BAYESIAN FUSION OF GEOPHYSICAL DATA-SETS: HOW TO INTEGRATE PASSIVE AND ACTIVE SEISMIC, STRUCTURAL AND BOREHOLE DATA FOR HIGH-RESOLUTION MODELING OF THE VIENNA SEDIMENTARY BASIN

PIANA AGOSTINETTI, Nicola* (1); DECKER, Kurt (2); LENHARDT, Wolfgang (3); GRASEMANN, Bernhard (2)

1: Dublin Istitute for Advanced Studies, Ireland; 2: Department of Geodynamics and Sedimentology, Vienna University; 3: Zentralanstalt für Meteorologie und Geodynamik, Vienna

piana@cp.dias.ie

Bayesian inference, joint inversion, passive seismic techniques, Vienna basin

We present the workflow of a Bayesian fusion algorithm applied to geophysical data-sets. The goal of our study is to obtain a high-resolution, multi-parametric model of the Vienna basin with associated uncertainties on the retrieved parameters. Such basin has been a target of a number of studies focused on determining the elastic properties of its geological units for oil&gas and geothermal exploration. Bayesian fusion is a novel methodology which can be used to overcome the main issues related to data-sets integration. A classical approach to geophysical data-sets integration is to reconstruct images of the basin structures using different methods, and then combine these images and interpret them simultaneously. Active seismic data, geological maps and borehole data are often integrated following such scheme, retrieving the elastic properties of the sedimentary units and the geometry of their contact interfaces. However, two issues must be faced. First, different spatial coverage, due to intrinsic limitation of each method, does allow for integration using expert knowledge only, while an analytical approach to joint inversion requires the same spatial sampling in all data-sets, a condition rarely realized in operational fieldwork. Because of this limitation, classical data-sets integration often does not quantify any uncertainties on the reconstructed model. Moreover, elastic models are usually limited to P-wave velocity models, and more elusive elastic properties (e.g. seismic anisotropy at depth) cannot be recovered due to the lack of complementary information.

Adopting a trans-dimensional Bayesian fusion methodology allows us to integrate un-evenly sampled information and estimate the uncertainties in the model parameters. The algorithm works as a standard trans-dimensional sampler, where the number of unknowns is an unknown itself. In this way, the resolution in the model is solely dictated by the data, without any dumping and/or smoothing of the solution. The algorithm is developed in a hierarchical Bayes framework and we do not need any subjective parameter to weight the data-sets in the likelihood function. In our workflow, we integrate both passive and active seismic data with published geological and geophysical data. Here, we present the details of the workflow together with examples from the Vienna basin.