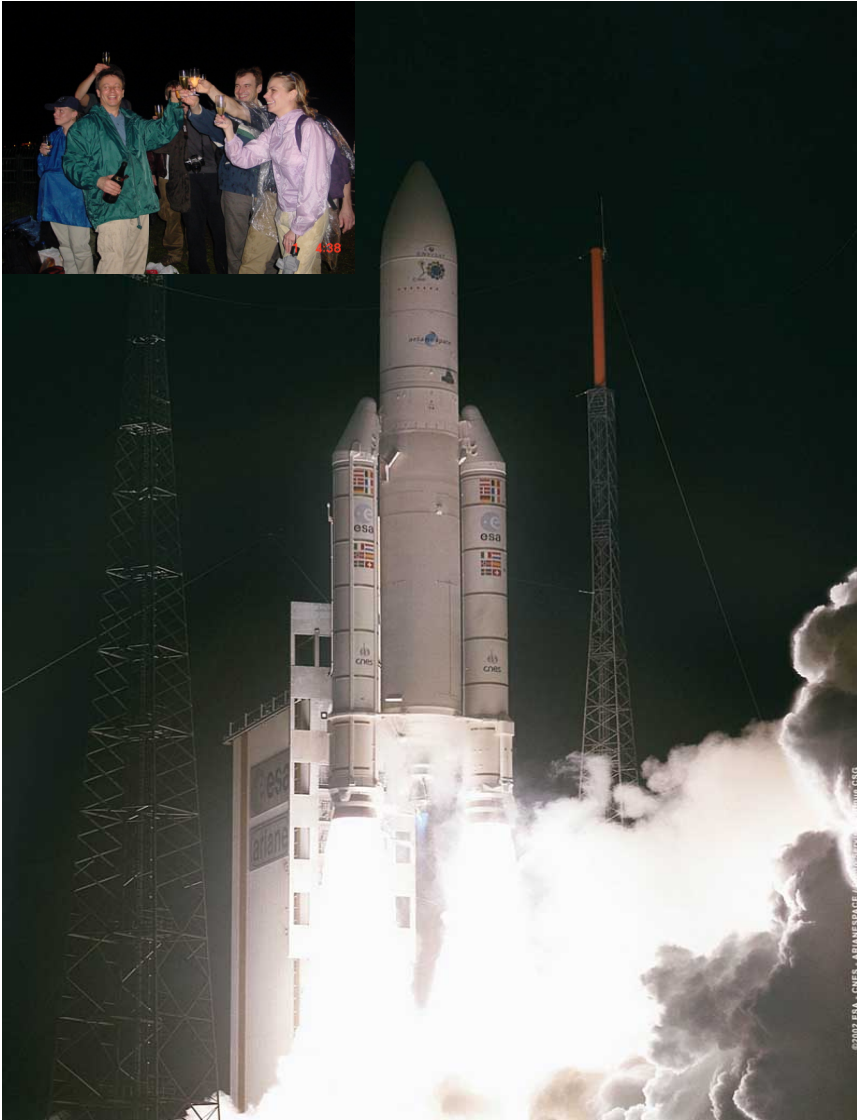


GOMOS measurements and cross sections

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Finnish Meteorological Institute



ENVISAT and GOMOS



Launch: March 1, 2002 Ariane 5

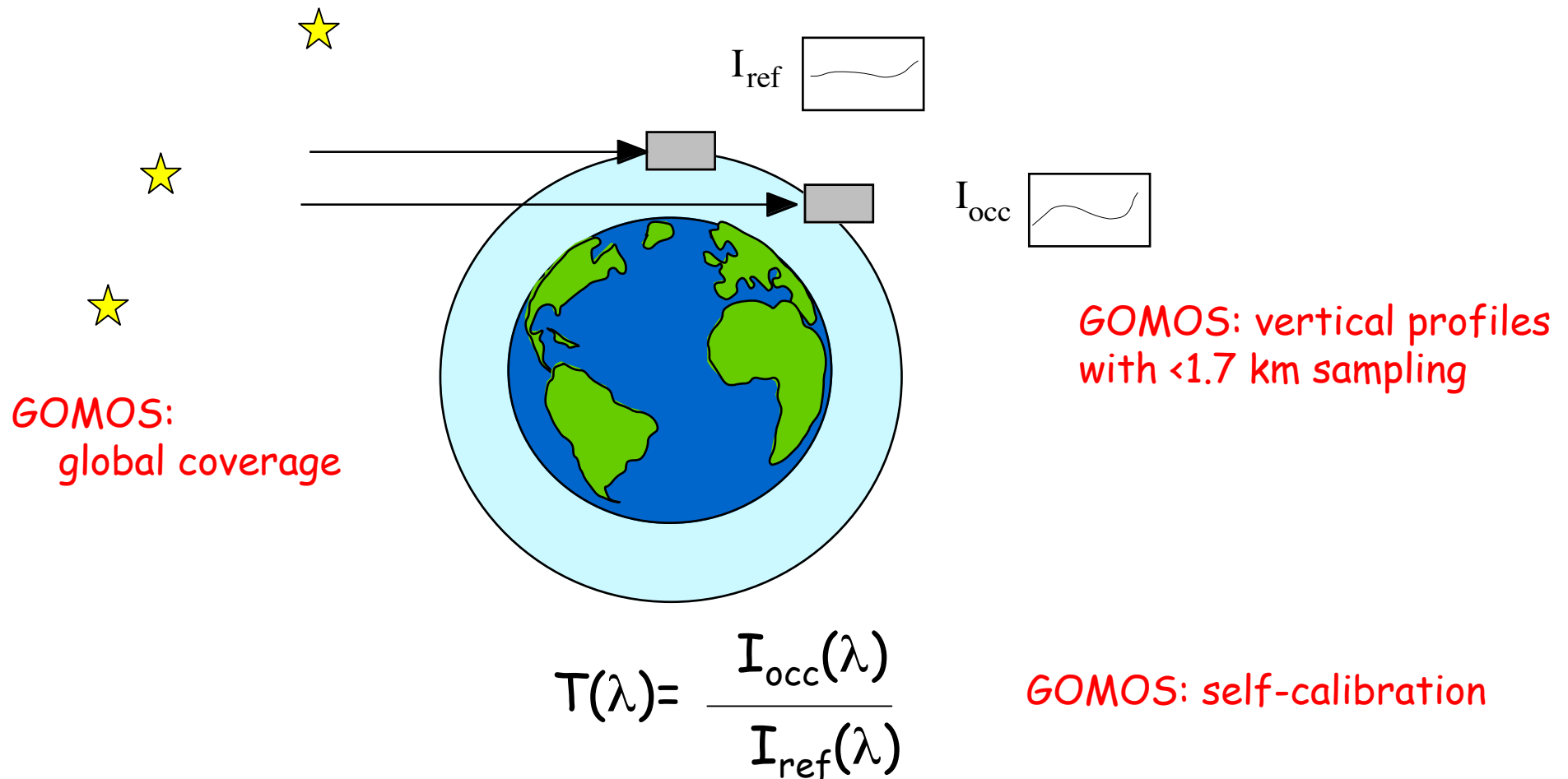
Envisat and GOMOS funded by ESA

11 instruments including 3 atmospheric chemistry instruments:
GOMOS, MIPAS, SCIAMACHY

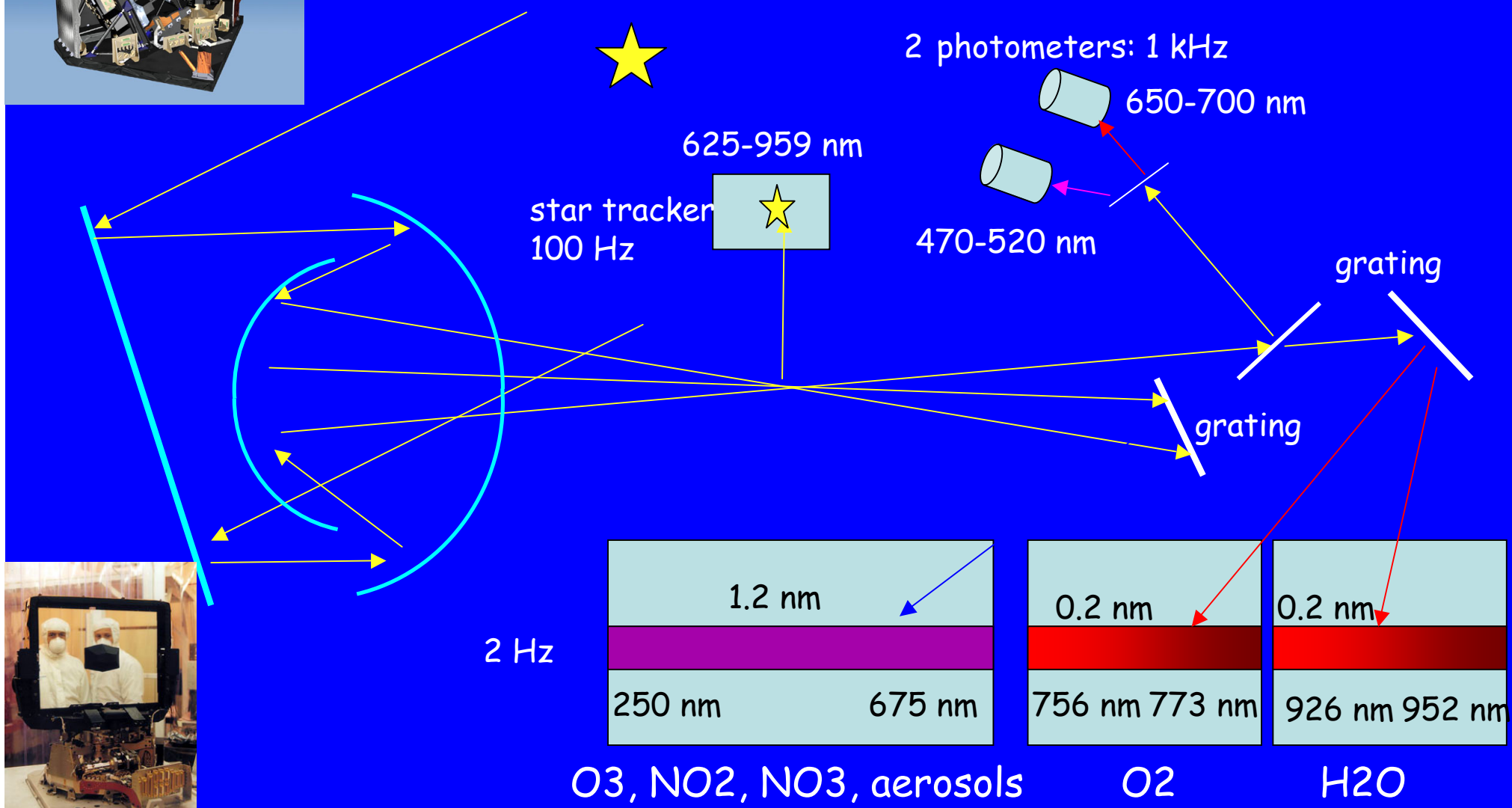
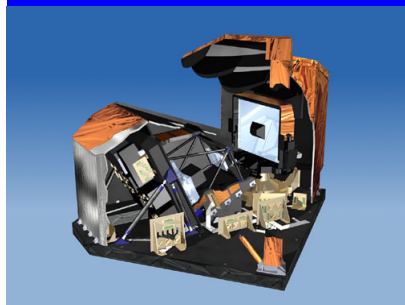
700 000 measurements

300 000 night time measurements

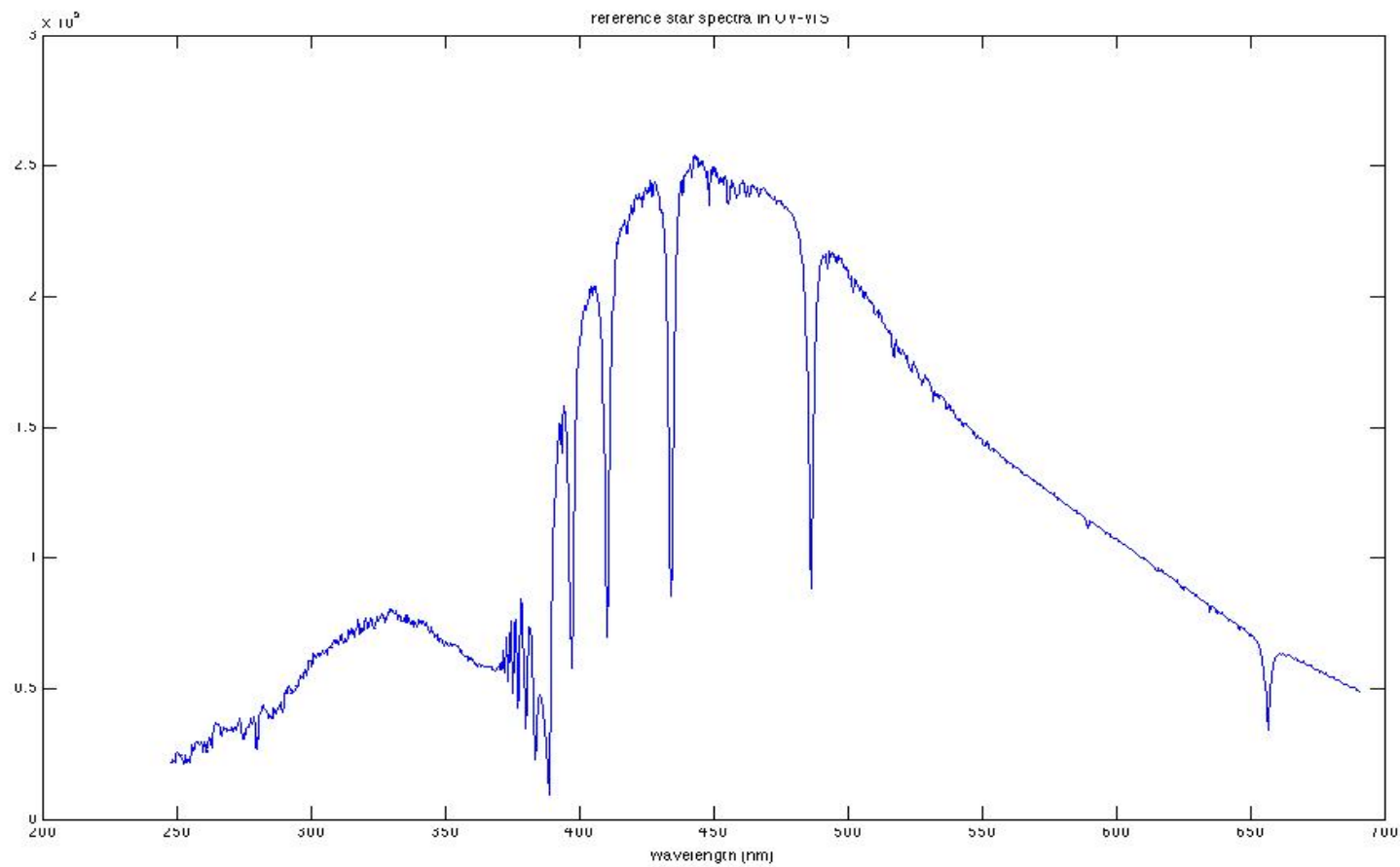
Global Ozone Monitoring by Occultations of Stars



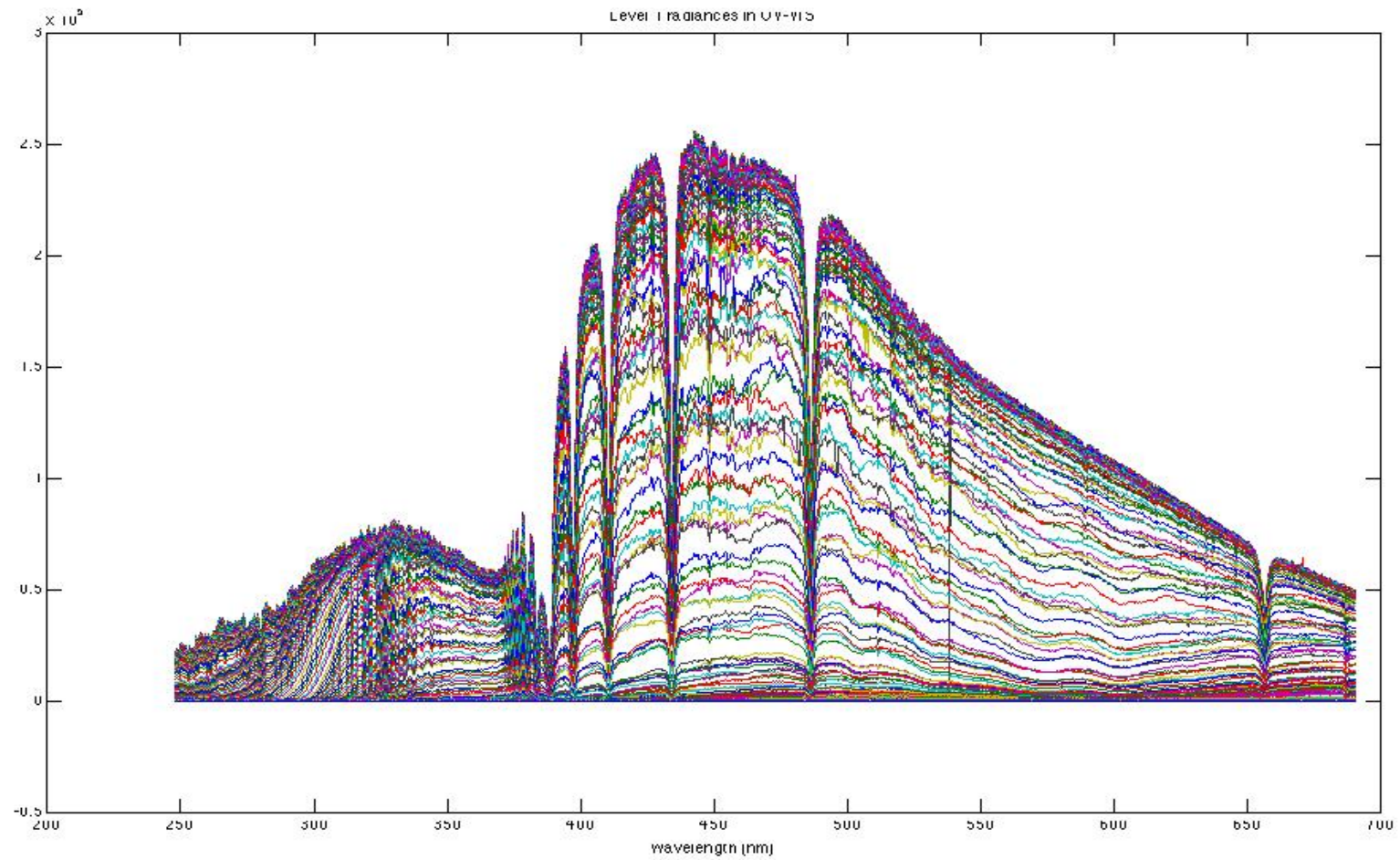
GOMOS instrument: optics and detectors



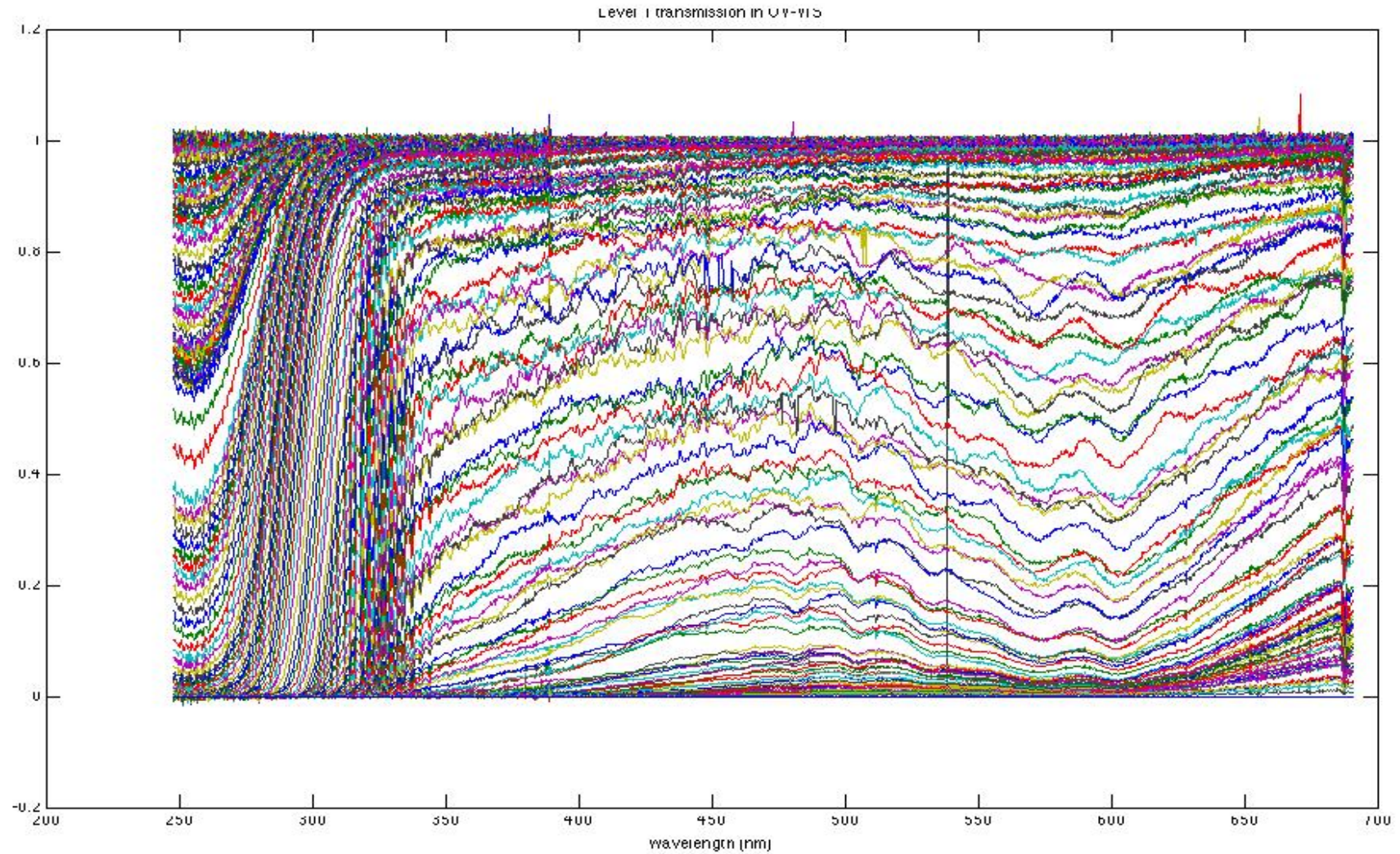
Measured Sirius reference spectrum at 130 km



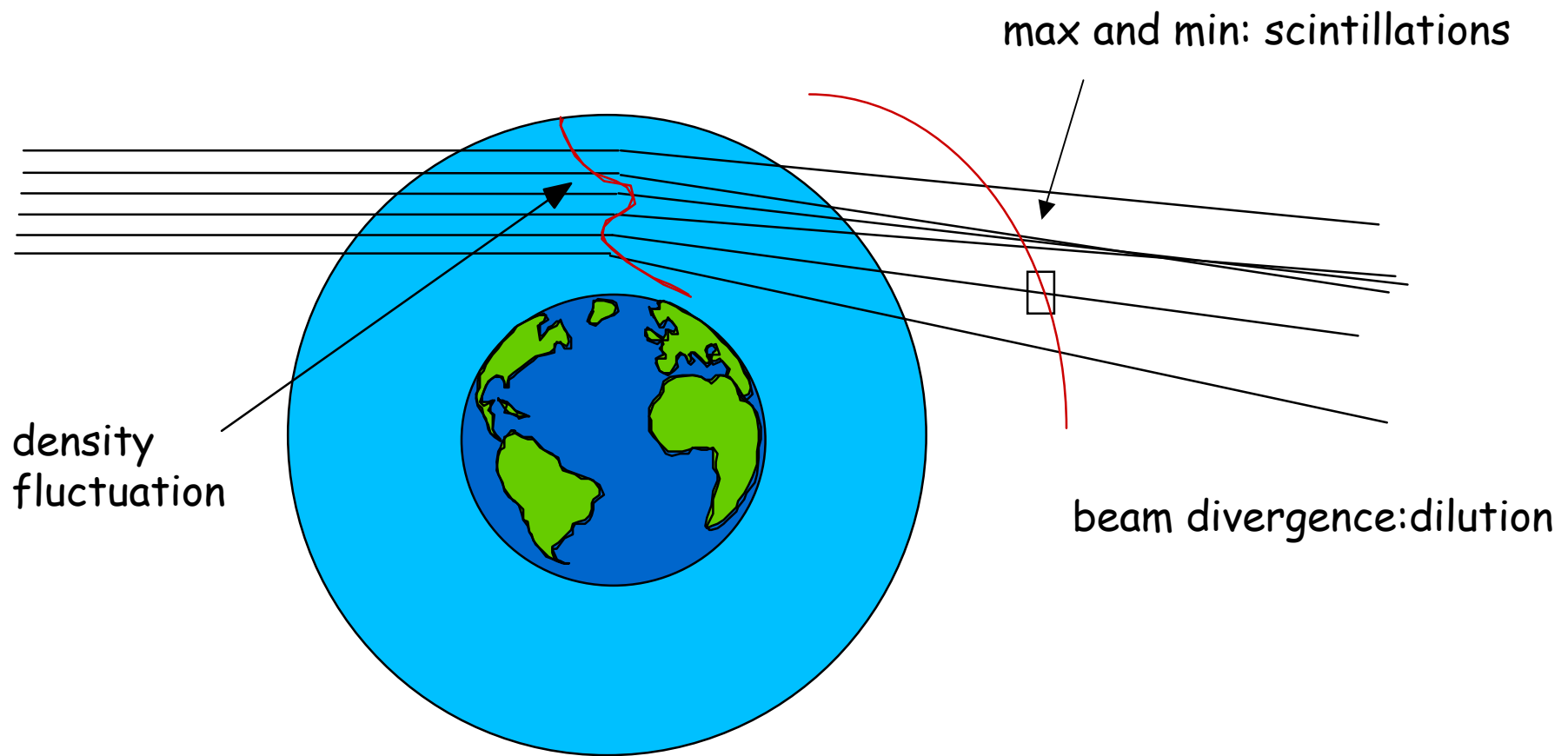
Calculated Sirius transmitted spectra at 100-5 km



Calculated Sirius transmissions at 100-5 km



Beyond Beer-Lambert: dilution & scintillations



$$T(z, \lambda) = T_{ref} T_{ext}$$

Transmission from refractive effects can be estimated from ray tracing calculations (dilution, chromatic effects). In addition, we need photometer measurements to estimate the random part (scintillations). This works well for orbital occultations.

$$T(\lambda, z) = \exp\left(-\sum \int \sigma_j(\lambda, T(z(s))) \rho_j(z(s)) ds\right)$$

Summing over absorbers and scatterers:
O3, NO2, NO3, air, aerosols

Along LOS integral with T-distribution. Main contribution from the tangent-point region.

GOMOS O3 cross sections

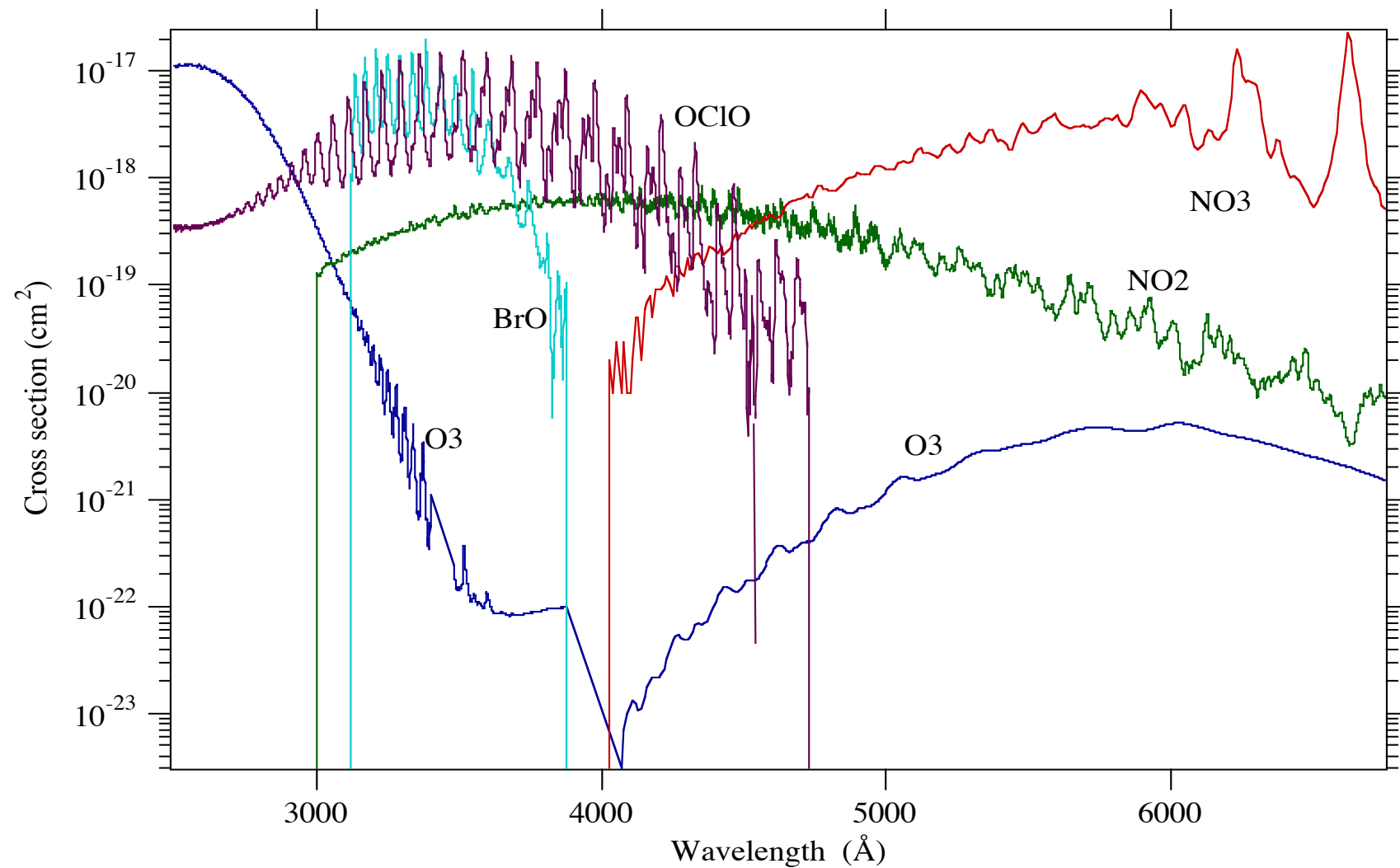
Source: Bogumil et al.

- 0.05 nm
- 235-700 nm
- T=200:10:300 by linear interpolation

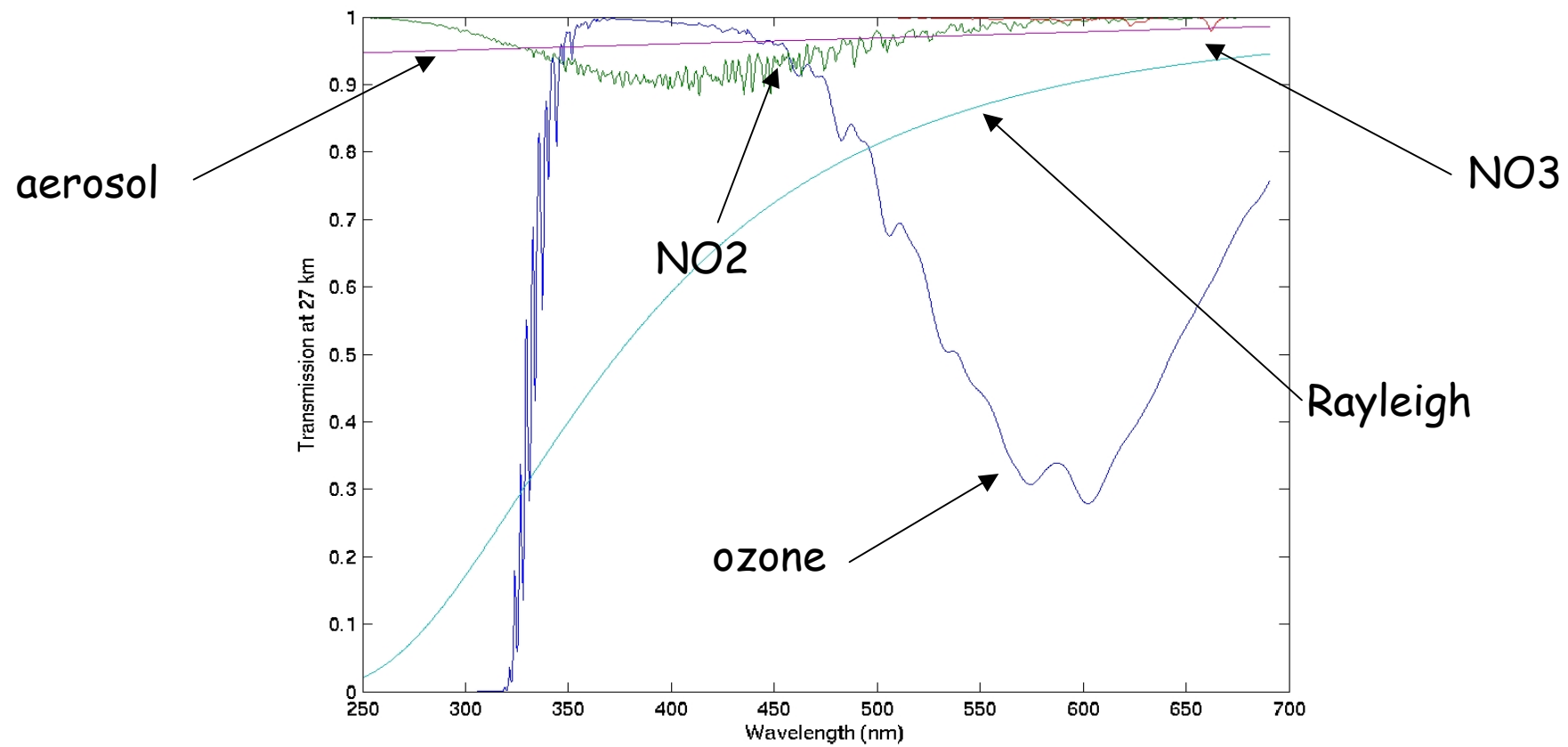
Retrieval:

- 0.3 nm (pixel)
- convolution with Gaussian instrument function
- 250-675 nm
- Linear T interpolation with ECMWF T

Cross sections



Transmission components at 27 km



GOMOS retrieval

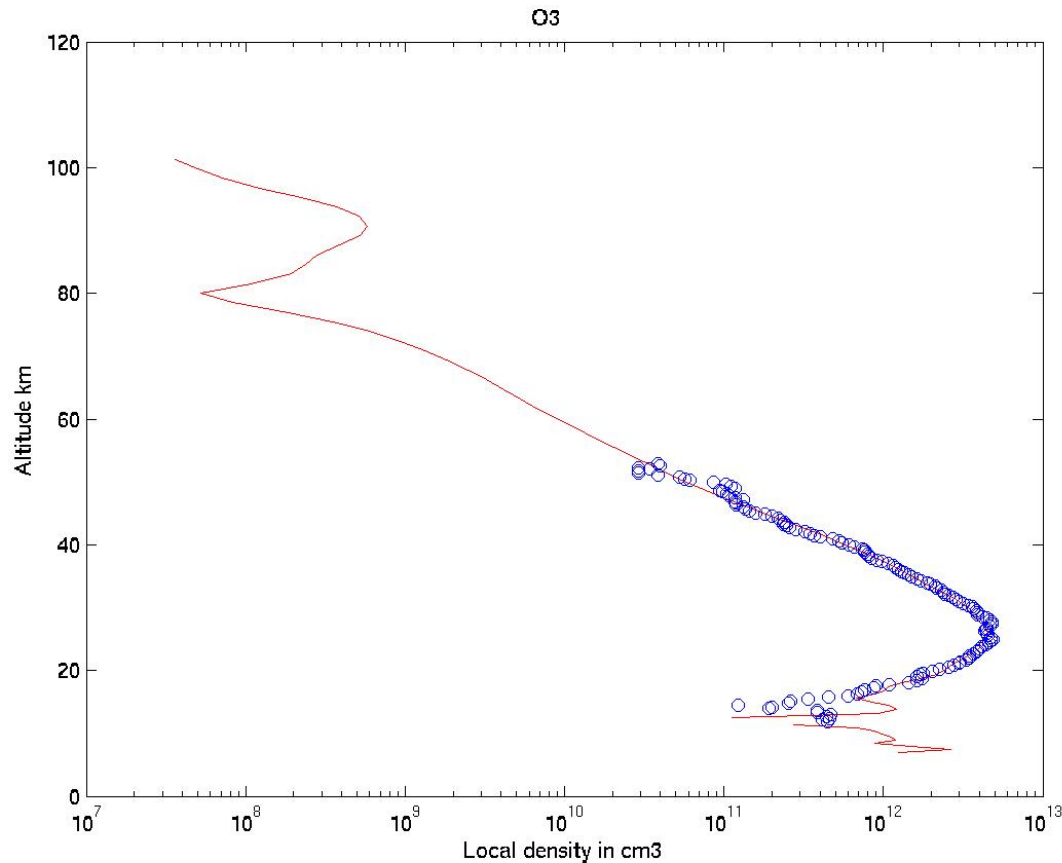
O₃, NO₂, NO₃, air and aerosols fitted at the same time using in 250-675 nm. Data is weighted by error variances.

- All wavelengths (1411 pixels)
- Non-linear fitting of transmissions to B-L
- Iteration over effective cross sections:

$$\tau = \sum_j \int \sigma_j(\lambda, T(s)) \rho(s) ds = \sum_j N_j(L) \sigma_j^{eff}(\lambda, L)$$

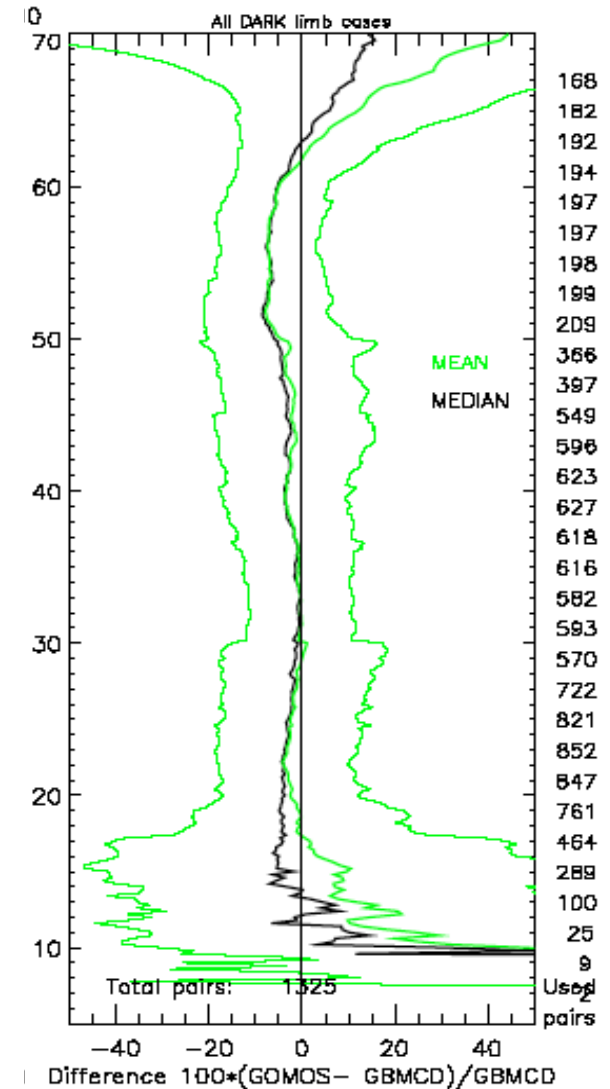
$$\sigma^{eff}(\lambda, L) = \frac{\int \sigma(\lambda, T(s)) \rho(s) ds}{N(L)}$$

Validation with ground based instruments

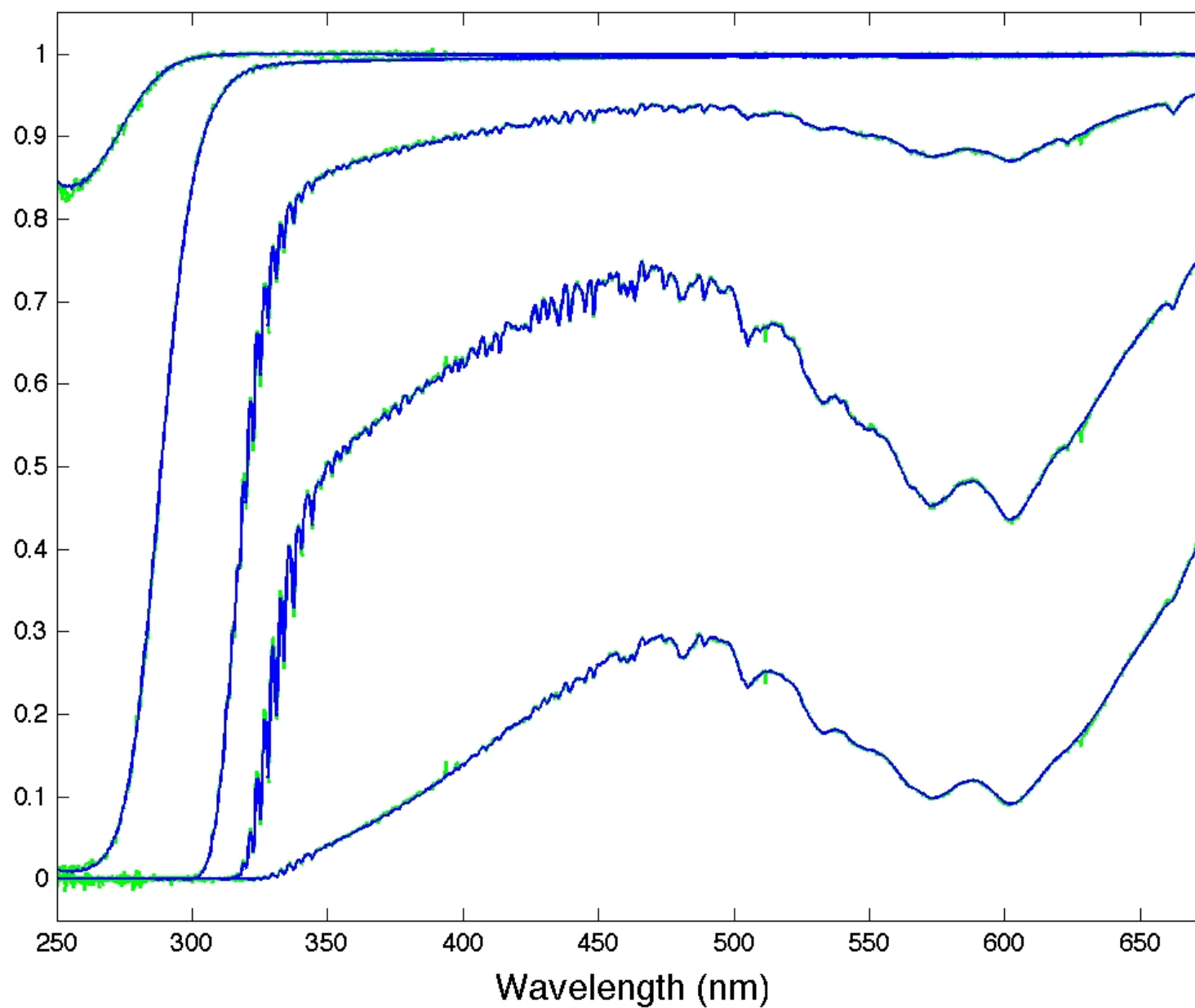


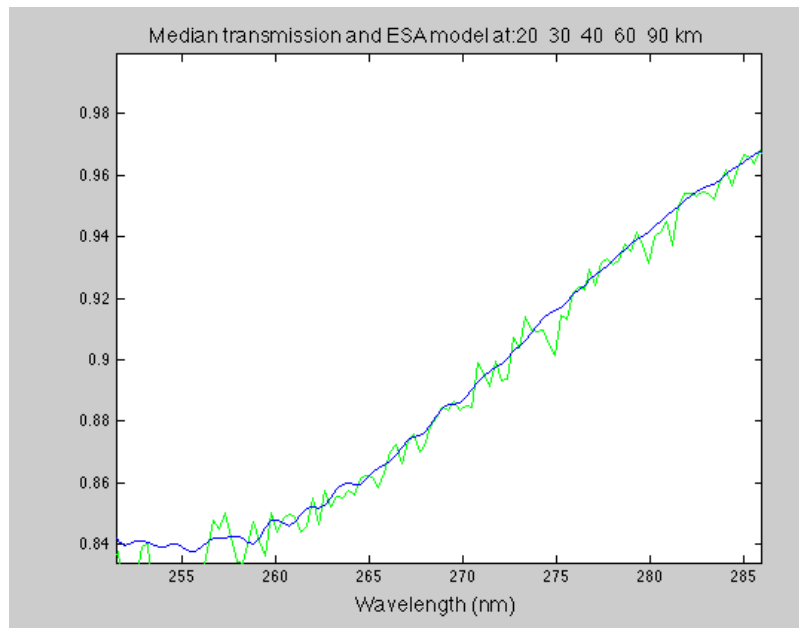
GOMOS vs Mauna Loa ozone lidar

Statistics of GOMOS vs
ground based instruments

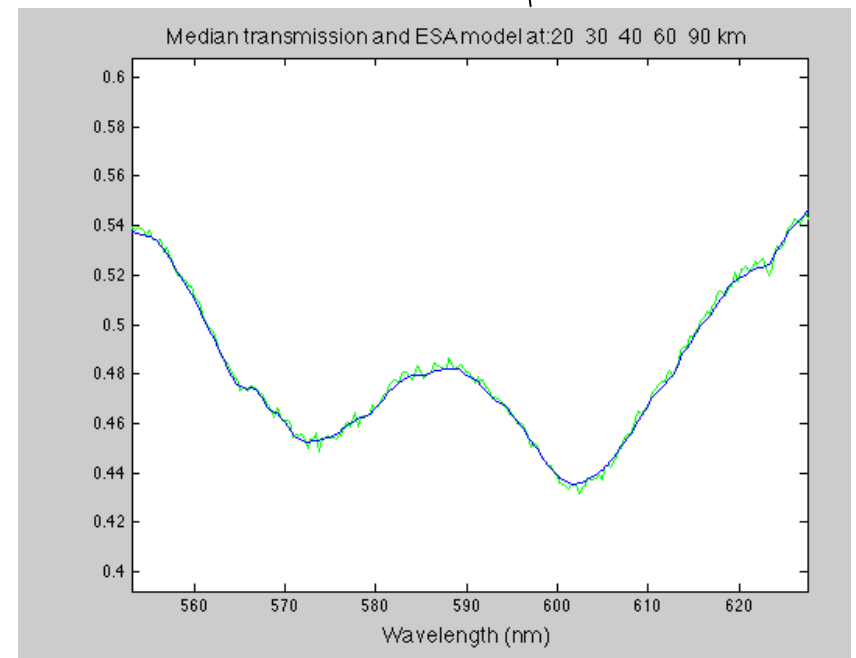
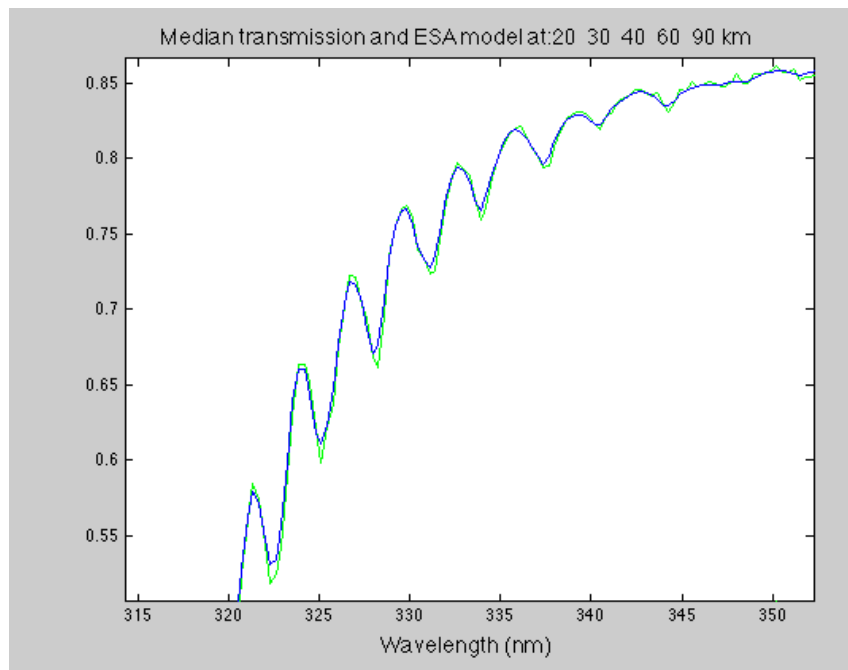
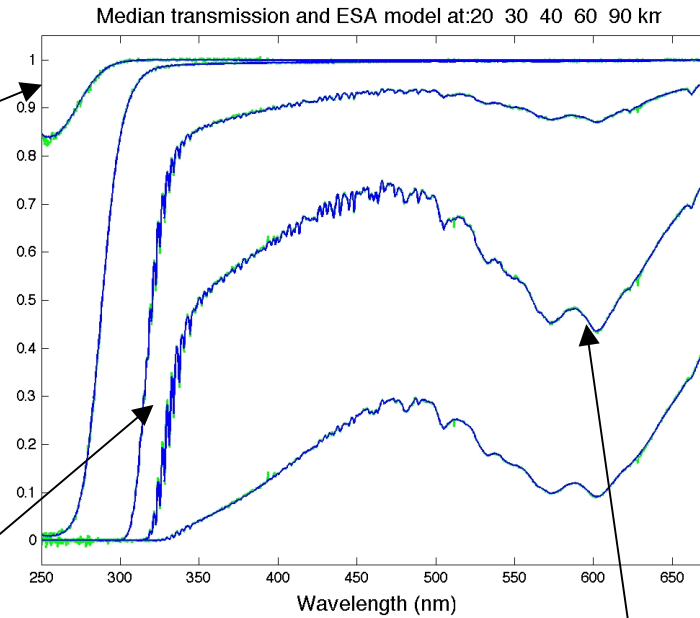


Median transmission and ESA model at:20 30 40 60 90 km

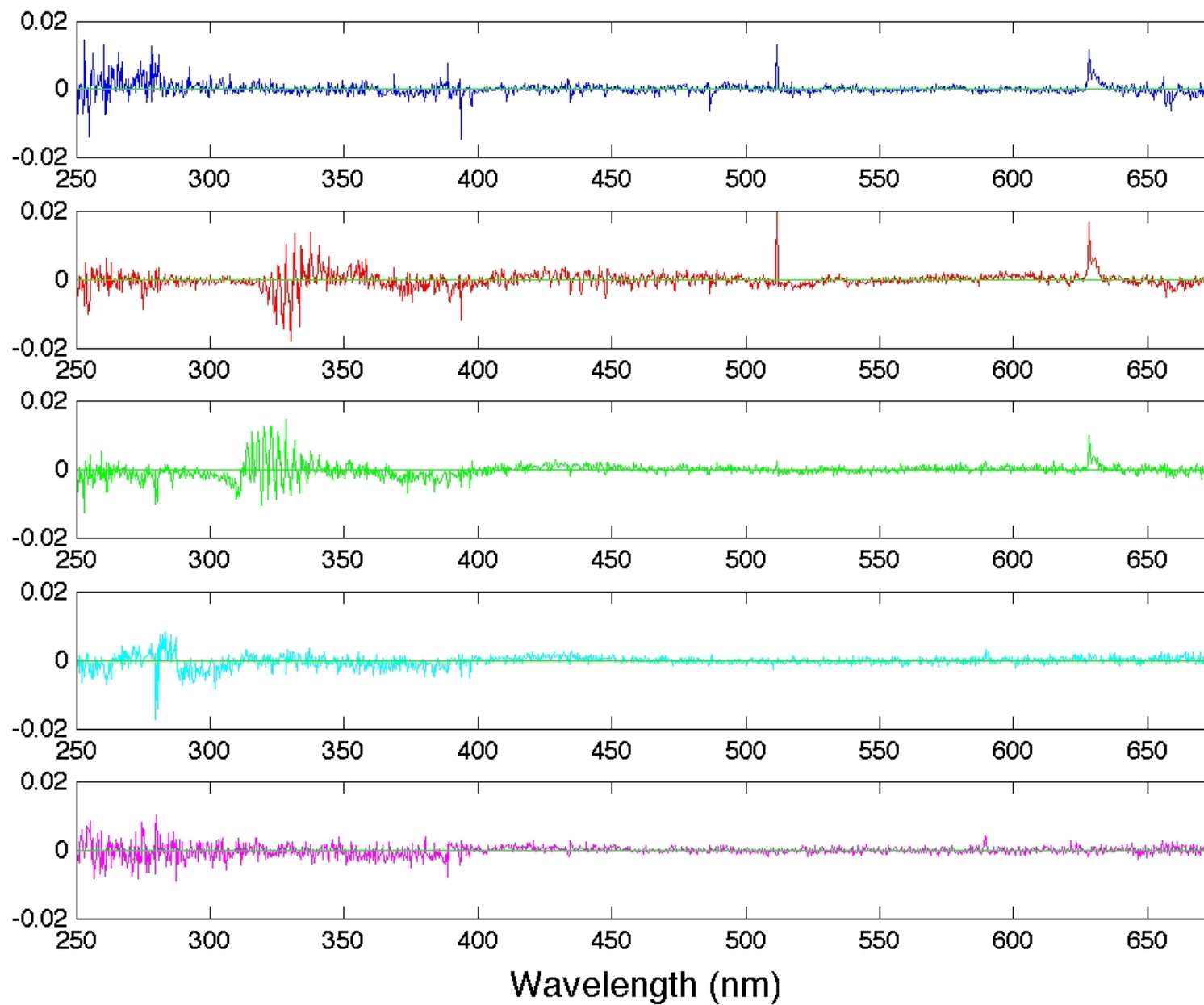




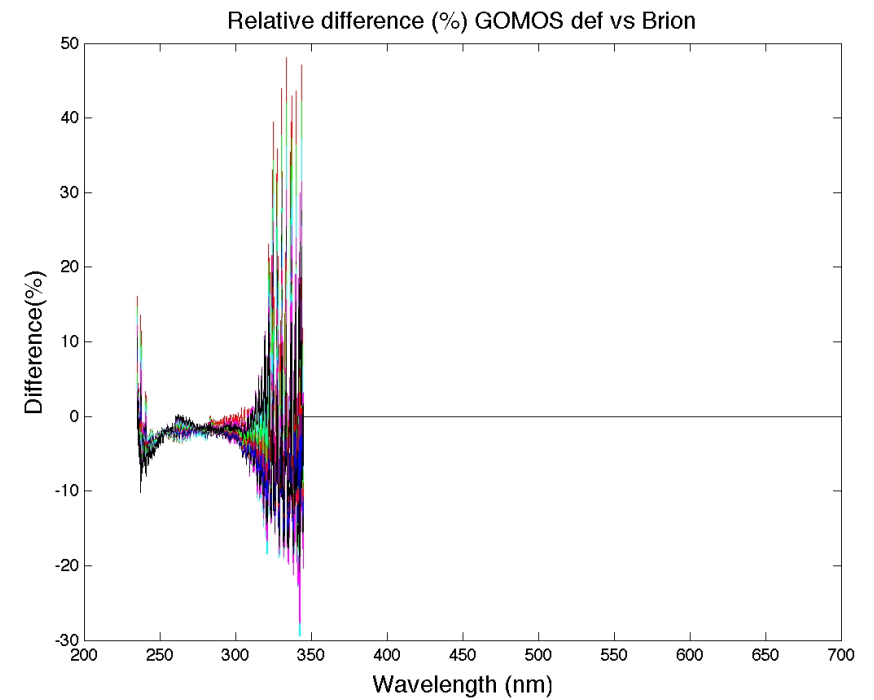
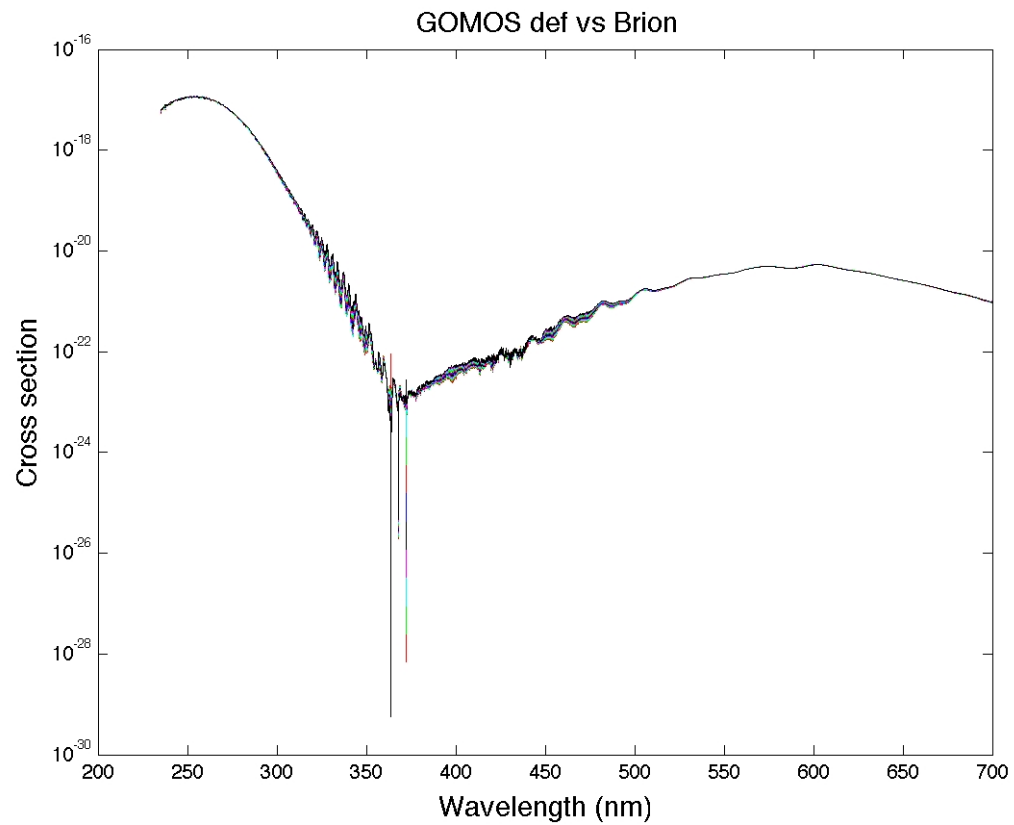
Examples of fits



Residuals

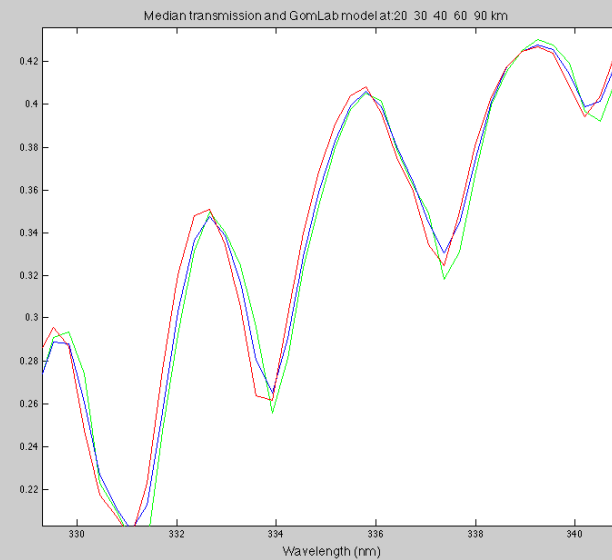
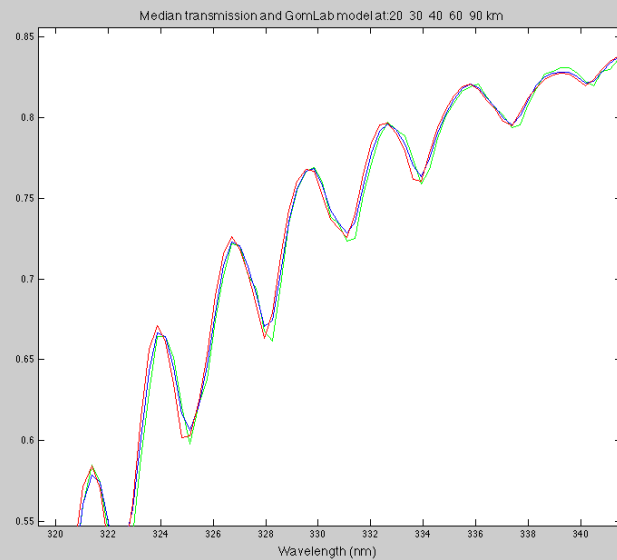
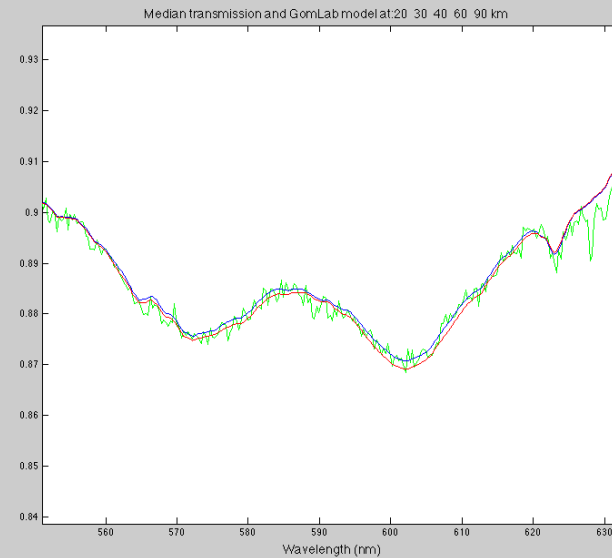
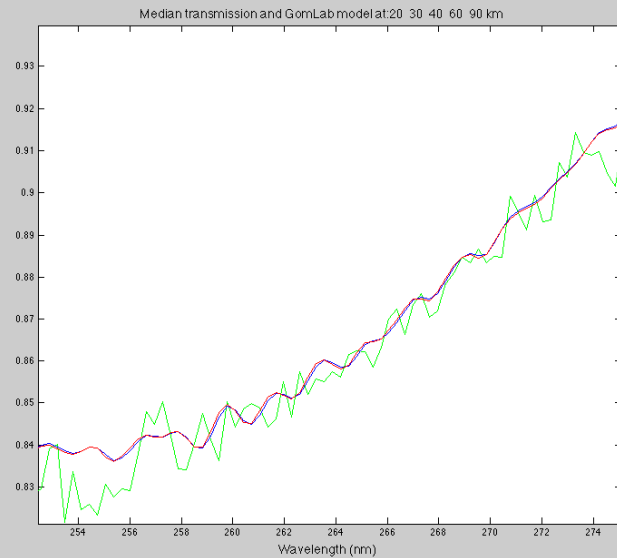


GOMOS cross vs Brion et al. cross



Details if fits when chancing cross sections

green: measured
blue: Gomos. def.
red: Brion et al.



Conclusion

GOMOS transmission measurements can be used to test cross sections in the wide wavelength region 250-675 nm at altitudes 20-100 km.