

Interactive comment on “Effects of DEM scale on the spatial distribution of the TOPMODEL topographic wetness index and its correlations to watershed characteristics” by D. R. Drover et al.

D. R. Drover et al.

droved16@vt.edu

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Response to referee #1: Referee #1 is correct that the conclusions regarding the effects of DEM on representation of this landscape should not be generalized to all landscapes. Recently, Gillin et al. (2015) similarly found that DEM resolution strongly affected topographic interpretation, but in the steep mountains of New Hampshire they found that a 3 to 5 m DEM resolutions best represented the observed variation in soil characteristics. We explicitly said that it was true at our site that 20-30m maps were more closely related to the observed groundwater map than higher-resolution maps (pg 11833, lines 5-11). The main point of our paper is that DEM resolution strongly

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affects inference about the spatial variation of topographic controls on hydrologic and soil characteristics, and caution is needed in choosing an appropriate resolution versus simply choosing the highest available resolution. Also, we attempted to be explicit about the theory behind our expectations for the non-linear response to soil moisture, and thus the response to TWI value (pg 11826, lines 15-21). Just because we didn't find that TWI was the main driver behind the nitrogen/carbon content of the A horizon doesn't mean that biogeochemistry isn't affected by TWI in those areas of accumulation. We also noted that evaluations of TWI distributions and landscape characteristics need to be extended to other landscapes and additional landscape characteristics (pg 11831, lines 1-4), and we should reiterate that point in the conclusions.

Response to referee #2: One instance of novelty in this work is that we are not aware of any papers that show maps of how spatial variation of TWIs varies with DEM resolution. Gillin et al. (2015) included maps of upslope accumulation calculated from DEMs with resolution at 1, 3, 5 and 10 meter cells. Also, their data were collected from higher relief topography (Hubbard Brook Experimental Forest, White Mountains, New Hampshire, USA), while ours were collected from rolling Coastal Plains topography. Thus, our paper differs from the Gillin et al. 2015 paper in two important ways. First, our paper presents maps of TWI from 2, 5, 10, 20, 30 and 50 m resolution DEMs, so provides visual interpretation of the landscape in terms of how the surface drainage network changes with an extended range of coarser resolution relative to the Gillin et al. (2015) paper. Second, our study area consisted of low-relief terrain, while Gillin et al. (2015) and many other papers that address TWI distribution with DEM resolution use high-relief terrain DEMs. Lin et al. (2010) examined even coarser resolution DEMs than we did (25, 50, 100, 200, 400 and 800m), and their data were based on 25m-cell topographic maps, while ours were resampled from sub-meter LiDAR data. Use of LiDAR data was in fact one of our primary questions, because although the tendency is to use the highest resolution possible, we found that TWIs generated from 10-20m resolution DEMs most accurately represented depth to groundwater and hydric soils. Lin et al. (2010) also focused on different questions (e.g. uncertainty of TOPMODEL

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simulations) regarding DEM resolution, not addressing the spatial variation and interpretation as ours did. As such, we did not cite the Lin et al. (2010) paper because its focus questions were not directly relevant to ours. However, since some of their findings regarding statistical treatment of distributions of TWI support our results, and uncertainty is an important part of hydrologic analysis, we have revised our manuscript to include references to the Lin et al. (2010) paper. We have also removed the reference to TOPMODEL in our title and keywords, as recommended by referee #2. We agree that soil chemistry is related to more factors than simply topographic position, but topographic position should clearly matter as one of the five factors of soil formation. The question is how to best represent topographic control. We appreciate the referees' thoughts and suggestions, and we want to thank them for their helpful critiques. We have revised the manuscript to reflect their recommendations.

References Gillin, C., Bailey, S., McGuire, K., and Prisley, S. (2015). Evaluation of Lidar-derived DEMs through terrain analysis and field comparison. *Photogrammetric Engineering & Remote Sensing*, 81(5), pp. 387-396.

Lin, K., Zhang, Q., Chen, X., (2010). An evaluation of impacts of DEM resolution and parameter correlation on TOPMODEL modeling uncertainty. *Journal of Hydrology* 394, 370-383.

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