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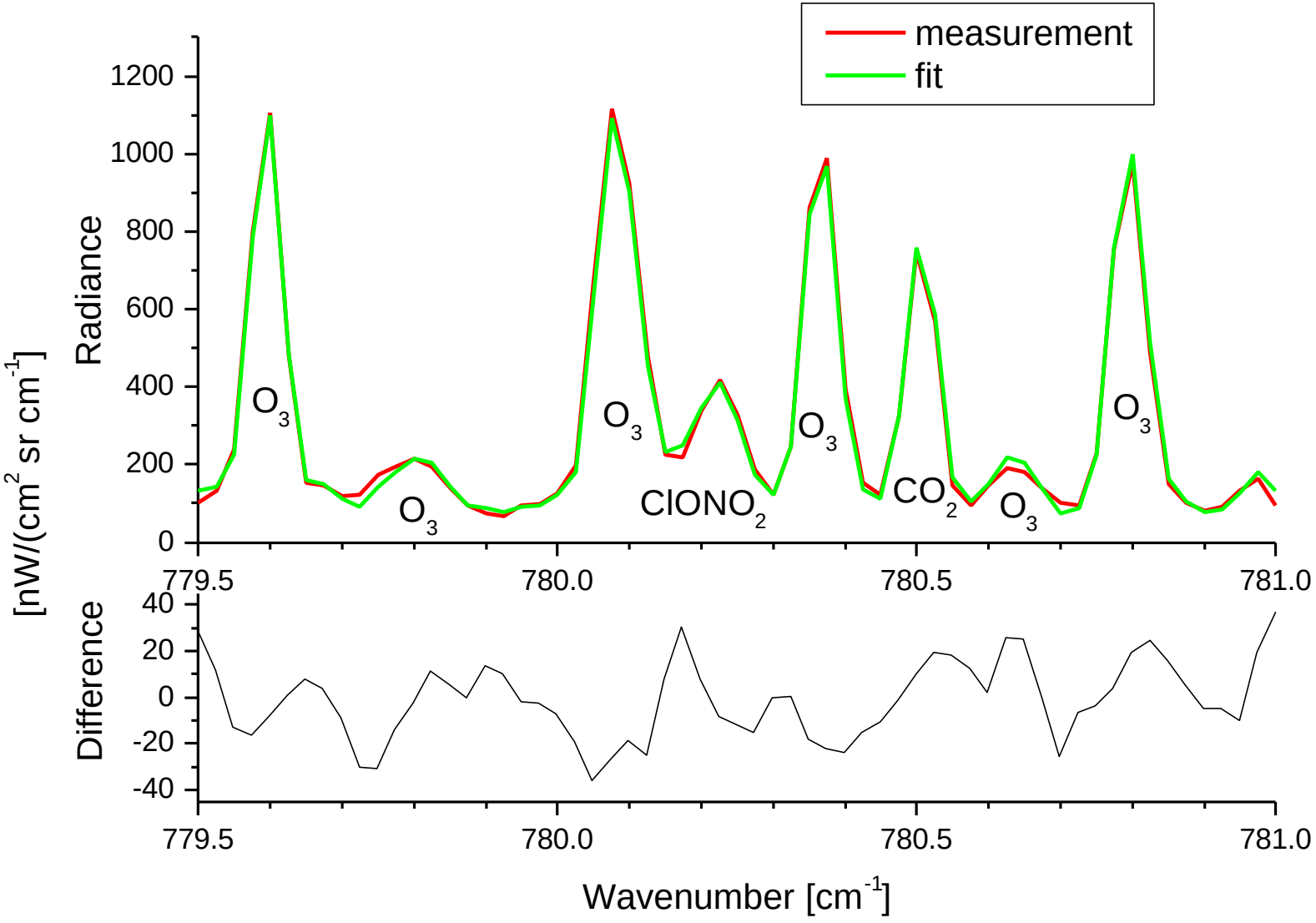
MIPAS measurements of $ClONO_2$ and polar stratospheric clouds during the Antarctic vortex split in September/October 2002

M. Höpfner, T. v. Clarmann, H. Fischer, B. Funke, N. Glatthor, U. Grabowski, S. Kellmann, M. Kiefer, A. Linden, G. Mengistu-Tsidu, M. Milz,
T. Steck, G. P. Stiller, D. Y. Wang
Institut für Meteorologie und Klimaforschung, Forschungszentrum Karlsruhe GmbH,
Postfach 3640, D-76021 Karlsruhe, Germany

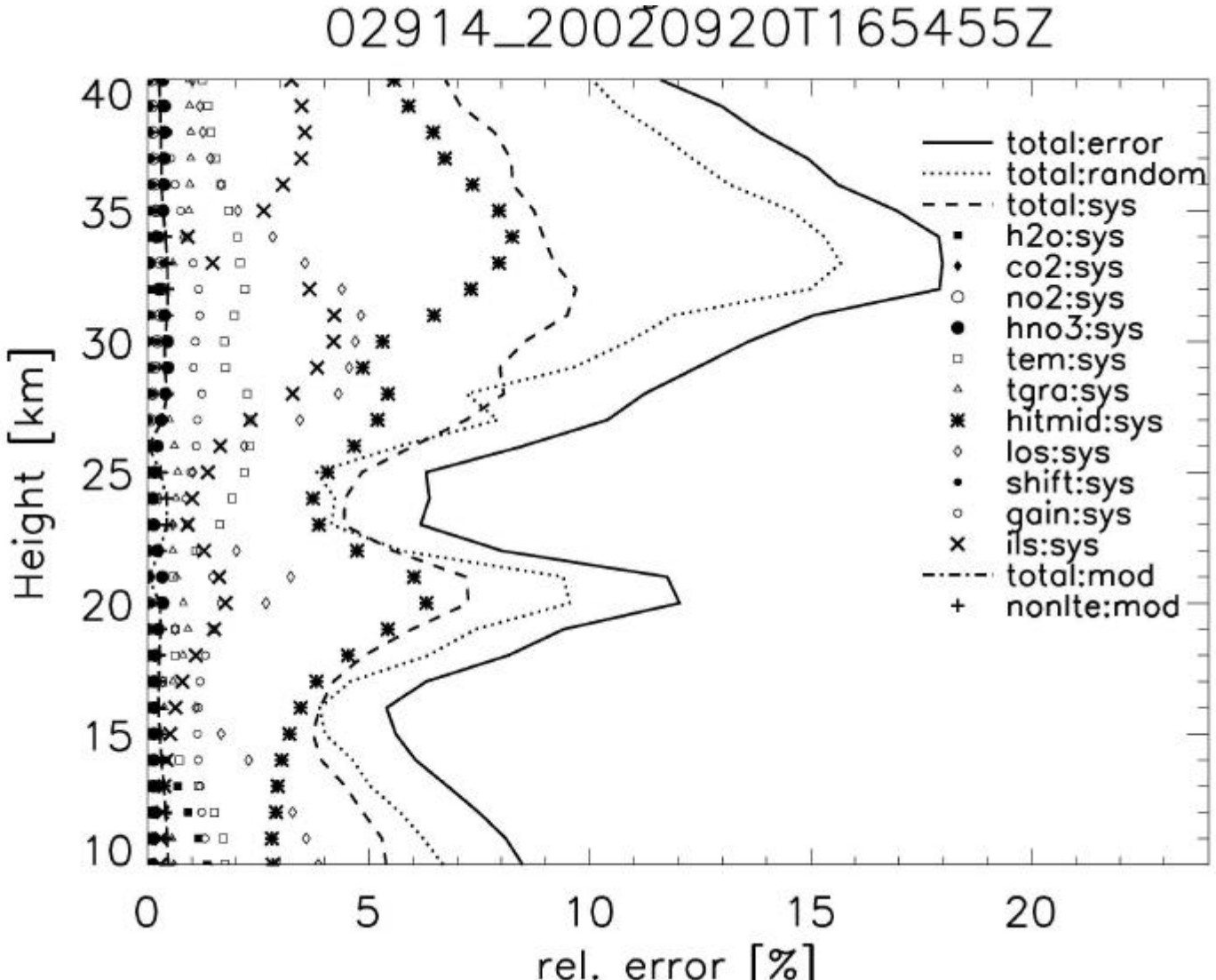
Retrieval procedure for $ClONO_2$

Processor	Scientific IMK level-2 processor
Method	Tikhonov first order smoothing with respect to reference profile shape (Steck, 2002)
Retrieval grid	Constant altitude levels with 1 km distance
Order	• Spectral shift • Temperature, tangent altitudes • $ClONO_2$
Spectral interval	779.5 – 781 cm^{-1}
Simultaneous fit parameters	$ClONO_2$, O_3, continuum, tangent height independent offset
Spectroscopic data	Pressure/temperature dependent cross-sections by Wagner and Birk, 2003

Fit quality


measurement
fit
Radiance
[nW/(cm^2 sr cm^{-1}]
1200
1000
800
600
400
200
0
O_3
O_3
O_3
$ClONO_2$
O_3
CO_2
O_3
779.5
780.0
780.5
781.0
Difference
40
20
0
-20
-40
779.5
780.0
780.5
781.0
Wavenumber [cm^{-1}]

Error budget for $ClONO_2$ (inside vortex, Sep. 20, 2002)



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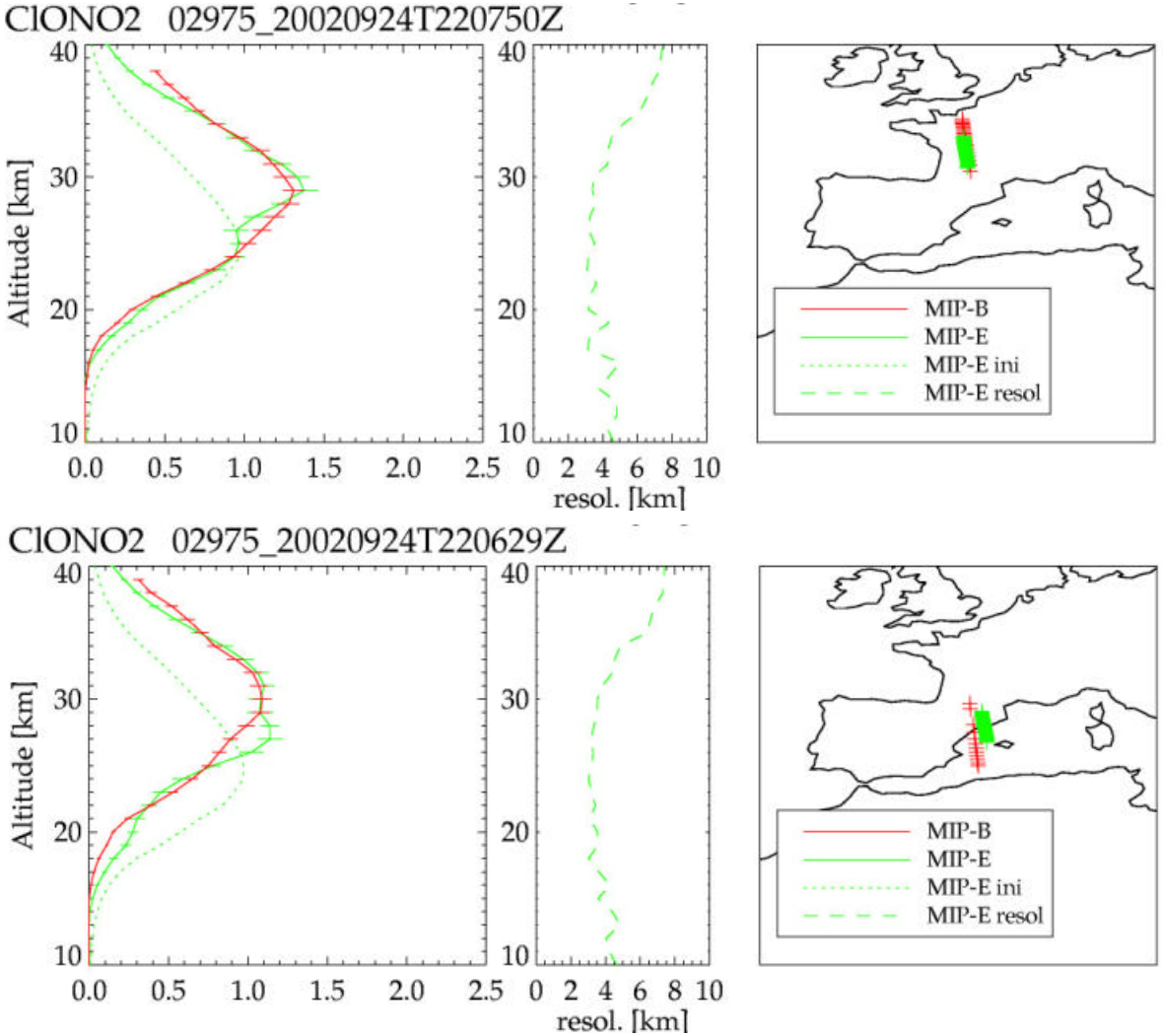
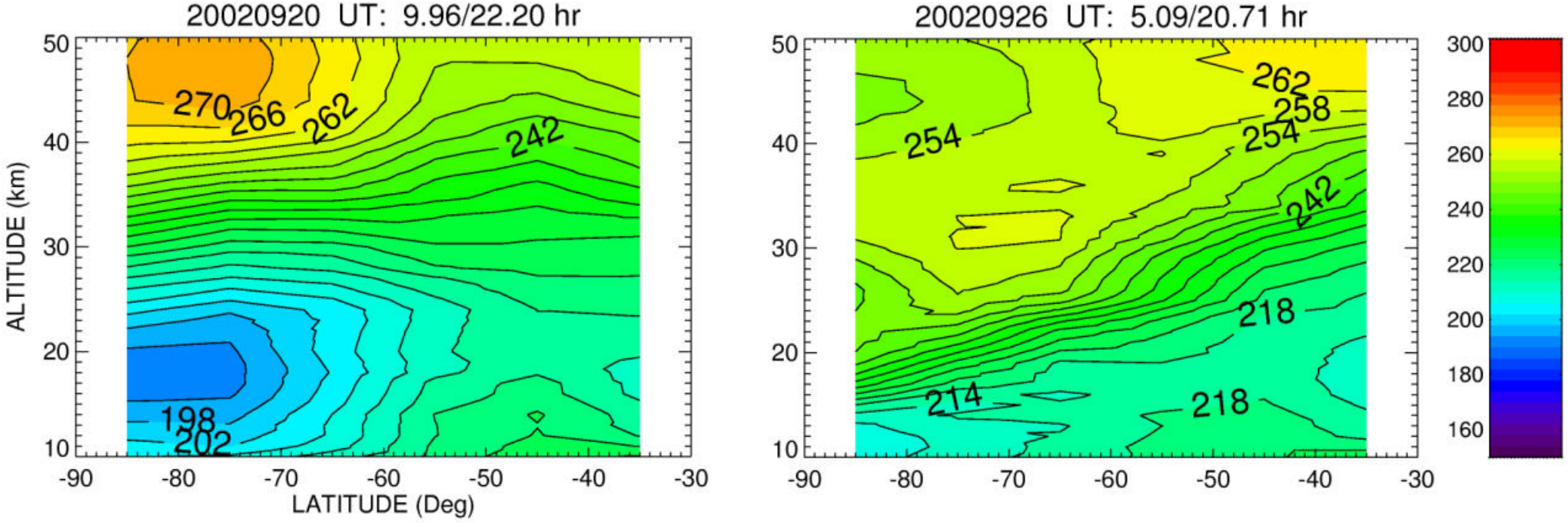
$ClONO_2$-Validation with MIPAS-Balloon

flight 24/25 Sep 2002 from Aire sur l'Adour



(see posters by Wetzel et al. and Steck et al.)

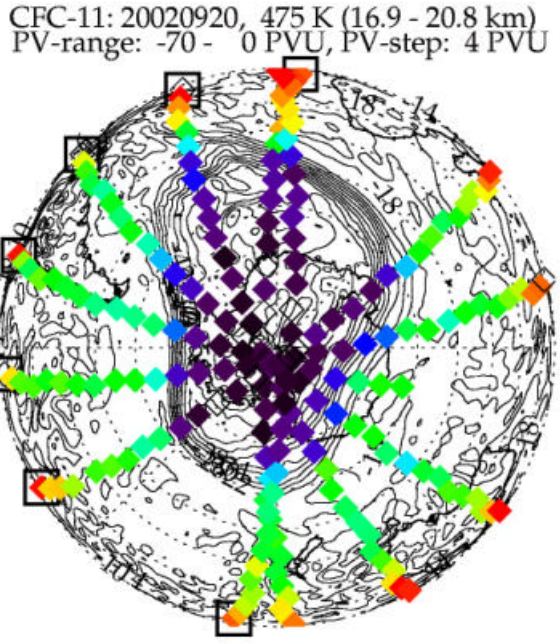
MIPAS zonal mean temperatures: reverse of the meridional temperature gradient ? *major stratospheric warming*



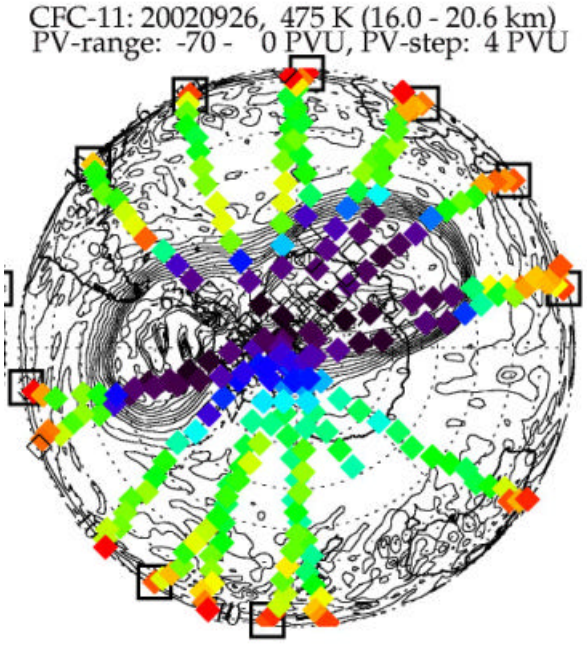
(see poster by Wang et al.)

MIPAS CFC-11 and ECMWF PV: isolation of vortex air

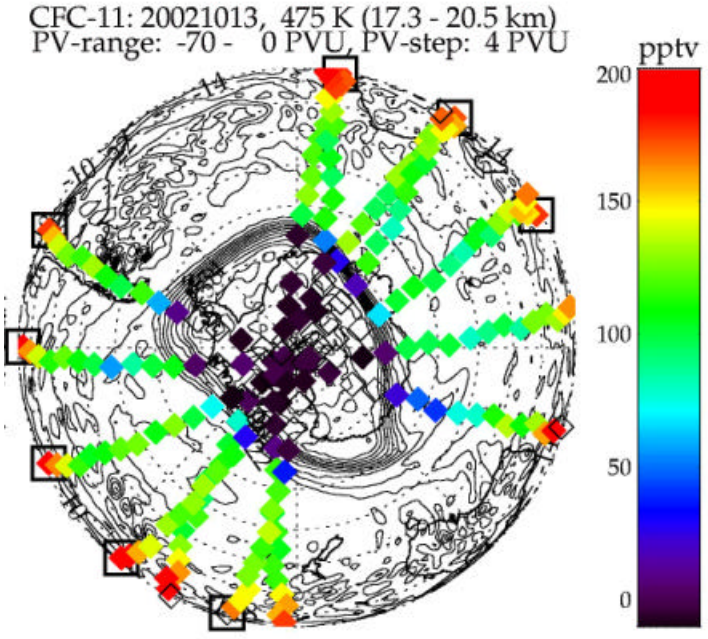
Sep. 20



Sep. 26



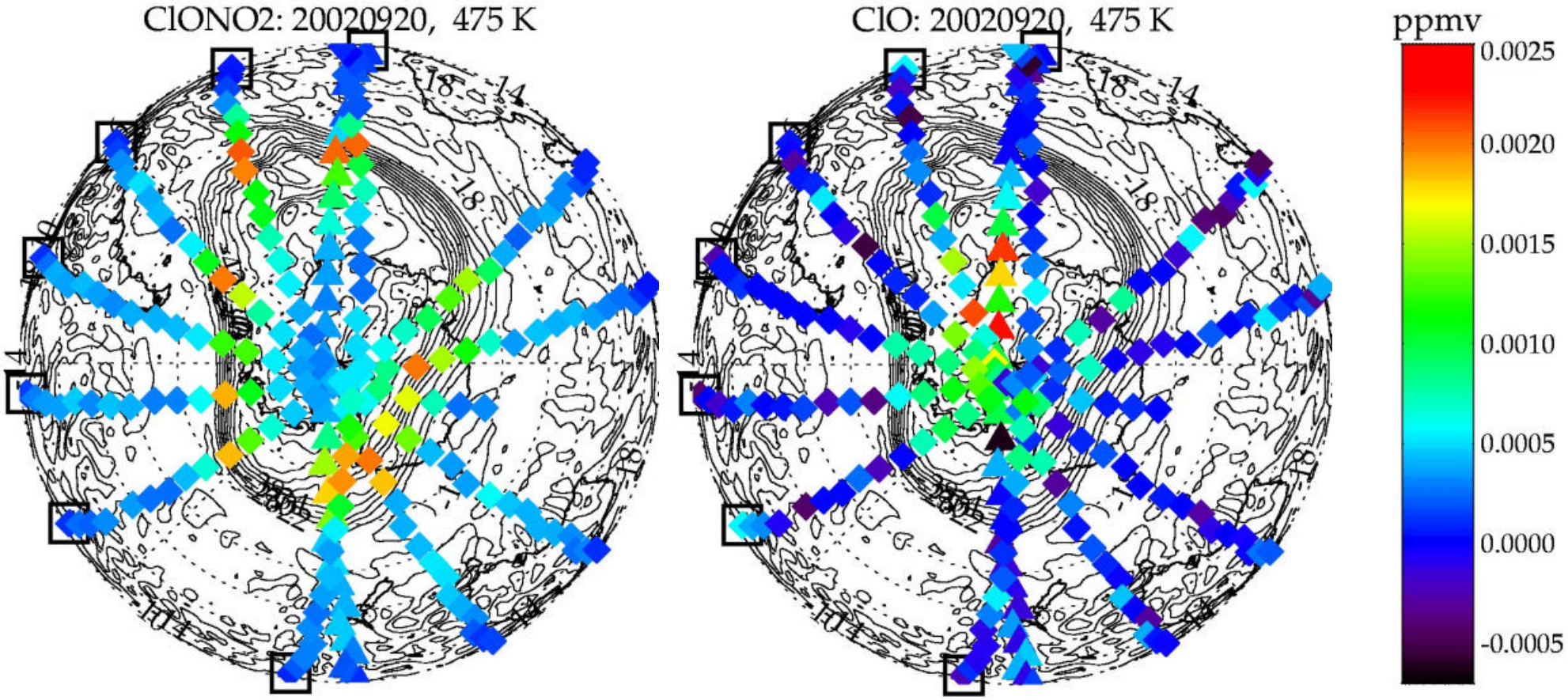
Oct. 13



Chlorine deactivation

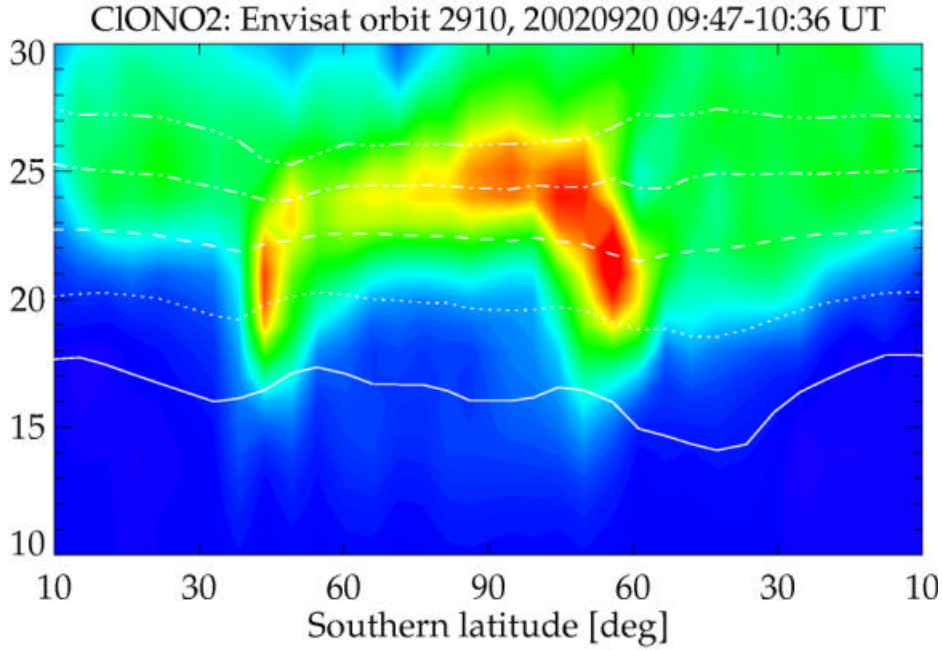
- $ClONO_2$ and HCl: major reservoirs of stratospheric Cl_y (ratio 1/2)
- Converted to Cl_2 via heterogeneous reactions on/in PSCs
- Warming of polar stratosphere in spring $\rightarrow$ recovery via:
  - $ClO + NO_2$? $ClONO_2$ (1) $\rightarrow$ Northern polar vortex
  - $Cl + CH_4$? $HCl + CH_3$ (2) $\rightarrow$ Southern polar vortex
- Rate for (1) depends on [ClO] and [NO_2] controlled by
  - $Cl + O_3$? $ClO + O_2$
  - $NO + O_3$? $NO_2 + O_2$ (and denitrification)

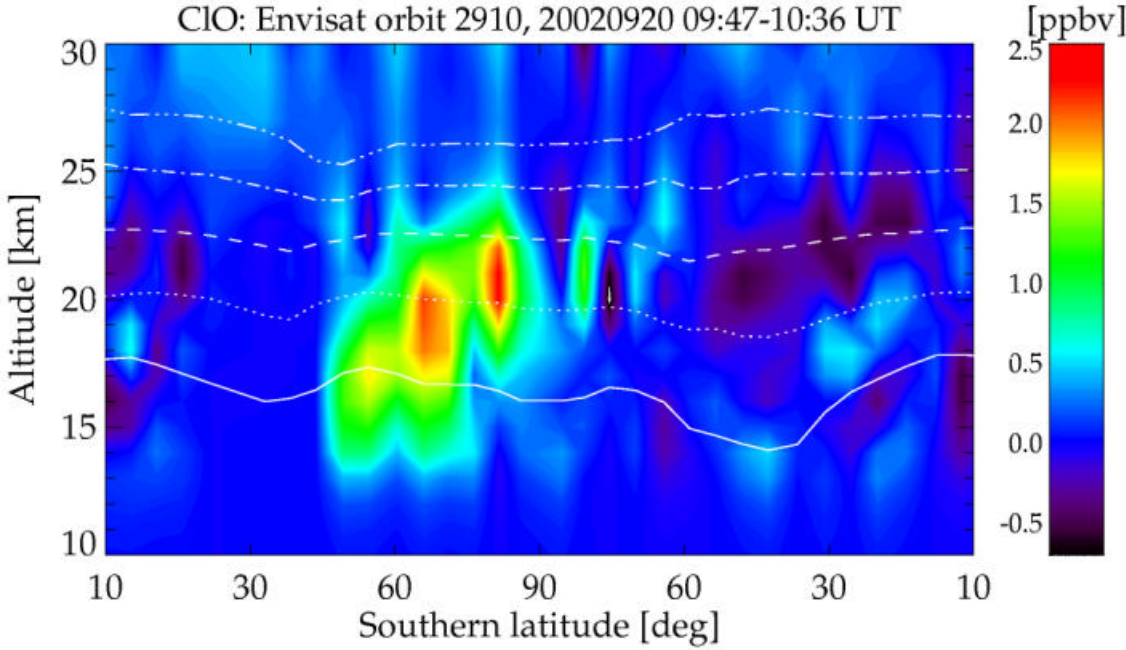
MIPAS $ClONO_2$ and ClO: inorganic chlorine on September 20, 2002



(see poster by Glatthor et al.)

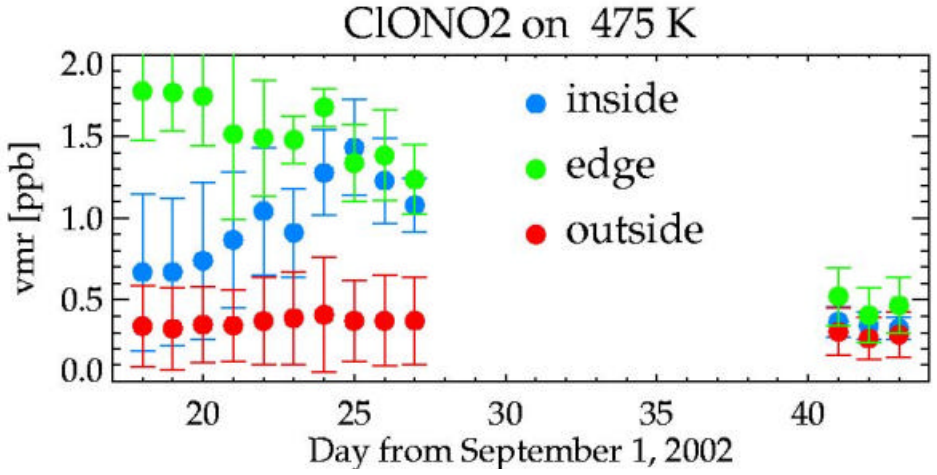
MIPAS $ClONO_2$ and ClO: inorganic chlorine on September 20, 2002, orbit 2910

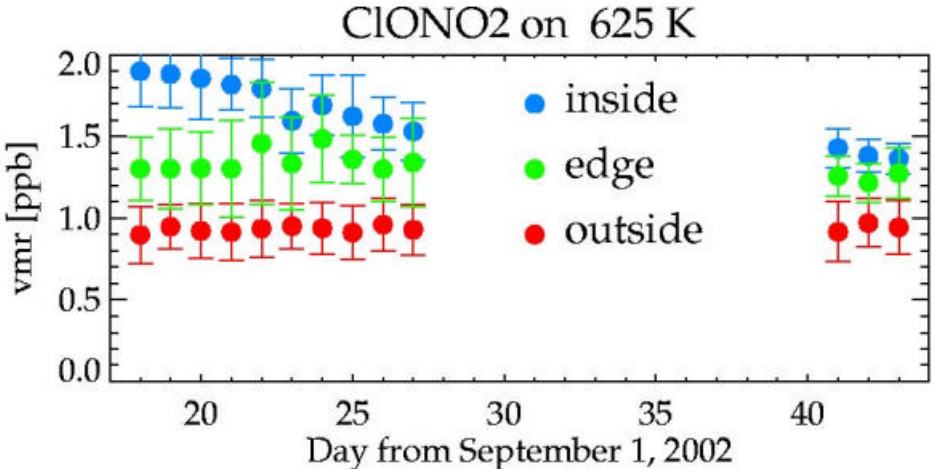


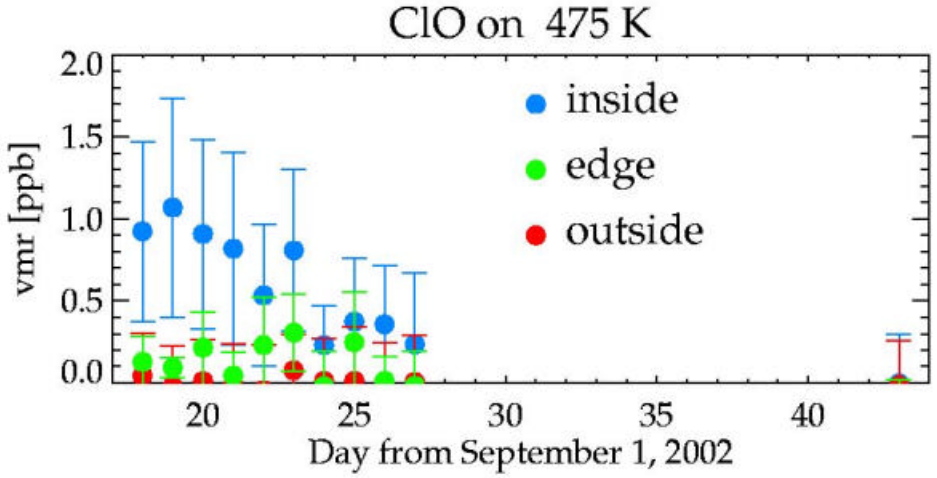


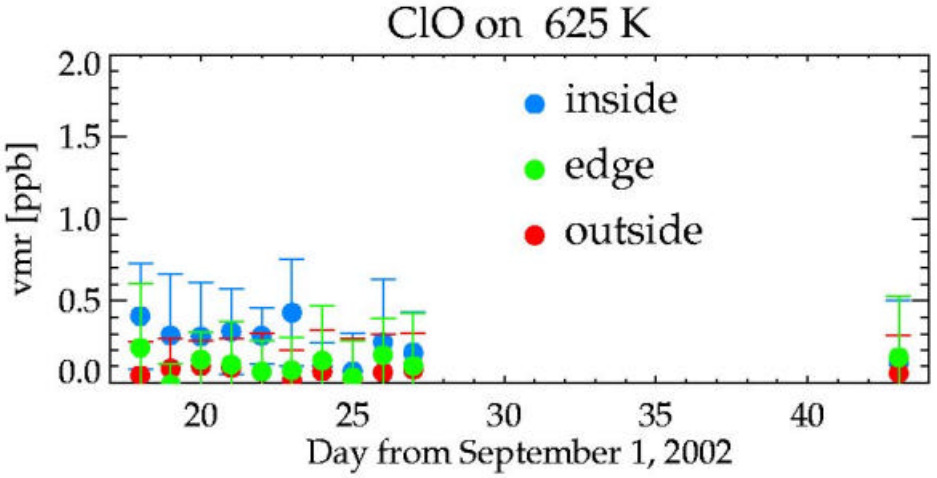
700 K
625 K
550 K
475 K
400 K

MIPAS $ClONO_2$ and ClO: daily mean values









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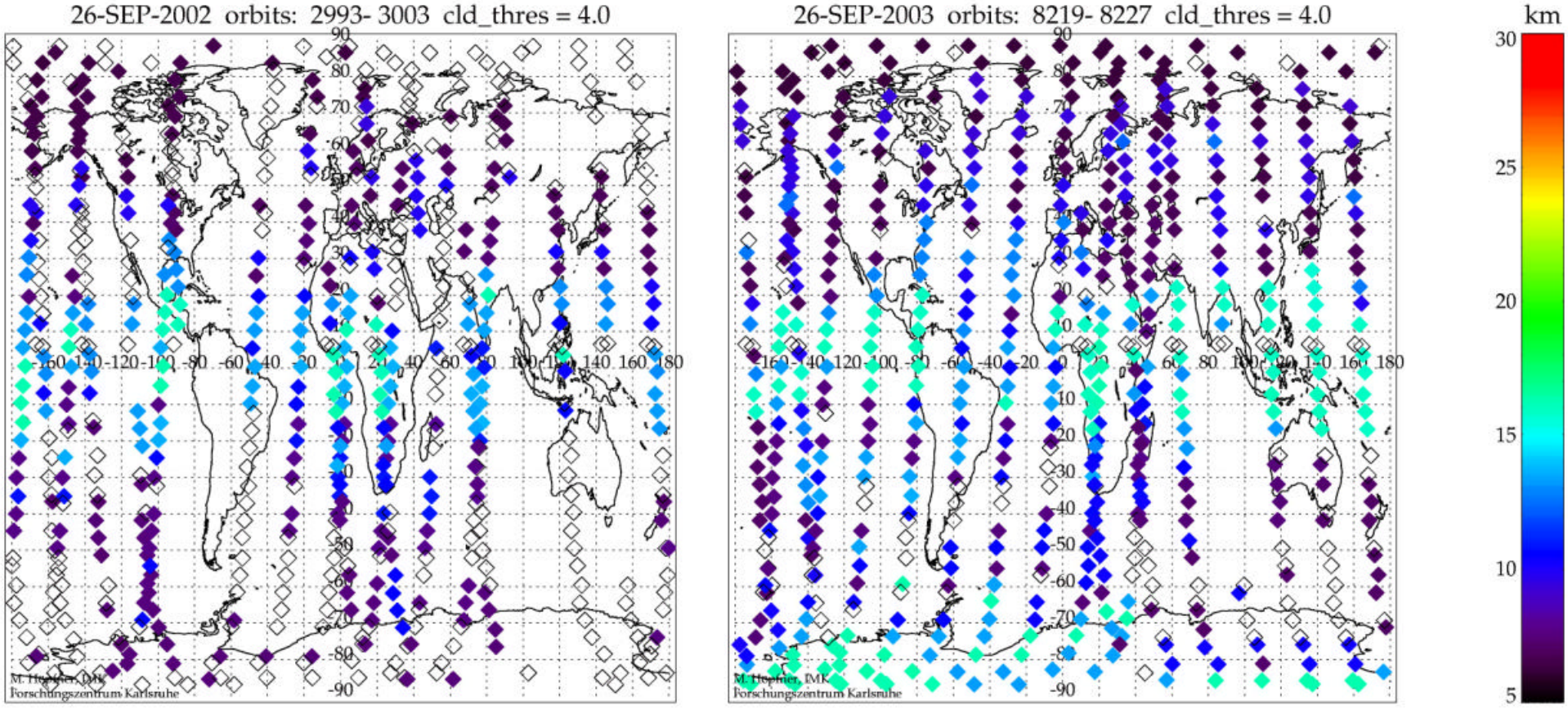
MIPAS polar stratospheric clouds: comparison between Sep. 26, 2002 and 2003



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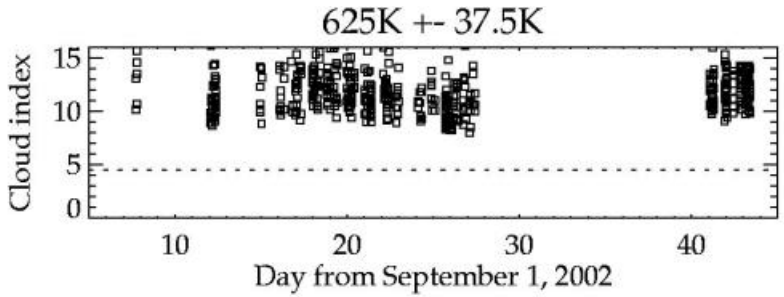

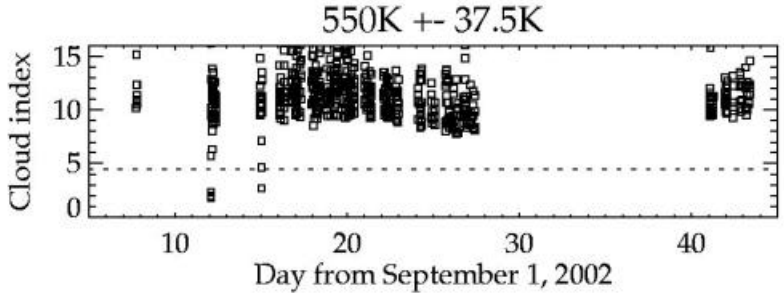

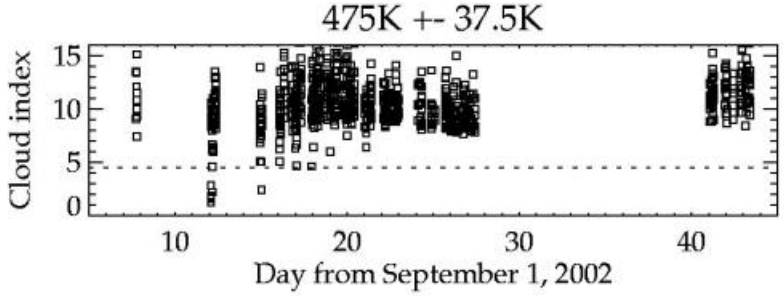

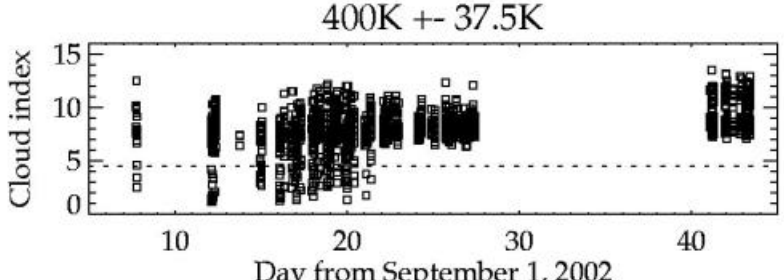

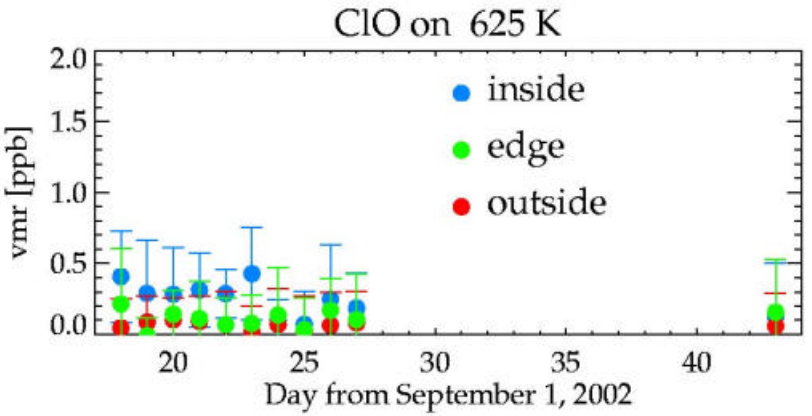

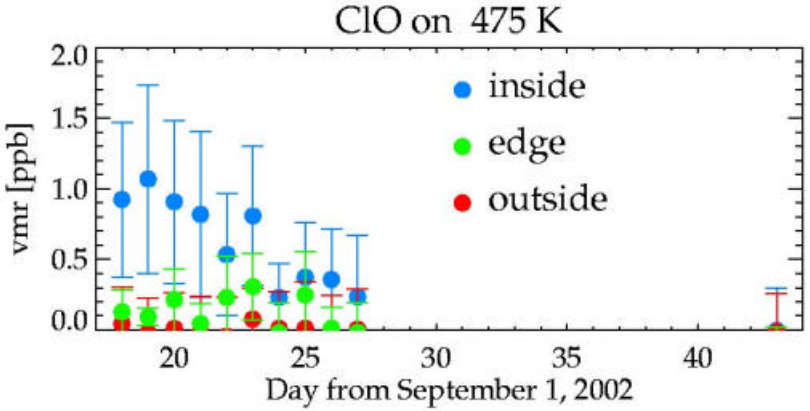

MIPAS Sep. 20, 2002 versus CLAES/UARS Sep. 17, 1992: mean inner vortex volume mixing ratios

	CLAES	CLAES (corrected for spectroscopic data)	MIPAS
465 K	0.9 ppbv	0.7 ppbv	0.7 ppbv
585 K	1.5 ppbv	1.1 ppbv	1.7ppbv

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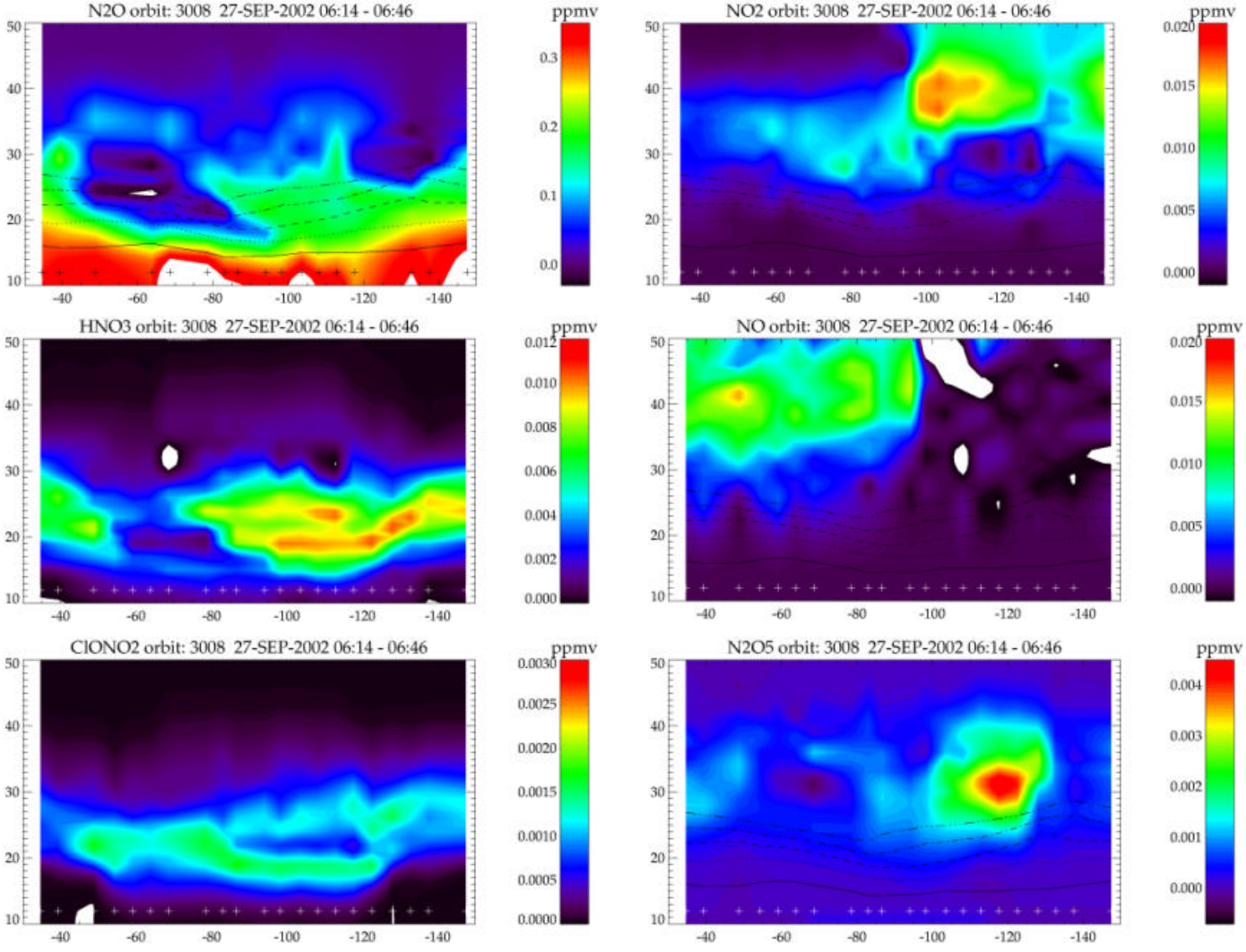
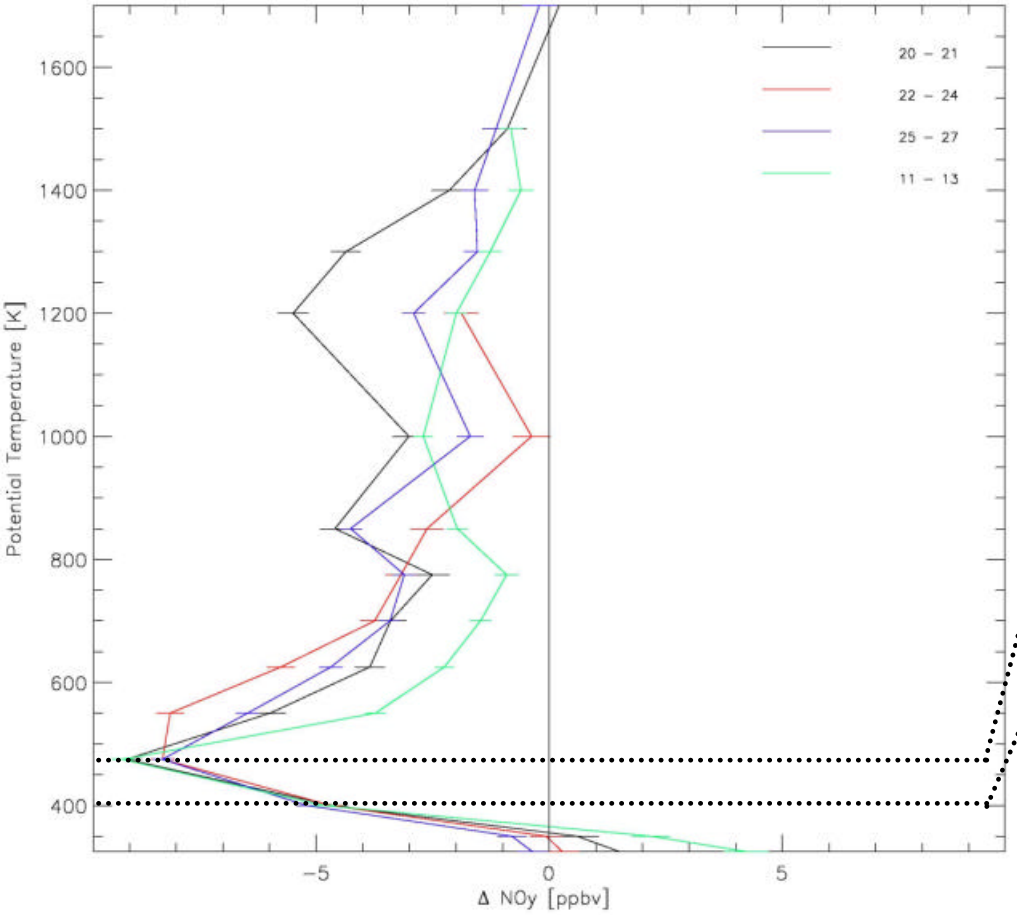
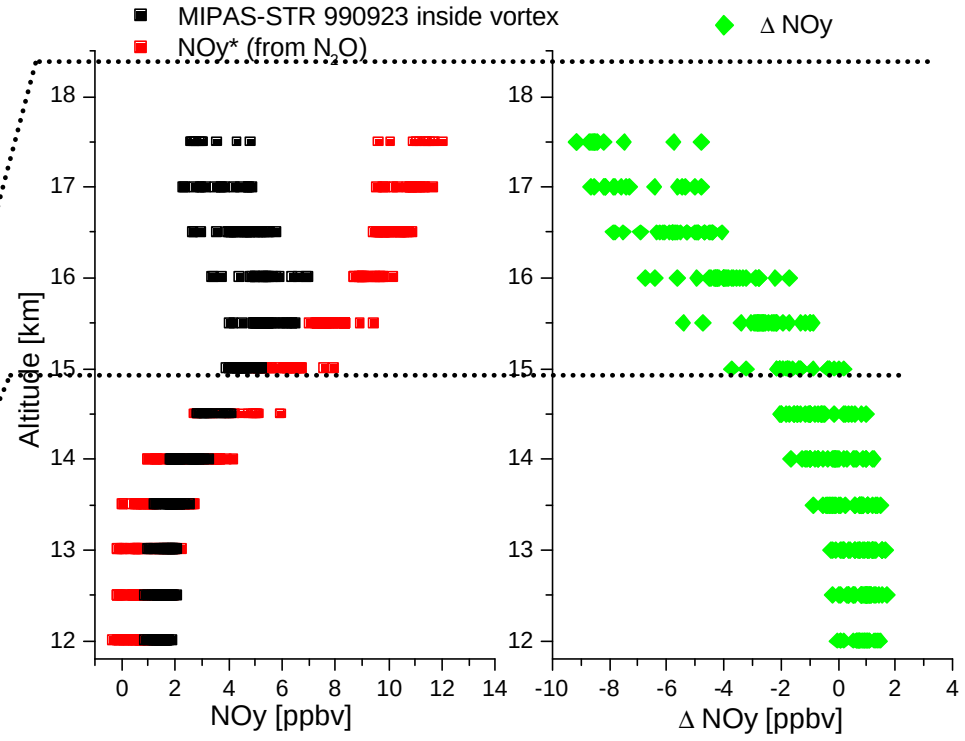
MIPAS NOy and N_2O measurements



MIPAS NOy-N_2O correlation: denitrification of the vortex and comparison with MIPAS-Geophysica in 1999





(see poster by Mengistu Tsidu et al.)

Summary

- Setup of a retrieval processor for evaluation of ‚scientific' MIPAS/Envisat data at IMK
- Error budget of $ClONO_2$ driven by noise and spectroscopic data
- Error budget of ClO driven by noise
- Validation of $ClONO_2$ with MIPAS-Balloon for 24/25 September 2002 (and 20/21 March 2003) very encouraging; further validation with groundbased FTIR measurements and MIPAS-Geophysica (MIPAS-STR and in-situ) ongoing
- Vortex split 2002:
  - → Tracers: no indication for strong mixing of mid-latitude air into the vortex
  - → First observation of $ClONO_2$ during the chlorine deactivation phase in the southern polar vortex
  - → Anticorrelation of $ClONO_2$ and ClO on 475 K → main pathway for deactivation of chlorine is conversion into $ClONO_2$ within 5 days
  - → On 625 K deactivation already had taken place
  - → Good correlation of deactivation process with PSC occurance
  - → Pre-split inner vortex $ClONO_2$ on 465 K comparable but on 585 K higher than in September 1992
  - → Degree of denitrification similar to September 1999
  - → Problems:
    - Temperatures profiles before September 18 unstable
    - CH_4 and N_2O in September systematically higher than in October after warming up of MIPAS