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The core structure of Mars as expected to be seen by InSight's VBB seismometer

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The question of the Martian core concerns our basic understanding of the planet's thermal evolution, dynamo models for the past and present, the composition of the Martian mantle, especially in regards to its iron content and prevalent phase transitions, which in turn constrain possible regimes of mantle convection. So far the (outer) core radius of Mars is uncertain to about 250 kilometers (Sohl et al., 2005), and evidence neither supports nor falsifies the existence of an inner core (Defraigne et al., 2003). We apply our extensions of the ray tracing toolbox TauP (Crotwell et al., 1999) to compute amplitude loss, ellipticity, crustal and topography corrections in combination with existing models of seismic activity on Mars (Golombek, 1992, Knapmeyer et al., 2006), crustal thickness models (Wieczorek, 2007) and structure models (e.g. Okal and Anderson, 1978, Zharkov and Gudkova, 2000, Rivoldini et al., 2011). In preparation for NASA's discovery mission InSight, we simulate the detected relative travel-time curves at a single seismic station in Elysium Planitia for several models of Martian structure, seismicity, environmental and instrumental noise. We discuss possibilities and difficulties of considering the effects of Martian ellipticity and topography up to degree 8 and 30, respectively. Furthermore, we demonstrate the effect of low velocity layers, as well as the relevance of modeling the effects of ellipticity and crustal thickness during the interpretation of seismic data acquired by InSight's SEIS instrument on Mars, especially concerning seismic phases which provide direct evidence on the core structure of Mars.