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# Implementation of fire into a general circulation model

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Evolving large scale fire models, incorporated into dynamic global vegetation models, are able to certain extent to reproduce spatial and temporal dynamics of area burnt. Such models as Reg-FIRM (Venevsky, et.al., 2002), SPIT-FIRE (Thonicke, et.al., personal communication) and SEVER-FIRE (Venevsky, 2006) can serve as prototypes for a future fire model incorporated into GCMs. However, no of these models at their recent stage can be directly plugged into GCMs, because of temporal and spatial limitation of the existing climate models. Indeed, a typical GCM has a spatial resolution of 1˚ to 2˚ longitude or latitude and 30 minutes – 1 hour time step, the spatial-temporal simulation frame in which the listed models were never tested.

This study presents a prototype fire model Hadley-FIRE designed for the LSS of HadCM3LC general circulation model.

Hadley-FIRE is based on approximation of equations used in Reg-FIRM and SEVER-FIRE. Area burnt in a grid cell is simulated as a product of fire weather risk (probability), number of ignitions per grid cell and fire spread during the GCM time step.

The fractional ratio for the given vegetation type (plant functional type) in a grid cell is determined by TRIFFIDS dynamic vegetation model, implemented into land surface scheme of HadCM3LC general circulation model.

There are five plant functional types (PFTs) in TRIFFIDS for which the bulk fuel densities $\rho_j$were defined based on the values for ten PFTs of the SEVER-DGVM (Venevsky, Maksuytov, 2007).

Global general circulation model with incorporated Hadley-FIRE model was run till the year 2070 with a business-as-usual carbon emission scenario to determine future

projections of area burnt. The results suggest that areas burnt are going to grow significantly in future especially in the Eastern and Central part of Brazil, Southern Asian part of Russia and the Southern United States. The most increase is seen in March-April-May and in September-October-November time. Australia has a significant decrease in fire frequency due to reducing of vegetation cover caused by drought conditions. This may set significant fire carbon emissions, which will contribute to global carbon cycle feedback into the land-climate system.

References

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