TITAN ENVIRONMENT MODELS FOR NORTHERN SUMMER POLAR EXPLORATION

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ABSTRACT

A promising and unique opportunity for the exploration of Titan exists in coming years. Launch in 2016-2018 could deliver a capsule to Titan's northern polar seas which present an interesting extraterrestrial marine environment to explore which will be in continuous or near-continuous Earth-view during late northern summer 2022-2024. The seas present a surface area large enough to easily target and with properties that lend themselves to easy sample acquisition. These aspects of this opportunity make it possible to contemplate a focussed Titan mission in the NASA Discovery mission framework, in particular the Titan Mare Explorer (TiME) mission being developed by APL and Lockheed Martin, with Ellen Stofan as PI. However, the environmental models (notably the Flasar wind model) developed for low latitudes for the Huygens mission are not applicable for the polar regions, so a new environment definition effort is required.

We examine Cassini observations, Huygens data and groundbased measurements, together with numerical circulation models, to determine likely limits on expected zonal, meridional and vertical winds for design of a northern summer polar mission. A considerable body of data on late summer polar conditions now exists since Titan has been subject to extensive observation in the southern summer 2000-2009 : polar summer winds are appreciably weaker than the equatorial zonal winds.

These results allow us to predict the small (<0.5%) probability of encountering convective updrafts or rain, together with a quantitative basis for estimating the probability of encountering various winds. Winds at the surface may be of the order of 1 m/s, and we present functions describing probabilistic wind envelope functions with altitude. These allow prediction of the dispersion of splashdown location for a given entry point and descent profile. Additionally, the surface winds will cause drift of a floating platform – for realistic vehicle configurations without dedicated sails or other structures, the drift rate will be about one tenth of the windspeed. Given the ~1 m/s winds predicted, a vehicle may drift about 10km per Earth day, or perhaps to the edge of Ligeia Mare (~500km across) in a month (~2 Titan days.)