Dynamics and Exploration of Titan's Seas

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Saturn’s moon Titan has seas of liquid hydrocarbons that are an important target for future exploration. The largest of these seas, Ligeia Mare and Kraken Mare, are ~400km and ~1000km in extent, respectively, and are composed of liquid methane at ~94K, with likely traces of ethane and other organic compounds. Titan's seas represent a novel laboratory for air:sea exchange and other hydrological and oceanographic processes.
Observations from the Cassini spacecraft, in particular its radar instrument, have measured the depth of Ligeia Mare to be ~160m, consistent with terrestrial basins of similar size. The tidal amplitudes have been predicted to be some tens of centimeters, and as surface windspeeds grow to 1-2 m/s as we approach northern summer in 2017, waves are expected to form. Cassini observations of sunglint and with radar/radio generally show the sea surface to be flat up to now, but some time-variable patches of reflectivity show that dynamic processes are active, and perhaps that waves are just beginning to form. The final observations of Titan’s seas by Cassini in April 2017 are eagerly anticipated and a brief report may be made at this meeting.
During Titan’s rainy summer, 10m or more of liquid may be added to the seas by rainfall. Some initial model results on the seas’ response to this input will be presented –Ligeia may overflow rather quickly through the channel Trevize Fretum into Kraken.
Several proposals have considered future missions to Titan's seas, including a floating capsule, the Titan Mare Explorer (TiME). This envisaged a radioisotope-powered capsule in Ligeia Mare in 2023, which it would traverse over several weeks blown by the wind. More recently, the NASA Institute for Advanced Concepts (NIAC) has sponsored a study of a robot submarine to explore Titan's seas circa 2040. Aspects of these and other future exploration concepts will be discussed.

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