JESTR: Jupiter Exploration Science in the Time Regime. K. S. Noll[1], A. A. Simon-Miller[1], M. H. Wong[2], D. S. Choi[1]; [1]NASA GSFC (Goddard Space Flight Center, B34 S154A, 8800 Greenbelt Rd., Greenbelt, MD 20771, Keith.S.Noll@nasa.gov), [2]University of California, Berkeley.

Introduction: Solar system objects are inherently time-varying with changes that occur on timescales ranging from seconds to years. For all planets other than the Earth, temporal coverage of atmospheric phenomena is limited and sparse. Many important atmospheric phenomena, especially those related to atmospheric dynamics, can be studied in only very limited ways with current data. JESTR is a mission concept that would remedy this gap in our exploration of the solar system by near-continuous imaging and spectral monitoring of Jupiter over a multi-year mission lifetime.

Mission Description: JESTR is a Discovery-class mission concept that includes a meter-class telescope in an orbit that allows for near-continuous monitoring of Jupiter. Observational capabilities will include diffraction-limited visible wavelength imaging and near- and mid-infrared spectral imaging. Mission operations are designed to be simple in order to constrain costs. At times when Jupiter is unobservably close to the Sun, alternative targets will be observed.

Science Drivers: A dedicated space telescope like JESTR is capable of addressing a number of scientific questions that are not addressable in any other way:

Atmospheric Dynamics. The gross dynamical structure of the atmospheres of the giant planets are dominated by alternating prograde and retrograde jets driven by a combination of radiative heating and internal heat flux [1]. Numerous smaller scale phenomena occur as well including hot spots, long-lived eddies, upward propagating convective storms, and a variety of wave phenomena [2]. However, groundbased observations are limited by poor and variable seeing and space-based observations are sparsely sampled snapshots [3]. Spacecraft-based sequences have changing resolution and are limited in duration. JESTR will be capable of studying changes on a near-continuous basis down to 100-km scales for an order of magnitude longer than the best existing data sets [4]. Data from JESTR will address outstanding questions regarding atmospheric energy transfer and synoptic meteorological phenomena on Jupiter.

Atmospheric Chemistry. Spectroscopic sounding utilizing ubiquitous CH_4 spectral features makes it possible to determine variable cloud heights, an essential piece of information when trying to understand the dynamical evolution of transient features [5]. Atmospheric constituents sensitive to photodissociation (NH_3 and PH_3) are another measure of cloudtop heights. Convection-sensitive minor constituents present in the mid-infrared spectrum (CO, GeH_4, AsH_3) serve as proxy samples of the deep atmosphere [6]

Impacts. Impacts have been detected in Jupiter's atmosphere [7,8] in 2009 and 2010 suggesting that observable small scale impacts may occur more frequently than previously expected. Small impact debris features are difficult to distinguish from variable cloud features in sparsely sampled data, but may be detectable with the high cadence sequences anticipated for JESTR.

Secondary Targets. Jupiter's regular satellites will pass periodically through the field of view allowing for long-term observation of, for example, volcanically-driven changes on Io. The irregular satellites can be targeted with small offsets at specified breaks in the observing cadence. When Jupiter is too close to the Sun to be observed, alternate solar system objects can be targeted, including other giant planets, comets, asteroids and KBOs.

References:

[1] Schneider, T., and Liu, J. (2009) Amer. Meteo. Soc. 66, 579-601. [2] Fletcher, L. et al. (2011) Icarus, Volume 213, 564-580. [3] Simon-Miller, A., and Gierasch, P. (2010) Icarus 210, 258-269. [4] Simon-Miller, A., et al. (2011) *this conference.* [5] Sanchéz-Lavega, A. et al. (2008) Nature 451, 437-440. [6] Noll, K. and Larson, H. (1991) Icarus 89, 168-189. [7] Hueso, R., et al., (2010) ApJ 721, L129-L133. [8] Sanchéz-Lavega, A. et al. (2011) Icarus, Volume 214, 462-476.

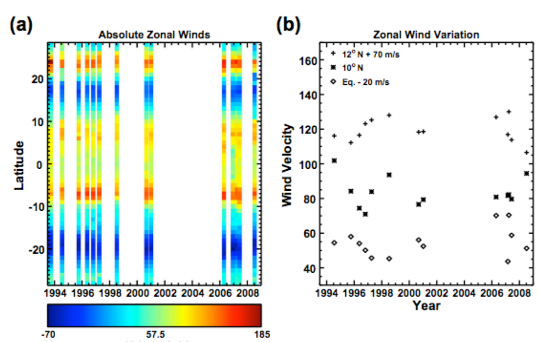

Figure 1a and 1b from [3] showing jet speeds from sparsely sampled space-based observations. Drivers act on shorter timescales and smaller spatial scales than can be observed from the ground or in sparse datasets.