Twenty-five years of ozone soundings at South Pole:

An assessment of changing loss rates

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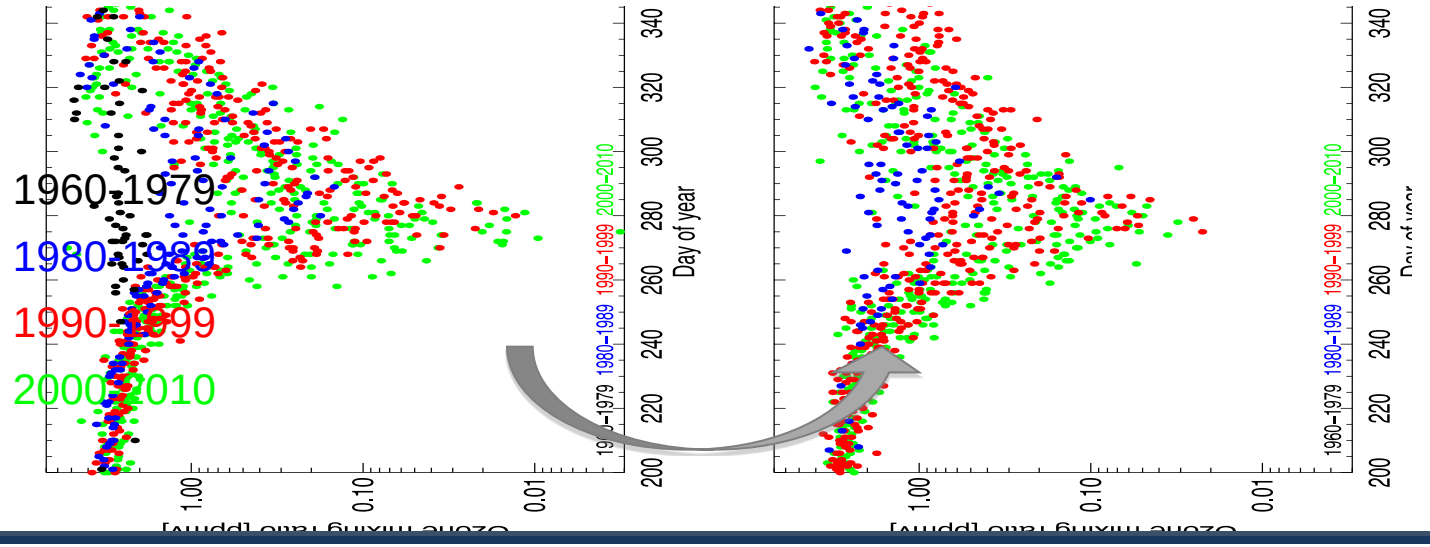
Introduction

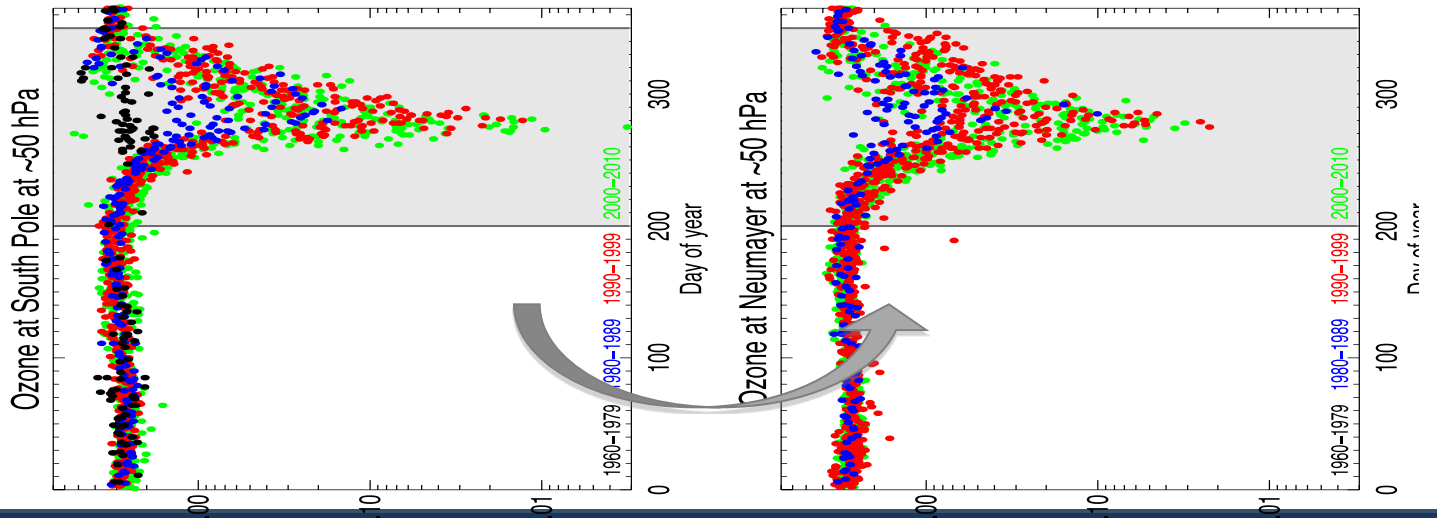
- Continue some of the work Dave Hofmann was doing
- 2010: 25 years of continuous ozone soundings at South Pole
- Update on ozone at South Pole measured with sondes: how does the last decade fit in the time series?
- How have ozone loss rates at South Pole changed over the last two and a half decades?
- When will ozone loss rates be measurably

South Pole ozone update I

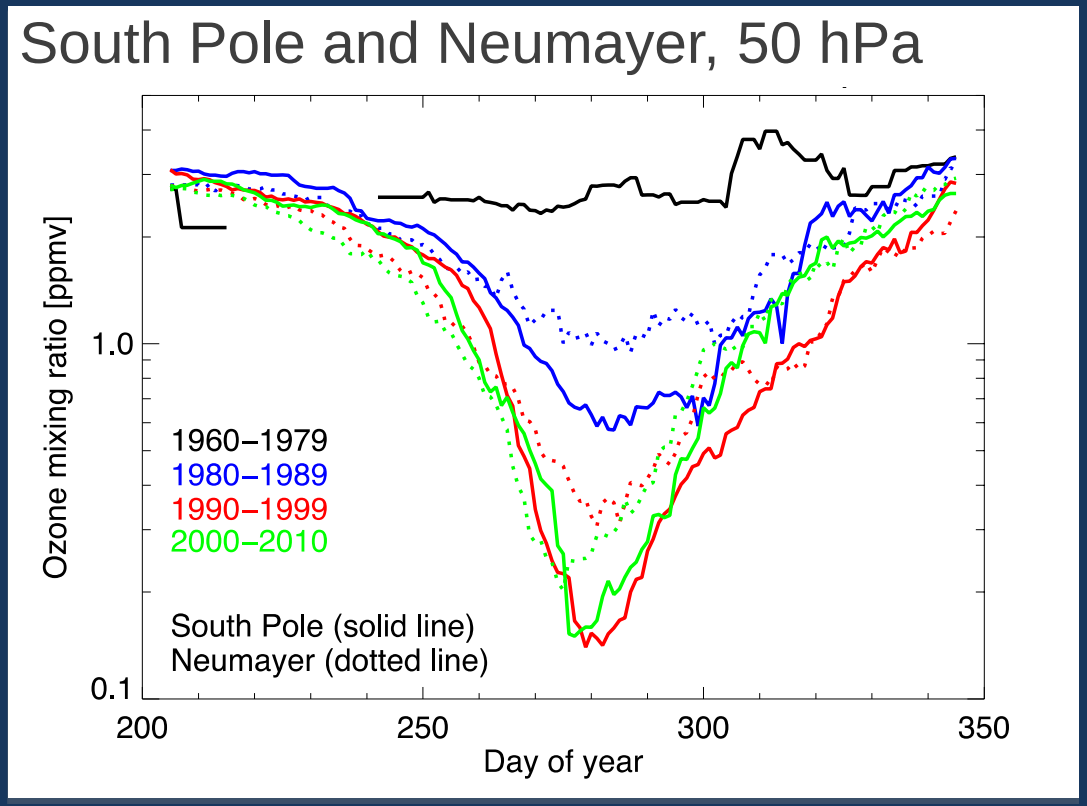
South Pole, 50 hPa



Neumayer, 50 hPa

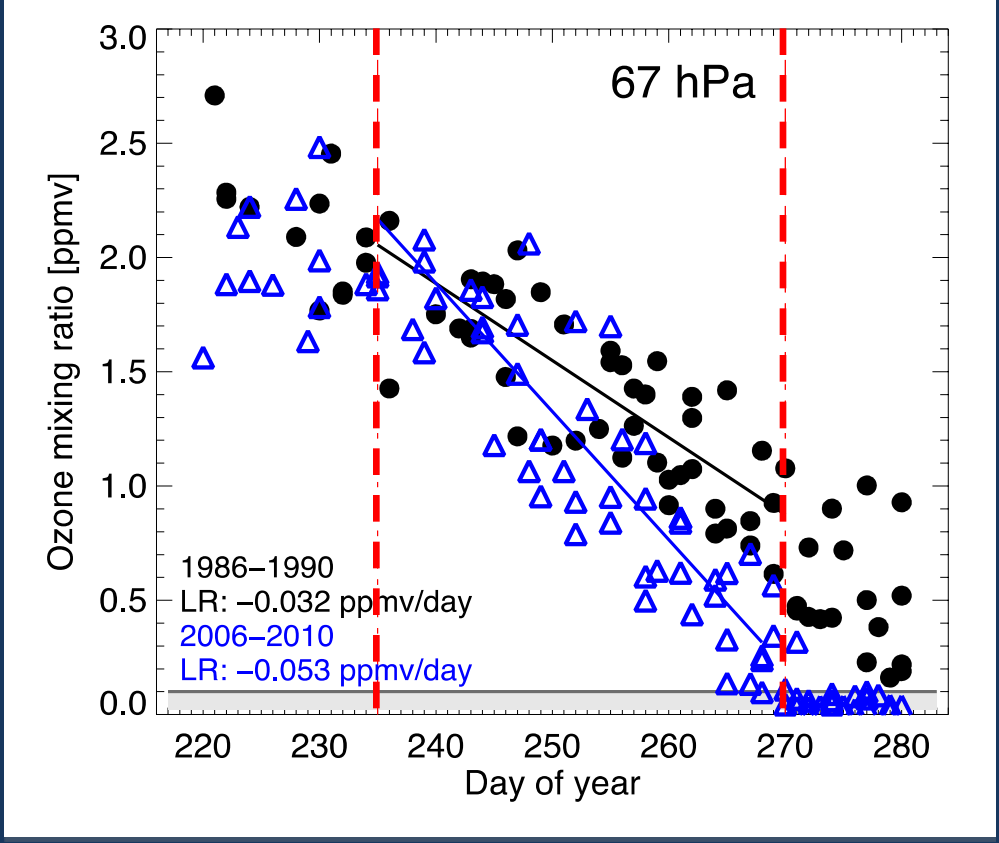


South Pole ozone update II



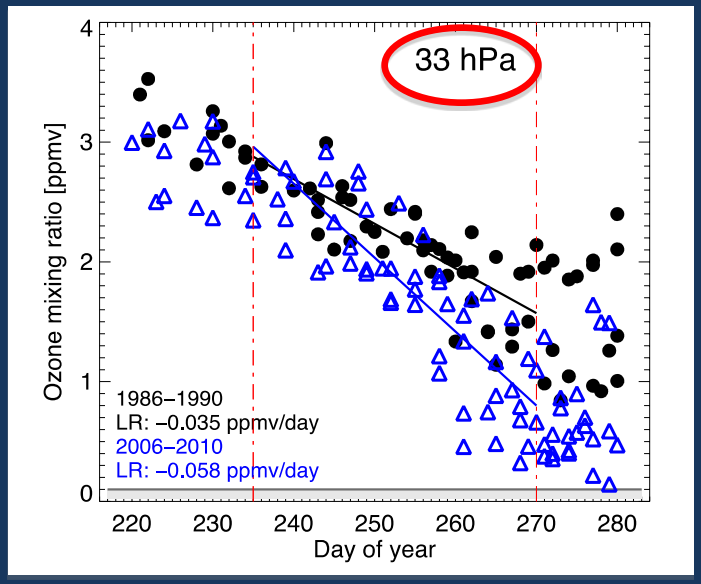
- 10-day sliding mean
- Neumayer coordinates: -70.65°S, 8.25°W
- No obvious decline of ozone depletion in most recent decade
- Onset of depletion earlier in more recent decades
- Stronger depletion in more recent decades
- Onset of depletion earlier at lower latitudes

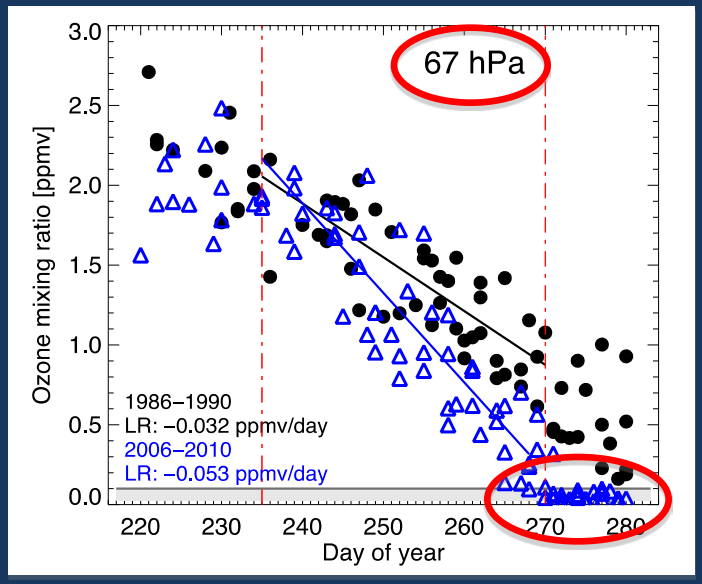
Describing South Pole ozone loss I

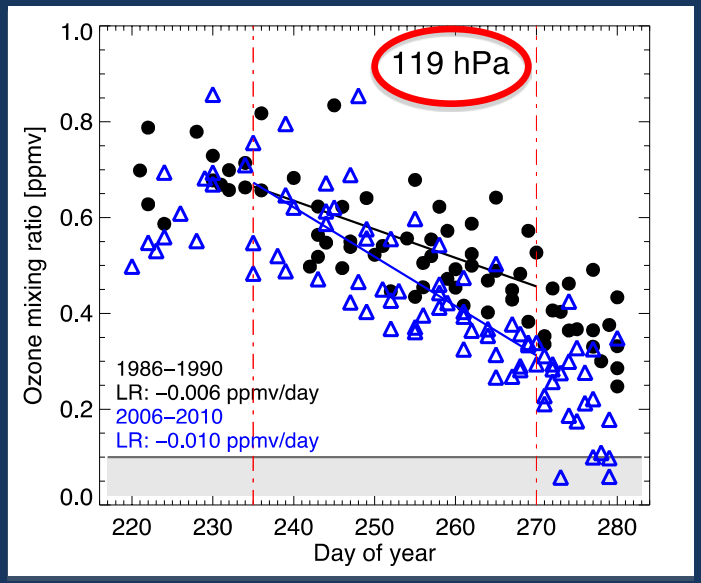


- 5-year periods
- Description of most rapid ozone loss
- Fixed start and end days (day 235 and day 270)
- Chosen because during that time ozone loss can be described by simple line
- Fit straight line => ozone loss rates obtained in unit ppmv/day
- Neglecting any dynamical influences (e.g. QBO, diabatic descent…)

Describing South Pole ozone loss II

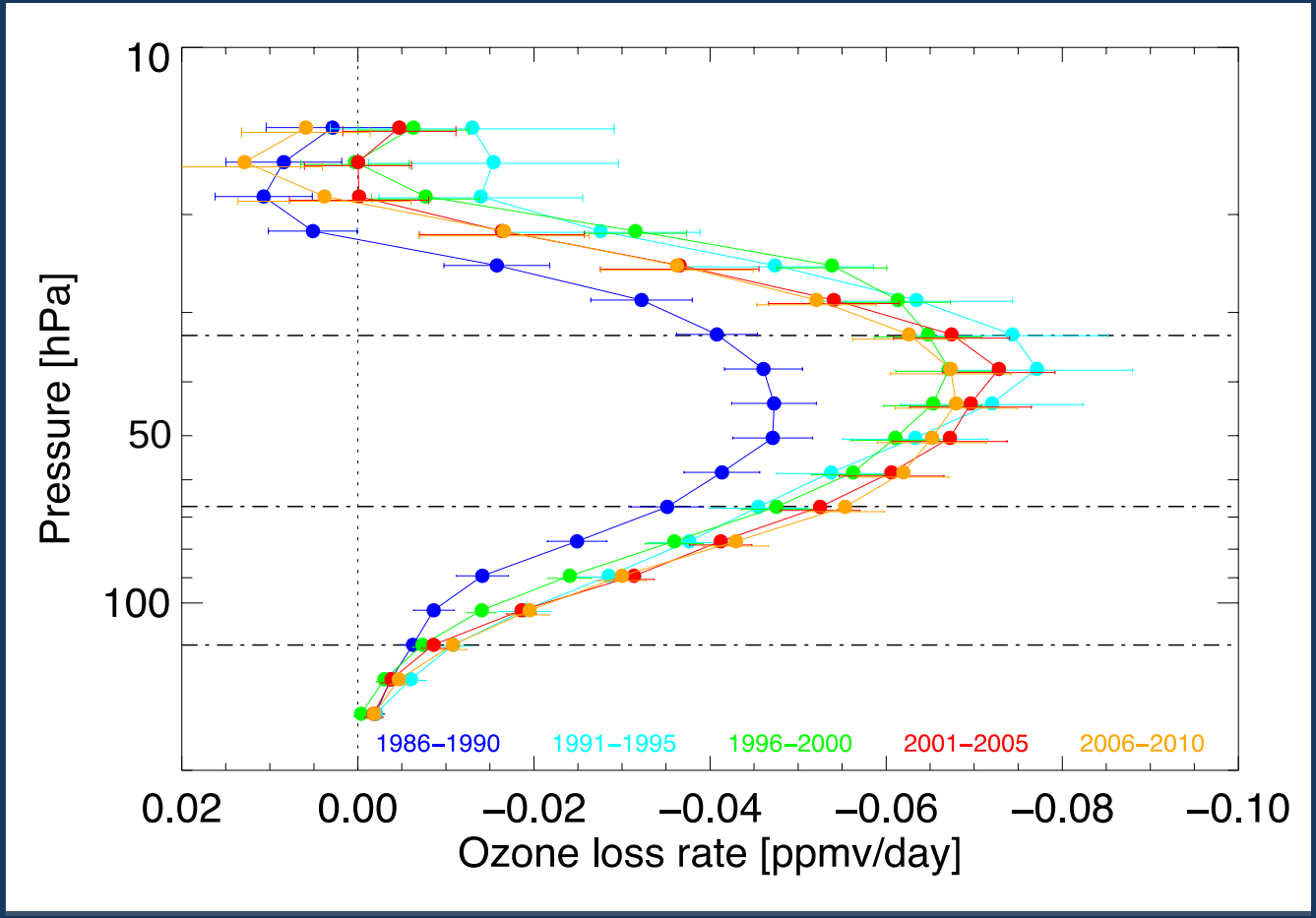






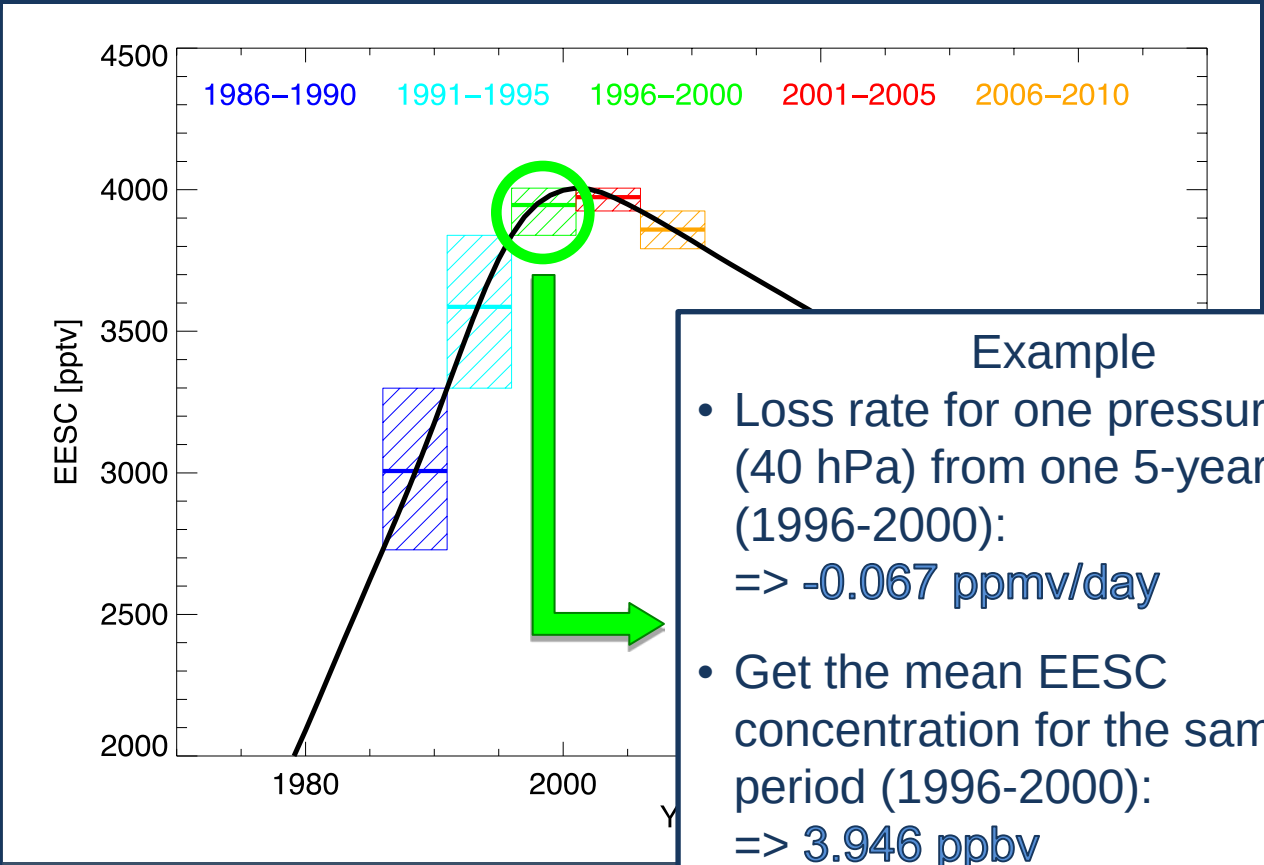
- Different loss rates at different pressure levels
- Faster ozone loss in most recent 5-year period compared with late 1980s
- Ozone loss saturation still reached in most recent 5-year period

South Pole ozone loss rates



- Highest loss rates between 60 hPa and 30 hPa
- Loss rates changed over the 25-year period
- Strong ozone depletion in early 1990s period => influence of Pinatubo eruption
- Most recent three periods comparable and within each

Normalizing ozone loss rates



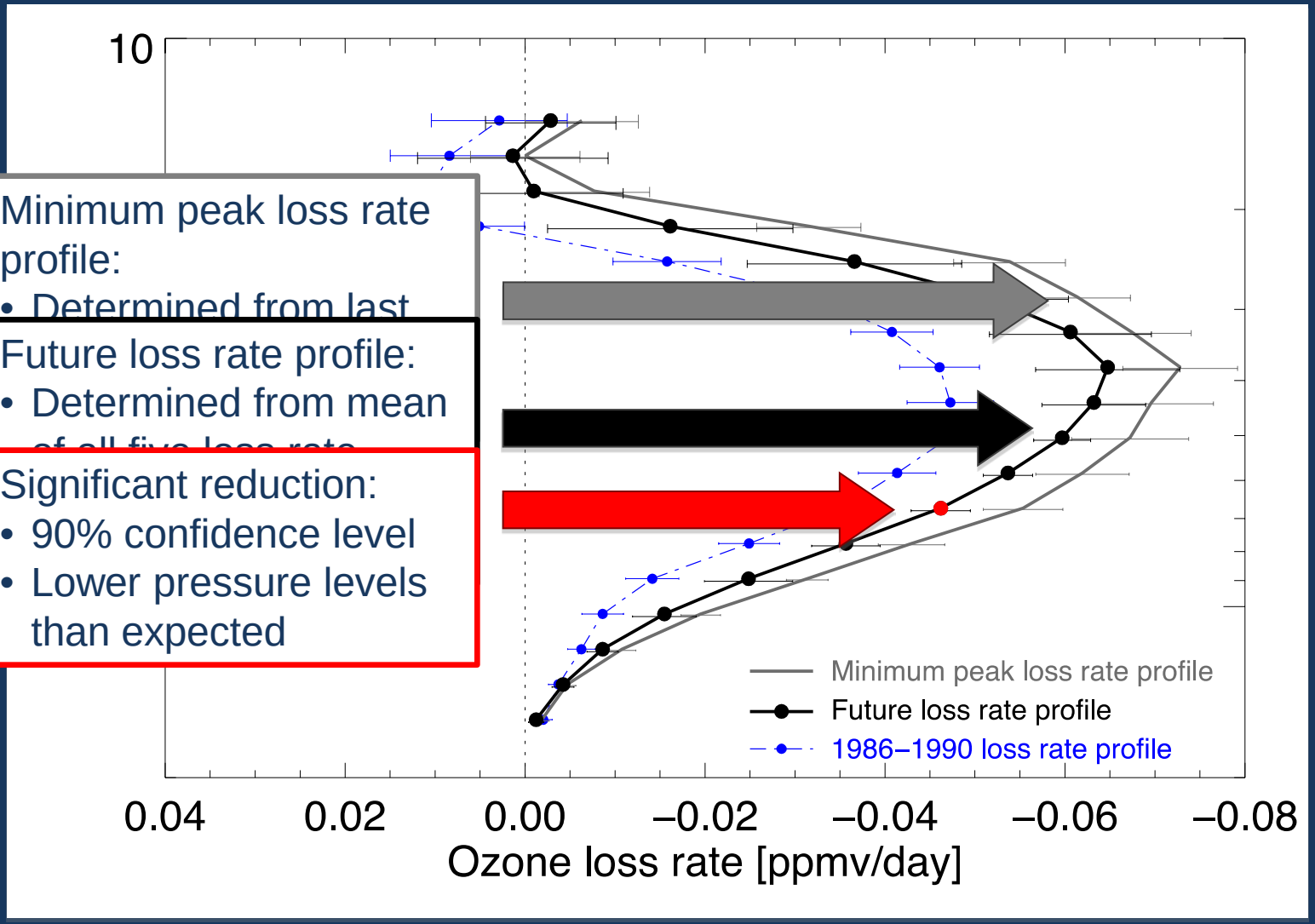
Example

- Loss rate for one pressure level (40 hPa) from one 5-year period (1996-2000):
  => **-0.067 ppmv/day**
- Get the mean EESC concentration for the same period (1996-2000):
  => **3.946 ppbv**
- Normalize the loss rate:

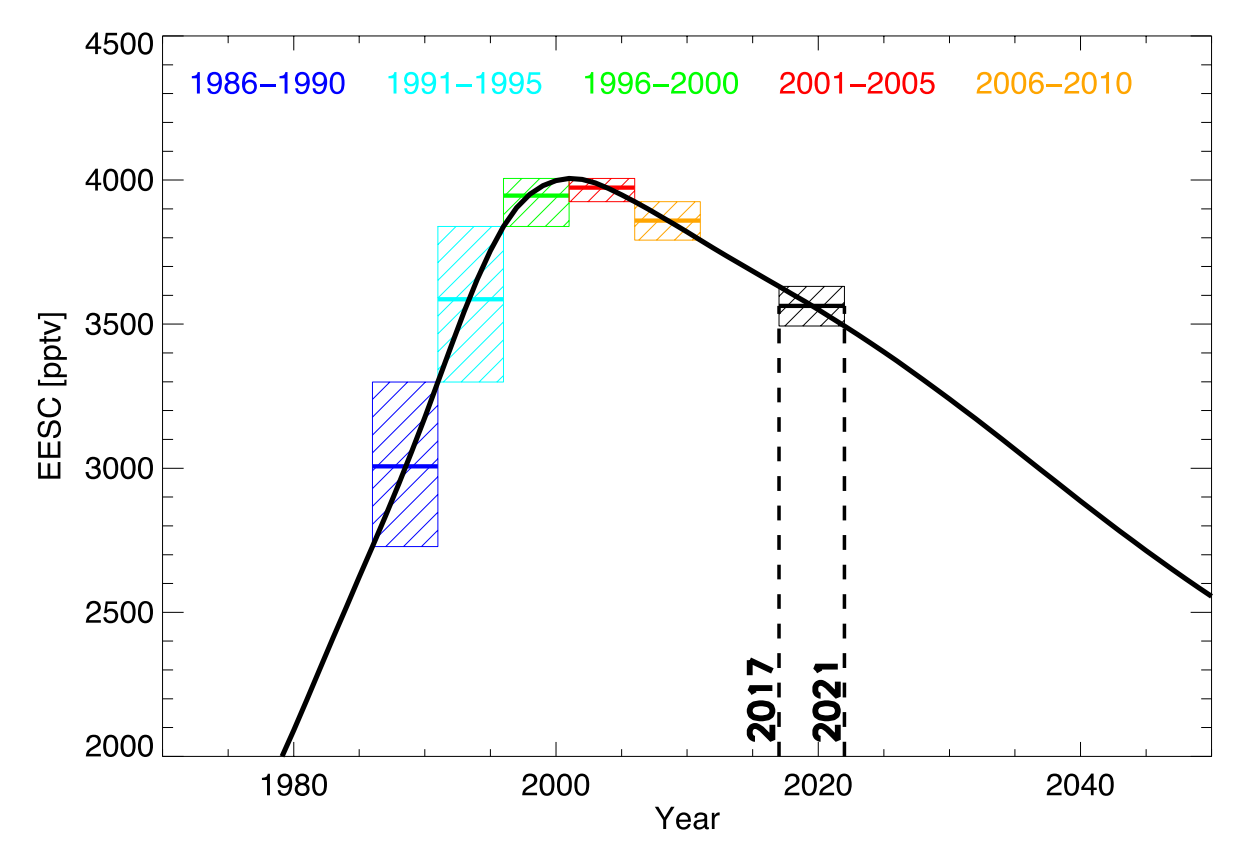
- Differences in ozone loss rate
  EESC concentrations
- Normalizing => divide loss rates by mean EESC for the respective 5-year period => unit (ppmv/day) / ppbv EESC

-0.017 (ppmv/day) / ppbv EESC

Estimating future loss rates



Reduced future loss rates



- Ozone loss rates are significantly lower (90% level) during the period 2017-2021 than now
- Result consistent with *Newman et al*., GRL, 2006 (appr. 2024) and *Vyushin et al*., JGR, 2007 (late in decade 2010-2020)
- Estimation of ozone values being low enough to be outside the natural variability

Summary and outlook

- **Unique** ozone time series for monitoring the evolution of ozone depletion
- Ozone loss at South Pole still **very strong** in spring
- **Changes** in ozone loss rates over the 25 years of observations
- If dynamics are **similar** to now, loss rates will be observably reduced in 2017-2021
- Method and result described in manuscript that is about to be submitted