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Discussions

Interactive comment on "Evaluating topographic wetness indices across central New York agricultural landscapes" *by* B. P. Buchanan et al.

Anonymous Referee #2

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This study aims to search the optimal formulation of topographic wetness index (TWI) or soil topographic wetness index (STI) for achieving a higher correlation between the computed TWIs or STIs and measured soil moisture at five agricultural fields in central New York. The authors spent a significant amount of effort in formulating TWI or STI; actually about 400 unique formulations were formed and tested. The conclusions drawn from this study are 1) finer resolution DEM is better than coarser resolution DEM; 2) including soil properties in the topographic index improved the correlation. Such conclusions are not new and the associated contribution to the current knowledge of soil moisture dynamics and the impacts of terrain and soil on soil moisture processes is not significant. On the other hand, I have several concerns with regard to the methodologies employed in this study.

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When the topographic index is computed, although we compute slope and flow accumulation area separately, these two variables should be computed using the consistent slope algorithm and flow accumulation algorithm. The combination of slope and flow accumulation algorithms may be called the topographic index algorithm and depends on the flow direction algorithms. For example, in the single flow direction (SFD) algorithm, the flow direction is defined as the steepest slope direction, and the flow accumulation area then is computed based on this steepest slope direction method, and the associated slope used in the topographic index calculation is computed as tangent of the slope angle along the steepest slope direction at each pixel. However, some slope algorithms and flow accumulation algorithms used in this study are not related therefore it may cause inconsistency in computing the topographic index.

Another issue is that zero slope value is not allowed in computing the topographic index. In this study, the authors did not mention how are flat pixels and zero slope values treated for computing the topographic index.

In Figure 1, only five dots show the locations of the five study sites. I wonder why not display the computed TWI or STI images, which would give audience a general idea of these five locations in terms of hydrologic setting, such as upland, midland, or lowland. The correlation between soil moisture and TWI or STI depends on these five locations. For example, if among these five sites, one third are in upland, one third in midland, and one third in lowland, the correlation between soil moisture and TWI or STI at these five sites must be greater than the correlation if all five sites are selected in one type of hydrologic setting area.

I don't think it is a good idea to select five sites in four or five different catchments, because one of advantages in the TOPMODEL is that through comparing the local topographic index or soil topographic index with the catchment areal average TWI or STI, we can evaluate the depth to water table or soil moisture deficit at each pixel. In this study, five sites are in different catchments and the areal average TWI or STI of these catchments are not necessarily same. On the other hand, five sites are not

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sufficient to have a good representation of the whole dynamic range of TWI or STI in a catchment.

The authors indicated the temporal characteristics of soil moisture processes vary with time, while TWI and STI are time-invariant variables. This implies that the correlation between soil moisture and TWI or STI must also vary with time. For example, during a storm event, soil is saturated across the catchment and the correlation between soil moisture and TWI may not be higher than the correlation during the soil moisture dry-down process when terrain and lateral flow and TWI play an important role in controlling soil moisture. Therefore, some effort is needed to investigate the temporal variation of the correlation between soil moisture and TWI or STI.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 14041, 2013.