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Modelling of seasonal dynamics of Wetland-Groundwater flow interaction in the Canadian Prairies

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Wetland-shallow groundwater interaction is studied at the St. Denis National Wildlife Area in Saskatchewan, Canada, located within the northern glaciated prairies of North America. Ponds in the Canadian Prairies are intermittently connected by fill-spill processes in the spring and growing season of some wetter years. The contribution of the ponds and wetlands to groundwater is still a significant research challenge. The objective of this study is to evaluate model's ability to reproduce observed effects of groundwater-wetland interactions including seasonal pattern of shallow groundwater table, intended flow direction and to quantify the depression induced infiltration from the wetland to the surrounding uplands. The integrated surface-wetland-shallow groundwater processes and the changes in land-energy and water balances caused by the flow interaction are simulated using ParFlow-CLM at a small watershed of 1km2 containing both permanent and seasonal wetland complexes. We compare simulated water table depth with piezometers reading monitored by level loggers at the watershed. We also present the strengths and limitations of the model in reproducing observed behaviour of the groundwater table response to the spring snowmelt and summer rainfall. Simulations indicate that the shallow water table at the uphill recovers quickly after major rainfall events in early summer that generates lateral flow to the pond. In late summer, the wetland supplies water to the surrounding upland when the evapotranspiration is higher than the precipitation in which more water from the root zone is up taken by plants. Results also show that Parflow-CLM is able to reasonably simulate the water table patterns response to summer rainfall, while it is insufficient to reproduce the spring snowmelt infiltration which is the most dominant hydrological process in the Prairies.