Aerosols are everywhere, lets map them!

Using MODIS

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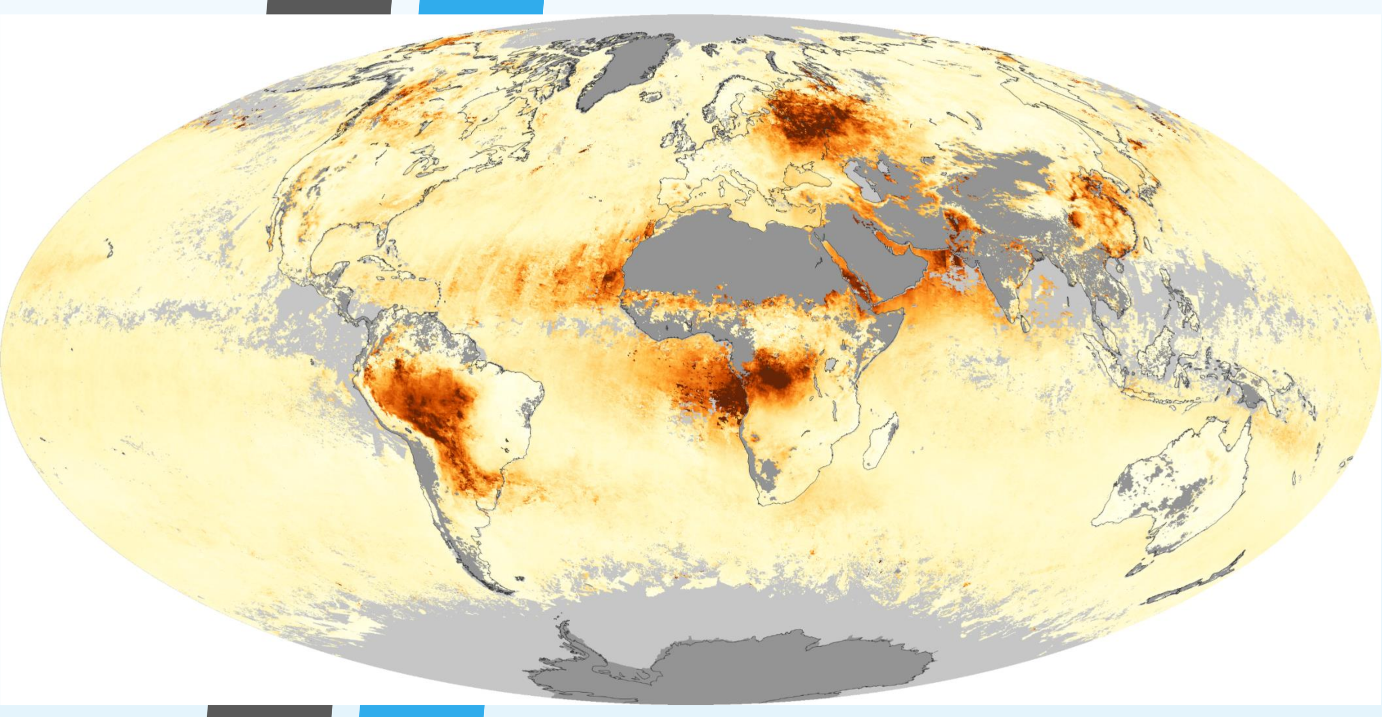
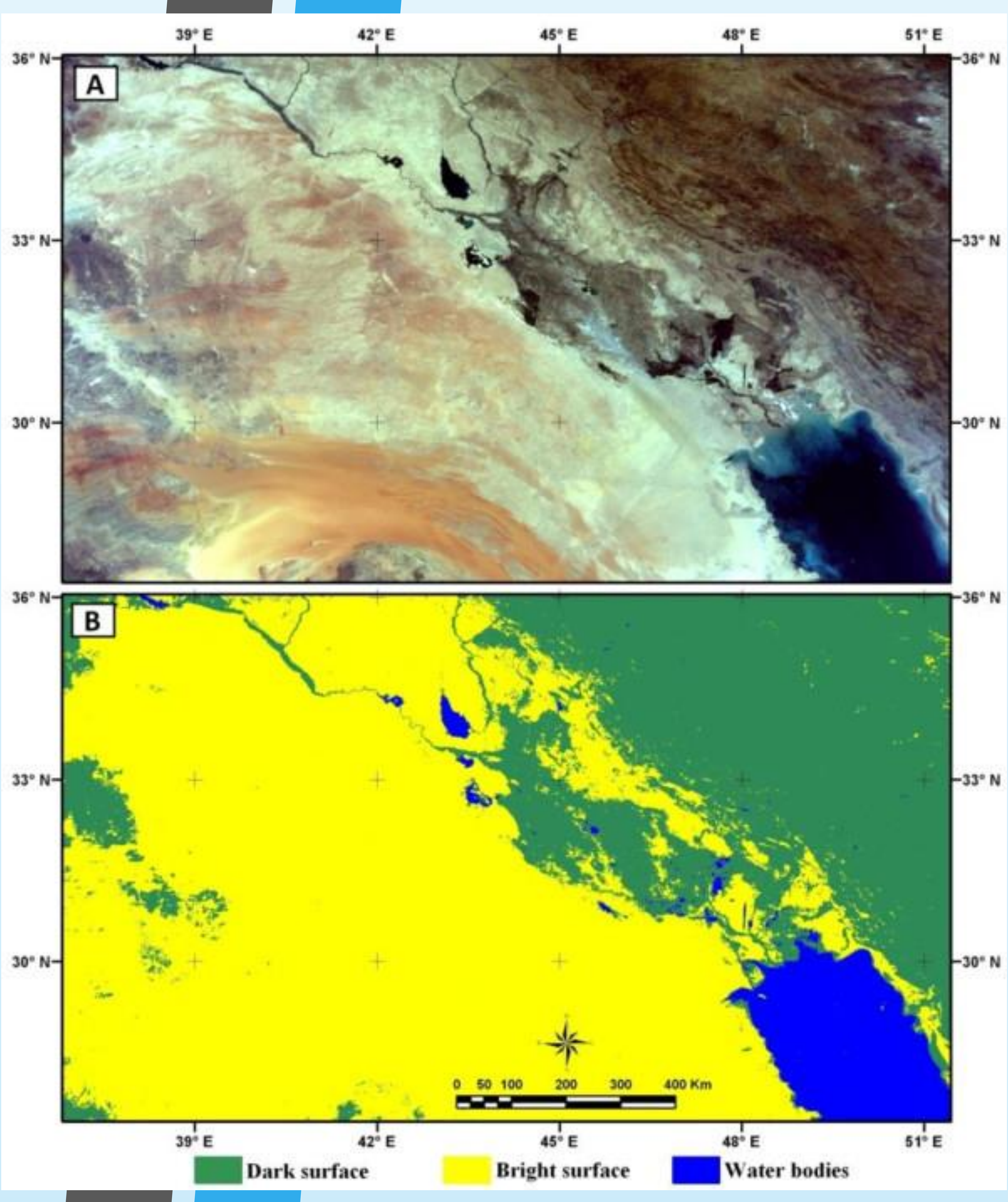


Aerosols in the atmosphere range from water vapor, smoke, particulate matter, or even dust! Aerosols have an affect on everyday life on a large scale, and are capable of traveling long distances. Some pathogens can be carried on dust particles across oceans and cause diseases in other continents.



To start, "dark land targets" need to be identified. These are objects with relatively lower reflectance values, like water or vegetation. It is important to maximize the difference in reflectance in the red and blue regions. Since aerosol and atmospheric effects affect those regions of the spectrum, they must be estimated from short-mid wave infrared reflectance.

A lookup table approach is then used to determine how the aerosol should be corrected for, and which wavelengths to get optimal scattering of just a certain aerosol. Differences in important aerosol properties include aerosol size distribution, refractive index, single-scattering albedo, and effect of nonsphericity on the phase function.

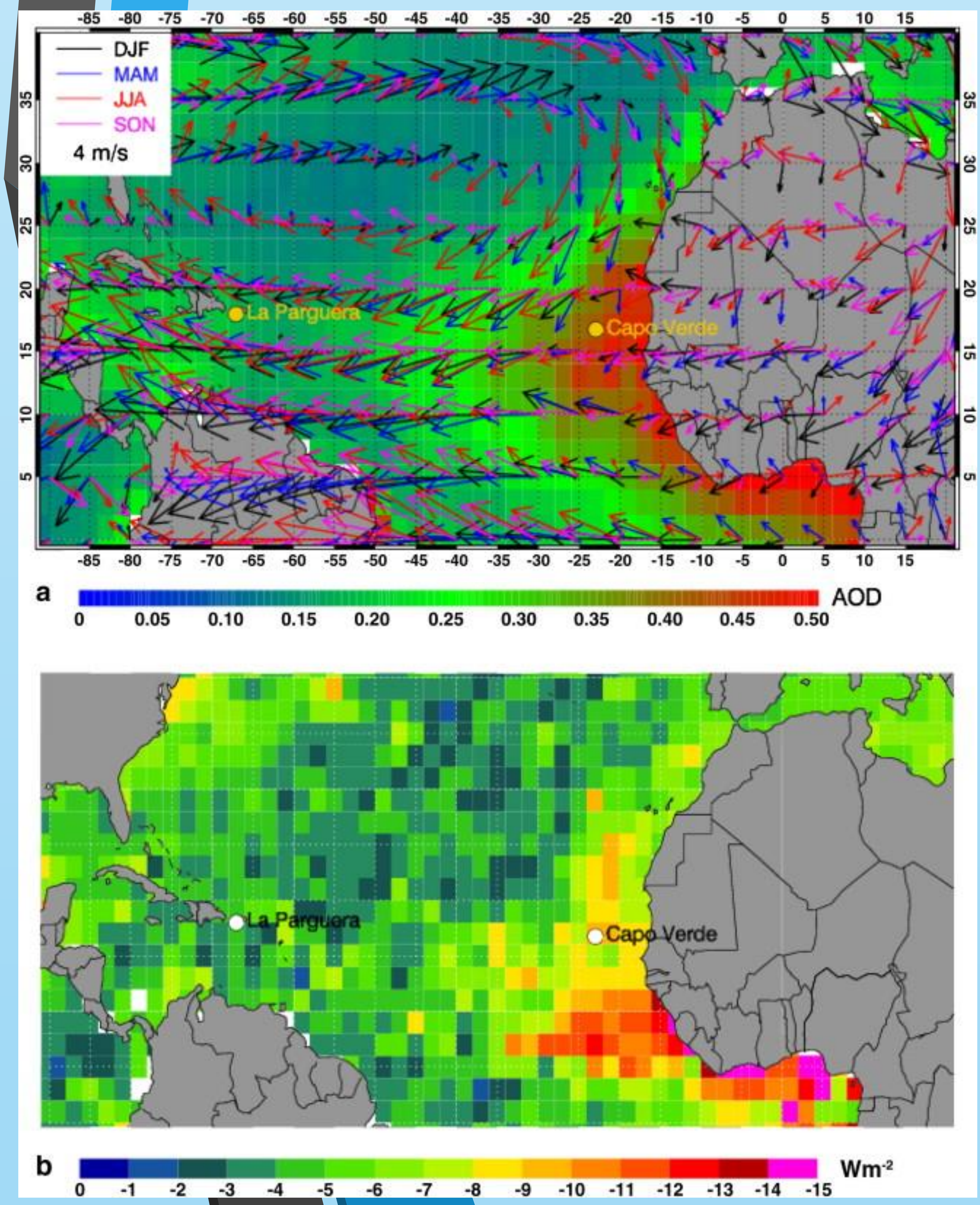
Table 1. Summary of Aerosol Dynamic Models

	r_g (μm)	r_v (μm)	σ	V_0 (10^6 cm³/cm²)	ω_0 (670 nm)
Continental Aerosol					
Water soluble*	0.005	0.176	1.090	3.050	0.96
Dust-like	0.500	17.60	1.090	7.364	0.69
Soot	0.0118	0.050	0.693	0.105	0.16
Biomass Burning					
Accumulation	0.061	0.130	0.500	$-2.4 + 45\tau$	0.90†
Coarse	$1.0–1.3\tau$	$6.0–11.3\tau + 61\tau^2$	$0.69 + 0.81\tau$	$2.4 - 6.3\tau + 37\tau^2$	0.84†
Industrial/Urban Aerosol					
Accumulation 1	0.036	0.106	0.60	$-2.0 + 70\tau - 196\tau^2 + 150\tau^3$	0.96
Accumulation 2	0.114	0.210	0.45	$0.34 - 7.6\tau + 80\tau^2 - 63\tau^3$	0.97
Salt	0.990	1.300	0.30	$-0.16 + 4.12\tau$	0.92
Coarse	0.670	9.500	0.94	1.92	0.88
Dust Aerosol					
Dust background					
mode 1	0.0010	0.0055	0.755	6.0×10^{-6}	0.015
mode 2	0.0218	1.230	1.160	1.0	0.95
mode 3	6.2400	21.50	0.638	0.6	0.62

Aerosol parameters of the continental model are from *Lenoble and Brogniez* [1984] and for the dust model from *Shettle* [1984]. Parameters of the aerosol models of industrial/urban and smoke used in the remote sensing procedure are after *Remer et al.* [1996, this issue], where the parameters are for a combination of lognormal size distributions given by the number distribution, or by the volume distribution:

A particularly interesting and problematic fraction of aerosol is dust picked up by winds in dry areas. The Sahara desert is a huge exporter of this dust; nearly 50% of airborne dust originates in the Saharan region. Dust can cause health issues in people, affect global albedo/temperature, and influence biogeochemical processes. Around 240 Tg leave Northern Africa every year.

240 teragrams ≈ 725 Empire State Buildings

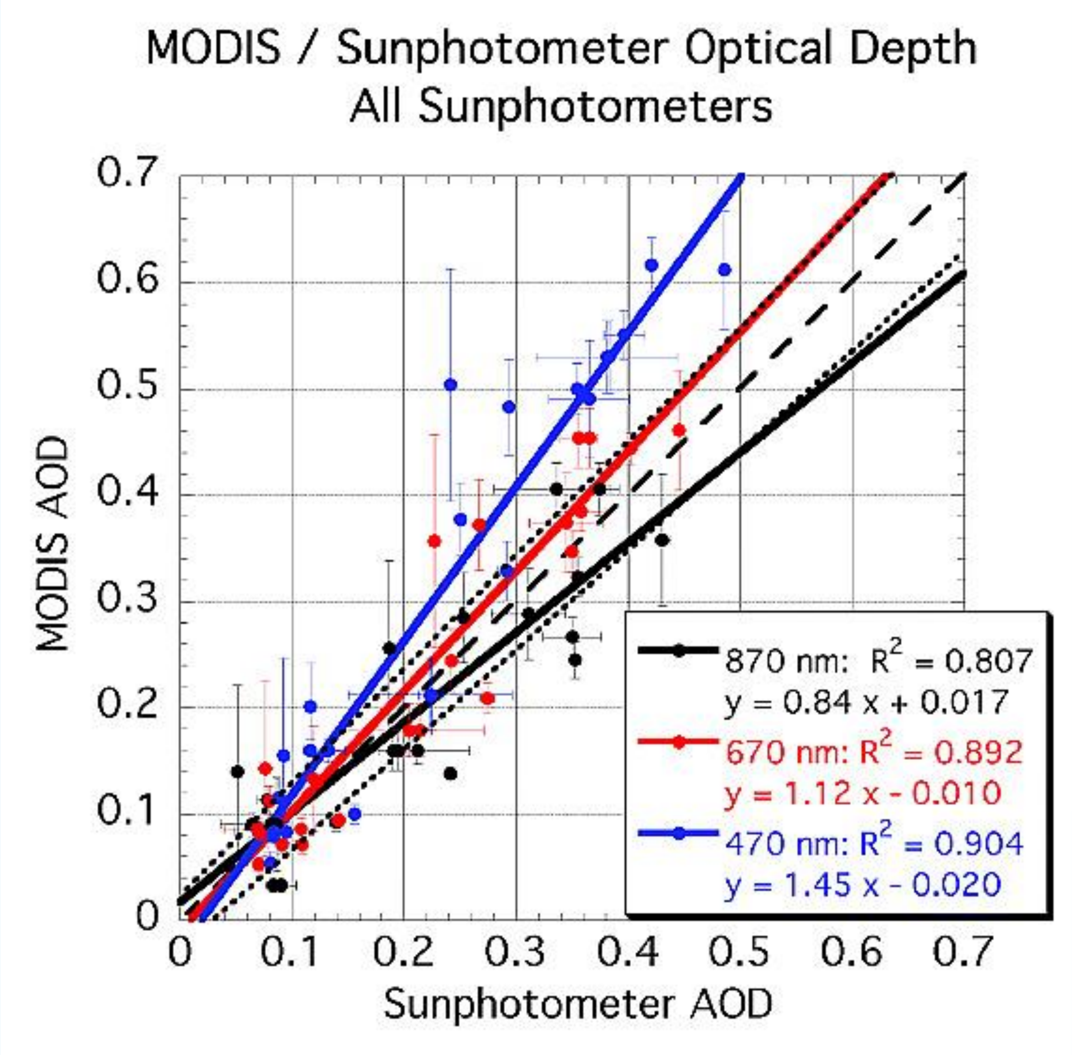


Woo boy that's dusty!

A dusty and non-dusty image are compared to find the optical thickness. Various wavelengths are used by the sensor to image the region, and depending on which shows the least difference in reflectance to the modeled reflectance, the appropriate model is used, and more information about the dust can be figured out now that it is defined.

Now that we know what kind of dust/aerosol we're dealing with, we know what the volume might be based on the reflectance we get back. If you've taken soils, you know that somehow you can go from a volume to a mass using density, in which the weight of dust is found.

Sun photometers on the ground are used to accurately determine the optical depth at various wavelengths. MODIS estimations correlate fairly well with sun photometer data, and the uncertainties can be attributed to other aerosols among other things.



The largest uncertainty associated with dust is not other aerosols. The reality is that dust is not spherical (which is assumed in most models), and depending on the angle of incidence, each particle could reflect light differently.

Works Cited (all images taken from works cited)

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