NOAA-TOVS 23 Year Total Column Ozone Product by Neural Network Retrieval System (NNORSY)

Anton K. Kaifel, Martin D. Müller

Center for Solar Energy and Hydrogen Research (ZSW)
Stuttgart, Germany

Outline

- Approach and processing
- Validation
- Comparison
- Trend analyses
- Conclusions
- Movie (09/79-12/01)*

**) mpeg movie of total ozone data (total 1.2GB) available on ftp-site: ftp.zsw-bw.de /pub/NNORSY/TOVS*

Neural Network Ozone Retrieval System (NNORSY)

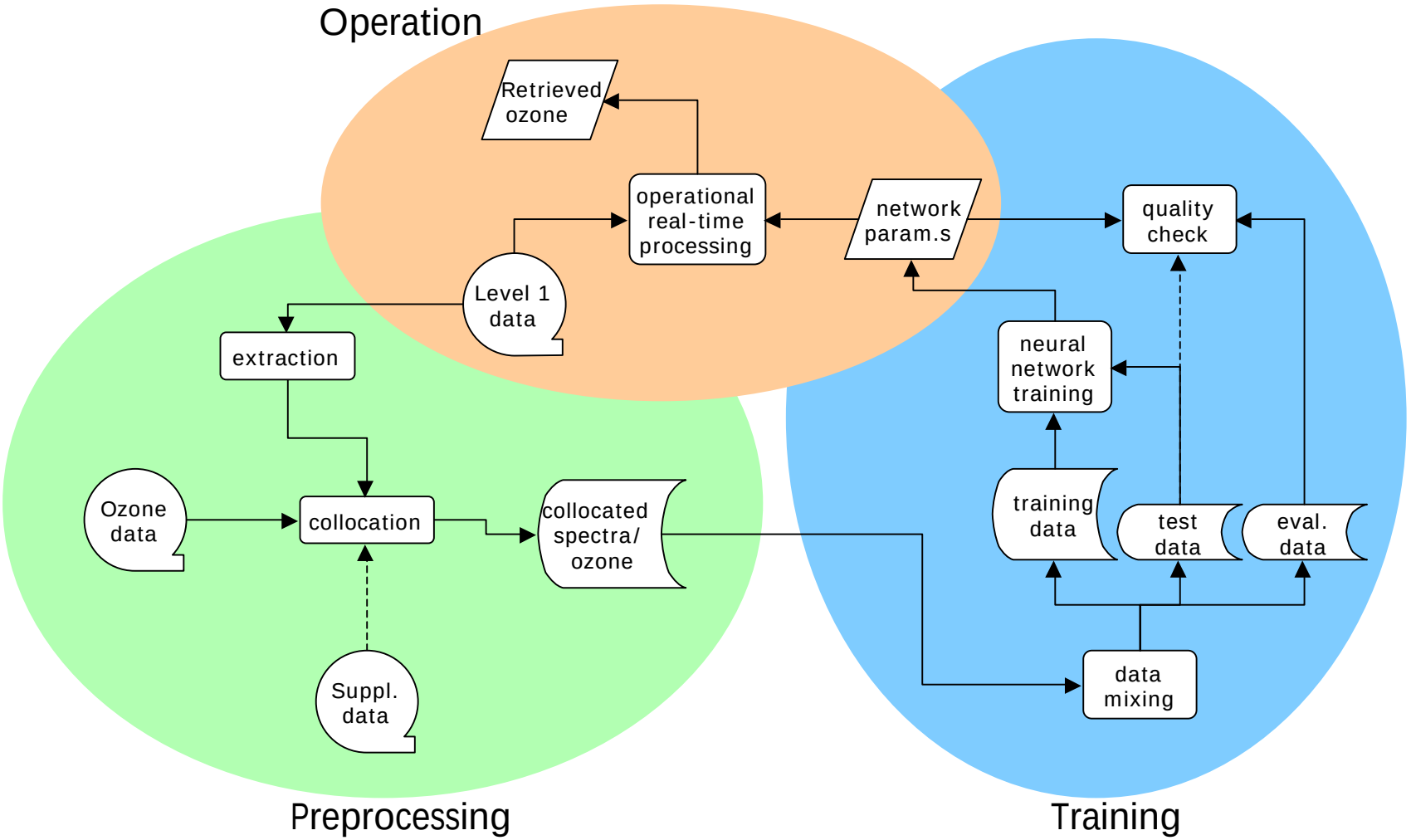
Current available:

- NNORSY-TOVS (total ozone column)
- NNORSY-GOME (total ozone column)
- NNORSY-GOME (profile)

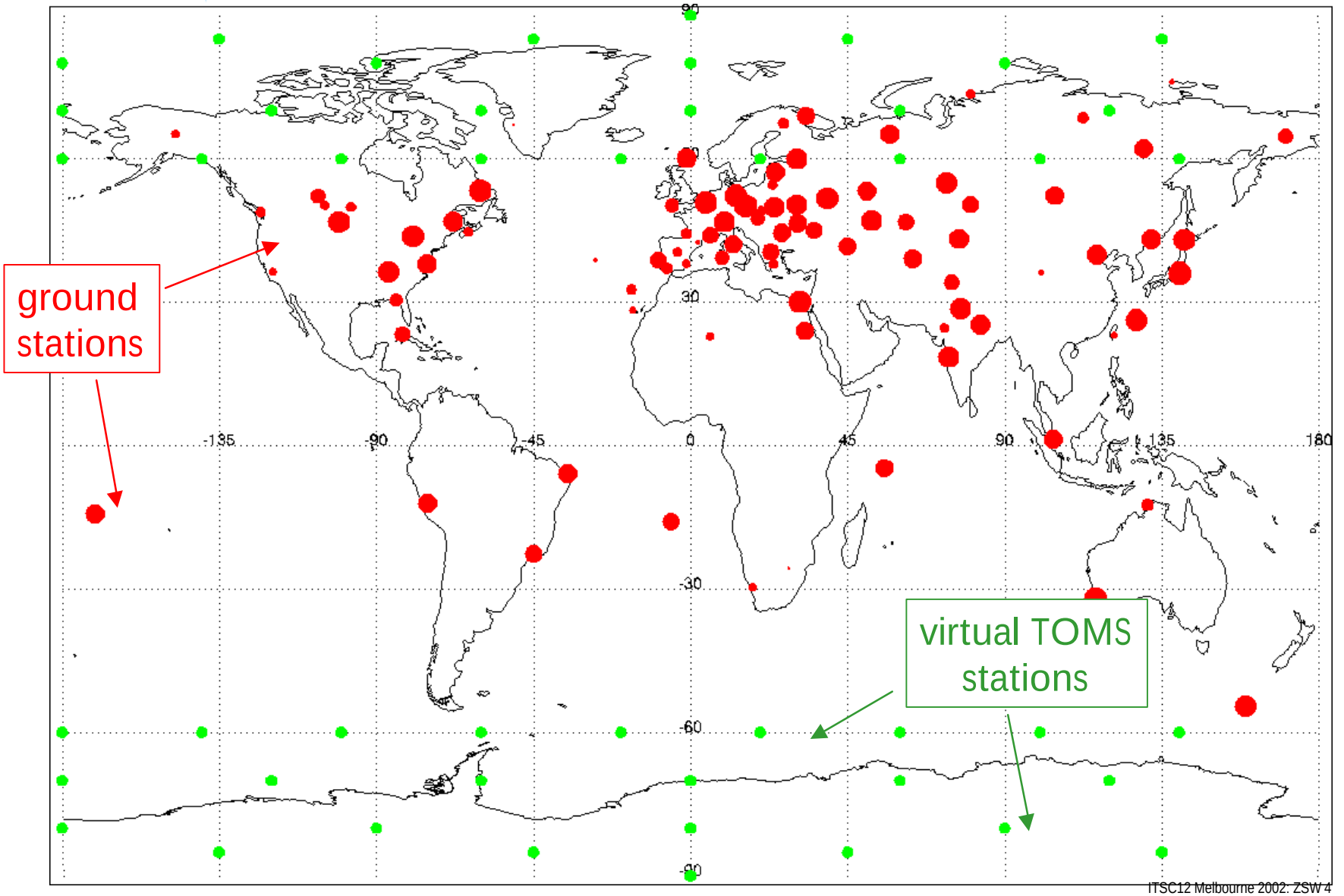
Planned:

- NNORSY-SEVIRI (total ozone column)
- NNORSY-OMI (profile and total column)

NNORSY Scheme

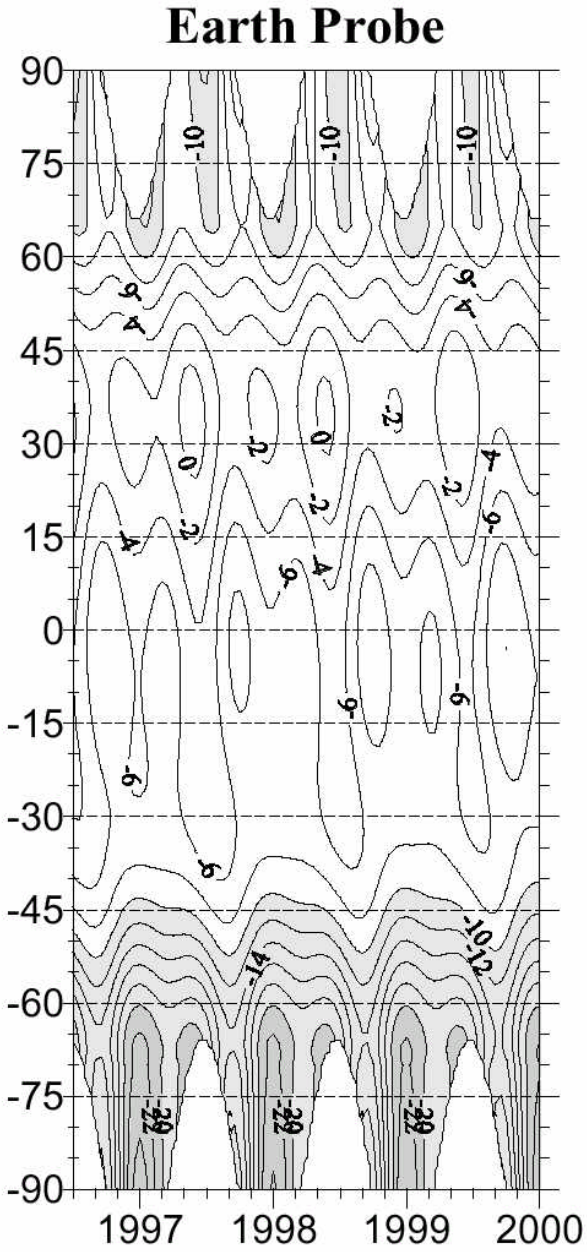


WOUDC/Virtual Station Distribution



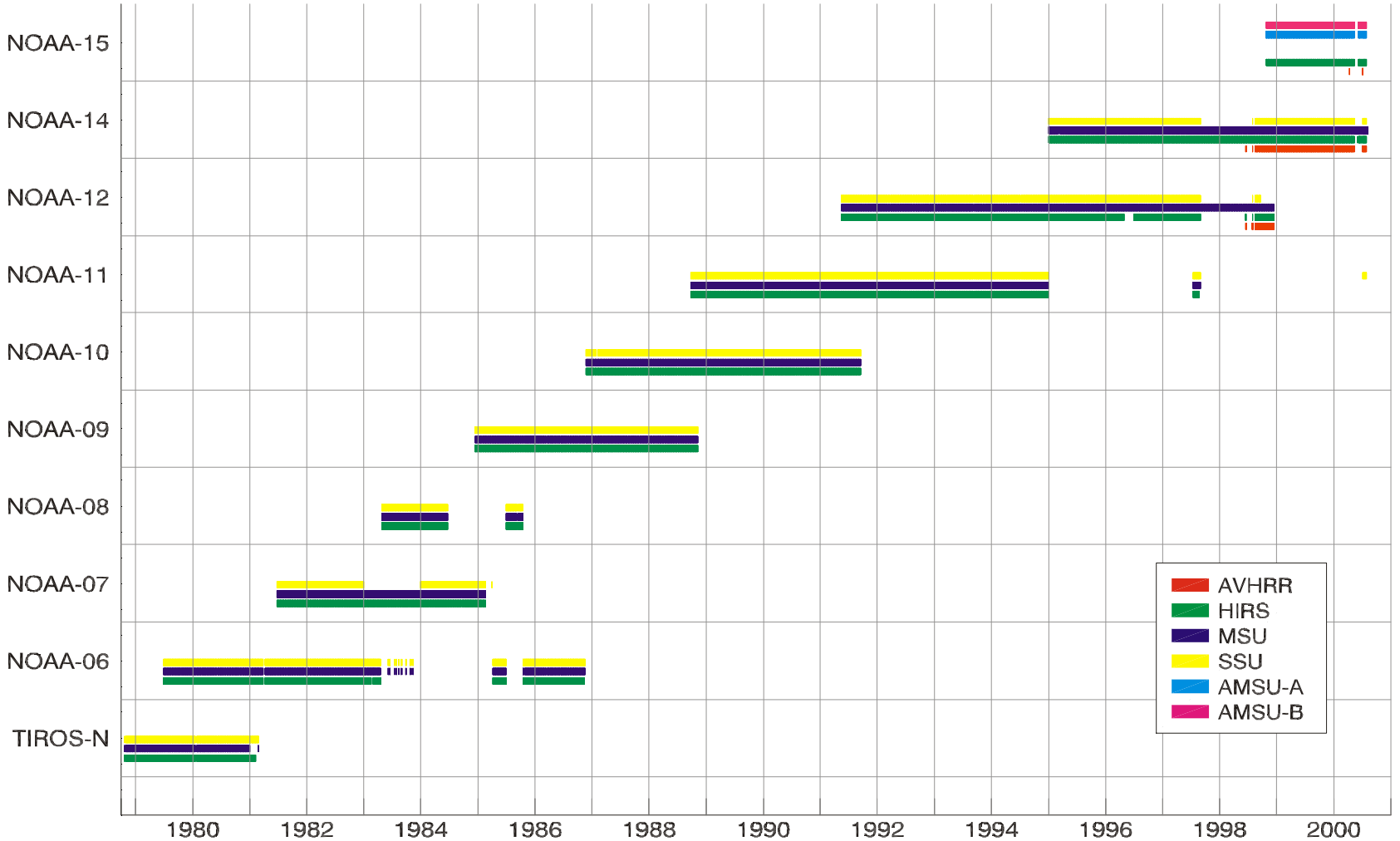
Climatological Correction of TOMS Data

EPT-Ground fit over latitude and time (DU)



(*Bodeker et al., 2001*)

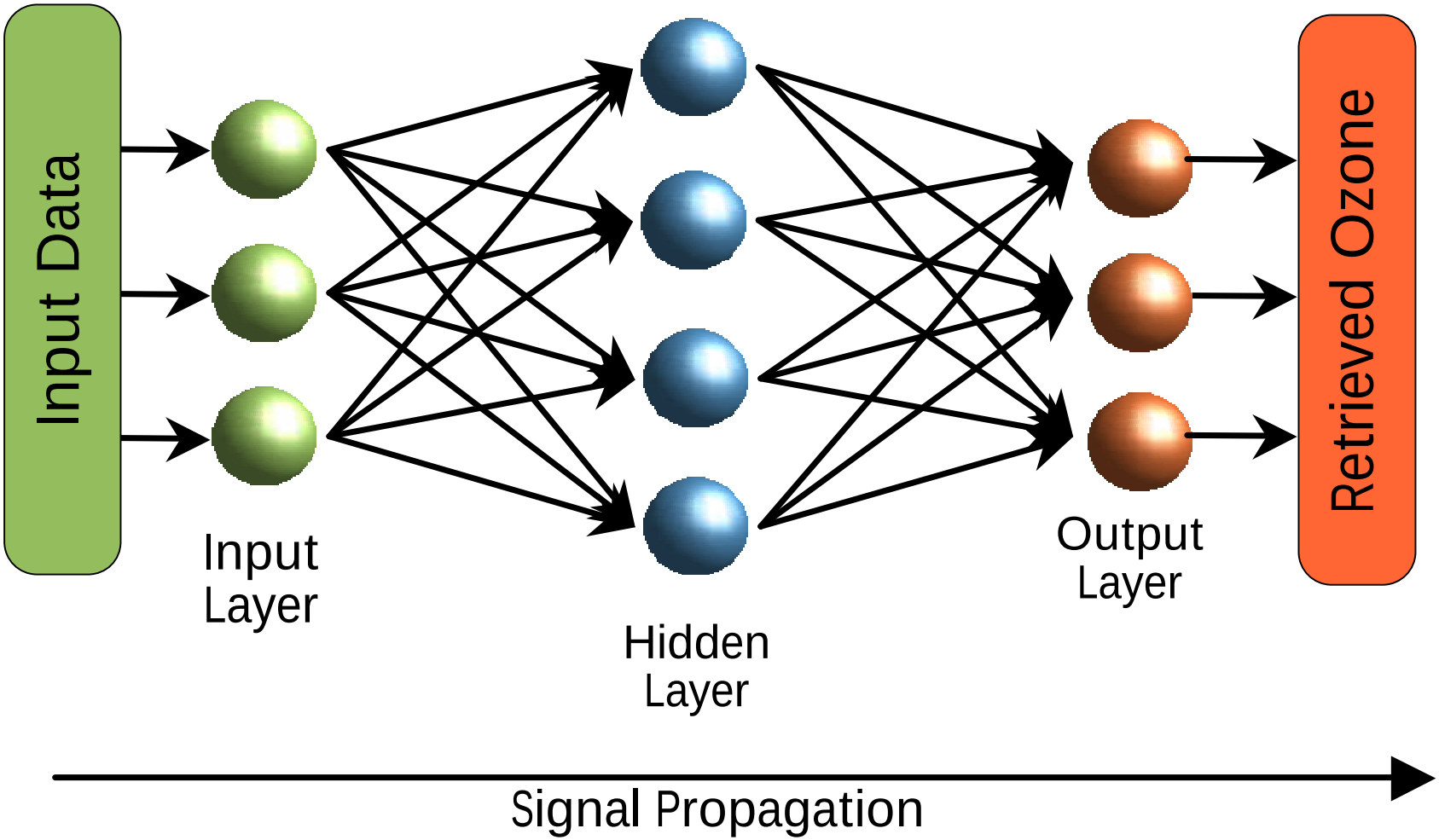
NOAA-TOVS Data at ZSW



NNORSY-TOVS: Input Data

- Timerange 09/1979 to 01/2002
- Satellites TIROS-N, NOAA-6 to NOAA-14
- Collocation radius 75 km
- yields:
  ~ 1.5 million training datasets
  ~ 200000 test datasets

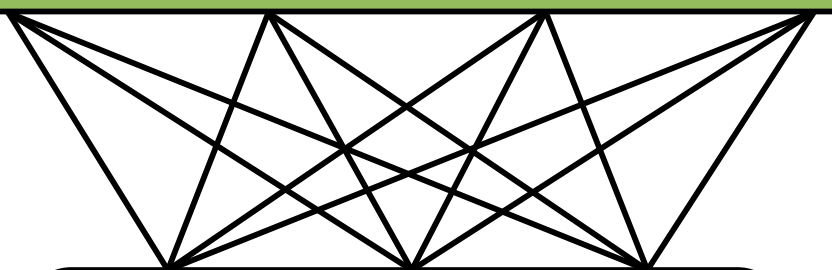
Feed-Forward Neural Network



NNORSY-TOVS: Input Data

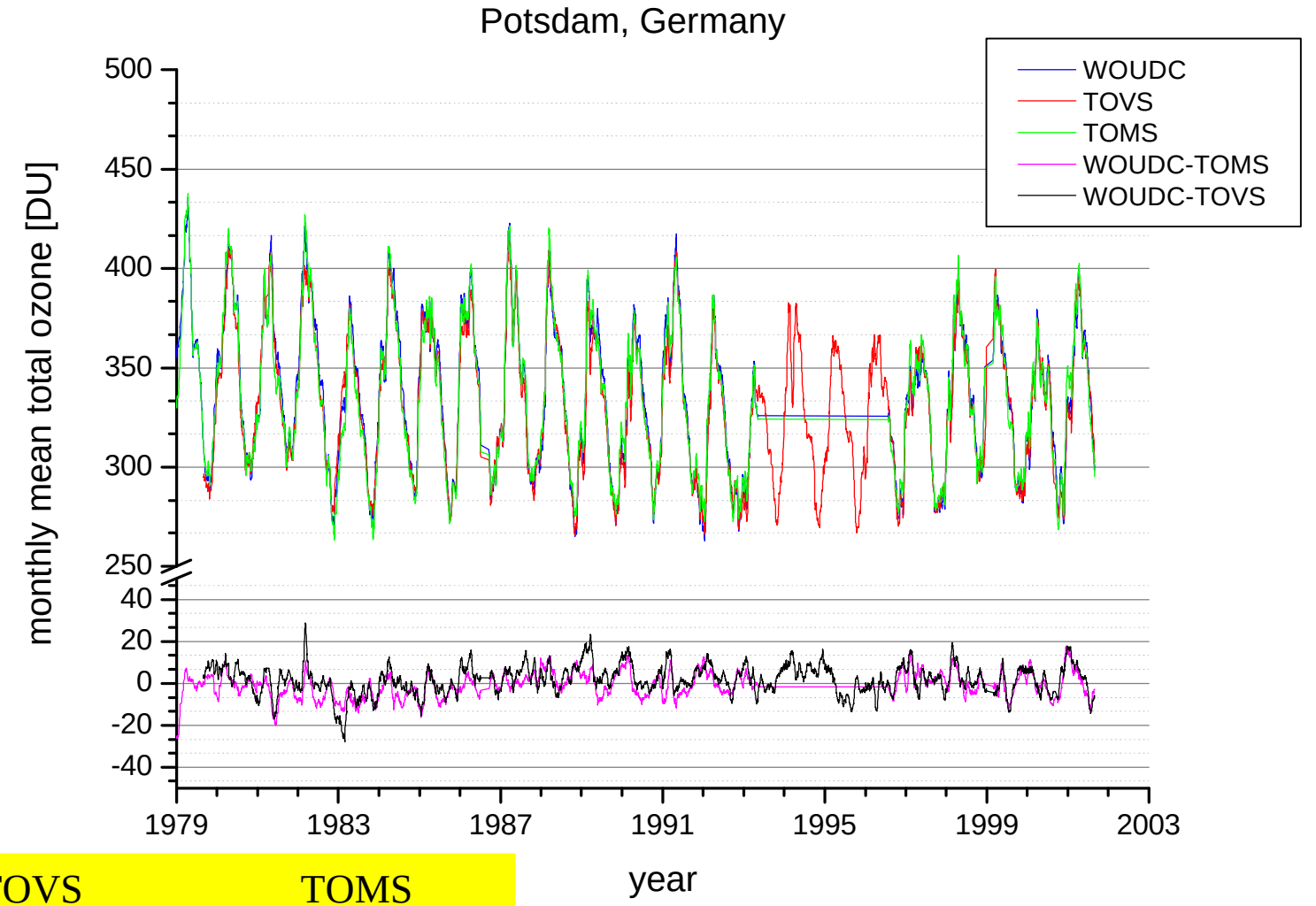
Neural Network Input (28 neurons):

- HIRS channels 1-19
- MSU channels 1-4
- HIRS scan angle
- Solar & satellite zenith angle
- Latitude
- Elevation



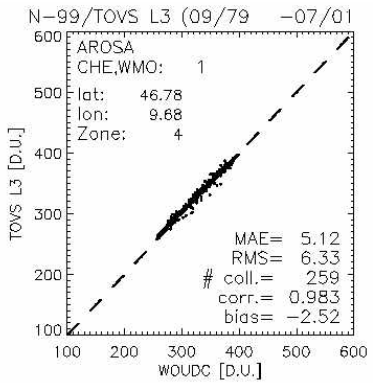
Retrieved Total Ozone

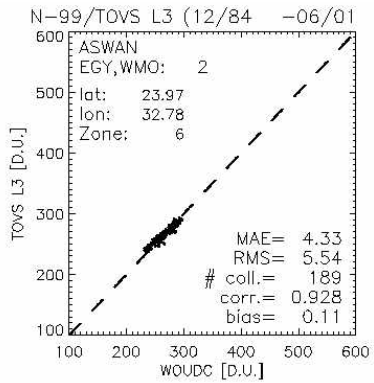
NNORSY-TOVS: Ground validation over time

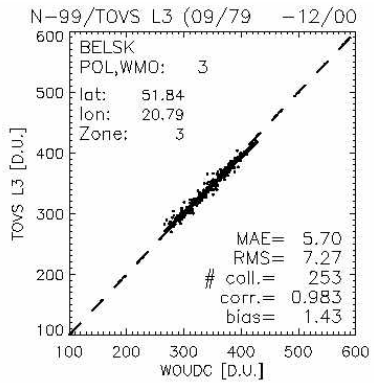


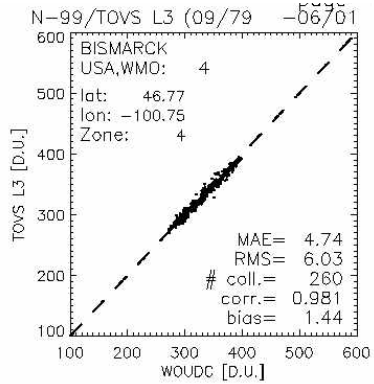
Potsdam	TOVS	TOMS
RMS:	7.2 D.U.	6.5 D.U.
Bias:	1.9 D.U.	-0.9 D.U.

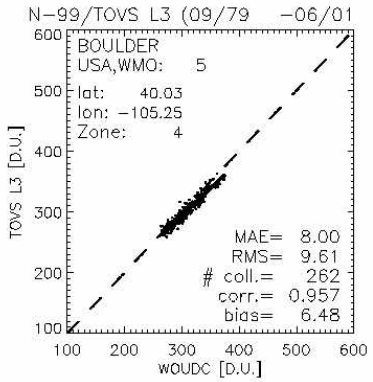
NNORSY-TOVS: Ground validation monthly mean 1/5

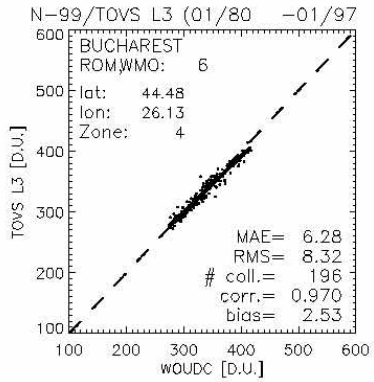


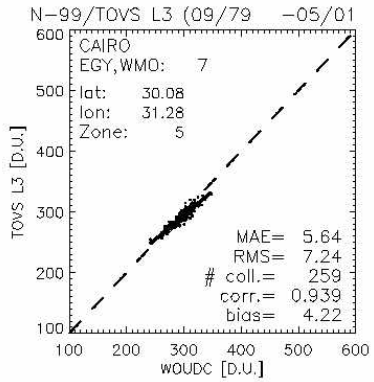


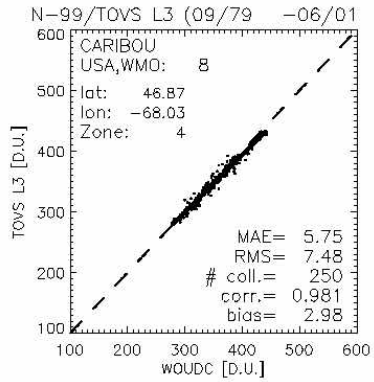


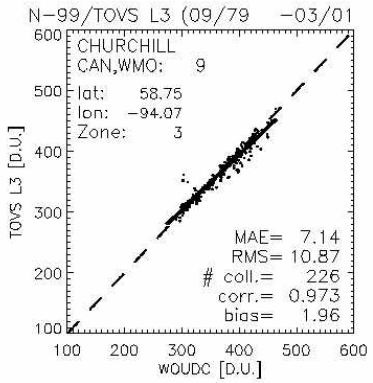


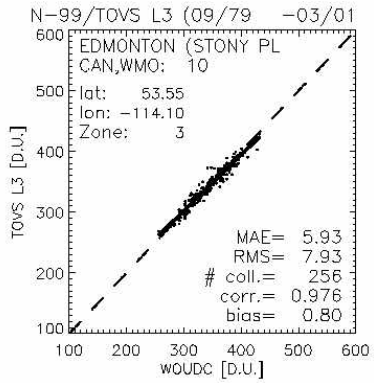


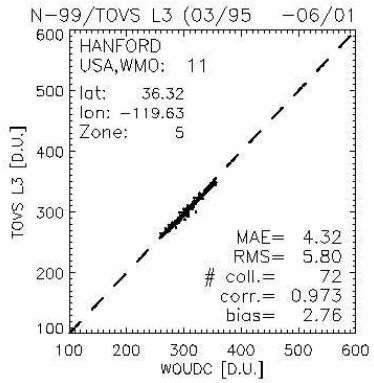


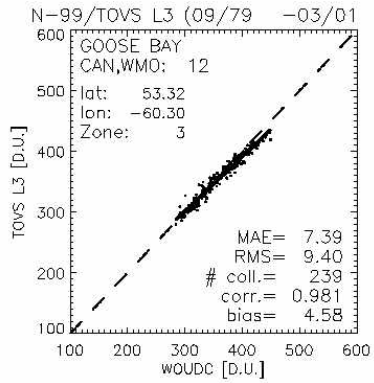




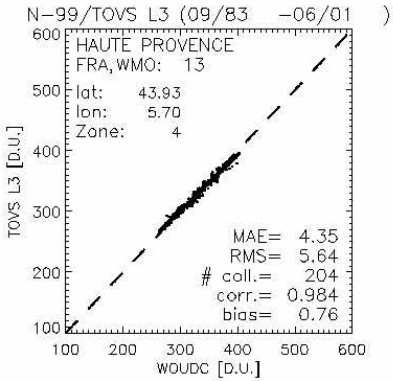


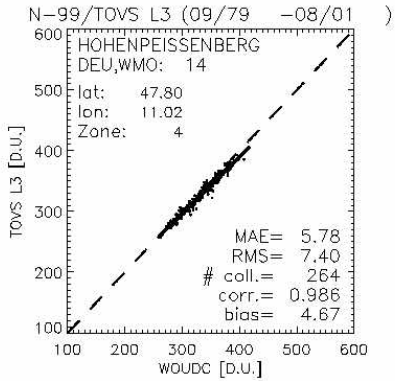


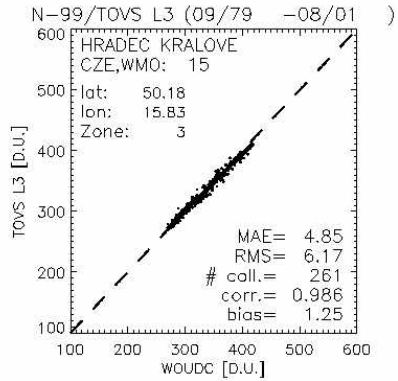


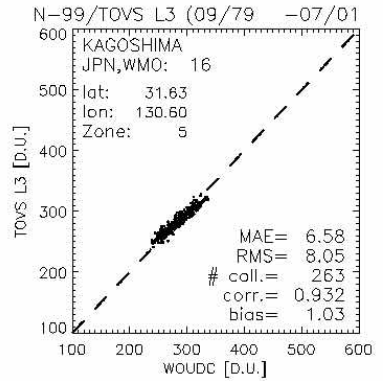


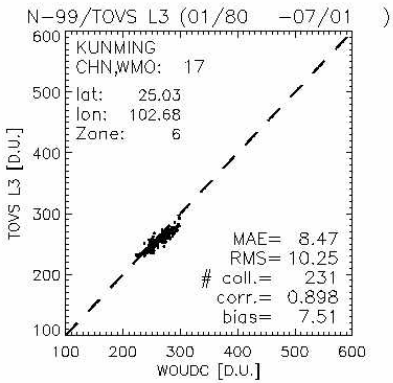
NNORSY-TOVS: Ground validation monthly mean 2/5

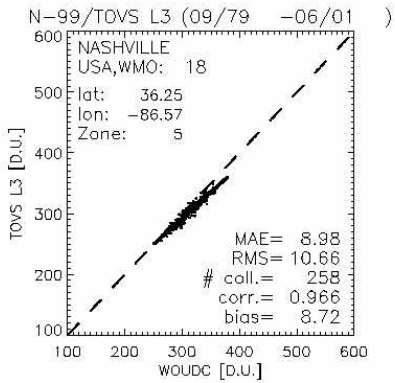


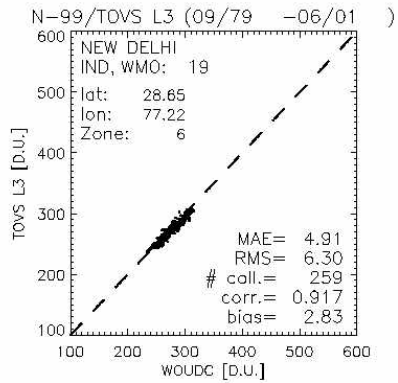


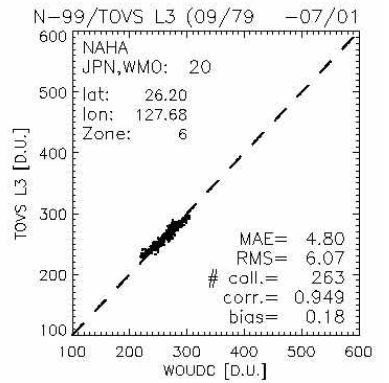


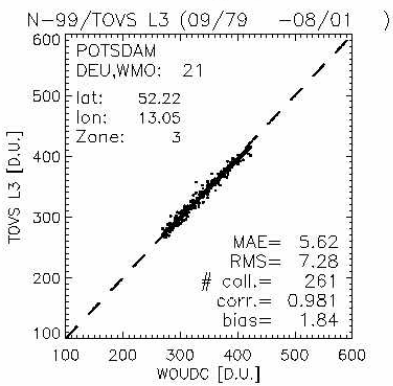


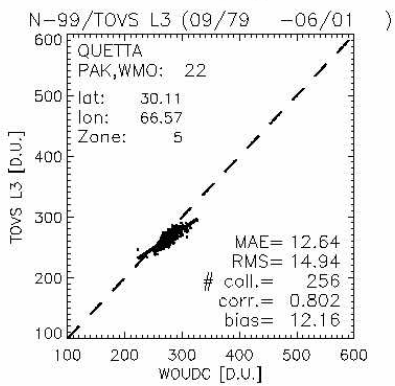


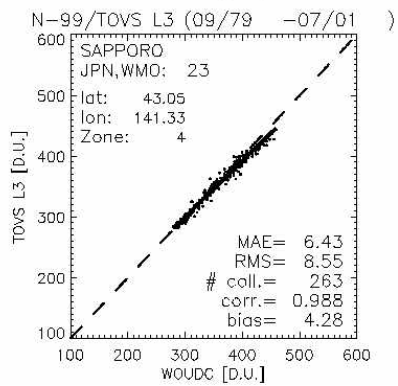


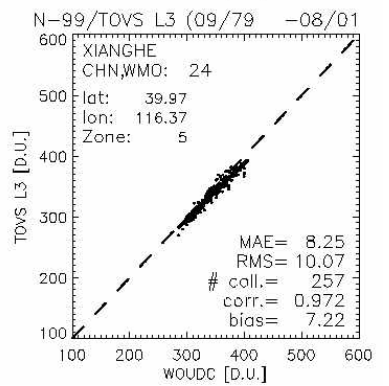




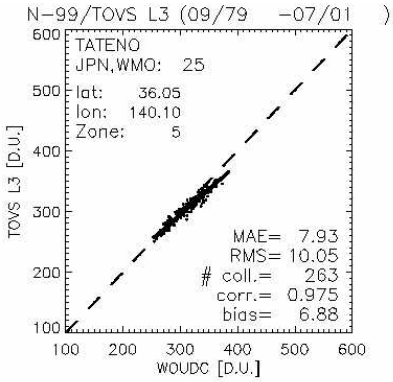


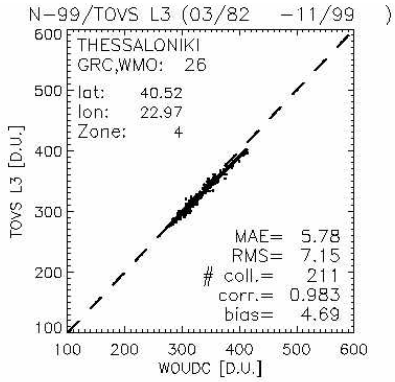


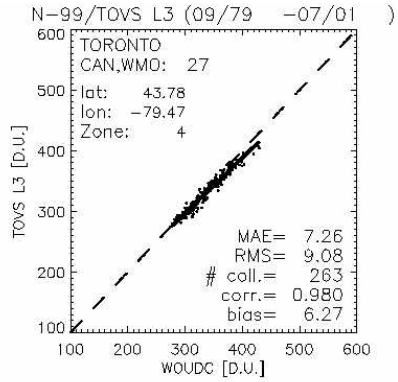


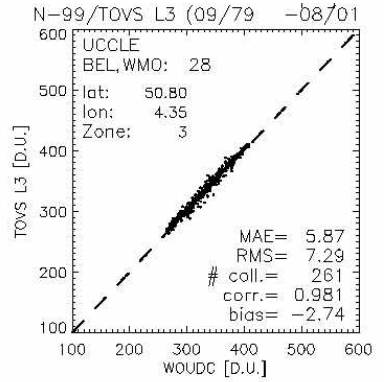


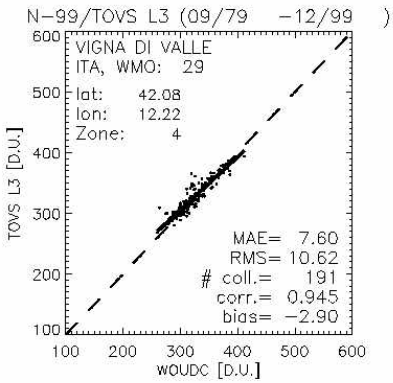
NNORSY-TOVS: Ground validation monthly mean 3/5

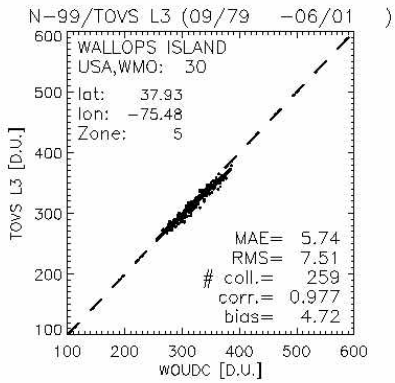


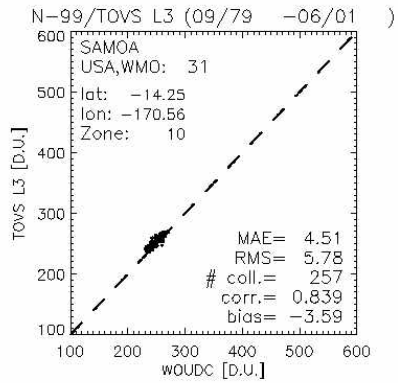


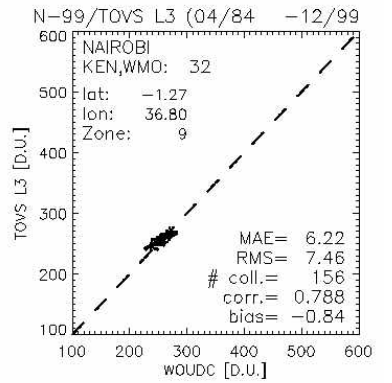


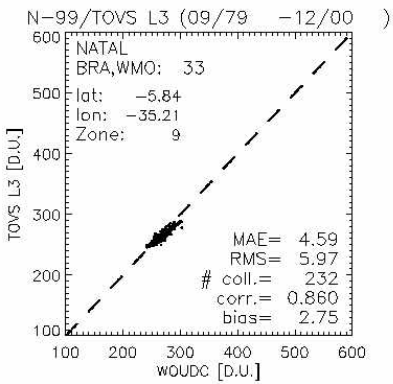


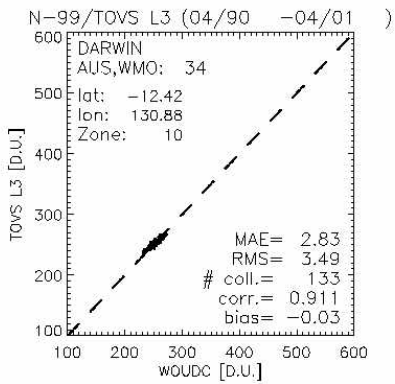


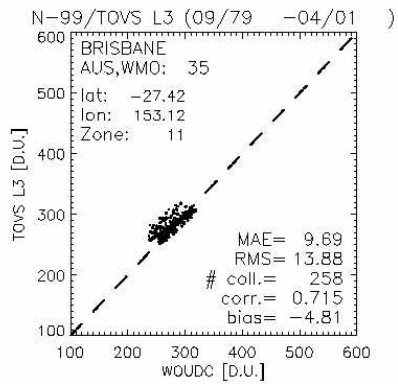


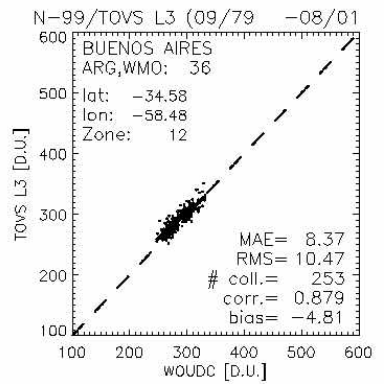




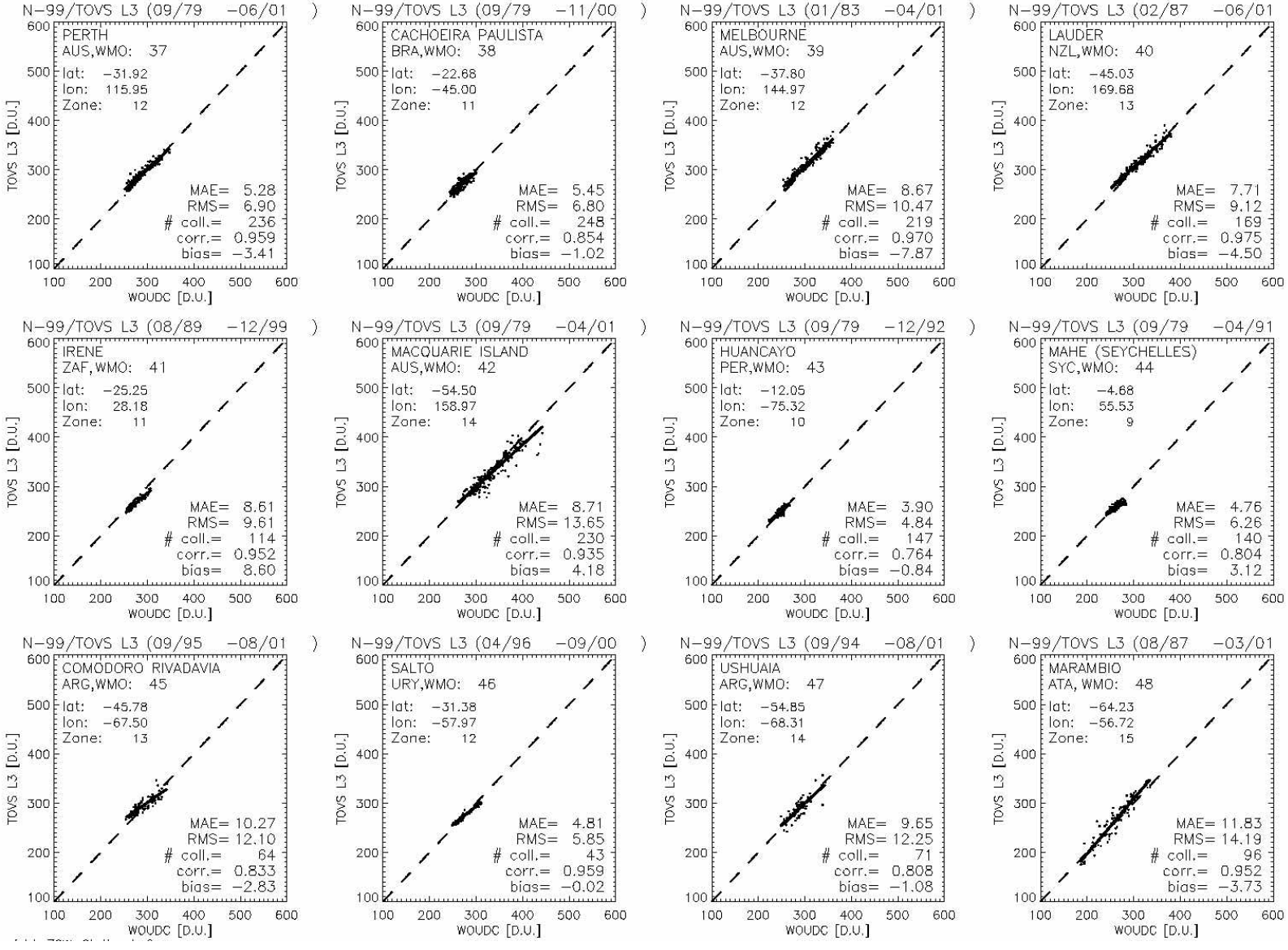




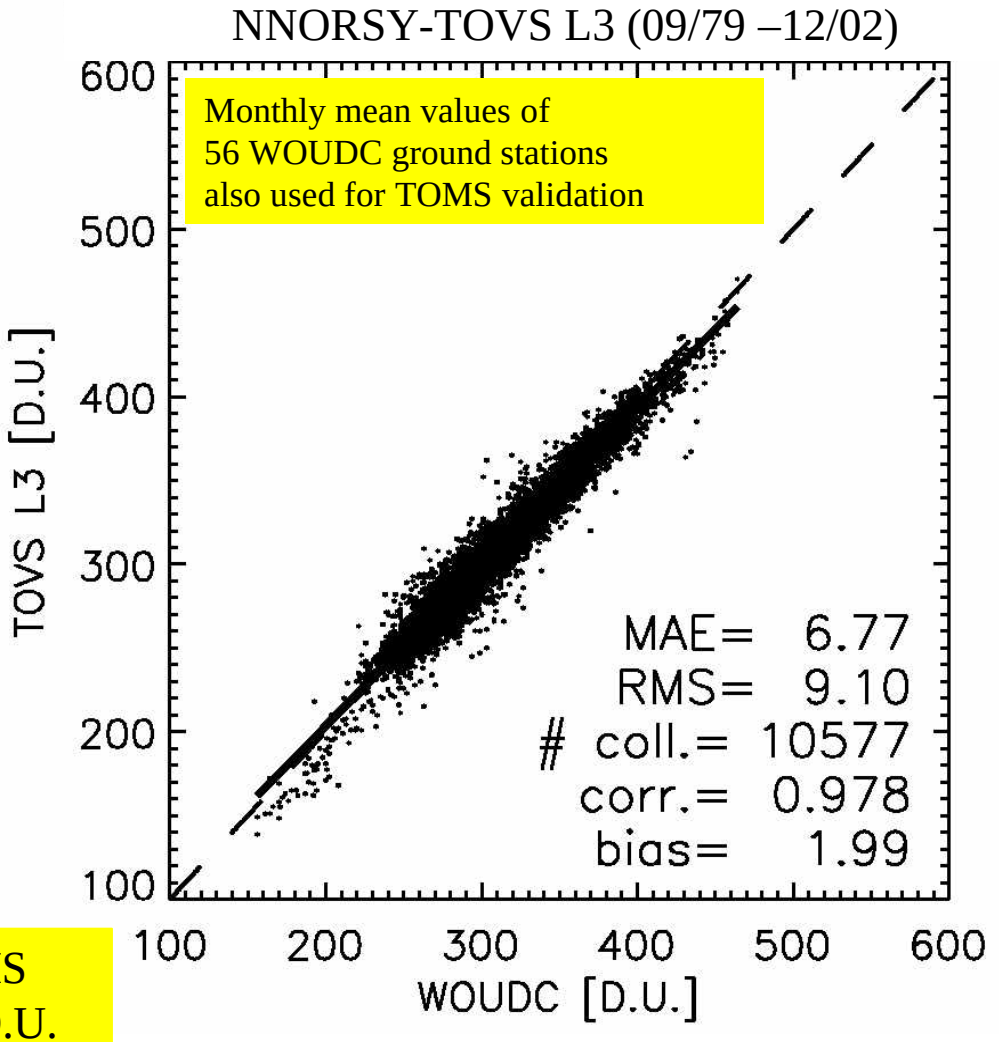




NNORSY-TOVS: Ground validation monthly mean 4/5



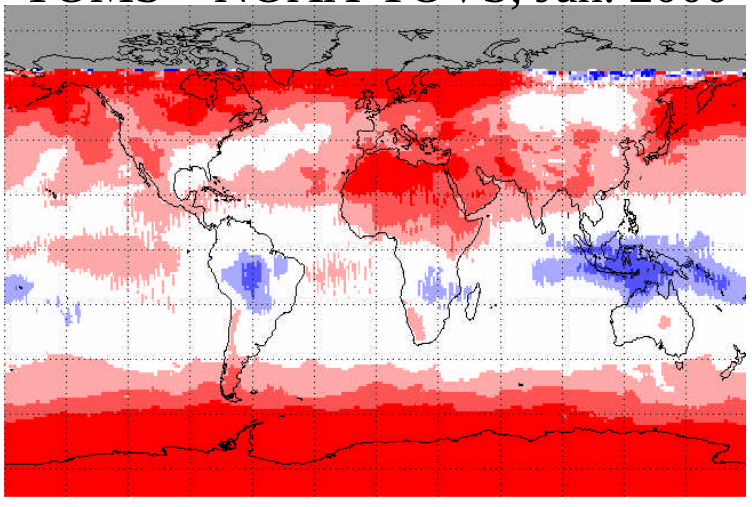
NNORSY-TOVS: Ground validation monthly mean 5/5



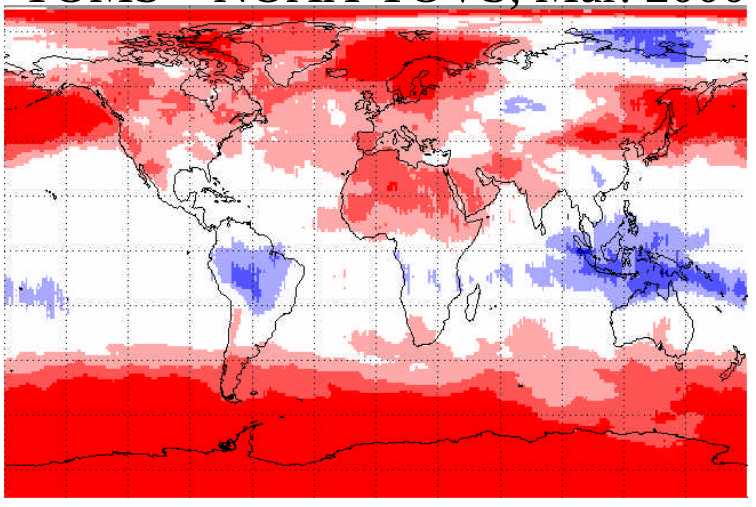
global	TOVS	TOMS
RMS:	9.1 D.U.	8.0 D.U.
Bias:	2.0 D.U.	-2.8 D.U.

Comparison of monthly mean with NOAA operational product 1/2

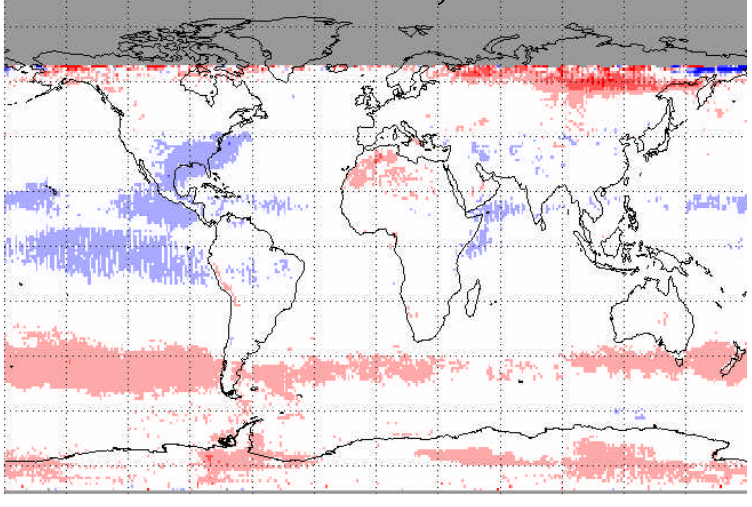
TOMS – NOAA-TOVS, Jan. 2000



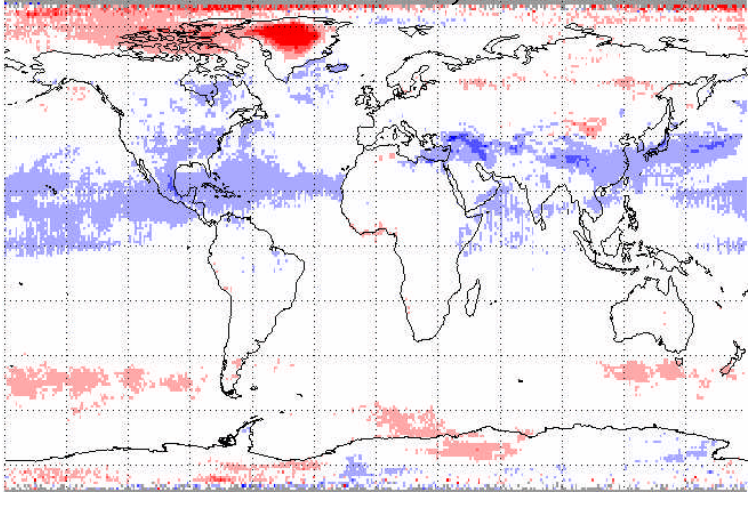
TOMS – NOAA-TOVS, Mar. 2000

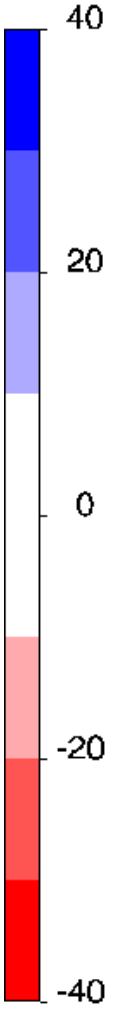


TOMS – TOVS-NN, Jan. 2000



TOMS – TOVS-NN, Mar. 2000

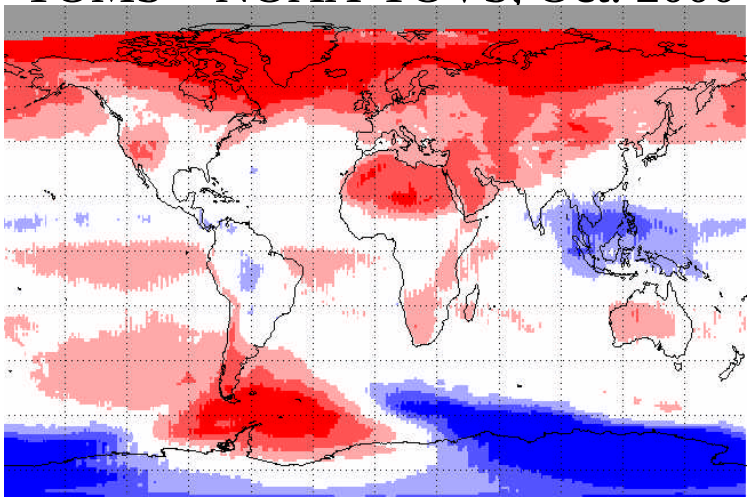




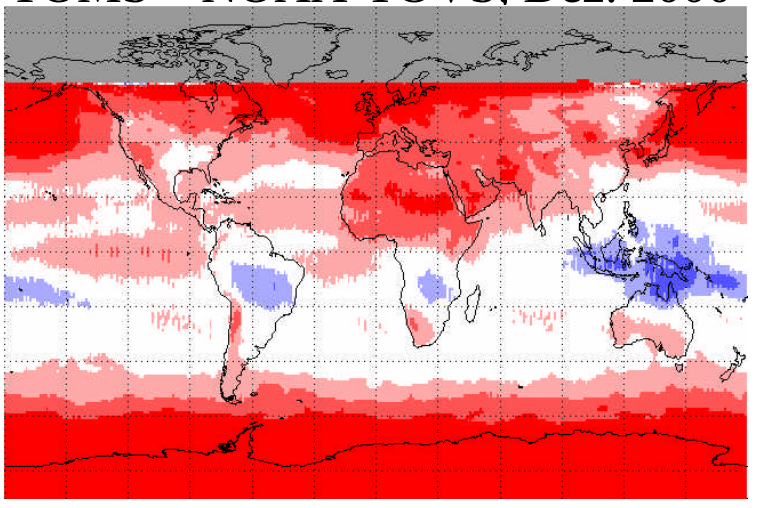
D. U.

Comparison of monthly mean with NOAA operational product 1/2

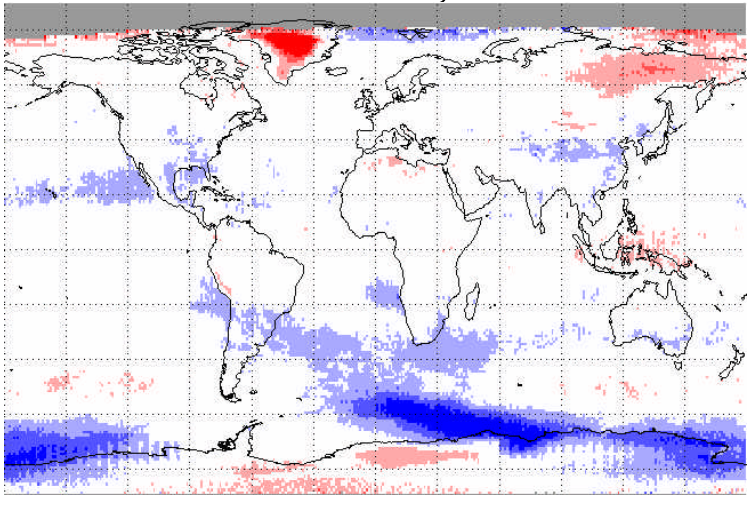
TOMS – NOAA-TOVS, Oct. 2000



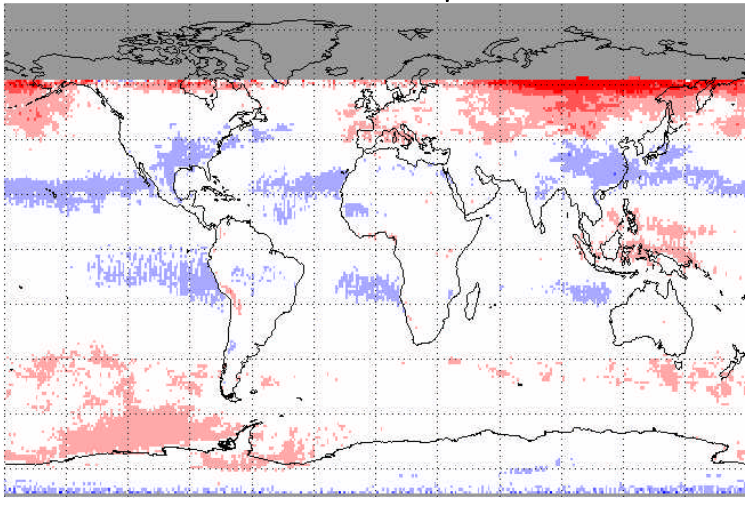
TOMS – NOAA-TOVS, Dez. 2000

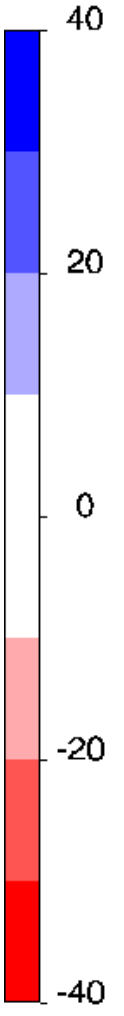


TOMS – TOVS-NN, Oct. 2000

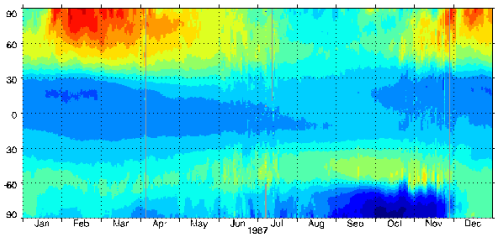


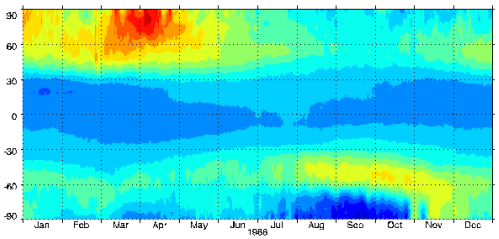
TOMS – TOVS-NN, Dez. 2000

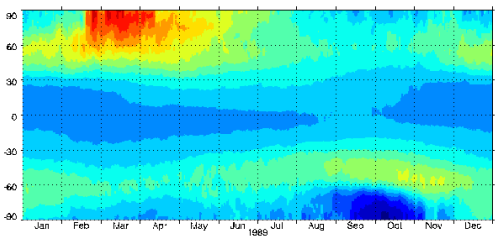


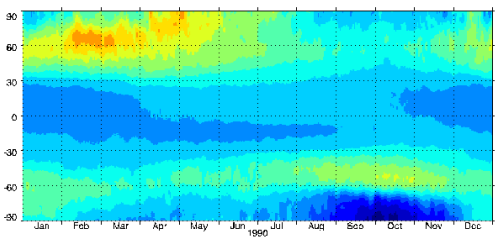


Examples of NNORSY-TOVS zonal mean values

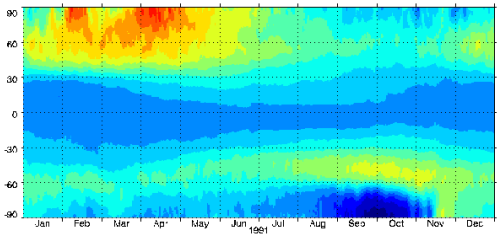


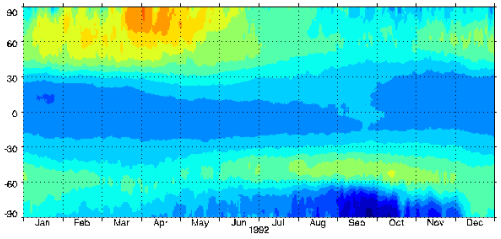


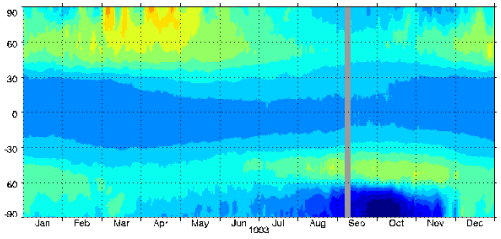


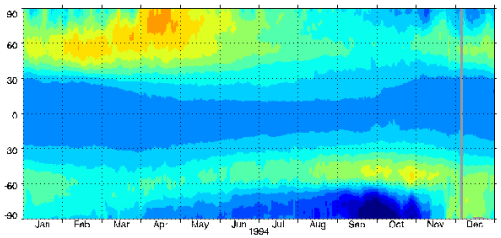


Year 1987 - 1990

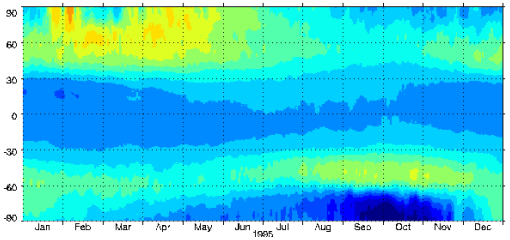


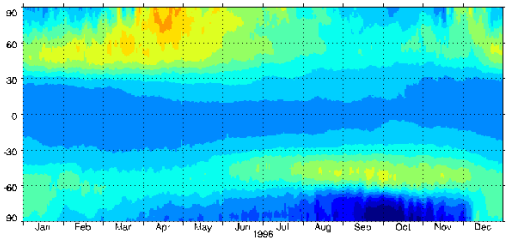


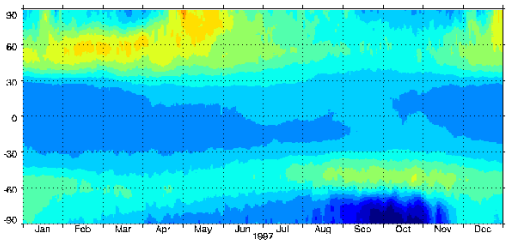


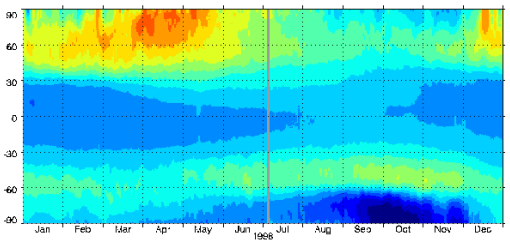


Year 1991 - 1994



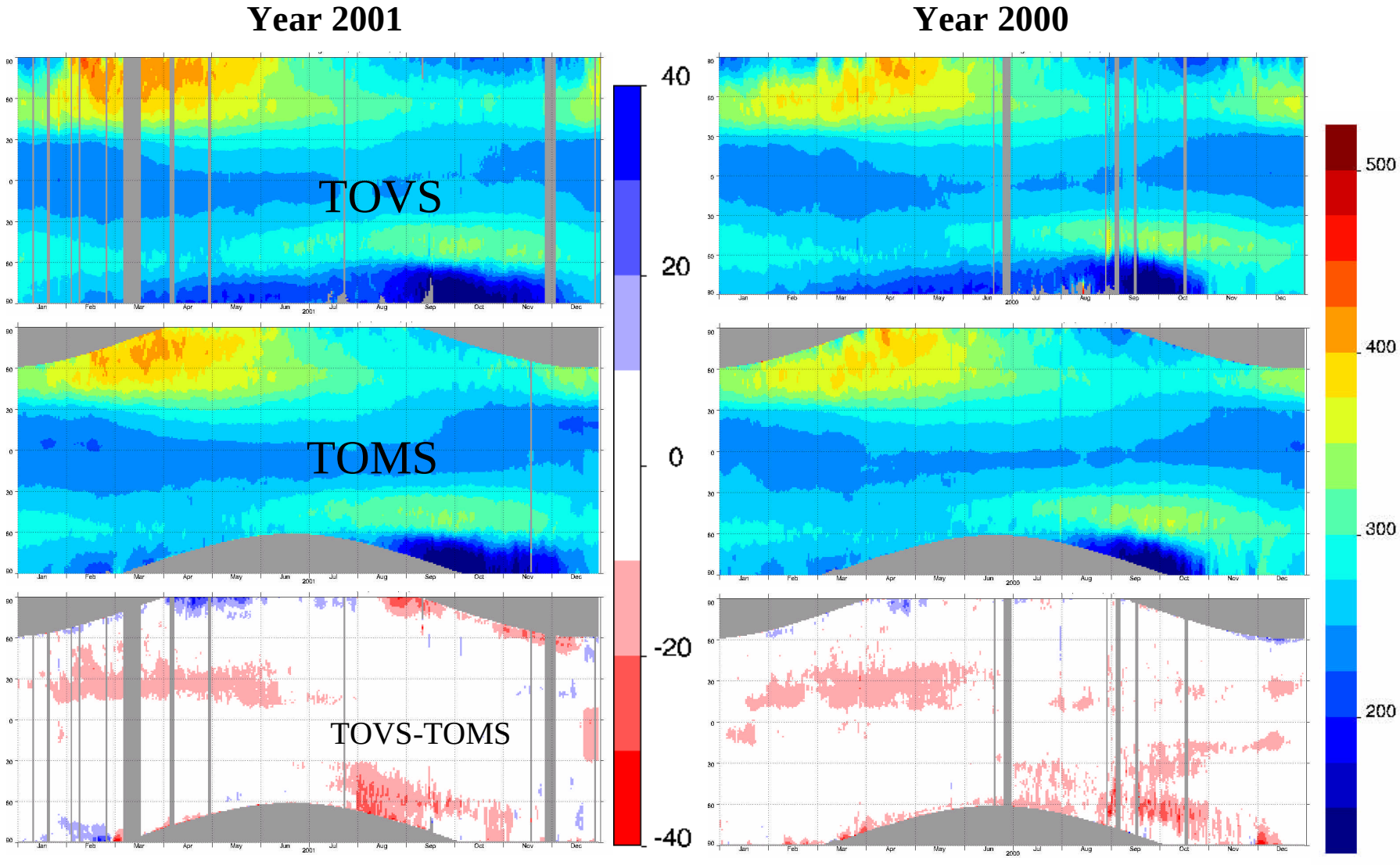




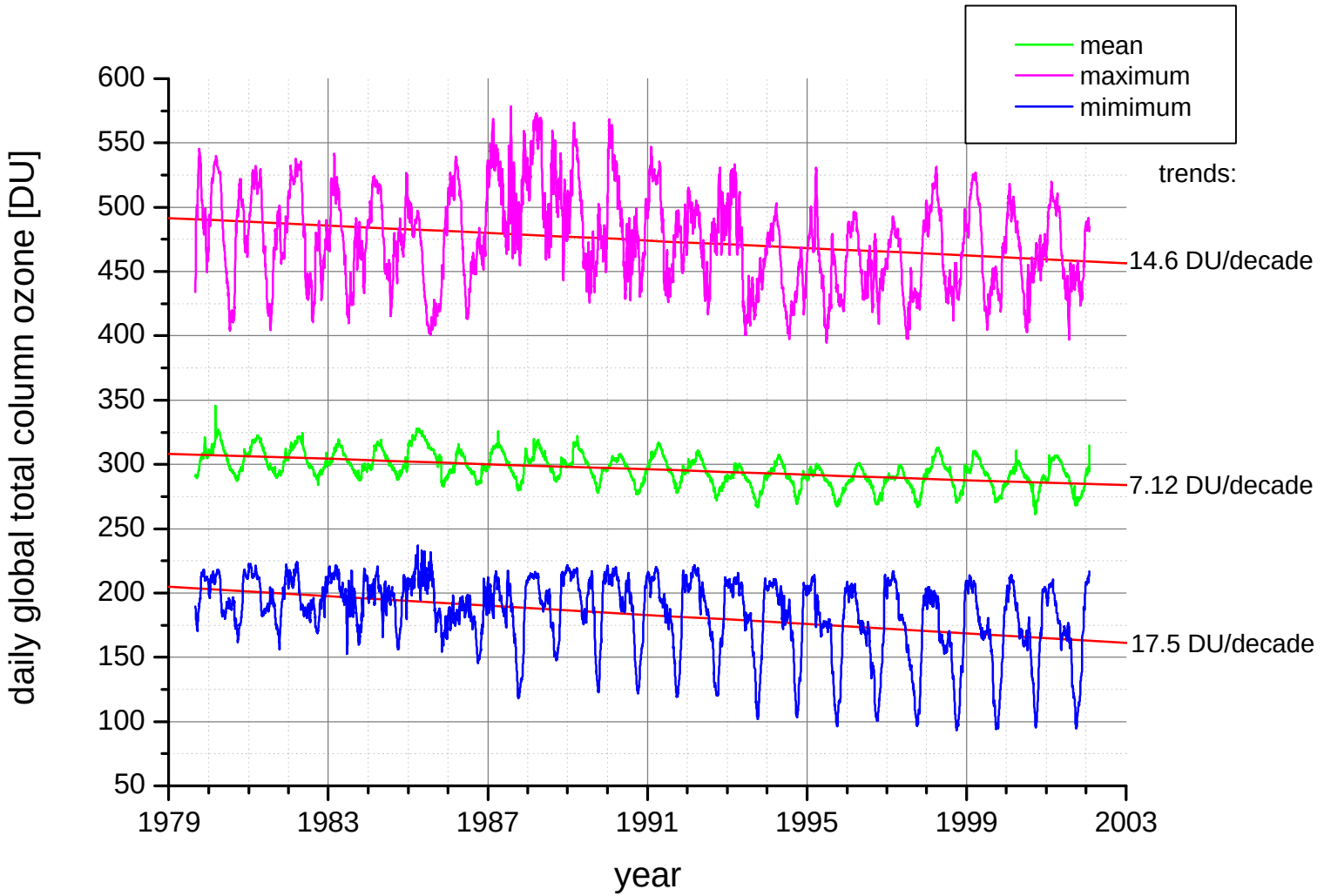


Year 1995 - 1998

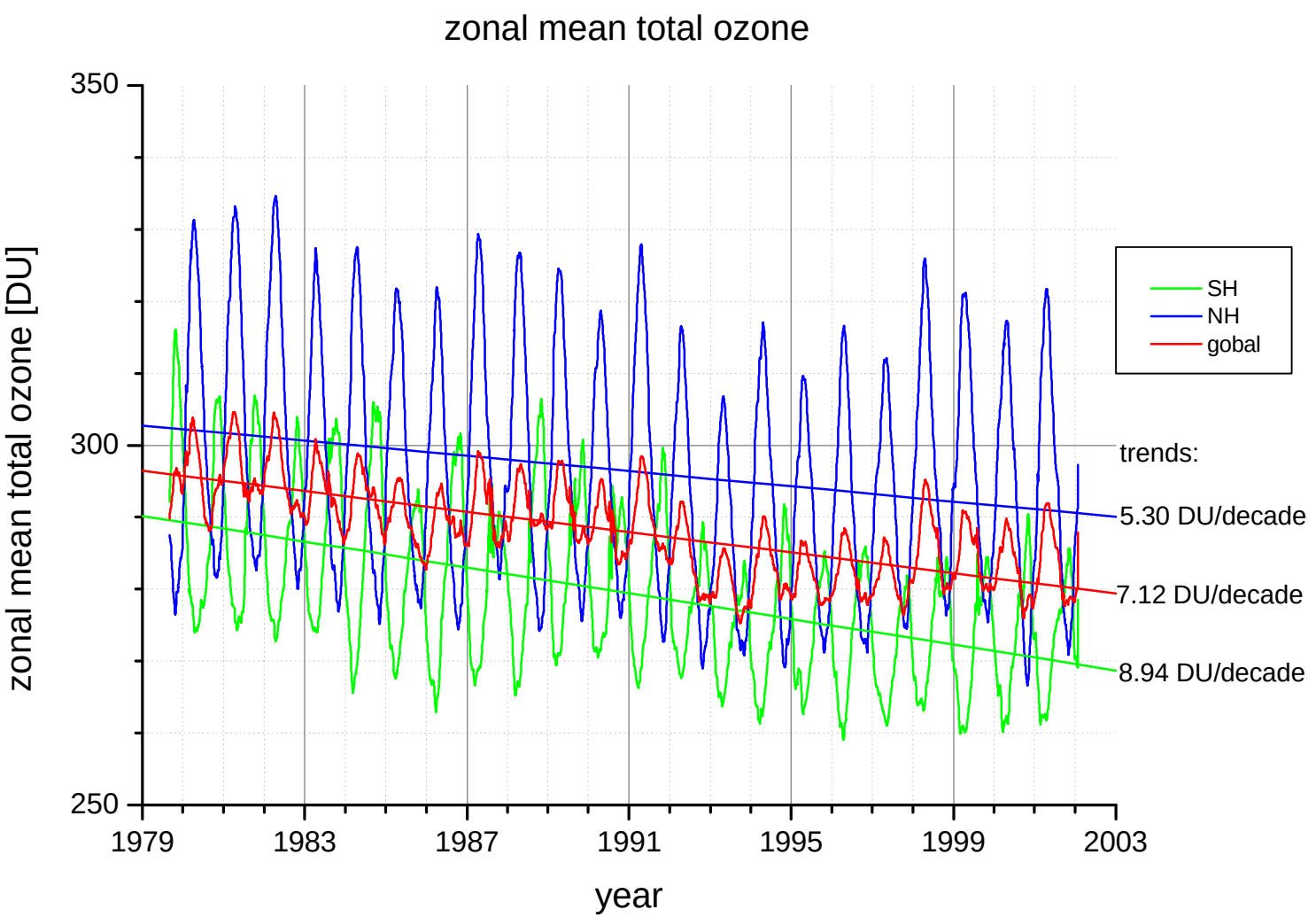
Comparison of zonal mean: NNORSY-TOVS - TOMS



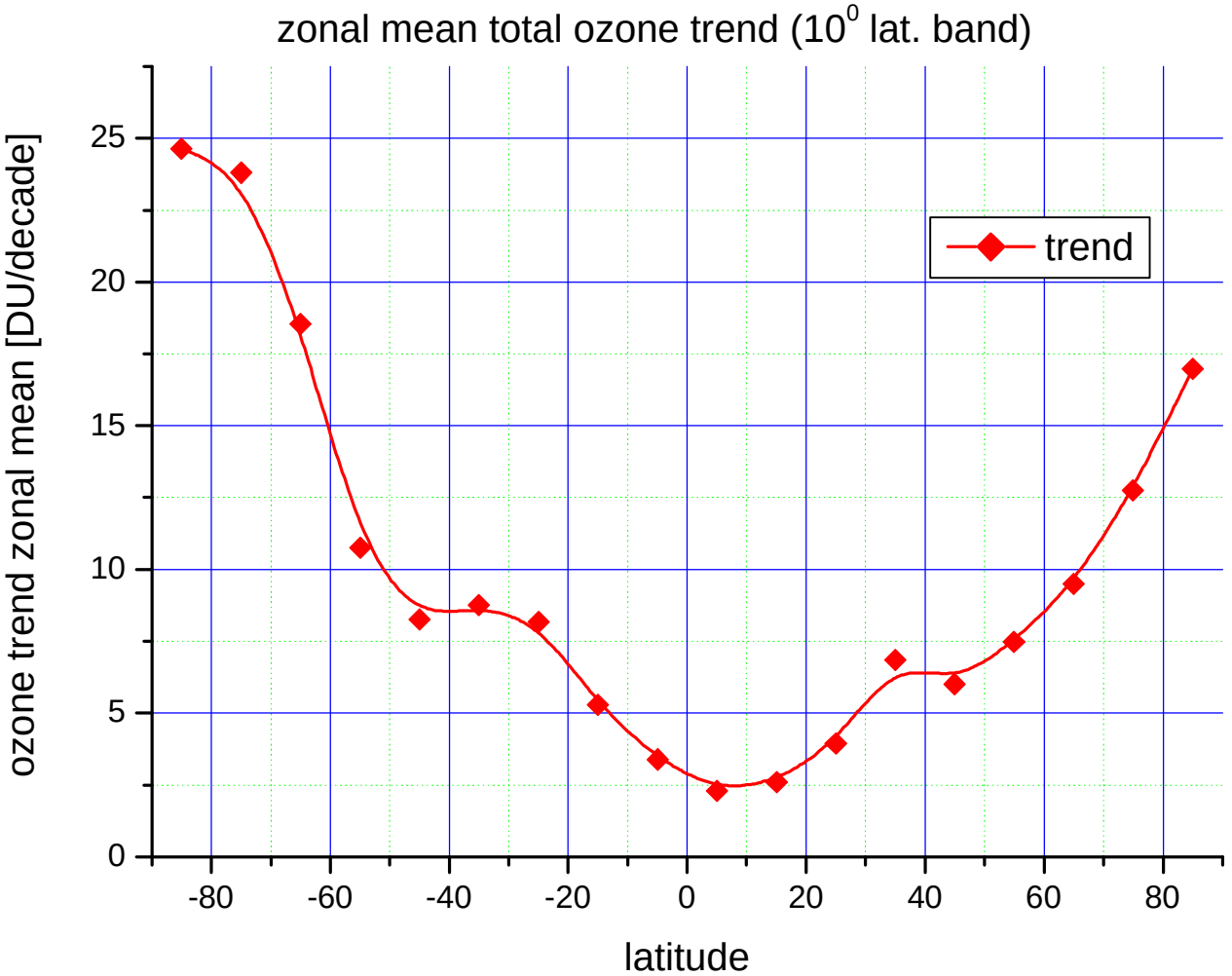
NNORSY-TOVS: Global trends



NNORSY-TOVS: Global trends



NNORSY-TOVS: Global trends



Conclusions

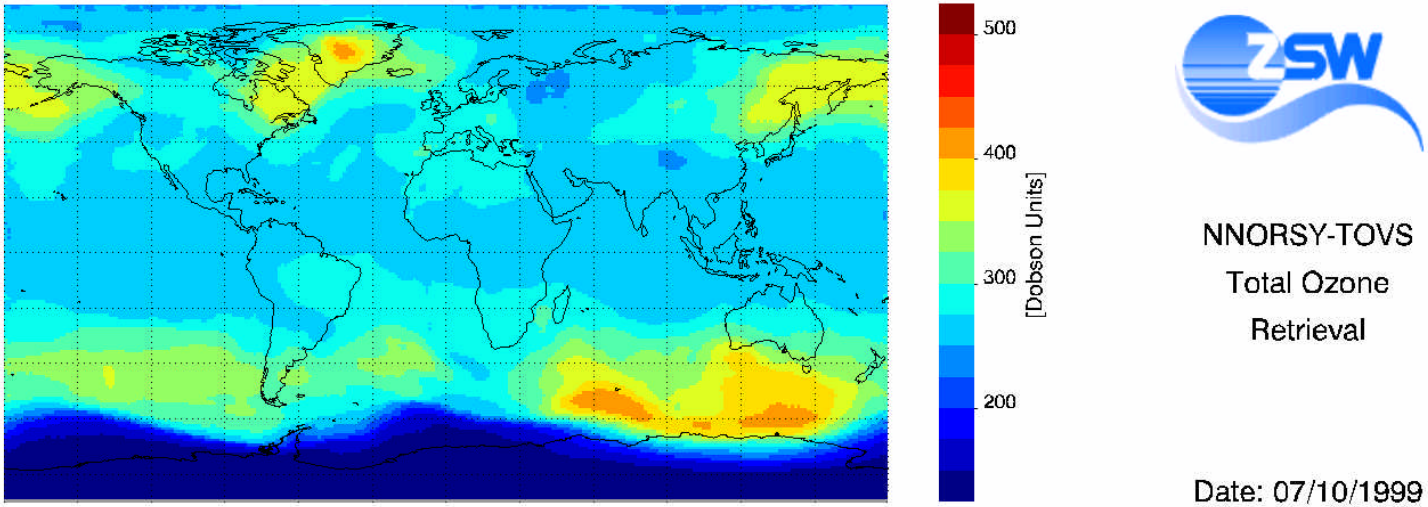
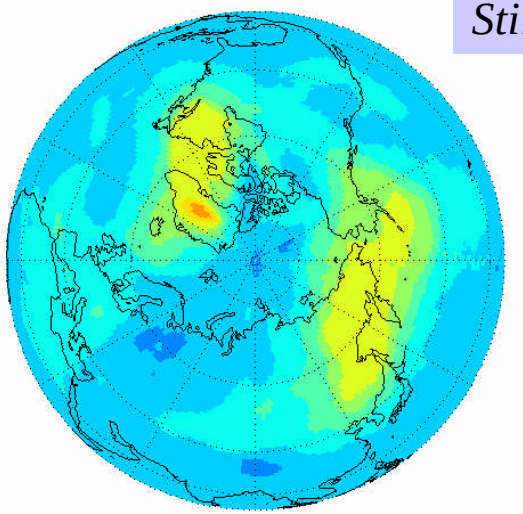
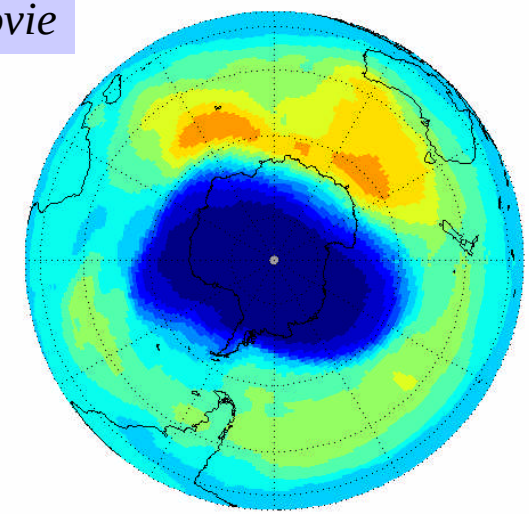
NNORSY-TOVS

- is very fast
- needs no cloud corrections or a priori information
- needs no limb correction for scan angle
- compares well with other sensors and ground data
- supplement for TOMS data gaps and night time retrieval
- is in real time operation for NOAA 14 at DWD

Future work

- support for NOAA KLM (15,16)
- MSG SEVIRI real time ozone retrieval
- OMI in co-operation with KNMI
- MetOp

MOVIE: NNORSY-TOVS 09/79 to 01/02



Still image of movie