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Modeling peat accumulation over decades to centuries: examples from Sweden and Canada, and perspectives for tropical peatlands

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Anticipated rates of climate change and increased land-use pressure will subject peatlands to disturbances or destabilization processes not previously experienced in the Holocene. Although many studies have looked at the dynamic response of peatland ecosystem carbon or vegetation to short-term variability in climate or weather conditions, it is still difficult to predict the long-term (decadal to millennial) functional stability of peatlands, especially when multiple disturbances interact (i.e. temperature increase, droughts/floods, fire, permafrost thaw, drainage). The Holocene Peat Model (HPM) is a one-dimensional peat accumulation model explicitly simulating the interaction between hydrology, vegetation production, and decomposition. We model peat accumulation for two northern peatlands (Mer Bleue bog, Canada; Degerö Stormyr poor fen, Sweden), and we adapt HPM to simulate peat accumulation for an Indonesian peat swamp forest, focusing on peat accumulation patterns over the past 500 years and the next few centuries. Simulated peat mass generally follows the main trends in reconstructed peat accumulation, although simulations are potentially limited by the quality of regional climate reconstructions. Different scenarios of disturbance or climate perturbation/change applied to the three sites indicate that peatlands have the resiliency to recover from a wide range of disturbances or perturbations within a few years to a few decades, but that cumulative impacts have the potential to destabilize peatlands enough to hamper their long-term carbon accumulation function.