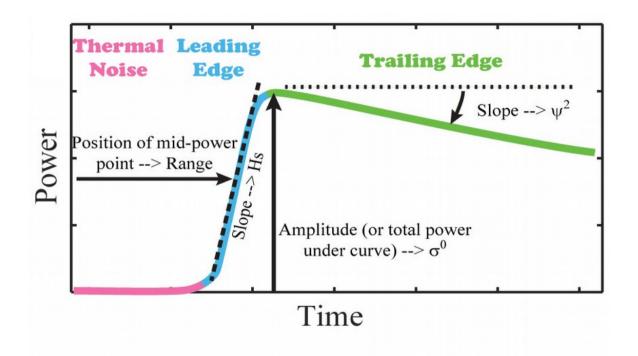
Assessing New Altimeter Algorithms

Graham Quartly, Florian Schlembach, Andrey Kurekin, Francesco Nencioli & Marcello Passaro



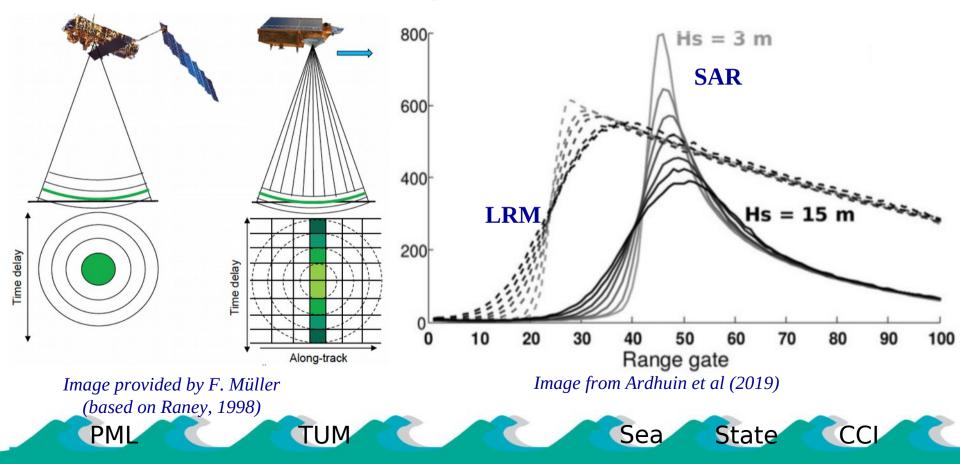


Altimeter Operation (LRM)





Altimeter Operation (SAR)



Candidate Algorithms

LRM

PML

MLE-3 MLE-4WHALES WHALES adj WHALES_PTR WHALES_PTR_adj TALES STARv2 Adaptive **Brown-Peaky**

TUM

SAR SAMOSA WHALES TALES STARv2 LR-RMC ACDC

Sea

State

Assessment Plan

1. Invalid observations

2. Noise level

PML

3. Comparison with buoys

4. Comparison with models

5. Processing Time

TUM

Round Robin Experiment for Radar Altimetry: 1) The Round Robin exercise is a transparent process. The programming language of the Round Preliminary notes 11 The Rouno noon exercise is a transpirent process. The programming unga Robin is MATUAB TUM will share the MATUAB code used for the Round Robin 3) The rules of the Round Robin are decided scales by the Consortium. If a member of the 2) The criteria of the Round Robin must be quantitative. 3) The rules of the Round Robin are decided <u>SeletyBy</u> by the Consortium # a member of the Consortium proposes a rule and this rule is accepted, it will need to provide the MATLAB code 4) TUM as leader of the <u>Attractory Alsoritory</u> Development group and the Science Leader of the cr of the leader of the <u>Attractory Alsoritory</u> Development group and the Science Leader of the to apply the proposed criteria. n i un an ensure or une <u>provided reasoning</u> unrecordence proop and un SS CQ Project have the final word in duritying disputes on methodology. 3 changes to the Round Robin methodology after the start of the exercise (KD+9) 3) Proposed changes to the Nound Robin methodology after the start of the describe (9D/97) will not be considered. Failing to contribute to the draft of this document will be considered as ng algorithm is going to be used in the data production phase, the code of the b) If a winning algorithm is going to be used in the data production phase, the code or the retracking (as open code or executable) will have to be given to System Development, who an implicit agreement on the methodology. the system subsector constructions were traver to be given to system useregoment, which is the system edge of the system state to be specified builtime to meet this and the state of the specified builtime to meet this and the state of the specified builtime to meet this and the state of the specified builtime to meet this and the specified builtime to meet this and the specified builtime to specified builtime to specified builtime to specified builtime to meet this and the specified builtime to specif ensine not to onsnow one to anyone exercise 55 a requested statute to meet this obtains will lead to the exhains of the algorithm from the System Development, although the control statute the exhains of the algorithm from the System Development, although onnion we wan to the examin or use appraint man an appraint the results and the description will still be shown in the documentation. Round Robin assesses the quality of the <u>Kuband</u> significant wave height at 2044. 1 If the bound moon assesses the quarky or the <u>MOODE</u> againstant wave image at a rest. We provide the transmission of the <u>SMM</u> units and the <u>SMM</u> units are set of the <u>SMM</u> units and the <u>SMM</u> units and the <u>SMM</u> units are set of the <u>SMM</u> units and the <u>SMM</u> units are set of the <u>SMM</u> units are set of the <u>SMM</u> units and the <u>SMM</u> units are set of the <u>SMM</u> are set o poviniers are entered to aveid bad practice such as: brong to absolute zero the 3005 using ode mail data to form retrievals at NNN. The participants shall provide a 1,0 flag to assess bad external cale to tone remevals # 595, the participants was proced a 24 using to anexo au rebreak and shall describe the orderia used for it. If the algorithm above, the authors hall retrients and shall describe the ordena used for it. If the appointm allows, the autility mail provide the estimations of sigmaD Finally, the putticipants must suggest the best strategy to account from solutions of sigmaD Finally, the putticipants and the solution of provide the estimations of signal Fraaly, the participants must suggest the best strategy to average from 20-Mz to 1-Mz data, since the frail product will be distributed as 1-Hz trom acter to 1442 data, since the mail product will be determined as 1440 models the Roand Robin will involve both informal consistency checks (selling), about measurements. The nound scotin well evolve both in ternal consistency crecios (959997), acres track variability-1 and validation with external data (buoys and models), as described in this 8) External data for validation (such as buoy data) will have to be selected and given to the accurate resource of the selected and given to the If Sternal data for vasilation (such as budy data) we have to be selected and given to the Application Development have by the other members of the Consolution in the form: "(rive, Lik-tion and a set Agontem Unelogement learn by the other members of the Construint in the form: "time, lat. 50, 50() flag. Some suggested busy locations in the southwest UK are shown in the Figure 95. XVII, ING. Some suggested taxy locations in the suggested runs are some in the regime felow. The infention in that Roand Robin electice will use a finited number of toury in between below. The Interction is that Round Robin exercise will use a limited number of buoys toetween 10 and 201 for a limited duration, so as not to compromise the Independence of the week of su and aug for a similed duration, so as not to compromise the independence of the work du-the Validation Team. Data from other sources need to be provided to the Algorithm

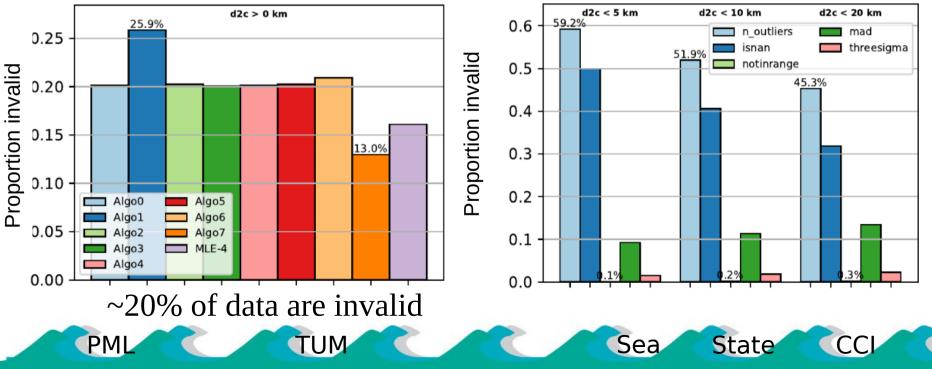
State

Sea

1. Invalid Observations

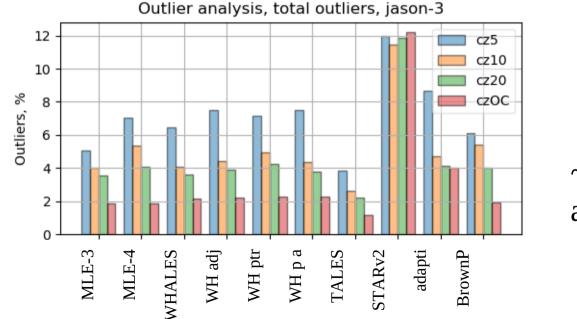
Algo1

- 1.1 NaNs (Unspecified values)
- 1.2 Hs>25m OR Hs<-0.25m (Physically unreasonable values)
- **1.3** > N x Median Absolute Deviation (Spurious outliers)



1.3 Occurrence of Outliers

Alternatively, we can use 3x1.48 x Median Absolute Deviation (eqv to 3 S.D.)



PML

~2% of data are outliers



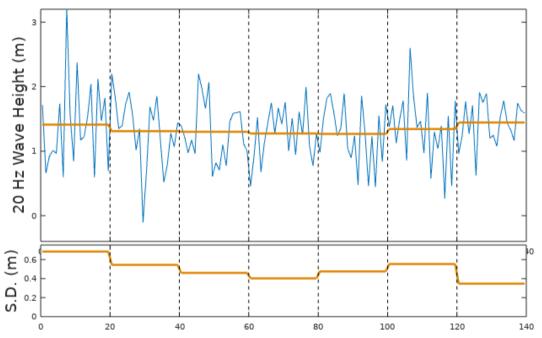
2. Measures of "Noise"

TUM

- 2.1 Along-track difference
- 2.2 $\sigma_{_{Hs}}$ (S.D. of 20 records in 1-second)

PM'

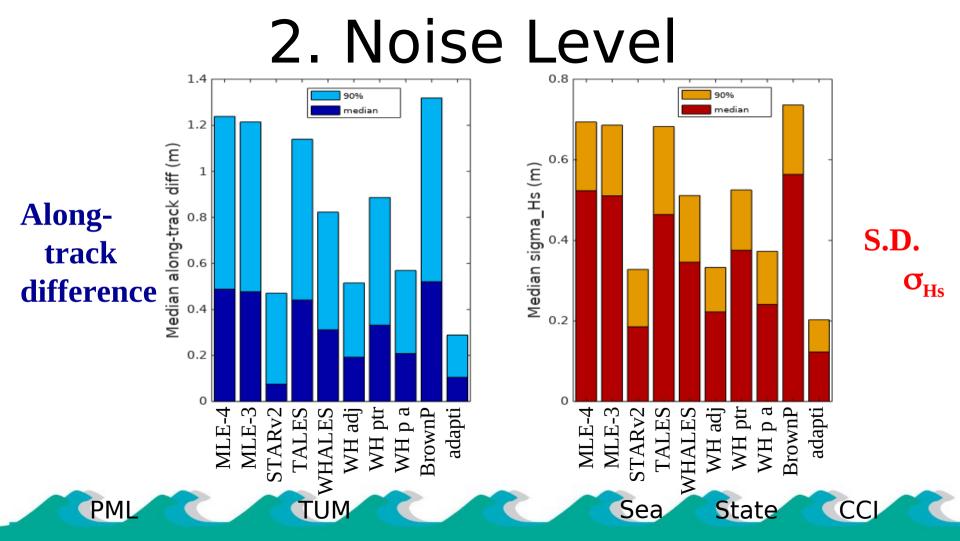
2.3 Spectra of Hs variation



Sea

State

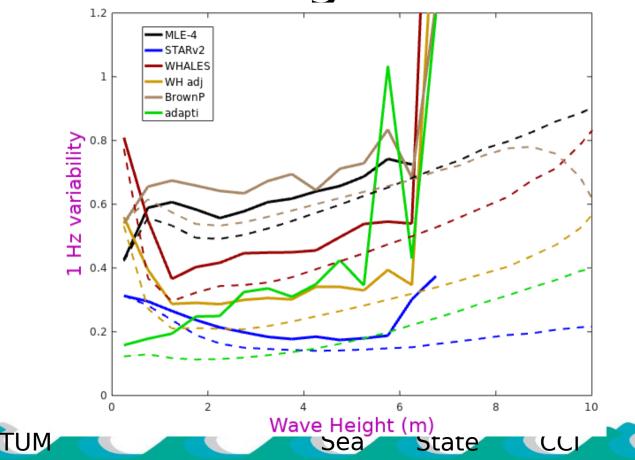
CC

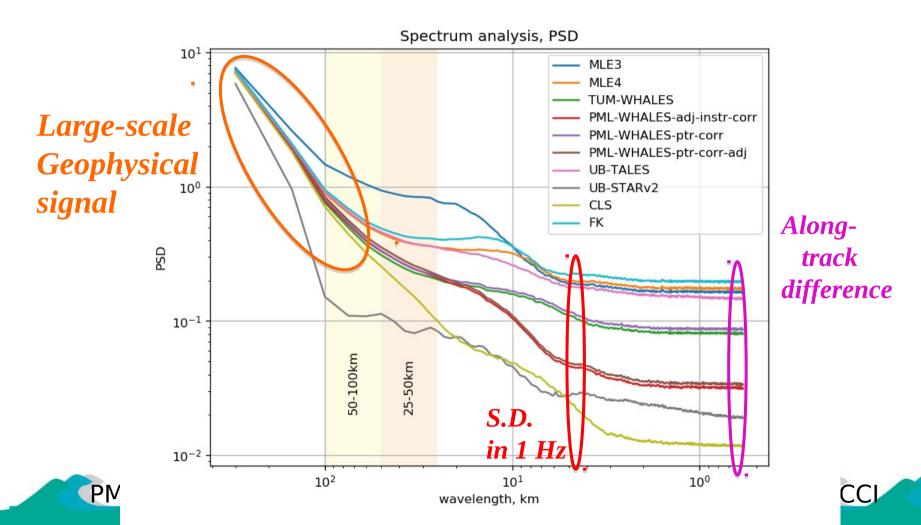


2. Noise Level: sigma Hs

σ_{Hs} — Variability of the 20 observations in a 1 Hz record

PM





3. Comparison with Buoys

Jason-3 repeats tracks every 10 days

Consider 51 obs. points (~17 km) nearest to buoy & calculate median:

Compare with hourly buoy records Interpolated to overpass time

Consider 2 Years data (~73 overflights) of 125 buoys

Some subsequent editing

PM



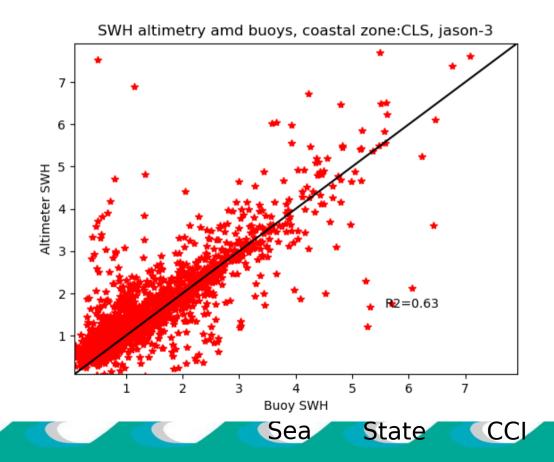
Buoys comparisons are mainly coastal; some enclosed or short-fetch

3. Comparison with Buoys

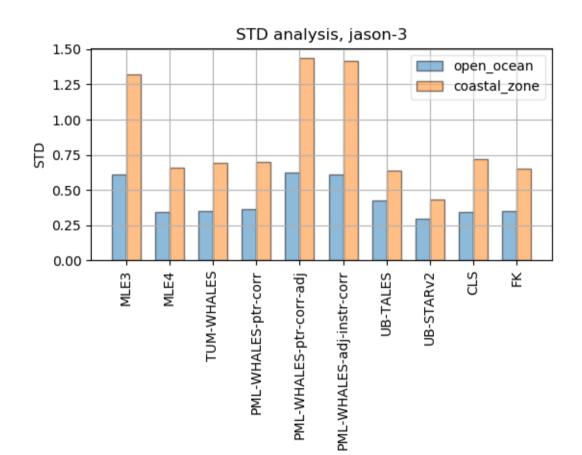
Scatterplot for buoys Used to derive: Median bias Correlation, r² Std. Dev.

PM'

UΜ



3. Comparison with Buoys



PML



4. Comparison with Models

Sea

State

Two models used: ERA5 WAM and CY46R1 Similar results, so only ERA shown here

Two years of data (spanning all seasons), interpolated to 1 Hz altimetry points Evaluate 1 Hz data points

TUM

PM'

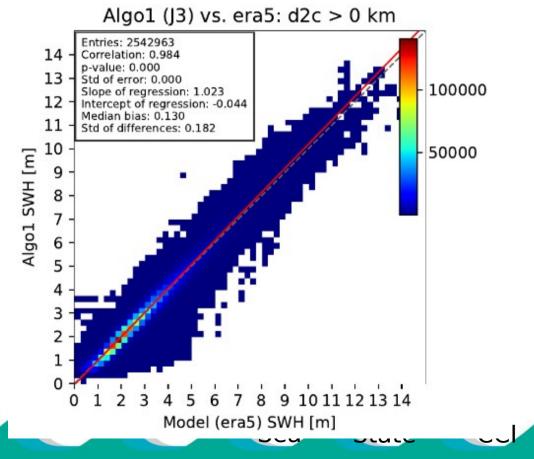
4. Comparison with Models

Scatterplot for models

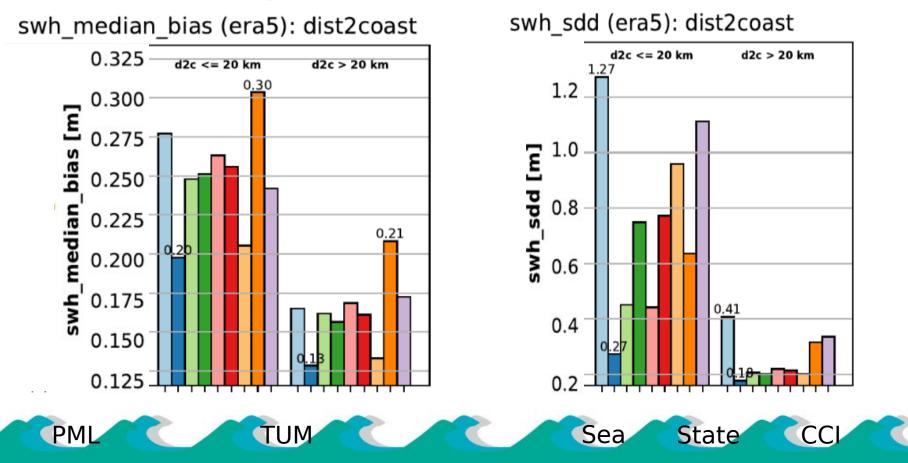
IIM

Used to derive: Median bias Correlation, r² Std. Dev.

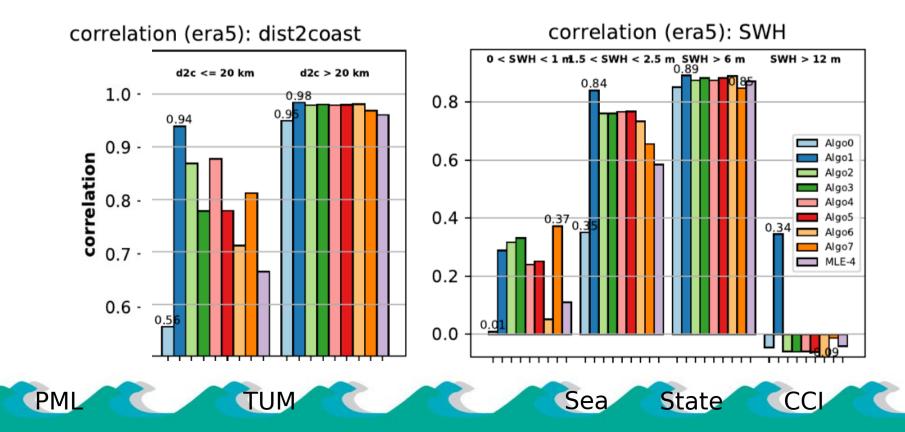
PM'



4. Comparison with Models



4. Correlation with ERA5



Choices / Compromise

We are nearing the end of a statistical evaluation of many state-of-the-art algorithms for deriving SWH from Jason-3 and Sentinel-3 (not shown).

Ideally, we would implement one that outperforms traditional inversions in terms of:

- 1. Coverage (fewer bad data points or outliers) especially in coastal zone
- 2. Noise level / uncertainty
- 3. Comparison with coastal buoys (minimal bias, low S.D., high correlation)
- Comparison with global models (minimal bias, low S.D., high correlation) Consistency between missions Processing time



You can influence the Decision

