Preliminary SCIAMACHY Lunar observations as intercalibration source

That’s no moon,
It’s a calibration source

Ralph Snel
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• SCIAMACHY
• SCIAMACHY Lunar Observations
• SCIAMACHY Degradation
• SCIAMACHY Calibration
• Future
SCIAMACHY on ENVISAT
Primary purpose

The main objectives of the SCIAMACHY mission are
• to improve our knowledge of global atmospheric composition,
• its change in response to both natural and anthropogenic activity and the processes associated to it, as well as
• the related global issues of importance to the chemistry and physics of our atmosphere

Monitor the Earth atmosphere (gases, aerosols, clouds) in reflected sunlight
The instrument

• Imaging spectrometer
• Spatial dimensions through scan mirror(s):
  – IFoV: 0.045 degrees by 1.8 degrees
• Spectral dimension through 8-channel spectrometer, 8192 wavelengths:
  – 214 nm to 1773 nm
  – 1934 nm to 2044 nm
  – 2259 nm to 2386 nm
• Nadir, Limb, sub-solar, solar occultation and lunar occultation views
• Many in-flight calibration and monitoring modes
SCIAMACHY viewing modes
Lunar observations

2 types of lunar observation:

• Lunar pointing using sun/moon follower (state ID 56 and 57)

• Lunar scanning, using sun/moon follower + superimposed scan of 0.66 degrees edge to edge (state ID 54)

• State IDs 56 and 57 show only a slice of the moon, not suited for this study

• State ID 54 shows the entire moon in the scans, 1-dimensional “image” in elevation direction:
  – 2 pixels high in 8192 wavelengths
  – 80 pixels high in 7 Polarisation Measurement Devices (PMDs), broadband linear polarisation, 6 wavelengths, 2 polarisation directions (90 and 45 degrees)
Number of lunar spectra

- 1112 orbits with State ID 54 (between 2002-12-16 and 2012-04-07)
- Focus here on 400 orbits between beginning 2003 and beginning 2008
- Dedicated lunar calibration campaign mid to end 2006 included
- Total number of spectra over the 400 orbits about 26000 spectra, 1 second per spectrum
Lunar phase angle coverage (2)
Lunar libration angle coverage
SCIAMACHY lunar albedo (1)
SCIAMACHY lunar albedo (2)
SCIAMACHY lunar albedo fit RMS
SCIAMACHY Degradation

SCIAMACHY Light Path Monitoring Results, Channel 1

Relative Avg. Signal (Median)

Orbit No.

01-Jan-03 01-Jan-04 01-Jan-05 01-Jan-06 01-Jan-07 01-Jan-08 01-Jan-09 01-Jan-10 01-Jan-11 01-Jan-12

WLS via ESM Mirror
Sun via ASM Mirror & ESM Diffuser
Sun via ASM Mirror & ESM Mirror
Sun via ESM Mirror (Subsolar Port - Fast sweep)
Sun via ESM Mirror (Subsolar Port - Pointing)

prod. 23-Apr-2012 by SOST-IFE (Stefan.Noel@iup.physik.uni-bremen.de)
SCIA Lunar Degradation (1)
SCIA Lunar Degradation (2)

SCIAMACHY lunar measurements / GIRO model, 380 nm

Normalised signal [

Time [years]

SCIA Lunar Degradation (3)
SCIA Lunar Degradation (4)
SCIA Lunar Degradation (5)
SCIA Phase Angle (1)
SCIA Phase Angle (2)

SCIAMACHY lunar measurements / GIRO model, 650 nm

Normalised signal [\(\times\)]

Lunar phase angle [deg]

2016-08-11  SCIAMACHY Lunar observations
SCIA ASM Angle (1)
SCIA ASM Angle (2)

SCIAMACHY lunar phase angle vs ASM angle

Lunar phase angle [degrees]

ASM angle [degrees]
SCIA ASM angle (3)

SCIAMACHY lunar measurements / GIRO model, 650 nm

On-ground
Calibrated
Future

• SCIAMACHY ASM-dependence
• SCIAMACHY Polarization
• SCIAMACHY Absolute Calibration
• Put the moon to good use
Potential uses:

SBAFs:

MSG1 Vis 006 – Aqua Ch 1

re 1. GIRO-based Lunar SBAFs (top row) and SCIAMACHY-based Lunar SBAFs (middle row) and comparison Deep

vective Clouds and Libyan Desert SBDFs (bottom row) for MSG1_VIS006 / AQUA_1
Summary

• SCIAMACHY
  – High (0.25nm) resolution lunar spectrum
  – Precise (<0.5%) lunar spectrum
  – Many (~1100) lunar measurements
  – Different geometries
  – New improved calibration (mirror model)
• Good (relative) agreement ROLO/GIRO (<0.5%)
Thank you