INITIATIVE ON
Extreme Weather and Climate
COLUMBIA UNIVERSITY

Estimating and predicting fire emissions for operational forecasts of global atmospheric composition in the Copernicus Atmosphere Monitoring Service

Mark Parrington
Francesca Di Giuseppe
Imke Hüser
Tadas Nikonovas
Mark de Jong
Martin Wooster
Anna Agustí-Panareda
Johannes Flemming
Samuel Remy
Johannes W Kaiser

Daily near-real time estimates of wildland fire emissions are essential to providing reliable and accurate forecasts of atmospheric composition and air quality. In the Copernicus Atmosphere Monitoring Service (CAMS), implemented by ECMWF on behalf of the European Commission, the Global Fire Assimilation System (GFAS) utilizes Fire Radiative Power (FRP) observations from MODIS to estimate daily fire emissions as surface boundary conditions for five-day forecasts of global atmospheric composition (including aerosols, reactive gases and greenhouse gases) and European air quality. GFAS and the CAMS composition forecasts are limited by: (i) the timeliness of daily emissions (1-day behind real time); (ii) the ability of low Earth orbiting (LEO) observations such as MODIS to represent the diurnal cycle of fire activity; (iii) persistence of the fire emissions over the duration of each 5-day forecast; (iv) detection of fires below the MODIS FRP detection limit, or explicit bias corrections for these; (v) reliance on calibration against top-down emissions estimates; and (vi) aerosol emissions that require upscaling to match AOD observations. New GFAS developments will address the first of these three limitations to improve the representation of fire emissions in operational composition forecasts by: (i, ii) parametrizing the diurnal fire cycle using observations from LEO platforms which, in conjunction with using geostationary FRP observations, will provide hourly emissions fluxes; (iii) forecasting FRP and emissions using meteorological parameters will reduce uncertainties in composition forecasts associated with assuming persistent fire emissions. The remaining limitations will be addressed in planned future GFAS developments. We present the first results of the current GFAS developments in CAMS global atmospheric composition forecasts using model smoke-related species and newly developed tracers for different emissions sources.