# Total Ozone Loss during the 2008/2009 Arctic Winter and Comparison to Previous Years.

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## Objectives and Method

- To quantify the chemical ozone loss inside Vortex
- Comparison between modeled passive ozone and measurements

MODEL
- 3D CTM
  *initialized on December 1, 2008 from ECMWF ozone fields*
  => REPROBUS (ECMWF, 1000 - 0.1 hPa)
  => SLIMCAT (ECMWF, 1000 - 0.3 hPa)

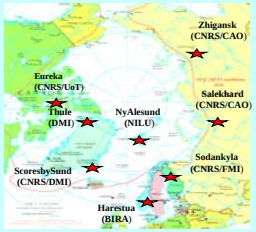
2 runs: a) Passive Ozone
b) Full chemistry

MEASUREMENTS
- Total ozone => SAOZ UV-Visible network - Twice daily

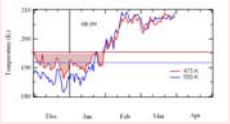
## UV-Visible SAOZ

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

## UV-Visible SAOZ network




## METEOROLOGY

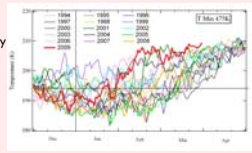


Cold Temperatures from December to end of January.

- Temperatures < 194 K from December 1, 2008
- Minor warming at Mid- January
- Final warming end of January 2009

### Warm winter in the decade

- Low temperatures during December and early January
- Compared to previous winters the final warming occurred earlier this year, around January 30.



### Conclusion

-Low temperatures <194K for the formation of Polar stratospheric clouds (**PSC**) only during limited period.
-On the PSC surface, **chemical reactions** occur which transform passive and innocuous halogen compounds (e.g. HCl and HBr) into **active chlorine** and bromine (e.g. ClO and BrO).
-Under sunlit conditions, these active species react with ozone through **catalytic cycles** which cause rapid **ozone destruction.**
- This processes were only possible **during January, 2009** when the cold areas received sunlight.

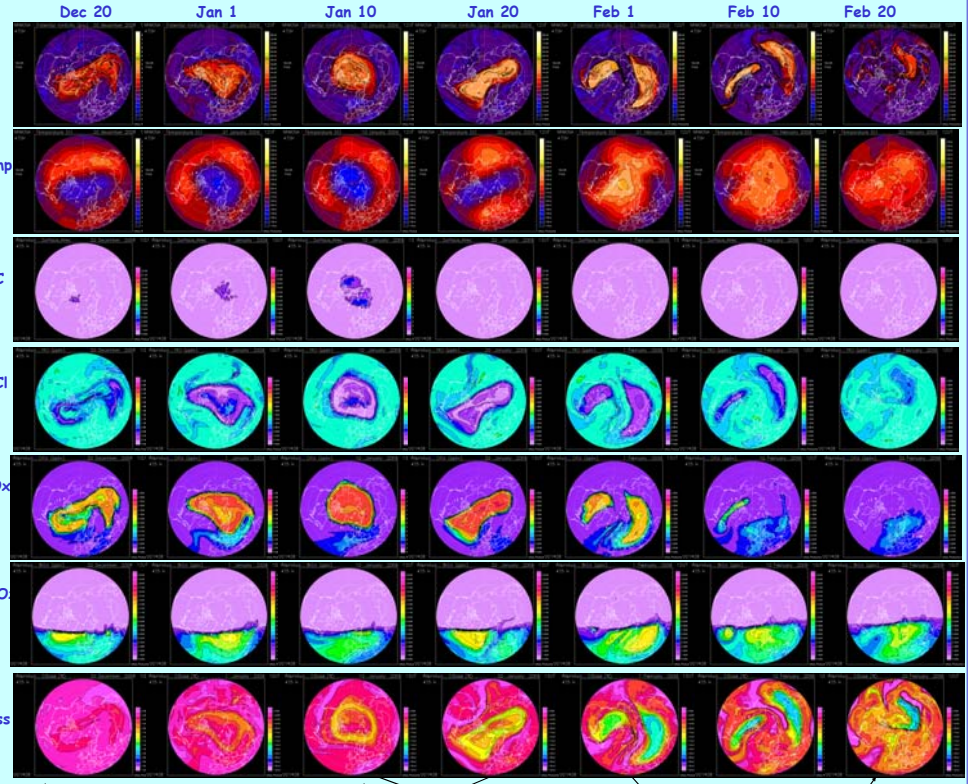
## Conclusions (at 475 K)

- The vortex was formed in early December 2008 and centered around the pole until mid- January.
- Then, it was elongated around Jan 20 and displaced to sunlit regions.
- The vortex spilt into two bulbs around Feb 1.

- Limited PSC surface from end of December towards Mid-January, linked to low temperatures.

- January 10, REPROBUS is simulating low HCl and high ClOx inside the vortex. However, limited O3 loss restricted to sunlit regions only.
-January 20, O3 loss reachng 16% at the vortex periphery.
- On February 1, after split of vortex in two bulbs, 18% O3 loss simulated increasing locally to 20% around Feb 20..

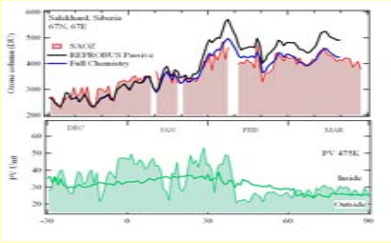
## REPROBUS 3D CTM SIMULATION (475 K) – MIMOSA PV FIELDS



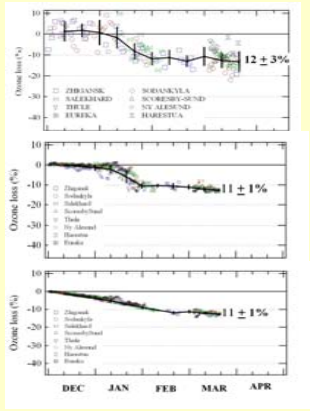

## MEASUREMENTS

### Ozone above SAOZ stations

At Salekhard station (Western Siberia):
- A difference between SAOZ O3 columns (pink) and passive O3 from REPROBUS (black) is observed at the end of January.
- At the beginning of February, Salekhard is inside vortex (PV > pv limit) the difference is ~60 DU



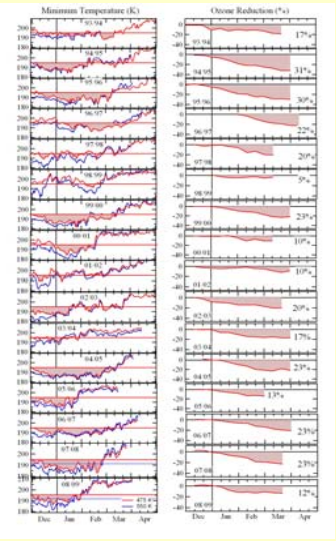
### O3 Loss in 2008/2009



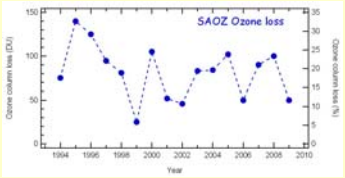

**Conclusion:**
- Small ozone loss in Vortex in winter 2008/2008
- According to SAOZ (using Passive ozone from REPROBUS), most of the loss occurred between Jan. 10 and Jan. 30 at a rate of 0.5% per day leading to a cumulative loss of 12% ± 3%. After that date the loss stopped.

- **REPROBUS:** Loss rate of 0.5% between January 10 and 30. Cumulative loss 11% on Feb. 1.
- **SLIMCAT:** Smaller loss rate of 0.15% between mid-Dec. and Feb. 20 but similar cumulative loss of 11 % on Feb. 1 .

### Comparison to Previous Winters



**Conclusion:**
- Limited O3 loss occurred during the winter 08/09.
- The temperature was below that's of PSC formation during a small period starting on December 1, until end of January.
- At the end of the period, around February 1, observed cumulative loss was **12 %.**
- This is similar to what was observed in 98/99, 00/01, 01/02 and 05/06 winters

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