Stability assessment of Sentinel3 MWR

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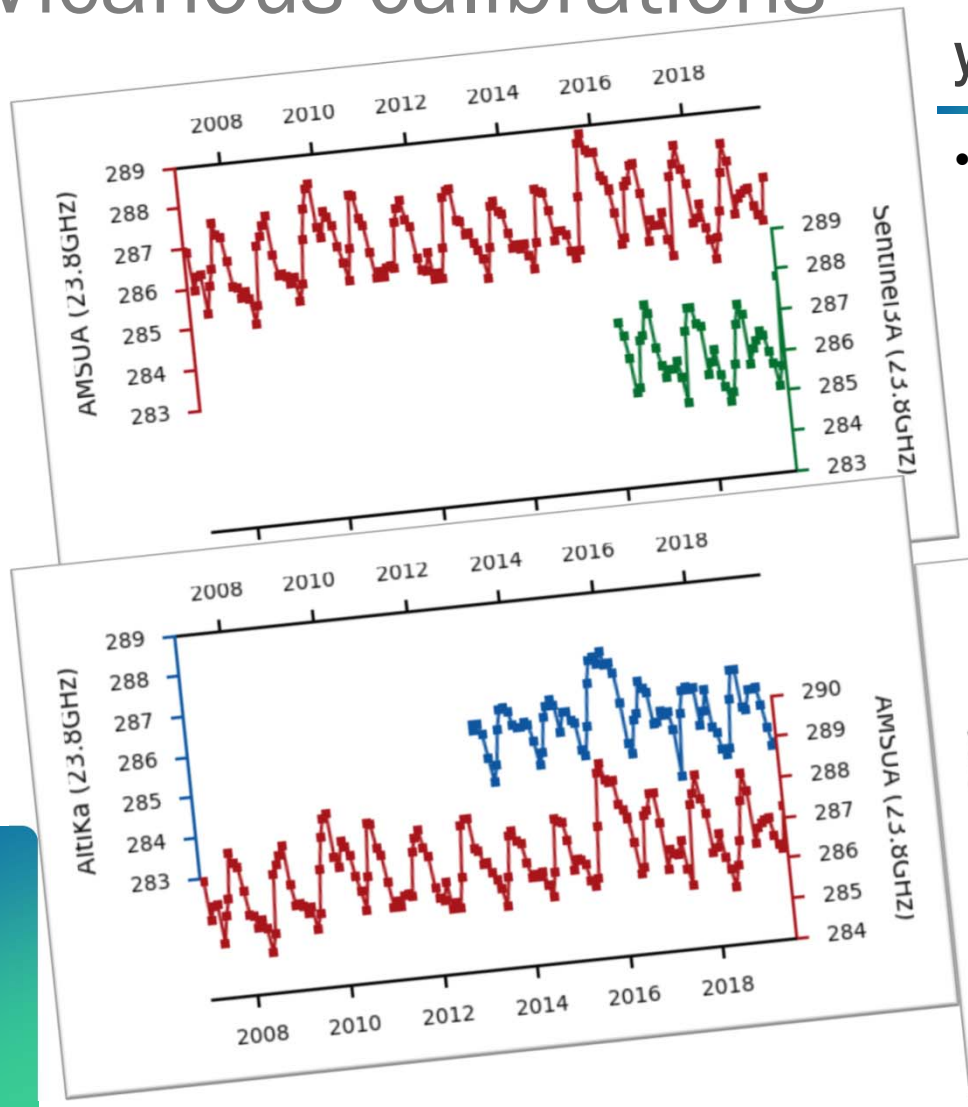
Context

- Microwave radiometers on-board Sentinel-3 (A/B) provide the correction of the wet path delay for the altimeter.
- Mission requirements provide a target for the stability of the MWR (≤0.6K over the lifetime for all channels)

- Wet troposphere correction is the main source of uncertainty on the GMSL trend (Ablain et al, 2009)
- Uncertainty of the GMSL trend due to the WTC estimated between 0.2 and 0.3 mm/yr
- GMSL trend estimated to 3.1 mm/yr with an accuracy of 0.6mm/yr (Ablain et al 2009)
  to 3.35 mm/yr with an accuracy of 0.4 mm/yr (90% confidence) (Ablain et al 2019)

- Drifts on wet tropospheric correction comes from instrumental drifts
- Important to detect and correct intrumental drifts

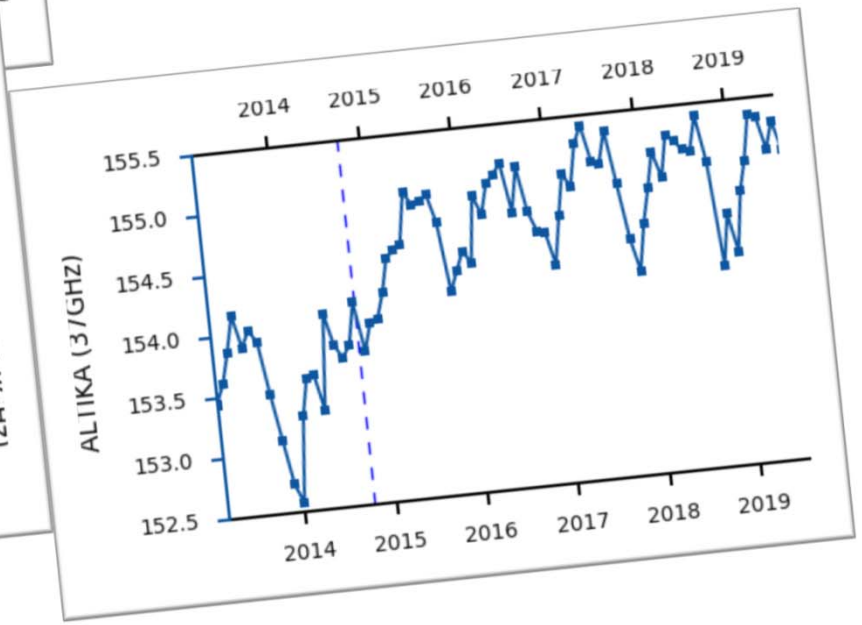
Vicarious calibrations

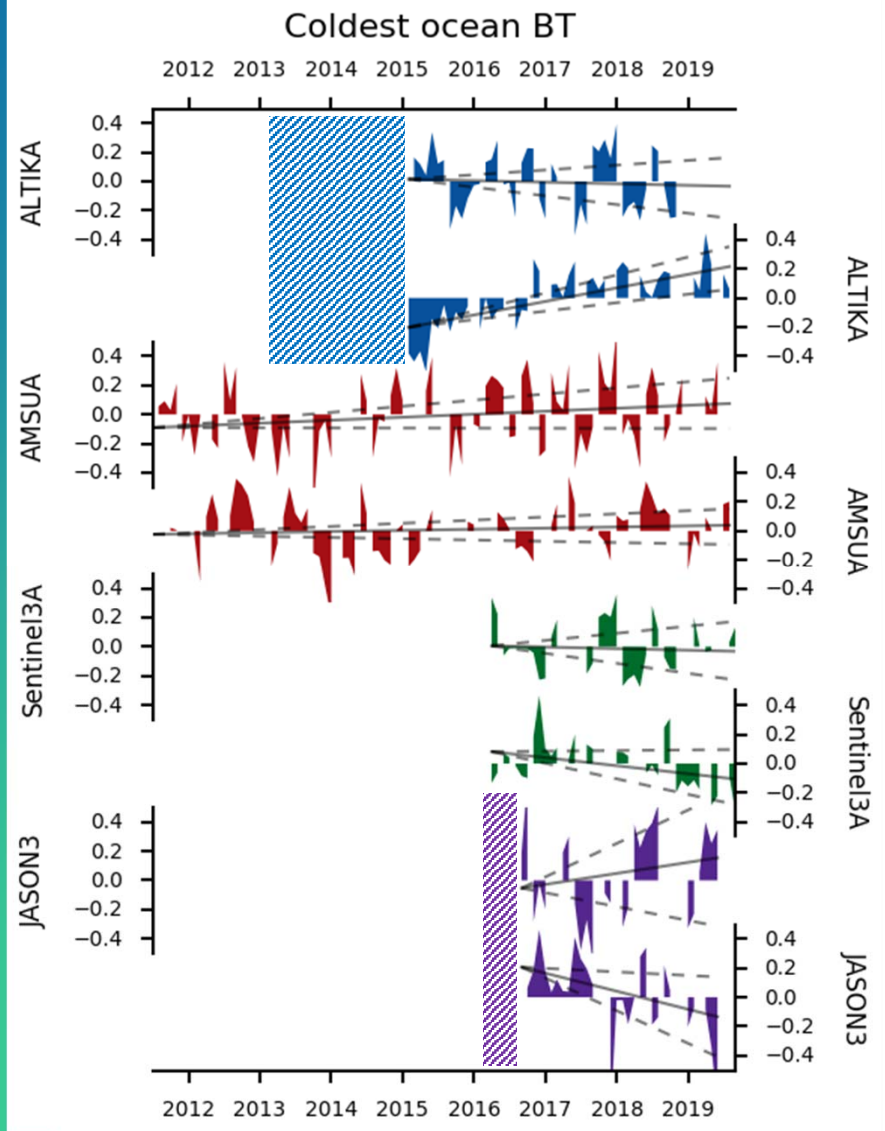


Raw signals can be decomposed as

$y(t) = m(t)+res(t) + s(t) + trend(t)$

- What can impact the estimation of the trend ?
  - Length of the timeseries
  - Geophysical conditions : el Nino
  - Instrumental issue





Coldest ocean temperatures

Residuals Obtained by removal of seasonal signal, estimation of the slope + 95% confidence interval

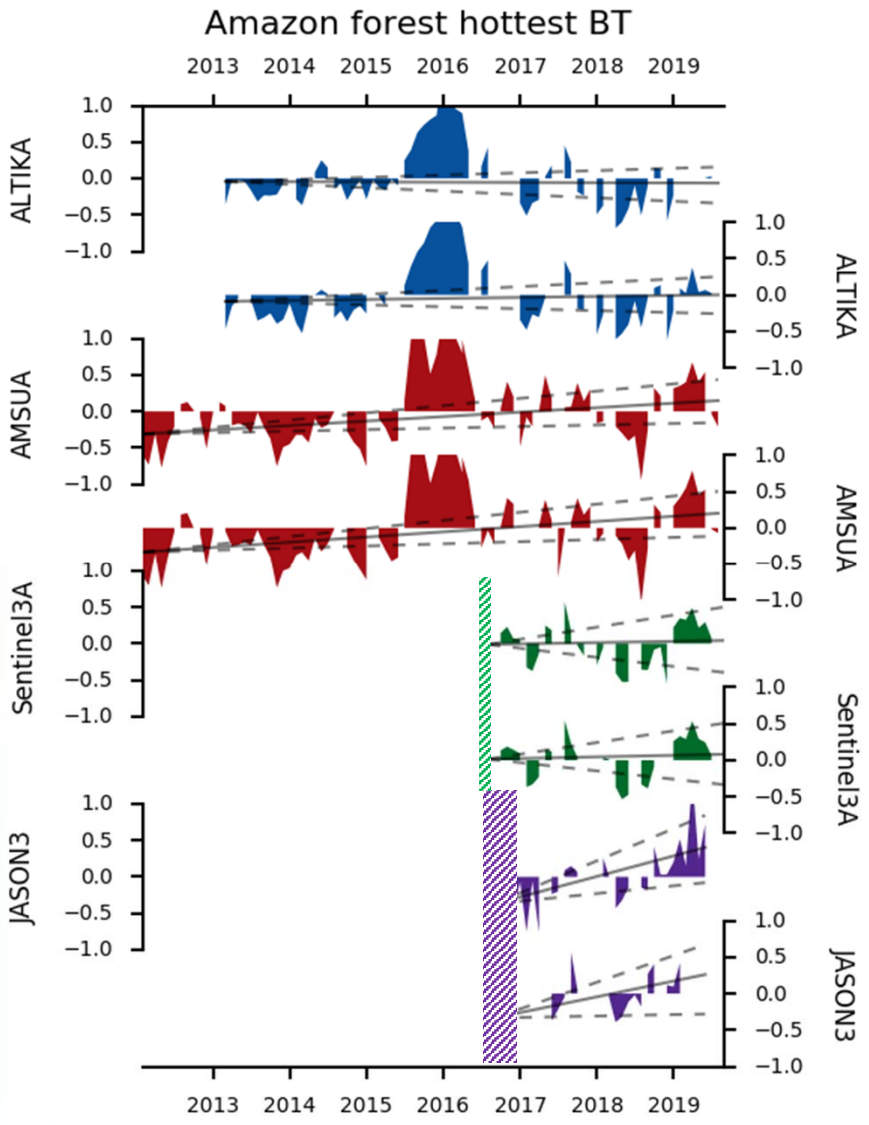
Removal of seasonal signal reduce the confidence interval

Low level of noise (residuals close to MWR sensivities)

	AltiKa	AMSU	S3A	J3
23.8 (K/yr)	-0.01 (-0.06/0.03)	0.02 (-0.00/0.04)	-0.02 (-0.07 / 0.04)	0.08 ✸ (-0.09/0.23)
Liq. wat/. (K/yr)	0.09 (0.06/0.12)	0.01 ✸ (-0.01/0.02)	-0.05 (-0.11/0.00)	-0.12 (-0.22/-0.02)

✸ : no seasonal estimated

raw signal:
0.00 K/yr (-0.19/0.15)



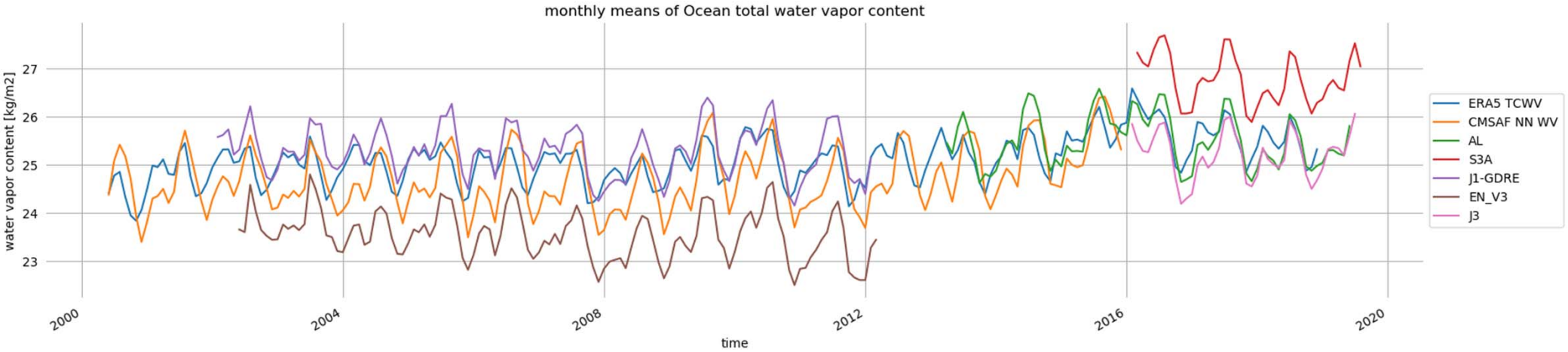
Amazon forest hottest temperatures

Residuals Obtained by removal of seasonal signal, Allow the estimation of the slope + 95% confidence interval

- Clear signature of El Nino (2016) (anomaly of water vapor over Amazon forest)
- Residuals follow same patterns

	AltiKa	AMSU	S3A	J3
23.8 (K/yr)	0.00 (-0.05/0.03)	0.06 (0.02/0.10)	0.02 (-0.12 / 0.17)	0.28 (0.11/0.44)
Liq. wat. (K/yr)	0.01 (-0.03/0.05)	0.07 (0.03/0.11)	0.02 (-0.11/0.16)	0.2 (0.01/0.34)

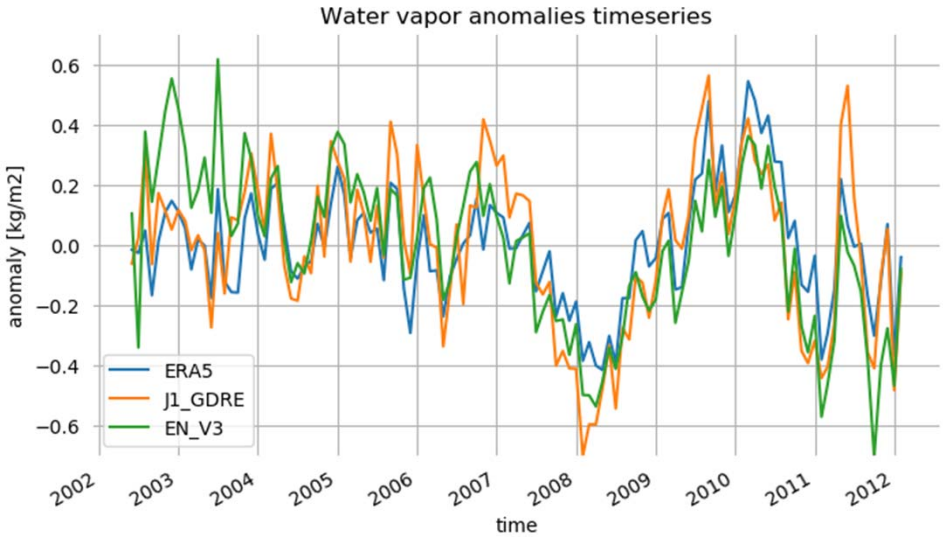
Water vapor timeseries

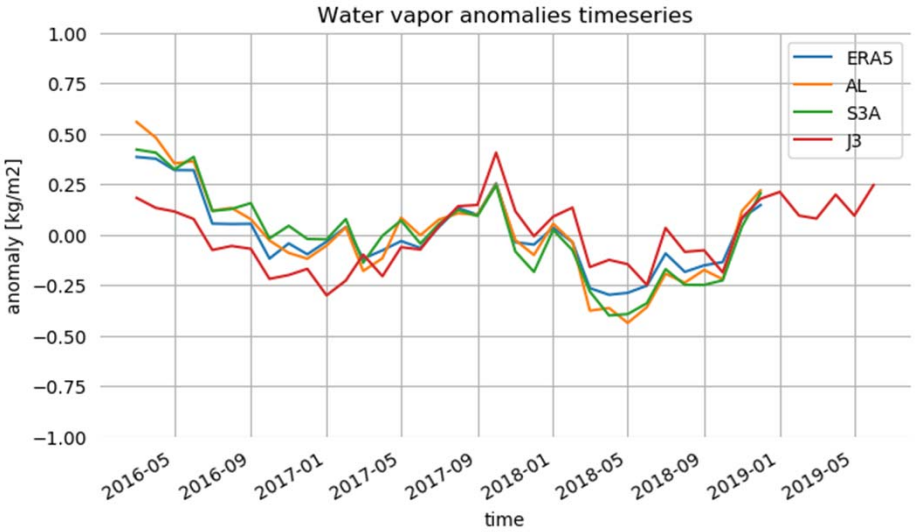


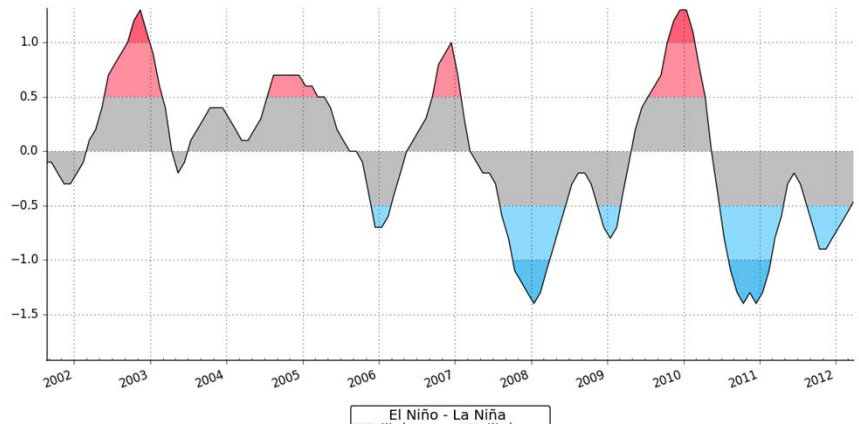
ERA5	ALTIKA	S3A	J1	ENVISAT	CMSAF CDR	J3
	GDR	NTC	GDR-E	V3	DOI:10.5676/EUM_SAF_CM/FCDR_MWI/V003	GDR-
					NN used to compute TCWV	

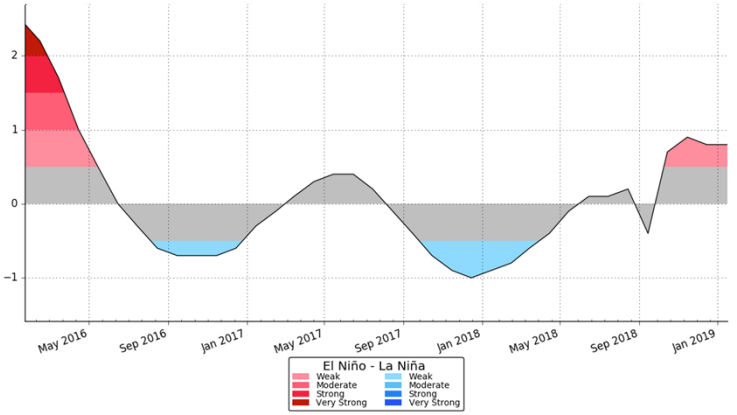
Water vapor timeseries

3 MWR
timeseries of monthly maps









Triple Colocation

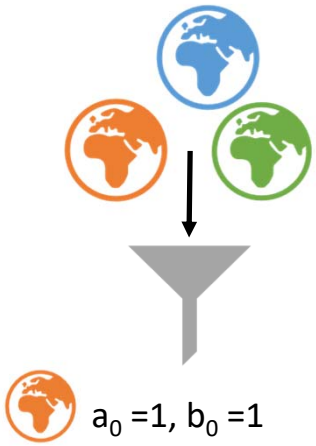
Janssen et al. 2007: *Error Estimation of Buoy, Satellite, and Model Wave Height Data*
Thao et al. 2014: *Trend and variability of the atmospheric water vapor: a mean sea level issue*

- Measurements Xi have independent errors ei
- Can be related to truth (T) through adjustment parameters a and b

$$X_i = a_i T + b_i + e_i$$

I={1..3} MWR index

a = Slope
b = intercept
Scatter index = (formula) ratio standard dev/mean signal value: proxy of how much the noise affects the signal.



3 MWR
timeseries of monthly maps

Harmonized dataset:
common time period and spatial filtering

$a_0 = 1$, $b_0 = 1$

Choose reference dataset set to be 'the Truth'

10

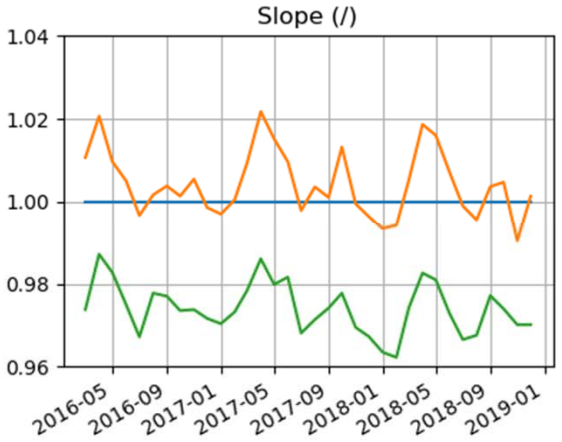
iterations until convergence

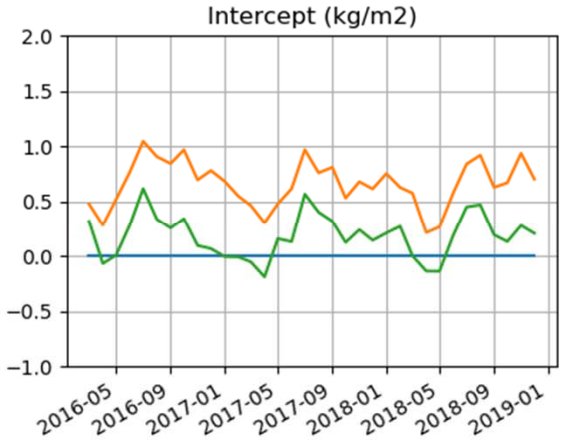
1. Computation of variances and covariances of adjusted measurements difference
2. Estimation of A,B parameters
3. Adjust measurements with A,B

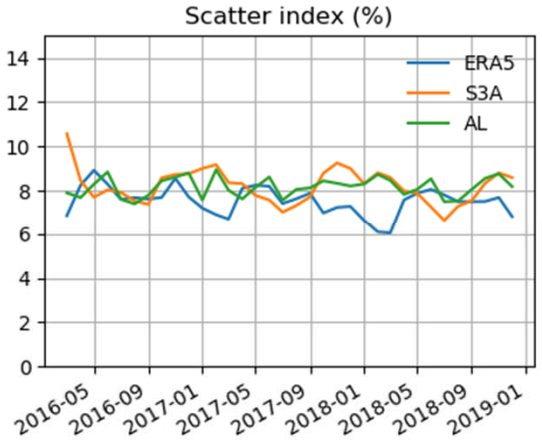
$$\begin{Bmatrix} a_0 & b_0 \\ a_1 & b_1 \\ a_2 & b_2 \end{Bmatrix}$$

Adjustment parameters relative to reference

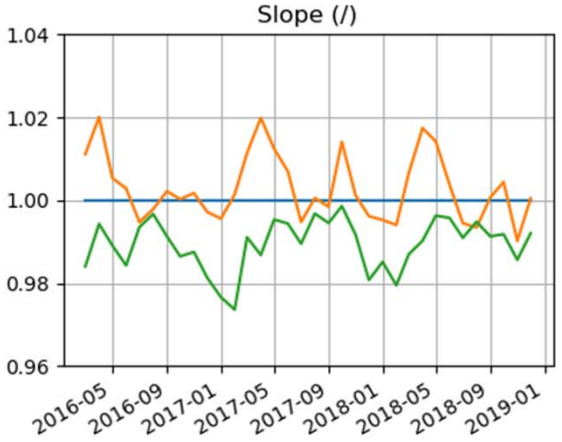
Triple coloc results (S3A period)

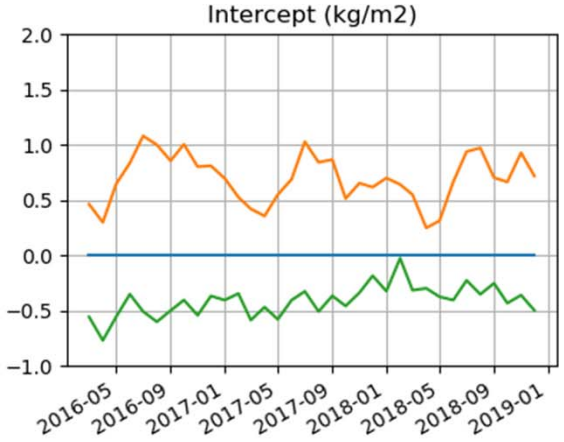


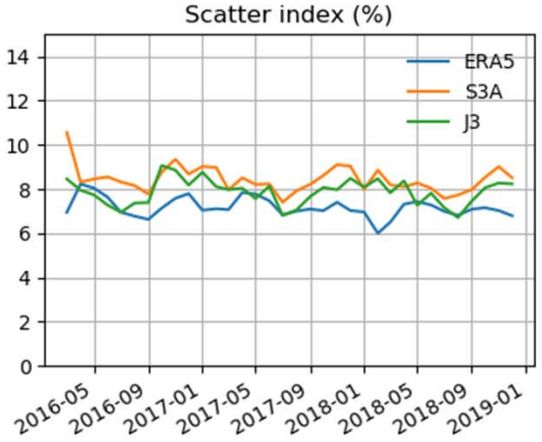




ERA5
S3A
AL

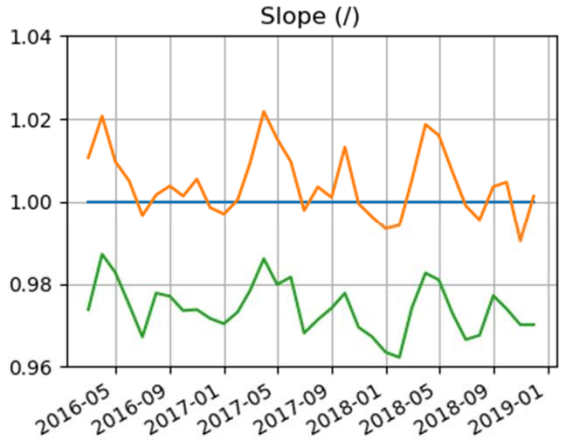


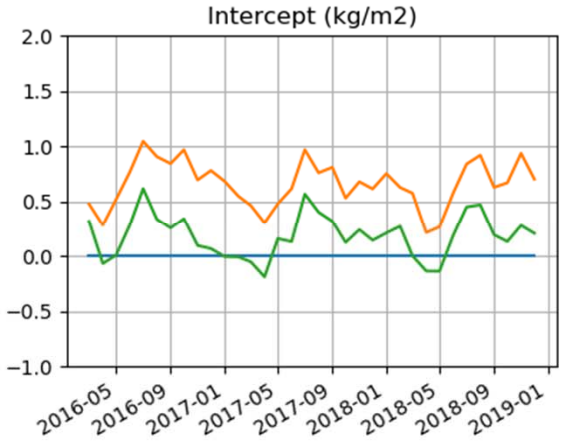


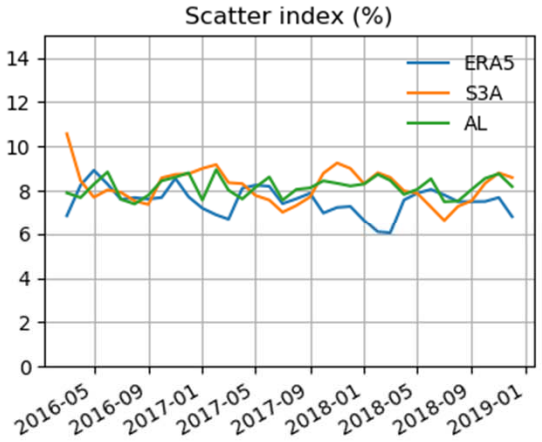


ERA5
S3A
J3

Triple coloc results (S3A period)







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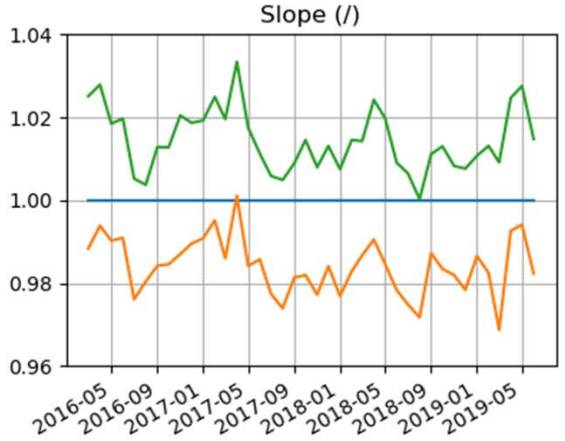
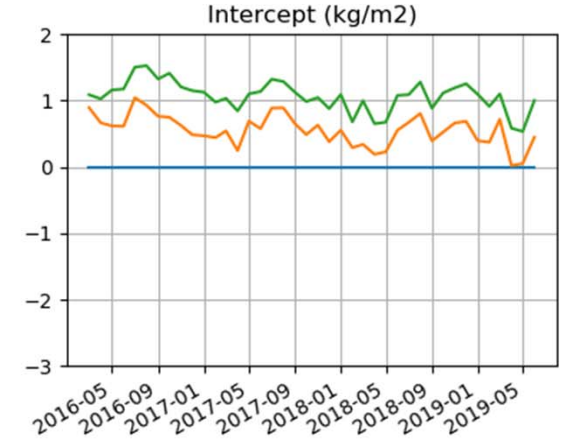
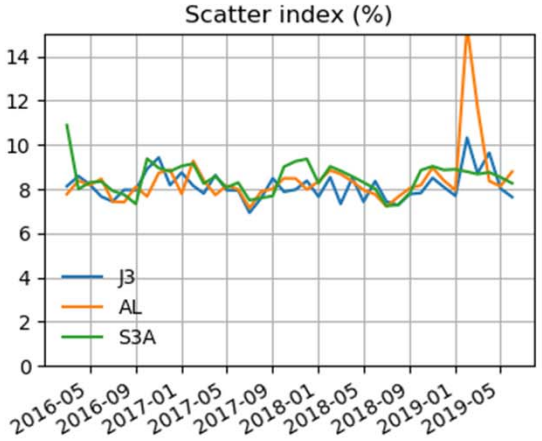
AL







J3
AL
S3A

Summary

Stability of Sentinel 3A MWR assessed

From brightness temperatures using vicarious calibrations

➔ S3A timeserie is still short, estimation of trend shows a large uncertainty

➔ No clear bias identified so far

	Coldest ocean points		Amazon forest	
	3 years	**S3A**	**3 years**	**S3A**
	23.8 (K/yr)	-0.02 (-0.07 / 0.04)	23.8 (K/yr)	0.02 (-0.12 / 0.17)
	Liq. wat/. (K/yr)	-0.05 (-0.11/0.00)	Liq. wat. (K/yr)	0.02 (-0.11/0.16)

Next steps: monitoring, part of MPC routine work

Comparing Water vapor products

➔Triple collocation used to compare water vapor products (Work still in progress)

➔ No trend observed on S3A data so far

Next steps: Move on with the analysis, add CDR data during S3A/J3 period