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Can we hear waves in Titan's lakes? - Microseisms on Titan

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Earth's oceans are the dominant source of noise in global seismology between 3 and 15 second period. While the strongest sources are in the open sea of the Northern Atlantic and the Southern Ocean, waves in smaller seas, like the Baltic Sea and even in large lakes have been shown to create an observable seismic signal. Since Titan is the only other place in the solar system with persistent surface lakes, lake microseisms might be an observable feature. On Earth, microseismic noise has been used widely to infer crustal thickness and composition in the regions with low seismicity, so a strong lake-generated ambient noise signal would be very valuable for interiour studies, e.g. in the context of the proposed Dragonfly mission.

We estimated the strength of microseismic noise on Titan, based on self-consistent interiour models and global circulation models. While waves of more than a few millimeters have never been observed by radar measurements of the lakes, GCMs predict winds of several meters per second, which would be strong enough to create meter-high waves. Due to the lower density of liquid hydrocarbons, compared to water, and the surface gravity of 1/7g, the wave-generated pressure on the sea floor is much lower than on earth. Since the impedance contrast between the methane ocean and the water ice below is lower than the contrast between liquid water and rocks on Earth, the amplification of secondary microseism is lower than on earth, but almost frequency- and depth-independent, so microseism could be created over the whole area of the lakes. The smooth western coastline of Kraken Mare could be reflecting ocean waves coherently enough to fulfill the Longuet-Higgins-criterion and therefore generate meicroseisms. The same effect could be reached by fast moving storm cells, creating opposing ocean wave trains.

Taking all these considerations into account, we estimate the global level of microseismic noise and find that even on stormy days, it is significantly lower than on Earth. This suggests it may only be observable a few hundred kilometers around the largest lakes with a realistic instrument.