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Preparing for Seismic Observations with Dragonfly: What Will Seismology Look Like on Titan?

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Dragonfly, NASA's next New Frontiers mission, will explore Titan in the mid-2030s and, for the first time, deploy a seismometer on the surface of an icy moon. Titan is believed to host a subsurface water ocean beneath a thick ice shell, making it a prime target for understanding *icy ocean worlds* and their potential habitability. In this context, seismology provides a unique tool to probe Titan's interior structure, complementing the mission's geochemical and atmospheric investigations. In particular, seismic observation could help constrain the thickness of the ice shell and ocean, detect lateral heterogeneities or convection within the outer ice shell, and assess the present-day activity of the satellite.

However, conducting seismology on Titan will be fundamentally different from doing it on Earth and its neighbors, Moon and Mars. To ensure successful observations, we must first anticipate the type of seismic events that can occur and evaluate which signals are likely to be detectable in such an exotic environment. Titan's surface displays a wide range of geological endogenous features–mountains ranges, vast dune fields, and methane lakes–indicating ongoing internal and surface processes. Among the most promising seismic sources are tidal stresses induced by Saturn, which may generate ice-fracturing events within the ice shell and could represent the largest and most detectable seismic events.

In this study, we present forward simulations of seismic waveforms generated by ice-cracking events, exploring how variations in interior structure models (e.g., ice shell thickness, attenuation properties) affect the resulting signals. We also investigate how environmental noise, such as atmospheric turbulence, and instrumental performance, influence signal detectability. Beyond predicting what *Dragonfly* might record, this work aims to identify robust seismic observables that can constrain Titan's upper internal structure.

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PhD 2nd year

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