
SARAL Project Status
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# Major events since last OSTST (October, 2015)

- **July 2016 : New mission phase SARAL-DP**

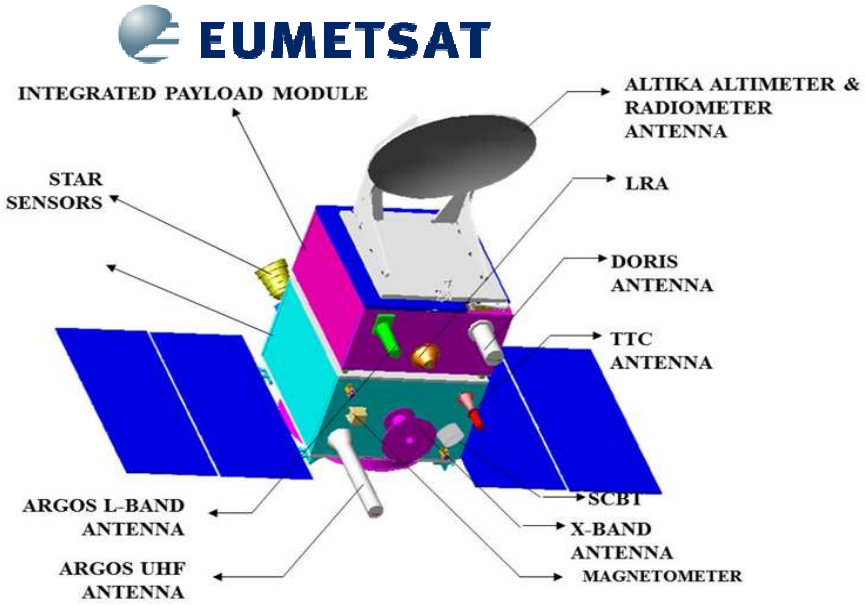
- Satellite major events
  - concerns about station keeping (ground track maintainance)
  - + 1km sma increase before to start the DP phase
  - concerns about  RW stiction/friction

- Payload major events
  - None

- Ground major events
  - Better X-Band antenna availability : new antenna in Inuvik

**Current SARAL-DP mission Status is OK**

# Platform Status




The SARAL satellite bus is **OK**

- Command / control , RF : **OK**
- Thermal aspects : **OK**
- Electrical aspects : **OK**
- AOCS (attitude and orbit control system) : **OK**

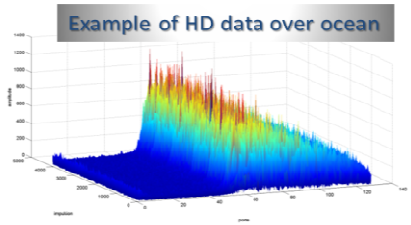
  with some concerns on reaction wheels

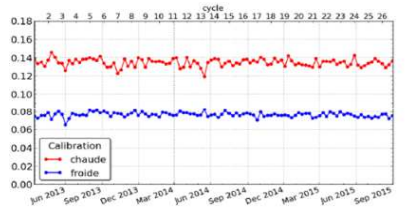
**SARAL bus is operational after 3,5 years in orbit**

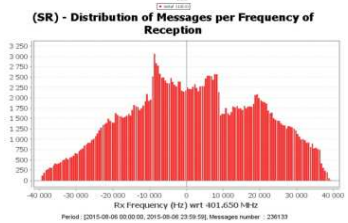
# Payload Status since last OSTST (October, 2015)

- 100% available
  - **AltiKa** **OK**
    - routine calibrations PTR, LPF
    - quarterly CNG calibrations $I^2+Q^2$
    - specific calibrations over sea & ice (HD mode)
  - **Radiometer** **OK**
    - Very good stability & sensitivity
    - 6 March, 15 May & 6 August : temporary radiometer K band saturation over South Africa due to weather radar
    - 29 August : same, over Hamburg (Germany)
  - **DORIS** **OK**
    - Nominal
  - **ARGOS** **OK**
    - Nominal; performance similar to other satellites

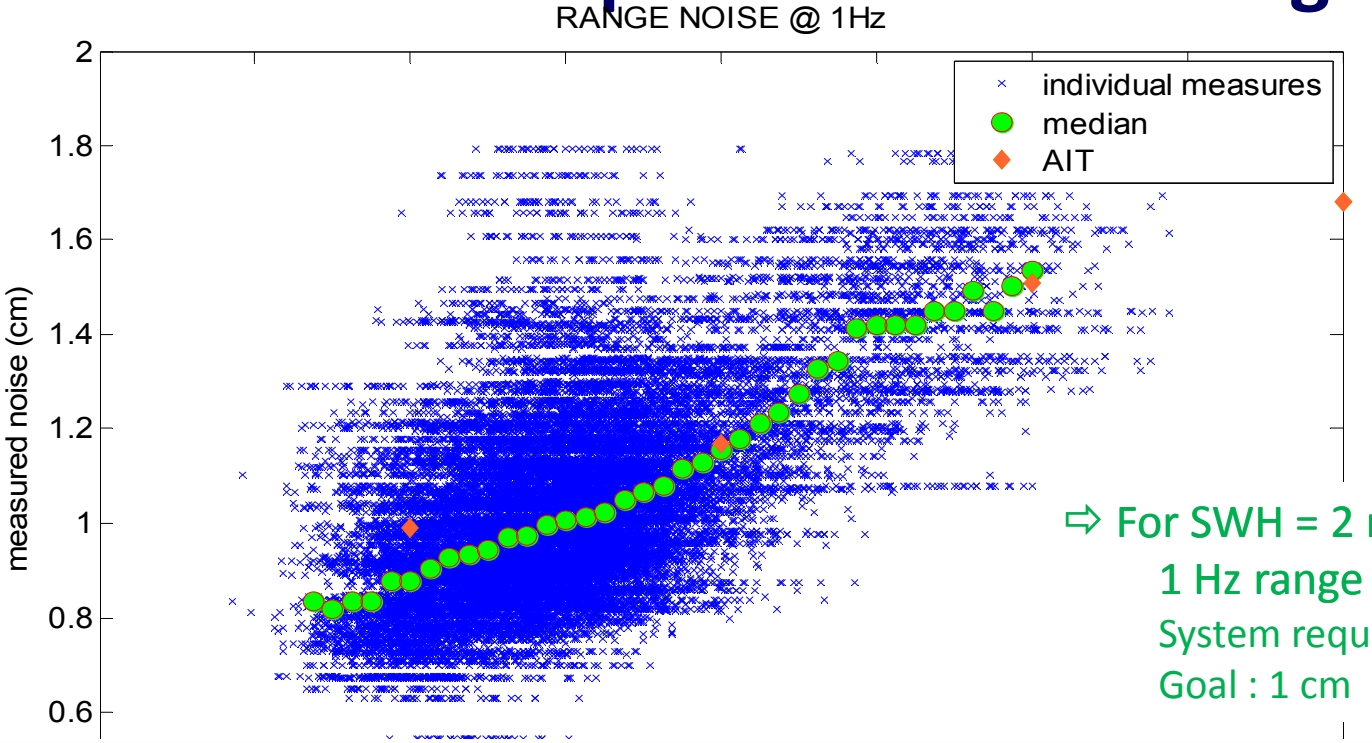
➔ **fully OPERATIONAL**



# Altimeter performances – range noise




⇨ For SWH = 2 m

1 Hz range : 0,9 cm

System requirement : 1,5 cm

Goal : 1 cm

| Altimeter parameter | Specifications | Measured on ground | In flight data |
|---|---|---|---|
| 1 Hz range | 1.5 cm | 0.9 cm | 0.9 cm |
| 1Hz SWH | 6.3 cm | 5.7 cm | 5 cm |
| 1 Hz Sigma0 | 0.2 dB* | N/A | 0.012 dB |

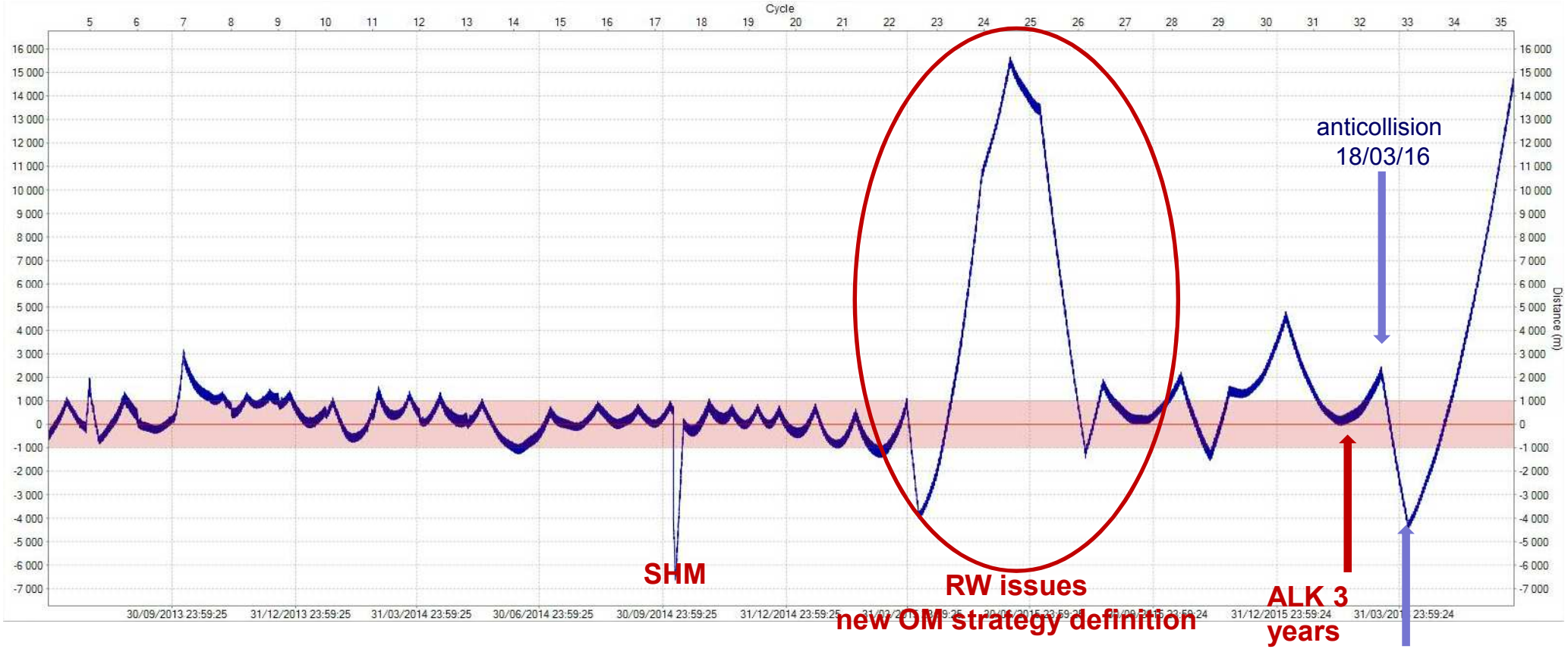
# Ground & Operations - Status and performances

- Earth terminals :
  - ISRO band-S (Bangalore, Lucknow) **OK**
  - ISRO band-X (Shadnagar) **OK**
  - CNES band-X (Kiruna and Inuvik) **OK**

- Control Centers :
  - ISRO/ISTRAC Control center **OK**

- Instrument Commanding and Monitoring Centers :
  - SSALTO for Altimetry **OK**
  - ARGOS PC for ARGOS **OK**

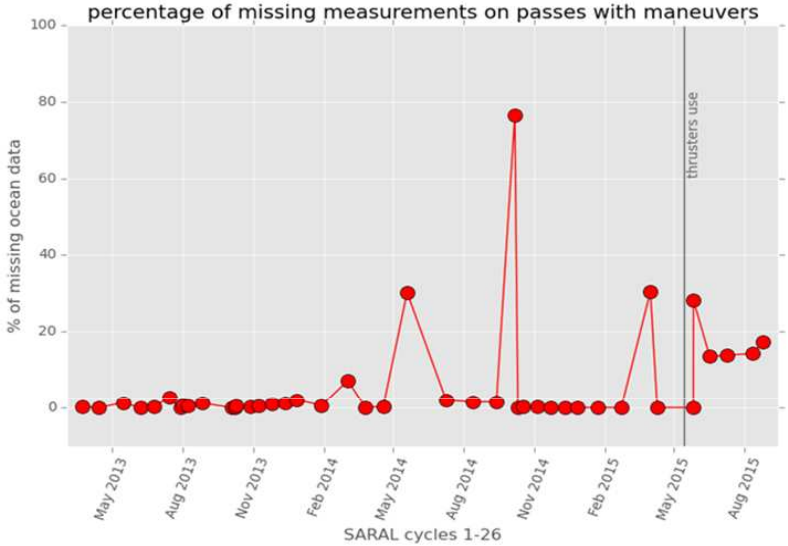
# SARAL Drifting Phase




Before March 2015, 90% of time in the ground track

# SARAL Drifting Phase history

- Since March 2015, maneuvers with thrusters in place with concerns for OPS team, altimetry, ARGOS
- October 2015 : 2 recommendations from the OSTST
- 25 February 2016 : SARAL/AltiKa 3 years in orbi

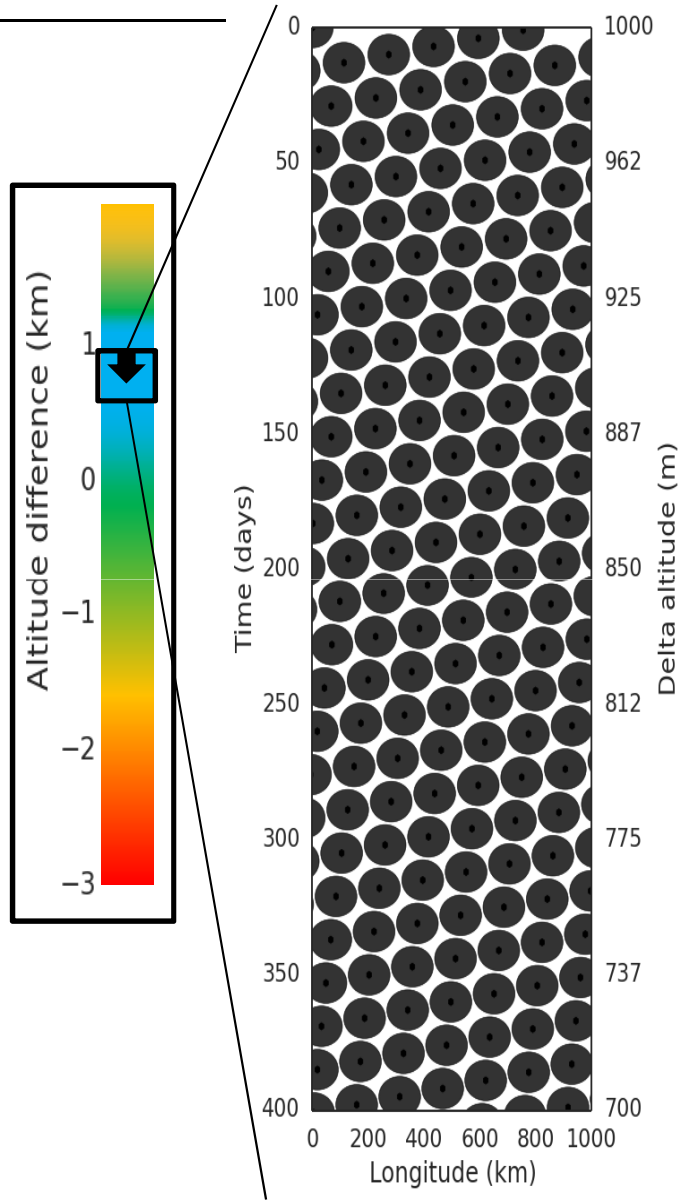



- Early 2016 : CNES study for determining the optimum orbit
- April 2016 : ISRO and CNES decide to implement a new phase for SARAL – **SARAL Drifting Phase**
- **4 July 2016 : start of the new phase**

# WHY INCREASE THE ALTITUDE ?

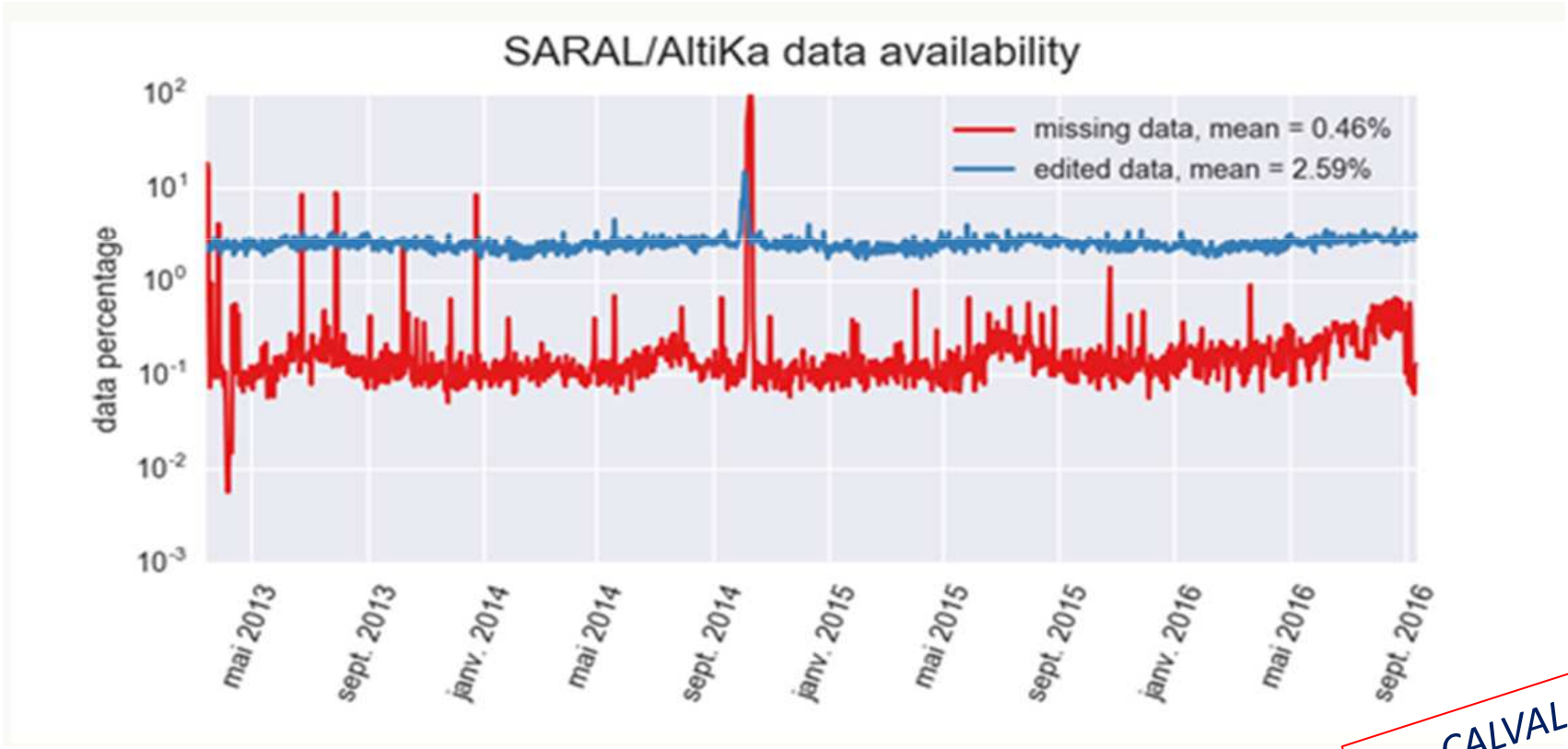
- No overlap between circles
- Excellent balance between space and time
- Altimeter tracks are well positioned thanks to the 16-day sub-cycle

➡ Mesoscale sampling is **excellent** for at least 3 years



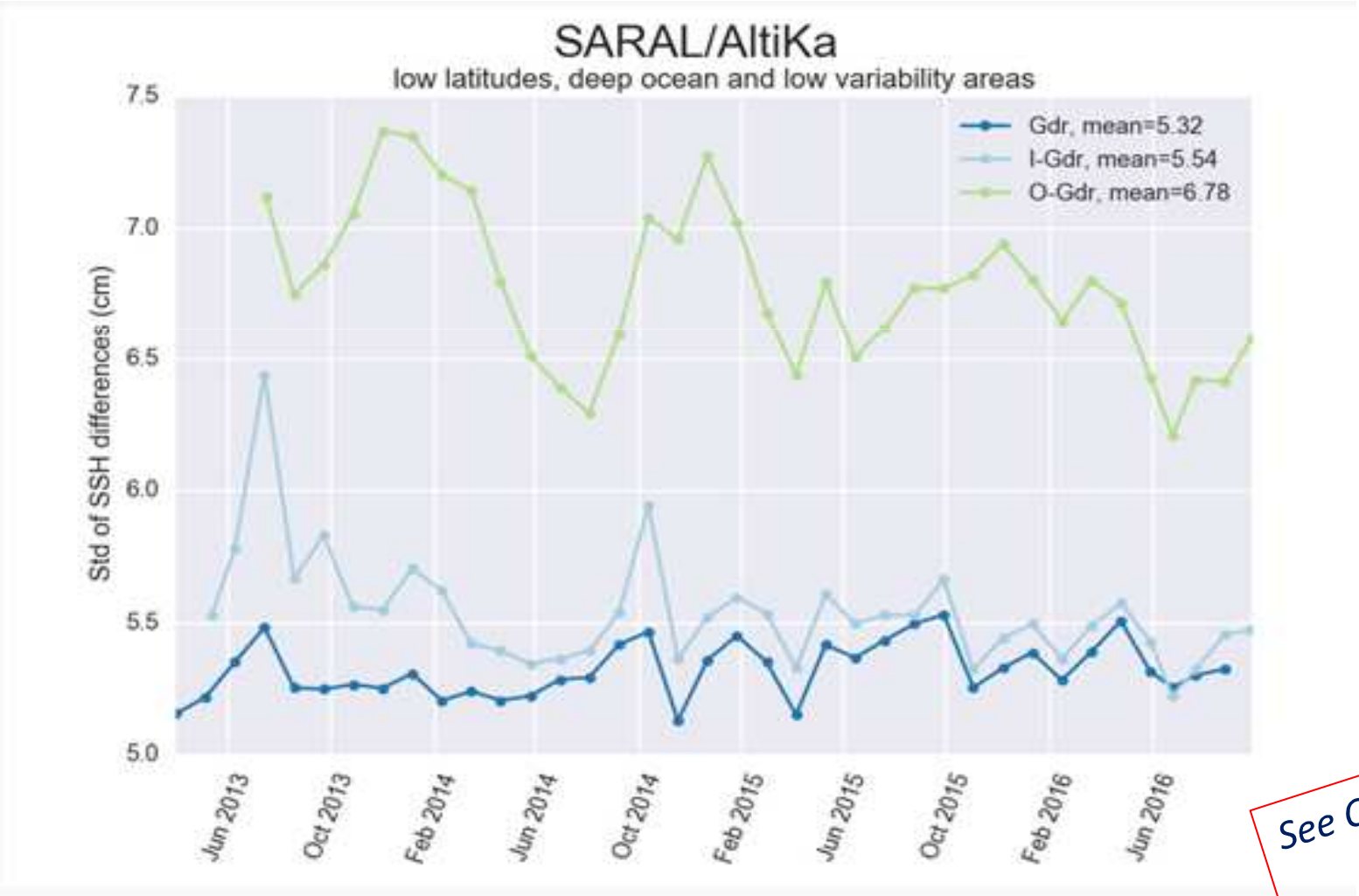
# Performances : Data availability – ocean only

- Exceeds mission requirements : **99.5%**




See CALVAL poster CVL-015

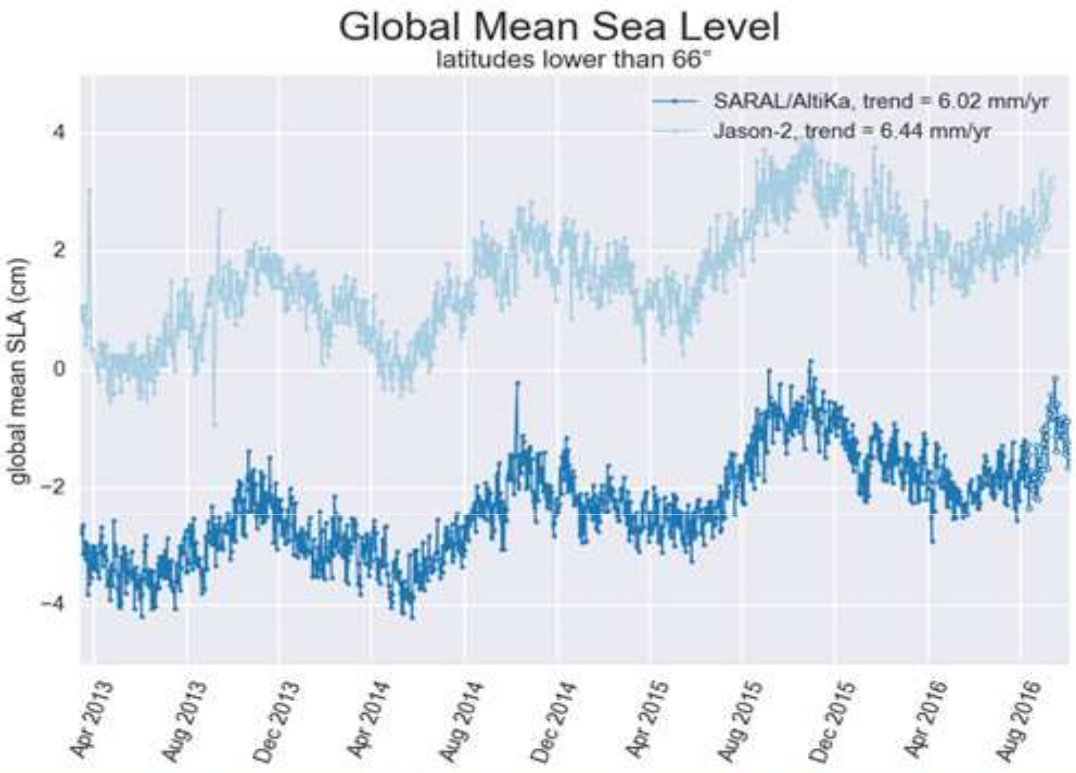
# Performances : Xover - 5.32 cm for GDRs



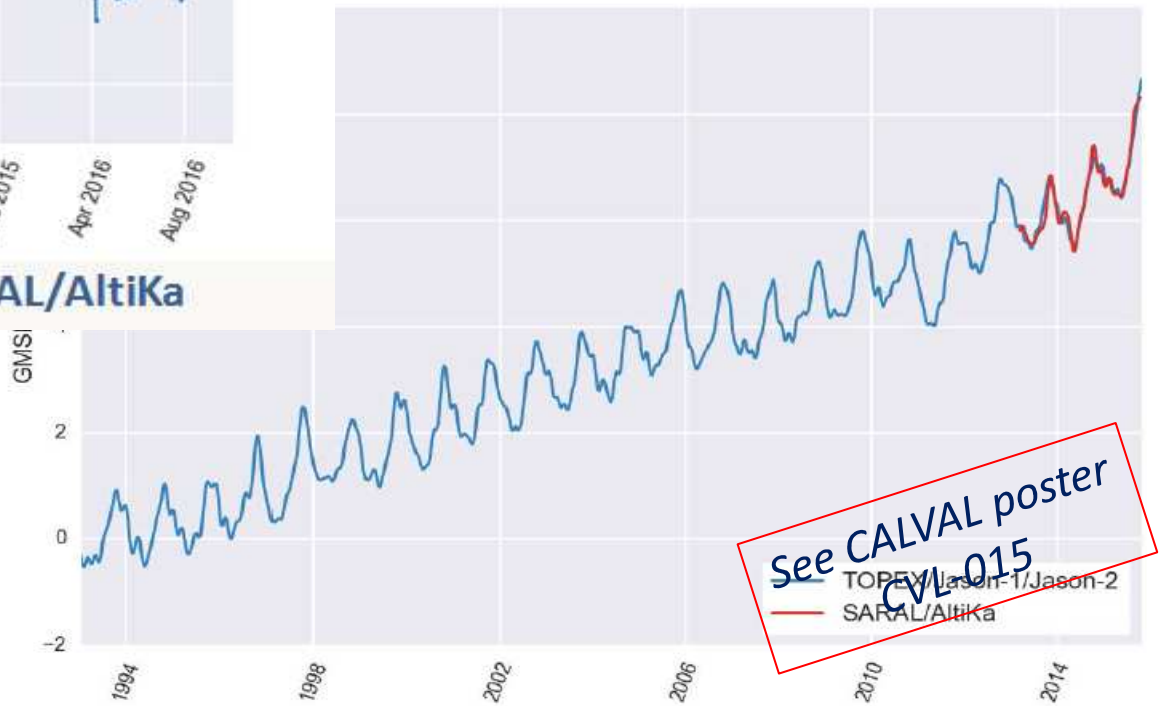

See CALVAL poster CVL-015

# Mean Sea Level

same pattern than Jason-2




GMSL records for Jason-2 and SARAL/AltiKa

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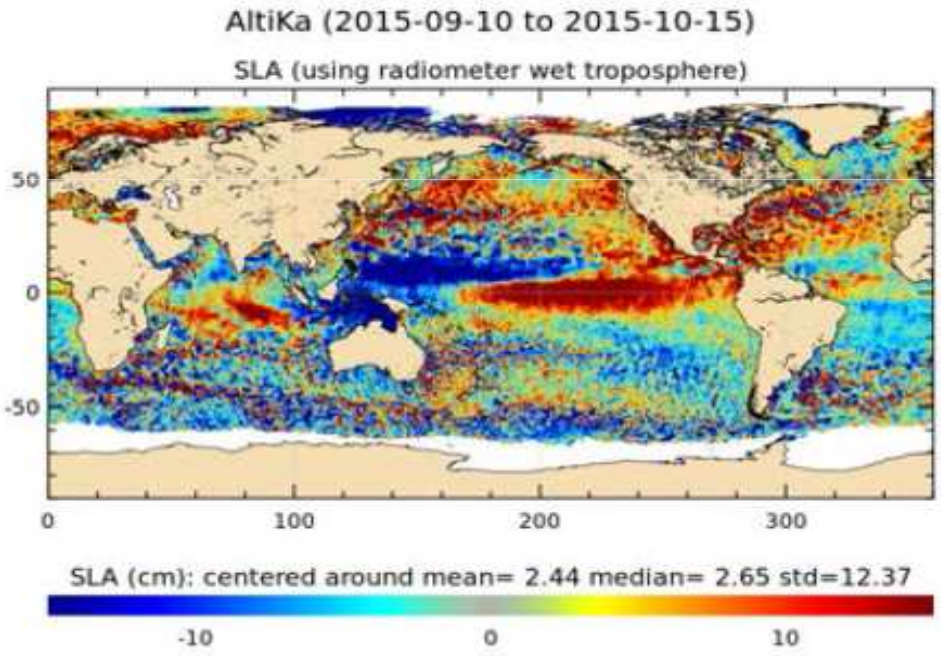
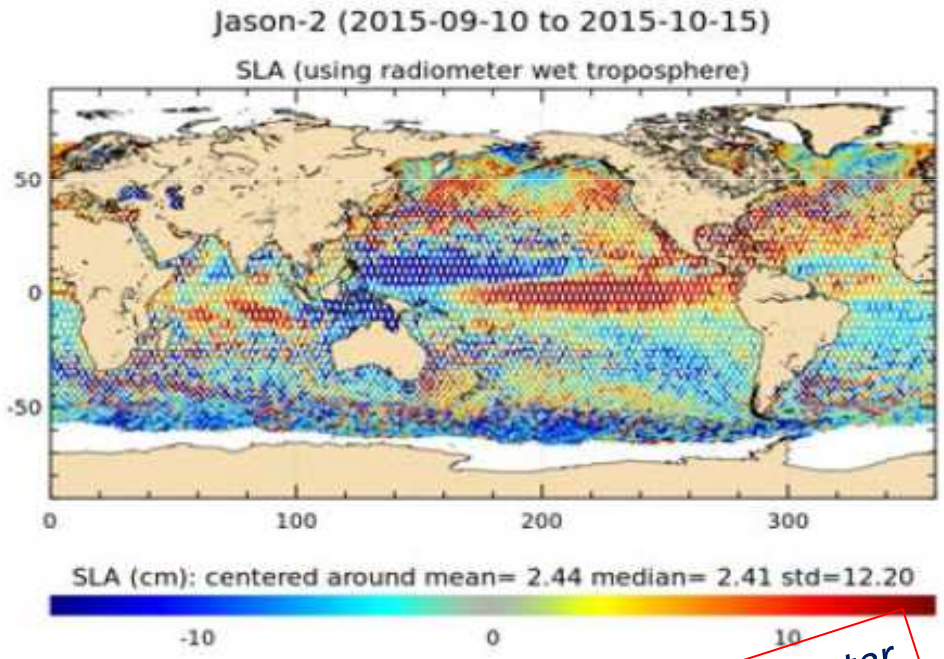
# Sea-level anomaly performances (Altika vs Jason-2)

Very limited differences; Good agreement



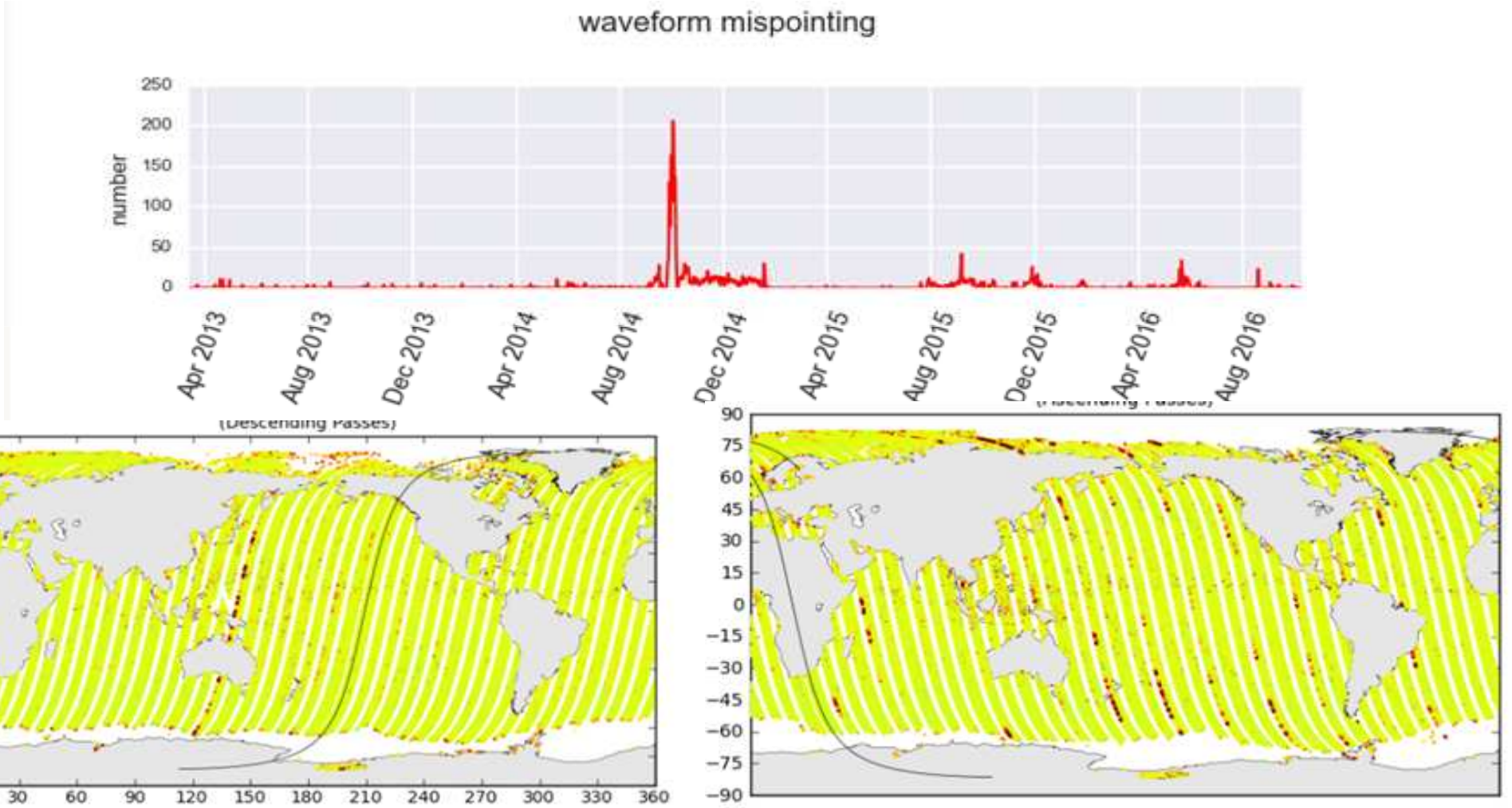




See CALVAL poster CVL-015

# products latency

| Product | Requirement | Effective performance for REVEX period | | |
|---|---|---|---|---|
| | | Revex#1 | Revex#2 | from 1/10/2015 to 30/9/2016 |
| OGDR | 75% ≤ 3 hours<br>95% ≤ 5 hours | 97% <3 hours[1]<br>97% <5 hours | 97.6% < 3 hours<br>98% < 5 hours | 97% < 3 hours<br>99.3% < 5 hours |
| IGDR | < 3 days<br>(objective : 1 or 1,5 days max) | 95,65% < 1,5d<br>99,7% < 3d | 97,18% < 1,5d<br>99,61% < 3d | 97,05% < 1,5d<br>99,5% < 3d |
| GDR | ~40 days | compliant for 9 cycles over 12 | compliant<br>(average: 35 days) | compliant<br>(average: 34 days) |

# Still some issues with nadir pointing



# System Requirements and Performances

from October 2015 until October 2016

⇒ **satellite unavailability** **~0 %** **< 4% req**

- bus : 0% altimeter : 0% Doris : 0% radiometer : 0%

⇒ **ground unavailability** **~0 %** **< 1% req**

## ➔ Global SARAL system availability : 99.7 %

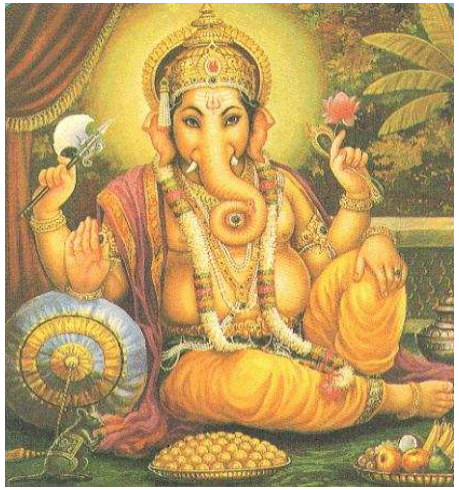
**NB : GDR data availability vs theory (from 2015 annual CALVAL report)**

**All surfaces : 96.7 %**

**Over Ocean : 99.5 %**

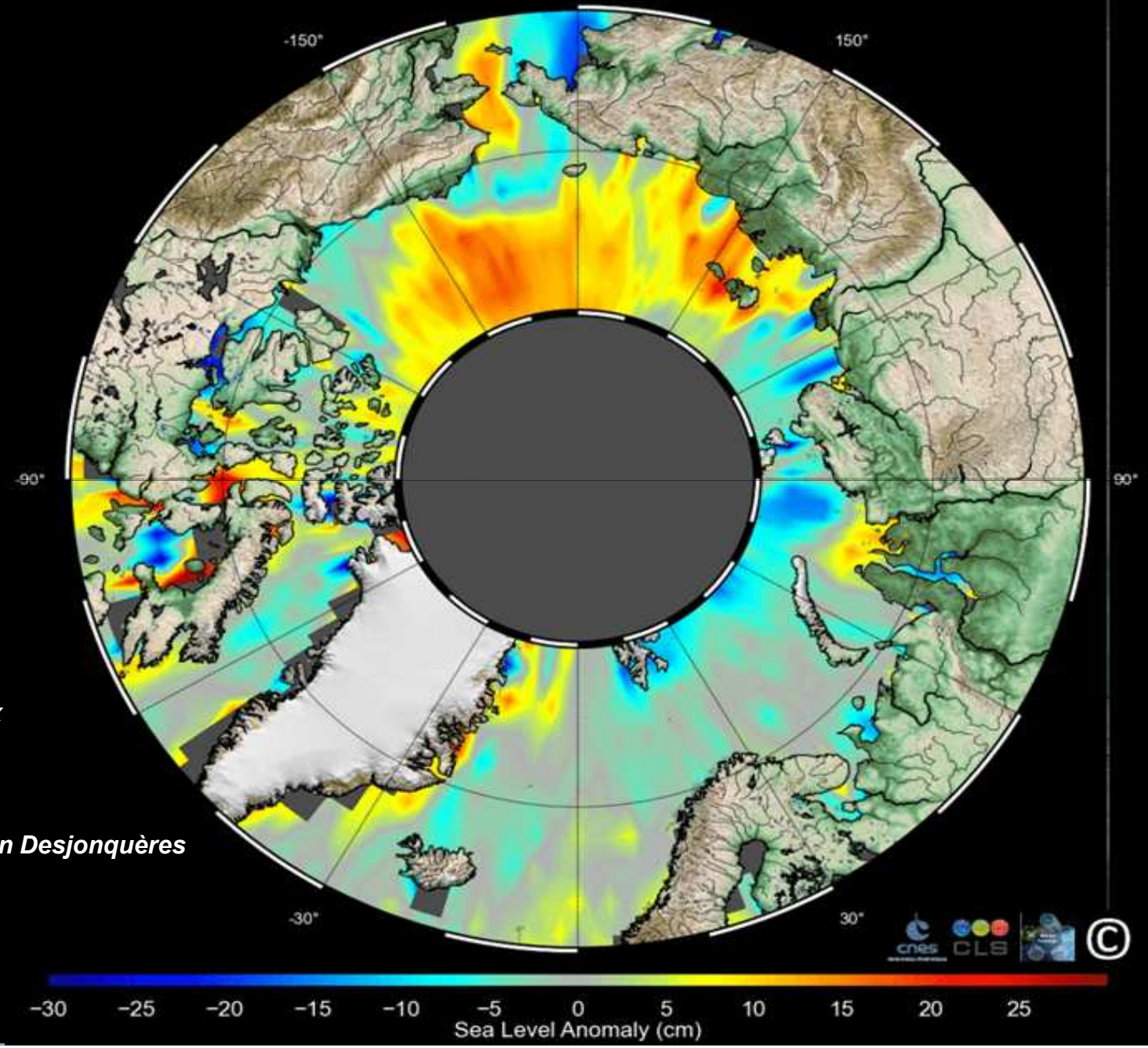
# Conclusion

- SARAL satellite is performing well
- AltiKa and ARGOS performances are excellent
- ISRO and CNES have implemented the 2015 OSTST recommendations
  ➔ Drifting Phase since July 2016
- Mission extension process for period [2018-2019]



***Thank you  for your attention and ….. and also to the contributors !!***

- *ISRO team*
- *EUMETSAT team*
- *CNES Team*
  - ***S. Mazeau***
  - ***D. Delacroix***
  - ***N. Steunou***
  - ***I. Denis***
  - ***N. Picot***
  - ***Jean-Damien Desjonquères***
  - ***F. Didelot***
- *CLS team*



# Backup slides

# New scenario

- **After REVEX #2, CNES has lead a dedicated study. It confirms the scenario proposed in October ➔ move to a drifting orbit**

- **Oceanography (mesoscale)**

**Stopping maneuvers on SARAL will not degrade the sampling for 3 years**
**Recommended to stay within [-0.9 km, +1.2 km] of current altitude**
**Recommended to increase the altitude by 1 km before the drifting phase**
**No benefit in a maneuver after the drift starts**
**Results are the same for all values of solar activity**

- **Geodesy**

**Uncontrolled drift provides a random sampling (decent but suboptimal)**
**Performing maneuvers (even 1/year) is highly undesirable**
**Results are the same for all values of solar activity**

- **Link between both applications**

**Short term:** leaving the 1km control band increases SLA error budget (undesirable but not a showstopper on ocean)

**Long term:** using a drifting orbit helps improving MSS models along uncharted tracks (e.g. SWOT, Sentinel-3, CFOsat)

# SARAL 35 days orbit
# Influence of sub-cycles on mesoscale sampling

- Altimeter tracks are displayed in the space / time plane (black dots)
- The circle around each dot is the region and period where the track is useful for mesoscale monitoring (correlation > 0.5)
- Sub-cycles control the circles alignments (here 3, 16 and 19 days)
- Good mesoscale sampling:
  - Minimizes the white areas (unsampled regions/periods)
  - No overlap between circles (information is not duplicated)
- Bad mesoscale sampling:
  - Circles overlap in space or in time (information is duplicated)

**Longitude of SARAL tracks at 30°N as a function of time**