

## ***Interactive comment on “Geostatistical modeling of spatial variability of water retention curves” by H. Saito et al.***

**H. Saito et al.**

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Cokriging is certainly one of the options for interpolation. Those parameters may be correlated. However, it will be very difficult and time-consuming to decide which parameter(s) will be used for secondary variable(s) as there are at least four parameters in each approach leading to a total of 24 possible combinations. The number of parameters used is nine for the NP approach (IF approach in the revised manuscript). In this sense, although we can do some arbitrary combinations of parameters, using parameters as the secondary variable in cokriging is not practically feasible, unless some prior knowledge is available on which parameters are correlated well with which other parameters. If cokriging is used, then the secondary variable should be the one obtained independently, such as in-situ water contents, so that this information can be used as a

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secondary variable for all parameters. Unfortunately, there are no such data available at this site. In addition, the purpose of this study is not to find the best estimation but to investigate the effect of taking different estimation paths. Therefore, we decided not to use cokriging in this study.

MSE has been replaced by ME to compare the quality of interpolation techniques. We have calculated standard deviations among 11 water contents at 447 sampling locations for observed retention data and those obtained by FIOK and IF11 for the BC model (not shown here). In general, standard deviations of observed retention data show a wider distribution than those obtained by FIOK and IF11s. It is, however, not straightforward to tell which approach, FIOK or IF11, has more smoothing effect from the distribution of the standard deviation.

We totally agree with Referee 3 that behavior and spatial correlations are different in horizontal and vertical directions. Some discussions on this topic have been included in the discussion section of the revised manuscript.

Nuggets of vertical and horizontal variograms were fitted to the same value but not to zero. Zonal anisotropy is of course an option to model nuggets in this study. However, using a zonal anisotropy model for the nugget effect leads to troublesome analysis later in kriging. It is required, therefore, that an equal value is chosen for the nugget effect in all directions. In this study, even though small nugget effects are fit to vertical semivariograms, because ranges for the first non-nugget structure are so small that the effect of having small nugget effects is minimal. As a result, zonal anisotropy is not used in this particular case.

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