Geophysical Research Abstracts
Vol. 15, EGU2013-12310, 2013
EGU General Assembly 2013

Estimates of river flows, floodplain inundation and land-atmosphere feedbacks in tropical African wetlands

Simon Dadson (1), Garry Hayman (2), and Neil MacKellar (3)

(1) School of Geography and the Environment, University of Oxford, South Parks Road, Oxford OX1 3QY (simon.dadson@ouce.ox.ac.uk), (2) Centre for Ecology and Hydrology, Wallingford, OX10 8BB, (3) African Climate and Development Initiative, University of Cape Town

The regional response of African rivers and wetlands to climate variability and change is of interest to hydrologists, meteorologists and water resource planners. 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. Moreover, 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 emissions ranging from 105—278 Tg yr^{-1}, approximately 75 percent of which comes from the tropics. Yet little is known about the ability of regional models to reproduce regional patterns of hydrological response to climate variability and change in Africa, and few studies have directly addressed the impact of fluvial inundation on water, energy and carbon fluxes between the atmosphere and the land surface.

Here we use the Joint UK Land-Environment Simulator (JULES) land surface model to produce estimates of river flows over Africa. The hydrological component of this model comprises a probability-distributed model of soil moisture and runoff production coupled with a discrete approximation to the one-dimensional kinematic wave equation to route river water downslope. We use subgrid-resolution topographic data to derive a two-parameter frequency distribution of inundated areas for each grid box which we then employ to represent overbank inundation in the model. The model was configured at 0.5 degree resolution and driven using the WATCH Forcing Data (WFD; Weedon et al., 2011) which is based on ERA-40 reanalysis data and an alternative based on applying the WFD methodology to ERA-Interim data (WFDEI; Weedon et al., 2012).

The model reproduces the salient features of the observed river flow and inundation patterns; these include substantial evaporative losses from inundated regions accounting for increased land-atmosphere water fluxes during periods of greatest flooding. We evaluate our predictions of inundated area against observed estimates of the extent of inundation obtained using satellite infrared and microwave remote sensing and discuss the implications of our findings in relation to future changes in climate, wetland extent and carbon fluxes.

Weedon, G. P., et al. (2011), Journal of Hydrometeorology, 12, 823-848.; Weedon et al., 2012 WFEI-Announcement paper