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The Optical Depth Sensor (ODS) for Mars and Earth environments

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Abstract

The optical depth sensor (ODS) was developped to retrieve the optical depth of the dust layer and to characterize the high altitude clouds on Mars. The sensor has been developped and was used for a field experiment in Africa in order to validate the concept and test the performance. In this work we present main principle of the retrieval, the instrumental concept and the result of the tests performed during the 2004-2005 winter field experiment.

Motivations and objectives

On Mars like on Earth, dust and clouds play an important role on meteorology and climate. On Earth: high altitude thin sub-visible cirrus clouds near the tropical tropopause are important players of the hydration / dehydration of the stratosphere, while Saharan and Asian mineral dust play a key role in the radiative transfer in the upper troposphere. On Mars: in the absence of condensed water and precipitation, dust lifted by storms is controlling the radiative balance of the atmosphere and are the unique condensation nucleii available. Its seasonal cycle is known to show a strong interannual variability. The capacity of ODS is the monitoring of dust optical thickness and size distribution on a daily basis as well as the detection of the altitude and opacity of high altitude sub-visible cirrus at twilight. On Mars, ODS was onboard Mars 96, then selected on Netlander, on the Scout project Pascal, and currently part of the Atmosphere Environmental Package (AEP) on the Humboldt Station of the ESA Exomars Mission. On Earth, ODS prototype deployed in West Africa sahel region in Ouagadougou, Burkina Faso next to a AERONET station.

Principle of the measurement

For the dust : opacity is retrieved by comparing the flux scattered by the atmosphere, and the sum of the scattered + the direct solar flux, observed from the surface. The ratio of these two fluxes depends on the total dust opacity. It is independent of any absolute calibration. For the clouds : Color index (C.I = IRED / IBLUE) with two channels. When high altitude clouds are present, they produce a peak in the time variation of C.I at the twilight.

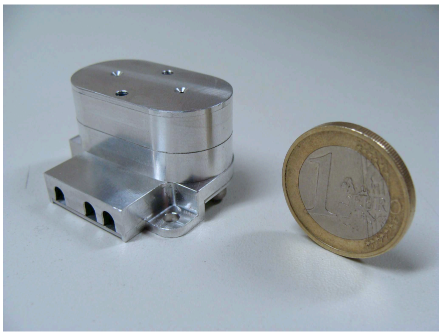

Figure 1: Left, Image of Titan at about 5μm showing the large polar cloud along with some subtle surface structures. Right: Same cube in the fluorescence emission lines 3.3μm. The haze layer reflects this emission, and thus we get a view of the main and detached haze layer.

In this presentation, we will present the procedures used to retrieve the dust optical dust and the high altitude cirrus altitude and opacity. Such procedures were used to analyze the data taken during the Ouagadougou field campaign. We then show our results concerning cloud properties and the dust optical depth. The latter is shown along with the retrieval of the AERONET photometer.