Geophysical Research Abstracts
Vol. 19, EGU2017-12164, 2017
EGU General Assembly 2017

Pluto's Haze from 2002 - 2015: Correlation with the Solar Cycle

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Occultations by Pluto were observed 2002, 2007, 2011 and 2015, with each event observed simultaneously in two or more wavelengths. Separate wavelengths allow us to discriminate between haze opacity and refractive effects due to an atmosphere's thermal profile – these two effects are notoriously hard to separate if only single-wavelength lightcurves are available. Of those four occultations, the amount of haze in Pluto's atmosphere was highest in 2002 (Elliot et al. 2003 report an optical depth of 0.11 at 0.73 μm in the zenith direction), but undetectable in the 2007 and 2011 events (we find optical depth upper limits of 0.012 and 0.010 at 0.6 μm). Cheng et al. (2016) report a zenith optical depth of 0.018 at 0.6 μm from the haze profiles seen in New Horizons images. These four data points are correlated with the solar cycle. The 2002 haze detection occurred just after the peak of solar cycle 23, the 2007 and 2011 non-detections occurred during the solar minimum between peaks 23 and 24, and the New Horizons flyby took place just after the peak of solar cycle 24. This suggests that haze production on Pluto (a) is driven by solar UV photons or charged particles, (b) that sources and sinks on Pluto have timescales shorter than a few Earth years, and (c) the haze precursors on Pluto are not produced by Lyman-alpha radiation, because Lyman-alpha output only decreased by about one third in between the cycle 23 and 24 peaks, much less than the observed change in Pluto's haze abundances.

References: Elliot, J.L. et al. (2003) Nature, Volume 424, Issue 6945, pp. 165-168.