

Polar Chemistry and Dynamics in CAM3.5, Results from Chapter 6, SPARC CCMVal2

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CCMVal Diagnostics:

- Polar Vortex Temperatures
- Polar Vortex Volume
- Activation Potential of Chlorine (PACl)
- Ozone Loss in Arctic and Antarctica

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Diagnostics

Diagnostics:

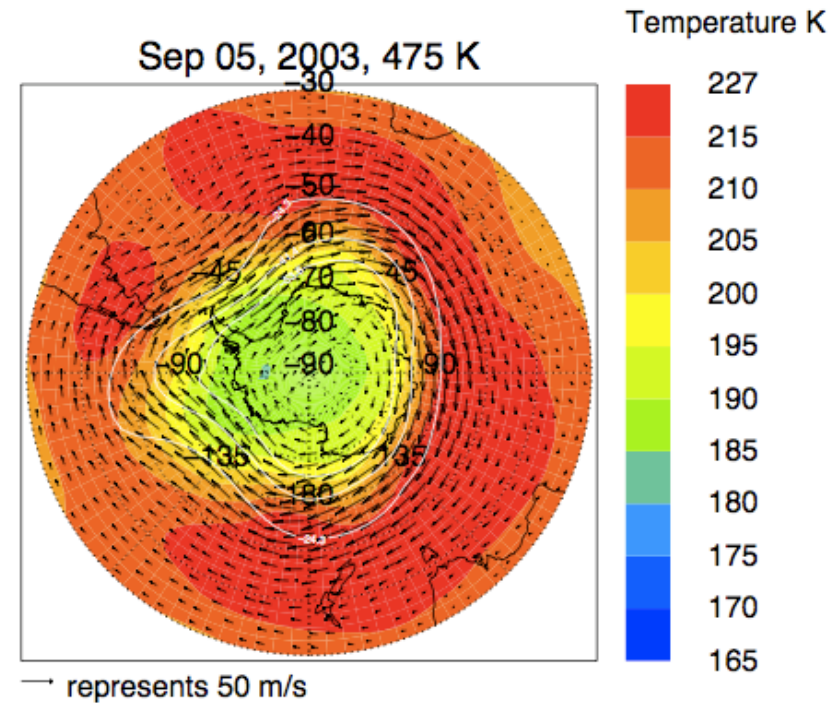
Averages over the vortex (Temperature, Ozone)

Sum over the vortex (Volume)

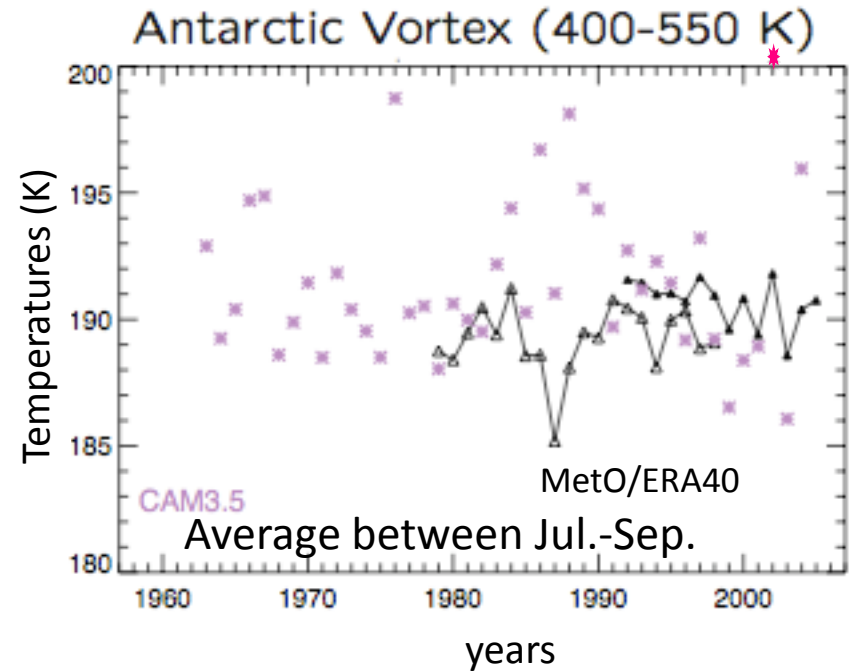
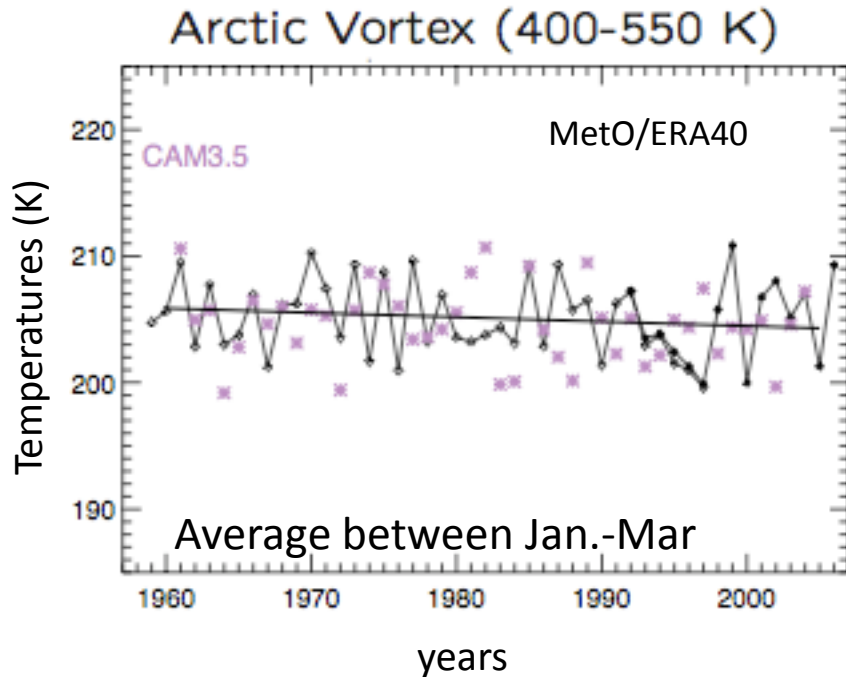
-> averaged over January to March/April (Arctic) /
July to Sept./Oct. (Antarctica) and between 400-
550 K

Vortex Edge defined using the potential vorticity
gradient times the horizontal wind field (Nash et
al., 1996)

Chemical Ozone Loss: derived using tracer-tracer
correlations



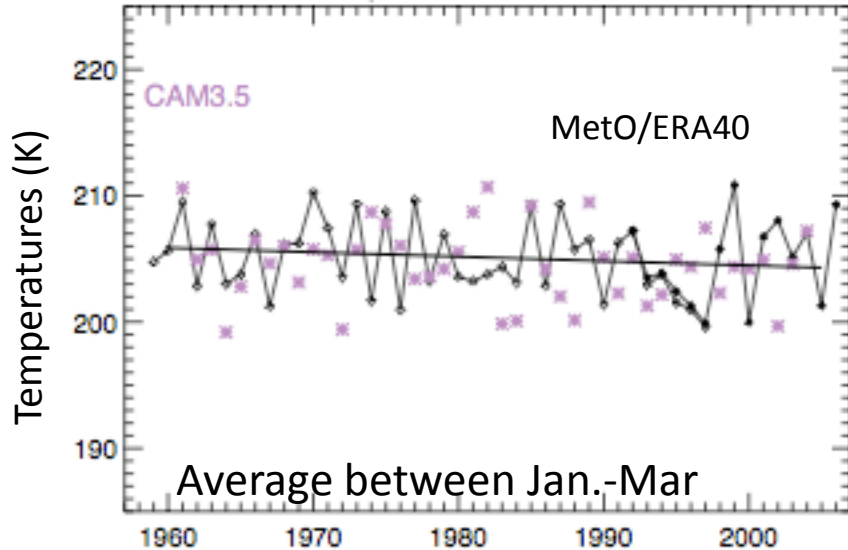
Polar Vortex Temperatures



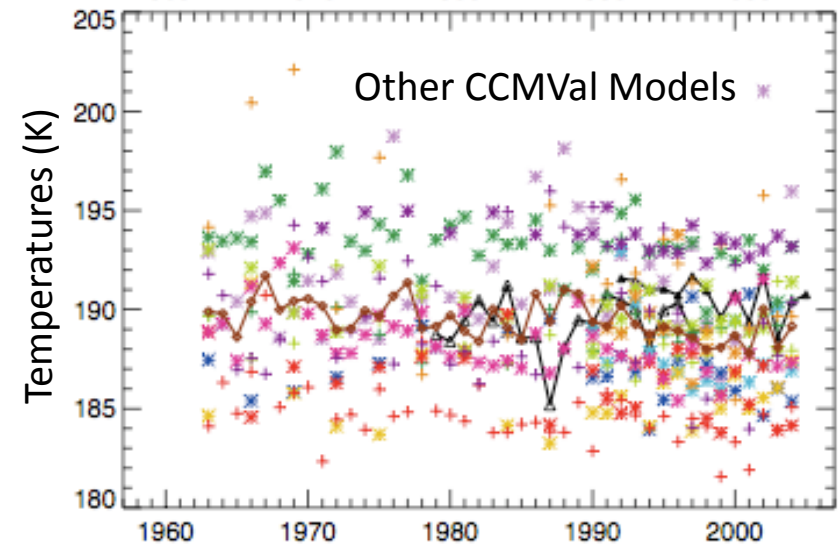
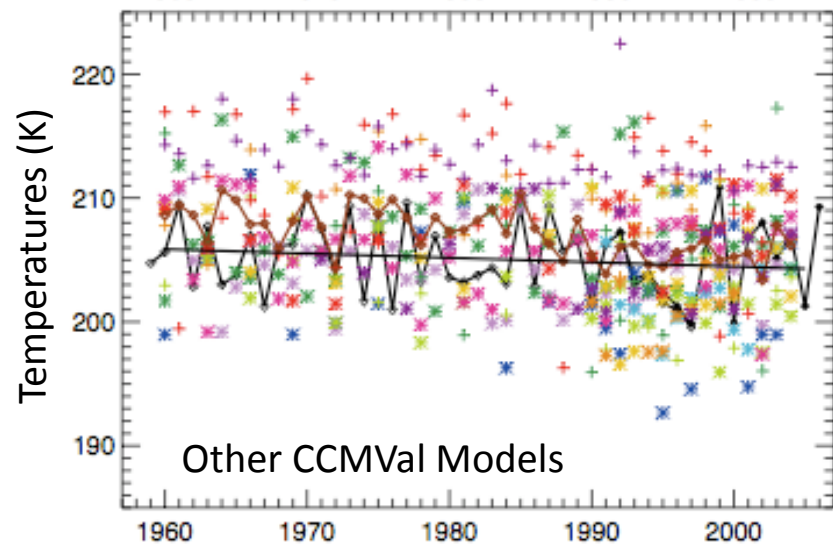
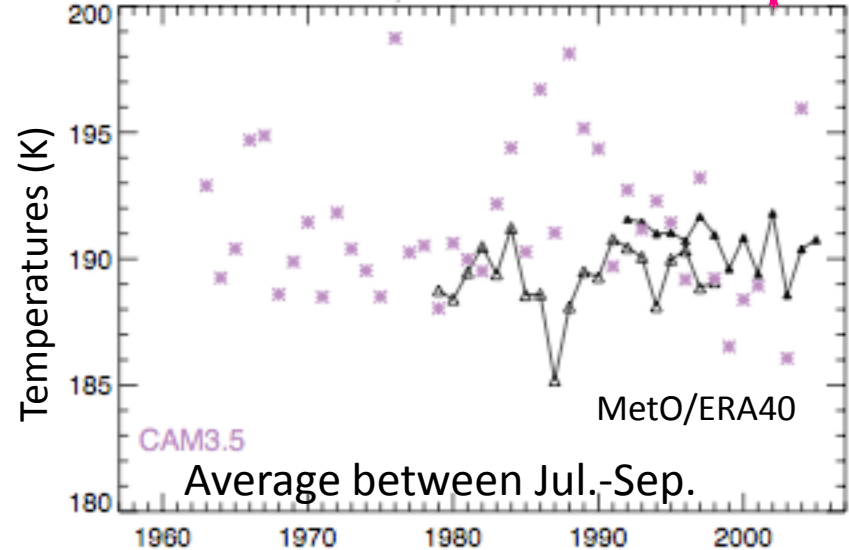
CAM3.5 vortex average temperatures are in agreement with meteorological analysis

Polar Vortex Temperatures

Arctic Vortex (400-550 K)



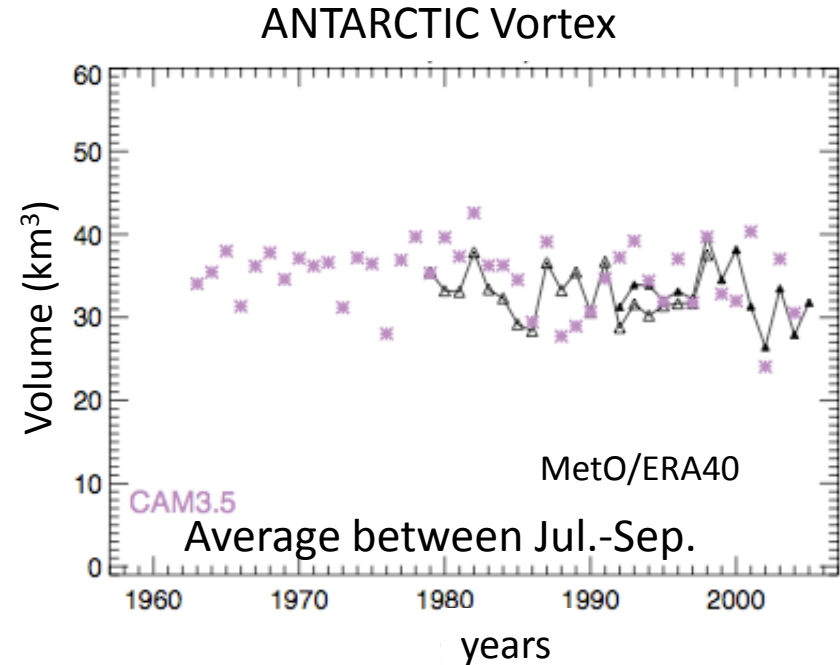
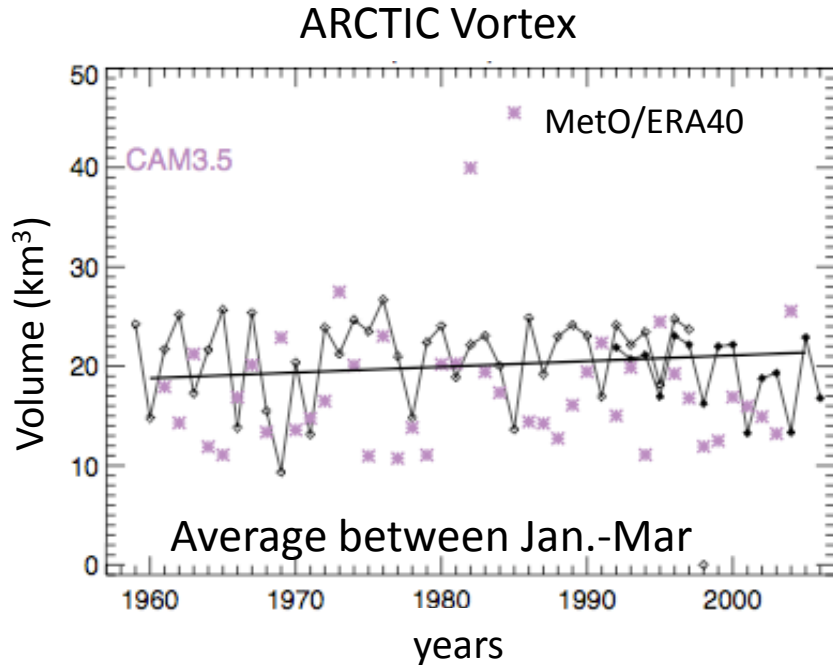
Antarctic Vortex (400-550 K)



years

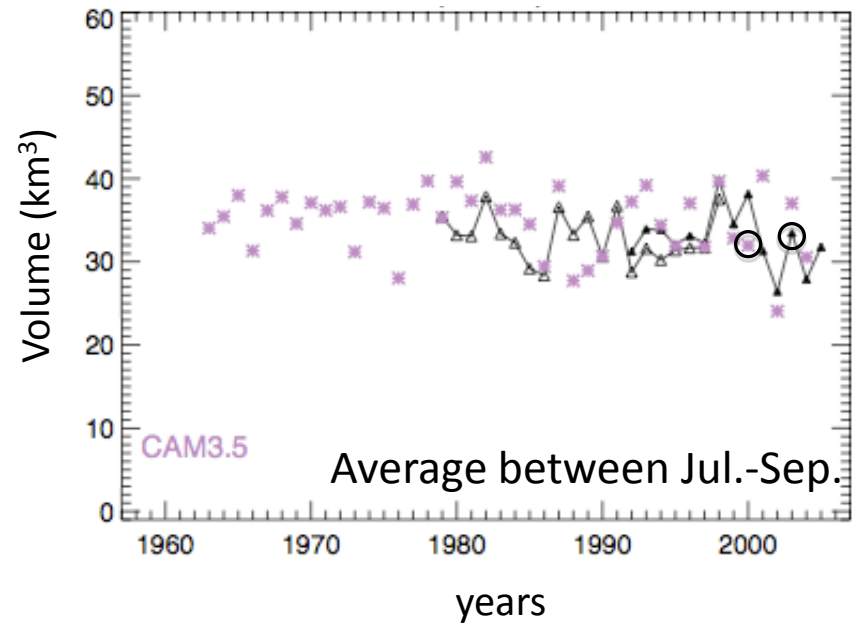
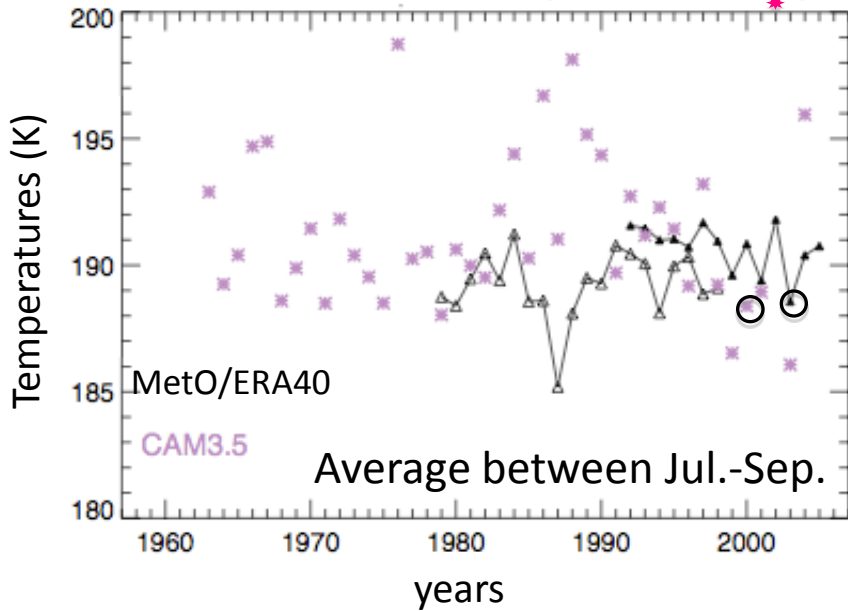
years

Polar Vortex Volume



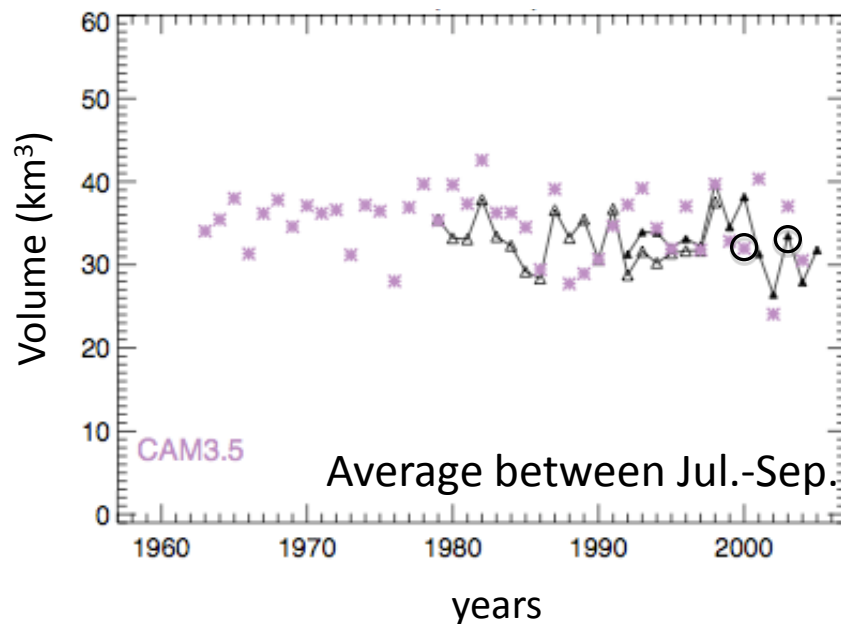
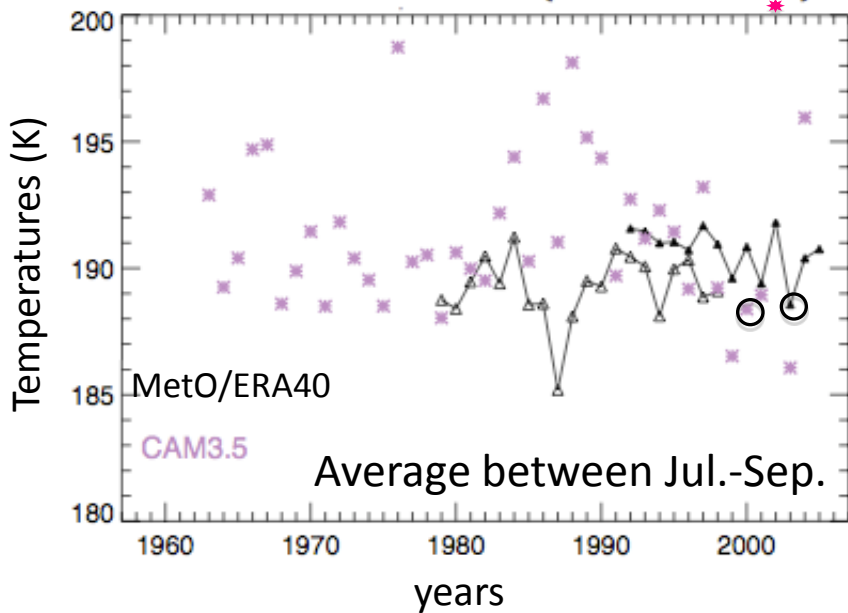
CAM3.5 vortex volumes are in agreement with meteorological analysis, in the Arctic simulated values are slightly smaller than observed

Antarctic Vortex (400-550 K)

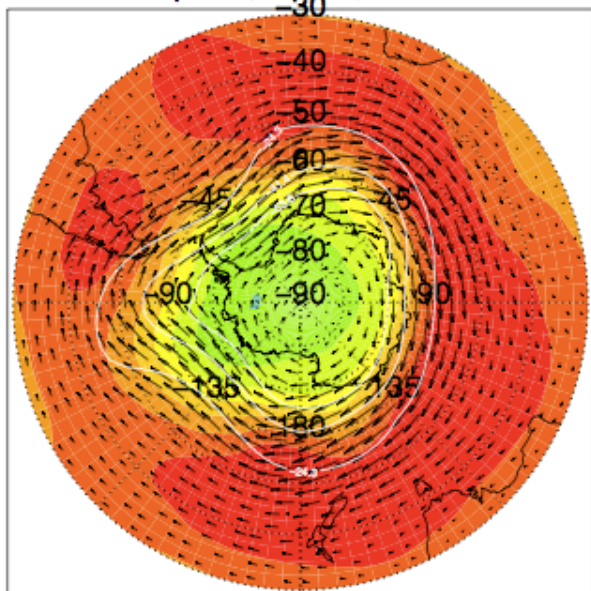


Antarctica: average vortex temperatures and volume of the vortex agree with observations. What about ozone loss?

Antarctic Vortex (400-550 K)

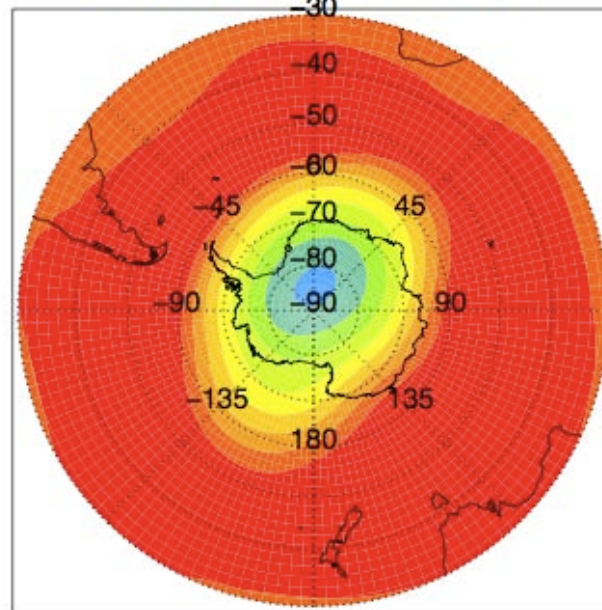


Sep 05, 2003, 475 K

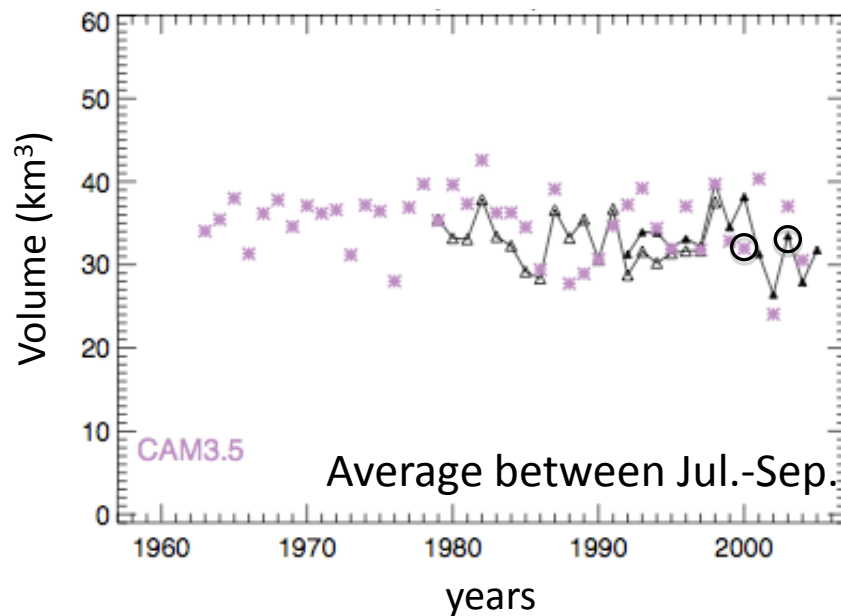
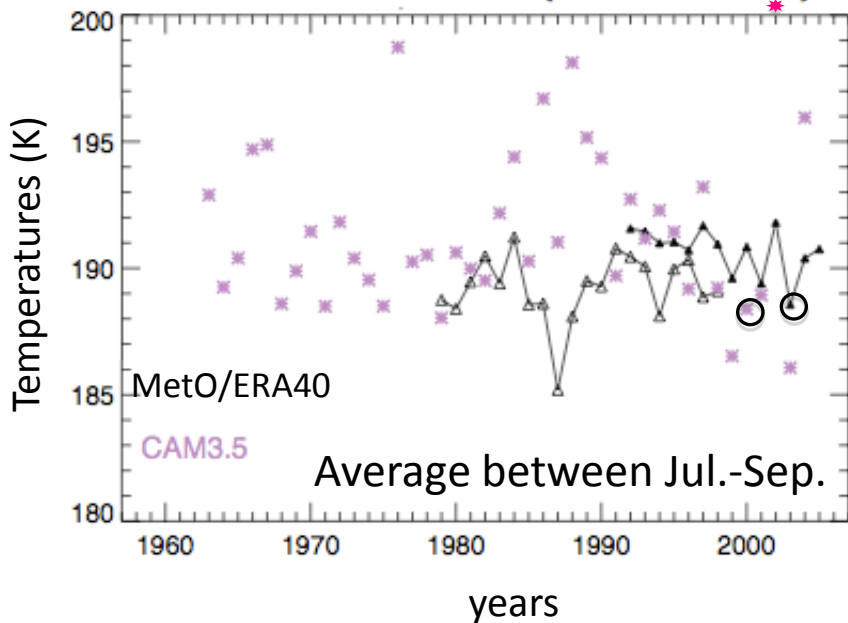


→ represents 50 m/s

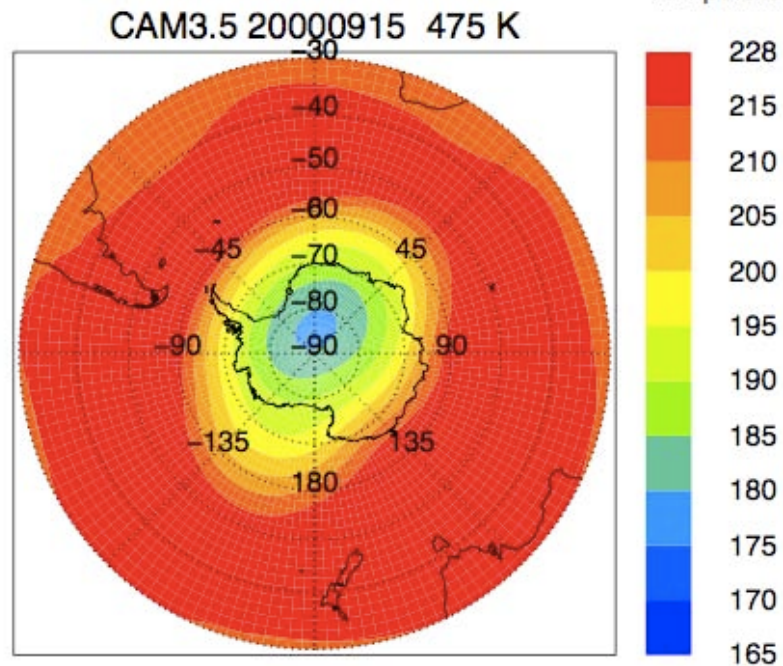
CAM3.5 20000915 475 K



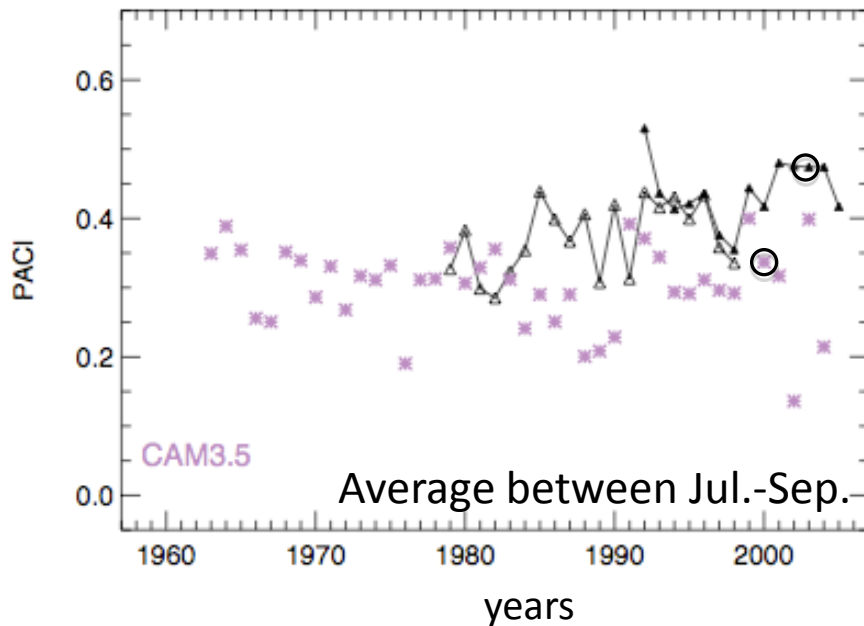
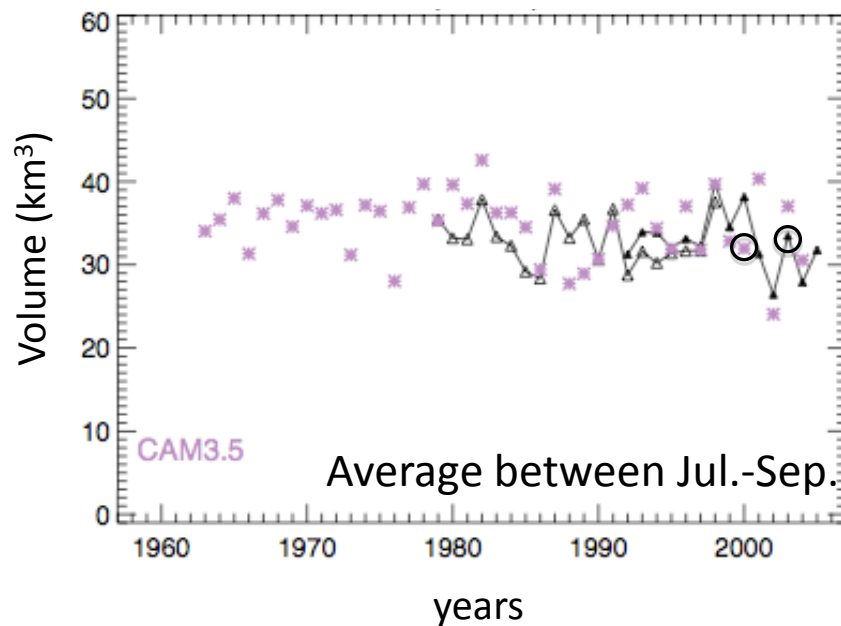
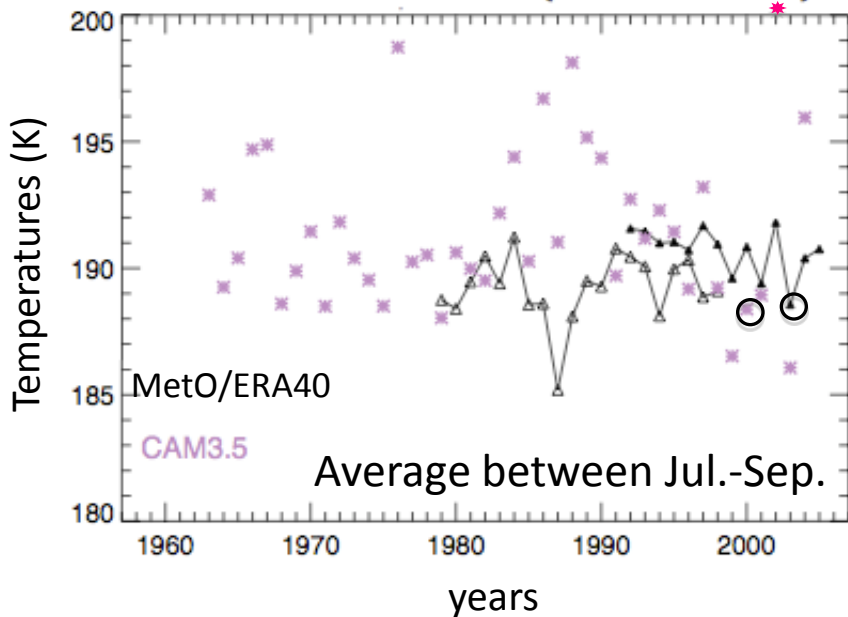
Antarctic Vortex (400-550 K)



The fraction of the vortex that is below the threshold temperature for chlorine activation is smaller than observed

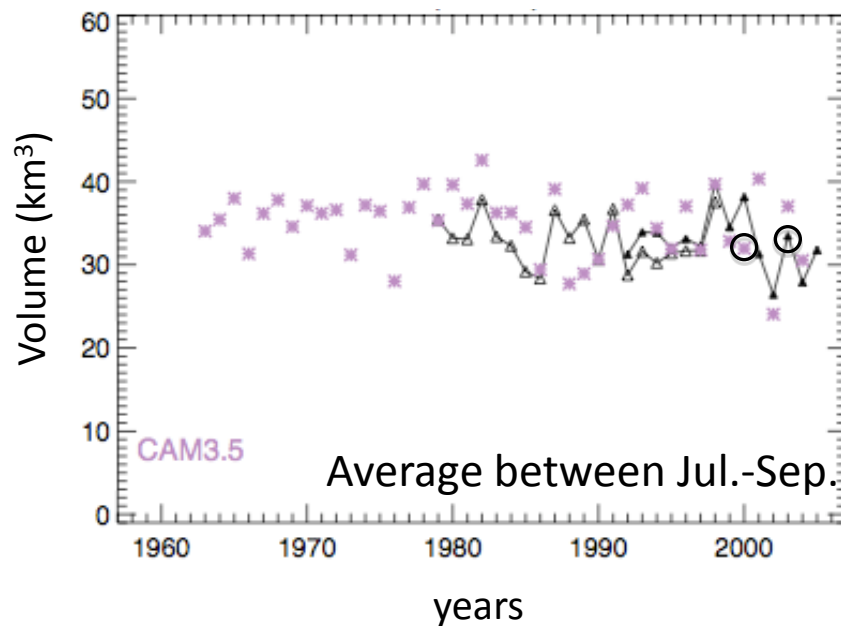
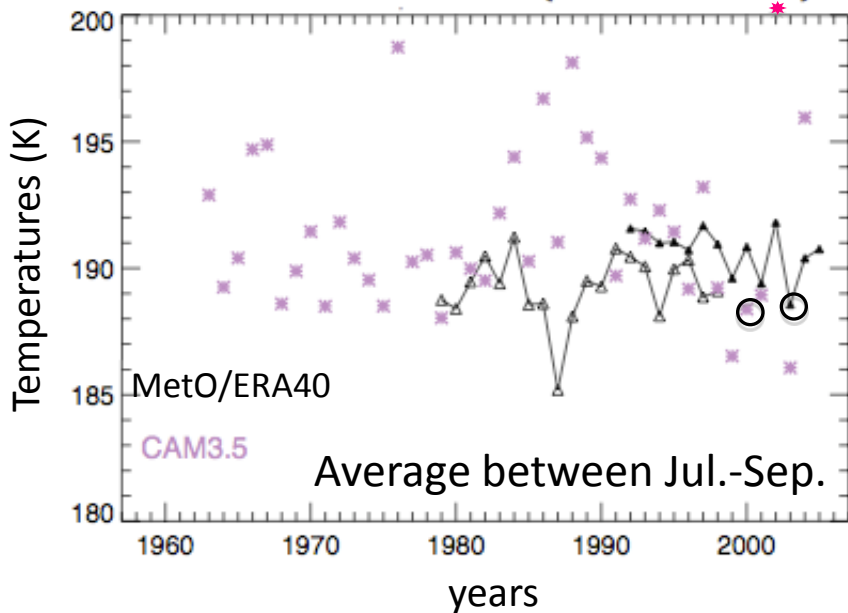


Antarctic Vortex (400-550 K)

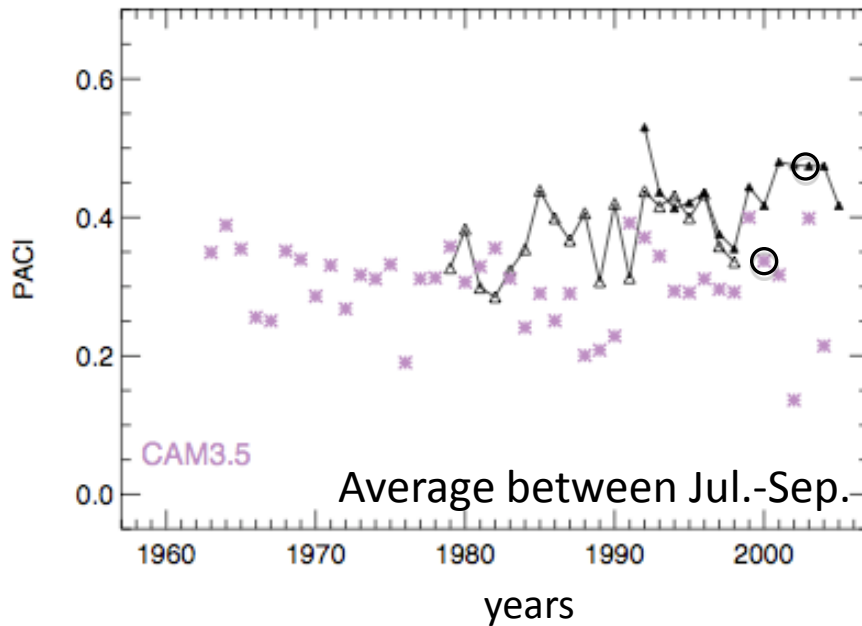
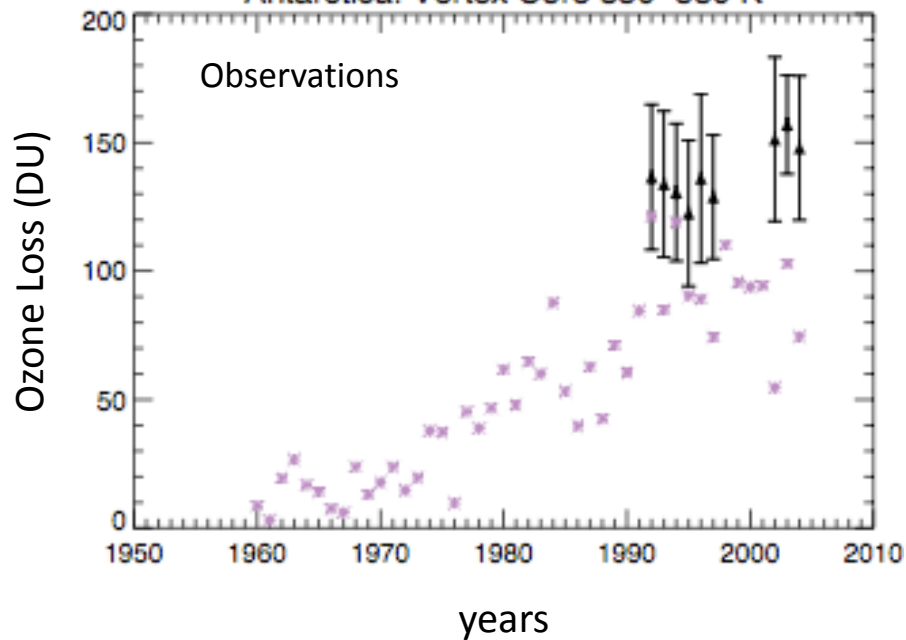


The fraction of the vortex that is below the threshold temperature for chlorine activation is smaller than observed

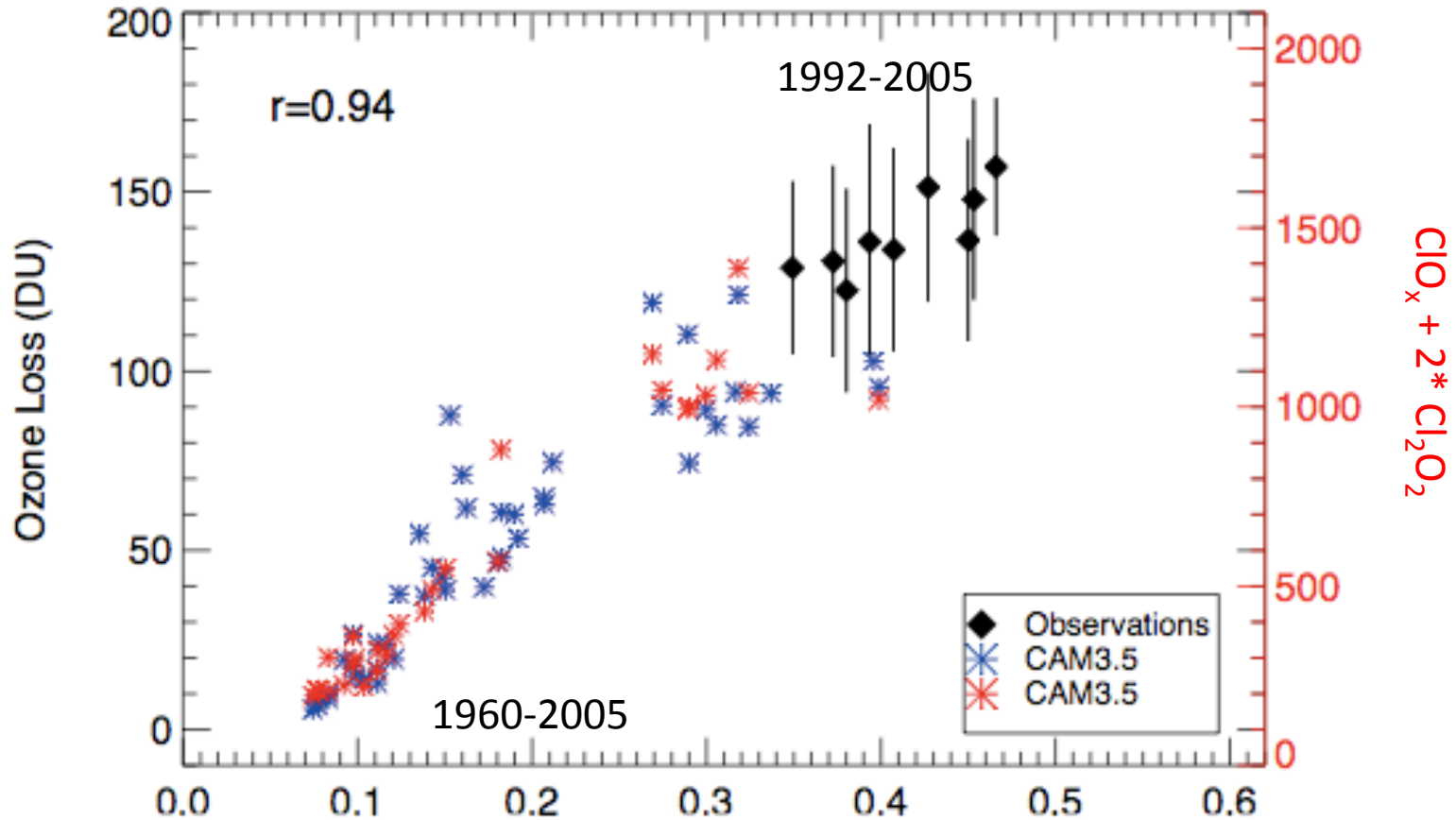
Antarctic Vortex (400-550 K)



Antarctica: Vortex Core 350-550 K

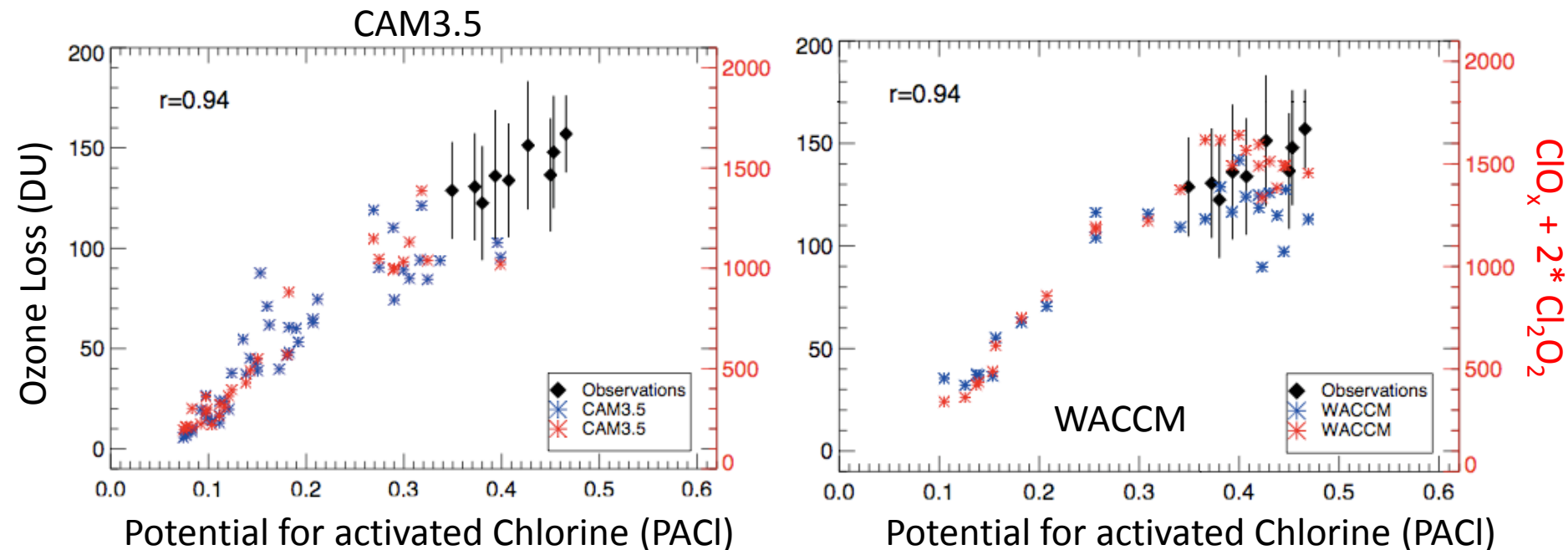


Antarctic Polar Ozone Loss



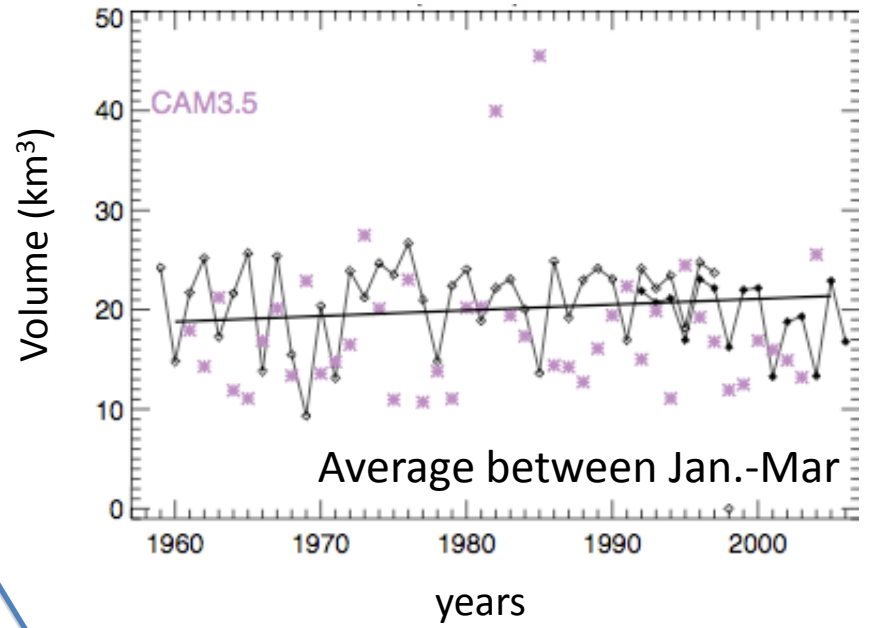
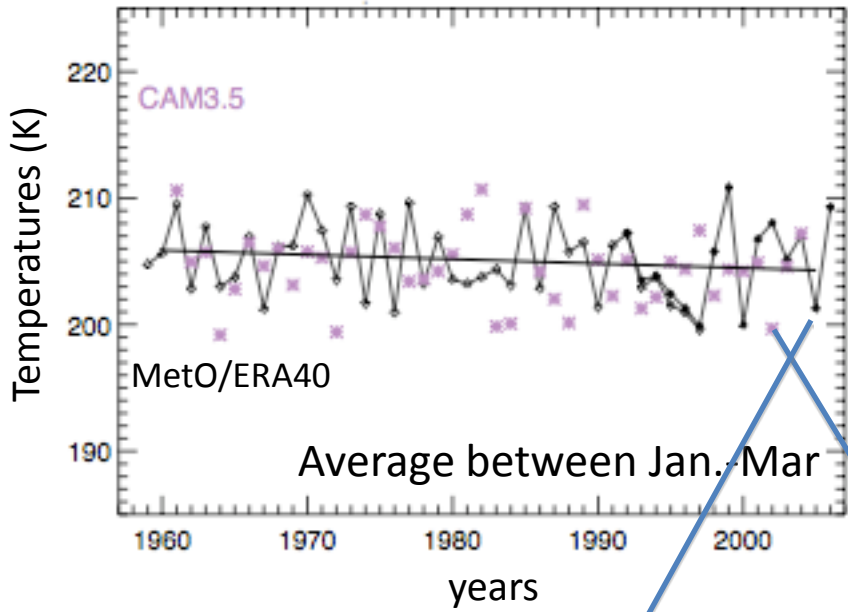
Potential for activated Chlorine (PACI)
(normalized with the amount of EESC)

Antarctic Polar Ozone Loss

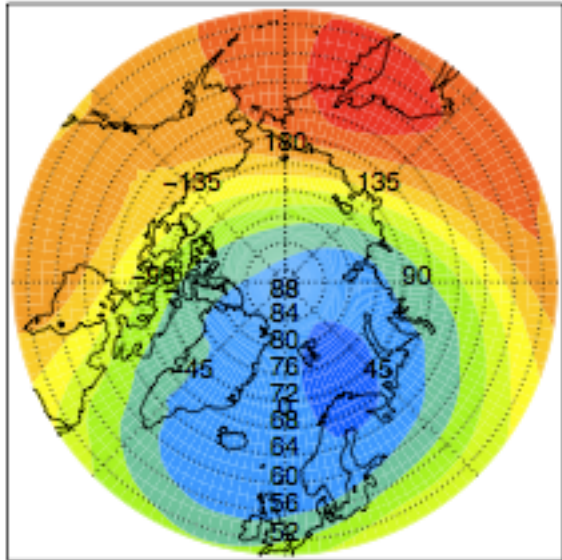


PACI is smaller than observed, however, even for largest PACI values chemical ozone depletion is underestimated
-> points to problems in the polar chemistry as well

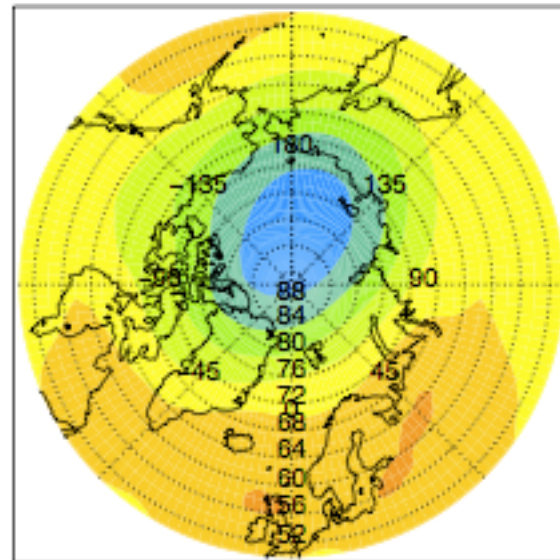
Arctic Vortex (400-550 K)



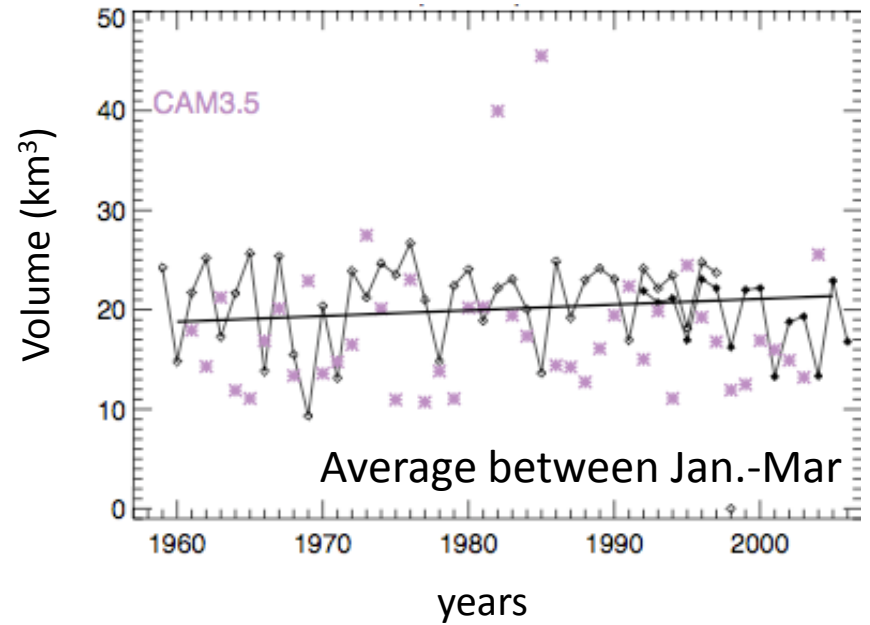
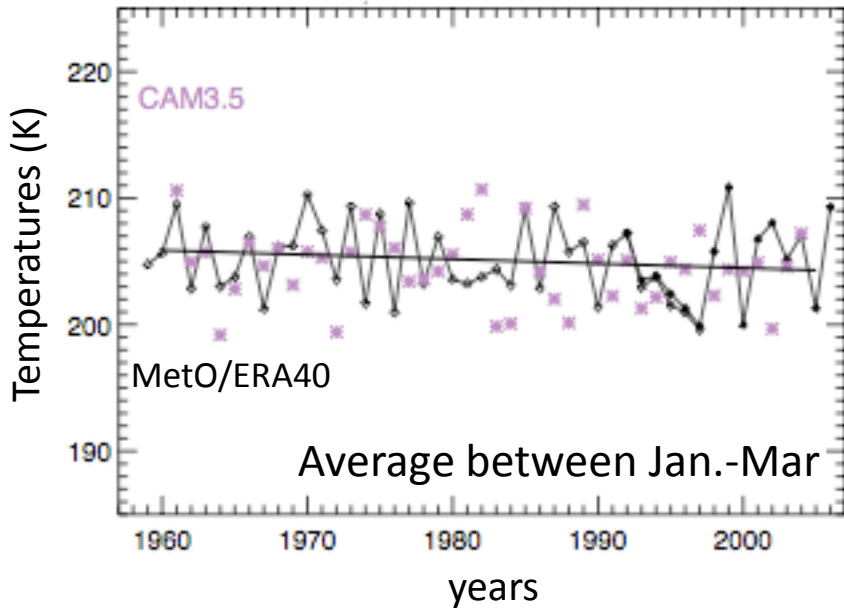
Geos5 20050217 475 K



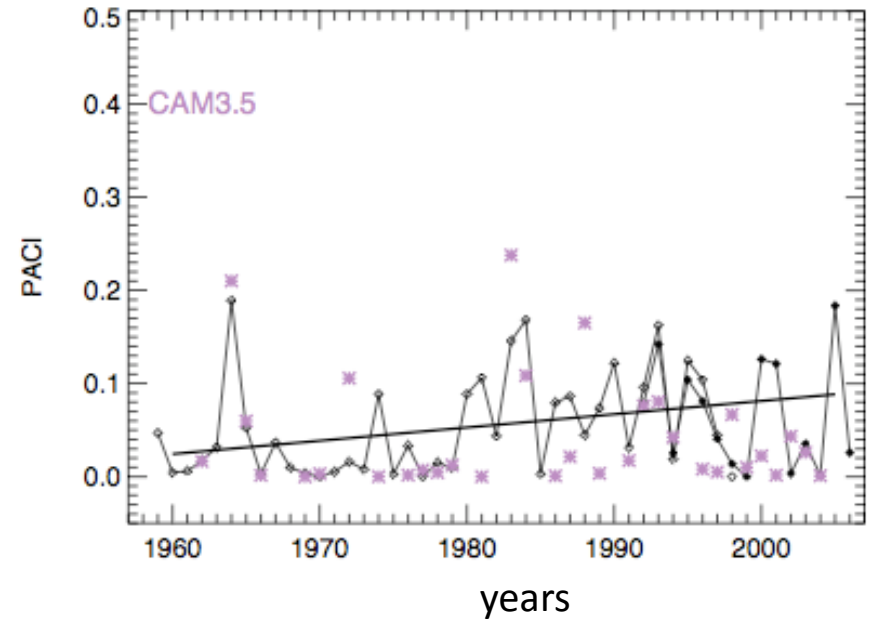
CAM3.5 20020217 475 K



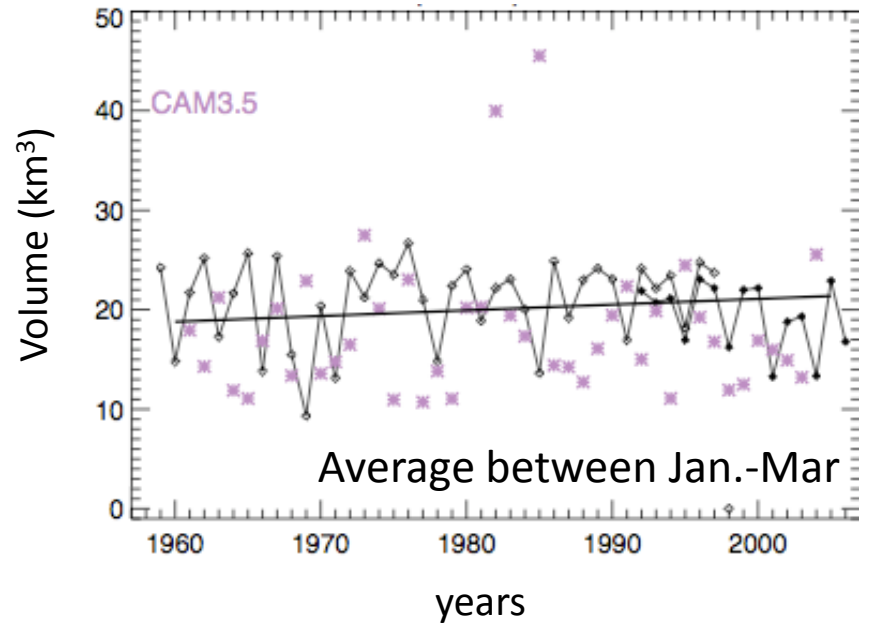
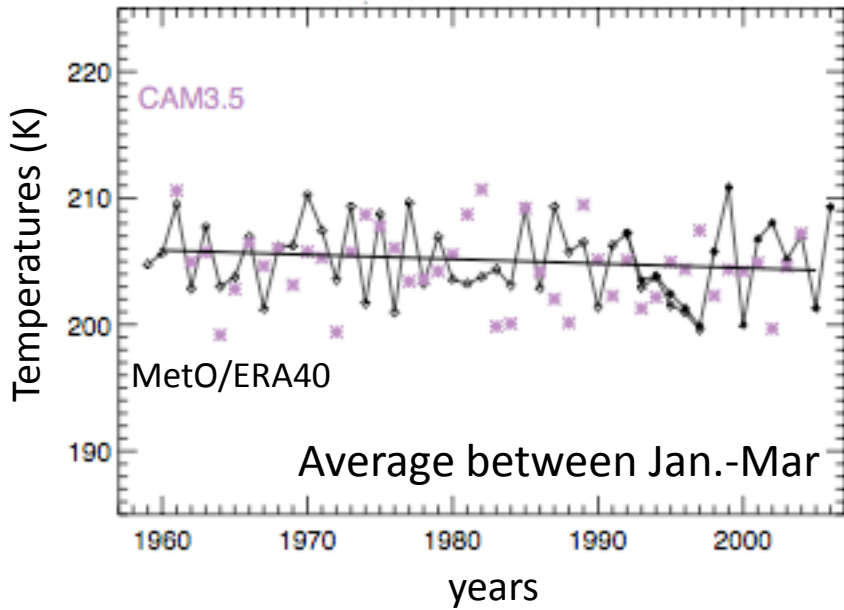
Arctic Vortex (400-550 K)



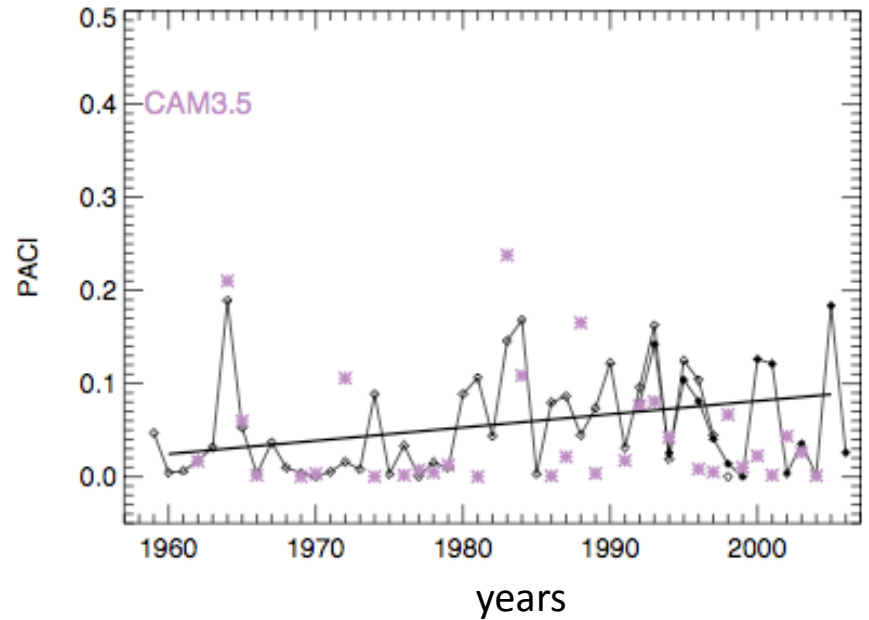
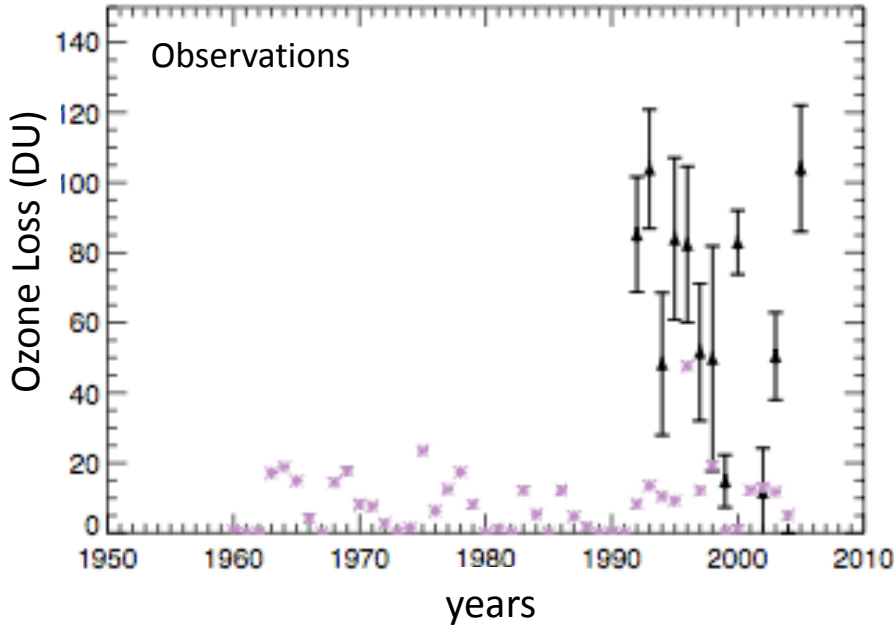
The fraction of the vortex that is below the threshold temperature for chlorine activation is much smaller than observed



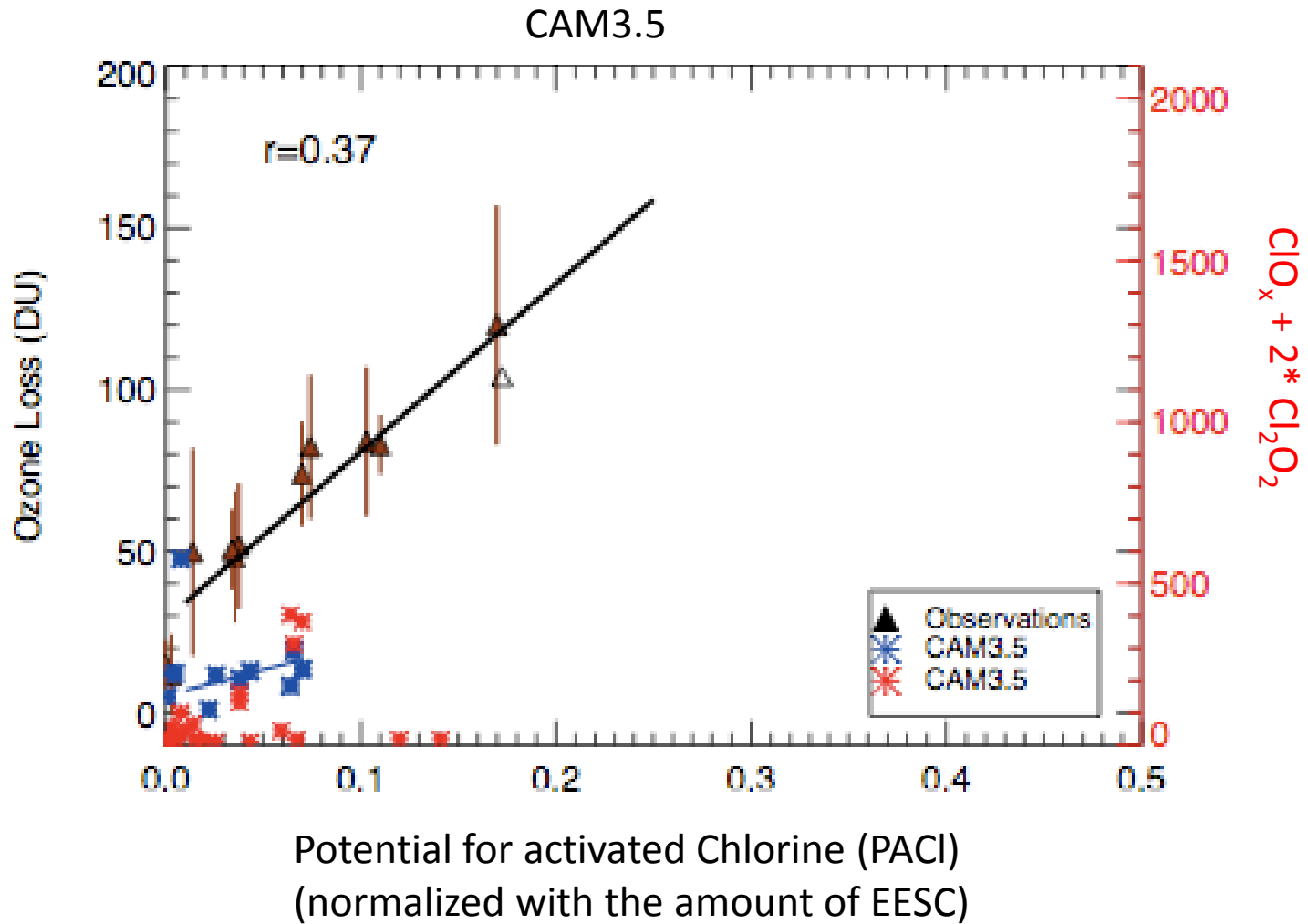
Arctic Vortex (400-550 K)



Arctic: Vortex Core 350-550 K



Antarctic Polar Ozone Loss



Summary

- **Average temperatures** in the Arctic polar vortex agree well with observations; Antarctica: larger variability than observed
- **Vortex volume** agrees well with observation in Antarctica, slightly smaller volume than the Arctic
- **Temperature distribution:** too cold in the polar vortex core, too warm at the edge of the vortex
 - > underestimation of the fraction of the vortex where chlorine activation is possible for both hemispheres
 - > **underestimation of chemical ozone loss expected**
- **Ozone loss and chlorine activation:**
indication of problems in the chemistry as well