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Time-lapse electrical resistivity and multi-compartment sampler measurements for monitoring flow and transport at Oslo airport, Gardermoen

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Pollution of soils is a widespread problem and is an important part of the still to be implemented Soil Directive (EU). To improve risk assessment, monitoring, and treatment strategies for natural attenuation, we require a better understanding of the effect of soil heterogeneity on contaminant movement and methods for monitoring the effects of this heterogeneity at contaminated sites.

Geophysical methods provide indirect measurements of subsurface properties over larger volumes than tradition techniques, and are potentially cost-efficient. However, the usefulness of any individual set of geophysical measurements (akin to a snapshot at one point in time) is severely limited by the problem of non-uniqueness or ambiguity when used to study contaminated sites, where the attendant processes vary in space and time. To make progress on soil contamination assessment and site characterization there is a strong need to integrate quasi field-scale, extensively instrumented tools, such as the multi-compartment sampler, with non-invasive (geophysical) methods. We illustrate this approach in an application to solute transport at Oslo airport, Norway.

The impact of annual infiltration of large quantities of de-icing chemicals at Oslo airport, Gardermoen, represents common challenge for all airports with winter frost. It is also similar to the challenge posed by de-icing salt application along roads. At the research field station at Gardermoen, a degradable de-icing chemical and an inactive tracer were added to the snow cover prior to snowmelt and to the surface during an irrigation experiment performed after the snowmelt. In order to link geophysical measurements to solute transport processes in the unsaturated zone, time-lapse cross borehole resistivity measurements were conducted at the same time as soil water samples were extracted at 51 cm depth with a multi-compartment sampler. Measurements of soil temperature, and tension were also carried out during the monitoring period. We present a selection of results from the infiltration experiments and combination of measurement techniques and illustrate the potential strength of geophysics for mapping the impacts of soil heterogeneity on solute transport.