Compendium of Airborne Trace Gas Measurements Collected in and around California Fire Plumes by the AJAX Project

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Abstract: Biomass burning, which includes wildfires, prescribed, and agricultural fires, is an important source of trace gases and particles, and can influence air quality on local, regional, and global scales. With the threat of wildfire events increasing due to changes in land use, increasing population, and climate change, the importance of characterizing wildfire emissions is vital. In this collection we document airborne in situ trace gas measurements sampled in and around the emissions from 12 wildfires and 1 prescribed fire event in California between 2013 and 2017, in some cases with multiple measurements of an individual fire performed on different days. Airborne measurements of carbon dioxide (CO_2), methane (CH_4), water vapor (H_2O), ozone (O_3), and formaldehyde (HCHO) were made by the Alpha Jet Atmospheric eXperiment (AJAX). The majority of these measurements were made as close as possible to each fire and represent fresh emissions from known fire sources. This archive also includes meteorological parameters measured in situ (pressure, temperature, 3-dimensional winds), as well as information collected from other sources and used to analyze the in situ measurements, including vegetation type, fire radiative power (FRP), and longer-term meteorological information.

Table 1 identifies the fifteen flights included in this collection and provides links to the data itself, as well as individual flight analysis documents. This collection is a subset of the larger AJAX project archive (doi:10.5067/ASDC/SUBORBITAL/AJAX/DATA001).

This Compendium also includes a comma separated variable text file (Data Table) summarizing the vegetation, fire and meteorological information assembled from multiple ancillary sources, as well as derived quantities including estimated plume age, sampling distance, and trace gas emission ratios (ERs). Figure 1 illustrates nine of the parameters contained in this summary file.

The fifteen flights in this collection sampled thirteen different fires, including five flights to the Soberanes megafire in 2016. Figure 2 shows the progression of the burned area for each flight day overlain on a map of land cover type.

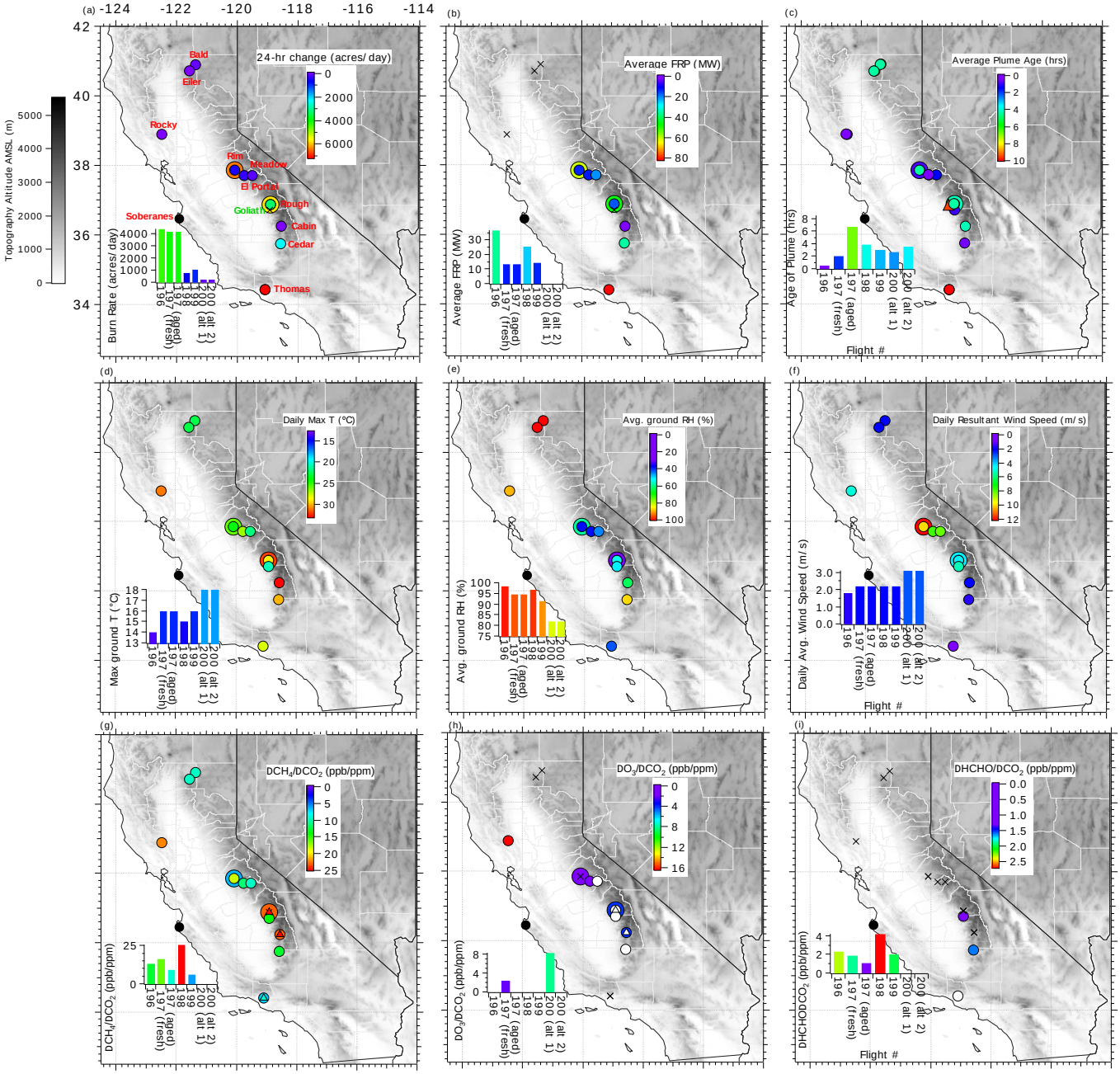

FIGURE 1: Topographical map showing the wide variety of environmental and fire conditions as well as trace gas observations among the multi-year record. (a) 24-hour change in acres burned; (b) fire radiative power (FRP) averaged for day and time of flight; (c) average plume age; (d) daily maximum temperature, (e) daily average relative humidity, and (f) daily average wind speed at nearby CARB monitoring stations; and (g-i) emission ratios (ERs). Multiple airborne measurements of same fire are shown with multiple circles (outer circle is earlier flight and inner circle is later flight), x markers signify no data, and white circles (ERs only) represent statistically insignificant Pearson's r^2 values between the respective trace gas and ΔCO_2. In plots (c and g-i) fire locations with a circle and a triangle represent fresh and aged emissions measured within one flight, respectively. Five flights were performed to measure the Soberanes fire, and results are shown in the bar graphs.

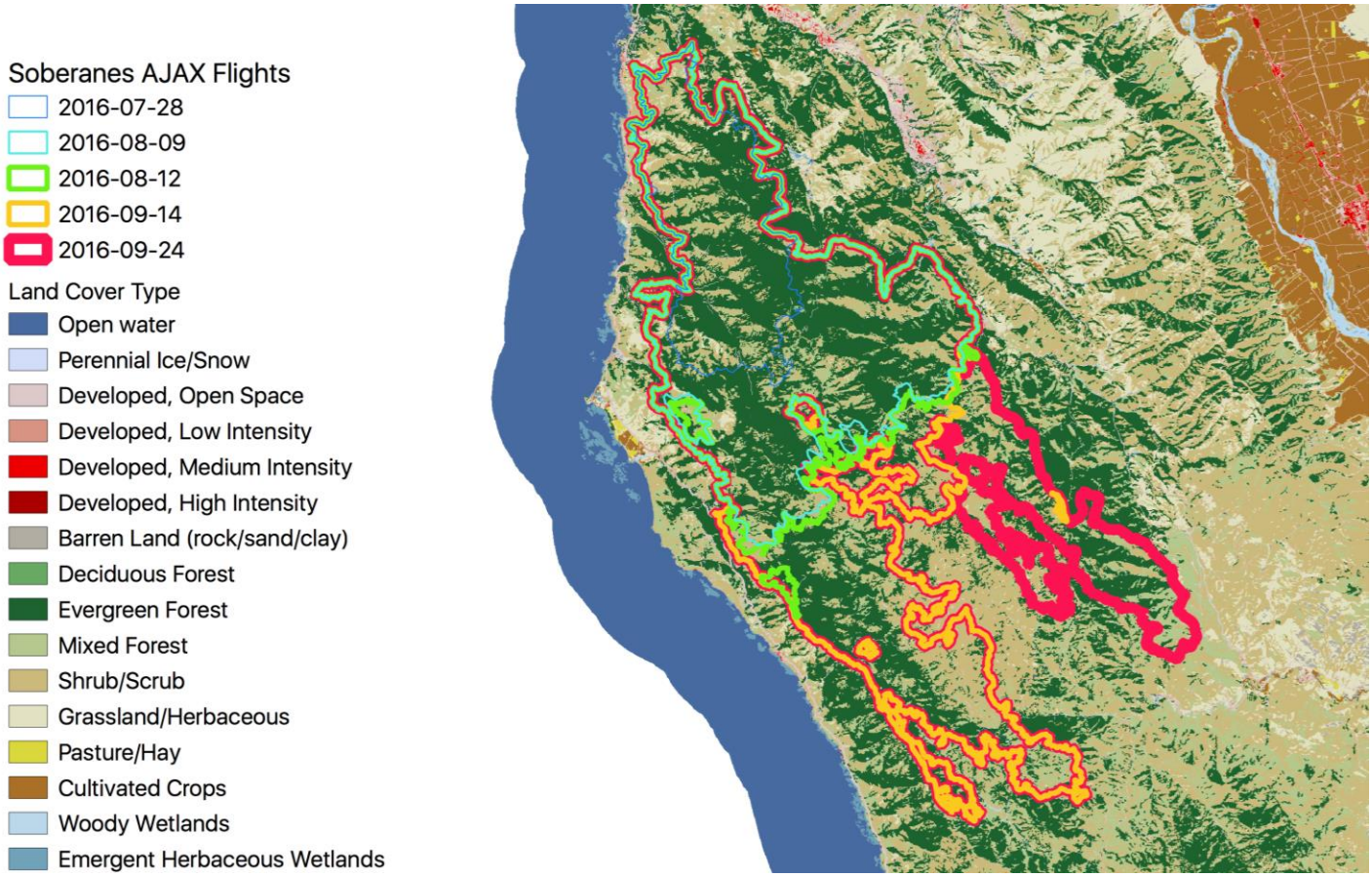

FIGURE 2: Land cover type and Soberanes fire perimeter for each of the five days AJAX measured in situ gases and meteorological parameters.

TABLE 1: List of AJAX Flights which sampled emissions from biomass burning in California. The first column contains links to flight data.

Link to Data Flight Number	Fire(s) Sampled	Date
100	Rim	29-Aug-2013
101	Rim	10-Sep-2013
136	El Portal	29-Jul-2014
137	Bald, Eiler	06-Aug-2014
141	Meadow	09-Sep-2014
166	Rocky	05-Aug-2015
167	Cabin, Rough	19-Aug-2015
168	Rough	02-Sep-2015
191	Goliath	15-Jun-2016
196	Soberanes	28-Jul-2016
197	Soberanes	09-Aug-2016
198	Soberanes	12-Aug-2016
199	Soberanes, Cedar	24-Aug-2016
200	Soberanes	14-Sep-2016
216	Thomas	13-Dec-2017