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Interactive comment on "Multi-scale analysis of bias correction of soil moisture" *by* C.-H. Su and D. Ryu

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The authors present a framework within which soil moisture time series (as derived from e.g. models or remote sensing instruments) can be analysed and compared at different temporal scales. Such data commonly exhibit complex scale-dependent behaviour: a fact to which only cursory attention is usually paid when soil moisture products are assessed or compared. The manuscript is thus certainly relevant for HESS - and the hydrological community at large. I also find it well written and generally carefully argued, but I would like to mention a few points that the authors might want to consider:

1. Previous work

p 8998, 1-12: this is mostly based on hydrological principles, previous empirical work (e.g. [1], [2],[3]) not being mentioned

2. Interpolation and interpretation of the results

p 9000, 1-2: how sensitive are the results to the choice of interpolation algorithm? I would expect it to be particularly relevant at fine temporal scales, but this is not included in the analysis of Section 4 (e.g. lines 14-15 on p 9004). More generally, the whole discussion seems to be based on a model that can represent discrepancies between two soil moisture products by noise and multiplicative biases, which has not been introduced at that point. I think that the section, and similarly Sec. 5, would be improved by clarifying this aspect, as well as by considering different descriptions of the discrepancies, as the assumption of temporal stationarity at any scale seems to be not easily tenable (e.g. apparent presence of secular trends). These trends, as well as more general additive biasses such as seasonal variations, could also furnish a parsimonious description for the discrepancies between products, e.g in Fig. 8a) in [4]; so would autocorrelated noise, the two being quite closely related [3]. They might not be easily incorporated into the framework, but by virtue of this, the analysis of such cases could aid future interpretation of data within this framework: how would, for instance, a seasonal additive bias be represented if such data were analysed with this model? These issues are only briefly touched upon in the conclusions.

3. Definition of model and relevant quantities

Sec. 5: which quantities are random and which are deterministic? If the time series are assumed to be realizations of stochastic processes (what kind of expectations are understood by the operator E?), which properties are attributed to these stochastic processes, esp. with regards to the wavelet representations, cf. [5] but also Appendix A, where they seem to be treated as deterministic. Are E(p) and E(f) time-variant?

4. Error structure

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p 9010, 8-20: you present the modification of the error-structure by scale-dependent bias correction as an unwelcome side effect. I do not think this is necessarily the case: it depends on which representation/transformation of the time series one is primarily interested in. As the careful analysis of diverse patterns of soil moisture time series is a great asset of this manuscript, I would welcome a slightly more detailed discussion.

5. Minor points

p 9001: please clarify the meaning of j, j_0, and J: $N = 2^j$, but then it seems to be 2^J

p 9002: is the (evenly sampled) time t dimensionless or not? The temporal location of $\phi_{j,k}$ is stated as $k * 2^j$, which is dimensionless.

p 9002, 23: the significance being based on what test and significance level?

p 9005, 23: that is rather consistency (and it is a limit in probability)

p 9006, 14: is not the identity of the signal components (treated as a deterministic or random variable) the criterion by which optimality (or ideality) is defined?

p 9015, 5: what are physically meaningful results? There are many additional reasons why e.g. negative variances could be obtained, such as inadequate rescaling or cross-correlation.

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[4] Jackson, T.J.; Cosh, M.H.; Bindlish, R.; Starks, P.J.; Bosch, D.D.; Seyfried, M.; Goodrich, D.C.; Moran, M.S.; Jinyang Du, Validation of Advanced Microwave Scanning Radiometer Soil Moisture Products, Geoscience and Remote Sensing, IEEE Transactions on , vol.48, no.12, pp.4256,4272, Dec. 2010.

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