Ground-based validation of altitude, temperature, and four primary trace gas products of the operational MIPAS Level-2 processor

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ACVE workshop 2016
MIPAS operational processor

A brief history of Level-2...

**Modifications in V7 processors**

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level-1b</strong></td>
<td></td>
</tr>
<tr>
<td>• inflight non-linearity correction,</td>
<td>• altitude determination,</td>
</tr>
<tr>
<td>• altitude determination,</td>
<td>• spike detection/correction,</td>
</tr>
<tr>
<td>• ...</td>
<td>• ...</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level-2</strong></td>
<td></td>
</tr>
<tr>
<td>• five more trace gas products,</td>
<td>• better microwindows FR,</td>
</tr>
<tr>
<td>• better microwindows FR,</td>
<td>• new approach continuum retrieval,</td>
</tr>
<tr>
<td>• new approach continuum retrieval,</td>
<td>• IVS regularisation,</td>
</tr>
<tr>
<td>• IVS regularisation,</td>
<td>• ...</td>
</tr>
</tbody>
</table>

**More at ACVE 2016**

V7: talk by Wetzel (MIPAS-B), and posters by Raspollini (ML2PP/ORM) & Laeng (IMK-IAA)

V8: talk by Perron (L1b), and posters by Raspollini, Piro & Sgheri (ML2PP/ORM)
Ground-based validation

GAW-contributing networks NDACC, SHADOZ, ...

- radio/ozonesonde (85)
- stratospheric O3 lidar (12)
- T lidar (9)
- FTIR (10-13)
- O3 MWR (2)

ACVE workshop 2016
More at ACVE 2016 talks on QA/val. system (Keppens), co-location mismatch (Verhoelst), homogeneity O3sonde network (Hubert) + posters on SCIAMACHY SGP V6 (Keppens), metrological best practices (Compernolle).
Temperature

V7 cooler for 2002-2004 & warmer in tropical UTLS 2002-2012

Acme workshop 2016
Temperature

Drift changes by 0.5–1 K / decade

- Only OR period considered
- Linear regression model
- Weighted average over station sample
- Preliminary drift + 95% CI
Altitude

Previous scale has clear limitations...

MIPAS corrected altitude – Radiosonde

<table>
<thead>
<tr>
<th>Pressure</th>
<th>Altitude (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>110 hPa</td>
<td>0.3</td>
</tr>
<tr>
<td>50.1 hPa</td>
<td>50</td>
</tr>
<tr>
<td>22.6 hPa</td>
<td>100</td>
</tr>
<tr>
<td>10.2 hPa</td>
<td>200</td>
</tr>
</tbody>
</table>

3-month moving median ± IP68%

MIPAS: V5 V6 V7

ACVE workshop 2016
Altitude

but the new ECMWF-anchored scale is superior (by far)

<table>
<thead>
<tr>
<th>MIPAS ECMWF corrected altitude – Radiosonde</th>
</tr>
</thead>
<tbody>
<tr>
<td>110 hPa (15 km)</td>
</tr>
<tr>
<td>50.1 hPa (20 km)</td>
</tr>
<tr>
<td>22.6 hPa (25 km)</td>
</tr>
<tr>
<td>10.2 hPa (30 km)</td>
</tr>
</tbody>
</table>

110.3 hPa (15 km)  50.1 hPa (20 km)  22.6 hPa (25 km)  10.2 hPa (30 km)
Ozone

FR: ~5% changes in UT/LS; OR: 1-2% increase
Ozone

Drift changes by 1–3% / decade

- Only OR period considered
- Linear regression model
- Weighted average over station sample
- Drift + 95% CI
CH\textsubscript{4}

FR: reduced bias; OR: increase by ~5%
$\text{N}_2\text{O}$

FR: reduced bias; OR: increase by $\sim 5\%$
HNO₃

No clear changes
## Conclusions

**ML2PP 7.03 released & characterised versus ground networks**

<table>
<thead>
<tr>
<th>Change V7 (vs. V6)</th>
<th>Altitude</th>
<th>Temperature</th>
<th>O3</th>
<th>CH4</th>
<th>HNO3</th>
<th>N2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>• V7 MIPAS corrected altitude better in FR, worse in OR</td>
<td>• V7 overall quite similar to V5/V6</td>
<td>• V7-MIPAS corrected altitude (no bias, no drift)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• ECMWF corrected altitude superior to MIPAS</td>
<td>• FR: increased negative bias</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>corrected altitude</td>
<td>• OR: similar bias, but positive drift V7-V6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(no bias, no drift)</td>
<td>• OR: V7-GNDS more stable in US, less stable in MS+LS</td>
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</tbody>
</table>

**Maturity**

- Consistent picture sonde and GPS RO
- Picture qualitatively consistent sonde, lidar, GPS RO and MIPAS-B
- Consistent picture sonde, lidar and MIPAS-B
- More consistent picture than for V6 comparisons
- Difficult intercomparison due to large spreads
- Rather consistent picture

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**Full details (of this analysis) in Technical Note**

https://earth.esa.int/documents/700255/2621625/TN-BIRA-IASB-MultiTASTE-Phase-F-MIPAS-ML2PP7-Iss1-RevB
More information

Detailed validation reports

Validation report

MIPAS ML2PP 7.03 profiles of T, altitude, O₃, CH₄, HNO₃ and N₂O

Available at

https://earth.esa.int/web/sppa
(Envisat > MIPAS > Cal/Val > Validation Activities)
More information

ESA SPPA website

https://earth.esa.int/web/sppa
Product Quality Readme File

MIPAS Level 2 version 7.03 products

Field | Contents
--- | ---
Document Title | Product Quality Readme File for MIPAS Level 2 version 7.03 products
Reference | ENVI-GSOP-EGOE-QD-16-0141, Issue 1.0, 07/05/2016
Affected Dataset | This Readme file applies to all MIPAS Level 2 products generated with the ESA Level 2 ML2PP processor version 7.03 (MIP_NL_2PW) and the MIPAS Auxiliary Data Files version 8.06.
Change Log | This document shall be amended by releasing a new edition of the document in its entirety. The table below records the history and issue status of this document.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Change</th>
</tr>
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<tbody>
<tr>
<td>1.0</td>
<td>07/05/2016</td>
<td>First release</td>
</tr>
</tbody>
</table>

Inputs | MIPAS Quality Working Group, MIPAS validation teams, MIPAS IDEAS+ (Instrument Data quality Evaluation and Analysis Service) team
Authors | Marta De Laurentiis (ESA-Serco SpA), Piera Raspolini (IFAC-CNR)
Approval | Angelika Dehn (ESA-ESRIN)

Available at [https://earth.esa.int/web/sppa](https://earth.esa.int/web/sppa)
(Envisat > MIPAS > Products & Algorithms > Products Information)