

# Sources and Characteristics of Summertime Organic Aerosols in the Colorado Front Range: Perspectives from Measurements and WRF-Chem Modeling

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## Abstract

Non-refractory aerosol composition along with a comprehensive suite of gas-phase measurements on the C130 during FRAPPÉ have provided the opportunity to examine contributions of urban, biogenic, and oil and natural gas (O&NG) exploration emissions to summertime organic aerosols in the Front Range. During FRAPPÉ (July-Aug. 2014), a significant increase in the enhancement ratio of organic aerosols (OA) with respect to carbon monoxide (DOA/DCO) was observed with photochemical aging, suggesting substantial production of secondary organic aerosols (SOA) in the region. Positive matrix factorization analysis on the OA spectra confirmed a large contribution of oxygenated organic aerosols to OA in the boundary layer. We investigated the evolution of OA and their precursors through measurements and WRF-Chem modeling (with volatility-basis set parameterization). WRF-Chem simulations included sensitivity runs to examine effects of primary OA (POA) volatility, biogenic SOA aging schemes, and updated emission ratios of volatile/intermediate volatility organic compounds from the O&NG sector on SOA formation. In this presentation, we compare measured and modeled parameters related to OA sources and formation, and provide an estimate for the contribution of O&NG emissions to summertime anthropogenic SOA.

## Methodology

### Airborne Measurements

- FRAPPÉ: C130 flights
- 26 July- 18 August, 2014
- Aerosol composition by mAMS
- Variety of trace gas measurements
  - Primary species (CO, NO<sub>x</sub>, ethane, VOCs)
  - Secondary species (HNO<sub>3</sub>, PAN, alkyl nitrates, HO<sub>x</sub>)
- Objectives
  - Identifying aerosol sources in the Front Range
  - Understanding organic aerosol (OA) formation using WRF-Chem

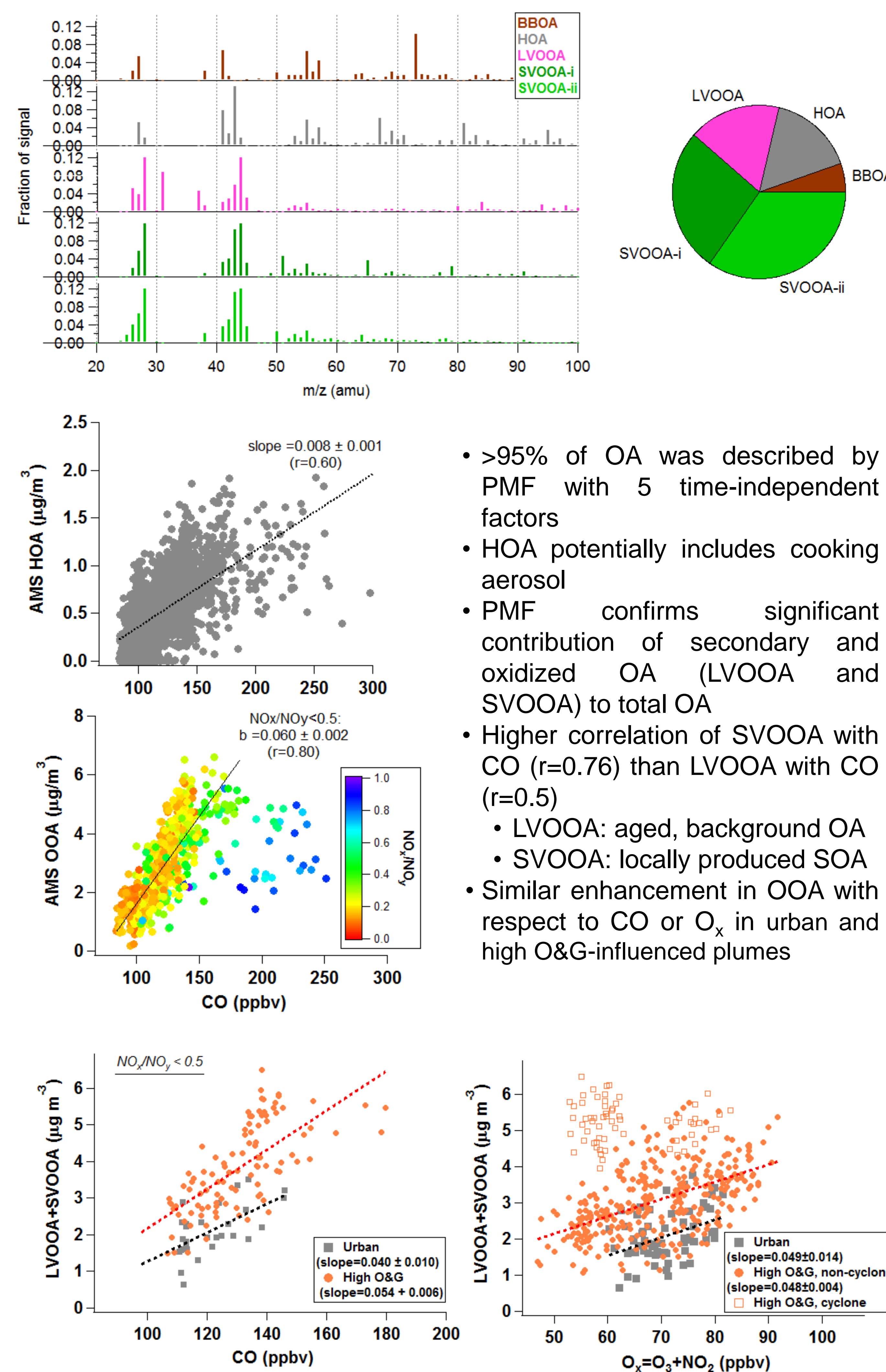
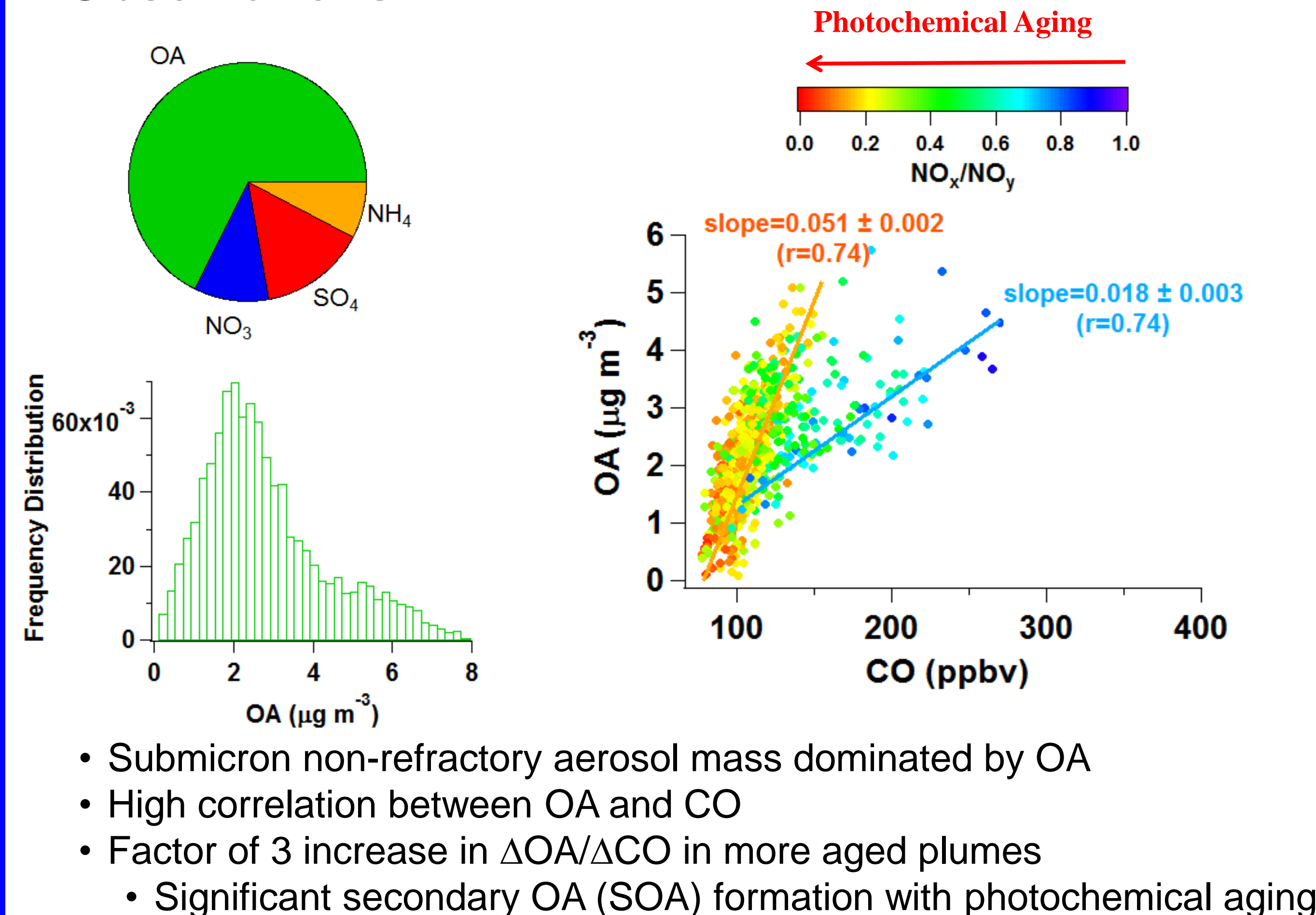
### WRF- Chem Model Runs

- July 27- Aug. 11, 2014
- Two model domains: 12km resolution over the contiguous US with 4km resolution inner domain over Front Range
- 50 vertical layers from surface up to 50 mbar
- Semivolatile POA
- VBS SOA parameterization with multigenerational oxidation
- Emissions:
  - Base anthropogenic emissions: NEI-2011 (v1)
  - O&G emissions: Top-Down Approach, based on observed CH<sub>4</sub> flux and ratios relative to CH<sub>4</sub> (SONNE 2012)
  - Biogenic emissions: BEIS 3.14
- Model cases:
  - Base case with above emissions
  - Base case with O&G emissions set to zero
  - Non-volatile POA, with O&G emissions
  - Non-volatile POA, with O&G emissions, aging of biogenic SOA turned off

### Data Analysis

- Boundary layer data, excluding strong biomass burning-influenced air masses
- Urban plumes: CO > 105 ppbv, C<sub>2</sub>H<sub>6</sub>/CO < 20 ppt/ppbv
- High oil and natural gas (O&G)- influenced plumes: C<sub>2</sub>H<sub>6</sub>/CO > 80 ppt/ppbv
- Positive Matrix Factorization on OA spectra (OA > 1 μg m<sup>-3</sup>) on July 26-28, July 31, Aug. 2-3, 8, and 11

## Observations



## WRF-Chem Simulations

