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Validation of a global dataset based on subwaveform retracking: improving the precision of pulse-limited satellite altimetry

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Summary

- Introduction: Background, Motivation, Data Sources
- High-rate Noise and new Sea State Bias
- Crossover Analysis
- Conclusions

Background

ALES (Adaptive Leading Edge Subwaveform) is a retracker: it fits the signals from satellite altimetry

Originally planned to improve the data near the coast; improvements validated through tide gauges in several publications

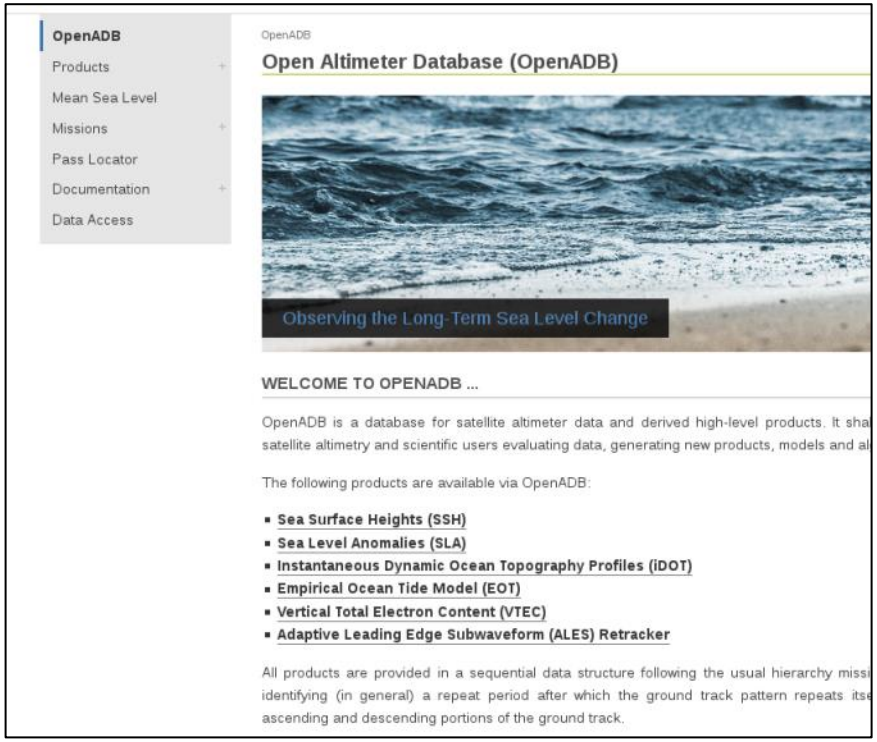
A version of ALES data at 20-Hz within 50 km of the coast is available from PODAAC for Jason-2 and Envisat (currently no Sea State Bias correction): ftp://podaac.jpl.nasa.gov/allData/coastal_alt/L2/ALES/

Regional post-processed sea level time series in North Sea and Med at 20-Hz and 1-Hz are available from COSTA: https://doi.pangaea.de/10.1594/PANGAEA.871920 (SEE POSTER IN SESSION „ADVANCES IN COASTAL ALTIMETRY!)

New global data availability: ALES in OpenADB

In the framework of OSTST Project RECAP24 (REprocessed Coastal Altimetry Products)

- From https://openadb.dgfi.tum.de/, in netCDF
- No hassle, made for users: Sea Surface Height already computed (corrections and 20Hz data available on request)



Data Format

The product "Adaptive Leading Edge Subwaveform (ALES) Retracker" includes the following parameters.

Parameter	Description
glon	Longitude of Satellite Footprint
glat	Latitude of Satellite Footprint
jday	Julian Day 2000
ssh	Sea Surface Heights
stdalt	Standard Deviation
swh	Significant Wave Height
mssh	Mean Sea Surface
otide	Ocean Tide Correction
ltide	Ocean Load Tide Correction
distance	Distance to Coast
sflags	Geophysical Corrections Quality Flags
oflags	Orbit Status and Quality Flags
iflags	Instrument Status and Quality Flags

The data will be provided in NetCDF. More details on the data is available here.

Scope and Data Sources

Today‘s menu: internal global single-mission validation, i.e. noise and crossovers statistics.

Scientific question: can ALES be used with confidence as a global ocean retracker?

Data sources:

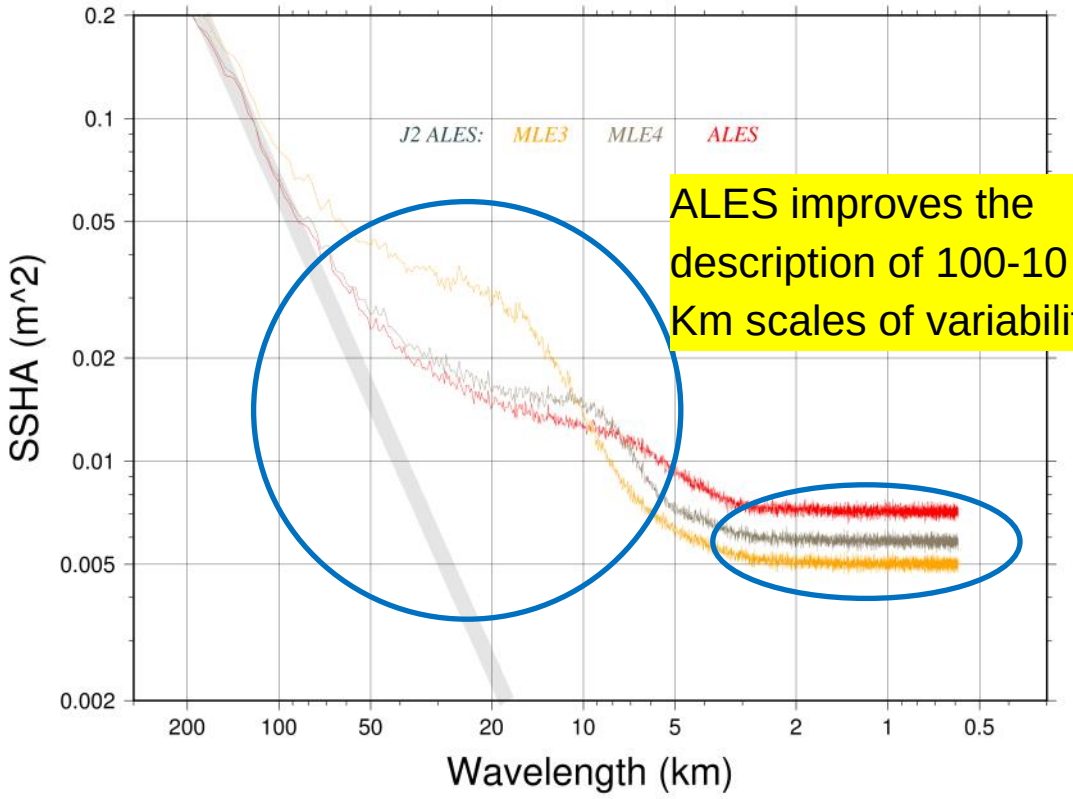
- High frequency: ranges and sea state bias from SGDR data (default mle4 retracker for Jason) and from ALES.

- 1-Hz averages: original ranges at 1-Hz from SGDR, computed averages from ALES

- To derive sea level data, same corrections applied to all dataset

Spectral Analysis – Jason 2 example

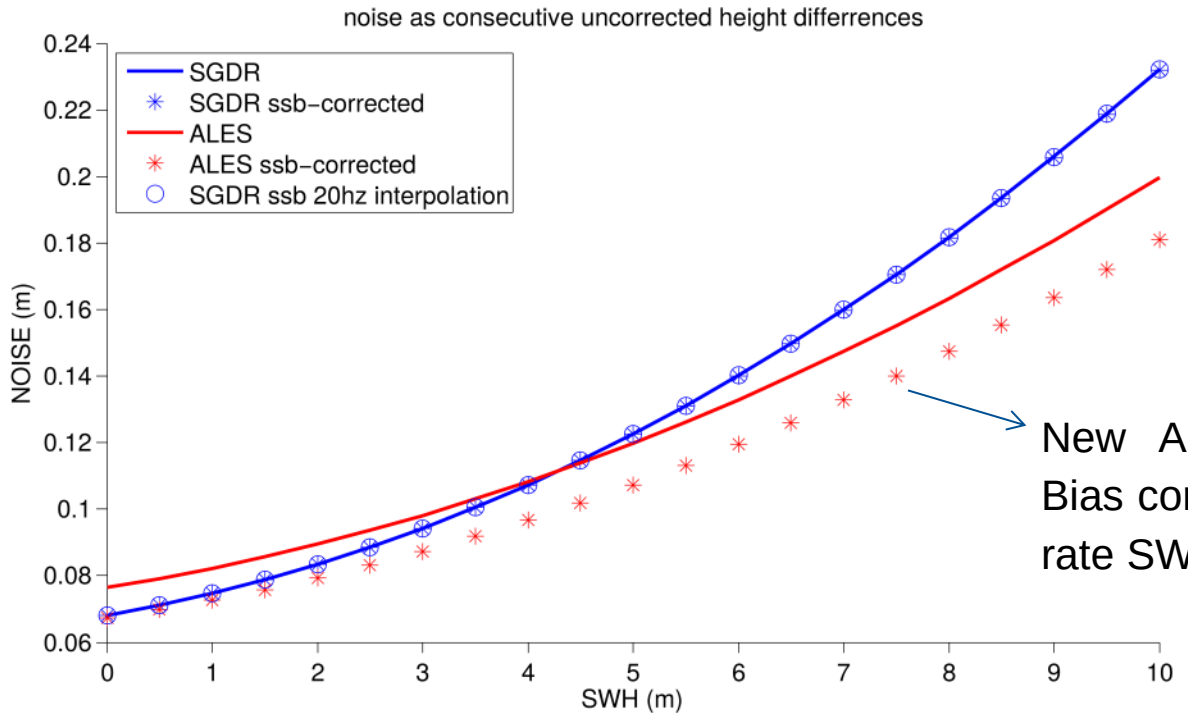
From Smith et al., 2017 (This conference!)



ALES improves the description of 100-10 Km scales of variability

Known tolerance on high-rate noise, „hidden“ by new SSB correction

High-rate noise as consecutive differences



New ALES Sea State Bias correction with high rate SWH and Wind

Example cycle 50 of Jason-2: 6% noise improvement at SWH=2.5, over 20% for extreme waves

Crossover Analysis - Methods

- Crossover: intersection of two tracks, assumes the same sea level for ‚small' space-time differences

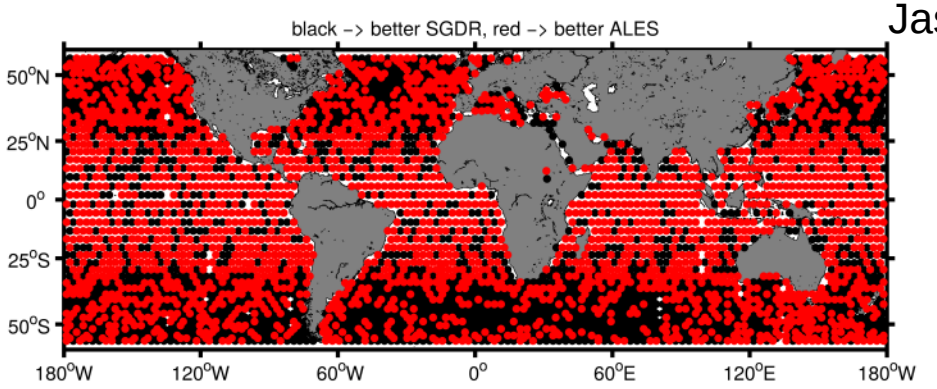
- Statistics: standard deviation of the crossover differences in space and time

- Max 5 km distance in space, Max 10 days difference, one measurement for each crossover location per cycle (median value if more than one point)

- Outliers are: Missing points & Crossover differences over 50 cm

Crossover analysis – in space

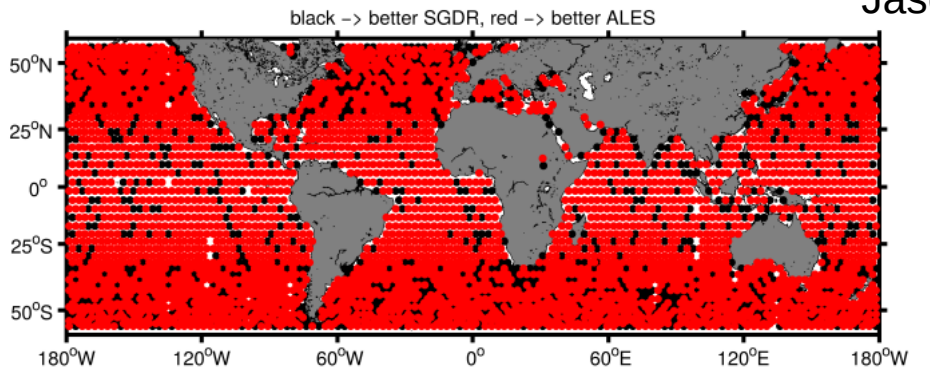
Jason-1



Standard Deviation of the Crossovers

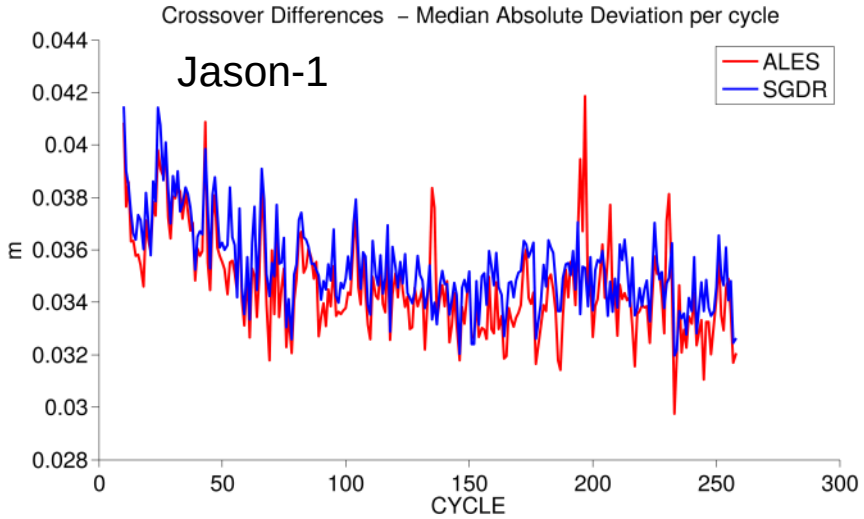
RED: std(ALES)<std(SGDR)

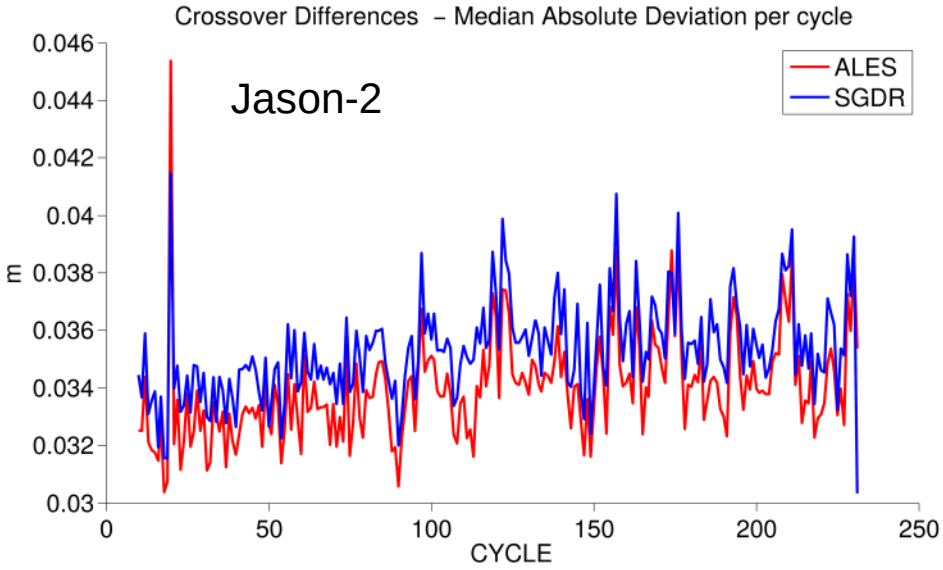
Jason-2



ALES IMPROVEMENT IS NOT RESTICTED TO THE COAST

Crossover analysis – in time





J1 Median improvement=0.08 cm

4.5% Variance Reduction

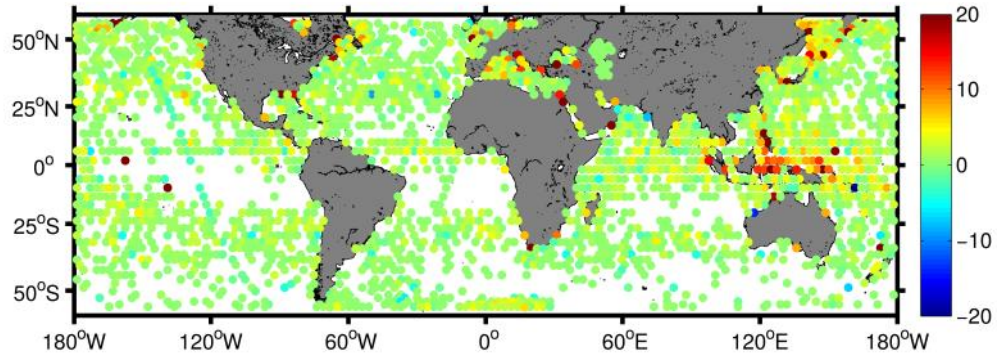
J2 Median improvement= 0.13 cm

7.5% Variance Reduction

NOTE: 0.5 cm/sqrt(20)=0.11 cm!
Verified!

Outliers analysis – in space

Jason-1



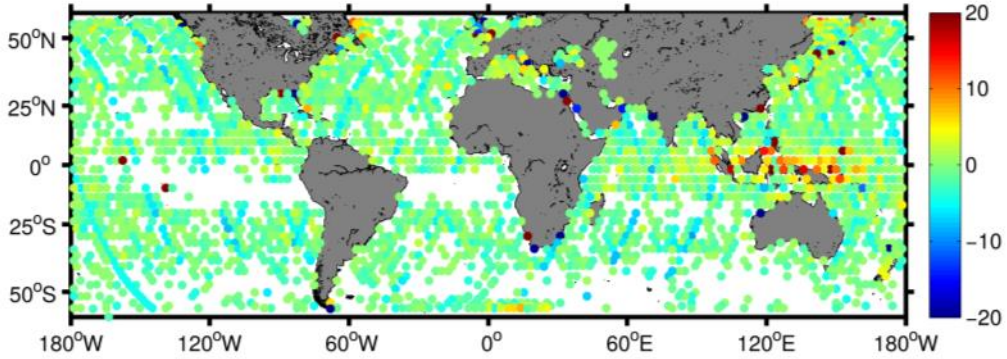
Number of outliers SGDR-ALES

ALES-> + 3337 valid crossover points

Outliers are:

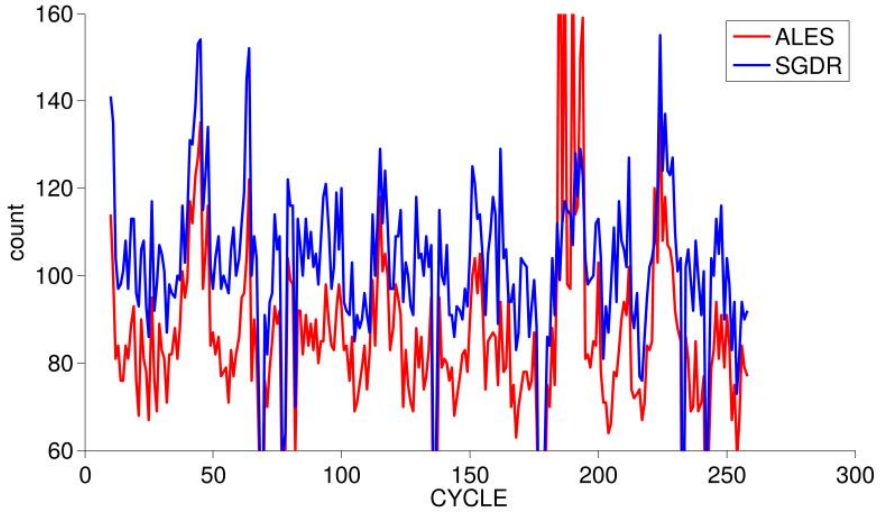
- Missing measurements at crossovers
- Crossover height differences >0.5 m

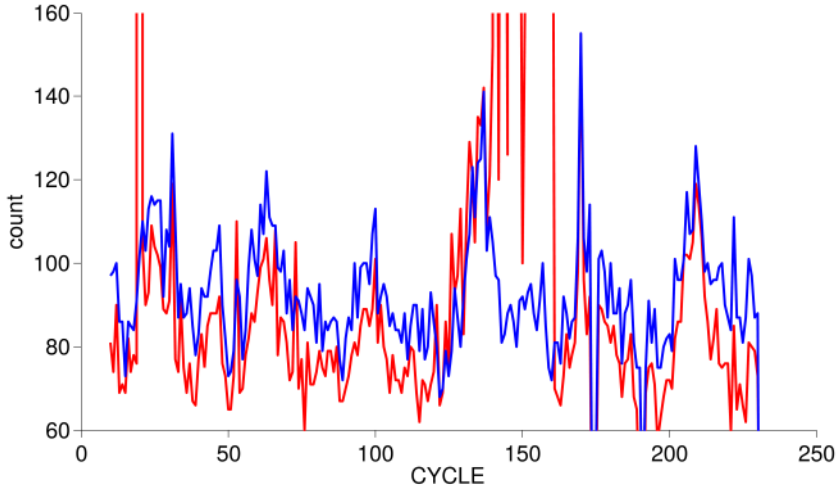
Jason-2



ALES-> + 1934 valid crossover points

Outlier analysis - in time





Except for some data gaps, ALES 1Hz crossovers have systematically less outliers than SGDR.

Conclusions

Scientific question: can ALES be used with confidence as a global ocean retracker?

YES, it SHOULD, because it even IMPROVES the current standards.

Conclusions

- A global 1-Hz ALES multi-mission dataset is now available in http://openadb.dgfi.tum.de/

- Compared to the current GDR products, ALES dataset has:
    1) A better representation of the spatial scales up to 10 km
    2) An improved precision
    3) 7% (4.5%) Variance reduction in Jason-2 (Jason-1)
    4) Less outliers

Next Steps towards higher precision

- Release of more missions and of high rate data with improved flagging
- New Sea State Bias MODEL for ALES
- Correction for correlated SWH/Epoch errors