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Spatio-temporal assessment of soil infiltration capacity through physical-based models and geostatistical inference

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Surface infiltration ponds (SP) provide an efficient and effective method to perform managed artificial recharge of aquifers whenever the soil hydraulic parameters are correctly predicted. In particular, the local-scale infiltration capacity varies in space and time and the pond-scale infiltration varies in time. Any estimation of these is uncertain due to complex clogging mechanisms and lack in the geological characterization of an infiltration sites. Here, we propose a method to combine geostatistical inference of spatial variability of soil characteristic with a temporally dependent physical model. In a field campaign we obtain experimental measurement of local-scale infiltration capacity at select locations within the SP as well pond-scale values of the global infiltration capacity during a large scale experiment. We adopt an exponential model to reproduce changes in the infiltration capacity with time. Accounting for experimental, site-dependent and model errors, we can map characteristic variables associated with the soil (e.g. soil-dependent clogging factors) with local uncertainty and the distribution of local infiltration capacity at different times during the infiltration. Assessing the spatial distribution of infiltration rates is important for the optimum scheduling of maintenance operations on the SP as well as for cost-effective designs of managed artificial recharge facilities.