Geophysical Research Abstracts
Vol. 21, EGU2019-11142, 2019
EGU General Assembly 2019

Votemap cluster inversion – a novel approach to link deep deep earth seismology and the gravity field

Wolfgang Szwillus, Jörg Ebbing, and Agnes Wansing
Kiel University, Geosciences, Geophysics, Kiel, Germany (szwillus@geophysik.uni-kiel.de)

The velocity distribution inside the deep Earth can be illuminated using a wide range of seismological techniques. This has revealed a number of surprising structures, such as the Large Low Shear wave Velocity Provinces (LLSVPs), that have been linked to fundamental behaviour of Earth's large scale convection. Since these structures should possess anomalous density, they are expected to be represented in Earth's long wavelength gravity field.

However, it is unclear how to determine the density anomaly associated with deep mantle structures from seismology. Commonly it is assumed that velocity and density are correlated, due to their common dependence on temperature. However, in the deep mantle, the scaling of velocity to density is highly uncertain, due to incomplete knowledge of mineralogy and rock properties at high pressures. In addition, compositional variations become more important in the deep Earth, because thermal expansivity is reduced at high pressure. If velocity anomalies are caused by compositional variations, there might be no or even a negative correlation of density and velocity. These theoretical problems are further compounded by methodological differences between different seismological methods, which lead to disagreements in terms of velocity anomaly magnitude and spatial structure.

As an alternative to converting velocity to density, we propose to use the recently developed idea of votemaps. Votemaps codense information from several seismic models, by counting at each position how many of the seismic models show a significant velocity anomaly (relative to the velocity scale of each model). In this way, probable locations of anomalous features are defined. We use a linear inversion to determine the density of each feature, by fitting the measured gravity field. Since it is unclear how much deep Earth signals are hidden by shallow density anomalies in the lithosphere, we will use both the isostatic gravity anomaly and a gravity anomaly determined by stripping the gravity effect of the seismological model Crust1.0.