Eye of the Storm: Structure of Saturn's South Polar Vortices
Final Report

NASA Grant: NNX10AI55G
For the period of
March 23, 2010 through March 22, 2012

Principal Investigator: Dr. Kevin H. Baines
University of Wisconsin Madison, Space Science and Engineering Center
Internal accounting: SSEC #6465 UW #PRJ35XA

Objectives:

The principal task of this effort is to determine key aspects of the structures of storm systems in Saturn, particularly in the south polar region. Cassini/VIMS data is analyzed with our radiative transfer software to characterize the heights of storm cloud tops, the cloud-scattering albedo as a function of wavelength, and characteristic particle sizes. We aim to determine the range of variability in both dark cloud and bright cloud structures, to look for correlations between (1) cloud altitude and brightness and (2) cloud particle size and brightness. Finally, we searchfor contrasts in gaseous composition associated with each of these discrete features and assess correlations between NH_3 and PH_3 abundances and cloud brightness. All of these correlations will help elucidate whether or not both types of clouds formed near the same depths, or whether one type of cloud formed at hotter and more thermochemically-active depths of the atmosphere.

Progress :

Modelling of atmospheric features in Saturn progressed significantly throughout this effort, but most notably in the last year. this effort A major storm system – the largest ever to be observed on Saturn - erupted in late 2010/early 2011 which provided a unique opportunity to witness the formation and evolution of convective storms. We pressed into service our radiative transfer software complete with new, more accurate methane absorption coefficients to determine the altitude and composition of this eruptive cloud, which we found to be largely comprised of relatively large particles of ammonia ice. The initial results were presented at the annual DPS meeting in Nantes, France and at the AGU meeting in San Francisco, California (Baines et al., 2011a,b).. A paper is in preparation for submission to a refered journal, likely *Icarus.*

For the south polar region, we continued to analyze spectra of dark and bright cloud features. Constraints on Mie scattering particle radii, cloud top pressure, and cloud opacities were determined by a combined analysis of 1.59, 1.69, and 2.12 micron data, similar to a technique the PI has shown yields meaningful values for these parameters for analysis of Jupiter spectra (Baines et al., 2012).

Work progressed on a Principal Components analysis (Richards, 1999) of the south polar region. We are applying this analysis tool in an attempt to isolate correlations between wavelengths, an example of such being the bright 5 micron structure we observe (internally-generated thermal radiation shining through cloudless regions) with the corresponding dark (cloudless) regions seen in medium-absorption bands observed in sunlight near 2.02 micron. Thus, this technique is being used to classify features throughout the region into a relatively small set of cloud morphologies for which detailed spectral analyses are required.

References:

Richards, J.A. 1999, Remote Sensing Digital Image Analysis: An Introduction, Springer-Verlag, Berlin, Germany, p. 240

Baines, K., Momary, T., Fletcher, L., Showman, A., Brown, R., Buratti, B., Clark, R., Nicholson, P., Go, C., and Wesley, A. (2011a). Saturn's enigmatic "String of Pearls" and northern storm or 2010-2011: Manifestations of a common dynamical mechanism. EPSC abstracts, Vol 6., EPSC-DPS2011-1658, 2011.

Baines, K., Momary, T., Fletcher, L., Showman, A. P., Delitsky, M., Brown, R., Buratti, B., Clark, R. N., Nicholson, P., Sotin, C. (2011b). The evolution of Saturn's Northern Storm of 2010-2011 and environs as viewed by Cassini/VIMS. Talk delivede at the Fall Meeting of the American Geophysical Union, December 2011.

Baines, K. H., Yanamandra-Fisher, P. A., Momary, T,. W., Orton, G. S., Villar, G. G. III., Fletcher, L. N., Campins, H., Rivkin, A. S., and Shara, M. (2012). The temporal evolution of the July 2009 Jupiter impact cloud. *Planet. Space. Sci*. in press.