Hydrological Impacts from Fire-Induced Surface Albedo Darkening in Africa

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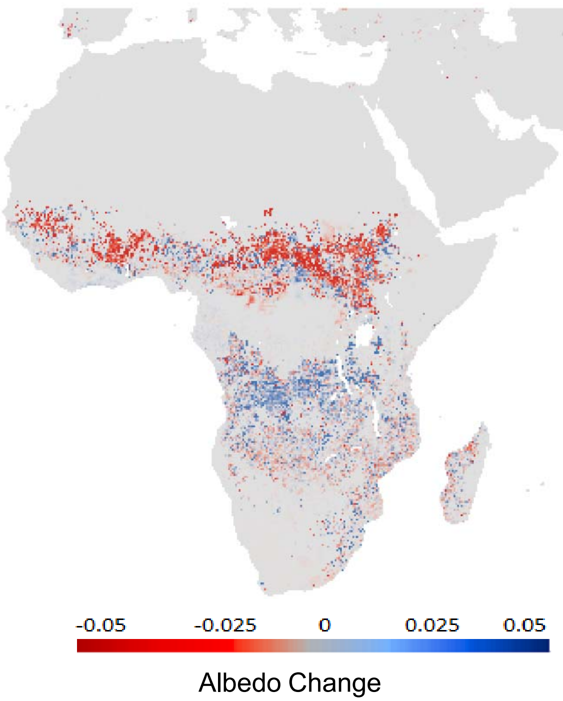

Figure 1

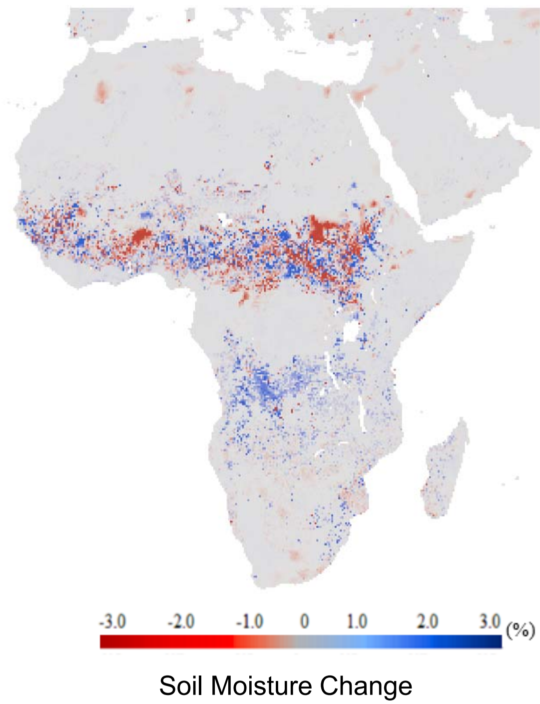

Figure 2a

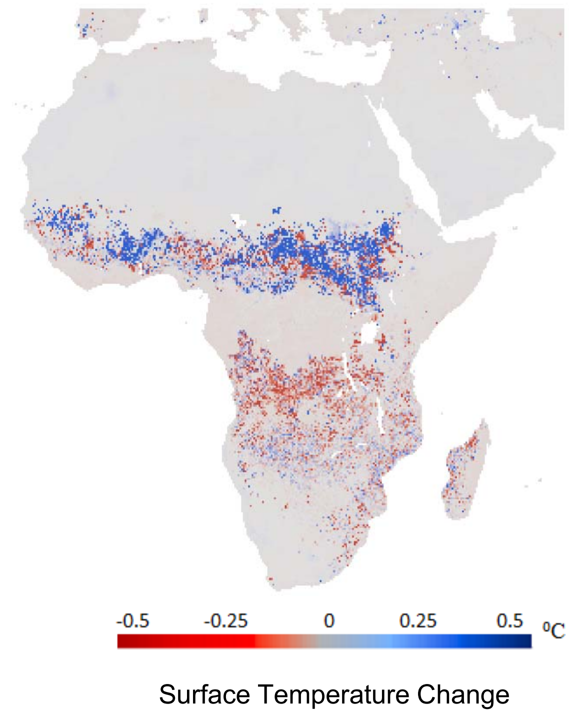

Figure 2b

Burning of biomass as observed by satellites causes a change in albedo that leads to a 1-3% decrease in soil moisture and up to a 1^{0}C increase in surface temperature.

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References:
Gupta, M., Bolten, J. D., Gatebe, C., and Ichoku, C., Regional Land Surface Hydrology Impacts from Fire-Induced Surface Albedo Darkening in Africa, Remote Sensing of Environment (In review)

Gatebe, C.K., Ichoku, C.M., Poudyal, R., Román, M.O., Wilcox, E., 2014. Surface albedo darkening from wildfires in northern sub-Saharan Africa. Environmental Research Letters 9, 065003. doi:10.1088/1748-9326/9/6/065003

Data Sources:
Modelled Products – soil moisture estimates obtained from NASA-LIS integrated Catchment Land Surface Model (CLSM)
Earth observation datasets – MODIS burned area product (MCD45A1), MODIS leaf area index, and MODIS land surface temperature and Greenness Vegetation Fraction (GVF) provided by NESDIS

Technical Description of Figures:
Figure 1: This figure illustrates the difference in mean albedo change for the modified run (with static albedo) with the control run (with modified albedo) for the period 2003-2010 due to fire events occurring

Figure 2a: This figure illustrates the difference in mean of soil moisture for the modified run with the control run for the period 2003-2010 using the Catchment Land surface Model (CLSM) and demonstrates a nearly 1-3% decrease in soil moisture during January after the fires in Dec-Jan.

Figure 2b: This figure illustrates the difference in mean of surface temperature for the modified run with the control run for the period 2003-2010 using the Catchment Land Surface Model (CLSM) and demonstrates a nearly 1^{o}C increase in surface temperature in January for the fires occurring in Dec-Jan.

Scientific significance, societal relevance, and relationships to future missions: Most land surface models do not adequately reflect changes in land surface water and energy cycle fluxes and states from land surface disturbances such as fire because they utilize climatologically-based biophysical parameters. These biophysical parameters are usually determined using built-in lookup tables or have been averaged on a monthly basis using multiple years' worth of earth observation products. However, large scale events such as fires need to be better represented, as they have a direct impact on the hydrological fluxes of a region. The current study employs satellite-observed changes in albedo. We have investigated how the Catchment Land Surface Model simulates hydrological and energy fluxes based on estimated change of surface albedo due to fires over different land cover types. We tested a new simple parameterization approach for the soil albedo and compared with observed MODIS-based land surface temperature. Since surface albedo is a key element of the surface energy balance, it is shown to drive the surface energy and hydrological cycles in the simulations for the eight-year period of study (2003-2010). This approach can be very valuable for climate studies, particularly in regions where surface observational data are scarce.