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Spatial Inhomogeneity in Thermal Infrared Images of Uranus and Neptune: The Context For Spitzer IRS Spectral Analysis

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On 2006 September 2 and 3 UT, Uranus and Neptune were imaged at thermal wavelengths using the VISIR mid-infrared camera/spectrometer on the Very Large Telescope UT-3. A single image of Uranus was made at a filter centered at a wavelength of 18.6 μm, a part of the spectrum dominated by collision-induced hydrogen opacity, sensitive to upper tropospheric temperatures near 90-120 mbar total pressure. Similar images of Neptune were made with filters dominated by hydrogen opacity, centered at wavelengths of 17.6 and 18.6 μm, sampling temperatures in Neptune's lower stratosphere around 60-110 mbar. Images of Neptune were also obtained near (i) 8.6 μm, which is sensitive to a product of the temperature and methane mixing ratio in the lower-pressure stratosphere, and (ii) 12.2 μm, which is sensitive to a product of the temperature and ethane mixing ratio in the stratosphere. The temperature field of Uranus shows a warm low-latitude region, with a region around the south pole which is equally warm and a region around the north pole which is cooler than its southern counterpart. The meridional distribution of temperatures is qualitatively similar to Voyager infrared results. Neptune provided the biggest surprises, displaying a concentration of warm tropospheric temperatures, and stratospheric temperature-times-methane or -ethane products at the south pole. The distribution of upper tropospheric temperatures is qualitatively different from the Voyager infrared observations, in which equatorial and polar temperatures were higher than those of mid-latitudes but were nearly equally warm. We also detected meridional variability in the methane-temperature and ethane-temperature products in the south polar region. The surprising amplitude of warm temperatures at Neptune's south pole is the best evidence for a

long-suspected leak of gaseous methane that is otherwise confined to the warmer troposphere by cold trapping. The warm stratospheric feature has no counterpart in the troposphere, but could be a localized upward propagating wave or even evidence for atmospheric collision by an icy object.