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Spatially constrained Bayesian inversion of frequency- and time-domain electromagnetic data from the Tellus projects

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The frequency- and time-domain airborne electromagnetic (AEM) data collected under the Tellus projects of the Geological Survey of Ireland (GSI) which represent a wealth of information on the multi-dimensional electrical structure of Ireland's near-surface. Our project, which was funded by GSI under the framework of their Short Call Research Programme, aims to develop and implement inverse techniques based on various Bayesian methods for these densely sampled data. We have developed a highly flexible toolbox using Python language for the one-dimensional inversion of AEM data along the flight lines. The computational core is based on an adapted frequency- and time-domain forward modelling core derived from the well-tested open-source code AirBeo, which was developed by the CSIRO (Australia) and the AMIRA consortium. Three different inversion methods have been implemented: (i) Tikhonov-type inversion including optimal regularisation methods (Aster el al., 2012; Zhdanov, 2015), (ii) Bayesian MAP inversion in parameter and data space (e.g. Tarantola, 2005), and (iii) Full Bayesian inversion with Markov Chain Monte Carlo (Sambridge and Mosegaard, 2002; Mosegaard and Sambridge, 2002), all including different forms of spatial constraints. The methods have been tested on synthetic and field data. This contribution will introduce the toolbox and present case studies on the AEM data from the Tellus projects.