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

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doi: 10.5067/ASDC/AJAX/wildfire

## Meadow Fire Flight 141 9 September 2014

The last wildfire measured in 2014 was the Meadow fire, which took place between August 15 and September 29, 2014, burning a total of 4,772 acres of Red fir forest, and was started from unknown reasons. At a CARB ground monitoring site nearby (Turtleback Dome, 11 miles west of fire), RH decreased by 33% over the course of the week leading up to the start of the fire and daily maximum temperature increased by 16% (Fig. 141-1). There are no precipitation measurements from the Turtleback Dome ground site. AJAX made measurements of this fire on September 9, 2014, which is 20 days before the fire officially ended. From the nearby ground site, the average RH was 46% and the maximum temperature reached 22°C. A brief pass near the location of the fire was made by our aircraft (marked with black edging in Fig. 141-2i,j) at an average altitude of 3910 (±62) m. Based on in situ wind measurements and the average distance from active burning, the age of the fire plume sampled is approximately 0.7 hours. Enhancements were observed for $\Delta CH_4$ and $\Delta CO_2$ with maximum mixing ratios within the plume reaching 68.8 ppb and 7.1 ppm, respectively, relative to the background portion of the flight marked by the cyan bar in Fig. 141-2. A strong linear correlation was found between mixing ratios of $\Delta CH_4$ and $\Delta CO_2$, with an Emission Ratio (ER) of 9.5 ppb $CH_4$ (ppm $CO_2$)$^{-1}$ (Fig. 141-2f). No correlation was found between $\Delta O_3$ and $\Delta CO_2$ (Fig. 141-2g).



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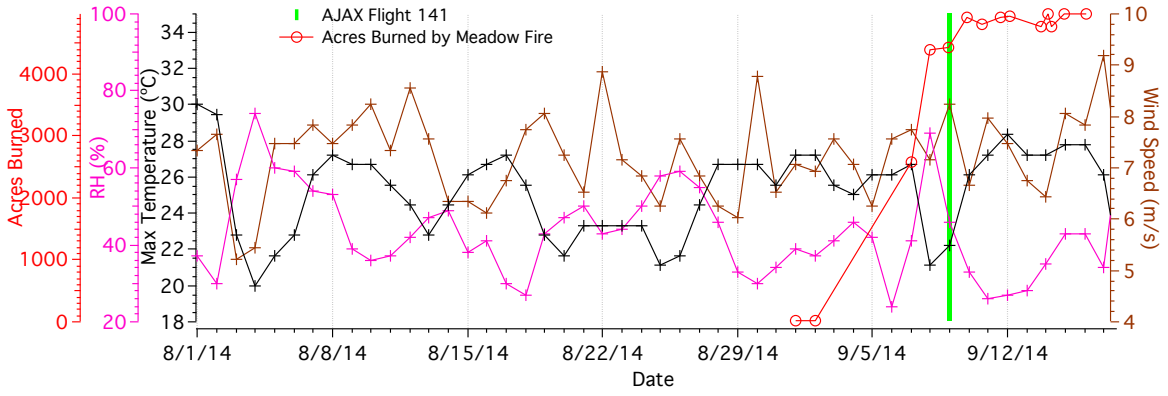


**Figure 141-1.** Time series of total acres burned for the Meadow fire (red) and AJAX flight 141 (green bar). Meteorological conditions for a nearby CARB ground monitoring site (Yosemite National Park-Turtleback Dome, 11 miles west of the Meadow fire) are also shown.

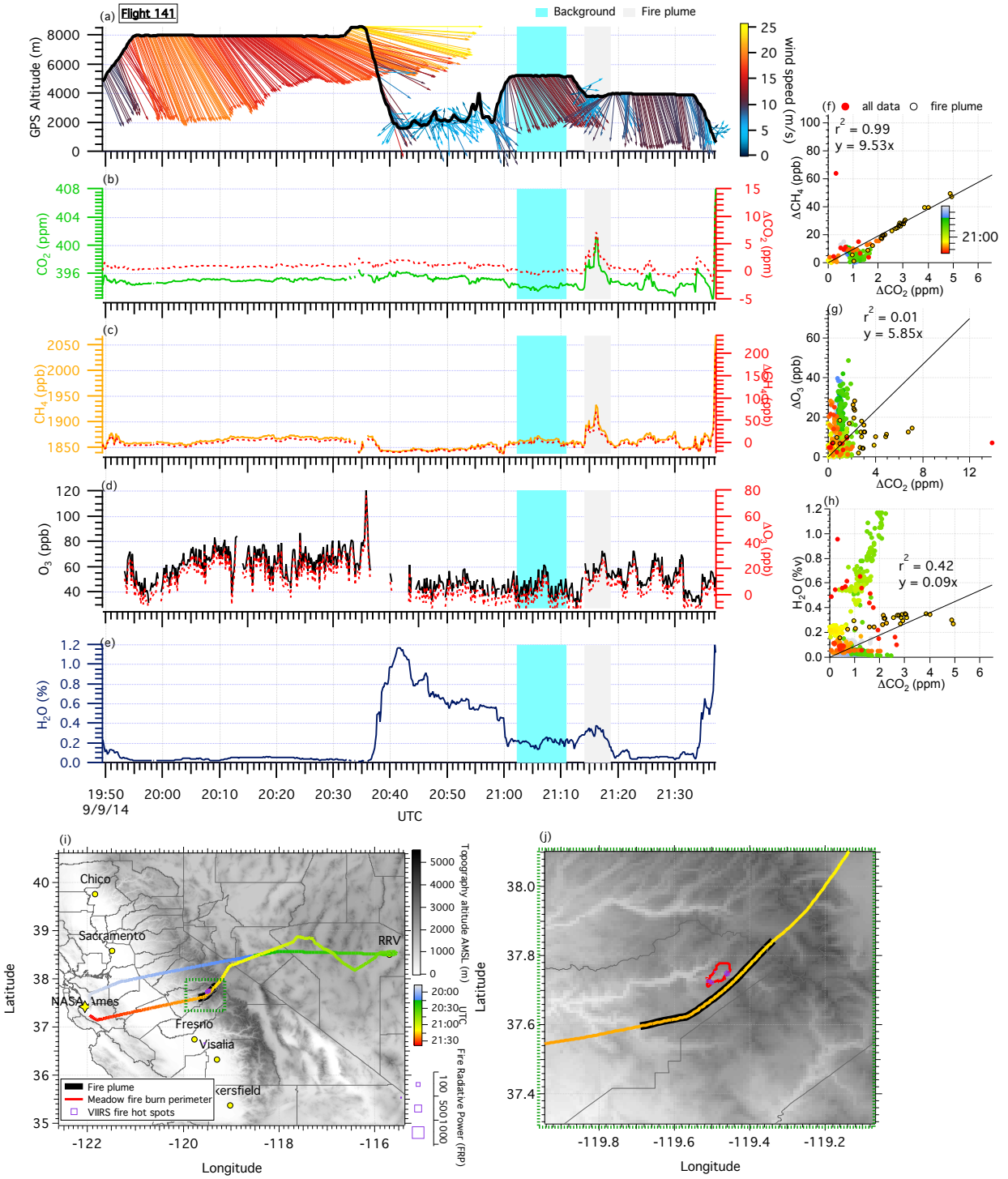


**Figure 141-2.** AJAX measurements during the Meadow fire. The aircraft altitude and wind speed/direction are shown in plot (a) followed by mixing ratios of trace gases in plots (b-e) (left y-axes) and enhanced mixing ratios (right y-axes). The gray bar represents the main fire plume. Scatter plots are shown for enhancements in (f) $CH_4$, (g) $O_3$, and (h) $H_2O$ vs $CO_2$. The AJAX flight path colored by time and fire burn area for that flight day are shown on a topographic map (i), with VIIRS fire hot spots sized by FRP.

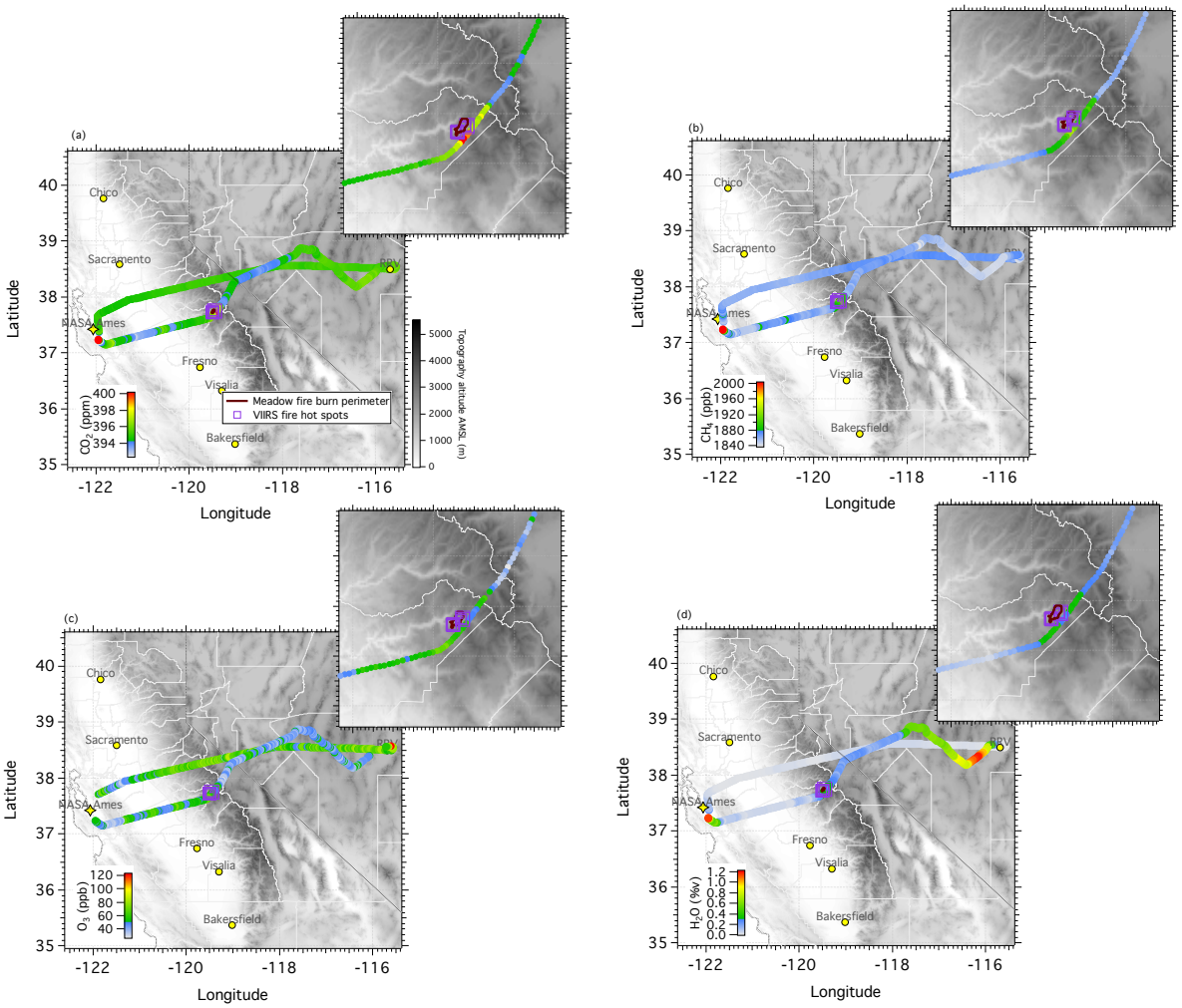


**Figure 141-3.** Flight path colored by mixing ratios of (a) $CO_2$, (b) $CH_4$, (c) $O_3$, and (d) $H_2O$ for Flight 141 (Meadow Fire), with VIIRS fire hot spots sized by Fire Radiative Power (FRP). See Figure 141-2i for FRP key. The expanded graphs show details close to the fire location.

**Data Sources and Citations:**

1. In situ trace gas data were produced by the AJAX project at NASA Ames Research Center.
   - https://asdc.larc.nasa.gov/project/AJAX

2. Fire Radiative Power (FRP) data were obtained from NASA's Visible Imaging Radiometer Suite (VIIRS) 375 m fire data aboard the National Polar-orbiting Partnership (S-NPP) satellite.
   - https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms

3. Meteorological data were obtained from the CARB Air Quality and Meteorological Information System (AQMIS) website
   - https://www.arb.ca.gov/aqmis2/aqmis2.php

4. Burn scar areas for wildfires were obtained from the Geospatial Multi-Agency Coordination (GeoMAC) database. GeoMAC fire perimeters are based on a combination of incident intelligence sources, Global Position System (GPS) data, and infrared (IR) imagery.
   - Walters, S. P., N. J. Schneider, and J. D. Guthrie (2011), Geospatial Multi-Agency Coordination (GeoMAC) wildland fire perimeters, 2008, *Report Rep. 612*, Reston, VA.