Biomass burning and cloud interactions observed during the DC3 field campaign over Colorado (USA)

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Measurements of aerosol optical, chemical, and microphysical properties were made aboard the NASA DC-8 in summer 2012 as part of the Deep Convective Clouds and Chemistry Project (DC3) field campaign. DC3 investigated the impact of deep, mid-latitude continental convective clouds, including their dynamical, physical, and lightning processes, on upper tropospheric (UT) composition and chemistry. The DC3 field campaign made use of extensively instrumented aircraft platforms and ground-based observations. The NSF/NCAR Gulfstream-V (GV) aircraft was the primary platform to study the high altitude outflow of the storms, and was instrumented to measure a variety of gas-phase species, radiation, and cloud particle characteristics. In addition, the NASA DC-8 aircraft completed the GV measurements with in situ observations to characterize the convective storm inflow.

On the morning of June 9, the High Park fire**,** caused by a lightning strike, was first detected. It was declared 100 percent contained on June 30, 2012. The High Park fire burned over 87,250 acres (353.1 km^2), becoming the second-largest fire in recorded Colorado history by area burned. On June 22nd, convective clouds started to pop out downwind the smoke plume. The DC-8 flew (1) in front of the convective cloud within the boundary layer (2) within the smoke plume (~7 km) and (3) the rear edge of the cloud to characterize the inflow the smoke plume and the outflow respectively.

Figure 1. Picture taken from the DC-8 on the 22nd of June 2012.

In-situ measurements of aerosol microphysical properties (number density, chemical composition, size distributions, growth rate and volatility) as well as optical parameters (extinction, scattering and absorption coefficients) were performed aboard the NASA DC-8 aircraft. The extinction coefficient measured within the smoke plume was up to 2 000 Mm^{-1}, the BC concentration about 5.5 $\mu g\ m^{-3}$ and the acetonitrile concentration reached 3 ppbv. Within the outflow (~10 km), prove of biomass burning aerosol transport are numerous: high extinction (~250 Mm^{-1}) and absorption coefficients (~20 Mm^{-1}), high aerosol number concentration (35 000 cm^{-3}). Surprisingly, the growth factor of biomass burning particles observed within the outflow was lower by a factor of 10% indicating a restructuration of the soot during the 'wet' transport.

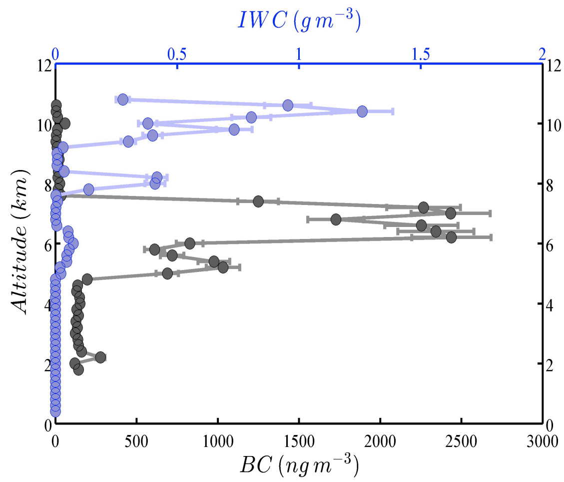

Figure 2. Profile of Ice Water Content (IWC) and Black Carbon (BC) observed during the 22nd of June 2012.

During the entire DC3 campaign, the DC-8 flew within the outflow of several convective systems (>10). The Ice Water Content (IWC) observations performed aboard the DC-8 were in average below 0.5 g m^{-3}. During the particular case of the June 22nd, a huge enhancement of the IWC has been observed within 2 distinct layers at 8km (i.e. right above the smoke plume) where the IWC was larger than 1 g m^{-3} and at 10km (within the outflow) where the IWC was larger than 1.5 g m^{-3}. GOES data will be analysed to better understand this case.