

Two Centuries of Volcanic Aerosols Derived from Lunar Eclipse Records, 1805-2015

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About once per year, on average, the moon is totally eclipsed; the moon is then illuminated by sunlight refracted into the umbra, primarily by the stratosphere. Stratospheric aerosols can affect the brightness of the eclipsed moon, and climatically significant, visible-band, global aerosol optical depth (AOD) can be directly measured from the difference between observed and predicted brightness.

In 2004, Hofmann et al. summarized five decades of stratospheric aerosol observations, “Surface-Based Observations of Volcanic Emissions to the Stratosphere”, in *Volcanism and the Earth’s Atmosphere*, Geophysical Monograph 139, American Geophysical Union. Among the records were lunar eclipse AOD, updated at the 2015 and 2016 NOAA Global Monitoring Annual Conferences (GMAC):

https://www.esrl.noaa.gov/gmd/publications/annual_meetings/2015/abstracts/100-150401-A.pdf and

http://www.esrl.noaa.gov/gmd/publications/annual_meetings/2015/posters/P-48.pdf , and

https://www.esrl.noaa.gov/gmd/publications/annual_meetings/2016/abstracts/121-160425-C.pdf and

https://www.esrl.noaa.gov/gmd/publications/annual_meetings/2016/posters/P60-Keen.pdf

Using eclipse observations published in the historic literature, the AOD time series has been extended back to 1805. Some climatically significant implications of this AOD record:

There was more volcanic effect on the climate during 1915-1962, and less from 1820-1882, than previously determined by Dust Veil (DVI) and Volcanic Explosivity Indices and other estimates. The largest DVI event, Cosigüina in 1835, is demoted to a minor event in the eclipse AOD record. Since 1979, Volcanoes are responsible for a half of the observed warming (MSU Satellite temperatures). Volcanic forcing has not increased since 1996, ruling out volcanoes out as a Cause of the 19-year Pause.

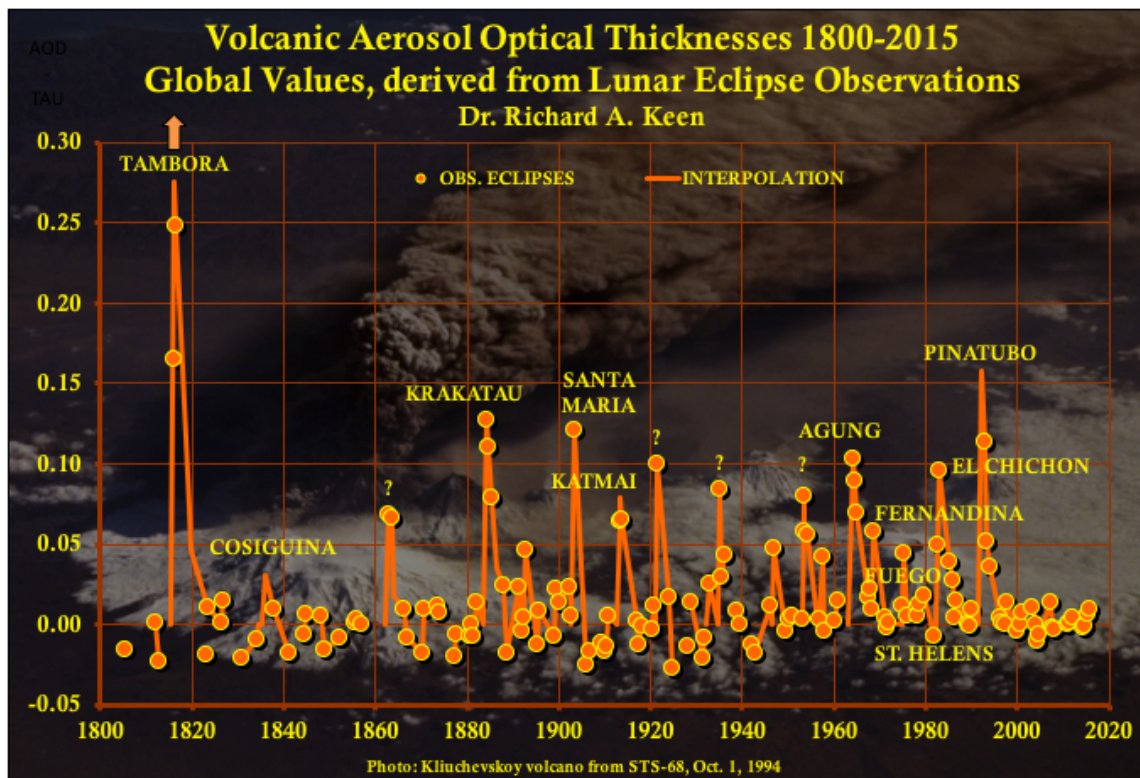


Figure 1. Global Volcanic Aerosol climate forcing from Lunar Eclipse observations, 1805-2015.