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Title: Topographic modelling of soil moisture conditions: a comparison and verification of two models.

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Abstract: Topography, as captured by a digital elevation model (DEM), can be used to model soil moisture conditions because water tends to flow and accumulate in response to gradients in gravitational potential energy. A widely used topographic index, the soil wetness index (SWI), was compared with a new algorithm that produces a cartographic depth-to-water (DTW) index based on distance to surface water and slope. Both models reflect the tendency for soil to be saturated. A 1 m resolution Light Detection and Ranging (LiDAR) DEM and a 10 m conventional photogrammetric DEM were used and results were compared with field-mapped wet soil areas for a 193 ha watershed in Alberta, Canada, for verification. The DTW model was closer to field-mapped conditions. Values of K_{match90} (areal correspondence, smaller values indicating better performance) were 7.8% and 12.3% for the LiDAR and conventional DEM DTW models, respectively, and 88.5% and 86.7% for the SWI models. The two indices were poorly correlated spatially. Both DEMs were found to be useful for modelling soil moisture conditions using the DTW model, but the LiDAR DEM produced the better results. All major wet areas and flow connectivity were reproduced and a threshold value of 1.5 m DTW accounted for 71% of the observed wet areas. The poor performance of the SWI model is probably because of its over-dependence on flow accumulation. Incorporation of a flow accumulation algorithm that replicates the effects of dispersed flow showed some improvement in the SWI model for the conventional DEM but it still failed to replicate the full

areal extent of wet areas. Local downslope topography and hydrologic conditions seemed to be more important in determining soil moisture conditions than is taken account of by the SWI. The DTW model has potential for application in distributed hydrologic modelling, precision forestry and agriculture and implementation of environmental soil management practices. [ABSTRACT FROM AUTHOR]

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