

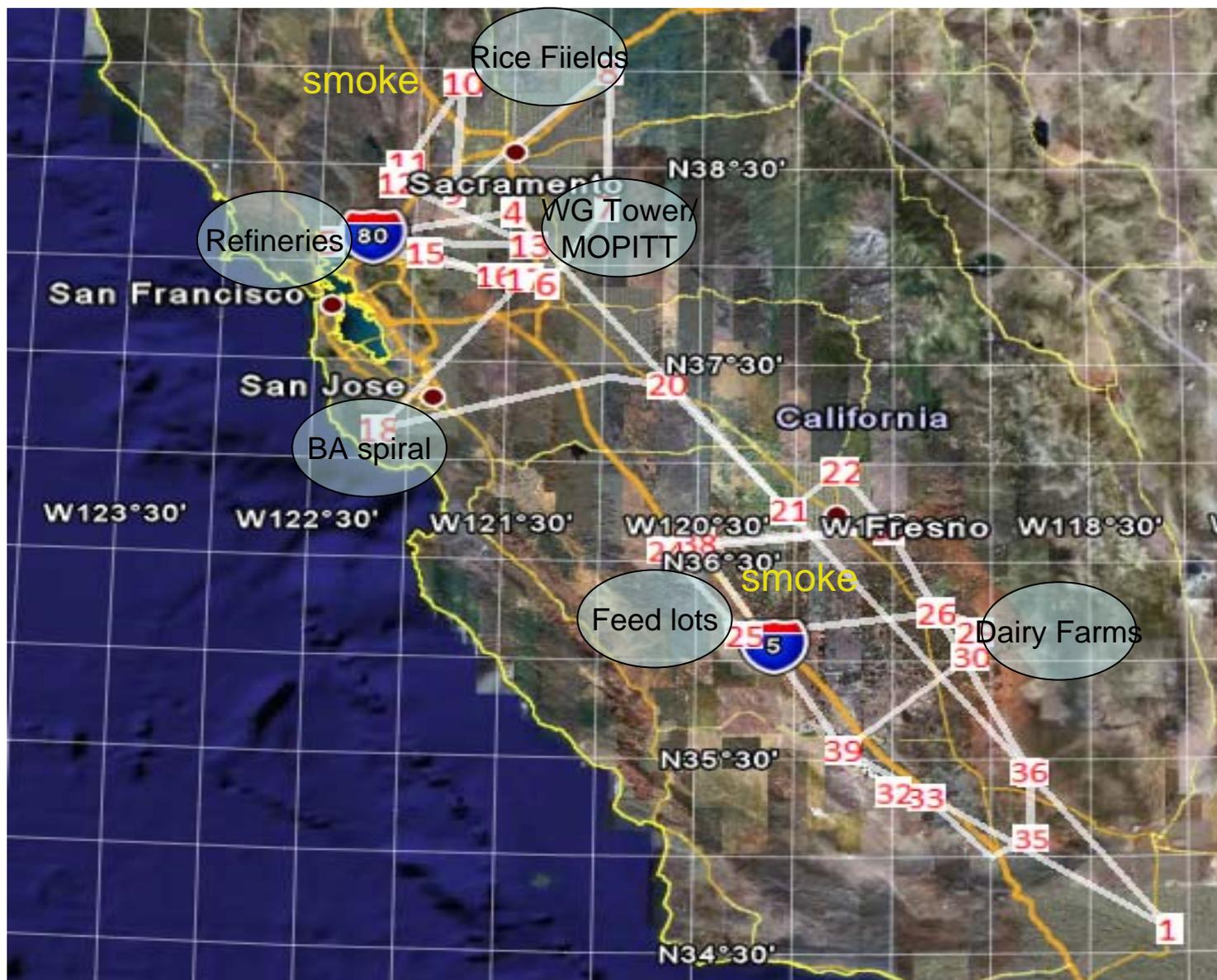
ARCTAS/CARB DC-8 Science Flight 13 (June 20, 2008; Friday)

This ARCTAS/CARB DC-8 science flight was the second sortie from Palmdale. The main objectives were to sample a large number of unique urban and rural source regions for Green House Gas (GHG) emissions in California, to characterize the east-west and north-south gradients of gases and aerosols over the Central Valley, and coordinate activities with LBL at the Walnut Creek Tower coincident with a MPITT over flight. The nominal flight tracks and Way Points (WP) are shown in slide 2 but these were modified in-flight to take advantage of specific opportunities and to avoid excessive cabin heating. Take off time was 1732 UT and the flight duration was 7.8 hours.

This was an excellent flight and we were able to meet all our objectives. Most instruments aboard the DC-8 performed normally and collected data. A large amount of flight time was spent in the boundary layer (BL) where the temperature often exceeded 100F. The cabin overheating problems were less than expected and were successfully managed by climbing (>10 Kft) for short periods of time as appropriate. Winds in the Valley remained light and variable under essentially cloud free conditions.

At the start of the flight we did a northerly track to WP 4 at 22 Kft to obtain a dial lidar curtain of Central Valley air (slide 3). Elevated aerosol and ozone were present in much of the troposphere and emissions evident from urban centers (e. g. Fresno). AT WP 4 (Walnut Grove Tower) the DC-8 spiraled down to 1 Kft providing a successful comparison with multi-level GHG sampling at the tower and also encountering significant pollution in the BL. The DC-8 then headed west to sample refinery emissions and the Sacramento BL. Typically in urban air NO_y was in the range of 10-25 ppb, CO did not exceed 220 ppb and O₃ remained below 110 ppb. In general in urban regions nearly 60% of NO_y was made up of primary NO_x emissions with lesser contributions from HNO₃ and PAN. Sampling in the vicinity of refineries showed elevated levels of CO₂ (400 ppm), SO₂ (10 ppb), and several VOCs (e. g. toluene). Flying north over agricultural areas including rice fields (WP 7-10), substantial elevation in CH₄ (>2200 ppb) and isoprene (3 ppb) was observed in the BL. High concentrations of methanol (>10 ppb) were nearly always associated with elevated methane suggesting a common source. A smoke plume was encountered at WP10 and we deviated to sample it. Extremely large concentrations of NO_y (40 ppb), methanol (50 ppb), formaldehyde (45 ppb), Hox (100 ppt) and organic Carbon (100 µg/m³) were measured in this plume. A spiral over the silicon Valley of Bay Area (WP 18) once again allowed us to get an excellent characterization of sources with a composition similar to that of Sacramento. Through out the Central Valley substantial concentrations of highly reactive species such as HCHO, CH₃CHO and C₂H₅OH were measured. On the return leg (WP 23-24) we sampled a fire plume at 12 Kft that contained about 600 ppb of CO and large concentrations of black carbon. The CO/CO₂ enhancement ratios in fire plumes are nearly 100 times larger than in urban plumes and, along with other tracers, offer an excellent opportunity to unravel the complex matrix of sources influencing the Central Valley air (slide 4). Sampling above feed lots and dairy farms at 1000 ft did not indicate substantial signals in VOCs although much of the VOC (and HCFC) data are yet to be processed from canister samples. Overall this flight produced a wealth of unique data to address several of CARB goals.

Flight 13 Central Valley Survey 06/20/2008: Mapping GHG emissions from urban & rural sources in California

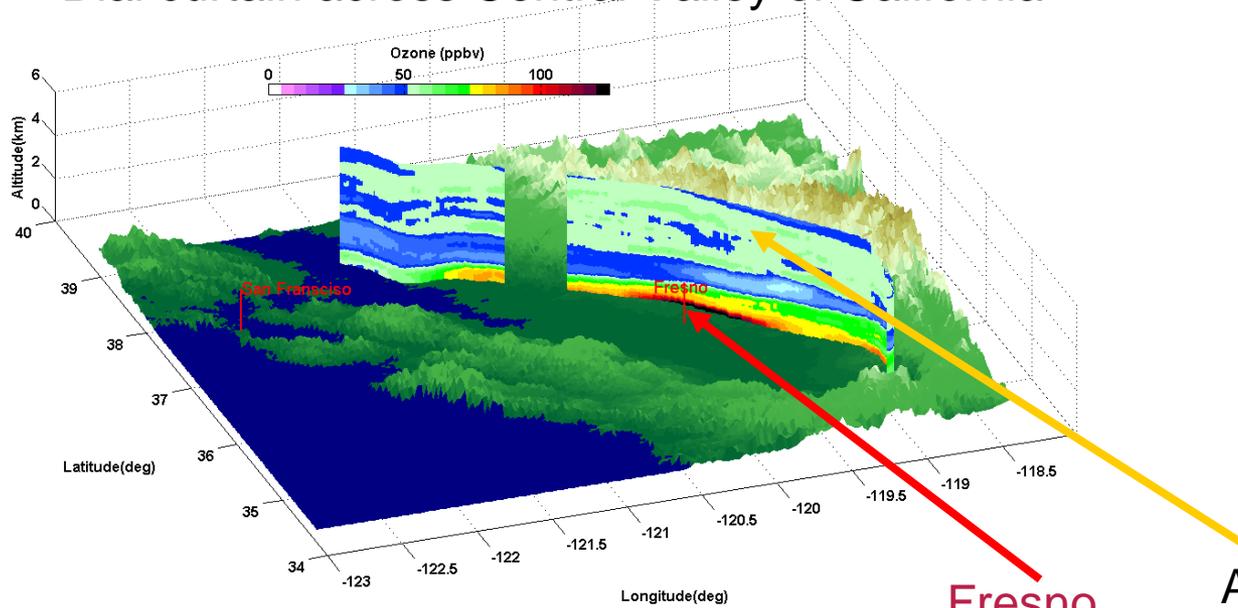


TARGETS:

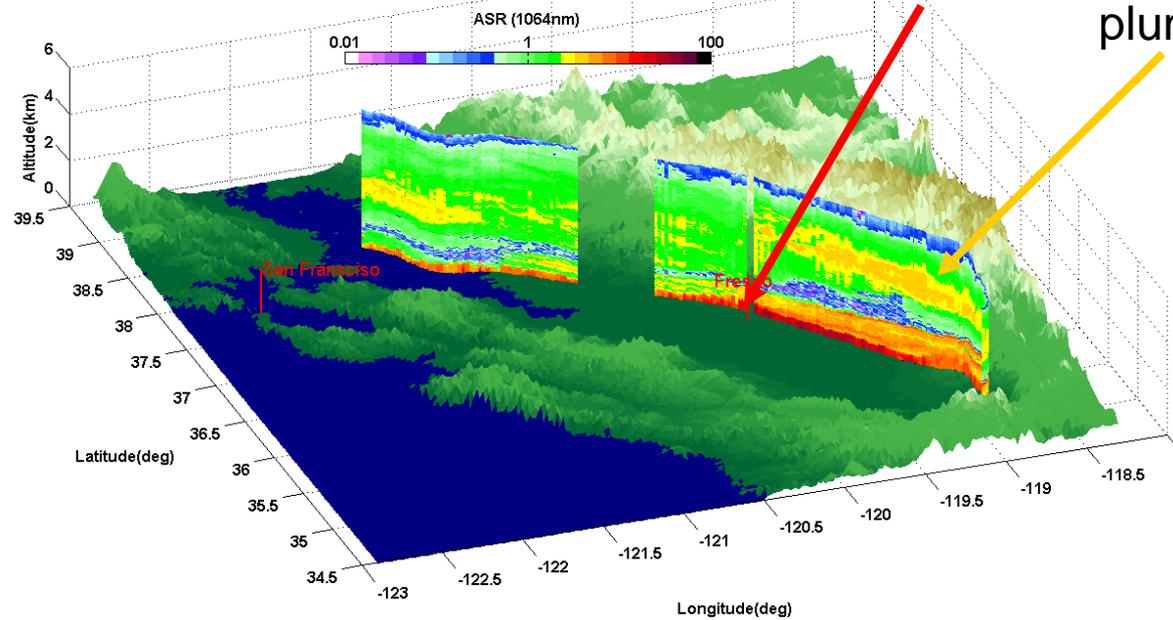
- Sampling upwind/downwind of urban areas: Fresno, Stockton, Sacramento, SF-bay (covariance of GHG's & tracers)
- "Non-urban" emissions of GHG species – methane, from rice fields
- Walnut Grove Tower time series & profiling
- Emissions from dairy areas & feedlots
- Characterizing Central Valley gas/aerosol composition & variability
- Lidar curtain across the Valley

Dial curtain across Central Valley of California

Ozone (ppb)



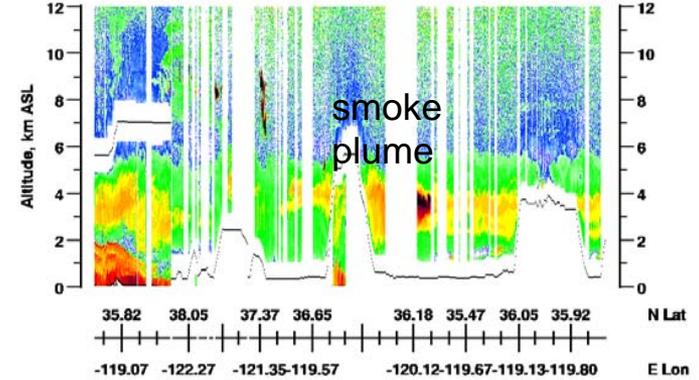
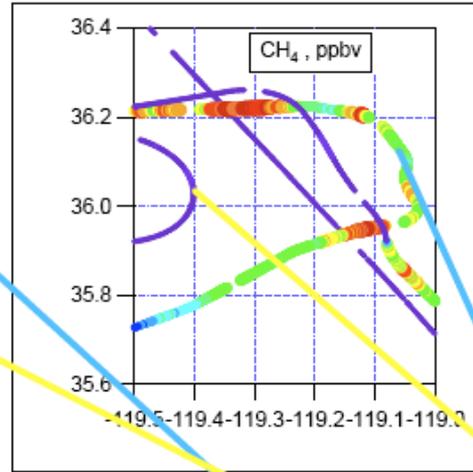
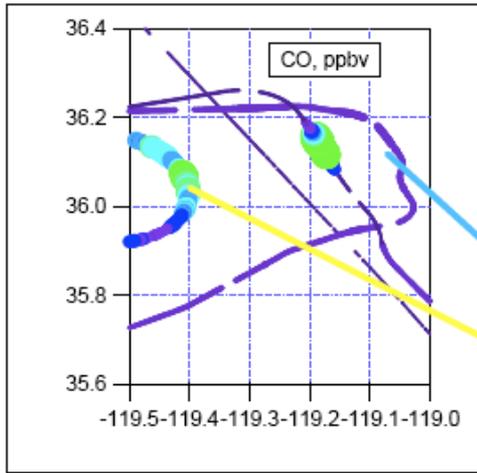
Aerosol Scattering Ratio (1064 nm)



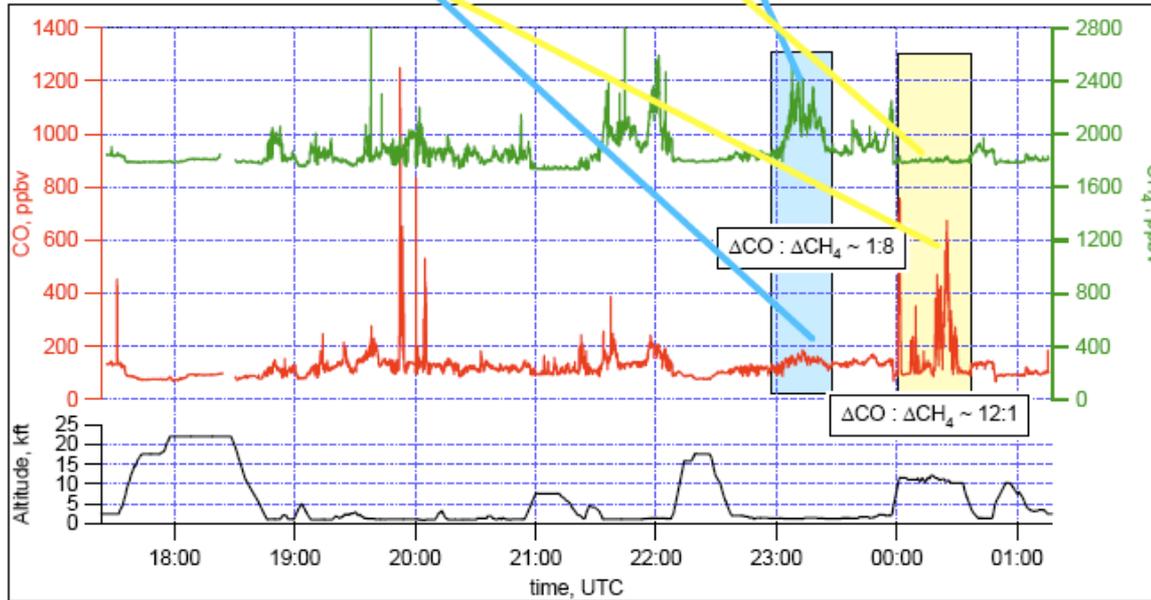
Fresno

Aged fire plumes

CO-CH4 enhancements in urban air and smoke plumes



$\Delta\text{CO}/\Delta\text{CH}_4$ is 100 times larger in fire plumes compared to urban plumes



DIAL

DACOM