Geophysical Research Abstracts
Vol. 20, EGU2018-13445, 2018
EGU General Assembly 2018

The impact of fire on the global carbon cycle and vegetation patterns

Gitta Lasslop (1), Stijn Hantson (2), Dominique Bachelet (3), Matthew Forrest (1), Fang Li (4), Joe Melton (5), Chao Yue (6), Almut Arneth (2), Sandy P. Harrison (7), and Stephen Sitch (8)

(1) Senckenberg Biodiversity and Climate Research Centre, Frankfurt am Main, Germany, (2) Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research, Atmospheric Environmental Research, (3) Biological and Ecological Engineering, Oregon State University, Corvallis, OR 97331, USA, (4) International Center for Climate and Environmental Sciences, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China., (5) Climate Research Division, Environment Canada, Victoria, BC V8W 2Y2, Canada., (6) Laboratoire des Sciences du Climat et de l'Environnement–Institute Pierre Simon Laplace, , (7) School of Archaeology, Geography and Environmental Sciences (SAGES) , Reading University, Reading, RG6 6AB, UK, (8) College of Life and Environmental Sciences, University of Exeter, Exeter EX4 4QF, UK

Fire is the main natural disturbance agent in terrestrial ecosystems and affects all major biomes. Fire exclusion studies have been used to quantify the effect of fire on ecosystems, but a global picture of the effect of fire can only be achieved using fire enabled global vegetation models. Eight models participating in the Fire Model Intercomparison Project (FIREMIP) have run simulations for a world with and without fire, the processes that are impacted by fire however varies between models. Only three of them included the effect on vegetation distribution. We use these simulations to quantify the effect of fire on tree cover, vegetation productivity, vegetation biomass, carbon stored in litter and soils globally. The models show a very different response both in terms of global impact and latitudinal gradients. Part of this variability in response to fire exclusion can be explained by the differences in simulated carbon storage and simulated burned area between the models. Models including the nitrogen cycle show a stronger impact of fire on the carbon cycle, while the inclusion of the impact on vegetation distribution does not result in a systematic difference. When excluding two models as outliers the impact of fire on global soil carbon storage for instance is between 4 and 7.5 %. Fire decreases the carbon turnover time in all models. The acceleration of the carbon cycle is between 2.5 and 10 %. For high latitudes where productivity is lower and therefore carbon accumulation and recovery from disturbances are slower, we find an increasing model mean of the impact of fire on carbon storage per unit area burnt in the reference simulation.
Only three of the FireMIP models included impact on the vegetation distribution, we complement the results of these models by estimating the impact of fire on tree cover with a data-driven statistical model for the tropical continents. The statistical model (a generalized additive model) is trained to reproduce the observed tree cover using several datasets including burned area as input. The effect of fire is then estimated by applying the model with burned area set to zero. The magnitude of the impact of fire on tree cover is similar for the statistical and the process-based FireMIP models.