

## Objectives and Method

- Quantification of chemical total ozone loss inside Vortex
- Comparison between modeled passive ozone and measurements

### MODELS

- 3D CTM
- initialized on December 1, 2011 from ECMWF ozone fields
- > REPROBUS (ECMWF, 1000 - 0.1 hPa)
- > SLIMCAT (ECMWF, 1000 - 0.3 hPa)

- 2 runs:
- a) Passive Ozone
  - b) Full chemistry

### MEASUREMENTS

- Total ozone => SAOZ/NDACC UV-Visible network
- Twice daily during twilight

## UV-Visible SAOZ

- Zenith sky UV-visible spectrometer
- Differential Optical Absorption Spectroscopy
- Ozone: Chappuis bands (450-550 nm)
- Consistency between stations: 3% (NDACC Intercomparisons)
- PSC days removed using a color index



## UV-Visible SAOZ network

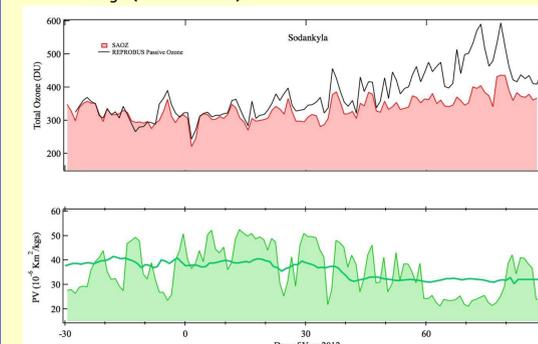


## TOTAL OZONE LOSS

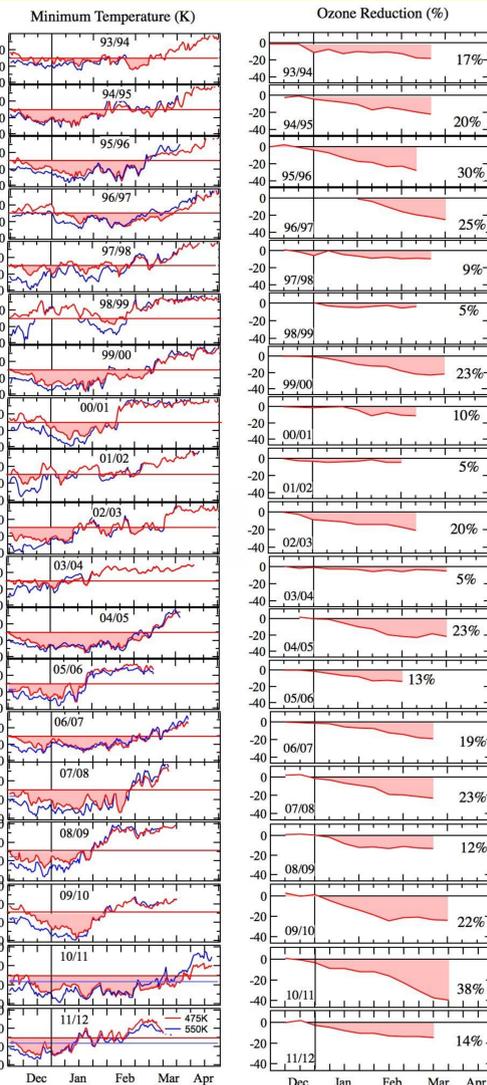
Example: Sodankyla (Finland)

- Top - Black: REPROBUS passive O3
- Pink: SAOZ O3 columns

Bottom - PV at 475 K from Mimosa contour advection model and vortex edge (Nash criteria)

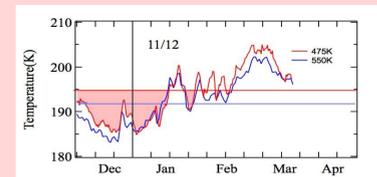


## Comparison to Previous Winters



## METEOROLOGY

Cold Temperatures from Early-December to mid-January

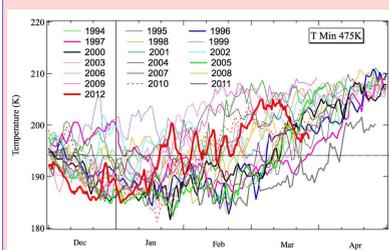


Temperatures below TNAT formation in December until January 20.

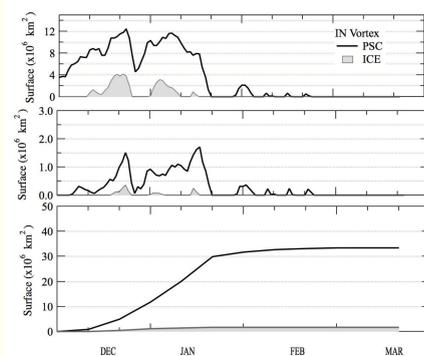
Minor warmings in end of January, early and mid-February.

Major warming at the end of February.

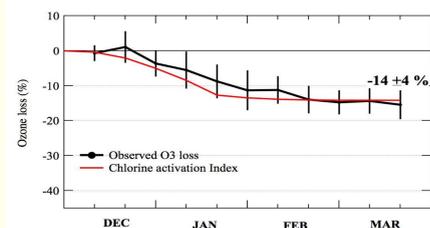
One of the coldest winter in December



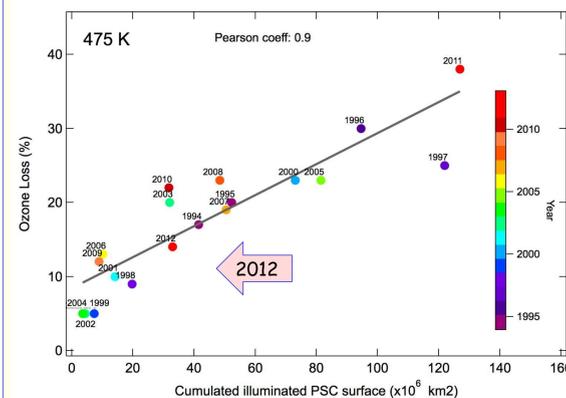
## CHLORINE ACTIVATION INDEX



Top: PSC Surface at 475K  
Middle: Sunlit PSC surface at 475K  
Bottom: Cumulated sunlit PSC surface = 1/Chlorine Activation Index

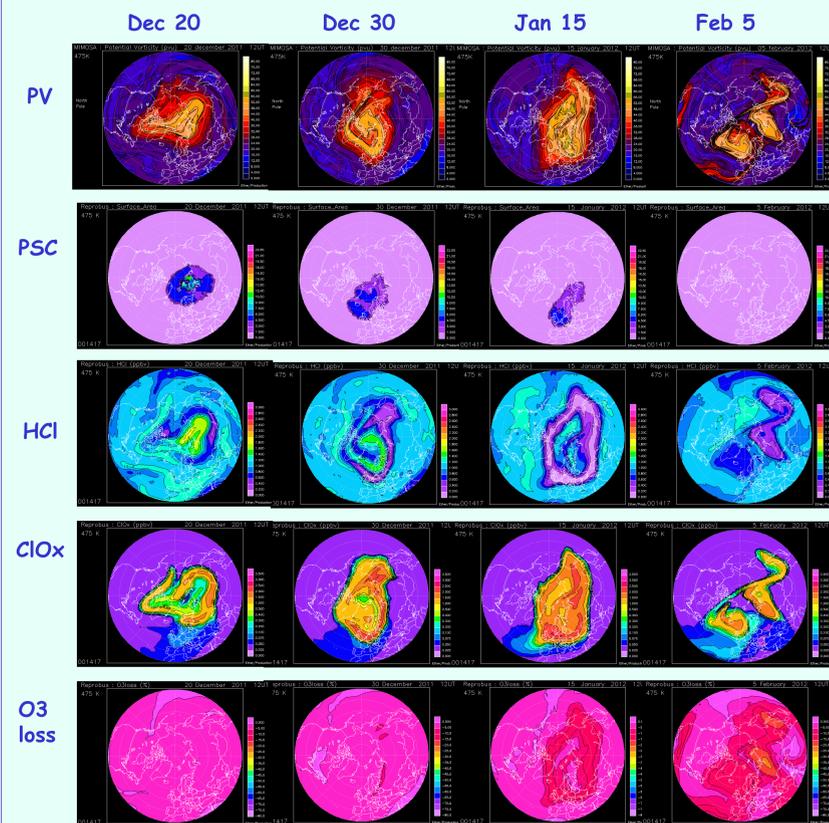


Comparison between cumulated sunlit PSC surface and O3 loss in 2012



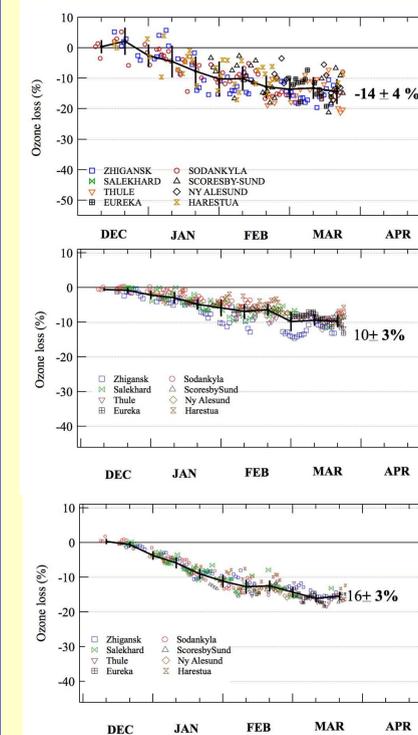
Consistent correlation between cumulated sunlit PSC surface and O3 loss, but  
i) larger loss on cold highly denitrified years (1996, 2003, 2008, 2007, 2010 and 2011)  
ii) significant depletion even in the absence of PSC (1998, 1999, 2001, 2002, 2004, 2006, 2009) due to gas phase NOx chemistry

## REPROBUS 3D CTM SIMULATION (475 K) AND MIMOSA PV FIELDS



Chlorine activation in December    Vortex fully activated    Ozone loss at vortex edge    Vortex split

## All stations



Observed: SAOZ

Simulated: REPROBUS

Simulated: SLIMCAT

Observed

Simulated

- Total ozone reduction in Vortex: 14% ± 4% or ~ 60 DU
- Loss rate -0.35% per day between end of December and early February

- REPROBUS: 10% or ~ 50 DU

- SLIMCAT: 16% or ~ 70 DU

**Conclusion 2012: record cooling in December, early ozone loss in late December but limited total depletion because of early warming in mid-January. Early loss slower in REPROBUS and faster in SLIMCAT**

## Acknowledgements

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Warm winters - very limited loss 5 - 10%  
- limited loss 10-20%  
1998, 1999, 2001, 2002, 2004  
2006, 2009, 2012

Cold winters - large loss 20%- 30%  
1995, 1996, 1997, 2000, 2003, 2005, 2007, 2008, 2010  
- Record loss 38% in 2011