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Seasonal variations in Titan's stratosphere observed with Cassini/CIRS after the northern spring equinox

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Abstract

Since 2004, Cassini has made more than 110 Titan flybys, observing its atmosphere with instruments including the Cassini Composite InfraRed Spectrometer (CIRS). We know from CIRS observations that the global dynamics drastically changed after the northern spring equinox that occurred in August 2009 ([1], [2], [3], [4]). The pole-to-pole middle atmosphere dynamics (above 100 km) experienced a global reversal in less than 2 years after the equinox [4], while the northern hemisphere was entering spring. This new pattern, with downwelling at the south pole, resulted in enrichment of almost all molecules inside the southern polar vortex, while a persistent enhancement due to the northern winter downwelling circulation is still seen in the north pole region (see Fig. 1 for HCN in February 2012). From General Circulation Model calculations, this single circulation cell pattern should remain until 2025.

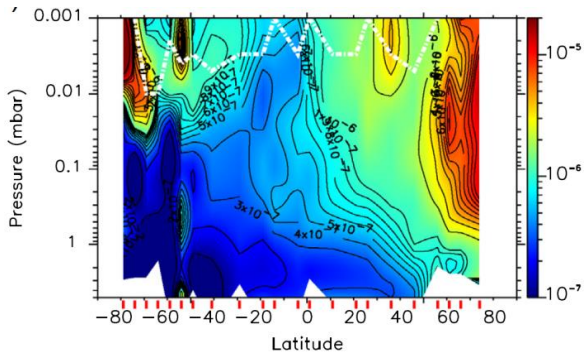

Figure 1: Pressure/latitude map of HCN mixing ratio in February 2012. White dashed line shows the levels above which constrains are poor.

We will present new 2015 CIRS limb observations analysis. We will show that many species (C_2H_2, HCN, HC_3N, C_6H_6, C_4H_2, CH_3CCH, C_2H_4) are now highly enriched near the south pole, by factors ~100 at 500 km compared to just a few years ago. Such large middle atmospheric enrichments were never seen before and are similar to in situ results from INMS at 1000 km [5].
We will also show that the north pole displays, for the first time since the beginning of the Cassini mission, a depletion of the molecular gas mixing ratios at altitudes higher than 300 km, while deeper levels remains enriched compared to mid-latitude regions.

References

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