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Interactive comment on "Representing northern peatland microtopography and hydrology within the Community Land Model" *by* X. Shi et al.

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This paper is a timely and valuable contribution to high-latitude wetland modeling. I am writing because I noticed an important omission in the discussion of previous attempts to model peatland microtopography, and its effects on hydrology and carbon fluxes, in the introduction.

On Page 3384, line 6, the authors state that:

"Many wetland ecosystem models drive biogeochemical simulations using observed water table depth as an input variable (St-Hilaire et al., 2010; Frolking et al., 2002; Hilbert et al., 2000). Even though such models include water table effects, the models have not simulated observed variation for hummock/hollow microtopography common

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to raised-dome bog peatlands. The absence of this important detail may limit the predictive capabilities of existing peatland models. Other ecohydrological models couple hydrology and carbon cycles in peatlands, but differ greatly among each other with respect to their hydrological schemes and the way they treat (or ignore) terrain topography (Dimitrov et al., 2011). Some models, such as Biome-BGC (Bond-Lamberty et al., 2007), and Wetland-DNDC (Zhang et al., 2002) only simulate vertical soil water flow, neglecting lateral flow components (Dimitrov et al., 2011) within peatlands. Others, such as BEPS (Chen et al., 2005, 2007) and InTEC v3.0 (Ju et al., 2006) include sophisticated ecohydrological and biogeochemical sub-models capable of simulating three-dimensional hydrology (for large scale topography) coupled to peatland carbon dynamics. Sonnentag et al. (2008) further adapted BEPS to model the effects of mesoscale (site level) topography on hydrology, and hence on CO2 exchange at Mer Bleue bog. To the best of our knowledge, only one ecosystem model currently includes representation of microtopographic variability (hummock-hollow topography), that being the “ecosys” model (Grant et al., 2012). Ecosys tracks horizontal exchange between hummock and hollow elements, but its prediction of water table dynamics is constrained by specifying a regional water table at a fixed height and a fixed distance from the site of interest."

However, at least two other ecosystem models have represented hummock-hollow topography: LPJ-WHyMe (Wania et al., 2010) and VIC (Bohn et al., 2013). Both of these models described their formulations in papers that focused on methane emissions (rather than net carbon exchange), which perhaps explains why the authors might have missed them in their literature searches. But both of these models simulate other aspects of the carbon balance and should be included in the current paper’s literature review.

In addition, several other studies have attempted to account for sub-grid water table heterogeneity via a TOPMODEL (Beven and Kirkby, 1979) approach, including Bohn et al. (2007), Bohn et al. (2010), Ringeval et al. (2010) and Zhu et al. (2014), although the TOPMODEL approach's validity is questionable in flat areas such as peatlands and its results can only pertain to heterogeneity at the spatial scale of the DEM that is employed (typically much coarser than the size of individual hummocks and hollows). Still, I think it is worthwhile to mention these studies, if only to contrast their approach with the current approach.

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