Geophysical Research Abstracts
Vol. 18, EGU2016-2646, 2016
EGU General Assembly 2016

Inversion as an iterative puzzle: A probabilistic formulation with graph cuts

Niklas Linde (1), Guillaume Pirot (1), Grégoire Mariethoz (2), and Tobias Zahner (1)

(1) Institute of Earth Sciences, University of Lausanne, Lausanne, Switzerland (niklas.linde@unil.ch), (2) Institute of Earth Surface Dynamics, University of Lausanne, Lausanne, Switzerland

Geophysical inversion results should ideally feature realistic connectivity patterns when considering applications of relevance for subsurface mass transfer. We argue that persistent resolution limitations of geophysical data are most likely to prohibit such a goal if the inversion framework does not incorporate geological considerations. Geological concepts can be included through multiple-point statistics tools that produce multiple subsurface realizations that are in agreement with a training image that defines the underlying conceptual geological model. A recent patch-based geostatistical resimulation algorithm that uses a graph cuts strategy allows for model realizations of similar quality as state-of-the-art multiple point statistics simulation codes, but at a fraction of their computational cost. This enables considerable speed-ups in sequential geostatistical resimulation algorithms that use Markov chain Monte Carlo to sample the posterior probability density function. Our algorithm works very well when considering continuous and discontinuous property fields for cases of noise-contaminated synthetic data and a training image that is consistent with the higher-order statistics of the test model. Applications to field data are more challenging due to inevitable discrepancies between the actual subsurface structure and the assumptions made in deriving the training image. We argue that the degradation of the inversion results obtained by using an inappropriate training image can be seen as a strength of the method as it forces the user to reconsider the conceptual geological model and petrophysical relationships until sufficient and appropriate details are included to obtain meaningful results. Possible pitfalls and working strategies for field data will be presented together with an outlook towards joint inversion of multiple geophysical and hydrogeological data types.