TITLE: Long-Term Monitoring of Infiltration at a Managed Aquifer Recharge Site Using Electrical Resistivity Probes
SESSION: H26. Hydrogeophysics: Advances in measurement, monitoring and modeling of hydrological processes.
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ABSTRACT: As part of an effort to understand the hydrogeologic parameters that influence the performance of a managed aquifer recharge project, four Electrical Resistivity Imaging (ERI) probes were installed beneath an artificial recharge pond to monitor changes in bulk electrical resistivity as a function of time. The probes were three meters long and installed to a depth of two meters below the pond bottom, with a one-meter section of the probe extending into the water. Resistance measurements were obtained through a group of 21 electrodes below the pond bottom, and a group of 4 electrodes in the water column. Spacing between electrodes in each group was 10 cm, while spacing between the subsurface and water column electrodes was 75 cm. While one probe failed immediately, the remaining three have been in operation for two years beneath the pond. A total of 96 measurements were made on each probe, every 18 minutes for two operational seasons (January - August). These seemingly simple measurements have provided tremendous insight into the subsurface flow at the base of the pond, and the challenges associated with using these data in a quantitative manner. Inversion of these data using an axially symmetric cylindrical inversion approach with both a L-1 and L-2 norm demonstrates that, despite the use of direct-push methods for probe emplacement, there is a significant disturbed zone adjacent to the probes. This disturbed zone adjacent to the probe leads to a violation of a one-dimensional assumption, and therefore complicates interpretation of the data. We note that, had we only used a traditional sampling array along the probe (e.g. a fixed a-spacing Wenner array), we would not see this disturbed zone and our calculated resistivity estimates would be influenced by the disturbed zone.

In addition to being able to detect, and subsequently account for, the disturbed zone, the high temporal sampling rate of these measurements gives us the ability to generate robust error estimates that can be used in our inversion. At this site, ERI monitoring sweeps occurred at a sampling rate that was much faster than the evolution of the hydrologic processes under investigation. We therefore used temporal compression, or stacking, to: 1) increases signal to noise ratio, and 2) provide a standard deviation of every datum, as a function of time.

Finally, following inversion, the models were averaged into horizontal regions, with the disturbed zone removed. This averaged times series show that 1) there is significant variability between the responses of each probe and 2) at this site there are a multitude of processes that affect the ERI results, such as changes in saturation, water chemistry, and temperature. The results demonstrate that without calibrating for these dynamic near-surface processes (as well as correcting for the disturbed zone), the use of rock physics relationships, such as Archie's law, to estimate soil properties from ERI data gives

erroneous results.

INDEX TERMS: [1895] HYDROLOGY / Instruments and techniques: monitoring, [1838] HYDROLOGY / Infiltration, [1835] HYDROLOGY / Hydrogeophysics.