Changing Conditions in the Arctic: An Analysis of Trends in Observed Surface Ozone Conditions

A. McClure-Begley[1,2], S.M. Morris[1,2,3], I. Petropavlovskikh[1,2], T. Uttal[3], O.R. Cooper[1,4], D. Tarasick[5], H. Skov[6] and S.J. Oltmans[7]

1Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309; 303- 497-6823, E-mail: audra.mcclure@noaa.gov
2NOAA Earth System Research Laboratory, Global Monitoring Division (GMD), Boulder, CO 80305
3NOAA Earth System Research Laboratory, Physical Sciences Division (PSD), Boulder, CO 80305
4NOAA Earth System Research Laboratory, Chemical Sciences Division (CSD), Boulder, CO 80305
5Air Quality Research Division, Environment and Climate Change Canada, Downsview, Ontario, Canada
6Aarhus University, Aarhus, Denmark
7Retired from NOAA Earth System Research Laboratory, Global Monitoring Division (GMD), Boulder, CO 80305

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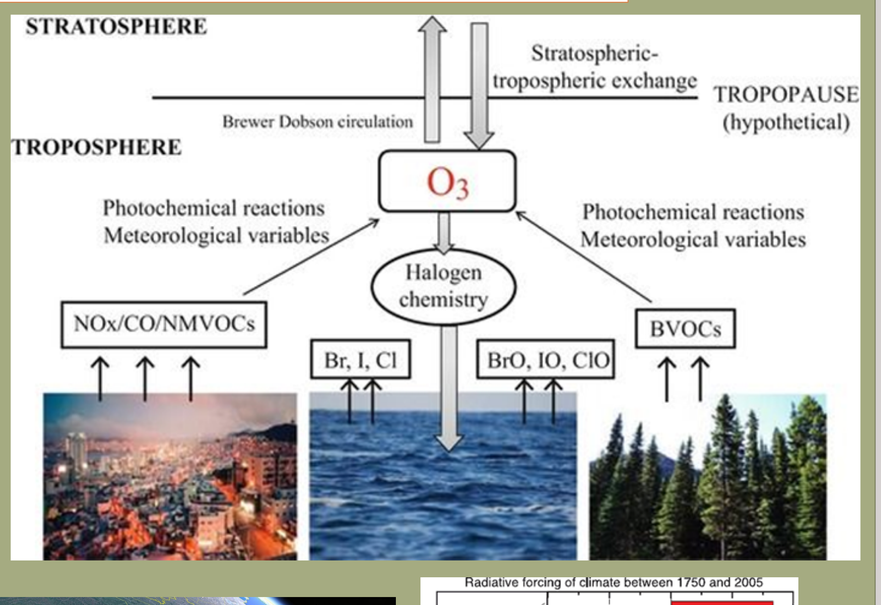
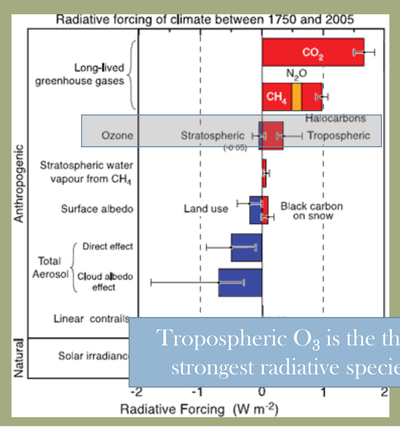
Arctic Surface Ozone Summary

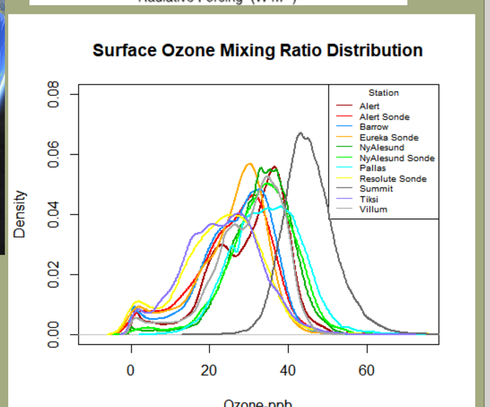
- Central species in the photochemical oxidation and radiative forcing processes of the atmosphere
- Secondary Pollutant, formed from reactions of primary pollutants
- Photochemical Smog
- Greenhouse Gas
- High levels negatively impact human health and ecosystem functioning



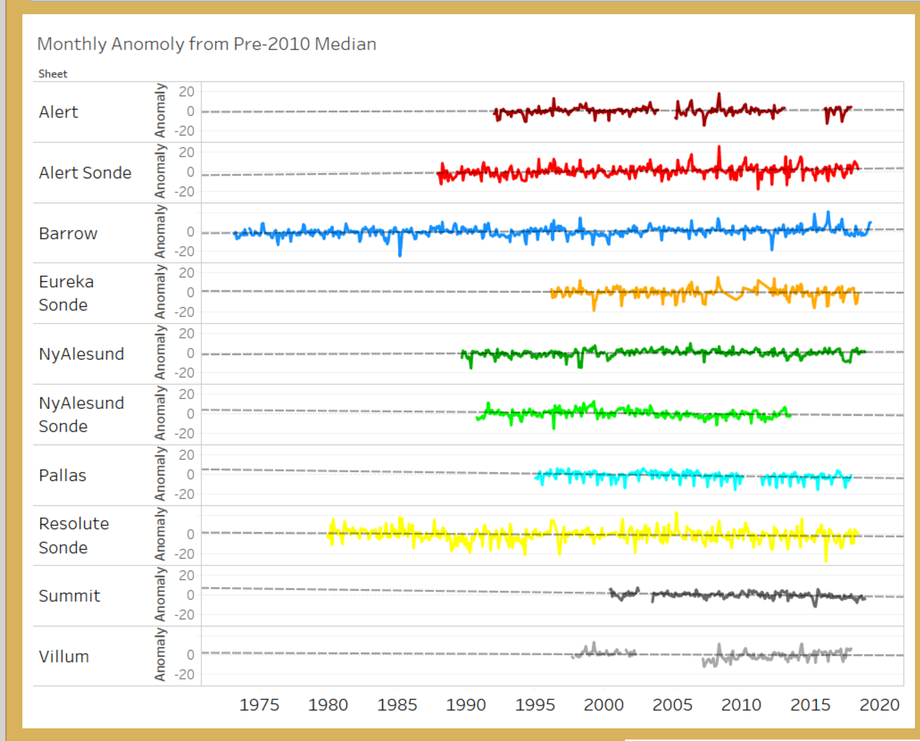
Surface Ozone Hourly Measurements: Alert, Barrow, Ny-Alesund, Pallas, Summit, Villum Stations
Ozone Sonde Surface Level Measurement from ECC: Alert, Eureka, Ny-Alesund, Resolute



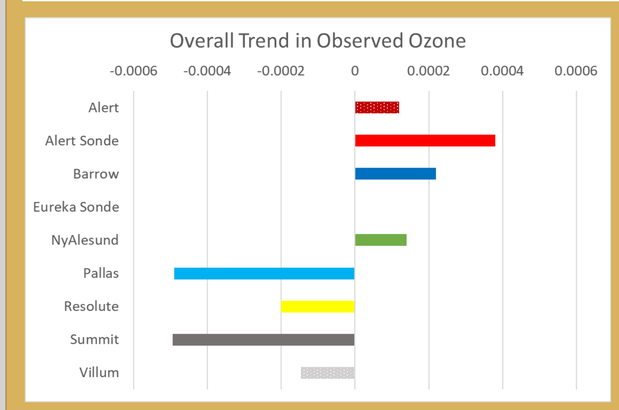
Tropospheric O_3 is the third strongest radiative species



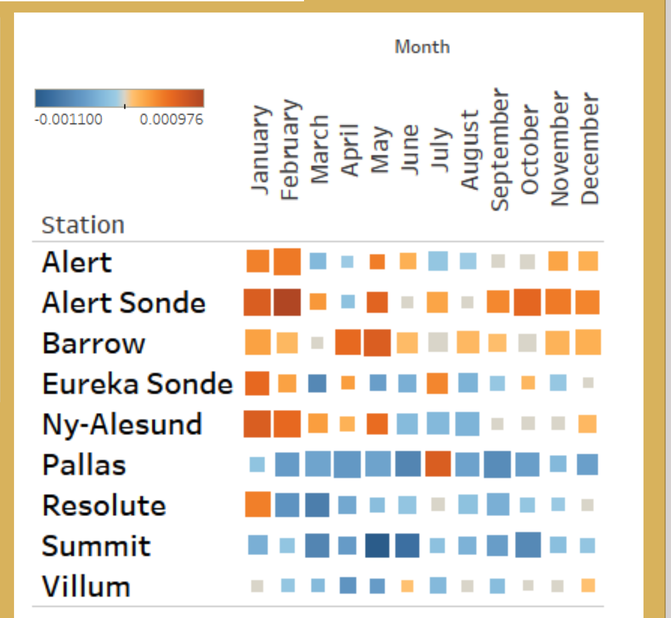
Trends in Surface Ozone from Arctic Locations



Time series of monthly anomaly calculated from the pre-2010 median. Alert and Barrow have increasing trends where-as all other Arctic monitoring locations show decreasing trends in ozone at the surface.

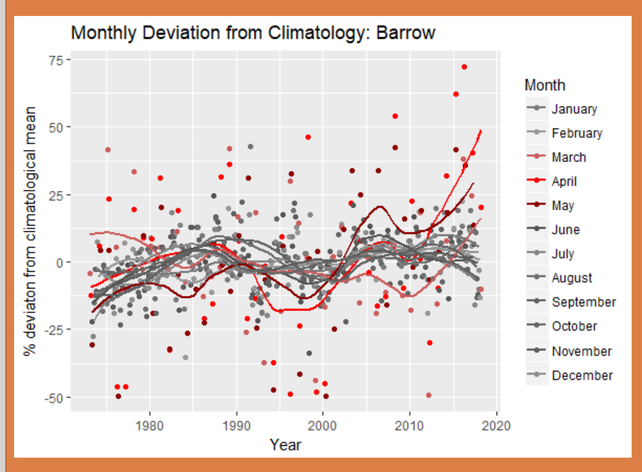


Slope of linear fit to monthly anomaly from pre-2010. Solid bars indicate statistically significant trends and dotted bars indicate not statistically significant trend. *Note: Eureka data from ozonesonde analysis shows no change over time.*

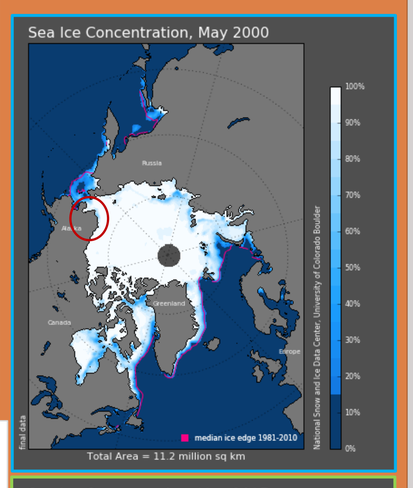


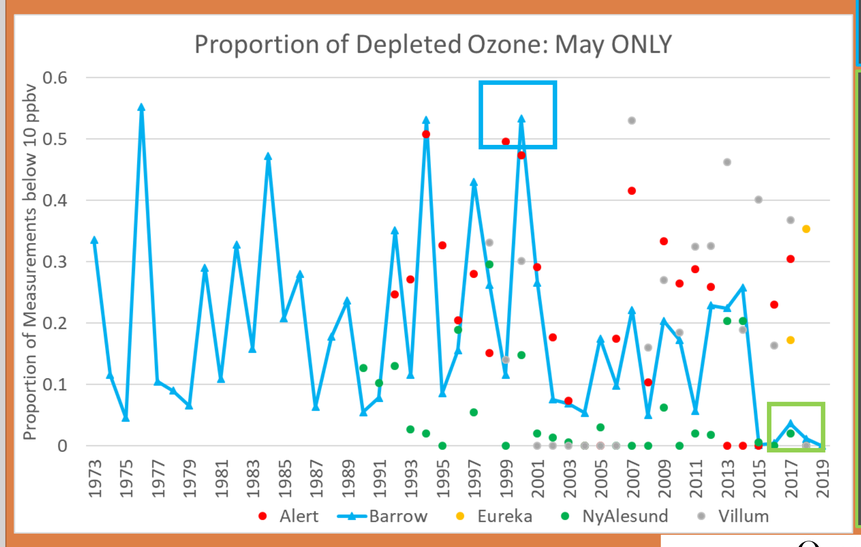
Trend over time by month for each station. Large squares indicate statistical significance. Color is determined by value of observed trend.

Barrow, Alaska: A closer look at MAY trend



- LOESS regression and linear fit to data reveal the same general trends
- In the **recent** years there has been a strong trend in the spring months

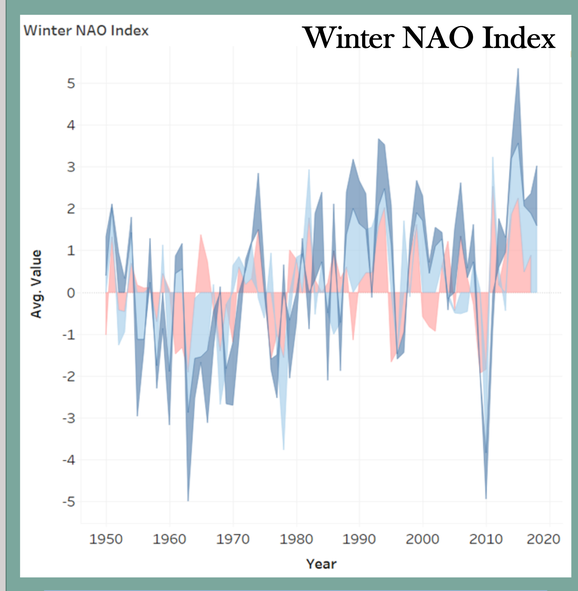




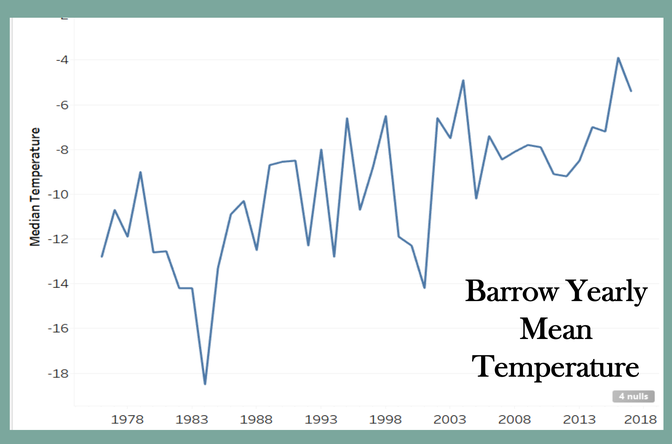
Dramatic reduction in MAY Sea ice conditions observed at the Barrow station have impact on ODE Frequency.
Less Ozone Destroyed → More Ozone Observed

Ozone Depletion Events
-Occur in Spring (MAM) each year across Arctic maritime locations
-Marine sources of halogen compounds are released into the atmosphere
-UV light in Spring initiates the depletion chemistry
-Air masses which have continental influence do not have ozone depleted conditions

Other Potential Influences on Observed Trends



During positive phases of the NAO, there is an upward trend in the transport of pollutants to the arctic from mid-latitudes *(Eckhardt et. al, 2003)*



- Meteorology
- Transport
- Global Circulation
- Photochemistry
  - Deposition
  - Production
- Precursor Emissions

Summary and Future Investigation

- **Long-term, continuous Arctic atmospheric** observations are essential for understanding atmospheric forcing and responses in the rapidly changing Arctic climate.
- **Increasing springtime ozone** concentrations at Barrow are strongly related to reduced springtime regional ice coverage.
- **Trends are varied in space and time across the Arctic** measurement stations
- Different sources and processes impact observed trends in ozone conditions
- **Future investigation** will analyze the influence of transport conditions, temperatures, and precursor species emissions on ozone conditions across the Arctic.

"Save the Arctic, and we might just save ourselves"

Sabrina Shankman, InsideClimate News: March 19, 2018

Contact:
Audra McClure-Begley
Audra.mcclure@noaa.gov
303-497-6823

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Google Earth