Geophysical Research Abstracts
Vol. 17, EGU2015-7433-1, 2015
EGU General Assembly 2015

Intelligent mapping of alluvial aquifer characteristics in the Otago region, New Zealand

Michael Friedel (1,2), Zara Rawlinson (3), Rogier Westerhoff (3,4)

(1) Hydrogeology Department, GNS, Lower Hutt, New Zealand (m.friedel@gns.cri.nz), (2) Mathematics and Statistical Sciences, University of Colorado, USA, (3) Hydrogeology Department, GNS, Wairakei, New Zealand, (4) Deltares, Utrecht Area, Netherlands

We adopt a hybrid approach to map the 3D hydrostratigraphy of an alluvial aquifer using big data collected in the Ettrick basin, Otago New Zealand. First, a subset (1%) of the 18 million regional helicopter frequency-domain electromagnetic (HEM) sounding measurements (300 Hz, Horizontal co-planar; 3300 Hz, vertical co-planar; 8200 Hz, horizontal co-planar; 40 kHz, horizontal co-planar; 137 kHz horizontal coplanar) and their numerically-inverted 1D resistivity (50¬–100 Ω-m) profiles are randomly split. For example, 50% of these data are used for training an unsupervised machine-learning (ML) network, and 50% of these data are used for performance at independent locations. The remaining set of HEM measurements are then presented to the vetted ML network to estimate regional resistivity structure which is compared to previously inverted resistivity. Second, about 50 borehole autocorrelation functions are computed based on cross-component correlations of quantized borehole locations sampled for lithology and HEM sounding data. Third, an unsupervised ML network is trained and performance tested using sparse borehole lithology (fractions of sand, silt, clay, mudstone, schist) and hydraulic properties (storage, hydraulic conductivity), and those HEM sounding data occurring within a radius defined by the maximum borehole autocorrelation distances. Fourth, this ML network is then used together with independent HEM sounding measurements to map the spatial distribution of physical aquifer properties and hydraulic properties across the basin.