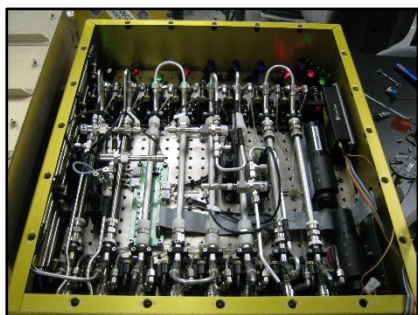


New cavity-enhanced detection methods for aerosols and gases

Rebecca Washenfelder



NOAA CSD has pioneered field measurements using cavity ring-down spectroscopy:



Aerosol optical extinction

Deployed on NOAA and NASA aircraft during four field campaigns.
Used to understand visibility, climate forcing, and vertical structure.

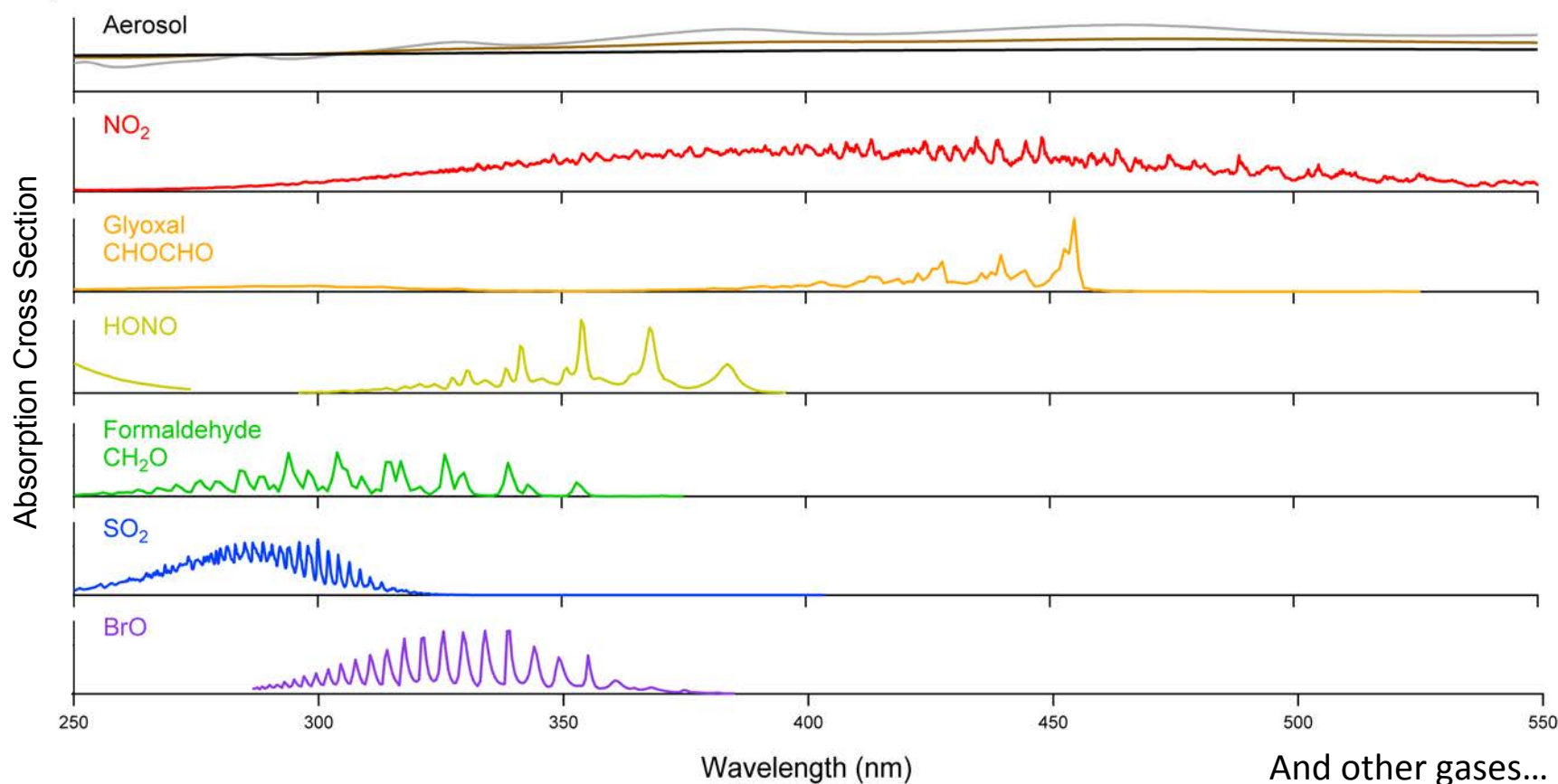
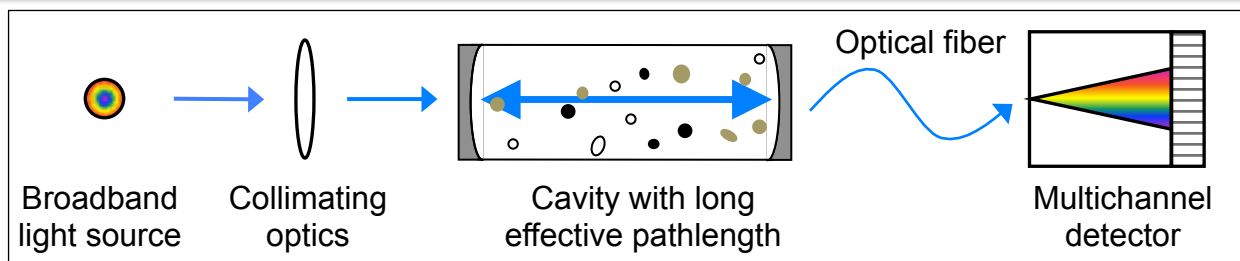


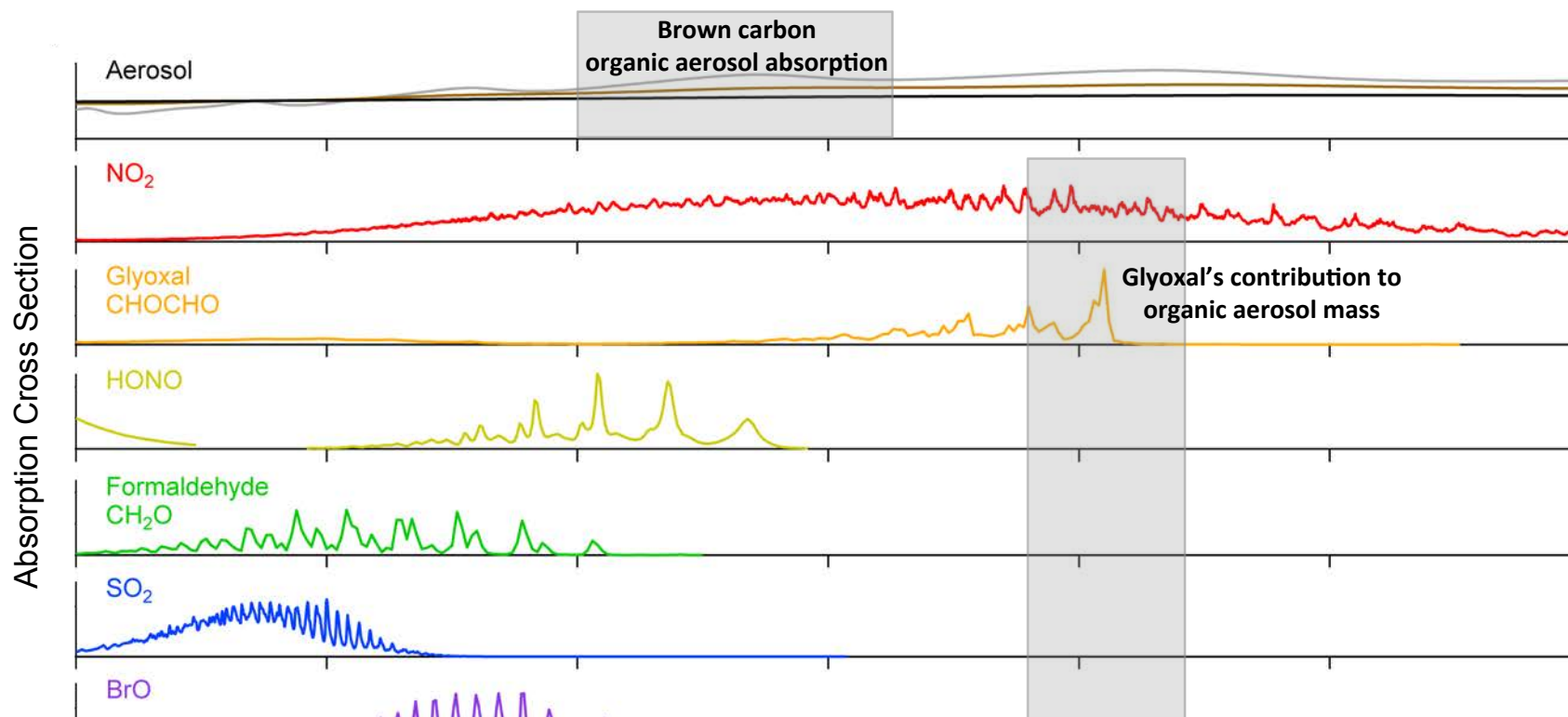
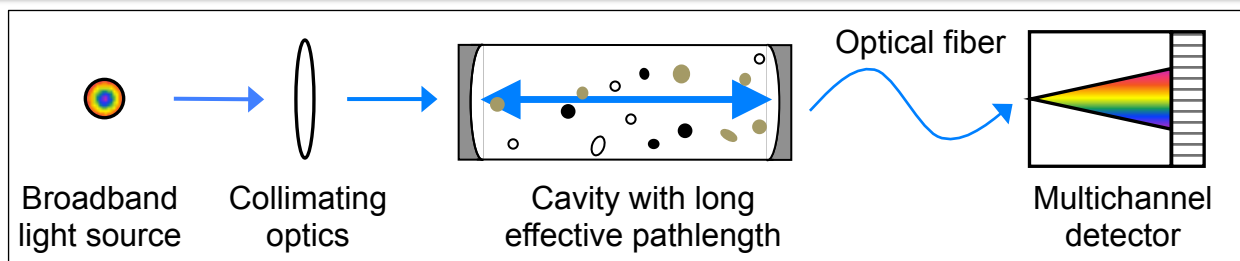
Nighttime nitrogen oxide species (NO_3 and N_2O_5)

Deployed on NOAA and NSF aircraft during five field campaigns.
Used to understand heterogeneous chemistry and hydrocarbon oxidation.

Cavity-enhanced instruments combine extinction spectroscopy with long path lengths.

New broadband and open path instruments can address new scientific questions.

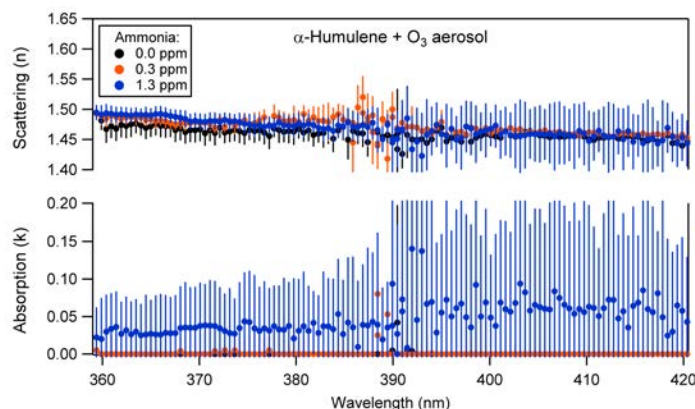




Broadband cavity-enhanced spectroscopy can measure multiple species simultaneously. Initially we have focused on organic aerosol questions.

Laboratory:

Does exposure to ammonia cause carbonyl-containing organic aerosol to absorb light?

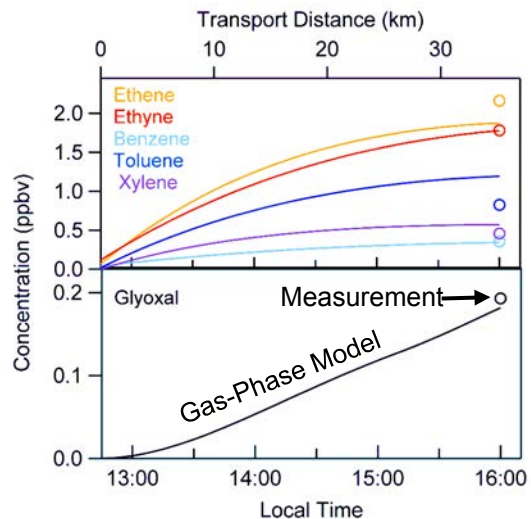
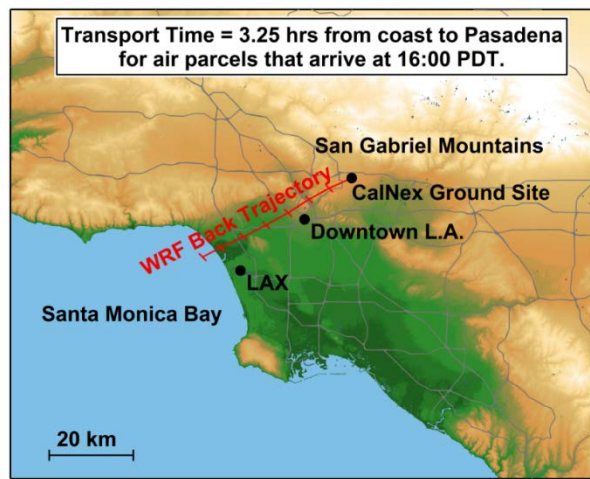


Yes, some carbonyl-containing particles react with high concentrations of ammonia to form absorbing chromophores.

Washenfelter et al, 2013
Flores et al, 2014

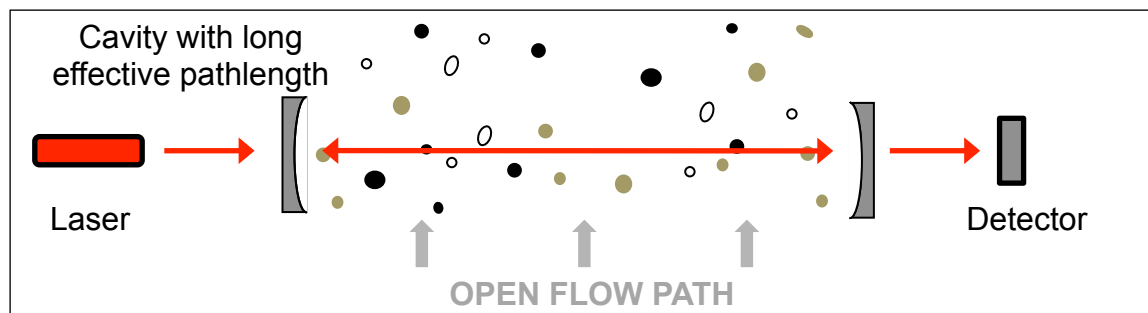
Field:

Does glyoxal contribute to organic aerosol mass in Los Angeles?



Glyoxal contributes 0 - 4%.
Other species play a more important role.

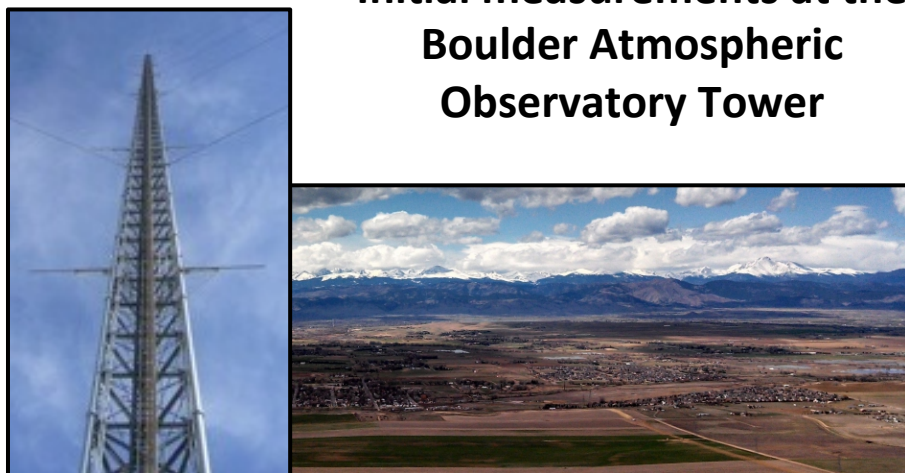
Washenfelter et al, 2011



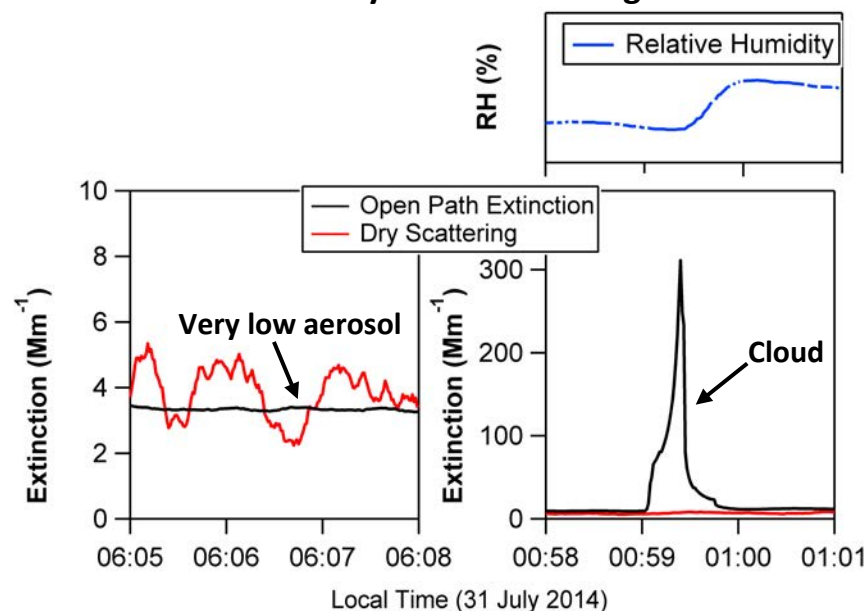
Major Advantages:

- Aerosol humidity and temperature are identical to ambient conditions.
- Large diameter particles are not lost.

Initial measurements at the Boulder Atmospheric Observatory Tower



Extinction by aerosol in a single cloud:



Gordon et al., in preparation

Short-term:

1. Expand our broadband measurements into the deeper UV spectral region, using new light sources and mirrors.
 - Scientific goals: Brown carbon absorption, formaldehyde, sulfur dioxide, bromine oxide.
2. Develop **very** broadband measurements (e.g. 300 – 400 nm) that imitate satellite observations of gases and aerosols.
 - Scientific goals: Satellite validation, measurement of multiple trace gas species.
3. Develop an aircraft instrument to measure open path aerosol extinction.
 - Scientific goals: Constrain radiative forcing, satellite validation.

Long-term: Use broadband and open path instruments for satellite validation.

