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Testing new methodologies and assessing their potential for reservoir characterisation: Geoelectrical studies in the Northwest Carboniferous Basin (Ireland).

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The overarching objective of this study is to improve our methods of characterising saline aquifers by integrating newly acquired electromagnetic data with existing geophysical and geological data. The work presented here is part of an ongoing project to evaluate Ireland's potential for onshore carbon sequestration (IRECCSEM; funded by Science Foundation Ireland). The methodology presented in this characterisation work is not only relevant for studying the potential for onshore carbon sequestration, but is generally applicable for aquifer characterisation, particularly for the evaluation of geothermal resources in appropriate geological settings. We present first results of the three-dimensional (3D) modelling and inversion of the magnetotelluric (MT) data acquired in the Northwest Carboniferous Basin (Ireland) in summer 2015. The electrical resistivity distribution beneath the survey area is constrained using a joint inversion of three different types of electromagnetic data: MT impedance tensor responses (Z), geomagnetic transfer functions (GTF) and inter-station horizontal magnetic transfer-functions (HMT). The preliminary 3D resistivity model obtained reveals the geoelectrical structure of the subsurface, which is translated into parameters relevant to fluid flow. The electromagnetic data were acquired along profiles linking four wells drilled in the area and the available well log data from those wells are used to evaluate some of the existing petrophysical relationships and calibrate them for the study area. This allows us to interpolate the rock physical properties from one well to another well, using the computed geoelectrical model as a reference. The obtained results are compared to available independent geological and geophysical data in order to analyse the validity of this technique, to characterise the uncertainties inherent to our approach, and to assess the potential of this methodology for reservoir characterisation.