

Trends in U.S. surface radiation and aerosol optical depth over the past 22 years

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Data are from SURFRAD
















NOAA's Surface Radiation Budget Network



Began operations on 1 Jan. 1995

Martin Wild's 2012 review of observed dimming and brightening at the surface

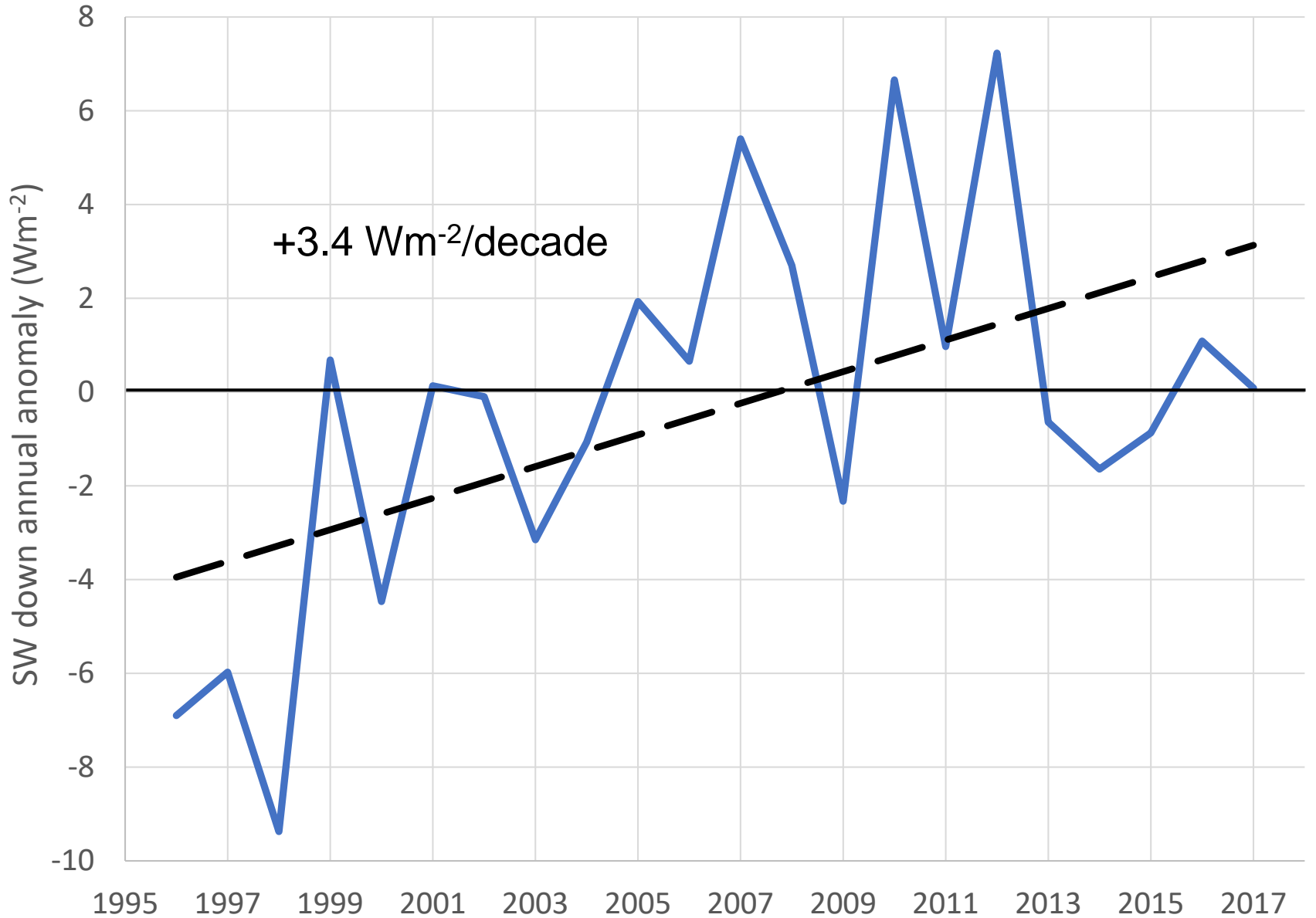
— SURFRAD —

	1950s-1980s	1980s-2000	after 2000
USA	-6 	5 	8 
Europe	-3 	2 	3 
China/Mongolia	-7 	3 	-4 
Japan	-5 	8 	0 
India	-3 	-8 	-10 

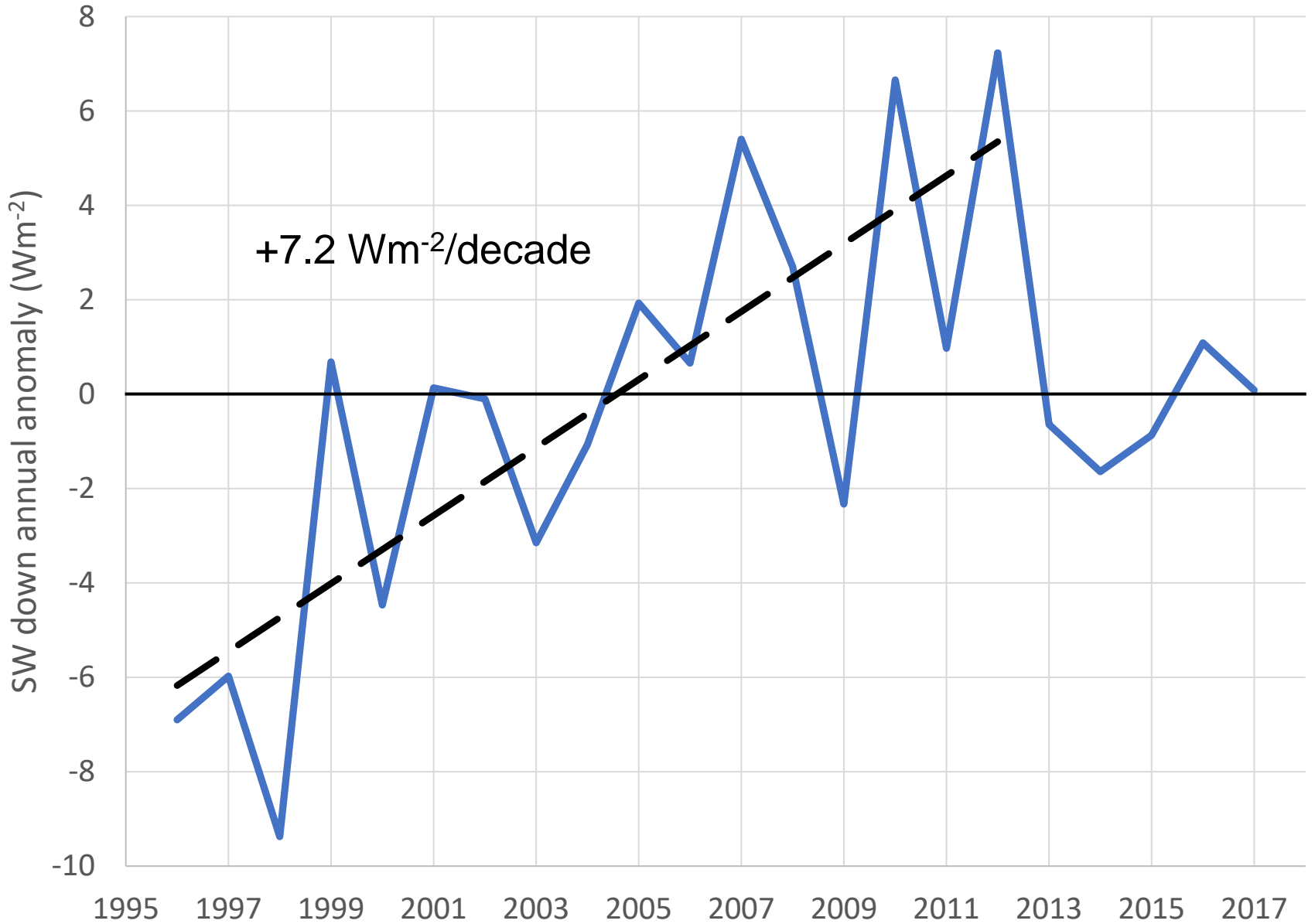
Trends in $Wm^{-2}/decade$

From: Wild (2012) *Enlightening Global Dimming and Brightening*,
<https://doi.org/10.1175/BAMS-D-11-00074.1>

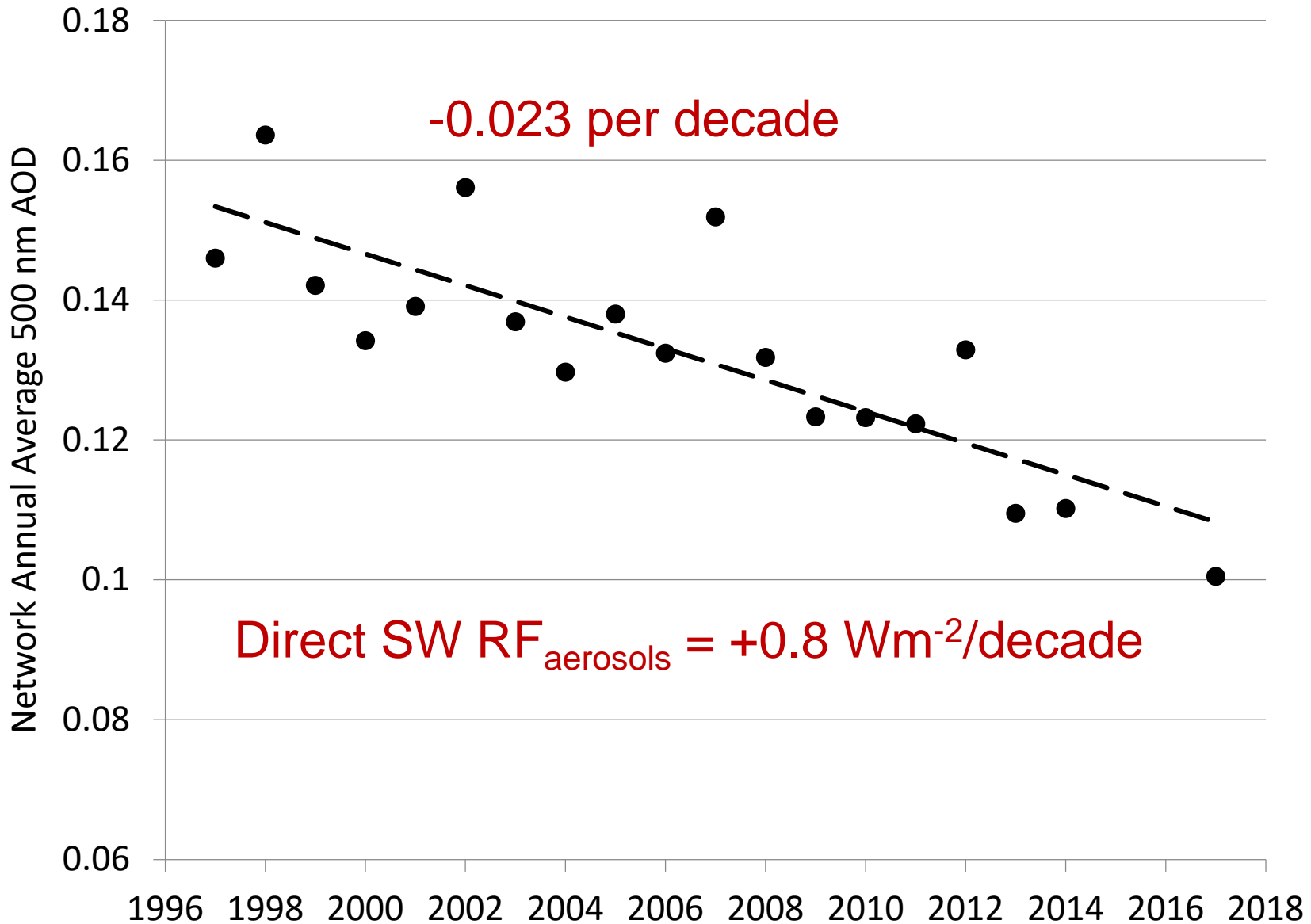
U.S. short wave down annual anomalies



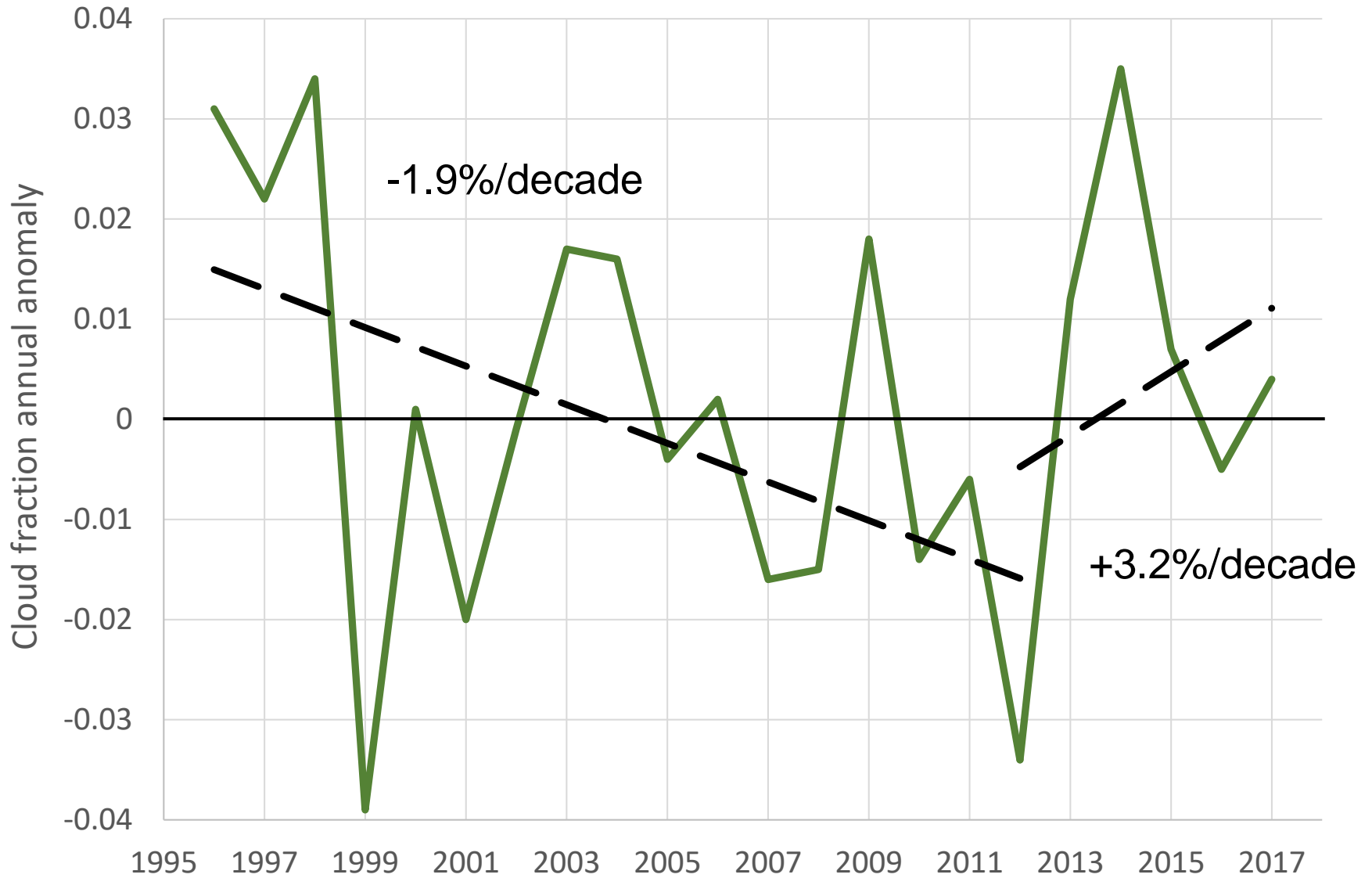
U.S. short wave down annual anomalies



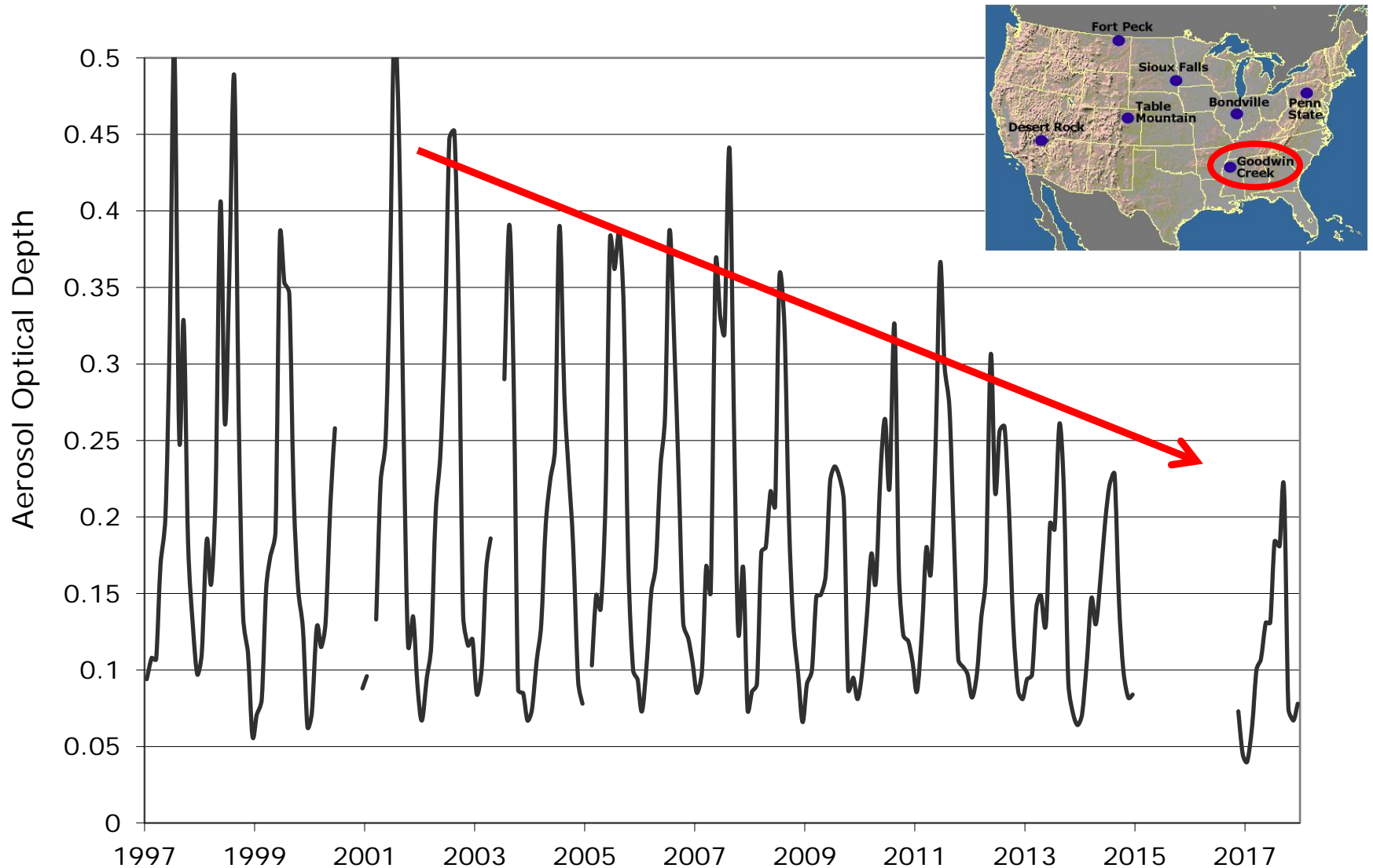
U.S. average annual 500 nm Aerosol Optical Depth



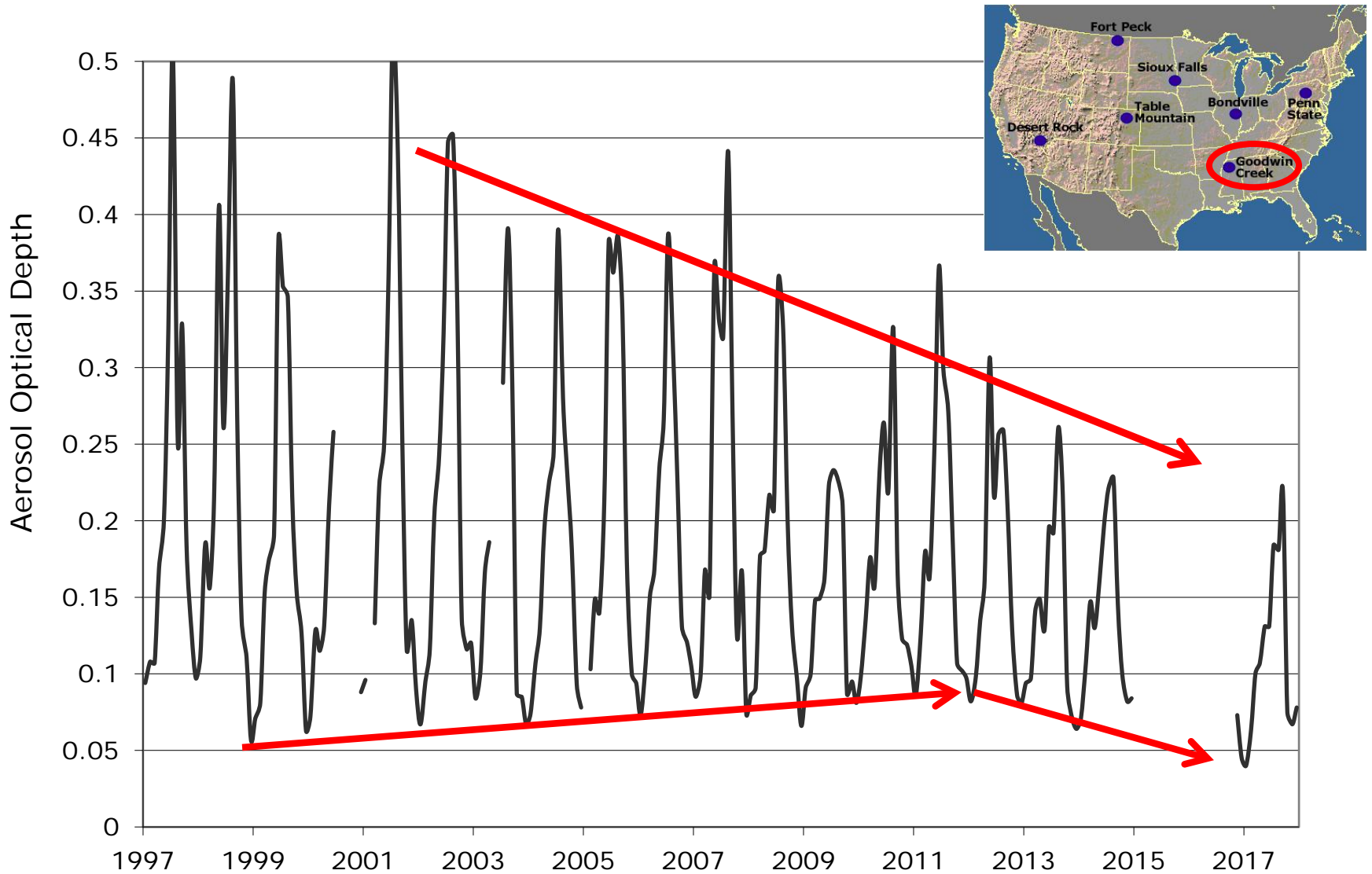
U.S. sky-cover annual anomalies



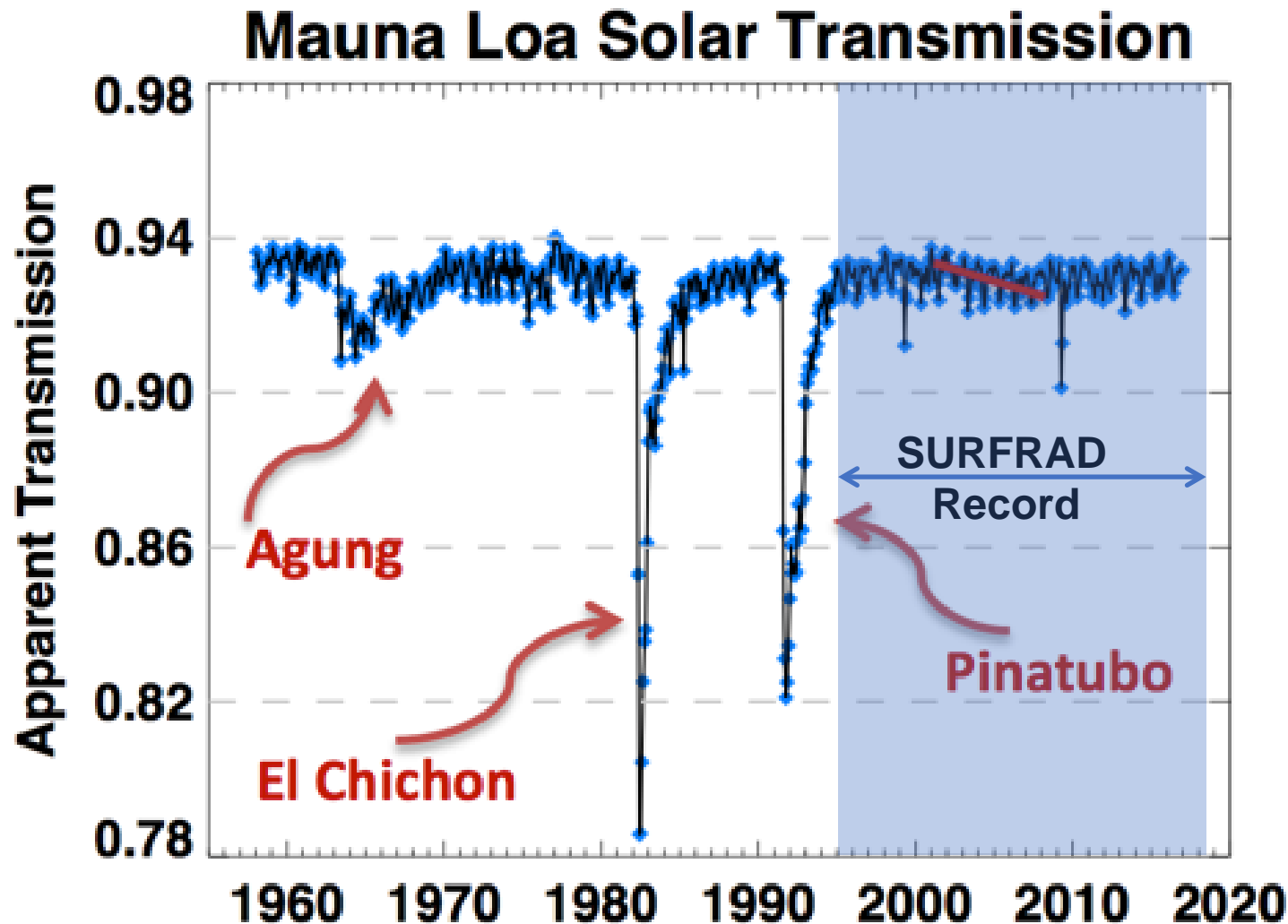
Goodwin Creek monthly average AOD at 500 nm



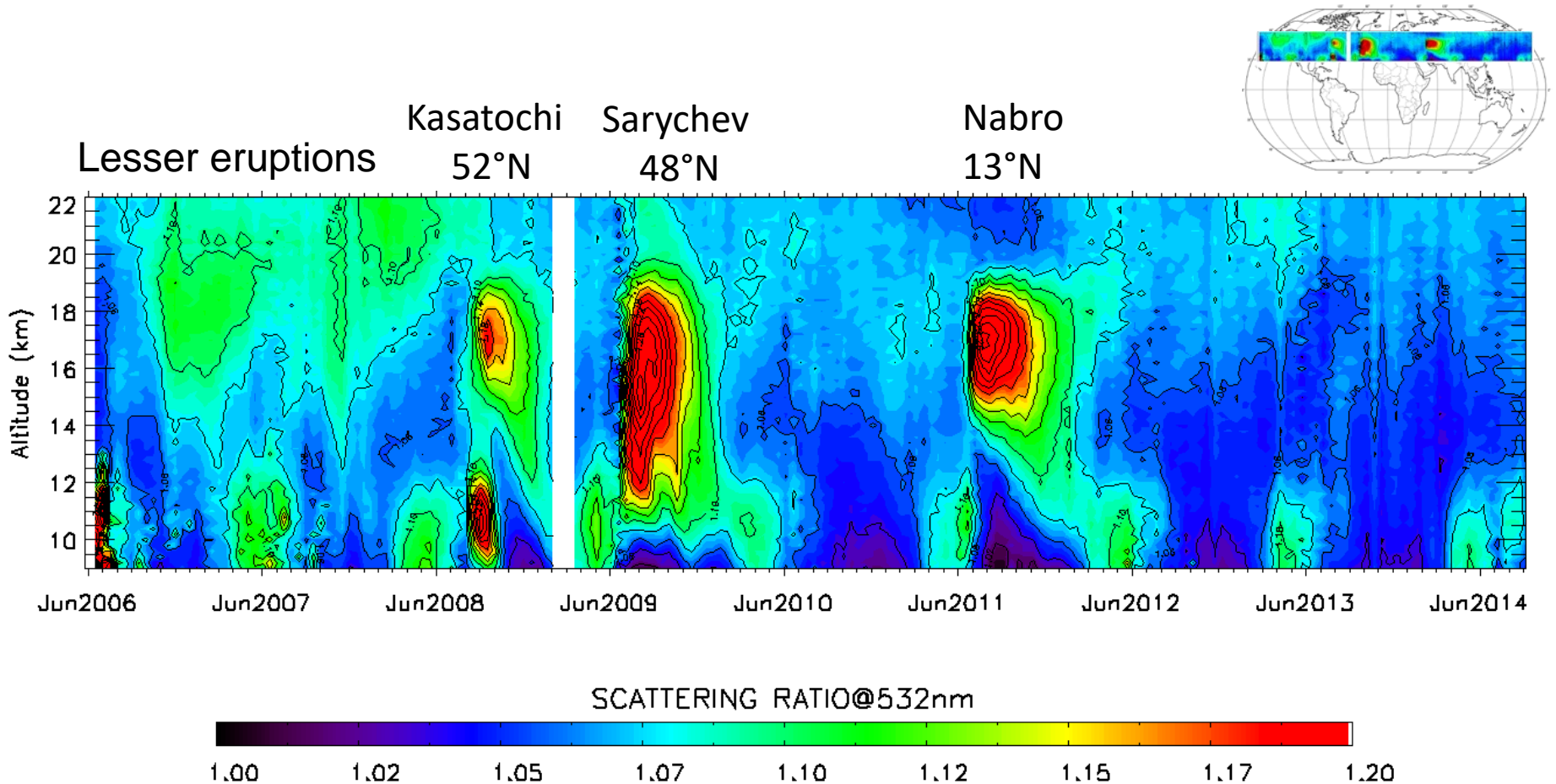
Goodwin Creek monthly average AOD at 500 nm



Until recently it was thought that only large tropical volcanic eruptions penetrated into the stratosphere

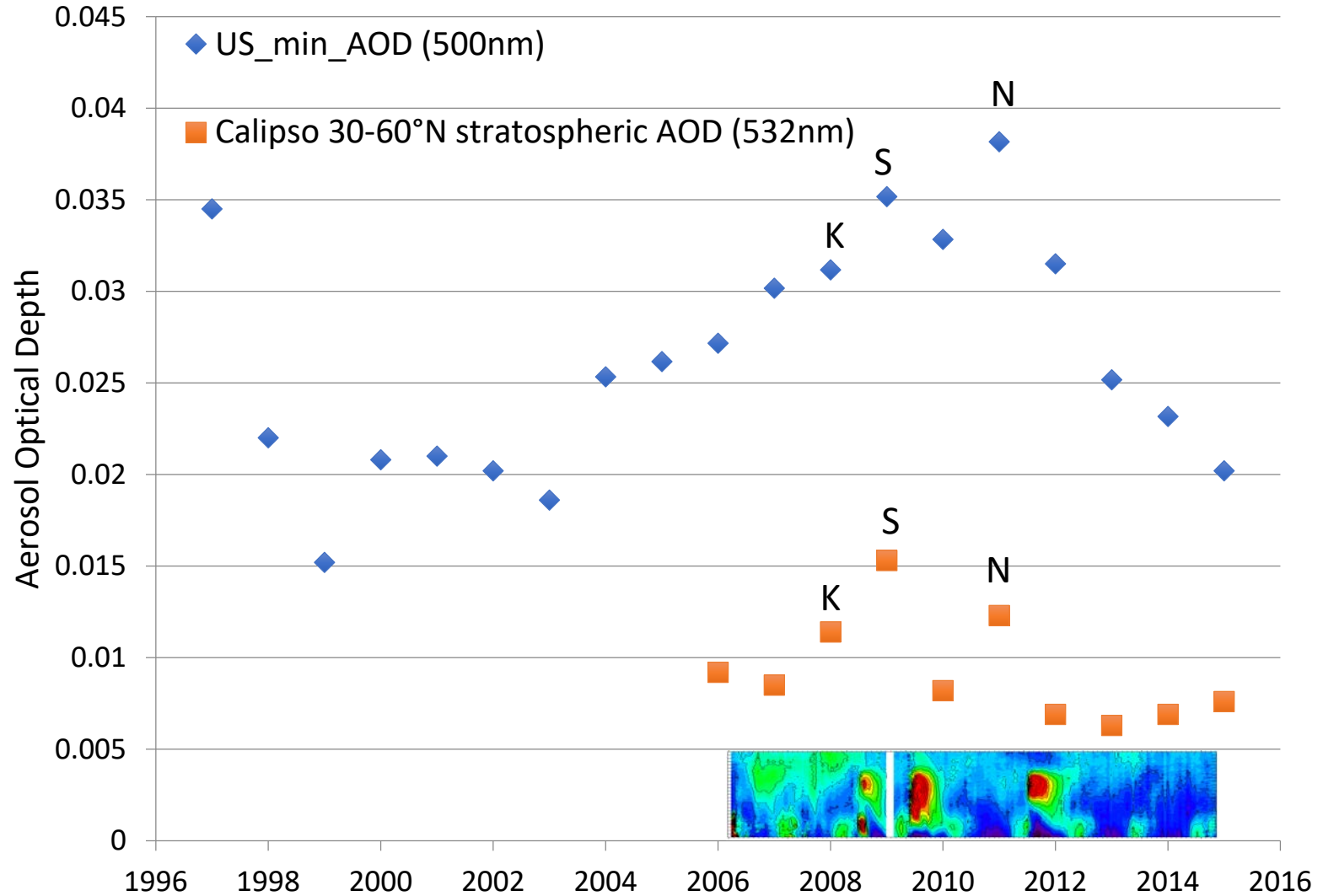


Time series of the CALIOP space lidar 532 nm scattering ratio for the UTLS (30° to 60°N)

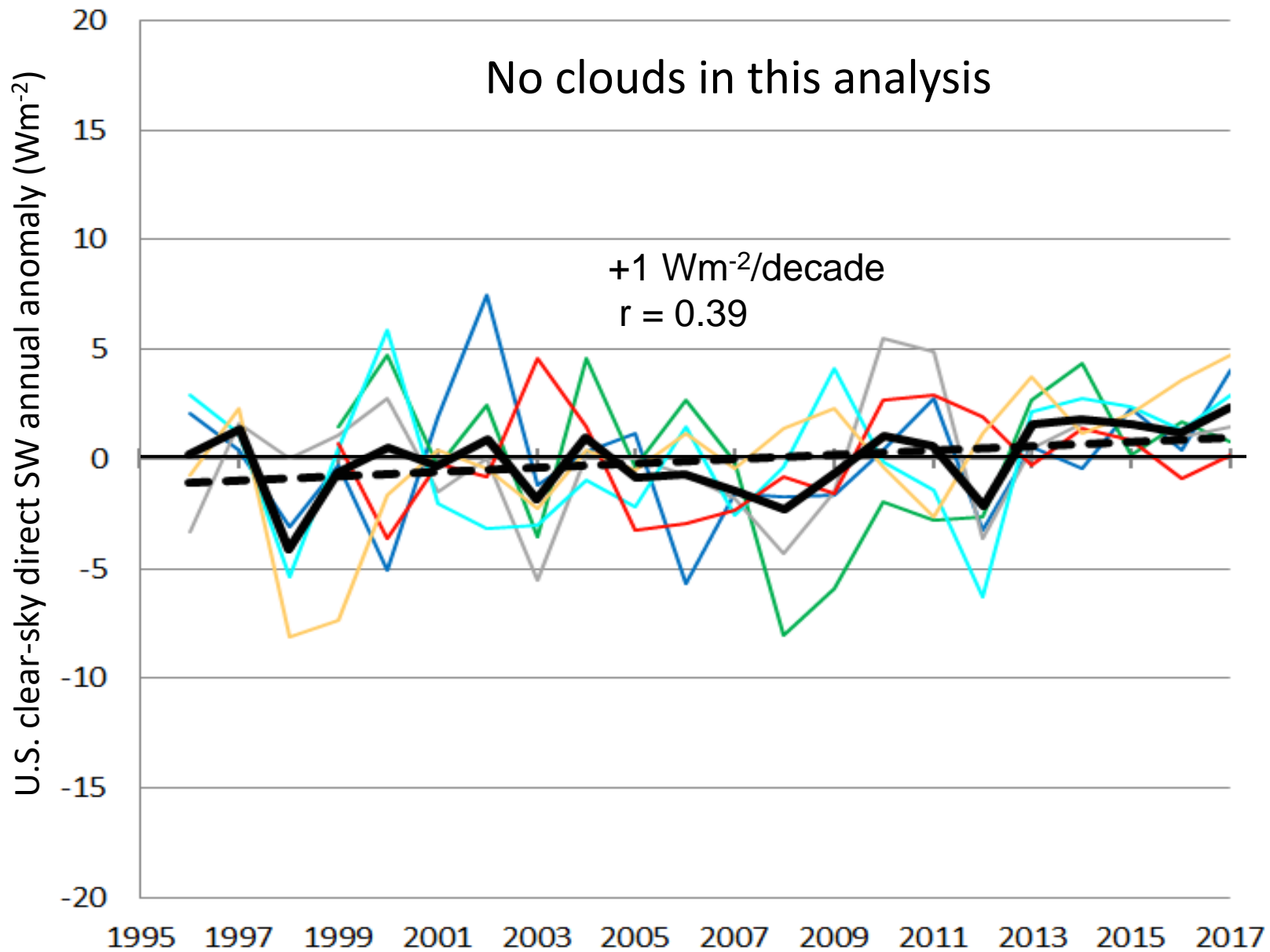


Provided by Jean-Paul Vernier, NASA Langley

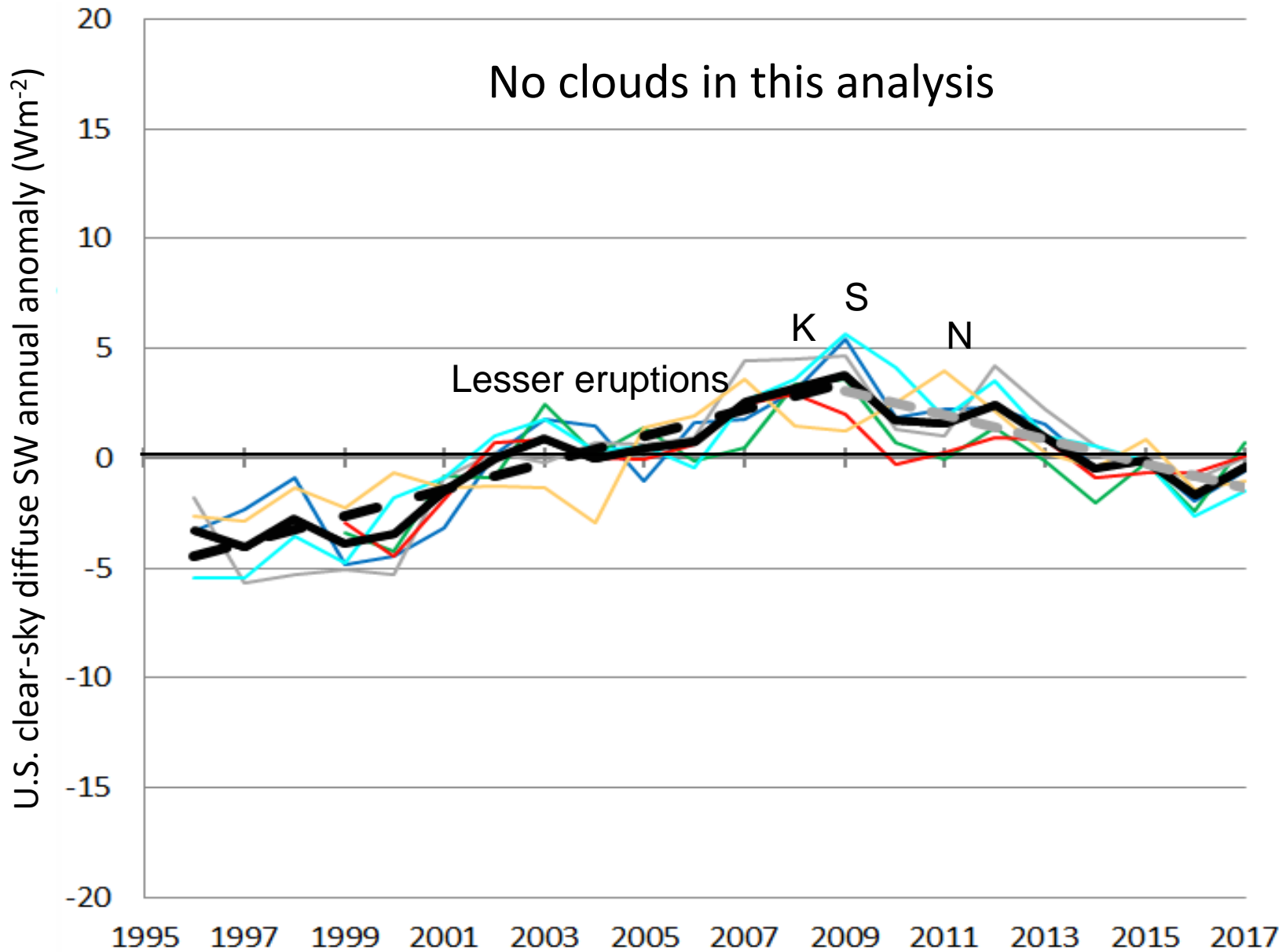
U.S. annual AOD minima and UTLS AOD from CALIOP



RadFlux: Clear-Sky-Equivalent Direct short wave



RadFlux: Clear-Sky-Equivalent Diffuse short wave



Summary

- Brightening of $+7.2 \text{ Wm}^{-2}/\text{decade}$ was observed from 1996 to 2012 over the U.S.
- There was a rapid return to “normalcy” over the last 5 years (2013-2017)
- U.S. brightening and dimming was attributed mostly to systematic changes in cloud cover
- The observed reduction in aerosols accounted for only a small part of the brightening
- From 2013 to 2017 brightening faded, while AOD continued to decrease and cloud cover increased, enhancing the relevance of clouds to recent brightening and dimming over the U.S.
- Interannual variability of AOD minima over the U.S. mirrors lower stratospheric AOD variability, and seems to explain the observed trend in clear-sky diffuse short wave at the surface

