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Seismic efficiency of meter-size impact craters forming on Mars

The NASA's InSight mission has placed the seismometer SEIS less than a year ago on the surface of Mars. SEIS was designed to detect planet's seismic activity. One of the suspected seismic sources could be meteorite impacts. It was been previously estimated that impacts forming up to 30 m diameter craters could be detected by SEIS. They are large enough yet frequent enough to occur during the InSight mission lifetime.
We simulated the formation of meter-size impacts on Mars, using the iSALE-2D numerical shock physics hydrocode. It has previously been shown that the properties of target medium (bedrock or porous regolith) influence the crater formation process and final crater morphology. In this work, our investigation focused on the propagation of impact-generated pressure waves in the target medium. We showed that the seismic efficiency, k (part of the impactor's kinetic energy that is transferred to seismic energy) is heavily dependent on the existence of pore space in the target medium. Previous works placed broad constraints that span 5 orders of magnitude for impact events in lunar and planetary environments. Our work helps narrow down this range; The seismic efficiency for porous targets was k~$10^{-5} - 10^{-4}$ and for bedrock targets $k = 10^{-3} - 10^{-2}$.
Together with the InSight science team, this is the first time numerical impact modelling is being connected with the seismic generation and propagation modelling. Defining seismic efficiency for meter-size craters on Mars is of great interest to the NASA InSight science, because it helps determine conditions of impact events that we hope to detect.

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