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Containing Englacial Attenuation in the Absence of Continuous Reflecting Interfaces

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The attenuation experienced by ice penetrating radar sounding signals within glaciers, ice sheets, or planetary ice shells is an expression of the temperature and chemistry of the ice through which it propagates. As a result, placing observational constraints on the amount and spatial variation of englacial attenuation can reveal the thermophysical and chemical configuration of planetary and terrestrial ice masses. In terrestrial radioglaciology, there are well-established techniques for estimating attenuation using continuous reflecting interfaces such as englacial layers or the glacier bed. However, for the most challenging and resource-constrained observing scenarios (e.g. the sounding of Jovian icy moons) such interfaces may be rare, unusable, or absent. In these scenarios, established approaches are unlikely to yield useful attenuation - and therefore thermal or compositional - estimates. To address this challenge, we develop, demonstrate, and discuss alternative analysis approaches to constrain ice-sheet and/or ice-shell attenuation in the absence of continuous reflecting interfaces by exploiting volume scattering, shadowing, iso-attenuation horizons, and isolated reflectors in radar sounding data.