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Intercontinental transport of biomass burning pollutants over the Mediterranean Basin during the summer 2014 ChArMEx-GLAM airborne campaign

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The Mediterranean Basin (MB) is at the crossroad of pollutant emissions from Western and Central Europe and of mineral dust from major sources in the Sahara and Arabian deserts. Several studies (e.g. Formenti et al., J. Geophys. Res., 2002; Pace et al., J. Geophys. Res., 2005; Ancellet et al., Atmos. Chem. Phys., 2016) have also shown the occurrence over the MB of long-range transport of air masses polluted by biomass burning aerosols. In the present study, we report two cases of long-range intercontinental transport of biomass burning products in the free troposphere over the MB in August 2014, identified with in situ measurements, and evaluate their impact on trace gas concentrations using modelling

The Gradient in Longitude of Atmospheric constituents above the Mediterranean basin (GLAM) airborne campaign occurred in August 2014 (Ricaud et al., BAMS, 2018), as part of the Chemistry-Aerosol Mediterranean Experiment (ChArMEx) project. It aimed at studying the tropospheric chemical variability of gaseous pollutants and aerosols along a West-East transect above the MB. During the GLAM campaign, several instruments were deployed onboard the Falcon-20 research aircraft (SAFIRE, INSU & Météo-France) including an infrared laser spectrometer (SPIRIT, LPC2E) able to detect weak variations in the concentration of pollutants.

During two flights on 6 and 10 August, increases in CO, O_3 and aerosols were measured over Sardinia at 5.4 and 9.7 km above sea level, respectively. To assess the origin of the air masses, 20-day backward trajectories were calculated with a nested-grid regional scale Lagrangian particle dispersion model (FLEXPART; Stohl et al., Atmos. Chem. Phys., 2005). Combined with emissions coming from the Global Fire Assimilation System (GFAS) inventory (Kaiser et al., Biogeosci., 2012), this allows us to quantify the biomass burning contribution to CO aircraft measured values. Biomass burning products came on 10 August from the northern American continent with air masses transported during 5 days before arriving over the MB. On 6 August biomass burning products came from Siberia with air masses travelling during 12 days and enriched in fire emission products above Canada 5 days before arriving over the MB. By estimating the injection height of the model and amplifying emission fluxes, FLEXPART was able to reproduce the contribution of those fires to CO enhancements.

Our measurements show that long-range transport of biomass burning induced, at the local scale, an increase by a factor of 1.7 to 3.7 of O_3 and CO with background mixing ratios of $\sim$25 and $\sim$70 ppbv respectively. To assess the biomass burning effect on ozone level at the regional scale over the MB, its tropospheric increase is estimated by using the chemical transport model MOCAGE.