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Underestimated Role of Fires in Providing Nutrients for Biogeochemical Cycles

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Fire regimes respond to both climate and human land management practice changes, in turn modifying land cover distributions, surface albedo, carbon storage, and emissions. Much attention has recently been given to the health and climate impacts of fires, but fires are also an important source of nutrients, such as iron and phosphorus, to both land and ocean biospheres. Fires therefore create important feedbacks within the Earth system. Here we discuss recent developments showing how fires are a previously underestimated source of limiting nutrients, providing up to half the annual deposited amount of soluble iron and soluble phosphorus to southern oceans and the Amazon, respectively. Fire can therefore stimulate ocean productivity by providing long range transport of essential nutrients, released from the vegetation burned and entrained with dust from the surrounding environment, to remote regions. We considered the impact of human activity on soluble iron deposition for the past (c.1750 CE), present (c.2010 CE), and future (c.2100 CE). We find that the global carbon cycle and climate response is dominated by changes to primary productivity within the Southern Ocean (>30°S) and that the carbon export efficiency (gram of carbon sequestered per gram of soluble iron added) for this region is 43% larger when altering fire emissions compared to altering dust emissions. Results suggest that modelling past and future changes in biogeochemical cycles should incorporate information on how fires, and the nutrients carried within their plumes, respond to changes in climate.