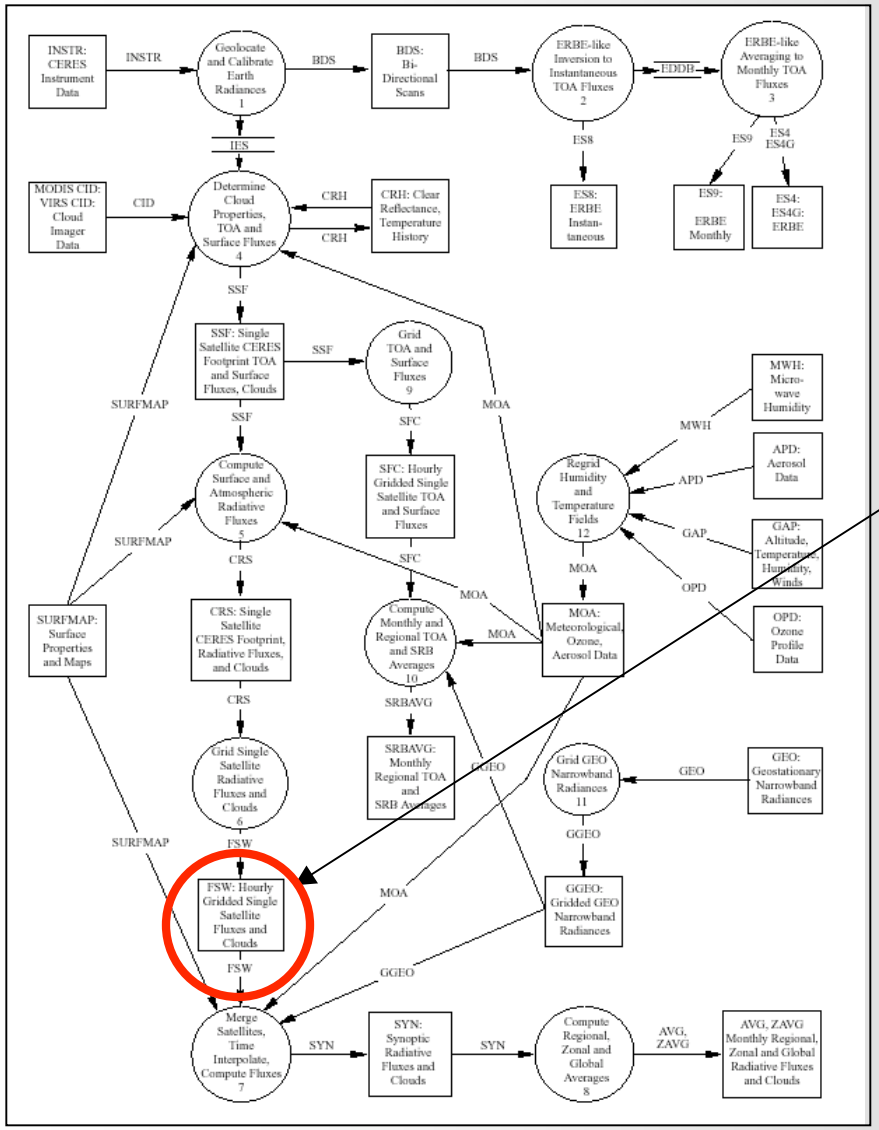
Surface and Atmospheric Radiation Budget (SARB)
FSW - Clear Sky Surface Albedo

The Langley SARB Group:
David Rutan, Tom Charlock, Fred Rose,
Lisa Coleman, Tom Caldwell, Scott Zentz,
Seiji Kato, Wenying Su,
(+ Many more outside Langley)

http://www-cave.larc.nasa.gov/cave/sfc_albedo.html

What is an FSW albedo?

CERES Flow Chart



SARB Motto: Eschew obfuscation.

FSW

(Archived CERES Data product)

Subsystem-6 output or

<u>"Monthly Gridded Single Satellite Fluxes and Clouds"</u> -> FSW

Quick Primer On SARB Surface Albedo

FLUT – Lookup table developed from Fu & Liou Radiation transfer model.

$$\alpha_{bb} = f\,(\,F_{SW}, \mu_o, \tau_{aer}, O_3, PW, \alpha_{nir}/\alpha_{vis}, p_s\,)$$

L a n d

Preprocess a month of SSF using FLUT
Clear Sky Albedo History (SALB-History)
Gives minimum $\alpha_{bb}(\mu_o, ,\theta,\phi)$ on 10' grid.

For a Footprint

Cloudy Land (No Snow)
α_{bb} – SALB - History

Clear Land (No Snow)
α_{bb} - FLUT

Snow/Ice (Thick cloud)
α_{bb} – SALB History

Snow/Ice (Thin cloud)
α_{bb} – FLUTS*

Require
$\alpha_{bb} = \Sigma\, \alpha_\nu$

Land

α_ν– IGBP 10' Map

Ocean

Ocean Albedo (COART *)
$\alpha_{bb}, \alpha_\nu = f(\lambda, \mu_o, \tau, \text{wind}, \text{chlorophyll})$

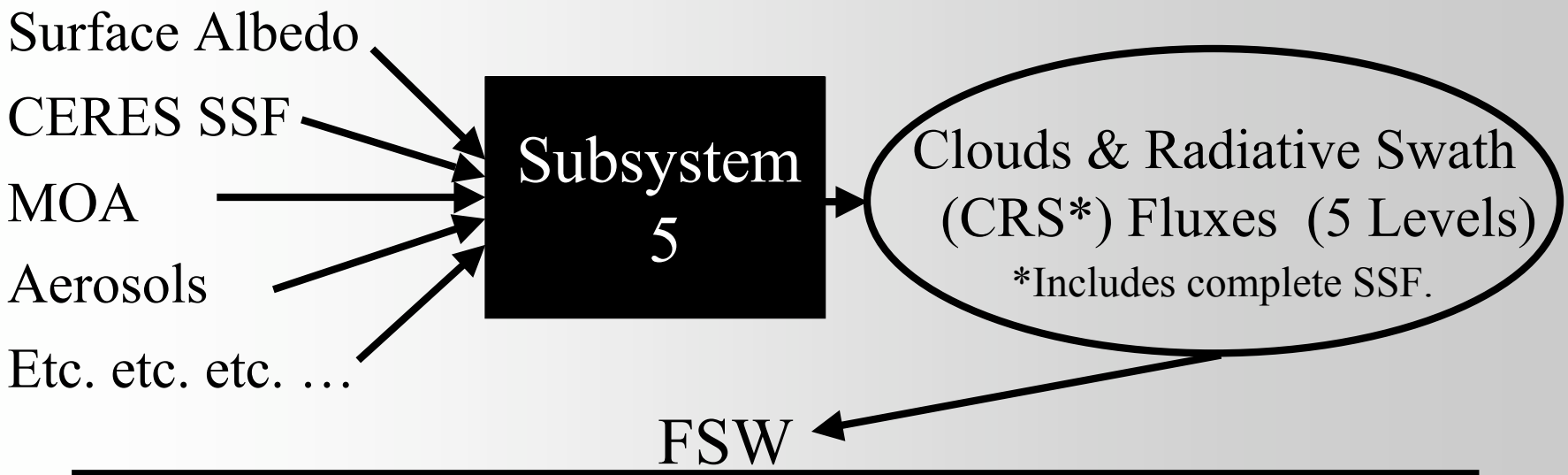
Self consistent
$\alpha_{bb} = \Sigma\, \alpha_\nu$

Input to Langley Fu & Liou
Spectral Albedo: α_ν

*FLUTS – Lookup table developed from Fu & Liou Radiation transfer model.
$\alpha_{bb} = f(\mu_o, cld_\tau)$

*COART – Lookup table developed from Z. Jin Coupled Ocean and Atmospheric Radiation.

From CRS to FSW



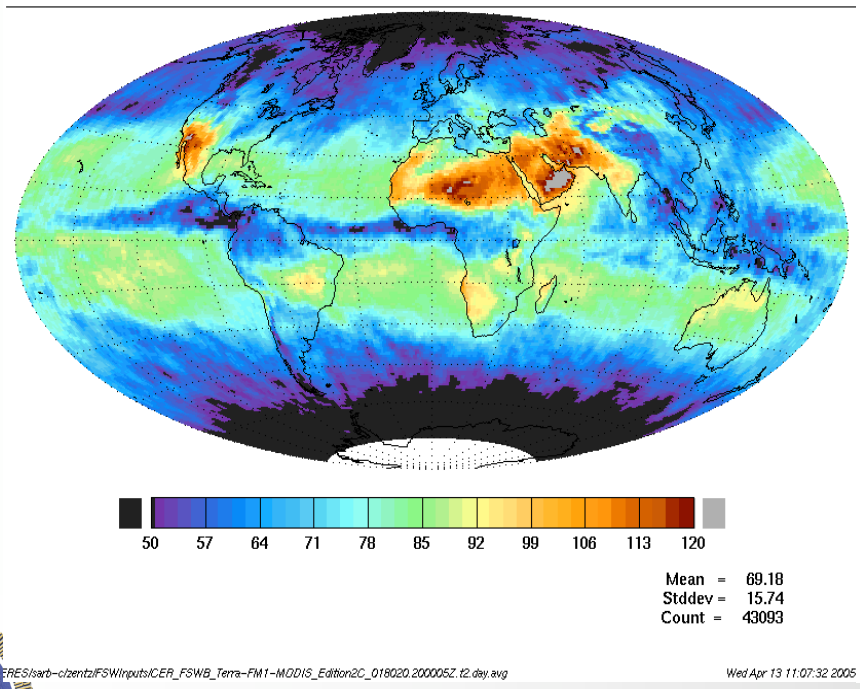
- Collect in 1 degree CERES grid boxes.
- Average spatially.
- Output 5 **zonal** bands per file per month.
- Include only hour boxes (1-744) with observations.
  (No temporal modeling. Month's worth of hour boxes.)
- 1 FSW ~ 50Mbytes
  A global data set requires ~ 1 Gbytes.(compressed HDF)

First SARB "Gridded" Product

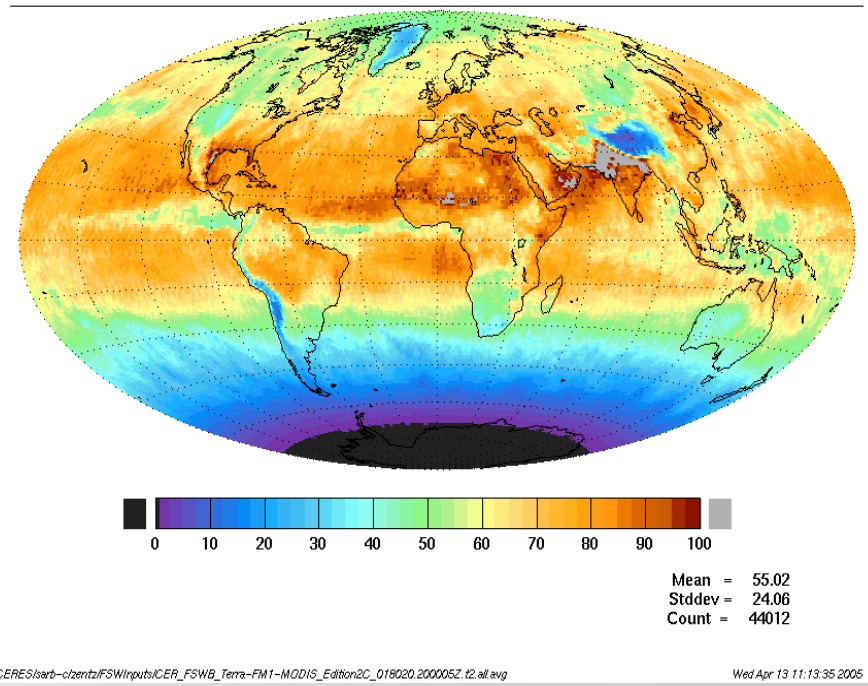
- SARB Group (Fred & Scott) have subset the FSW, averaged over the month, and pieced together files.
- Find tables of statistics/plots of all subset variables at:

http://asd-www.larc.nasa.gov/sarb/fsw_plots.html

Window Flux, TOA, Untuned, All Sky



Surface to 500mb Flux Convergence SW Full Sky



FSW Albedo Maps

- Extracted, modeled, clear sky, untuned, up and down surface fluxes from SARB , FSW subset files.
- Calculated sky surface albedo.

  (not the input surface albedo but under clear sky will be close)
- Created global, monthly, ASCII data files.
- Filter for extremely low solar zenith angle.
- Added diurnal model coefficient and snow flag.
- Created a web page to explain and make this "product" available.
- Currently 58 months available.

Data File

Monthly mean clear sky surface albedo
Satellite=Terra; Instrument=FM1; Date=2000/05

Albedo;	Cos(SZA);	D-value;	Snow/Ice Flag
0.469	0.326	0.200	1
0.469	0.326	0.200	1
0.469	0.326	0.200	1
0.469	0.326	0.200	1
0.469	0.326	0.200	1
0.469	0.326	0.200	1
0.469	0.326	0.200	1
0.469	0.326	0.200	1
. . . . .			
. . . . .			

Data in each 1 degree grid box is for mean solar zenith angle for the month for footprints averaged in that grid box.

Snow flag based on std dev of albedo for mean IGBP grid over the globe.

Diurnal Modeling

SARB uses a single parameter function for diurnal modeling of broadband surface albedo:

$A_1 = A_0(1+d)/(1+2d\mu_0)$*

Where d = f(IGBP surface scene type)

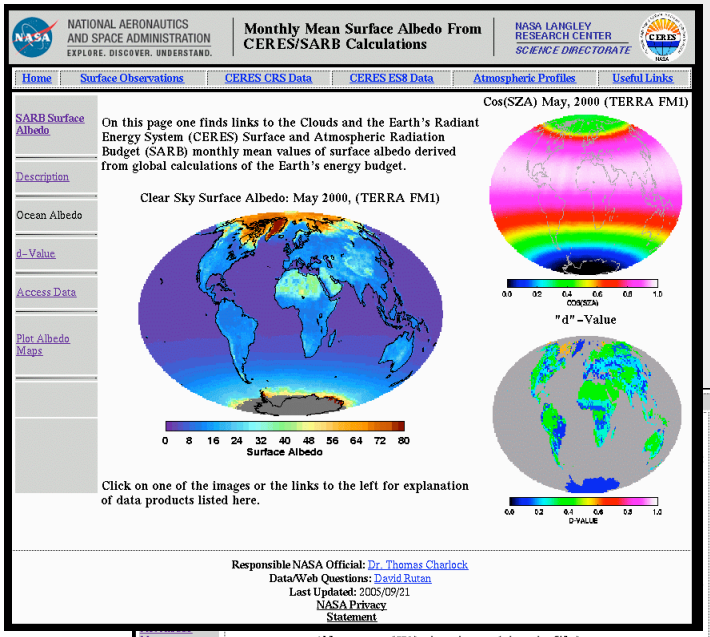
d value sources include literature and CARE helicopter experiment, modeling.

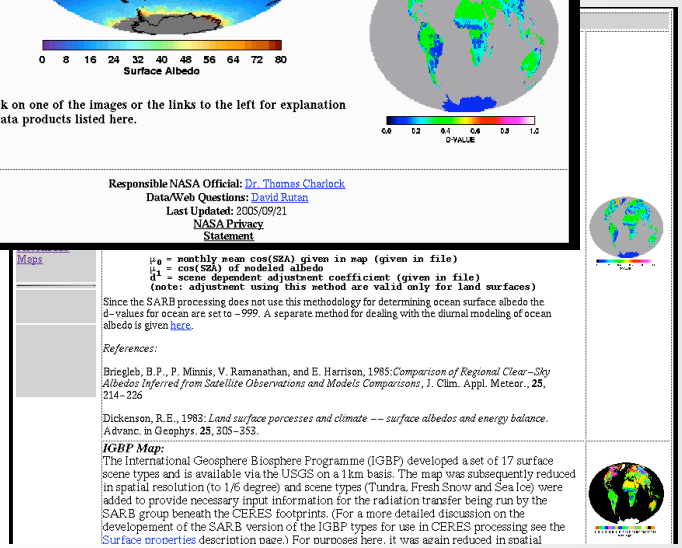
Does not apply to ocean albedos.

(*Briegleb et al. 1985, Dickenson, 1983.)

Web Site

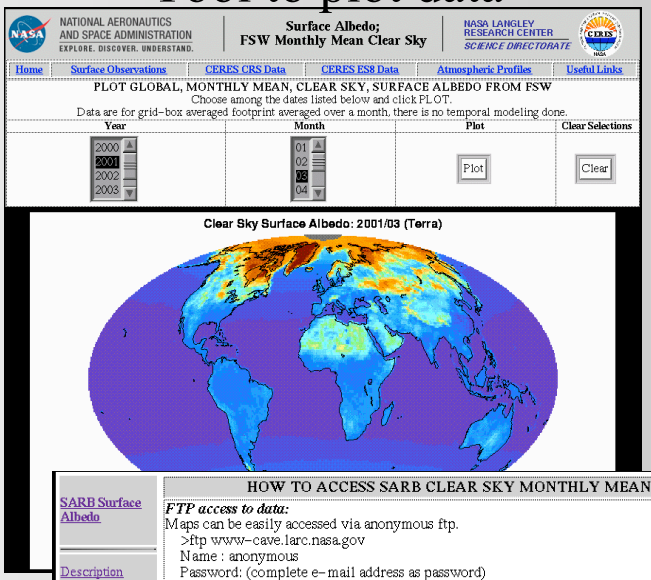
Overview

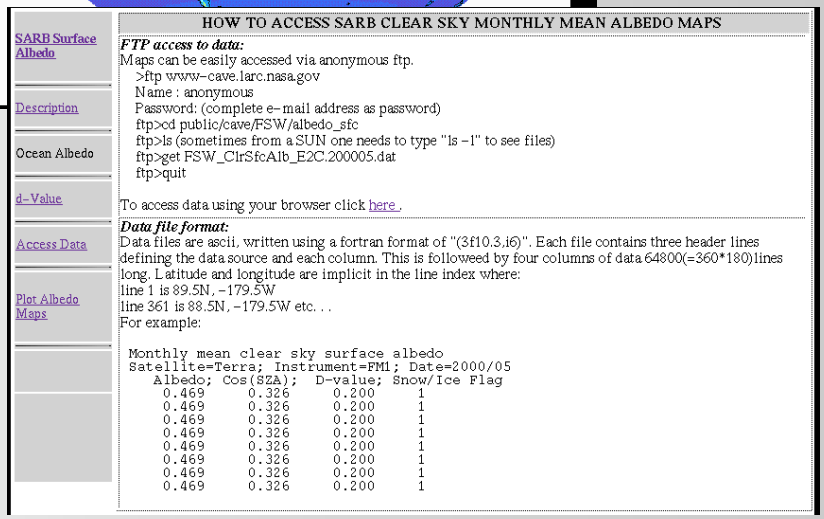




Detail on each parameter

Tool to plot data





Description of data files

http://www-cave.larc.nasa.gov/cave/sfc_albedo.html

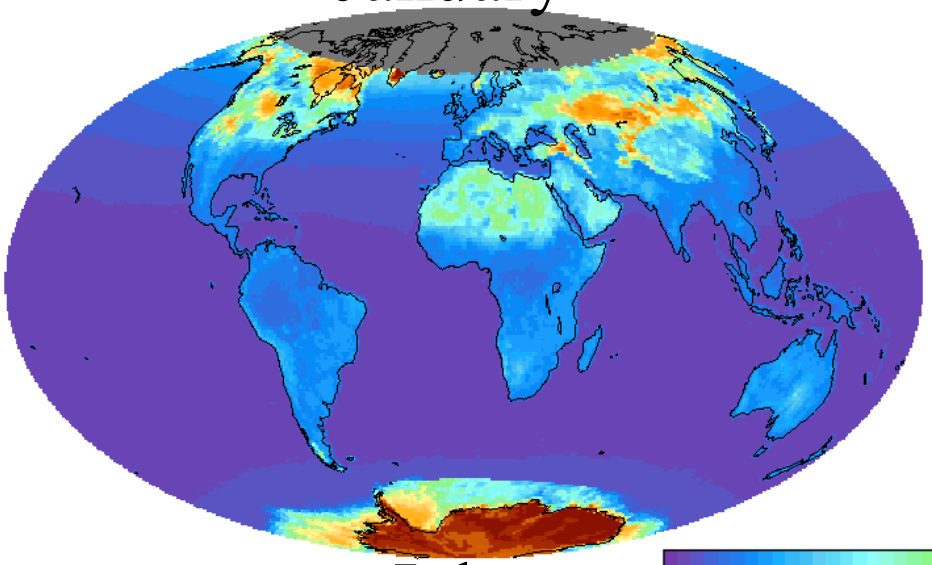
Multi-Year Analysis

- Time period is from March 2000 through December 2004.
- Have “moved” data to overhead sun using given d-values.
- Look at canonical mean months and standard deviation.
- Consider correlation with climate indices.

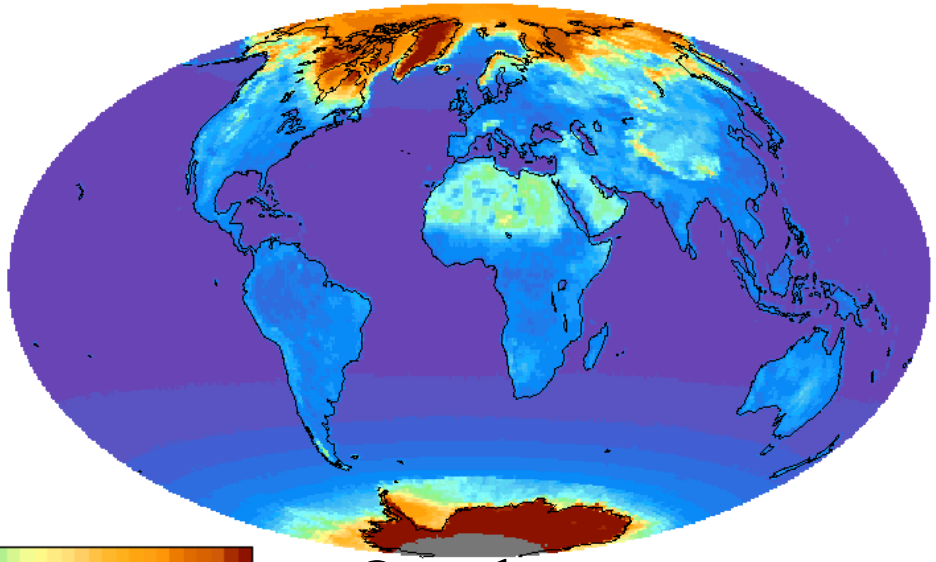
(Ideally for ocean on should use the COART Ocean albedo lookup table.)

Mean Months

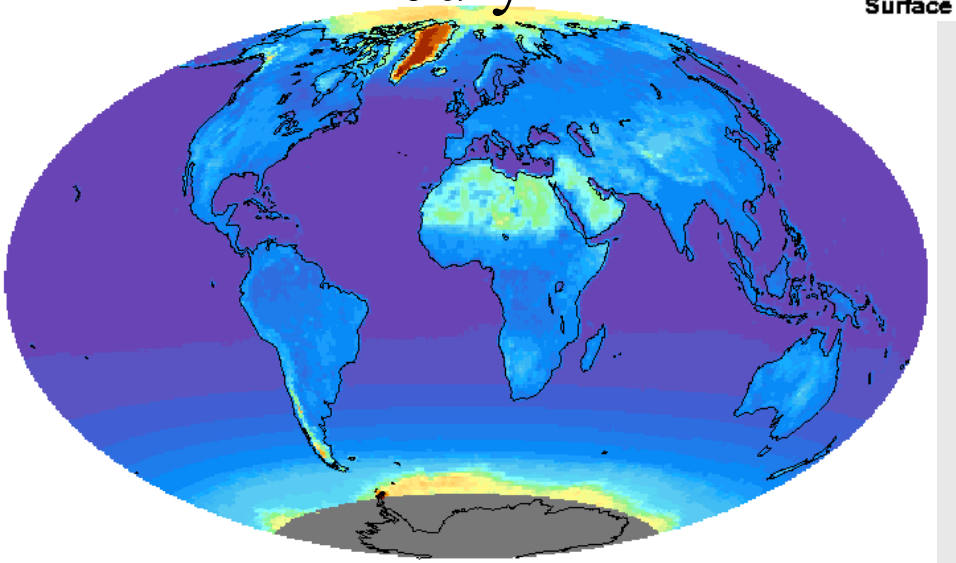
January



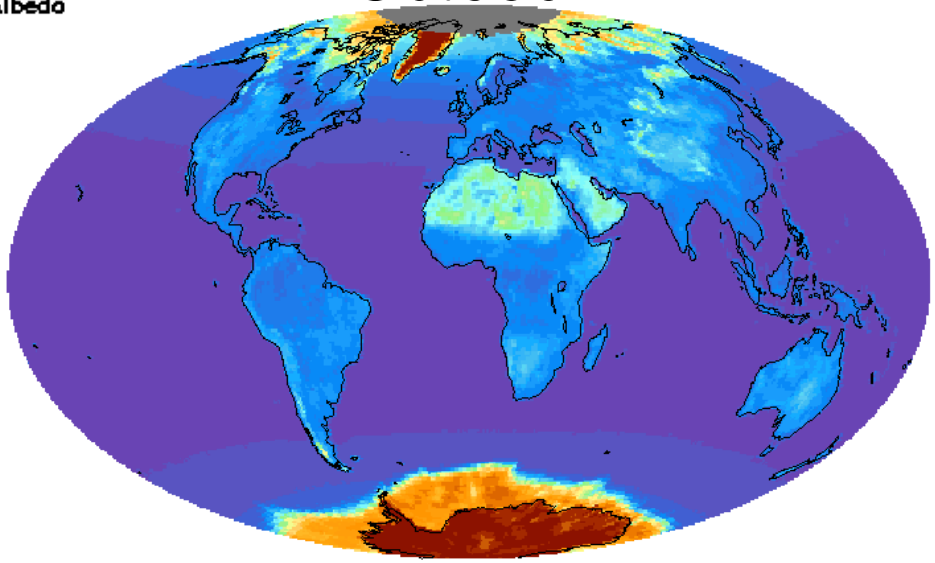
April



July

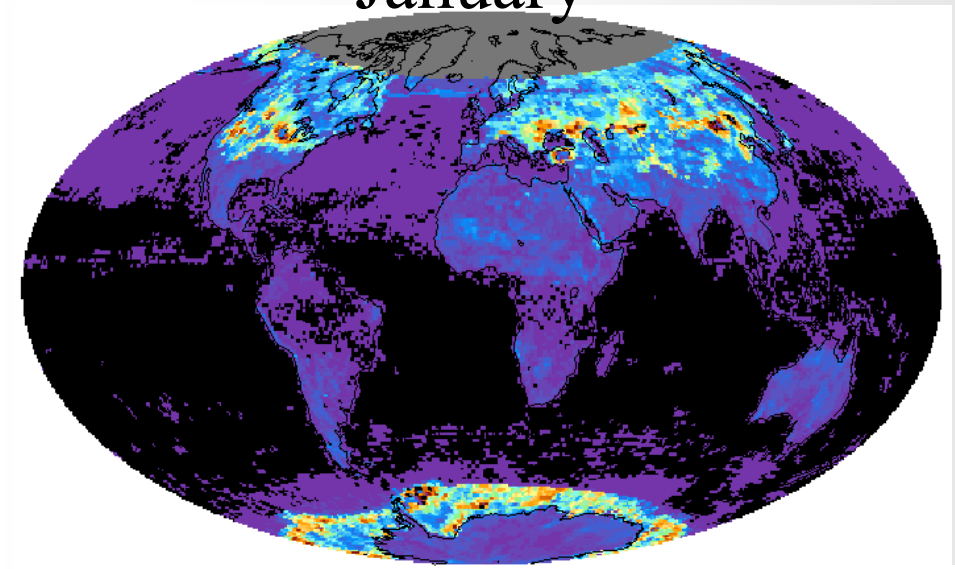


October



Monthly Standard Deviations

January



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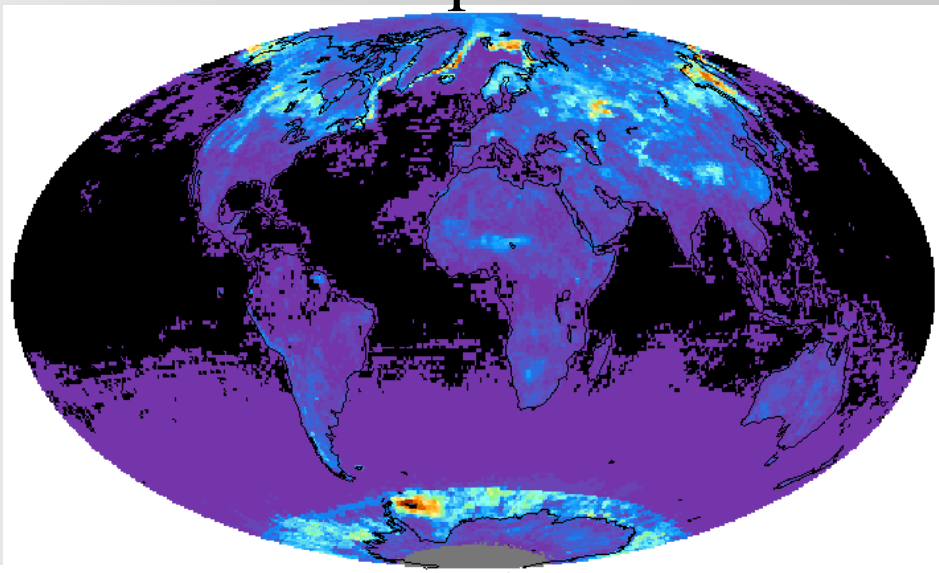

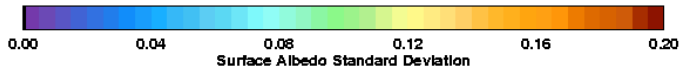

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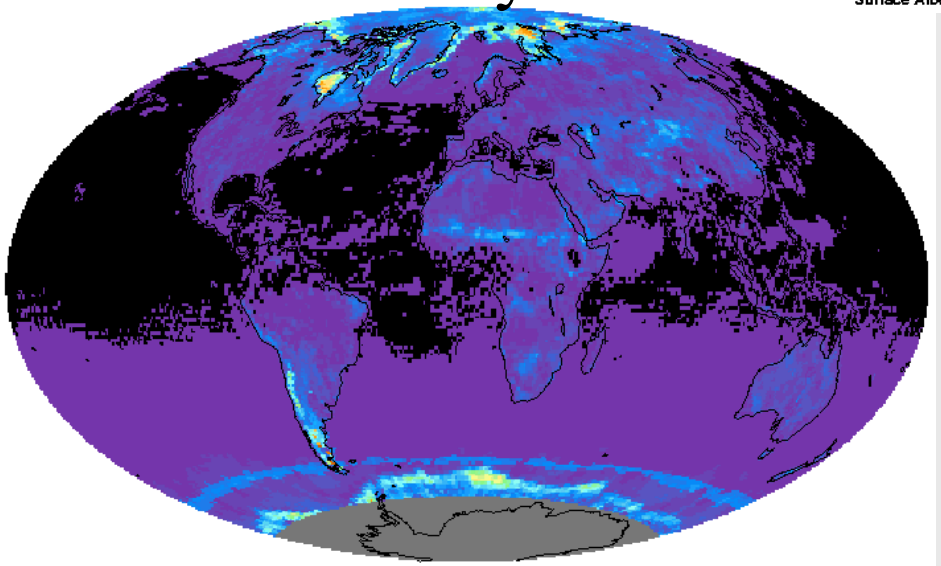
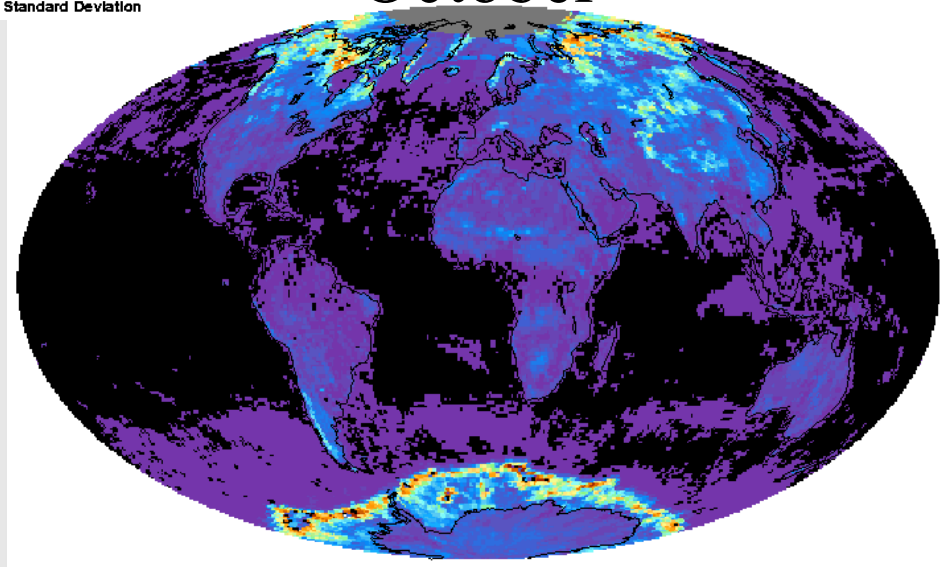
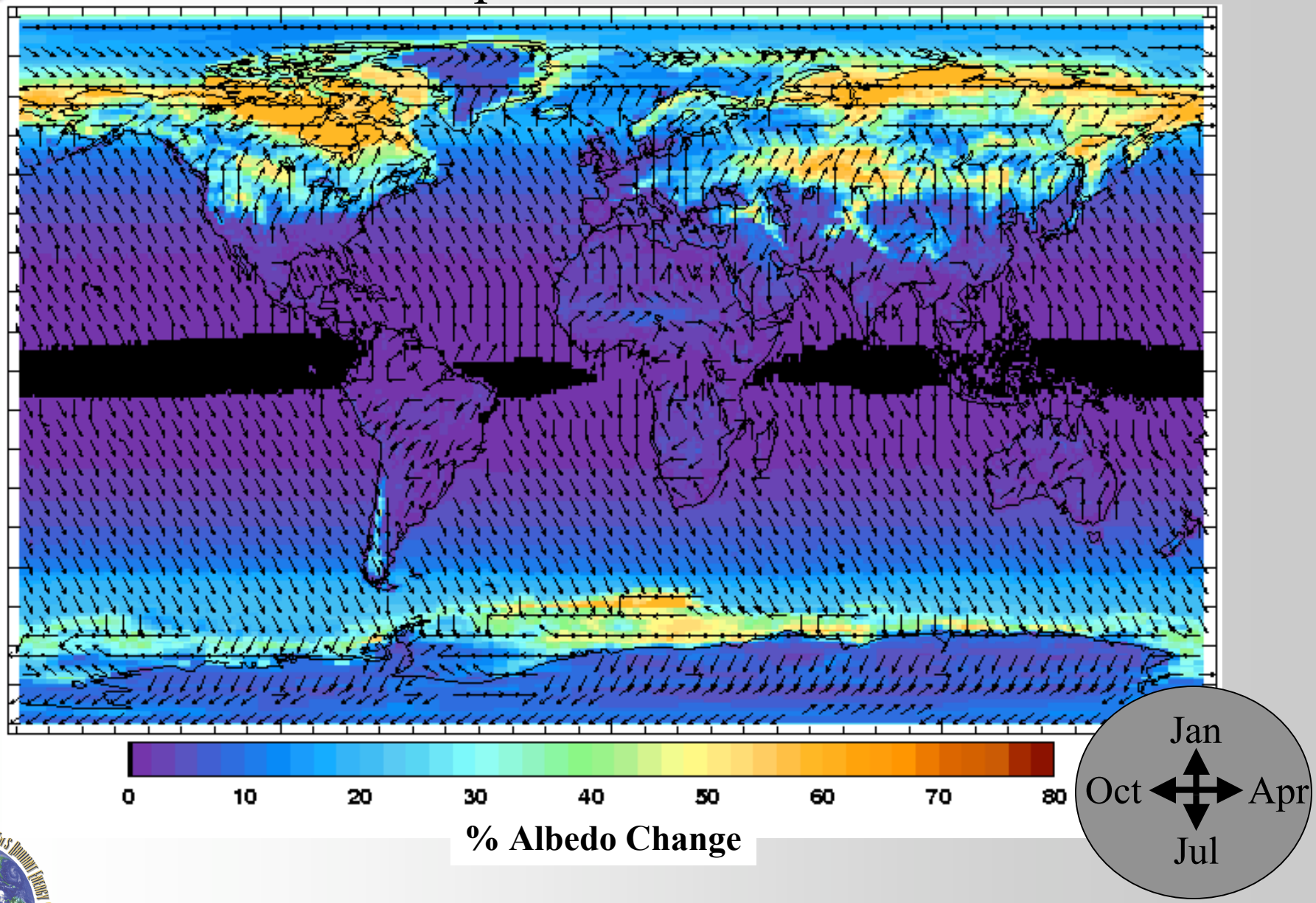


October

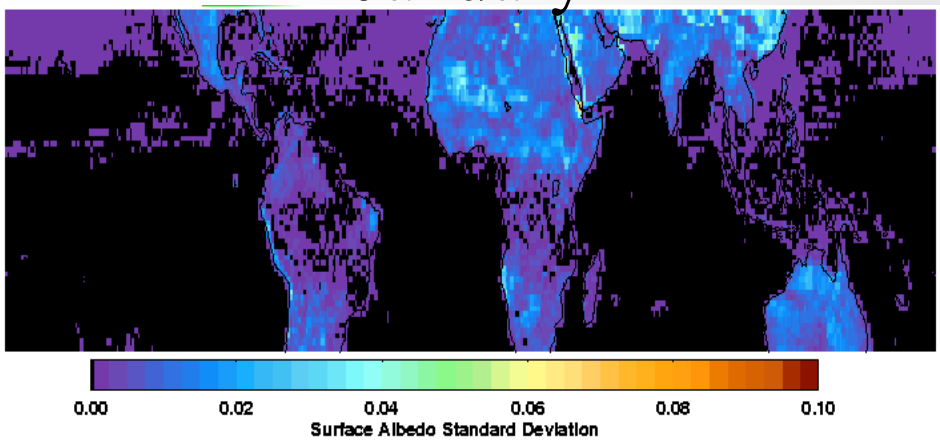


Amplitude and Phase



Tropical Monthly Standard Deviations

January



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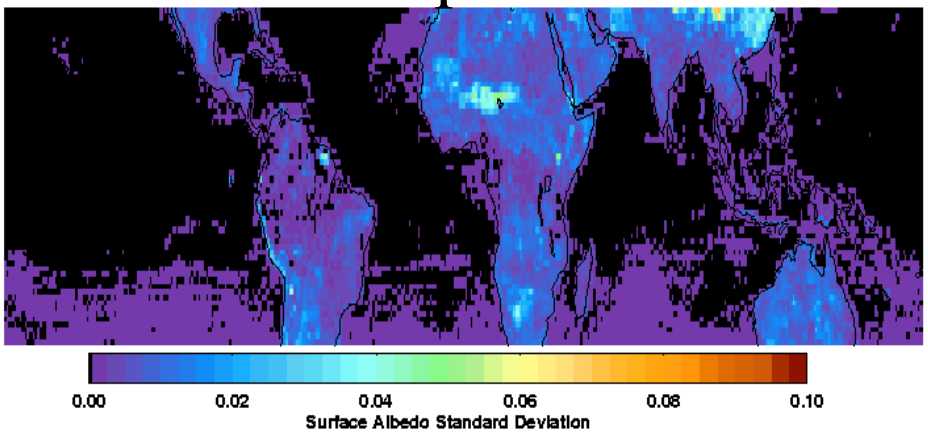

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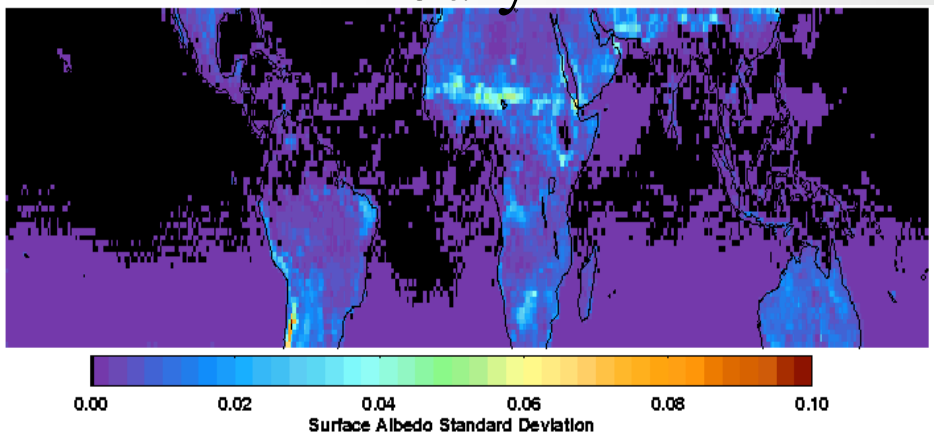
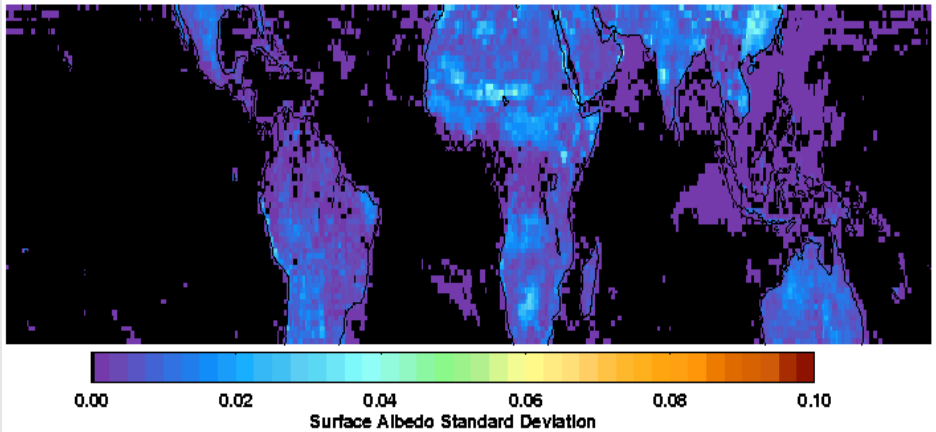
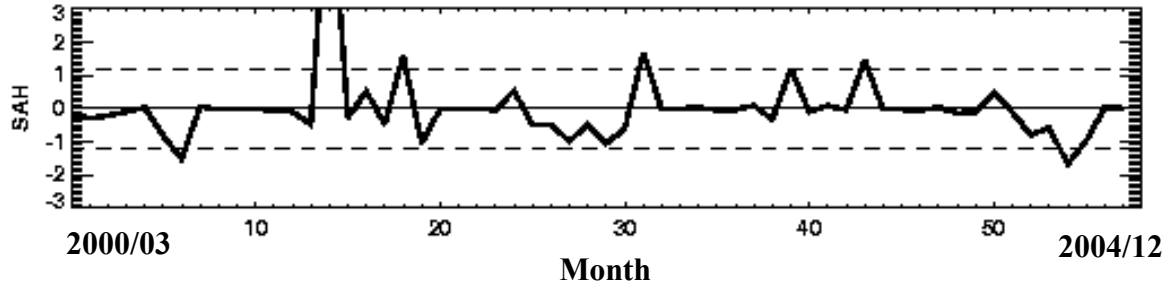
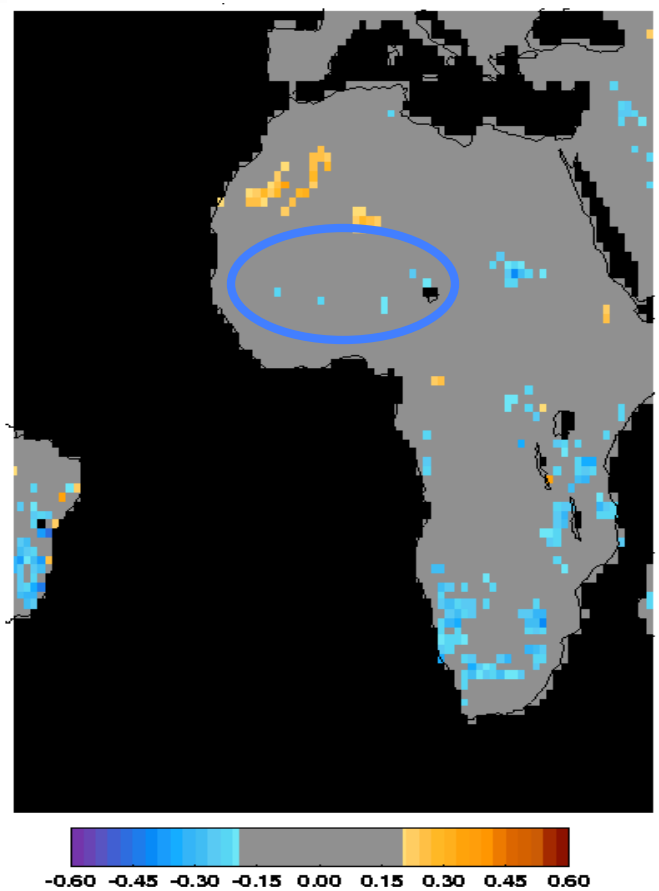


October

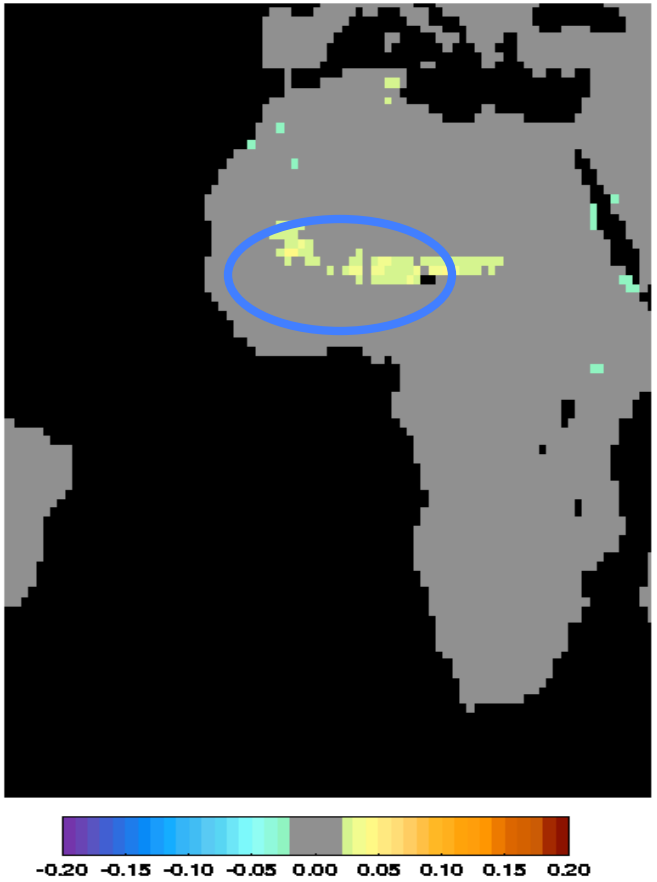


Sahel Rainfall Index



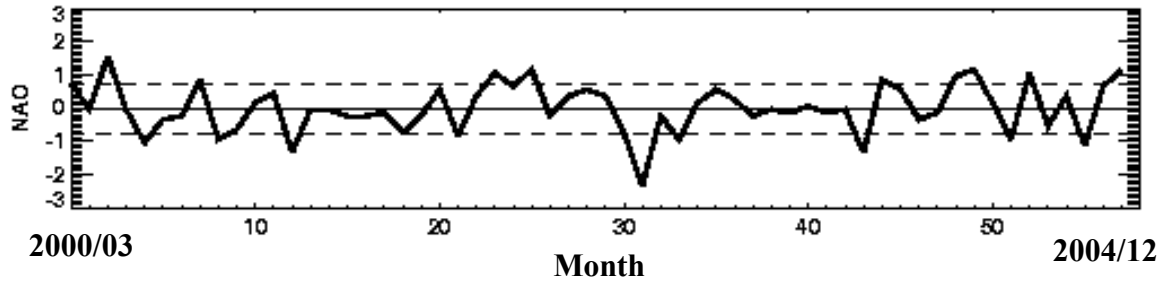


Correlation SAH w/ Albedo anomaly

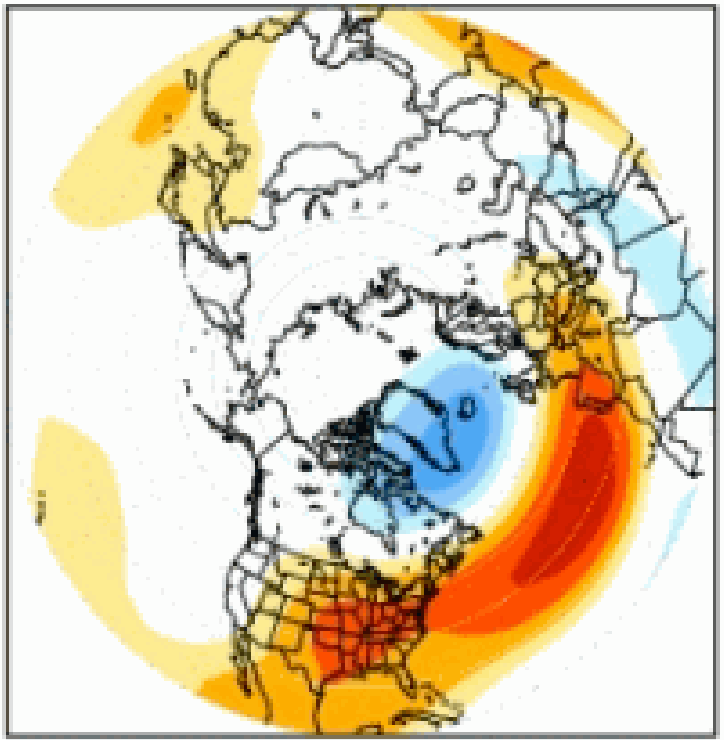


Composite Albedo anomaly: - SAH

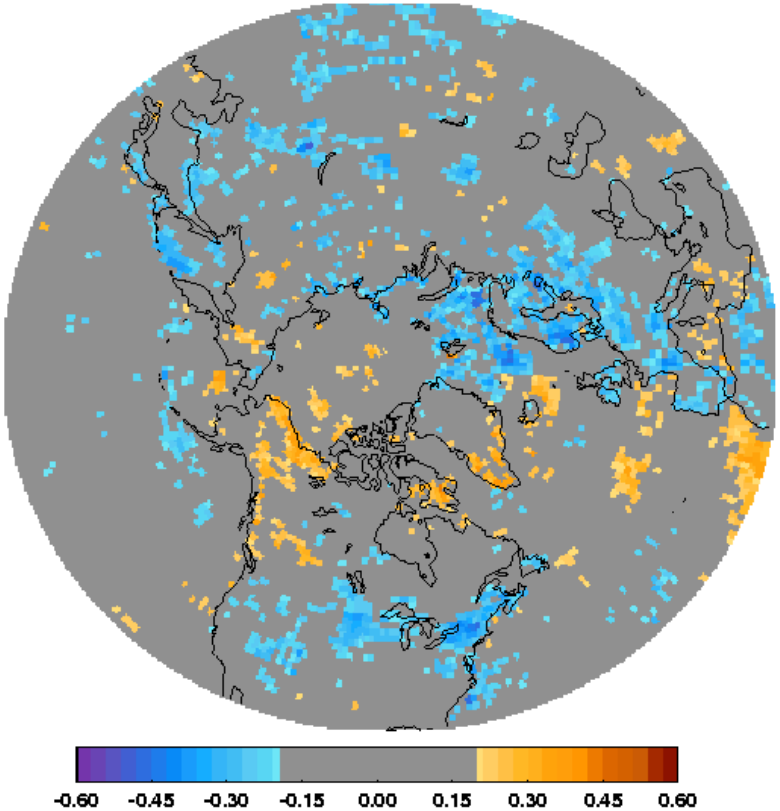
North Atlantic Oscillation



January

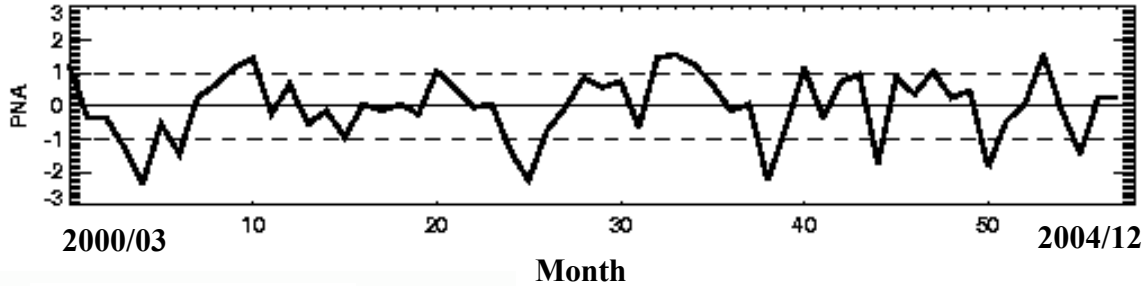


Correlation NAO w/ 500mb anomaly

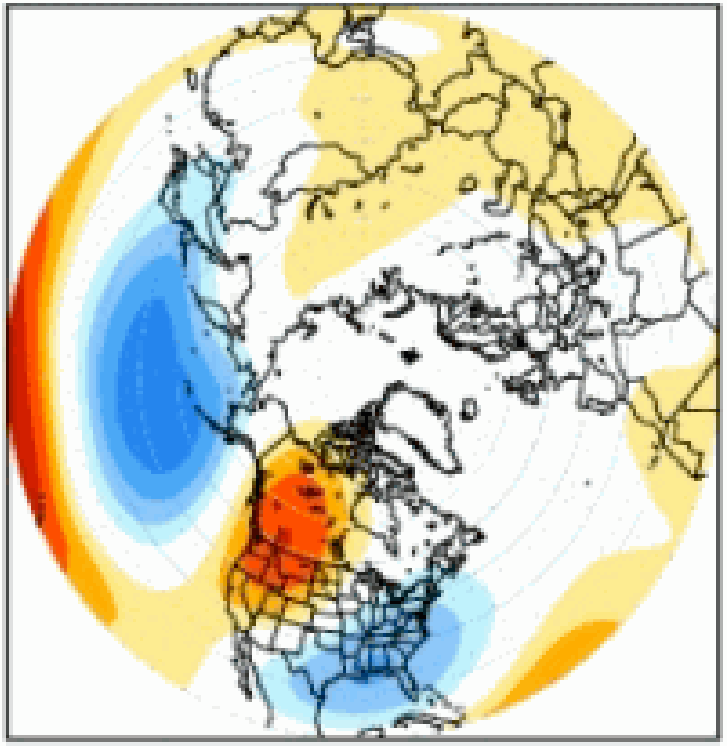


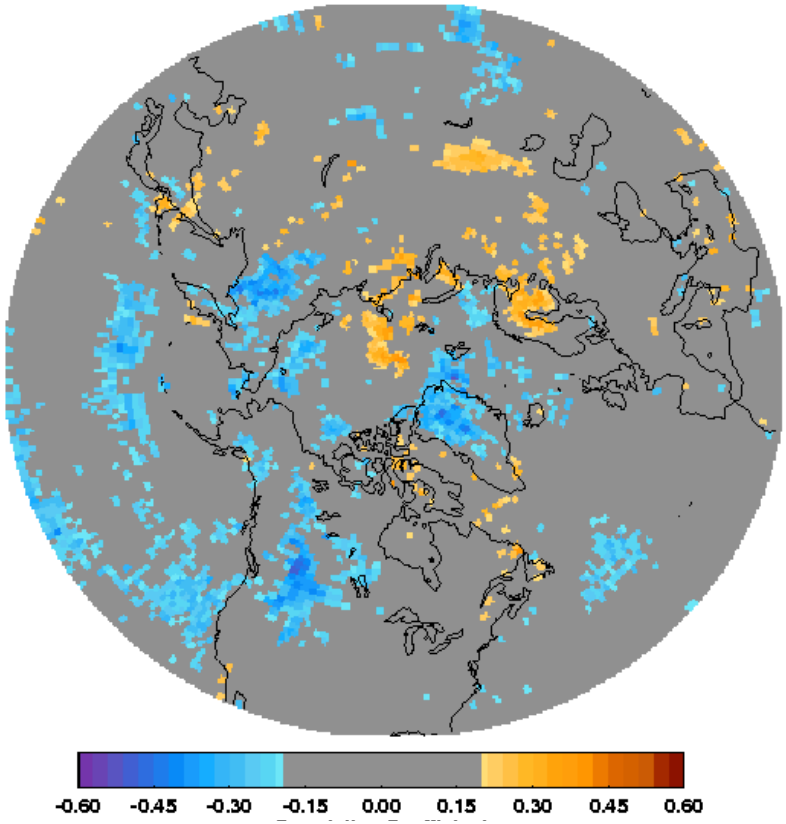
Correlation NAO w/ Albedo anomaly

Pacific North America Oscillation



January

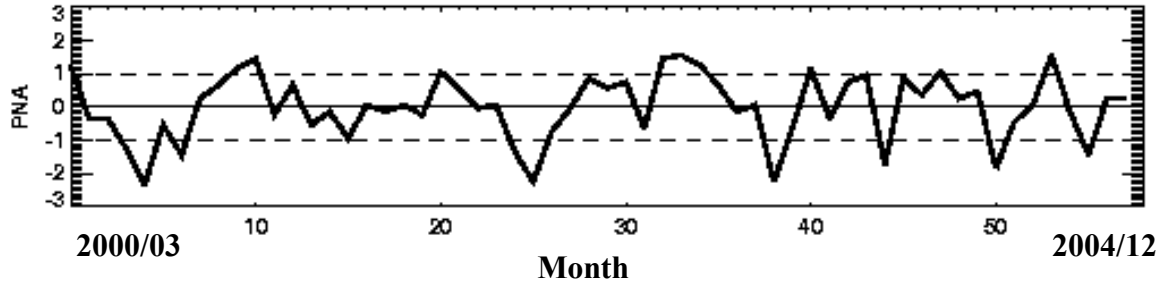




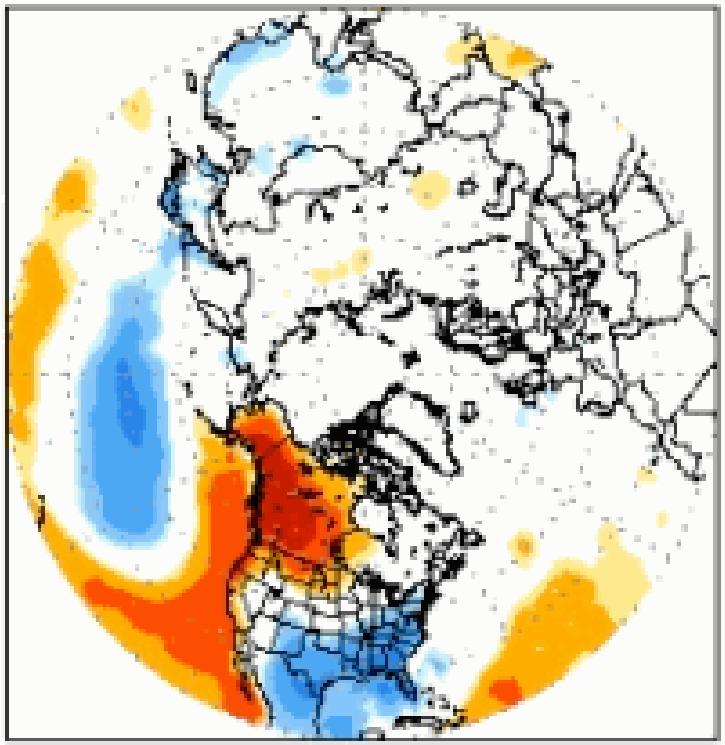
Correlation: PNA w/ 500mb anomaly

Correlation: PNA w/ albedo anomaly

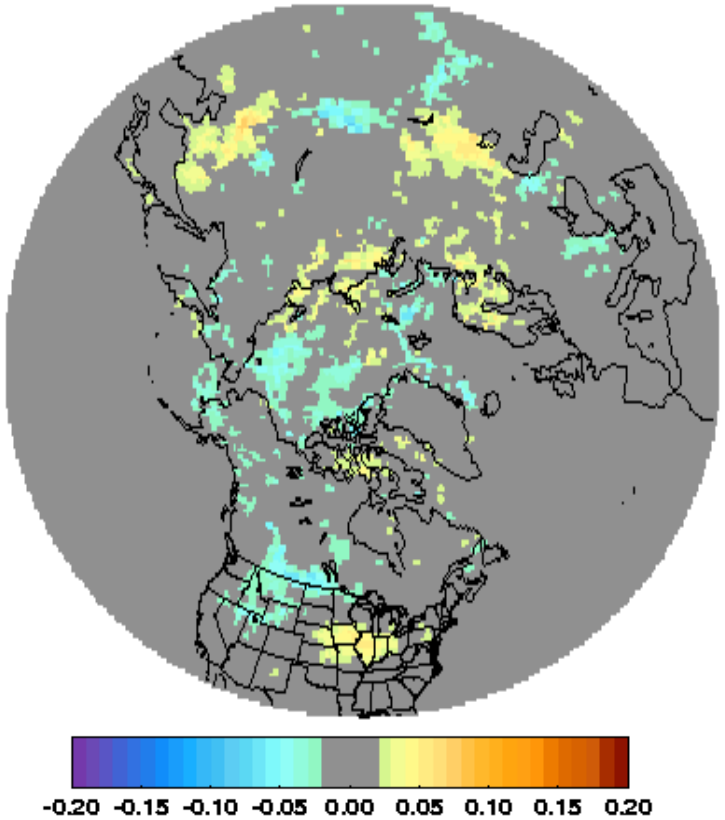
PNA (Surface Temperature)



January



Correlation: PNA w/ T_s anomaly



Composite Albedo anomaly: + PNA

Summary

¬From CERES FSW files developed a data base of global, monthly mean, clear sky, surface albedo maps.

¬Developed web site for release of the data:

http://www-cave.larc.nasa.gov/cave/sfc_albedo.html

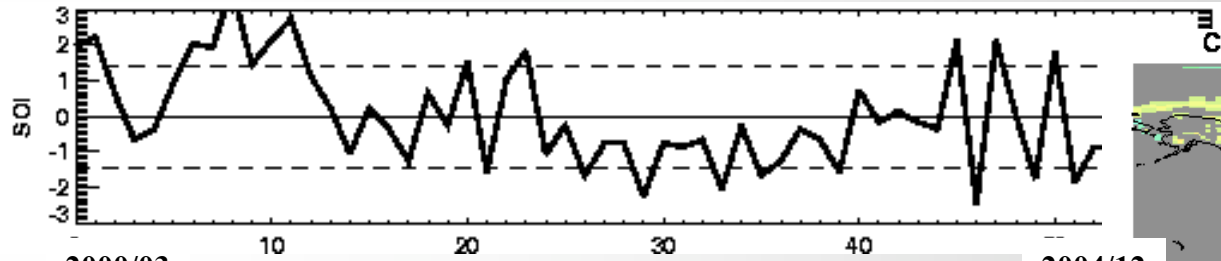
¬Canonical mean/std dev maps give comprehensive description of annual cycle of snow and its variability

¬Comparison to climate indices shows some correlation with PNA and NAO oscillations and NH snow.

¬Sahel rainfall record hints at a correlation but doesn't pick up all variability seen in standard deviation maps.

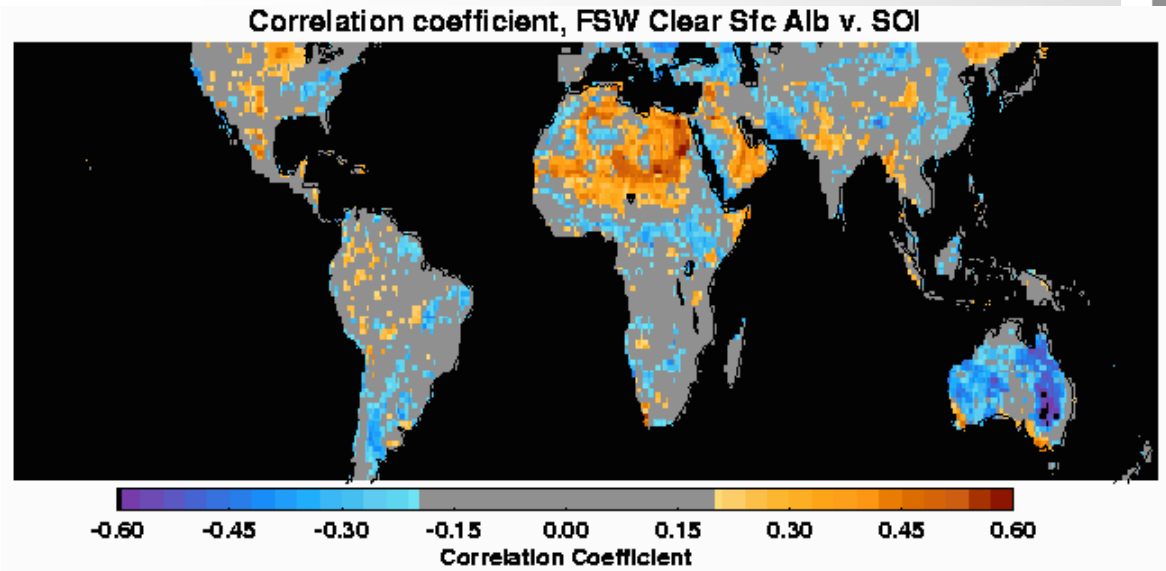
(Still not sure what "FSW" stands for.)

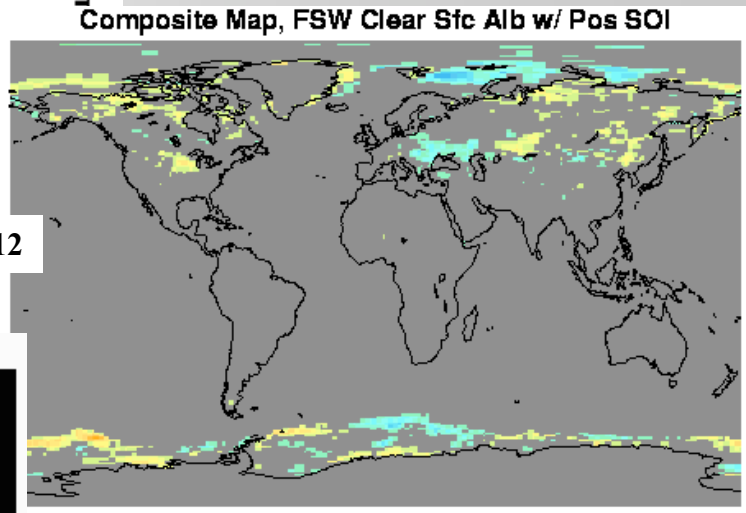
Southern Oscillation Index

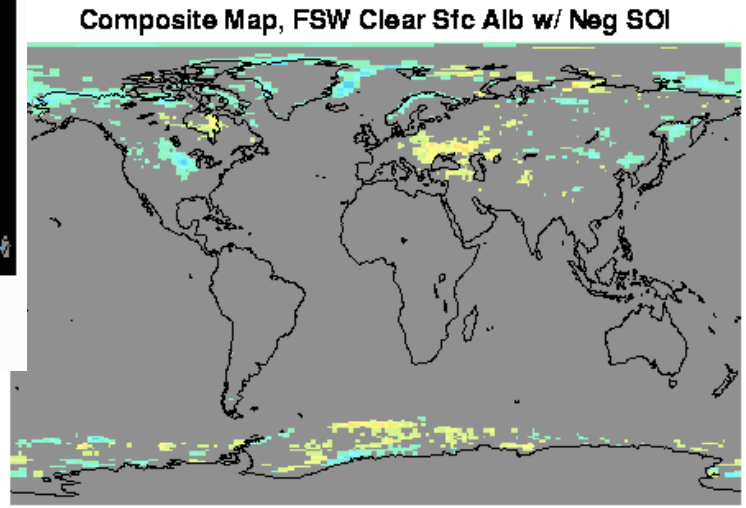


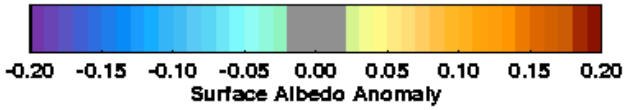
2000/03

2004/12

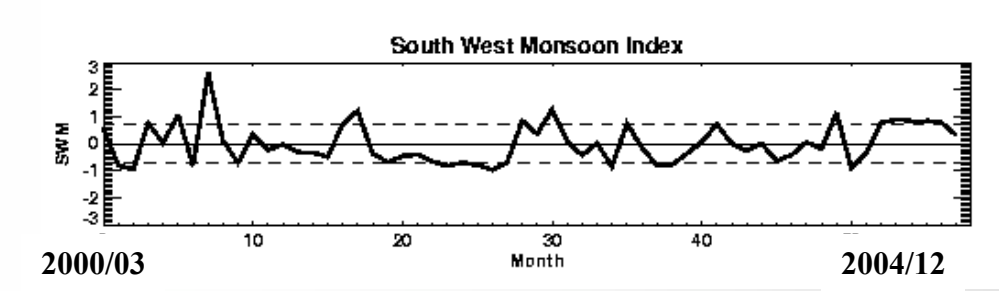


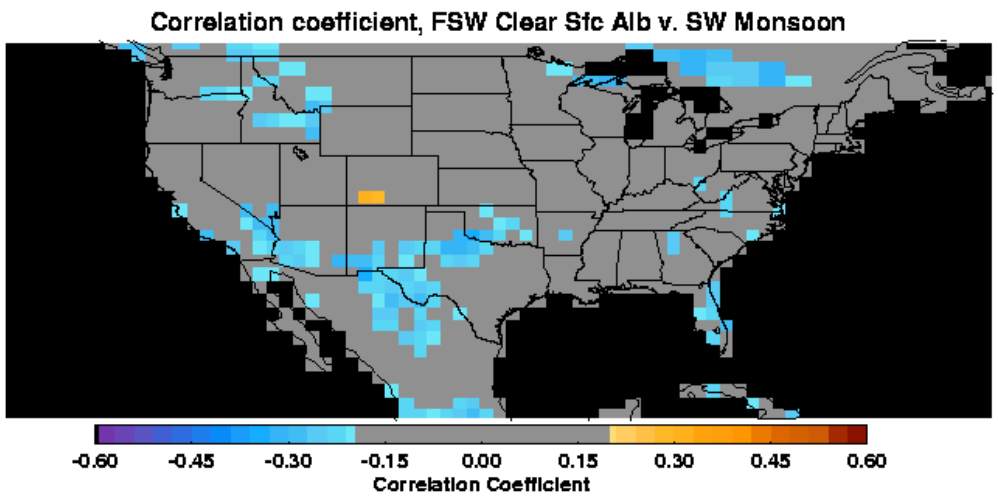


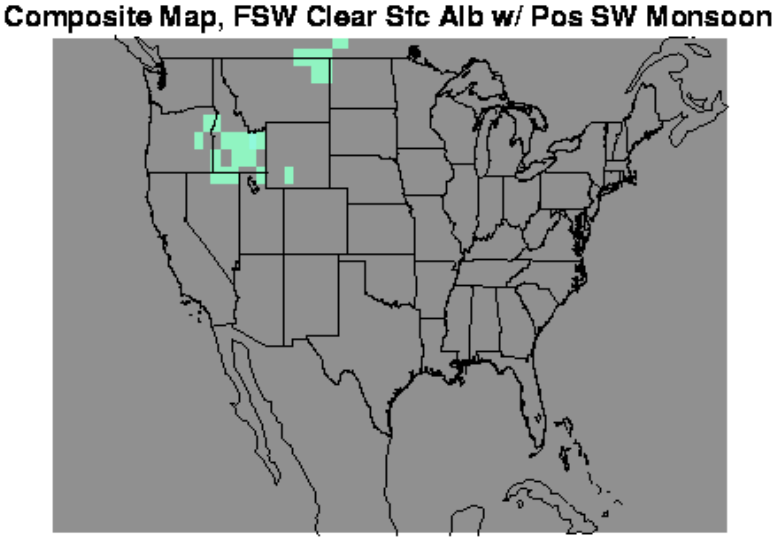


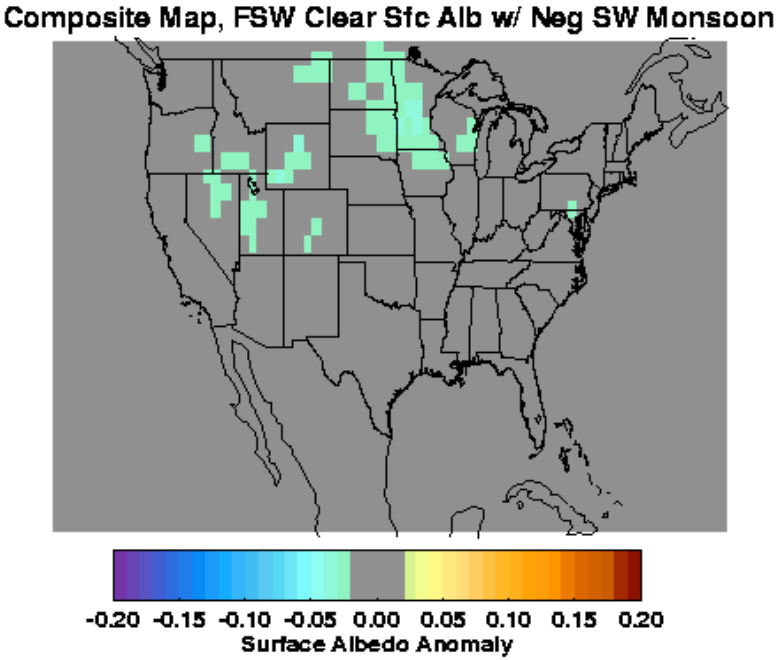


Extra - South West Monsoon

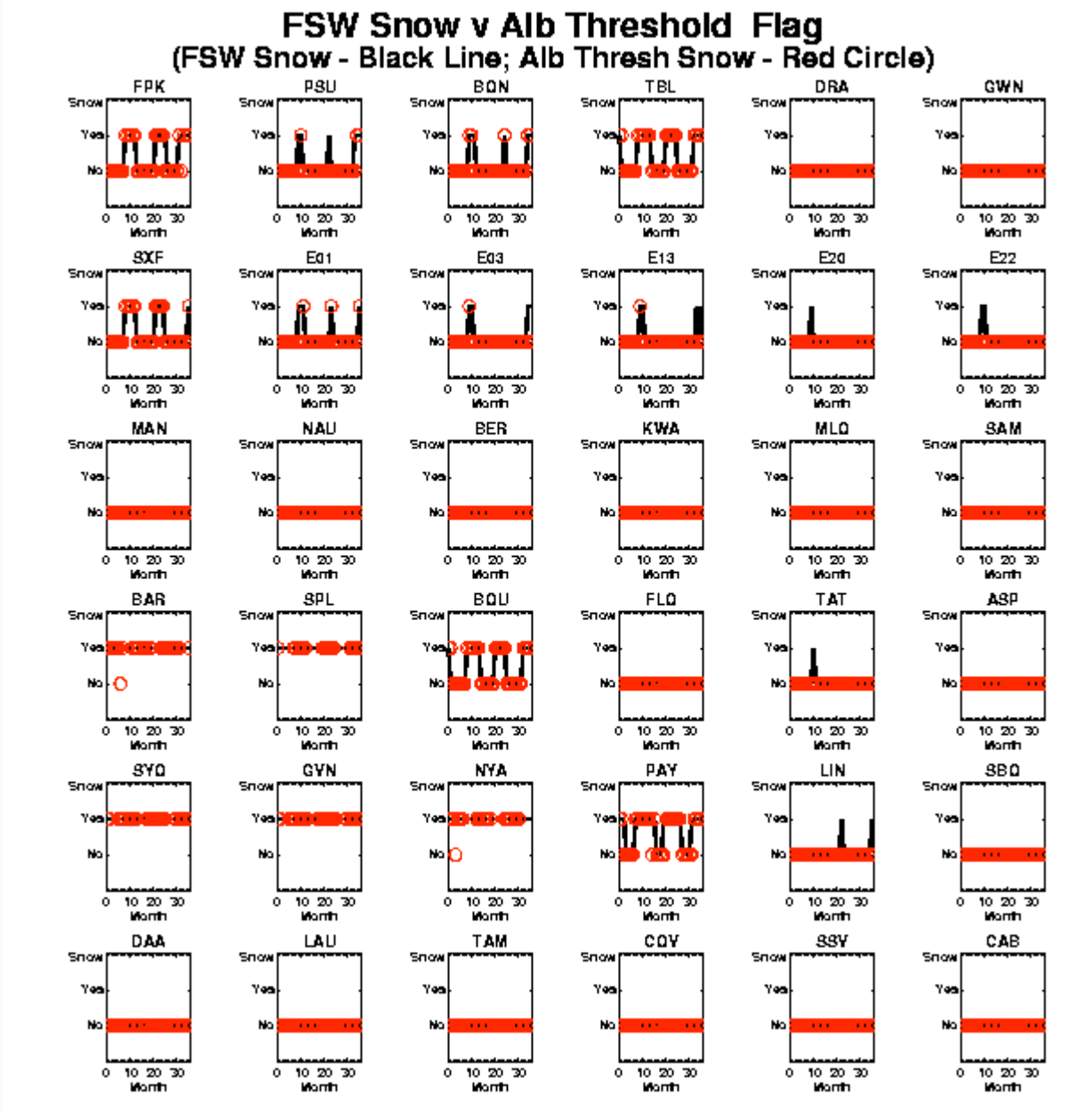




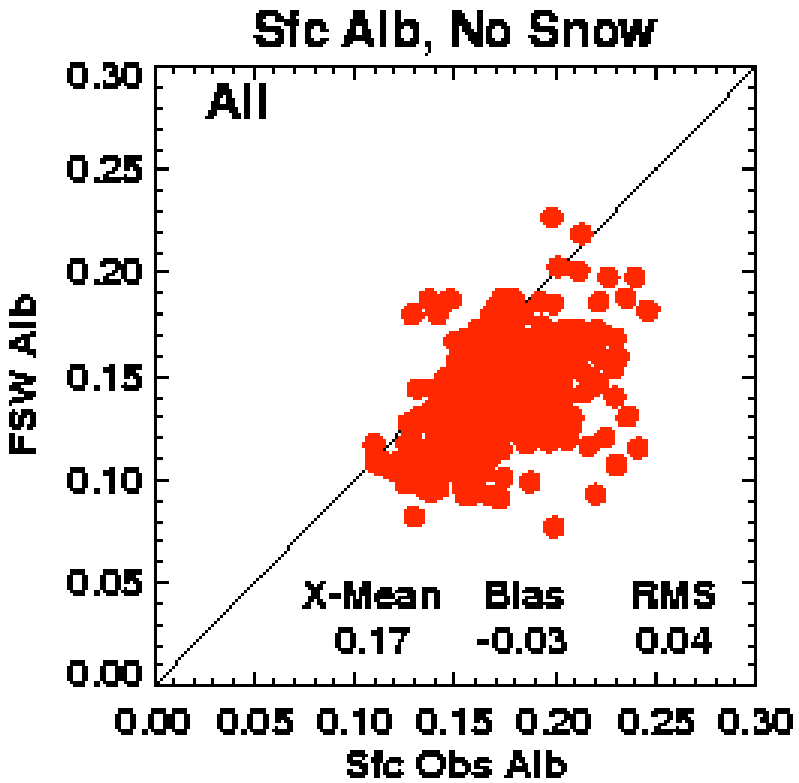


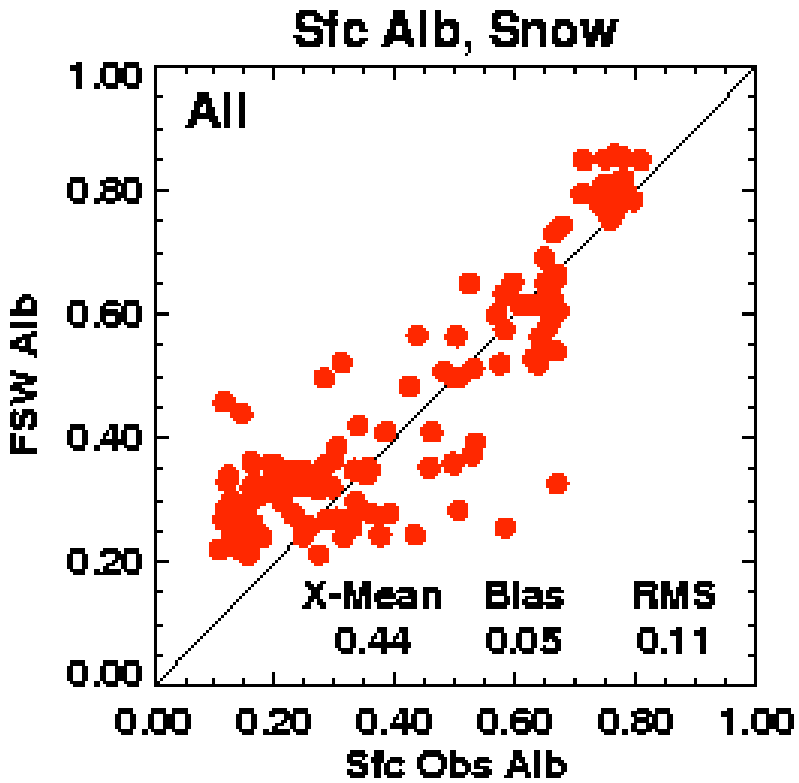


Extra- Snow Flag validation



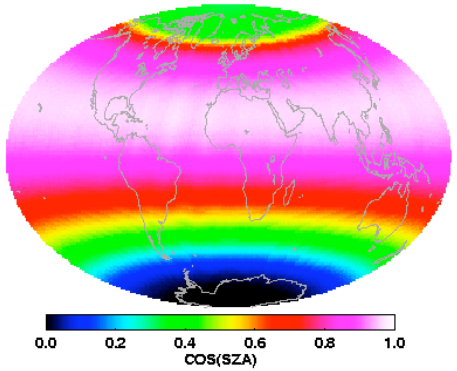
Extra - Albedo Validation (by CAVE Site)



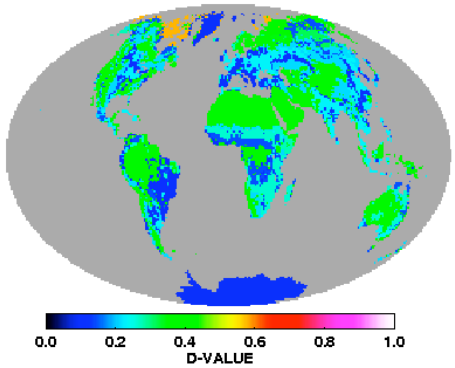


Creating Overhead Sun Albedo Maps

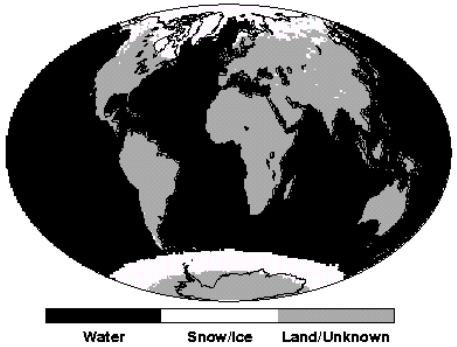
Cos(sza)

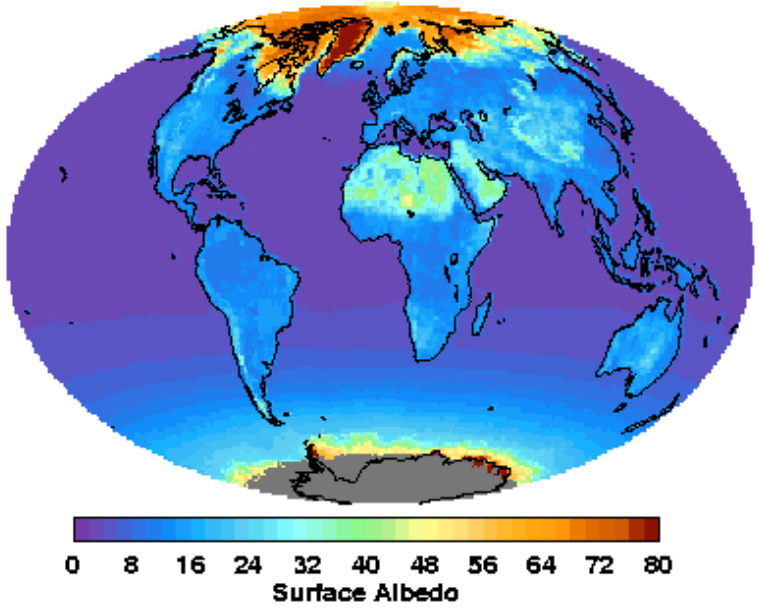


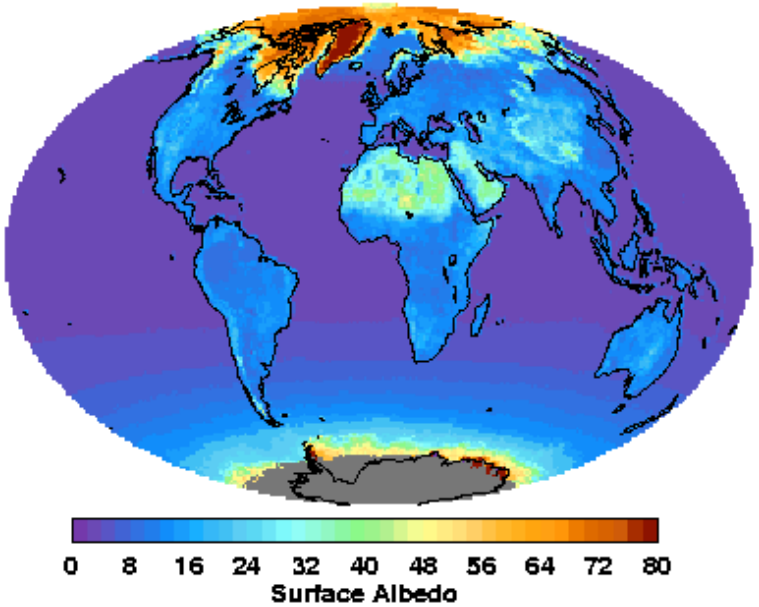
d-value



Snow/Ice Flag
(no modeling)

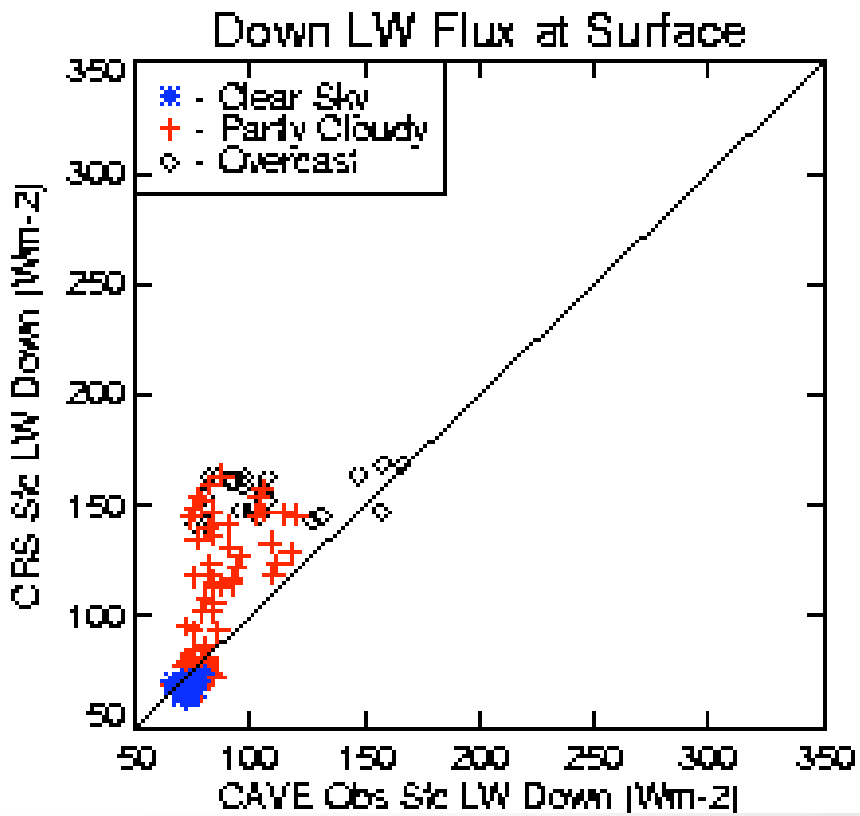




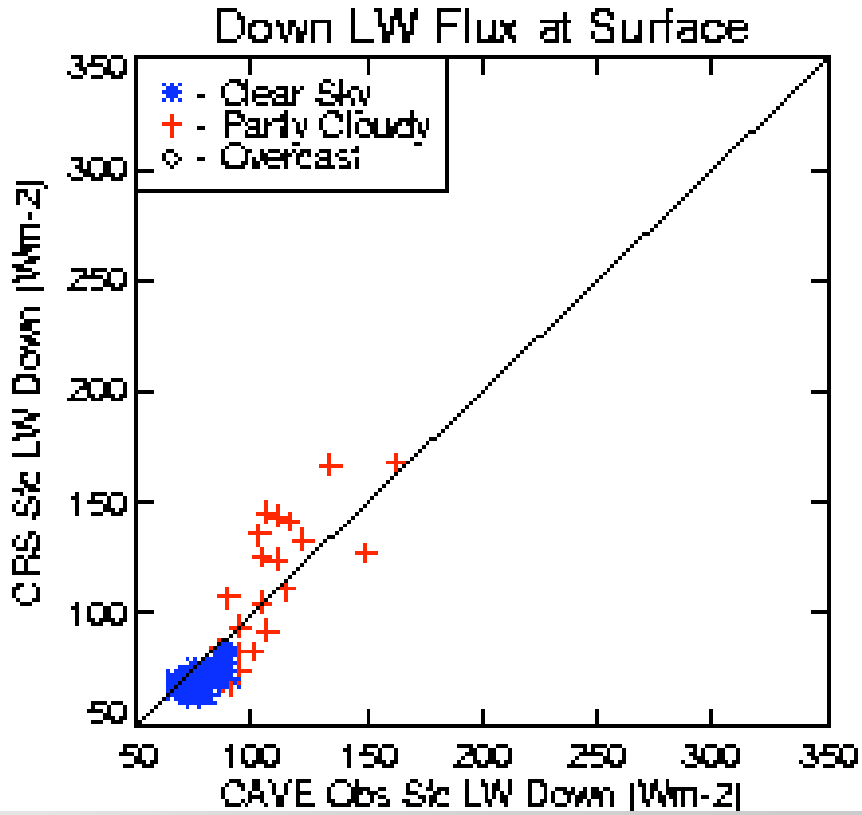


SARB/CRS Validation at South Pole

Terra Jun 2003



Aqua Jun 2003



Cloud Fraction # FPs

	Total	Clear	Overcast	DLF Bias
Terra	142	12(10%)	21	15Wm-2
Aqua	116	83(70%)	0	-5Wm-2