Pidlisecky, A., and Knight, R., Temperature dependence of electrical resistivity measurements: A useful infiltration tracer? *Eos Trans. AGU, 89(53),* Fall Meet. Suppl., Abstract H42D-06, Oral Presentation, 2008.

Temperature dependence of electrical resistivity measurements: A useful infiltration tracer?

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As part of an ongoing monitoring project, three resistivity probes were installed to a depth of 2m below a seasonal infiltration pond on the central coast of California. The probes were instrumented with 35 resistivity electrodes and 5 temperature loggers. They were designed to monitor the change in bulk resistivity beneath the pond during infiltration. The pond was filled in January 2008 and resistivity measurements were made on each probe every hour for a period of 4 months. In addition to changes in bulk resistivity, we observed diurnal fluctuations in the apparent resistivity signal due to the temperature dependence of in-situ resistivity. By processing the resistivity data, using a band pass filter, we can recover a time-depth section of pseudo-temperature data. We refer to these data as pseudo-temperature because they can be treated as a surrogate for temperature in terms of phase but not amplitude. These pseudo-temperature sections can be used as a tracer to calculate 1D infiltration rates. When compared with in-situ temperature loggers, we see good agreement. Moreover, we note that the resistivity fluctuations correspond to temperature variations that are less than one degree Celsius. The use of the temperature dependence of measured resistivity is a promising field technique. The pseudo-temperature data may prove more robust than using traditional temperature probes given that the larger sampling volume of the resistivity measurement will limit the influence local flow path perturbations caused by probe installation. Future research will involve extending this approach to 2D tomography in hopes of providing us with a technique for obtaining spatially exhaustive estimates of near-surface infiltration rates.