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First Receiver Functions on Mars – Constraints on the Martian Crust from InSight

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Page: Abstract Information

Abstract Title

First Receiver Functions on Mars – Constraints on the Martian Crust from InSight

Abstract Description

NASA’s InSight mission has for the first time deployed a very broad-band seismometer, SEIS, on the surface of Mars, which has been collecting data continuously since early February 2019. The main focus of InSight is to enhance our understanding of the internal structure and dynamics of Mars, including better constraints on its crustal thickness. Various models based on topography and gravity observed from the orbit currently differ by more than 100% for the average crustal thickness. Here, we present P-to-S and S-to-P receiver functions, which are available for 4 and 3 marsquakes, respectively, up to now. All of these quakes are located at comparatively small epicentral distances, between 25° and 40°. We observe three consistent phases within the first 10 seconds of the P-to-S receiver functions. The S-to-P receiver functions also show a consistent first phase. Later arrivals are harder to pinpoint, which could be due to the comparatively shallow incidence of the S-waves at the considered distances, which prevents the generation of converted waves. To obtain better constraints on velocity, we also calculated apparent velocity curves from the P-to-S receiver functions, but these provide meaningful results for only one event so far, implying a large uncertainty. Due to difficulties in clearly identifying multiples, the receiver functions can currently be explained by either two crustal layers and a thin (25-30 km) crust or three crustal layers and a thicker (40-45 km) crust at the landing site. This model range already improves the present constraints by providing a new maximum value of less than 70 km instead of more than 100 km for the average crustal thickness. Information from noise autocorrelations as a complementary method, identification of P-reverberations and S-precursors in the event recordings, and more extensive modeling, ultimately including 3D-effects, are investigated to tighten the constraints.

Page: Technical Sessions

Technical Session

Insight Seismology on Mars: Results From the First (Earth) Year of Data and Prospects for the Future

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