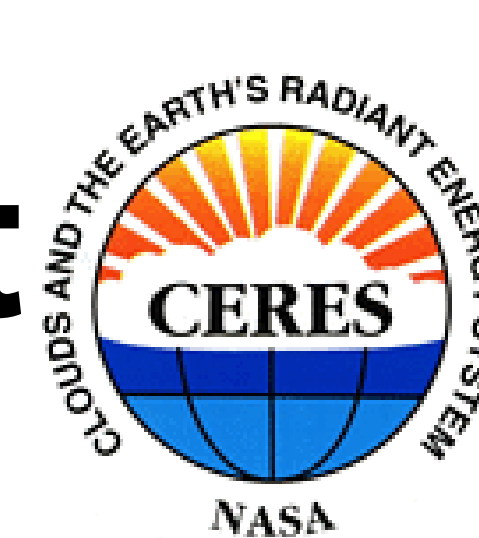


Interannual Variation In Surface Shortwave Transmission and TOA Albedo at ARM Southern Great Plains Test-bed

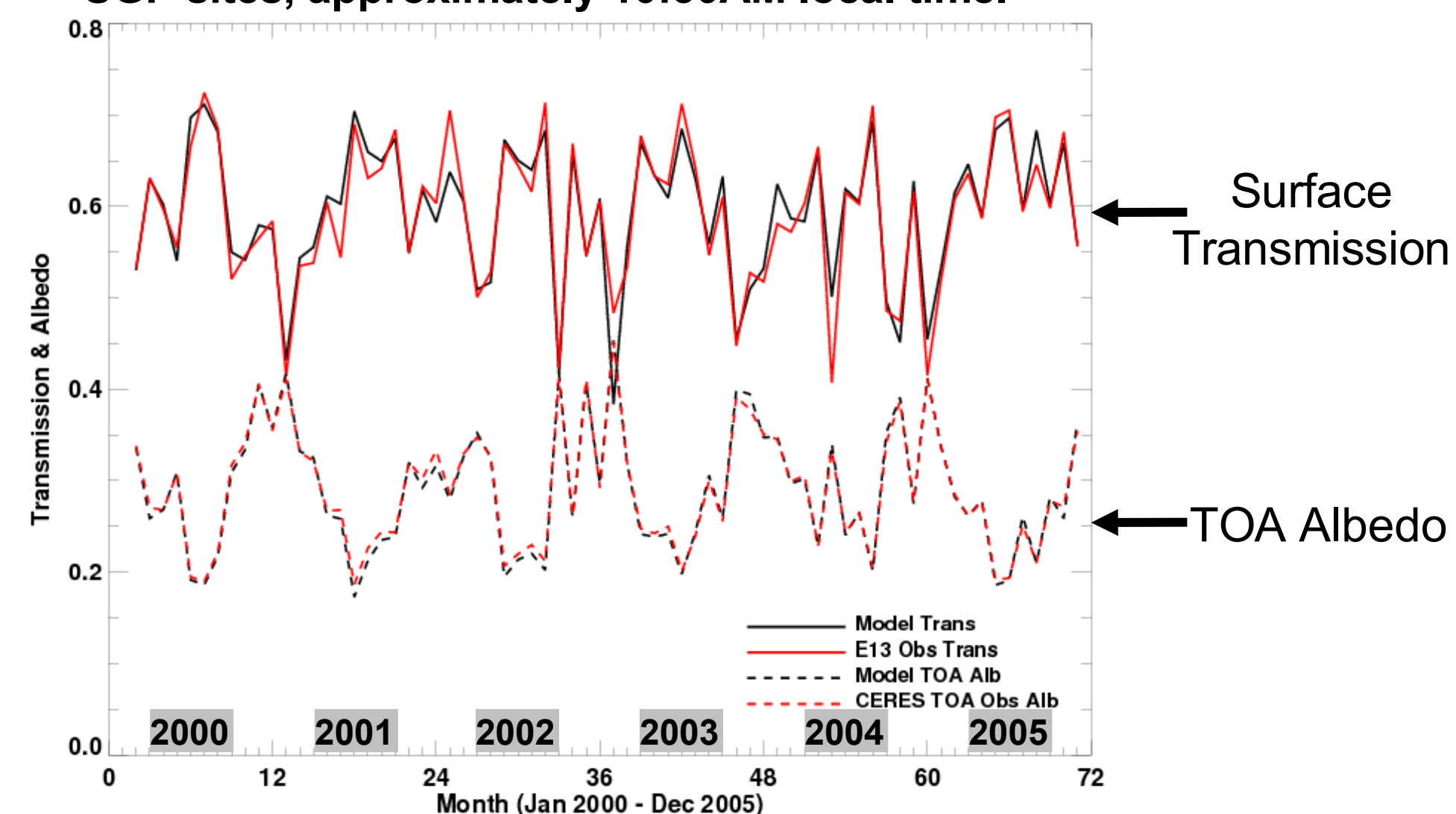


David Rutan¹, Tom Charlock², Fred Rose¹

Q: How well can a satellite observing a site daily recover inter-annual variability of surface & TOA SW radiation?

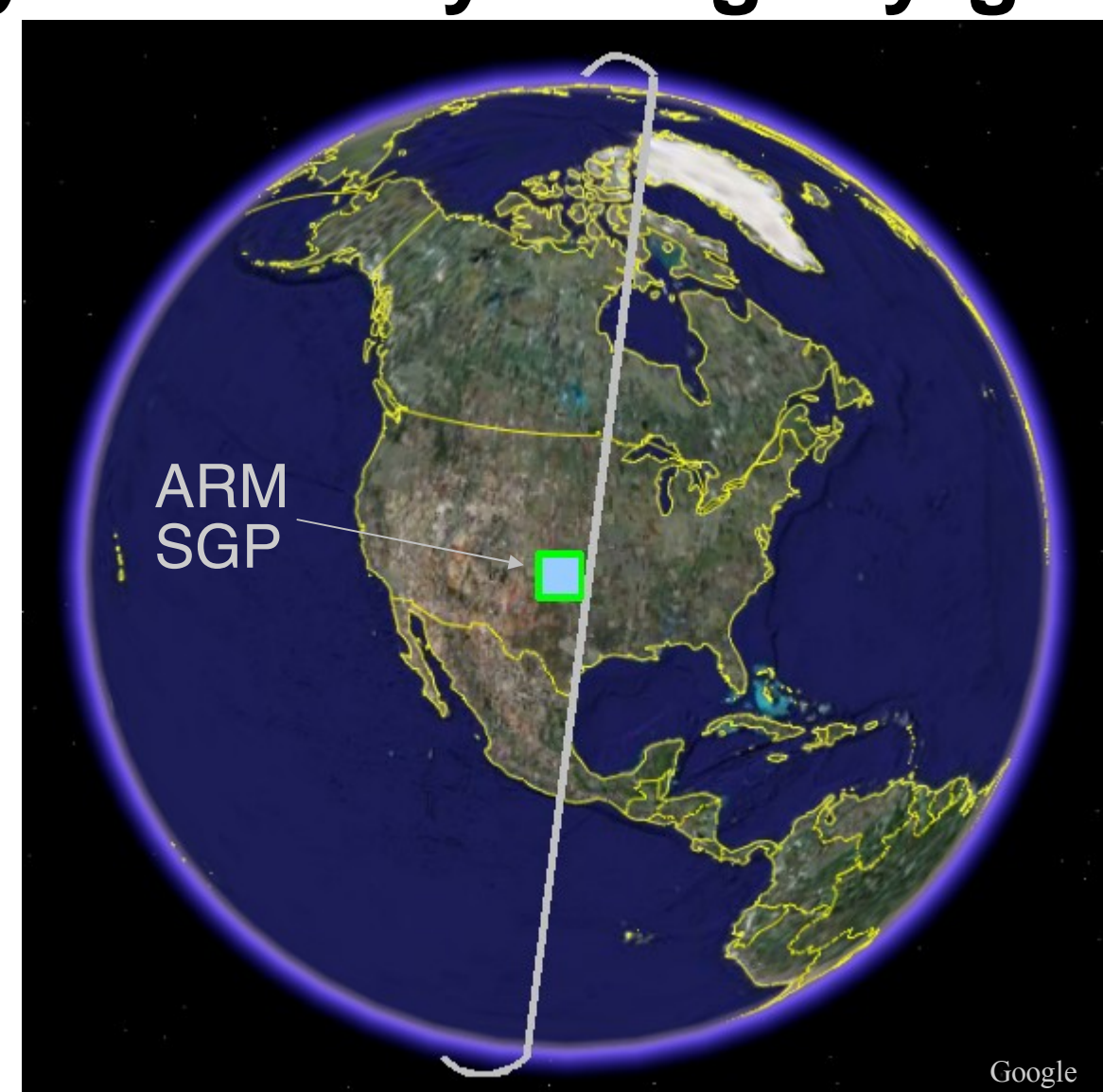
Monthly Mean* Surface Transmission & TOA Albedo Averaged at 19 ARM SGP Sites

* Monthly mean is based on time of CERES observation of SGP sites, approximately 10:30AM local time.

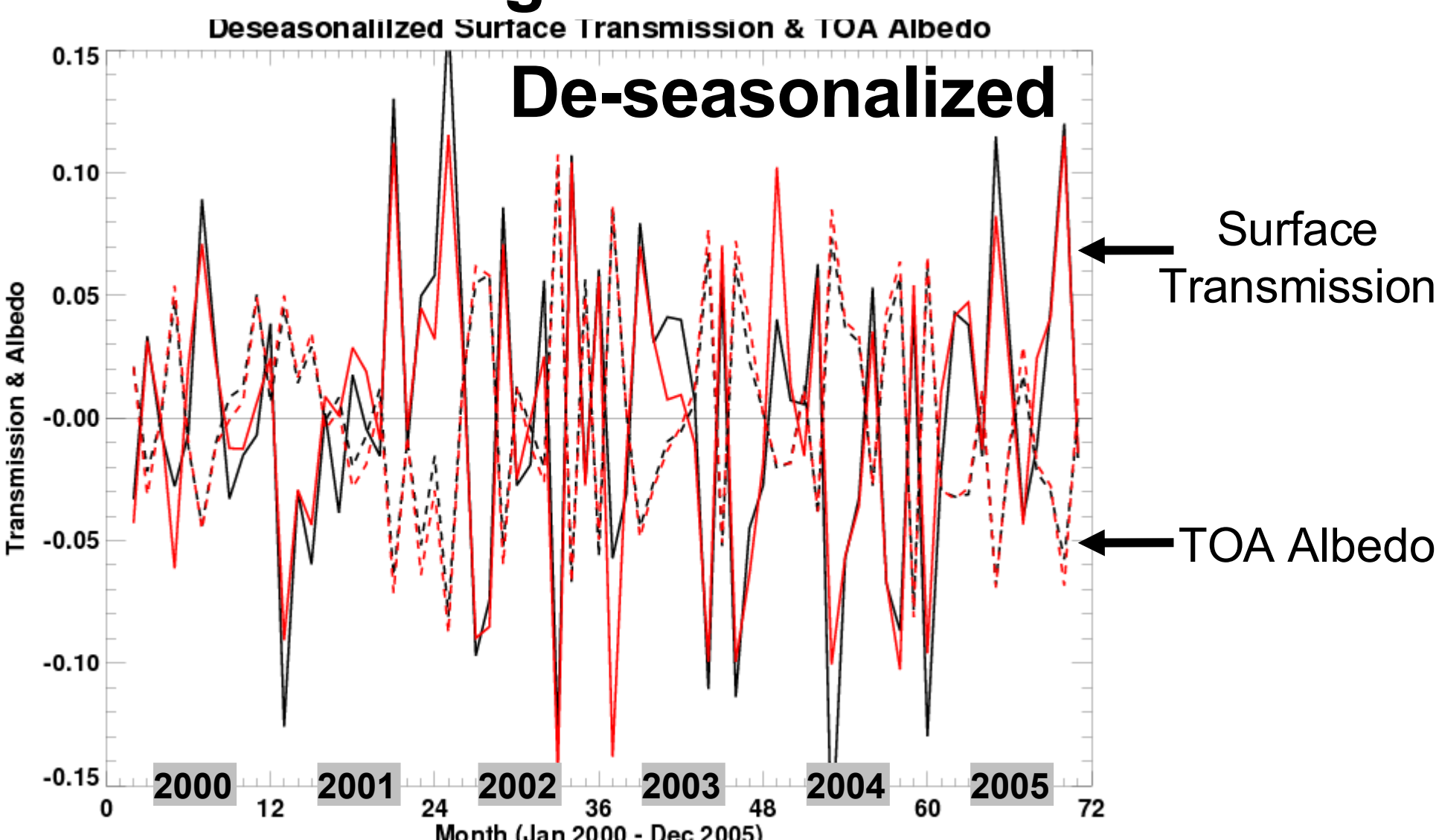


Variability of TOA albedo and surface transmission are directly linked, though negatively correlated, via scattering and absorption of light by clouds and aerosols which can vary greatly over the course of one day.

CERES on Terra and Aqua view ARM/SGP nominally once a day during daylight hours.



Monthly Mean* Surface Transmission & TOA Albedo Averaged at 19 ARM SGP Sites

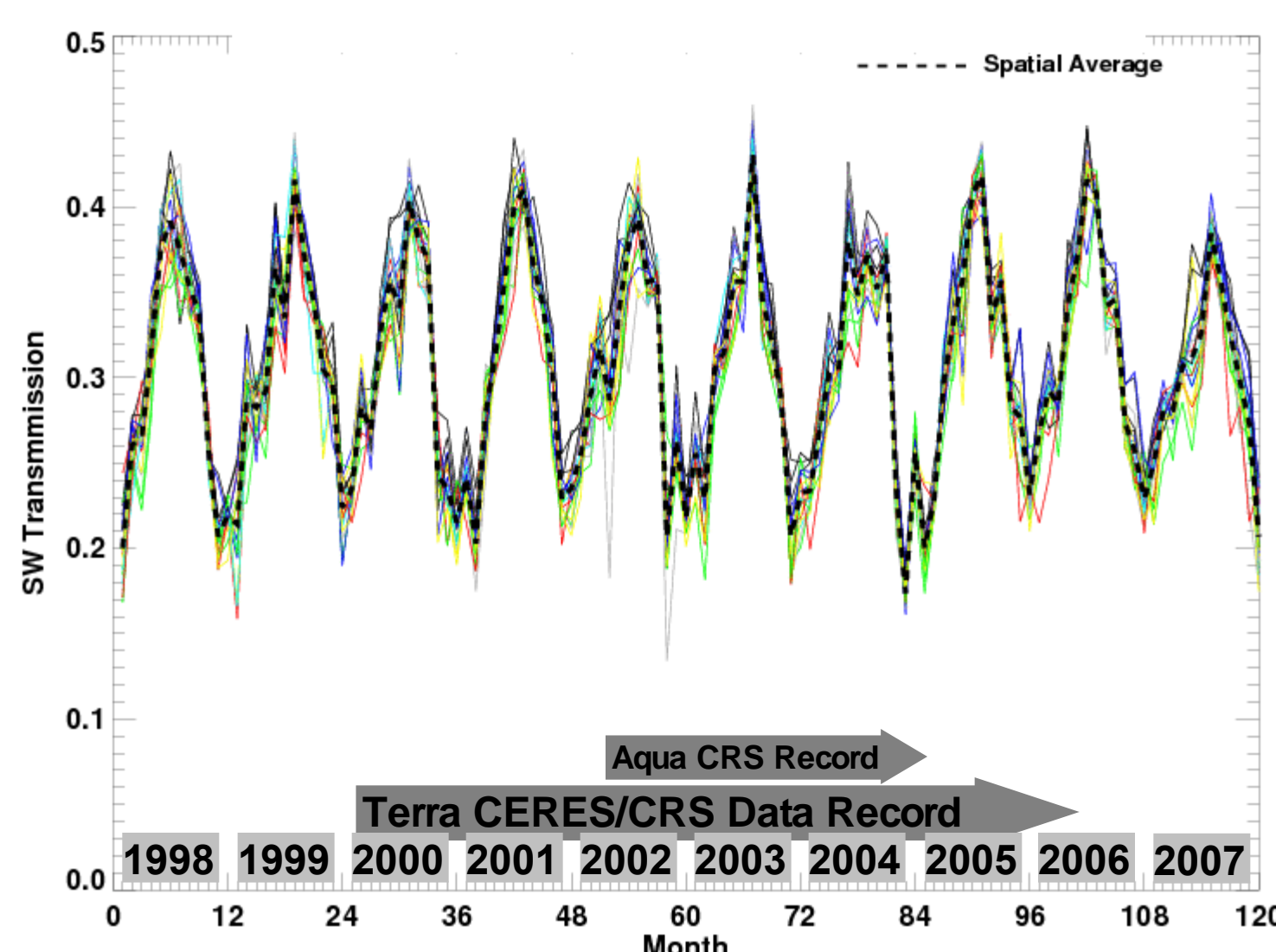


There is a large amount of month to month, high frequency variability in the de-seasonalized record. Can the infrequent satellite sampling recover any portion of the underlying inter-annual signal in transmission and so subsequently (give confidence to monthly mean variations as found in) CERES TOA albedo?

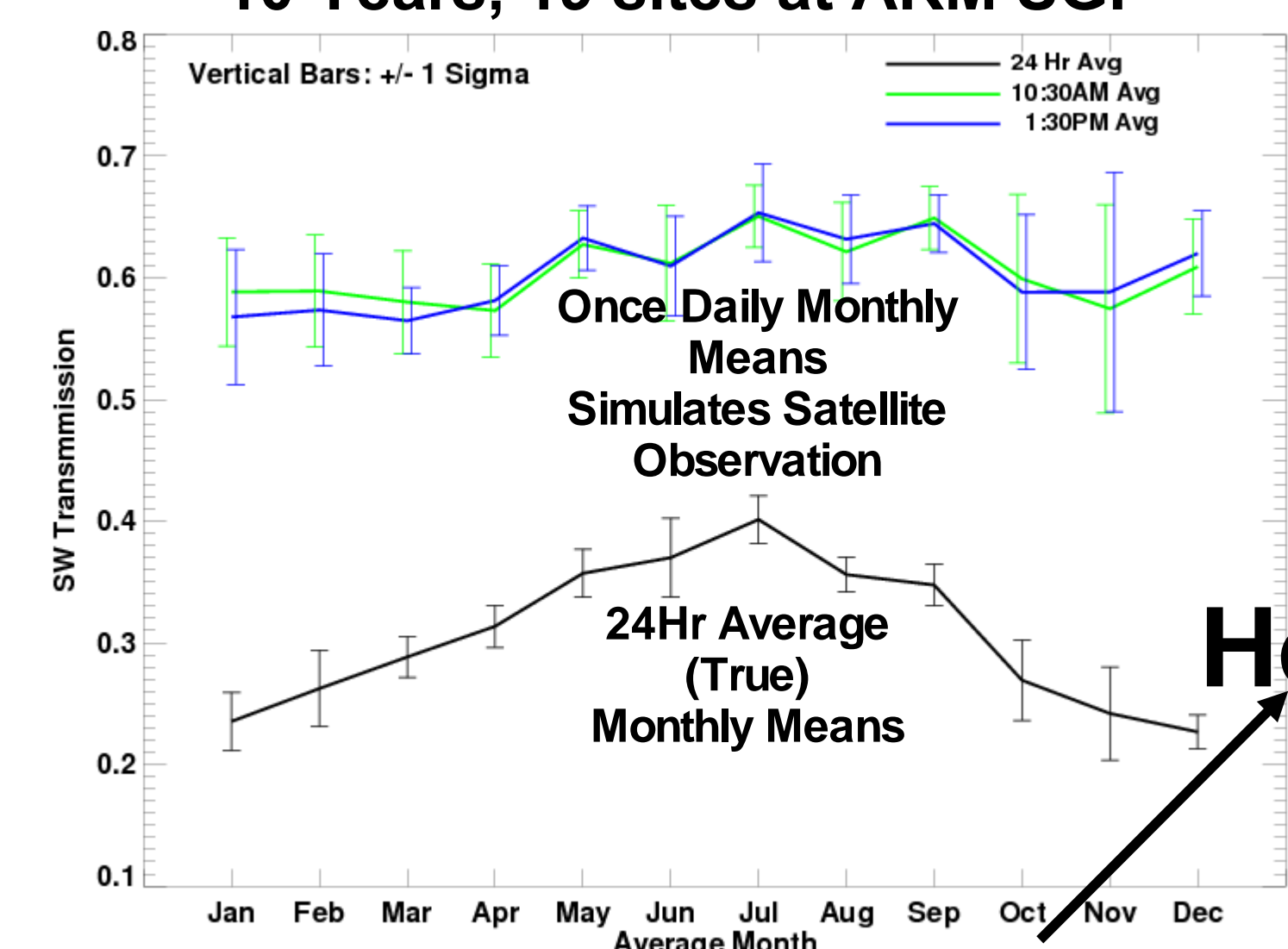
What can the ARM observations of transmission across the SGP region tell us?

Observed Monthly Mean** Surface Short Wave Transmission at 19 ARM SGP Sites for 10 years.

** Monthly mean is based on 24 hour averages of observed shortwave insolation.

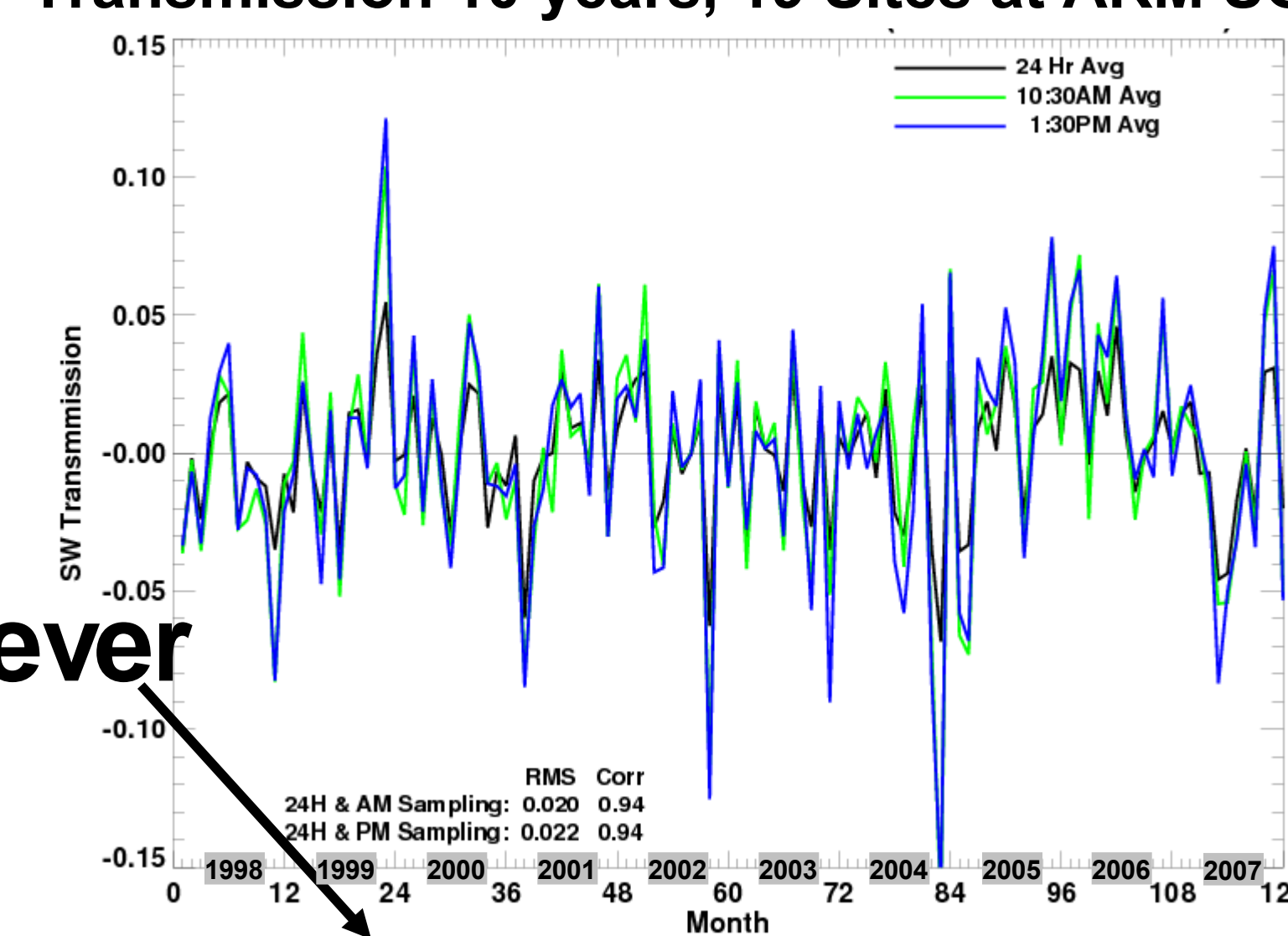


Annual Mean & Std Deviation by month for 10 Years, 19 sites at ARM SGP



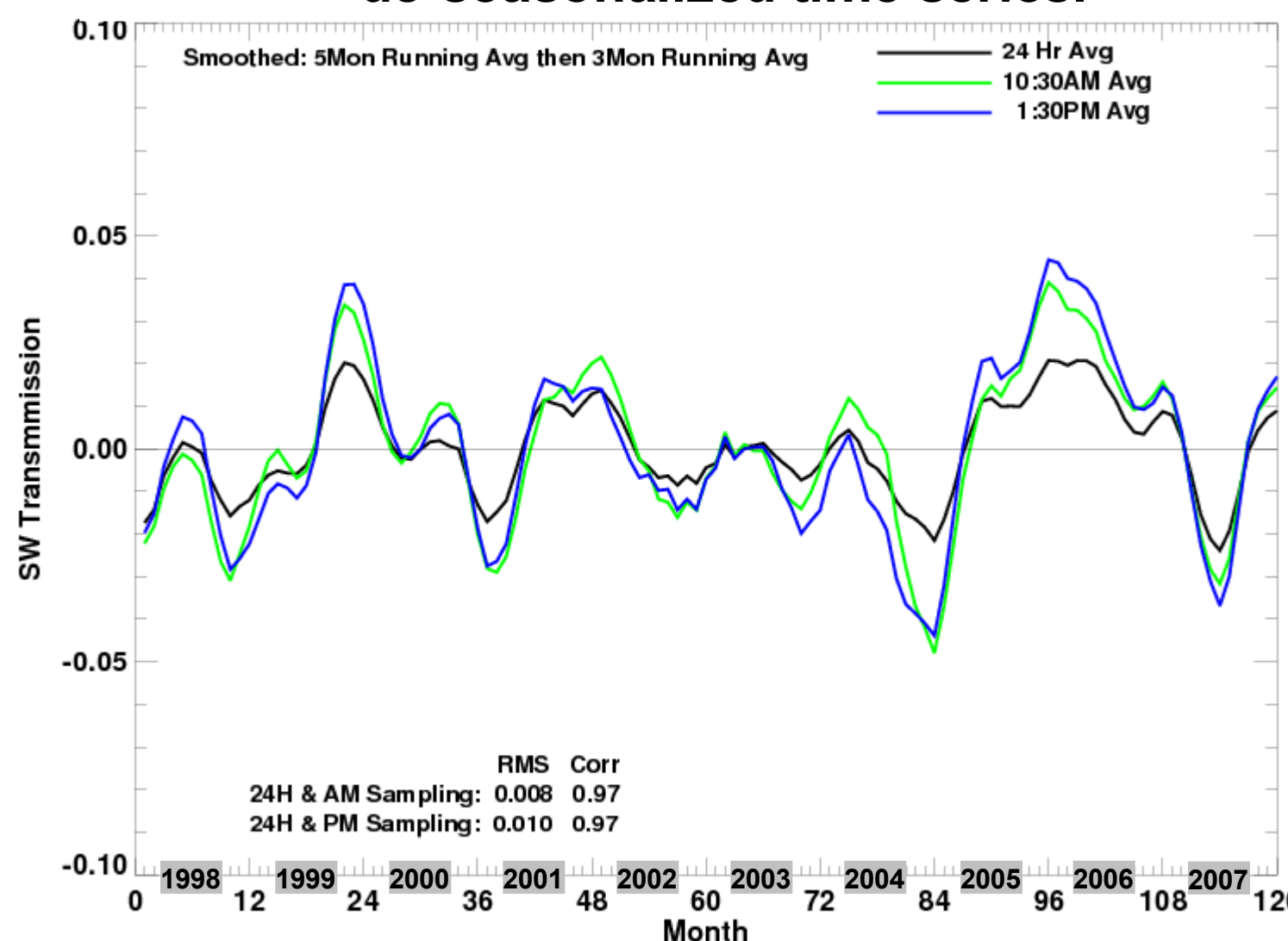
Transmission averaged at 10:30AM and 1:30PM do not give a good representation of what is happening in the mean.

De-seasonalized Time Series of Transmission 10 years, 19 Sites at ARM SGP

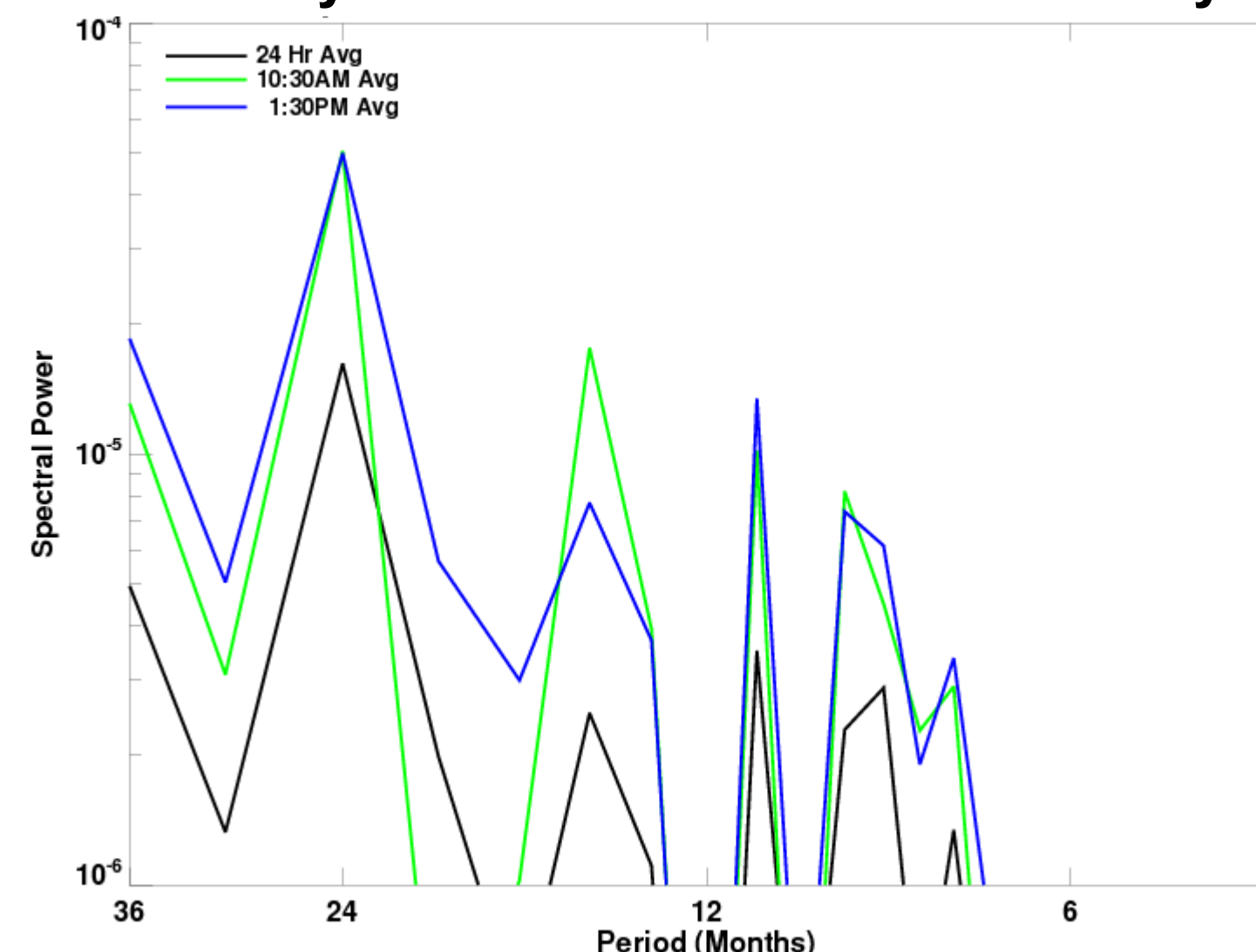


De-seasonalized time series do track one-another quite well. Is there a longer term signal in the time series?

Filter high frequency variations from de-seasonalized time series.



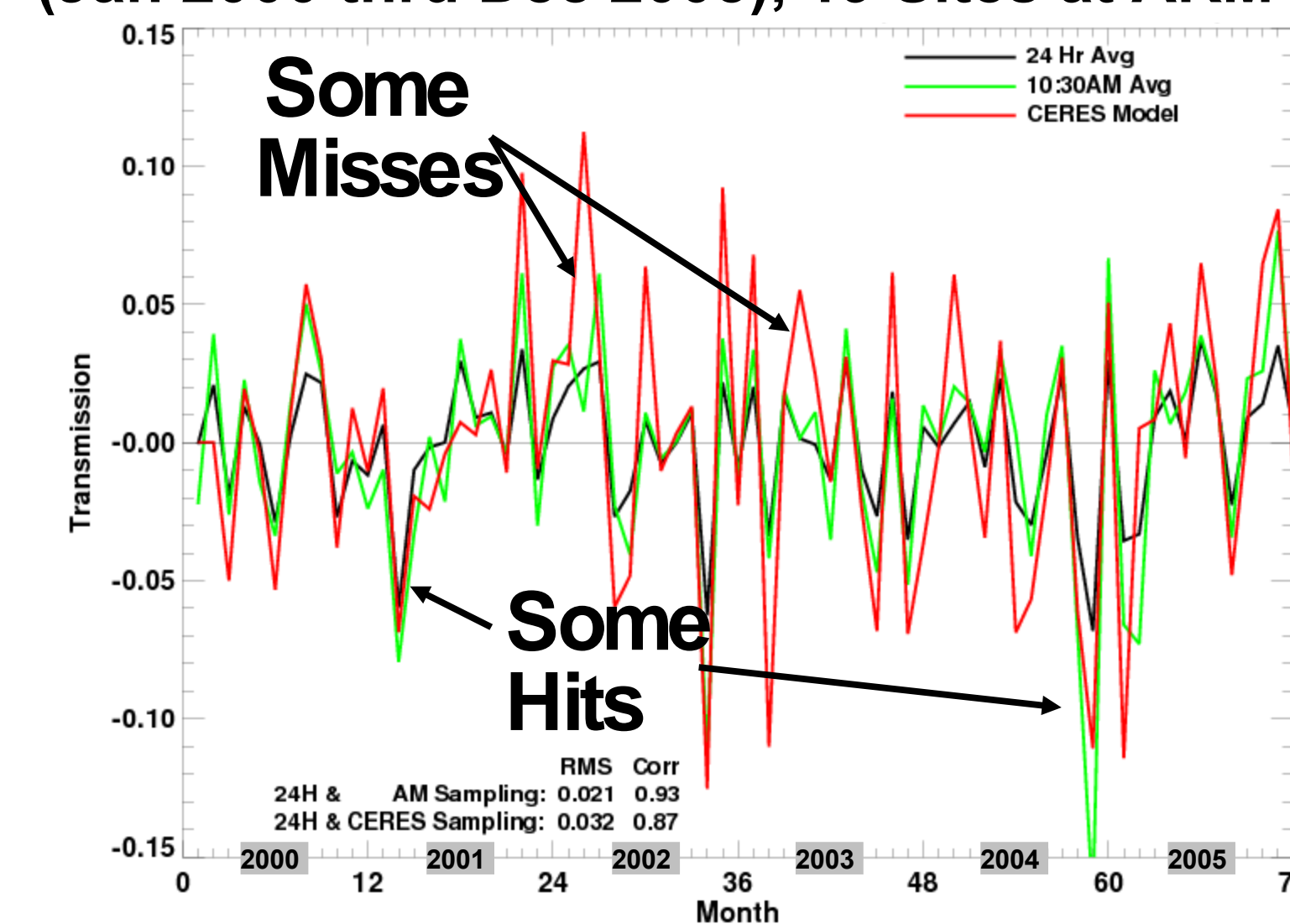
Fourier analysis reveals good agreement between 24 hour averages and AM and PM ability to retrieve inter-annual variability



Conclusion 1: Analysis of ARM observations above indicate sampling once a day in either AM or PM can recover, with a good correlation, the majority of interannual variability of surface SW transmission.

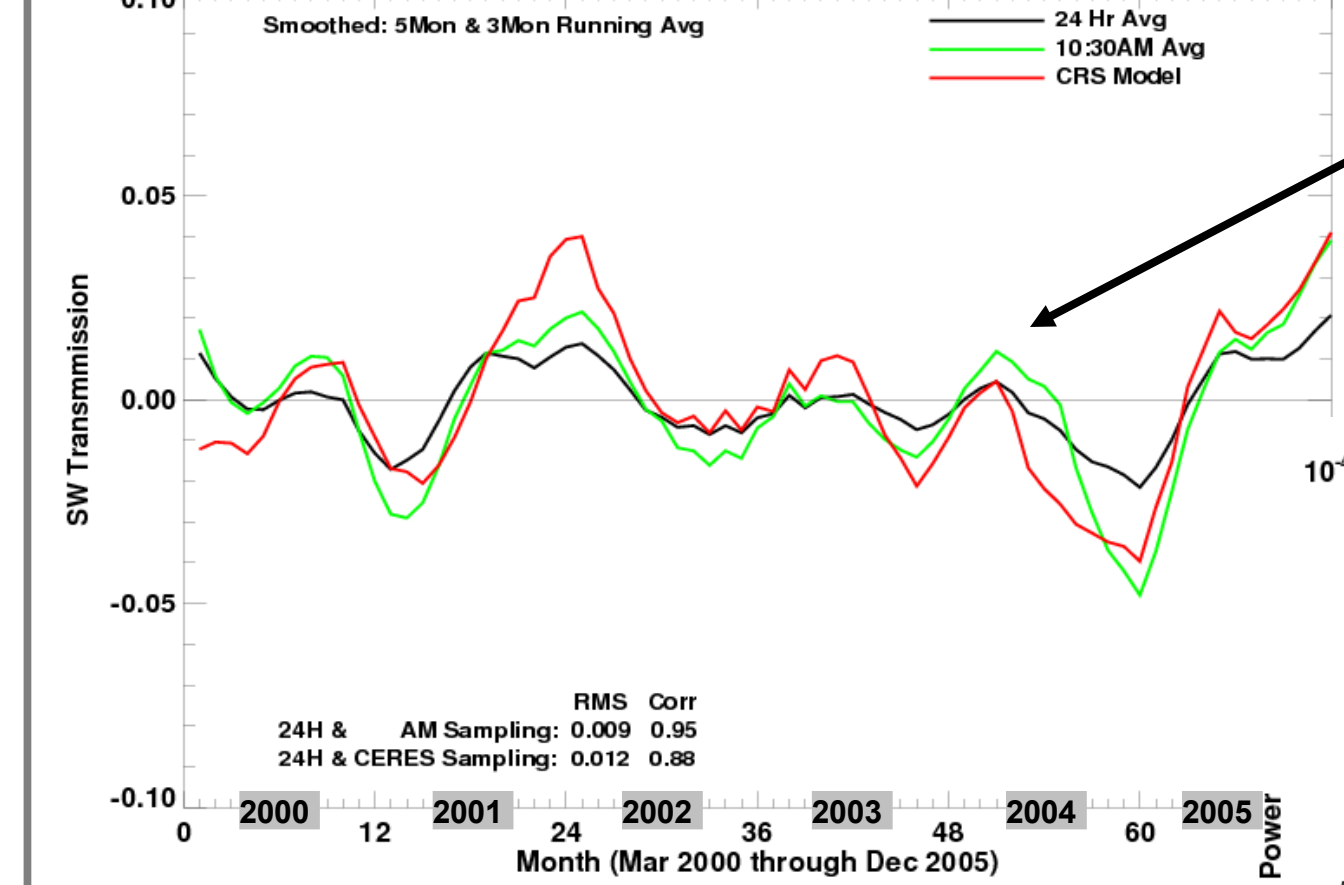
Now, match satellite calculations of transmission to surface observation over coincident time period. (Jan 2000 thru Dec 2005), 19 Sites at ARM SGP

Some Misses

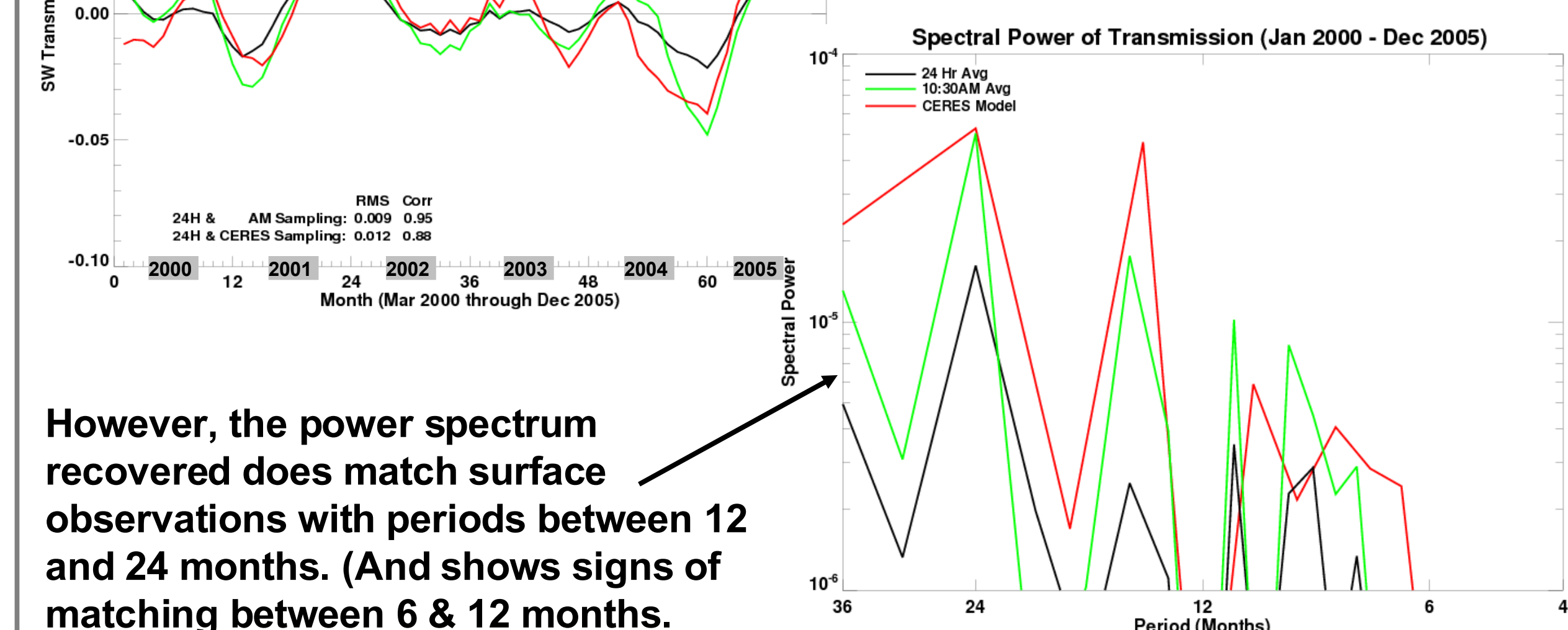


CERES/SARB model transmission does not match the 10:30 sampled ARM transmission as well as hoped. Correlation falls below 0.90 with 24 hour mean transmission

Model & Observed De-seasonalized Transmission (Jan 2000 - Dec 2005)



Smoothed transmission within the Terra CRS record tracks surface observations well but does not result in a significant increase in the correlation.

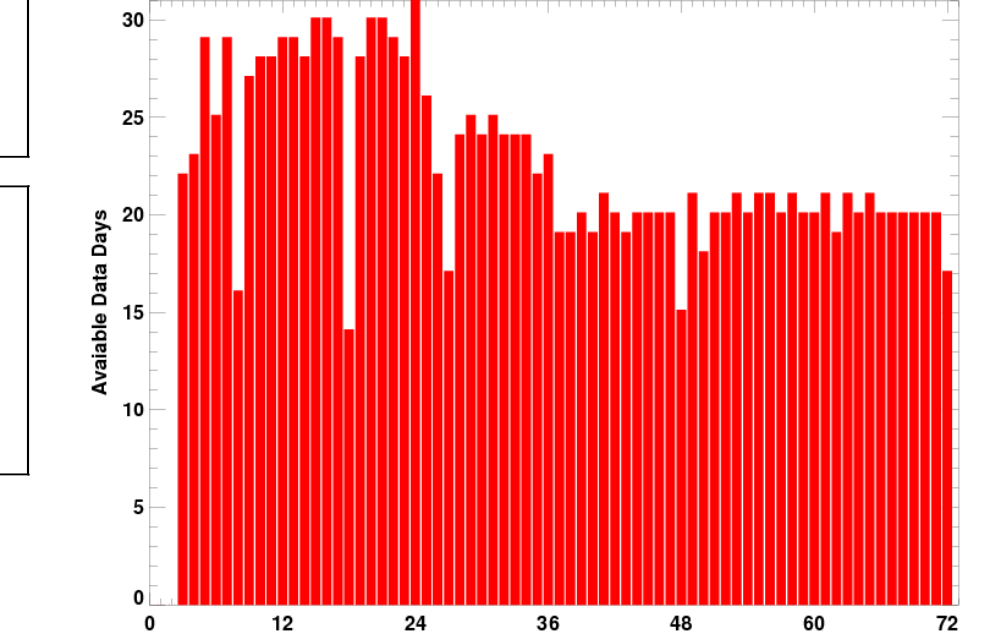


However, the power spectrum recovered does match surface observations with periods between 12 and 24 months. (And shows signs of matching between 6 & 12 months.)

De-seasonalized Correlations

	PM Avg	AM Avg	CRS Avg
24Hr Avg	0.94	0.94	0.87
24Hr Avg Smoothed	0.97	0.97	0.88

Number of CERES/SARB calculations in each monthly mean for C01 site.



De-seasonalized RMS(1)

	PM Avg	AM Avg	CRS Avg
24Hr Avg	0.022	0.021	0.032
24Hr Avg Smoothed	0.010	0.009	0.012

1. Some of the RMS is attributable to variability in surface instrumentation. As an example the RMS for the 10 year record (Jan 1998 through Dec 2007) between surface shortwave transmission observed at ARM/SGP central facility suites E13 and C01 is 0.06

This plot shows sampling of less than once a day of CERES/SARB calculations throughout the lifetime of the CERES instrument. (SARB calculations under-sample CERES observations due to computational costs of radiation transfer calculations.)

Conclusion 2: Calculation of transmission from the CERES/SARB subsystem does recover the majority of inter-annual variability of surface transmission as observed by 19 ARM SGP sites. This then gives confidence in CERES' ability to recover global, inter-annual variability in TOA albedo. Particularly for signals with periods longer than 12 months.

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