Application of Principal Component Analysis to Planetary Data: Variation of Phosphine in Saturn's Troposphere.

Dr. Padmavati A. Yanamandra-Fisher and Dr. Amy Braverman
Jet Propulsion Laboratory, Pasadena, CA USA

With NASA/Cassini mission underway and anticipation of return of large science data sets, the task of timely and thorough exploration and analysis of the data requires a paradigm shift in data analysis. Investigators must be able to quickly identify trends or patterns in the data and infer the statistical significance of the same to ensure repeatability both from the spacecraft and any ground-based observational support. We illustrate this shift in paradigm with the analysis of near-infrared spectroscopic data cubes of Saturn, in preparation of the spectroscopic data that will be acquired by Cassini/Visual Imaging Mapping Spectrometer (VIMS) in 2004, using the principal component analysis (PCA) method.

The data was acquired at the NASA/InfraRed Telescope Facility (IRTF), Mauna Kea, Hawaii, in October 1999, with a new facility near-infrared spectrometer, SpeX. The spectral range covers the wavelength interval from 1.58 to 5.4 microns, at a resolution of 1500. In this near-infrared interval, there exist several micro-spectral windows that serve as diagnostic windows to identify a trace compound, phosphine, in Saturn's troposphere. Phosphine is usually found in the deeper levels of Saturn's atmosphere. Its detection in the troposphere is indicative of dynamical processes that dredge up the phosphine.

We are currently analyzing the spectroscopic data in several ways to: (a) detect the presence of phosphine; (b) spatially correlate the detection in longitude and latitude; and (c) spectrally correlate the detection in two separate independent spectral windows. Our results indicate definite detection of phosphine in Saturn's troposphere. Principal component analysis (PCA) technique is utilized to determine both spatial and spectral correlation. While such correlation is confirmed spatially, the spectral correlation has not been confirmed yet.