Total Ozone Loss during the 2007/2008 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, 2007 from ECMWF ozone fields
  => REPROBUS (ECMWF, 1000 - 0.1 hPa)
  => SLIMCAT (ECMWF, 1000 - 0.3 hPa)

2 runs: a) Passive Ozone
b) Full chemistry

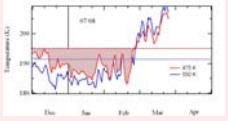
MEASUREMENTS
- Total ozone => SAOZ UV-Visible network - Twice daily

UV-Visible SAOZ

- Zenith sky visible spectrometer.
- Differential Optical Absorption Spectroscopy
- Ozone: Chappuis bands (450-630nm)
- Consistency between stations: 3% (NDSC Intercomparisons)
- PSC days removed using a color index

UV-Visible SAOZ network

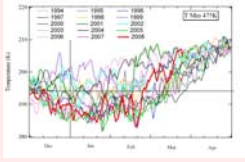
METEOROLOGY



Cold Temperatures from December to end of February.

- Temperatures < 194 K from December 1, 2007
- Minor warming at the end of January and in February
- Final warming around February 25, 2008

Cold winter in the decade

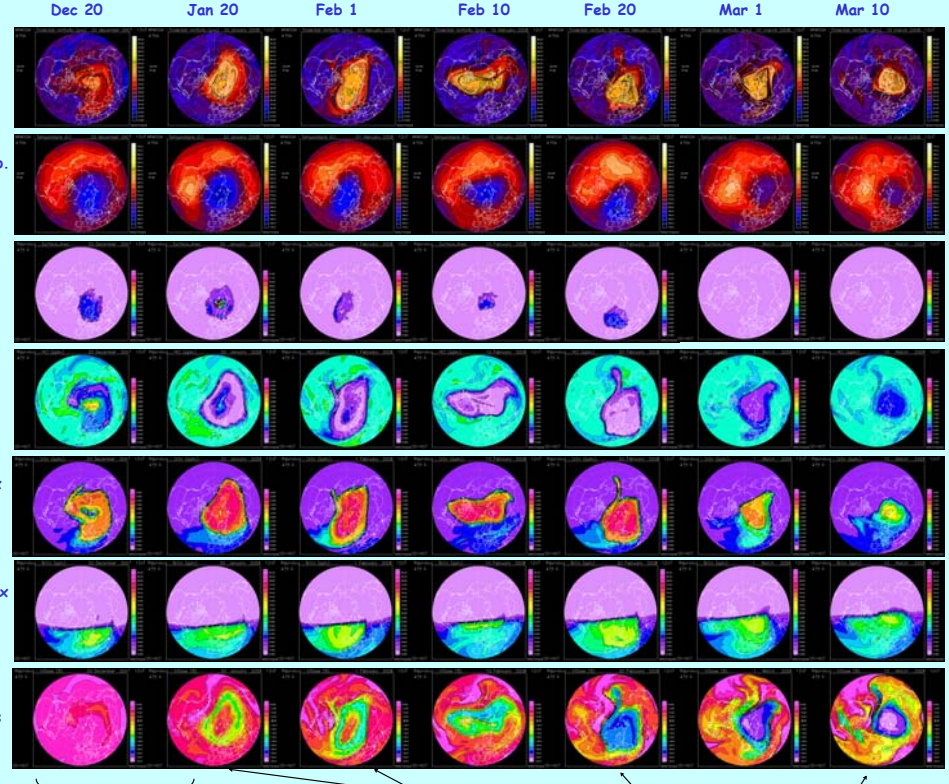


- Persistence of low temperatures as in the cold winter of 2004/05
- Compared to previous winters the final warming occurred earlier this year, around February 25.

Conclusion

-Low temperatures <194K allow the formation of Polar stratospheric clouds (**PSC**)
-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 **from January 15, 2008** when the cold areas were displaced toward sunlit regions

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



Conclusions (at 475 K)

- The vortex was formed in late December 2007. and centered around the pole until mid- January.
- Then, it was elongated and displaced to sunlit regions.
- The surface of the vortex reduced after March 1.

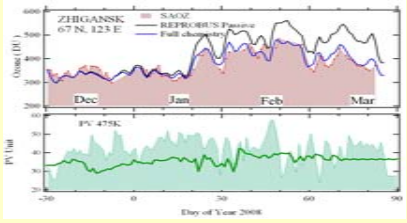
- Important PSC surface from second half of December towards February 20, linked to low temperatures.

- January 20, REPROBUS is simulating low HCl and high ClOx inside the vortex. However, limited O3 loss restricted to sunlit regions only.
- On February 1, after displacement of vortex toward sunlit areas, 15-20% O3 loss are simulated.
- The O3 loss is rapidly increasing during the month of February.
- On March 10, low ClOx and low BrOx. However, the model simulates more than 40 % O3 loss in the remaining vortex.

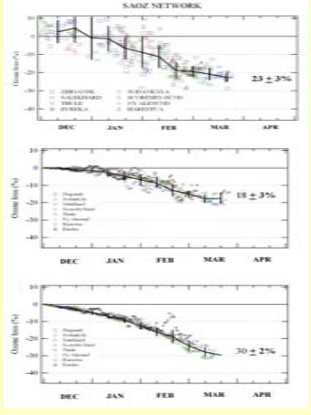
MEASUREMENTS

Ozone above SAOZ stations

At Zhigansk station (Eastern Siberia):
- A difference between SAOZ O3 columns (pink) and passive O3 from REPROBUS (black) is observed after January 20.
- This difference is increasing throughout the winter indicative of an O3 loss building up inside the polar vortex.
- Around March 15, Zhigansk is inside vortex (PV > pv limit) the difference is ~ 100 DU



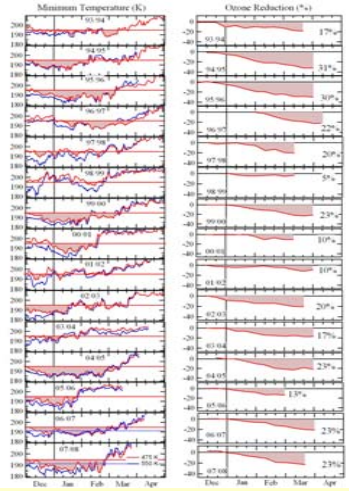
O3 Loss in 2007/2008



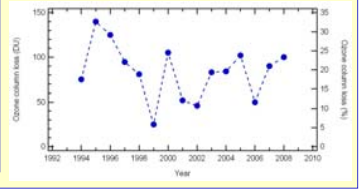
Conclusion:
- Significant ozone loss in Vortex in winter 2007/2008
- According to SAOZ (using Passive ozone from REPROBUS), most of the loss occurred between Jan. 10 and Feb. 20 at a rate of 0.5% per day leading to a loss of 20%. After that date the loss significantly slowed down at a rate of 0.1% per day.
- The cumulative loss on Mar. 10 reached 23% ± 3%.

- Smaller results are simulated by REPROBUS : 18% on Mar. 10
- Larger loss are simulated by SLIMCAT : 30 % on Mar. 10
- The difference between the 2 models is still under investigation.

Comparison to Previous Winters



Conclusion:
- Significant O3 loss occurred during the winter 07/08.
- The temperature was below that's of PSC formation during a long period starting on December 1, with a final warming occurring around February 25.
- At the end of the period, around March 10, observed cumulative loss was **23 %.**
- This is smaller than the 30% observed in 94/95 and 95/96 values but larger than the 5-10% observed in 98/99, 00/01, 01/02 and 05/06 winters



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