GOMOS level 1b processor improvements

Gilbert Barrot
ACRI-ST
GOMOS measurement principle

Occultation of stars

30-40 per orbit
150,000 per year
GOMOS data processing

GOMOS measurements (star+limb) from high to low altitudes

Level 1b
- Atmospheric transmissions
- Error bars
- Photometer signal
- Geolocation, Datation

Level 2
- Line densities of species
- Local densities of species
- Error bars, HRTP
GOMOS level 1b tasks

• Provide the geolocalisation and the datation of the observations
  
  need the data and an orbital model/data

• Clean the GOMOS measurements from environmental and instrumental perturbations
  
  need calibration tables and algorithm parameters

• Computes the atmospheric transmission and associated error bars at all tangent point altitudes
Instrumental perturbations

Level 0 data

- Offset
- Dark charge
- Electronic gain
- Non-linearity
- Clean spectrum

Star 029
mv = 1.67

Wavelength assignment
**Instrumental perturbations**

**Level 0 data**

- Dark charge + RTS
- Clean spectrum

**Star 106**

$mv = 2.65$

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GOMOS level 1b processing status

Current version is defined by level 1b DPM 6.1

Products format defined by IODD 6.0

Prototype GOPR 6.0a
IPF processor 5.00 (prev. July)
Level 1b processing improvements

Three sources of improvements

1. Processor improvements *(algorithms/parameters)*
2. Instrument knowledge improvement *(calibration)*
3. New data in the output products

No important modification since previous issue *(DPM 5.4 - GOPR 5.4d - IPF 4.x)*
Level 1b processor improvements

⭐⭐⭐ Background correction (parameters only)
  exponential interpolation between bands
  no background correction in full dark limb

⭐⭐ PRNU correction (algorithm+calibration)
  star spectrum location on CCD defined by LUT

⭐ Reference star spectrum validity (algo+parameters)
  no possible negative values

Atmosphere thickness (parameters only)
  atmosphere width set to 160 km

Ray tracing (parameters)
  convergence of ray tracing set to 0.1 µrad

Cosmic rays (algorithm+parameters)
  thresholds function of gain setting
Instrument knowledge improvements

⭐⭐ Spectrometer B PRNU
   for a better flat-field correction
⭐⭐ Star spectrum location on the CCD array
   also for a better flat-field correction
⭐ Reflectivity LUT upgrade
   for a better transmission computation
Illumination conditions

- sun zenith angles at satellite and tangent point
- sun azimuth angle at the tangent point
- sun coordinates
- illumination condition ($PCD_{illu}$)
- classification dark, twilight/straylight, daylight

Geometrical information

- occultation obliquity

Limb signal in the central band

- ratio U/C indicates the percentage of limb light mixed to the star signal
Level 1b processing improvements

Impact on LMA minimisation (level 2) below 50 km

$T_{\text{measured}}$ versus $T_{\text{model}}$

Level 1b $5.4$ Chi-2 > 3

Level 1b $6.0$ Chi-2 < 2
Level 1b processing improvements

Impact on Ozone

small impact between 20 and 40 km

noisy below 20 km because still use level 2 issue 5.4d for comparison

O3 local density $\Delta < 0.5\%$
Level 1b processing improvements

Impact on Ozone
better catch of the O3 secondary peak at altitude 80 to 100 km

White curve is 6.0
Level 1b processing improvements

Impact on O2 (SPB1)

O2 local densities
Δ < 1 % (5.4 vs 6.0)
Impact on H2O
better flat-field correction

H2O transmission
$\Delta > 3\%$ (5.4 vs 6.0)
Level 1b processing improvements

Impact on H2O

H2O local densities

$\Delta > 15\% \ (5.4 \ vs \ 6.0)$
Still some work to do…

Bright limb mission
cleaning the star signal from limb light

Shot-noise error of limb band ≈ 10% of the star signal at 30 km
For Star 3 (mv=-0.05)
Shot noise error >100% at 30 km for Star 105 (mv=2.64)
Still some work to do...

**Bright limb mission**

Star signal is not properly correctly... transmission is unrealistic

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Star signal after limb correction

Estimated transmission

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Still some work to do…

Reflectivity correction in elevation

How to characterise it?

![Graph showing reflectivity correction factors vs. wavelength](image)
Still some work to do…

Spectrometer B PRNU (H2O species)

PRNU characterised a posteriori from transmission spectra?
Still some work to do...

**SP-FP discrepancy**

- differences between SP spectral average and FP temporal average in the same spectral band

**Correction of the residual RTS signal**

- use the transmission model as a « reference » in the level 2 processing

**LSF larger than target band**

- will imply a modification of the band setting
- re-calibration needed

and for more details... read the GOMOS data disclaimer
Level 1b processing and calibration status

Conclusion

- Dark limb cases (algorithms+parameters+calibration) are correctly handled by GOMOS level 1b processing (6.0a)

- Bright limb mission must be improved