

Aerosol Measurements at South Pole: Climatology and Impact of Local Contamination

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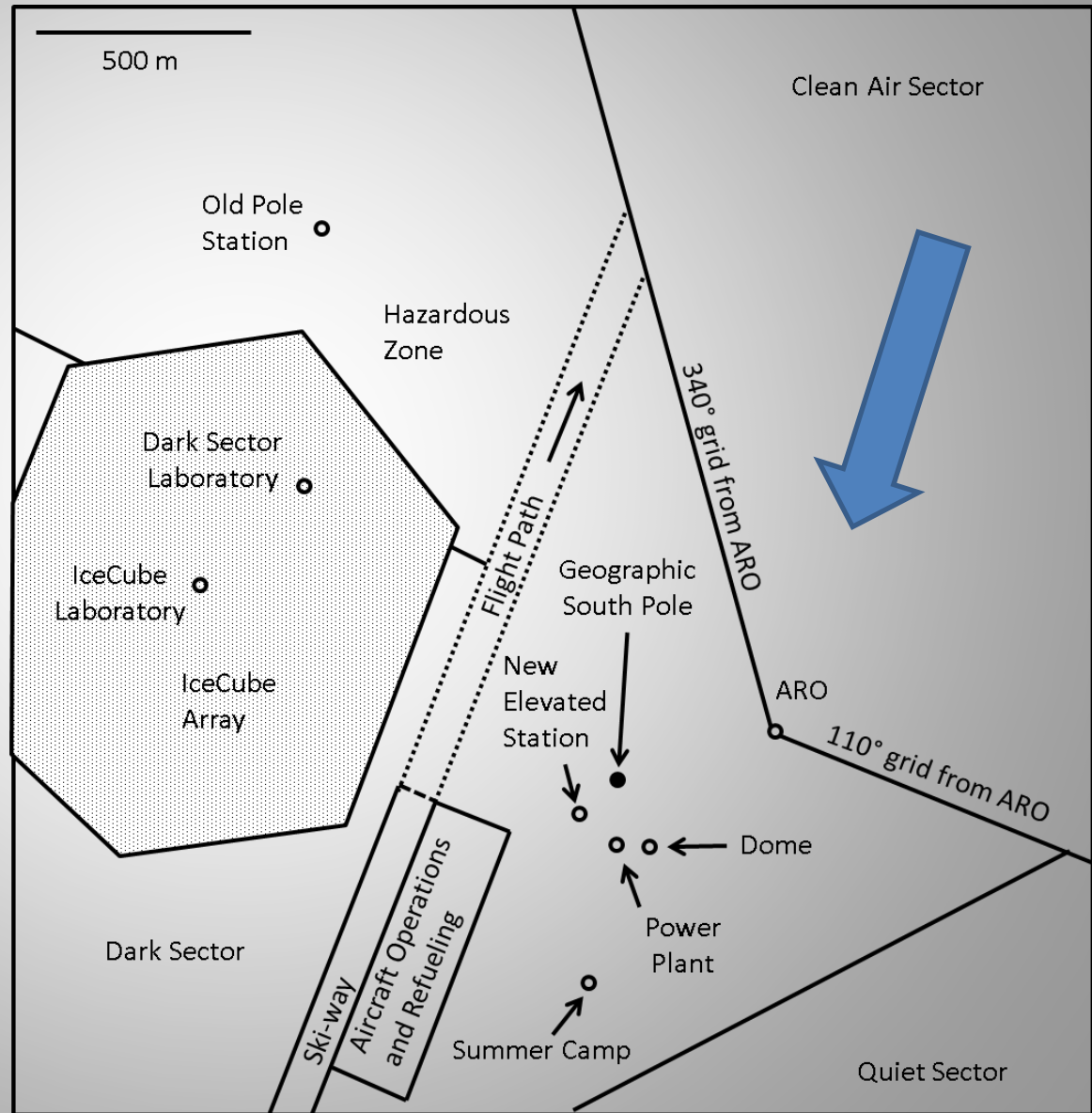
²Cooperative Institute for Research in Environmental Sciences, University of Colorado,
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Motivation/Objectives

- Present the updated aerosol and wind climatologies for SPO (Sheridan *et al.*, 2015)
- Determine whether long term aerosol record shows any significant influence from periods of increased human activity at Pole
- Look at a well documented case of local contamination and how it affected the aerosol measurements

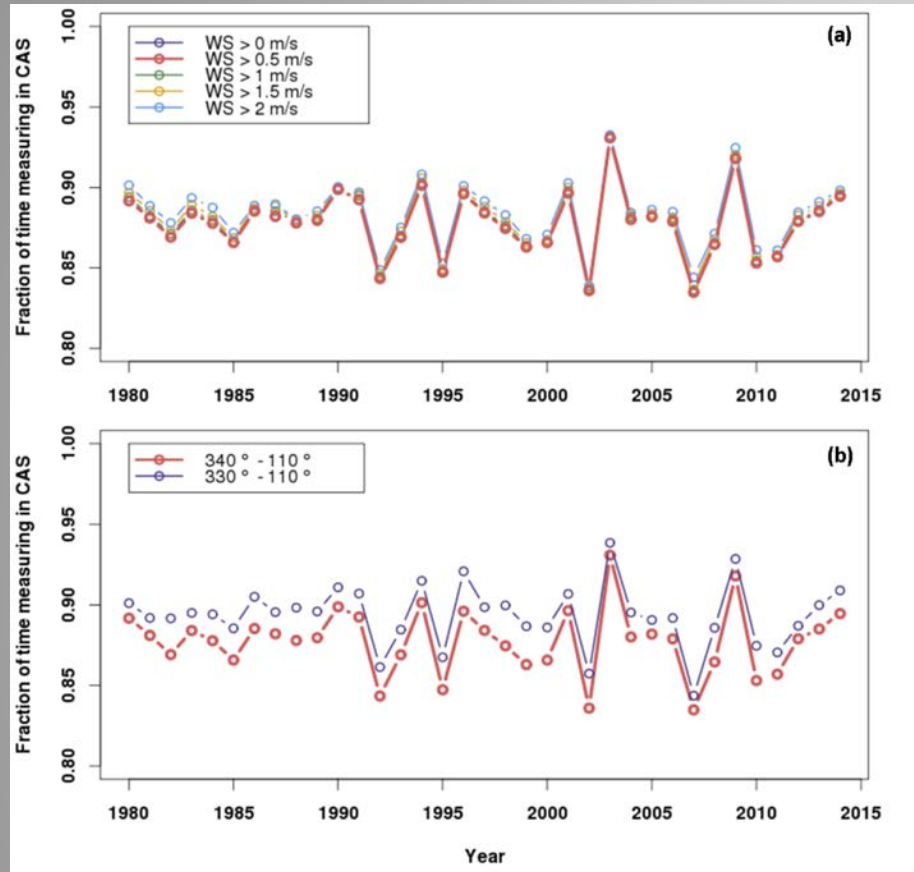
The Contamination Problem... a human outpost next to a station measuring 'the cleanest air on earth'.

- Dominant wind direction to ARO is from the CAS
- Downwind of the ARO are lots of pollution sources
- When winds are calm or blowing from outside the CAS, local pollution aerosols can enter the CAS
- Recirculation of contaminated air through the CAS is not always easy to detect.

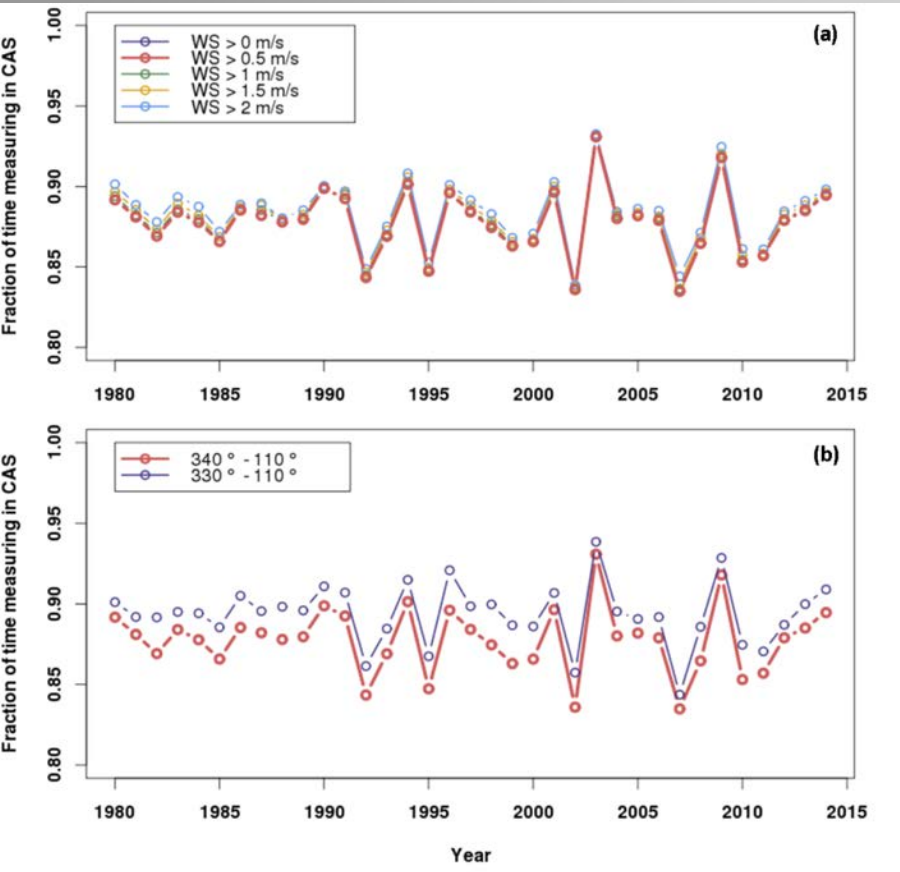


Wind Climatology: Have the winds changed at SPO over time?

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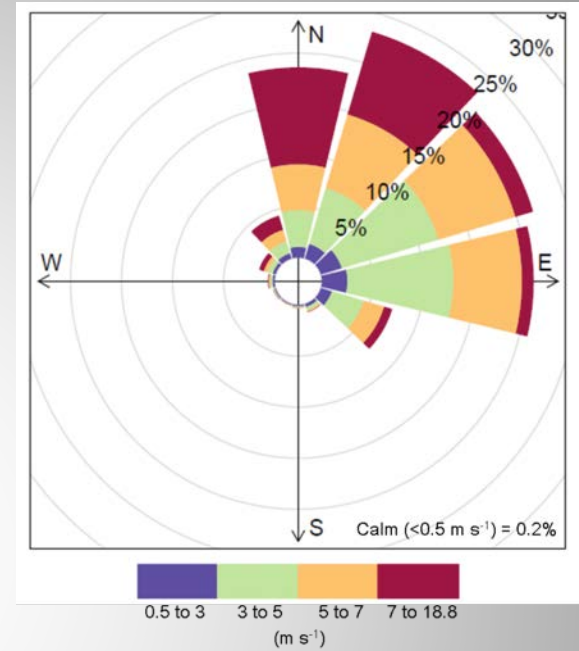
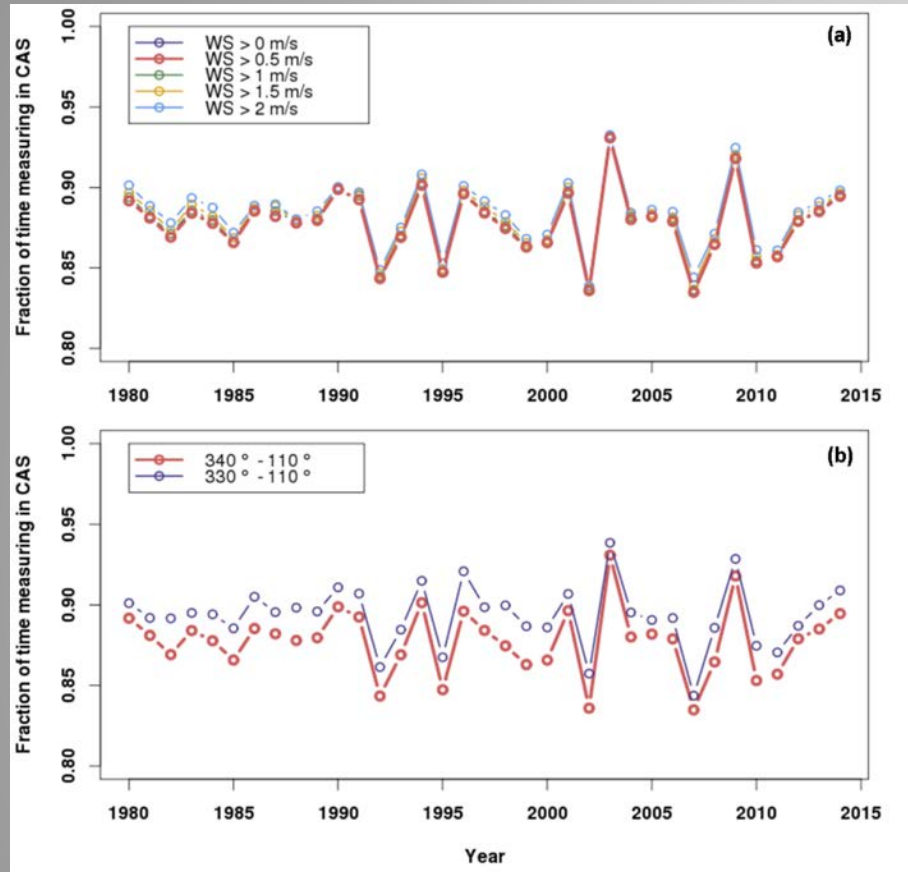


Fraction of observations in CAS

Year Hour Minute

2013	88.46%	88.63%
2014	89.49%	89.39%

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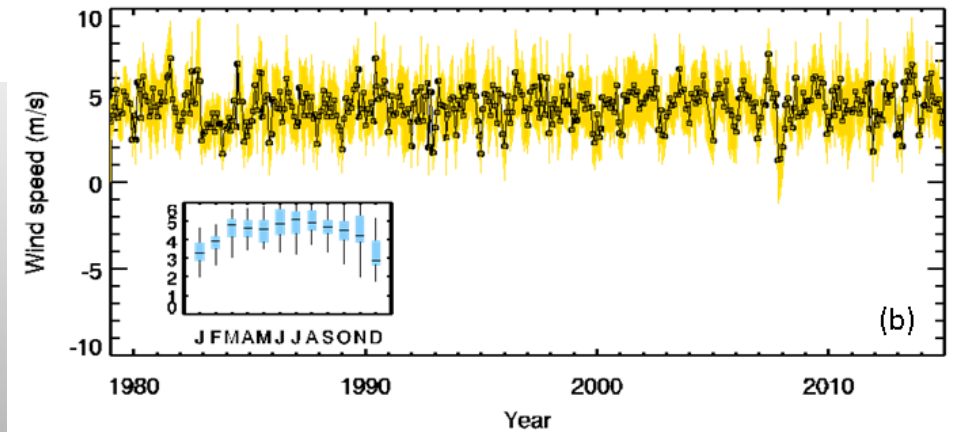
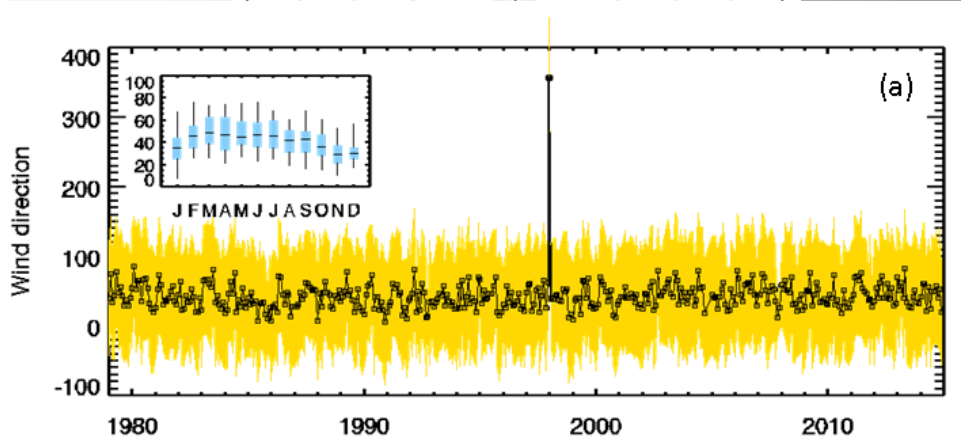
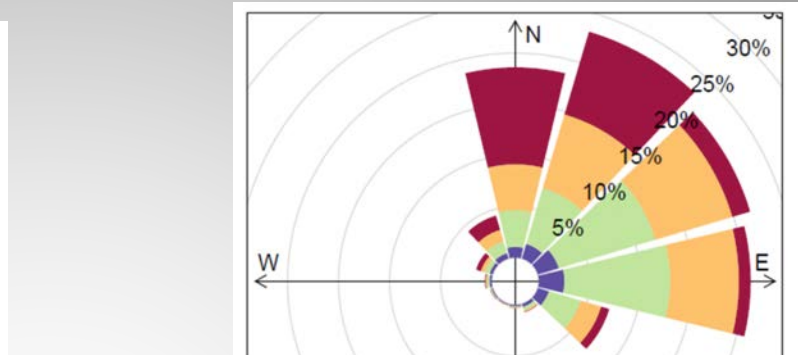
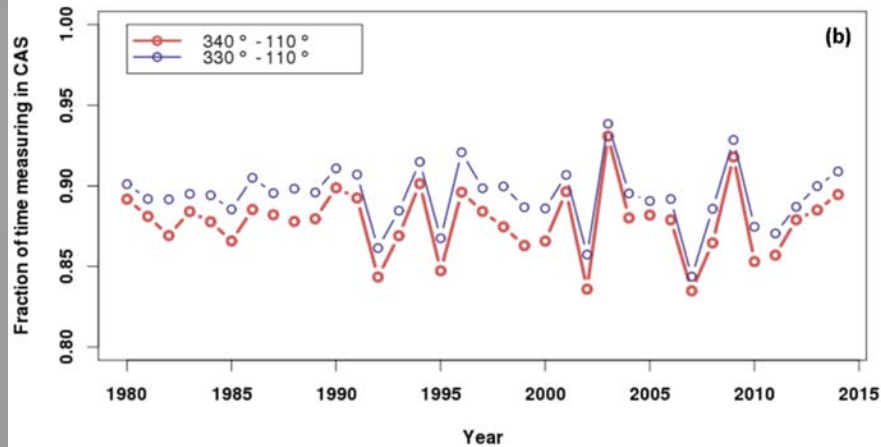
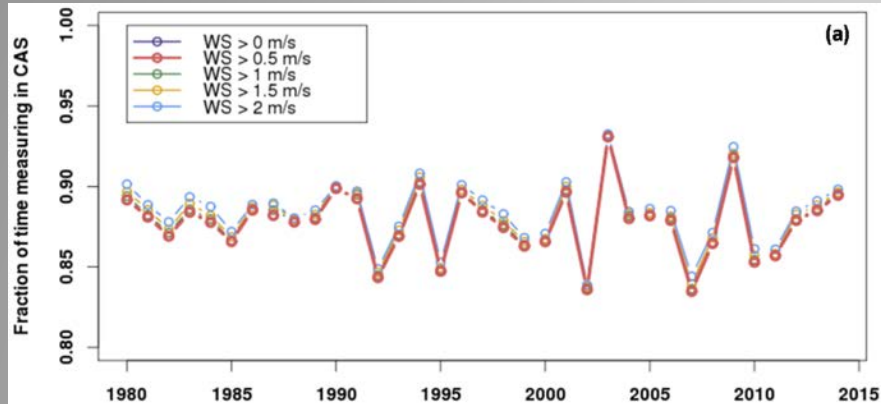
Grid 0° = 0° longitude (Greenwich)

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Sources of Local Contamination at SPO



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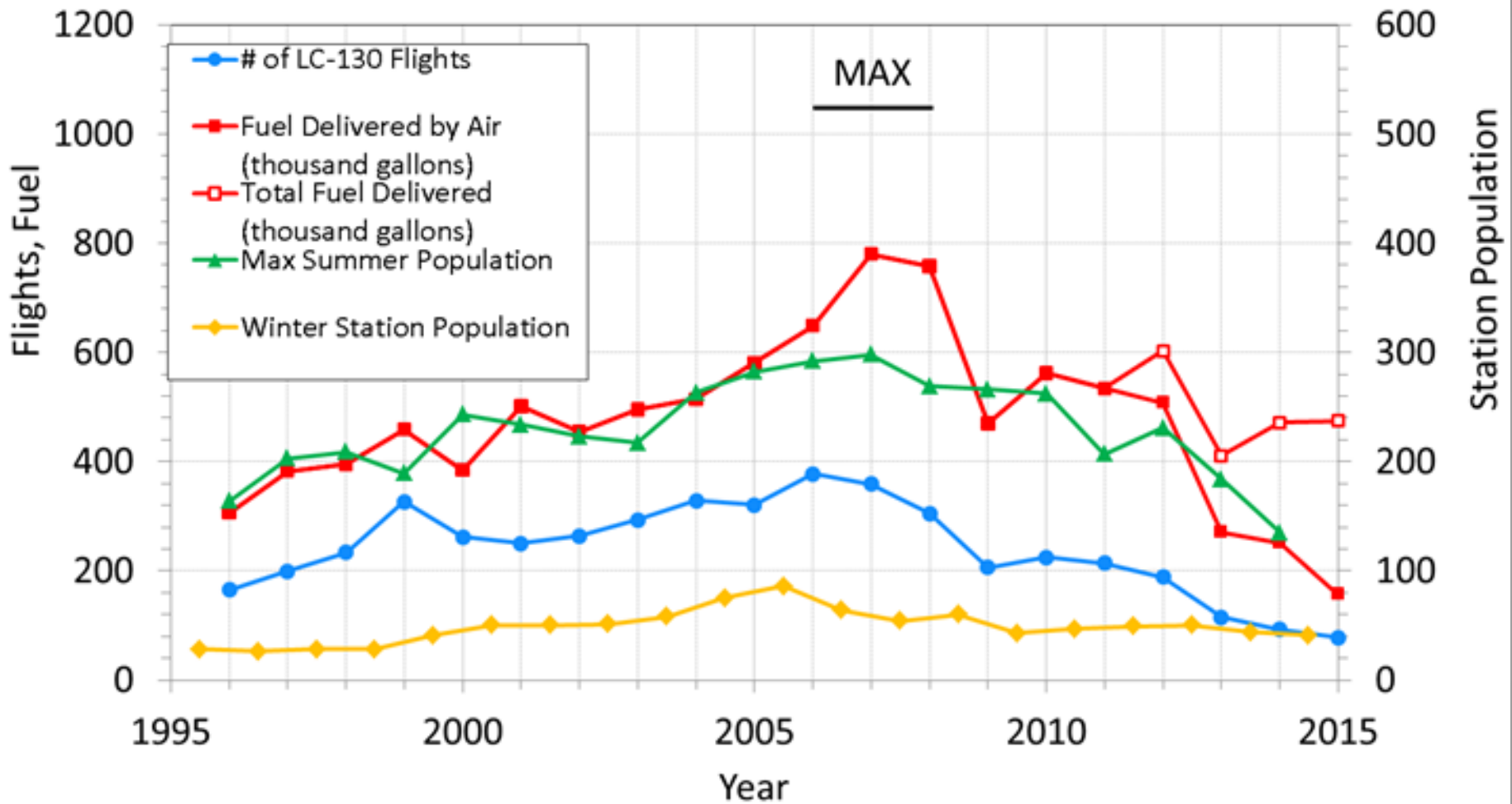
Use proxies that track human activity

Markers of Human Activity at South Pole*

- Number of people on station
- Number of LC-130 flights to/from Pole
- Amount of fuel delivered to Pole

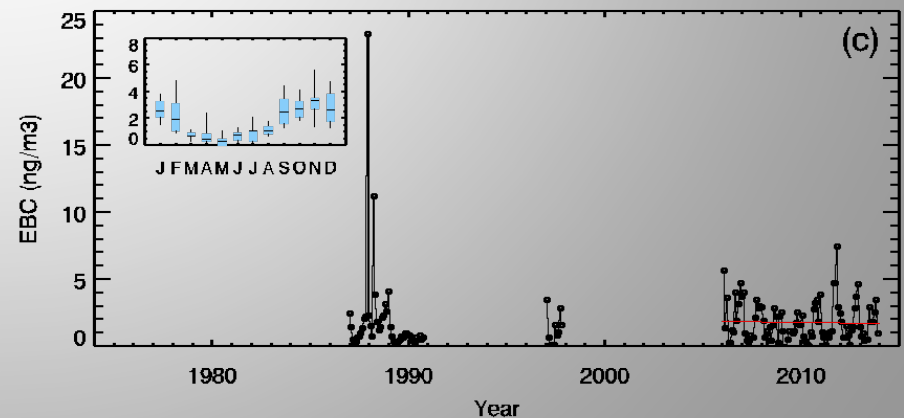
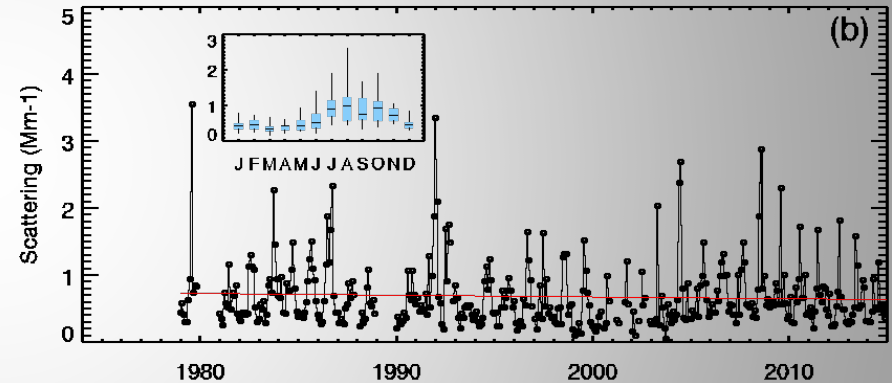
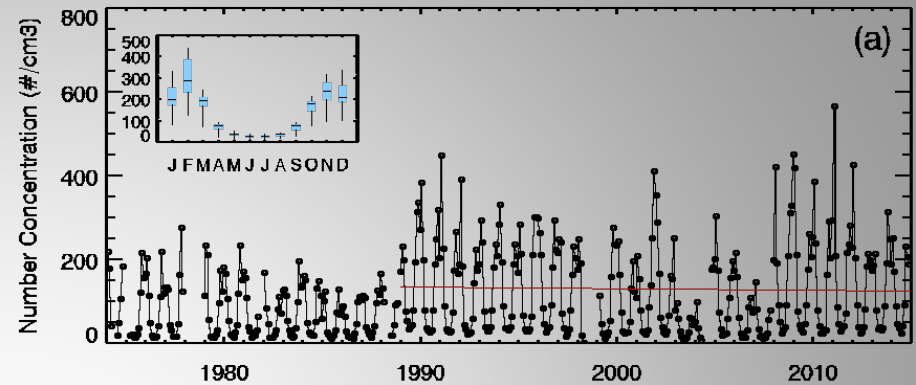
*from NOAA and NSF/Contractor records

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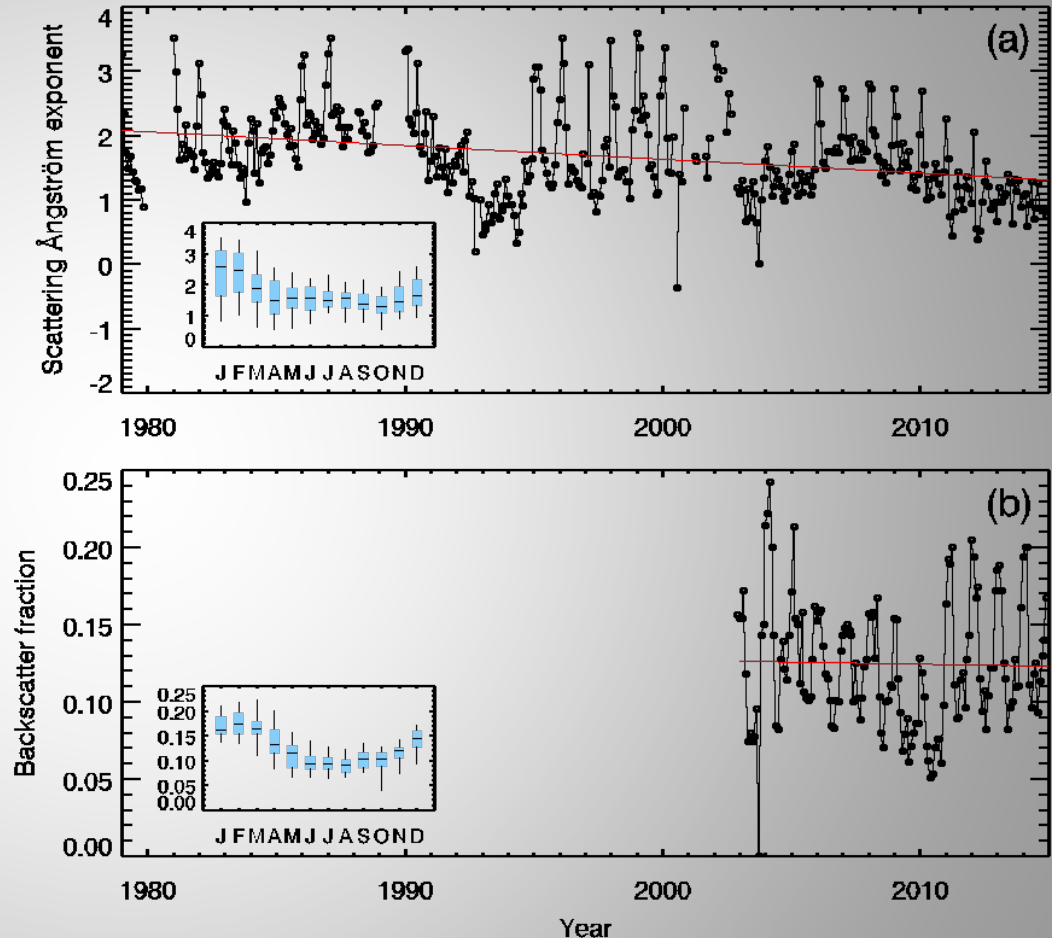
Aerosol Climatologies (1)

- Data presented are monthly averages, annual cycle is shown in inset box.
- Annual cycles are evident in all measurements.
- Obvious step change in N_{tot} at start of 1989 due to instrument change.
- No statistically significant trends were observed at the 95% confidence level for any of these parameters.
- No bump in the mid-2000's, suggesting that our data QC procedures were robust.



Aerosol Climatologies (2)

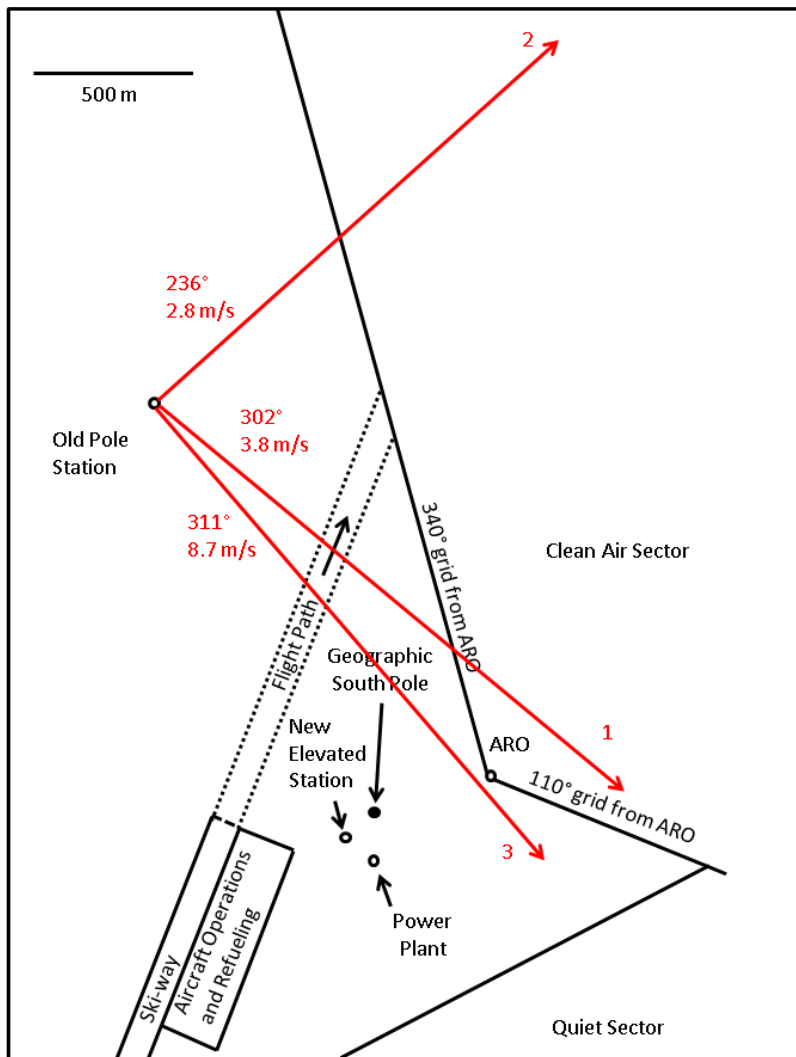
- No statistically significant trend for backscatter fraction, but a significant downward trend of $\sim -0.02 \text{ yr}^{-1}$ for scattering Ångström exponent.
- Suggests a gradual increase in the relative influence of larger particles in the scattering measurement.
- Instrument change near end of 2002 could have contributed to this trend.



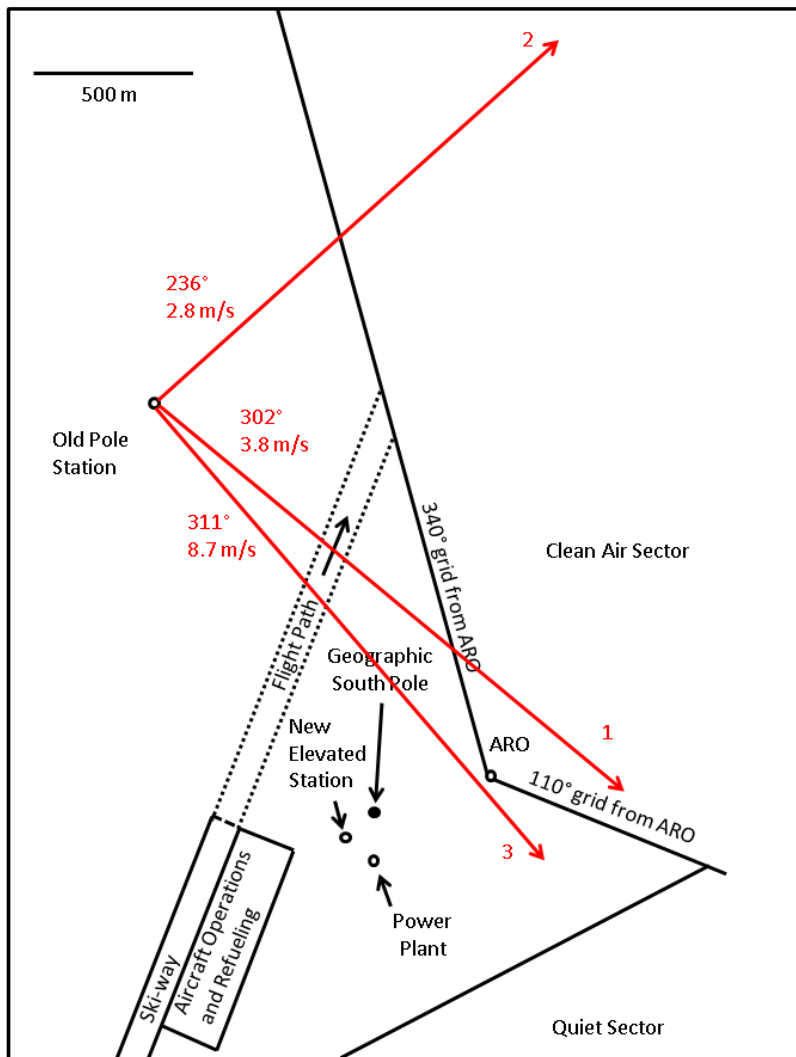
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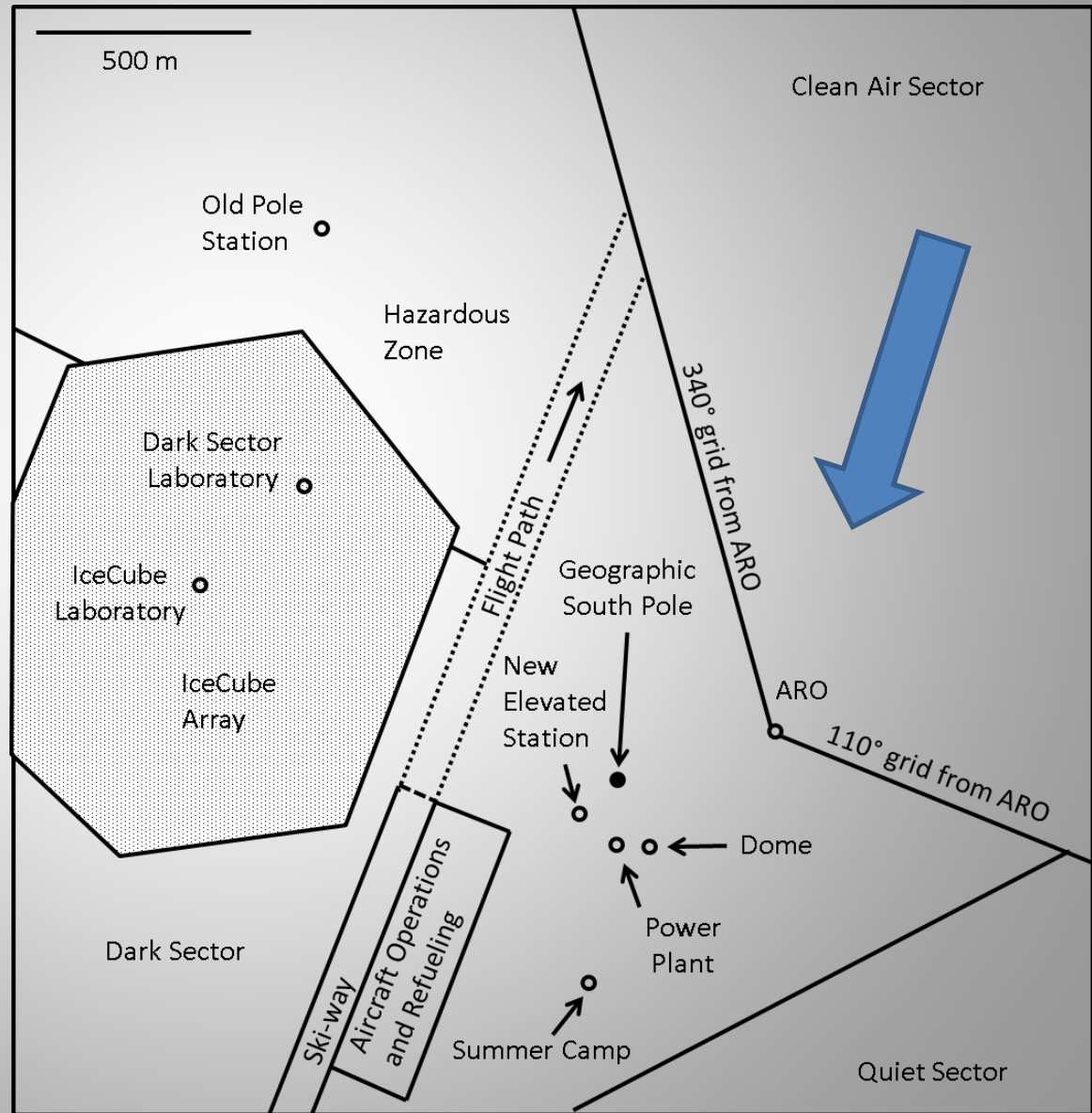


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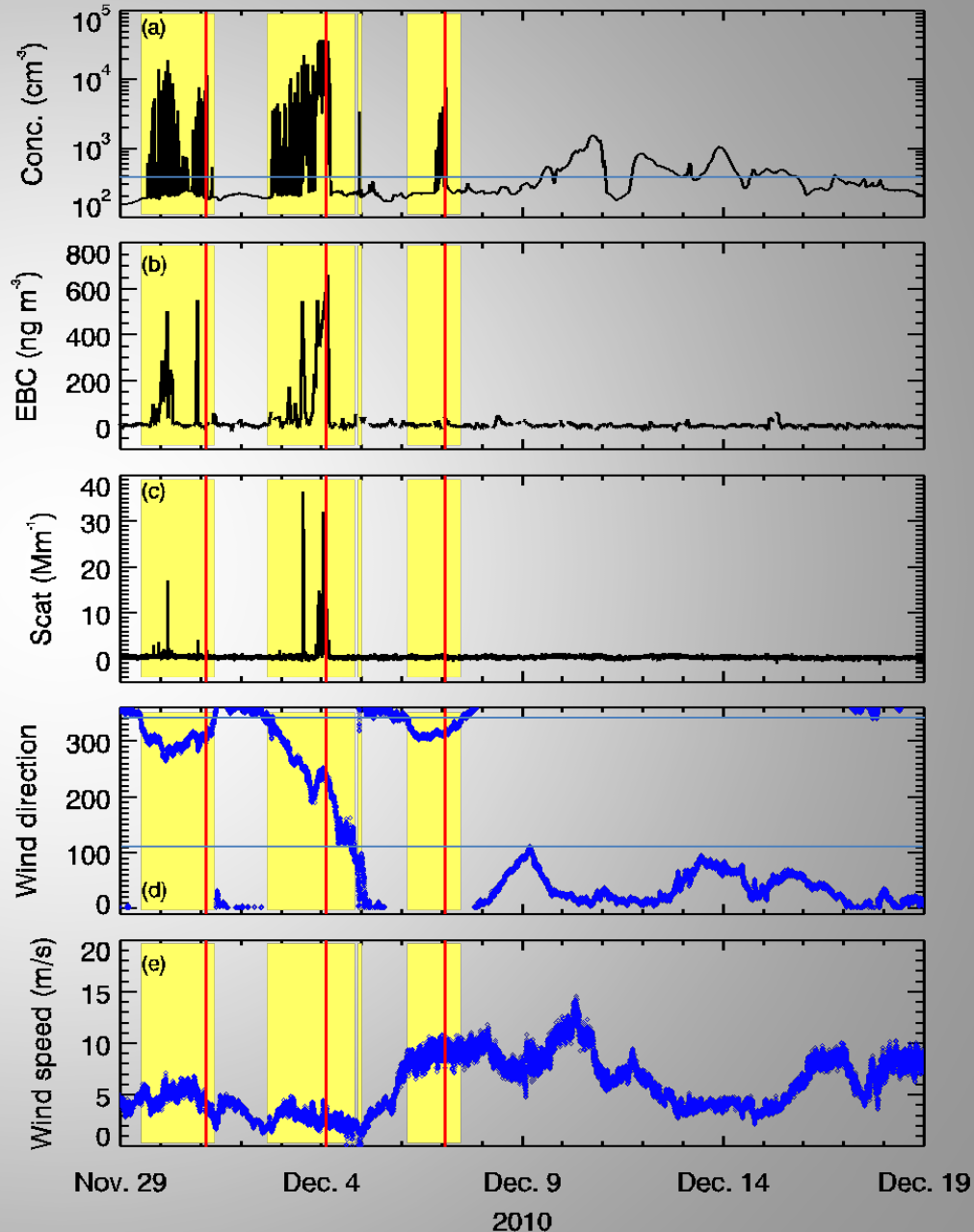
The Contamination Problem... a human outpost next to a station measuring 'the cleanest air on earth'.

- When winds are calm or out of sector, data are flagged as contaminated
- Recirculation of contaminated air through the CAS is not always easy to detect by wind screening
- If particle concentrations are abnormally high or changing rapidly, data are also automatically flagged as contaminated.
- Site scientist has discretion to manually flag data



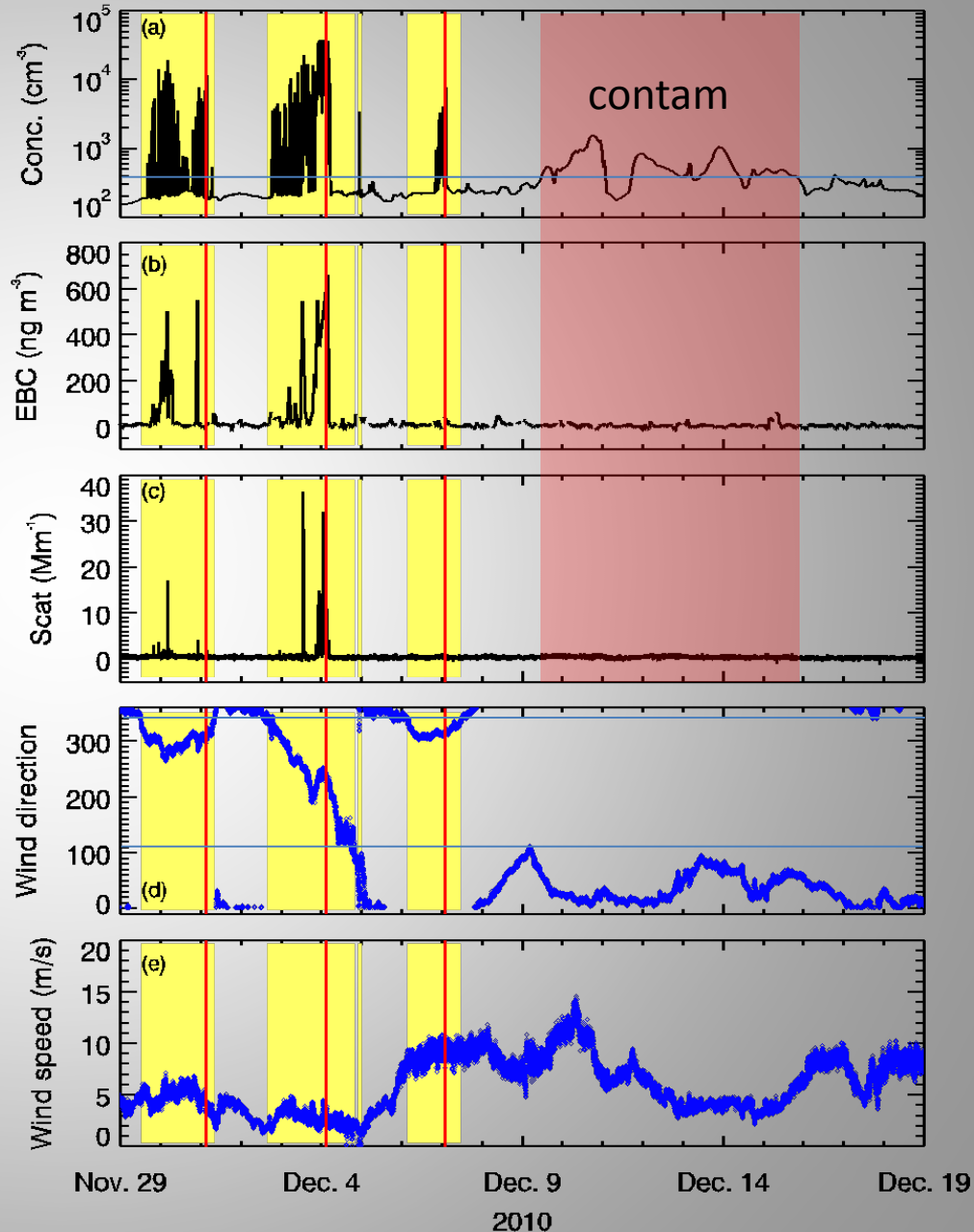
Aerosol Measurements During the Blasting Period

- Blast times are shown as red lines
- Winds blowing from outside of CAS during yellow periods.
- Local contamination before the each blast.
- 3rd blast passed the ARO very quickly



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Summary

- Updated the wind and aerosol climatologies for SPO
- Winds have not changed appreciably since 1979, blowing from the CAS (340°-110°) ~ 88% of the time.
- Year to year variability in winds ~ +/- 5%
- Peak activity at South Pole: Summer seasons 2006-2008.
- Do not observe a peak in the clean data record at these times.
- Contamination identification procedures are working very well?
- Old Pole station blasts allow us to investigate the problem of recirculation of aerosol contamination from the CAS

