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Study of liquid exchanges between Titan's seas Kraken Mare and Ligeia Mare

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Titan is the only other solar system body with surface seas besides the Earth. Since 2006, Cassini has been observing those seas and, in particular, the two largest ones, Kraken Mare and Ligeia Mare. A bathymetry map of Ligeia Mare is now available [1] while, in Kraken Mare, the seafloor was not detected except in Moray Sinus [2]. Kraken Mare and Ligeia Mare have recently been shown to be connected by a strait called Trevise Fretum and observations of the Visual and Infrared Mapping Spectrometer (VIMS) from February 12, 2015 detected specular reflection away from the specular point on the Ligeia outlet of this strait [3]. This connection could explain the difference in liquid properties observed in Moray Sinus with respect to other areas of Kraken Mare: the methane richer liquid coming from Ligeia could modify the composition of the liquid in the northern part of Kraken Mare.

In this work, we simulate the tidally induced liquid exchanges between Ligeia and Kraken Mare by means of SLIM (Second-generation Louvain-la-Neuve Ice-ocean Model, www.climate.be/slim_flyer). This will allow us to assess whether or not the tides can bring liquid from Ligeia to Moray Sinus and locally modify the liquid properties. SLIM2D solves the depth-averaged shallow water equations on an unstructured mesh, which allows higher accuracy in the straits without drastically increasing the computational costs. It has recently been used to simulate the tidal response in Ontario Lacus [4]. The impact of the density gradient due to the variation in the composition is then studied by means of the 3D version of SLIM. SLIM3D is a baroclinic model capable of simulating the effect of density gradient on the flow exchanges and, hence, studying accurately the flow in Trevise Fretum. This will be useful for assessing whether or not the solar glints observed in Trevise Fretum could be generated by strong currents [3]. The present study provides new insights into the liquid exchanges between Ligeia and Kraken Mare which have significant implications for the long term dynamics and evolution of the surface seas.

[1] Mastrogiuseppe et al. (2014) Geophysical Research Letters, 41(5), 1432-1437. [2] Mastrogiuseppe et al. (2016) EGU, 13172. [3] Sotin et al. (2015) AGU, P12B-04. [4] Vincent et al. (2016) Ocean Dynamics.