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Long-term Evolution of Neptune's Atmosphere

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Abstract

We present an analysis of the temporal evolution of hazes on Neptune, as retrieved from HST images taken between 1994 and 2018. Disk-integrated data show a maximum reflectivity in 2002. In the same period, southern mid-latitudes show a decrease in the methane abundance and a change in the location of the top of the hydrogen sulphide ice cloud.

1. Observations & Results

We retrieved HST archival data at visible wavelengths from the WFPC2 and WFC3 cameras.
We assessed the changes over time of the global reflectivity in the F850LP/F845M (methane) and F467M (blue) filters, adding more than 10 years of data to previous analysis [1]. We see an increase in brightness in the methane filter from at least 1994 until 2009, followed by a decrease until today, both in a disk-averaged sense and from cloud-free regions only. A similar behavior is observed in the blue filter, which reaches a maximum disk-integrated I/F value in 2002, confirming the b-magnitude photometric record of Neptune published in [2].

We also evaluate variations in individual latitudinal bands in the 30°-60° S region. We performed radiative transfer modeling to identify changes in the atmospheric vertical structure that may give rise to the observed trends. Adopting the SUNBEAR code and two-haze-layer model from [3], we found an optically thin (τ_α =0.18-0.21) upper haze layer placed around 0.4-1.5 bar and a optically thicker (τ_β =2.6-2.9) lower cloud based at 3.7-4.1 bar. This structure describes the observed I/F values of the atmosphere in 1996 as well as from 2008 to today, but does not agree with measurements in 2002. The parameters retrieved for this year hint at a lower methane mixing ratio in the troposphere (0.02 as opposed to 0.04), with the lower cloud layer placed at a higher altitude (3.0 bar) for 30°-45° S and deeper in the atmosphere (4.3 bar) for 45°-60° S. Note that these levels indicate the altitudes of the top of the cloud layers, rather than the bottom; the bottom of the cloud layers may be unaltered and consistent with the location of the H_2S ice cloud layer [4].

2. Summary and Conclusions

- We present a new analysis of Neptune's hazes from 1994 to 2018 using HST imaging
- Neptune's atmosphere reached maximum brightness in both the blue (467 nm) and methane (845 nm) filters around the year 2002
- Radiative transfer models indicate the tropospheric methane mixing ratio may have decreased by a factor of ~2 in 2002 compared to 1996 and 2008

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References

[1] Karkoschka, E. et al., 2011. Icarus, 215, 759-773.

[2] Lockwood, G.W., 2019. Icarus, 324, 77-85.

[3] Molter, E.M., et al., 2019. Icarus 321, 324-345.

[4] de Pater, I., et al., 2014. Icarus 237, 211-238.