Jason-2 “Extension of Life” phase: best orbits for Geodesy and Oceanography

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Introduction: an « Extension of Life » for Jason-2

- Jason-2 is 7 years old and performing (very) well
- Still an increasing risk of onboard failure due to ageing
- Need to protect the TOPEX orbit for follow-on missions
- If the risk to lose control of Jason-2 is too high, it will be moved to an “Extension of Life” orbit (like Jason-1)

but

- We cannot use the Jason-1 GM orbit again

Purpose of this talk

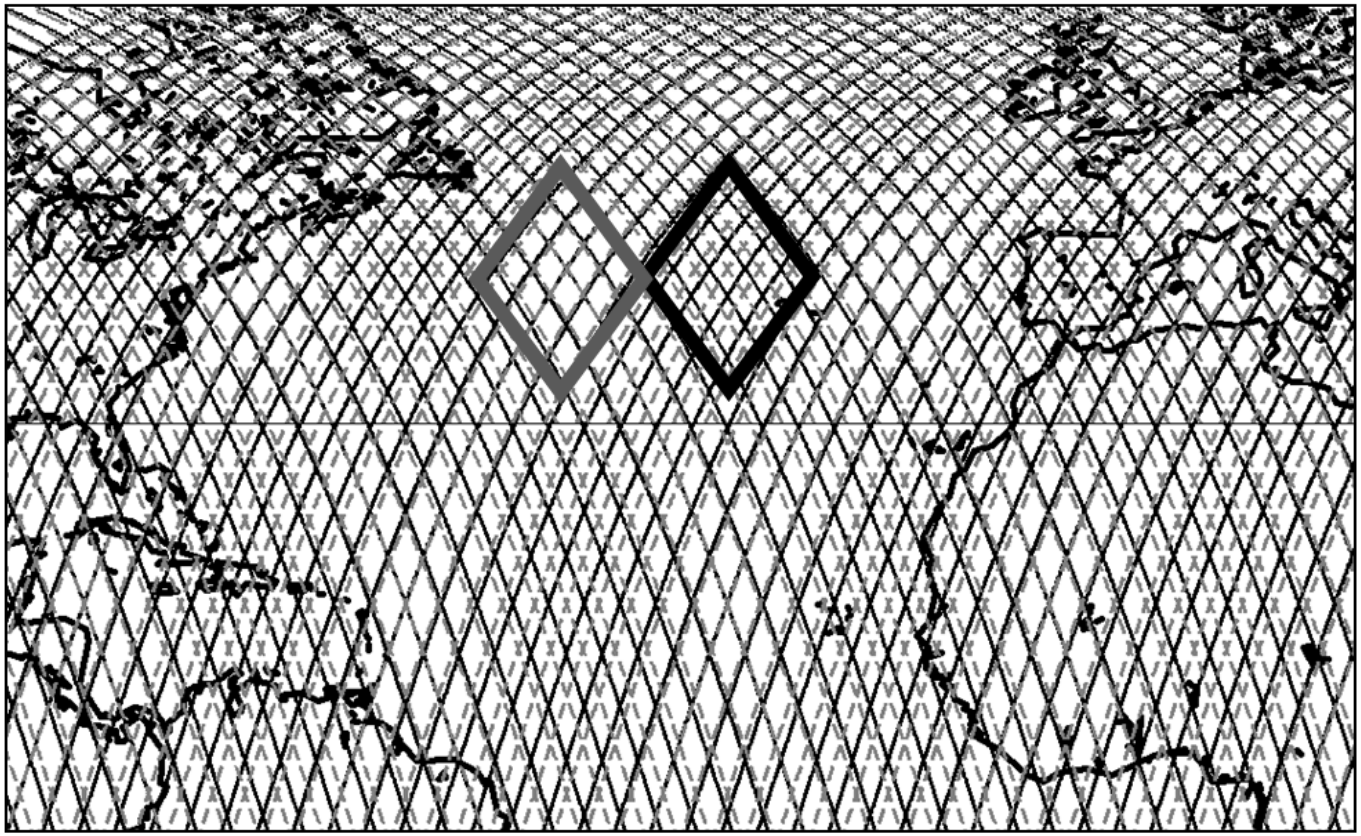
➡ How to select desirable EoL orbits for Jason-2 ?

Context: drifting EoL orbits

Dibarboure et al (2012). Finding desirable orbit options for the “extension of life” phase of jason-1. *Marine Geodesy*, *35*(sup1), 363-399.

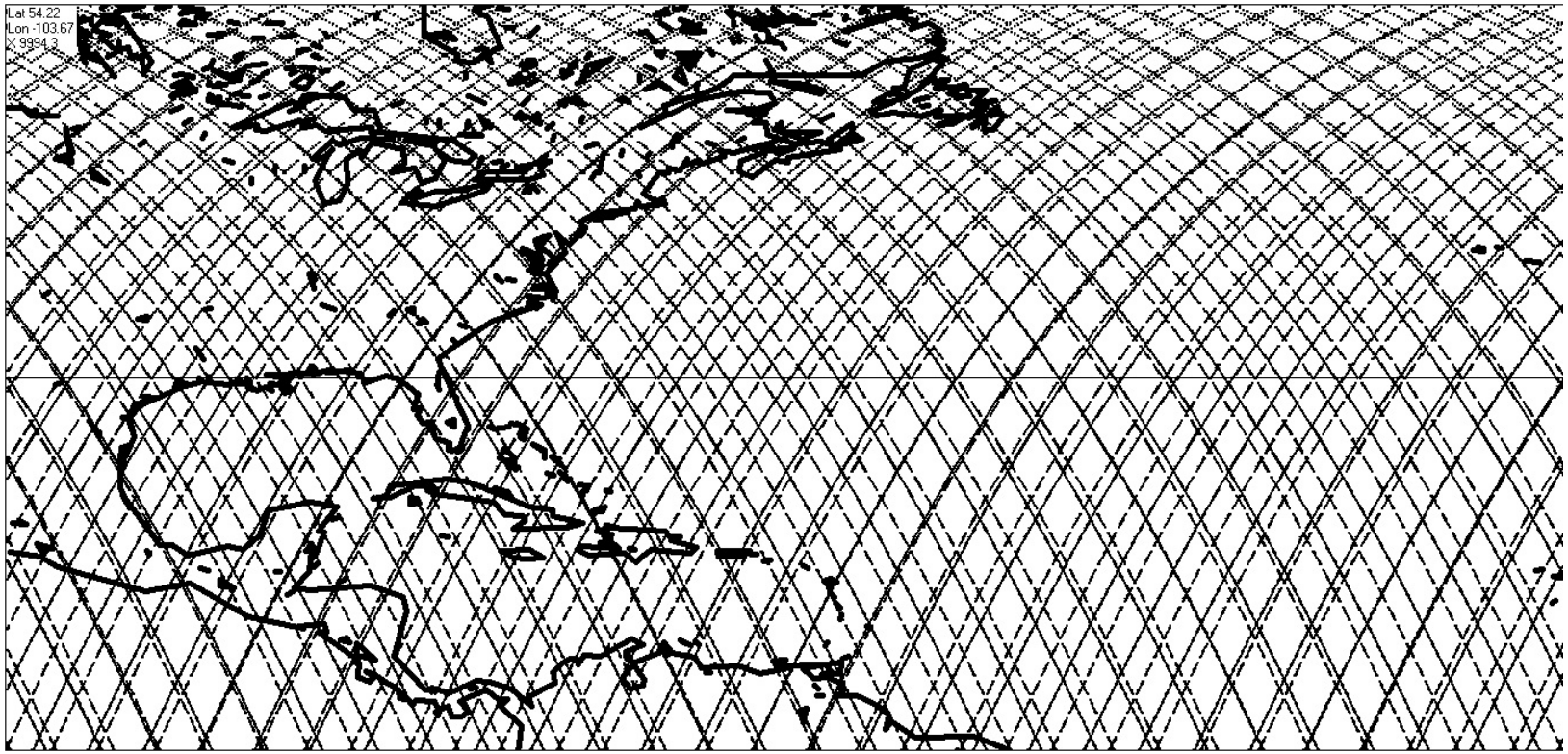
Breaking the interleaved configuration

- Interleaved sampling is optimal for mesoscale and sea state
- Any other orbit generates sampling loss (25~30% duplication)
- Geographically variable (Moiré patterns)



Breaking the interleaved configuration

- Drifting orbits have a very long repeat cycle
- Moiré patterns move around in a cyclic way (J1GM below over 40d)
- Geometry of patterns and travelling speed can be wildy different



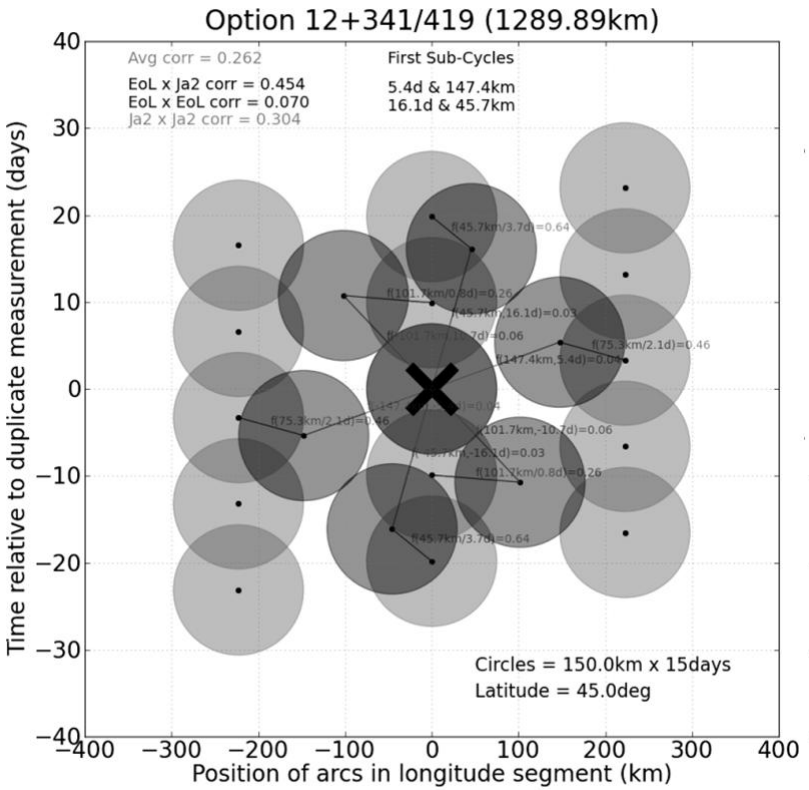
Jason-2 (plain) and Jason-1GM (dashed) tracks over 4 subsequent periods of 10 days

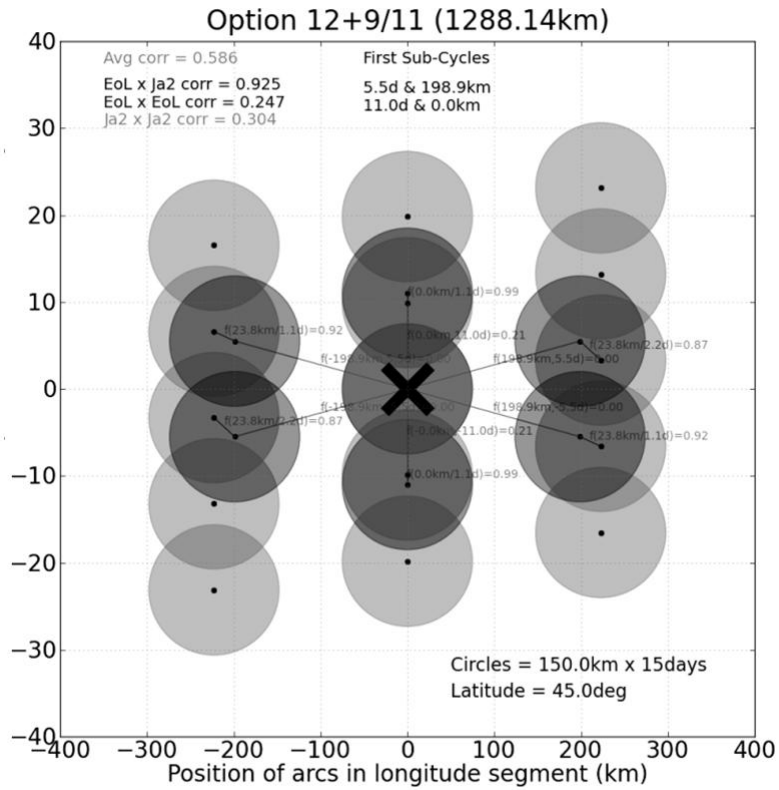
Strategy used for Jason-1

Dibarboure et al (2012): Finding desirable orbit options for the “extension of life” phase of jason-1. *Marine Geodesy*, *35*(sup1), 363-399.

Goal #1: minimize sampling loss

- Duplication between both altimeters is bound to happen sometimes
- Good orbits (for mesoscale or sea state) avoid systematic duplication



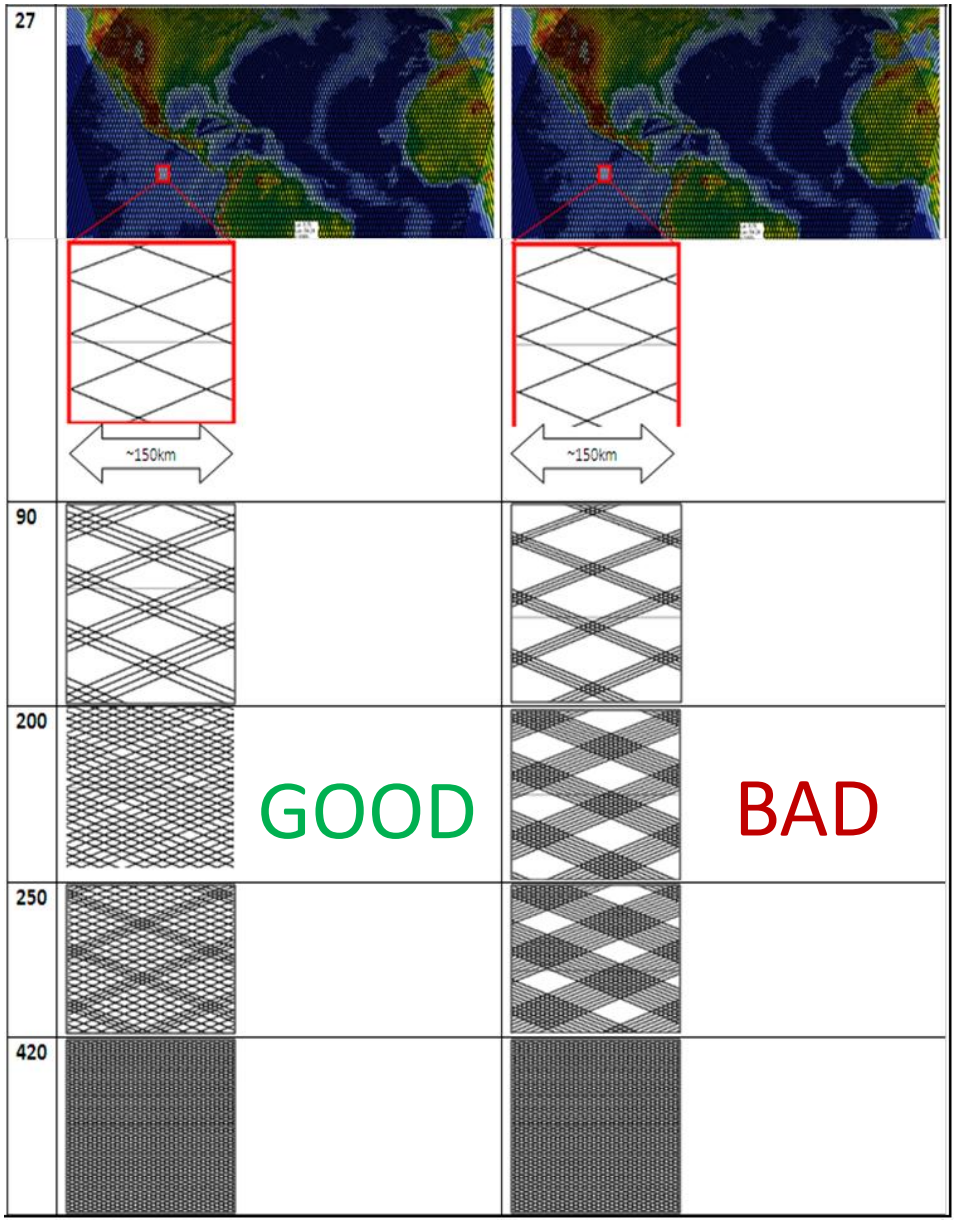


GOOD: Duplication limited near overlap

BAD: Systematic duplication for 40 days

Goal #2: collect a good geodetic dataset

- Exact repeat is lost so the best option is to use a drifting (geodetic) orbit for bathymetry or mean sea surface models
- Orbit repeat cycle should be 1 year or more (7 km grid)
- Desirable to have intermediate sub-cycles (120-180days)
- If the satellite dies before a full cycle, a global coverage is still acquired (e.g. 15 km)

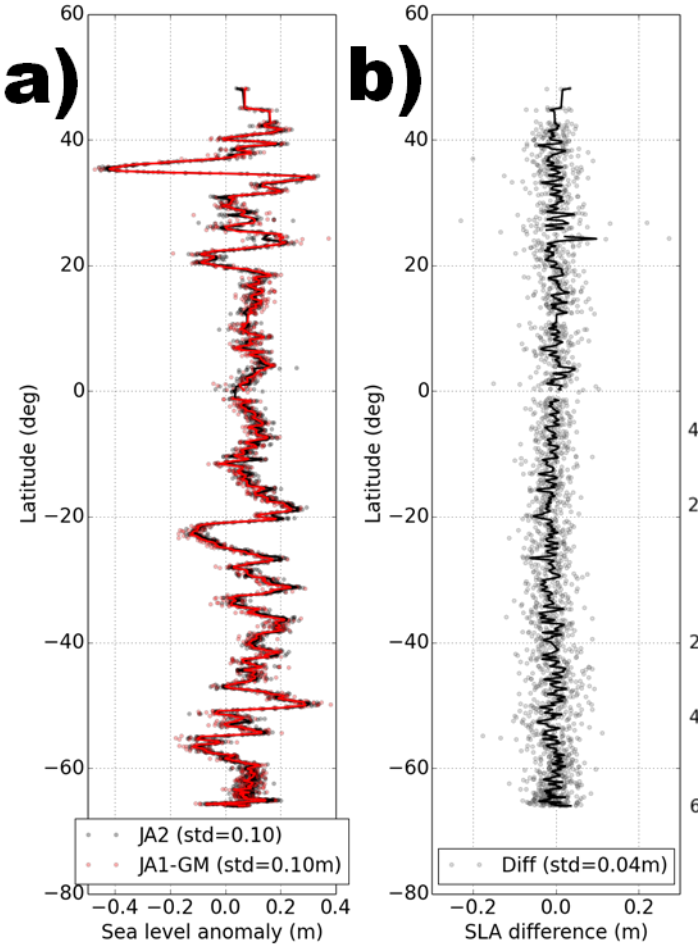


Strategy update for Jason-2

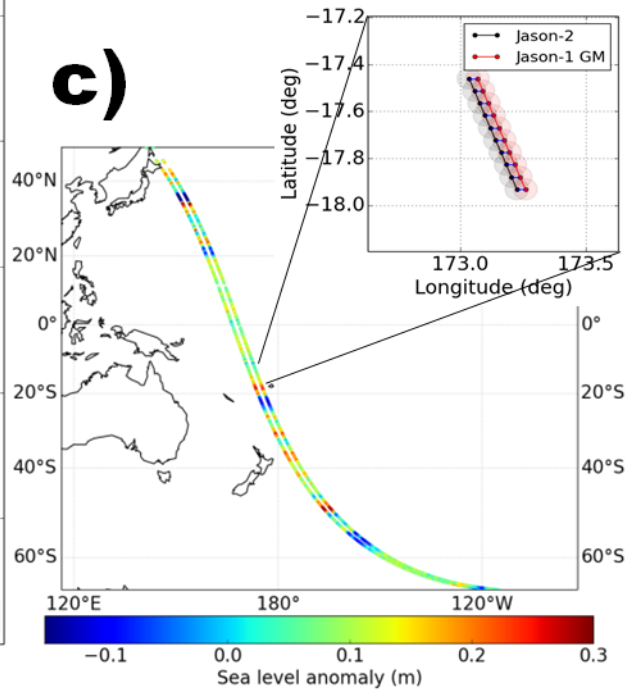
Dibarboure et Morrow (submitted to JTech)
More details in Poster

Jason-1 GM / Jason-2 overlap events

- Drifting tracks of Jason-1 GM sometimes align perfectly with Jason-2
- Lag between for 2 SSH profiles can range from 0 to 10 days or more

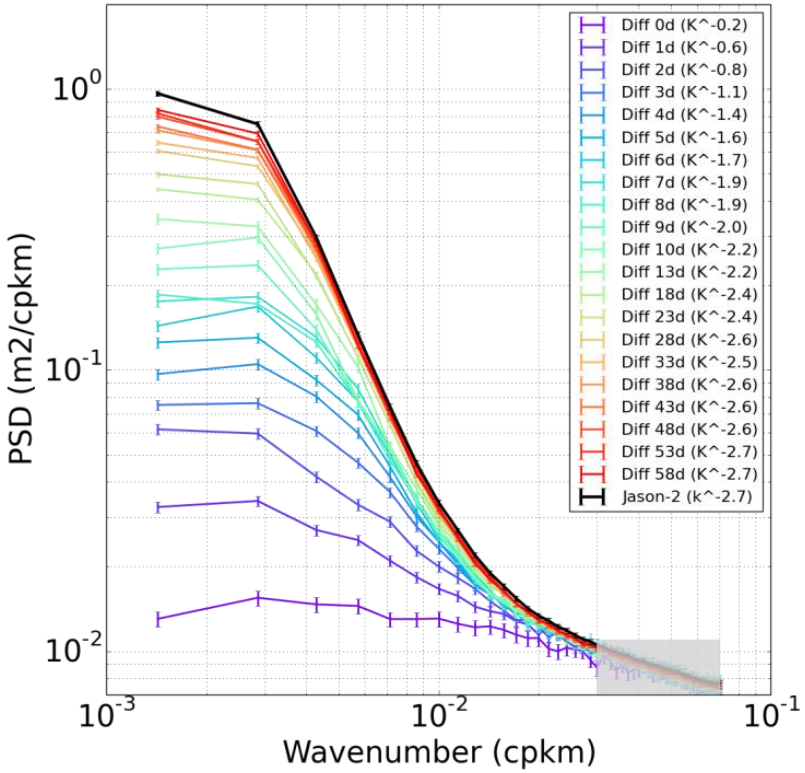


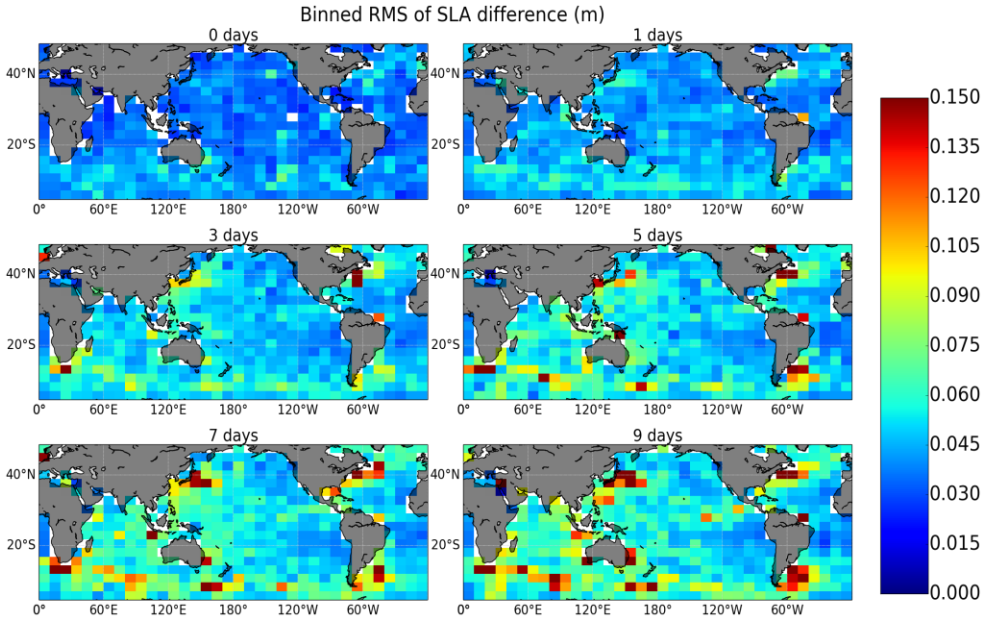
0-day overlap: the difference is 1 Hz altimeter noise



Value of overlap events to study rapid oceanic changes

- 1200 overlap events for dx < 10 km and dt < 10 days
- When the lag increases from 1 to 10 days, rapid oceanic changes can be observed in the difference
- First results are very encouraging (see poster)



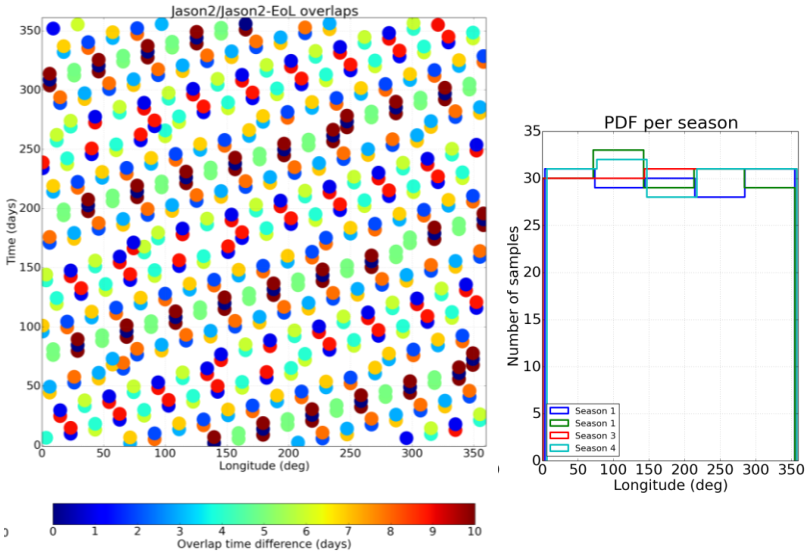


Strategy update for Jason-2 EoL orbits

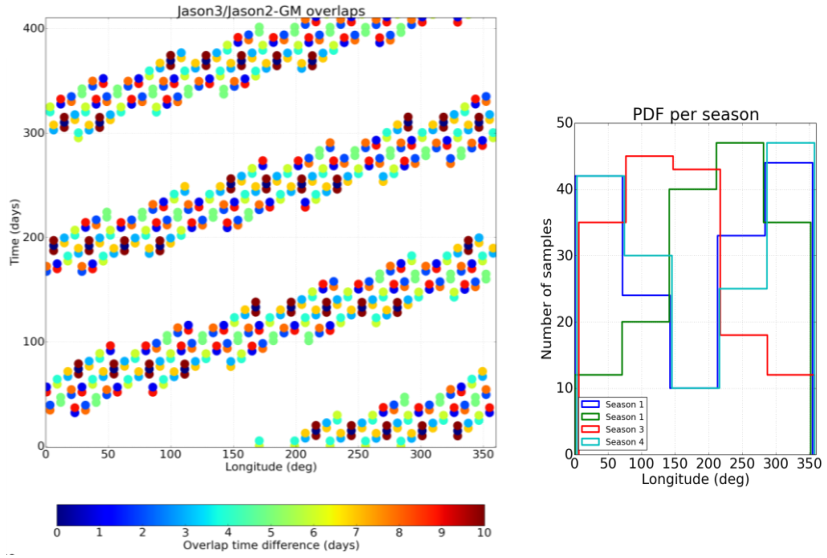
- A Jason-2 EoL phase will collect more overlap events with Jason-3

➡ Goal #1: Keep sampling and geodetic criteria from Jason-1 study

➡ Goal #2: Ensure overlap events with Jason-3 are well distributed in space and in time (all basins, all seasons, all time differences)



GOOD orbit: Overlap events are homogeneously distributed



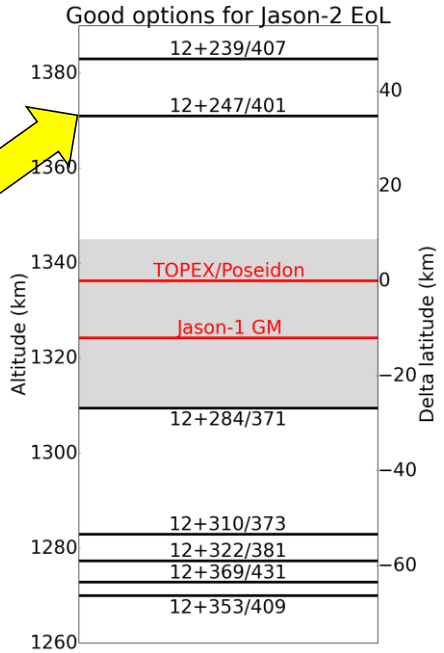
BAD orbit: Aggregation of overlapping tracks in certain basins/periods (skewed sampling)

Conclusions

Recommended orbits and conclusions

- 7 high priority orbits found
- Best contender: codename 12+247/401
  - 35km above Jason-3
  - Minimizes mesoscale sampling duplication
  - Good geodetic grid
- Gains (geodesy) and losses (mesoscale) of geodetic phase will be the same as for Jason-1

Priority	Revs per day	Sub-cycles
1	12+247/401	3, -5, 13, 138, 401
2	12+369/431	-7, -146, 431
3	12+353/409	-7, 22, -73, 168, 409
4	12+310/373	-6, -77, -148, 373
5	12+284/371	-4, 17, 81, 145, 371
6	12+322/381	-6, 13, -71, 155, 381
7	12+239/407	-2, 5, -17, -63, -172, 407



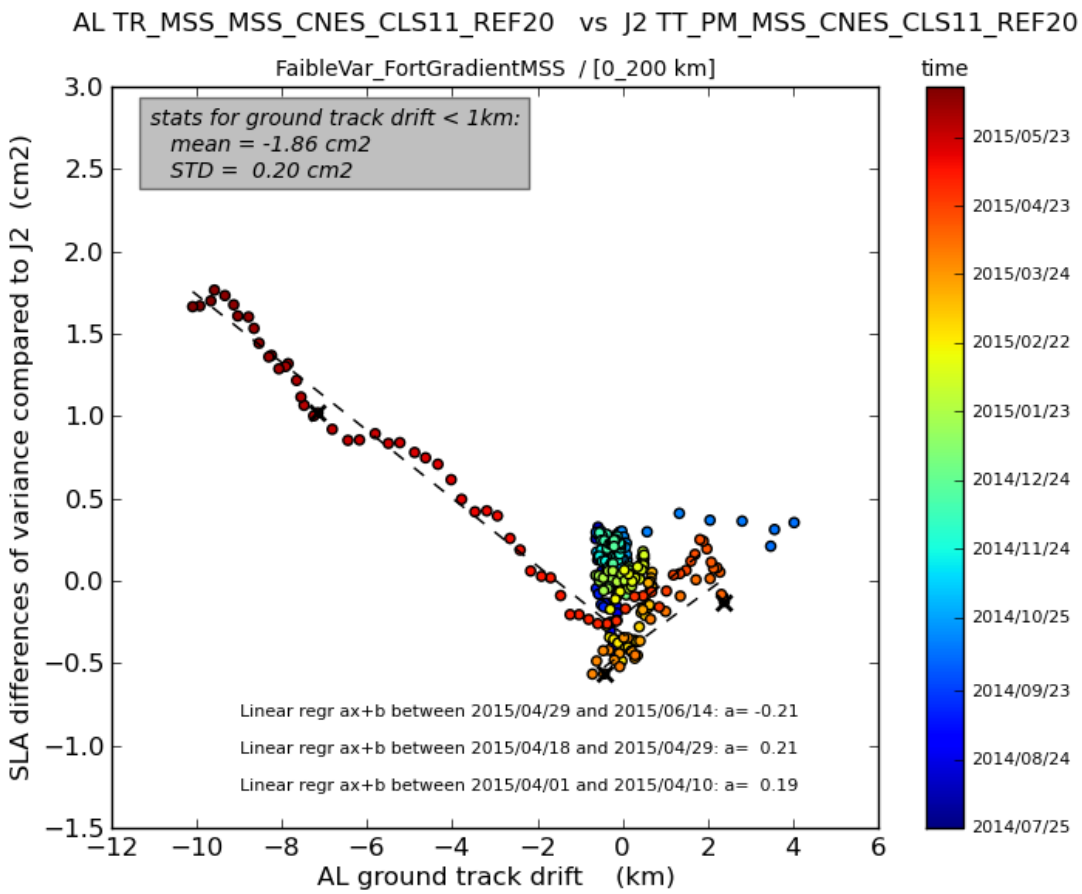
- Technical feasibility to put Jason-2 on these orbits is being investigated by ops team
- Next question for EoL group: <u>when</u> should the EoL phase start ?

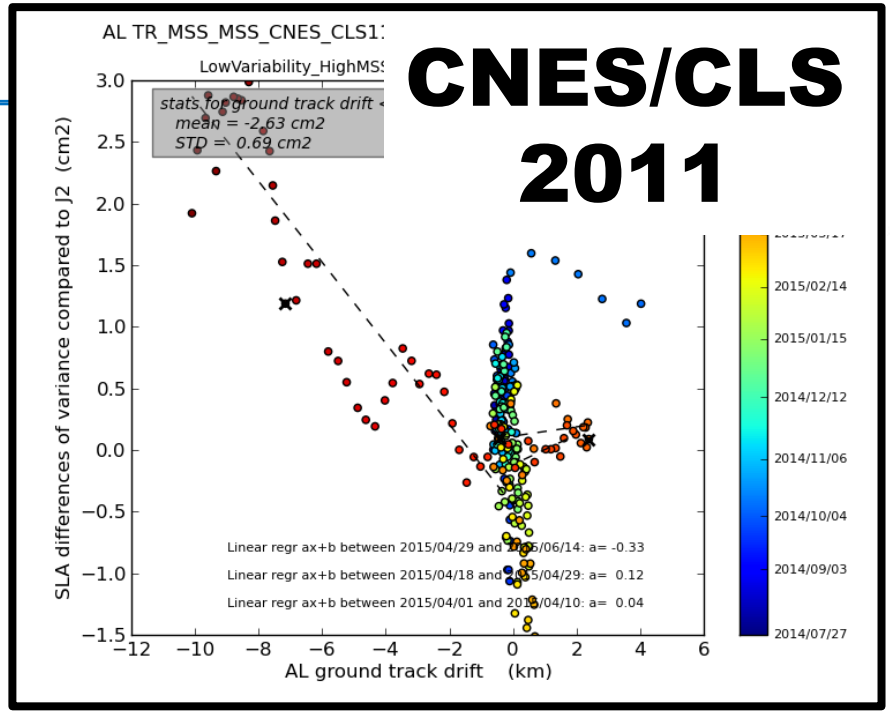

Thank you for you attention

Using an uncharted ground track

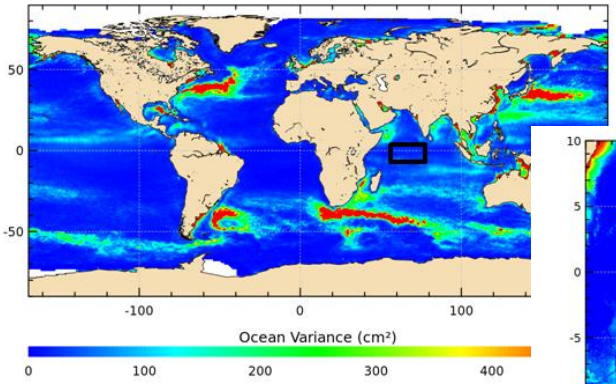
- Repeat track analysis and mean profiles cannot be used on EoL orbit
- Gridded mean sea surface (MSS) models must be used instead

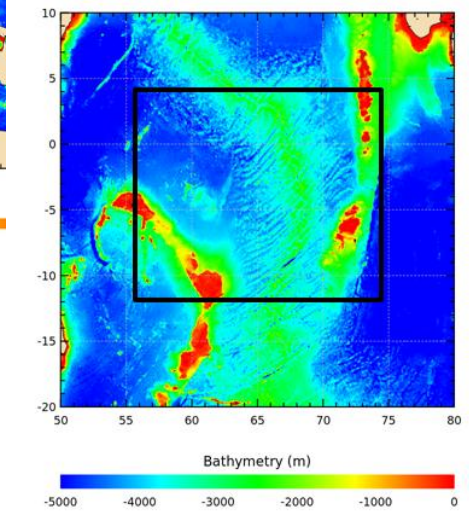
- Error increase of the order of 1-2 cm RMS
- Also observed when AltiKa drifted away from the ERS/ENVISAT track
- The error is smaller for recent/future MSS models based on Cryosat, Jason-1 GM… and Jason-2 EoL



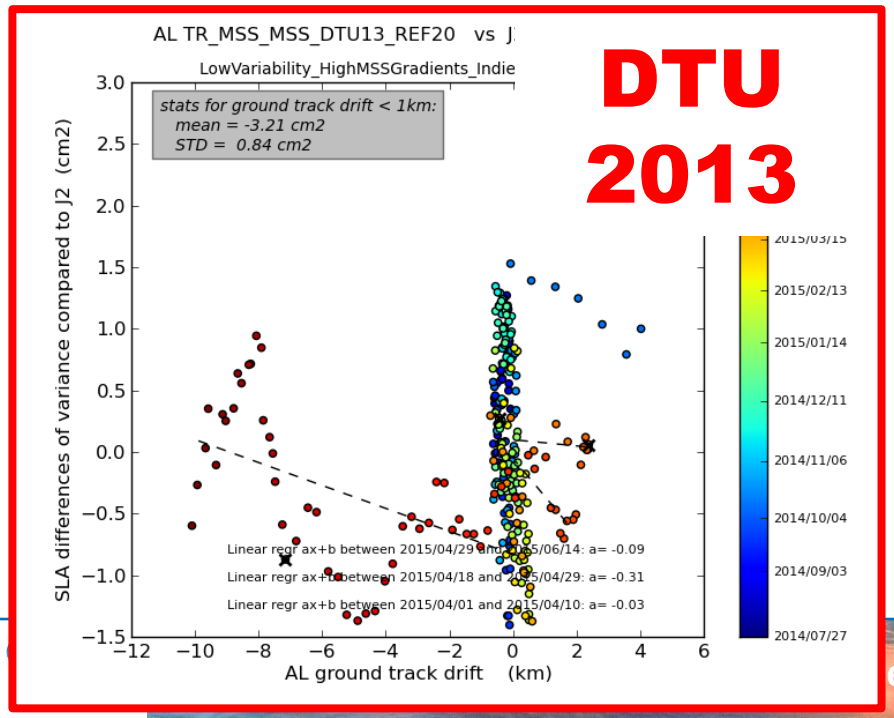


CNES/CLS 2011

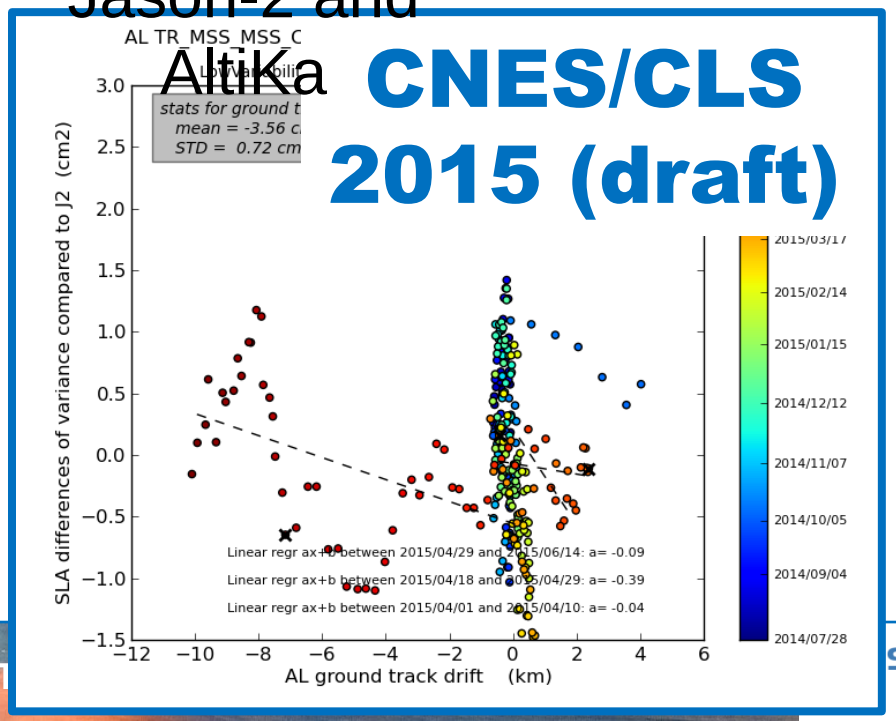




Comparing regional variance from Jason-2 and AltiKa



DTU 2013



CNES/CLS 2015 (draft)

Distribution of overlap events