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Trandimensional Inference in the Geosciences

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An inverse problem is the task often occurring in many branches of Earth sciences, where the values of some model parameters describing the Earth must be obtained given noisy observations made at the surface. In all applications of inversion, assumptions are made about the nature of the model parametrisation and data noise characteristics, and results can significantly depend on those assumptions. These quantities are often manually 'tuned' by means of subjective trial-and-error procedures, and this prevents to accurately quantify uncertainties in the solution.

A Bayesian approach allows these assumptions to be relaxed by incorporating relevant parameters as unknowns in the inference problem. Rather than being forced to make decisions on parametrisation, the level of data noise and the weights between data types in advance, as is often the case in an optimization framework, the choice can be informed by the data themselves. Probabilistic sampling techniques such as transdimensional Markov chain Monte Carlo, allow sampling over complex posterior probability density functions, thus providing information on constraint, trade-offs and uncertainty in the unknowns.

This presentation will present a review of transdimensional inference, and its application to different problems, ranging from Geochemistry to Solid Earth Geophysics.