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CONNECTING SCIENCE GOALS TO PAYLOADS FOR TITAN EXPLORATION: A FOCUS ON GEOMORPHOLOGY

Abstract

Titan's unique and rich geomorphology gives rise to a large number of hypotheses and theories about the origin and development of Saturn's largest moon. For the first time, we present a complete, holistic Science Traceability Matrix (STM) linking high-level scientific objectives, through measurement requirements and specifications, directly to specific instrumentation. This STM serves as a comprehensive guide, consolidating all observation requirements for Titan into a single resource. It highlights how a select number of instruments can address a broad spectrum of scientific questions. Furthermore, the wide-ranging nature of this STM shows the key role connectivity science, where multiple different observations are combined, could play in multi-component missions, such as the proposed Astraeus mission - with an orbiter, aerial flying vehicle and lake submersible - which this work supports. We demonstrate that the step-by-step science-driven approach of an STM is critical to the development of an effective space mission.

We analysed previous missions and proposals, and selected the most relevant instruments and observation techniques to ensure our STM would lead to the capture of high-quality data on Titan's sub-surface, surface, atmosphere and magnetosphere. In this paper, we specifically consider the surface and subsurface processes on Titan which are of key scientific interest, and address geomorphological processes such as cryovolcanoes and hydrocarbon lakes. We analysed existing data from the Cassini-Huygens mission, and proposed methods of further study capable with our selected instruments.

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