Uncertainty of temperature, humidity and pressure profiles from the first ROM SAF Climate Data Record.

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ROM SAF

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Outline

Uncertainty in CDR's

Assessing randum uncertainty in ROM SAF CDR v1.0
    ROM SAF CDR v1.0
    GRUAN network
    RO-GRUAN biases
    RO - GRUAN random uncertainty
    S-matrix

Real problems in CDRs: Systematic errors
    Mission differences

Conclusion

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Uncertainty in CDR's, why care about random errors?

There is a demand for long term 1D-Var products - especially water vapor (Copernicus, G-Vap, GRUAN...)

Systematic uncertainties are determining for quality of gridded data and trends.

Random uncertainty is determining the amount of *observational information* in CDR's.

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ROM SAF CDR v1.0
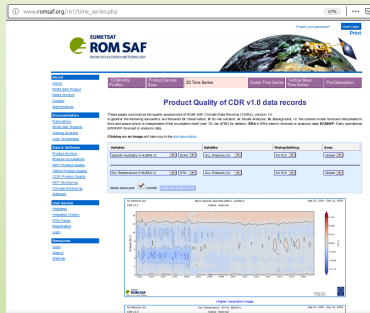
$> 10^7$ profiles
$> 10^6$ validation plots
Bending angle
Refractivity
Dry temperature
Temperature
Spec. humidity
Pressure
Surface pressure
+ gridded data

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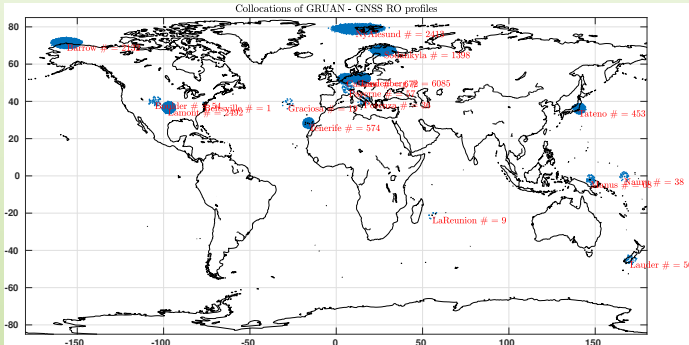RADIO OCCULTATION METEOROLOGY

Specific humidity retrieval.

Method: 1D-Var
(http://www.romsaf.org/product_documents/romsaf_atbd_1dvar.pdf)
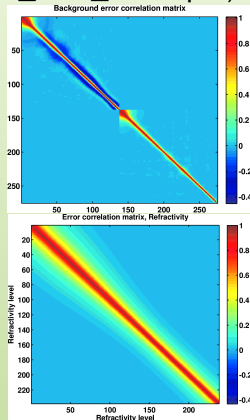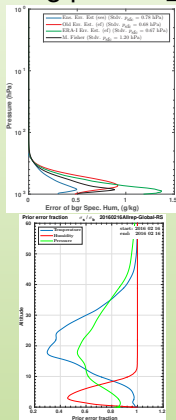
I.e., it is a tropospheric humidity product.
It is not the usual RO < 0.2 % accuracy

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GCOS Reference Upper-Air Network, GRUAN

Collocations of GRUAN - GNSS RO profiles

Accurate stratospheric RO temperatures used as reference.
Tropospheric GRUAN sp. hum. and temperature used as references.
We do not expect high accuracy as known to RO in the stratosphere.

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GRUAN humidity and temperature comparison method

- 16552 collocations 2006-2016. dist < 300km, t < 3 h
- Interpolation to 100 m grid

For standard deviatiation:

- Train box filter (MCMC): $\min\{q_{RO} - F(q_{GRUAN})\}$
- GRUAN $\rightarrow$ F. Filter width = 0.5 - 2.0 km.
- Standard deviation $\rightarrow$ Collocation distance linear regression
- Extrapolation to zero distance.
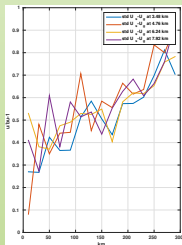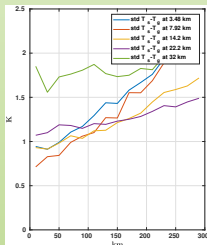
RO-GRUAN systematic error "global"
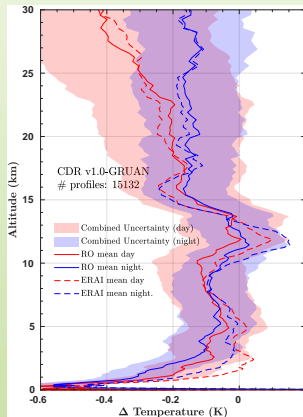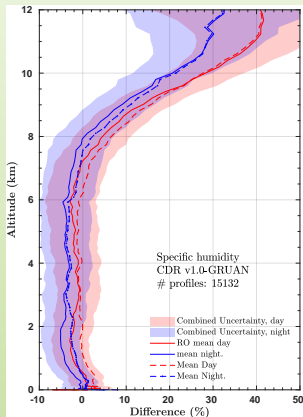
Estimated uncertainty dominated by systematic GRUAN uncertainty.

Related issue: Mid latitude specific humidity artefact
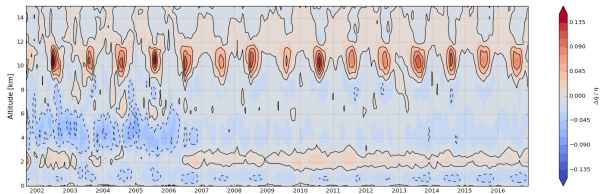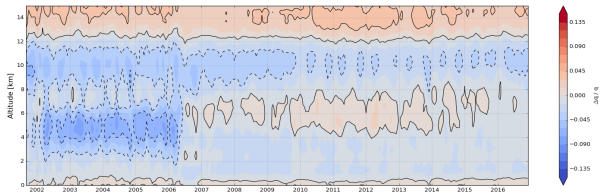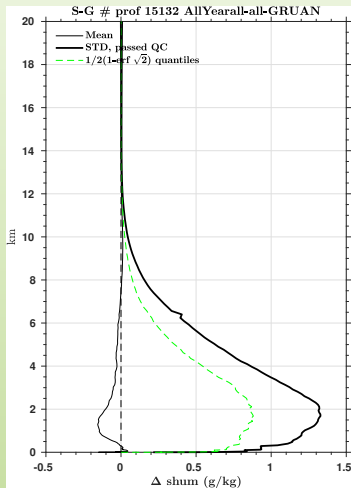

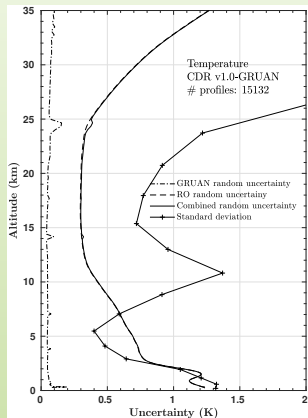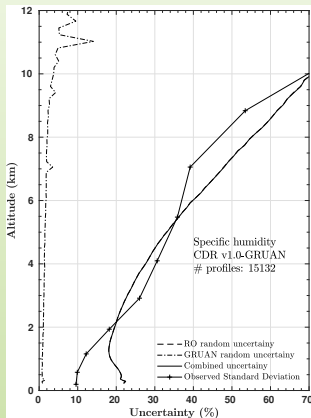SH mid latitudes :

Tropics :

Almost gone in wth ERA5

SH mid latitudes :
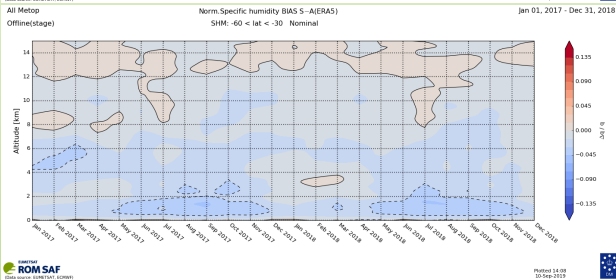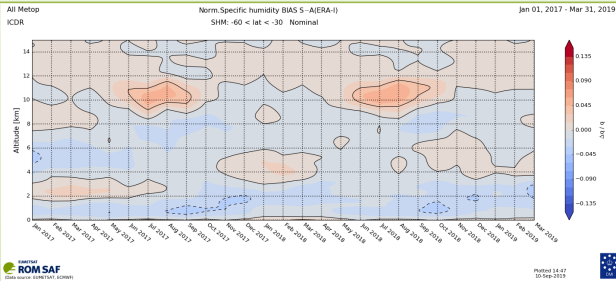
Tropics :

# Absolute values for reference
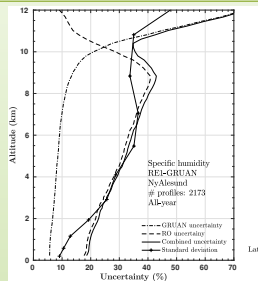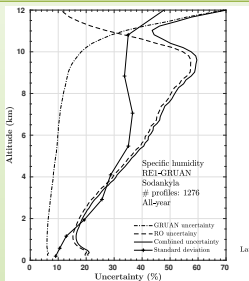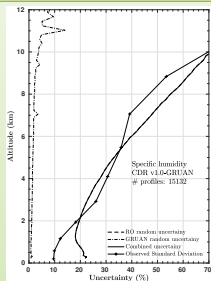

S-G # prof 15132 AllYearall-all-GRUAN

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Uncertainty: Expected and observed STDV

Estimated uncertainty dominated by random RO uncertainty.
Specific humidity random uncertainty consistent.
Stratospheric temperature accuracy is overestimated.

Selected Stations, Specific Humidity STDV

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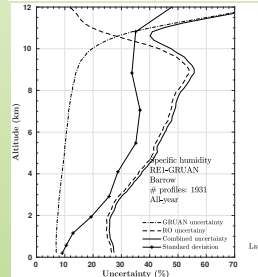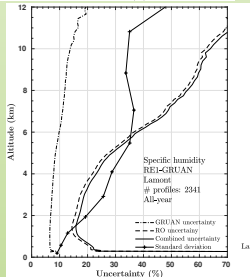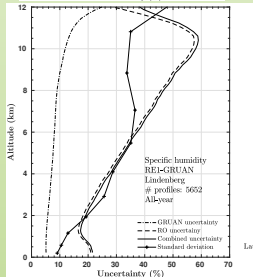
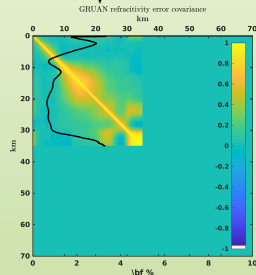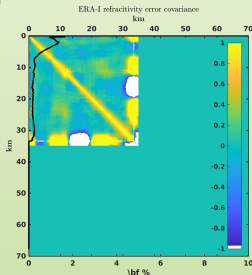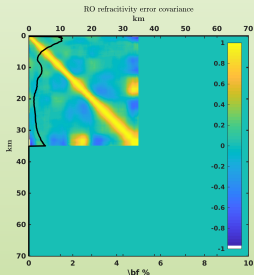# Vertical resolution, (solution uncertainty correlation)

Next step; compare uncertainty correlations
- GRUAN is not there yet.

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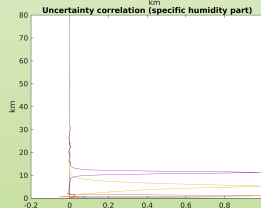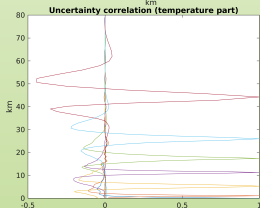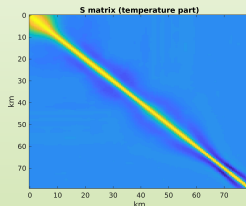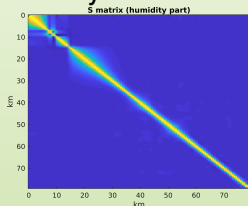
3CH vertical resolution issue

But then we can infer uncertainty covariance from the data?
(Refractivity error covariances shown here)
High vertical resolution is punished... Not fair to sondes ↓

This can most likely be improved

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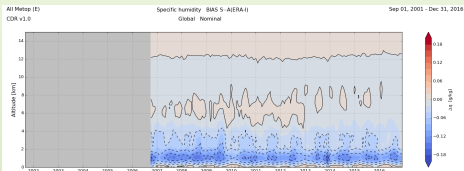
Outline

Metop :

COSMIC-I :
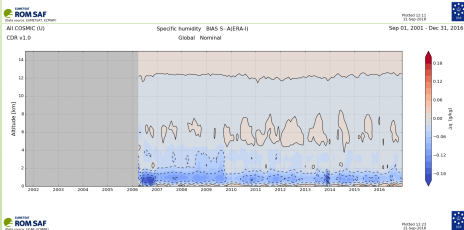
Somebody: Fix this!

Issue number II: Background stability (not)
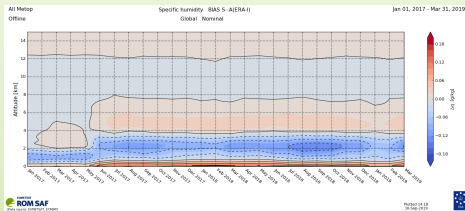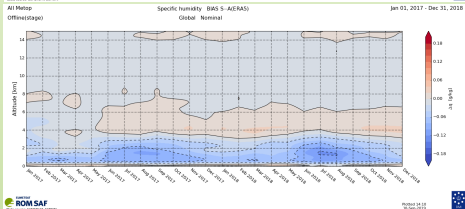
(Metop, ERA-I background) :

(Metop, ERA5 background) :

Should we de-trend and remove transient features from background.
I think so.

Outline

Conclusions

▶ RO humidity accuracy comparable to IASI

▶ Known biases to some degree reduced with ERA5.

▶ Specific humidity uncertainty consistent with GRUAN, but there is potential for improved tropospheric information content.

▶ Random uncertainty: Still room for improvement, but we are getting there.

▶ Unstable background: We can maybe fix it.

▶ Intermission "bias" below 3 km: Really serious problem that the community should focus on.

▶ Next steps: New background (ERA5.1?); Correlation validation; Inferred uncertainty.

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