Ozone, Aerosols and Carbon gases at the Mt. Bachelor Observatory.

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The Mt. Bachelor Observatory (MBO)

MBO is a high elevation (2.8 km asl) research site located on the summit of the Mt. Bachelor ski area in Central Oregon and is an ideal location to capture background/baseline air entering North America. The site was started by the University of Washington in 2004, and since then we have focused of measuring O3, aerosols, carbon gases, Hg and related trace species in order to better understand the sources, chemistry and transport of pollution in the free troposphere.

Past Discoveries at MBO

- Long-range transport of CO, O_3, aerosols, and Hg from Asia to the U.S.
- Identification of a significant under-estimation in Asian emissions of Hg.
- Use of MBO data to validate global models for Hg, O_3, and CO.
- Identification of a significant source of Hg^{+2} in the free atmosphere.
- Identification of living micro-organisms in the free troposphere.
- Use of MBO observations to understand changes in aerosol properties during long range transport events.
- Use of MBO observations to understand NOx, O_3, PM and photolysis in wildfire plumes.
- Better understanding of the contribution of Asian pollution to U.S. air quality.
- Positive trend in spring and summer O_3 and negative trend in CO over past decade.

>51 papers have been published using data collected at MBO since 2004

The summit building at Mt. Bachelor

Collaborations with NOAA and other groups

- MBO has been part of the Carbon Cycle Greenhouse Gases Group's cooperative air sampling network since 2011.
- A new collaboration with the NOAA Aerosol Group and Ozone and Water Vapor Group started in 2018.
- MBO data have been used by scientists from 36 different institutions

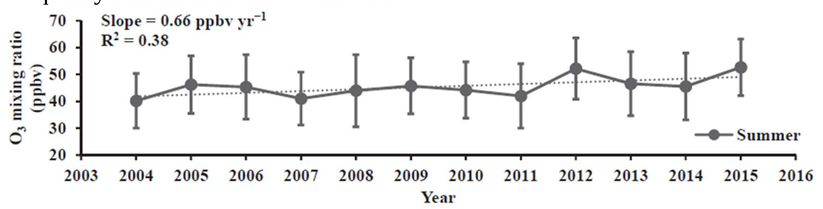
Measurements at MBO

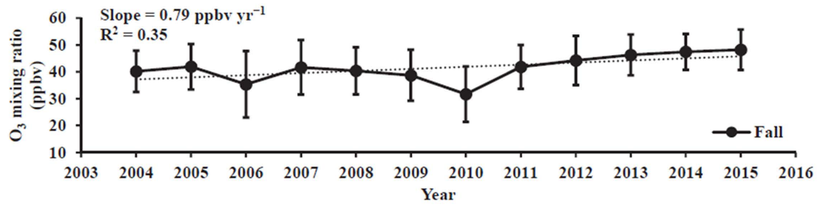
- Continuous Measurements
  - CO, CO_2
  - NOAA flask samples
  - O_3
  - Aerosol scattering and absorption
  - Particulate matter mass concentration
  - Particle number concentration
- Campaign-based Measurements
  - Aerosol size distribution (SMPS)
  - Black Carbon by Single Particle Soot Photometer (SP2)
  - Aerosol speciation by Aerosol Mass Spectrometer (AMS)
  - Mercury speciation
  - Size-resolved elemental composition using a DRUM and X-ray fluorescence (XRF) analysis

Jaffe Group Website:
http://blogs.uw.edu/djaffe/
NOAA MBO website:
https://www.esrl.noaa.gov/gmd/aero/net/mbo.html

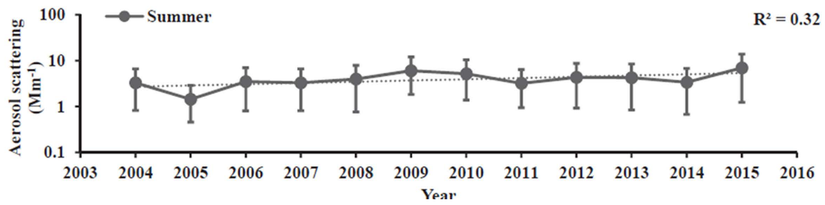
Long Term Trends of O_3 and aerosol scattering

- From 2004-2015, an increase in O_3 was found in spring, summer and fall, and aerosol scattering was observed to increase in the summer.
- Possible causes for these increases are long-range transport of Asian pollution in the spring and regional wildfires in summer and early fall.
- This upward trend in O_3 has important implications for meeting the US air quality standards in the western US.





Trends and interannual variations of O3 mixing ratio in the summer and fall.

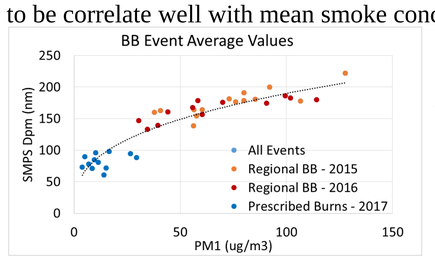


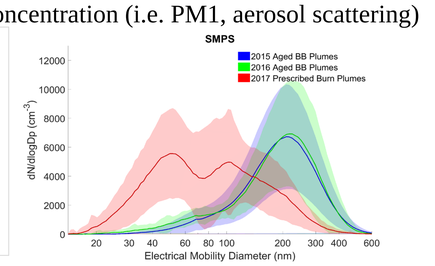
Trends and interannual variations of the aerosol scattering coefficient during summer months.

Zhang and Jaffe. 2017.

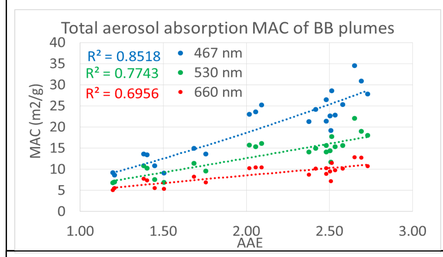
Physical and Optical Properties of Biomass Burning Plumes

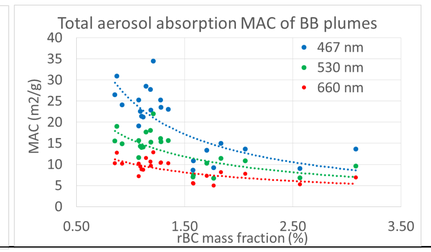
We have observed biomass burning (BB) plumes from nearby prescribed burns, regional wildfires, and Siberian wildfires. Mean plume particle size has been found to be correlate well with mean smoke concentration (i.e. PM1, aerosol scattering)





We parameterized mass absorption coefficients (MAC) of BB plumes as a function of their brown carbon content (AAE values) and their BC mass fraction.





Future Work at MBO

- Continue the long term measurements of critical air pollution species.
- Compare the TAP and CLAP aerosol absorption instruments in an ambient environment, and compare the use of different filter types in the instruments.
- 2019 intensive on smoke with AMS, CIMS, etc (Q. Zhang, J. Thornton)