Geophysical Research Abstracts
Vol. 21, EGU2019-14093, 2019
EGU General Assembly 2019

Decorrelation of pressure signals on SEIS records and ground compliance estimates

Balthasar Kenda (1), Raphaël G. Garcia (2), Taichi Kawamura (1), Philippe Lognonné (1), William T. Pike (3), William B. Banerdt (4), Don Banfield (5), Martin van Driel (6), Mélanie Drilleau (1), Anna Horleston (7), Robert Myhill (7), Naomi Murdoch (2), Jose Antonio Rodriguez Manfredi (8), Martin Schimmel (9), Aymeric Spiga (10), Éléonore Stutzmann (1), Nicholas A. Teanby (7), Daniel Viúdez-Moreiras (8), and James Wookey (7)

(1) Institut de Physique du Globe de Paris, Paris, France (kenda@ipgp.fr), (2) Institut Supérieur de l'Aéronautique et de l'Espace, Toulouse, France, (3) Imperial College London, UK, (4) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA, (5) Cornell University, Ithaca, USA, (6) Eidgenössische Technische Hochschule Zürich, Switzerland, (7) University of Bristol, UK, (8) Centro de Astrobiologia, Instituto Nacional de Técnica Aeroespacial, Spain, (9) Institut de Ciències de la Terra Jaume Almera, Spain, (10) Laboratoire de Météorologie Dynamique, Sorbonne Université, Paris, France

Mars atmospheric pressure variations induce ground deformations that are the main source of environmental noise on the InSight SEIS instrument. Phenomena generating pressure variations, such as meteorological wavefronts, gravity waves, convective vortices and small-scale turbulence are covering the whole frequency range of SEIS broadband seismometers. These signals impact the capability of SEIS sensors to detect seismic waves propagating in Mars interior. However, the relation between pressure variations measured by the InSight pressure sensor and ground movements measured by SEIS being essentially linear, it is possible to invert both signals to find the transfer function between pressure and ground motion. Then, pressure generated ground movements can be substracted from SEIS records in order to improve their sensitivity to seismic waves. The transfer function, usually called compliance, depends on the ground properties. Thus, the decorrelation of SEIS records from pressure effects will also allow us to constrain the subsurface properties at the InSight landing site.

Our study compares two different pressure decorrelation methods applied to Mars synthetic data, and records by both short period and very broadband SEIS sensors. The pressure-decorrelation methods are presented and their differences in terms of underlying assumptions and implementations are explained. Their performances and drawbacks, analyzed on realistic synthetic datasets, are discussed. We plan to apply these methods to real Mars data and use them to retrieve the ground compliance at the InSight landing site over a broad frequency range. Accordingly, we expect to extract elastic properties of the subsurface through the compliance measurements. Wind measurements by the TWINS wind sensor will be integrated in order to separate the effects of various atmospheric phenomena. This sensor is almost identical to the Rover Environmental Monitoring Station sent to Mars as part of the Mars Science Laboratory (MSL), which operated even after the damage suffered during the MSL landing for more than two Martian years. Thus, wind measured by TWINS will provide valuable inputs to the decorrelation on the InSight SEIS instrument. Finally, the variations of decorrelation performances and compliance measurements with the diurnal Mars cycle will be analyzed.