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Unexpected results from the Descent Imager/Spectral Radiometer on the Huygens probe

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The Descent Imager/Spectral Radiometer (DISR) had imagers, spectrographs, photometers, and a sun sensor that probed the intensity of the surface and sky in almost all directions during the descent in Titan's atmosphere. All goals of the instrument were achieved and published during the first five years after the descent. Here, we focus on a refined analysis of the data that yielded a number of unexpected results during the last five years.

DISR's Side-Looking Imager revealed dark, thin atmospheric layers at 21, 11, and 7 km altitude. The phase-angle dependence of these data suggests that aerosols are slightly larger at these altitudes compared to nearby altitudes. Otherwise, Titan's sky away from the sun was remarkable smooth without any small-scale feature above the detectability limit, the 0.2 % contrast level.

The 3800 spectra of the Downward-Looking Visible Spectrometer (DLVS) provided color maps of Titan's surface. Almost all derived colors are linear mixtures between a brighter component with a more positive spectral slope and a more neutral, darker component. The darker component has a similar color as Titan's aerosols.

The reflectivity of Titan's surface varies with emission angle in different ways for different regions. This investigation was facilitated by the fact that typically dominating effects due to illumination and shading on most planetary surfaces are greatly subdued on Titan due to almost uniform illumination from the whole sky, at least near visible wavelengths.

The reflection of the light from DISR's lamp from Titan's surface was recorded from up to 100 m altitude, at phase angles as low as 0.02 degrees. These data revealed an extremely large opposition surge, with the reflectivity increasing by 80 % below phase angles of 1 degree.

Among the more than 200 images taken after landing, one image displayed a large, bright spot that was not present on the other images taken in the same direction. Based on its shape and location, we concluded that the camera caught a dew drop falling from the outermost edge of the instrument.

Several DISR and HASI instruments recorded changes during the first seconds after landing. We concluded that Huygens bounced out of its impact hole and then slid and wobbled. The data constrain the location and angle of the probe as function of time quite well. The last recorded deviation from Huygens' resting position was a 1 mm offset 8 seconds after impact recorded by DISR's DLVS.

We revisited some previous results from DISR data and refined them through more sophisticated calibration and modeling. For example, we found that the aerosol single scattering phase function varies with altitude within in the troposphere, probably due to methane condensation.

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