Global and Antarctic Ozone Observations

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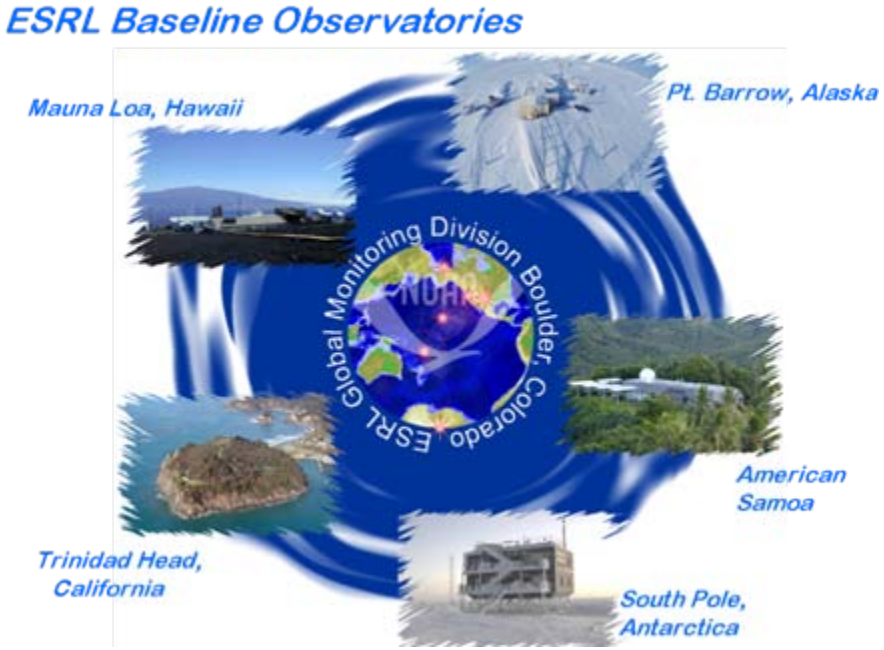
(with input from Bryan Johnson, Sam Oltmans, Ells Dutton, Joe Michalsky, John Barnes, Mike O'Neill and others)



ESRL Atmospheric Chemistry Review
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PREFACE

Accurate, long-term measurements are a science and a service

- *Careful measurements are key to being able to do valuable science.*
- A most difficult task is to turn over a measurement to the world to use, *and* be certain that it is accurate.
- Those that use the data for science understand how valuable this service is.

From Observations to Assessments

- Key among ESRL's mission strategies are *long-term measurements*. NOAA's history in ozone monitoring dates back to the 1960's.

- Following the formation of NOAA in 1970, these measurements found homes in permanent observatories established at *Barrow, Alaska; Mauna Loa, Hawaii; American Samoa, and the South Pole.* Additional Dobson sites were established in conjunction with NOAA's National Weather Service sites and in collaborative efforts in other countries.

- Currently, ESRL monitors total column ozone at 15 Dobson and 6 Brewer sites and ozonesonde vertical profiles at 12 sites. In addition, ESRL operates the *World Standard Dobson* and several secondary standards which are used to calibrate most of the instruments used in constructing surface-based global column ozone trends for the International Scientific Assessment of Ozone Depletion (1985, 1989, 1991, 1994, 1998, 2002, 2006).

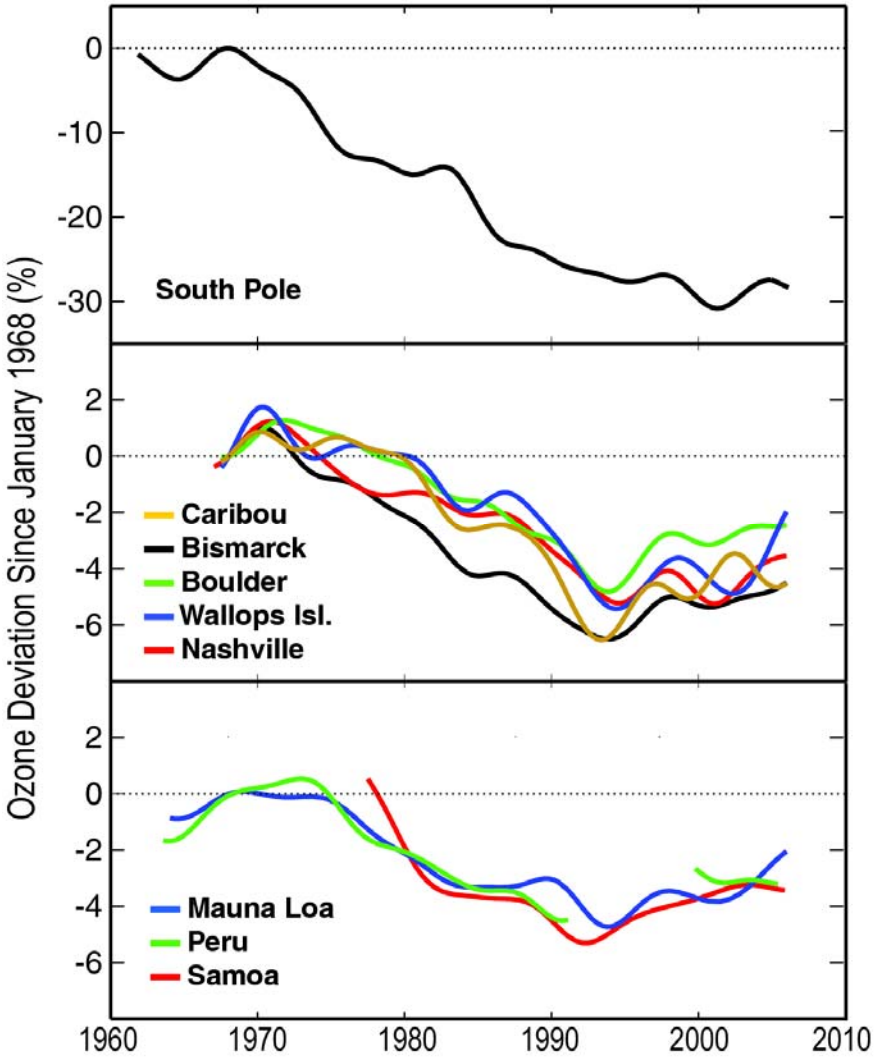
Research Highlights

- Dobson and Brewer ozone networks
- South Pole ozone
- Complimentary measurements:
  - Spectral UV
  - Aerosol LIDAR

Overarching Question Driving the Research:
ODSs are declining….What are Ozone and UV Doing?

Dobson Ozone Spectrophotometers

Dobson Ozone Trends



Harris, J.M., S.J. Oltmans, P.P. Tans, R.D. Evans, and D.L. Quincy, *Geophys. Res. Lett. 28,* 4535, 2001 (updated)

Brewer vs OMI
Daily Ozone on the Web

(a new ESRL Product)

Brewer Spectrophotometer

Used to measure ozone as well as UV

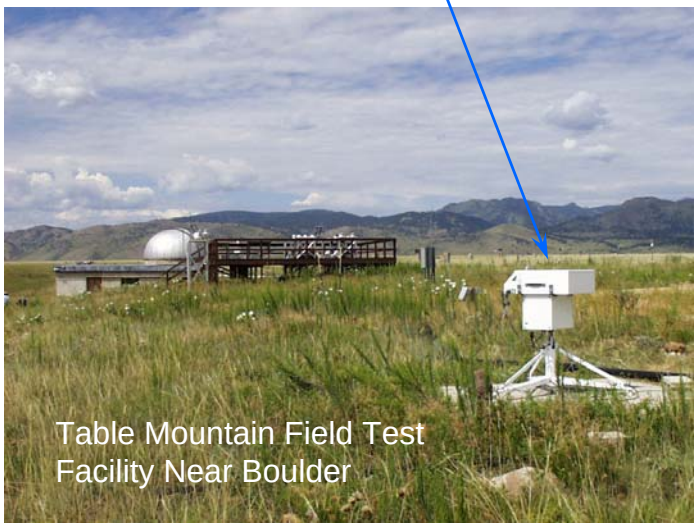
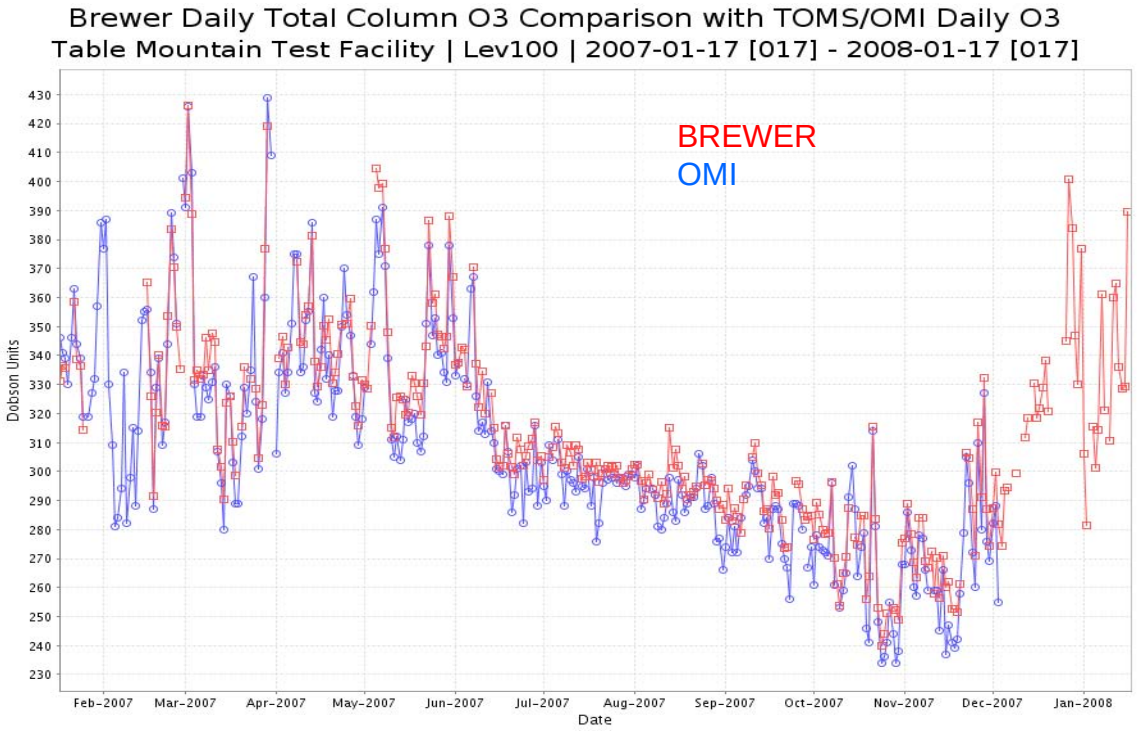


Table Mountain Field Test Facility Near Boulder



http://www.esrl.noaa.gov/gmd/grad/neubrew/

NOAA at South Pole

- Scientists from a NOAA predecessor agency began monitoring total ozone at South Pole in 1964.
- Collaborating with the National Science Foundation, NOAA has monitored continuously to date.
- The annual "Ozone Hole" is monitored with balloon borne instruments.
- Two NOAA staff winter at South Pole.

NOAA Clean Air Facility

New South Pole Station

Astronomical Observatories

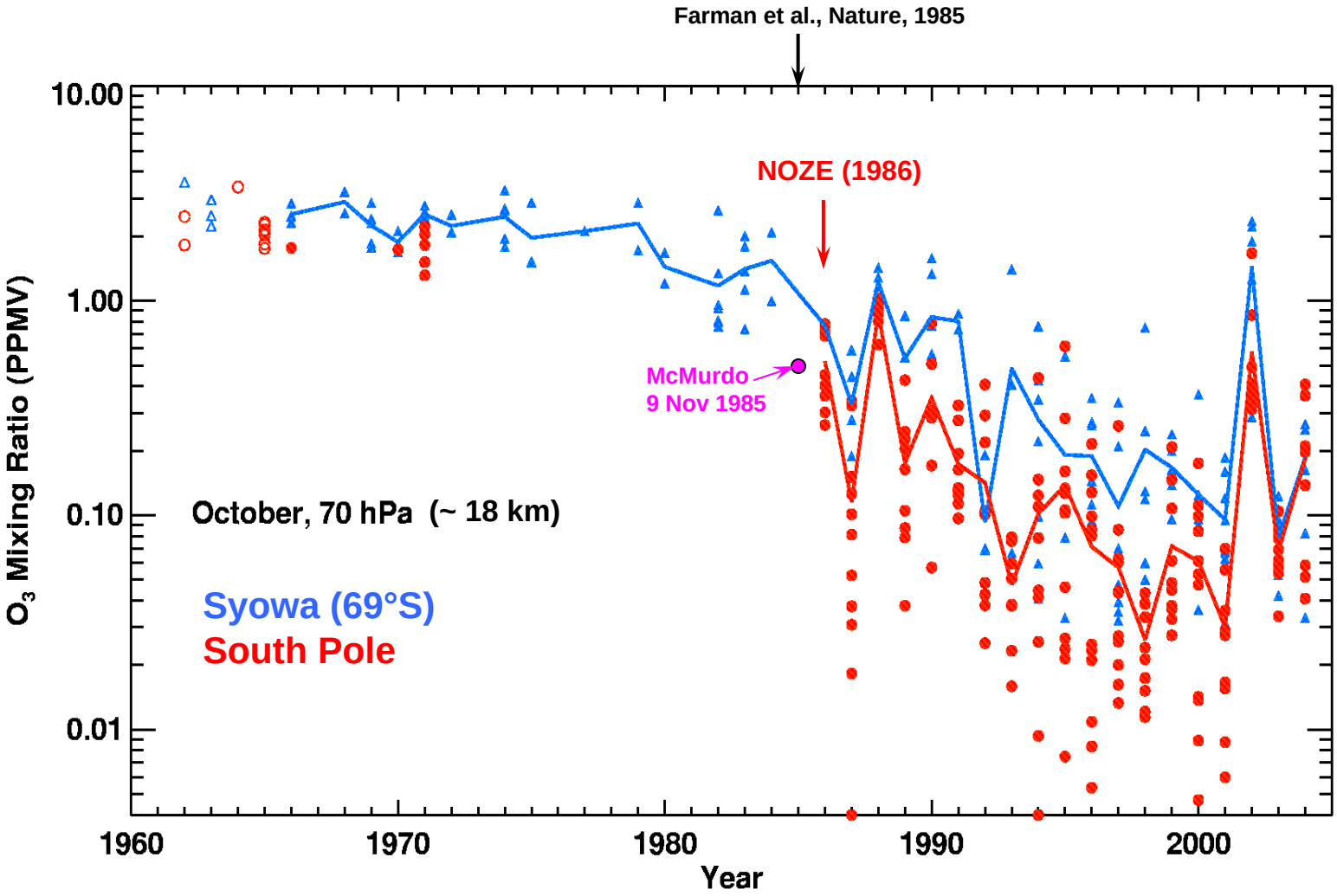
Runway

NOAA operates the Clean Air Facility for continuous monitoring of trace gases, aerosols, ozone and solar radiation in the NSF Atmospheric Research Observatory. The new South Pole main station was dedicated on January 12, 2008.

Four Decades of Ozonesonde Measurements Over Antarctica

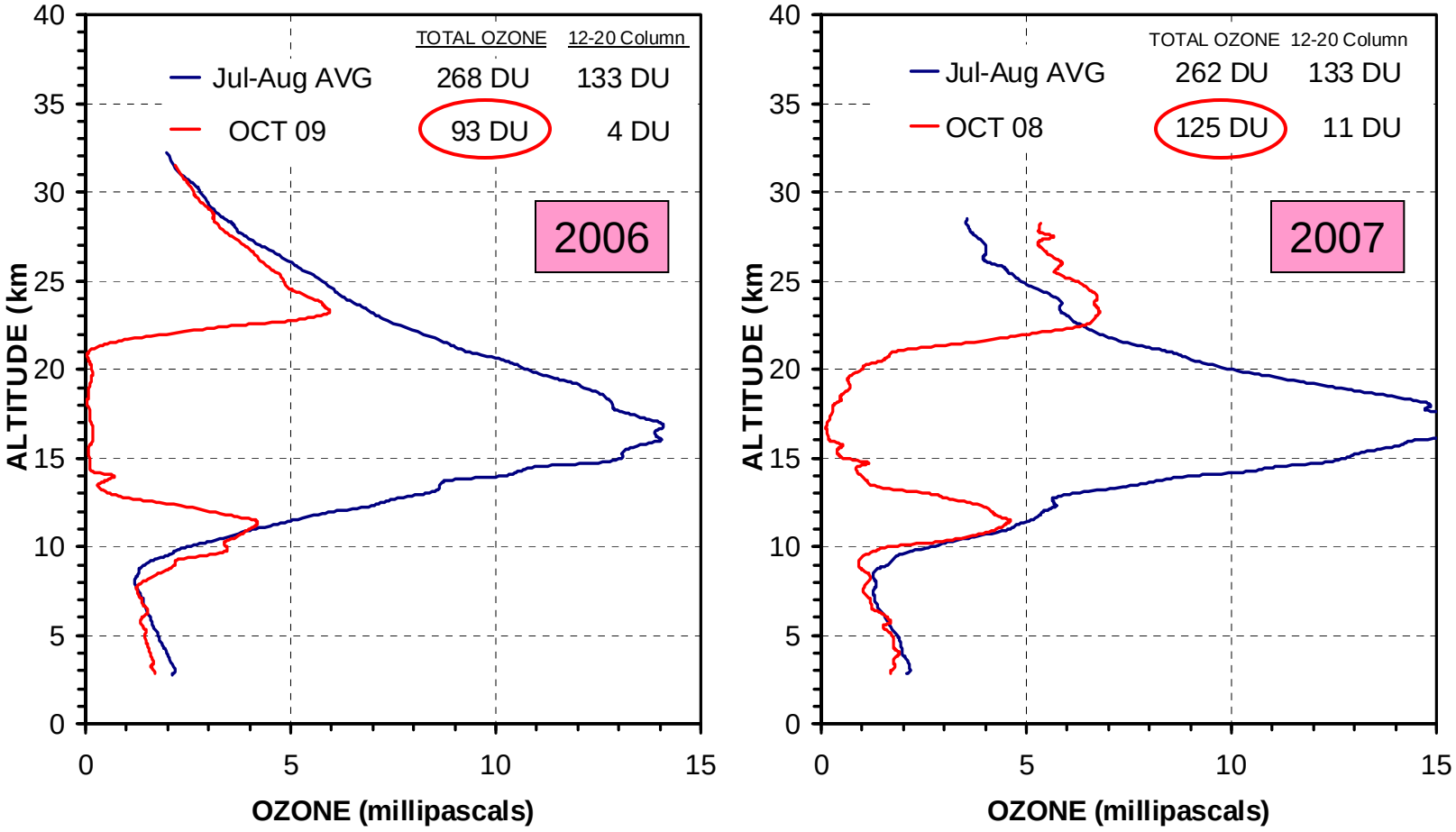
Solomon, S., R.W. Portmann, T. Sasaki, D.J. Hofmann, and D.W.J. Thompson,
J. Geophys. Res., 110, D21311, doi:10.1029/2005JD005917, 2005.

An ESRL CSD/GMD Collaboration



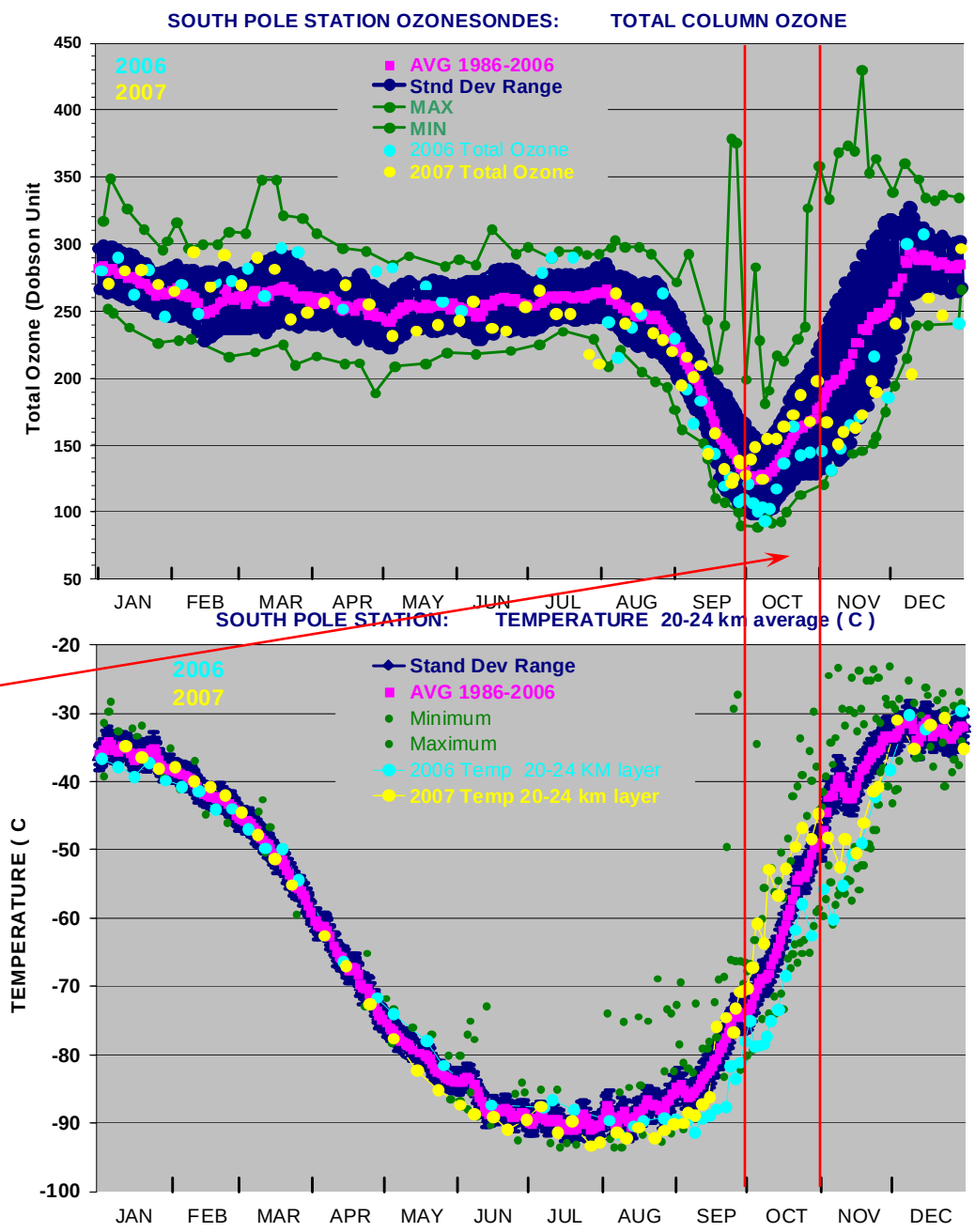
Recent Results at South Pole

Minimum Total Ozone Profiles

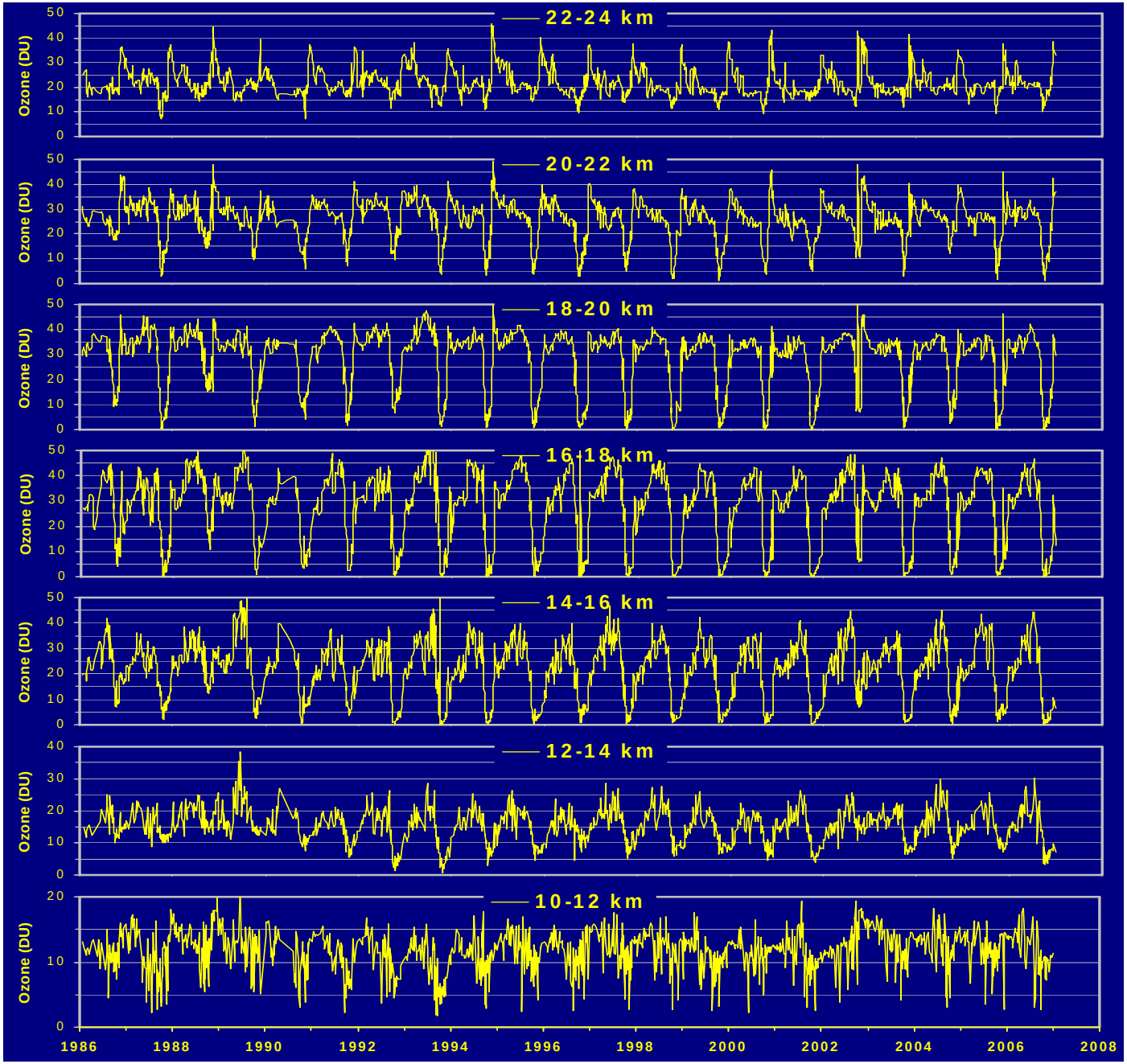


No Evidence for Lessening of Ozone Hole Severity

2006 and 2007 again demonstrated the dynamic interannual variability in Antarctic ozone depletion. Enhanced wave activity in October 2007 resulted in upper vortex disturbances and increased temperatures with enhanced ozone, while 2006 remained cold with low ozone throughout the September – November period.



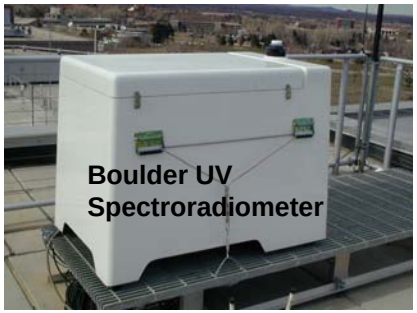
Antarctic Ozone Hole Recovery Studies Will Continue



All data between 10 and 24 km altitude from over 1500 ozonesondes flown at South Pole over the past 22 years

UV Radiation

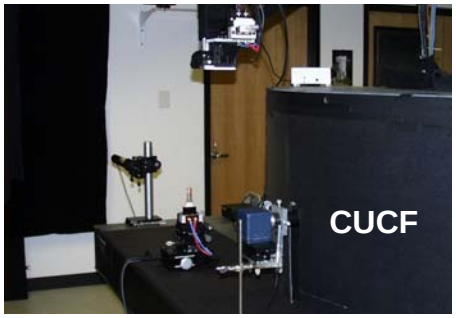
- Spectral UV is measured at the Mauna Loa Observatory and at Boulder through a collaborative program with NIWA New Zealand.



- ESRL operates a six-station Brewer spectrophotometer network for UV and ozone formerly operated by the EPA.

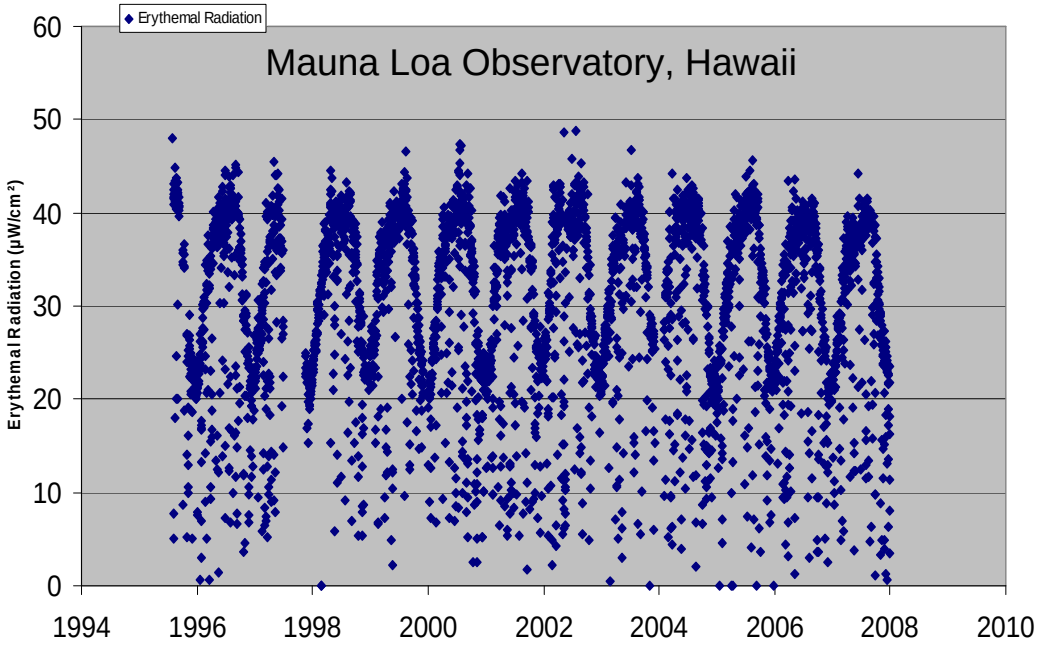
Brewer Network Stations

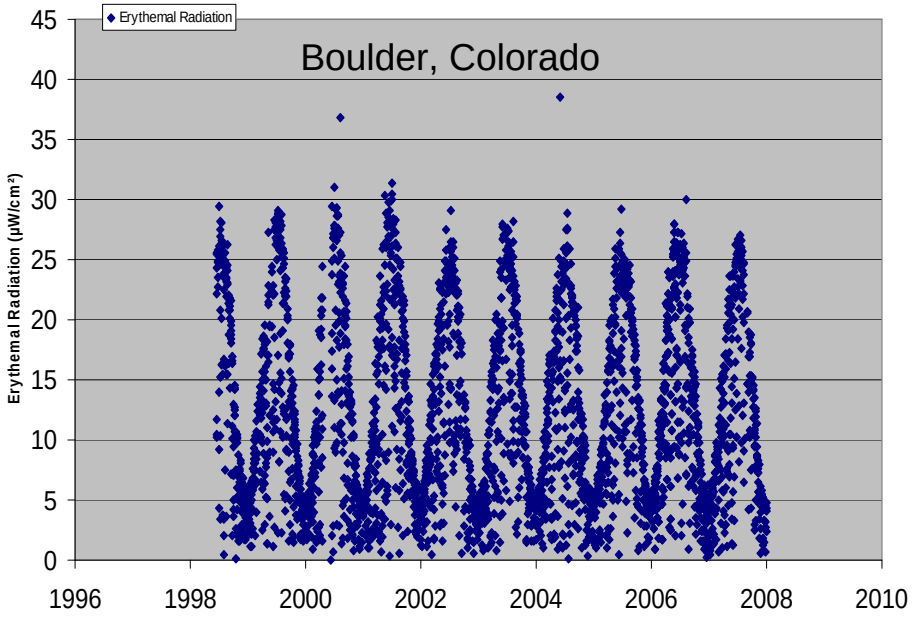
- ESRL operates the Central UV Calibration Facility (over 100 instruments are calibrated each year in the laboratory; many are also calibrated in the field with a portable calibrator).

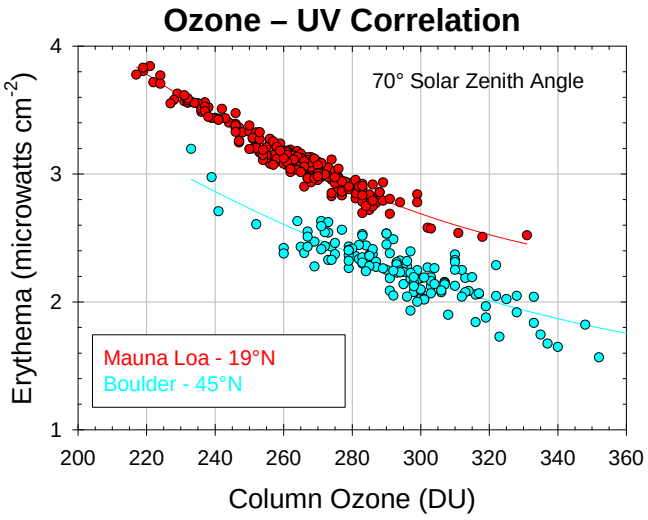


UV Monitoring

Local noon erythemal (biologically harmful) radiation calculated from UV spectroradiometers (1 nm resolution) at Mauna Loa, Hawaii and Boulder, Colorado





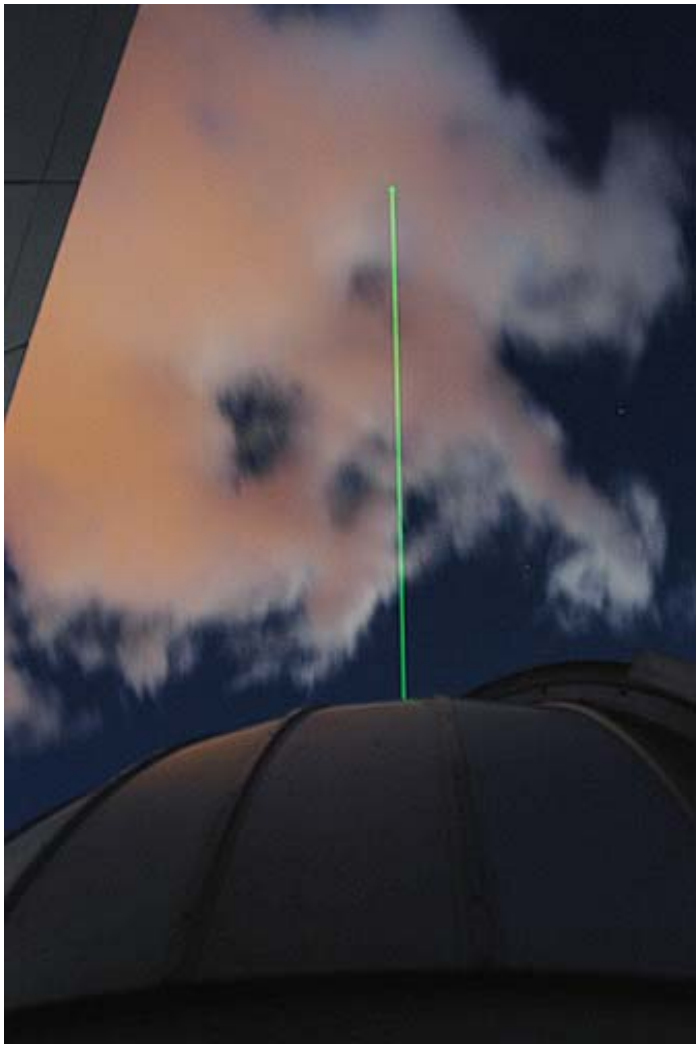


Stratospheric Aerosol LIDARS

Volcanic eruptions increase the stratospheric aerosol which has both climatic (cooling) and ozone layer (increased aerosol surface area) effects.

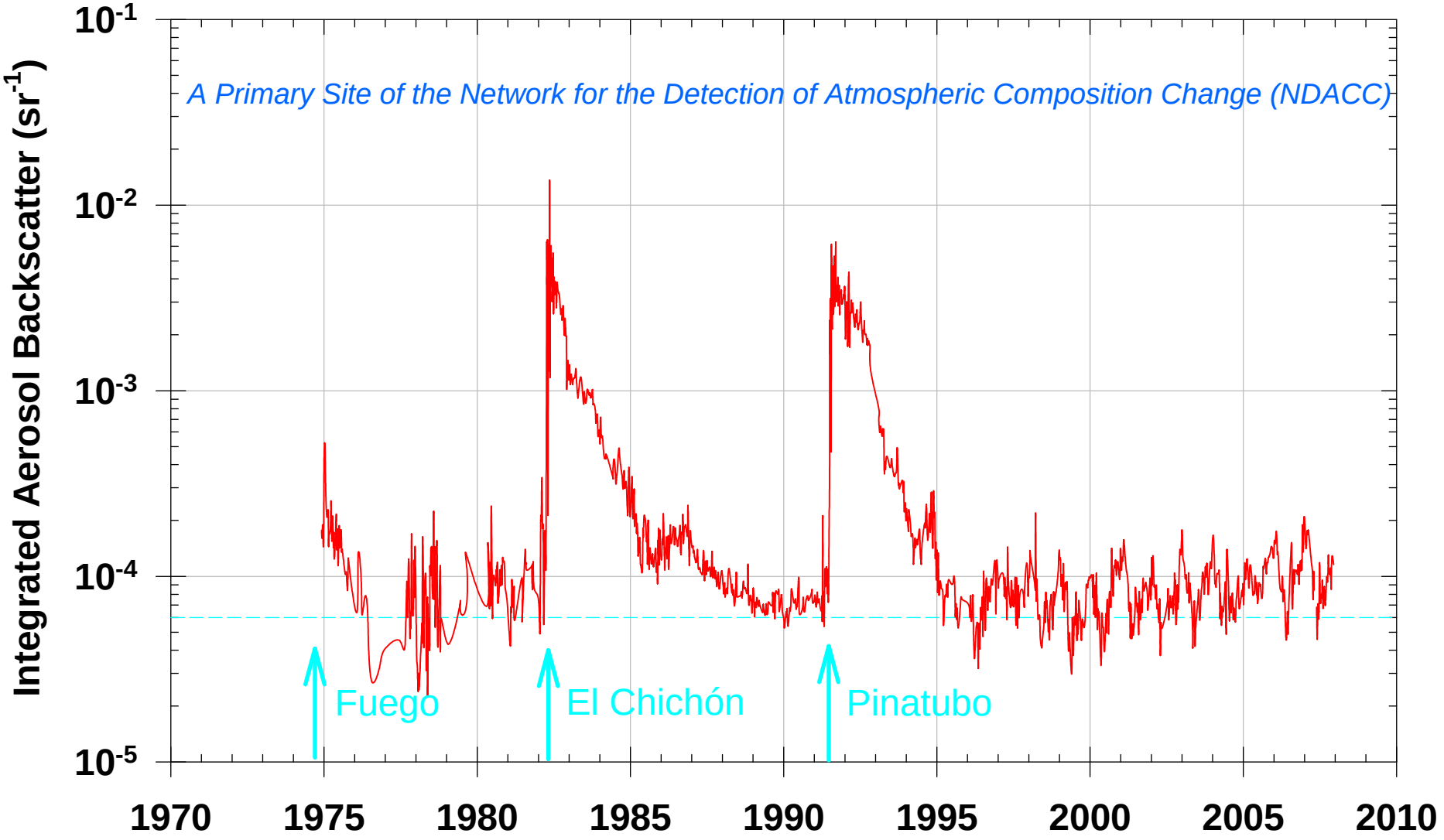
ESRL LIDARS:

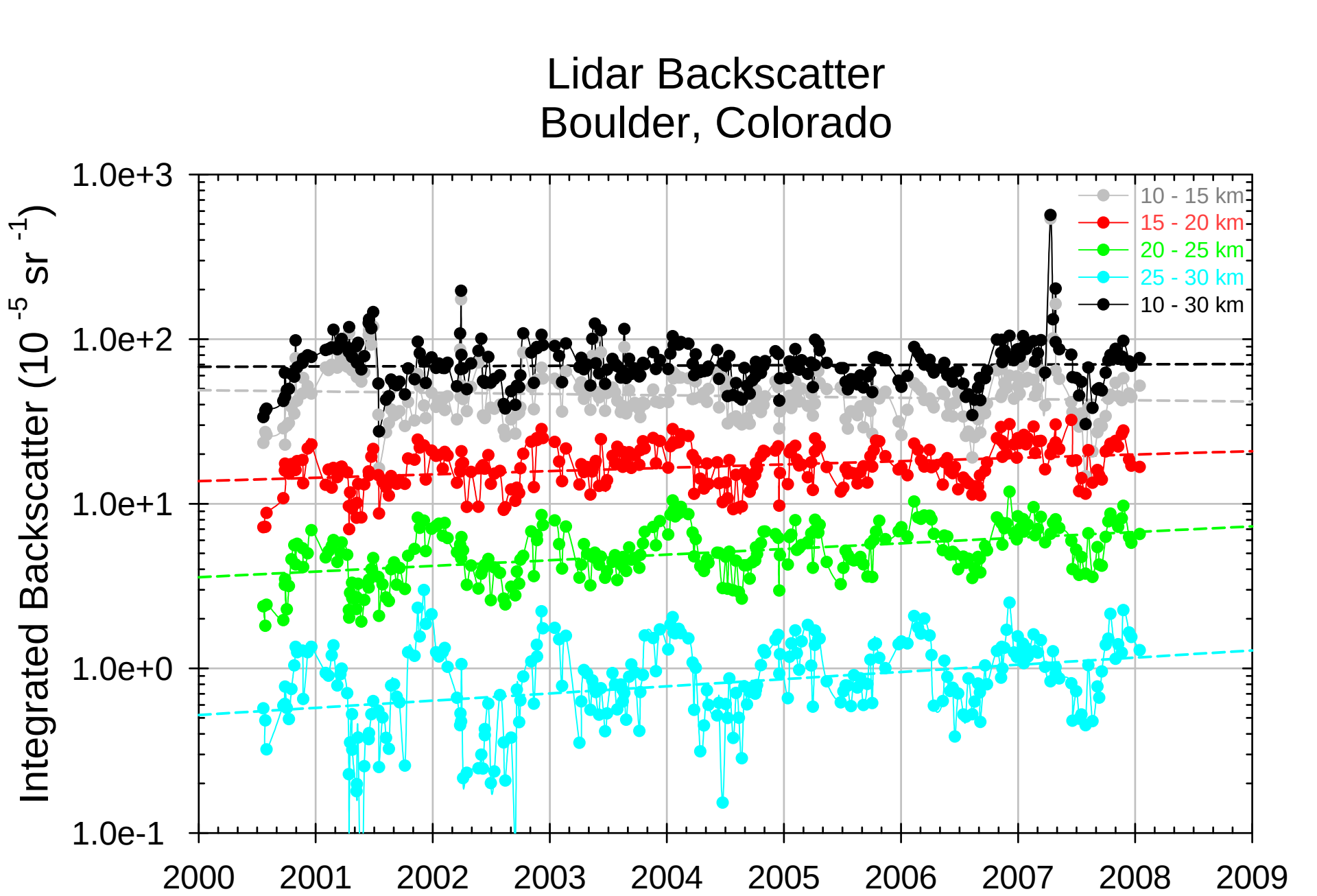
- Mauna Loa since the 1970's
- Boulder since 2000
- American Samoa since 2006

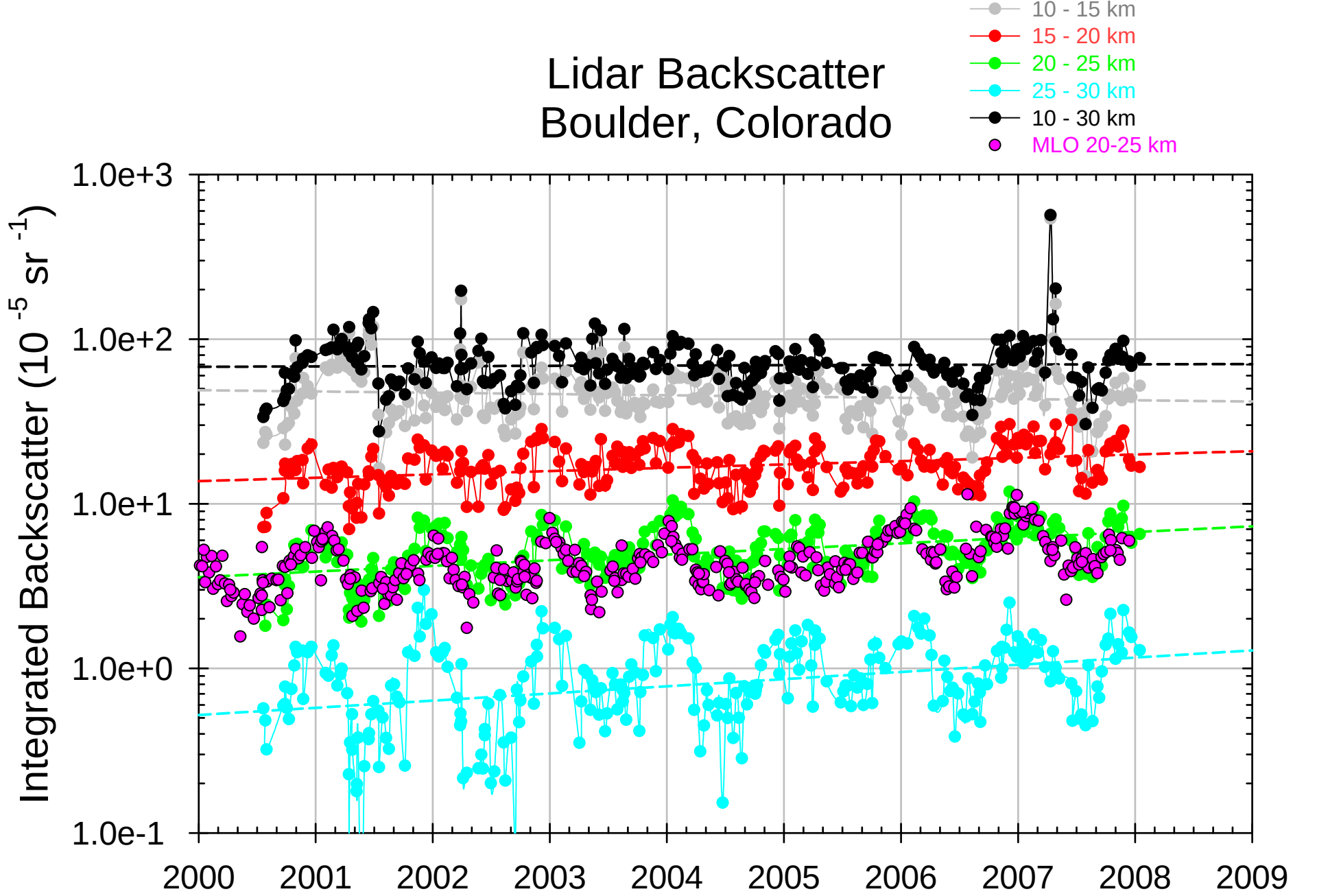


Mauna Loa Observatory Aerosol Lidar

(one of the longest records in existence)




Lidar Backscatter
Boulder, Colorado
Integrated Backscatter (10 -5 sr -1)
1.0e+3
1.0e+2
1.0e+1
1.0e+0
1.0e-1
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
10 - 15 km
15 - 20 km
20 - 25 km
25 - 30 km
10 - 30 km


Lidar Backscatter
Boulder, Colorado
10 - 15 km
15 - 20 km
20 - 25 km
25 - 30 km
10 - 30 km
MLO 20-25 km
Integrated Backscatter (10 -5 sr -1)
1.0e+3
1.0e+2
1.0e+1
1.0e+0
1.0e-1
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009

The Future

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

- A new realization of the importance of ozone depletion for climate changes has increased the visibility and importance of the research.

THANK YOU

NOAA staff walk 0.5 km from the main support facility to and from the Atmospheric Research Observatory in all types of weather, all year around. Six months of the year the walk is in darkness.