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A simple hydrologic framework for simulating continental and global wetlands

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We present a simple hydrologic framework for simulating wetlands at continental to global scales based on the water table depth. A synthesis of hydrologic controls on wetlands highlights the key role that groundwater plays. It directly feeds wetlands, supports surface-water fed wetlands by maintaining a saturated substrate, and links land drainage to sea level by impeding drainage in lowlands. Forced by routine climate model output (precipitation – evapotranspiration - surface runoff), land topography, and sea level, we simulate the present-day water table in North America at the 1km scale. We validate the simulation with water table observations and compare regions of shallow water table to mapped wetlands. Our results show that the framework captures the salient features of wetland distribution and extent at regional and continental scales, a direct result of large-scale groundwater convergence that nourishes the lowlands even in arid climates. The low requirement of forcing data and computational needs make the framework easy to incorporate into climate and earth system models for simulating wetland responses and feedbacks to climate and sea level change, for the present, for paleo reconstructions, and for future projections.