



HANDOUT: Seasonal Variability of Stratospheric H₂O on Titan

This handout provides additional figures, plots, and context to support the material presented in the poster. It includes extended data visualizations, fitting details, and supplemental results that complement the main findings.

1. Fitting the continuum with parameterised Gaussian cross-sections

- The continuum of the spectrum is affected by temperature, collision-induced absorption, ices and hazes
- The far-infrared range of Cassini CIRS contain a feature exhibit by Haze B – a layer of photochemical aerosol that is present at the poles but not the mid-latitudes
- Water features are small, so fit to continuum must be perfect
- Very little knowledge of cross-section or profile of Haze B

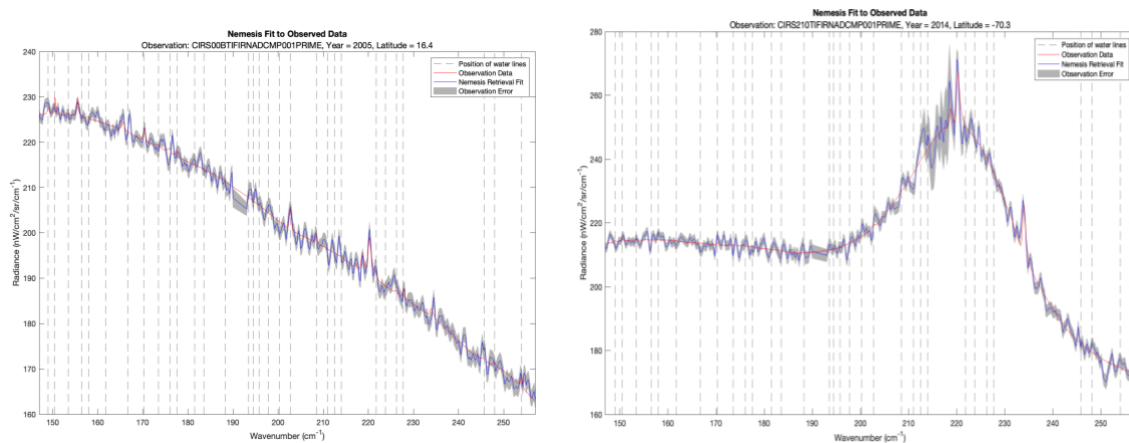


Figure 1: Spectra of observation at the equator (left) and north pole(right) showing the change in continuum from Haze B

- To fit the continuum, 13 individual hazes with Gaussian cross sections were used. Abundances were uniform at 100-150km based on de Kok et al., 2007a.

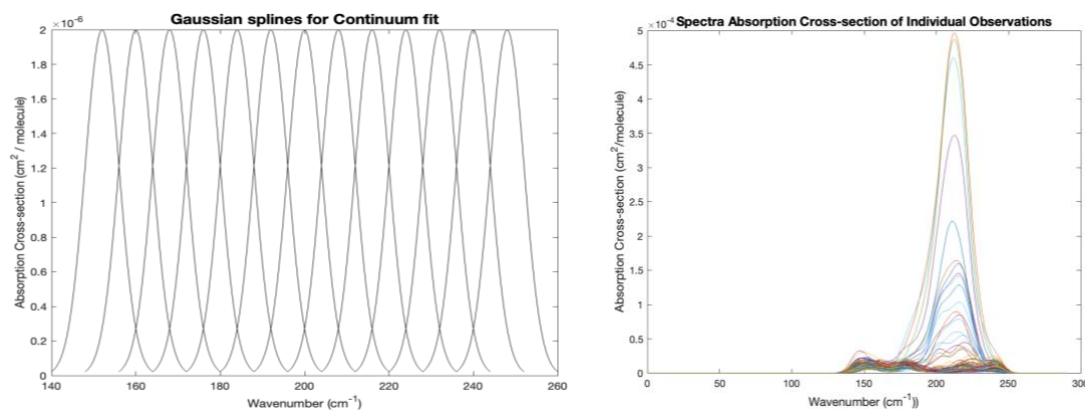


Figure 2: (left) 13 individual hazes with gaussian cross-sections as input producing (right) joint cross-sections for each observation



2. Column Abundance

- Volume Mixing Ratio (VMR) measures the percentage of a species at a certain altitude. Column Abundance measures the amount of particles of the species per cm in a column of atmosphere and is typically a better representation of the global abundance

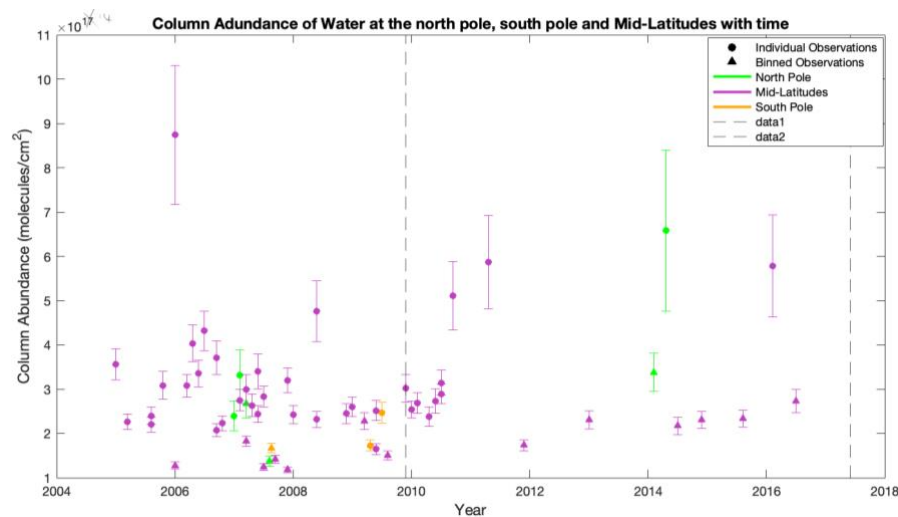


Figure 3: Column Abundance across south pole, north pole and mid-latitudes

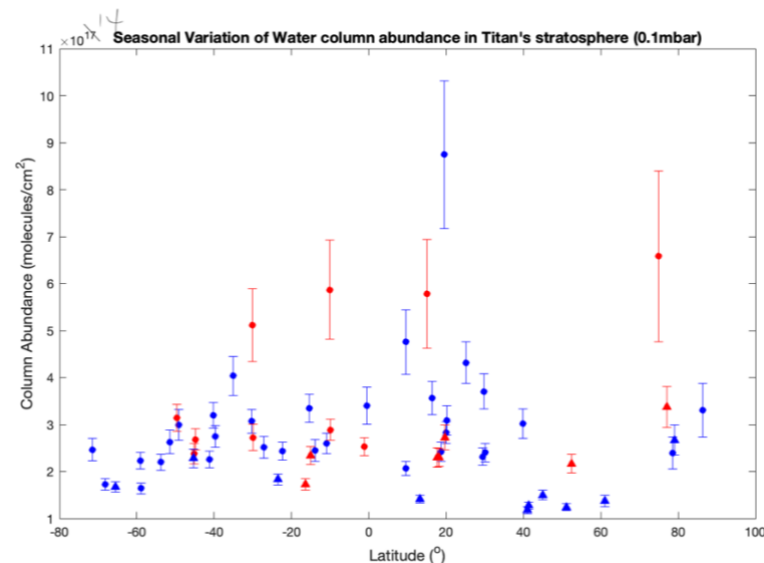


Figure 4: Column Abundance across south pole, north pole and mid-latitudes

- The column abundance at the poles are not as high as the VMR and are lower than the equator. This is because while the temperature is high at the upper stratosphere, cold temperature at the lower stratosphere is increasing the saturation vapor pressure causing more water to condense and thus decrease the amount of water in the column
- Small increase of Column Abundance with time
- The outlier may be an impact from a micrometeorite temporarily increasing the abundance and VMR



3. Temperature/SVP Controlling Water Abundances

- Like most trace species at Titan, water is condensed at its saturation vapour pressure around the tropopause (10mbar)
- The saturation vapour pressure can increase or decrease dependent on temperature and this “shifts” the vertical profile
- Titan is hottest at its equator getting colder towards the poles. However, the poles can also have high temperatures in the upper stratosphere due to the polar vortex

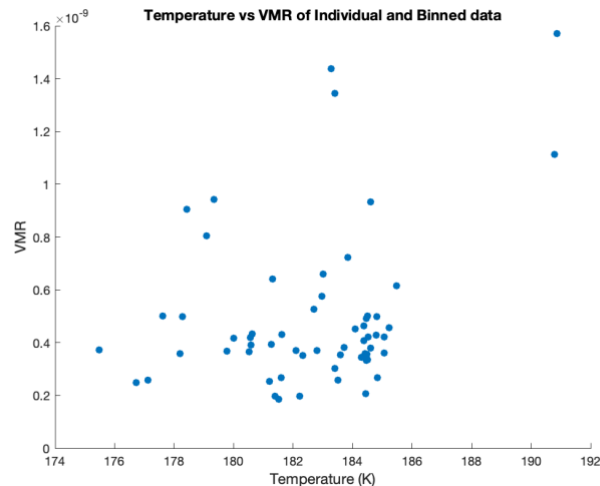


Figure 5: Temperature vs VMR plot showing positive linear correlation

- Correlation coefficient of 0.3 with a p-value of 0.02 signifying that VMR has a statistically significant moderate linear correlation with temperature

4. Correlation to Enceladus Distance

- In an attempt to explore the external sources of H₂O and correlate to abundances, different external factors were explored including:
 - ⇒ Distance between Titan and Enceladus
 - ⇒ Strength of Solar flux
 - ⇒ Strength of Saturn’s Electromagnetic field
 - ⇒ Large plume activity of Enceladus
- No correlation was found between abundances and distance to Enceladus

Figure 6: VMR and Column Abundance vs distance between Titan and Enceladus

