The Case for a Titan Geophysical Network Mission

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Science (measurements and pedigree in 2007 Titan Explorer Flagship Study)

- Meteorology. Even simple pressure sensor would provide important information, detecting the gravitational tide in the atmosphere. Conventional met package even better. Simple atmospheric optics measurements.

- Seismology/tilt. Changing tidal stresses likely excite impulsive signals, allowing crustal thickness to be inferred from reverb (probably viable from single station). Multiple stations offers prospects for isolating sources. Tiltmeters allow crustal rigidity to be inferred from changing tidal acceleration.

- Magnetics. Induced magnetic field can be isolated from long time-series and simultaneous multi-point measurements. Infer depth to ocean and its conductivity. (Detecting intrinsic field more challenging - cleanliness, zero offset)

- Radio Tracking. Precision tracking by VLBI/Doppler would allow rotation state variations to be measured, with implications for interior structure and seasonal wind changes. Also get 'occultation' as Earth sets.

(Also trickle back descent imagery?)

3 stations allows for some minimal longitude/latitude diversity for meteorology/magnetics ; 4 stations are suggested for robustness. In a stand-alone mission scenario they could be delivered to direct entry by expendable carrier (just as Pioneer Venus' 4 probes in 1979). Could also be released from orbit, or dropped by balloon as part of a Flagship mission.

EDL can be made very simple (DS-2-like frangible entry shield ; or conventional entry capsule with small drogue chute : crushable foam or similar impact attenuator.)

Relatively low instrument data rate permits science value to be realized via direct-to-Earth communication with low/medium gain antenna.

Radioisotope power source is essential (for heat as well as power). For geophysical measurements a thermoelectric source would be ideal - no EMI/vibration (although
Early ASRG tests are promising) Half-ASRG might be a good fit, possibly even generous.

Small payload (1-20kg) and easy EDL make this potentially more affordable than Viking/Phoenix lander considered in Flagship study with chemistry/sampling arm etc.
(NB A mission of simple geophysical landers was NOT considered in the 'Billion

Relationship to Titan Flagship

2007 Titan Explorer
Orbiter + Balloon + Lander (long-lived, dunes, chemistry + geophysics)

2008 Titan Saturn System Mission
Orbiter + Balloon + Lander (short-lived, lake, chemistry)

Smaller Flagship might choose 2 of these 3 elements. Logically this should be Orbiter + Balloon
(why - balloon needs some technology push, not credibly proposable to NF? Balloon mission needs high bandwidth to do justice to its observing opportunities - a new vista every hour - so balloon benefits most from orbiter relay support)

So - standalone landed missions are the 'piece to bite off' for competed mission.

Recommendations

1. A stand-alone Titan Network Mission should be considered in the mission list for future New Frontiers solicitations.

2. Multiple small geophysical stations should (continue to) be considered a possible element in a Titan Flagship mission architecture.

3. One or more ‘small RPS’ options such as a small RTG or half-ASRG should be developed by NASA in time to be available for the above opportunities.