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Two global climatologies of daily fire emission injection heights since 2003

Samuel Remy (1), Andreas Veira (2), Ronan Paugam (3), Mikhail Sofiev (4), Johannes Kaiser (5), Franco Marenco (6), Sharon P Burton (7), and Angela Benedetti (8)

(1) Laboratoire de Météorologie Dynamique, IPSL, CNRS/UPMC, Paris, France (samuel.remy@ecmwf.int), (2) Max Planck Institute for Meteorology, Hamburg, Germany, (3) King's College, London, United Kingdom, (4) Finnish Meteorological Institute, Helsinki, Finland, (5) Max Planck Institute for Chemistry, Mainz, Germany, (6) Observational Based Research, Met Office, Exeter, United Kingdom, U.K., (7) National Aeronautics and Space Administration, Langley Research Center, Hampton, CA, U.S.A., (8) European Centre for Medium-range Weather Forecasts, Reading, U.K.

The Global Fire Assimilation System (GFAS) assimilates Fire Radiative Power (FRP) observations from satellite-based MODIS sensors to produce daily estimates of biomass burning emission. It has been extended to include information about injection heights of biomass burning species provided by two distinct algorithms, which also use meteorological information from the operational weather forecasts of ECMWF.

Injection heights are provided by the semi-empirical Sofiev parameterization and an analytical one-dimension Plume Rise Model (PRM). The two algorithms provide estimates for injection heights for each satellite pixel. Similarly to FRP observations, these estimates are then gridded, averaged and assimilated, using a simple observation operator, so as to fill the observational gaps. A global database of daily biomass burning emissions and injection heights at 0.1° resolution has thus been produced for 2003-2015. The database is being extended in near-real-time with the operational GFAS service of the Copernicus Atmospheric Monitoring Service (CAMS).

The two injection height datasets were compared against a new dataset of satellite-based plume height observations. The Sofiev parameterization showed a better overall agreement against observations, while the PRM was better at capturing the variability of injection heights and at estimating the injection heights of large fires. The results from both also show a differentiation depending on the type of vegetation. A positive trend with time in median injection heights from the PRM was noted, less marked from the Sofiev parameterization. This is provoked by a negative trend in number of small fires, especially in some regions such as South America.

The use of biomass burning emission heights in atmospheric composition forecasts was assessed in two case studies: the SAMBBA campaign which took place in September 2012 in Brazil, and a series of large fire events in the Western U.S. in August 2013. For these case studies, forecasts of biomass burning aerosol species by the Composition-Integrated Forecasting System (C-IFS) of CAMS were found to better reproduce the observed vertical distribution when using PRM injection heights from GFAS.