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Sensitivity of elastic surface deformations caused by atmospheric, hydrologic, and oceanic loads to the Earth's crust and mantle properties

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The elastic deformation of the Earth's surface due to atmospheric surface pressure, terrestrial water storage, and ocean bottom pressure on seasonal or shorter time scales is usually represented by a set of elastic load Love numbers or the corresponding Green's function, determined from a radial Earth structure like PREM. Thereby, the influence of local deviations of the Earth's crustal and mantle properties is assumed to be negligible. However, local Green's functions derived individually for 1° grid cells from the 3D crustal structure model CRUST1 show large variations for in particular smaller distance angles. The loading response due to small-scale surface loads extending over less than 2500km^2 significantly depends on the heterogeneous shallow structure of the Earth. In this contribution, we discuss the influence of lateral variations in the crust and mantle structure on atmospheric, hydrologic, and oceanic surface loads with regard to their spatial scales and distribution. Non-tidal atmospheric loading is calculated from an atmospheric surface pressure time series covering four decades (1976 - 2015) based on 3-hourly atmospheric data of ECMWF that has been homogenized by mapping surface pressure to a common reference orography. Hydrological loading is calculated for daily terrestrial water storage from LSDM over the same time period, where the surface water compartment is mapped from the 0.5° model resolution to a 0.125° GIS-based river network. Ocean tidal loading is exemplarily calculated based on the FES2014 ocean tidal model (0.0625°). Especially along the coasts of the oceans; in regions with steep orographic gradients; and in areas with thick crustal layers or sediments we will show the significant influence of the Earth's structure on small-scale deformation features caused by surface loads.