The impact of fire on vegetation: model intercomparison of impacts in eight global process-based models and a statistical model

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Fire is a major disturbance agent in terrestrial ecosystems and affects all major biomes. Locally fire exclusion studies can quantify the effect of fire on ecosystems, a global picture of the effect of fire needs to involve models.

The fire model intercomparison project (FireMIP) provides simulations for eight global fire enabled vegetation models for a world with and without fire. We quantify the effect of fire on vegetation and the carbon cycle and compare the results of the FireMIP models to exclusion experiments. A previous study using a rather simple modelling approach showed a strong and clear picture of the impact of fire on vegetation. The more complex approaches of modelling fire and vegetation processes used in this study show large variations in the spatial pattern and the magnitude of the impact of fire. The latitudinal pattern of the effect of fire differs between living biomass and soil carbon pools: we find a stronger latitudinal variation in absolute changes compared to relative changes for the living biomass and low latitudinal variation for the absolute and relative changes for the soil carbon pools.

We complement the process-based models by using a statistical model for the tropics. The statisical model is trained to reproduce the observed tree cover and biomass 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 statistical model and the process-based models show differences between the tropical continents. The strongest impact of fire is found for the African continent followed by South America.