Validation of satellite hyperspectral L2 products with *in situ* measurements: a discussion of the collocation errors in the validation budget using GRUAN data.
X. Calbet, M. Crapeau, T. August (EUMETSAT)

Cal/Val Strategy the Standard way

1. Collocation
2. Pre-processing
3. Comparison

… but …

- Collocation errors???
- Sonde humidity errors???
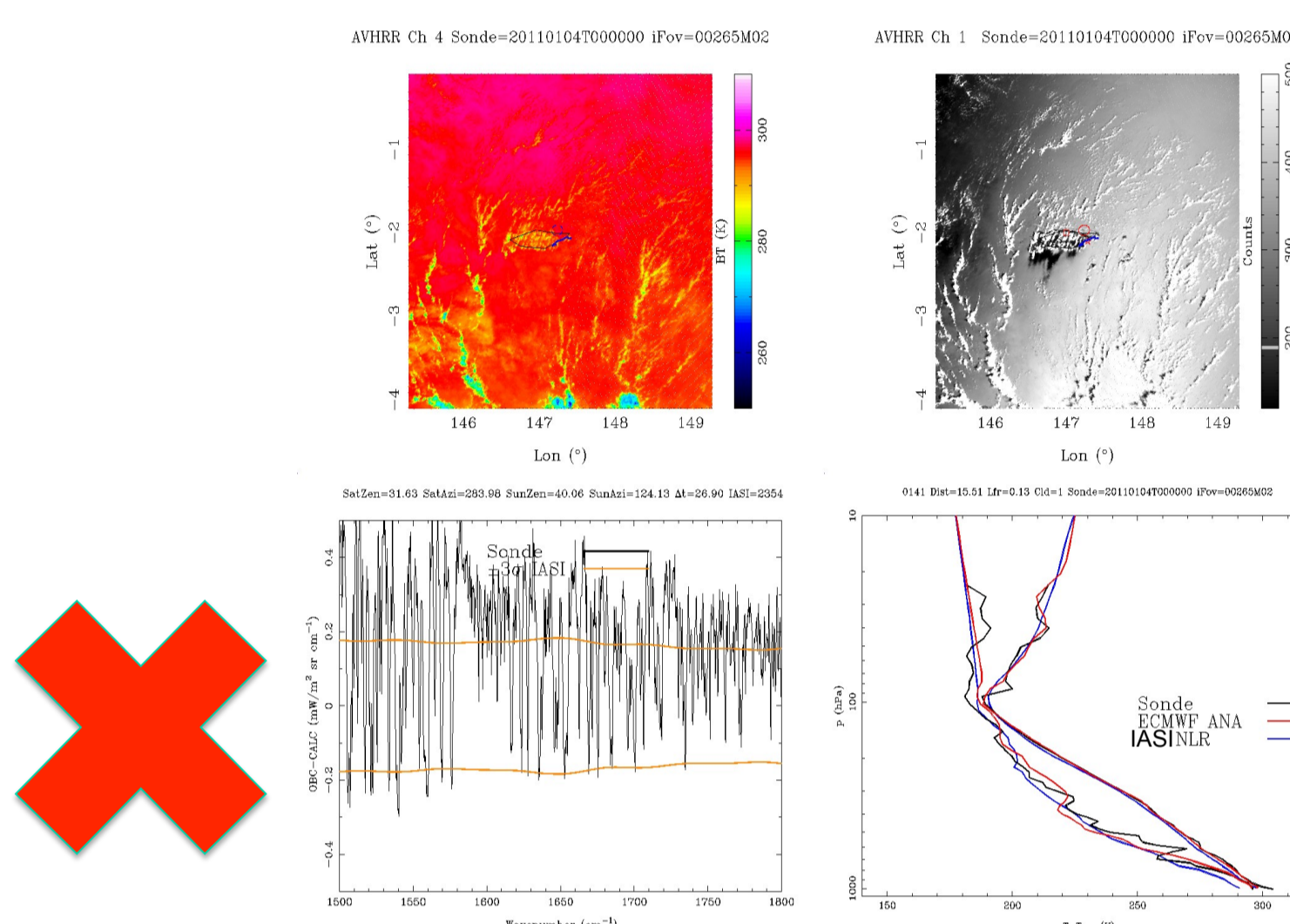
Alternative Cal/Val Strategy

1. Collocation
2. Pre-processing
3. CONSISTENCY CHECK!! Assess their co-location and quality by doing an Observed versus Calculated radiance comparison
4. Comparison

Nomenclature
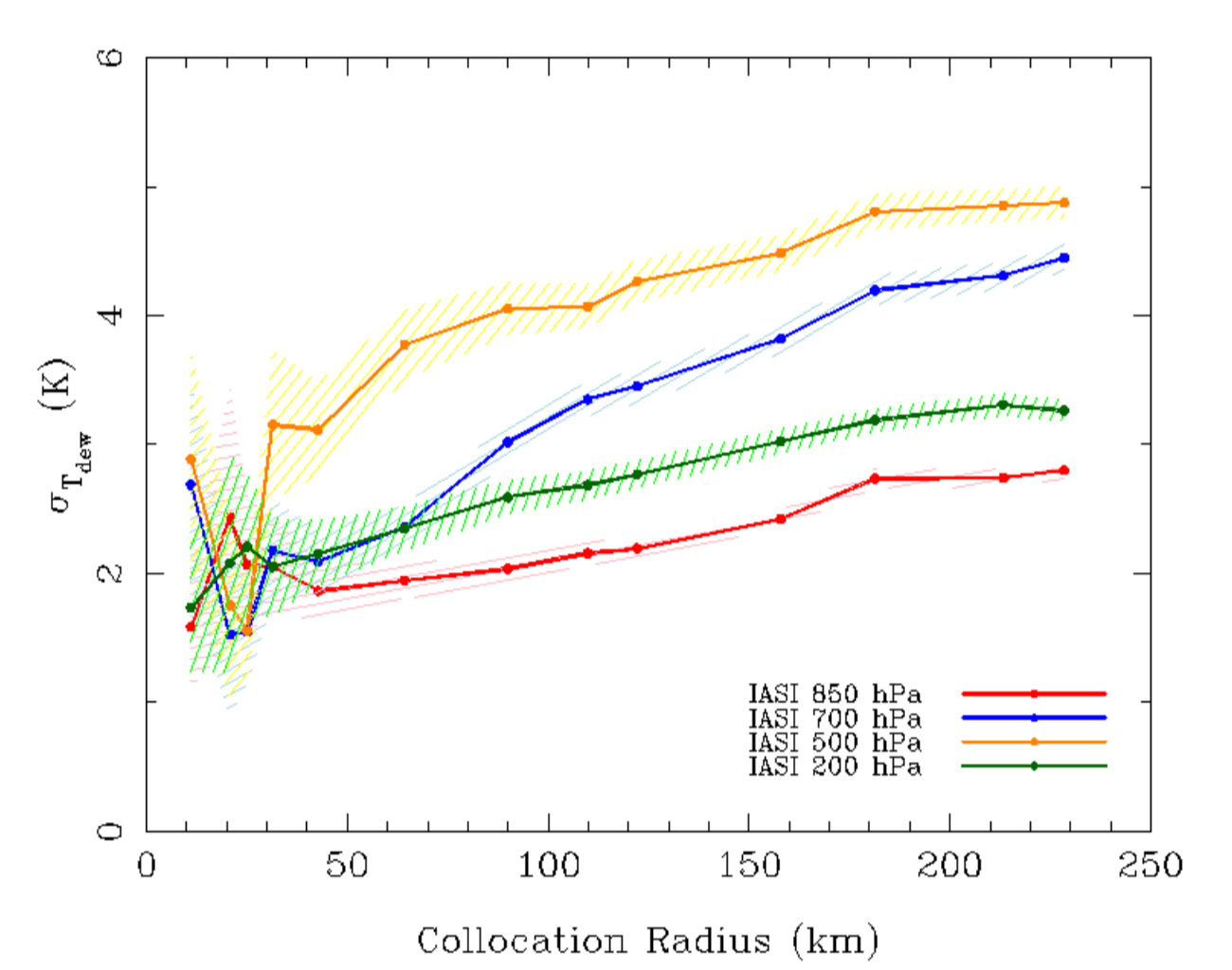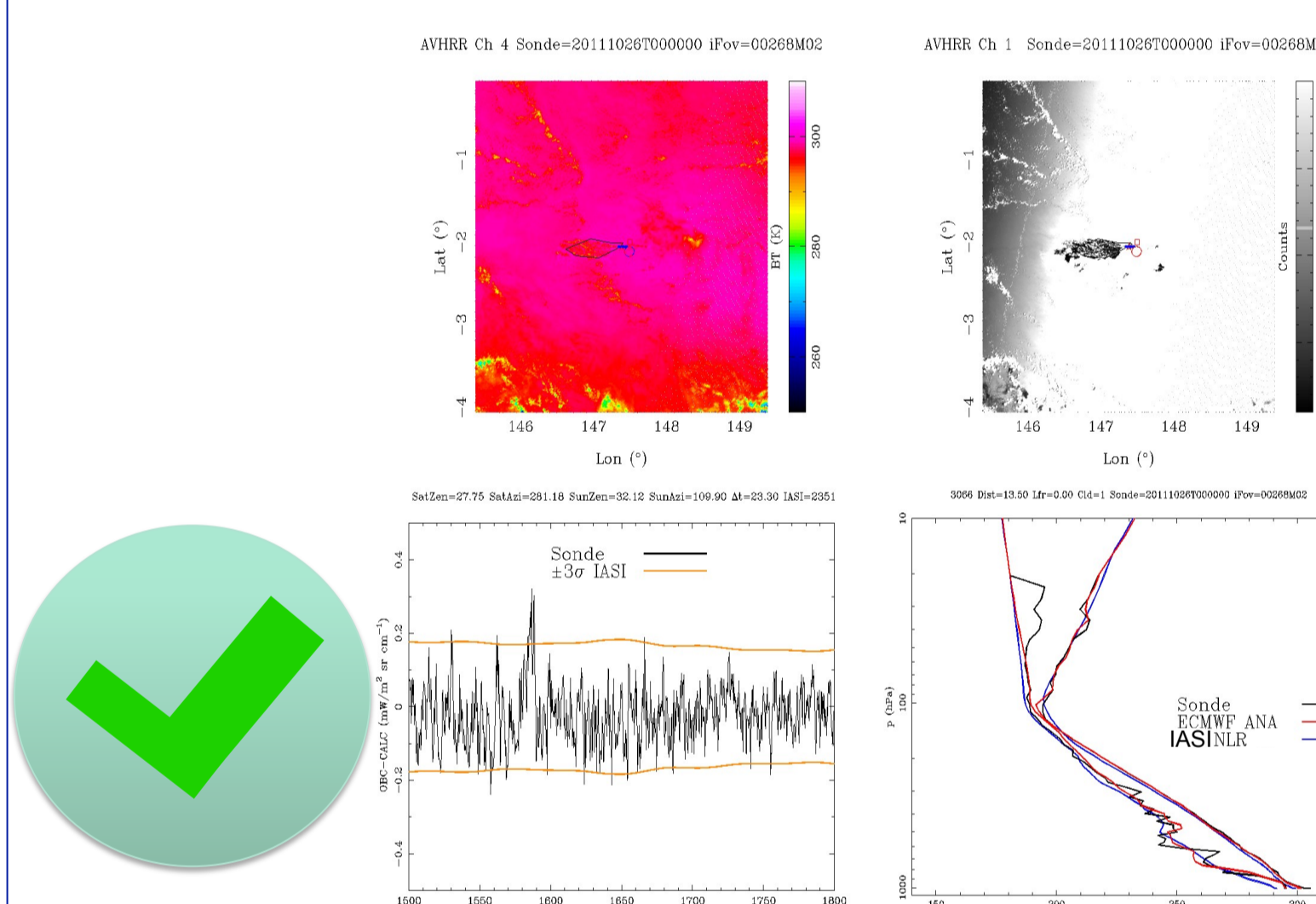
- Reference profile: ground based Remote Sensing, GRUAN Sondes, NWP profiles, etc.

- Satellite observations: microwave, infrared hyperspectral (IASI), etc.

GRUAN: Collocation
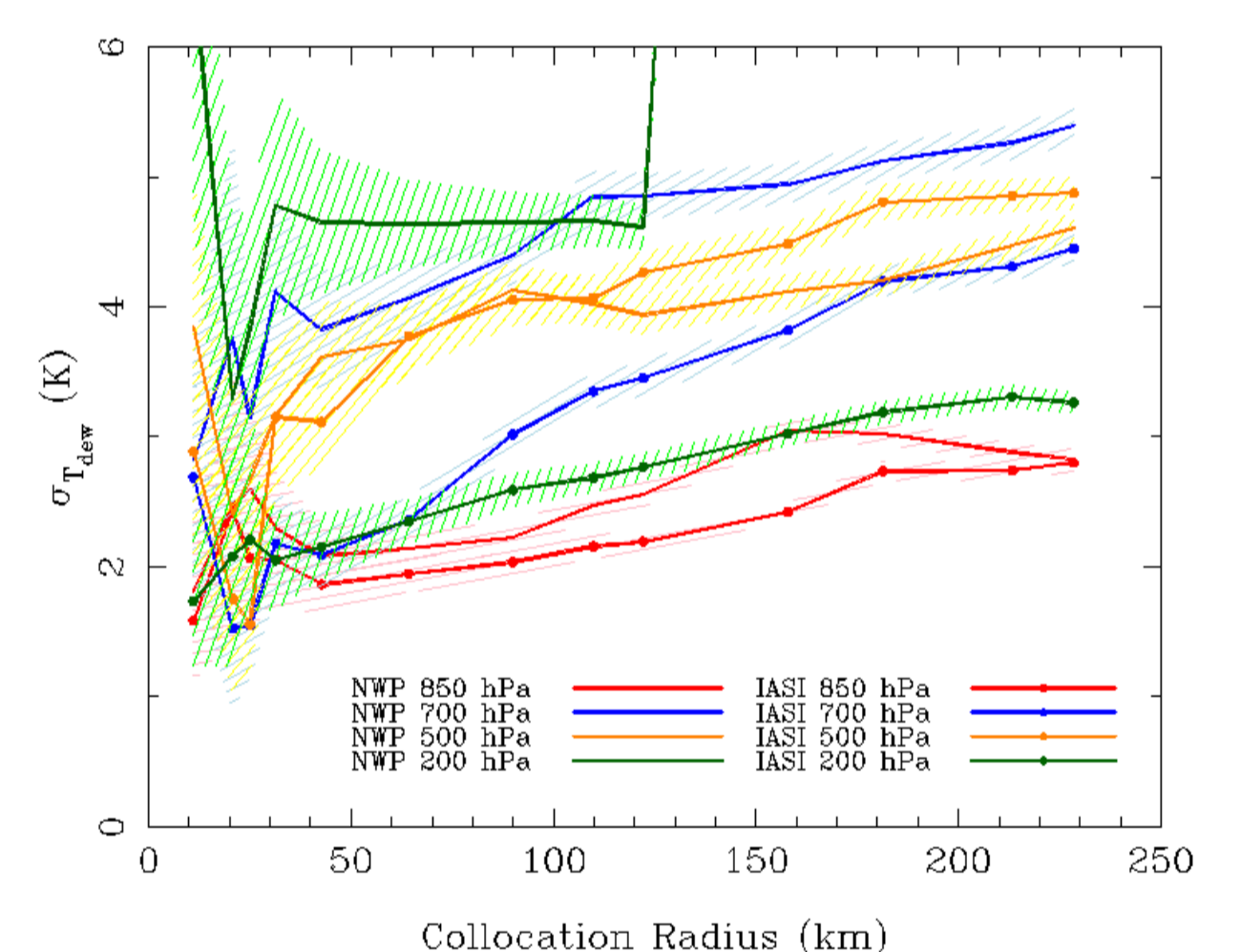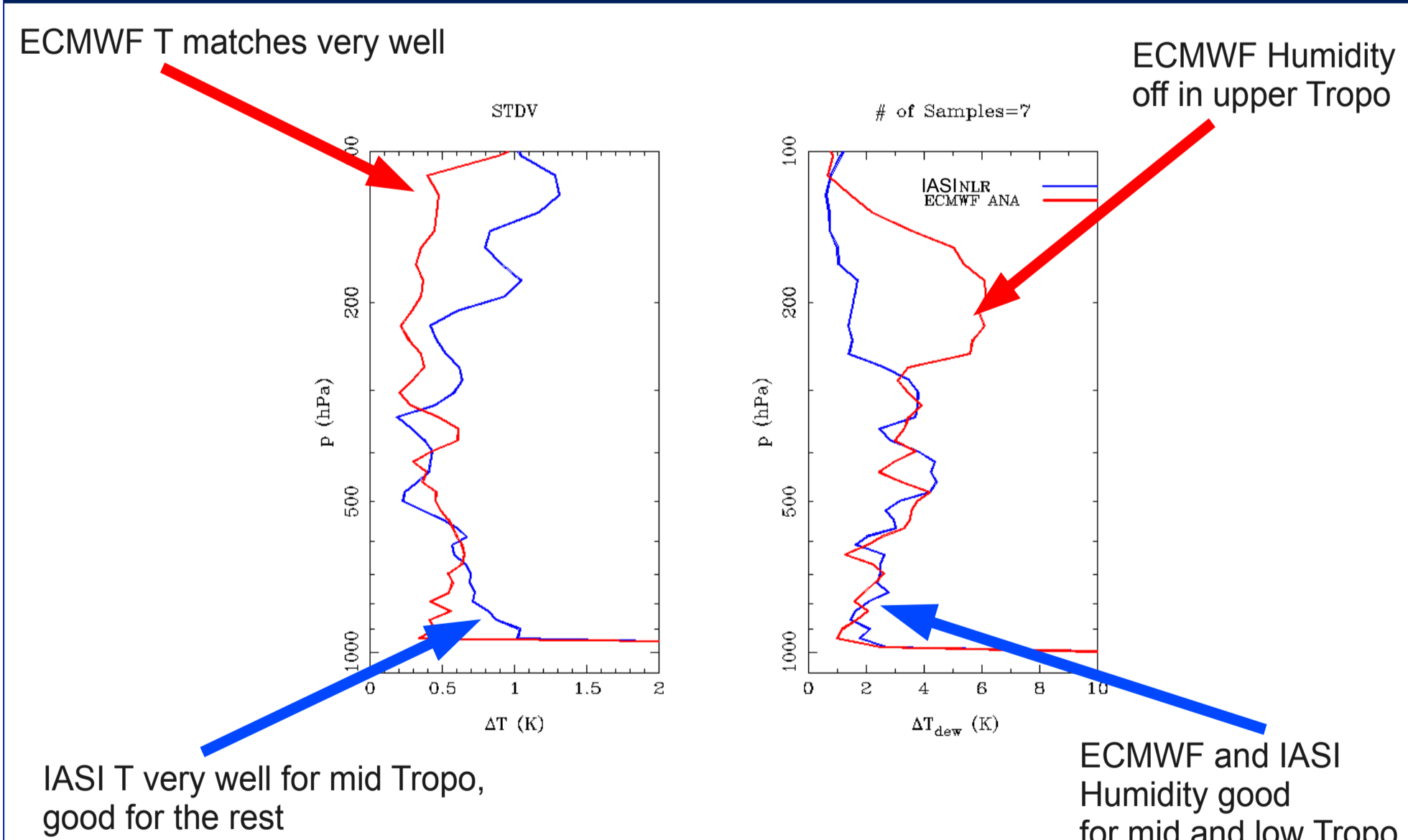
1. Collocation
   - Orbits close to 00Z and 12Z
   - IASI FOVs less than 25 km and 30 min apart from Manus
   - With above criteria met, searched for IASI FOVs 500 km away
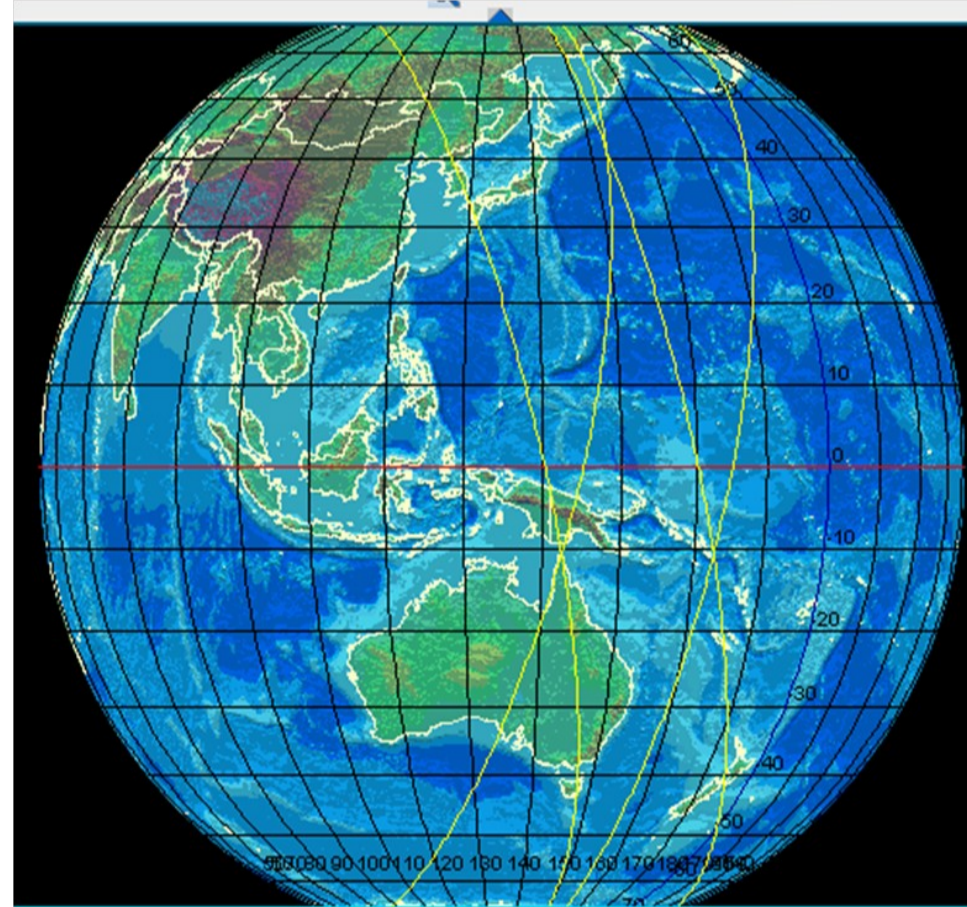
Instr/Category	Product Type	Start Date	Stop Date
HIRS	HIRoot1B	2011/06/05 22:46:53	2011/06/05 00:27:58
HIRS	HIRoot1B	2011/06/05 00:27:58	2011/06/05 02:09:55
HIRS	HIRoot1B	2011/06/05 02:09:55	2011/06/05 03:54:54
HIRS	HIRoot1B	2011/06/05 03:54:54	2011/06/05 05:36:09

GRUAN: Pre-processing

2. Pre-processing
   - No interpolation
   - Humidity bias corrections for the Calculated radiances: GRUAN + 3% RH (most likely coming from RTM)

Cal/Val Strategy: Consistency check

3. Consistency check
   - New proposed step which seems pivotal
   - Observed IASI radiances (OBS) are compared to
   - Calculated radiances (CALC) using Sonde profile + Radiative Transfer Model (RTM)
   - OBS-CALC should fall within ±3σ IASI instrument noise
   - Necessary, but not sufficient condition!
   - Ideally not to be used as a further selection criteria! == Do not include in pre-processing, if possible.

Cal/Val Strategy: Consistency check

Cal/Val Strategy: Consistency check

Cal/Val Strategy: Comparison: Profile Statistics

ECMWF T matches very well

ECMWF Humidity off in upper Tropo

IASI T very well for mid Tropo, good for the rest

ECMWF and IASI Humidity good for mid and low Tropo

Other Examples

Reference	Instruments	Collocation	Pre-processing	Consistency check	Conclusion
Sodankylä	RS92+CFH -1 hour, RS92 -5 min	25 km 30 min	Time interpol., In situ bias correction, Clear cases	Passed 4 out of 4	Good measurement strategy and processing
SALSTICE	RS92 type Dropsondes approx. IASI collocated	25 km 30 min	No interpol., Kivi RH bias correction, Clear cases	Not all passed (~15/30)	Needs further work
GRUAN	RS92 Sondes at 00 and 12 UTC (Manus is IASI collocated)	25 (500) km 30 min	No interpol., Direct GRUAN data, Clear cases	Passed 7 out of 8	Good measurement strategy and processing

Dependency of Statistics with Collocation Radius

IASI: $H_I(x_I) = H(x_I) + \mu_I + \sigma_I$

GRUAN: $H_S(x_S) = H(x_S) + \mu_S + \sigma_S$

Validation: $\sigma^2(H_I - H_S) = \sigma^2_C + \sigma^2_I + \sigma^2_S$

Dependency of Statistics with Collocation Radius

Dependency of Statistics with Collocation Radius: can this be modelled with ECMWF?

Collocation error?
A comparison Sondes vs model, vs IASI L2 (Temperature)
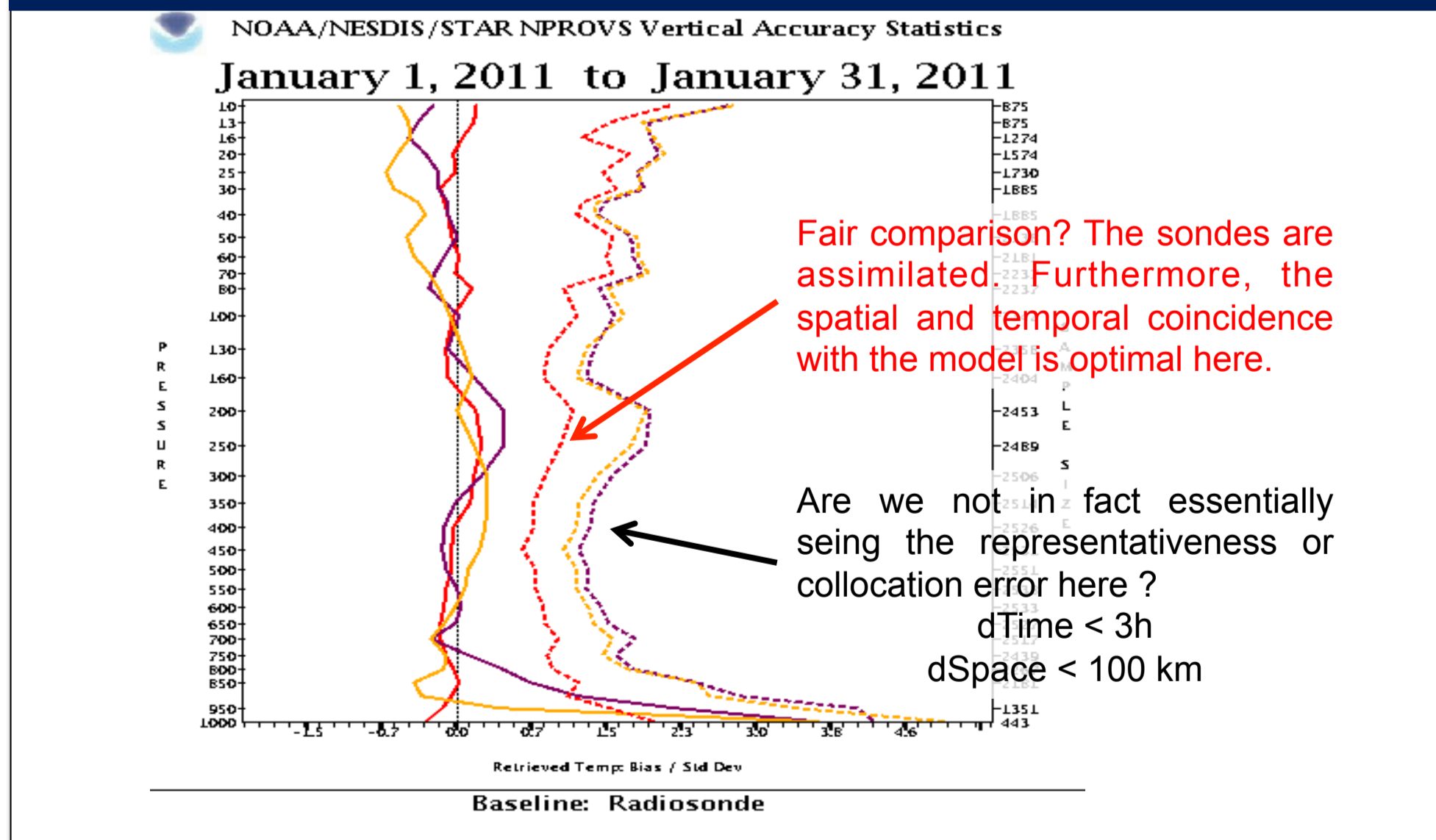
Fair comparison? The sondes are assimilated. Furthermore, the spatial and temporal coincidence with the model is optimal here.

Are we not in fact essentially seing the representativeness or collocation error here ?
dTime < 3h
dSpace < 100 km

Credits: NOAA / NESDIS Center for Satellite Applications and Research.

CONCLUSIONS

- Only Manus is well located with launches at 00 and 12 UTC to collocate well with IASI. Only 8 clear sky collocations in one year.
- GRUAN humidity needs to be corrected with RH+4%. An issue most likely from the RTM, but...?
- RTM issue with the Water Vapour Continuum?
- Consistency check reduces collocation errors to a minimum.
- For most atmospheric levels, the collocation error for humidity, in Manus, can be modelled with ECMWF.
- ECMWF humidity not accurate at 200 hPa in this region.
- More interaction possible between RTM, Sat and Sonde groups?

contact: xavier.calbet@eumetsat.int