

# ROM SAF analysis of PPF 5.0 data

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# Outline

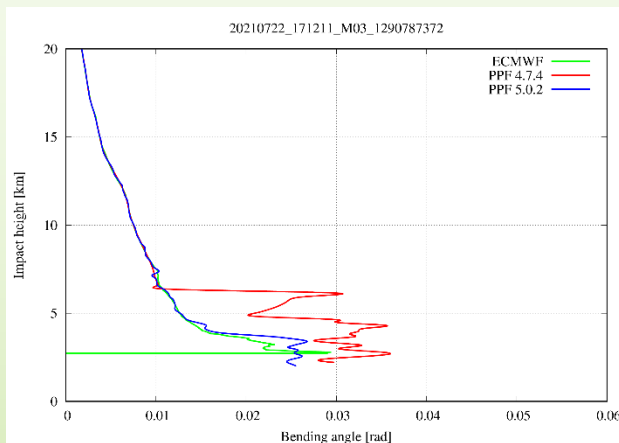
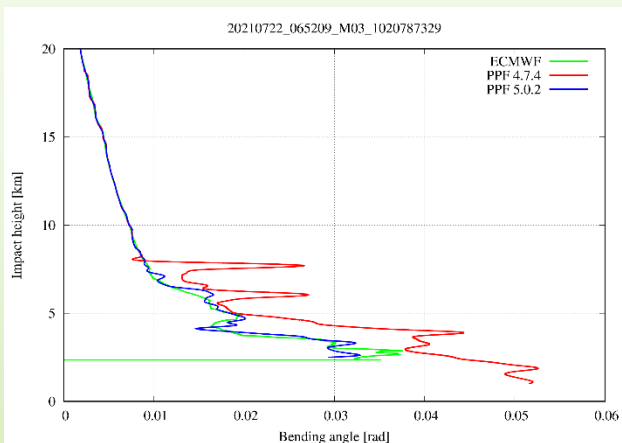
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- A closer look at two anomaly reports – and the improvements in PPF 5.0
- Refractivity statistics
- NWP users analyses

# Anomaly reports

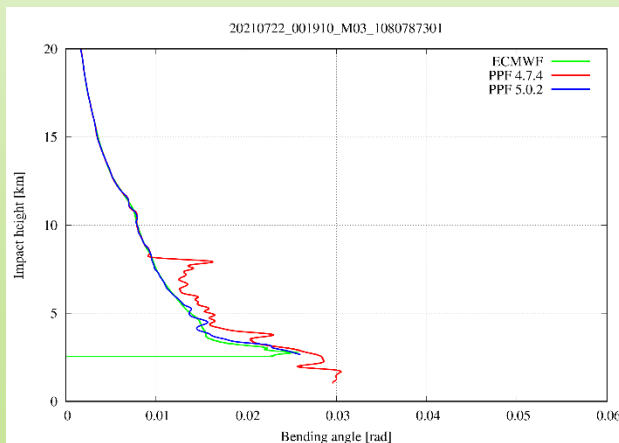
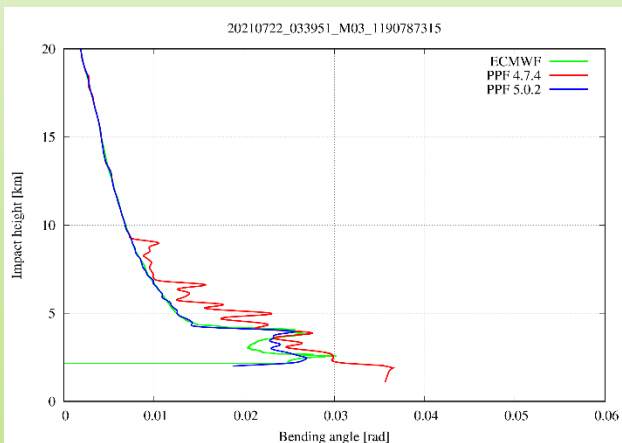
- EUM/EPS/AR/18843.7 (ROM SAF Elog 506)
  - ▶ Suspiciously large bending angles in the lower troposphere (bending angle spikes)
    - ◆ Although the data provided by EUMETSAT is based on open loop tracking (raw sampling mode) in the lower troposphere, and processed using a wave optics method, there are a number of cases where the refractivity and the bending angle are quite different from the corresponding ECMWF forecasts, and where the bending angle gradient (and corresponding refractivity and dry temperature) becomes suspiciously large below 8 km.
  - ▶ In ROM SAF refractivity processing many of these profiles fail the ROM SAF Nagios QC 13
  
- EUM/EPS/AR/18844.7 (ROM SAF Elog 507)
  - ▶ Erroneous bending angle oscillations in the stratosphere (differences in smoothing L1 and L2)
    - ◆ A large number of bending angle profiles are affected by erroneous oscillations in the stratosphere that seems to be a result of different smoothing between L1 and L2 signals.
  - ▶ In ROM SAF refractivity processing many of these profiles fail the ROM SAF Nagios QC 12

# Comparisons between PPF 4.7.4 and PPF 5.0.2 – anomaly examples

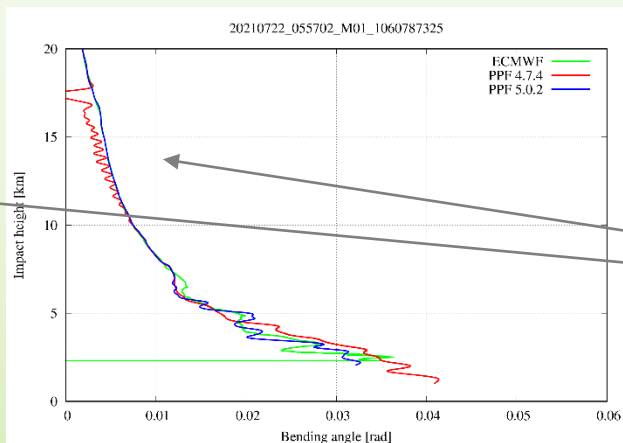
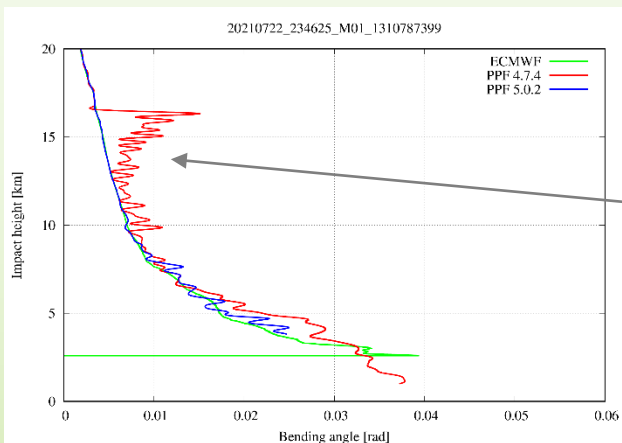


**EUM/EPS/AR/18843.7:** Suspiciously large bending angles in the lower troposphere (bending angle spikes)

- Suspiciously large bending angles in the lower troposphere are generally gone in PPF 5.0.2
- Large gradients in PPF 5.0.2 often confirmed by large gradients in ECMWF
- Lowest bending angles in PPF 5.0.2 match better the ECMWF surface (green horizontal line)

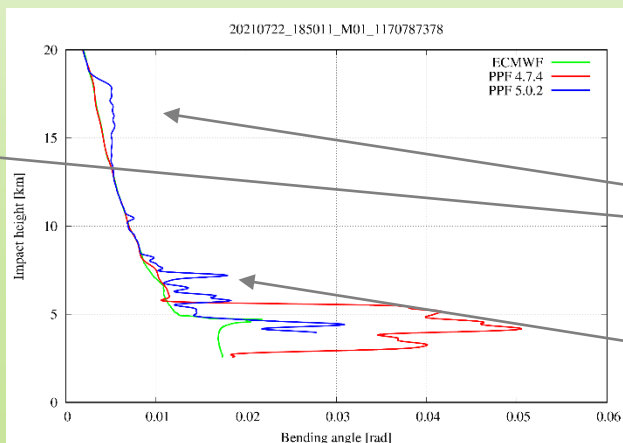
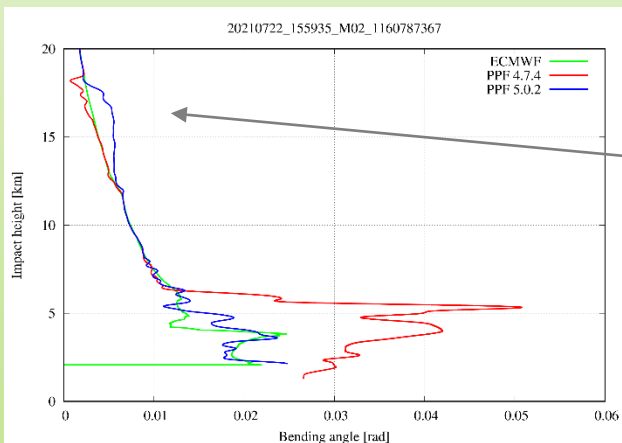


# Comparisons between PPF 4.7.4 and PPF 5.0.2 – anomaly examples



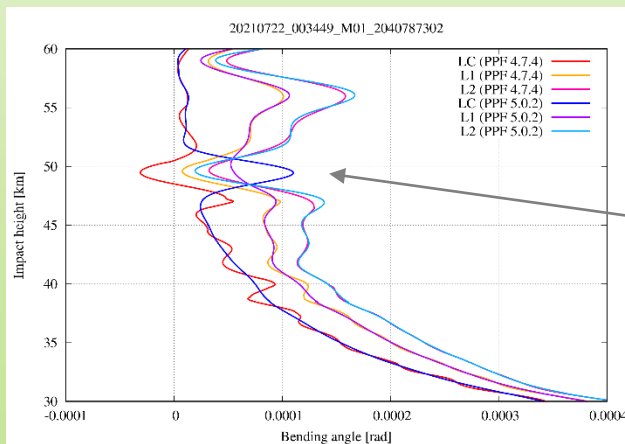
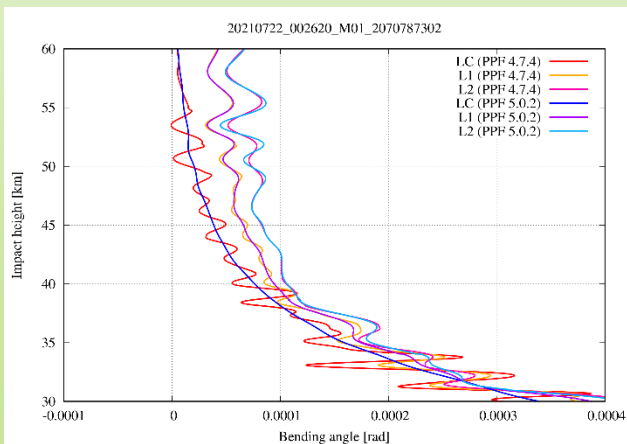
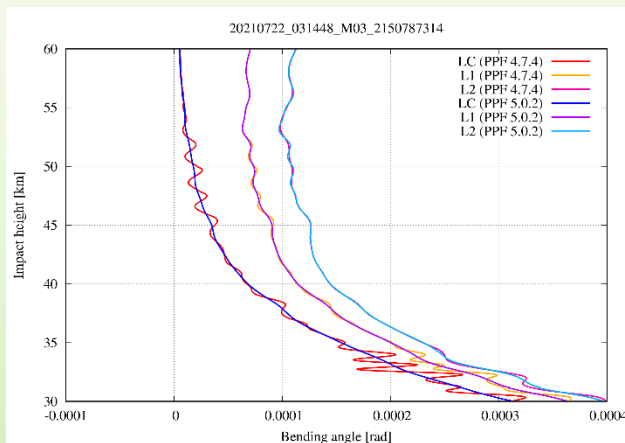
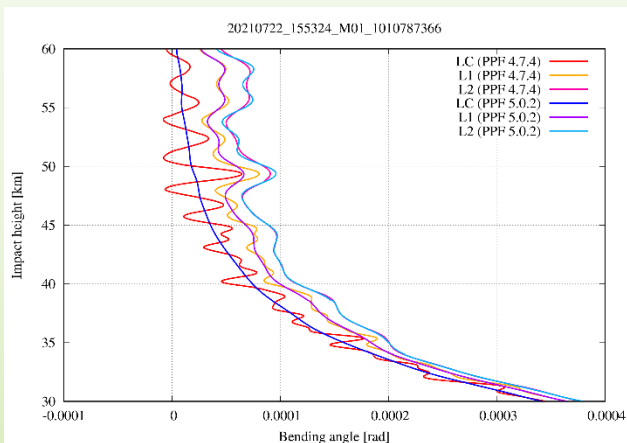
**EUM/EPS/AR/18843.7:** Suspiciously large bending angles in the lower troposphere (bending angle spikes)

- Rare cases with sudden erroneous features in the upper troposphere are also gone in PPF 5.0.2



- In other rare cases erroneous features have appeared in PPF 5.0.2 that were not there in PPF 4.7.4
- These new cases are very rare (less than 1%) – they are generally caught in other ROM SAF QC checks
- In very few cases there are still some spikes in the lower troposphere (here at 6-8 km)

# Comparisons between PPF 4.7.4 and PPF 5.0.2 – anomaly examples



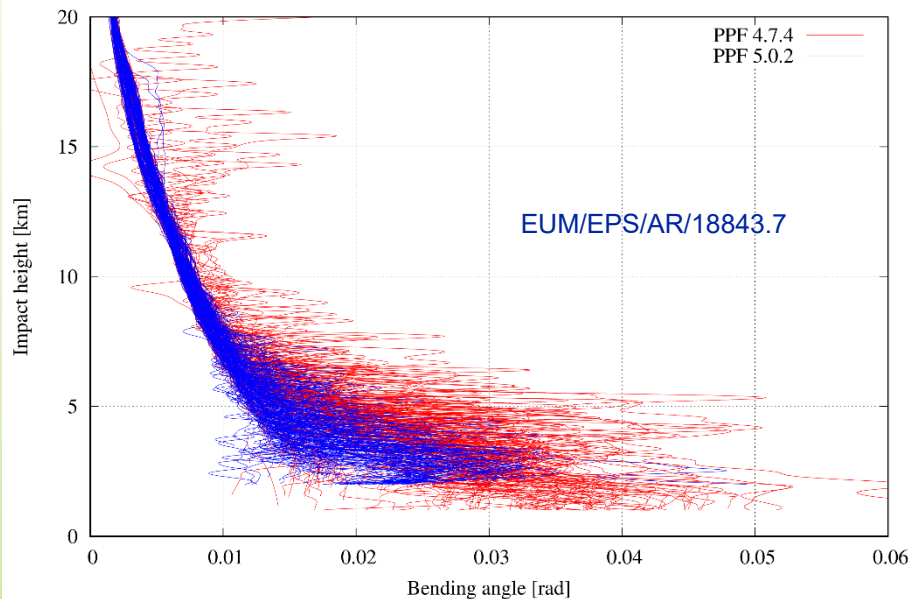
**EUM/EPS/AR/18844.7:** Erroneous bending angle oscillations in the stratosphere (differences in smoothing L1 and L2)

- Erroneous bending angle oscillations in the stratosphere are generally gone in PPF 5.0.2
- L1 and L2 vertical structure are similar in PPF 5.0.2, generally giving rise to a nice and smooth LC bending angle

- In very few cases wiggles in L1 and L2 are not similar in PPF 5.0.2, and erroneous features remain in the LC bending angle
- These cases are usually at high altitudes (50 km and above) and caught in ROM SAF QC

# Comparisons between PPF 4.7.4 and PPF 5.0.2 – anomaly conclusions

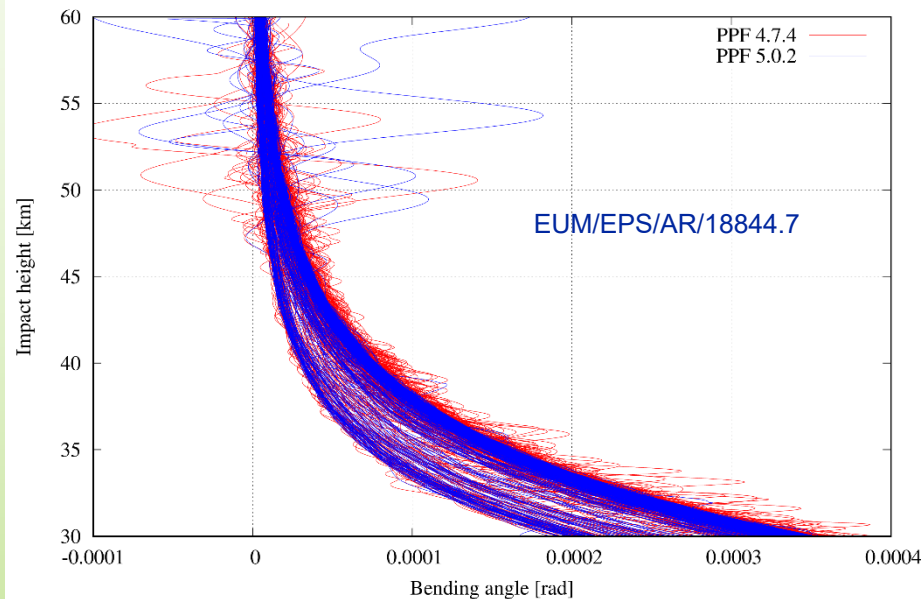
135 Occultations failing ROM SAF Nagios QC 13 in NRT (with PPF 4.7.4) on 2021-07-22



- Suspiciously large bending angles in the lower troposphere are generally gone in PPF 5.0.2
- In very rare cases erroneous features have appeared in PPF 5.0.2 that were not there in PPF 4.7.4 – they are caught in ROM SAF QC

**EUM/EPS/AR/18843.7 can be closed from ROM SAF point of view**

334 occultations failing ROM SAF Nagios QC 12 in NRT (with PPF 4.7.4) on 2021-07-22



- Erroneous bending angle oscillations in the stratosphere are generally gone in PPF 5.0.2
- In very few cases erroneous features remain in the LC bending angle at high altitudes – they are caught in ROM SAF QC

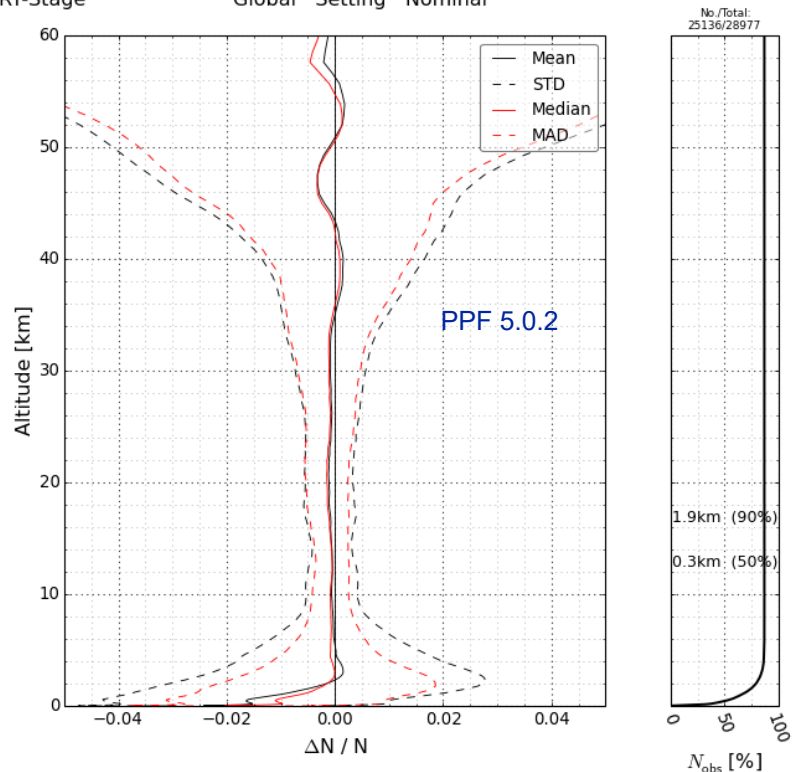
**EUM/EPS/AR/18844.7 can be closed from ROM SAF point of view**

# Refractivity statistics



# PPF 5.0.2 statistics compared to PPF 4.7.4 (refractivity; setting)

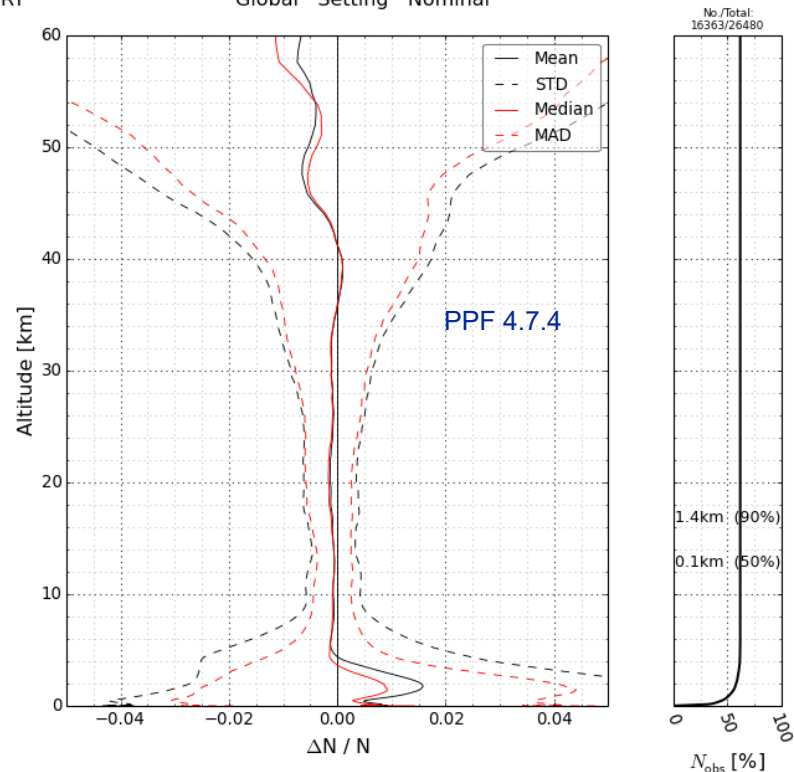
All Metop  
NRT-Stage  
Refractivity O-B(ECMWF)  
Global Setting Nominal  
Jul 22, 2021 - Aug 21, 2021



Plotted 23:59  
22-Aug-2021



All Metop  
NRT  
Refractivity O-B(ECMWF)  
Global Setting Nominal  
Jul 22, 2021 - Aug 21, 2021

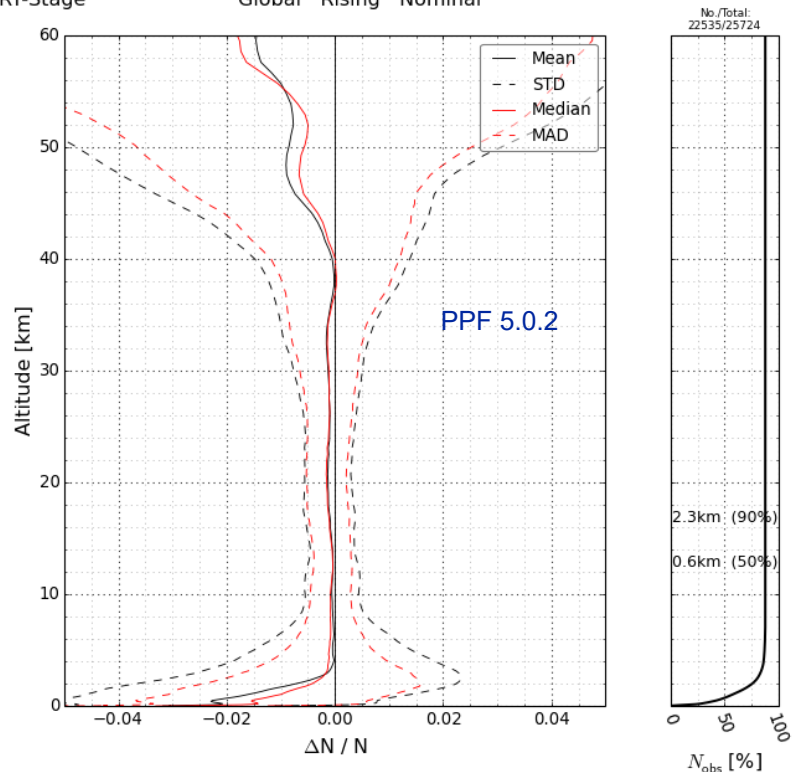


Plotted 23:33  
22-Aug-2021

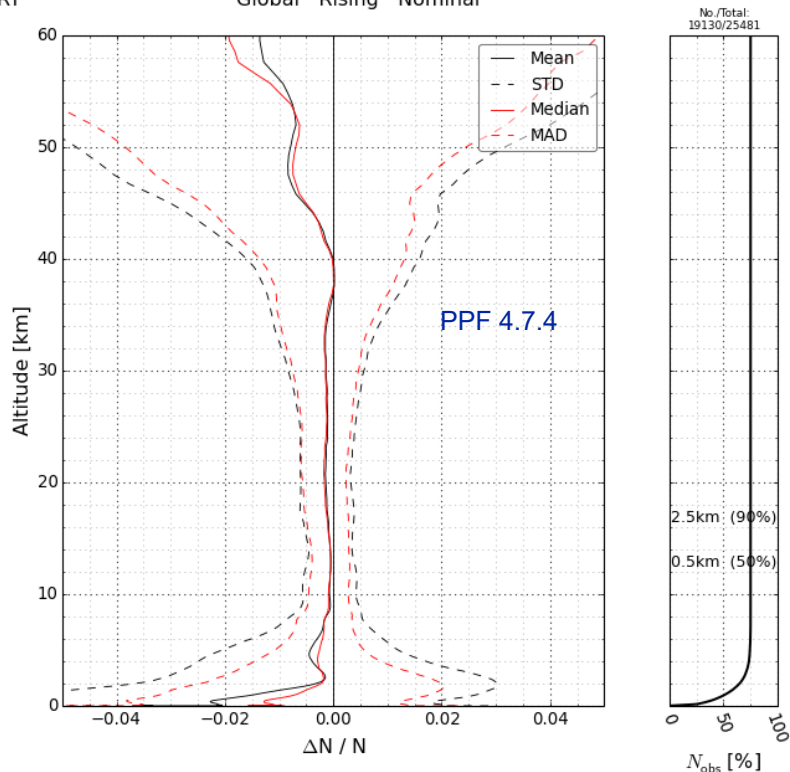


# PPF 5.0.2 statistics compared to PPF 4.7.4 (refractivity; rising)

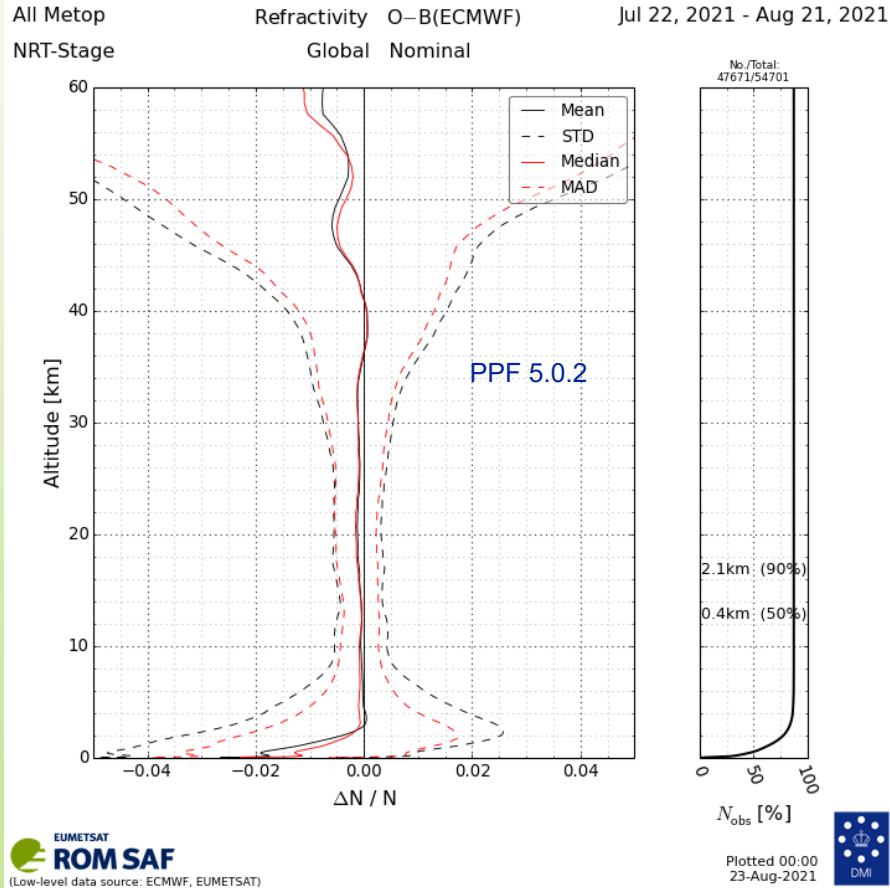
All Metop  
NRT-Stage  
Refractivity O-B(ECMWF)  
Global Rising Nominal  
Jul 22, 2021 - Aug 21, 2021



All Metop  
NRT  
Refractivity O-B(ECMWF)  
Global Rising Nominal  
Jul 22, 2021 - Aug 21, 2021



# PPF 5.0 test data – ROM SAF stage processing (refractivity)



- ROM SAF started stage runs with PPF 5.0 test data on 23 Feb
- Continued stage runs with GS2 PPF 5.0.2 data on 21 July
- About 85-90% pass QC compared to 65-75% in current NRT
- Rising and setting biases in the lower troposphere are much more similar than in current NRT
- 1D-Var results are consistent with changed refractivity biases
- ROM SAF processing system was upgraded (to accommodate the new PPF 5.0 format) on 27 July
- Notification with information about ROM SAF test data was sent to users on 13 August

**The ROM SAF processing system is ready for EUMETSAT upgrade on 14 September**

# NWP users analyses

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**Dominique Raspaud at Météo-France** downloaded the ROM SAF test data and provided their analyses:

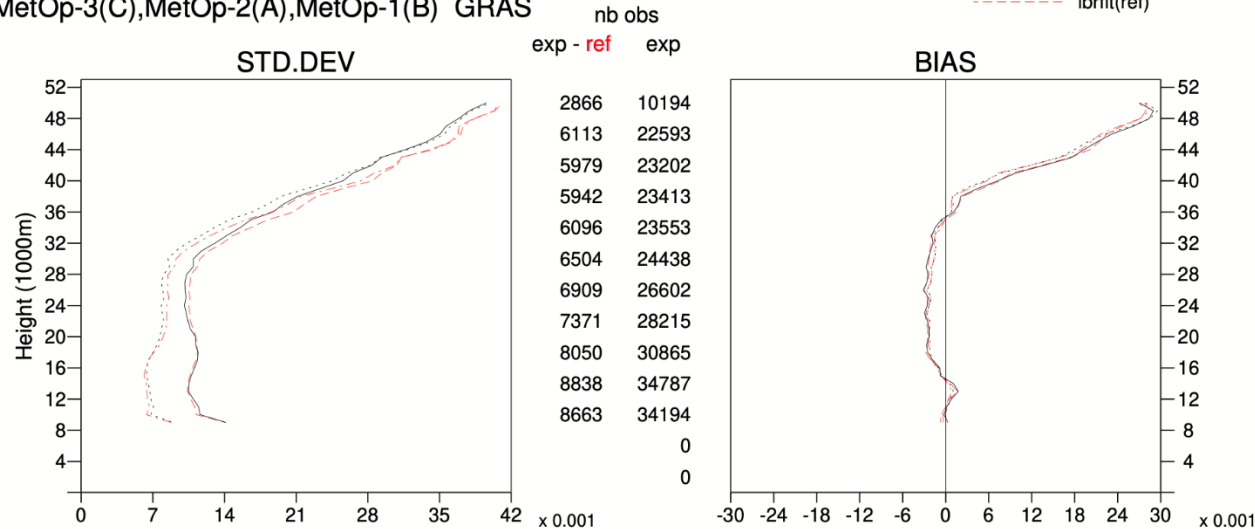
“We see a clear improvement with a significant reduction of the standard deviations of the statistics O-B, particularly in altitude (mainly above 35 km or even 30 km). We also notice a strong increase of the number of the data (up to 25% for the test day).”

GAGH-OPER arpA.4dvarfr 2021072200-2021072300

GRAS oper vs V5 Bending Angle Globe

Used Alpha

MetOp-3(C),MetOp-2(A),MetOp-1(B) GRAS



(Courtesy of Dominique Raspaud)

**Hui Shao at NOAA** told us that she downloaded the ROM SAF test data, but did not so far provide any feedback

**Josep Aparicio at Environment and Climate Change Canada** acknowledged the receipt of the ROM SAF notification, but did not so far provide any feedback

# Conclusions

- PPF 5.0.2 data are generally looking fine from ROM SAF point of view
  - ▶ Very rare cases of erroneous features in bending angles are caught in ROM SAF QC and not considered blocking for bringing PPF 5.0.2 into operations
- The two anomaly reports raised by ROM SAF can be closed from our point of view
  - ▶ ROM SAF recommends to EUMETSAT to investigate (at a later time) rare new cases in PPF 5.0.2 (that are not in PPF 4.7.4) of positively biased erroneous features in the upper troposphere (see slide 5)
  - ▶ ROM SAF recommends to EUMETSAT to investigate (at a later time) few remaining cases of L1 and L2 dissimilar wiggles around 50 km and above (see slide 6)
- Improved level 2 quality and quantity with PPF 5.0.2:
  - ▶ ROM SAF refractivity biases in the lower troposphere are now much more similar for rising and setting
  - ▶ 1D-Var results are consistent with changed biases
  - ▶ Number of nominal occultations are about 85-90% as opposed to 65-75% in current NRT
- Positive feedback has been provided by NWP user(s):
  - ▶ Significant reduction of O-B standard deviations in particular above 30-35 km
  - ▶ Strong increase in the number of data