# Analyzing Titan's Surface using the Downward Looking Visual Spectrometer aboard Huygens


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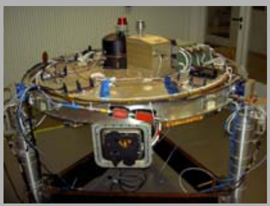
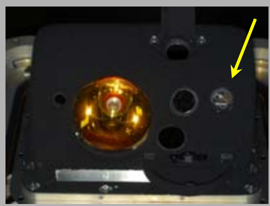
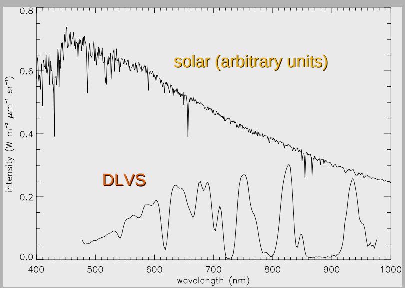
The *Descent Imager / Spectral Radiometer* (DISR) aboard Huygens carried the *Downward Looking Visual Spectrometer* (DLVS), and the *Surface Science Lamp* (SSL). The DLVS was sensitive in the wavelength range of 480-960 nm, and the slit imaged the surface over a range of 10°-50° in nadir angle. The DLVS worked flawlessly to record some 430 spectra during the descent and almost 200 spectra while on the surface. We present a first analysis of the DLVS spectra.

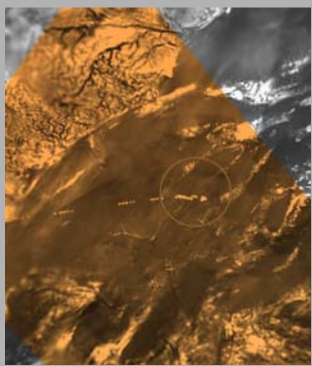


**Left**: DISR mounted on the Huygens engineering model. **Right**: Close-up of the DISR underside. The arrow points at the DLVS, the SSL is easily recognized.

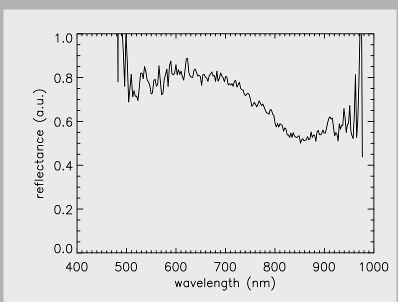


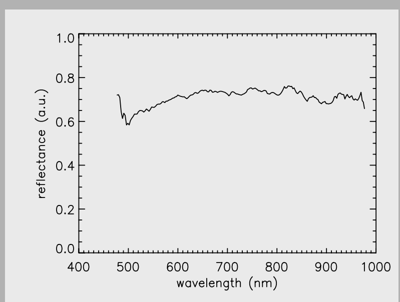



One of the last DLVS spectra recorded before landing is overlaid with a scaled solar spectrum. At lower wavelengths the increasing dominance of the haze and a decreasing surface reflectivity conspire to decrease the observed intensity. Note the methane windows (at 751, 829, and 935 nm) in which the surface is well visible.

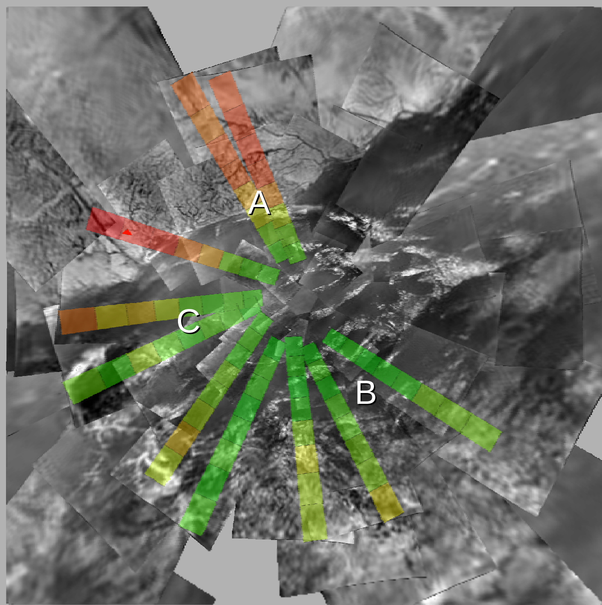


A view down to the surface of Titan, shown approximately as it would appear to the human eye from a height of 9 km (colorized using actual DLVS data).




Basically, we do not know what covers the surface of Titan. Favorite candidates are water ice and complex organic matter, coined *tholin* by Carl Sagan. The figures show my current best efforts to reconstruct the surface reflectance. **Left**: A reconstruction based on spectra acquired seconds before landing. The originals show methane absorption lines, whereas the reconstruction does not. **Right**: the reflectance of (a different part of) the surface, derived from a spectrum acquired after landing. It does show methane lines, even though the optical path length is ~1 m. The significance of the purported broad absorption feature (left), and the methane absorption lines (right) is under consideration. (Note: reflectance is presented in arbitrary units.)




The panorama above is overlaid with DLVS footprints colorized according to the intensity ratio in two methane windows (829 nm / 751 nm), selected to allow us a clear view of the surface, i.e. minimizing the contribution of the atmosphere. A red color means a high degree of reddening (high ratio), a green color a low degree (low ratio). We see that the 'land' area is redder than the 'lake' area.

Below we compare the average spectra of two land pixels (indicated by **A** in the top figure) with that of two lake pixels (**B**). The albedo of the land terrain is higher overall than that of the lake terrain, and therefore we have divided the spectra by the total intensity to emphasize the color difference. We see that the reddening is present over the whole wavelength range, although we have to regard the lowest wavelengths with caution. The spectra of **C** pixels are intermediate between those of the **A** and **B** pixels, indicating that the 'lake bed' in front of the river mouths is intermediate in color, suggesting contamination by river outflow. The asterisks indicate the two methane windows involved in the ratio mentioned above.