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Wetland inundation dynamics in a model of land-surface climate: Evaluation in the Niger Inland Delta region

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Observed river gauging data show significant evaporative losses from the land and water surface in the Niger Inland delta. These losses indicate an important potential feedback between the land-surface and atmosphere. Moreover, the reduction in river flow downstream of the wetland has clear implications for water management in the region and beyond. Here we have modelled the evaporative losses that occur over the Niger Inland Delta by adding an over-bank flow parameterization to the Joint UK Land-Environment Simulator (JULES) land-surface model. The hydrological component of this model comprises a probability-distributed model of soil moisture and runoff production (PDM) coupled with a discrete approximation to the 1D kinematic wave equation to route river water down-slope (G2G). We use sub-grid-resolution topographic data to derive a two-parameter frequency distribution of inundated areas for each grid-box which we then employ to represent over-bank inundation in the model. The model was driven using data from the ALMIP experiment (ALMIP stands for AMMA Land-surface Model Inter-comparison Project, wherein AMMA stands for African Monsoon Multidisciplinary Analyses). The model reproduces the salient features of the observed river flow and inundation patterns; these include significant evaporative losses from the inundated region accounting for doubling of the total land-atmosphere water flux during periods of greatest flooding. Our predictions of inundated area are in good agreement with observed estimates of the extent of inundation obtained using satellite infra-red and microwave remote sensing.