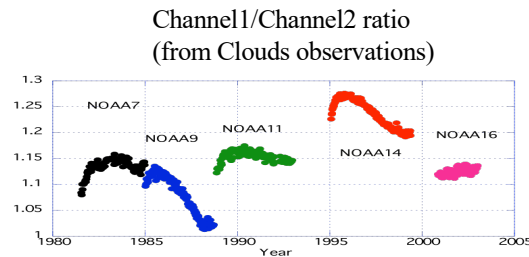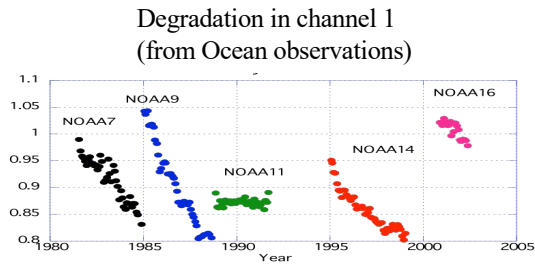# Planet Data Calibration Evaluation

Vermote et al.

NASA/GSFC
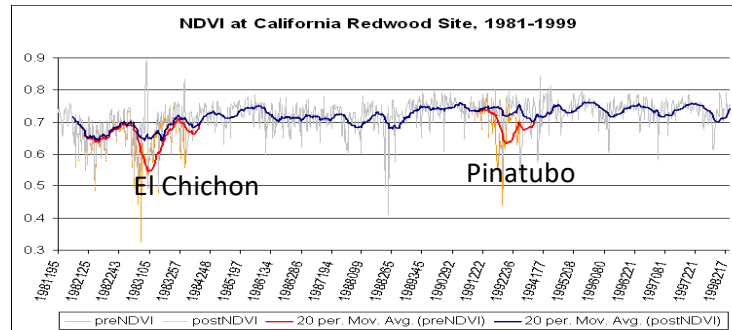
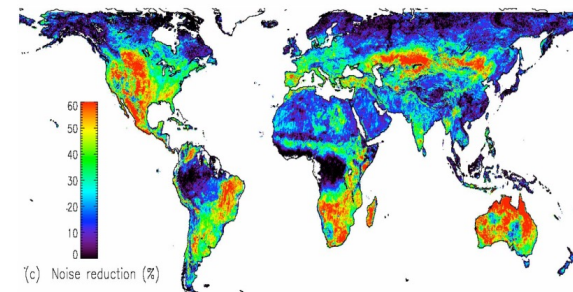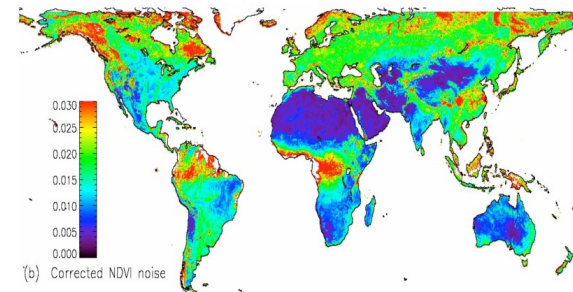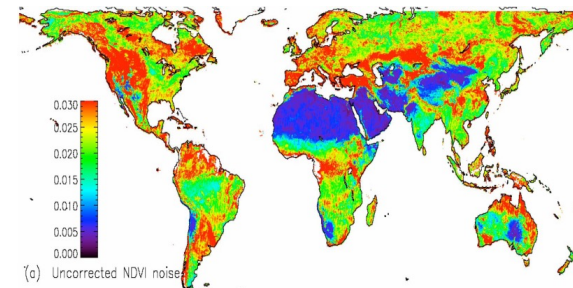# Land Climate Data Record (Approach)

Needs to address geolocation, calibration, atmospheric/BRDF correction issues

CALIBRATION

ATMOSPHERIC CORRECTION

BRDF CORRECTION

Degradation in channel 1
(from Ocean observations)

Channel1/Channel2 ratio
(from Clouds observations)

NDVI at California Redwood Site, 1981-1999

El Chichon   Pinatubo

preNDVI   postNDVI   20 per. Mov. Avg. (preNDVI)   20 per. Mov. Avg. (postNDVI)

(a) Uncorrected NDVI noise

(b) Corrected NDVI noise

(c) Noise reduction (%)

Cross-Calibration over BELMANIP sites

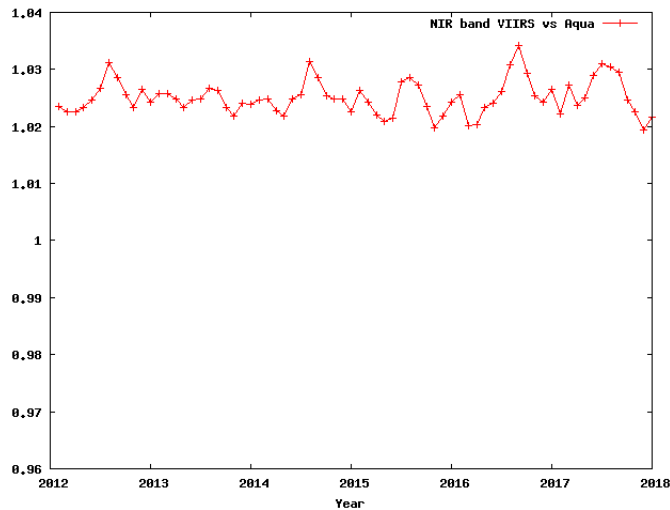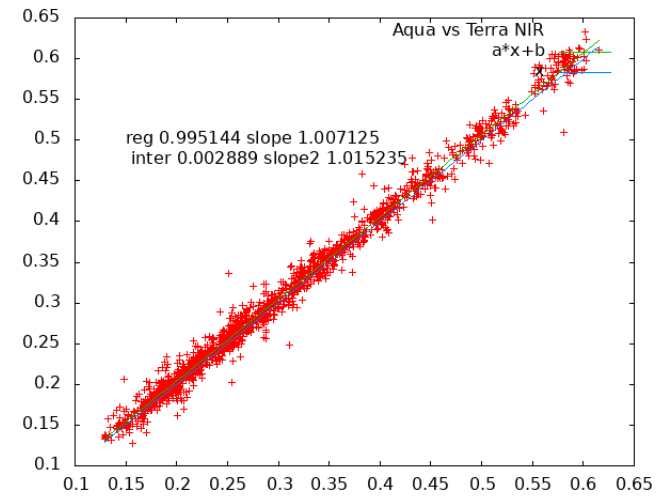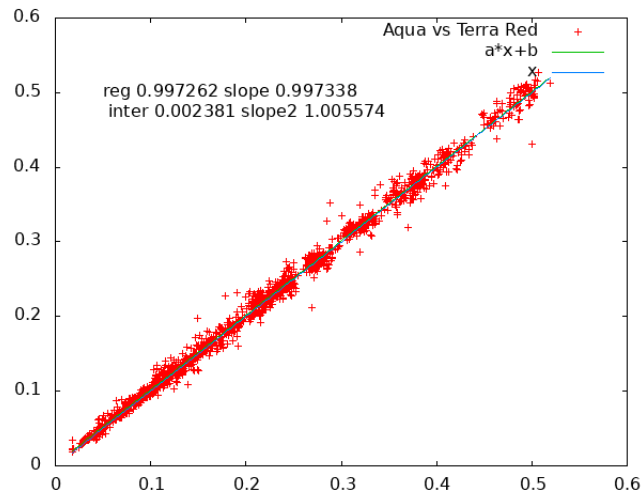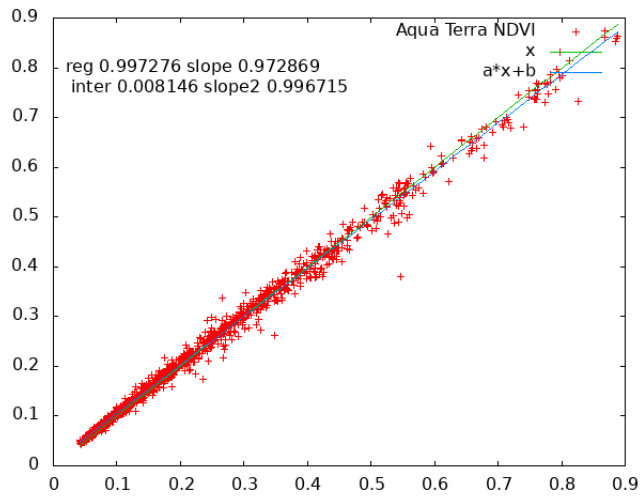- Data are corrected for Atmosphere and BRDF and normalize to Nadir view sun at 45deg.
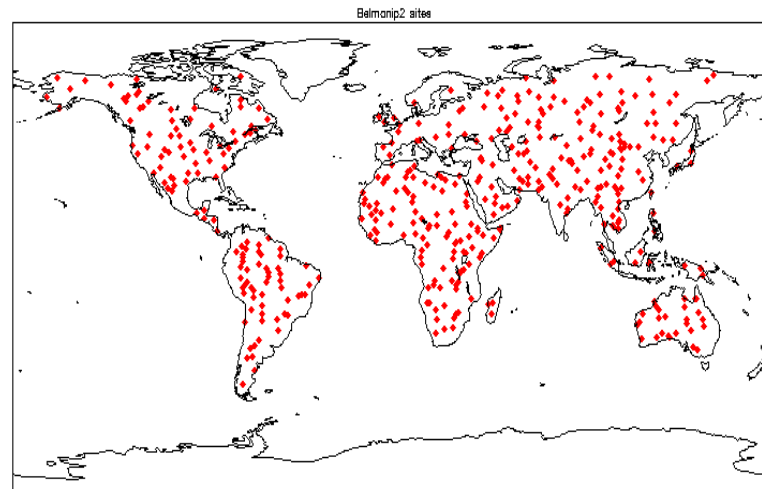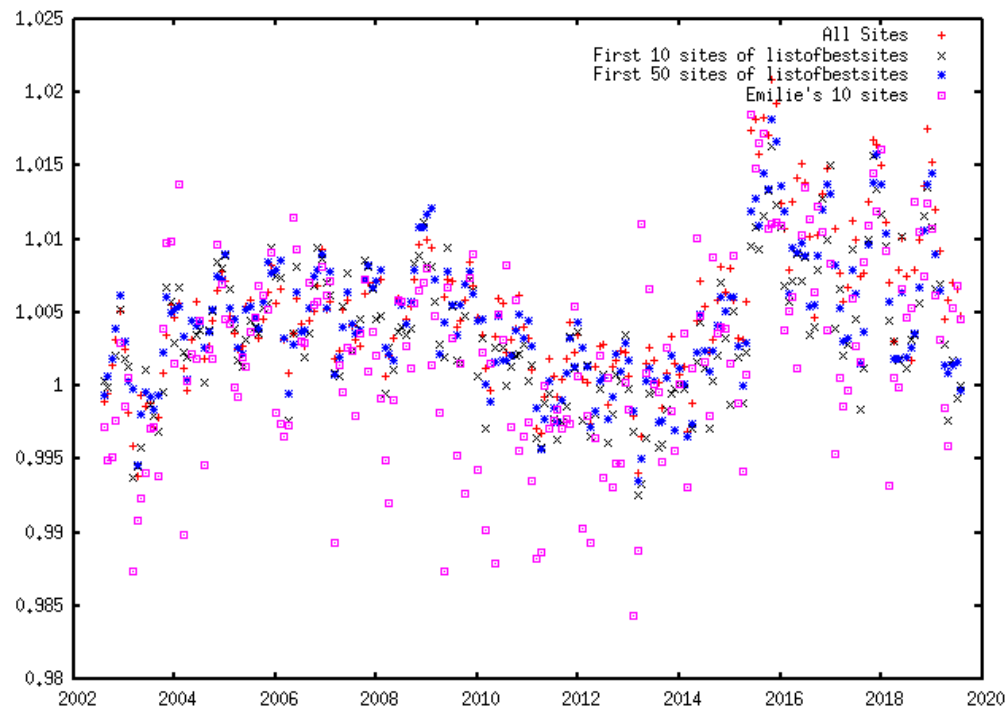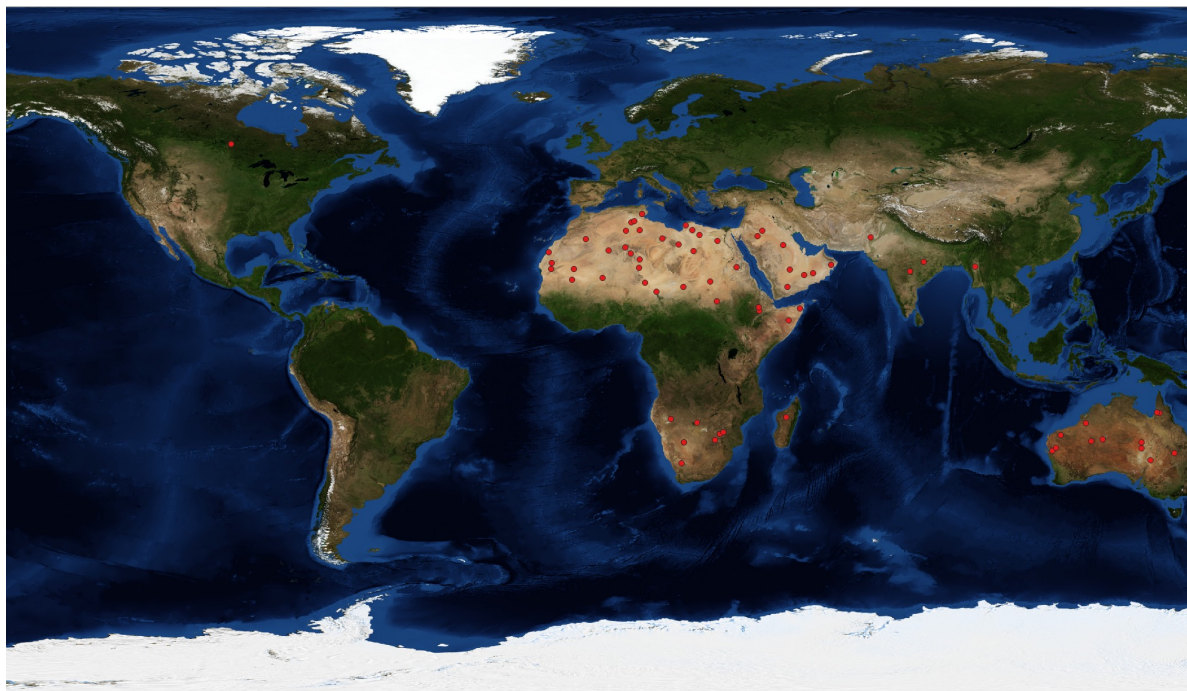

Automated monthly VIIRS cross comparison (over BELMANIP sites) with MODIS Aqua from 2012. the stability of both VIIRS and MODIS Aqua is excellent in both red and NIR as shown (+/- 0.5%).

Scatters plot : Aqua vs Terra Dec 2018

We reduced the number of sites for planet

Application to Planet Data

- First evaluation Planet Site selection (67 sites) – 6 Months (1/1/2019 to 6/30/2019) Dove Classic and Dove R (.SD SuperDove)

- Both Planet Surface Reflectance and In house atmospheric correction of planet data (similar method) were evaluated, no major differences were found

- Cloud contamination on planet were mitigated using a threshold on the standard deviation of the blue band on the site.
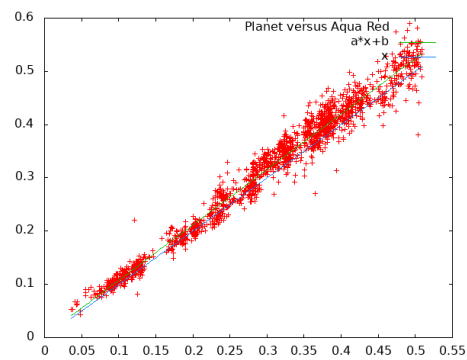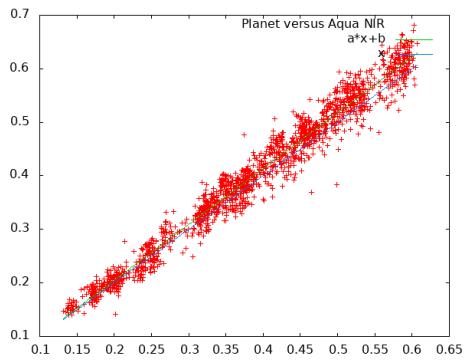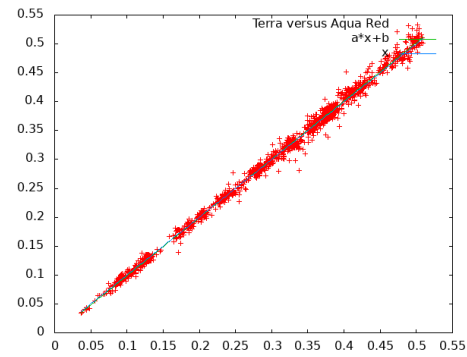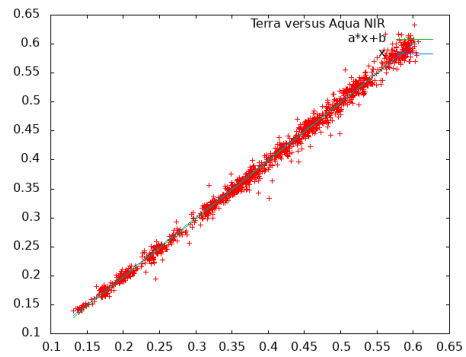
Scatter plots : Terra/Aqua, Planet/Aqua

	R^2	Slope	Intercept	Slope (forced through origin)
Planet Red	0.987	1.04	0.004	1.05
Terra Red	0.998	1.01	-0.002	1.00
Planet NIR	0.985	1.04	-0.004	1.04
Terra NIR	0.997	1.01	-0.005	1.00

- Monthly stats: Terra/Aqua, Planet/Aqua

|	Cal Ratio NIR	std -NIR	Cal Ratio Red	std Red	Nb
PLANET Jan 19	1.021	0.055	1.05	0.078	244
PLANET Feb 19	1.037	0.06	1.065	0.103	257
PLANET Mar 19	1.038	0.056	1.063	0.092	262
PLANET Apr 19	1.03	0.061	1.045	0.073	312
PLANET May 19	1.036	0.063	1.062	0.069	342
PLANET Jun 19	1.039	0.067	1.061	0.067	284
Terra Jan 19	0.992	0.03	1.001	0.035	244
Terra Feb 19	0.993	0.026	1.001	0.031	257
Terra Mar 19	0.996	0.023	1.001	0.025	262
Terra Apr 19	0.993	0.026	0.998	0.033	312
Terra May 19	0.995	0.025	1.001	0.029	342
Terra Jun 19	0.996	0.023	1.001	0.029	284
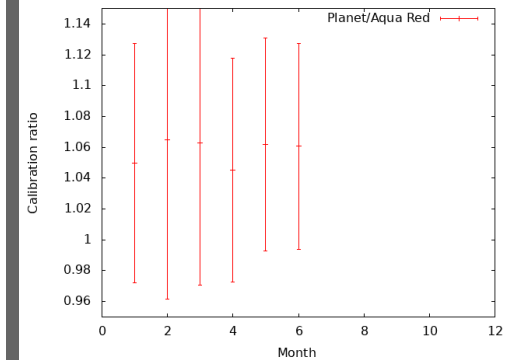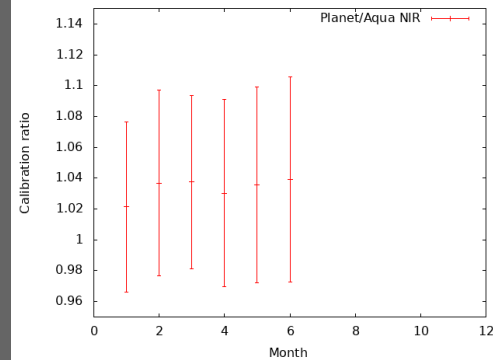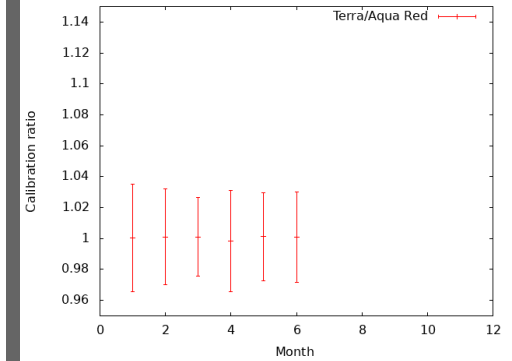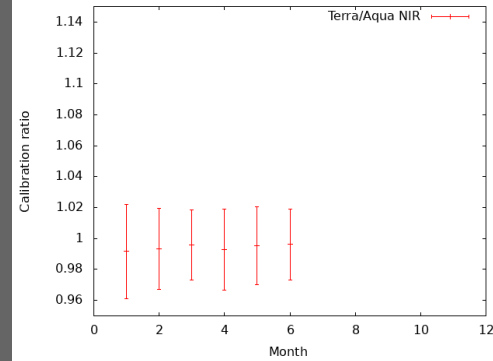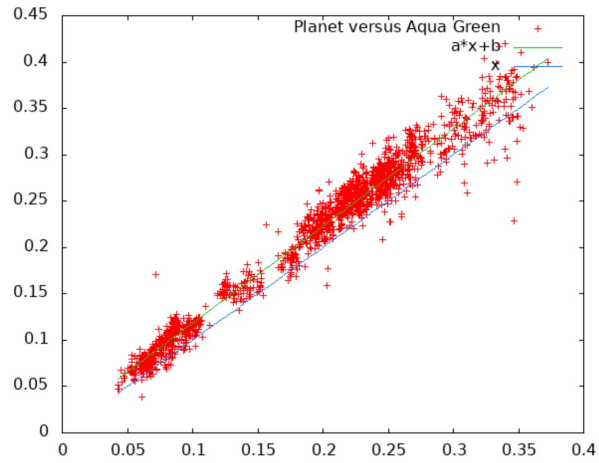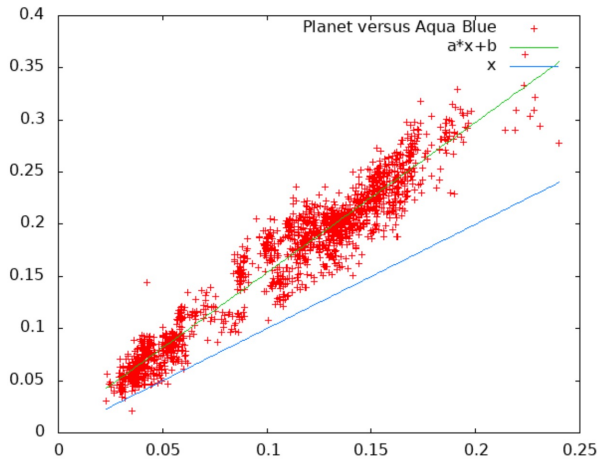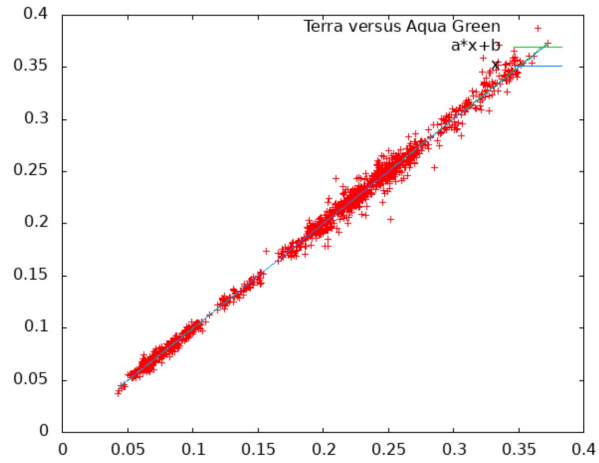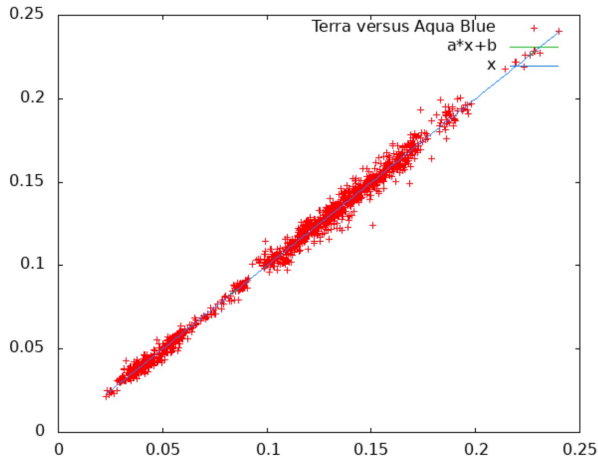
Scatter plots : Terra/Aqua, Planet/Aqua

	R^2	Slope	Intercept	Slope (forced through origin)
Planet Blue	0.966	1.44	0.010	1.51
Terra Blue	0.997	1.00	0.000	1.00
Planet Green	0.984	1.05	0.013	1.11
Terra Green	0.997	1.01	-0.001	1.00

Monthly stats: Terra/Aqua, Planet/Aqua

	Cal Ratio Green	Stdev Green	Cal Ratio blue	Stdev blue	Number of observations
PLANET Jan 19	1.138	0.103	1.580	0.225	244
PLANET Feb 19	1.157	0.128	1.615	0.247	257
PLANET Mar 19	1.149	0.107	1.621	0.211	262
PLANET Apr 19	1.113	0.091	1.543	0.204	312
PLANET May 19	1.112	0.095	1.511	0.194	342
PLANET Jun 19	1.126	0.083	1.524	0.191	284
Terra Jan 19	0.997	0.042	0.999	0.043	244
Terra Feb 19	0.999	0.037	1.001	0.039	257
Terra Mar 19	1.001	0.032	1.002	0.038	262
Terra Apr 19	0.999	0.037	0.999	0.047	312
Terra May 19	1.000	0.030	1.002	0.038	342
Terra Jun 19	1.000	0.036	1.002	0.045	284
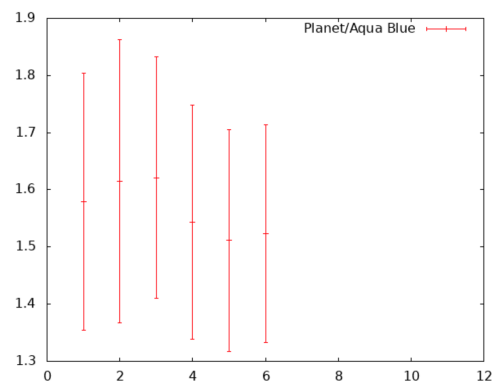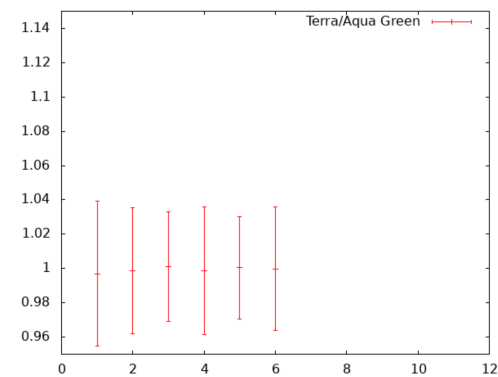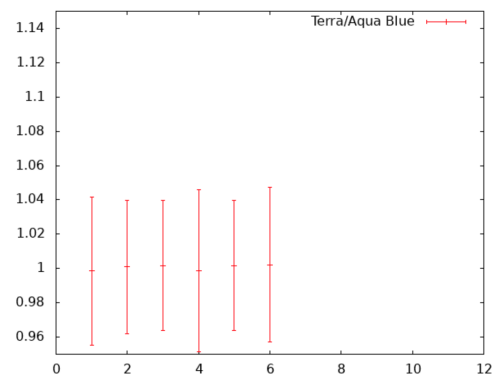
Planet new generation evaluation

- Planet new generation sensors
  - PS2.SD, PSB.SD

- 133 BELMANIP sites
- Covering June 2019 – June 2020
- Total individual Planet scenes: **9749**
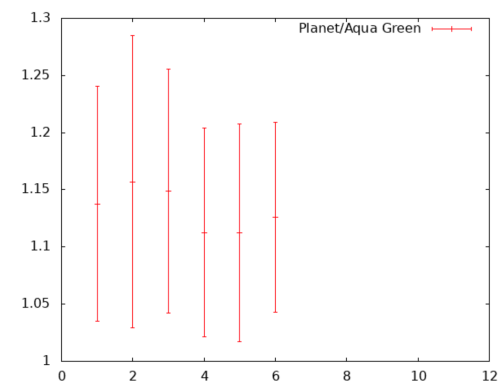 - **~73 scenes per site**
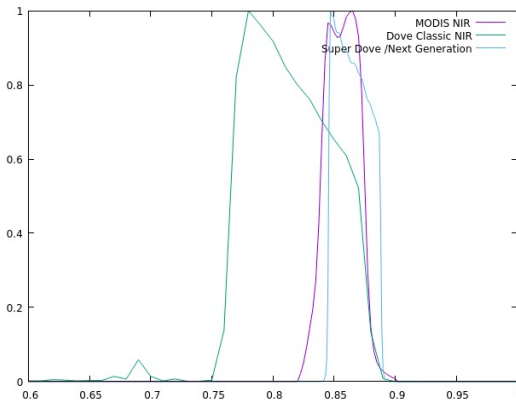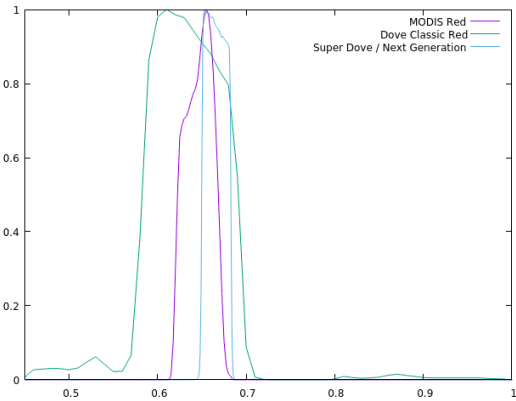
SUPERDOVE
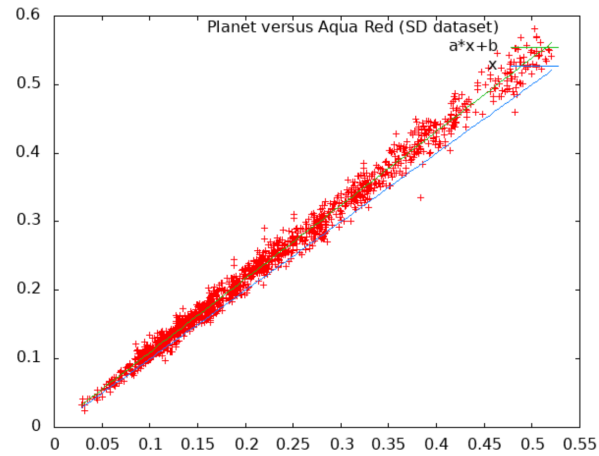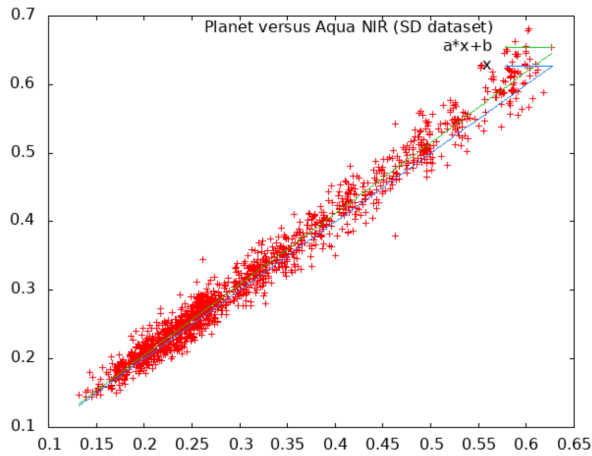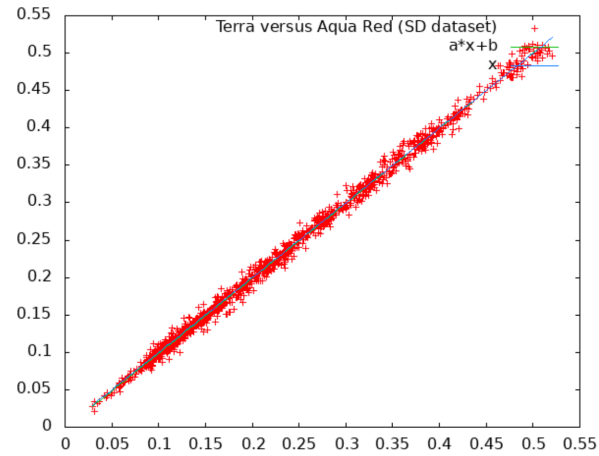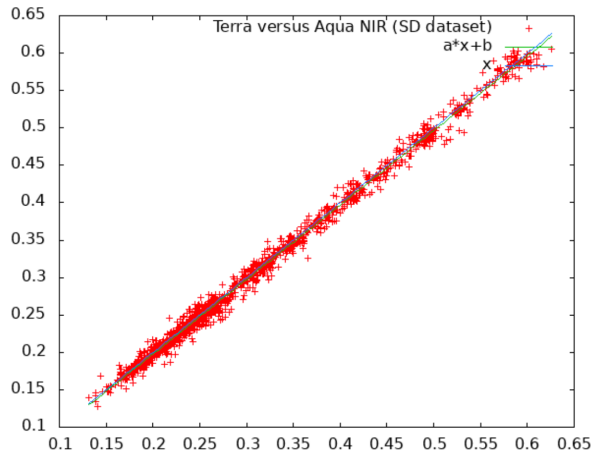
Scatter plots : Terra/Aqua, Planet/Aqua

	R^2	Slope	Intercept	Slope (forced through origin)
Planet NIR	0.978	1.034	-0.001	1.030
Terra NIR	0.995	0.996	-0.002	0.992
Planet Red	0.990	1.074	0.002	1.082
Terra Red	0.997	1.004	-0.002	0.998

SUPERDOVE

Monthly stats: Terra/Aqua, Planet/Aqua

|	Cal Ratio NIR	Stdev NIR	Cal Ratio Red	Stdev Red	Number of observations
PLANET Jun 19	1.037	0.061	1.111	0.064	90
PLANET Jul 19	1.040	0.060	1.106	0.059	103
PLANET Aug 19	1.040	0.058	1.100	0.051	127
PLANET Sep 19	1.036	0.057	1.092	0.051	133
PLANET Oct 19	1.041	0.056	1.096	0.059	131
PLANET Nov 19	1.042	0.060	1.096	0.057	139
PLANET Dec 19	1.032	0.063	1.096	0.062	126
PLANET Jan 20	1.037	0.054	1.094	0.056	112
PLANET Feb 20	1.033	0.057	1.085	0.063	128
PLANET Mar 20	1.017	0.052	1.065	0.060	96
PLANET Apr 20	1.013	0.061	1.061	0.058	105
PLANET May 20	0.999	0.061	1.048	0.058	110
PLANET Jun 20	1.010	0.061	1.060	0.072	100
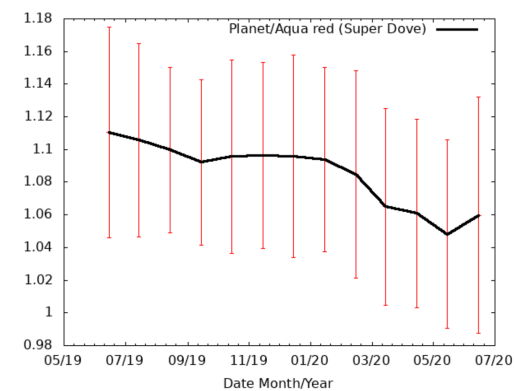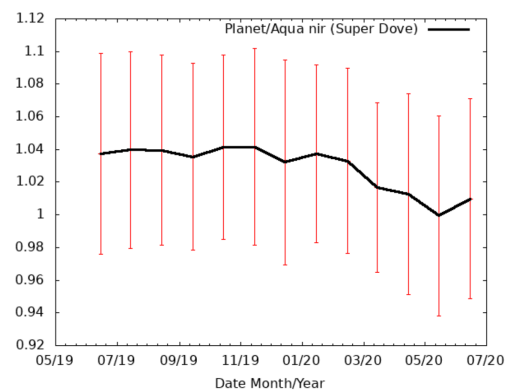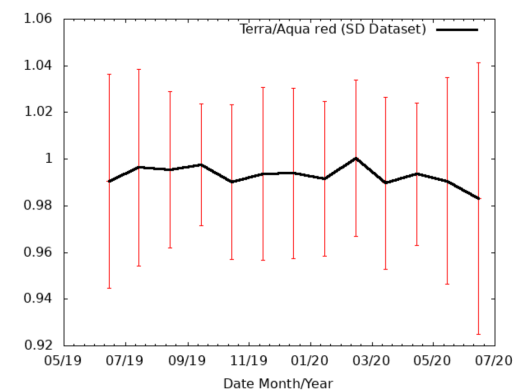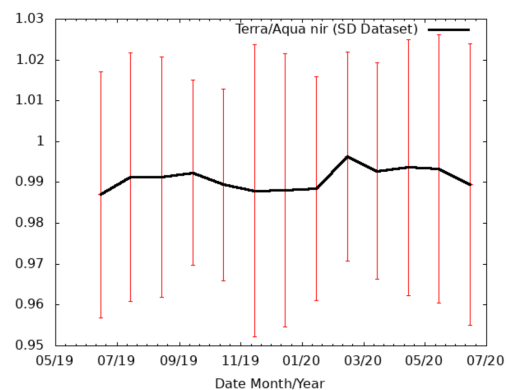
SUPERDOVE

Monthly stats: Terra/Aqua, Planet/Aqua

|	Cal Ratio Blue	Stdev Blue	Cal Ratio Green	Stdev Green	Number of observations
PLANET Jun 19	1.334	0.177	1.175	0.092	90
PLANET Jul 19	1.299	0.128	1.168	0.077	103
PLANET Aug 19	1.283	0.120	1.157	0.067	127
PLANET Sep 19	1.250	0.108	1.148	0.071	133
PLANET Oct 19	1.274	0.136	1.153	0.076	131
PLANET Nov 19	1.276	0.133	1.159	0.077	139
PLANET Dec 19	1.263	0.150	1.155	0.077	126
PLANET Jan 20	1.249	0.141	1.155	0.072	112
PLANET Feb 20	1.229	0.128	1.138	0.072	128
PLANET Mar 20	1.219	0.125	1.119	0.078	96
PLANET Apr 20	1.196	0.124	1.110	0.085	105
PLANET May 20	1.151	0.116	1.091	0.078	110
PLANET Jun 20	1.188	0.161	1.102	0.092	100
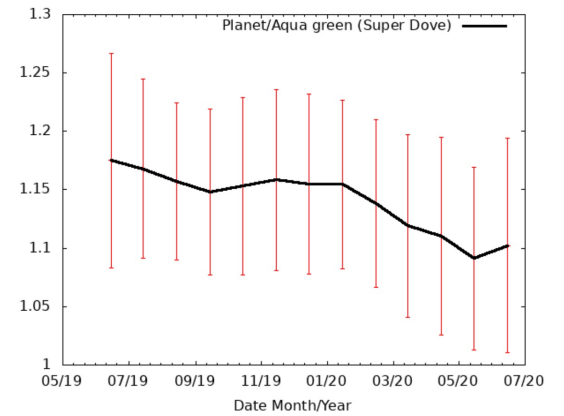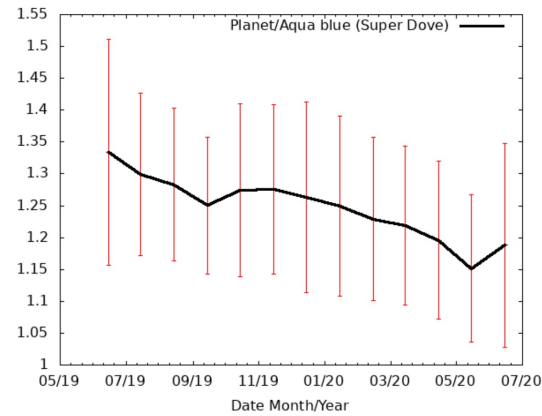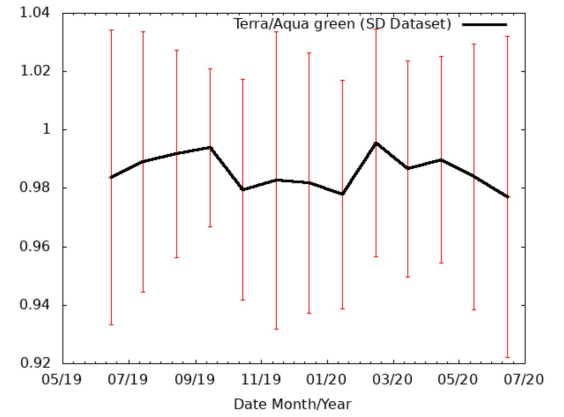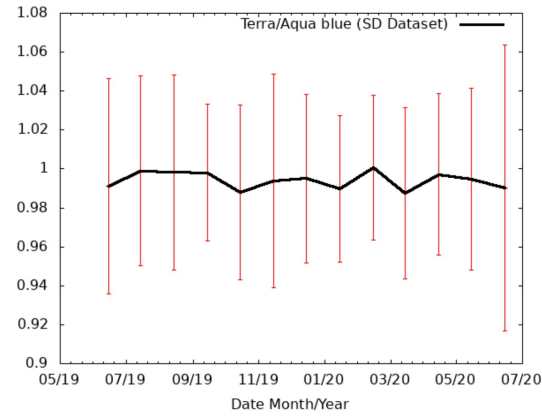
DOVE CLASSIC
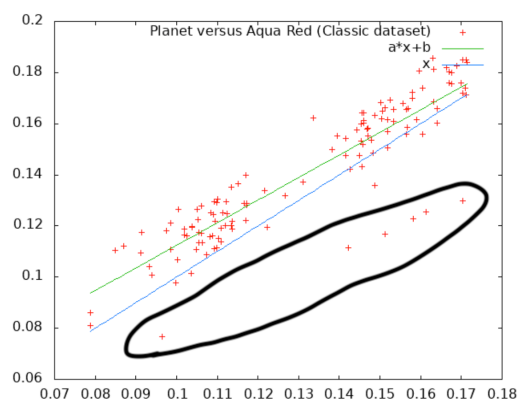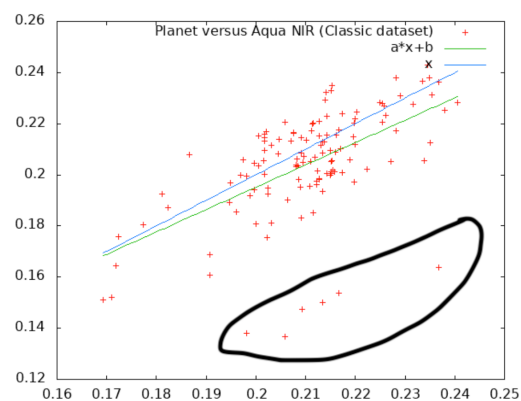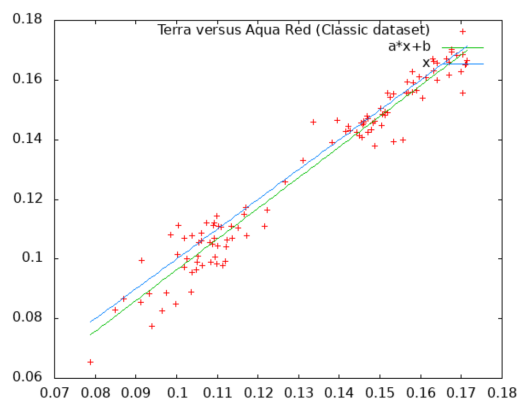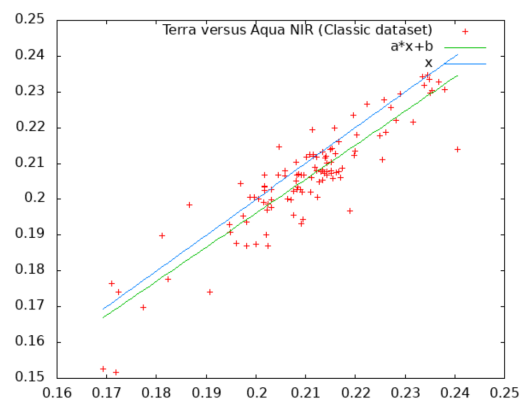
Scatter plots : Terra/Aqua, Planet/Aqua

	R^2	Slope	Intercept	Slope (forced through origin)	Stdev of ratio	Number of observations
Planet NIR	0.529	0.917	0.014	0.985	0.058	123
Terra NIR	0.812	0.944	0.007	0.979	0.031	123
Planet Red	0.910	0.930	0.020	1.078	0.073	123
Terra Red	0.957	1.023	-0.006	0.982	0.052	123

DOVE CLASSIC
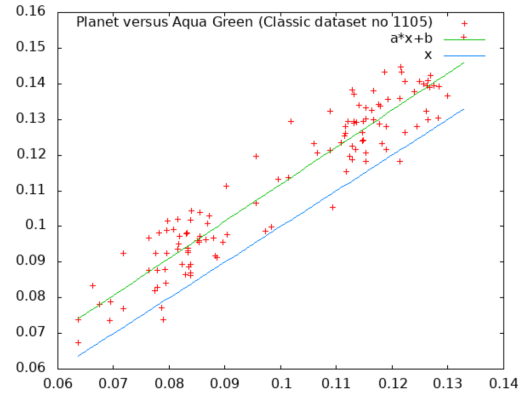
Terra versus Aqua Blue (Classic dataset no 1105)

Terra versus Aqua Green (Classic dataset no 1105)

Planet versus Aqua Blue (Classic dataset no 1105)
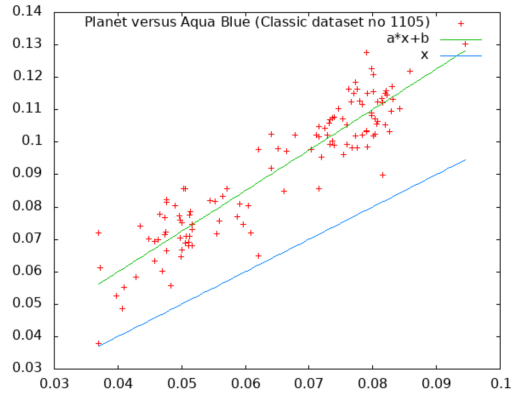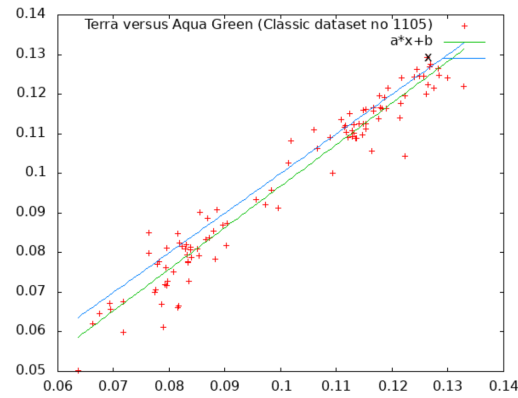
Planet versus Aqua Green (Classic dataset no 1105)

Scatter plots : Terra/Aqua, Planet/Aqua

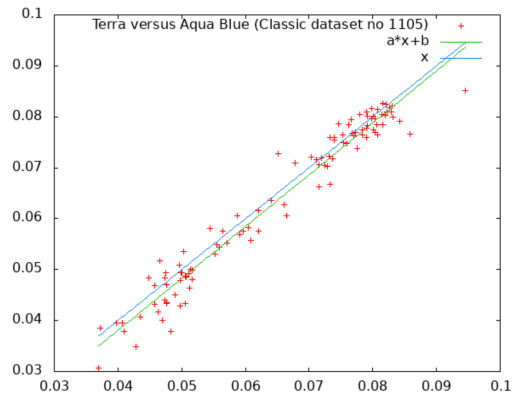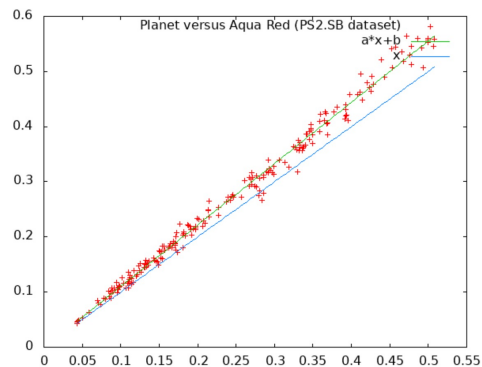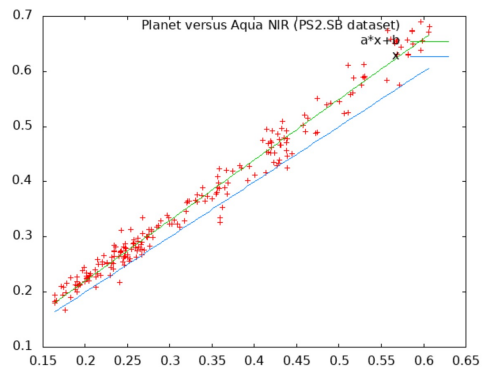|	R^2	Slope	Intercept	Slope (forced through origin)	Stdev of ratio	Number of observations
Planet blue	0.849	1.250	0.010	1.399	0.141	123
Terra blue	0.961	1.018	-0.003	0.980	0.055	123
Planet green	0.892	1.036	0.008	1.117	0.074	123
Terra green	0.950	1.048	-0.008	0.972	0.056	123

DOVE NEXT GENERATION

Scatter plots : Terra/Aqua, Planet/Aqua

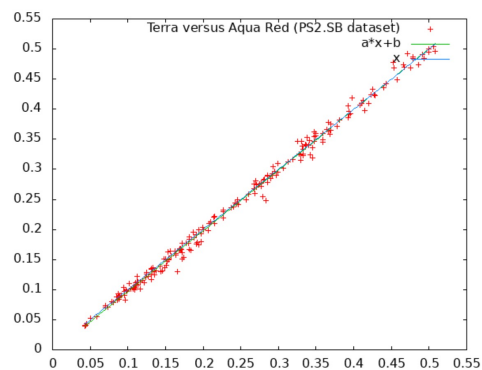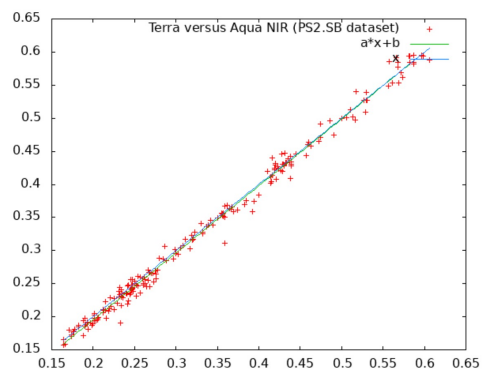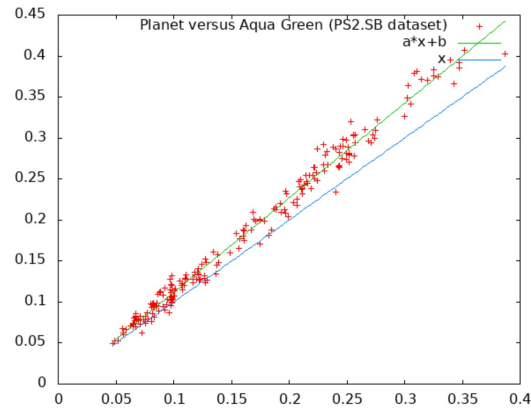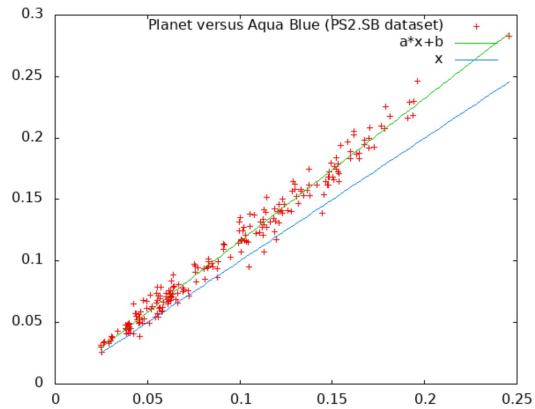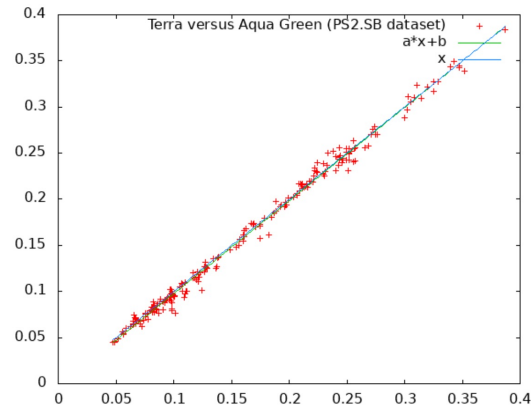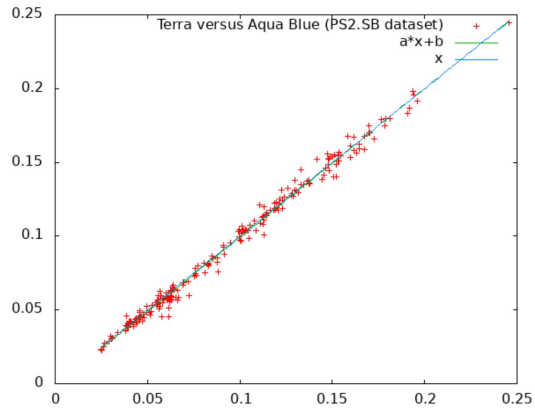|	R^2	Slope	Intercept	Slope (forced through origin)	Stdev of ratio	Number of observations
Planet NIR	0.979	1.100	0.000	1.101	0.060	221
Terra NIR	0.994	1.012	-0.007	0.993	0.033	221
Planet Red	0.991	1.116	-0.002	1.111	0.055	221
Terra Red	0.996	1.009	-0.004	0.996	0.043	221

DOVE NEXT GENERATION

Scatter plots : Terra/Aqua, Planet/Aqua

	R^2	Slope	Intercept	Slope (forced through origin)	Stdev of ratio	Number of observations
Planet blue	0.978	1.165	-0.000	1.165	0.096	221
Terra blue	0.992	1.008	-0.001	0.995	0.052	221
Planet green	0.986	1.156	-0.004	1.138	0.076	221
Terra green	0.994	1.010	-0.003	0.993	0.048	221

Conclusions/Recommendations

- A rigorous calibration approach should be designed (dark current correction, temporal monitoring, independent calibration for each instrument) as much as possible independent of the validation set (cross comparison with MODIS is validation)

- Cloud screening is very important for cross-comparison

- Atmospheric correction also could be improved.

- The overall conclusion is that PLANET calibration needs improvements, each instrument needs to be characterized prior to launch, calibrated while in flight and this calibration assessed independently (possibly using our methodology). In-flight calibration should be achieved by a combination of on-board system and vicarious calibration methods (Moon, Cloud, Rayleigh Scattering, etc.). Those tasks need to be documented (e.g. ATBD, journal article) and peer reviewed.