

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://ftp.zsw-bw.de> /pub/NNORSY/TOVS*

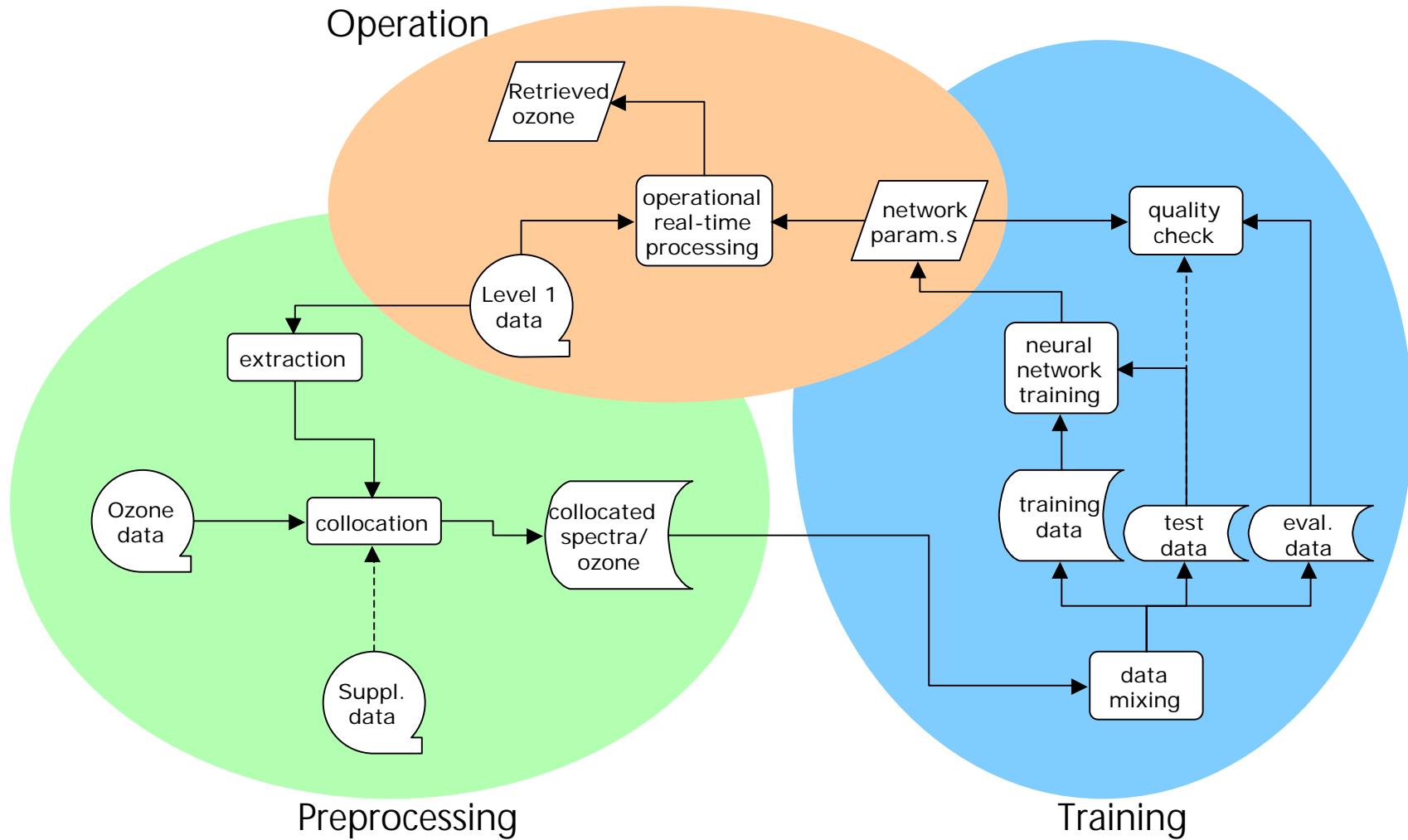
Neural Network Ozone Retrieval System (NNORSY)

Current available:

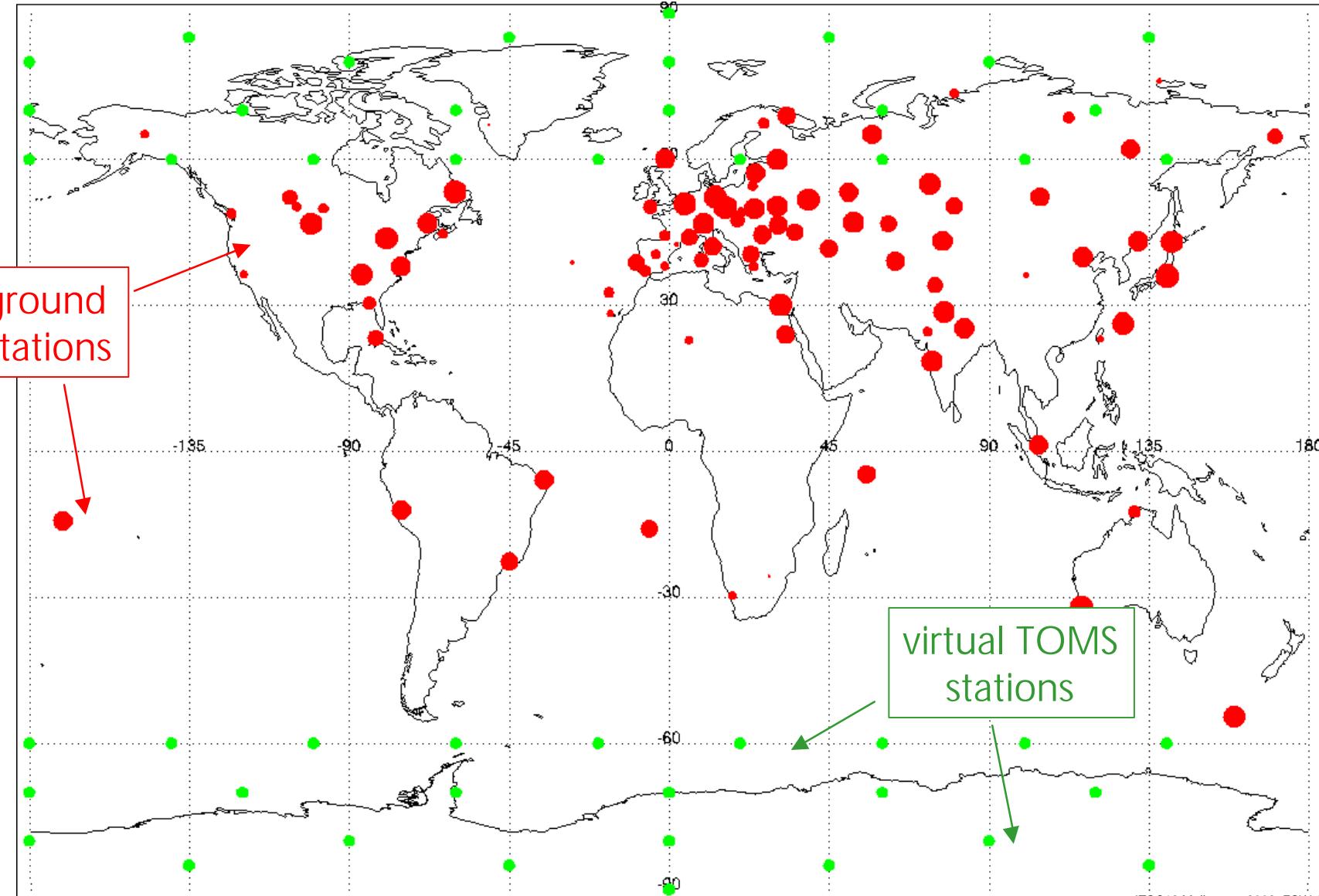
- NNORSY-TOVS (total ozone column)
- NNORSY-GOME (total ozone column)
- NNORSY-GOME (profile)

Planned:

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

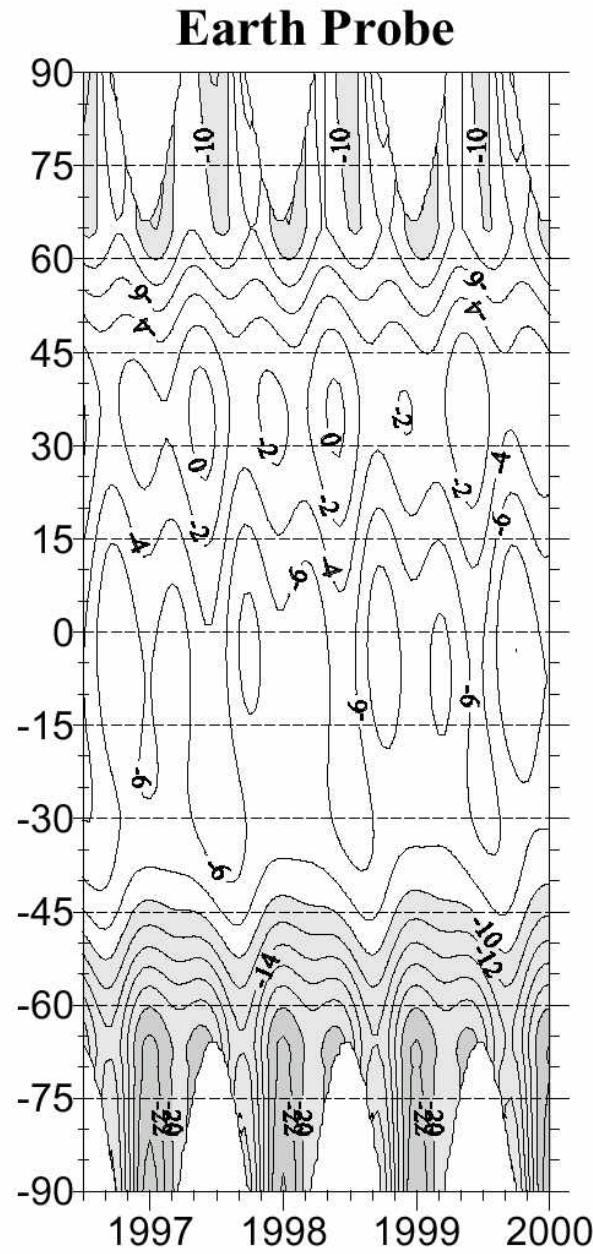


WOUDC/Virtual Station Distribution



Climatological Correction of TOMS Data

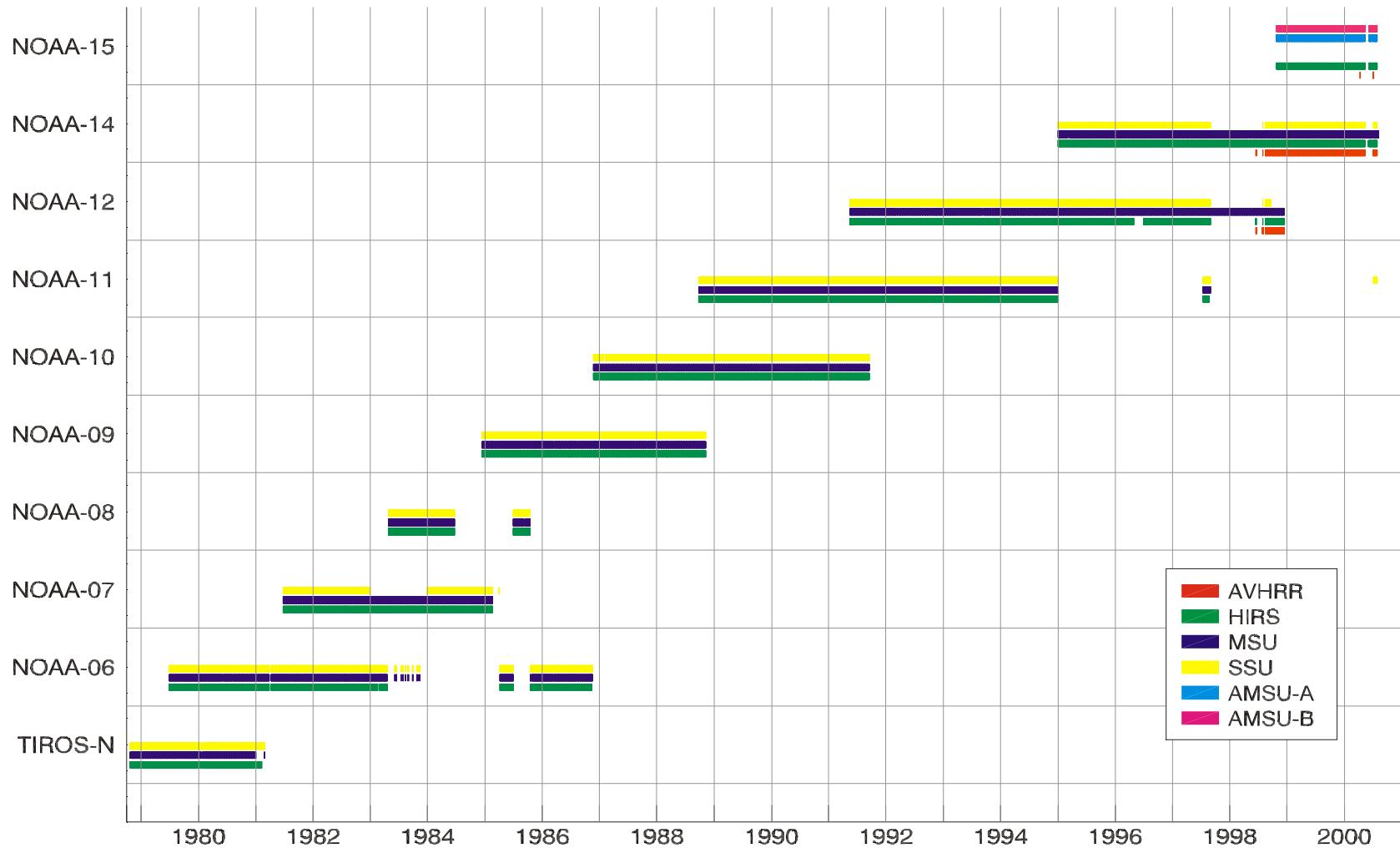
EPT-Ground fit over latitude and time (DU)



(Bodeker et al., 2001)

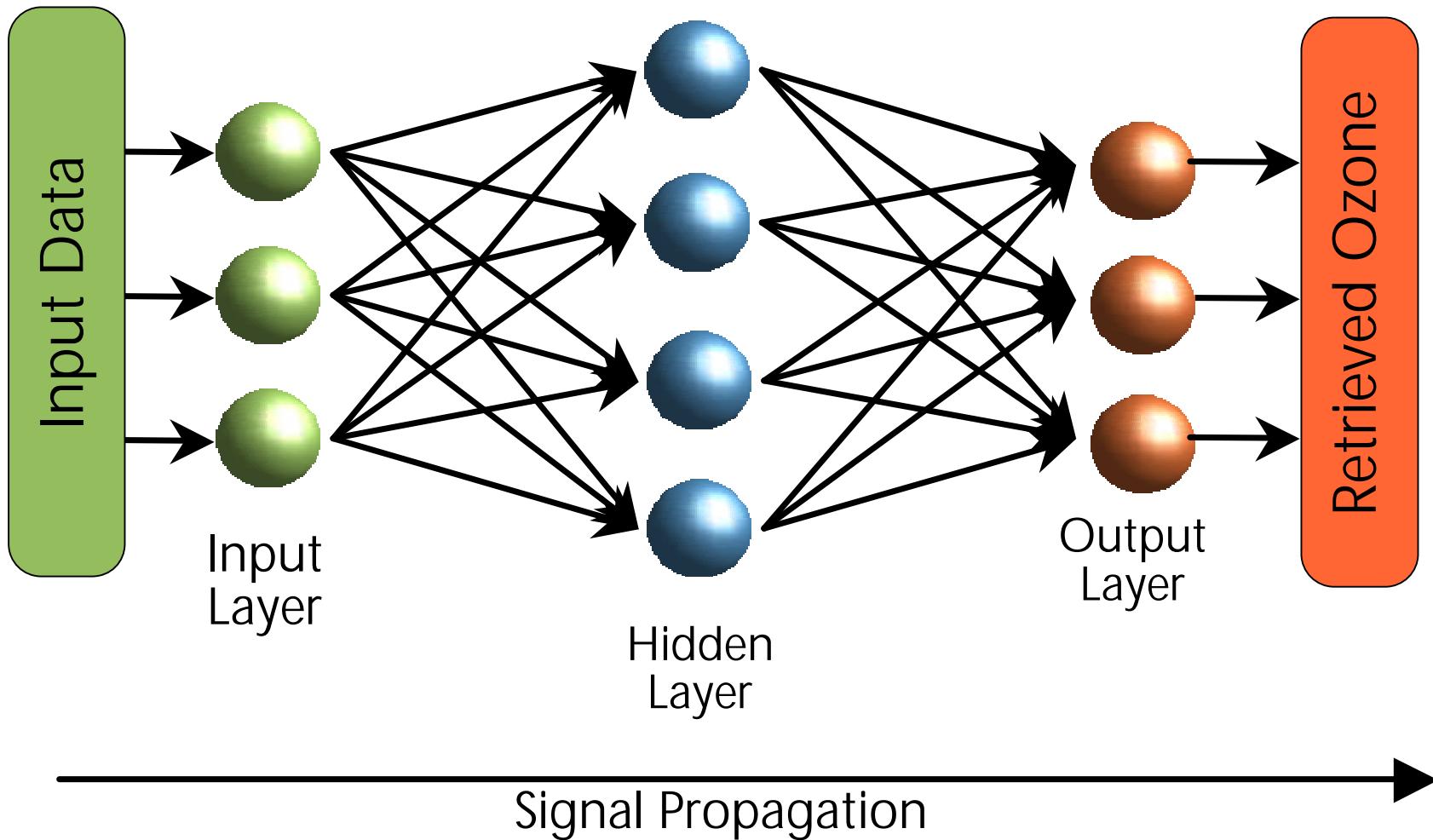


NOAA-TOVS Data at ZSW



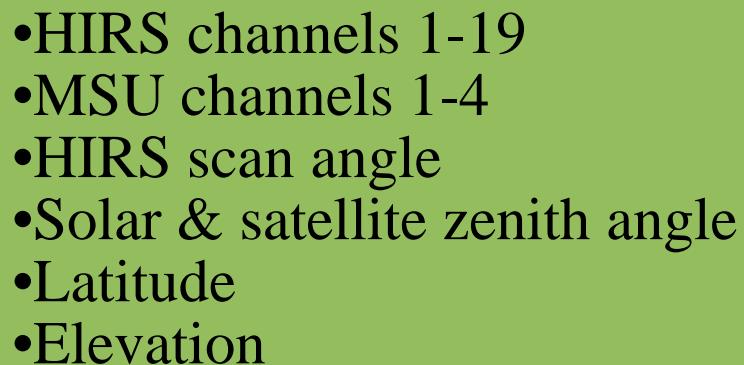
- Timerange 09/1979 to 01/2002
- Satellites TIROS-N, NOAA-6 to NOAA-14
- Collocation radius 75 km
- yields:
 - ~ 1.5 million training datasets
 - ~ 200000 test datasets

Feed-Forward Neural Network



Neural Network Input (28 neurons):

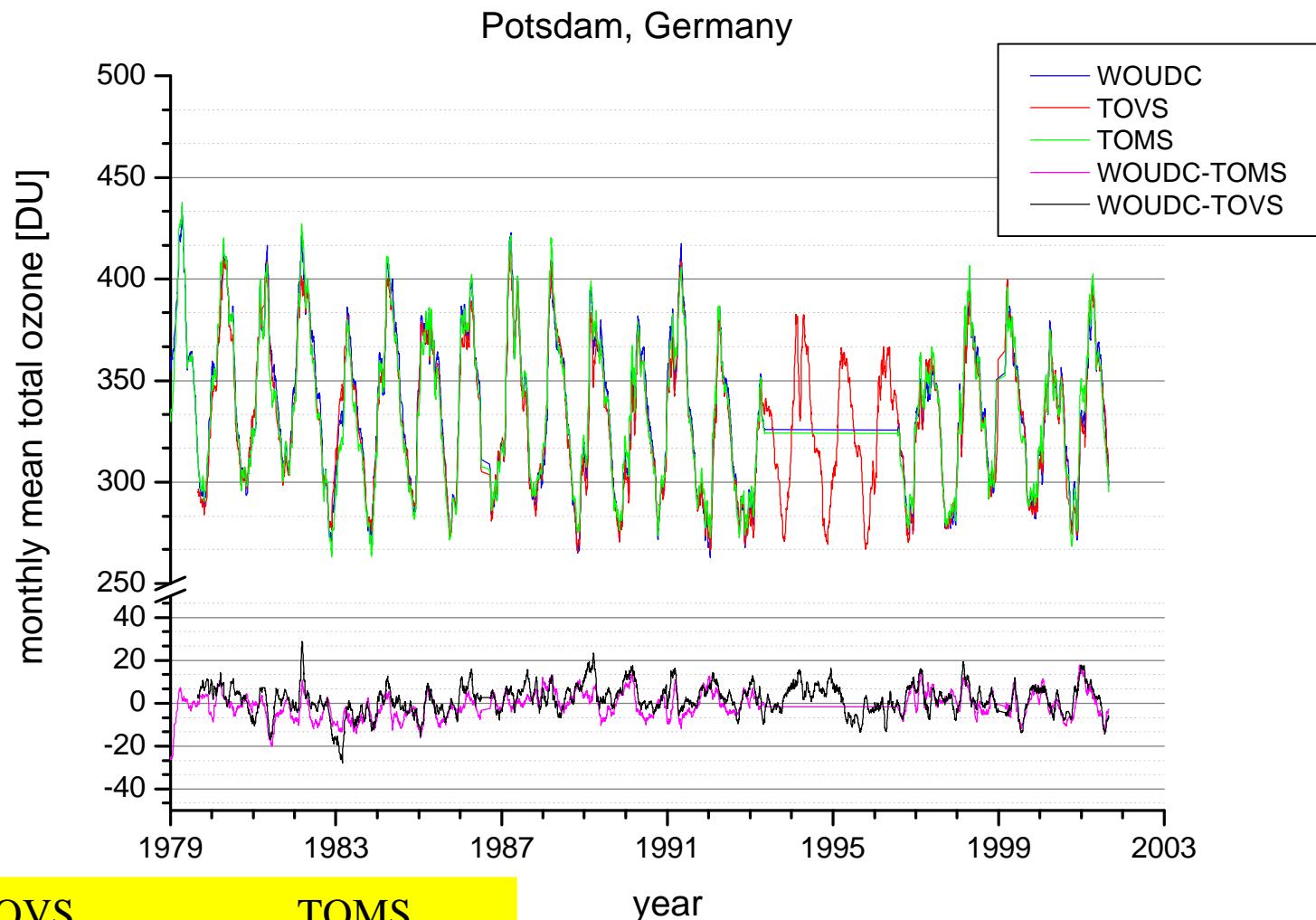
- HIRS channels 1-19
- MSU channels 1-4
- HIRS scan angle
- Solar & satellite zenith angle
- Latitude
- Elevation



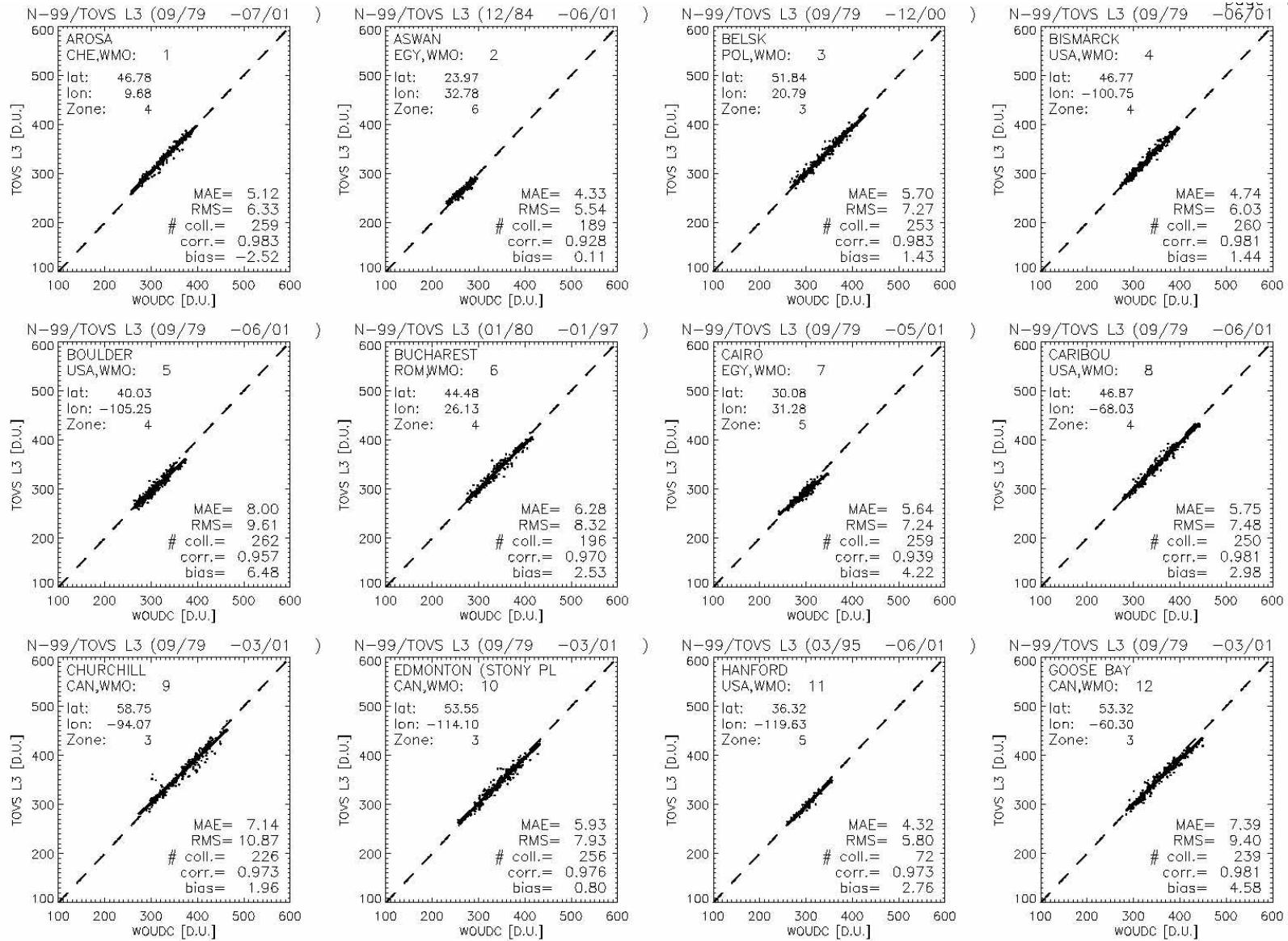
The diagram illustrates a neural network architecture. At the top, a green rounded rectangle contains the text "Neural Network Input (28 neurons)". Below it, a white area shows a network of black lines forming a grid-like structure, representing the connections between input neurons and hidden neurons. At the bottom, an orange rounded rectangle contains the text "Retrieved Total Ozone".

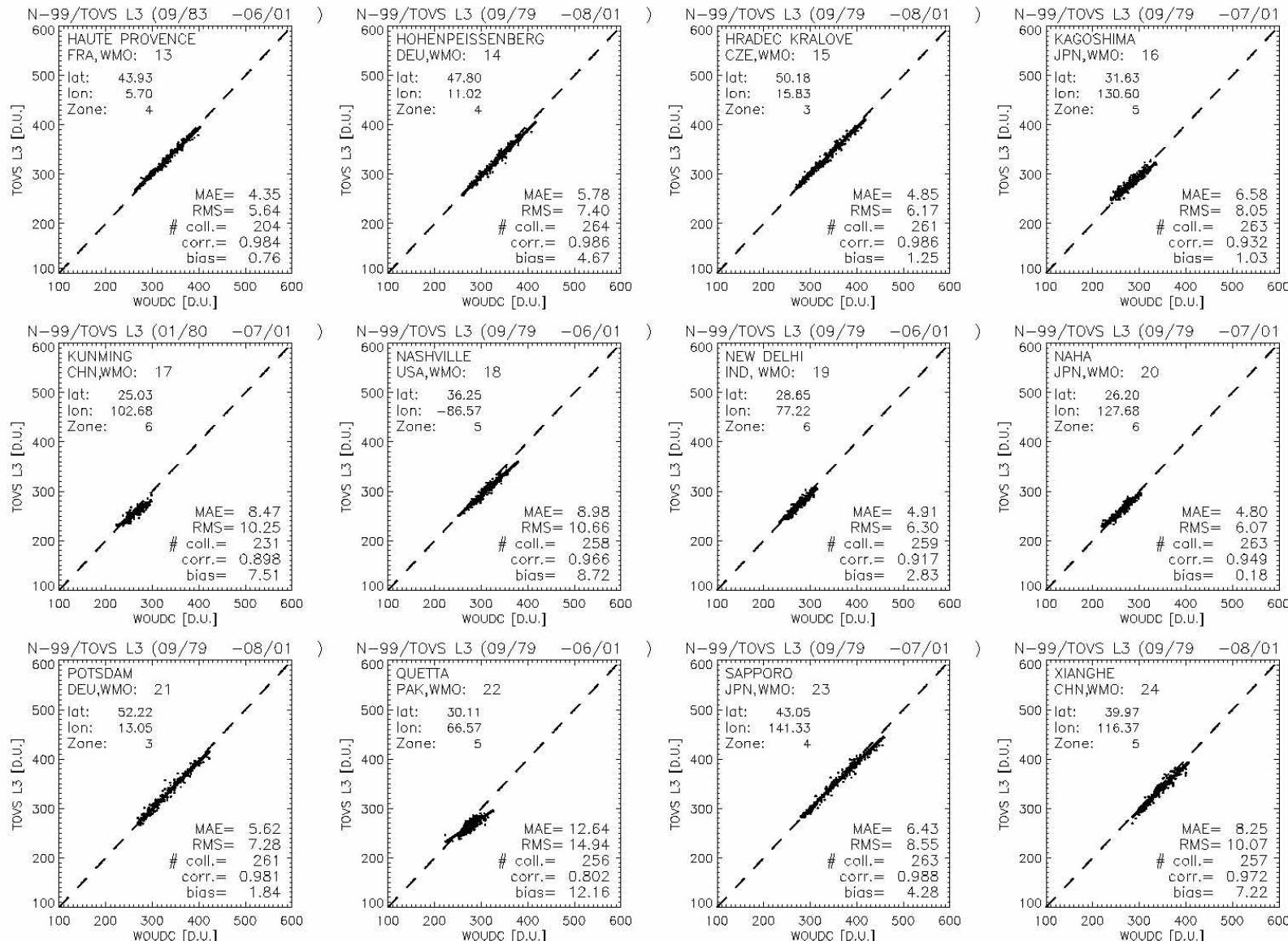
Retrieved Total Ozone

NNORSY-TOVS: Ground validation over time

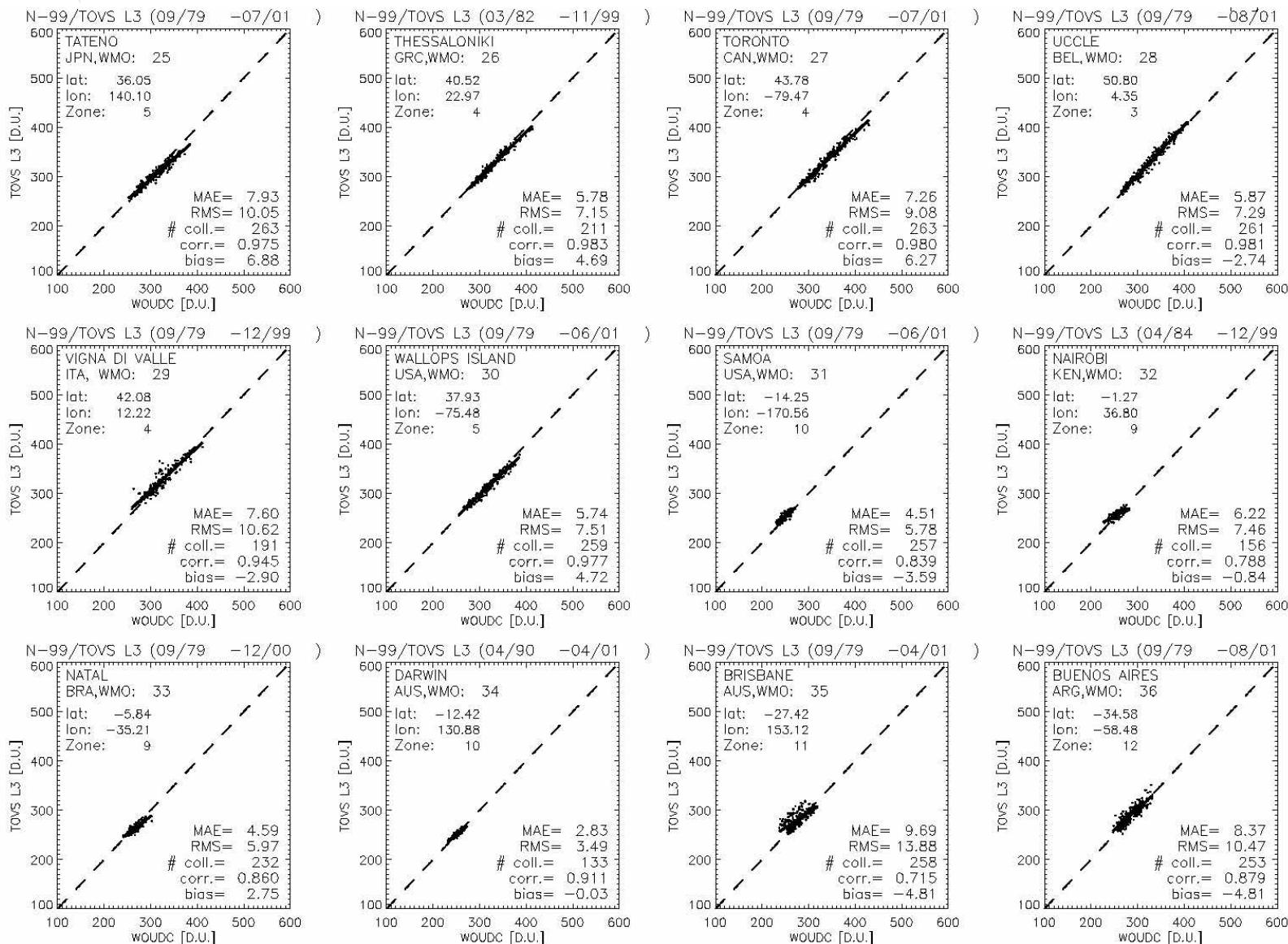


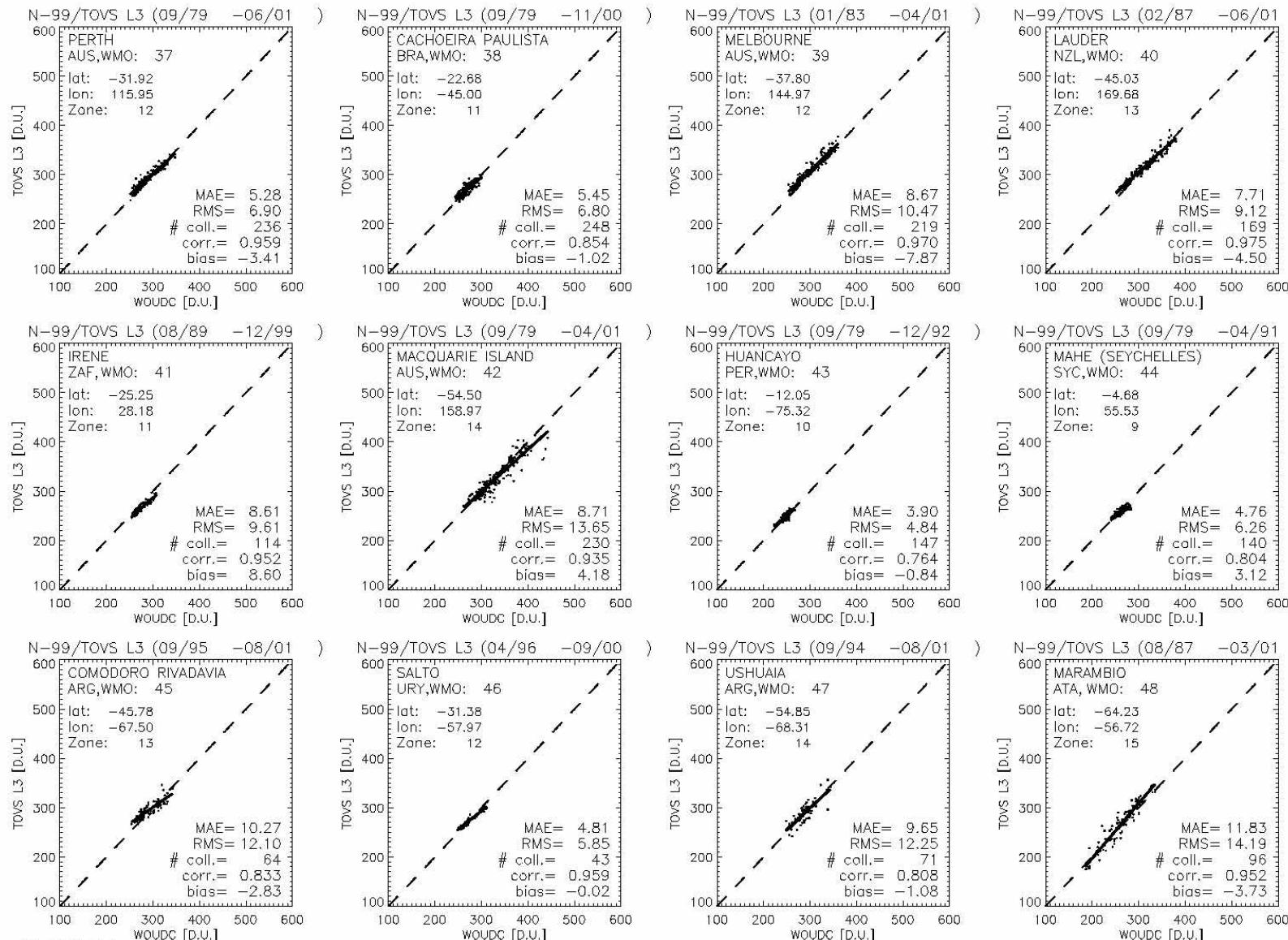
Potsdam	TOVS	TOMS
RMS:	7.2 D.U.	6.5 D.U.
Bias:	1.9 D.U.	-0.9 D.U.

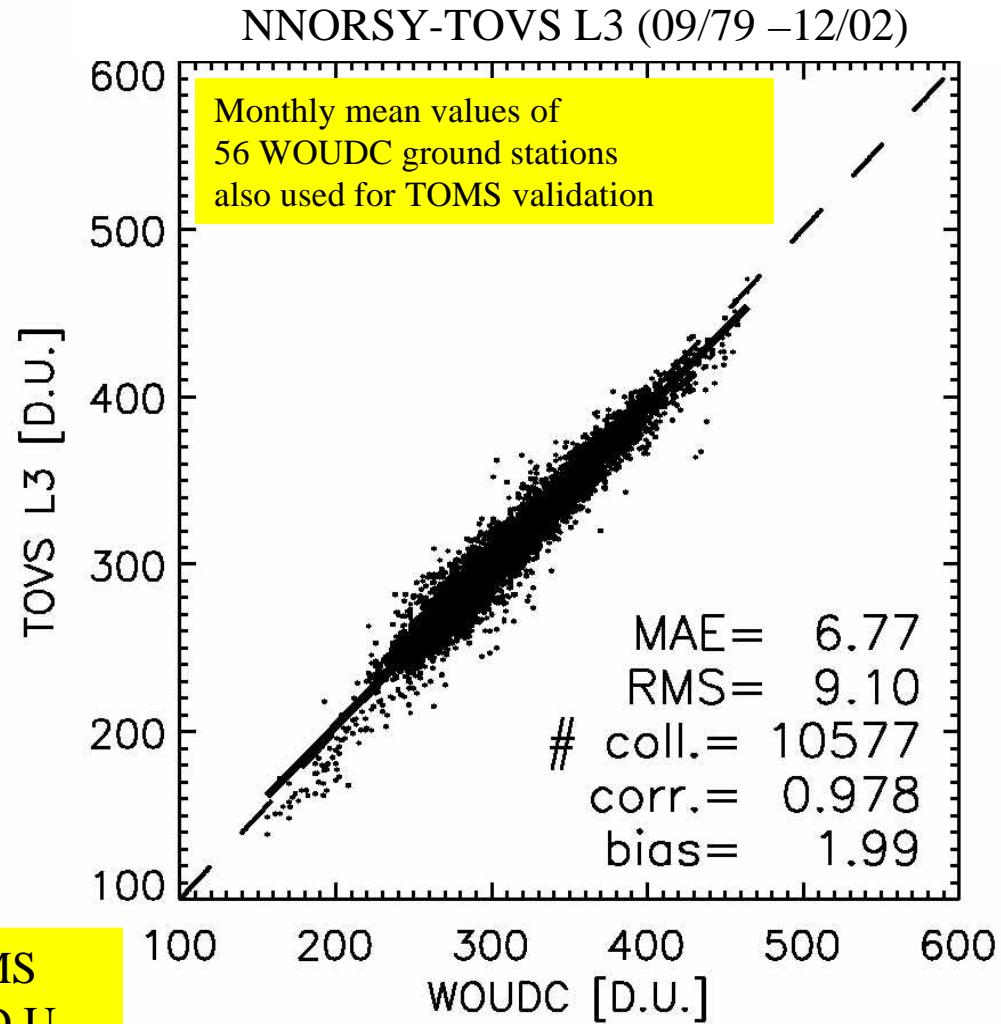




NNORSY-TOVS: Ground validation monthly mean 3/5



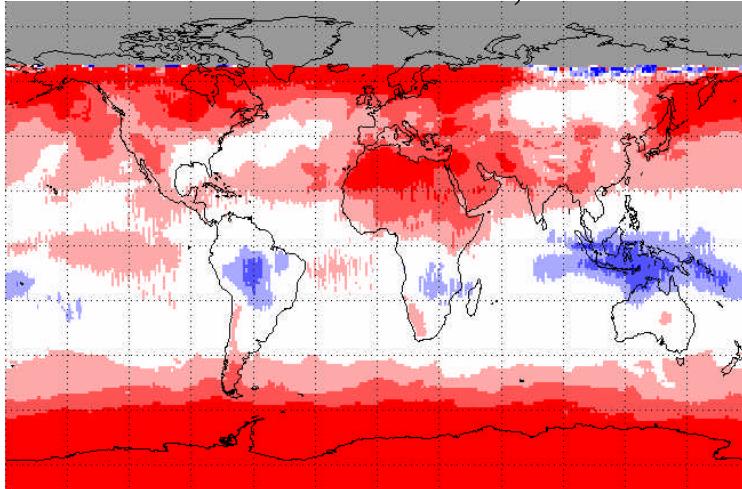




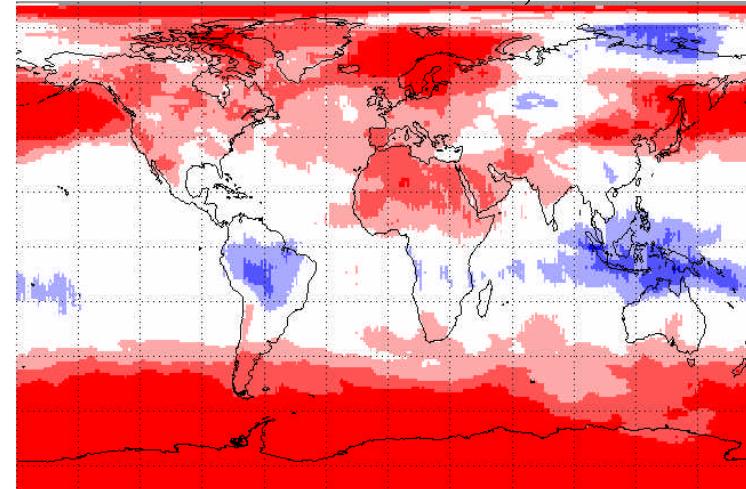
global	TOVS	TOMS
RMS:	9.1 D.U.	8.0 D.U.
Bias:	2.0 D.U.	-2.8 D.U.

Comparison of monthly mean with NOAA operational product 1/2

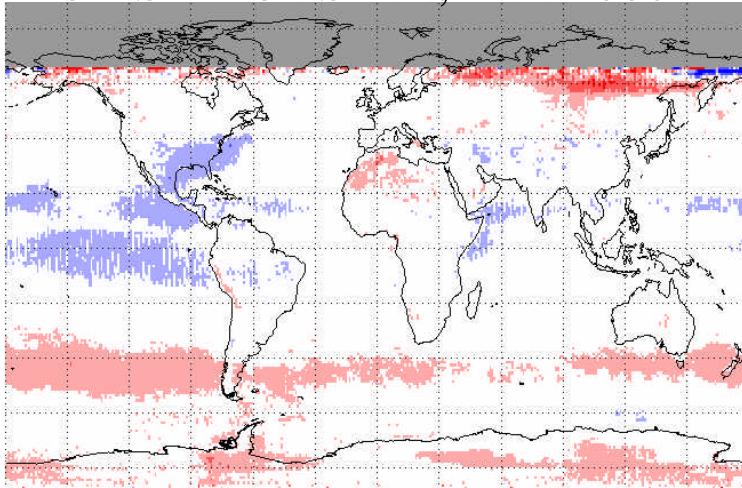
TOMS – NOAA-TOVS, Jan. 2000



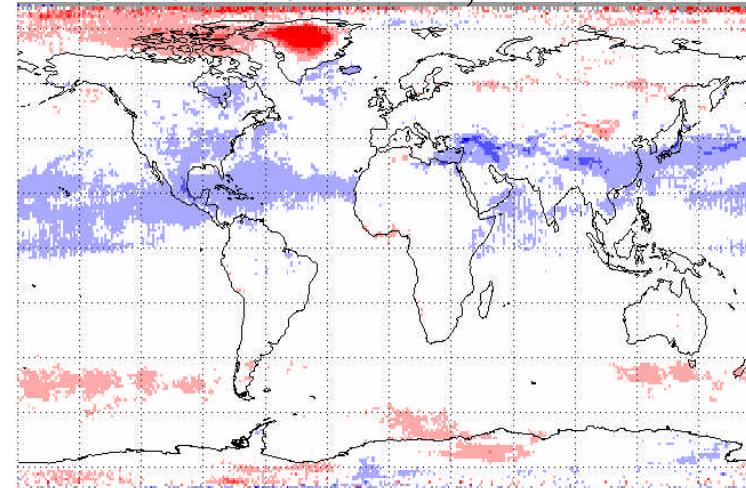
TOMS – NOAA-TOVS, Mar. 2000



TOMS – TOVS-NN, Jan. 2000



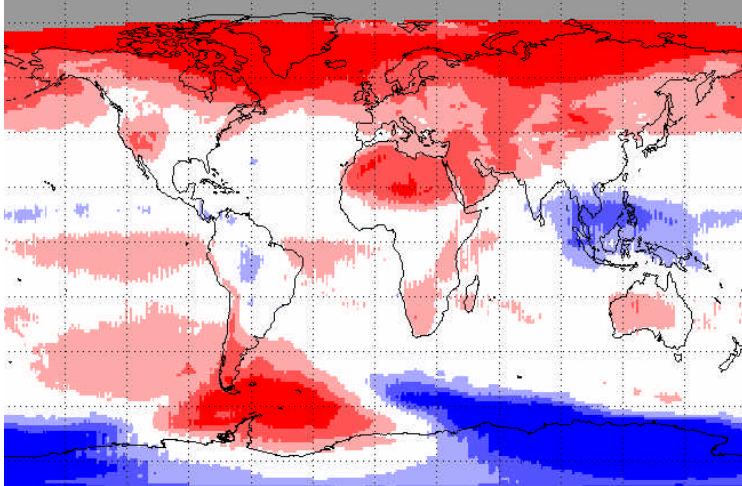
TOMS – TOVS-NN, Mar. 2000



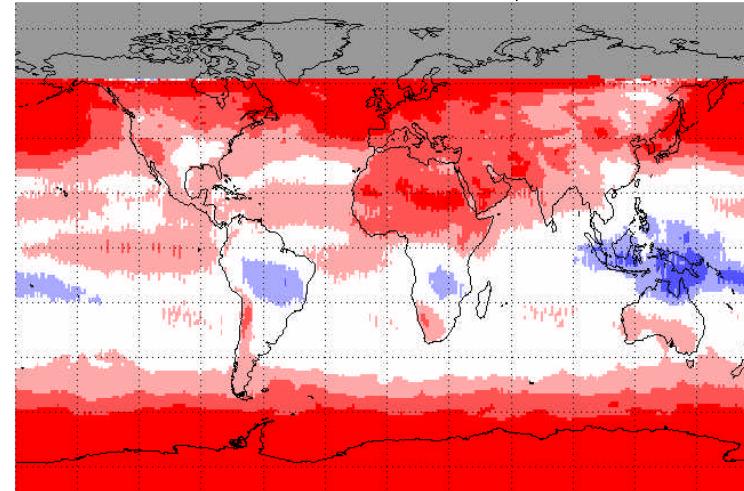
40
20
0
-20
-40
D. U.

Comparison of monthly mean with NOAA operational product 1/2

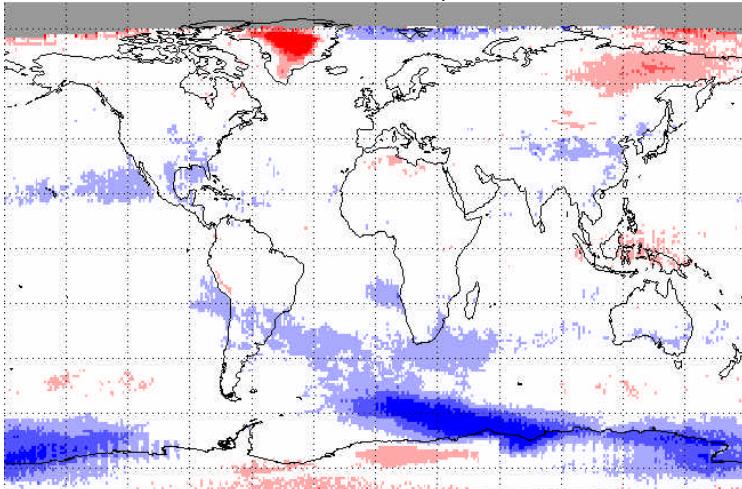
TOMS – NOAA-TOVS, Oct. 2000



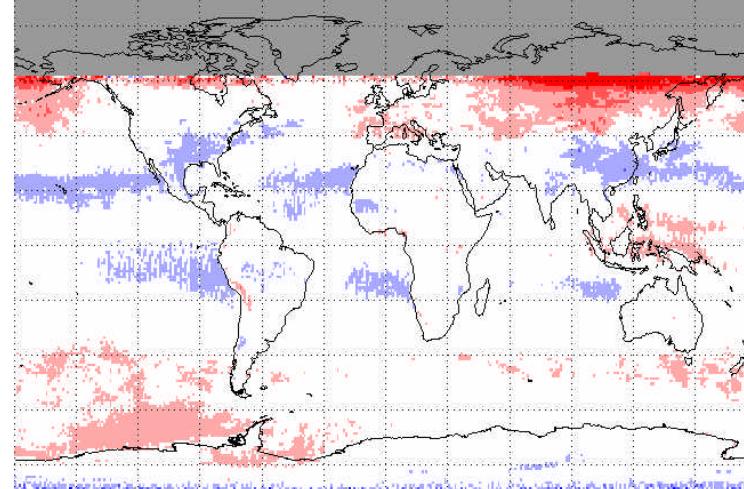
TOMS – NOAA-TOVS, Dez. 2000



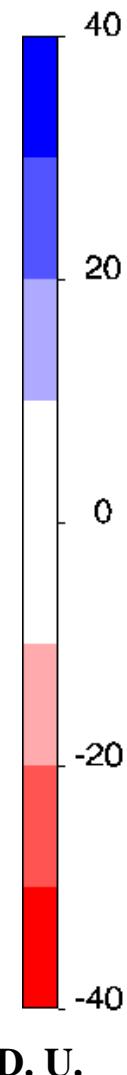
TOMS – TOVS-NN, Oct. 2000



TOMS – TOVS-NN, Dez. 2000

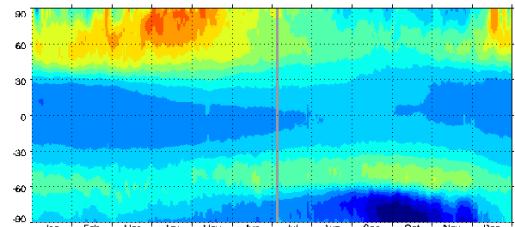
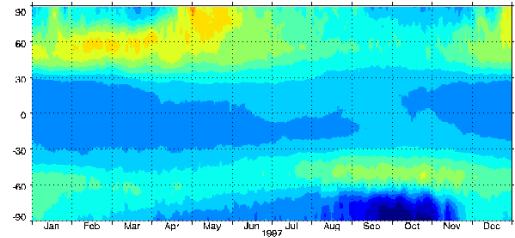
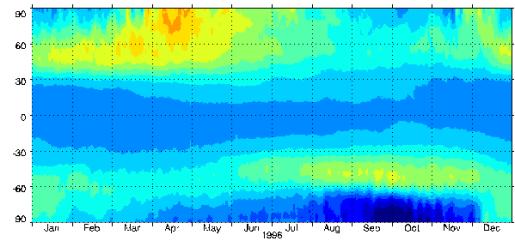
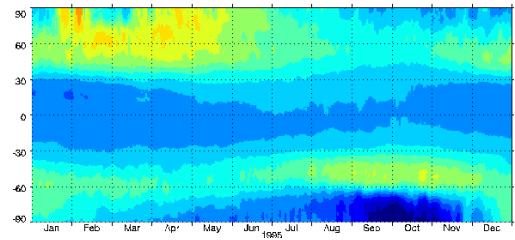
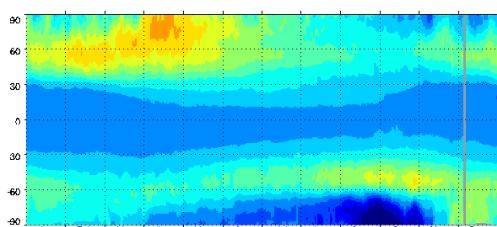
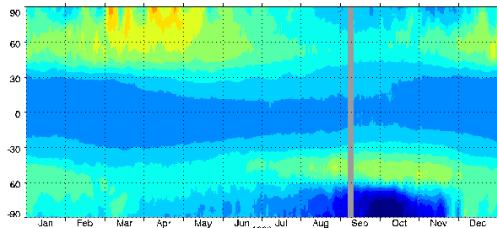
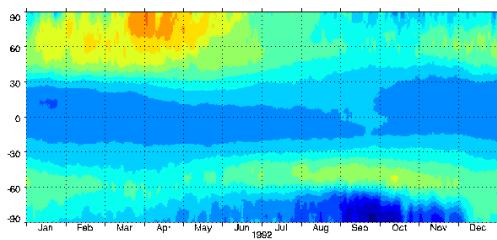
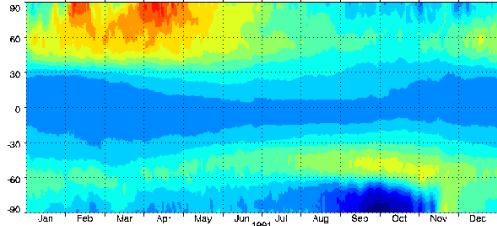
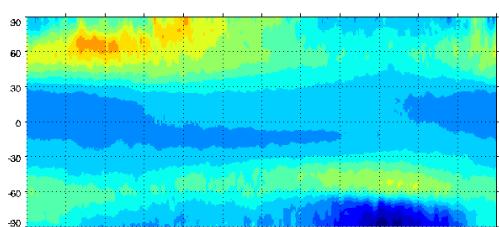
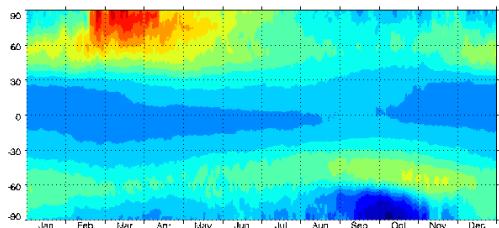
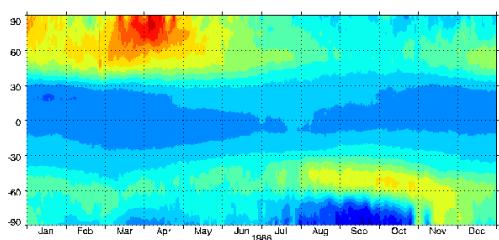
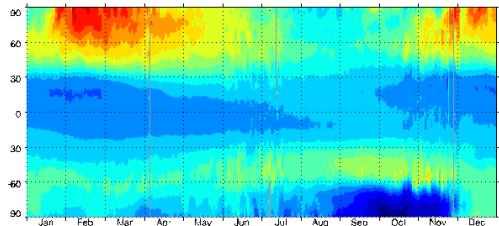


D. U.



A vertical color bar on the right side of the figure, labeled "D. U." at the bottom. The bar has numerical ticks at -40, -20, 0, 20, and 40. It shows a gradient from dark red at -40 to dark blue at 40, with intermediate colors in white, light blue, and light red.

Examples of NNORSY-TOVS zonal mean values



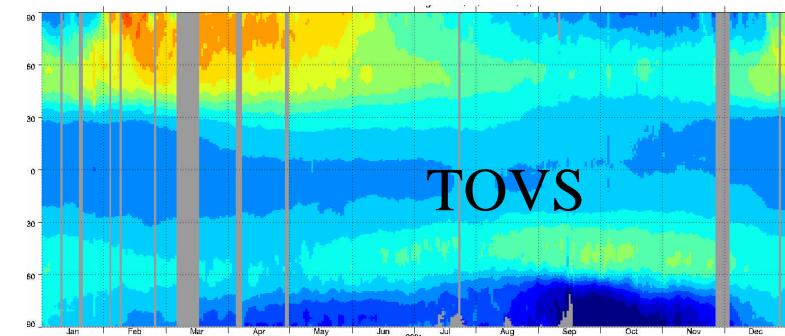
Year 1987 - 1990

Year 1991 - 1994

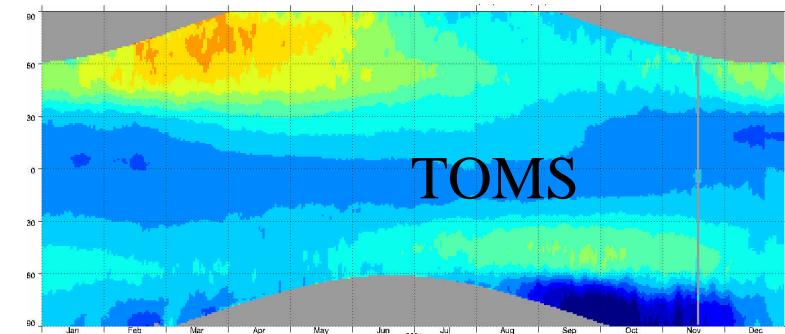
Year 1995 - 1998

Comparison of zonal mean: NNORSY-TOVS - TOMS

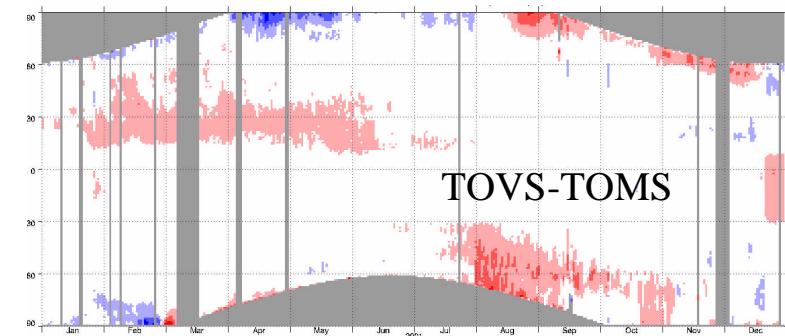
Year 2001



TOVS



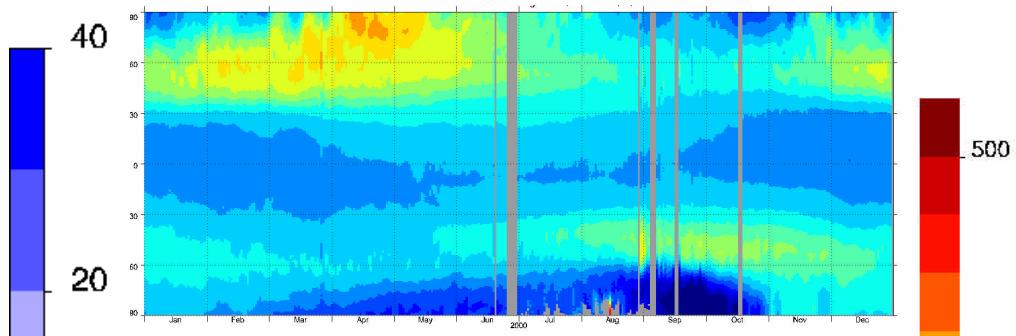
TOMS



TOVS-TOMS

D. U.

Year 2000



40

20

0

-20

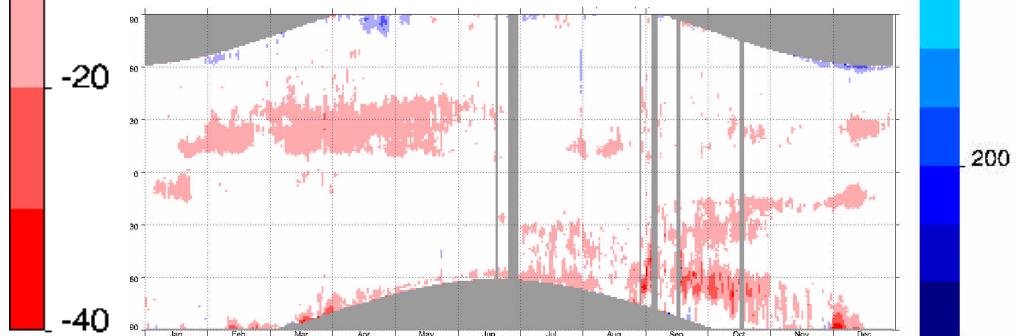
-40

500

400

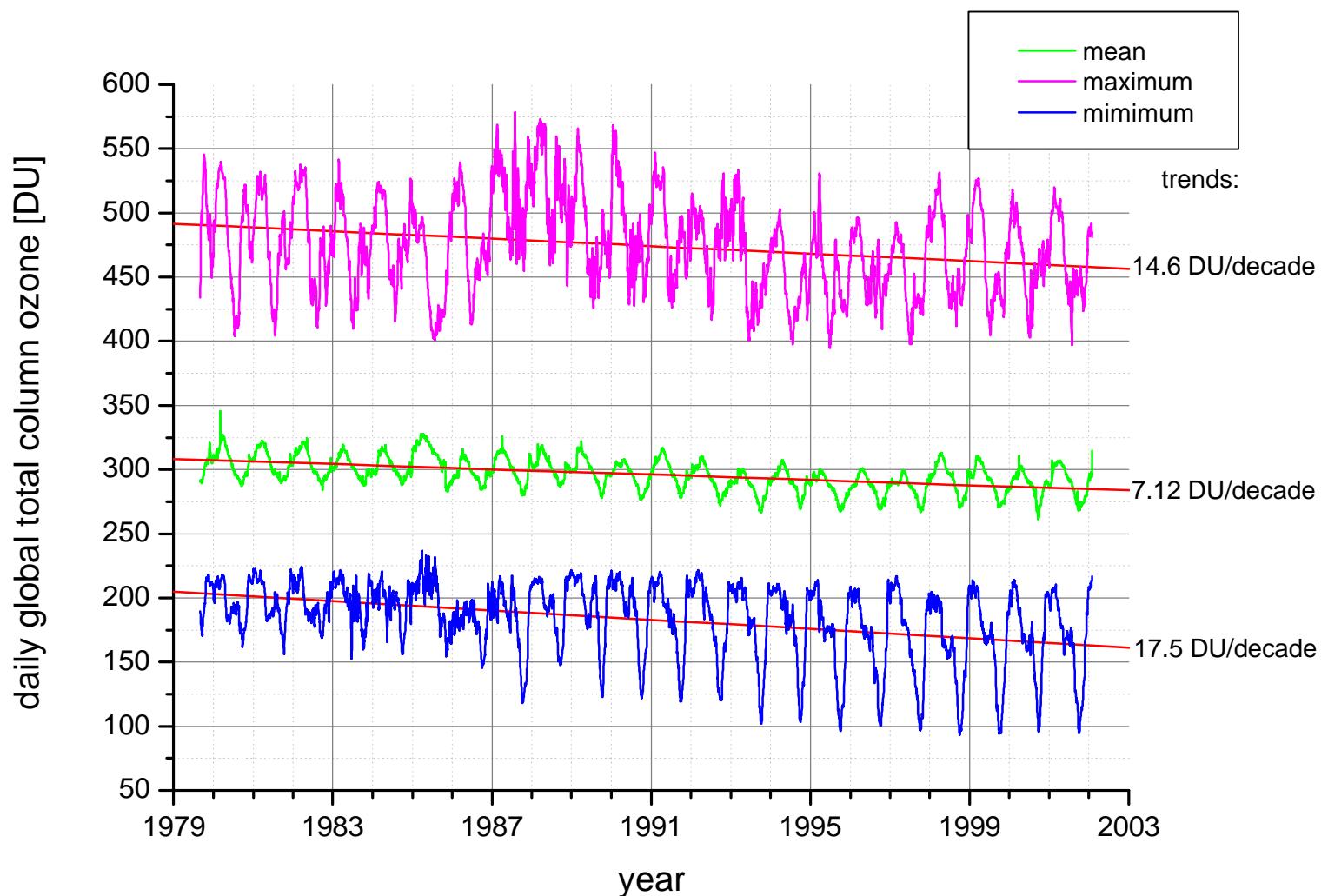
300

200

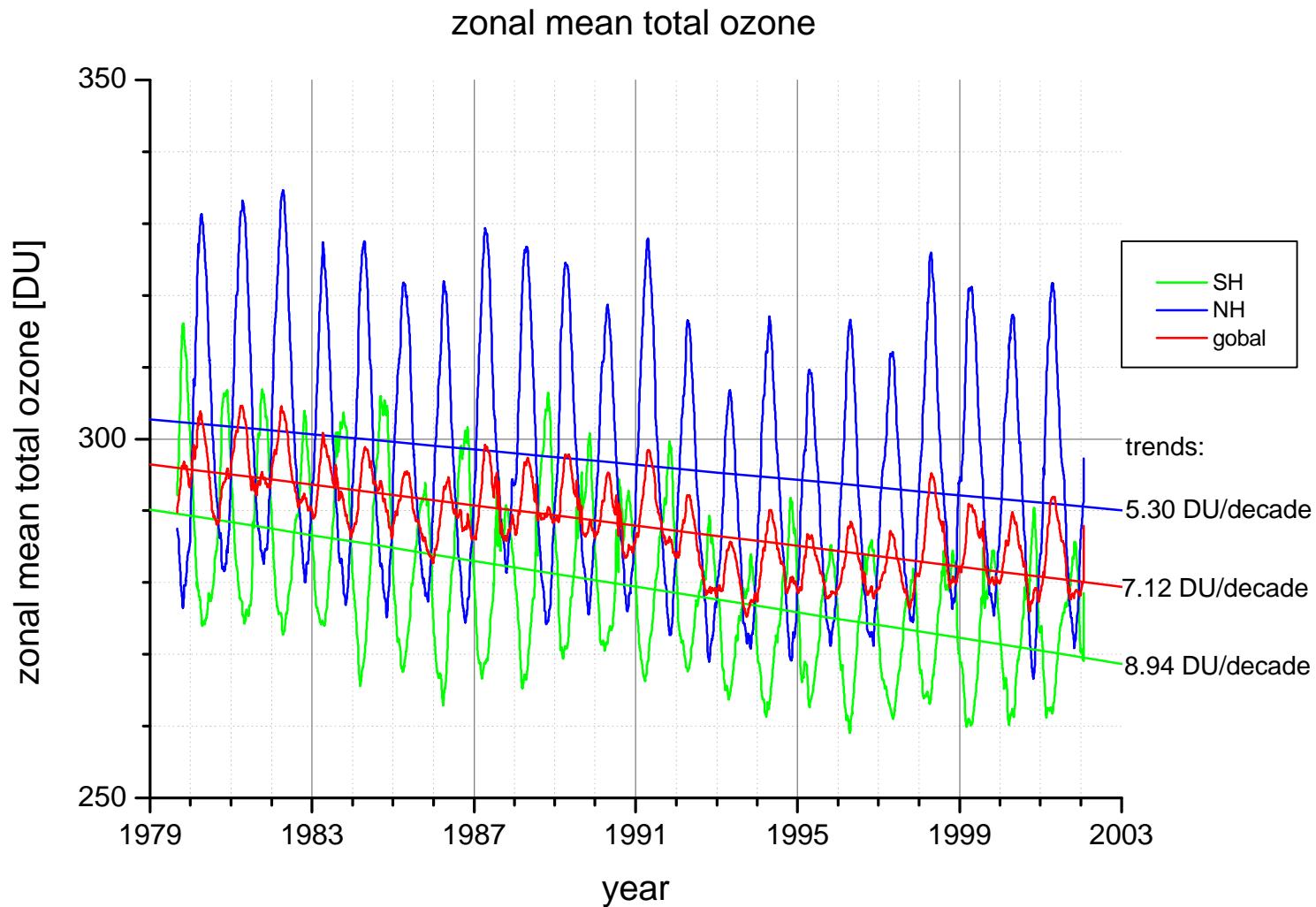


D. U.

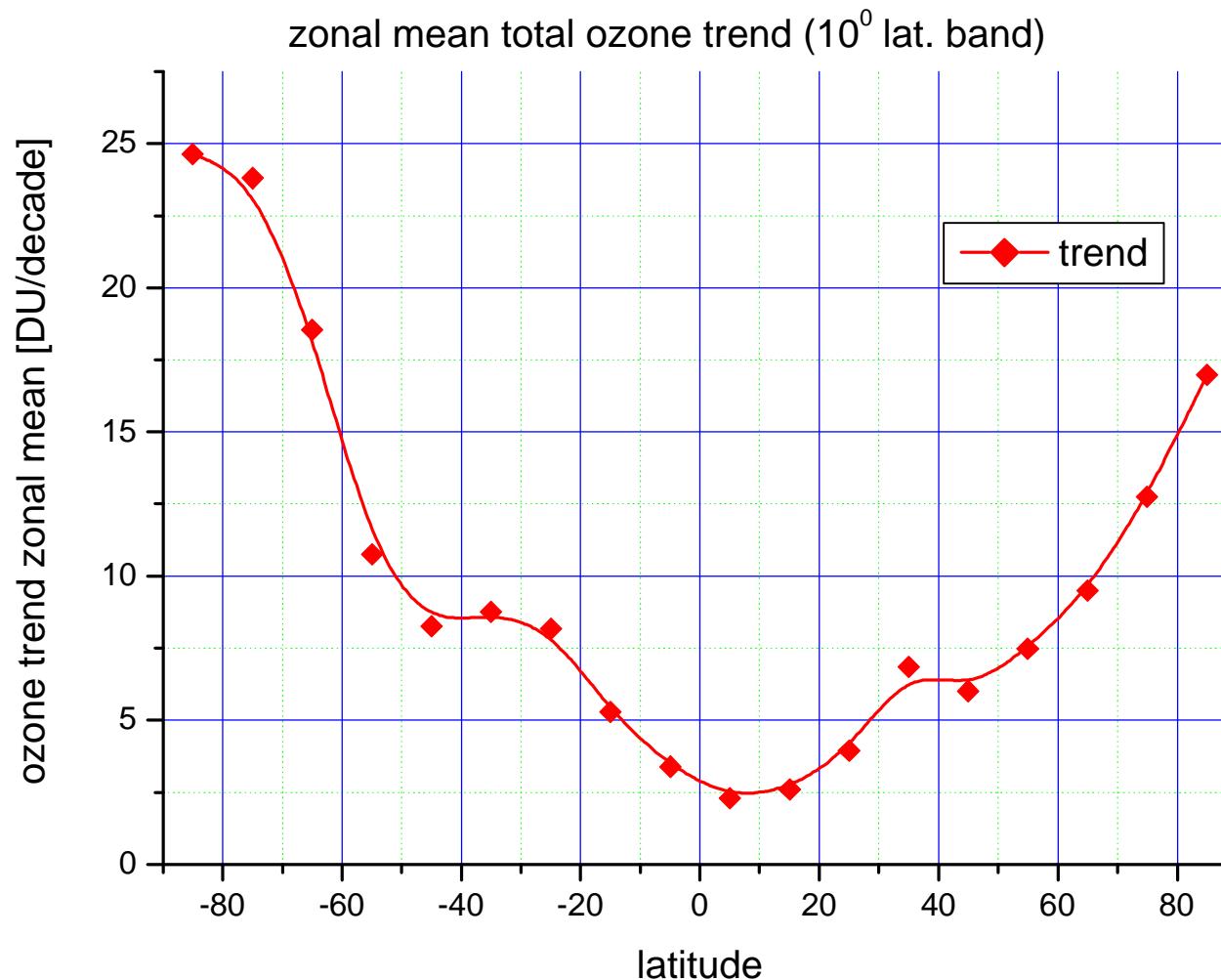
NNORSY-TOVS: Global trends



NNORSY-TOVS: Global trends



NNORSY-TOVS: Global trends



Conclusions

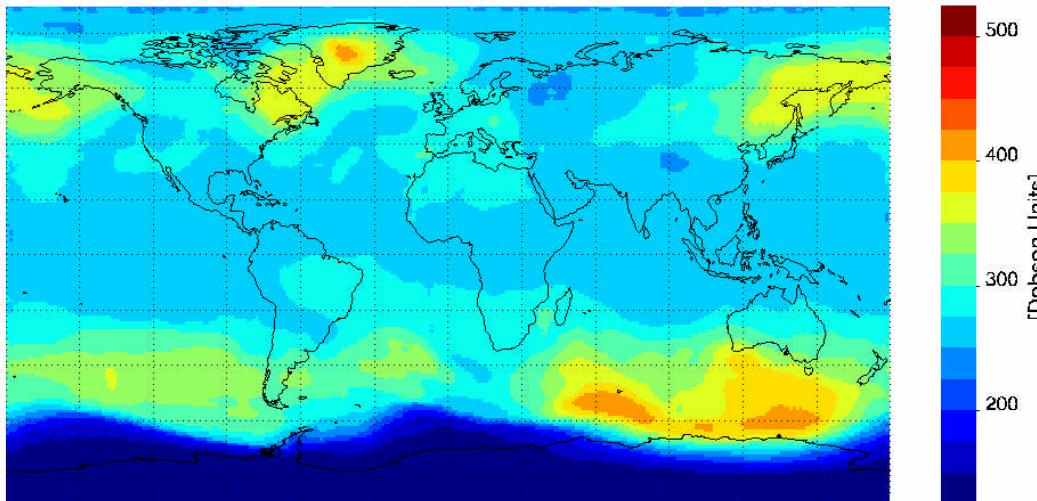
NNORSY-TOVS

- 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



NNORSY-TOVS
Total Ozone
Retrieval

Date: 07/10/1999

Still image of movie

