

Transient Aircraft Soot Emissions Indicate That Steady-State Measurements Likely Underestimate Real-World, Take-Off Emissions

Time-Varying Aircraft Take-Off Emissions Indices Measured at Los Angeles International Airport

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INTRODUCTION

- Aircraft engine emissions are unique among mobile pollution sources in that their impacts affect the local air quality near airports as well as upper tropospheric composition and climate over regional-to-hemispheric scales.
- Here, we analyze aircraft emissions during take-off operations at Los Angeles International Airport. The data were collected as part of the NASA Alternative Fuel Effects on Contrails and Cruise Emissions (ACCESS) project in May 2014, and the dataset is publicly available (QR Code Below).

METHODS

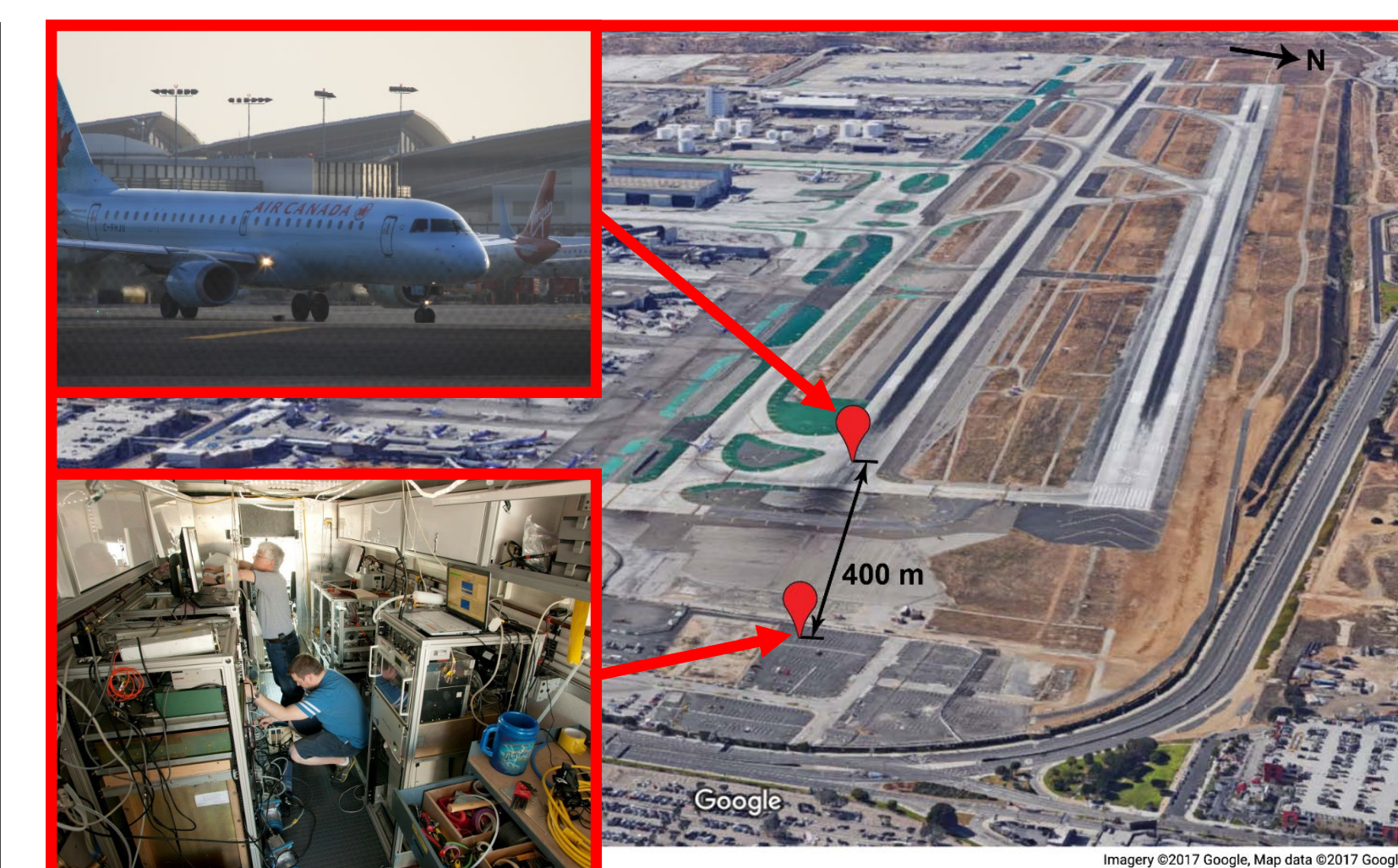
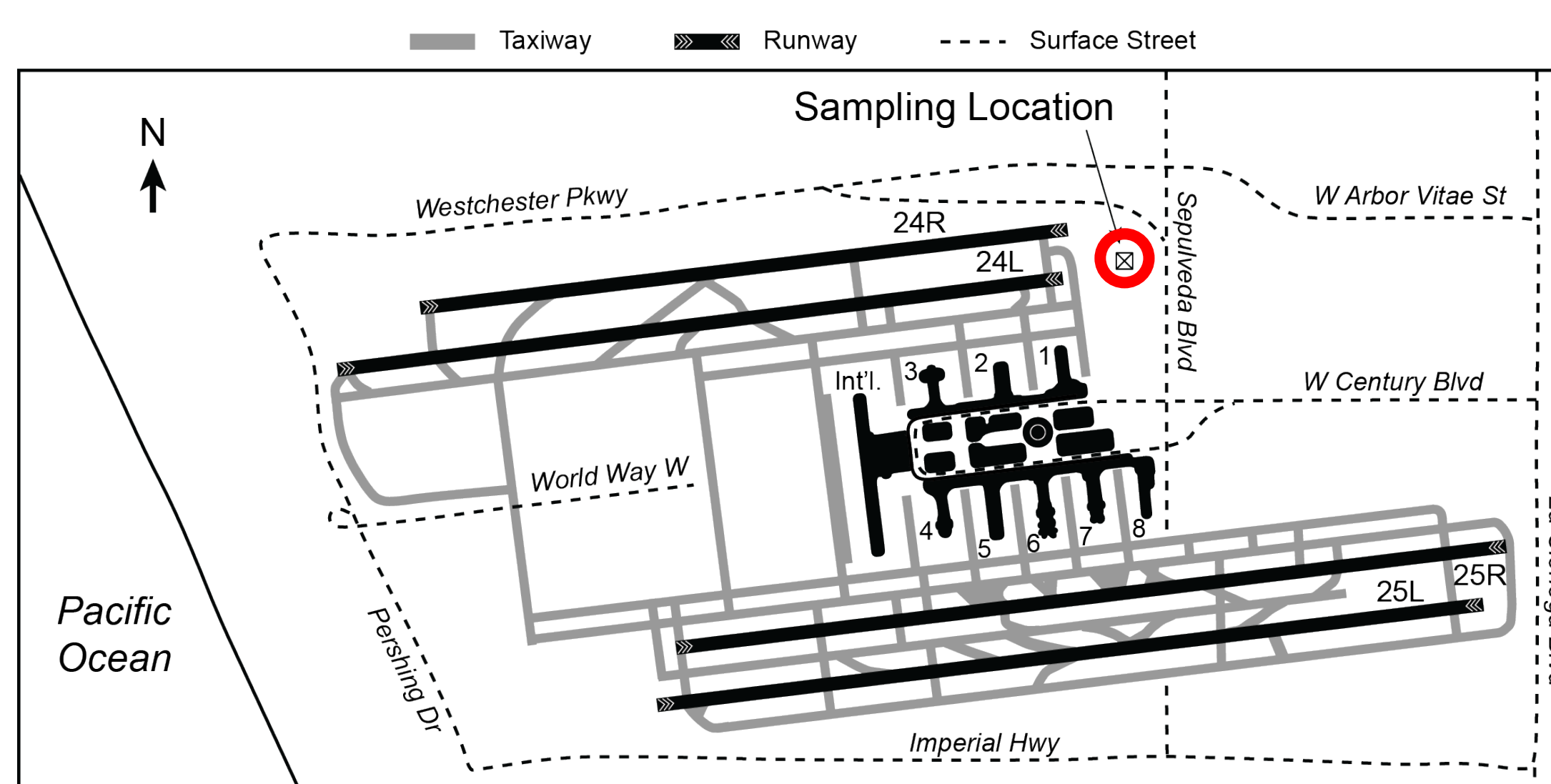
- Particle emissions indexes (EIs) found by integrating area under each timeseries curve (ΔX) normalized by CO_2 area (ΔCO_2):

$$EI_X = \frac{\Delta X \cdot V_m}{\Delta CO_2 \cdot M_{CO_2}} (EI_{CO_2}) \quad \text{where, } EI_{CO_2} = \frac{RT}{PV_m} \frac{M_{CO_2}}{M_C + \alpha M_H} \sim 3160 \text{ gCO}_2 \text{ kg-fuel}^{-1}$$
- Aircraft tail numbers link the emissions plumes to engine information in from online aircraft registration databases.
- Transient emissions behavior evaluated by changing the integration time periods to include the entire peak as well as the initial and later portions of the peak (somewhat subjective).

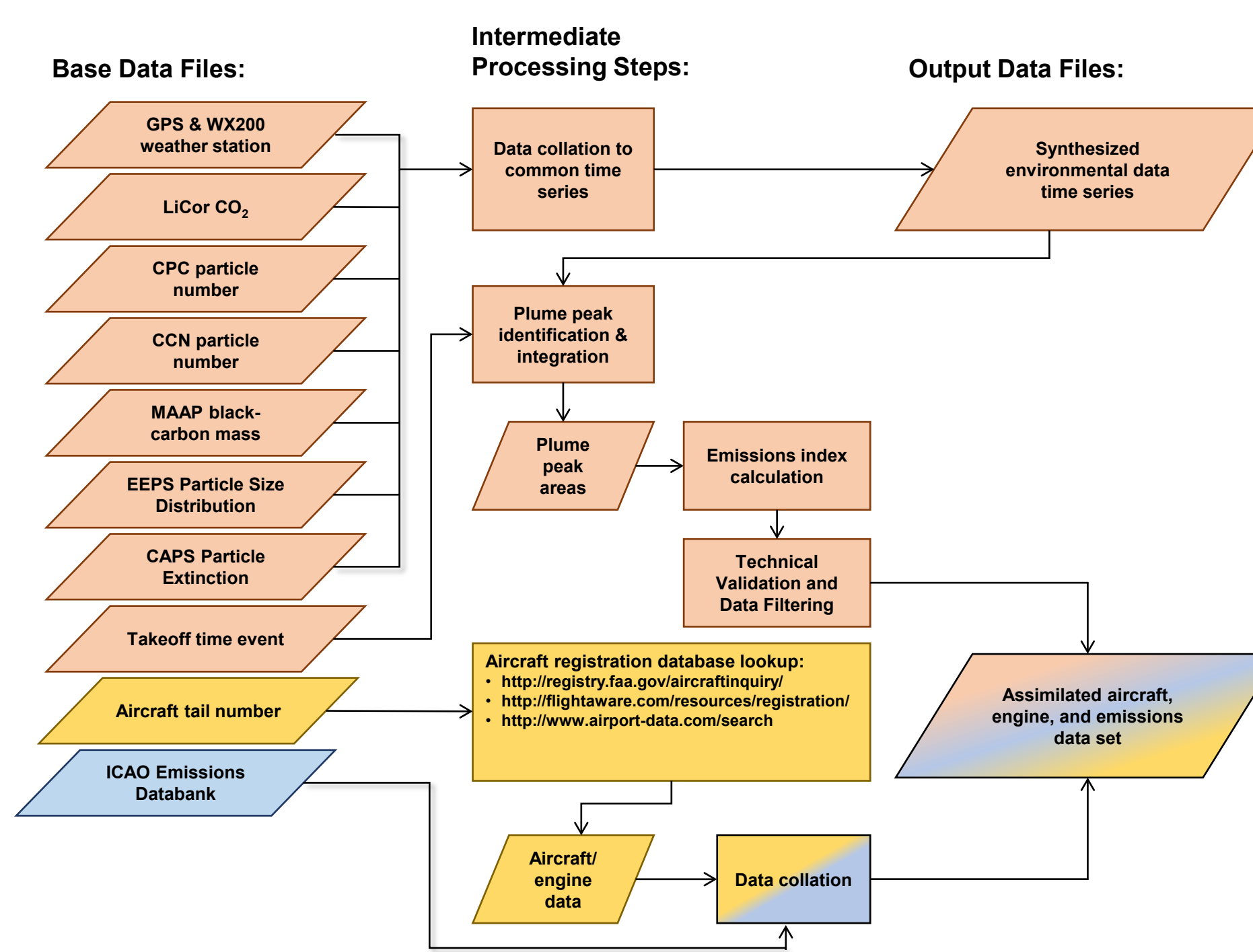
RESULTS & CONCLUSIONS

- Mass and number EIs are significantly greater (for some engines) relative to the ICAO certification data
- Accounting for transient emissions versus steady state engine conditions helps to partially explain this discrepancy
- Important to measure real-world EIs to constrain models!

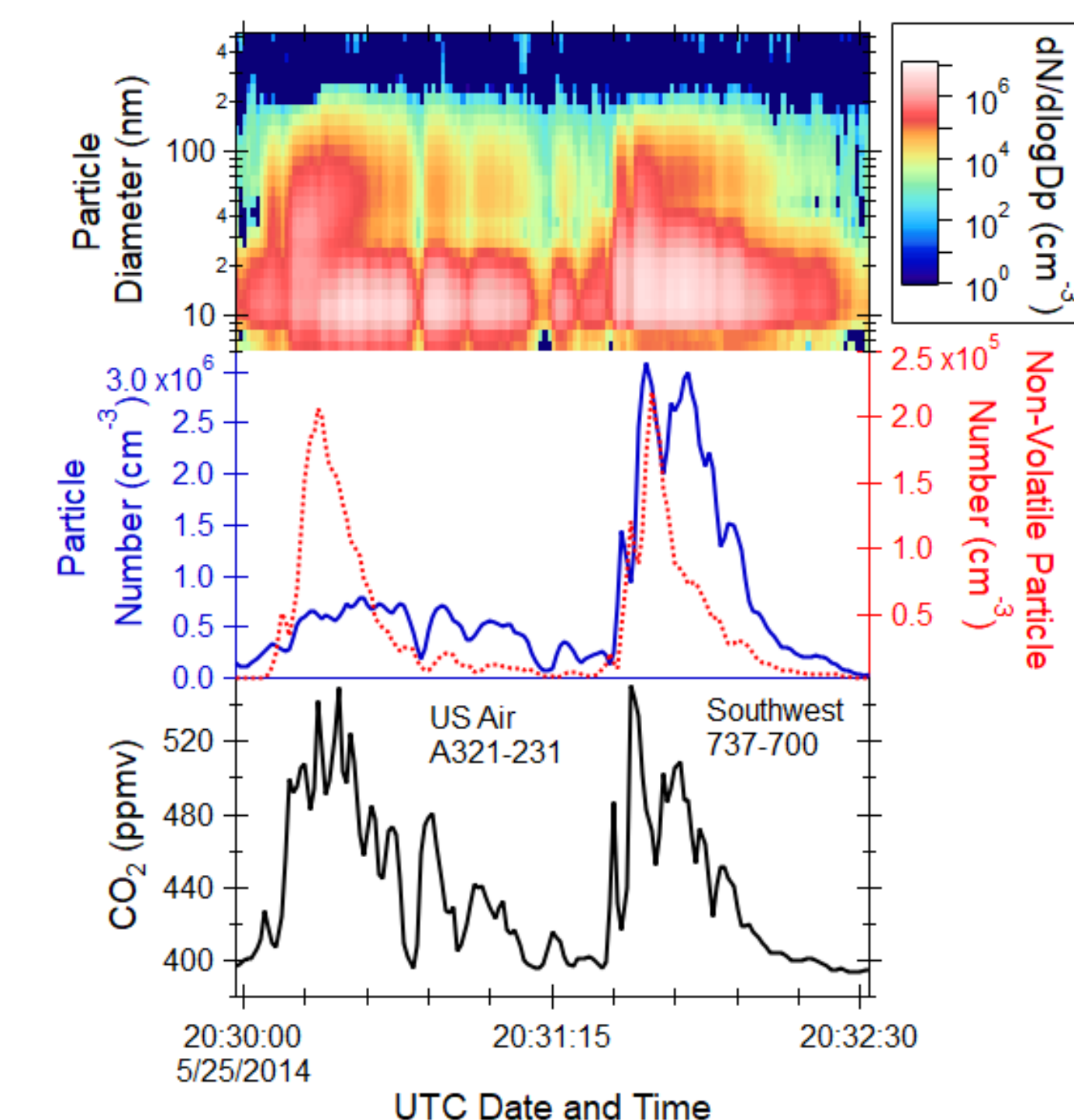
NASA Langley Mobile Emissions Laboratory Positioned Just East of the Northern Runways:



Data Synthesis and Workflow:



Timeseries Show High Non-Volatile Particles in the Early Part of the Plume:



Generally, ACCESS EIs Are Greater Than ICAO Certification EIs; Although, Transient nvPM Can Only Partially Explain This Discrepancy:

