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Bayesian data fusion applied to water table spatial mapping

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Water table elevations are usually sampled in space using piezometric measurements that are unfortunately expensive to obtain and are thus scarce over space. Most of the time, piezometric data are sparsely distributed over large areas, thus providing limited direct information about the level of the corresponding water table. As a consequence, there is a real need for approaches that are able at the same time to (i) provide spatial predictions at unsampled locations and (ii) enable the user to account for all potentially available secondary information sources that are in some way related to water table elevations. In this paper, a recently developed Bayesian Data Fusion framework (BDF) is applied to the problem of water table spatial mapping. After a brief presentation of the underlying theory, specific assumptions are made and discussed in order to account for a digital elevation model as well as for the geometry of a corresponding river network. Based on a data set for the Dijle basin in the north part of Belgium, the suggested model is then implemented and results are compared to those of standard techniques like ordinary kriging and cokriging. Respective accuracies and precisions of these estimators are finally evaluated using a “leave-one-out" cross-validation procedure. Though the BDF methodology was illustrated here for the integration of only two secondary information sources (namely a digital elevation model and the geometry of a river network), the method can be applied for incorporating an arbitrary number of secondary information sources, thus opening new avenues for the important topic of data integration in a spatial mapping context.