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The 'Geosaucer' and beyond - 'The Future of Small Long-Lived Landing Systems for Titan'

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Within the framework of ESA's Cosmic Vision programme, the TandEM/TSSM mission to Saturn's moon Titan has been proposed and studied, using two in-situ elements (ISE's), i.e. a Montgolfière and a Lake lander. Emerging from the availability of unallocated mass and volume at the Montgolfière, a high risk, but feasible approach of using these margins has been proposed, that would allow to investigate geophysical properties of the solid surface and deep interior, which were not feasible by the other two ISE's.

The proposed package of instruments was designed for limited lifetime, using its own dedicated power supply, thermal control and communication subsystem. It would have been integrated into the Montgolfière's heat shield and would have hitchhiked to the surface after the heat shield would have been separated from the Montgolfière, benefiting from atmospheric conditions that would have allowed impact conditions to be sufficiently benign to allow survival and later operation the package. Though the TandEM/TSSM mission has not been selected for further study within the Cosmic Vision framework, we will present the basic outcomes of the performed study, keeping in mind the importance of a long-lived geophysical lander for Titan exploration. Based on this, we will propose and evaluate future concepts for long-lived landing systems that could be comparable or inherently different from the 'Geosaucer' concept, which was in a first mass allocation roughly 25 kg with a lifetime of 135 days. For this purpose we will look into general mission constraints, requirements and demands in technology development.

Within this presentation we will also give an overview over the science rationale of such a geophysical lander. Evidently, long-time monitoring of geophysical processes on the large icy moons and especially on Titan will give new insights into the internal structure of these bodies, i.e. hinting to subsurface oceans. Consequently, the 'Geosaucer' instrument package had been composed of a magnetometer, a Micro-seismometer and a radio science beacon, to address aspects of highest importance, related to i) the non-synchronous rotation state of the crust as a result of a putative subsurface ocean as suggested by Cassini observations, ii) tidally-induced deformations of the satellite's outer ice shell in the presence of a subsurface ocean, iii) the magnetic field induced in a subsurface ocean during Titan's passage within Saturn's magnetosphere, iv) Titan's internal structure.