band on an individual basis)

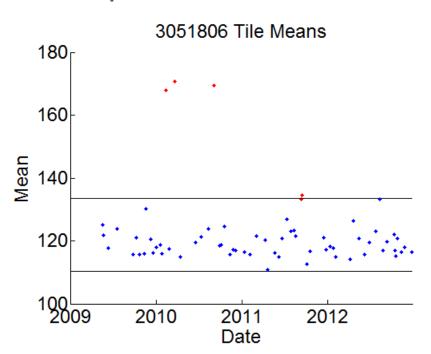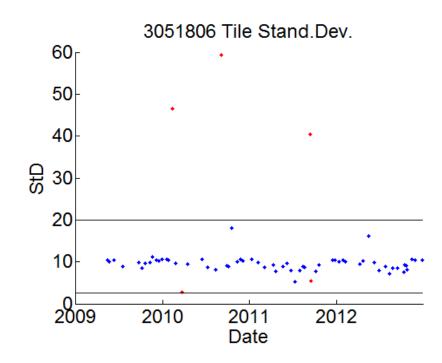# INDIVIDUAL TILE FILTERING

- Samples per year (6 minimum)

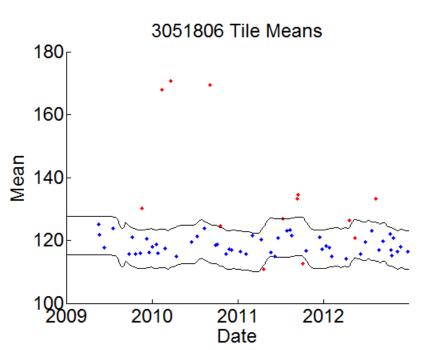# INDIVIDUAL TILE FILTERING (CONT.)

- Simple mean + stand. dev. threshold.
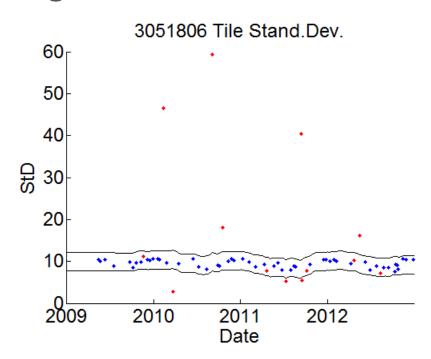
- Median/Mean Filter ± Shrinking R^2.
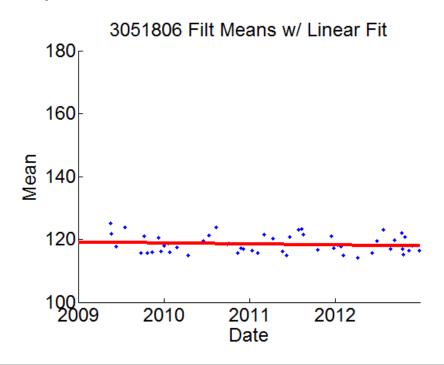
INDIVIDUAL TILE LINEAR FIT

- Linear Least Squares Fit of filtered tile means.

3051806 Filt Means w/ Linear Fit
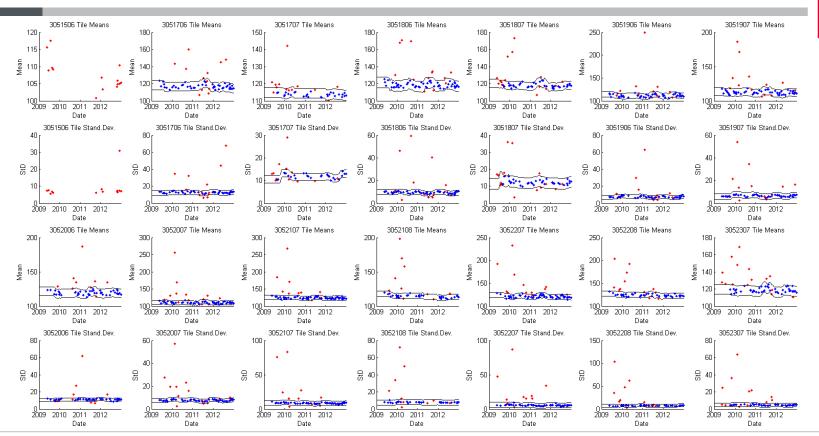
PROCEDURE

Cumulative Site

(Preformed for each satellite and band on an individual basis)

FILTER ALL TILES IN A SITE

This Cal-Site Includes 28 Tiles

LINEAR FIT ALL TILES IN A SITE
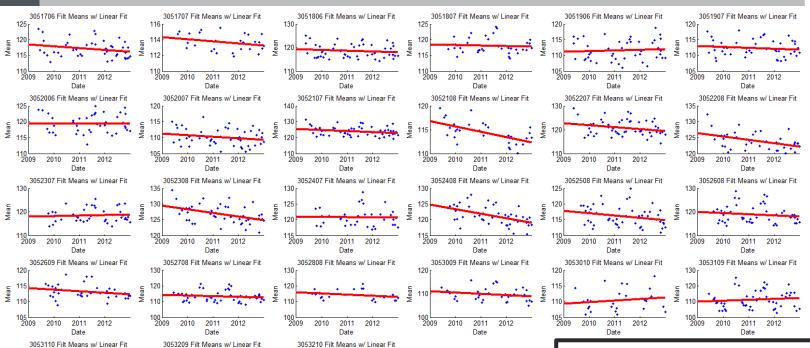
27 Tiles Pass the Individual Filter Stage for this Cal-Site

FILTER TILE LINEAR FITS
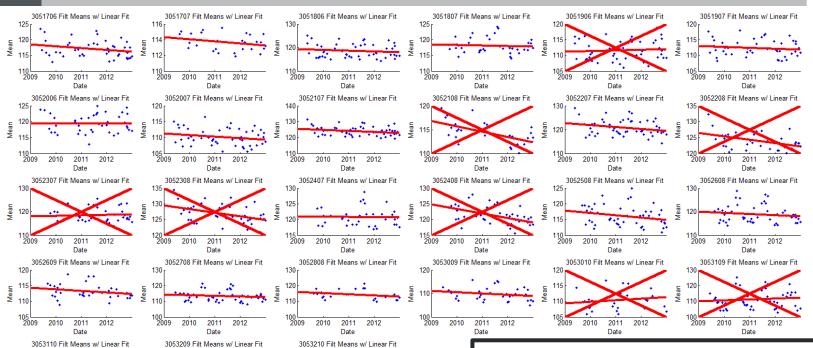
Linear fits are filtered by mean of the slope ± std. dev. 17 Tiles Pass this stage.

NORMALIZE TILE LINEAR FITS
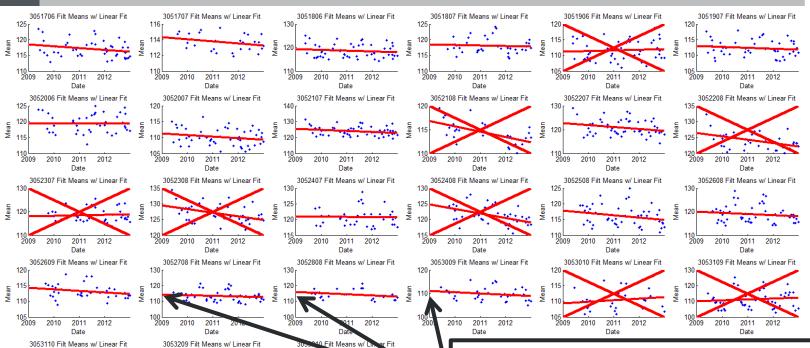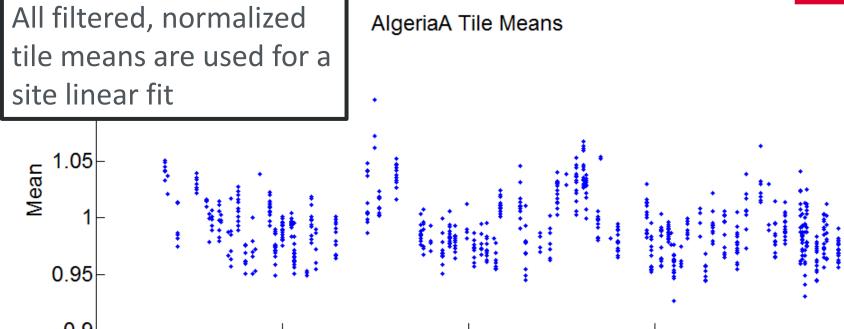
Divide individual tile means by the linear fit value at a certain calibration zero point

CAL-SITE LINEAR FIT

All filtered, normalized tile means are used for a site linear fit

AlgeriaA Tile Means

CAL-SITE LINEAR FIT (CONT.)

The linear fit at the cal-zero point is forced to 1.

Sensor degradation can be obtained by the value at the end of the period (1 - 0.985 = 1.5%).

AlgeriaA Tile Means

RMSE = 0.01955
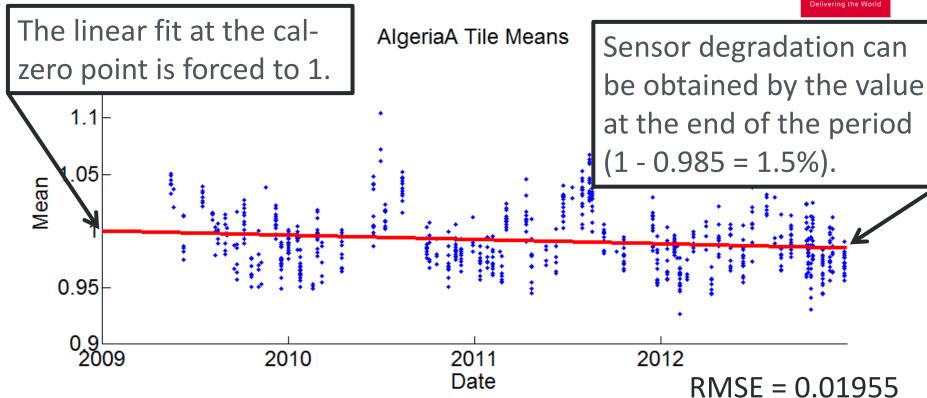
PROCEDURE

Complete Satellite-Band

(Preformed for each satellite and band on an individual basis)

CAL-SITE FILTERING
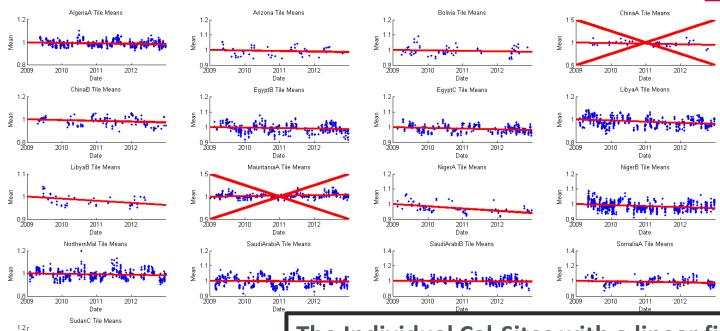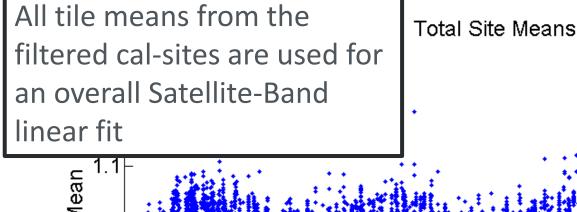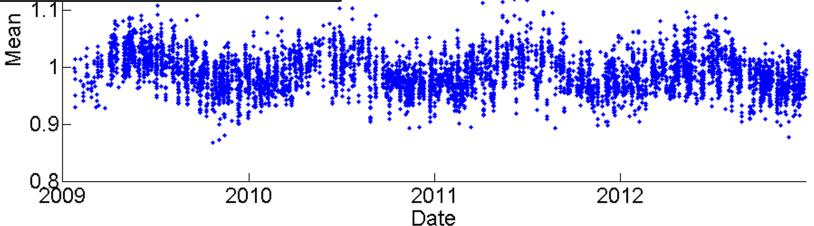
The Individual Cal-Sites with a linear fit RMSE > the mean RMSE + the std. dev are filtered.

TOTAL COMBINED LINEAR FIT

All tile means from the filtered cal-sites are used for an overall Satellite-Band linear fit

Total Site Means

TOTAL COMBINED LINEAR FIT (CONT.)

Total Site Means

1 - 0.9804 = 1.96% drop

This "degradation value" is used to adjust the imagery.

RMSE = 0.02600
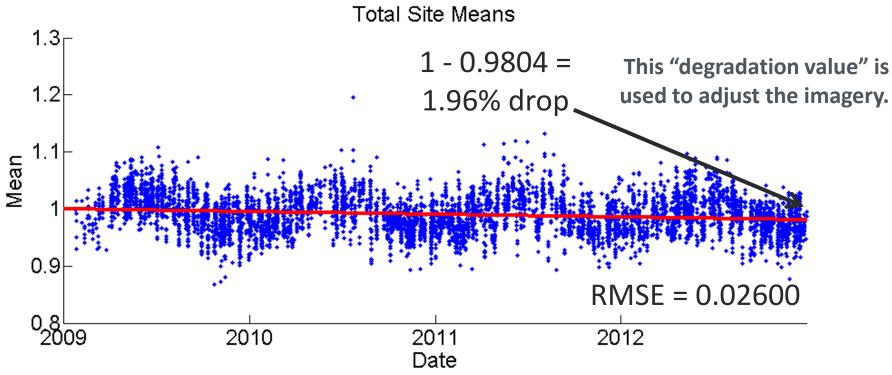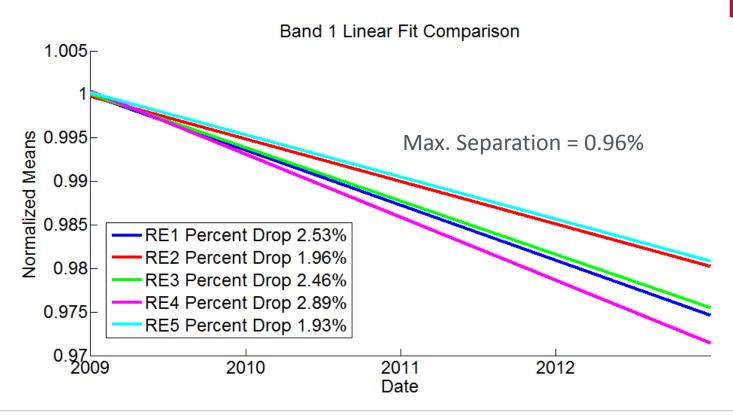
FULL CONSTELLATION SATELLITE-BAND COMPARISON

BLUE BAND

Band 1 Linear Fit Comparison

Max. Separation = 0.96%

RE1 Percent Drop 2.53%
RE2 Percent Drop 1.96%
RE3 Percent Drop 2.46%
RE4 Percent Drop 2.89%
RE5 Percent Drop 1.93%

GREEN BAND

Band 2 Linear Fit Comparison

Max. Separation = 1.17%

Legend:
- RE1 Percent Drop 1.30%
- RE2 Percent Drop 0.59%
- RE3 Percent Drop 1.43%
- RE4 Percent Drop 1.76%
- RE5 Percent Drop 1.64%

RED BAND

Band 3 Linear Fit Comparison

Max. Separation = 2.62%

RE1 Percent Drop 1.37%
RE2 Percent Drop 0.62%
RE3 Percent Drop 1.49%
RE4 Percent Drop 3.24%
RE5 Percent Drop 1.13%

RED-EDGE BAND

Band 4 Linear Fit Comparison

Max. Separation = 3.24%

Legend:
- RE1 Percent Drop 1.94%
- RE2 Percent Drop 0.66%
- RE3 Percent Drop 1.00%
- RE4 Percent Drop 3.90%
- RE5 Percent Drop 1.54%

Y-axis: Normalized Means
X-axis: Date

NIR BAND

Band 5 Linear Fit Comparison

Max. Separation = 1.13%

RE1 Percent Drop 1.37%
RE2 Percent Drop 0.86%
RE3 Percent Drop 1.20%
RE4 Percent Drop 1.99%
RE5 Percent Drop 1.22%
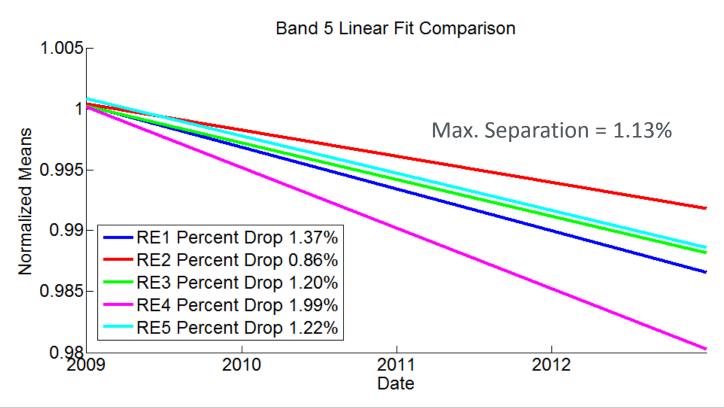
CONCLUSIONS

CONCLUSIONS

- There is some seasonal variation in the cal-sites.

  - Analyzing over an entire year helps minimize this effect.

- The RapidEye fleet has been quite stable since starting operations.

  - Maximum drop for one satellite-band is RE 4 Band 4 (3.90%)

- All Satellite Bands agree well with each other.

  - Maximum difference between Satellites is in Band 4 (3.24%).

- All degradations are accounted for in RapidEye products.

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