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ORIGINAL ARTICLE

Dispersion in Neptune's zonal wind velocities from NIR Keck AO observations in July 2009

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Abstract We report observations of Neptune made in H-(1.4–1.8 μm) and K'-(2.0–2.4 μm) bands on 14 and 16 July 2009 from the 10-m W.M. Keck II Telescope using the near-infrared camera NIRC2 coupled to the Adaptive Optics (AO) system. We track the positions of 54 bright atmospheric features over a few hours to derive their zonal and latitudinal velocities, and perform radiative transfer modeling to measure the cloud-top pressures of 50 features seen simultaneously in both bands.

We observe one South Polar Feature (SPF) on 14 July and three SPFs on 16 July at ∼65 °S. The SPFs observed on both nights are different features, consistent with the high variability of Neptune's storms.

There is significant dispersion in Neptune's zonal wind velocities about the smooth Voyager wind profile fit of Sromovsky et al. (Icarus, 105:140, 1993), much greater than the upper limit we expect from vertical wind shear, with the largest dispersion seen at equatorial and southern mid-latitudes. Comparison of feature pressures vs. residuals in zonal velocity from the smooth Voyager wind profile also directly reveals the dominance of mechanisms over vertical wind shear in causing dispersion in the zonal winds.

Vertical wind shear is not the primary cause of the difference in dispersion and deviation in zonal velocities between features tracked in H-band on 14 July and those tracked in K'-band on 16 July. Dispersion in the zonal velocities of features tracked over these short time periods is dominated by one or more mechanisms, other than vertical wind shear, that can cause changes in the dispersion and deviation in the zonal velocities on timescales of hours to days.

Keywords Infrared: planetary systems · Planets and satellites: Neptune: atmospheres

1 Introduction

The zonal wind velocities of the giant planets can be derived by tracking the motions of cloud features in their atmospheres. Accurate tracking of the motions of cloud features in Neptune's atmosphere was first achieved with data from the Voyager 2 spacecraft in 1989 (Stone and Miner 1989). Sromovsky et al. (1993) made a smooth fit to the zonal velocities vs. latitudes of discrete cloud features in Neptune's atmosphere which were tracked by Limaye and Sromovsky (1991) in Voyager 2 images. Neptune's canonical zonal wind profile is this smooth Voyager wind profile. The wind velocities derived from individual features in Neptune's atmosphere since Voyager 2 are observed to remain consistent with this smooth Voyager wind profile, with the exception of features which display significant deviation in

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