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Modelling land-atmosphere interactions in tropical African wetlands

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Wetlands interact with the climate system in two ways. First, the availability of water at the land surface introduces important feedbacks on climate via surface fluxes of energy and water [1]. Over wet surfaces, high daytime evaporation rates and suppressed sensible heat fluxes induce a shallower, moister planetary boundary layer, which affects atmospheric instability and favours the initiation of new storms [2].

Second, wetlands form a key link between the hydrological and carbon cycles, via anoxic degradation of organic matter to release methane (CH_4). Wetlands are the largest, but least well quantified, single source of CH_4, with recent emission estimates ranging from 105–278 Tg yr^{-1}, $\sim$75% of which comes from the tropics [3]. Although the emissions of methane from boreal wetlands and lakes are less than those from tropical wetlands [3], their size and remoteness pose significant challenges to the quantification of their feedbacks to regional and global climate.

In this paper, I present a summary of recent work on modelling hydrological and biogeochemical aspects of wetland formation and the associated land-atmosphere feedbacks in African and boreal environments. We have added an overbank inundation model to the Joint UK Land Environment Simulator (JULES). Sub-grid topographic data were used to derive a two-parameter frequency distribution of inundated areas. Our predictions of inundated area are in good agreement with observed estimates of the extent of inundation obtained using satellite infrared and microwave remote sensing [4,5]. The model predicts significant evaporative losses from the inundated region accounting for doubling of the total land-atmosphere water flux during periods of greatest flooding. I also present new parameterisations of methane generation from wetlands.

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