FDR4ATMOS (Task A): Improving SCIAMACHY Level 1 and add calibrated lunar data

G. Lichtenberg[1], S. Slijkhuis[1], B. Aberle[1], A. Kumar[1], M. Krijger[2], J.-C. Lambert[3], J. van Gent[3], D. Hubert[3], S. Noël[4], K. Bramstedt[4], P. Green[5], P. de Vis[5], A. Dehn[6], G. Brizzi[7]

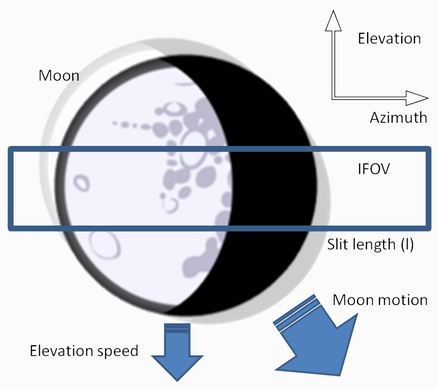
[1]Remote Sensing Technology Institute (IMF), German Aerospace Center (DLR), Oberpfaffenhofen, Wessling, Germany; [2]Earth Space Solutions, Utrecht, The Netherlands (ESS); [3]Belgian Institute for Space Aeronomy (IASB-BIRA), Brussels, Belgium; [4]Institute of Environmental Physics / Remote Sensing (IUP/IFE), University of Bremen, Germany; [5]National Physics Laboratory, Teddington, UK (NPL UK); [6]ESA-ESRIN, Frascati, Italy; [7]SERCO Italy

Introduction

The project FDR4ATMOS (**Fundamental Data Records in the domain of satellite Atmospheric Composition**) has been initiated by the European Space Agency (ESA). Task A of the project covers the **improvement of the SCIAMACHY Level 1b degradation correction**, with the aim to remove ozone trends from the SCIAMACHY Level 2 data set that were introduced during the development of baseline version 9 (both data sets not released). We will also, for the first time, **add calibrated lunar data to Level 1**, covering the whole spectral range of SCIAMACHY and the full mission time.

Lunar Data

- SCIAMACHY made regular Moon measurements and covered a large range of observation parameters
- The spectral range and resolution of the observations constitute a unique data set
- The lunar disk fills part of the slit and was scanned several times. Each individual scan had a 2 second duration.
- In total there were 1123 measurements of the moon covering a wide range of lunar observation geometries



The new SCIAMACHY Level 1 product will contain

- Averaged data for the orbit, including reflectance and irradiance for the full disk
- Individually measured data
- Additional parameters to be used in further analysis like lunar phase angle, lunar latitude and longitude etc.

Lunar data validation

- We used the ROLO/GIRO (e.g. Wagner et al. 2015) as an independent validation source
- The data agree within the estimated error of the ROLO data (Stone, T. et al. 2004)
- There is no discernible trend in the SCIAMACHY data (not shown) over the mission lifetime; the degradation correction works

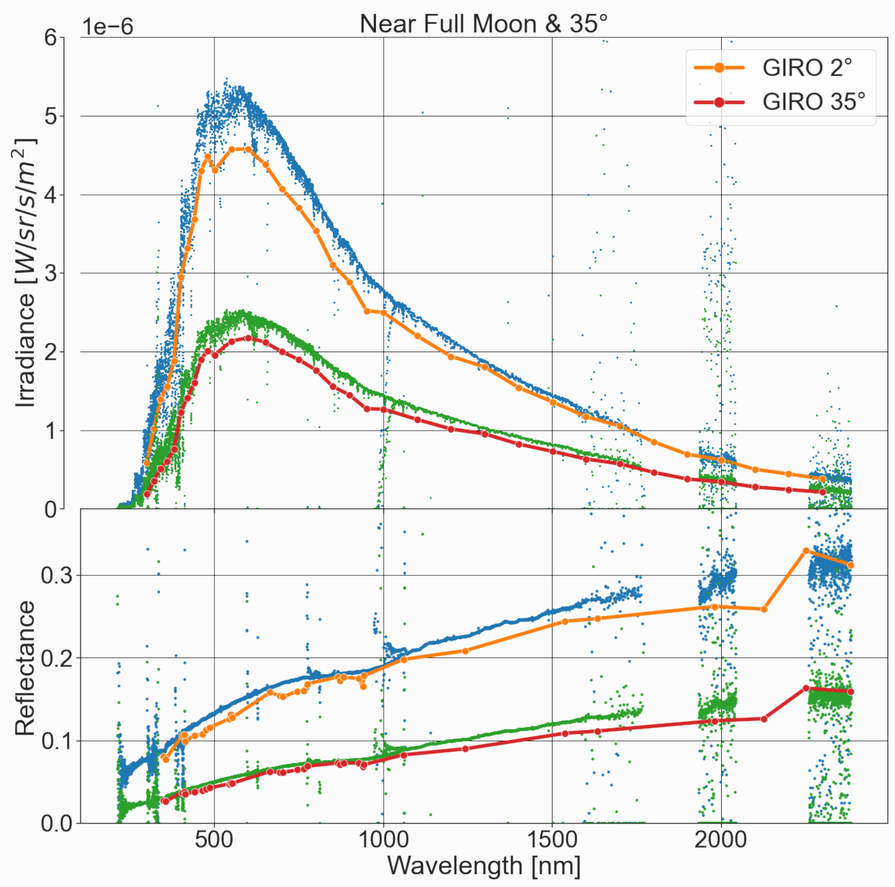


Figure: **Top:** Comparison full disk irradiance GIRO vs SCIAMACHY data (dots). **Bottom**: Comparison full disk reflectance GIRO vs SCIAMACHY data.

Lunar Data Coverage

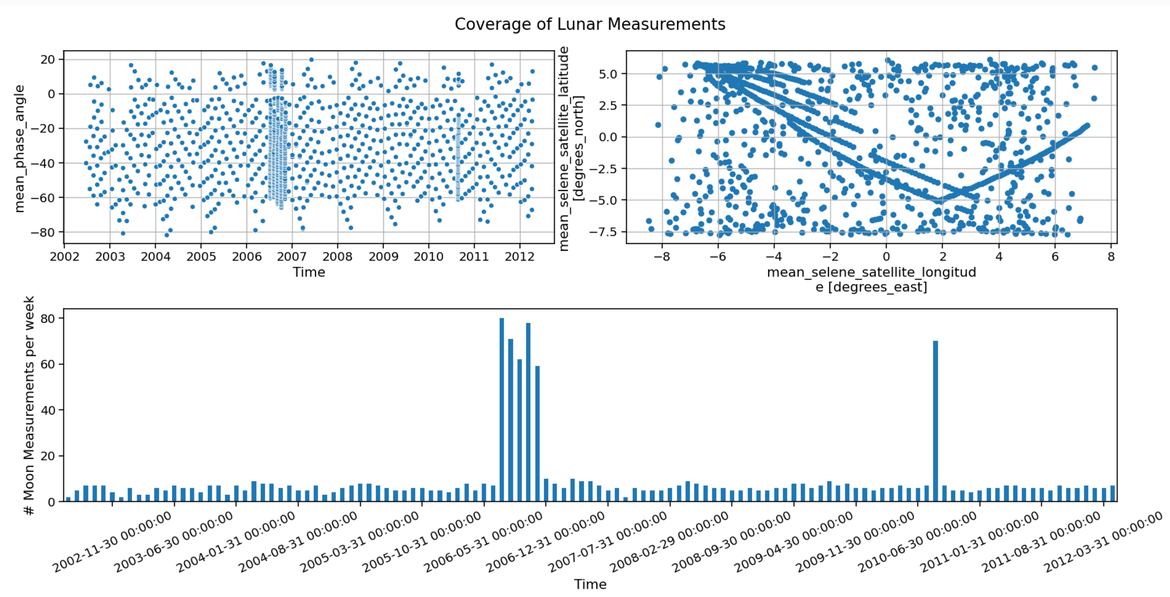


Figure: **Top**: Lunar phase angles (left) and coordinates (right) covered by SCIAMACHY measurements. **Bottom**: Number of lunar measurements per months.

Fixing the O_3 trend

- An erroneous trend in the O_3 VCD values was discovered during the validation of the previous processor version 7.0

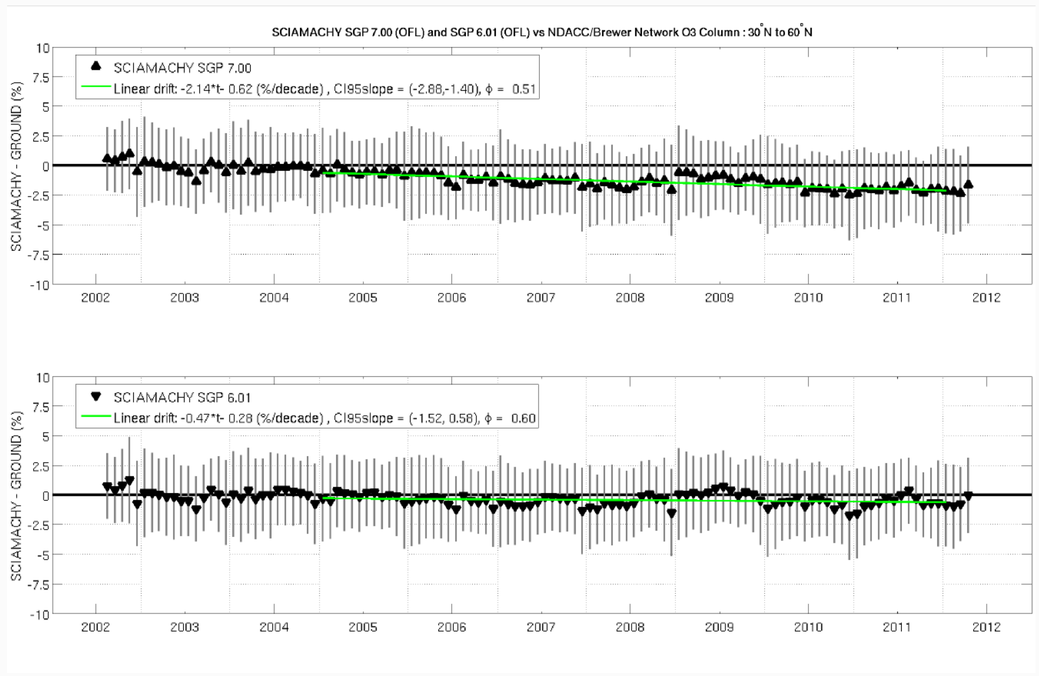


Figure: Validation of Ozone VCD for Level 2 V. 7 (top) and V.6.01. The retrieval algorithm was not changed, but V.7 values show a clear trend (Source: BIRA/IASB).

- Investigations showed that the cause was a change of the degradation correction in *Level 1*
- Most likely the degradation correction led to structures in the radiance that mimic the spectral signature of O_3.
- The Level 1 processing was changed to correct the degradation
- The O_3 values that are retrieved using the updated Level 1 reverses the trend in O_3
- O_3 is currently validated using independent data

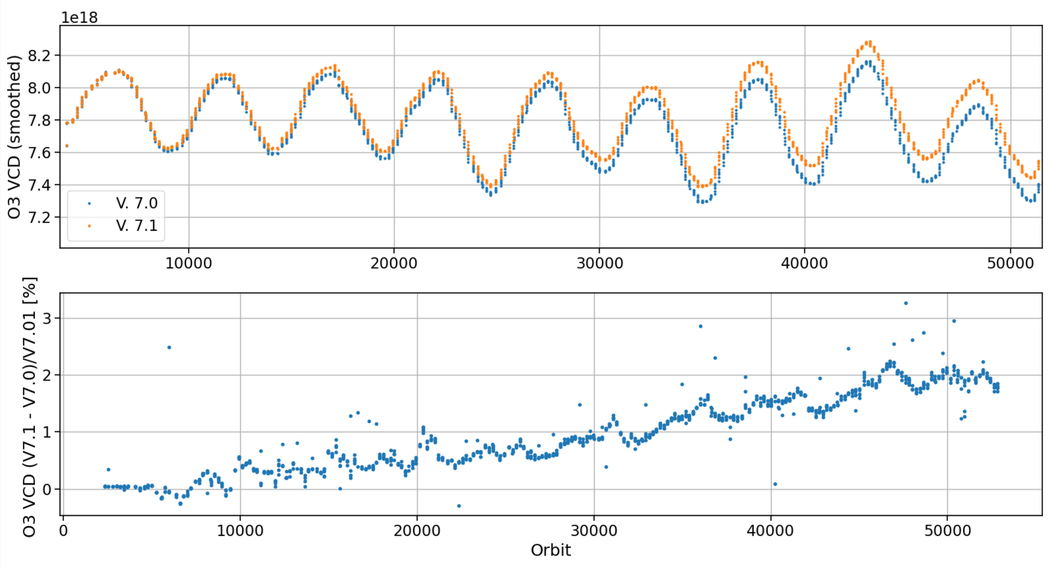


Figure: Re-calculation of O_3 using updated radiances. **Top**: VCD V7.0 using old Level 1 (blue) and VCD 7.1 using updated Level 1 data (orange). Data were smoothed to make the trend visible. **Bottom**: Relative Difference between V7.0 and V7.1 showing a reversal of the trend.

Status/Outlook

- The full mission Level 1 data with updated degradation correction and lunar data were generated
- The lunar data will also be released as separate data set.
- The Level 2 (geophysical products) data are currently validated
- After validation the data will be prepared for a release to the users
- **All products will be in netCDF format** instead of the previously used ENVISAT byte stream format

Contact Information

If you like to have further information, you can reach me at guenter.lichtenberg@dlr.de

References & Further Information

- Stone, Thomas & Kieffer, H.. (2004). Assessment of uncertainty in ROLO lunar irradiance for on-orbit calibration. Proceedings of SPIE - The International Society for Optical Engineering. 5542. 10.1117/12.560236.
- Wagner, S.C. et al. A summary of the joint GSICS CEOS/IVOS lunar calibration workshop: Moving towards intercalibration using the Moon as a transfer target. In Proceedings of the Sensors, Systems, and Next-Generation Satellites XIX, Toulouse, France, 21â24 September 2015; Volume 9639, p. 96390Z.