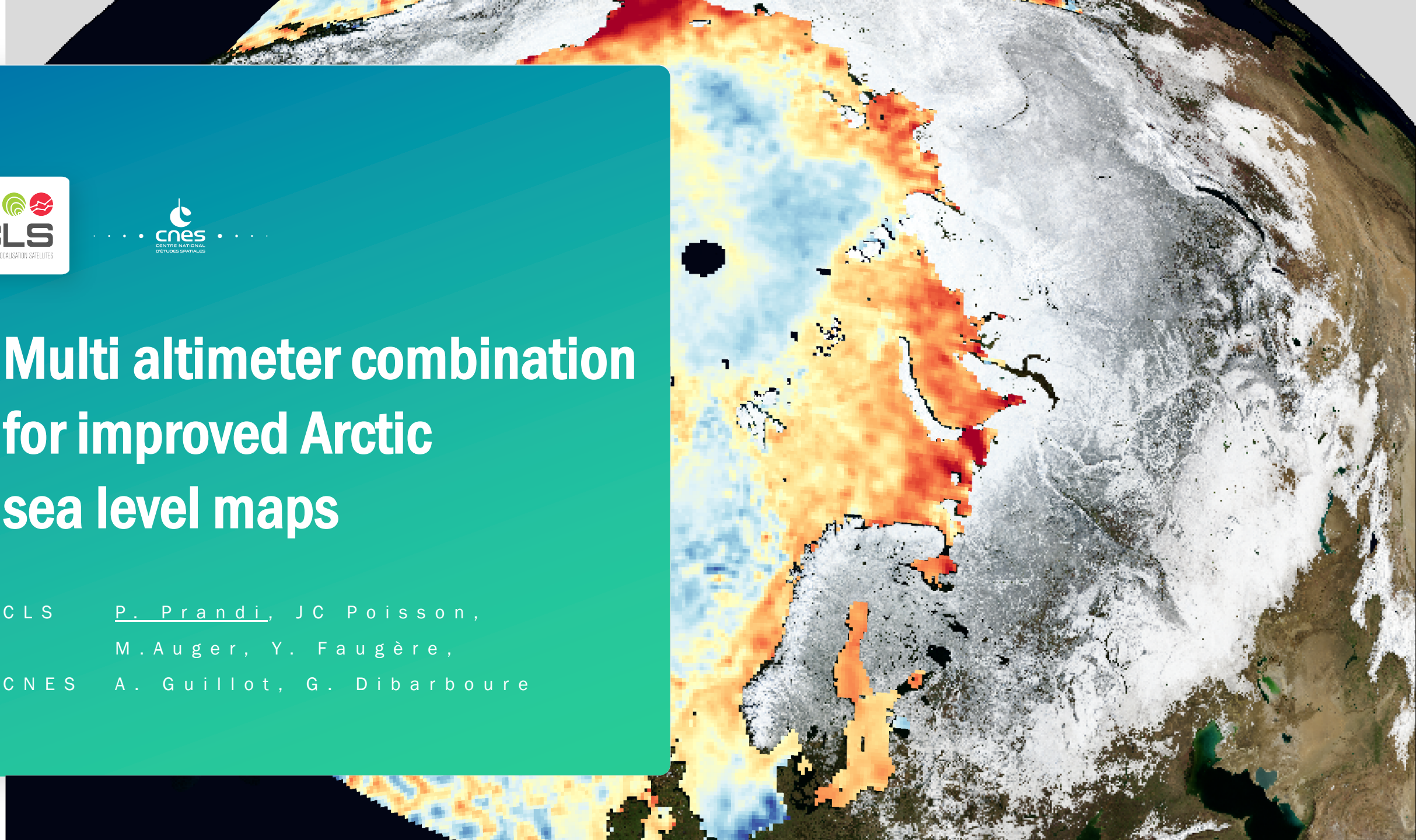

# Multi altimeter combination for improved Arctic sea level maps


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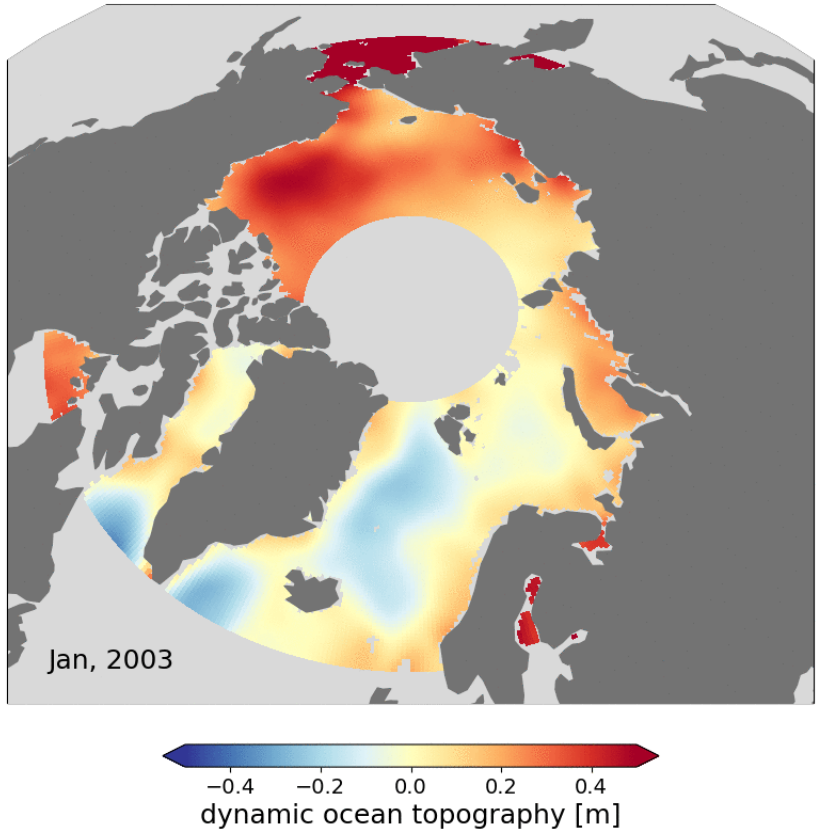
# Trying to get sea level in the Arctic has a long history

- Laxon 1994, designed ERS ground processor,
- Peacock and Laxon, 2004, first sea level variance map,
- Giles et al., 2012, Beaufort gyre freshening,
- Armitage et al., 2016,
- Rose et al., 2019, processed all data since 1993,

- **All limited to large-scale, monthly fields**

- Can we improve Arctic sea level maps ?




CPOM DOT (Armitage et al., 2016)

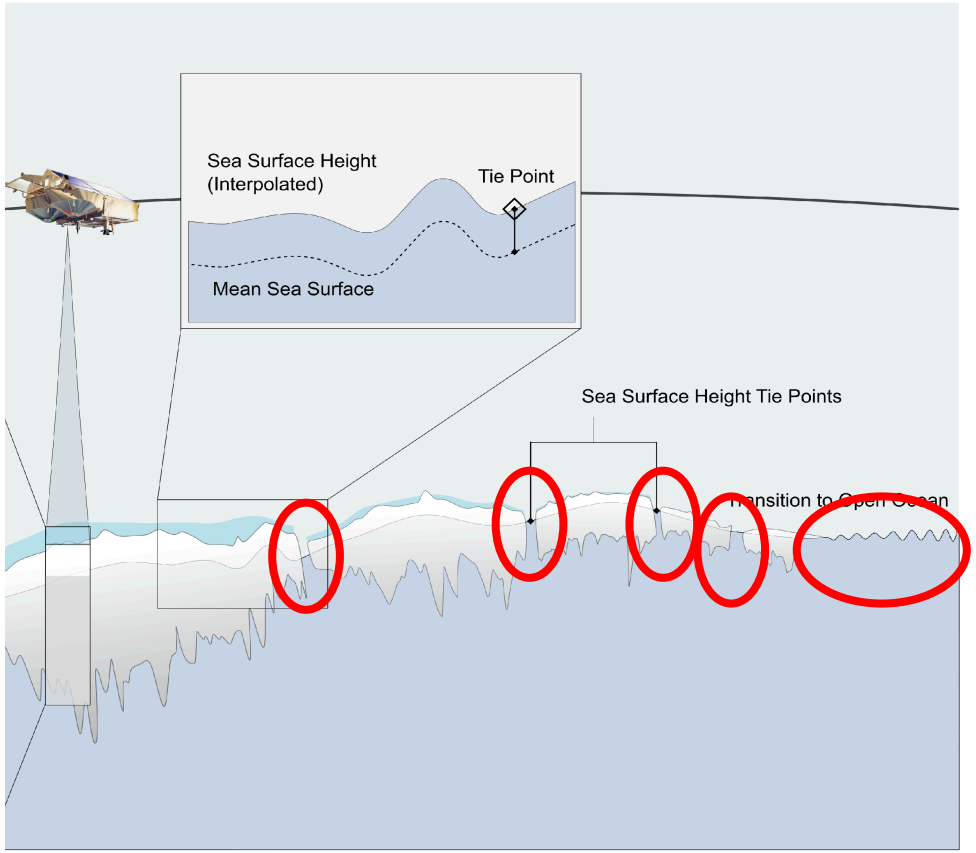
# Processing strategy

All groups follow the same processing strategy:

- Identify leads in the ice pack, where ocean surface appears,
- Estimate sea surface height from these tie points,
- Apply all necessary corrections and data editing,
- Apply a mapping algorithm.

Here important aspects are

- Leads identification is based on a neural net waveform classification,
- Adaptive retracker on SARAL/AltiKa ensuring open ocean/ice covered processing continuity and a baseline for cross-calibration,
- Mapping of multimission product based on an adaptation of the optimal interpolation used by DUACS.




From Quartly et al., 2019

# Data sources

We combine three altimeters together to improve Arctic Ocean sampling:

| mission | data source | period processed |
|---|---|---|
| SARAL/AltiKa | CNES Peachi | 2013/03/28-2018/12/27 |
| CryoSat-2 | PDGS Ice BaselineC SAR mode | 2010/07/30-2018/12/25 |
| Sentinel-3A | CNES S3PP with 0pad/Hamming | 2016/07/15-2018/06/15 |

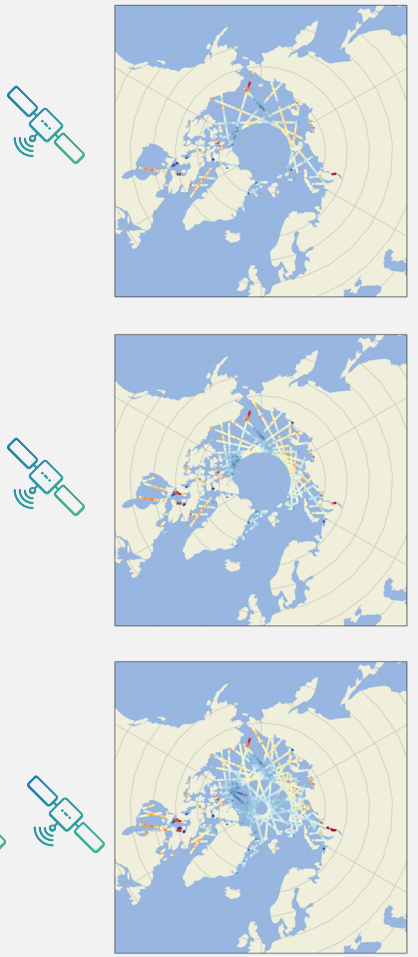
SARAL/AltiKa is used as the reference mission,

Only the SAR mode areas of CryoSat are used, providing no information on open ocean areas,

All standard instrumental and geophysical corrections applied,

SLA are expressed with respect to DTU15 MSS.

Typical one day sampling of the ice-covered Arctic Ocean with 1, 2 and 3 missions



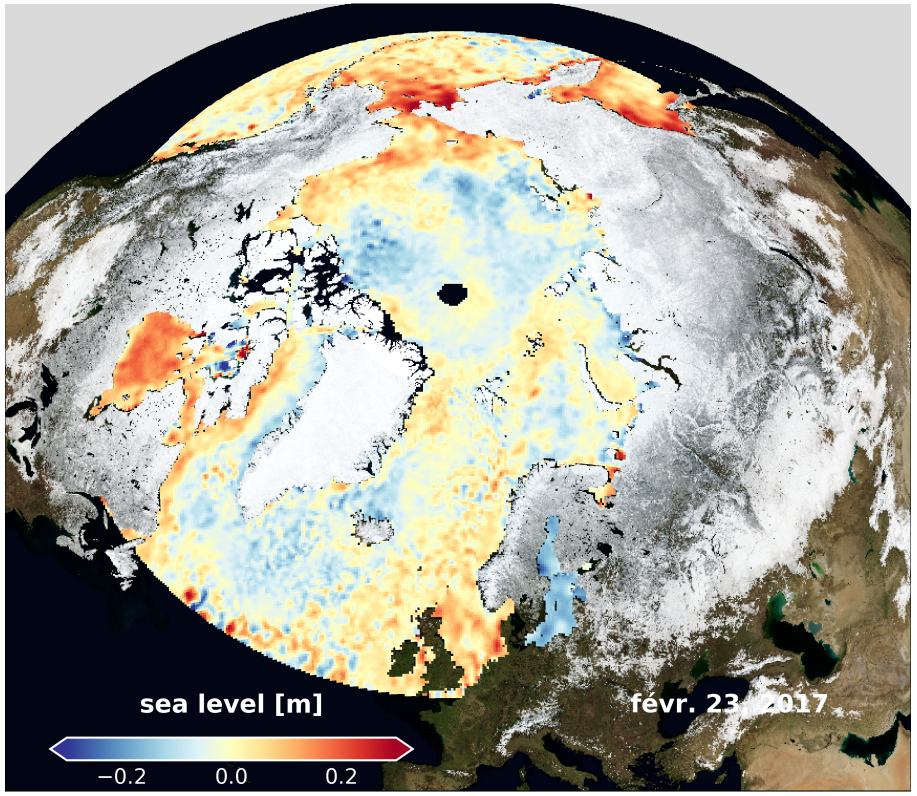
# Gridding

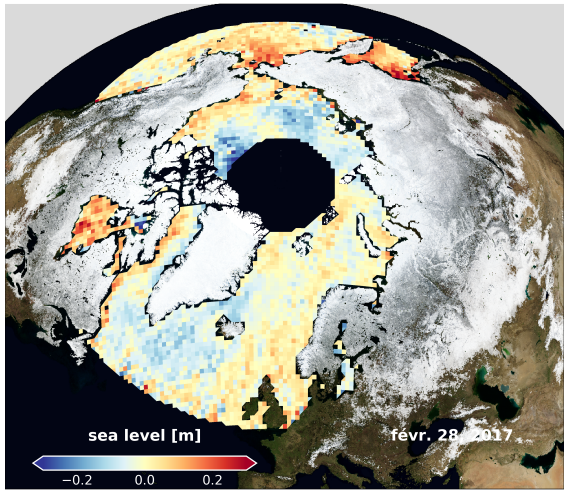
The Optimal Interpolation is based on DUACS,

All missions are referenced to SARAL/AltiKa prior to the OI,

SL is mapped onto a 25 km EASE2 grid, every three days,

Animation available @https://youtu.be/KDiIPkgwCYw




Mono-mission products are also available, but at lower resolution (75km, 10 days),

Simpler box averages are used.

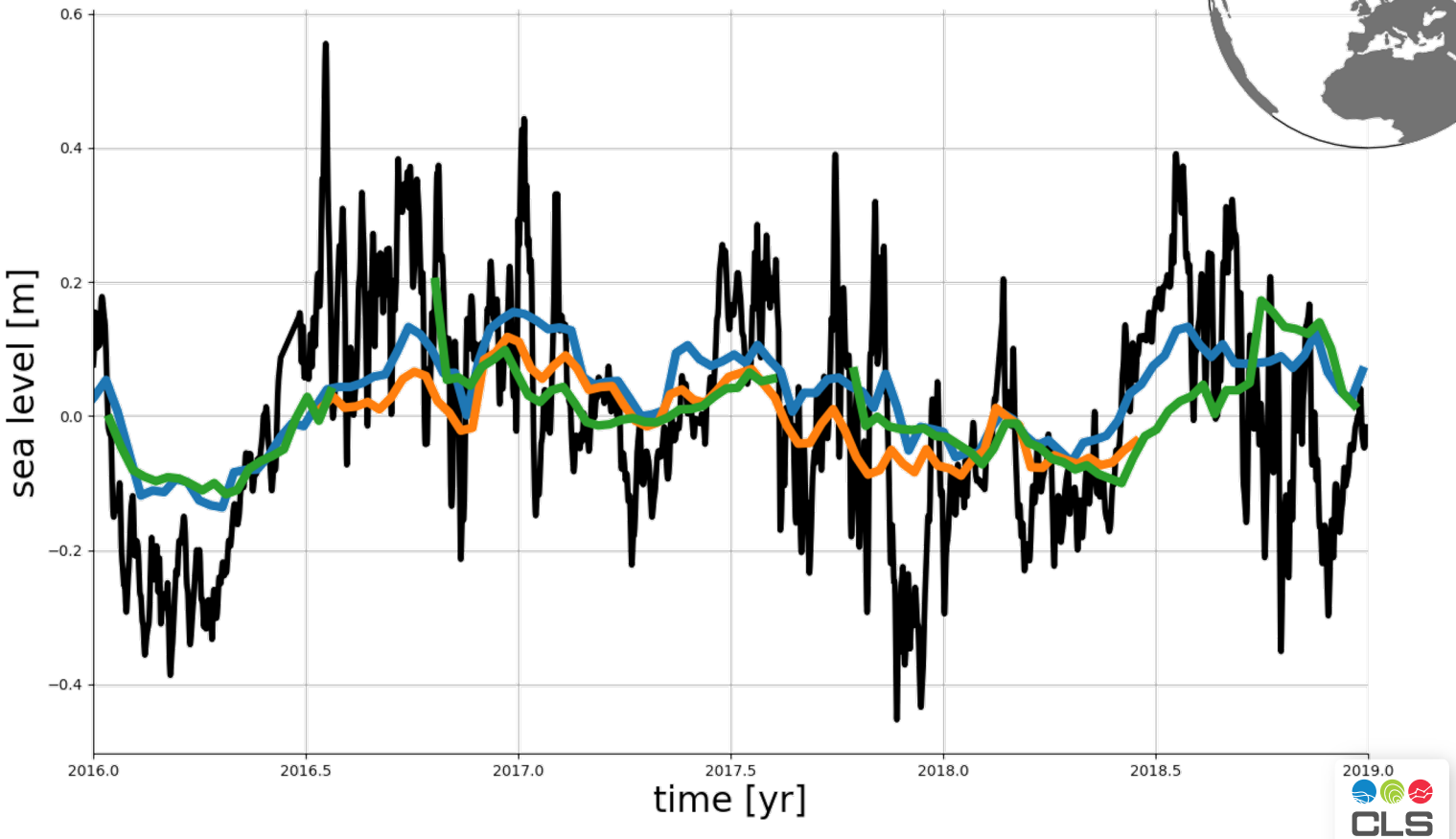
# Is the combined product any better ?

We compare satellite SL with in-situ measurements. This is not easy as there are few tide gauges in the Arctic.

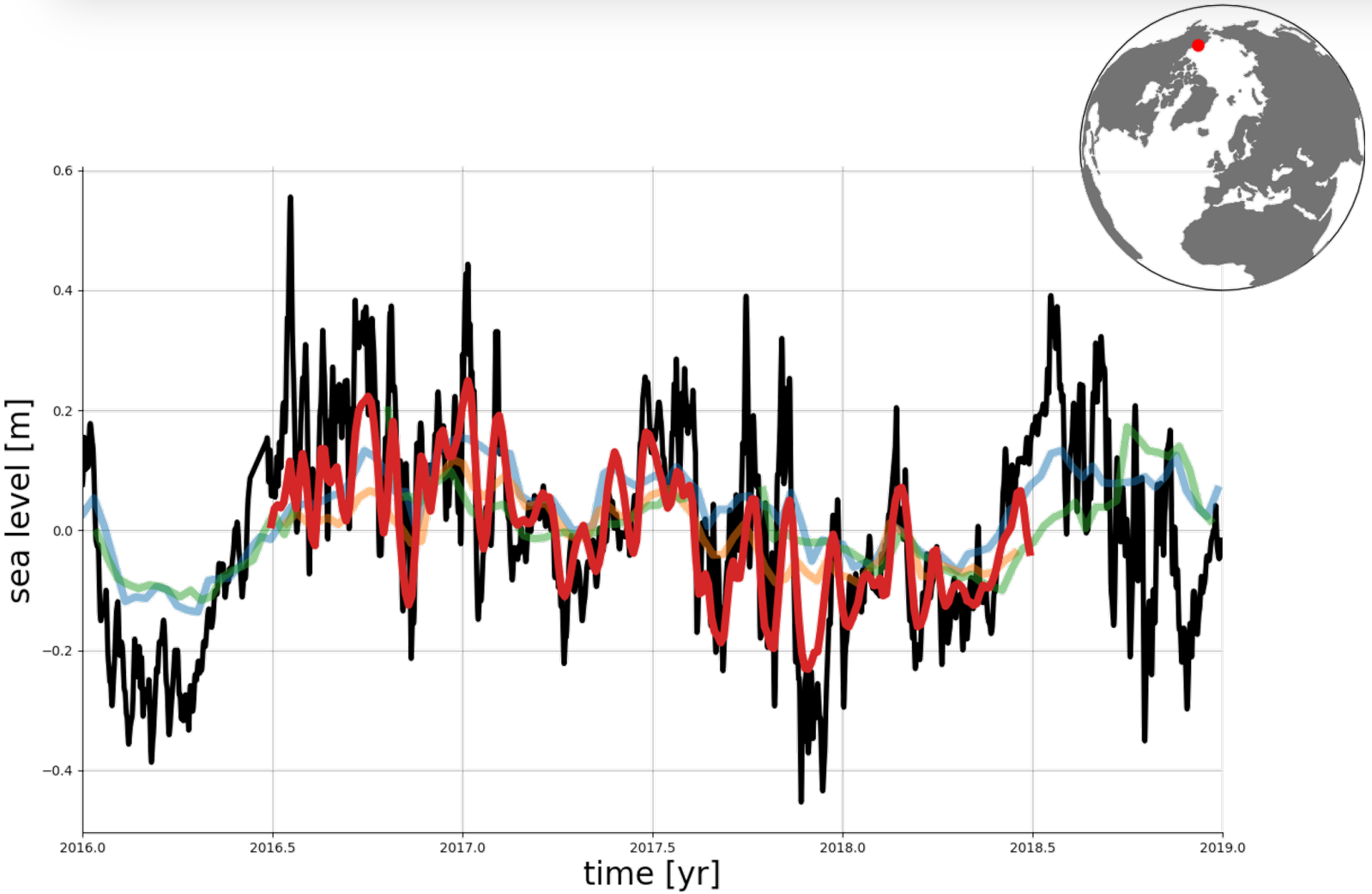
Here is a comparison at Prudhoe Bay (AK), first using mono-mission products:

- SARAL/AltiKa
- CryoSat-2
- Sentinel-3A

Low frequencies are consistent, but HF variability is clearly lacking in the altimeter record.



# Is the combined product any better ?



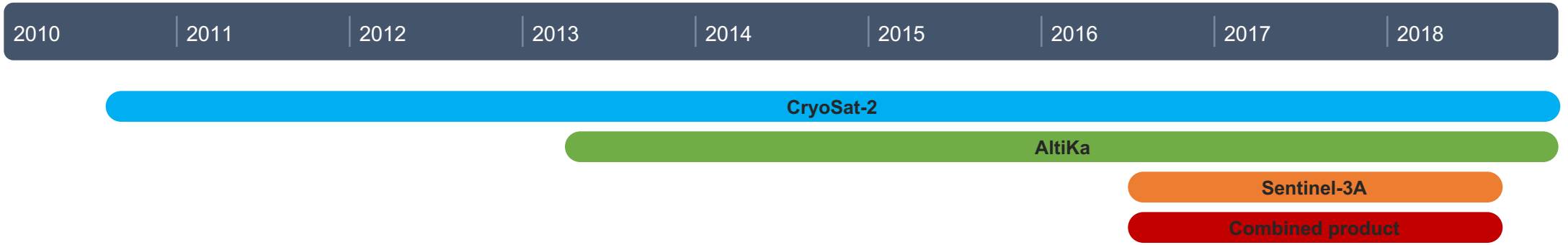

Prudhoe Bay is an interesting station, inside the Arctic, with seasonal sea ice cover.

The combined product performs much better than any of the three mono-mission products.

At 23 tide gauge stations in the region comparisons favor (higher correlation, lower RMSd) the combined product over any mono-mission product (out of 28).

# Products Availability

We provide four products, 3 mono-mission, 1 combined, over different time periods




All products are freely available through AVISO

https://frama.link/arctic-sea-level

Any questions or feedback

pprandi@groupcls.com

# Conclusions

We’ve built a multi-mission sea level dataset for the Arctic Ocean,

This product observes small scale features of the Arctic Ocean, unseen by mono-mission products,

More geophysical validation is needed so user feedback is essential.

This is a prototype for a future CMEMS product,

- One year extension planned,
- Delivery of along-track data for data assimilation in 2021,
- Operations will require delivery of 0pad/Hamming SAR mode measurements from agencies,