A large fluvial pulse of organic carbon following the Bornean peat swamp forest fires of 2009

Conference or Workshop Item

Geophysical Research Abstracts
Vol. 13, EGU2011-7842-1, 2011
EGU General Assembly 2011

A large fluvial pulse of organic carbon following the Bornean peat swamp forest fires of 2009

Vincent Gauci (1), Sam Moore (1), Chris Evans (2), and Susan Page (3)

(1) CEPSAR, Dept. of Earth and Environmental Sciences, The Open University, Milton Keynes, United Kingdom MK7 6AA (v.gauci@open.ac.uk), (2) Centre for Ecology and Hydrology, Environment Centre Wales, Deiniol Road, Bangor, LL57 2UW, UK, (3) Department of Geography, University of Leicester, University Road, Leicester, LE1 7RH, UK

Tropical peatlands are high carbon density ecosystems that are currently extremely vulnerable to destabilisation through human and climate induced changes. They contain 89 Gt carbon (3% global soil carbon) but rapid land use changes (deforestation, drainage) and consequent fire are rapidly releasing this. There are approximately 27.1 million hectares (Mha) (an area approximately equivalent in size to the UK) of peatland in Southeast Asia which accounts for around 56% of all tropical peatlands worldwide. 20.7 Mha (83%) is found in Indonesia, primarily in Eastern Sumatra and Central Kalimantan. The dry season of 2009 (May-October) proved to be one of the most intense Bornean fire events since 1997. We sought to establish how fluvial carbon dynamics in tropical peat rich catchments were affected in the period following these catastrophic fires. Fluvial carbon fluxes were quantified from 8 channels draining peat swamp forest (PSF) catchments in Central Kalimantan, Borneo from weekly measurements over a 6-month period immediately following the end of the fire period. These included 5 channels draining degraded PSF catchments that were subject to fires during the dry season of 2009 and 3 channels draining intact PSF that was unaffected by the fires. Cumulative total organic carbon (TOC) fluxes for the duration of the study were 32 to 68% larger in the catchment channels that had been affected by fire, when compared to fluxes during the same interval in the previous year (which was unexceptional in terms of fire). This is in marked contrast to channels draining the intact (no fire) forest where there were no differences observed in fluxes. Concentration data demonstrates that there was an initial decrease in dissolved organic carbon (DOC) concentration and an increase in particulate organic carbon (POC) immediately following the onset of the first rains which continued for $\sim$1 month until reaching similar levels to the corresponding period in the previous year. For DOC fluxes (the largest fraction) this decrease in concentration was more than offset by a large increase in fluvial discharge (from decreased transpiration and increased runoff through denuded vegetation cover) which contributed an overall net increase in flux. The fire-stimulated increase in fluvial carbon flux is set against a pattern of higher fluxes in the degraded catchments established during the pre-fire year where oxidation of the peat column results in high losses. Our data are the first to demonstrate a large and sustained pulse of fluvial carbon following large scale fires in carbon rich tropical PSF. They point to a previously uncharacterised pathway of carbon loss from these vast carbon stores and they underscore the vulnerability of these stores when subject to anthropogenic disturbance.