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Titan's 220 cm^{-1} Ice Cloud: Seasonal Evolution in the North and South

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ABSTRACT

A stratospheric ice cloud identified by an emission feature in Titan's far-infrared spectrum has been changing character since Cassini arrived at Saturn. Until recently, the emission at 220 cm^{-1} had been found only in the polar north, where its spectral intensity had been decreasing gradually during mid-late winter and early spring [1]. Between 2005 and 2012 the emission in the north diminished by about a factor of five. Then in 2012 the emission feature was seen for the first time near the south pole [2]. Although the emergence of the ice cloud in the south was not unexpected, given the approach of winter, the emission appeared rather suddenly in July 2012. The advent of the southern ice cloud coincided with the rapid formation in 2012 of a haze hood and vortex at the south pole seen in Cassini images [3]. The 220 cm^{-1} emission arises from altitudes of 80-150 km and peaks sharply near 140 km. The material responsible for the spectral feature is not known, but indirect evidence hints at a condensate arising from complex nitriles that build up in the polar shadow at high winter latitudes. As gases migrate downward in the polar regions they encounter a dip in winter stratospheric temperatures near 150 km where some nitriles condense and form a cloud layer. The cloud material eventually precipitates and reaches the surface. By combining our observations from the north and south we can get an idea of the seasonal cycle of the ice cloud over much of a Titan year. From the southern data we see that the cloud begins to form in mid-autumn and from the northern data we infer that a maximum must occur around the beginning of winter, followed by a steady decline by late winter. Little of the ice cloud remains by summer. Our studies of the 220 cm^{-1} ice cloud, first observed by the Infrared Interferometer Spectrometer (IRIS) on *Voyager* 1 [4], are performed on Cassini with the Composite Infrared Spectrometer (CIRS) [5-8]. CIRS will track the northern and southern ice clouds through the remainder of the Cassini mission.

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