

REVIEWER # 3:

- 1) 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.

RESPONSE: We considered all combinations of slope and flow accumulation algorithms. We have added text to acknowledge this point (lines 202-206). To the best of our knowledge, many of the flow accumulation algorithms do not have established, corresponding, slope algorithms. In the case of MD ∞ , for example, there is currently no conveniently packaged code which allows us to calculate both MD ∞ flow accumulation with a separate MD ∞ -based slope map. This makes it difficult to calculate a TWI using the MD ∞ algorithm despite its advantages over other flow accumulation expressions. Developing such algorithms is beyond the scope of this study.

- 2) 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.

RESPONSE: We set all zero slopes equal to 0.001. We clarified this point in lines 284-287.

- 3) 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.

RESPONSE: All fields were in “mid-slope” or “midland” positions, in part because our focus was on regional agricultural lands and they tend to be in these landscape positions. We have clarified this limited scope and its justification (lines 157, 169-172 and 650-653). In addition, we added the mean, standard deviation, minimum/maximum TWI values to Table 1. We chose not to include the TWI maps mostly because they would add a lot of figures to what is already a lengthy paper (~9,000 words, six tables, 13 figures and an appendix).

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

RESPONSE: Although we described the five field sites as being in different catchments, we could define a watershed using an outlet four or five kilometers away and most of our sites would be in the same one, i.e., the selection of watersheds is somewhat arbitrary. We chose outlets close to our sites mostly out of computational ease. Also, we are not using TOPMODEL here but adding to the literature evaluating topographic indices as proxies of hydrologic similarity. Our study includes more sites than any of the similar studies, which typically use only one study site and a few use as many as three. Also, this study was focused on regional agricultural lands so we were not necessarily looking for the full dynamic range of hydrologic-landscape settings.

- 5) 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 drydown 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.

RESPONSE: Figures 11 and 12 and the associated text include some temporal information; interestingly, we did not see any significant ($p < 0.05$) differences in the strength of the relationships with season or average soil moisture (we have added text to clarify this on lines 697-706). We looked at how TWI-soil moisture correlations changed as a function of mean soil moisture content at each sampling date. In general, as the mean soil moisture content of all sampled field sites increased the y-intercept increased. In contrast, the slope remained relatively less sensitive to antecedent conditions. This is consistent with the findings of Tague et al. (2010) and indicates that the rate of change in soil moisture as a function of TWI is somewhat independent of moisture state at the spatial and temporal scales of our measurements.

We recognized that the TWI concept is somewhat predicated on the assumption of quasi-steady state conditions so we purposefully avoided days with or immediately following storms. However, the very issue being raised in this comment is part of an on-going

extension of our study in which the sampling is being done much more frequently right after storm events.