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Probing the vertical cloud structure of Uranus and Neptune with ground-based near-infrared observations at UKIRT, IRTF and Gemini-North

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In 2006, 2007 and 2008 observations of the near-infrared spectrum of Uranus were made with the UIST instrument of the UK Infrared Telescope, covering the period of Uranus' Northern Spring Equinox in 2008. A significant change in the visible appearance of Uranus occurred during this time with the southern polar zone at 45°S fading, while a corresponding zone at 45°N began to form. In addition, the visibility of the equatorial zone and darker mid-latitude belts increased. The observed spectra were fitted (Irwin et al., Icarus 203, 287 – 302, 2009), using the NEMESIS optimal estimation retrieval model to determine the variation in the latitudinal and vertical cloud structure during this time. However, since publication, a new set of methane absorption data has become available (Karkoschka and Tomasko, 2009, Icarus, submitted), which appears to be more reliable at the cold temperatures and high pressures of Uranus' deep atmosphere. We have fitted k-coefficients to these new methane absorption data and we find that although the inter-annual changes reported by Irwin et al. (2009) stand, the new k-data place the main cloud deck at lower pressures (2-3 bars) than derived previously in the H-band of $\sim$ 3-4 bars and $\sim$ 6 bars in the J-band. In addition, we find that using the new methane coefficients it is much easier to fit simultaneously the 1.6, 1.3 and 1.1 μm peaks.

During the Uranus observations in 2007, corresponding observations were also made of Neptune's near-infrared spectrum, albeit with substantially poorer spatial resolution. The spectra were nevertheless sufficient to retrieve the gross variation in Neptune's latitudinal-vertical cloud structure and, like previous studies, we find the main cloud deck to exist at similar pressure levels to the main Uranus cloud deck, but with considerably thicker overlying stratospheric haze. The retrieved vertical-latitudinal cloud structure on Uranus and Neptune, observed with identical instrument setups, will be presented and discussed.

Observations of both Uranus and Neptune were also made in 2009 with the SpeX instrument (0.8 to 2.4 μm) on the NASA Infrared Telescope Facility and also with the NIFS and NIRI instruments on the Gemini North telescope. The IRTF measurements were made with seeing conditions of approximately 0.5 arcsec, while the Gemini observations were made with Adaptive Optics and thus have considerably better spatial resolution. We intend to use the NIFS observations to study the limb-darkening curves from 1.45 to 1.75 μm, which should provide better constraints in the vertical cloud structure and we intend to use the IRTF measurements to extend our analysis to shorter wavelengths and also provide better radiometric calibration between the different reflectance peaks.

These new observations will be presented and compared with the previous UKIRT observations.