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The complex hydrogeological equilibrium of the Salar de Atacama (NE Chile): a numerical approach for the management of salt flats systems

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Salt flats (salares) are one the main global sources of lithium, as well as other mineral resources such as nitrate, sodium chloride, iodine, potassium and bischofite. These mineral resources have been accumulating for thousands of years as a consequence of the high rates of evaporation and are dissolved in the brine which facilitates their exploitation. The strong anthropogenic pressures (brine pumping) require the development of techniques and methodologies that facilitate efficient sustainable management of ecosystems of high ecological value.
A detailed integral methodology has been proposed for the sustainable management of salt flats. The main part of this methodology is the numerical modelling of salt flats at a low computational cost in order to be applied to the management carried out by the administration and mining companies. This methodology has been applied to the Salar de Atacama, which is the predominant source of lithium in the world.
The numerical modelling is based on the application of corrections to the hydraulic heads of freshwater and mixtures. This procedure is highly effective emulating the dynamics produced by the variable density effects at a regional scale. The minimum hydraulic head is defined at the mixing zone or slightly displaced towards the nucleus as a consequence of the complex processes that take place in this area. This, together with the proposed boundary conditions for the mixing zone, has allowed the reproduction of vertical flows in the interface (lagoons and wetlands). It is therefore confirmed as a powerful and low computational cost tool for the sustainable management of the marginal lagoon ecosystems of salt flats.