CRS – Clouds & Radiative Swath which is an CERES archived footprint level data product

Aerosol Forcing from CERES CRS in Niamey Niger During RADAGAST

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ARM- Atmospheric Radiation Measurement Program (Now Atmospheric System Research or ASR)

AMMA – African Monsoon Multidisciplinary Analyses

GERB – Geostationary Earth Radiation Budget Experiment

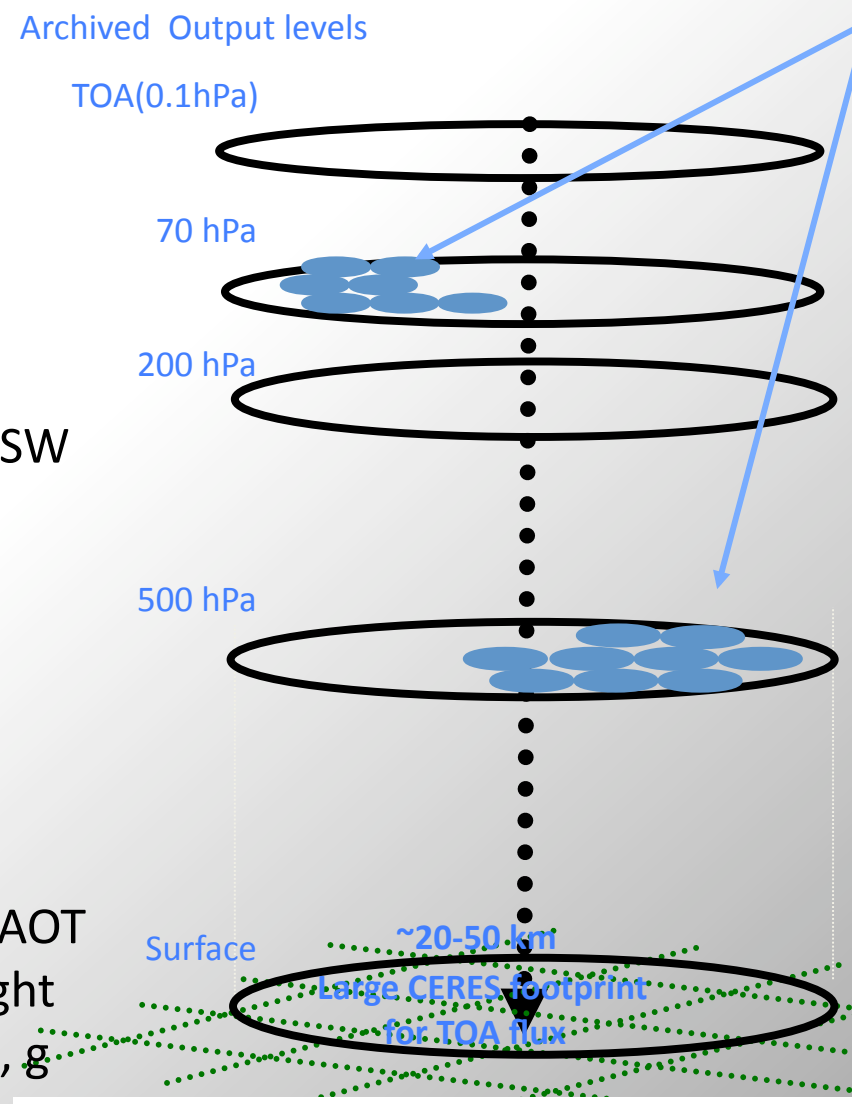
Niamey, Niger

Clouds & Radiative Swath CRS

RT Model
- Langley Fu & Liou
- Delta 2-stream
- Up to 36 levels
- 2 near surface levels
- Floating cloud boundaries
- Correlated K with 15SW &12 LW bands

Ozone
- NCEP Mostly from SBUV/2

Aerosols
- MODIS & MATCH ->AOT
- MATCH -> type, height
- OPAC & Lacis-> SSA, g



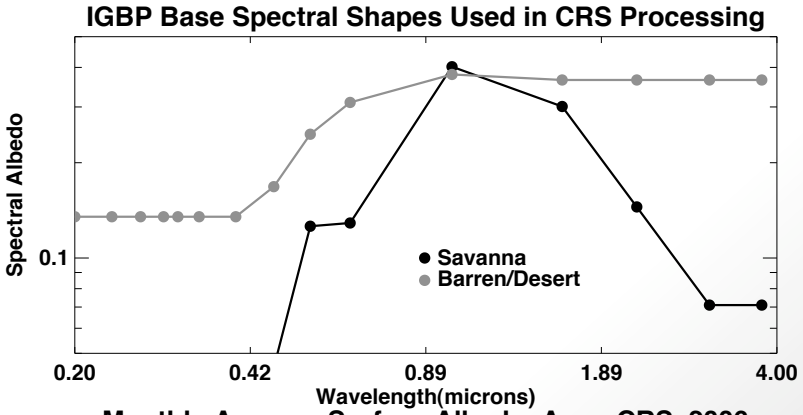
Cloud properties
- MODIS (Minnis)
- Given for 2 levels
- No overlap
- (Spatial Average)

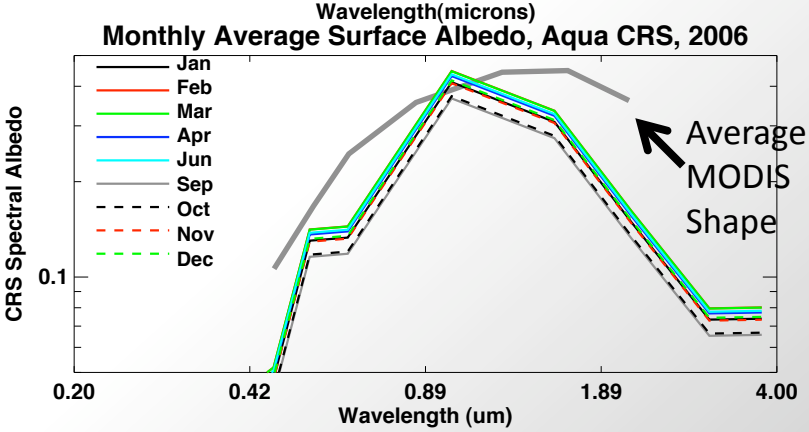
Atmosphere
- GEOS4(GMAO) Reanalysis(1Deg)

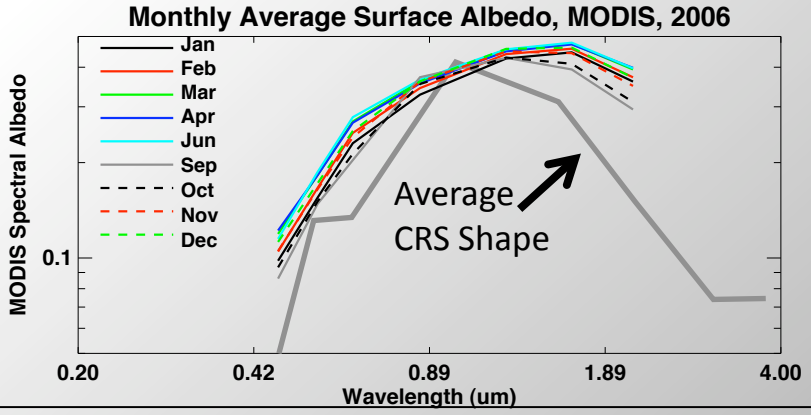
Surface properties
- $\alpha(\nu)$ – scene
- α Broadband
  - clear – CERES
  - cloudy – History
- Skin T
  - clear - MODIS
  - cloudy – GEOS4

SARB/CRS runs up to 2 million footprints per day

Spectral Sfc Albedo cf. to MODIS estimates







CRS assumes land spectral shape is some integral of a set of predefined spectral albedos assigned to 1/8 degree resolution IGBP scene type map.

IGBP map in/around Niamey are defined as “Savanna”.

MODIS (MCD3C1) data product shows that the area around Niamey is a better fit to the CRS “Barren/Desert” shape.

Edition 3 CRS will use the MODIS spectral albedo as a source for input spectral shape.

Model For Atmospheric Transport & Chemistry (MATCH)

SARB subsystems (CRS & SYN) require aerosol type, OD & scale height globally.

MATCH provides global maps of AOD & scale height profiles for 10 distinct aerosol types:

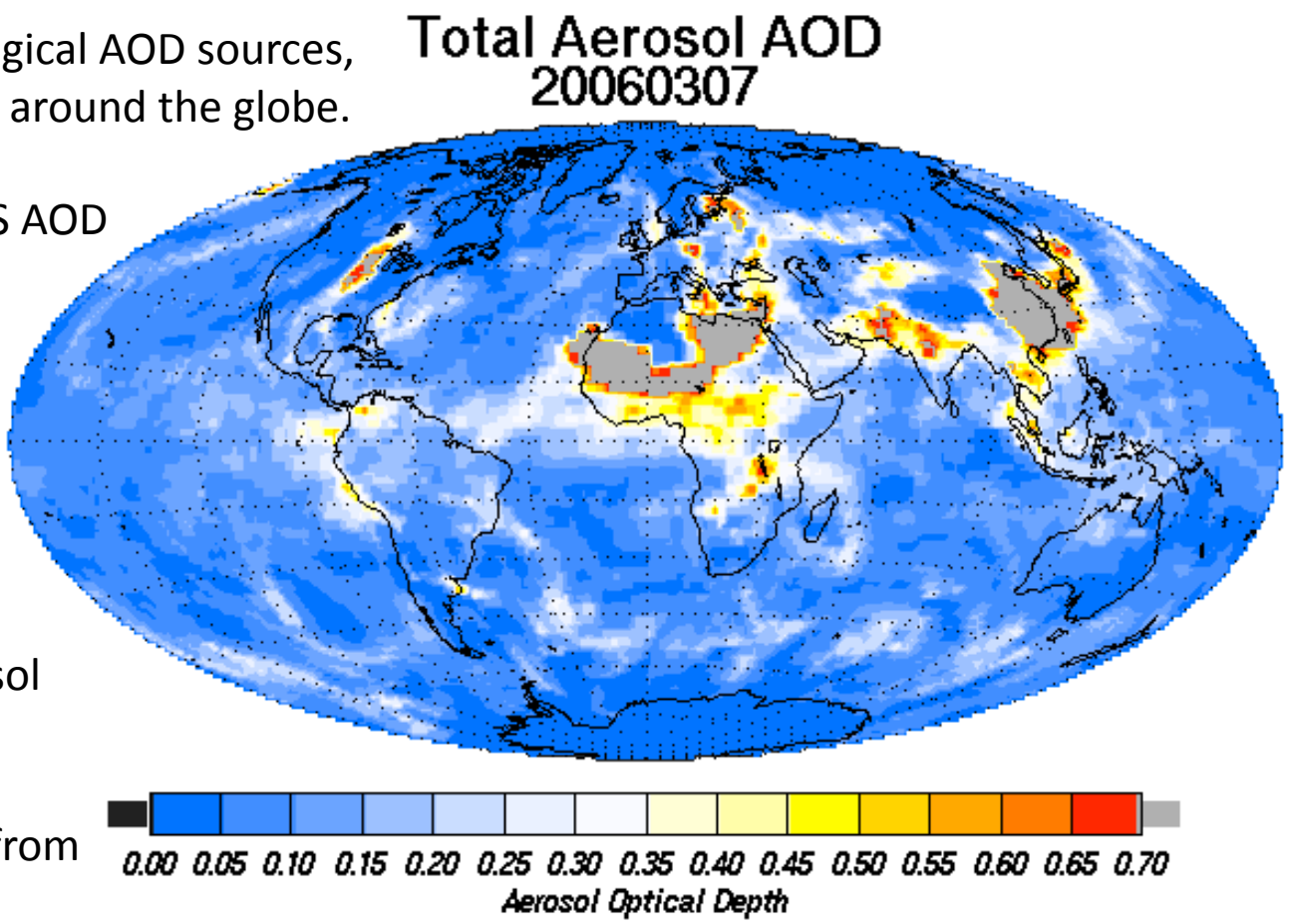
MATCH includes climatological AOD sources, sinks advecting aerosol around the globe.

MATCH assimilates MODIS AOD

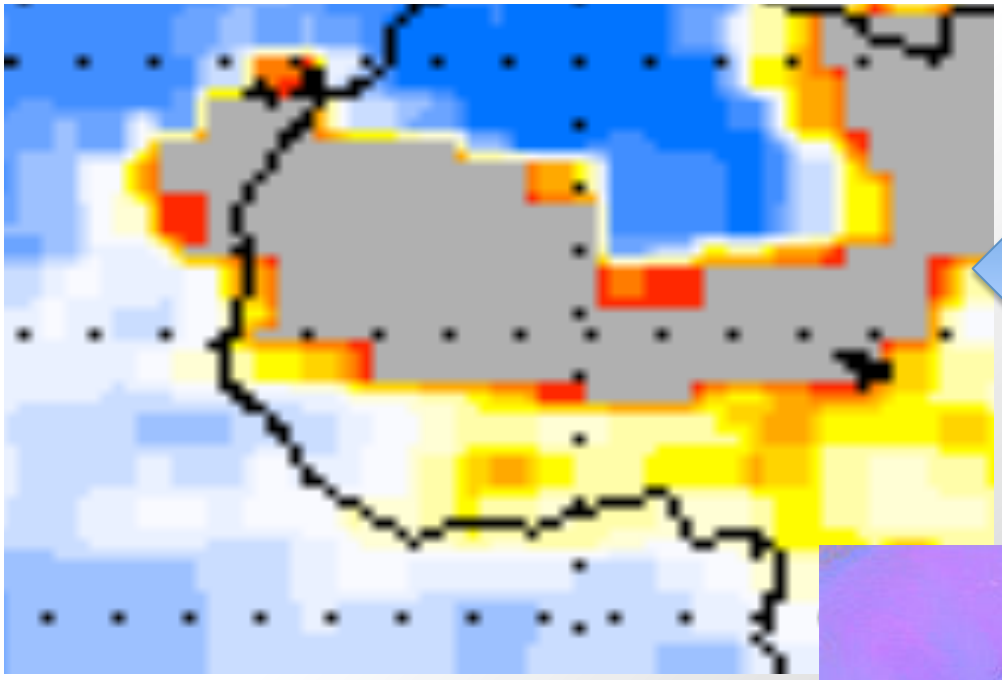
SARB Hierarchy for AOD
- MODIS instantaneous
- MODIS daily average
- MATCH

A given CRS footprint can run up to 7 distinct aerosol types.

Aerosol properties from OPAC and Lacis



MATCH assimilation of MODIS AOD supplies realistic AODs when SARB could not otherwise get them.

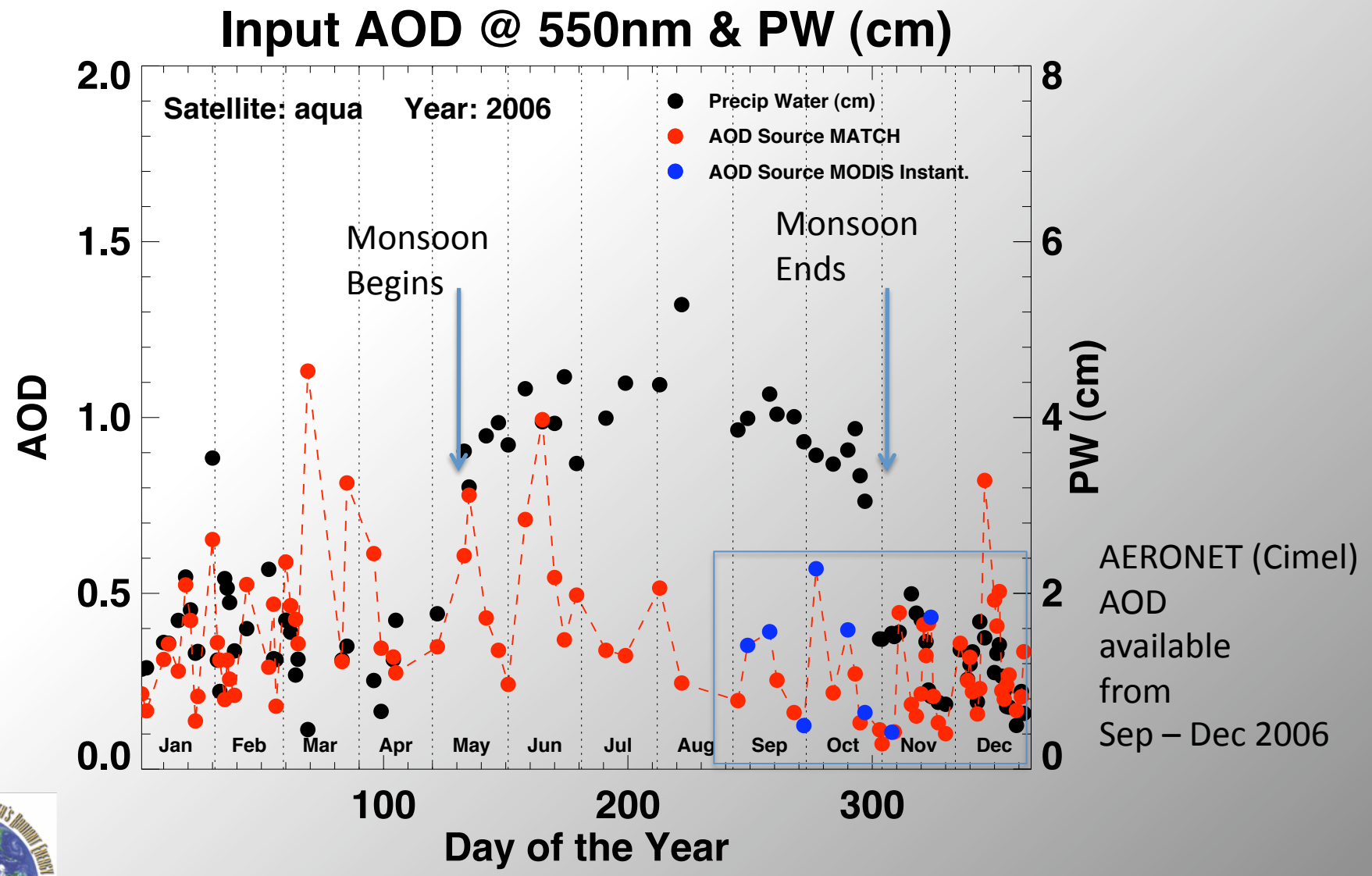


MATCH Total Aerosol OD
March 7, 2006 (Scale 0 to >0.7)

On March 7, 2006 no instantaneous MODIS AOD available over Niamey.

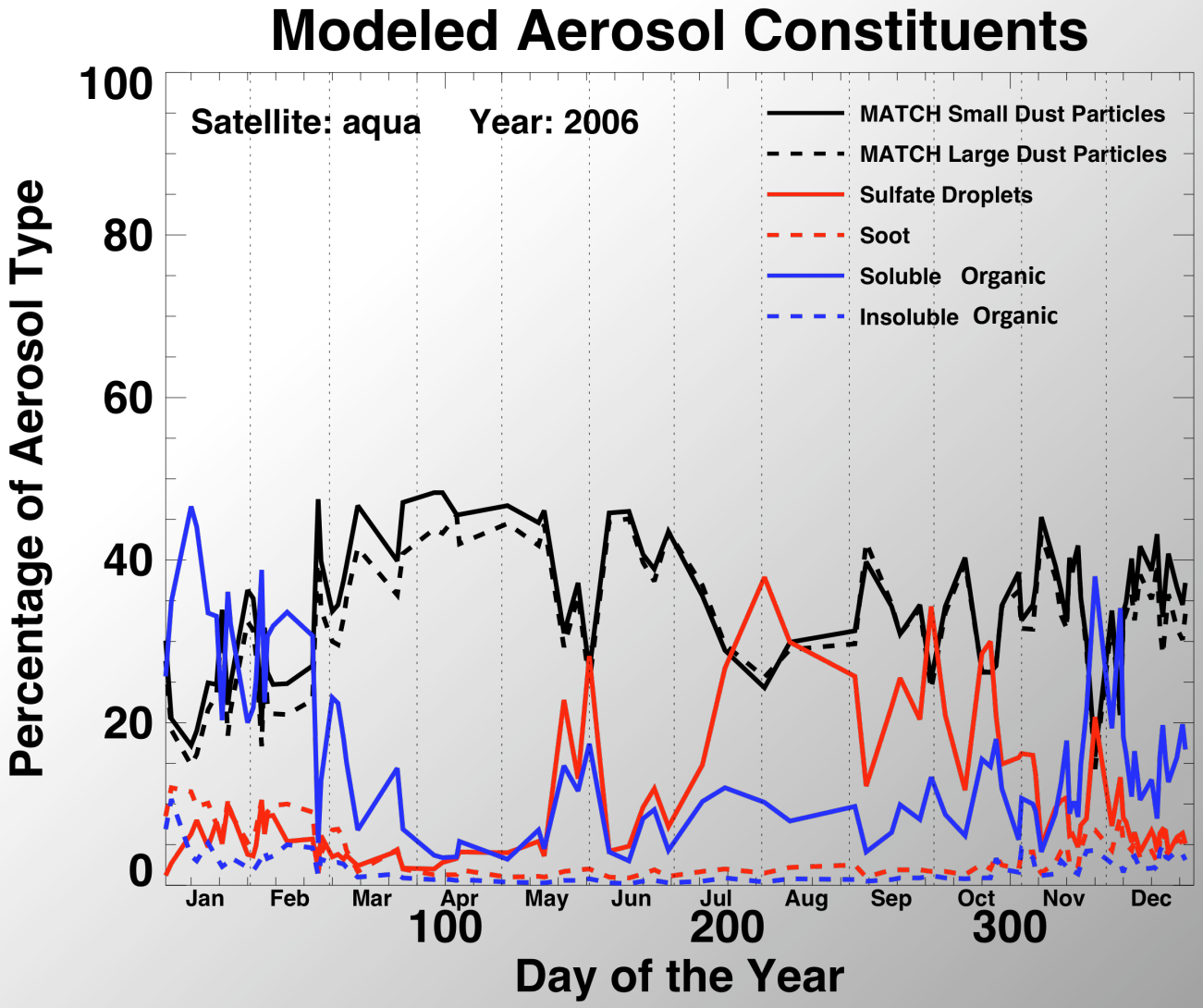
METEOSAT SEVERI
March 7, 2006
(Pink Dust Storm)

Aerosol Optical Depth and PW For Clear Sky Footprints at Niamey

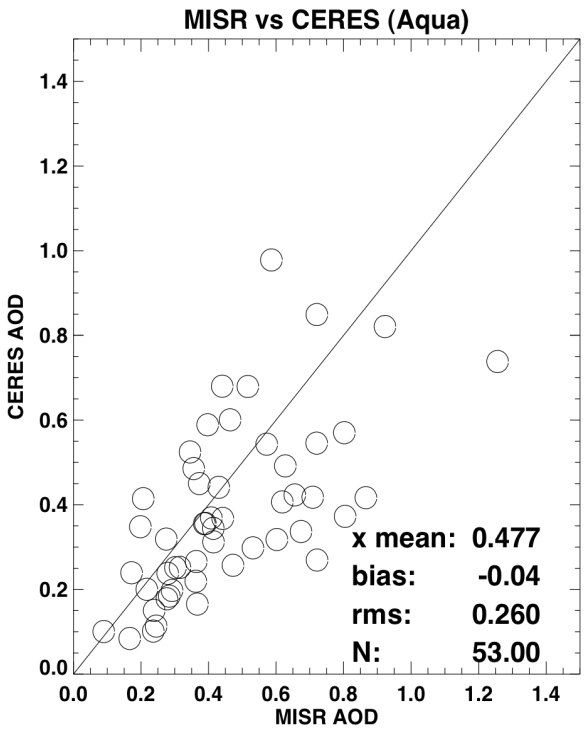


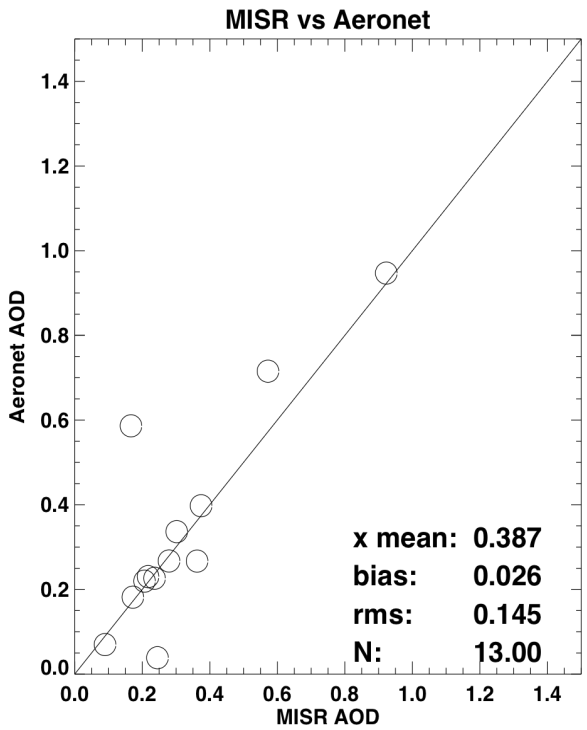
AERONET (Cimel) AOD available from Sep – Dec 2006

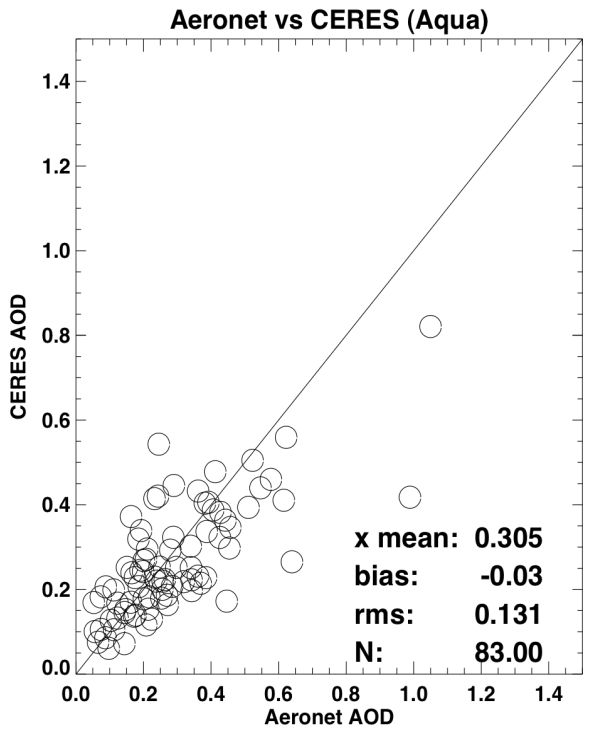
Percentage Aerosol Constituents For Clear Sky Footprints at Niamey



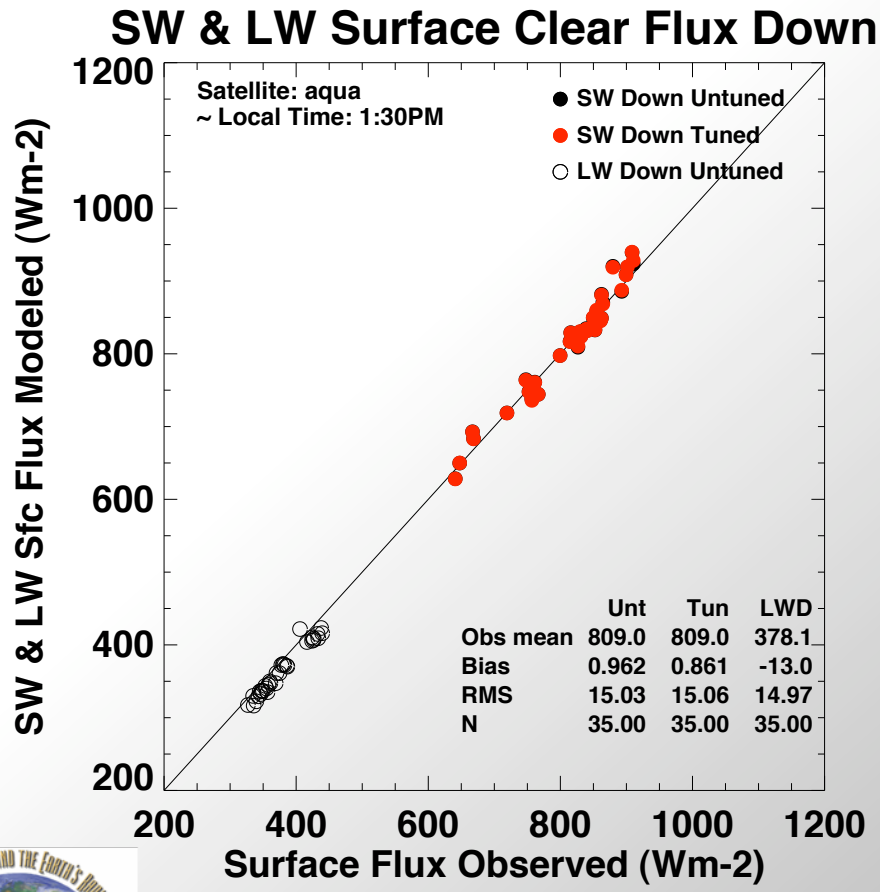
CRS input AOD compared to independent Observations ‘closely’ matched in 2006 at Niamey

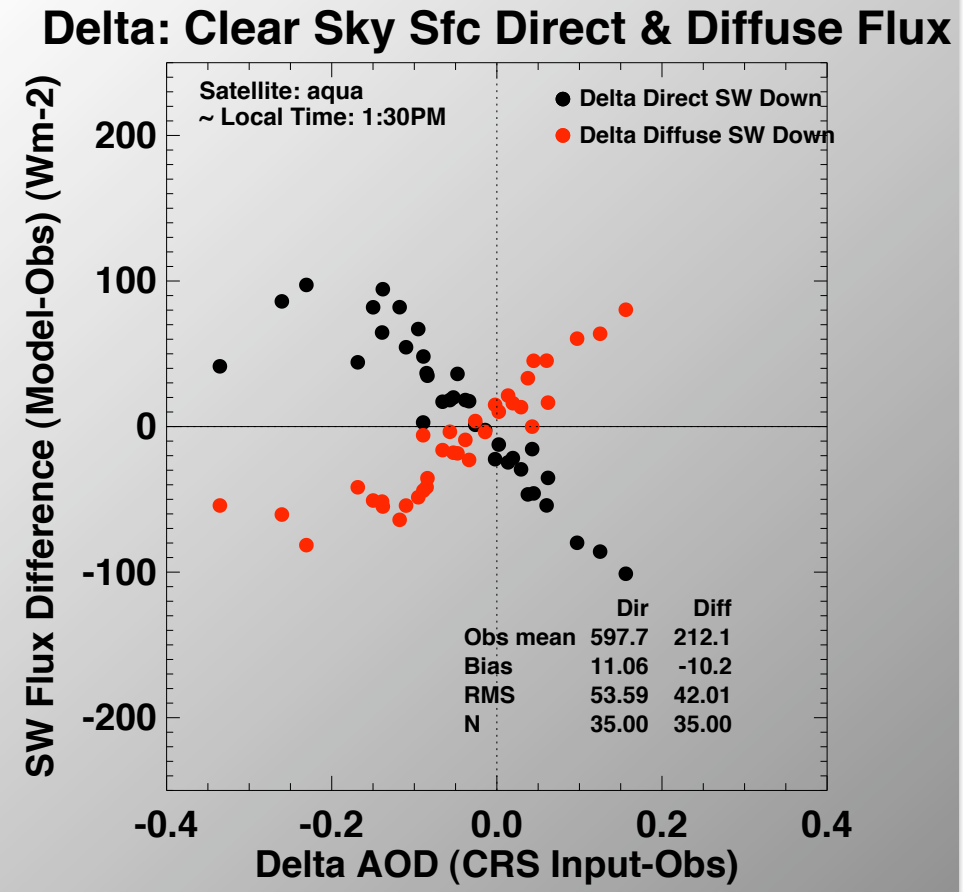




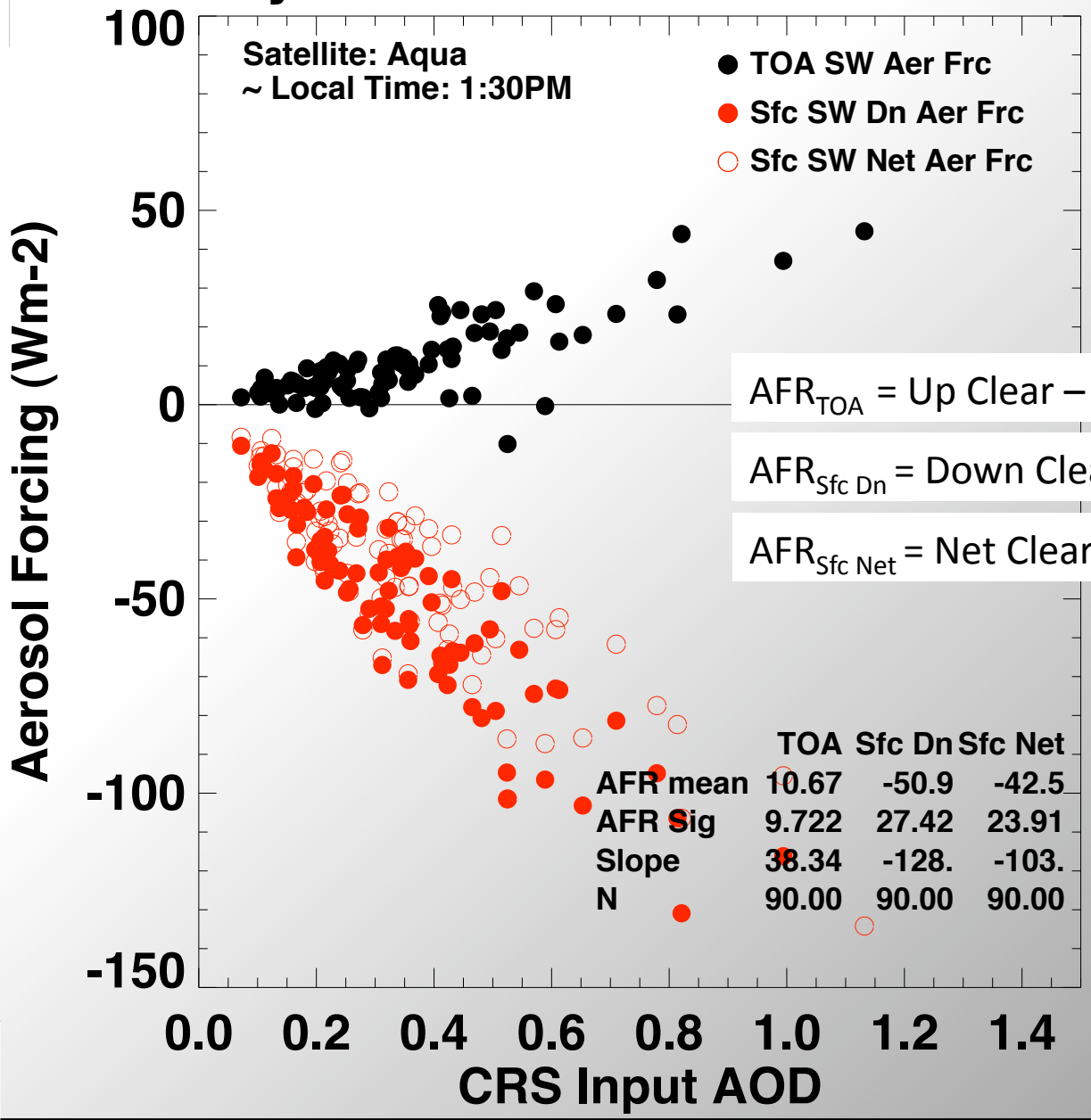


Compare Aqua CRS Total Surface SW, LW Direct & Diffuse Clear Sky (Sep-Dec 2006) Coincident AERONET Observation.





Clear Sky SW TOA & SFC Aerosol Forcing



AFR_{TOA} = Up Clear – Up Pristine

$AFR_{Sfc\ Dn}$ = Down Clear – Down Pristine

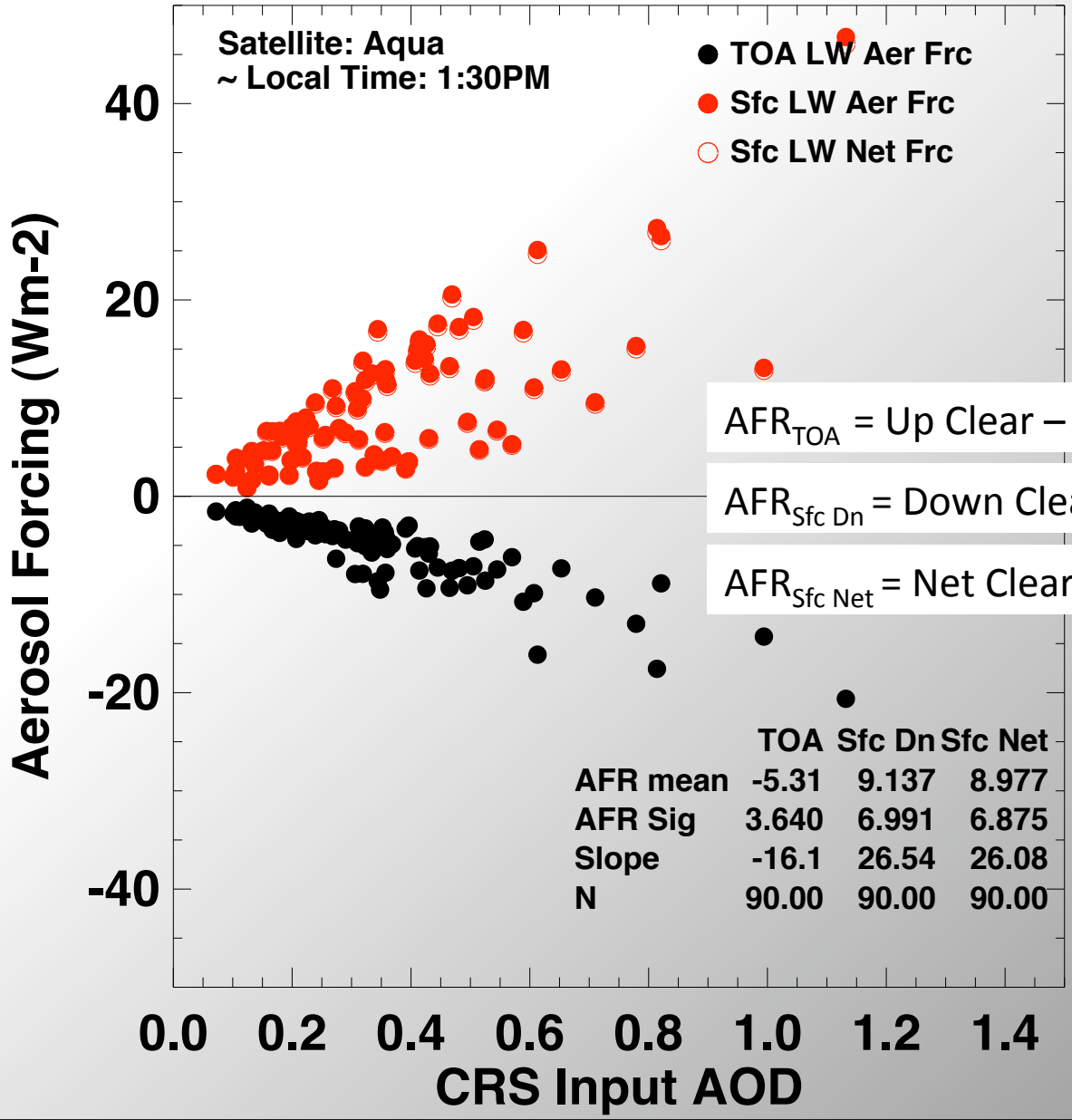
$AFR_{Sfc\ Net}$ = Net Clear – Net Pristine

SW Net Radiative Forcing Surface and TOA

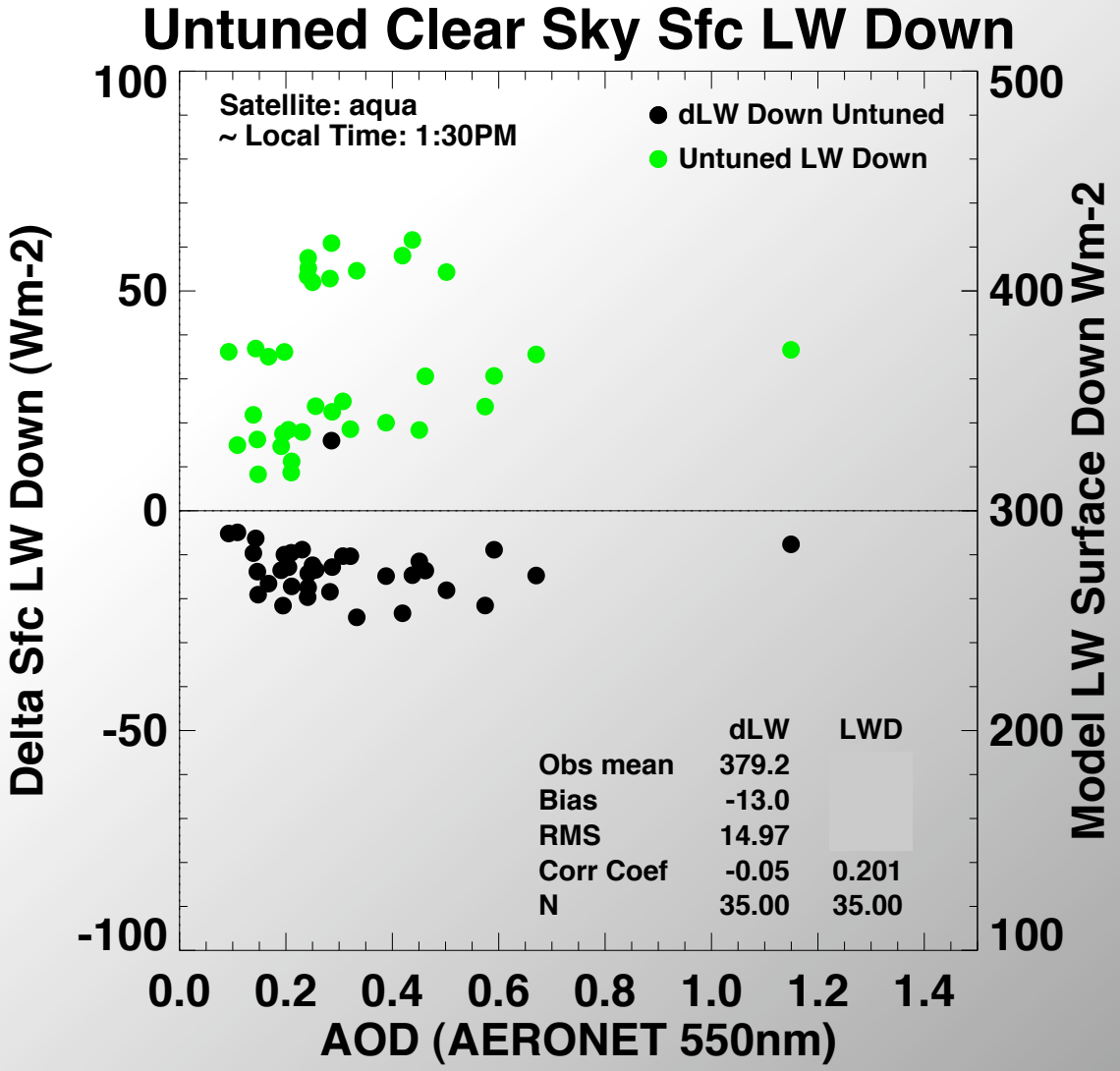
SW Surface Net Aerosol Radiative Forcing (Clear – Pristine) All in W/m^2			
	CERES results using model Surface SW	CERES results using observed Surface SW	McFarlane et al. 2009 using observed Surface SW
Aerosol Forcing	-42.5	-41.9	-38.5
Std Deviation	23.9	37.4	38.4
Slope	-103.0	-97.6	-88.3
Intercept	-6.7	-7.9	-7.6
No. Of Points	90	90	(Clear Sky for 2006)

TOA Aerosol Radiative Forcing (Clear – Pristine) All in W/m^2	
	SW Day
Aerosol Forcing	10.7
Std Deviation	9.7
Slope	38.3
Intercept	-2.7
No. Of Points	90

Clear Sky LW TOA & SFC Aerosol Forcing



Confidence in our estimate of LW surface radiative forcing given large bias?



LW Net Radiative Forcing Surface and TOA

LW Surface Net Aerosol Radiative Forcings (Clear – Pristine) All in W/m2		
	Day	Night
Aerosol Forcing	9.0	10.5
Std Deviation	6.9	9.4
Slope	26.1	30.1
Intercept	-0.1	-1.7
No. Of Points	90	133

TOA Aerosol Radiative Forcing (Clear – Pristine) All in W/m^2		
	LW Day	LW Night
Aerosol Forcing	-5.3	-1.8
Std Deviation	3.6	1.6
Slope	-16.1	-3.5
Intercept	0.3	-0.4
No. Of Points	90	133

Summary

Isolated clear sky CERES footprints over Niamey, Niger during AMF deployment during RADAGAST, 2006.

MATCH model is capturing dust outbreaks, climatological changes in aerosols across the Sahel.

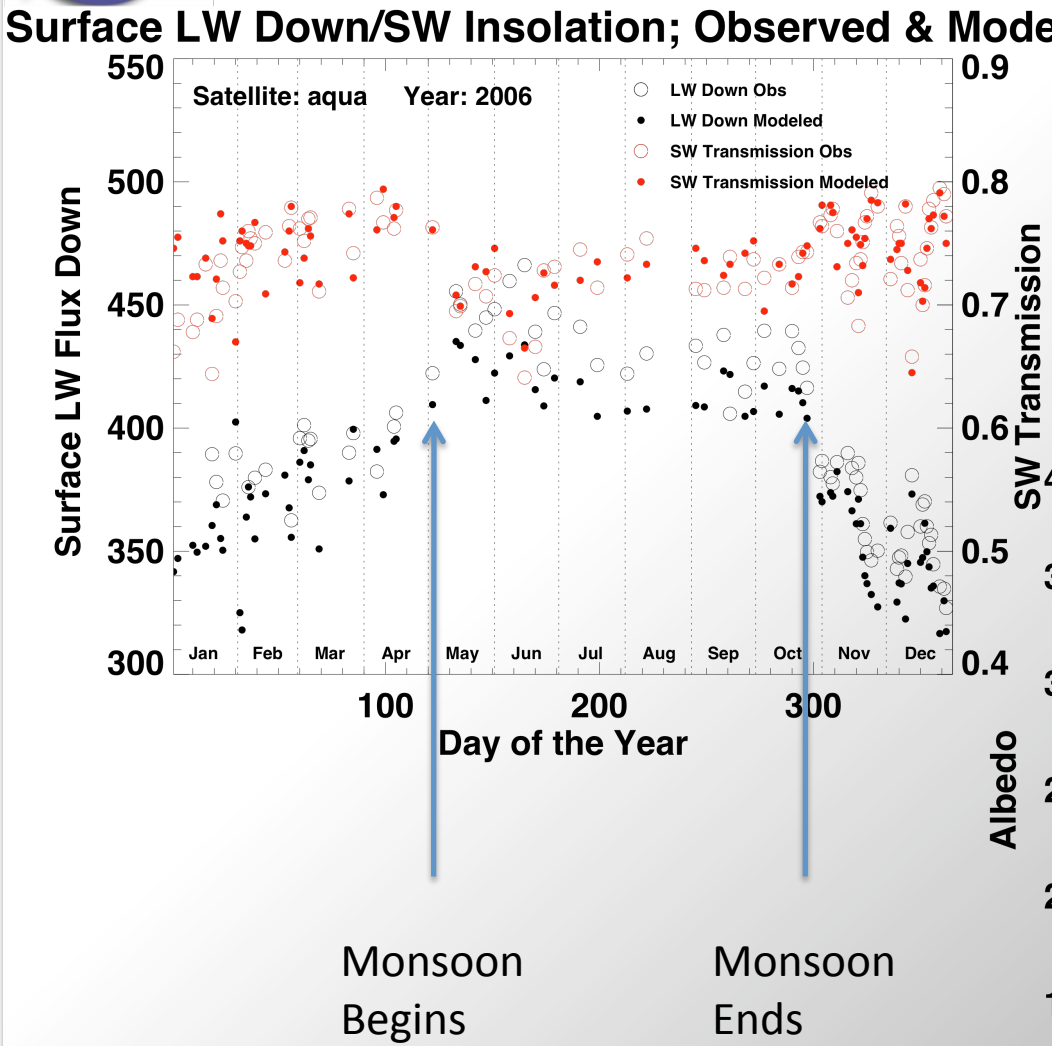
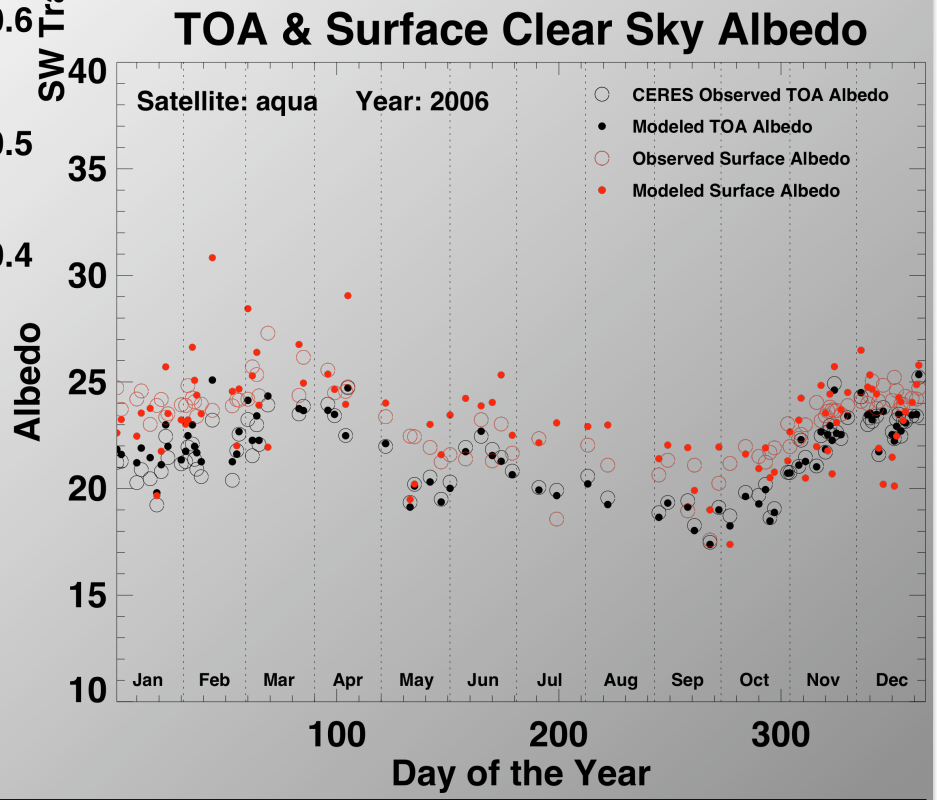
Comparisons of CRS AOD with MISR and AERONET are reasonable.

(Bias ~10% of independent observation RMS ~50% of obs mean.

Clear sky SW CRS calculations match ARM observations to within 0.1W/m2 though offsetting direct/diffuse errors can be up to 15% of mean observation.

CRS net surface SW aerosol forcing mean (-42W) & slope (-98W) is within 10% of that calculated by McFarland et al. , -39W & -88W respectively using AMF instrumentation & RRTM.

LW ARF shows an interesting decoupling day vs night at the TOA but not at the surface.

Thank you!

Characterization Based on CRS 100% Clear Sky Footprints