1. Algorithm Description

- Optimal estimation with TOMS V8 ozone climatology
- Fitting window: 289-307 and 326-339 nm (could not be used in between due to calibration problems)
- 11 layers (2-3 layers in the troposphere, use NCEP tropopause to divide troposphere and stratosphere)
- Wavelength calibrations: variable slant widths, shifts among radiance, radiations, and cross-sections
- Radiometric calibrations: undersampling correction, a 2nd-order polynomial correction in 290-310 nm and a 2nd-order surface albedo in 325-339 nm
- Vertical resolution: 9-16 km in the troposphere
- Global averaged retrieval accuracy in TCO: 21%
- Precision in TCO: from ~15% in the tropics to ~50% at high latitudes

2. Retrieval Characterization of Tropospheric Ozone

- Vertical resolution: 9-16 km in the troposphere
- DFe: 0.5-1.5 between 550 N/S
- Precision: < 10% Precision + Smoothing: 15-25%
- in TCO in areas with mean biases usually within 3 DU (15%)
- Precision + smoothing in TCO: <12% in tropics to <25% at high latitudes
- A priori influence in TCO: from ~15% in the tropics to ~50% at high latitudes
- Spatial resolution: normally 960-80 km² (320x40 km² is possible after June 1998)

3. Daily Retrievals and Validation

- Detailed TCO response to the 1997-1998 El Niño event (dry weather and wildfires) over Indonesia (Fig. 2b-e)
- Changes of 10-20 DU within a few days (Fig. 2b)
- TCO (>40 DU) in Feb. over North Africa (Fig. 3b)
- Band of high TCO (40-60 DU) at 25-45ºN in June (Fig. 3b)
- Distinct differences at 25-40ºN (Fig. 3c-d) between 1-3 Sep. and 16-18 Sep., a 12 DU increase over Indonesia
- Transport of southern subtropical high-ozone air to the tropics and American Samoa in Nov. (Fig. 2b, Fig. 3c-d)
- Capture most of the temporal variability of ozone profile observations (Fig. 2a, Fig. 2b, Fig. 4)

4. Global Distribution of TCO

- Tropical wave-1 during most months especially in the southern hemisphere
- TCO of 33-39 DU near Gulf of Guinea during North Africa biomass burning season (support for the tropical Atlantic paradox)
- Significant spatiotemporal variation over tropical pacific, location of low TCO migrates with TCZ (Fig. 2c)
- Wave-1 patterns weakens in the extratropics with nearly uniform bands at ~30ºS/NC
- Enhanced TCO at 25º-35ºN in April-July (36-48 DU) and at 25º-33ºS in Sep.-Nov. (33-45 DU)
- At ~30ºS and over the tropical south Atlantic, TCO maximizes in Sep.-Nov. and minimizes in Mar.-June
- TCO of <30 DU uniformly distributed south of 15ºS during all seasons with a large latitudinal gradient

5. Comparison with the GEOS-CHEM Model

- Enhanced TCO at 25º-45ºN in April-July (36-48 DU) and at 25º-33ºS in Sep.-Nov. (33-45 DU)
- Significant discrepancies remain:
  - In GEOS-CHEM, the northern bands are broader and are extended to some tropical and subtropical areas; GOME TCO is consistently smaller by 5-20 DU over these regions.
  - GOME TCO does not show a regional maximum of >42 DU over India and Southeast Asia in MAM and Middle-East maximum in JJA and SON, indicating a local ozone source.

Conclusions and Future Outlook

Ozone profiles and tropospheric column ozone are derived from GOME data using the optimal estimation technique after detailed wavelength and radiometric calibrations and forward modeling. The retrieved TCO captures most of the temporal variability in daily ozone profile observations with mean biases usually within 3 DU (15%).

Both GOME and GEOS-CHEM TCO show similar overall structures: tropical wave-1 structure, distinct differences in 25-40ºN in the extratropics, near zonal bands of enhanced TCO of 15-45 DU at 20-30ºS during the austral spring and at 25º-45ºS during boreal spring and summer, TCO of <30 DU zonally distributed at southern middle to high-latitudes.

Significant positive biases of 5-20 DU occur at some marginal tropical and subtropical regions.

Reprocessing of GOME data (July 1995-June 2003) is ongoing with a degradation correction scheme and improvements in track gas (SO2, NOx, HCHO) fitting (e.g., fitting weighting functions, using model-simulated profiles to represent a priori and derive effect air mass factor), and other minor enhancements.

Apply this algorithm to SCIAMACHY, OMI and GOME-2 observations...