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MP3 - A Meteorology and Physical Properties Package to explore Air:Sea interaction on Titan

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The exchange of mass, heat and momentum at the air:sea interface are profound influences on our environment. Titan presents us with an opportunity to study these processes in a novel physical context. The MP3 instrument, under development for the proposed Discovery mission TiME (Titan Mare Explorer) is an integrated suite of small, simple sensors that combines the a traditional meteorology package with liquid physical properties and depth-sounding. In TiME's 6-Titan-day (96-day) nominal mission, MP3 will have an extended measurement opportunity in one of the most evocative environments in the solar system. The mission and instrument benefit from APL's expertise and experience in marine as well as space systems.
The topside meteorology sensors (METH, WIND, PRES, TEMP) will yield the first long-duration in-situ data to constrain Global Circulation Models. The sea sensors (TEMP, TURB, DIEL, SOSO) allow high cadence bulk composition measurements to detect heterogeneities as the TiME capsule drifts across Ligeia, while a depth sounder (SONR) will measure the bottom profile. The combination of these sensors (and vehicle dynamics, ACCL) will characterize air:sea exchange. In addition to surface data, a measurement subset (ACCL, PRES, METH, TEMP) is made during descent to characterize the structure of the polar troposphere and marine boundary layer.
A single electronics box inside the vehicle performs supervising and data handling functions and is connected to the sensors on the exterior via a wire and fiber optic harness.
ACCL: MEMS accelerometers and angular rate sensors measure the vehicle motion during descent and on the surface, to recover wave amplitude and period and to correct wind measurements for vehicle motion. TEMP: Precision sensors are installed at several locations above and below the 'waterline' to measure air and sea temperatures. Installation of topside sensors at several locations ensures that at least one is on the upwind side of the vehicle. PRES: The barometer subsystem uses pressure sensors from FMI of the type flown on Huygens. METH. Methane humidity (and the presence of fog) is measured with a near-IR differential absorption spectro-photometer. The humidity may vary with and fetch, as well as on nearby rainfall. WIND. An ultrasonic anemometer, mounted on a mast to minimize flow perturbations, measures wind speed and direction. DIEL : An immersed parallel-plate capacitor (spare from Huygens SSP) fills with liquid to measure the dielectric constant. This is sensitive to the methane/ethane ratio, and to the possible presence of nitriles such as HCN. SOSO : A pair of ultrasound transducers (SSP spares) measure the speed of sound in the liquid, a function of the methane/ethane ratio (unaffected by trace nitriles). SONR : A down-looking piezoelectric depth-sounder to measure the bottom profile. The echo record will also indicate suspended scatterers and the presence of bubble noise at the sea surface. TURB. A visible light beam is passed through the liquid and the direct and scattered intensity is measured to gauge particles in the liquid and the deposition of solar heat with depth.