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Effects of slope aspect on soil development in the Canadian prairies: a digital approach

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Soil forming factors that are causally connected to the latitudinal and longitudinal positioning of the Rumsey Natural Area in the Canadian prairies were linked to varying intensities of point-specific soil forming processes within the case study area due to its intricate hummocky topography. Soil properties over the last 15,000 years since the melting of the Laurentide Ice Sheet were simulated in accordance with SoilGen 2.24 (Finke, 2012; Finke and Hutson, 2008), a numerical model that simulates vertical changes in soil properties over the millennia. By comparing simulated soil properties at north and south facing slopes, this study specifically aims to assess the relative intensity of predominant soil forming processes due to slope aspect. By applying the Random Forest Model, which was specifically used as a vegetation distribution model, this study found the present-day aspen vegetation to be strongly correlated to north facing point locations rather than to grass and shrub vegetation which can be mainly found on south facing slopes. In a subsequent step the subregional vegetation pattern was linked to point-location-specific differences in calcite, pH and organic carbon development since SoilGen suggests a strong correlation of these three parameters in the case study area. Especially for soils on north facing point-locations, calcite and pH development are strongly correlated. On south facing slopes preliminary results suggest that high organic carbon and humus contents are responsible for deviations from this norm. The model output further indicates that due to shading effects on north facing slopes, the soils on these locations were exposed to more translocation processes over the millennia, which especially had an impact on formation of secondary carbonates. By comparing calcite development on north and south facing slopes, this study assessed the possibility of using a relative calcite development ratio as an indicator for calcite and pH development at other inclined point-locations of Canada's interior plains. Since this study attempts to assess the feasibility of solely using remote open-source soil assessment tools, the incorporation of GIS with freely-available initial and boundary conditions of soil development as SoilGen model input, further studies that compare results of in-situ measurements with the modelled output have to follow.