Quarterly Data Quality Reports at Planet

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VH-RODA | November 20, 2019

Lake Saint Pierre, Canada – April 14, 2016

OUR CONSTELLATIONS

Flock	**Dove-Classic (PS)**	**RapidEye**	**SkySat**	**Dove-R (PS)**
Sensor Type	Four-band frame imager with a split-frame NIR filter	Multispectral push-broom	Multispectral / Panchromatic push-frame	Four-stripe push-frame imager
Spectral Bands	Blue: 455 - 515 nm Green: 500 - 590 nm Red: 590 - 670 nm NIR: 780 - 860 nm	Blue: 440 - 510 nm Green: 520 - 590 nm Red: 630 - 685 nm Red Edge: 690-730 nm NIR: 760 - 850 nm	Blue: 450 - 515 nm Green: 515 - 595 nm Red: 605 - 695 nm NIR: 740 - 900 nm PAN: 450 - 900 nm	Blue: 490 nm Green: 565 nm Red: 665 nm NIR: 865 nm
Orbit	SSO	SSO	SSO	SSO
GSD	~3.0 m	~6.5 m	~1.0 m (~0.8 pan)	~3.0 m
Frame Size / Swath Width	~ 24.6 km x 16.4 km	77 km	~ 3.2 km x 1.4 km (single camera)	~ 26 km
Crossing Time	9:30 - 11:30 am	11:00 am	10:30 - 13:00	9:30 - 11:30

DATA QUALITY REPORTS AT ESA

Data Product Quality Reports

The MPC-CC provides a monthly status of the quality of Sentinel-2 L1C and L2A products via respective Data Quality Reports (DQR). The DQRs provides information on the monitoring and measurement of L1C and L2A product performances against the proposed specification, viz:

Geometric Performance

- Geometric Calibration Status
- Absolute Geolocation
- Multi-Spectral Registration
- Multi-Temporal Registration

Radiometric Performance

- Radiometric Calibration Status
- Radiometric Uncertainty
- Noise
- Modulation Transfer Function

It also documents observed anomalies and known issues, the list of defective pixels, and any processing chain improvements resulting in an increment of the Processing Baseline.

Latest Data Quality Reports

Source: https://sentinels.copernicus.eu/web/sentinel/data-product-quality-reports

DATA QUALITY REPORTS AT PLANET

- Following the structure of the monthly data quality reports for Sentinel 2

- Create quarterly data quality reports
  - L1 Data Quality Report PlanetScope
  - L1 Data Quality Report SkySat
  - L2 Data Quality Report PlanetScope

- If not stated otherwise, all the results presented here are from the Q3 2019 reports

DATA QUALITY REPORTS AT PLANET
Content

	L1 PS	L1 SSat	L2 PS			L1 PS	L1 SSat	L2 PS
Introduction	✔	✔	✔		**Radiom. Uncertainty**	✔	✔	✔
Performance Overview	✔	✔	✔		Interoperability	✔		
Exposure Settings	✔				**Noise**	✔	✔	
Geom. Reference Data	✔	✔			**Focus**	✔	✔	
Absolute Geolocation	✔	✔			Product Format	✔	✔	✔
Band Registration	✔	✔			**Product Anomalies**	✔	✔	✔
Temporal Registration	✔	✔			Pixel Status	✔		
Relative Geolocation	✔	✔			**Product Features**	✔	✔	✔
Radiometric Status	✔	✔			Active Satellites	✔		

L1 Data Quality Report PlanetScope

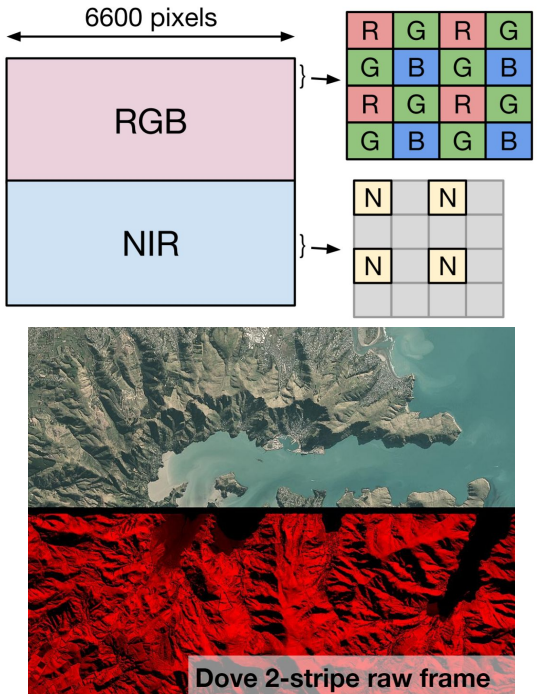
Woody Island, South China Sea – March 28, 2018

PLANETSCOPE SATELLITES

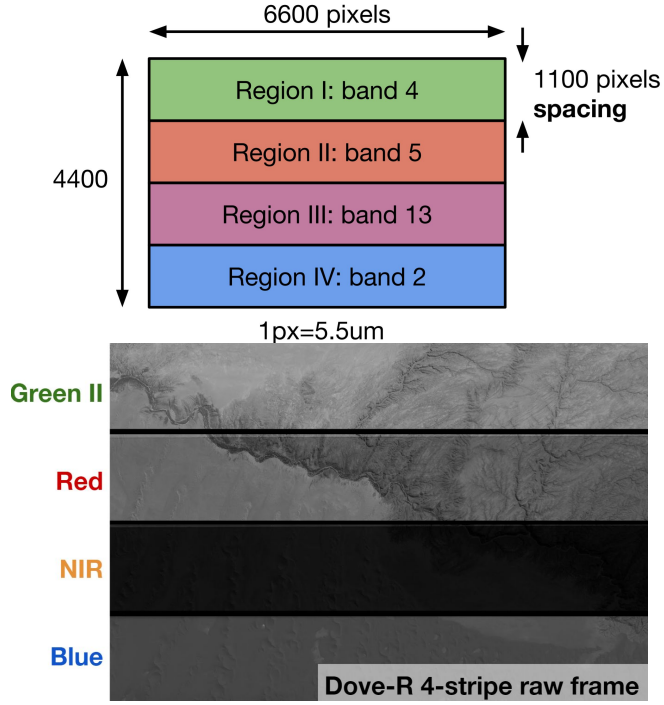
Dove-Classic and Dove-R (Refresh)

- Currently Dove-R makes up ~35% of the PlanetScope data

Dove



Dove-R



L1 DATA QUALITY REPORT PLANETSCOPE
Geometry

Dove-Classic shown

Absolute Geolocation

Average RMSE rad [m]	PCTL90(RMSE rad) [m]	STD(RMSE rad) [m]
3.6	6.8	2.3

Temporal Registration

Average RMSE rad [m]	PCTL90(RMSE rad) [m]	STD(RMSE rad) [m]
1.8	3.1	2.4

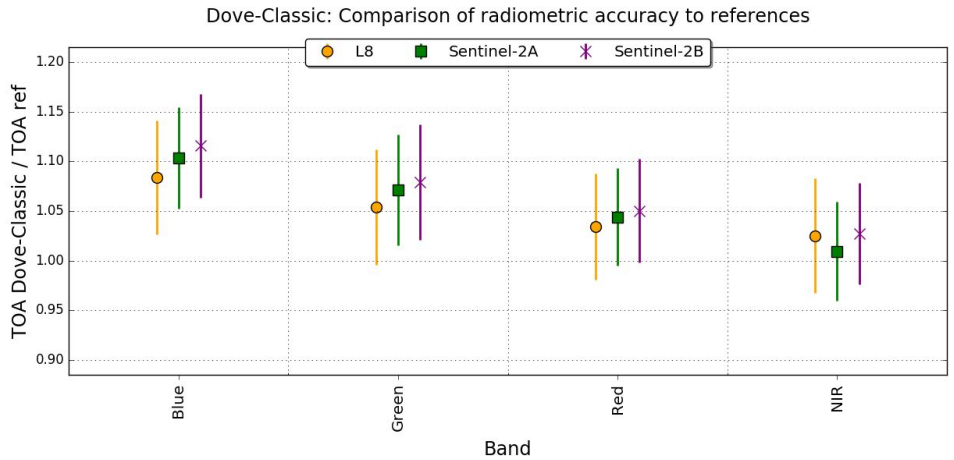
Relative Geolocation

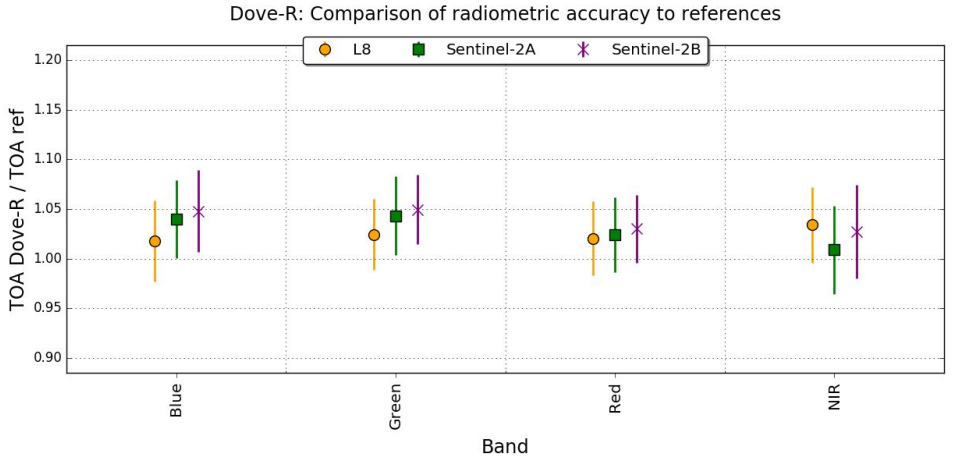
Average RMSE rad [m]	PCTL90(RMSE rad) [m]	STD(RMSE rad) [m]
1.2	2	1.6

Band Registration

Band Combination	Average RMSE rad [m]
Blue - Green	0.140
Blue - Red	0.158
Blue - NIR	1.602
Green - Red	0.160
Green - NIR	1.550
Red - NIR	1.671

L1 DATA QUALITY REPORT PLANETSCOPE
Radiometry





Band	Dove-Classic		Dove-R	
	Gain Coefficient	Standard Deviation	Gain Coefficient	Standard Deviation
Blue	1.103	0.054	1.036	0.042
Green	1.070	0.058	1.040	0.038
Red	1.044	0.051	1.025	0.036
NIR	1.019	0.052	1.021	0.045

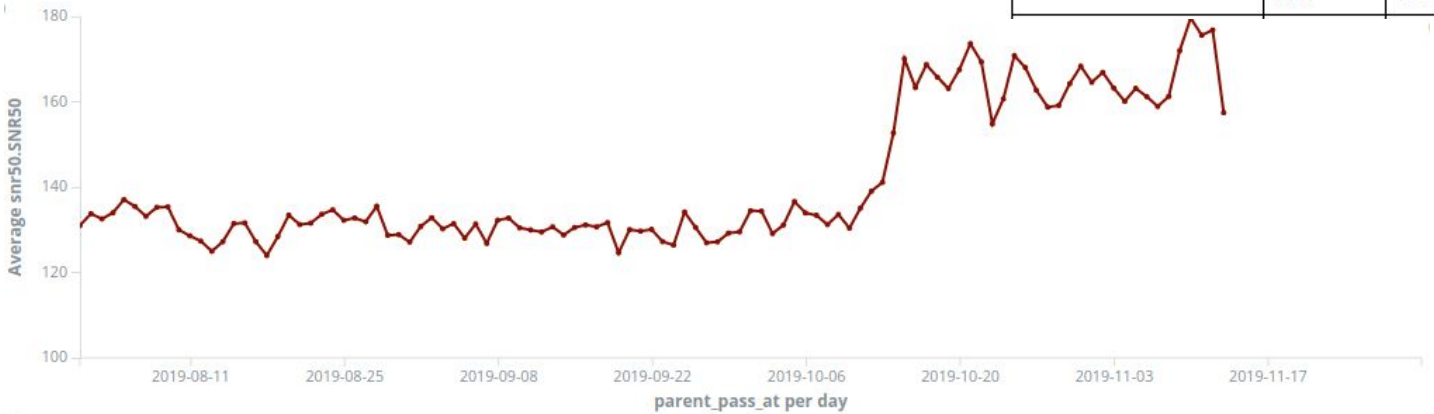
L1 DATA QUALITY REPORT PLANETSCOPE
Noise

Dove-Classic shown

SNR50 - measured from the raster data at 50% of the dynamic range of each scene

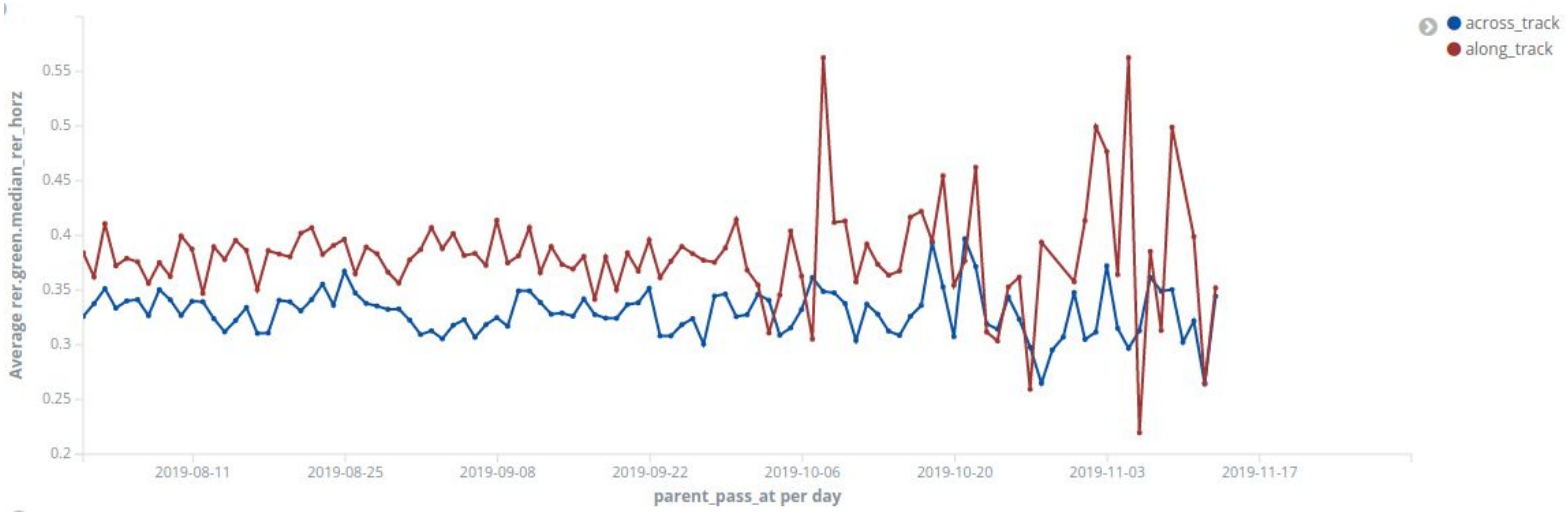
Satellite	SNR50 luminance
Two-stripe Dove-Classic	140.777

Satellite	Band	Average reference radiance (W·sr−1·m−2)
Two-stripe Dove-Classic	Red	110
	Green	86
	Blue	130
	NIR	266



L1 DATA QUALITY REPORT PLANETSCOPE
Focus

Satellite	RER green across track		RER green along track	
	native	Normalized to 3m GSD	native	Normalized to 3m GSD
Two-stripe Dove-Classic	0.329	0.26	0.378	0.297
Four-stripe Dove-R	0.329	0.25	0.362	0.274



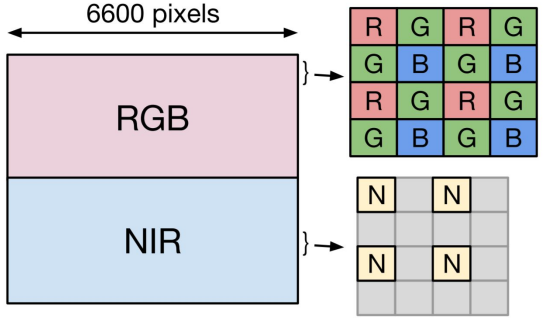
L1 DATA QUALITY REPORT PLANETSCOPE
Product Anomalies

Major known anomalies, actively being worked on and planned to be fixed in the future

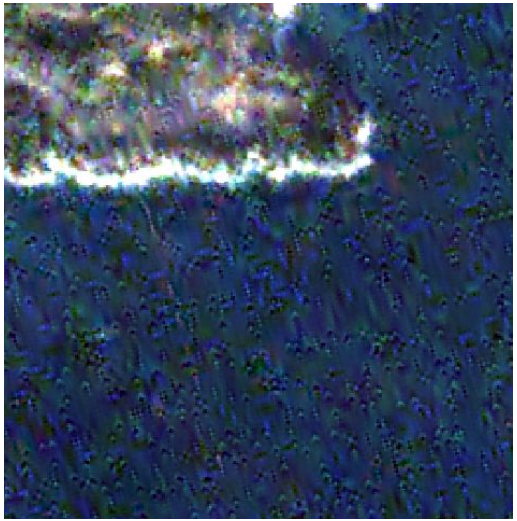
- Blurry overlap between successive scenes
- Tonal difference between successive scenes
- Saturation and Blooming - significantly less frequent in Dove-R
- Tap imbalance
- NIR misalignment - only Dove-Classic
- Misalignment between successive scenes
- Missing scenes in a Strip
- Frame-rate issue

L1 DATA QUALITY REPORT PLANETSCOPE

Product Features - Dove-Classic



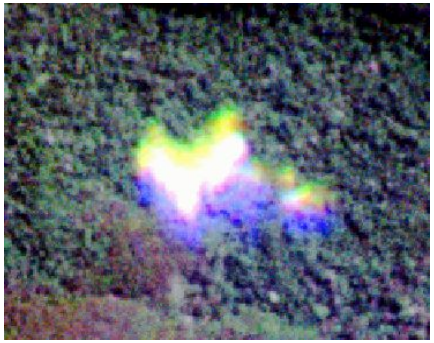
- J2K compression artifacts
- Zipper artifact through debayering

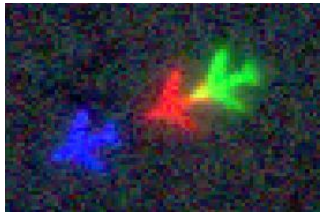


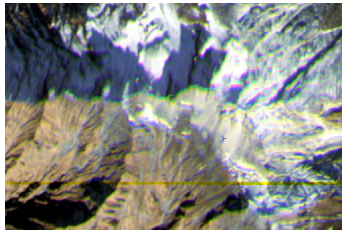
L1 DATA QUALITY REPORT PLANETSCOPE
Product Features - Dove-R

Region I: band 4
Region II: band 5
Region III: band 13
Region IV: band 2

- Clouds
- Planes
- Steep terrains
- Waves







L1 Data Quality Report SkySat

Woody Island, South China Sea – March 28, 2018

L1 DATA QUALITY REPORT SKYSAT
Geometry

Absolute Geolocation

Sample Size	Average RMSE rad [m]	PCTL90(RMSE rad) [m]
858	4.3	7.4

Band Registration

Band Combination	Average RMSE rad [m]
Blue-Green	0.15
Blue-Red	0.19
Blue-NIR	0.3
Green-Red	0.12
Green-NIR	0.25
Red-NIR	0.24

Temporal Registration

Sample Size	Average RMSE rad [m]	PCTL90(RMSE rad) [m]
749	4.1	7.6

Relative Geolocation

Sample Size	Average RMSE rad [m]	PCTL90(RMSE rad) [m]
12362	1.7	3.2

L1 DATA QUALITY REPORT SKYSAT
Radiometry

Calibrated using RadCalNet

Validated using RapidEye and LandSat-8 crossovers

Well within 10%

L1 DATA QUALITY REPORT SKYSAT
Noise

Differential SNR (gSNR):

$$gSNR = \sqrt{M}\,\frac{N_{15}-N_7}{\sqrt{N_{15}+N^2_{noise}}}$$

readout

N_{15} and N_7: number of electrons in the well of a pixel due to 15% or 7% lambertian reflectivity

M: number of measurements

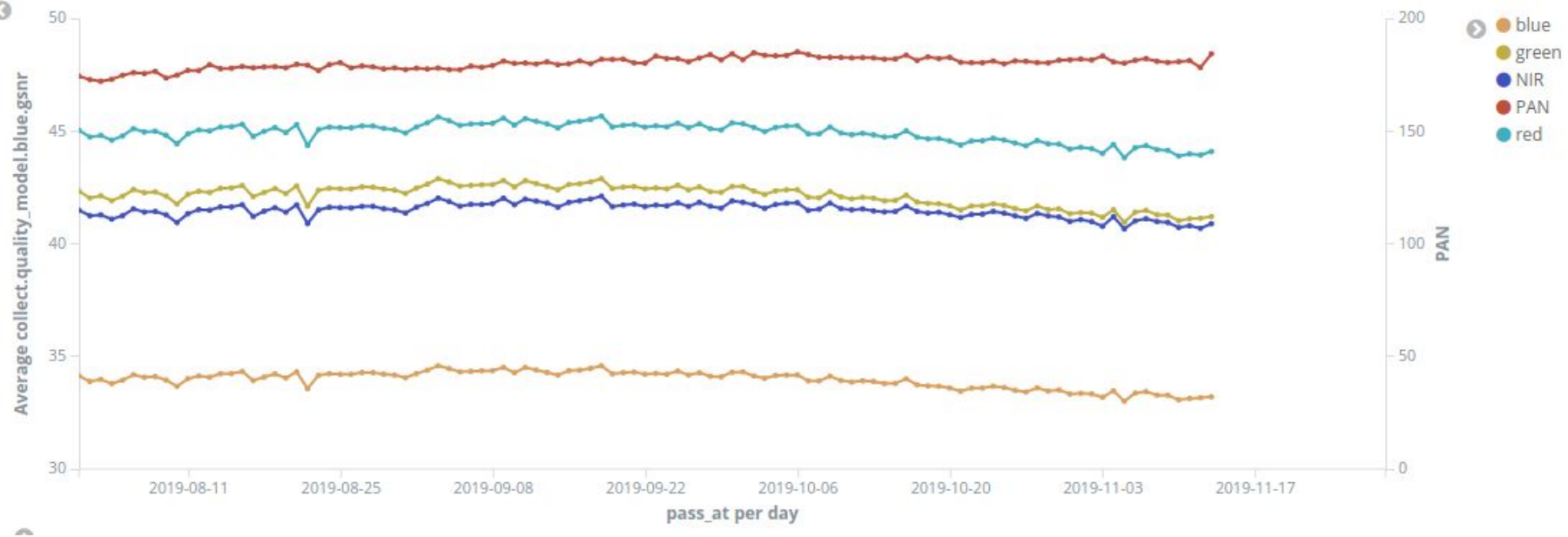
N_{noise}: number of noise electrons during

gSNR	blue	green	red	NIR	PAN
Average	34.21	42.44	45.27	41.83	181.29

L1 DATA QUALITY REPORT SKYSAT

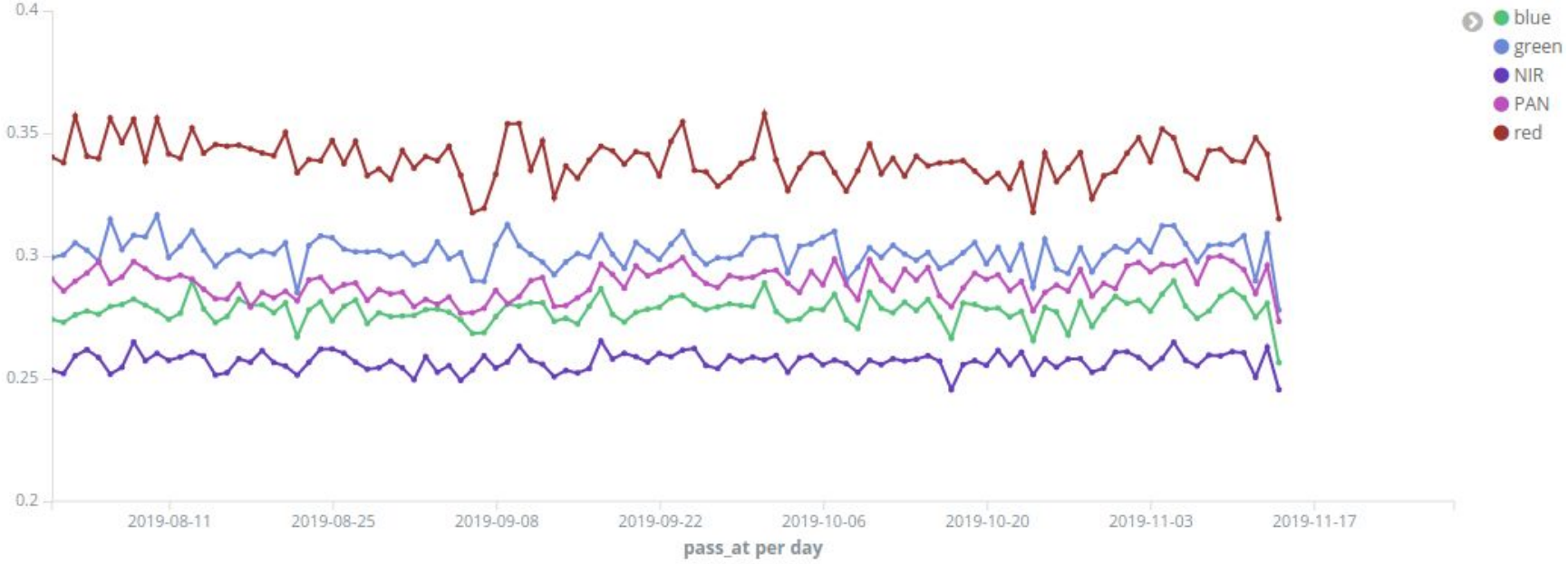
Noise

gSNR	blue	green	red	NIR	PAN
Average	34.21	42.44	45.27	41.83	181.29



L1 DATA QUALITY REPORT SKYSAT
Focus

RER	blue	green	red	NIR	PAN
Average	0.275	0.301	0.336	0.255	0.284

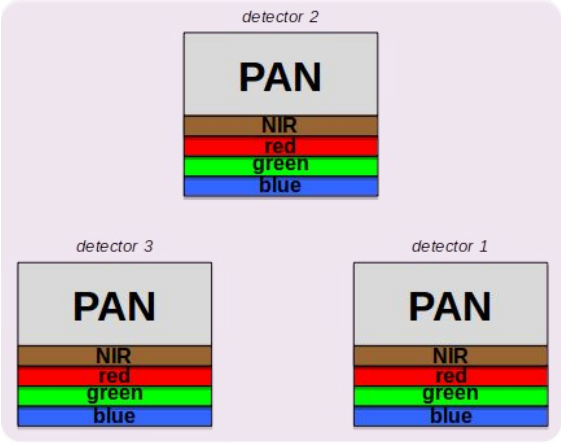


L1 DATA QUALITY REPORT SKYSAT
Product Anomalies

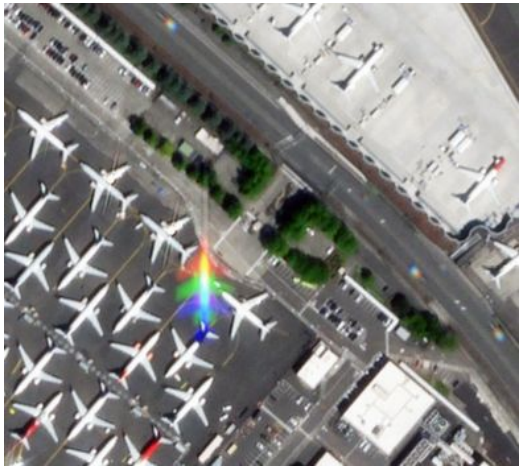
Major known anomalies, actively being worked on and planned to be fixed in the future

- Border Artifacts - **reduced by 4 percent points since Sept 11th**
- Column Streaking
- C2 brightness - **code updated on Sept 6th, reduced by 2.6 percent points**
- Black edge
- ~~Pixelated grid~~ - **fix pushed out on Aug 12th**
- ~~Thick horizontal bands~~ - **fix pushed out on Sept 11th**
- ~~L0 misregistration~~ - **fix pushed out on Oct 15th**
- Image warping
- Vertical color edge

L1 DATA QUALITY REPORT SKYSAT
Product Features



- Gapping (only SkySat-1)
- Parallax blurring
- Movement and Terrain



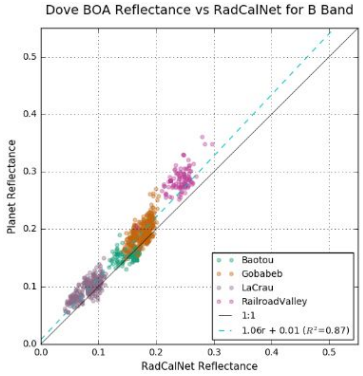
L2 Data Quality Report PlanetScope

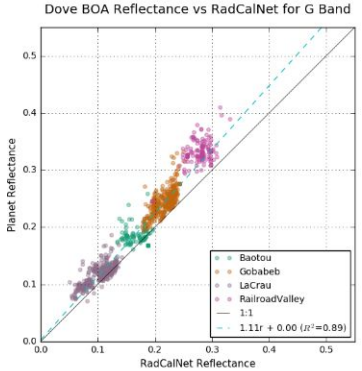
Woody Island, South China Sea – March 28, 2018

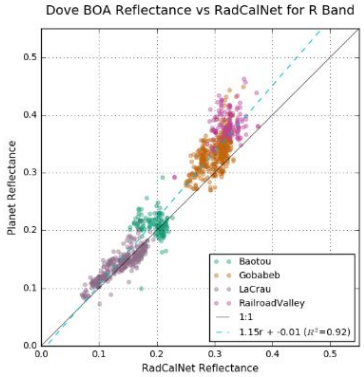
L2 DATA QUALITY REPORT PLANETSCOPE

- No formal product requirements exists

- Radiometric Accuracy of Surface Reflectance Product
- Product Anomalies
- Product Features







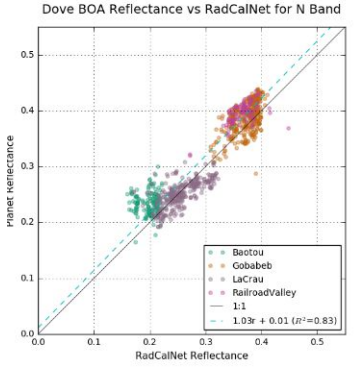


Table 1: Measured Performances for Doves

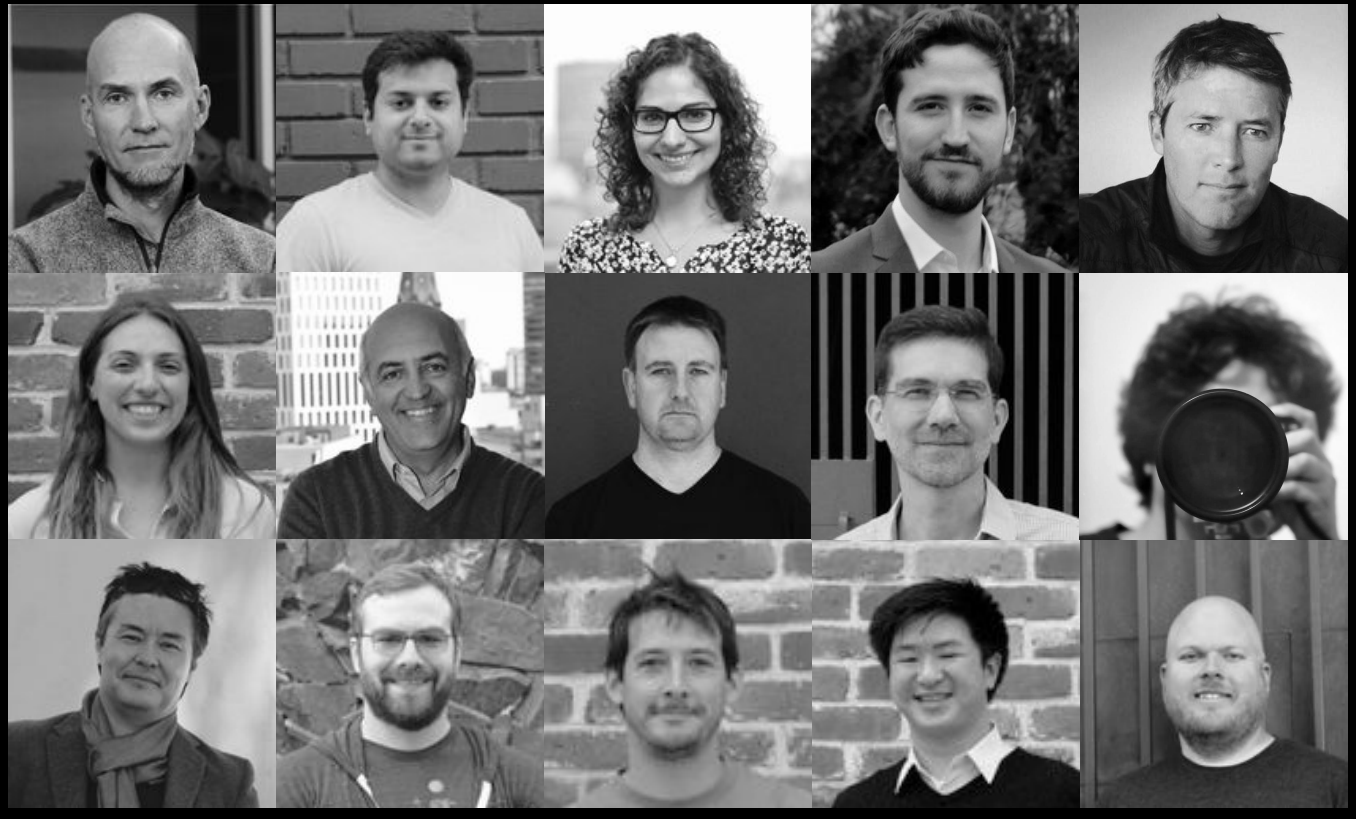
Band	Absolute Accuracy %	Precision %	Uncertainty % (1 sigma)
Blue	10.42	13.59	17.13
Green	11.62	11.90	16.64
Red	10.30	11.32	15.31
NIR	7.91	11.81	14.21

CONCLUSION AND OUTLOOK

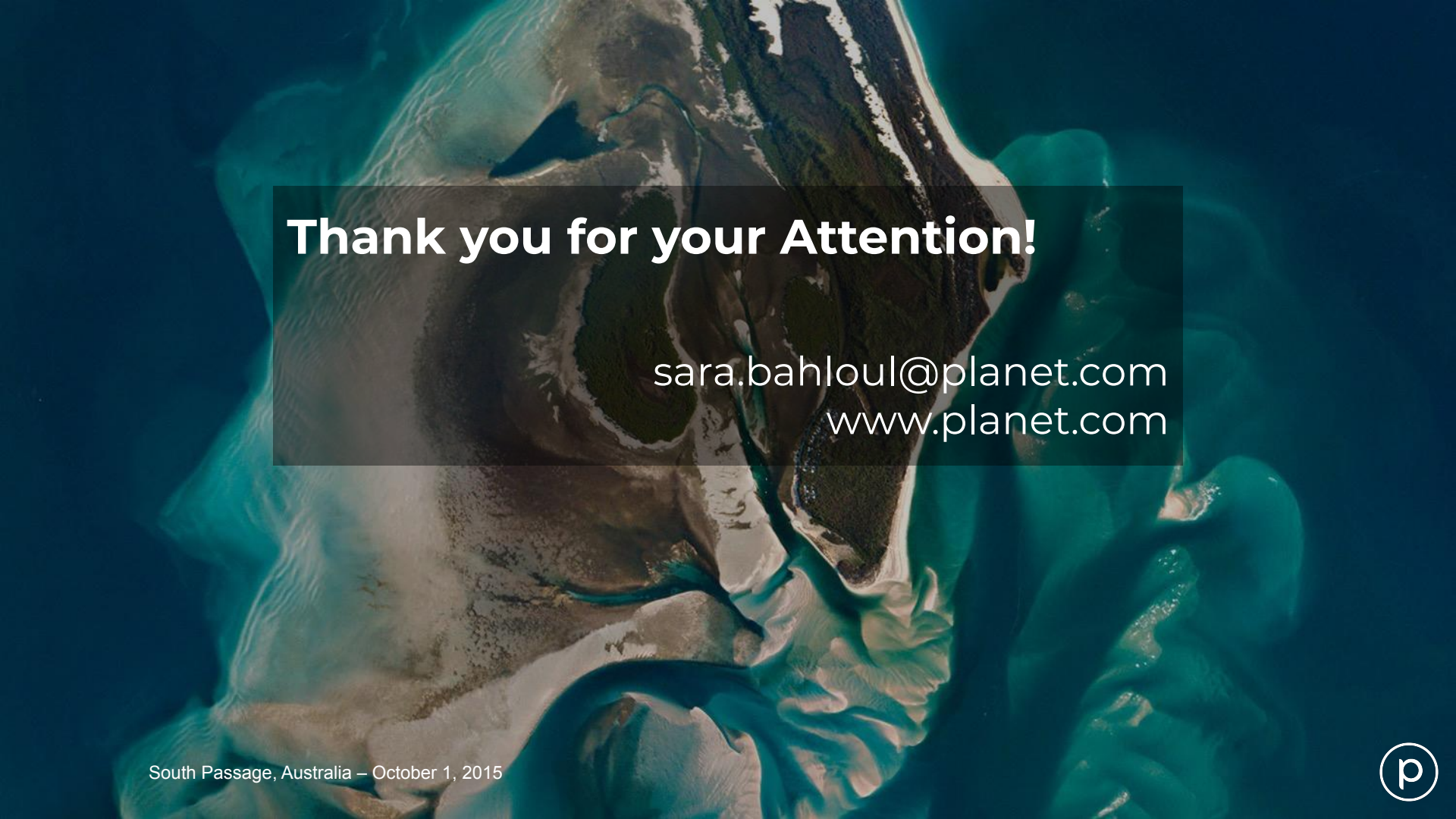
- The data quality reports bring transparency and openness into the IQ processes and status at Planet
- **The data quality reports show the current IQ status and are separate from product requirements or commitments and SLAs !!!**

- Availability
  - Q2 2019 reports are available in the support portal with customer-only visibility
    - https://support.planet.com/hc/en-us/categories/360001160454-White-Papers-Guides
  - Q3 2019 reports will be released soon
  - You can contact me directly or anyone within the Payload Group at Planet

- We are working on having accompanying data packets for each of the reports



Planet Labs Payload Group



Thank you for your Attention!

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www.planet.com

South Passage, Australia – October 1, 2015