The recent drift of SARAL: an unexpected MSS experiment

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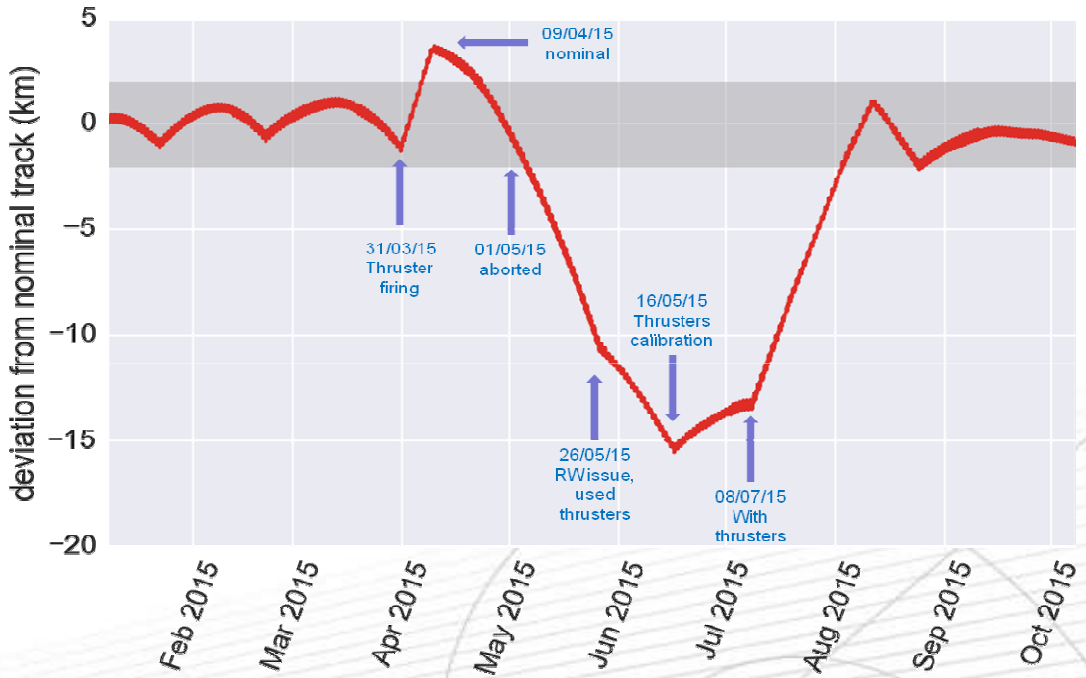
Objectives

Main objective: Take advantage of the recent drift of SARAL, up to 10km from its nominal ground track due to the temporary stop of its orbit housekeeping to refine the estimation of the MSS errors far from the repetitive ground track positions & evolution of this errors with ground track position distance



Additional objective: discuss crucial importance and processing issues using geodetic missions for MSS computation

Methodology

➢Analyze of the SLA variance along the tracks of different altimeters

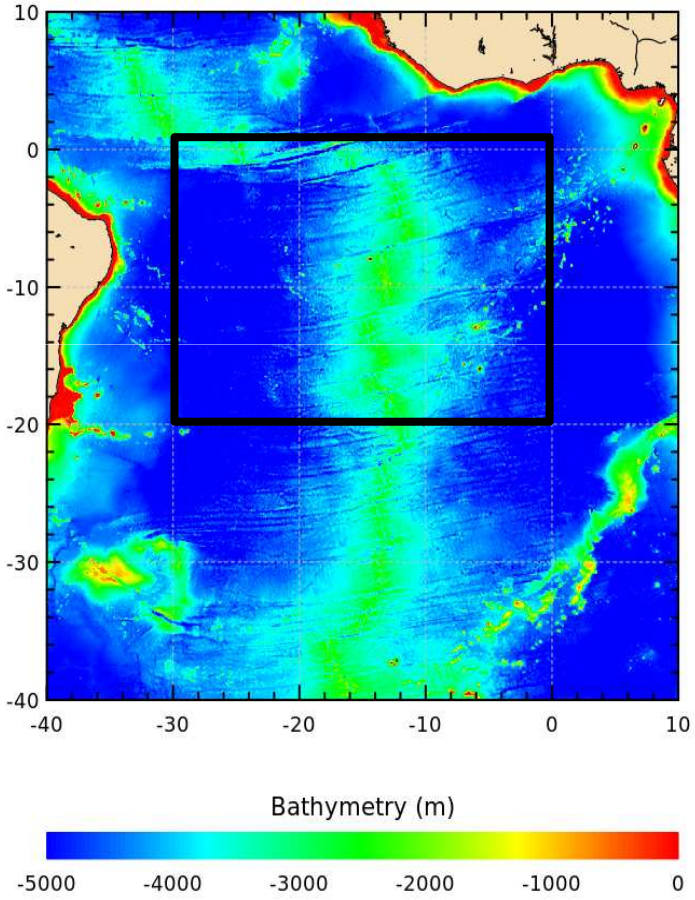
- AL : on its nominal ground-track position (Jan-Mar 2015)
- AL opportunity during the drift of the ground-track position (May-Jul 2015)
  =>not ingested in MSS, independent dataset
- J2 used as reference (Assume MSS error minimal along J2 repetitive ground tracks)

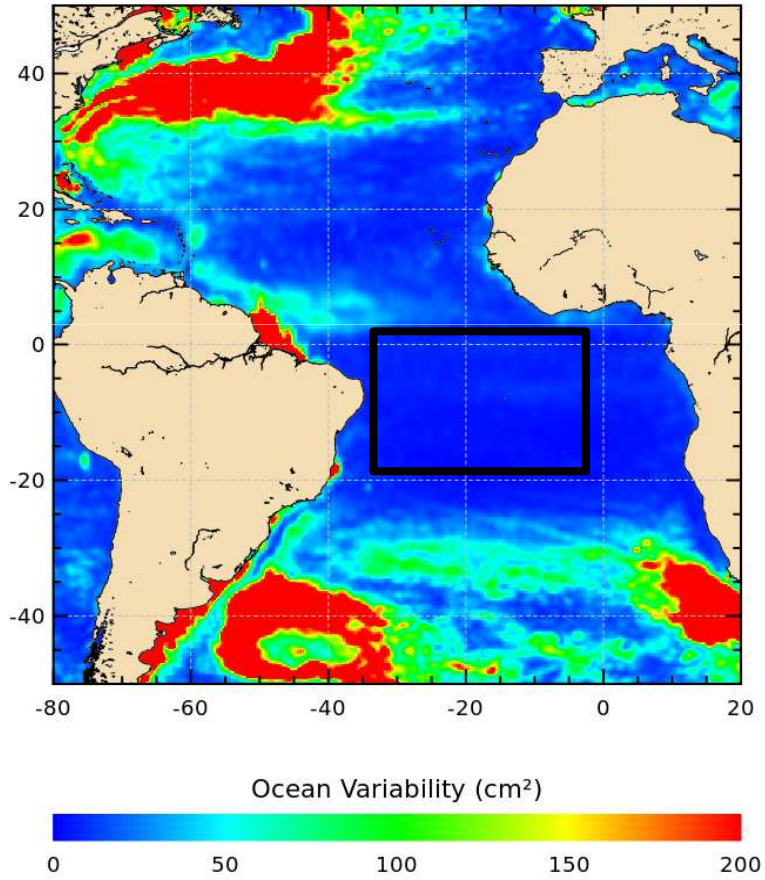
➢Analysis of the temporal evolution of the SLA variance

- Focus on a low variability area with high MSS gradients
- Focus on wavelength < 200 km only

➢Spectral Analysis

Methodology





Methodology

➔ Comparison of 3 different MSS:

MSS_CNES_CLS_2011

- Referenced on [1993, 2012] Period; ocean variability removed
- Uses Mean Profiles for large and small scales information : TP/J1/J2 ; E2/EN ; G2 ; TPN/J1N
- geodesic mission used : ERS-1

MSS_CNES_CLS_2015

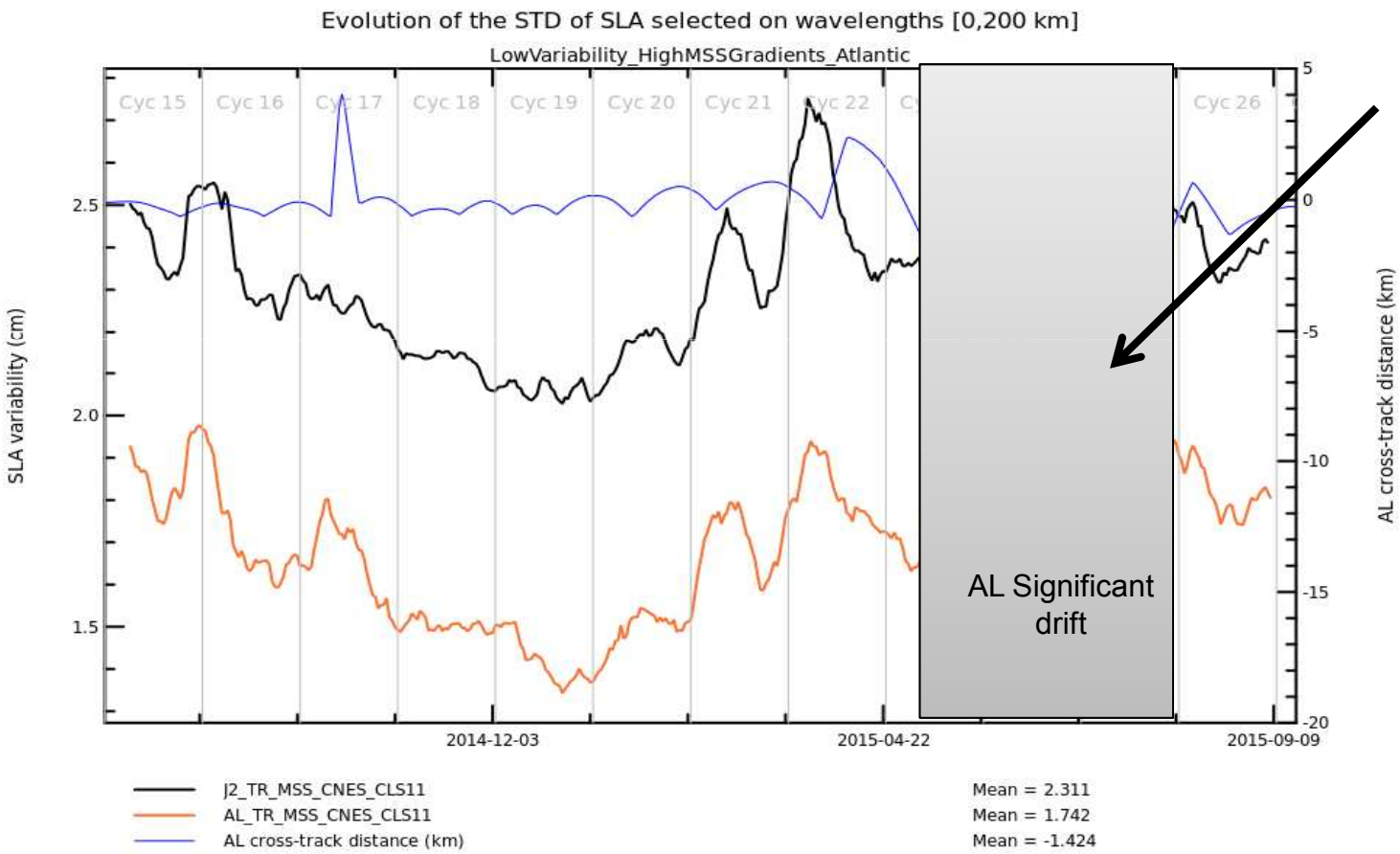
- Referenced on [1993, 2012] Period ; ocean variability removed
- Uses Mean Profiles for large and small scales information : TP/J1/J2 ; E2/EN ; G2 ; TPN/J1N
- geodesic mission used : ERS-1; J1G, C2[2011,2014]

MSS_DTU13

- Referenced on [1993, 2012] Period
- Uses Mean Profiles for large scales (> ~250km) information : TP/J1/J2 ; E2/EN ; G2 ; TPN/J1N
- Use geodetic mission for small scales (< ~250km) information : Geosat ; ERS-1; J1G ; C2[2012]

Variance analysis

MSS_CNES_CLS11 used



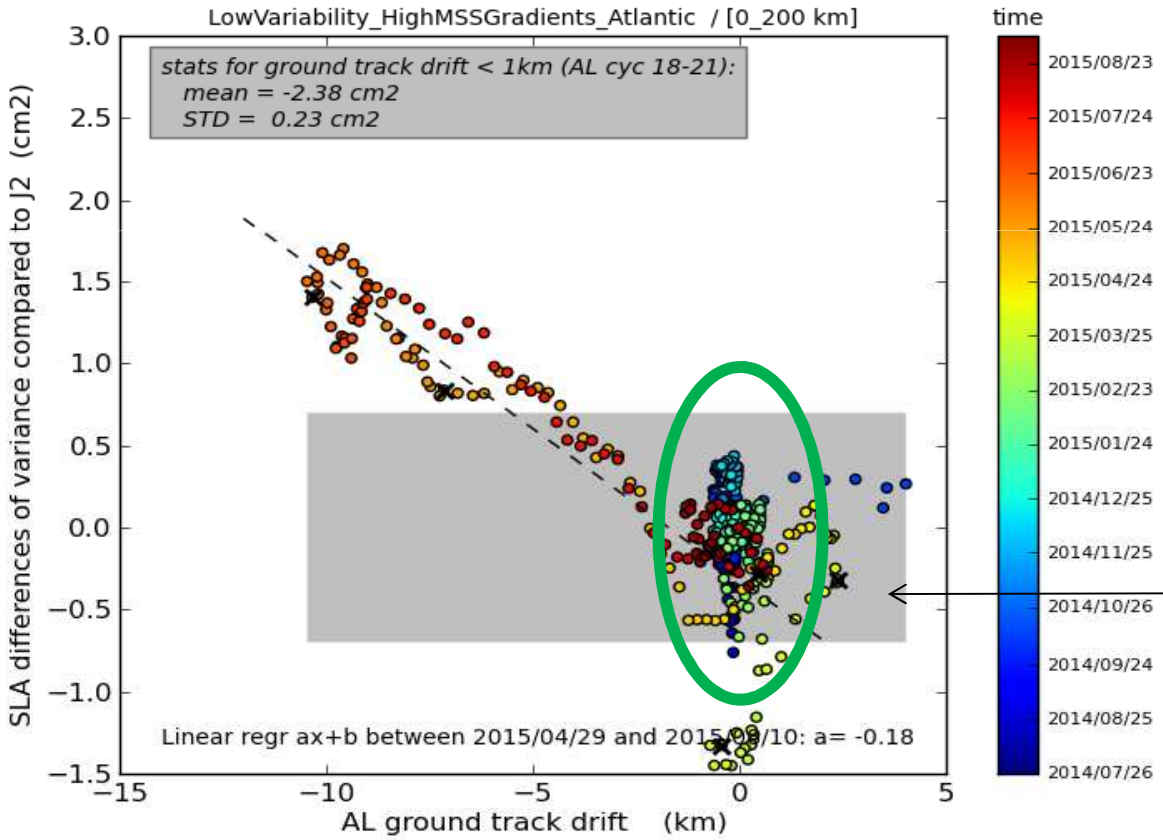
- Short Wavelength (< 200km) SLA variability increase along Al tracks during the ground-track drift

- Not observed along J2 tracks

Variance analysis

MSS_CNES_CLS11 used

(SLA variance along AL tracks – SLA variance along J2 tracks) as a function on the Al ground-track drift



Variability differences between J2 and AL : -2.38 ±0.23 cm²

Induced by :

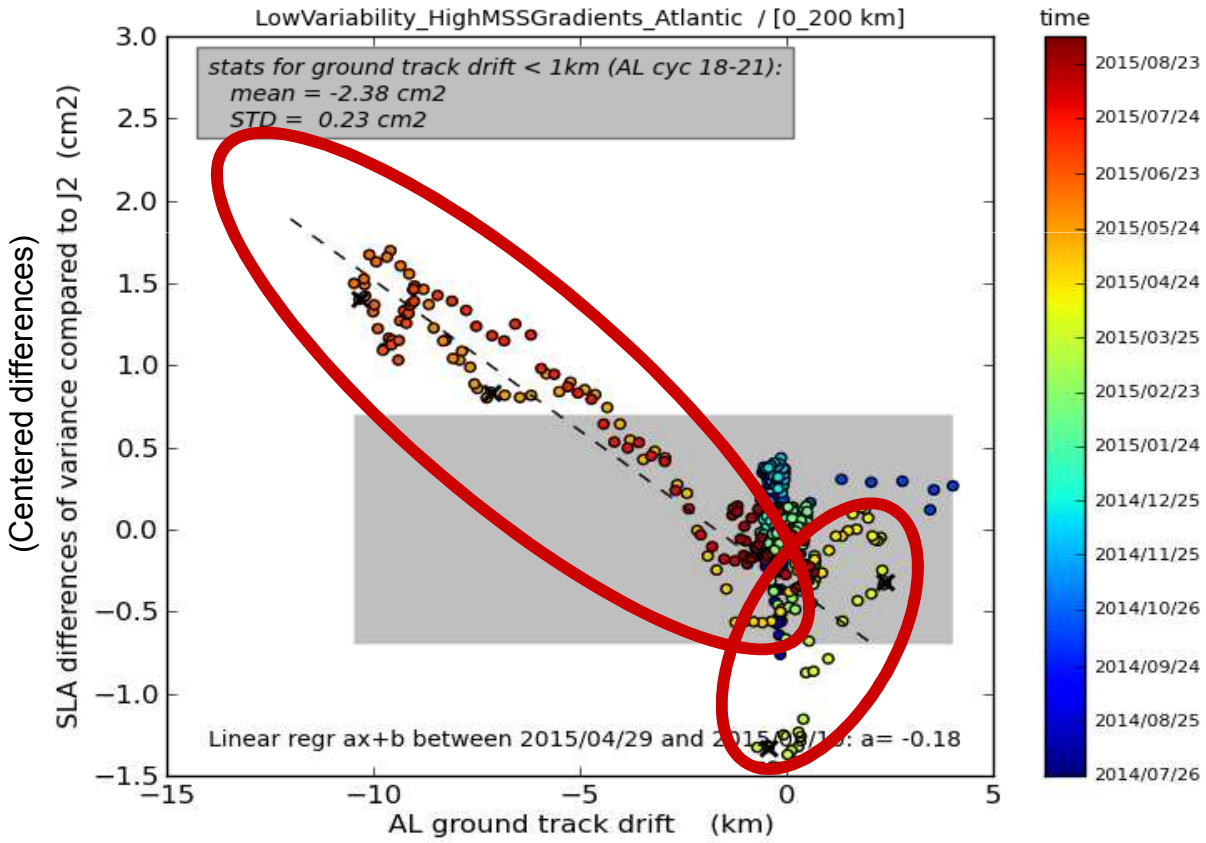
- Different 1Hz noise errors for the two altimeters (bias removed on the plot)
- Ocean surface variability differently sampled

→ we use the variability of the differences to define the error of the methodology : Error Bar = 3σ

Variance analysis

MSS_CNES_CLS11 used

(SLA variance along AL tracks – SLA variance along J2 tracks) as a fct on the Al ground-track drift



MSS error evolution with AL ground-track position:

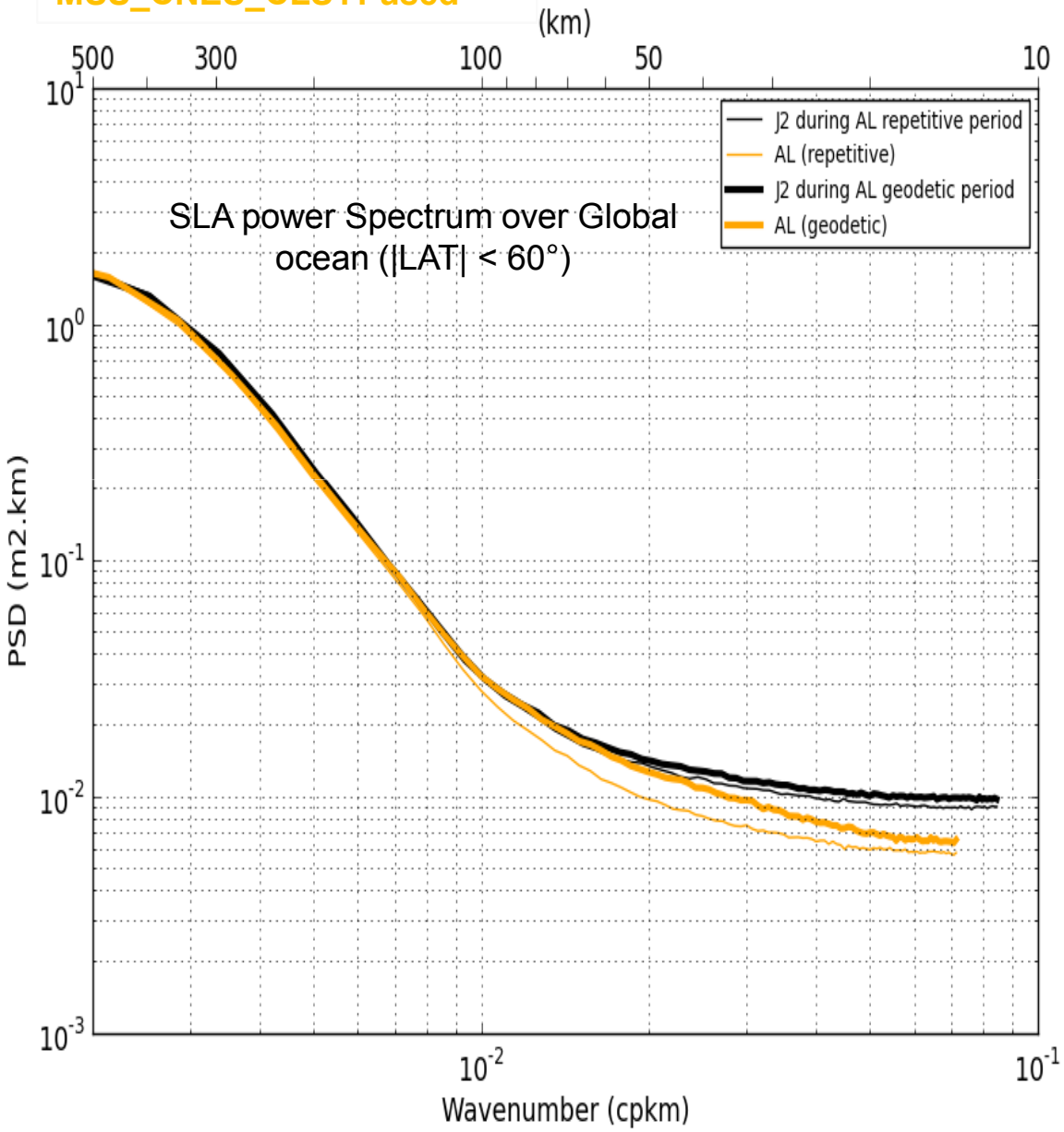
→**Err = 4.2 mm rms / km**

→ Mixed with ocean variability between 0-4 km

→ **Err significant for ground-track distance > 5km** (low variability & high MSS gradients area)

Spectral analysis

MSS_CNES_CLS11 used

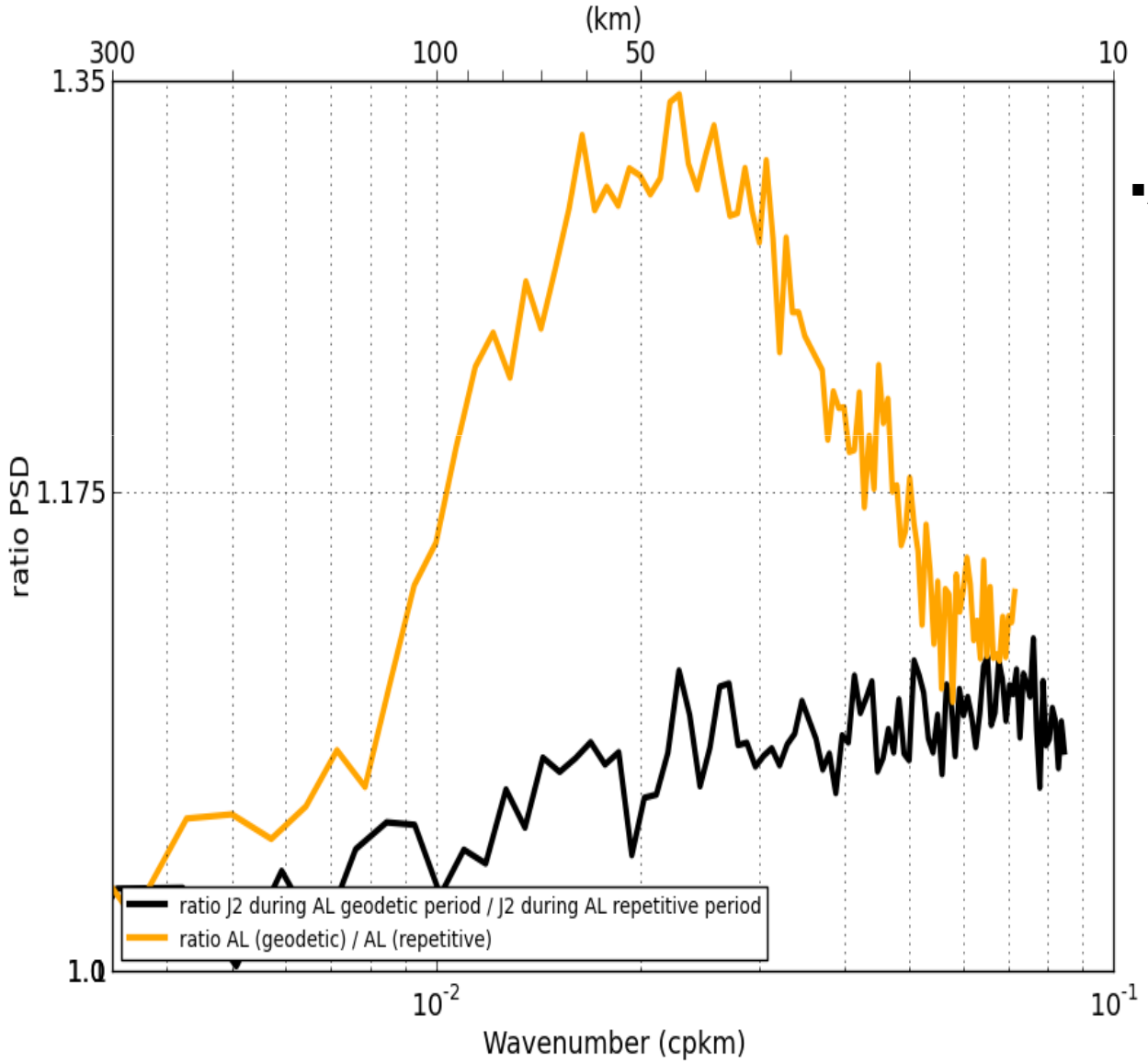


- **AL and J2 SLA Spectra for two period:**
  - Before the drift (AL_Repeat)
  - during the drifting phase(AL_Geo)

- **Increased AL energy during the drift** not observed with J2
  - →characterize MSS error increase when the ground track is far from its nominal position
  - →omission error: few geoid signal information at 50km scales due to the poor geodetic coverage before 2010

Spectral analysis

MSS_CNES_CLS11 used



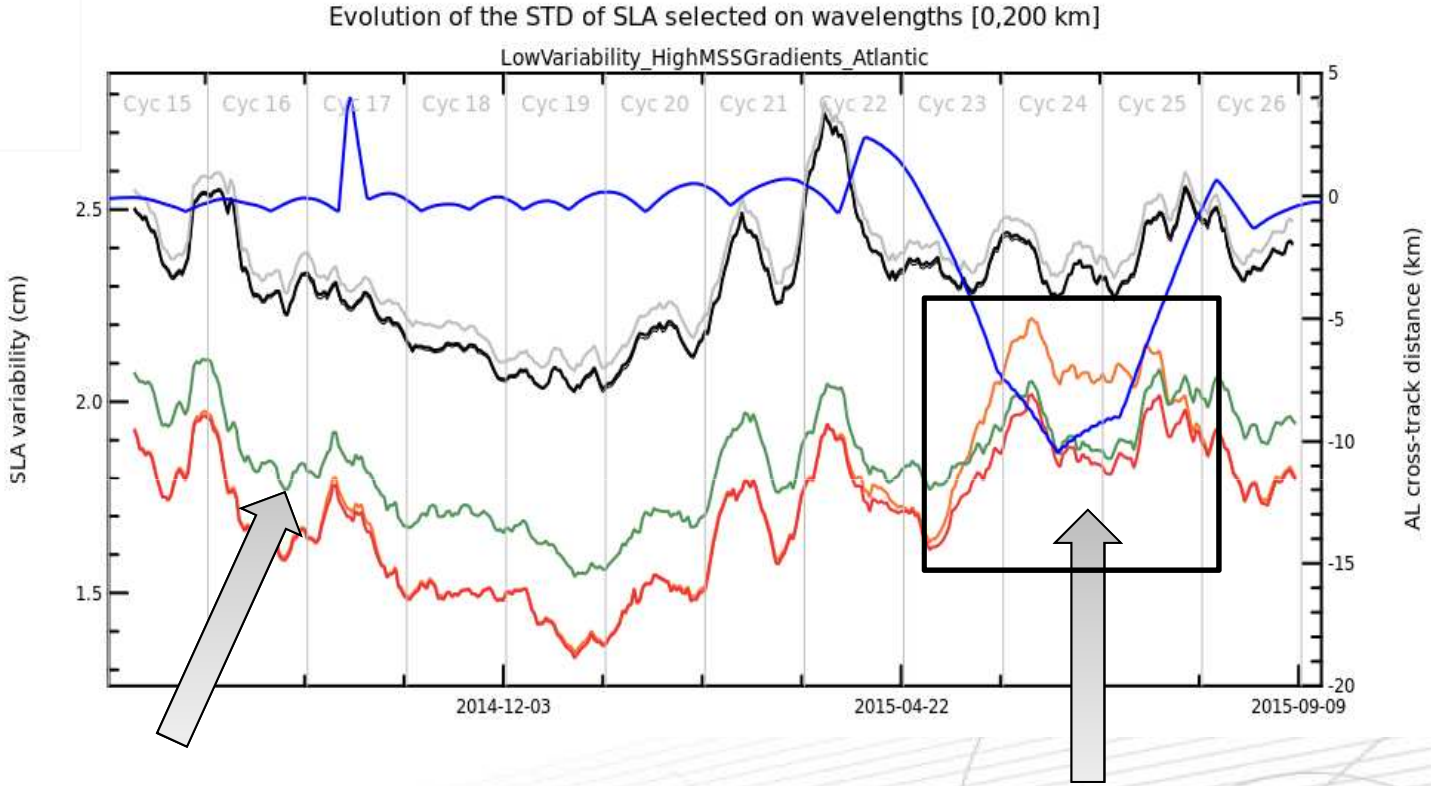
- **AL and J2 Ratio Spectra**
  - **AL(AL_Geo) / AL(AL_Repeat)**
  - **J2(AL_Geo) / J2(AL_Repeat)**

- **Max impact between 20-200km**:
  + 30% additional errors at 50km
  ~+10% (i.e. 0.95 cm rms) for wavelengths 20-200km

What's about the latest MSS ?

Variance analysis

MSS_CNES_CLS11 used
MSS_CNES_CLS15 used
MSS_DTU13 used



Along repetitive AL tracks

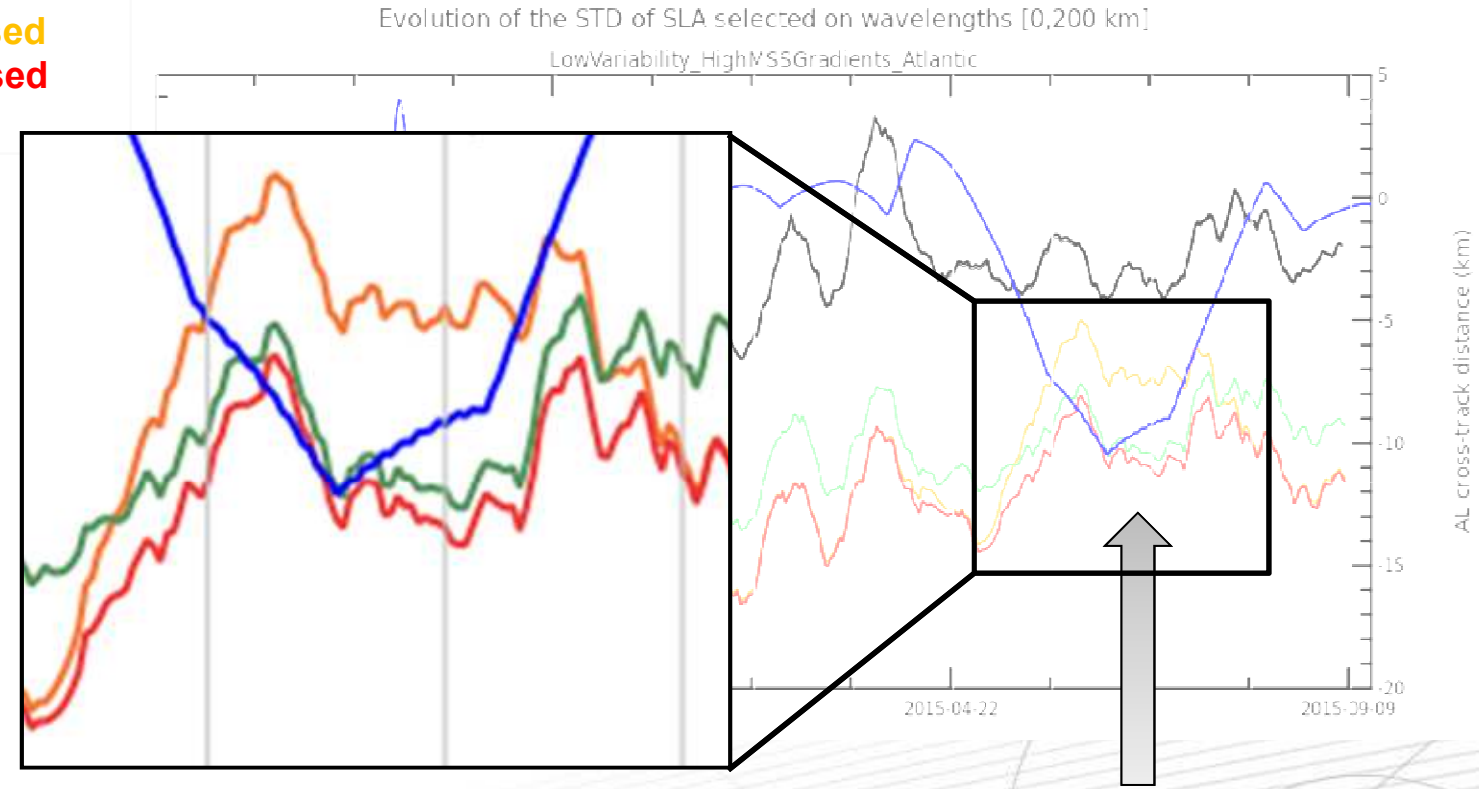
MSS_DTU13 variance globally higher than for MSS_CNES_CLSxx : +0.75 cm rms

Along drifting AL track

Strong improvement with **MSS_DTU13** and **MSS_CNES_CLS15** during AL drift thanks to the use of geodetic mission Ja1G and C2

Variance analysis

MSS_CNES_CLS11 used
MSS_CNES_CLS15 used
MSS_DTU13 used

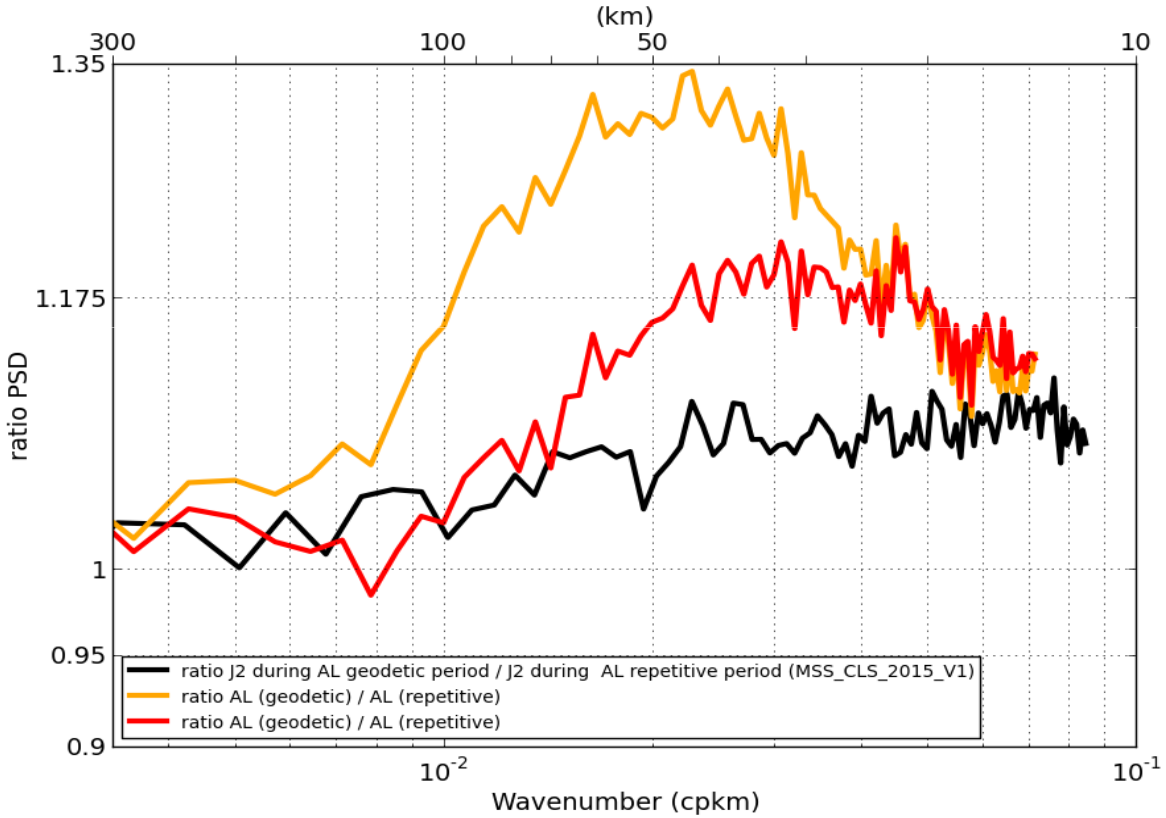


MSS_DTU13 error globally higher than for MSS_CNES_CLS11 along repetitive AL tracks : +0.75 cm rms

Small error increase using **MSS_DTU13** and **MSS_CNES_CLS15** during AL drift thanks to the use of geodetic mission Ja1G and C2

Spectral analysis

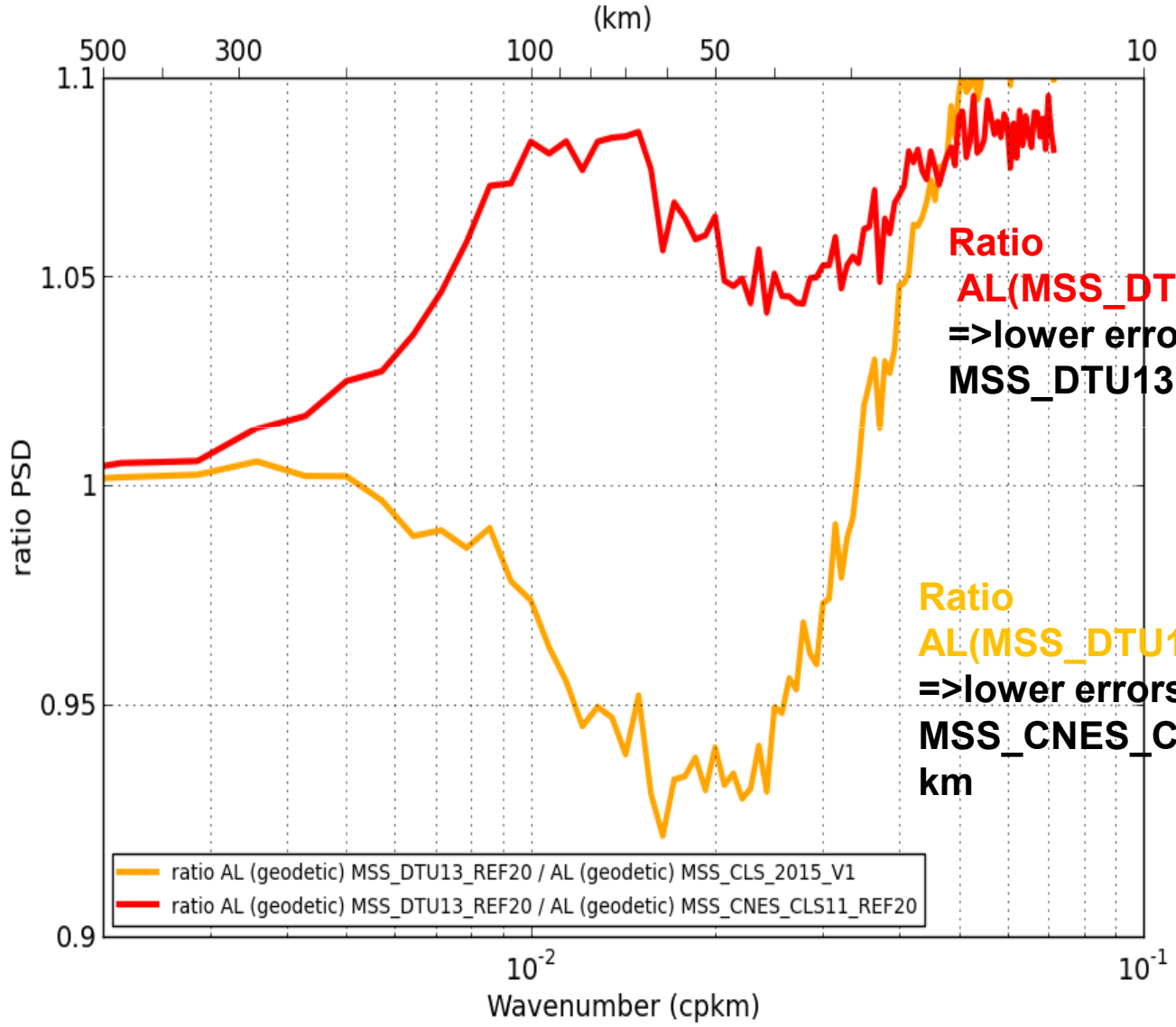
MSS_CNES_CLS11 used
MSS_CNES_CLS15 used



- **AL and J2 Geo/Repeat Ratio Spectra**
  - **J2(AL_Geo) / J2(AL_Repeat)**
  - **AL(AL_Geo) / AL(AL_Repeat) with MSS_CNES_CLS11**
  - **AL(AL_Geo) / AL(AL_Repeat) with MSS_CNES_CLS15**

- MSS Error reduced by 90% (noises errors excluded)

Spectral analysis



- **AL Ratio Spectra during the geodetic period with several MSS**

Ratio AL(MSS_DTU13) /AL(MSS_CNES_CLS15)
=>lower errors for MSS_CNES_CLS15 vs MSS_DTU13 at wavelengths <200km

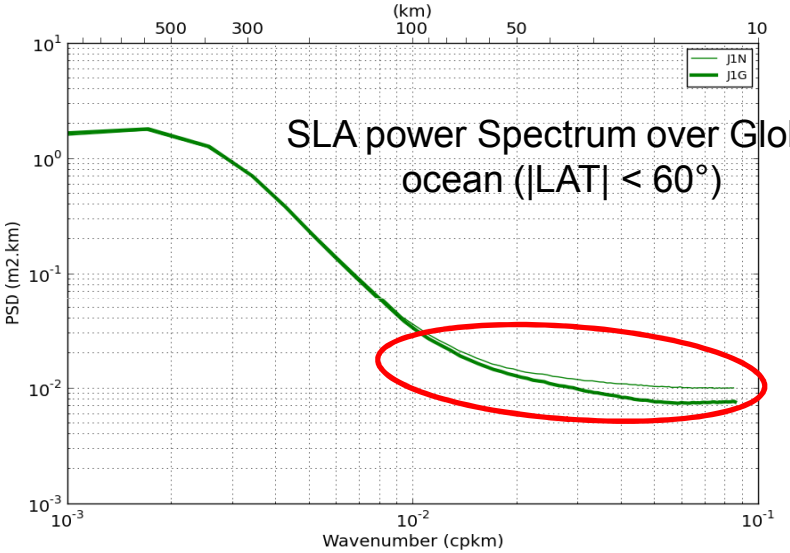
Ratio AL(MSS_DTU13)/AL(MSS_CNES_CLS11):
=>lower errors for MSS_DTU13 vs MSS_CNES_CLS15 at wavelengths 200-30 km

What's about Ja1 Geodesic mission?

J1G Vs J1N analysis

MSS_DTU13 used

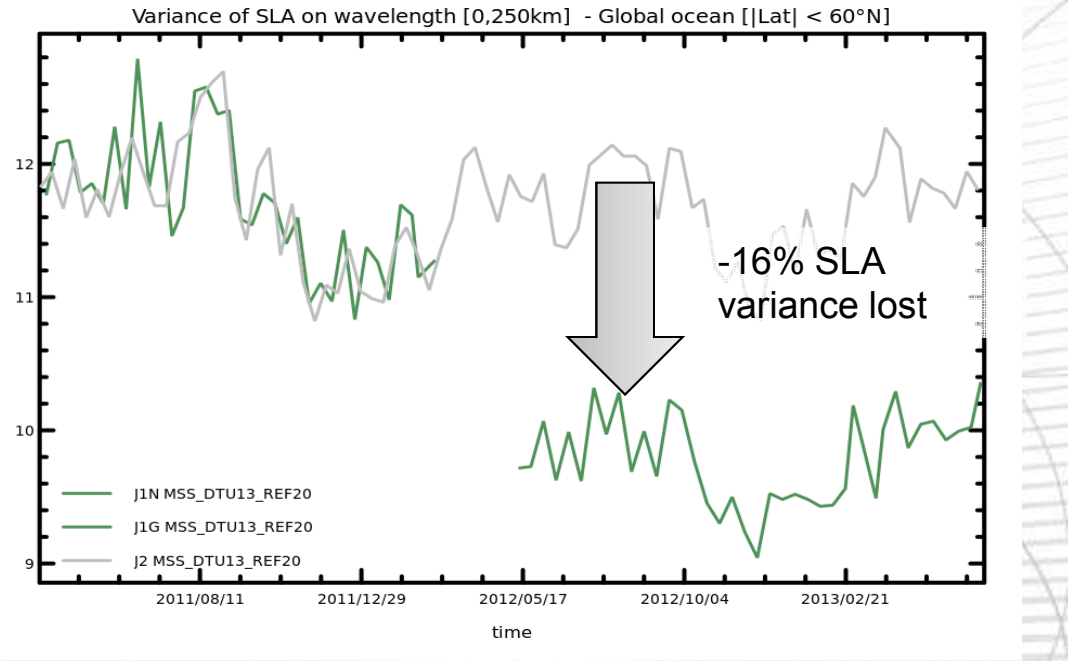
SLA analysis along J1N & J1G tracks: **data ingested in the latest MSS estimation**



MSS_DTU13:

- Loss of SLA variance for wavelength <250km]: -16% (~-1.4 cm rms)

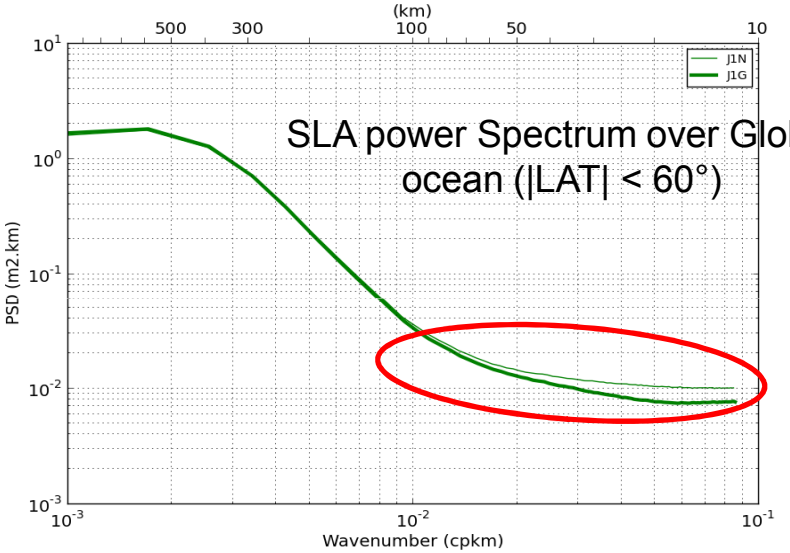
➔ Commission errors suspected: part of the ocean variability and measurement short wavelengths errors observed with J1G are introduced in the MSS



J1G Vs J1N analysis

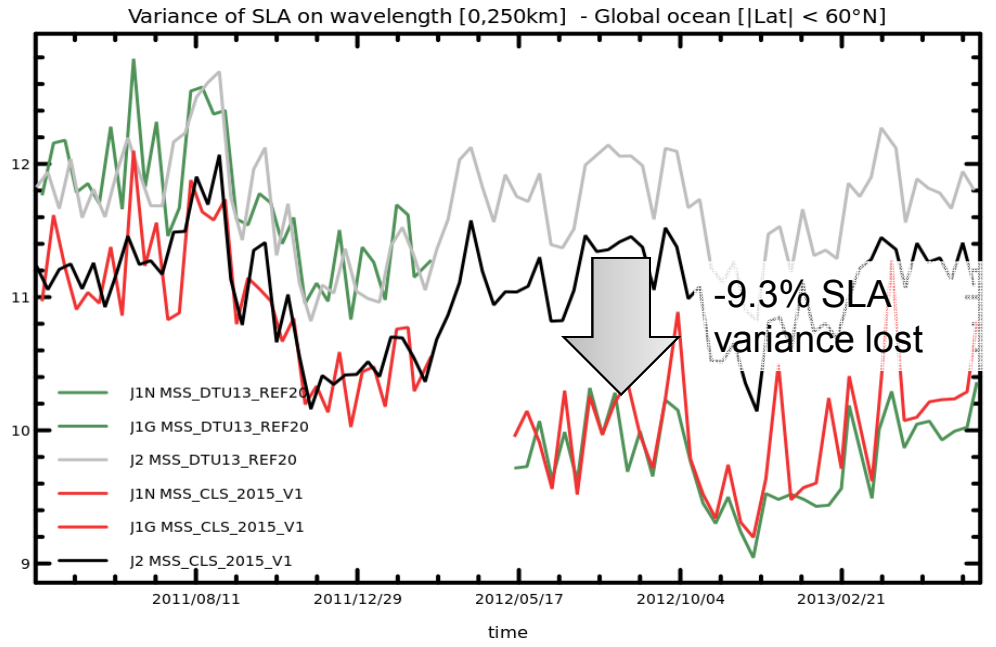
MSS_CNES_CLS15 used
MSS_DTU13 used

SLA analysis along J1N & J1G tracks: **data ingested in the latest MSS estimation**



MSS_CNES_CLS15:

- Loss of SLA varianece for wavelength <250km]: -9.3% (-1 cm rms)



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Conclusions

❑Altika drift gives us the great opportunity to characterize the MSS error increase according to the distance to the repetitive ground-track positions
=> MSS_CNES_CLS11 : **increase of the MSS Err according repetitive ground-track distance : +4.2 mm rms/km**

❑**Strong improvement with recent MSS**
=>MSS_CNES_CLS15 (vs MSS_CNES_CLS11): omission error reduced by ~90% for scales 200-40km
=>Geodetic missions used in these recent solutions **largely contribute to improve the MSS precision** outside of the repetitive ground-track
=>Need of geodetic mission, with good performance at small scales to improve the small scales of the MSS: **=>Recommendation for a drifting Altika phase**

❑**Inclusion of geodetic missions in MSS is crucial but the ocean variability remains an issue for those data**
=>MSS_CNES_CLS15 & MSS_DTU13: significant loss of signal at wavelengths < 250km : commission errors signature