Results of Cross-comparisons using multiple sites

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RAL Space

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- AATSR Drift Analysis
- AATSR vs. MERIS comparisons over Deserts
- Intercomparisons Over Dome-C
- Summary of Results
- Next Steps

Site Selection Criteria

Uniform reflectance over large area

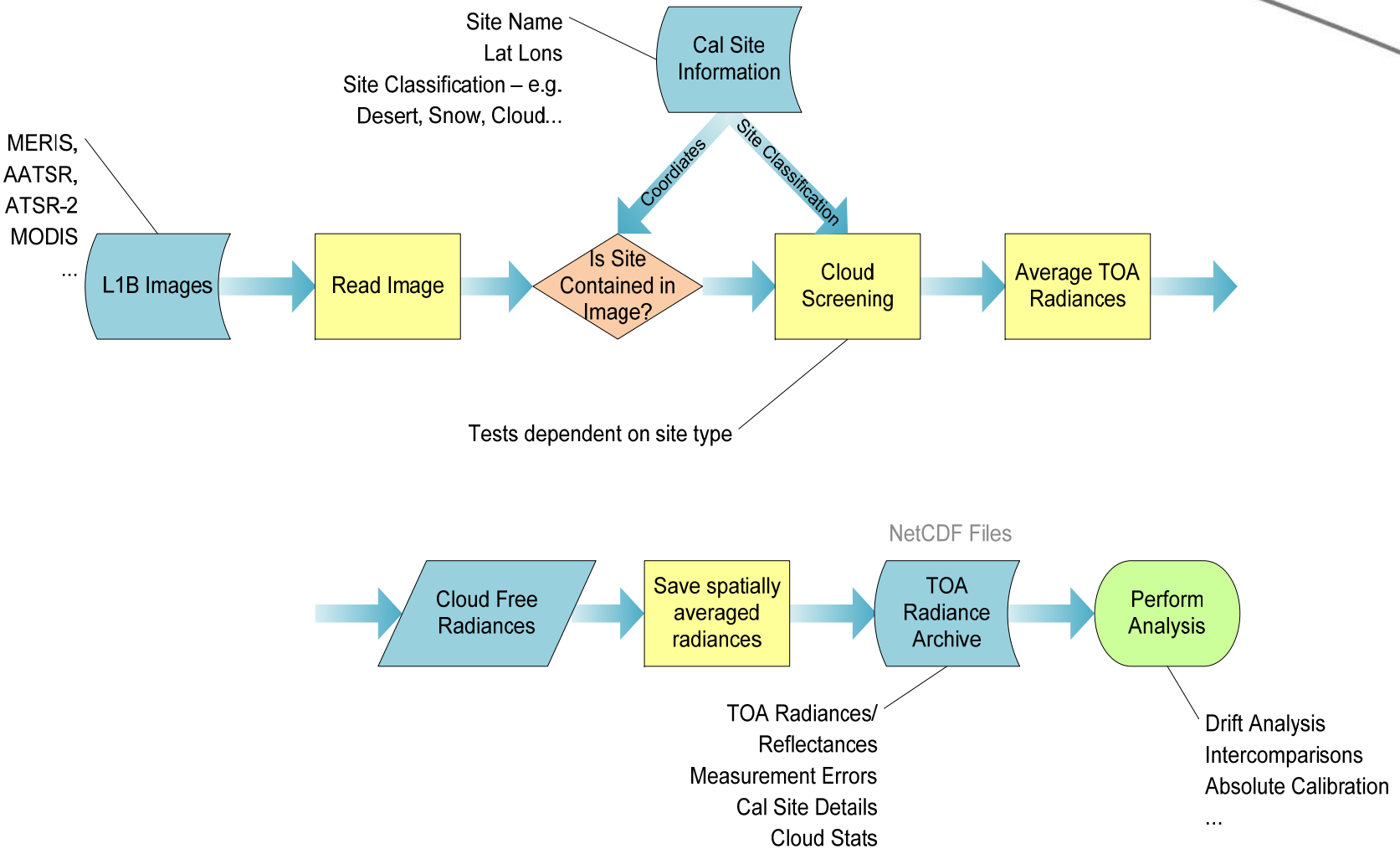
Long term-radiometric stability of the calibration sites

-ensures long-term stability of the top-of-the atmosphere (TOA) albedo (and of seasonal variations, if any) or reflectance over large spatially uniform areas.

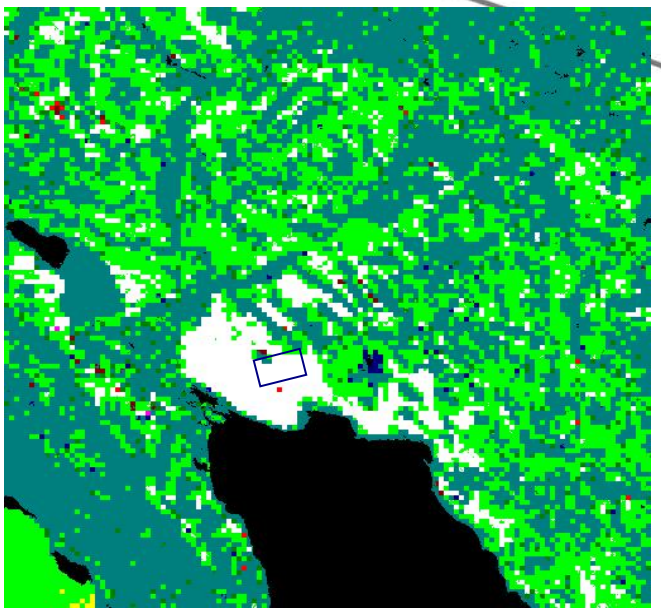
High surface reflectance to maximise the signal-to-noise and minimise atmospheric effects on the radiation measured by the satellite

		Lat center (°)	Long center(°)
Sahara	**Algeria1**	23.8	-0.4
	Algeria2	26.09	-1.38
	Algeria3	30.32	7.66
	Algeria4	30.04	5.59
	Algeria5	31.02	2.23
	Arabia1	18.88	46.76
	Arabia2	20.13	50.96
	Arabia3	28.92	43.73
	Sudan1	21.74	28.22
	Niger1	19.67	9.81
	Niger2	21.37	10.59
	Niger3	21.57	7.96
	Egypt1	27.12	26.1
	Libya1	24.42	13.35
	Libya2	25.05	20.48
	Libya3	23.15	23.1
	Libya4	28.55	23.39
	Mali1	19.12	-4.85
	Mauritania1	19.4	-9.3
	Mauritania2	20.85	-8.78
Ice	**Greenland**	73.75	-40
	Dome-C	-73.75	120

Site Data Extraction Procedure



Desert 'Cloud' Test



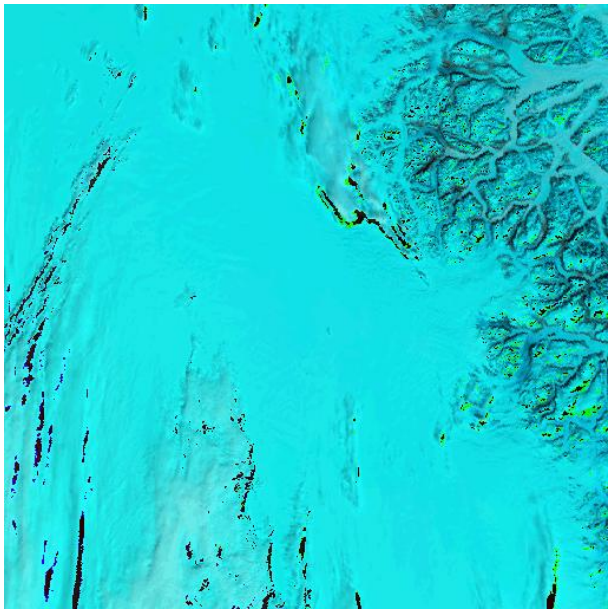
Sonora, Mexico

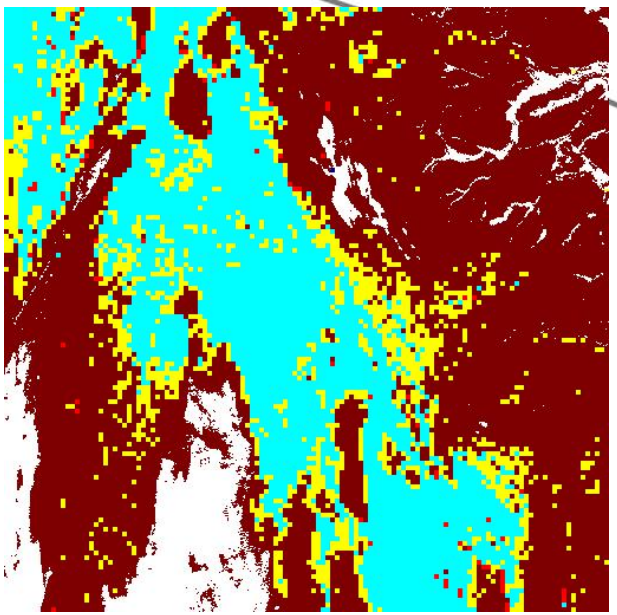
- Test of 4km x 4km regions
- Cloudy if:
  - $\Delta R_{1.6\mu m}/R_{1.6\mu m} > 0.1$
  - $\Delta T_{11\mu m}/T_{11\mu m} > 0.01$
  - $\Delta T_{12\mu m}/T_{12\mu m} > 0.01$
  - $Tmax_{11\mu m}\text{-}Tpeak_{11\mu m} > 25K$

Smith, Mutlow and Rao – App. Optics 41, pp515-523

- No clouds
- 1.6um reflectances out of range
- 12um variance threshold exceeded
- 11um variance threshold exceeded
- 11 and 12um variance threshold exceeded
- 1.6um threshold exceeded
- 1.6um + 12um threshold exceeded
- 1.6um + 11um threshold exceeded
- 1.6um + 11um +12µm threshold exceeded
- BT distribution Test failed

Ice/Cloud Screening Proceedure





- Test of 4km x 4km regions
- Cloudy if:
  - $\Delta R_{0.87\mu m} > 0.005$
  - $\Delta T_{12\mu m} > 0.5K$
  - $R_{1.6\mu m} > 0.2$

  - Smith, Mutlow and Rao – App. Optics 41, pp515-523

Clear Sky (ice)
0.87µm range threshold exceeded
12µm range threshold exceeded
0.87µm and 12µm
1.6µm reflectance threshold exceeded
1.6µm and 0.87µm
All thresholds exceeded

AATSR Drift Corrections

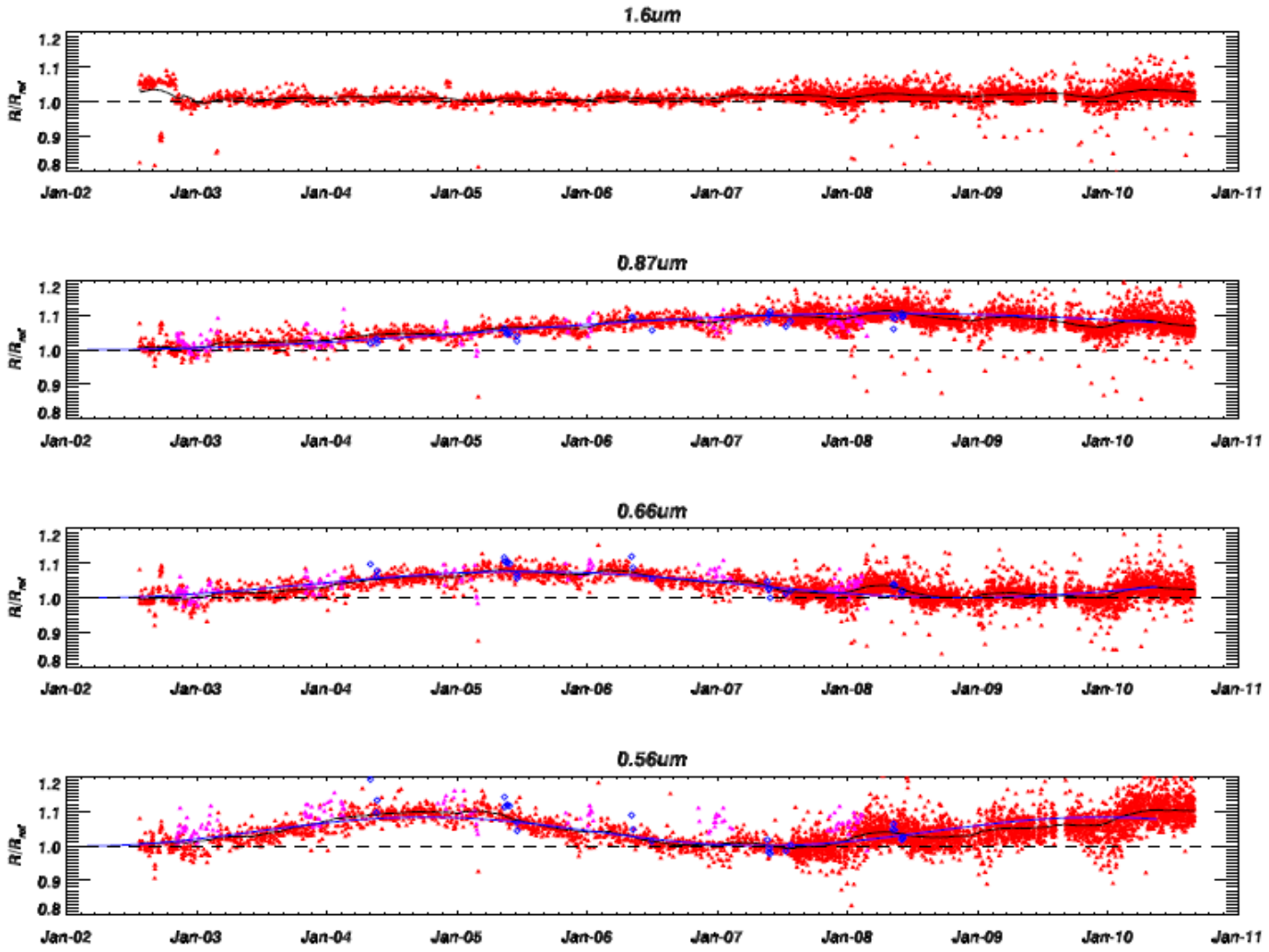
- For AATSR L1b images it is advised to remove existing drift corrections (based on early analysis) and use the drift correction look-up-table and tools available on-line via CEOS cal-val portal
  http://calvalportal.ceos.org/cvp/web/guest/aatsr-envisat

- IDL tools have been developed to identify and implement appropriate corrections to L1B products

  - AATSR_CORRECT_V16_NONLINEARITY.PRO
    - corrects 1.6um nonlinearity if not already implemented.
  - AATSR_REMOVE_DRIFT_CORRECTION.PRO
    - removes existing drift correction to allow the latest and best drift corrections to be applied
  - AATSR_APPLY_DRIFT_CORRECTION.PRO
    - Applies the drift correction using a look up-table containing the measured drift for each channel

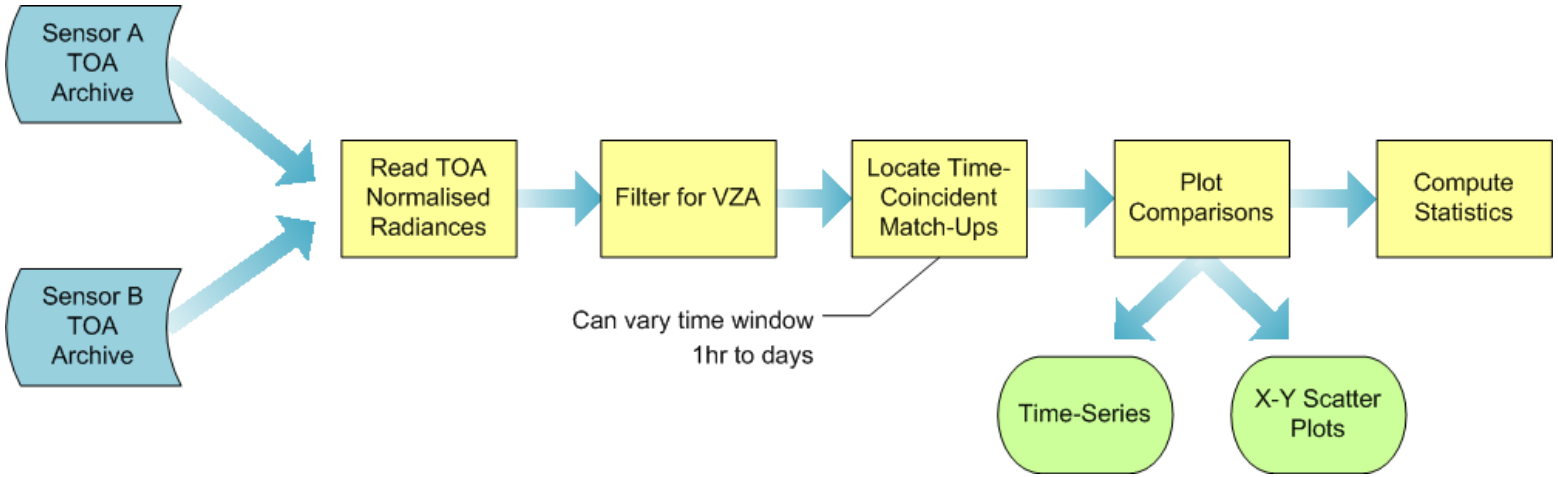
- These correction tools have also been implemented as BEAM extensions.

AATSR Drift Correction



Intercomparison Methodology A – No BRDF Correction

Approach works for SNO with sensors at similar local time



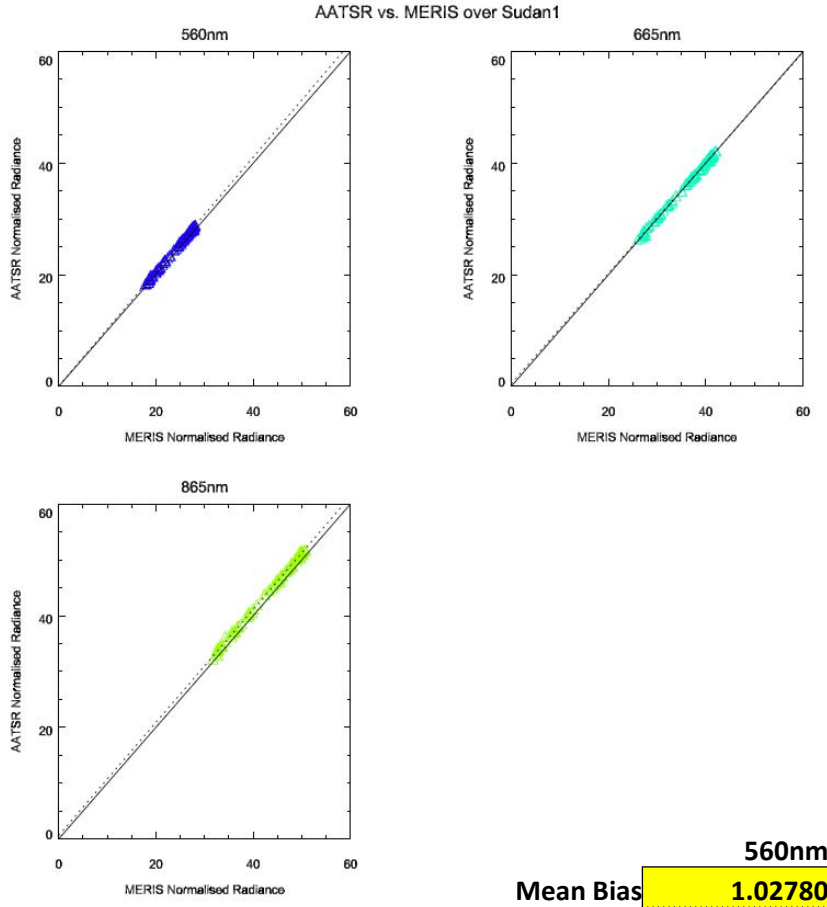
Parameter being compared is Normalised Radiance at TOA

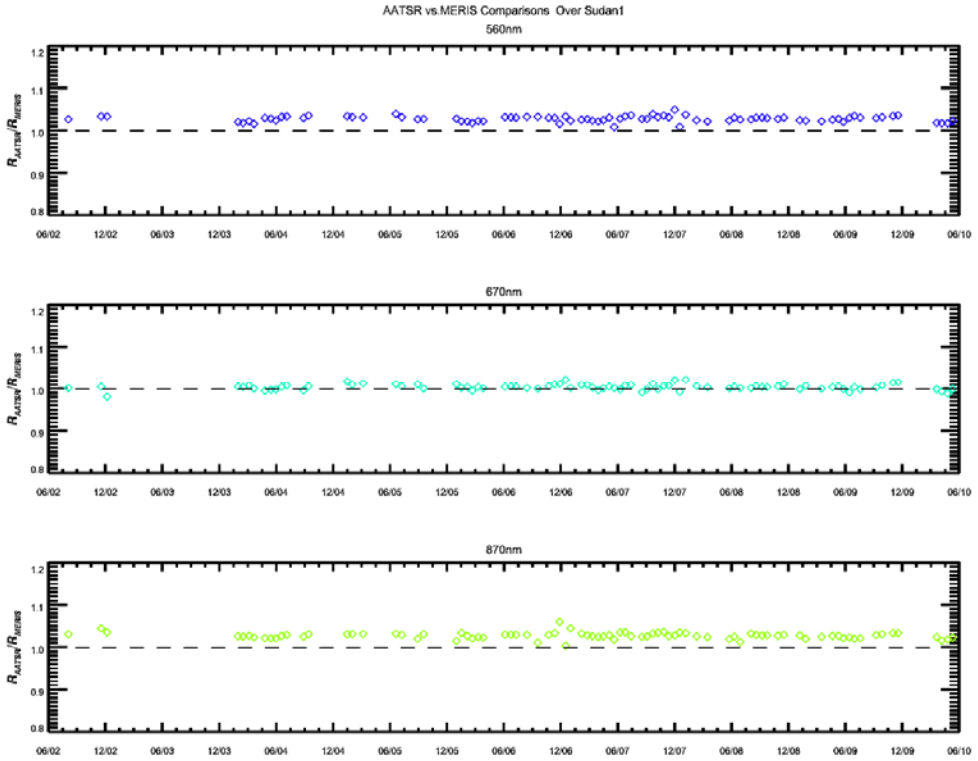
$R_{scene} = L(\lambda)\pi/E_s(\lambda)$ - where E_s is corrected for sun-earth distance

NOT Reflectance

$\rho_{scene} = L(\lambda)\pi/\cos(sza)E_s(\lambda)$

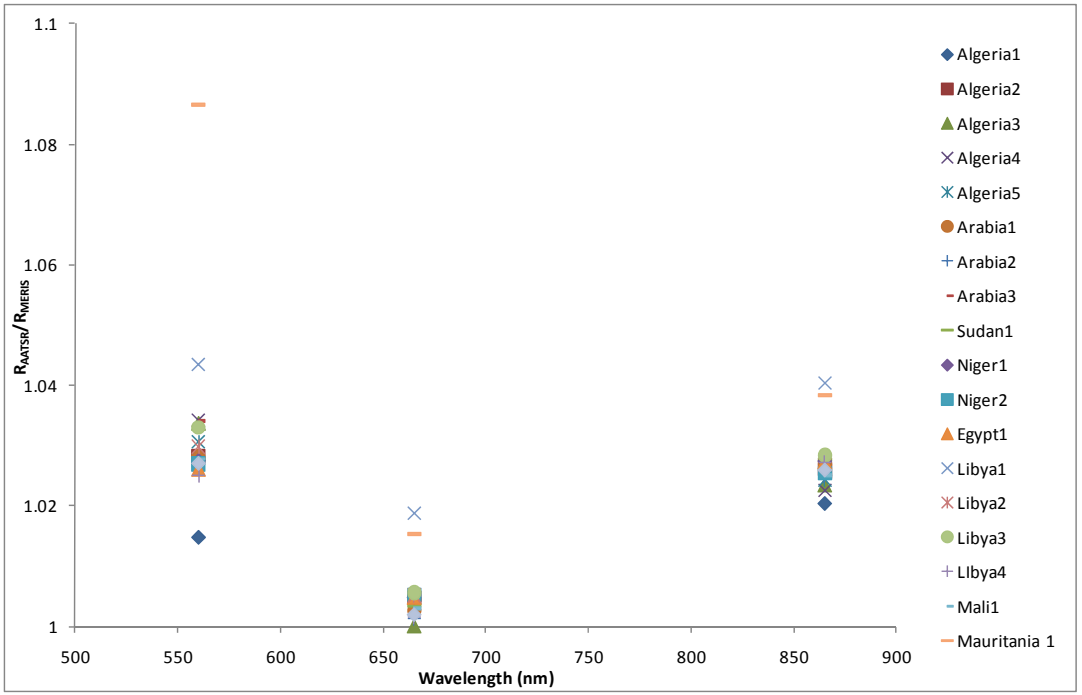
AATSR vs. MERIS over Deserts





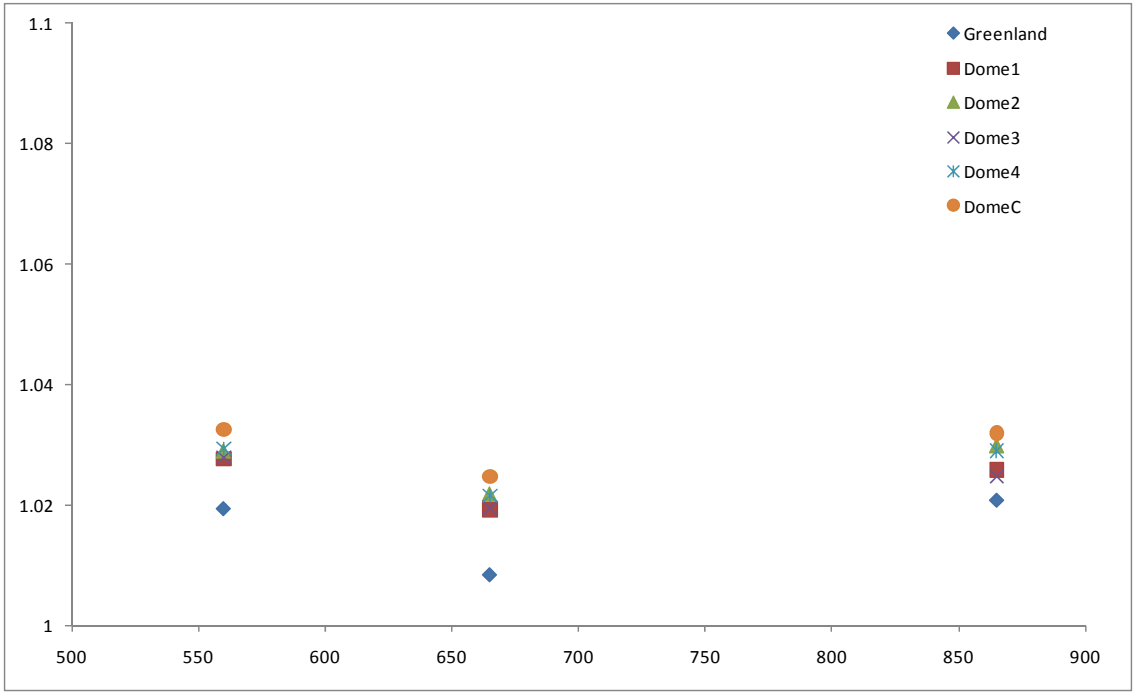
	560nm	665nm	865nm
Mean Bias	**1.02780**	**1.00340**	**1.02770**
Std Dev	0.00710	0.00760	0.00770
N_Samples	155	155	155
Site Uncert	**0.00057**	**0.00061**	**0.00062**

AATSR vs. MERIS Desert Site Summary



	560nm	665nm	865nm
Weighted Mean Bias	**1.03092**	**1.00403**	**1.02679**
Std Dev	0.01066	0.00414	0.00386
N_Sites	19	19	19
Uncert of Mean	0.00245	0.00095	0.00089
Site Uncert	0.00168	0.00104	0.00098
Total Uncertainty	**0.00297**	**0.00141**	**0.00132**

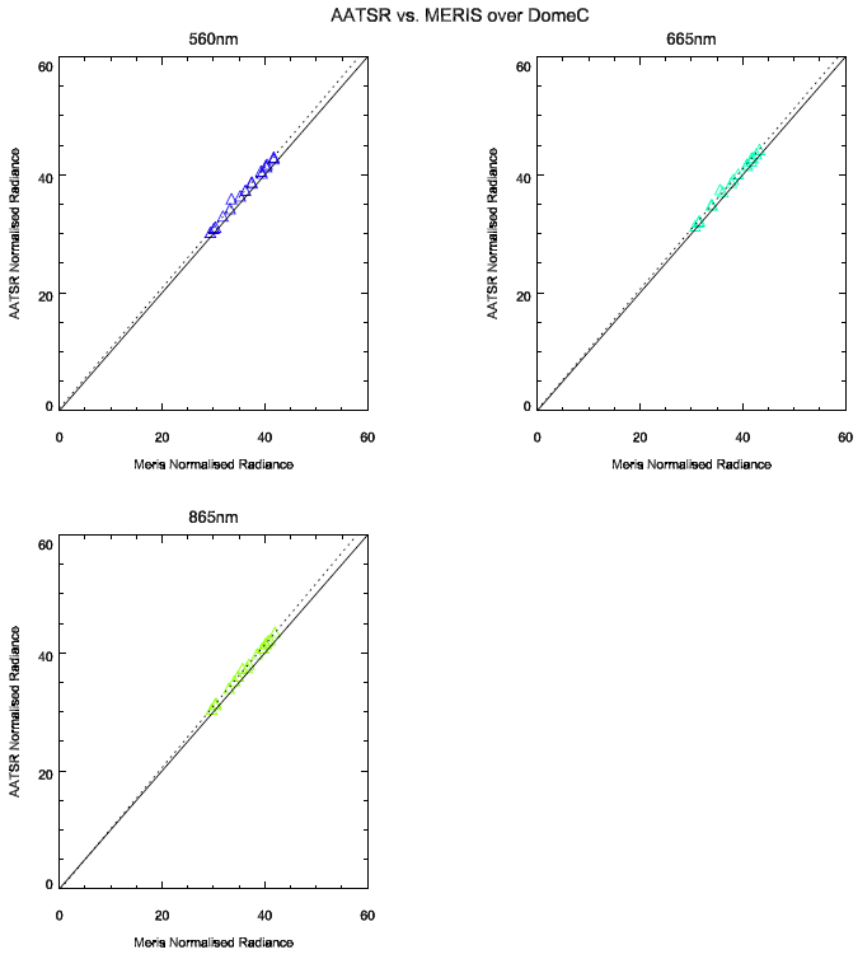
AATSR vs. MERIS Ice Site Summary

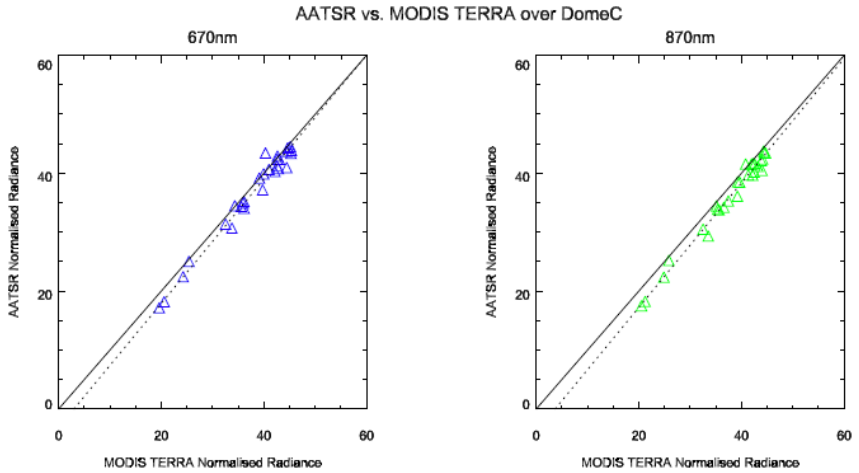


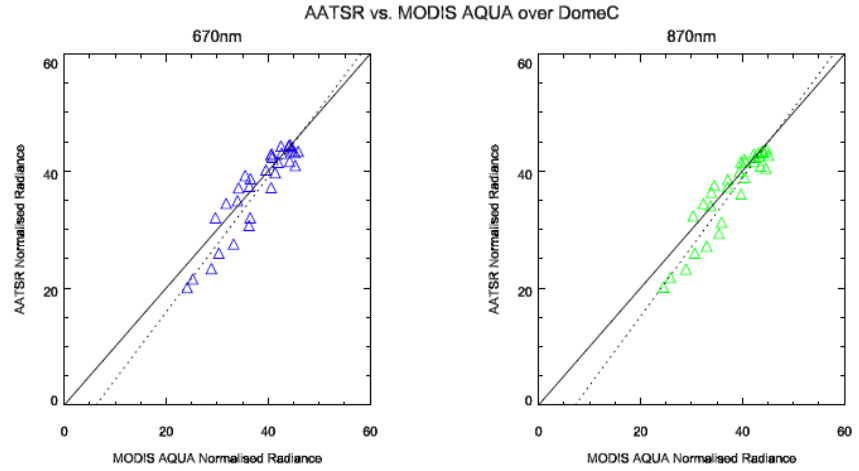
Averages for Antarctica only

	560nm	665nm	865nm
Weighted Mean Bias	**1.029278**	**1.021351**	**1.028239**
Std Dev	0.001841	0.002124	0.002678
N_Sites	5	5	5
Uncert of Mean	0.000823	0.00095	0.001197
Site Uncert	0.00134	0.001494	0.001508
Combined Uncertainty	**0.001573**	**0.001771**	**0.001925**

Comparisons over Dome-C - No BRDF Correction

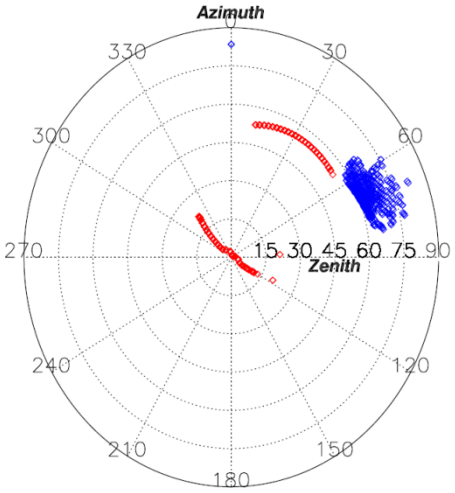


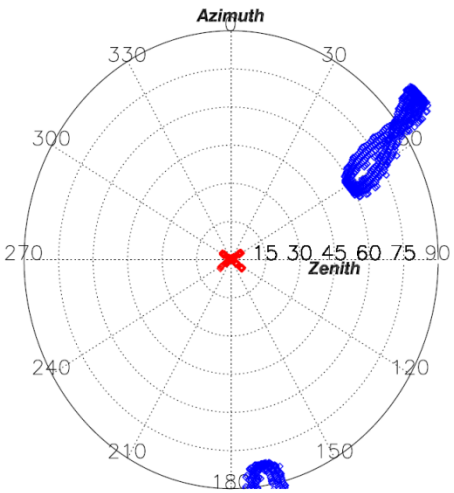




View-Zenith Geometry over Dome-C

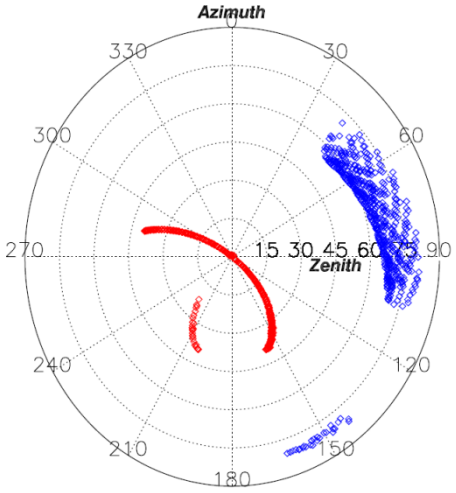
AATSR

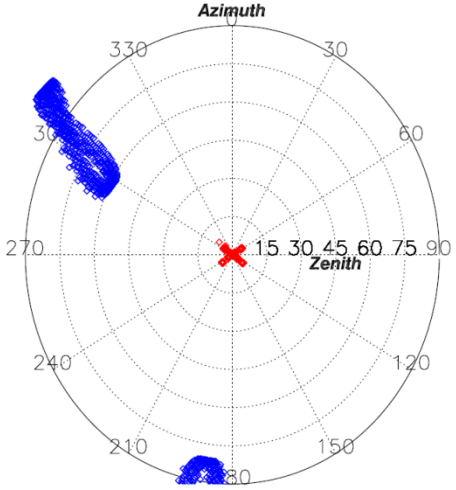




MODIS Terra

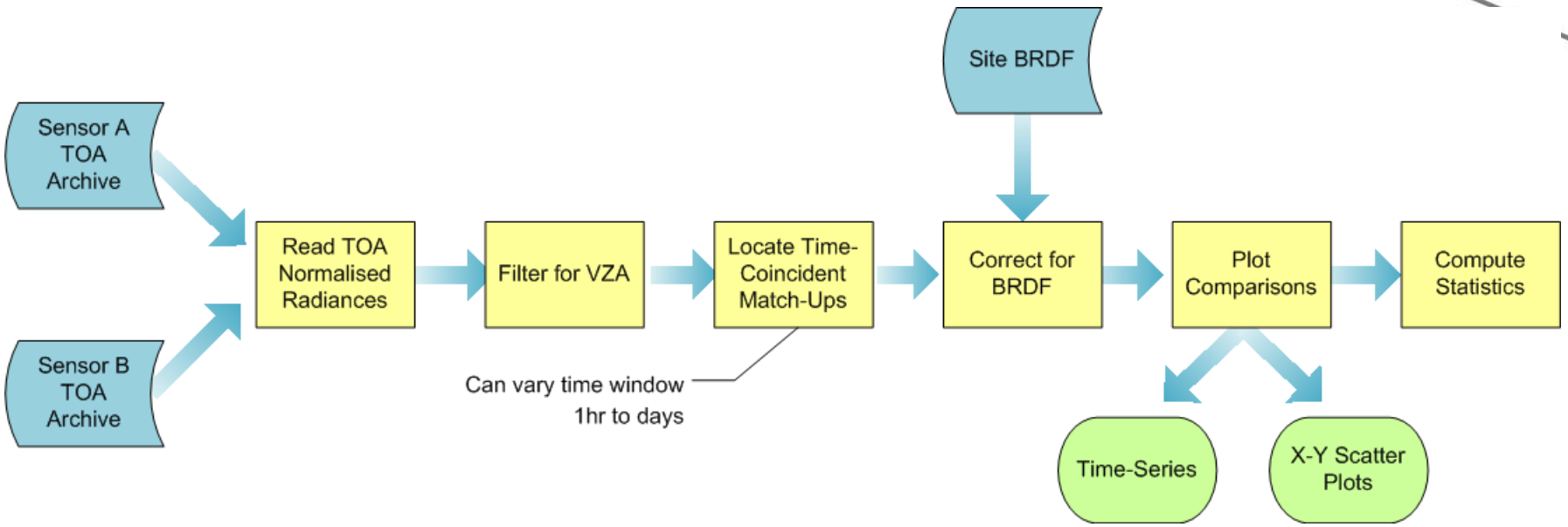
MERIS





MODIS Aqua

Intercomparison Methodology B – With BRDF Correction



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NOT Reflectance

$\rho_{scene} = L(\lambda)\pi/\cos(sza)E_s(\lambda)$

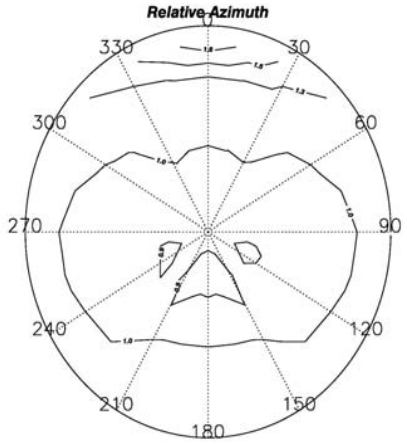
BRDF Correction for Dome-C

Here we utilise BRF measurements of DOME-C site from University of Washington (Stephen Hudson and Steven Warren et al, 2006)

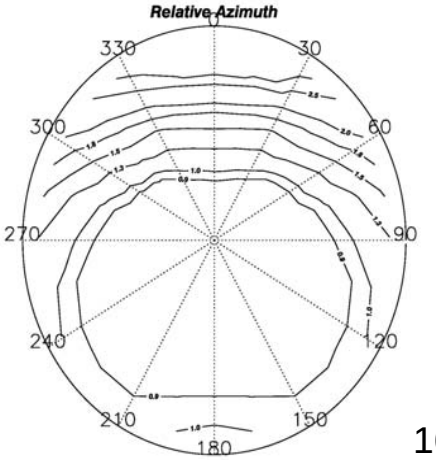
Note we do not use albedo since we are only correcting for the differences in view and solar geometry.

Correction from sensor B to sensor A

= $BRF(\lambda,sza_a,sza_a,az_a)/BRF(\lambda,sza_b,vza_b,az_b)$

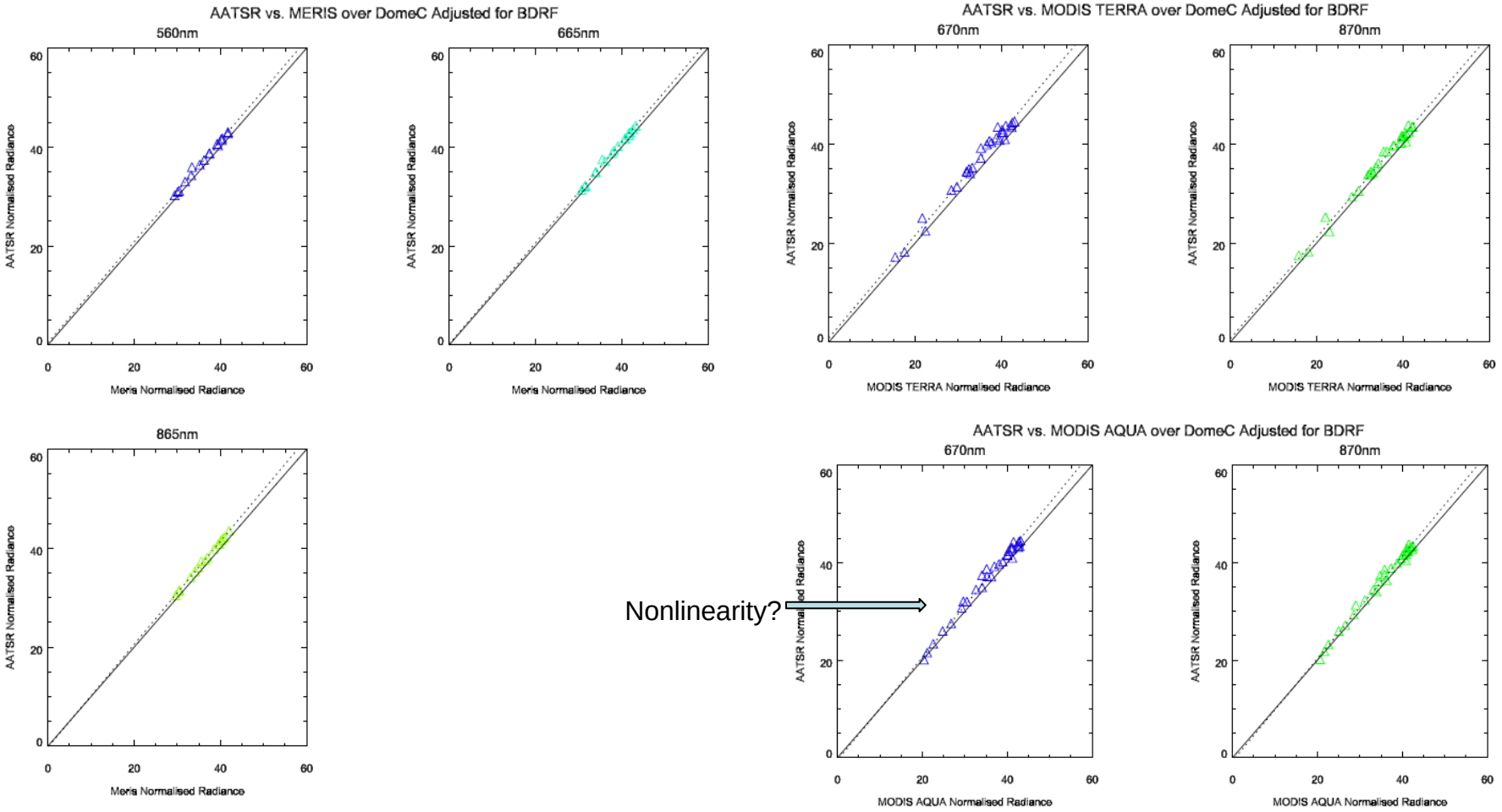


600nm

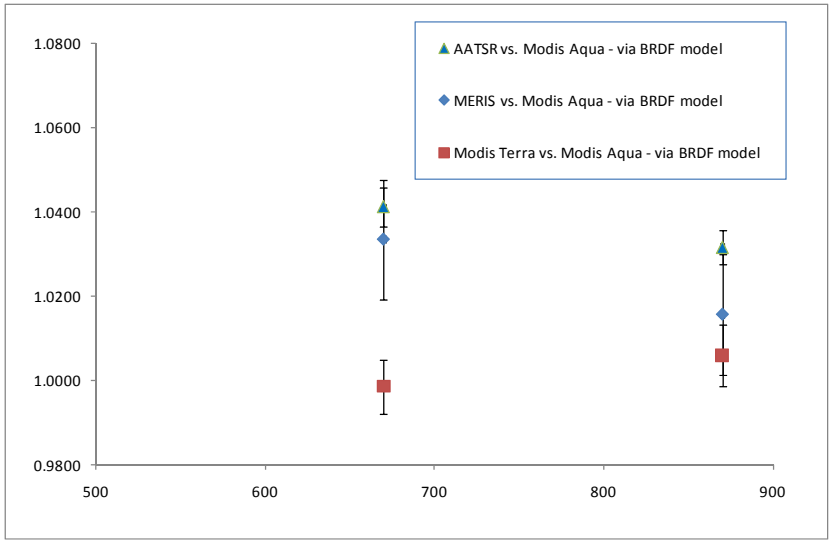


1600nm

Comparisons over Dome-C - With BRDF Correction



Comparisons over Dome-C -after BRDF correction



Reference Modis Aqua 0.64um

	Mean Bias	Uncertainty	CJRS Value
Modis Terra	0.9986	0.00638	
Meris	1.0335	0.01408	1.0074
AATSR	1.0412	0.00648	1.0176

Reference Modis Aqua 0.86um

	Mean Bias	Uncertainty	CJRS Value
Modis Terra	1.0060	0.00730	
Meris	1.0157	0.01437	0.9878
AATSR	1.0317	0.00401	0.9810

These results are not consistent with the initial values in the CJRS paper

Discuss

Compared value in CJRS is reflectance NOT radiance

Spectral differences in BRF not accounted for in current analysis – effect should be small

Atmospheric Effects (Rayleigh & Ozone) are not accounted for in measurements

Conclusions & Next Steps

- Comparisons over desert and ice targets have provided relative biases between sensors
  - BRDF correction is essential for comparisons of observations with different view, solar geometry
  - Results suggest that there are site dependent variations in the relative biases
    - Could indicate stray light effects?
    - Results also suggest some non-linearity
- Comparisons will be updated to include correction for Ozone & Rayeligh Scattering
- Comparisons with other MODIS bands is needed for ECV work
  - In particular for 560nm and 1600nm
- Comparisons with ATSR-2 to be included
  - Analysis of overlap period has started using Envisat format data.