EARTH SYSTEM RESEARCH LABORATORY
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Stratospheric Ozone and Complimentary Observations

ESRL Global Monitoring Division
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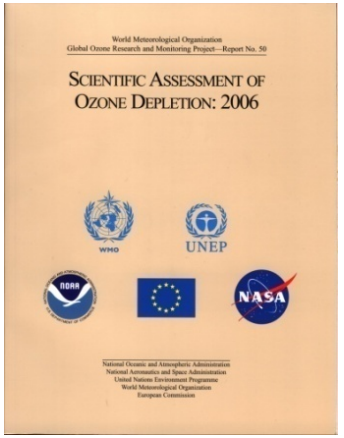
Stratospheric Ozone Research Theme Presentation, DSRC, December 4, 2008

From Observations to Assessments

- NOAA's history in ozone monitoring dates back to the 1960's.
- Dobson ozone spectrophotometers are located at NOAA's observatories at *Barrow, Alaska; Mauna Loa, Hawaii; American Samoa, and the South Pole,* at National Weather Service sites in the U.S., and in other countries (15 total).
- In conjunction with EPA, Brewer spectrophotometers are deployed at 6 U.S. sites to measure ozone and UV.
- Vertical ozone profiles are measured at 12 ozonesonde sites.
- UV nanometer resolution spectral measurements and LIDAR aerosol measurements are made at Boulder and Mauna Loa.
- ESRL operates the *WMO World Standard Dobson* and several secondary instruments which are used to calibrate most of the Dobsons used in constructing surface-based global column ozone trends for the International Scientific Assessments of Ozone Depletion.

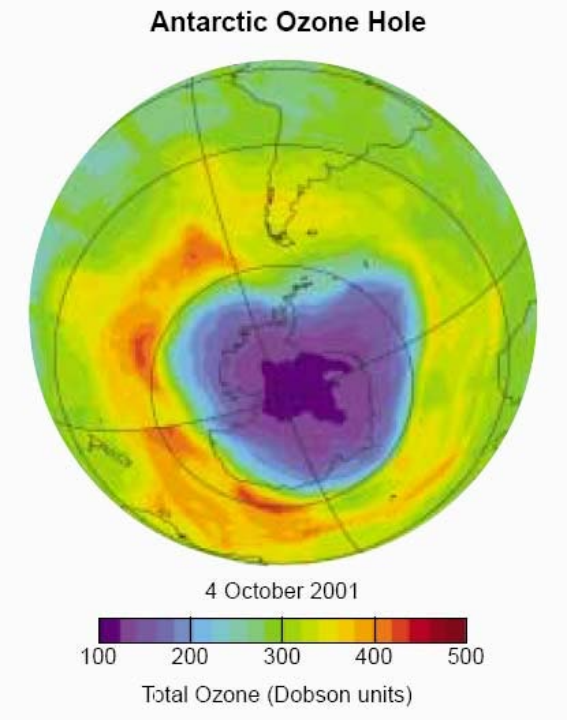


Research Highlights

Posters around the room describe the

- Dobson ozone network
- Brewer ozone/UV network
- Ozonesonde network
- UV Spectrometer network

In the time available, I will briefly cover South Pole ozone hole observations.



NOAA at South Pole

- Scientists from a NOAA predecessor agency began monitoring total ozone at South Pole in 1964.
- The annual “Ozone Hole” has been monitored with balloon borne instruments since 1986.

Clean Air Sector

NOAA Clean Air Facility

New South Pole Station

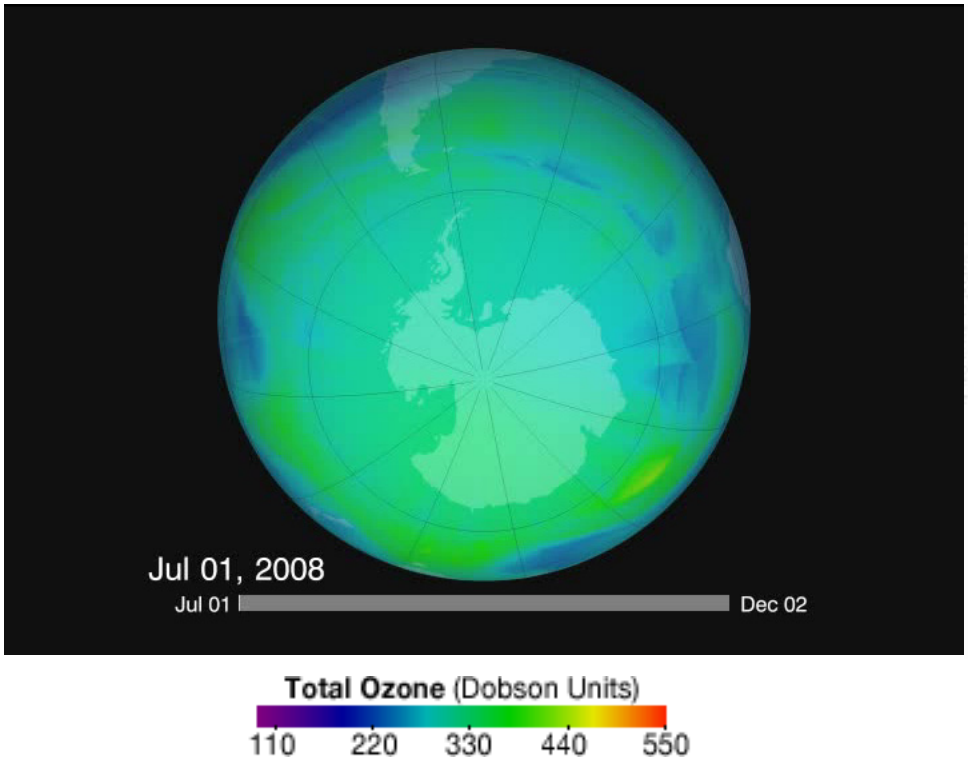
Astronomical Observatories

Runway

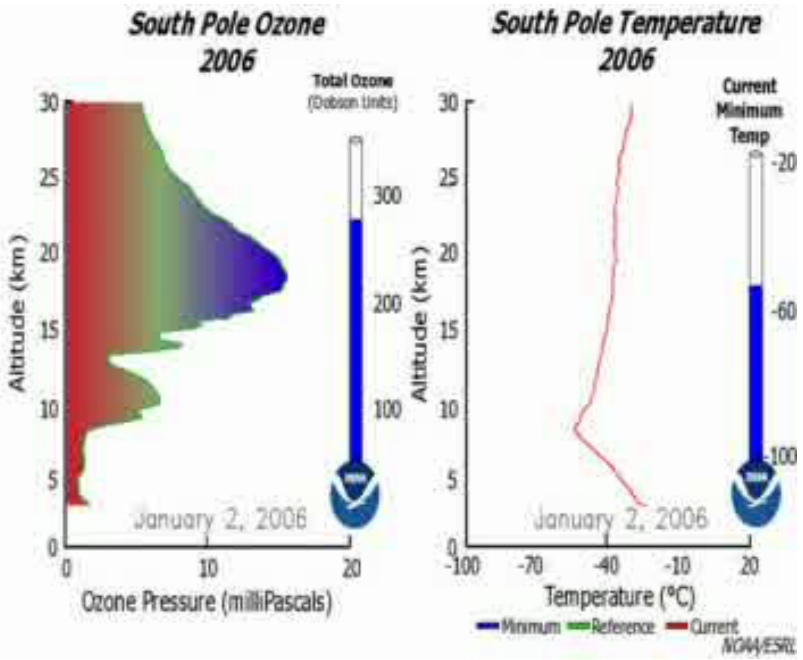
ANTARCTIC OZONE HOLE

A springtime loss of >90% of the ozone in the mid-stratosphere, generally centered over the south pole with an area larger than North America.

NASA Satellite Observations: X and Y

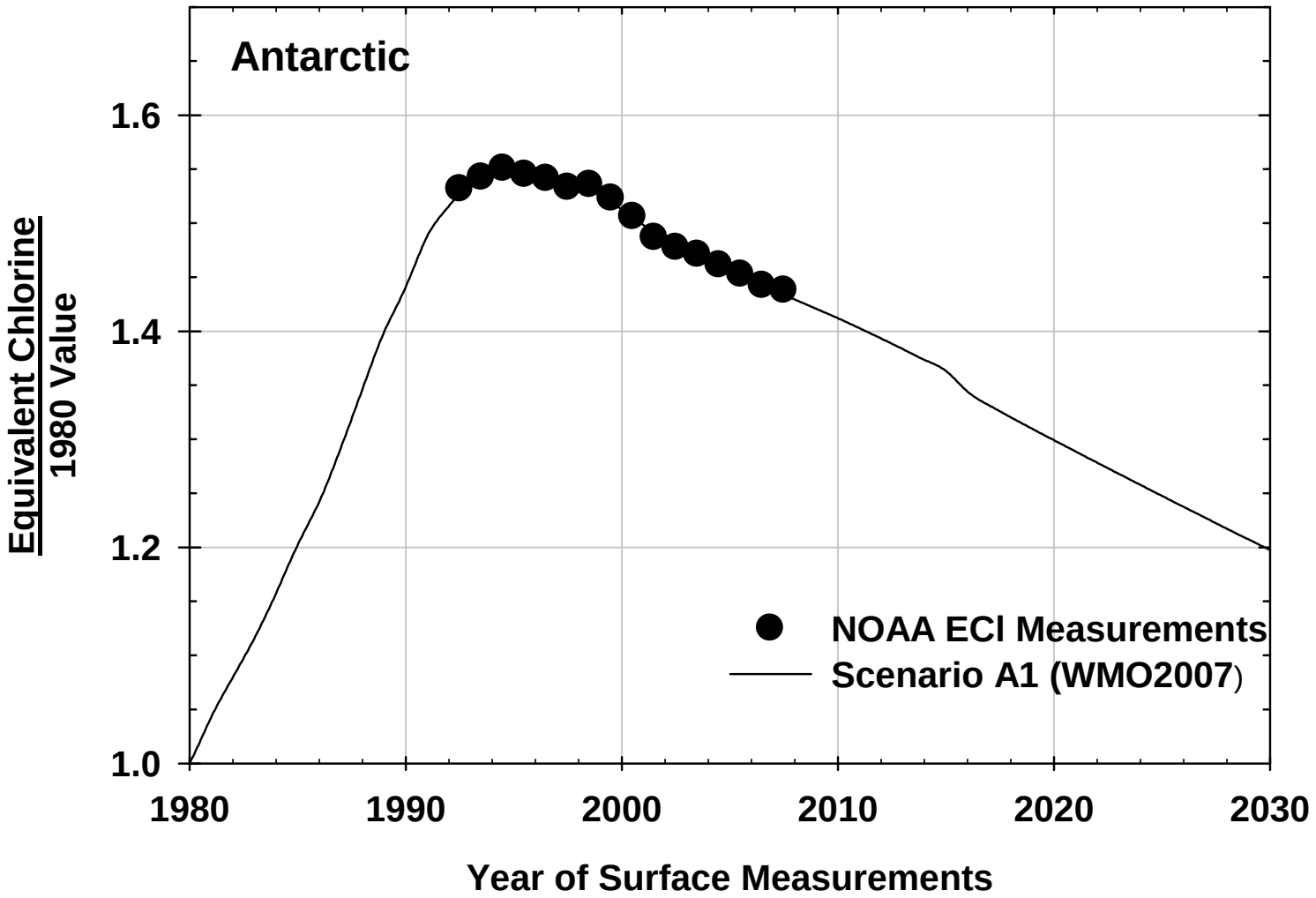


NOAA Balloon Observations: Z



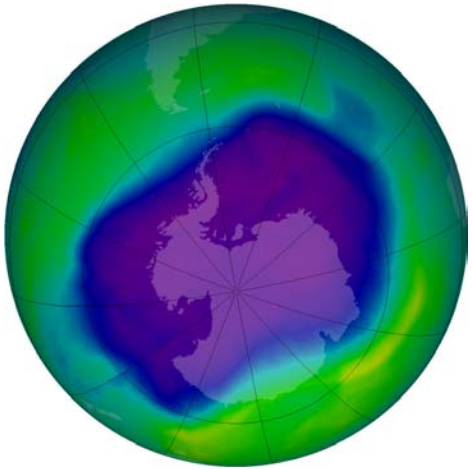
A major driver: Ozone-depleting substances are on the decline !

(Equivalent chlorine represents the ozone destroying capacity of all chlorine- and bromine-bearing atmospheric molecules)

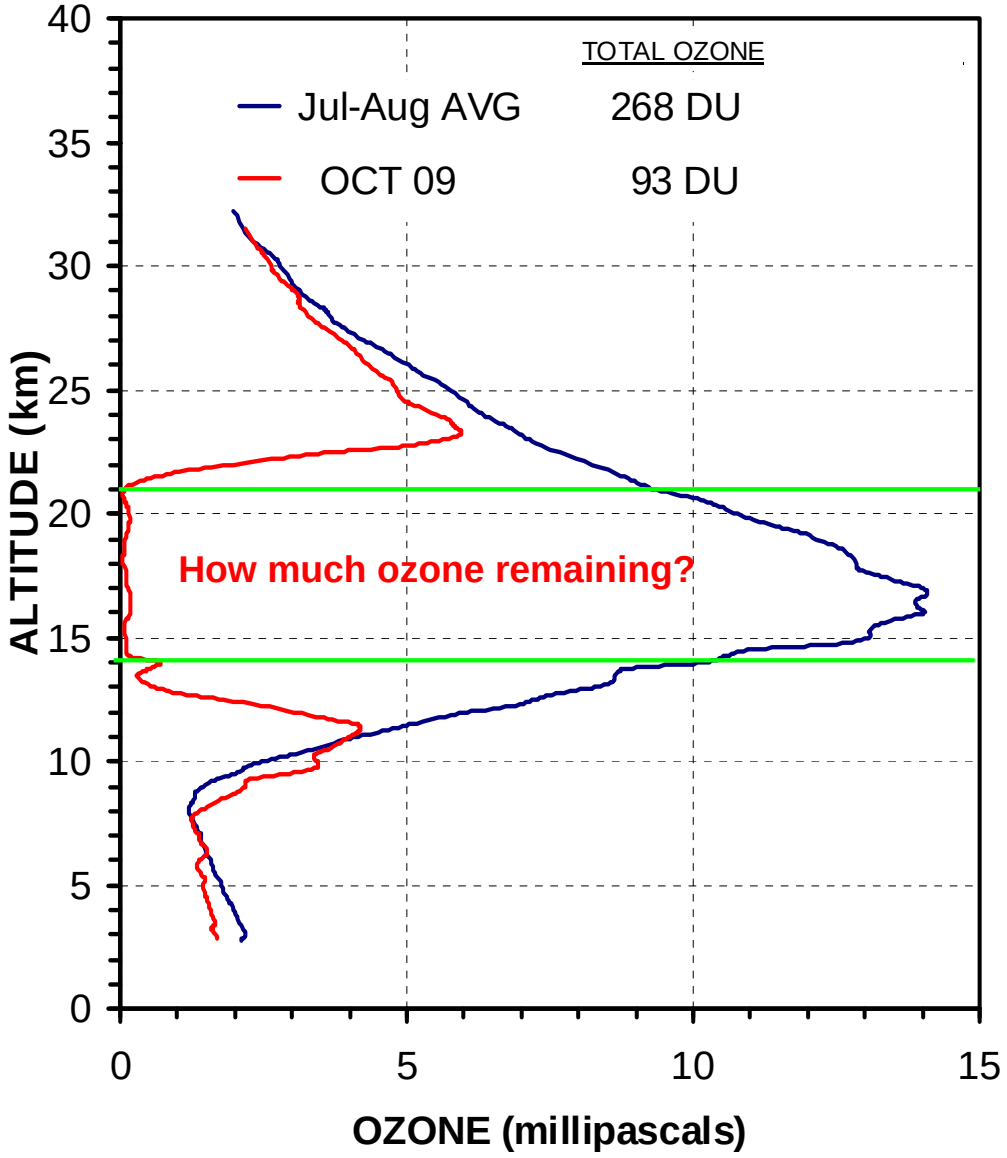


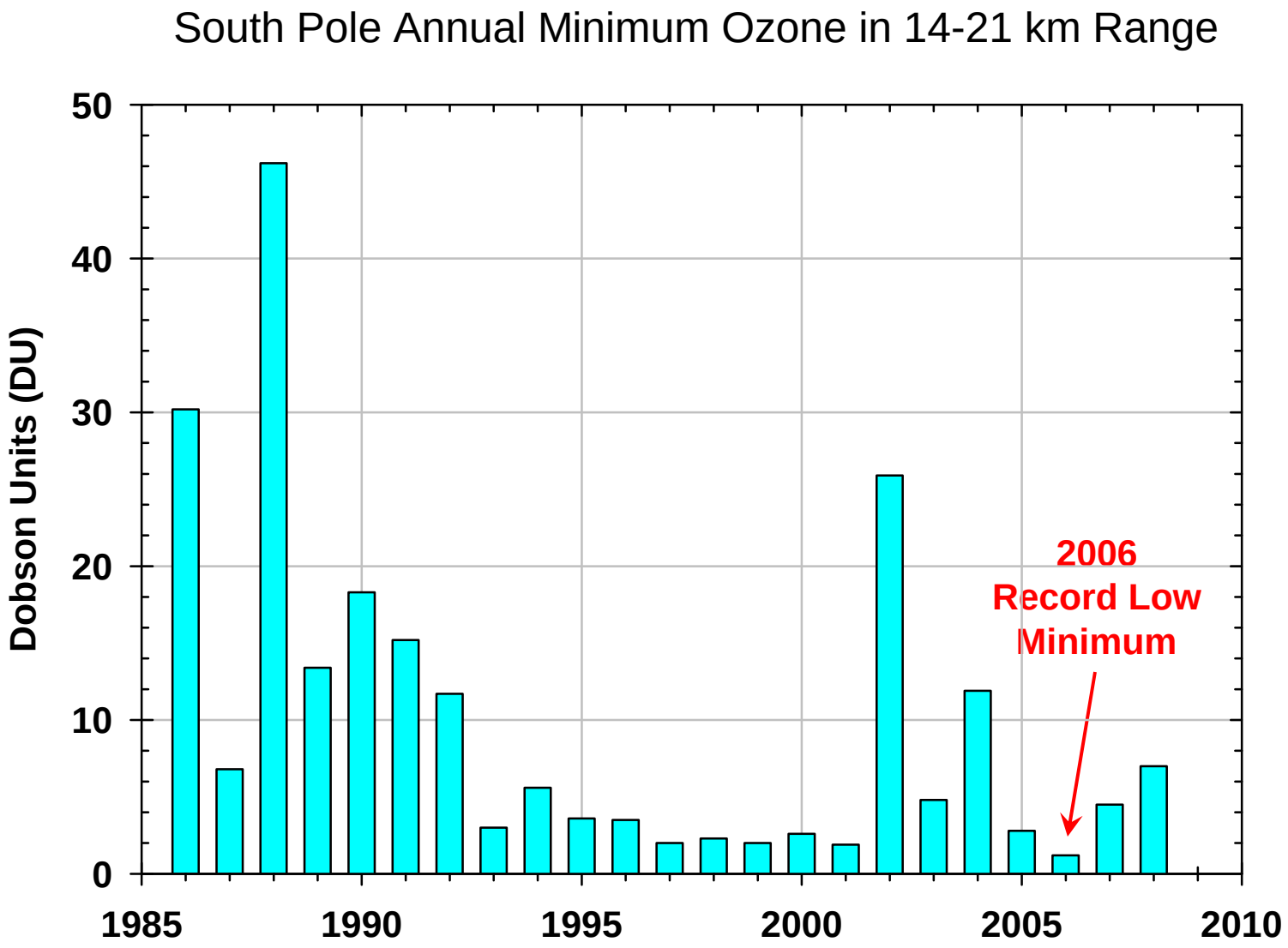
Is there any sign of ozone hole recovery?

South Pole Ozonesonde Profiles - 2006



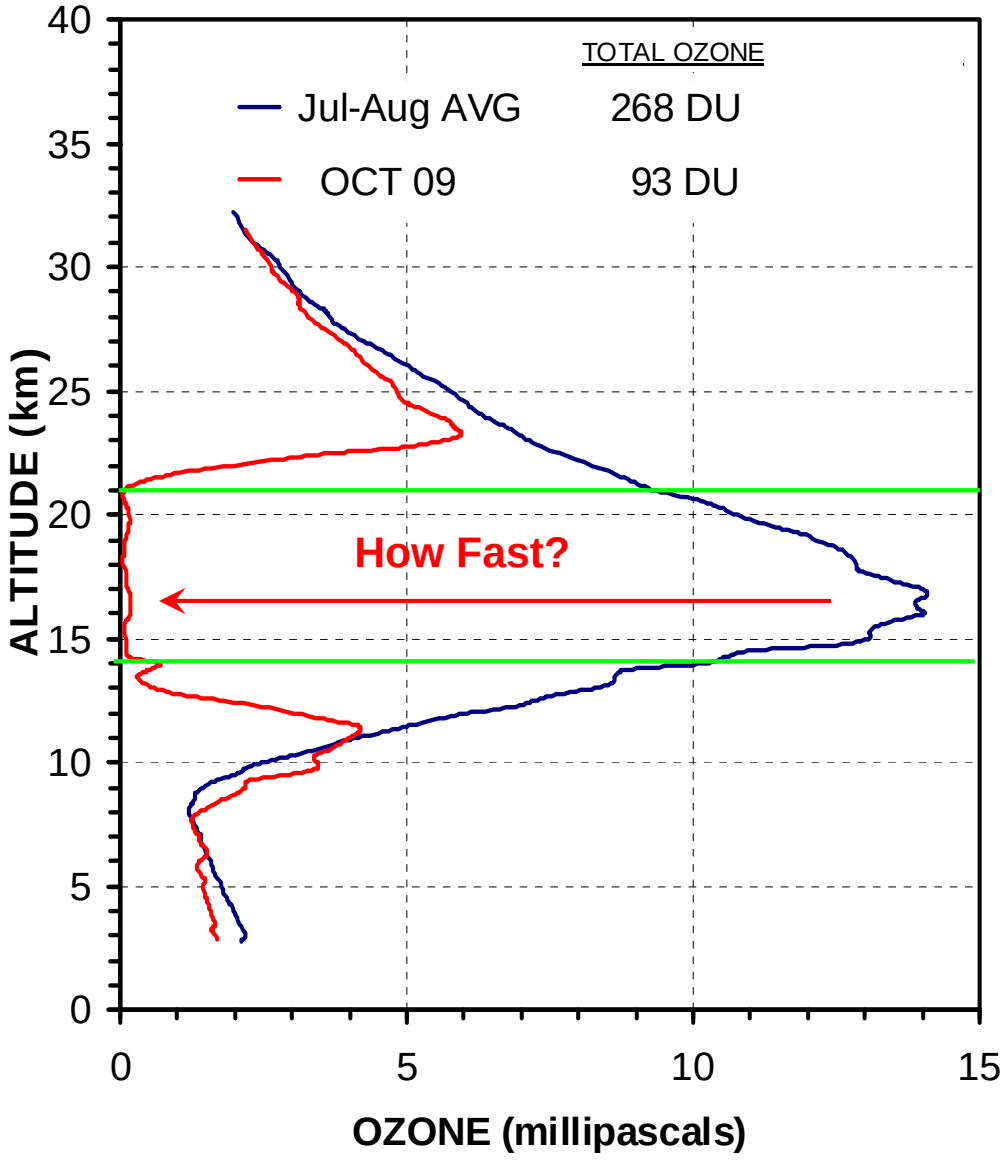
14–21 km Zero Ozone Region




South Pole Annual Minimum Ozone in 14-21 km Range
Dobson Units (DU)
50
40
30
20
10
0
1985
1990
1995
2000
2005
2010
2006
Record Low
Minimum

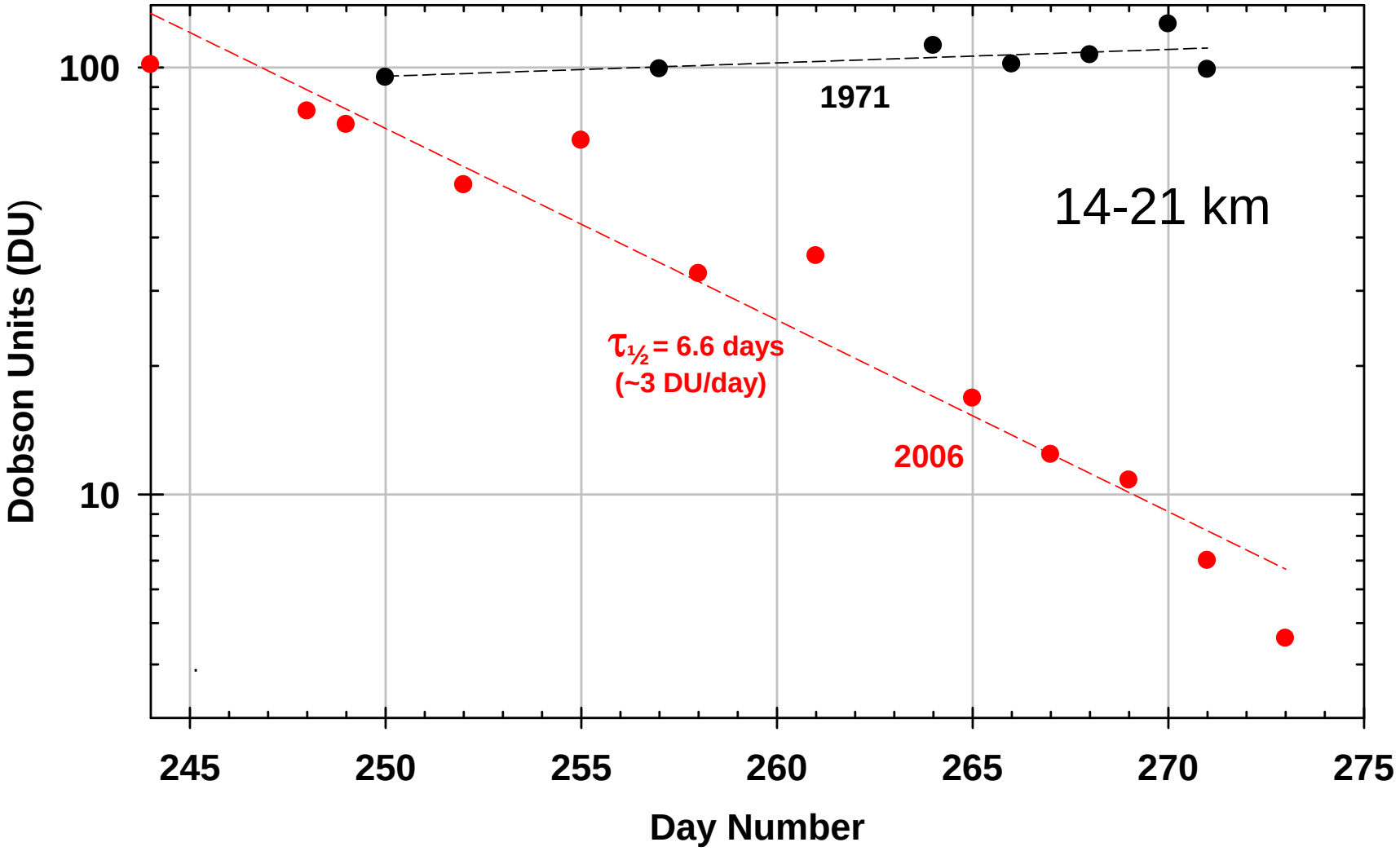
South Pole Ozonesonde Profiles - 2006

14–21 km Zero Ozone Region

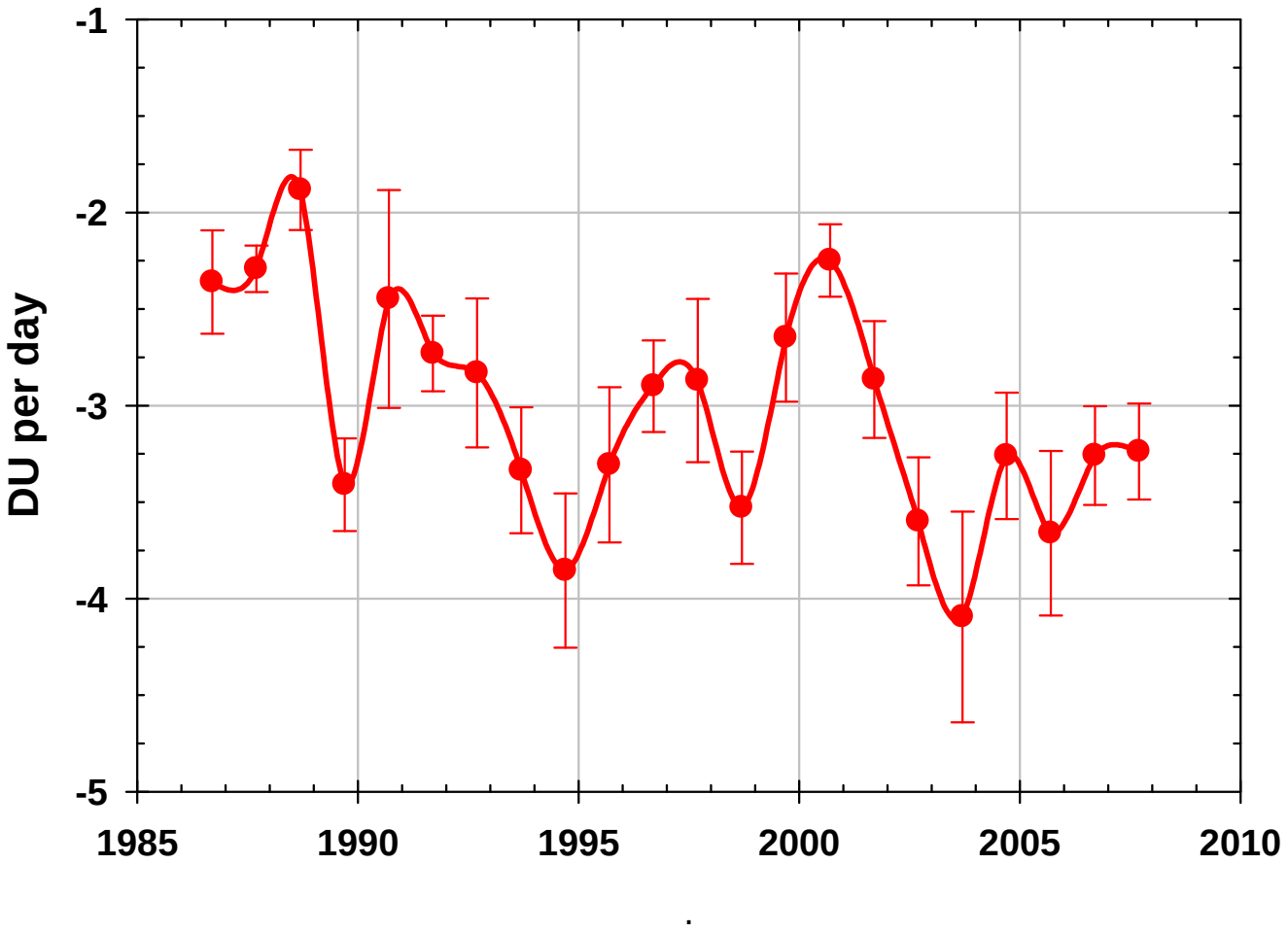


All else being equal, the rate of ozone decline in September should be proportional to the amount of chlorine/bromine present

September Ozone Loss Rate – An Ozone Hole Recovery Indicator?

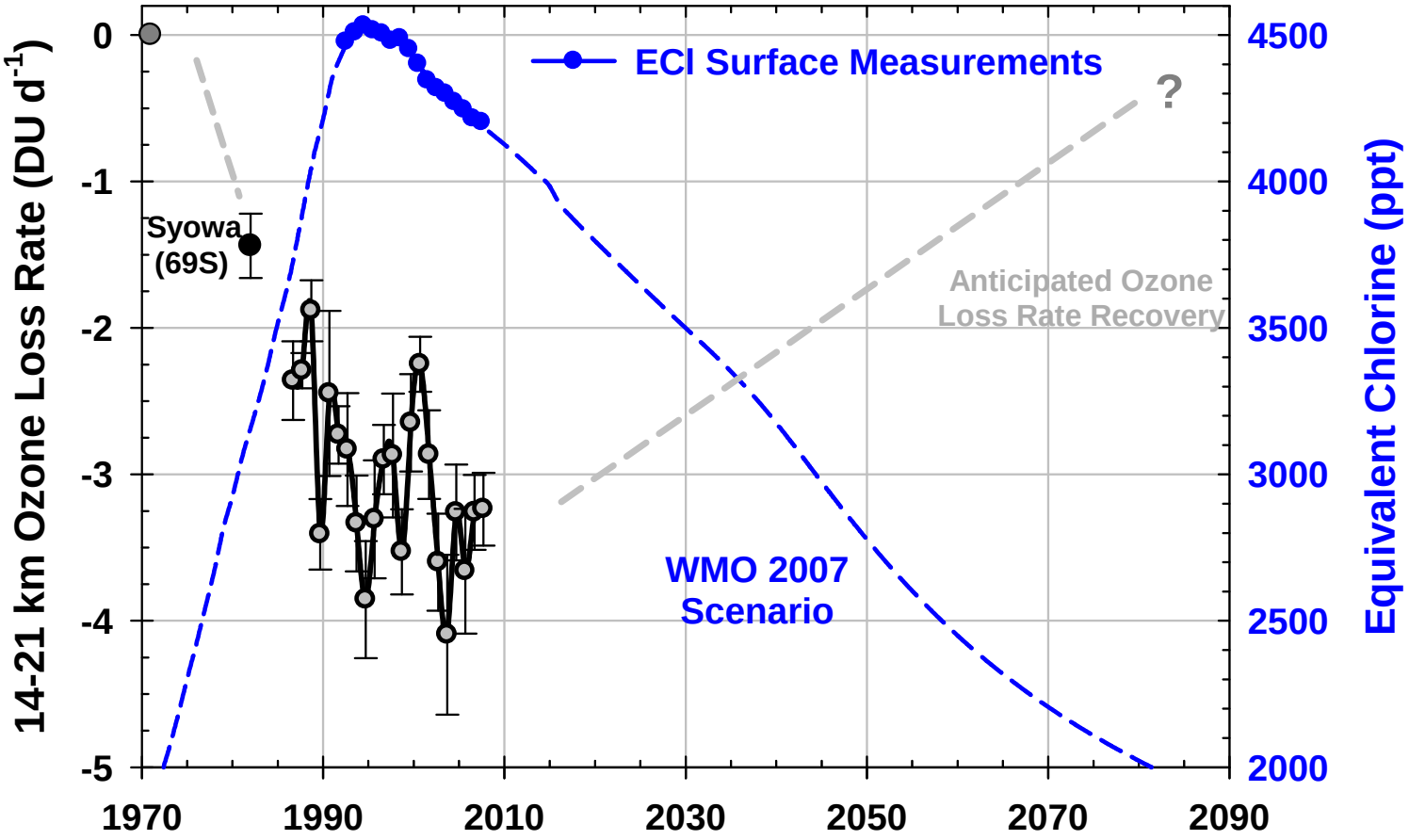


South Pole September 14-21 km Ozone Loss Rate



Interannual variability in the September ozone loss rate is larger than expected

South Pole September Ozone Loss Rate & ECl

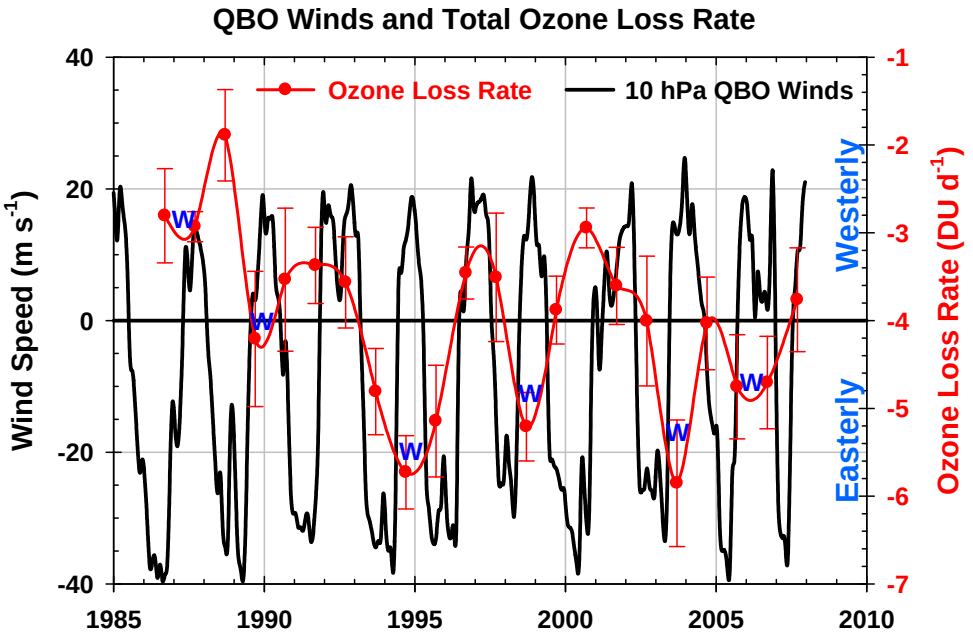


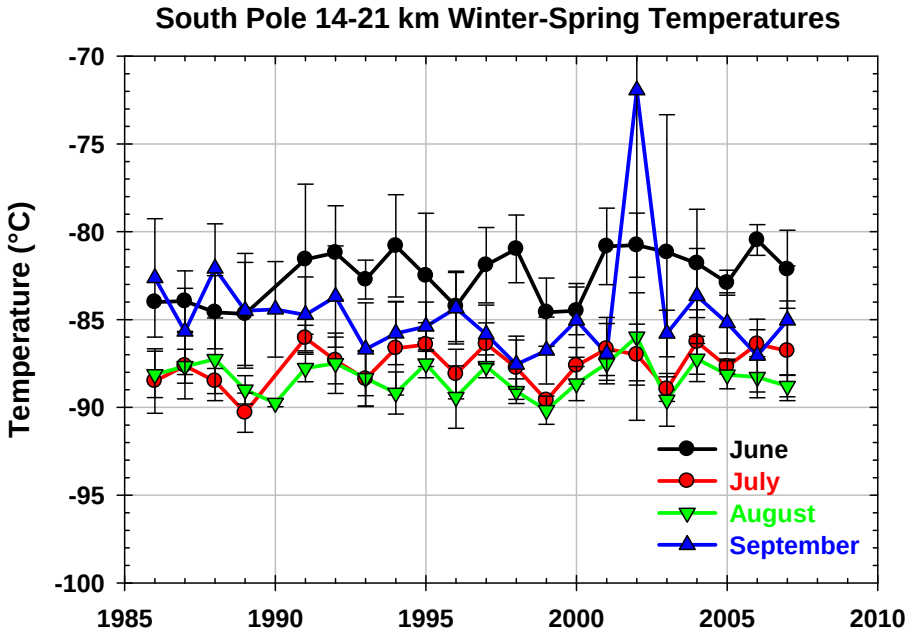
The high degree of variability in the ozone loss rate will make detection of the beginning of the recovery of the ozone hole difficult!

Variability in Ozone Loss Rate - A Research Topic

Interannual variations in winter-spring temperatures and in transport of gases into the vortex could cause variations in the September ozone loss rate.

There are no clear correlations between ozone loss rate and temperature; however, it is noted that all six of the high ozone loss rate peaks occurred during the westerly phase of the quasi-biennial oscillation (QBO) in tropical wind direction at ~30 km. This may be related to QBO modulation in the transport of gases into the south polar vortex.

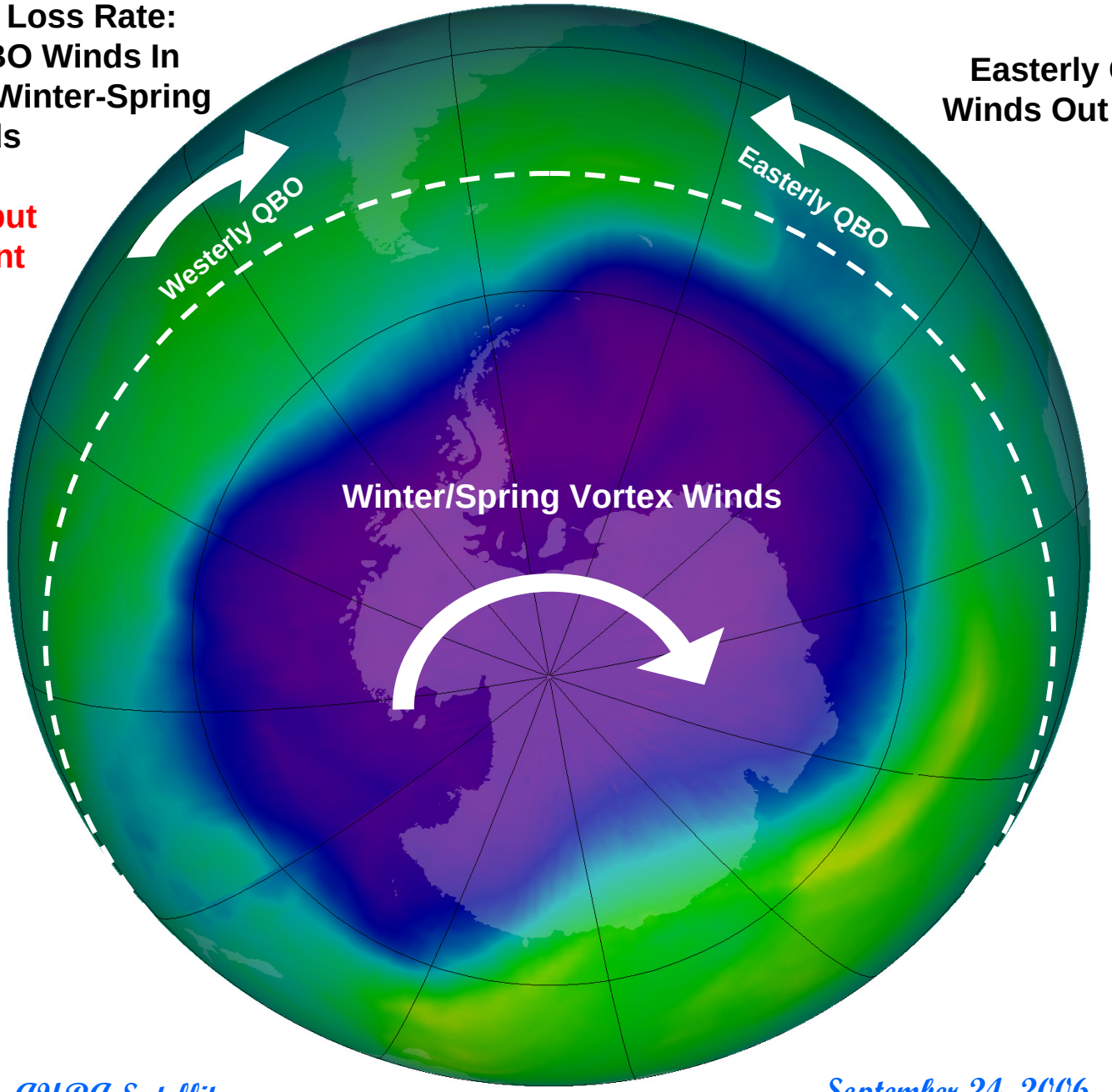




Peak Ozone Loss Rate: Westerly QBO Winds In Phase with Winter-Spring Vortex Winds

Necessary but Not Sufficient Condition

Easterly QBO - Winds Out of Phase



OMI – AURA Satellite

September 24, 2006

Conclusion

In spite of anticipated reductions in halogens in the Antarctic stratosphere, there is no clear evidence that the South Pole ozone hole has begun to recover. A large amount of interannual variability in, for example, the September ozone loss rate makes this detection difficult at the present time.

The Future

- NOAA/ESRL will continue to monitor the ozone layer and the ozone hole to study ozone, aerosol and UV trends in search of the first signs of recovery of the ozone layer and disappearance of the ozone hole.

- Identifying the causes of variability in the rate of ozone hole formation will help determine when the first signs of a reduction in chemical ozone loss due to halogens has been observed.