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Hydrological variability and peatland functioning

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One type of wetlands are peatlands. Peatlands are widespread in the Northern high latitudes and they store a significant fraction of the world's soil organic carbon. The carbon storage of peatlands is highly climate sensitive. Therefore, to assess the future peatland carbon exchange, there is a need to understand the climate sensitivity of peatland functioning. In this presentation, we examine how hydrologic variability affects peatland functioning. In particular we examine implications of hydrologic variability on peatland thickness, water table dynamics and peat accumulation and depletion processes. We use a model that represents feedbacks by coupling ecosystem processes such as peat accumulation and depletion processes with the water balance. The model has previously been used to show that peatlands are bistabile, i.e. having the possibility of having two co-existing steady states. While previous studies apply the model in a deterministic framework, we apply it in a stochastic framework by treating precipitation/water availability as a stochastic forcing variable. Our study show that while two co-existing steady states (a thick and a thin peat state) may exist during small variability in water availability, the co-existence disappear when the variability in water availability is large. During large variability in water availability steady state peatlands has characteristics that are intermediate of the two co-existing states. Thus, our results suggest that in a more variable future climate co-existing thick and thin peatlands will transition to a single steady state with intermediate thickness. This transition may have long lasting impact on peatland carbon exchange. However, the net peatland carbon exchange of a region is dependent on the distribution of thick and thin peatlands because thick peatlands will lose carbon while thin peatlands will sequester carbon. Furthermore, our model informs about steady state peatland behavior. We found that steady state peatlands cycles between accumulation and depletion periods that may last over decades. We also found that steady state peatlands have preference for either

accumulation or depletion at any given time or point in space. Therefore, only spatially distributed and long measurement campaigns can detect changes in peatland dynamics. Our work highlights that accounting for hydrological variability and feedbacks between ecosystem processes gives new understanding of peatlands.