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Parameterization of Fire Injection Height in Large Scale Transport Model

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The parameterization of fire injection height in global chemistry transport model is currently a subject of debate in the atmospheric community. The approach usually proposed in the literature is based on relationships linking injection height and remote sensing products like the Fire Radiative Power (FRP) which can measure active fire properties. In this work we present an approach based on the Plume Rise Model (PRM) developed by Freitas et al (2007, 2010). This plume model is already used in different host models (e.g. WRF, BRAMS). In its original version, the fire is modelled by: a convective heat flux (CHF; pre-defined by the land cover and evaluated as a fixed part of the total heat released) and a plume radius (derived from the GOES Wildfire-ABBA product) which defines the fire extension where the CHF is homogeneously distributed. Here in our approach the Freitas model is modified. Major modifications are implemented in its initialisation module: (i) CHF and the Active Fire area are directly force from FRP data derived from a modified version of the Dozier algorithm applied to the MOD12 product, (ii) and a new module of the buoyancy flux calculation is implemented instead of the original module based on the Morton Taylor and Turner equation. Furthermore the dynamical core of the plume model is also modified with a new entrainment scheme inspired from latest results from shallow convection parameterization.
Optimization and validation of this new version of the Freitas PRM is based on fire plume characteristics derived from the official MISR plume height project and atmospheric profile extracted from the ECMWF analysis. The data set is (i) build up to only keep fires where plume height and FRP can be easily linked (i.e. avoid large fire cluster where individual plume might interact) and (ii) split per fire land cover type to optimize the constant of the buoyancy flux module and the entrainment scheme to different fire regime.
Result shows that the new PRM is more likely to predict fire variability, correcting the general overestimation of the original version.