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Combining air quality network data and chemistry-transport modeling for the attribution of extreme pollution events: a case study of Santiago, Chile

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In wintertime, high background concentrations of atmospheric fine particulate matter ($PM_{2.5}$) are commonly observed in the metropolitan area of Santiago, Chile. Although the frequency of alert events has been decreasing in the recent years, two short-lived peak events reaching up to 600µg/m^3 for a few hours were observed in the city on June 18th and June 26th 2016, triggering emergency measures for the next day.

The observed meteorological conditions at the time of these peaks are not unusual. In addition, a high-resolution meteorology and chemistry-transport simulation with the WRF meteorological model and the CHIMERE chemistry-transport model reproduces fairly well the meteorology and levels of PM for June 2016, except for those two particular events that are not captured by the model. The combination of these elements leads to the conclusion that sporadic strong emissions are at play.

The analysis of recorded concentration ratios of $PM_{2.5}$, NOx and CO points to a specific source, departing significantly from the average signal for the season. Based on the literature and HTAP emission ratios, usual sources of PM such as traffic, residential heating and industry can be ruled out. The temporal correlation of the events with soccer games of the Chilean team and the recorded chemical footprint lead to conclude to the dominant contribution of massive barbecue cooking at the peak times.

Following the source identification via surface stations analysis, the next question was to quantify the potential transport and impact of such pollution peaks in the Santiago Metropolitan area. An additional source term was added in the chemistry-transport simulation, and maps of PM changes were analyzed. For both events, the same region in the Southwest of Santiago was impacted by the plume.

A natural continuation of this work is the study through modeling of the dispersion patterns of polluted plumes outside of the Santiago basin on a longer time scale. In particular, significant deposition of light-absorbing particles has been measured on glaciers near the capital city, without a clear identification of their source or the underlying processes of transport.