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## Ozone loss In the Arctic winter 2014/2015

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## Objectives and Method

Quantification of chemical total ozone loss inside Vortex by comparison between modeled passive ozone and measurements

### MODELS

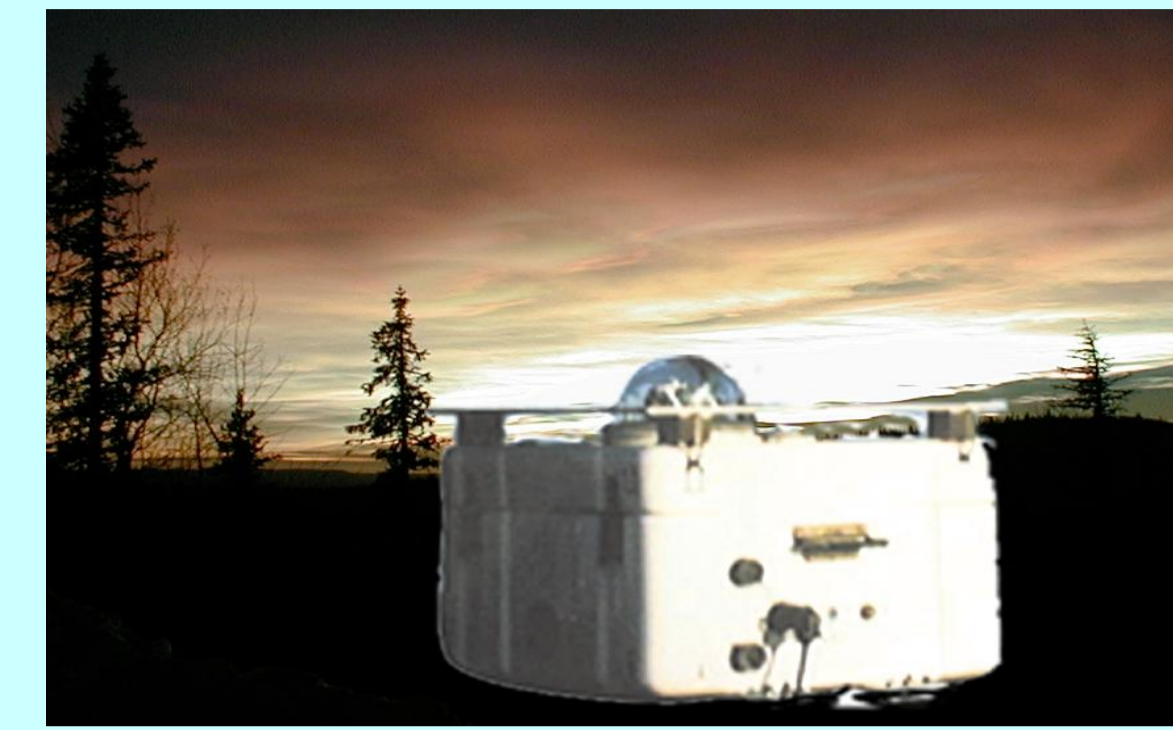
3D CTM  
 initialized on December 1, 2014 from ECMWF ozone fields  
 => REPROBUS (ECMWF, 1000 - 0.1 hPa)  
 => SLIMCAT (ECMWF, 1000 - 0.3 hPa)

2 runs:  
 a) Passive Ozone  
 b) Full chemistry

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

## UV-Visible SAOZ

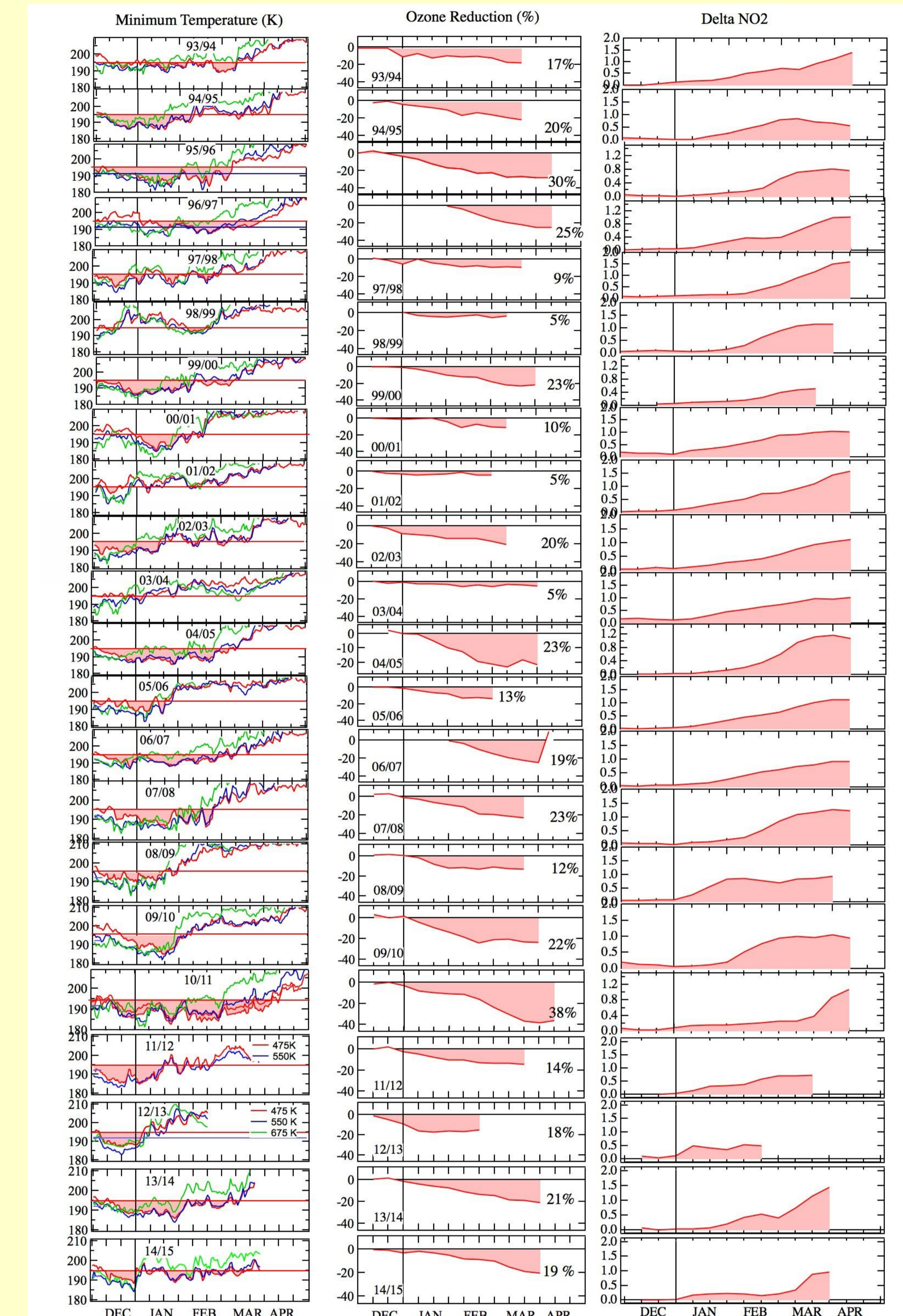
- Zenith sky UV-visible spectrometer
- Differential Optical Absorption Spectroscopy
- Ozone: Chappuis bands (450-550 nm)
- Consistency between stations: 3% (NDACC Intercomparisons)
- PSC days removed using a color index



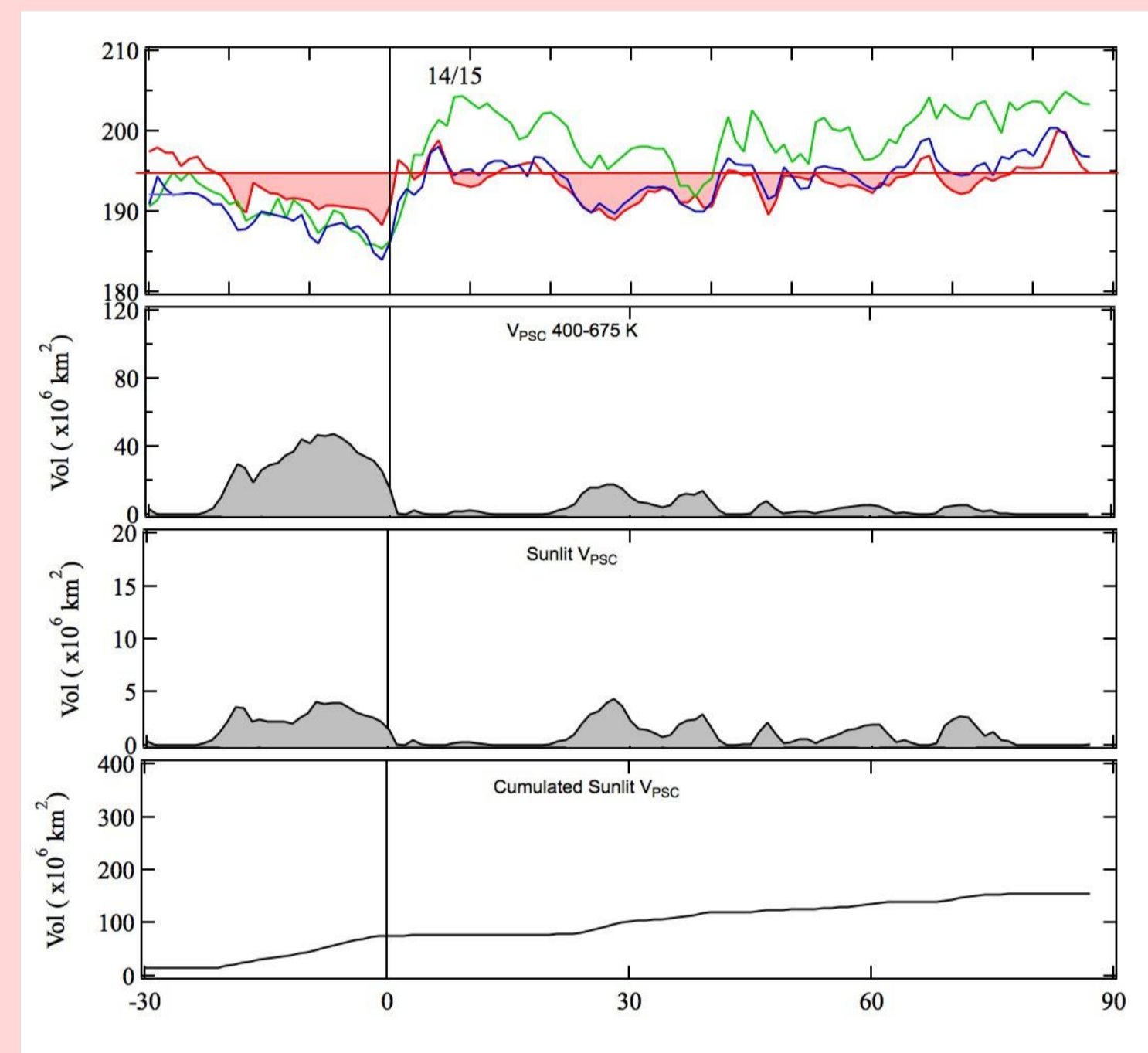
## UV-Visible SAOZ network



## 5- COMPARISON TO PREVIOUS WINTERS

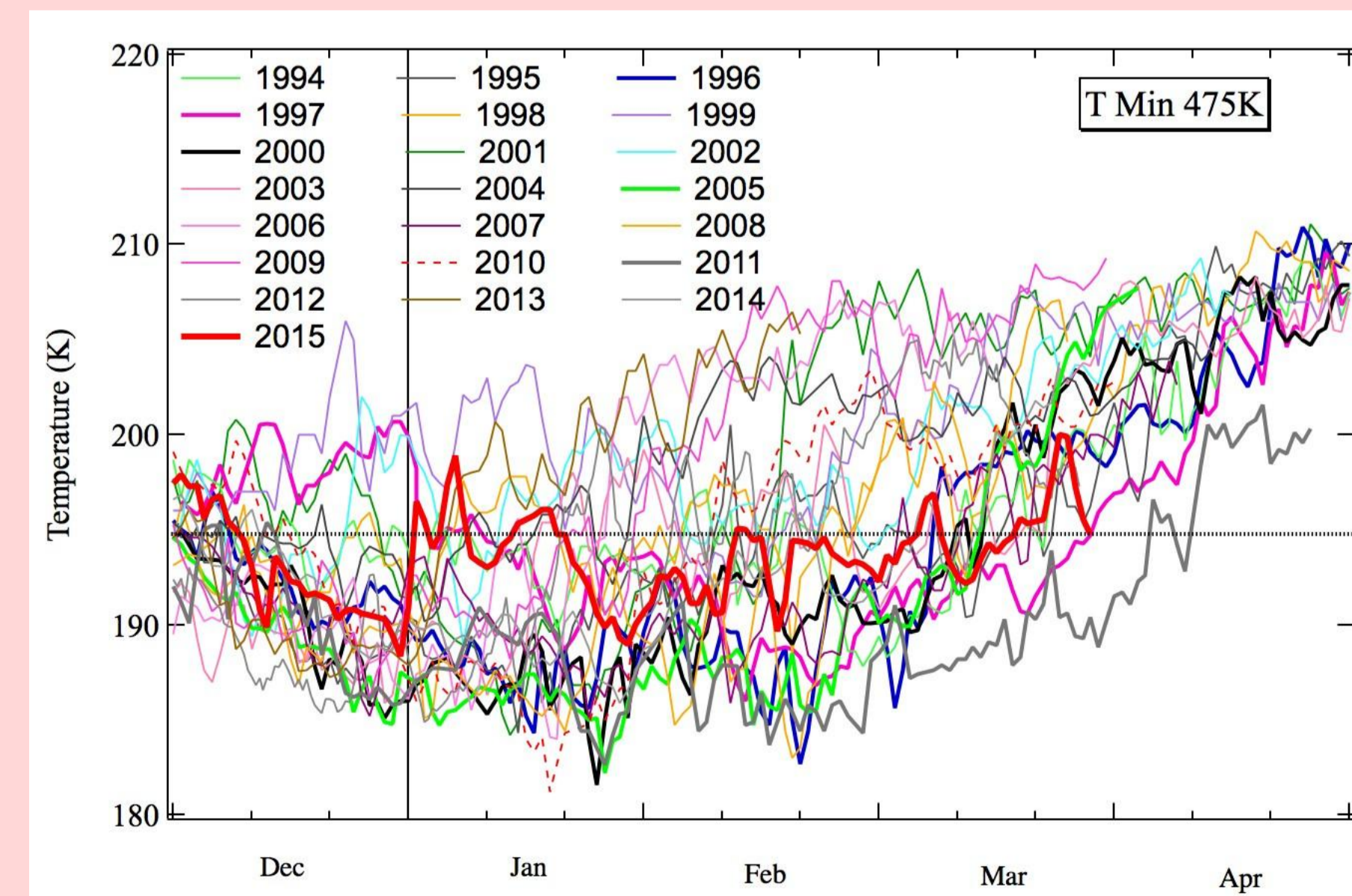


## 1- METEOROLOGY



- T < T<sub>nat</sub> from Dec 10 to Dec 31 at 475K and 550K
- Large sunlit V<sub>PSC</sub> from Dec 10 to Dec 31
- Sporadic cooling below T<sub>nat</sub> and V<sub>PSC</sub> in Jan-Mar until March 20

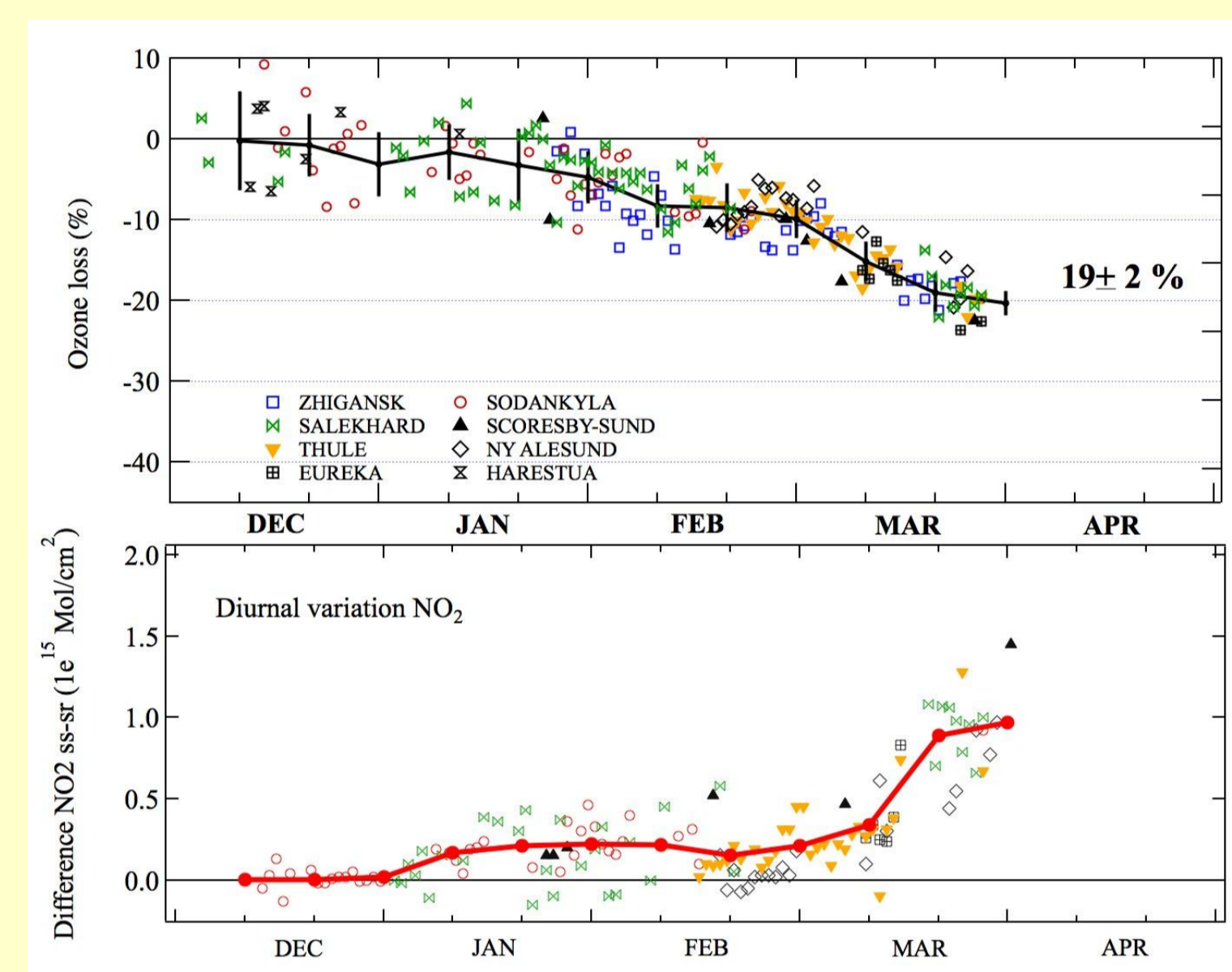
### Comparison to previous winters



- Sudden warming on Jan 1 followed by progressive cooling
- Cold period in March compared to other winters
- Final warming after March 20

## 2- SAOZ OBSERVATIONS

### Ozone loss and denitrification

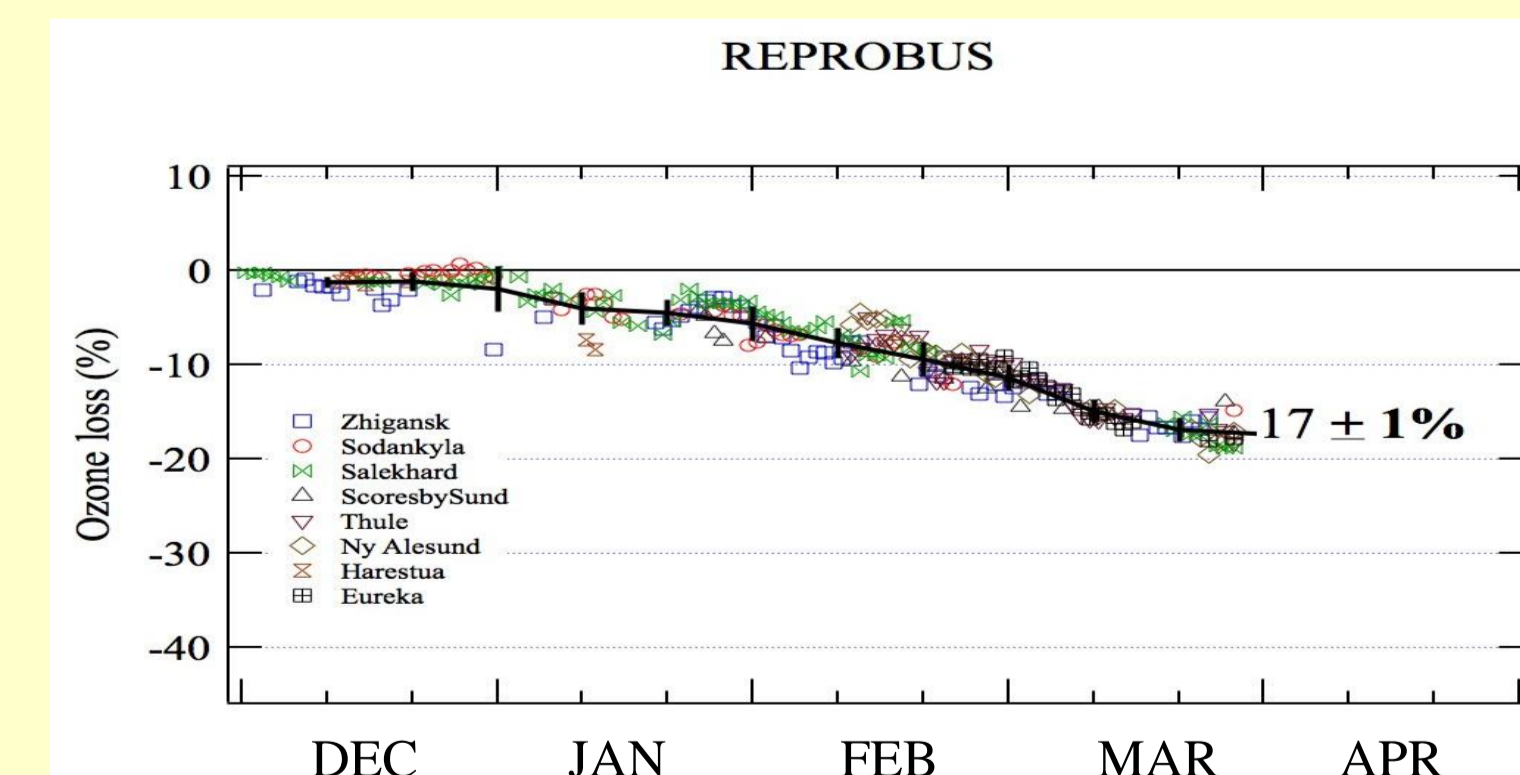


Top  
 -Evolution of ozone loss above SAOZ stations inside vortex

Bottom  
 Difference between sunset and sunrise NO<sub>2</sub> columns inside vortex

- Small ozone depletion rate of 0.3% / day between Jan 10 and Feb 10
- Stopped between Feb 10 and Feb 28
- Restarted to 0.5% / day between Mar 1-March 20
- Stopped on March 20
- NO<sub>2</sub> diurnal increase and chlorine deactivation after March 10
- Total cumulated loss of 19 ± 2% close to Arctic Spring average

## 4- MODEL LOSS ABOVE SAOZ STATIONS



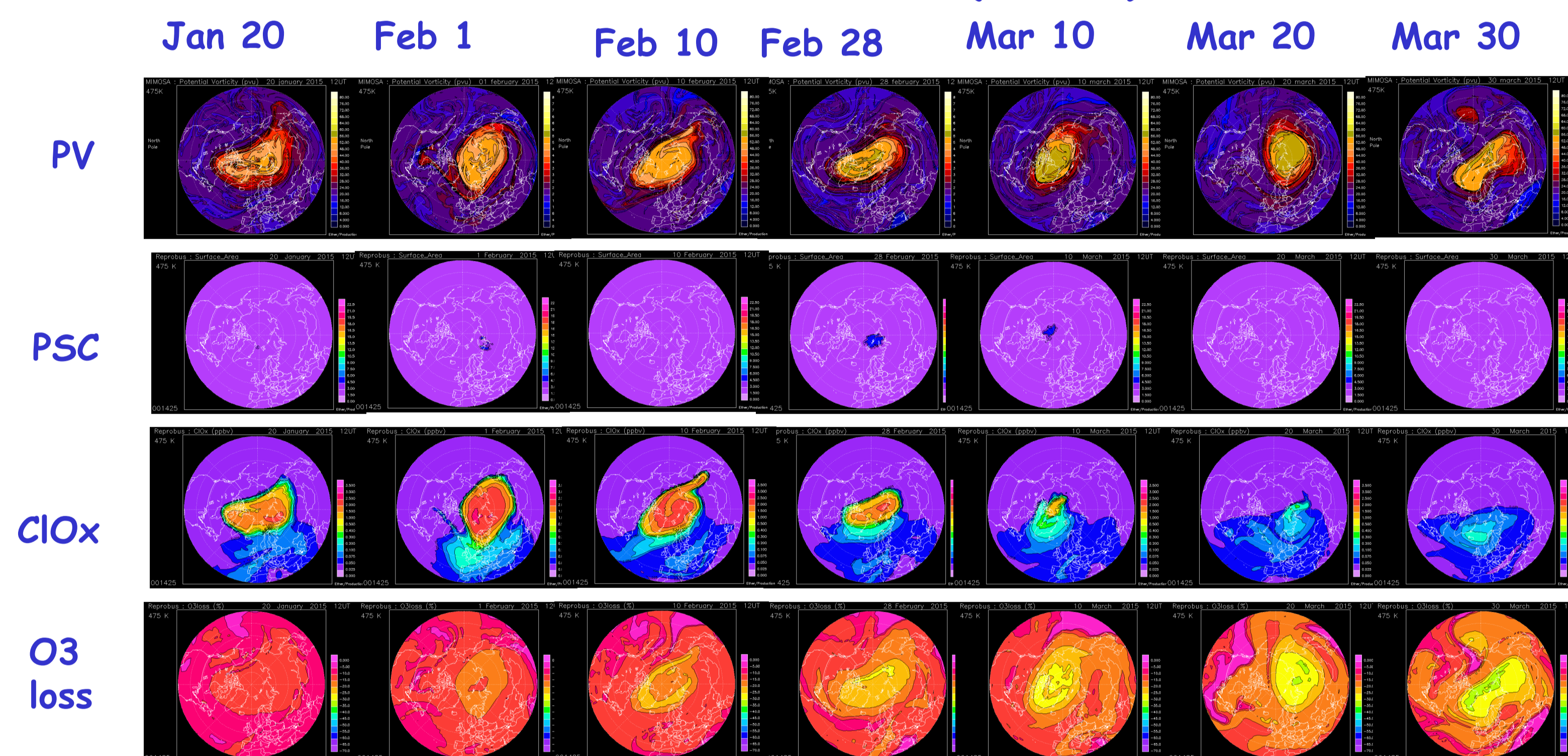
REPROBUS: 17% ~ 89 DU

REPROBUS timing:  
 ♦ 0.15%/ day from Jan 1 up to March 1  
 ♦ 0.5%/day from March 1 up to March 15  
 ♦ Stopped on March 20

### Acknowledgements

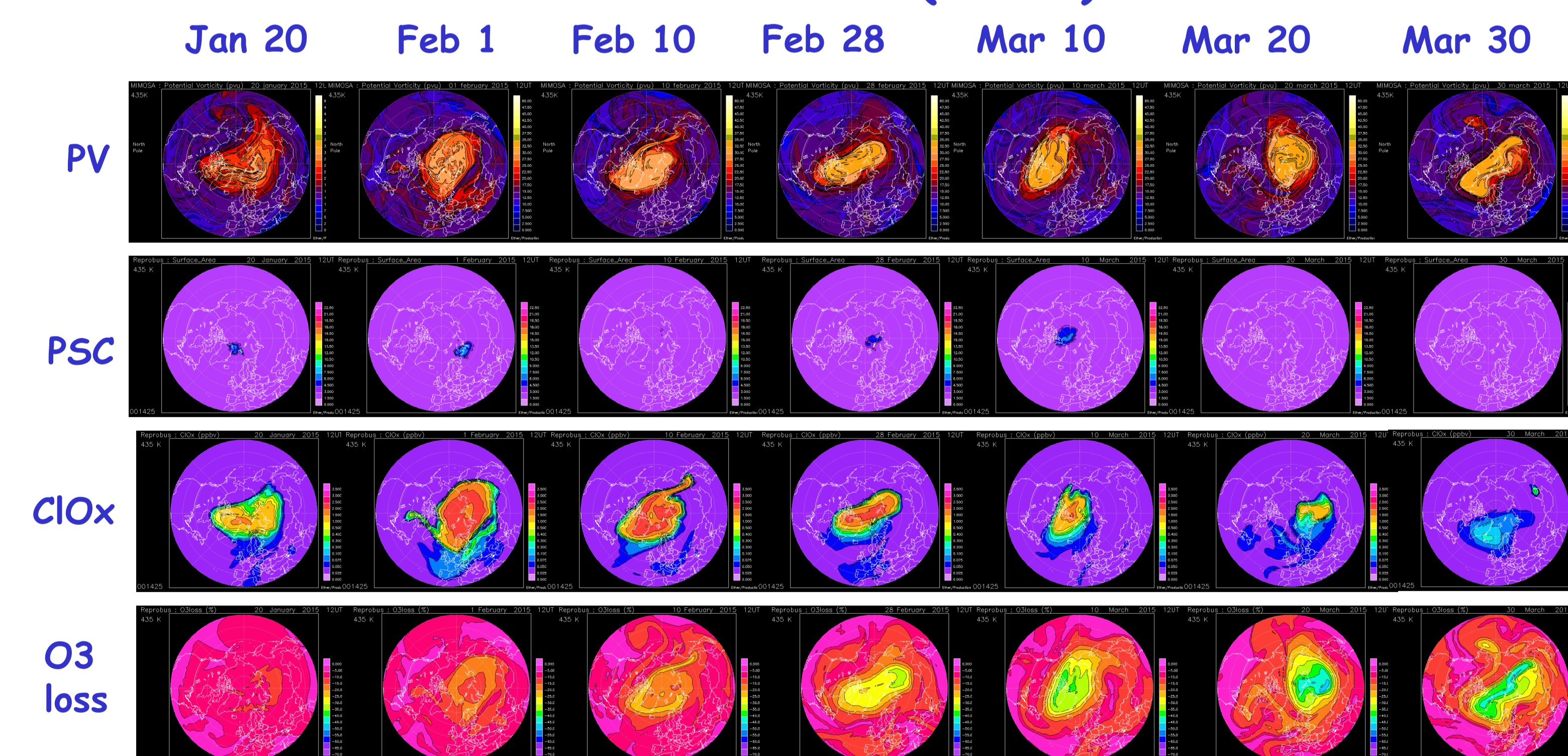
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- This work was supported by the French CNES and CNRS/INSU within the NDACC/OVSQ
- The SAOZ network is part of NDACC (Network for Detection of Atmospheric Composition Change).
- The authors thank gratefully C. Boone at the Centre for Atmospheric Chemistry Products and Services "ETHER" for providing MIMOSA and REPROBUS maps and data above SAOZ.
- The authors thank Vera Sitnikova and the Russian CAO/Roshydromet ozone network for providing Zhigansk and Salekhard Mini-SAOZ data

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

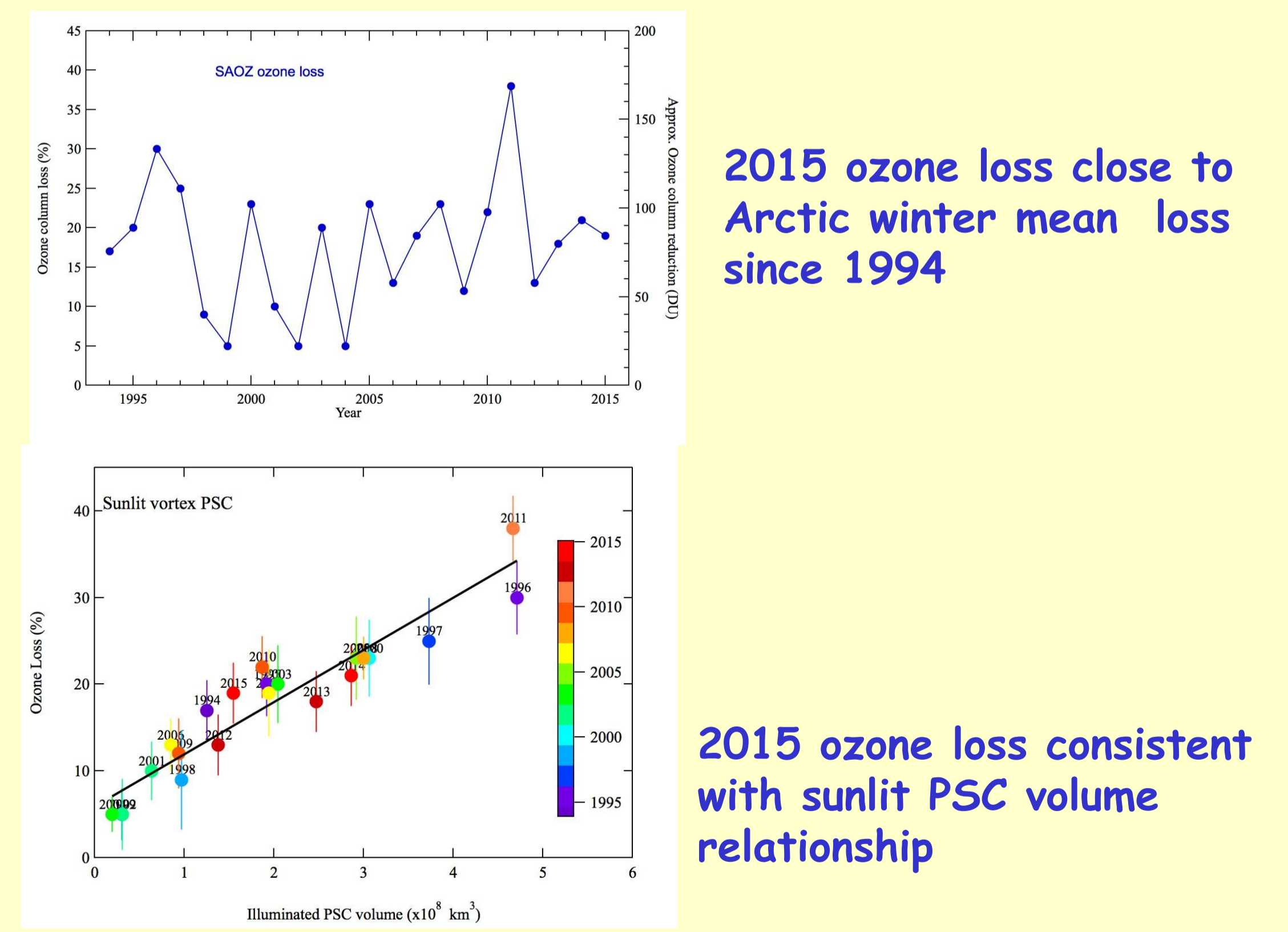


- Small size vortex centered at the North Pole until late March
- Few PSC only in early and late Feb at the Pole
- Chlorine activated until mid- Feb, deactivating progressively
- Ozone loss start in early Feb only, propagating until end of March

## SIMULATION (435 K)



- Much more PSC, chlorine activation and ozone loss up to 50% at lower altitude at 435 K in late illuminated vortex in March



2015 ozone loss close to Arctic winter mean loss since 1994

2015 ozone loss consistent with sunlit PSC volume relationship

## CONCLUSION WINTER 2014/2015:

- Long lasting vortex
- Total ozone loss of 19% close to average depletion in the Arctic
- 19% loss due to vortex duration until March 20
- Less de-activation at lower altitude (435 K)
- Maximum destruction at lower altitude (435 K) than usual (475-550 K)