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Adjoint-state inversion of electric resistivity tomography data of seawater intrusion at the Argentona coastal aquifer (Spain)

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Seawater intrusion in aquifers is a complex phenomenon that can be characterized with the help of electric resistivity tomography (ERT) because of the low resistivity of seawater, which underlies the freshwater floating on top.
The problem is complex because of the need for joint inversion of electrical and hydraulic (density dependent flow) data. Here we present an adjoint-state algorithm to treat electrical data. This method is a common technique to obtain derivatives of an objective function, depending on potentials with respect to model parameters. The main advantages of it are its simplicity in stationary problems and the reduction of computational cost respect others methodologies.
The relationship between the concentration of chlorides and the resistivity values of the field is well known. Also, these resistivities are related to the values of potentials measured using ERT. Taking this into account, it will be possible to define the different resistivities zones from the field data of potential distribution using the basis of inverse problem.
In this case, the studied zone is situated in Argentona (Baix Maresme, Catalonia), where the values of chlorides obtained in some wells of the zone are too high. The adjoint-state method will be used to invert the measured data using a new finite element code in C ++ language developed in an open-source framework called Kratos.
Finally, the information obtained numerically with our code will be checked with the information obtained with other codes.