Geophysical Research Abstracts
Vol. 20, EGU2018-5307, 2018
EGU General Assembly 2018

Can satellite gravity data help to cover gaps in ground based datasets?

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In the framework of the ESA Support to Science Element "3D Earth – A Dynamic Living Plant" we explore how satellite gravity data can help to cover spatial gaps of ground-based datasets in a joint inversion. We use the XGM2016 satellite gravity model together with magnetotelluric (MT) data from the MT component of the USArray. At a later stage surface wave data from the USArray will also be included. Our test area is characterized by a variety of different tectonic provinces (e.g. orogens, cratons) and processes (e.g. subduction, hotspot volcanism). Previous inversions of the data from the MT component of the USArray in the North-Western USA have shown some similar features such as low conductivities beneath the Wyoming craton and a generally conductive lower crust, but beneath the Yellowstone Hotspot different models show varying conductivity structures. Using a joint inversion we investigate if it is possible to clarify the structure of the North-Western USA.

We start by individually processing and inverting the MT and gravity data. The resulting MT model shows many of the features already observed in previous analyses of similar datasets. The unconstrained inversion of the gravity data suffers from the lack of vertical resolution but shows distinctive lateral patterns of density variations. For the joint inversion we test the influence of the starting model by using (i) the final individual conductivity and density models and (ii) a 1D conductivity model based on the inversion of an average station and a homogeneous density model as starting models. By comparing the joint inversion results with the models resulting from the individual inversions we demonstrate the added value of jointly inverting different datasets. Finally, we show how the joint inversion results change when only a subset of the MT stations is used in order to simulate a dataset with a less homogeneous data coverage than the USArray and how satellite data can help to recover information in those data-gaps.