THE ATMOSPHERIC VIEW FROM THE SIDE WINDOW OF HUYGENS PROBE. P. H. Smith[1], M. G. Tomasko[1], L. R. Doose[1], B. Rizk[1], and J. Moores[1], [1]Lunar and Planetary Laboratory; University of Arizona; Tucson AZ 85721 (psmith@lpl.arizona.edu).

Introduction: As the Huygens Probe descends through Titan's atmosphere on January 14, 2005 its six instruments will record a description of the atmospheric structure and composition impossible to deduce from remote sensing. The Descent Imager/Spectral Radiometer (DISR) [1] will provide data sets that are central to the interpretation of the radiative and thermal balance of the dense atmosphere. The primary spectral and imaging results will be reported elsewhere at this conference; however, there is an additional mode of data collection that gives a unique and informative insight into subtle variations in the haze and cloud profile. This mode is called by the team: the side-looking image strips.

At the time of writing the probe has not yet encountered Titan. Without the actual data set this abstract cannot be considered more than a placeholder, a brief description of the data and its analysis leading to the types of results that may reasonably be expected.

Background: The DISR combines imaging and spectroscopic modes to collect data that can be combined to form a complete picture of the atmospheric structures and the local surface properties. Details of the shapes and scattering properties of the aerosols are deciphered from a solar aureole mode and a sun sensor provides a timing pulse to distribute observations in azimuth as the probe rotates. The imaging system consists of side-looking, medium-resolution, and high-resolution imagers all sharing a single CCD detector by virtue of a custom fiber optic bundle. This abstract explores data sets taken by the side-looking imager (SLI).

The properties of the SLI are easily described. A section of the CCD, 128 x 254 pixels in size, receives the light from a 25.9° x 50.4° field of view (FOV) with the longer side vertical. This FOV is centered at 70.6° from the nadir such that the upper row of pixels sees almost 6° above the horizontal. Images are acquired during imaging cycles that are mosaiked to the 2 higher resolution image sets to produce full hemispheric views of the surface. All imagers accept light between 0.6 and 1.0 μm in wavelength; the exact spectral balance depends on the concentration of methane above the probe. During non-imaging, or spectrometric, cycles the SLI data is compressed to 2 strips per image.

The probe begins collecting data near 160 km above the surface. By the time it reaches 20km, we expect 33 non-imaging cycles: a vertical resolution of several km/cycle. During each cycle, six frames are taken equally spaced around the Sun direction. The reduction and analysis of these data will be discussed in the next section.

Data and Data Analysis: To form SLI strips, the first and last 13 columns are averaged by an on board processor row by row to create 2 vertical scans separated by about 20°. Because of the averaging, the signal-to-noise ratio (SNR) of these strips is 3-4 times larger than for a single pixel, or several hundred to one. The combination of high SNR and the horizontal viewing geometry enables the SLI to detect vertical structures and thin haze layers that cannot be seen any other way.

The strips can be combined in several ways to afford a quick look at the entire atmosphere. First, all strips near a chosen azimuth can be displayed as an image with the vertical profile shown versus the altitude. A color scale is used to label the pixel values. Alternately, an altitude range can be specified and the vertical profile shown versus azimuth. The entire altitude set can be sequenced to make an animation of the descent graphically revealing haze layers and cloud structures. If the radiance variation is modeled with a simple function, then it can be subtracted and the difference stretched to reveal subtle haze layers.

Huygens descends by parachute through a windy and dynamic atmosphere, it may develop a pendulum or swinging motion as it descends. Wind shears may rapidly change these motions. Differencing the 2 strips taken simultaneously and plotting these at single azimuths versus altitude can reveal even slight motions of the probe during descent. These periodic angular tilts can be modeled to help understand the probe dynamics and the wind fields that drive them.

Discussion: Sagan and Thompson [2] predict that organic gases created in photochemical region high in the atmosphere will diffuse to lower altitudes creating thin organic hazes. The likely zone for these hazes is between 60 and 100 km where the stratospheric temperature profile drops sharply from an isothermal region near 160 K to the tropospheric minimum at about 70 K. A wide selection of organic compounds condenses within this temperature range. We hope to identify organic compounds by detecting thin hazes, identifying the local temperatures and the candidate gases that condense at those temperatures. The thickness of the haze will serve as an indicator of the concentration of the compound.

For years, models of haze reflectance and methane absorption have predicted that the tholins created at the top of the atmosphere do not extend to the surface. The altitude of the bottom of the haze layer and the mechanism that causes the haze to rain out are poorly understood. The SLI strips will reveal the exact altitude of the haze bottom and its properties: is it an abrupt cutoff or a gradual dispersion? As we approach the surface, questions about ground hazes and methane clouds can be addressed.

The SLI strips are but one of the experimental tools available within DISR to address the vertical structure of the atmosphere. In combination with spectral intensity and fluxes a complete model of the atmosphere can be formulated with confidence. Naturally, this model is limited to the place and time of the encounter and certainly will not apply globally or over all seasons. However, the Huygens model will serve as a baseline and variables can be adjusted to understand other regions and times.

References: [1] Tomasko, M. G. et al. (2002) *Space Sci. Rev.,* 469–551. [2] Sagan, C. and W. R. Thompson (1984), *Icarus,* 59, 133-161.