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pyR2, an easy to use graphical user interface and python API for hydrogeophysical DC/IP applications

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Geoelectrical methods provide spatial images of electrical properties of the subsurface at a wide range of spatial scales. Their adaptation to time-lapse monitoring allows spatio-temporal investigations of subsurface processes. They are probably the most widely used class of method in hydrogeophysics. Many inversion frameworks are available for inversion of electrical geophysical data; some require advanced knowledge of using complex command line tools, others provide graphical user interfaces (GUI) with limited control on the inversion process. This can make the process of inverting/modelling geoelectrical data for non-specialist users challenging. To tackle this issue and broaden the use of hydrogeophysics without constraining complexity, we designed pyR2 a free and open-source software with a modern tabbed graphical user interface and a python API (https://gitlab.com/hkex/pyr2), which is based around the mature R2/R3t (resistivity) and cR2/cR3t (induced polarization) inversion codes. As the python wrapper is open source, the scientific community can view, check and improve the code. The GUI allows the user access many of the powerful features of the inversion codes, as well as relevant pre- and post-processing features (such as conversion of images to hydrological properties and states), while its python API allows to create repeatable python scripts and jupyter notebooks.

We demonstrate how pyR2 can improve the use of hydrogeophysics for different applications: (1) monitoring of root water uptake from time-lapse ERT survey, (2) effect of soil compaction on soil moisture dynamics, (3) inversion of partially submerged electrodes survey in a river, (4) monitoring moisture dynamics of a landslide. Since good data acquisition is a key primary stage, pyR2 also includes modelling tools to assist in survey design. The ultimate aim is to demonstrate the usefulness for a wide range of hydrogeophysics problems and make it easier to design, invert and interpret the results while keeping the user in full control. We hope this will allow broader use of hydrogeophysics, particularly in multi-disciplinary ventures.