Thermal Mapping to Achieve 3-D Structure and Dynamics of Planetary Atmospheres Throughout the Solar System. T.K. Greathouse[1] and K.D. Retherford[1], K.E. Mandt[1], D.Y. Wyrick[1], [1]Southwest Research Institute (6220 Culebra Road, San Antonio, TX 78228, tgreathouse@swri.edu)

Introduction: As instrumentation on the ground and in space continually improve, we are now beginning to open up a new chapter in the understanding of planetary atmospheres. Recent ground-based high-spectral resolution mapping observations of Jupiter show the stratosphere to be a region of intense wave activity [1]. This activity forces winds and controls globally dynamics. There is much to be learned from studying the dynamics of the Outer Planets which lack the solid surfaces that drive orthographic waves on terrestrial planets, and have size scales that dwarf the Earth. At the same time, studies of atmospheric dynamics on the tenuous atmosphere of Mars and the dense opaque atmosphere of Venus offer atmospheric dynamisits a plethora of unique laboratories to test theories and models. However, to test those theories and models we require data. As stated initially, work of this nature has been growing over the years, but the build up of unique thermal datasets of jupiter's stratosphere is beginning to uncover fine details about Jupiter's dynamics and structure. Looking from today, forward 30-35 years into the 2050 time frame, one could imagine retrieving datasets from constellations of satellites orbiting any given planet in the Solar System, much like weather satellites at earth (i.e., an Earth style A-Train for Jupiter). The question is not are the other planets interesting enough to warrant such attention, but how to overcome the technological hurdles that such missions currently pose.

We plan to report on some unique groundbased observations of Jupiter's atmosphere which show that even today we can retrieve detailed information that is revolutionary in the constraints it offers for current dynamical models. We will then look to ways of instrument miniaturization and simplification which could allow such measurements to be made from orbiting spacecraft. However, even with building such an instrument we will run into further issues such as instrument cooling to increase sensitivity, data downlink restrictions, radiation hardening, and powering such instruments, especially those orbiting the outer planets so far away from the sun. Additional issues include solutions to accurate position knowledge of both the spacecraft and the observed features in the atmosphere (the need for global positioning satellites for all of the planets). While some of these things may sound like dreams now, we believe all of the individual hurdles have solutions. Only by acknowledging the need for research to overcome these hurdles will we then focus our attention to solving them. Just imagine a future where we would be able to produce daily weather predictions for not only Earth, but also for Venus, Mars, Jupiter, Saturn, Uranus, and Neptune.

References:

[1.]Greathouse, T.K., et al., *Tracking Jupiter's Quasi-Quadrennial Oscillation and Mid-Latitude Zonal Waves with High Spectral Resolution Mid-Infrared Observations*, in *AAS/Division for Planetary Sciences Meeting Abstracts*. 2016.