

Solar-modulated effects in the atmosphere of Uranus

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Long-term measurements (1972-2015) of the reflectivity of Uranus at 472 and 551 nm display variability that is incompletely explained by seasonal effects. Spectral analysis using the Lomb periodogram technique shows that this non-seasonal variability tracks the 11-year solar cycle. By analogy with Neptune, where a solar cycle variation in reflectivity has been known for many years, two mechanisms could cause solar modulation. The first is nucleation onto ions or electrons created by galactic cosmic rays (GCR), and the second is UV-induced aerosol colour changes. In this presentation, we use ion-aerosol theory to identify expected relationships between reflectivity fluctuations and GCR flux which we test with multiple regression and compare to the linear response predicted between reflectivity and solar UV flux. The statistics show that 24% of the variance in reflectivity fluctuations at 472 nm is explained by GCR ion-induced nucleation, compared to 22% for a UV-only mechanism. Similar GCR-related variability exists in Neptune's atmosphere, hence the effects found at Uranus provide the first example of common variability in two planetary atmospheres driven through energetic particle modulation by their host star.