

Neural Network based Ozone Profile Retrieval Using Combined UV/VI and IR Satellite Data

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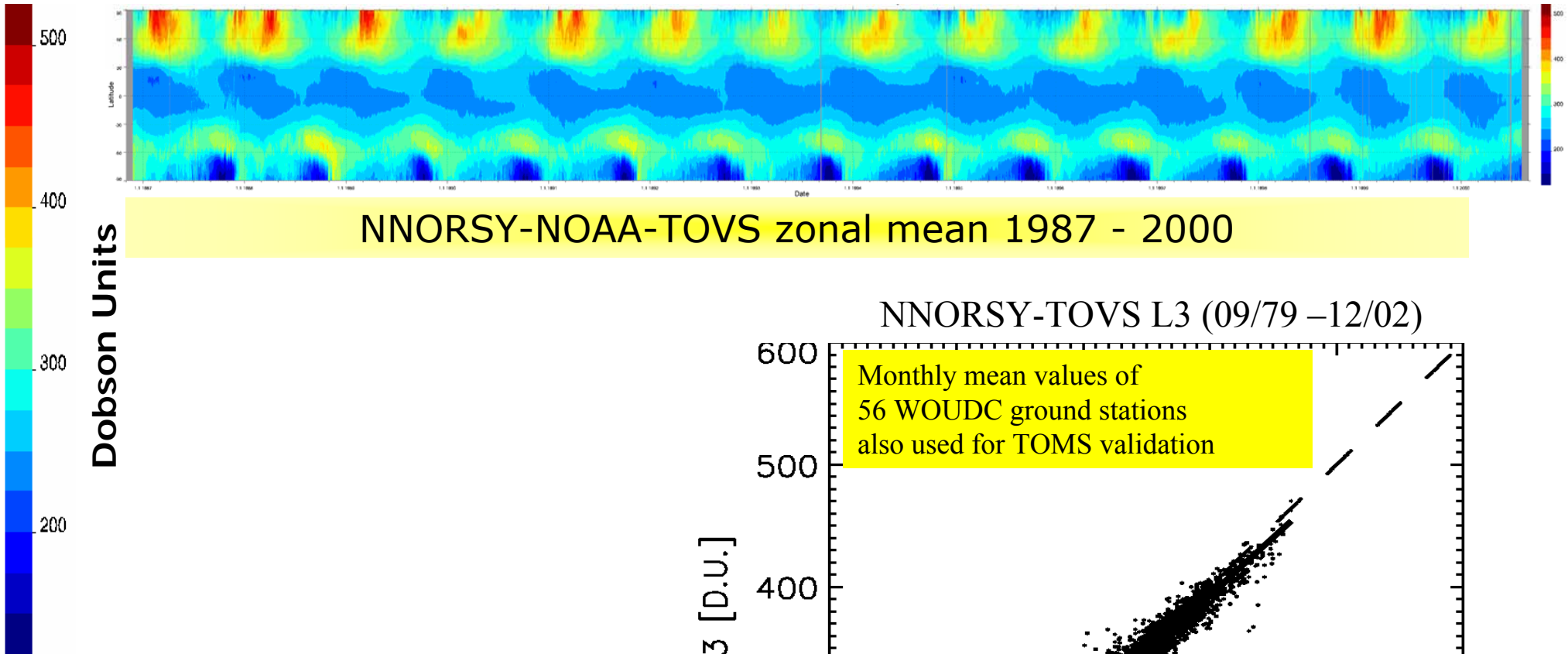


Outline

1. *Start with TOVS*
2. *NNORSY and Optimal Estimation (OE)*
3. *Approach for NNORSY*
4. *Local error estimation*
5. *Results of NNORSY-GOME/TOVS*
6. *Summary and future*

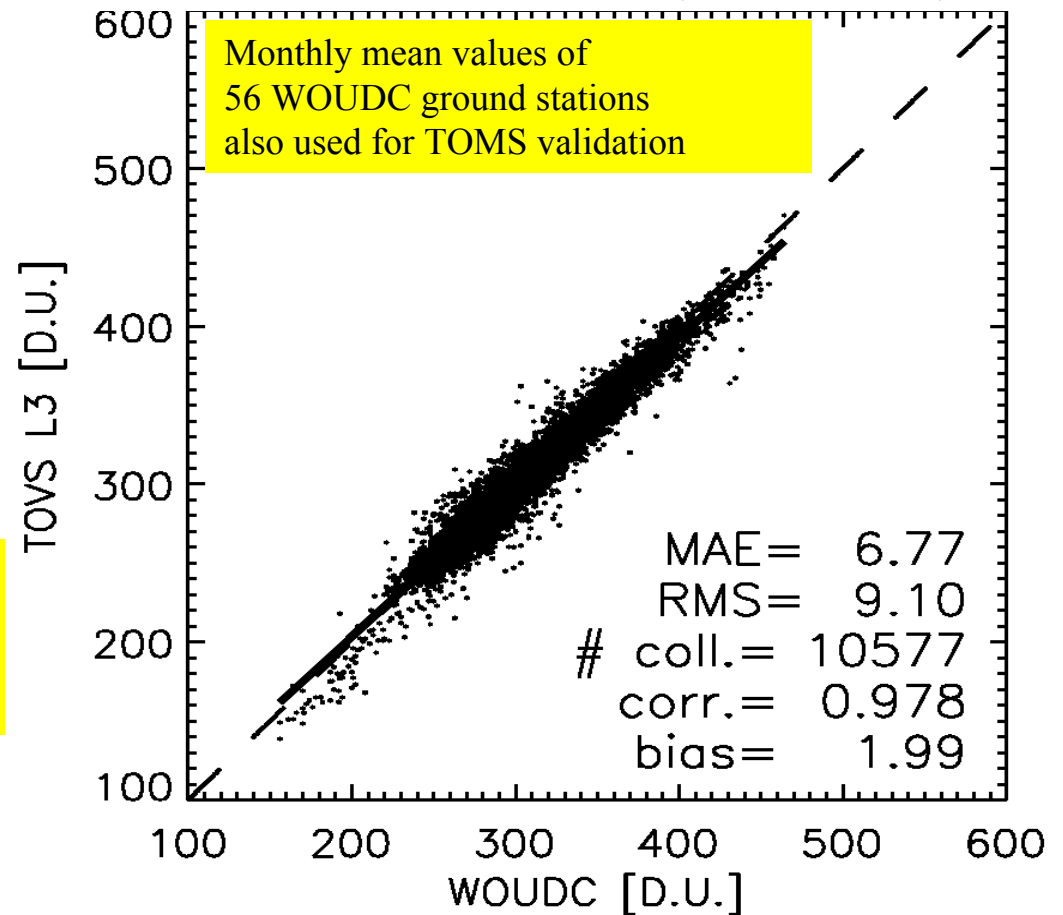


NNORSY-TOVS Total Ozone



NNORSY-NOAA-TOVS zonal mean 1987 - 2000

NNORSY-TOVS L3 (09/79 - 12/02)



global	TOVS	TOMS
RMS:	9.1 D.U.	8.0 D.U.
Bias:	2.0 D.U.	-2.8 D.U.



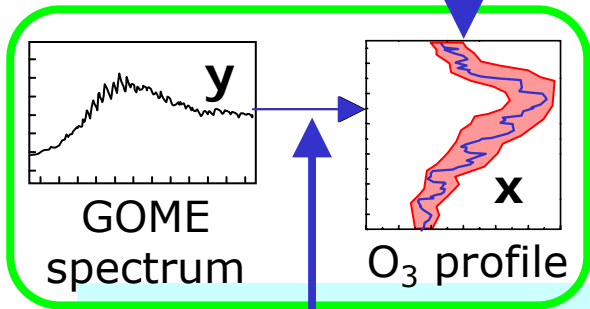
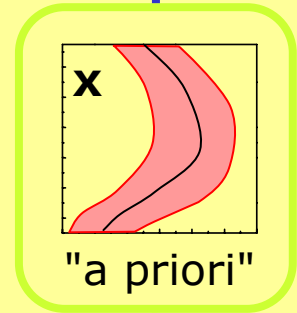
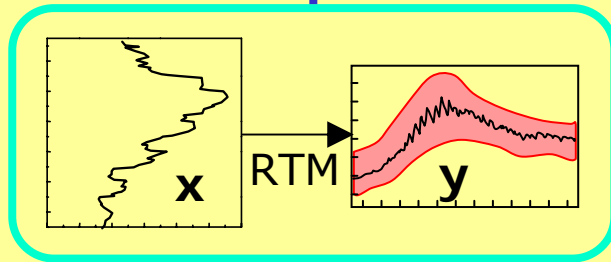
Comparison of retrieval approaches

Optimal Estimation

Optimal Estimation

z.B. FURM, OPERA, ...

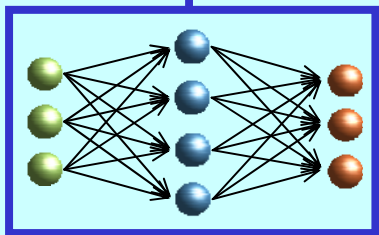
~1 min/profile



$$p(\mathbf{x}|\mathbf{y}) = \frac{p(\mathbf{y}|\mathbf{x}) p(\mathbf{x})}{p(\mathbf{y})}$$

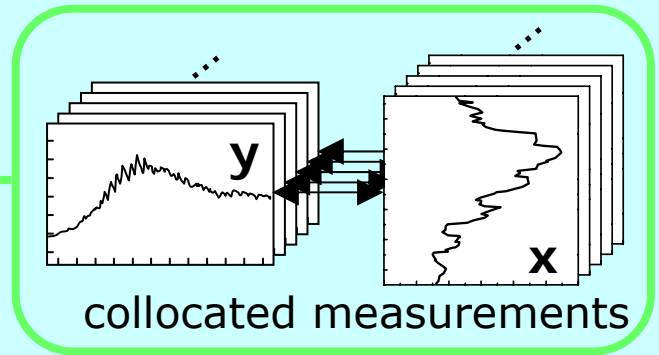
NNORSY

~1 ms/profile (!)



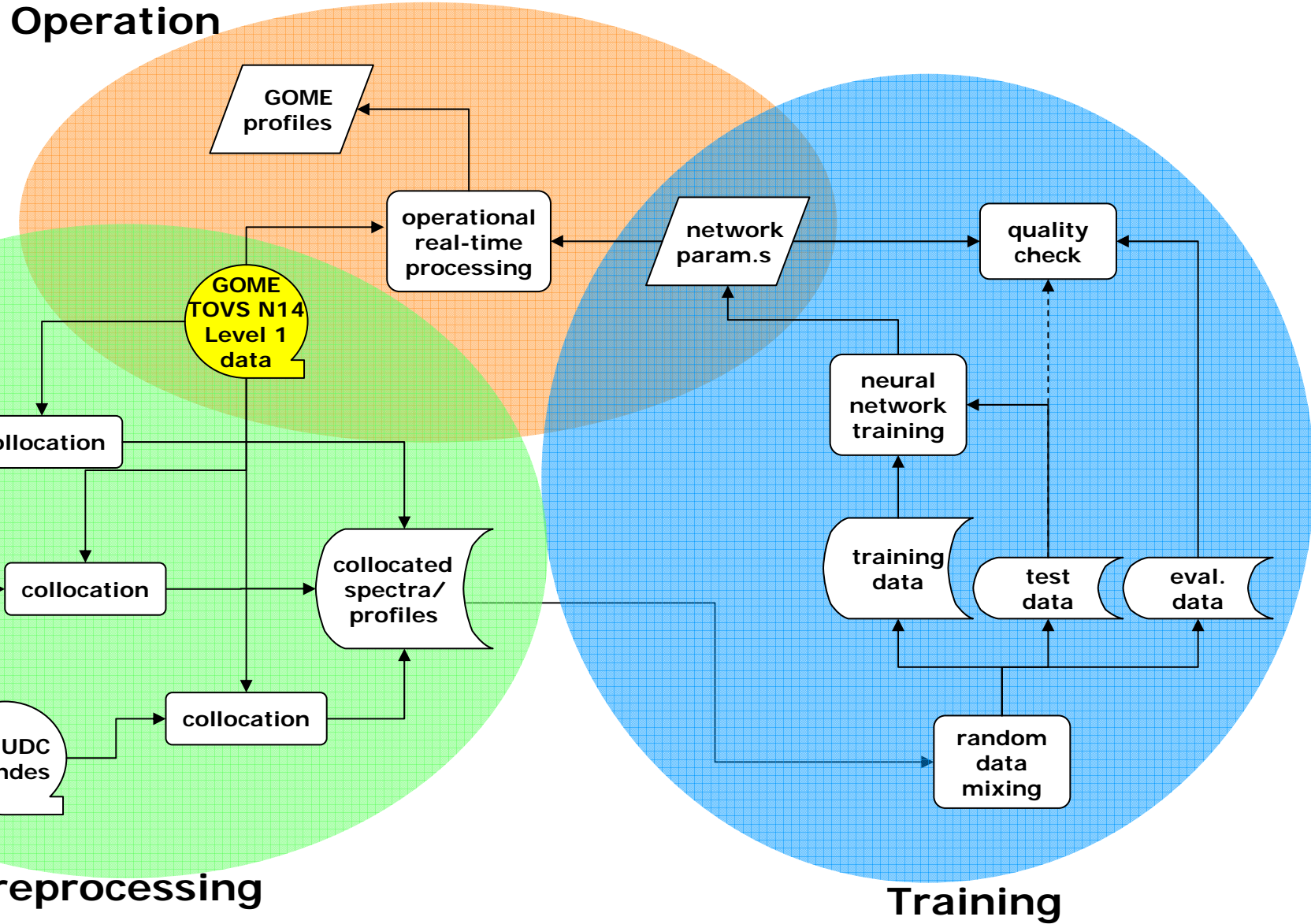
NNORSY

$$k(\mathbf{x}, \mathbf{y})$$



Overview NNORSY

Operation



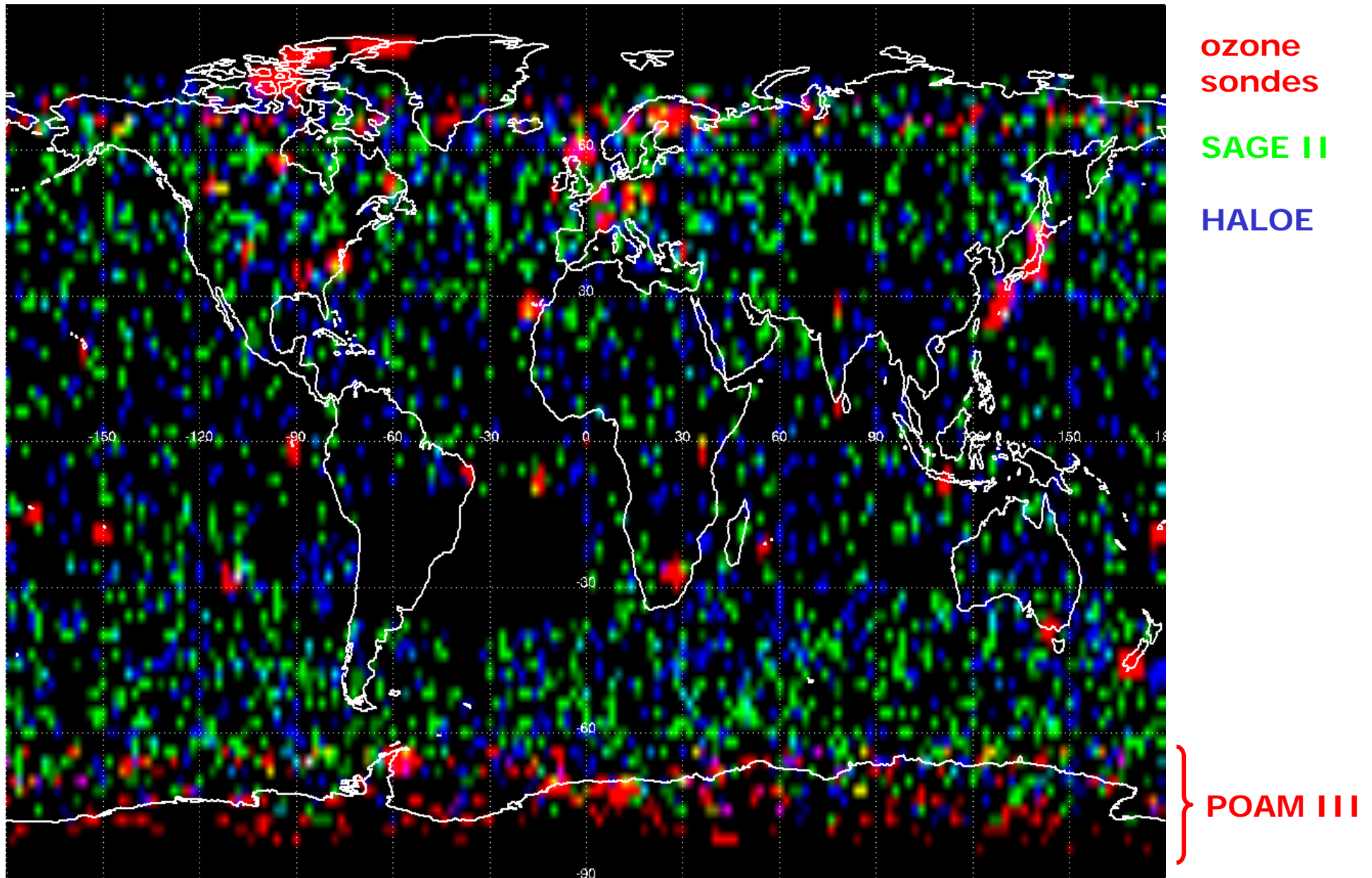
Preprocessing

Training

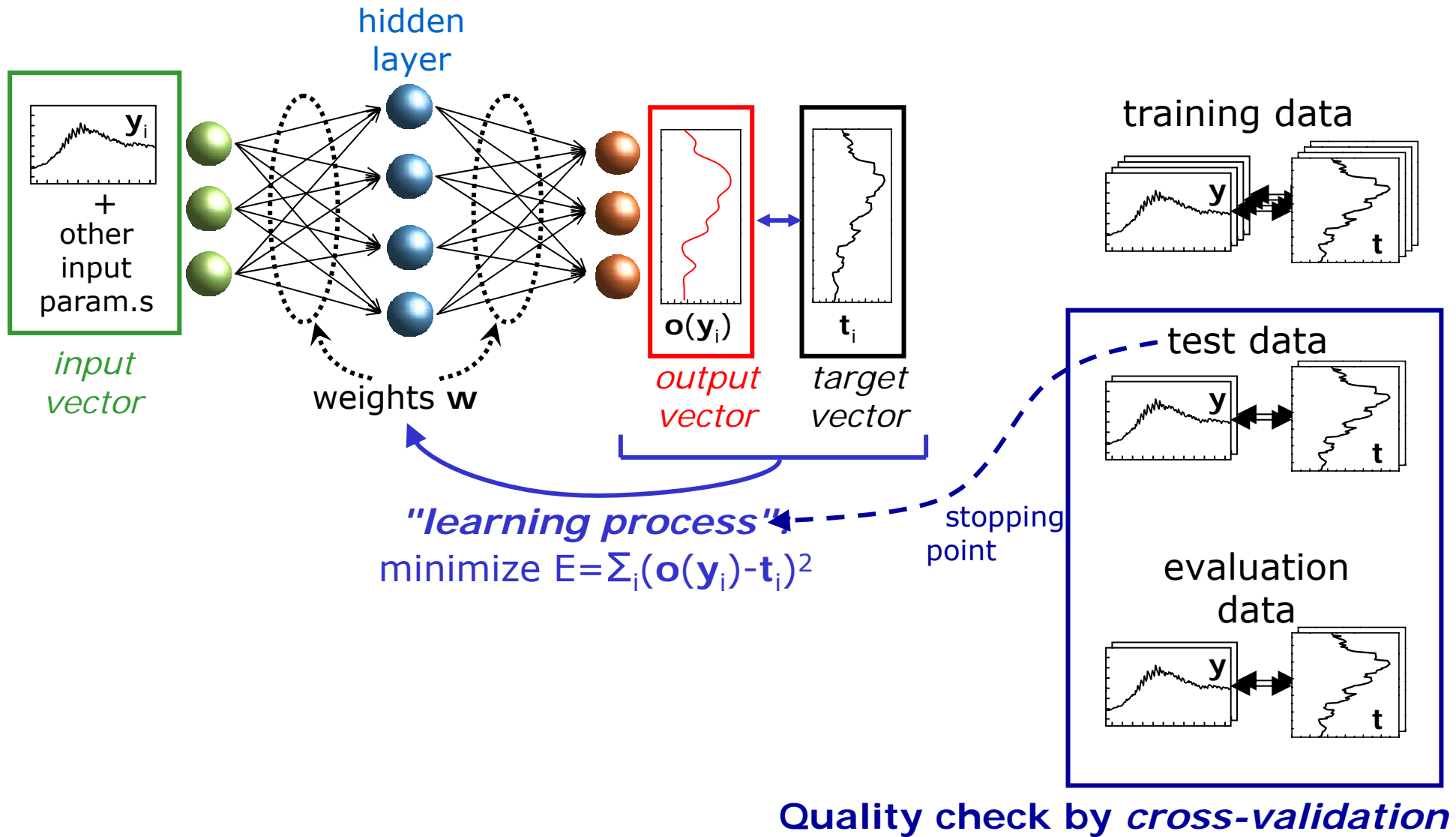


NNORSY: Collocation Example

test data set: 01/1996 – 07/2001, 12000 collocations



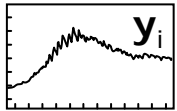
Training and Test for NNORSY



NNORSY (Neural Network Ozone Retrieval System)

NNORSY Input Parameters

Input data for neural network



GOME
spectral
data

270 – 325 nm (O₃ Hartley & Huggins)
380 – 385 nm (atmosph. window)
598 – 603 nm (O₃ Chappuis)
758 – 772 nm (O₂ → cloud info)

geolocation

SZA, SAA
sensor scan angle
LOS type (east, nadir, west)

meteorol. info

GEOS4 temperature profile

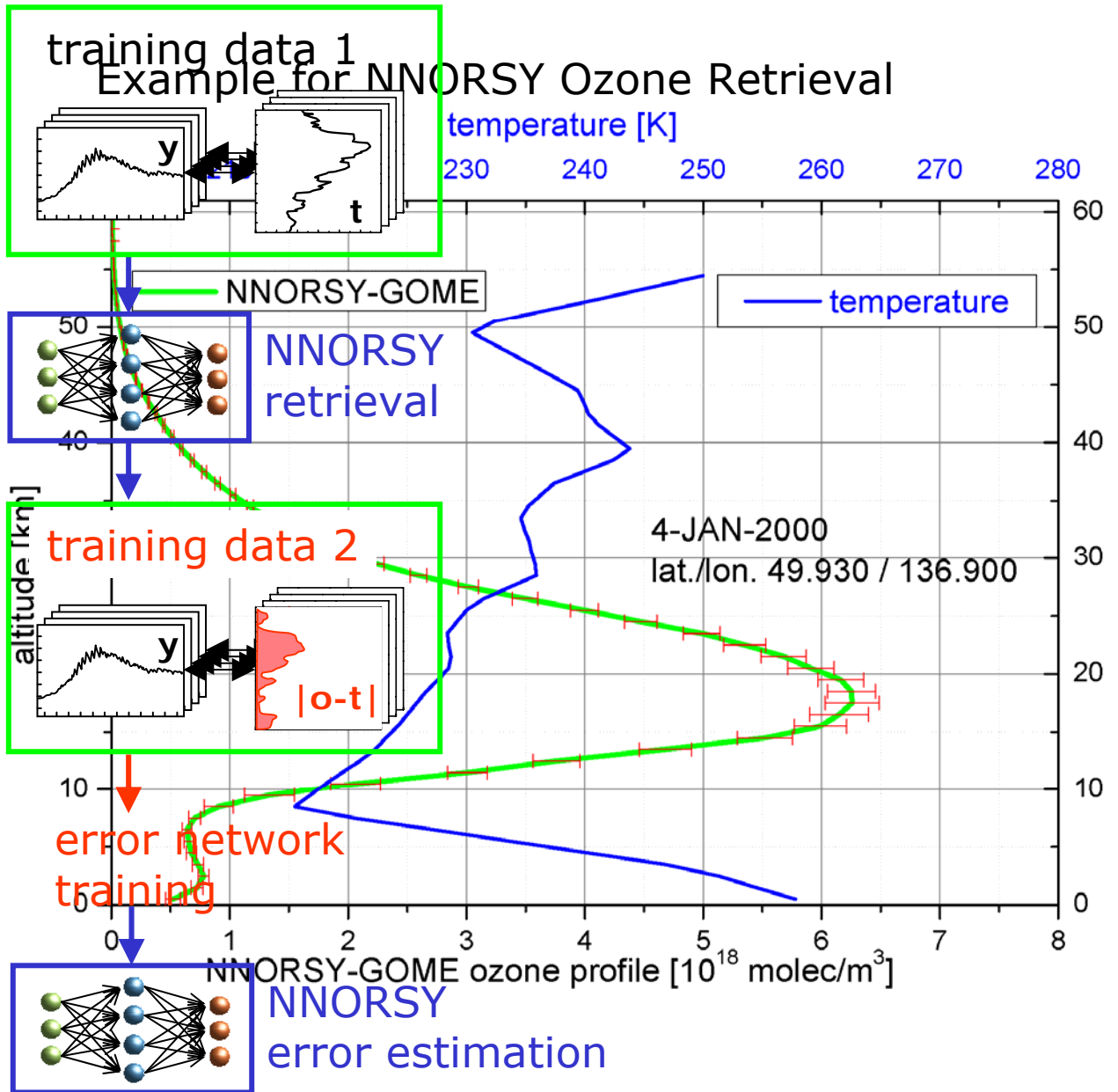
climatological
predictors

Latitude
Season and sensor age

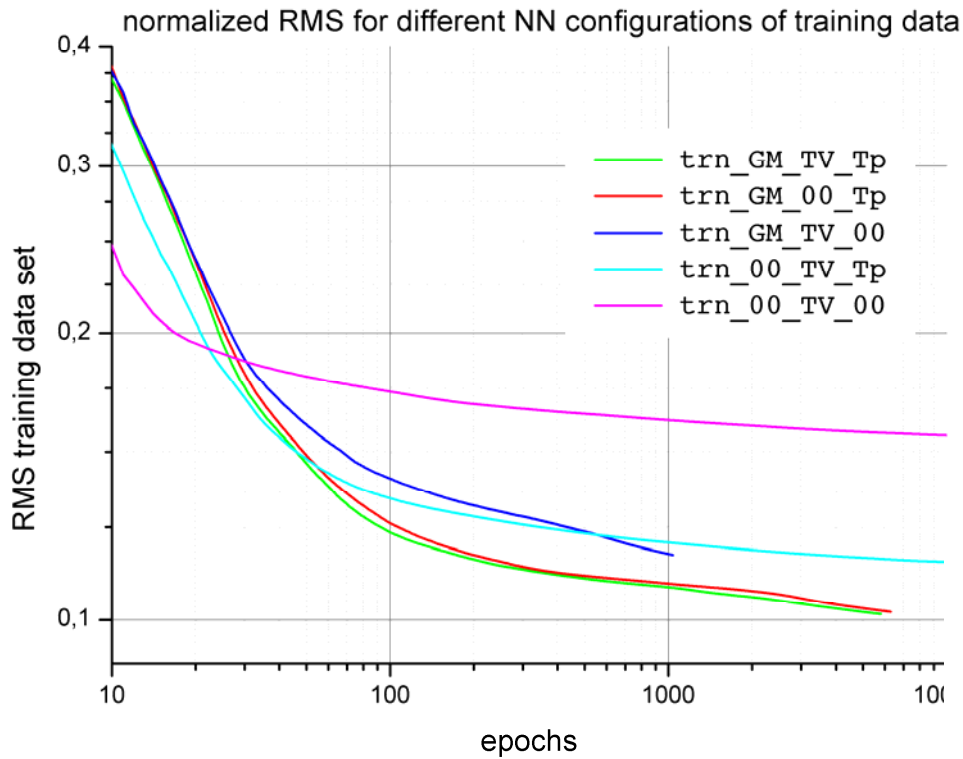
TOVS
Tb

HIRS
MSU

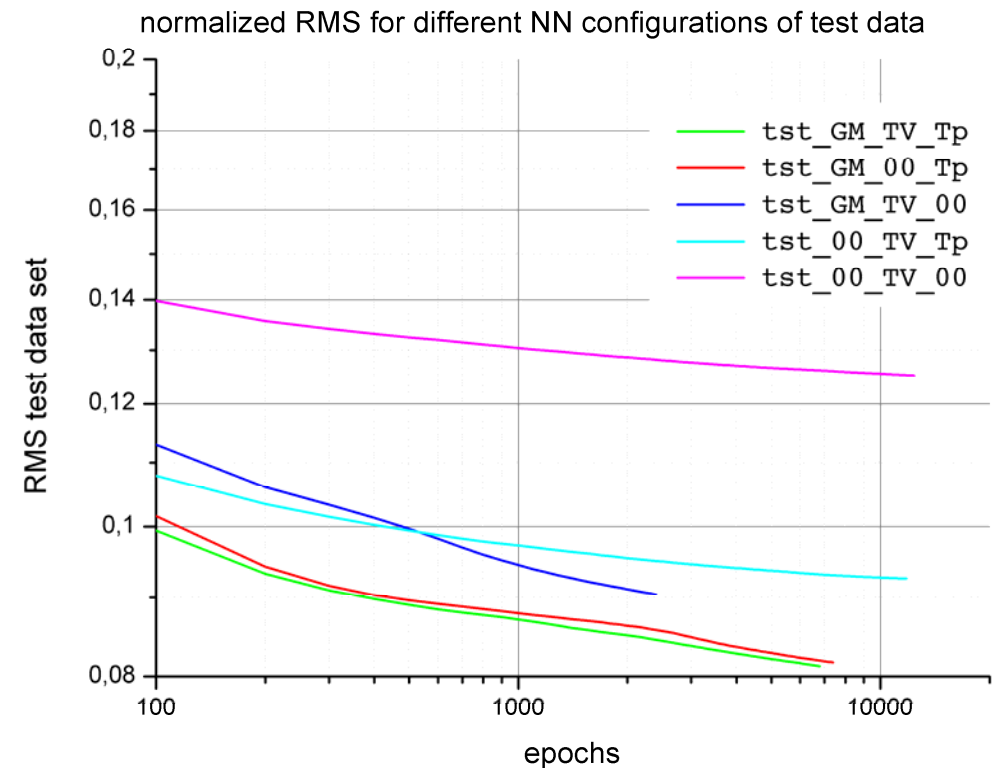
Estimation of Local Retrieval Error



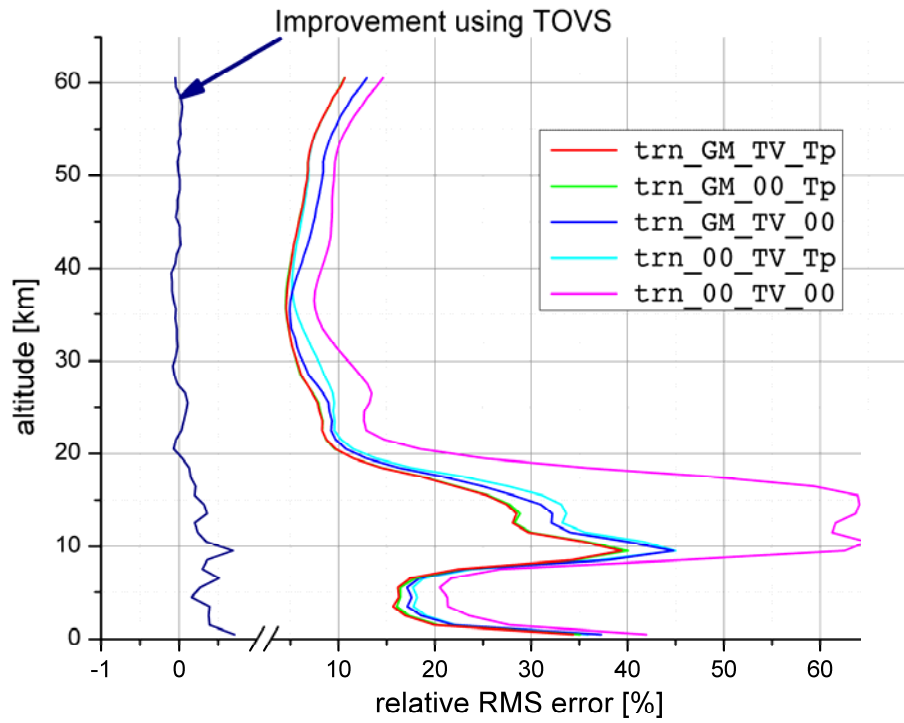
NNORSY NN configurations: training/test



GM: GOME
TV: TOVS
Tp: temperature profile

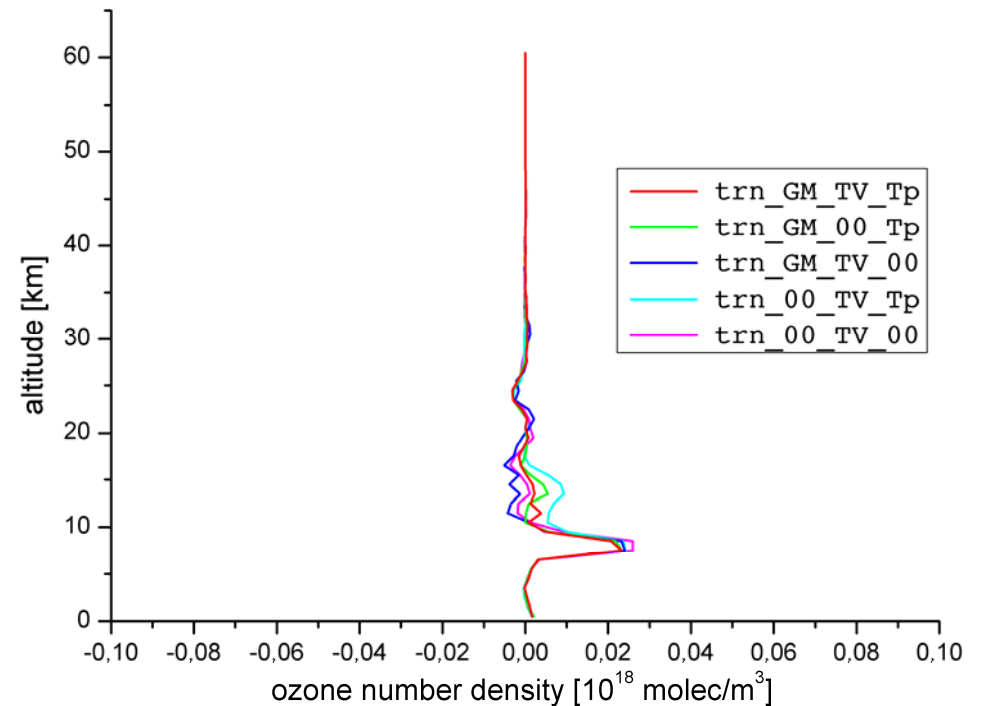


NNORSY NN configurations: profiles

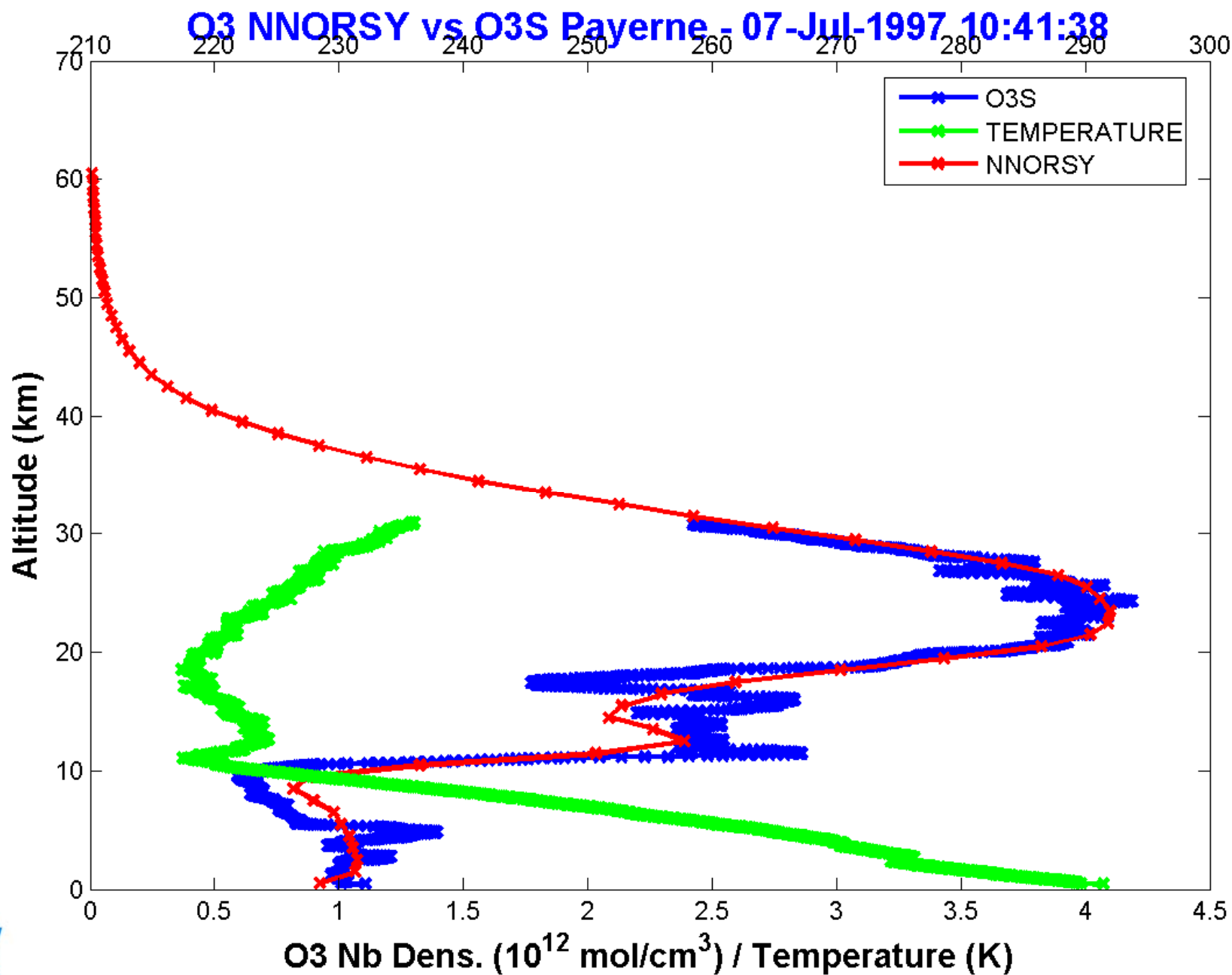


GM: GOME
TV: TOVS
Tp: temperature profile

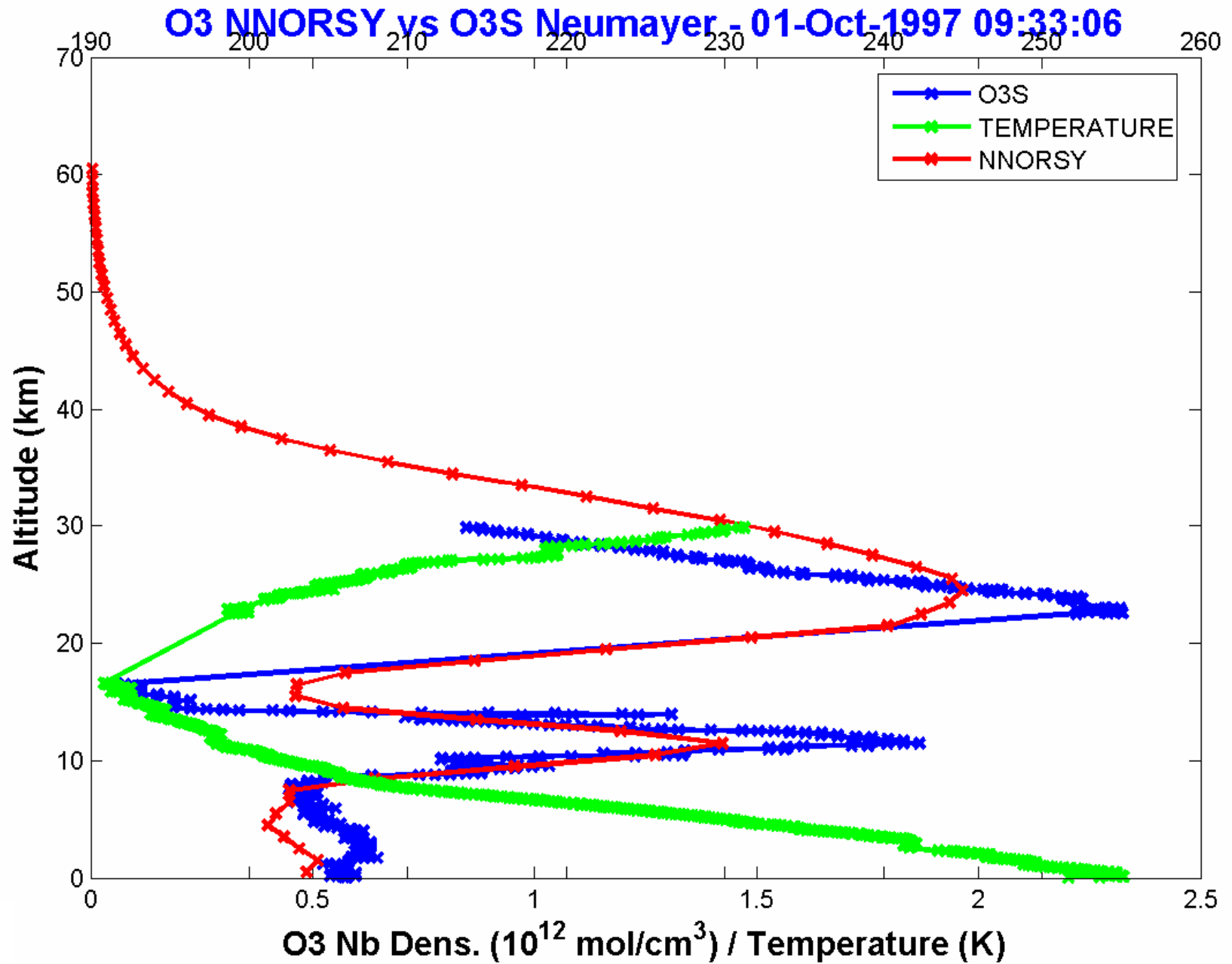
absolute bias error of different NN configurations



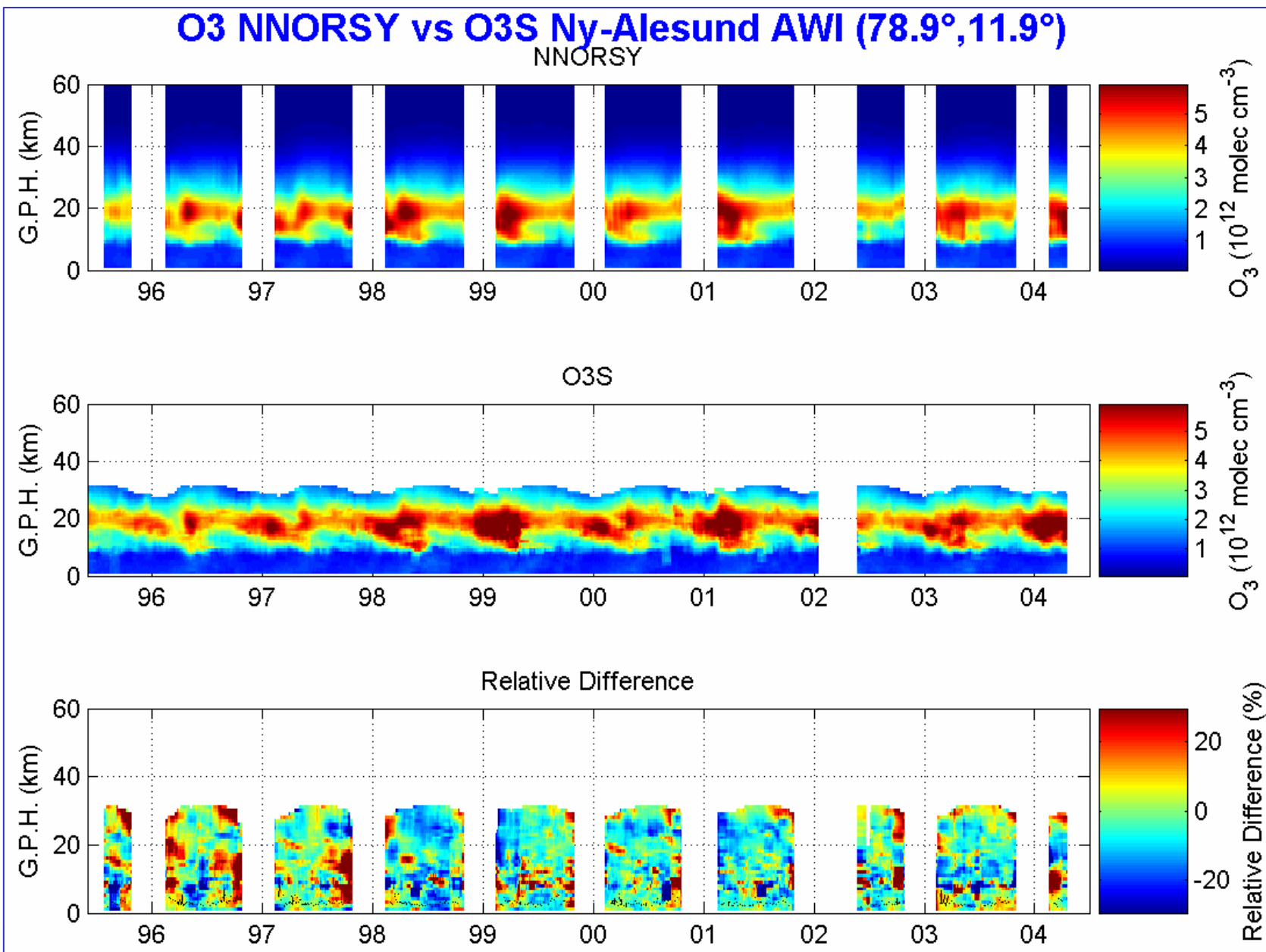
NNORSY-GOME Single Ozone Profile I



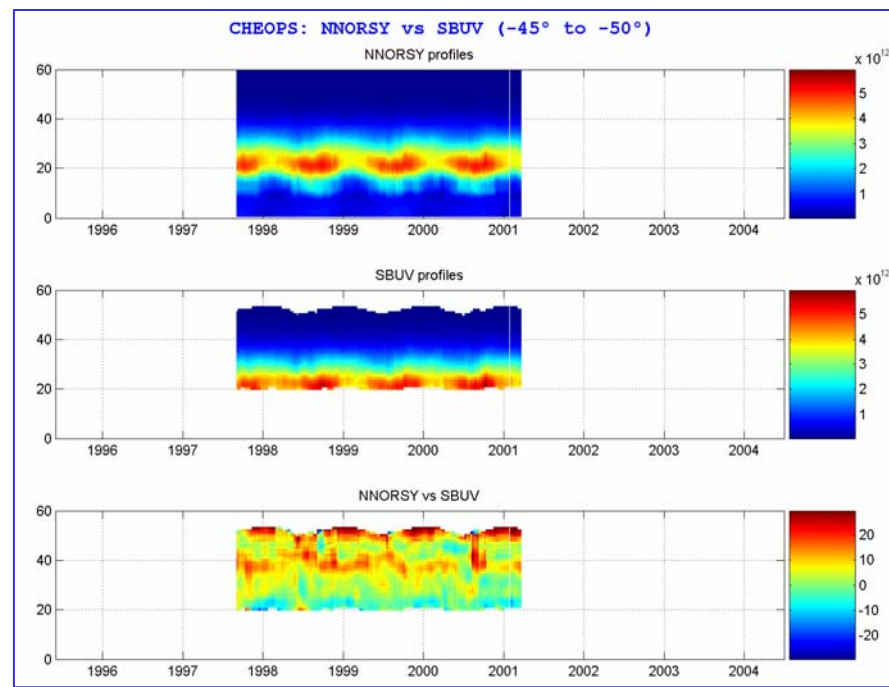
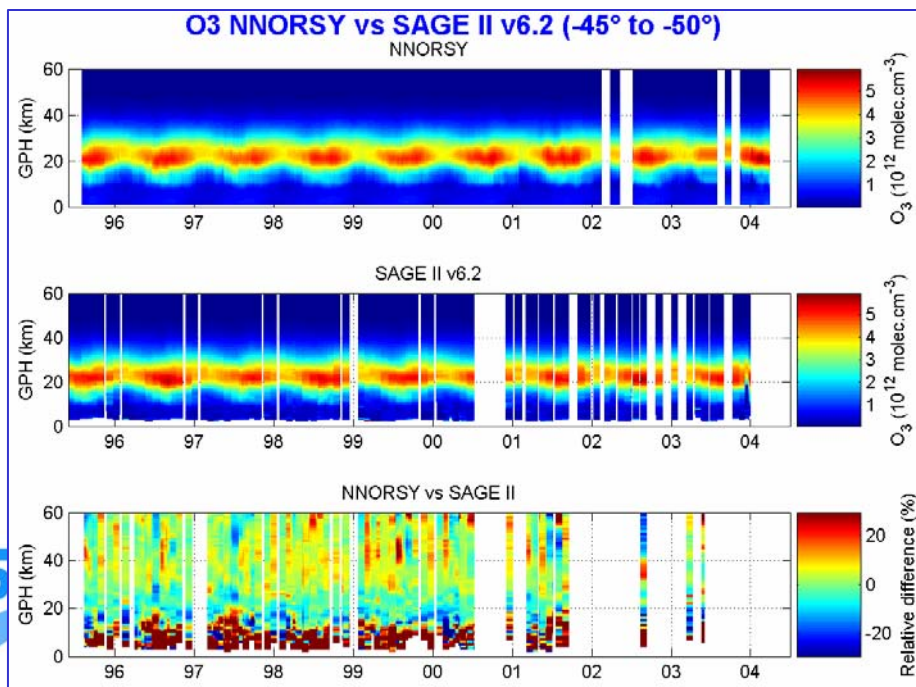
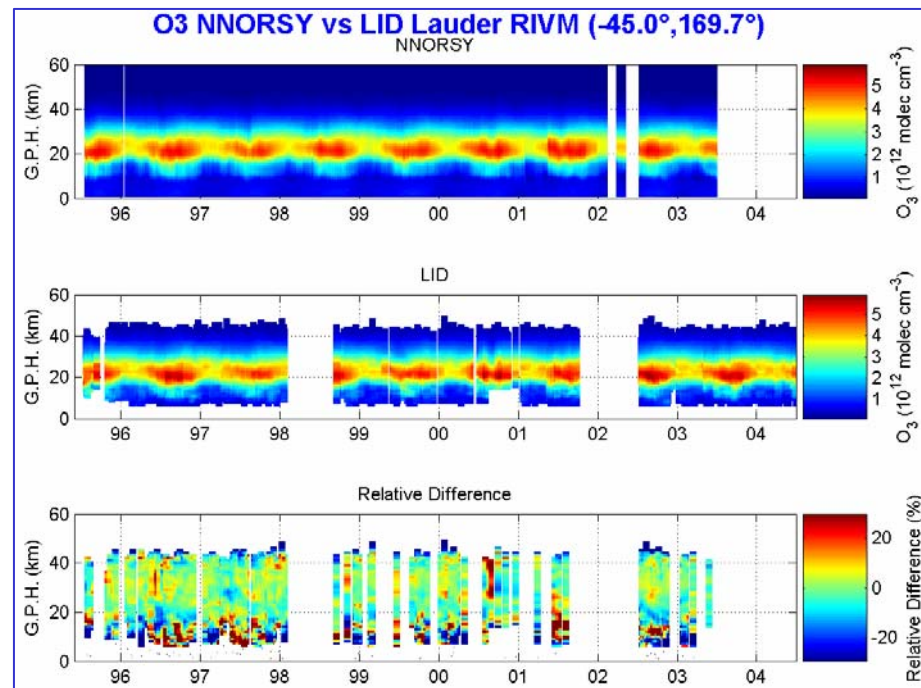
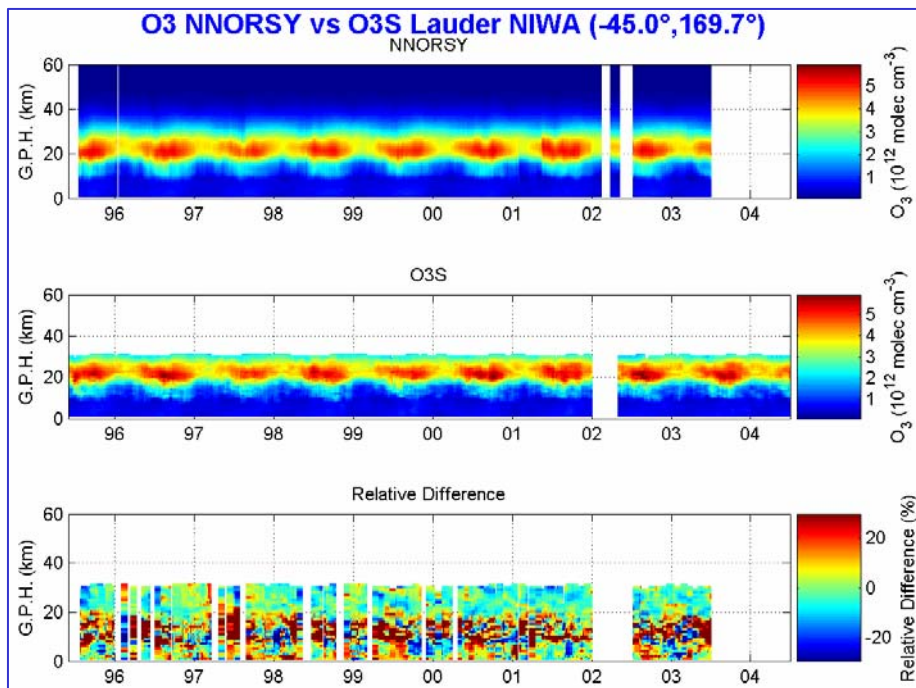
NNORSY-GOME Single Ozone Profile II



Correlative Analysis: Artic

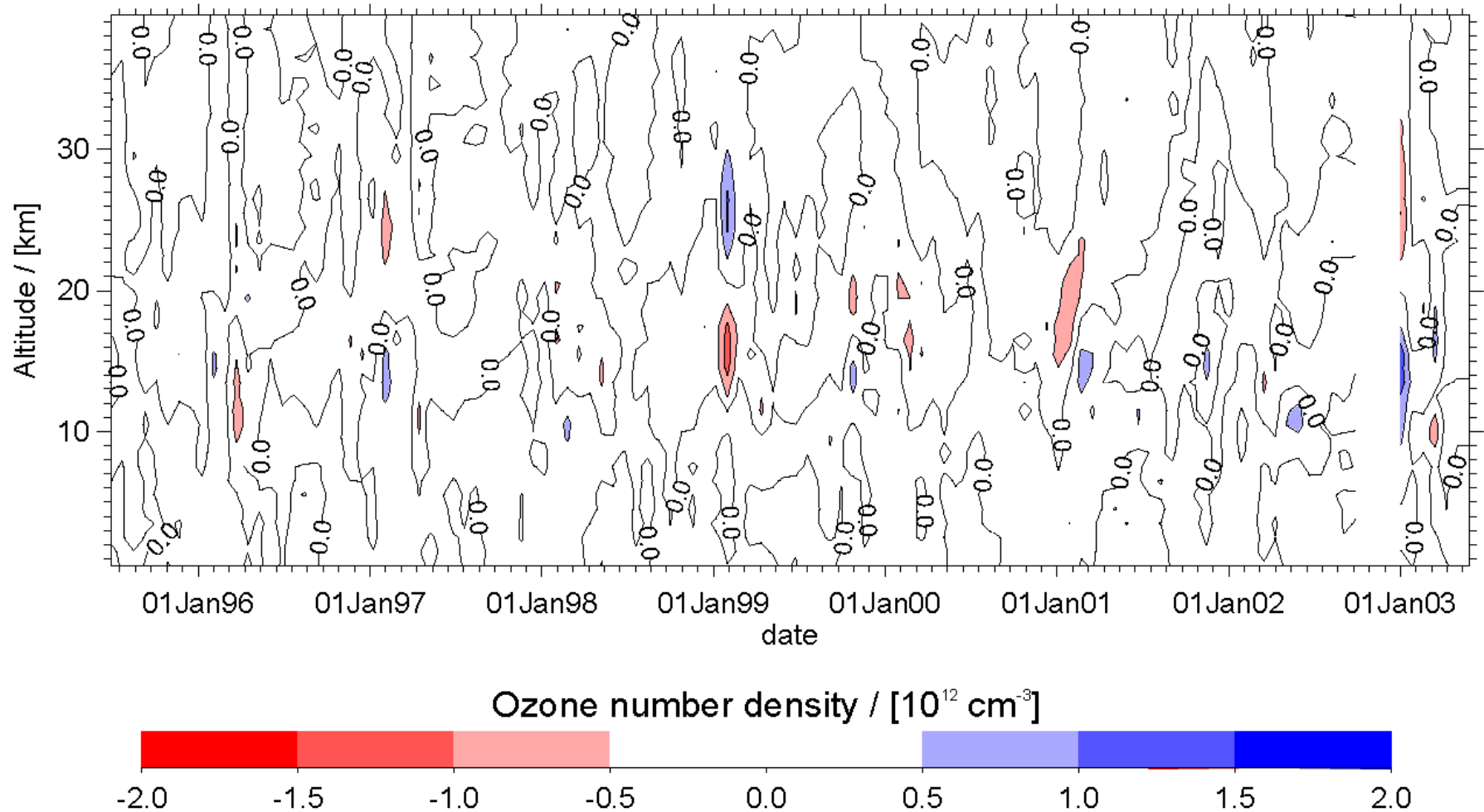


Correlative Analysis: 40° S / New Zealand



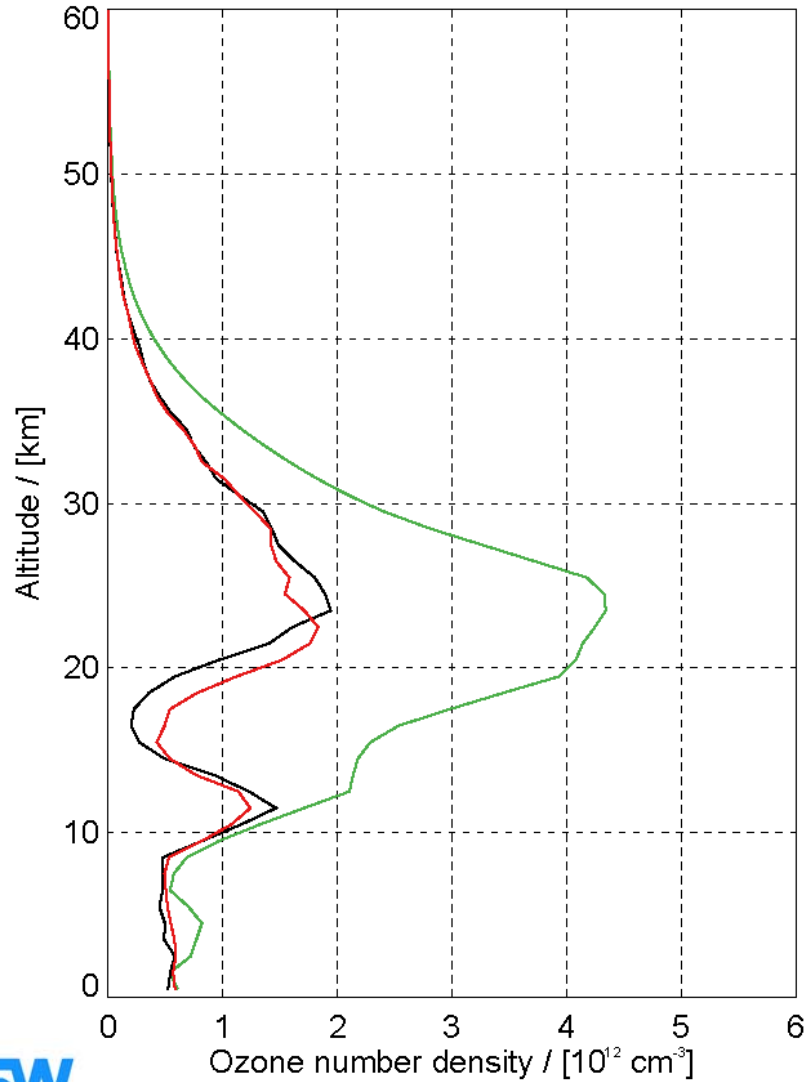
NNORSY-Climatology (TLLO): Time Series

NNORSY-CLIMA (TLLO): H-Peiss. lat: 47.80 lon: 11.02

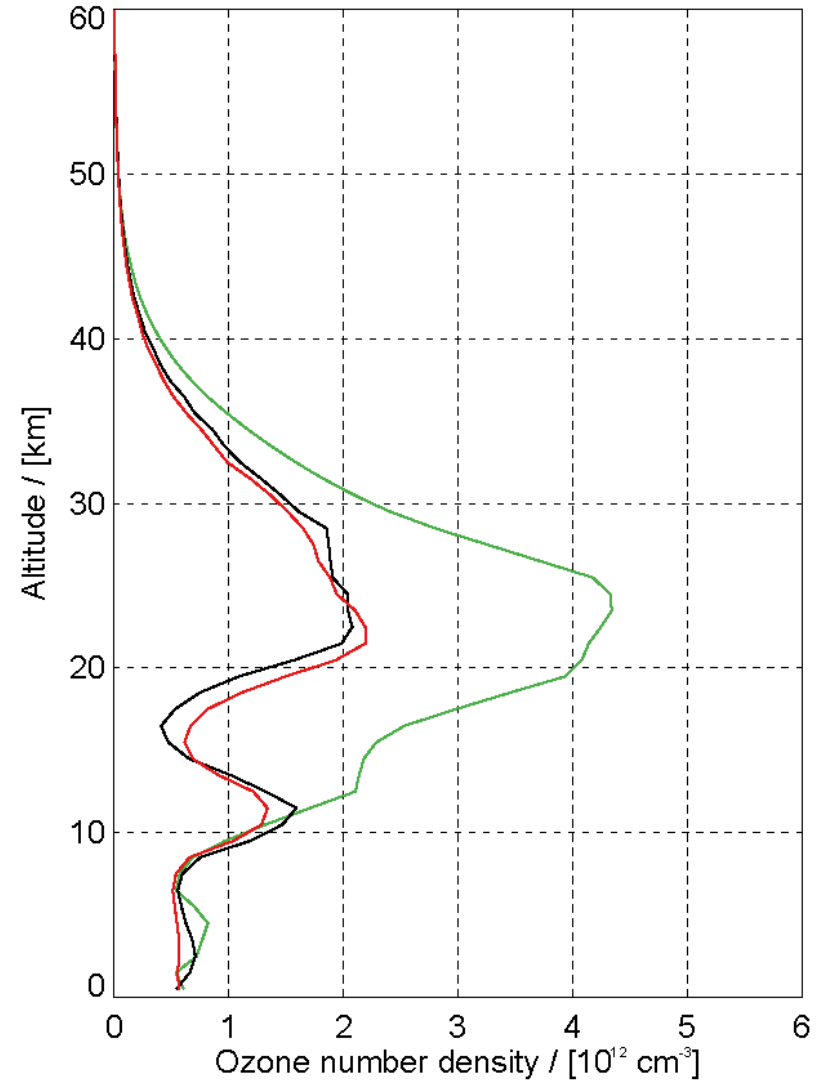


NNORSY-Climatology (TIIO): Single Profiles for Antarctic

x: 1893 Date: 04/10/95-0551 Lat:-69.81 Lon: 36.8 DU: 136.



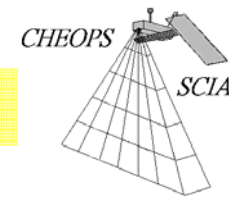
x: 1667 Date: 08/10/99-0648 Lat:-69.47 Lon: 40.7 DU: 163.



NNORSY: Summary and Current

- ▶ 10 year NNORSY-GOME ozone profile data set
- ▶ comparison/validation with sonde/lidar/satellite and data assimilation
- ▶ Combining GOME with TOVS: small improvements in troposphere
- ▶ New dynamic ozone profile climatology available

- ▶ Using NNORSY for setup of new ozone profile retrieval
 - ▶ NNORSY application to SCIAMACHY nadir
 - ▶ NNORSY-OMI for ozone profile retrieval



NNORSY-MetOp: Future

- ▶ Total ozone column

 - ▶ ATOVS, IASI, GOME, GOME+IASI

- ▶ Ozone profiles

 - ▶ IASI, GOME, GOME+IASI