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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Exploring hydrological similarity during soil moisture recession periods using time dependent variograms" *by* Mirko Mälicke et al.

Anonymous Referee #1

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This is an interesting study, but there are some failures of clarity, and ultimately I am unconvinced by the analysis.

The authors raise the general point that the spatial covariance parameters of soil water content (SWC) are unlikely to remain fixed as the soil wets and dries. This is a reasonable point. I think that the authors' treatment of it would gain considerably in clarity if they expressed it in terms of current practice for space-time geostatistical modelling. They state from time to time that one cannot interpolate SWC data because of the possibility that covariance parameters change with time, but this is not true if one interpolates for a single time, and if one interpolates from a full space-time sample then

one requires a space-time model, not just a spatial model even when one can be defined. Various space-time models are available, of which the simplest are the separable models. But even a relatively simple non-separable model, the product-sum model, requires that we can assume a marginal spatial variogram. The authors' contention is that such a marginal variogram cannot be defined for SWC because of changes in the spatial parameters over time.

I am not convinced by the approach that the authors have taken. In summary they want to cluster empirical spatial variograms to identify time periods in which these appear to be stationary. But it is not clear that this is useful. If one's objective is to interpolate within a period corresponding to a cluster one is still ignoring the temporal variation and the temporal dependence that it might exhibit. It would be more appropriate to develop an extension of existing space-time models, using appropriate methods to deal with non-stationarity (Pintore, A., Holmes, C.C., 2005. A dimension-reducing approach for spectral tempering using empirical orthogonal functions. In: Leuangthong, O., Deutsch, C.V. (Eds.), Geostatistics Banff 2004. Springer, Dordrecht, pp. 1007–1015; Sampson, P.D., Guttorp, P., 1992. Nonparametric-estimation of nonstationary spatial covariance structure. Journal of the American Statistical Association 87, 108–119).

Second, I do not think that ranks are an appropriate way to tackle this problem. Rank statistics throw away a lot of information, and their statistical distribution makes them unsuited to most geostatistical modelling.

Finally, it is surely clear that a network of 15 sensors is entirely inadequate to estimate the parameters of a spatial model. Aggregating over time might give the illusion of respectable sample sizes, but given the temporal dependence which is to be expected for SWC this could be seriously misleading.

In summary, I think that there is the germ of an interesting study here, but it requires a more adequate data set, and appropriate models based on a stronger conceptual

approach as might be offered by space-time geostatistical models.

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