

GOMOS O₃, NO₂ and NO₃ measurements in 2002-2007



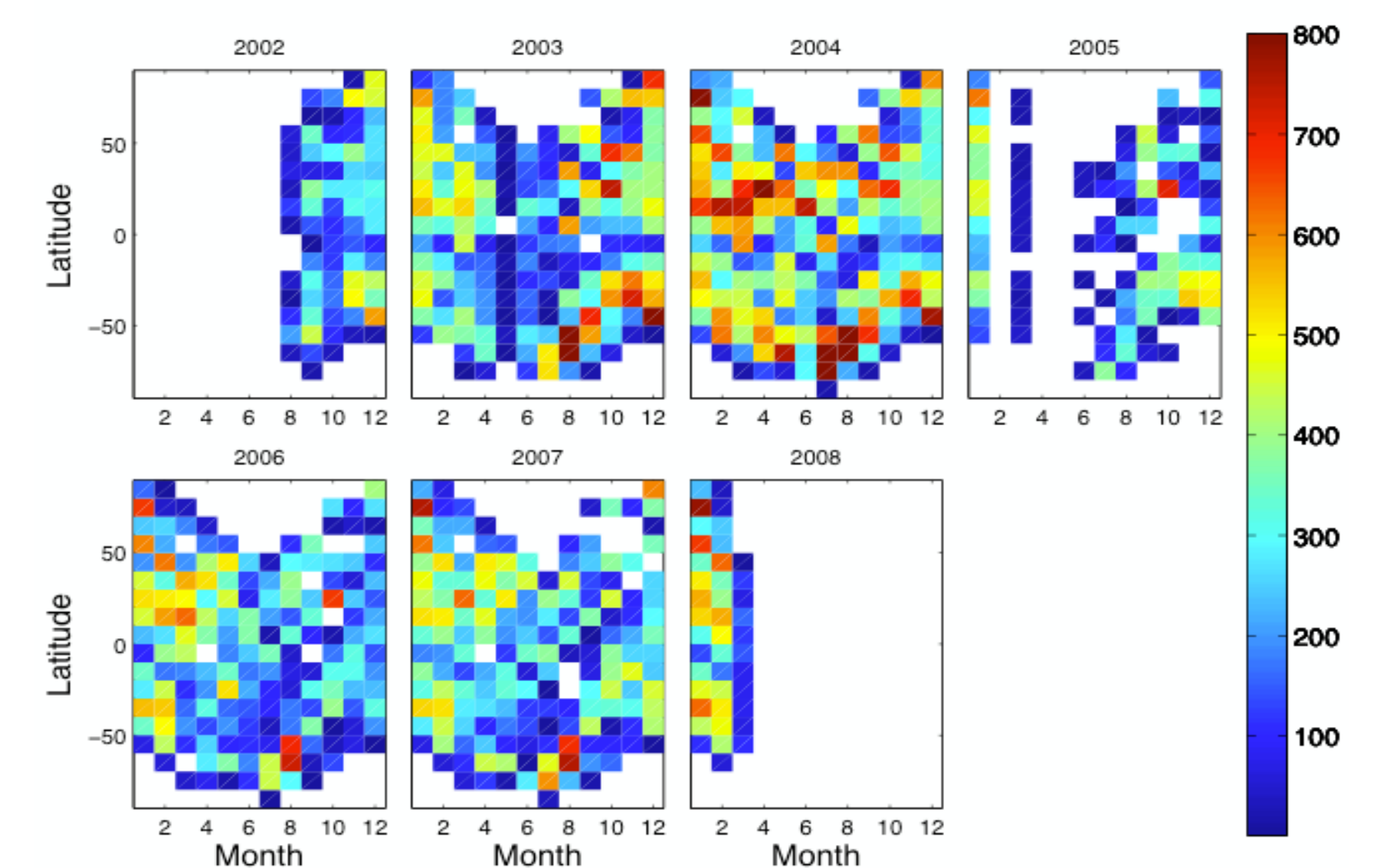
E. Kyrölä, J. Tamminen, V. Sofieva, Finnish Meteorological Institute, Helsinki, Finland
 J. L. Bertaux, A. Hauchecorne, F. Dalaudier, Service d'Aéronomie du CNRS, Verrieres le Buisson Cedex, France
 D. Fussen, F. Vanhellemont, Institut d'Aeronomie Spatiale de Belgique, Brussels, Belgium
 O. Fanton d'Andon, G. Barrot, M. Guirlet, ACRI-ST, Sophia Antipolis, France
 T. Fehr, L. Saavedra de Miguel, ESA/ESRIN, Frascati, Italy

GOMOS (Global Ozone Monitoring by Occultation of Stars) on ESA's Envisat-satellite measures transmission spectra of light through the Earth's limb using the stellar occultation method. From these spectra it is possible to retrieve profiles of O₃, NO₂, NO₃, H₂O, O₂, neutral density, and aerosols in the stratosphere and mesosphere. GOMOS has an UVIS spectrometer at 248-690 nm and two IR spectrometers at 750-776 nm and 916-956 nm. The spectrometers use 0.5 sec integration time, which provides 0.3-1.6 km vertical sampling resolution. Two photometers (1 KHz) record fast fluctuations of light (scintillations) caused by small-scale turbulence in the stratosphere. During 24 h GOMOS measures 300-500 occultations leading to good global coverage. During the first six years of operation GOMOS has measured more than 550 000 occultations. An extensive validation program has shown that ozone profiles agree well with various validating data. Using available GOMOS data it is now possible to build global night-time profile distributions of some key constituents. In this poster we show the development of the ozone, NO₂ and NO₃ profile distributions in 2002-2007.

Selected GOMOS publications

- Bertaux, J.L. et al., First results on GOMOS/Envisat, *Adv. Space Res.*, 33, 1029, 2004.
 Kyrölä, E. et al., GOMOS on Envisat: An overview, *Adv. Space Res.*, 33, 1020, 2004.
 Fussen, D. et al., Global measurement of the mesospheric sodium layer by the star occultation instrument GOMOS, *GRL*, 31, No. 24, L24110, 2004.
 Seppälä, A. et al., Solar Proton Events of October-November 2003: Ozone depletion in the Northern hemisphere polar winter as seen by GOMOS/Envisat, *GRL*, 31, L19107, 2004.
 Hauchecorne, A. et al., First simultaneous global measurements of nighttime stratospheric NO₂ and NO₃ observed by Global Ozone Monitoring by Occultation of Stars (GOMOS)/Envisat in 2003, *JGR*, 110, No. D18, D18301, 2005.
 Vanhellemont, F. et al., A 2003 stratospheric aerosol extinction and PSC climatology from GOMOS measurements on Envisat, *ACP*, 5, 2413, 2005.
 Verronen, P.T. et al., A comparison of night-time GOMOS and MIPAS ozone profiles in the stratosphere and mesosphere, *Adv. Space Res.*, 36, 958, 2005.
 Verronen, P.T. et al., Diurnal variation of ozone depletion during the October-November 2003 solar proton events, *JGR*, 110, A9, A09S32, 2005.
 Fussen, D. et al., A global OCIO stratospheric layer discovered in GOMOS stellar occultation measurements, *GRL*, 33, Issue 13, L13815, 2006.
 Kyrölä, E. et al., Nighttime ozone profiles in the stratosphere and mesosphere by GOMOS on Envisat, *JGR*, 111, D24306, 2006.
 Sofieva, V. et al., Global analysis of scintillation variance: Indication of gravity wave breaking in the polar winter upper stratosphere, *GRL*, 34, L03812, 2007.
 Seppälä, A. et al., Arctic and Antarctic polar winter NO_x and energetic particle precipitation in 2002-2006, *GRL*, 34, L12810, 2007.
 Verronen, P.T. et al., Production of Odd Hydrogen in the Mesosphere During the January 2005 Solar Proton Event, *GRL*, 33, 24, L24811, 2006.
 Hauchecorne, A. et al., Large increase of NO₂ in the north polar mesosphere in January-February 2004: Evidence of a dynamical origin from GOMOS/ENVISAT and SABER/TIMED data, *GRL*, 34, 2007.

GOMOS NIGHT-TIME MEASUREMENTS 2002-2008



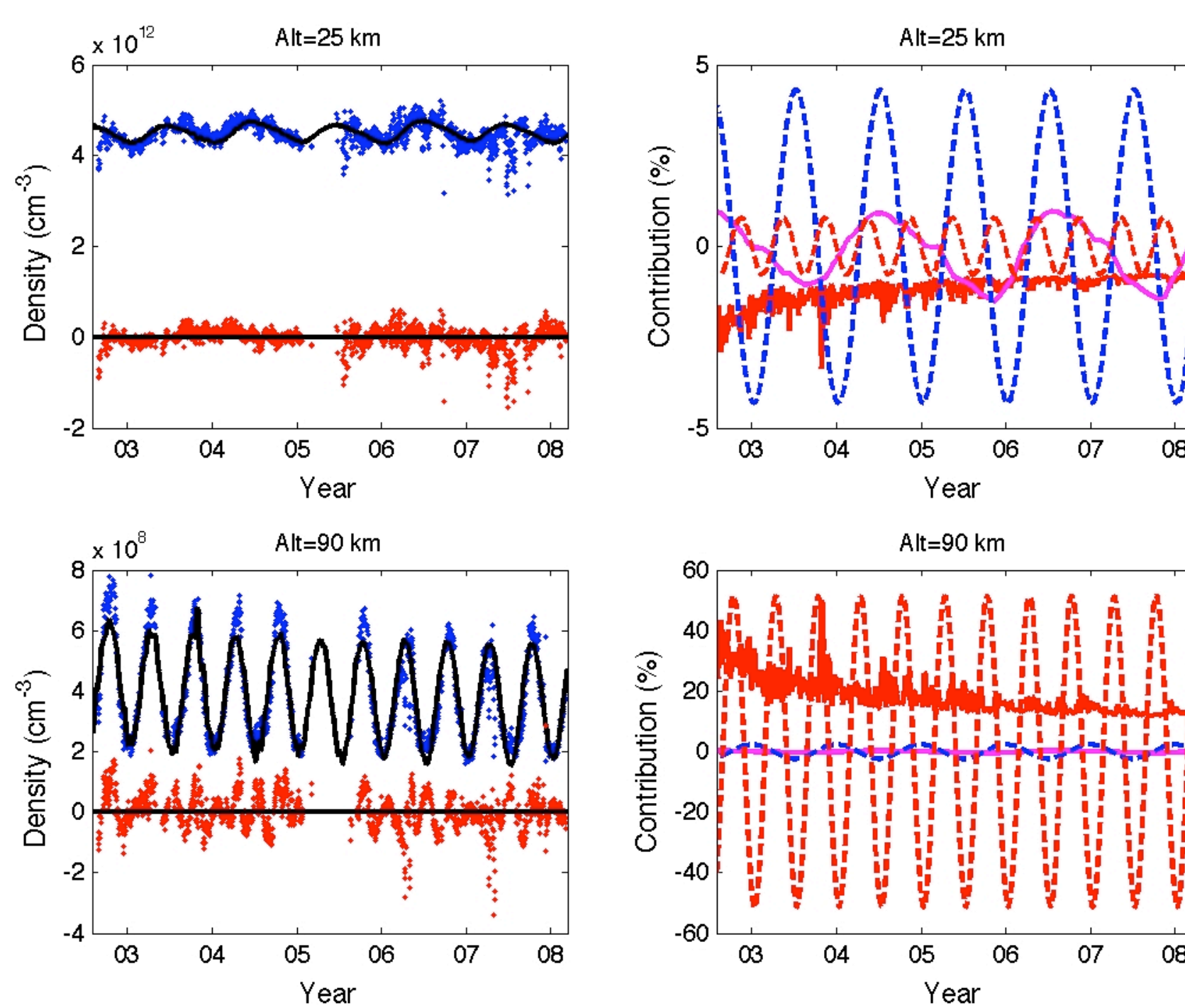
Time series analysis

GOMOS measurements in 2002-2007 can be used for time series analysis. For trend analysis the coverage is too short but seasonal and other shorter time variations can be investigated. We have applied the following model to GOMOS time series:

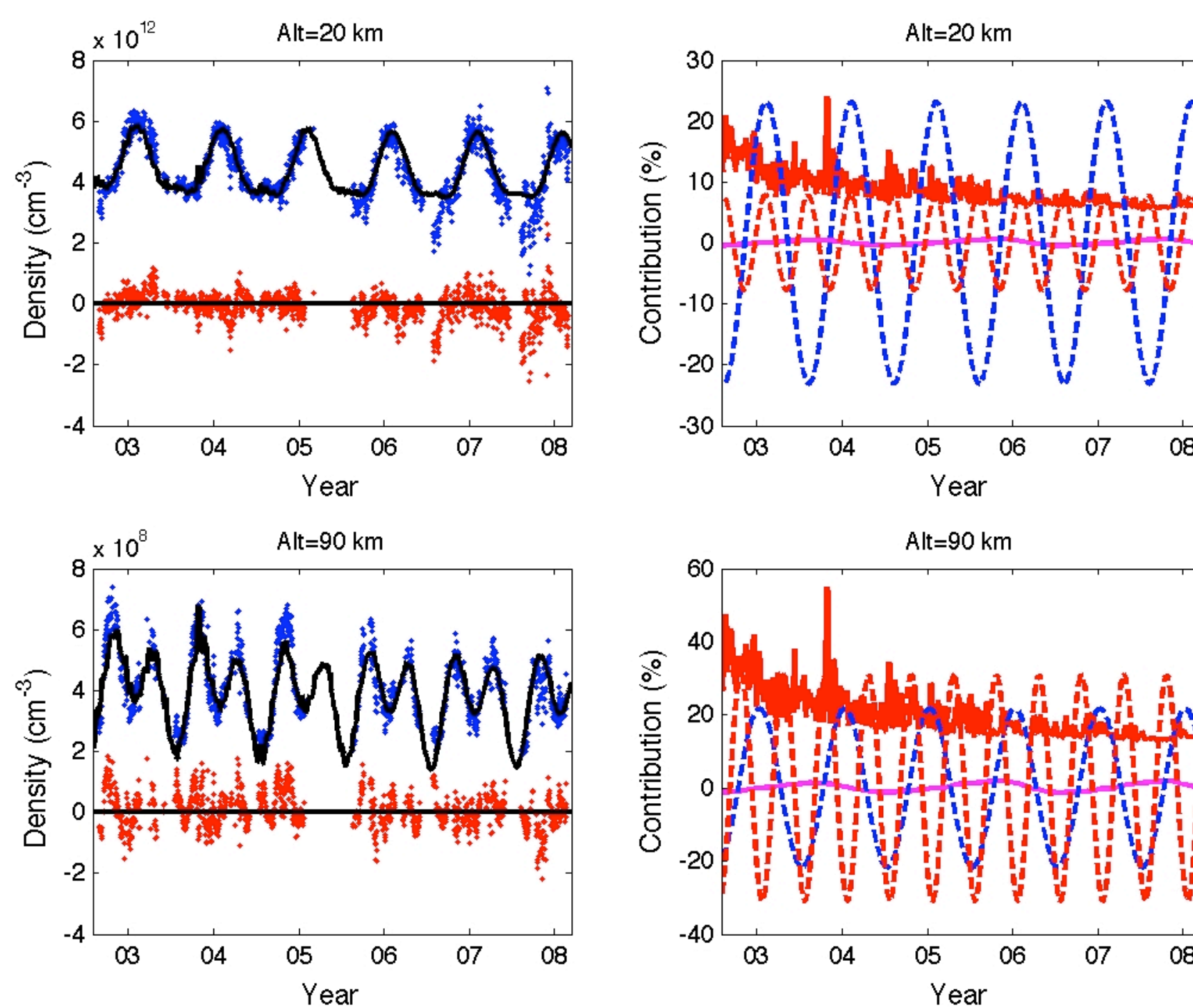
$$\rho(z,t) = a(z) + b(z)F_{10.7}(t) + c(z)F_{QBO}(t) + \sum_{n=1}^p (d_n(z) \sin(n\omega t) + e_n(z) \cos(n\omega t))$$

Preliminary results for the zonally averaged number densities are shown in the figures below.

Reference: Kyrölä, E. et al., GOMOS trace gas observations 2002-2007, in preparation.



GOMOS ozone at equator. Left panels: GOMOS ozone (blue dots), fits (black lines), and residuals (red dots). Right panels: Fit components: Annual (blue dash), semi-annual (red dash), solar F10.7 (red), QBO (magenta).



GOMOS ozone at north mid-latitudes. Left panels: GOMOS ozone (blue dots), fits (black lines), and residuals (red dots). Right panels: Fit components: Annual (blue dash), semi-annual (red dash), solar F10.7 (red), QBO (magenta).

Zonal monthly climatologies for O₃, NO₂ and NO₃

