

RAW versus RMC: A Coastal Study

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S6VT Meeting #4
Online, 13th of July 2022



Outline

1. Motivation
2. Data
3. CORALv2 Coastal Retracker
4. Results
5. Conclusion

Motivation

- In the S6JTEX project, we (as TUM) perform a coastal assessment of the Sentinel-6 data within the tandem phase with J3
- The focus of the assessment at S6JTEX is on a global scale of both **SLA** and **SWH**
 - Outliers, L2 noise, comparing S6-LRM, S6-RAW/RMC and J3-LRM (+ retracked datasets with coastal retrackers)
 - Coastal crossover analysis of S6 and J3 for assessing biases, drifts, and their geophysical patterns

This case study focuses on an in-depth analysis of the accuracy with regards to a high-resolution coastal wave model.

- Assessment of SWH only
- Maximum distance-to-coast of 30km
- Limited to SWAN-Kuststrook model domain

Data

S6MF data

- Dedicated RAW2RMC converted S6MF data provided by EUMETSAT Helpdesk
- Cycles 25-27
- Baseline F03

Assessed L2 datasets

- PDAP_HR-RAW
 - PDAP_HR-RMC
 - PDAP_LR
 - CORALv2-RAW
 - CORALv2-RMC
- } EUM L2 products
- } CORALv2 = coastal retracker, starting from EUM L1b product level

Data

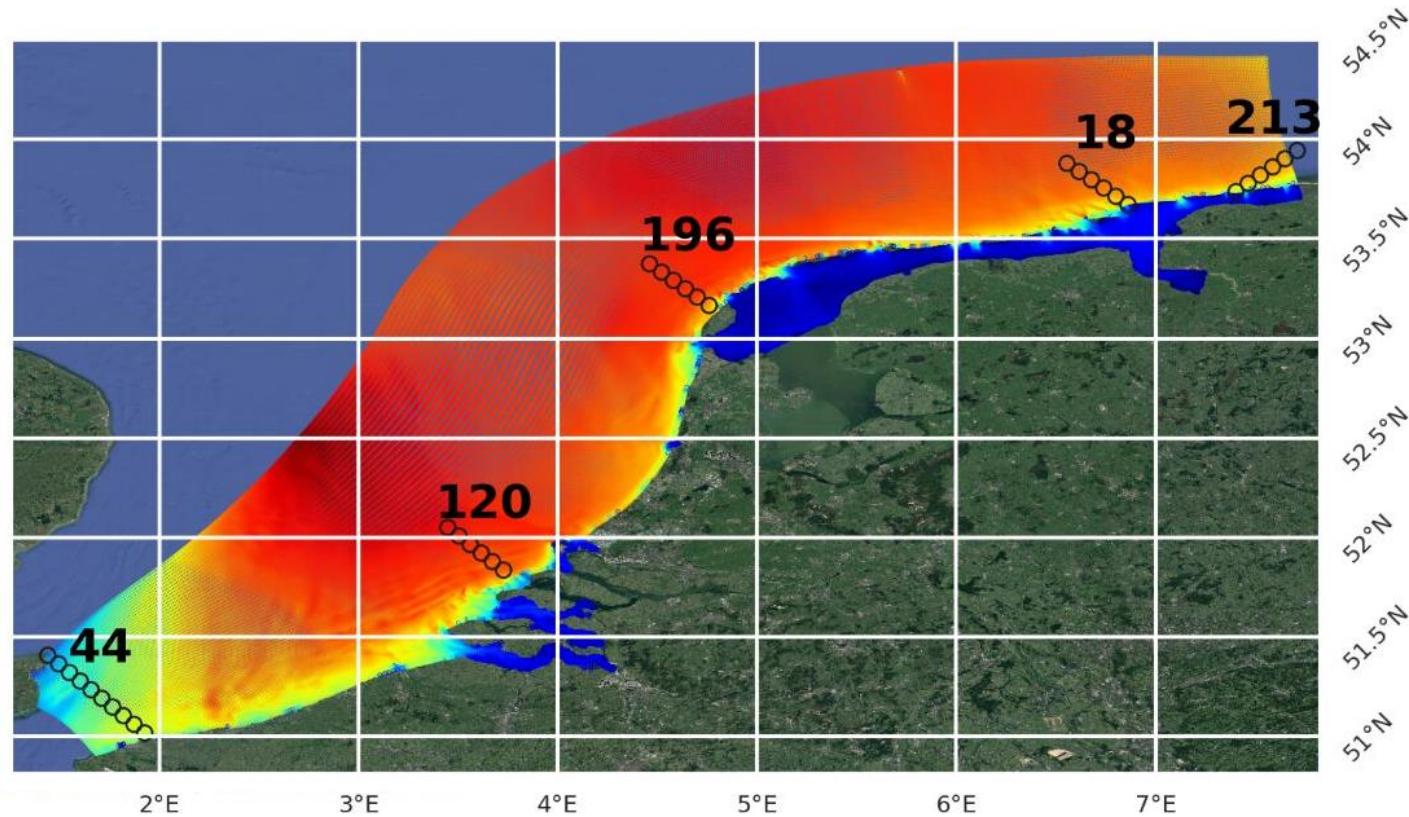
High-resolution Model Data

- Operational (forecast) model SWAN-Kuststrook from Deltares
- SWAN-based
- Model domain: Dutch Wadden Sea and Eastern/Western Scheldt
- SWAN offshore wave boundary conditions from ECMWF-WAM
- Water level/current fields from WAQUA-ZUNA
- Wind fields from HIRLAM
- Bathymetry data from a combination of EMODnet (deeper parts) and Baseline (near the coast)

Data

Collocation

- Passes 44, 120, 196, 18, 213 of the cycles 25, 26, 27
- Maximum distance-to-coast of 30km
- coast = nearest shoreline = first contact with land (Wadden islands, sand bank)



CORALv2 Coastal Retracker

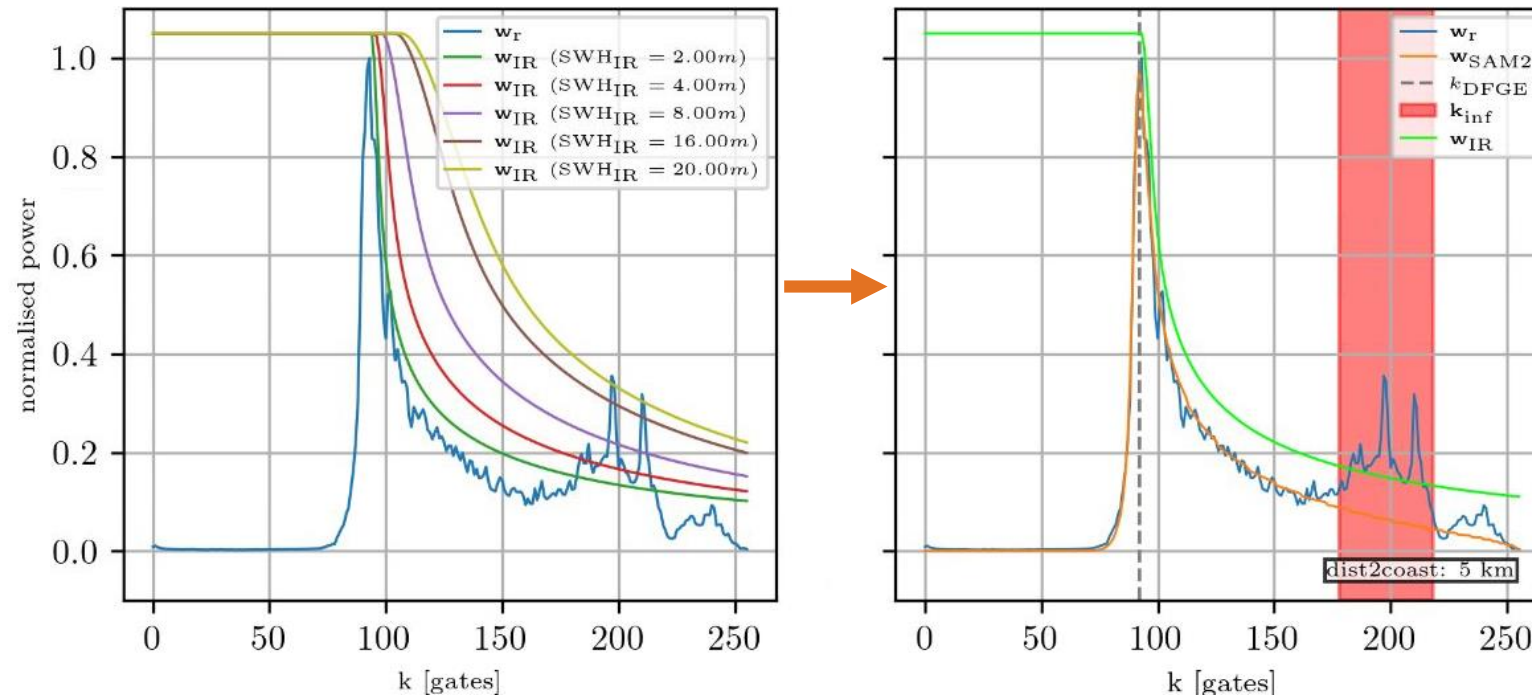
Schlembach F., Passaro M., Dettmering D., Bidlot J., Seitz F.:
Interference-sensitive coastal SAR altimetry retracking strategy
for measuring significant wave height. Remote Sensing of
Environment, 274, 112968, [10.1016/j.rse.2022.112968](https://doi.org/10.1016/j.rse.2022.112968), 2022



Adaptive Interference Masking (AIM)

→ senses and masks interference within the trailing edge

Generation of a single-look SAMOSA model w_{SAM2} to produce the interference reference waveform $w_{IR}(SWH_{IR})$



detected interference gates

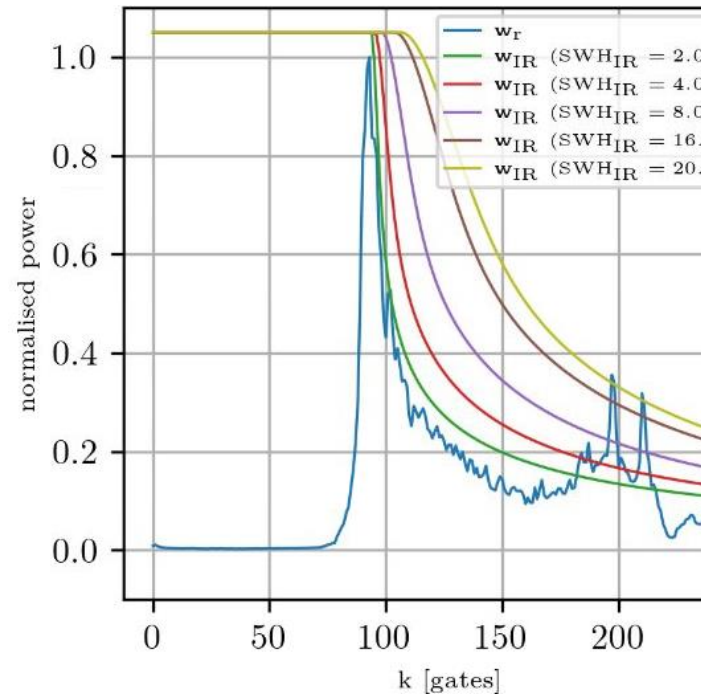
$$k_{inf} = \text{True}(w_r > w_{IR})$$

→ AIM detects interference gates and excludes them from fitting procedure → **quality** of SWH estimate is improved.

CORALv2 Coastal Retracker

Adaptive Interference Masking (AIM)

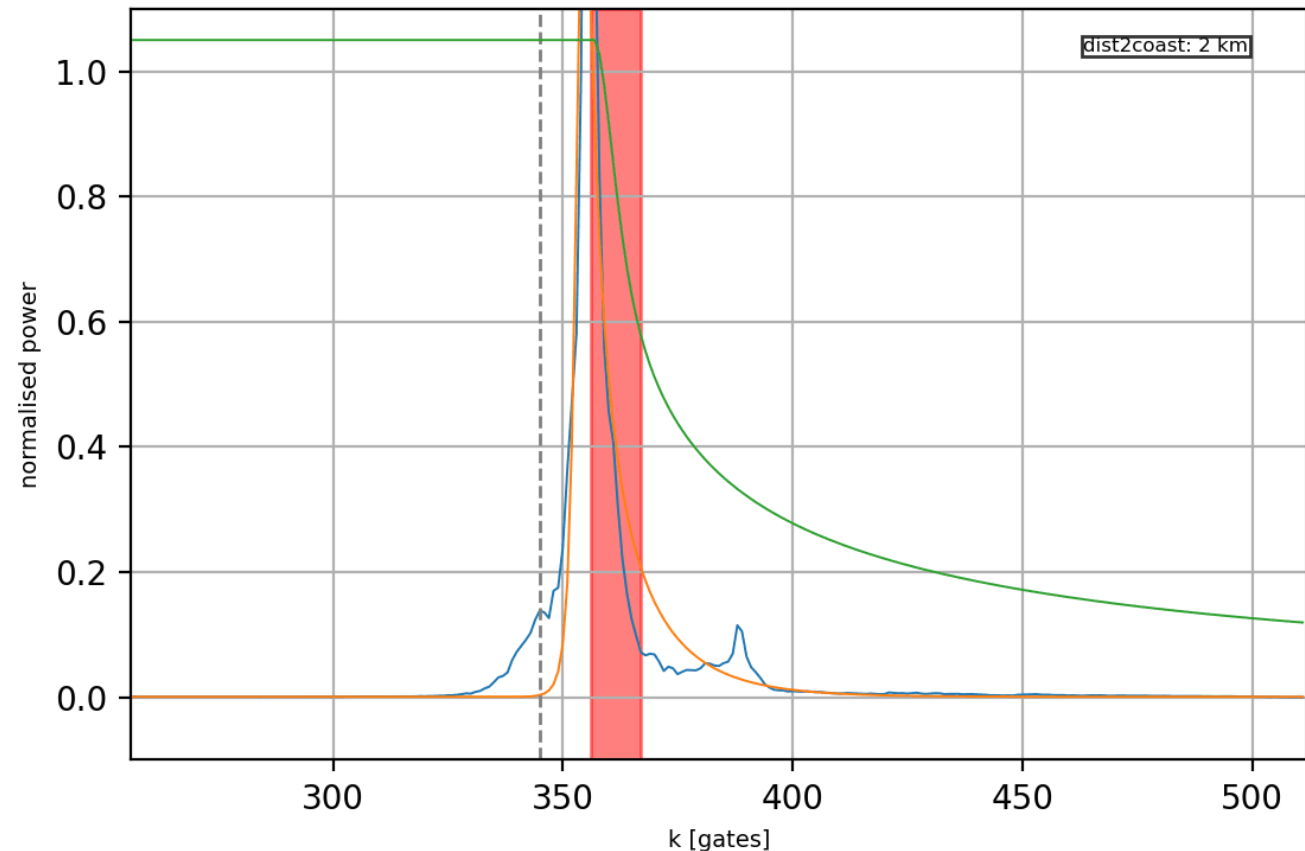
→ senses and masks interference within the Generation of a single-look SAMOSA model w_S .



→ AIM detects interference gates and excludes

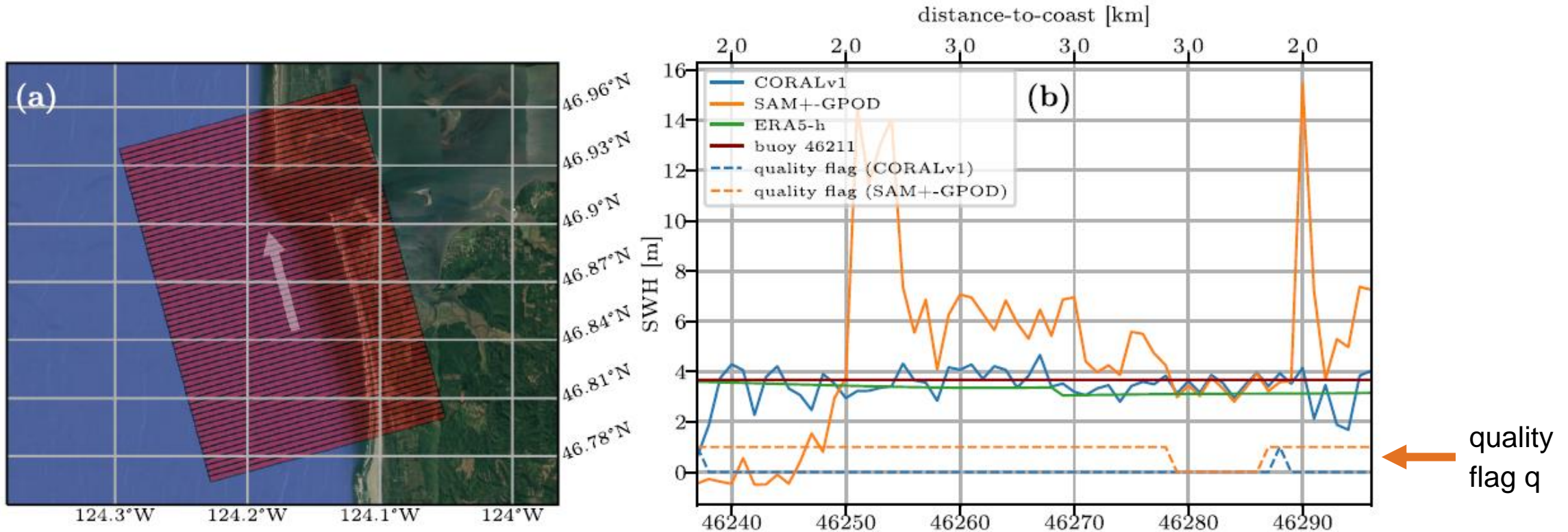
S3A_SR_1_SRA_BS_20180414T050110_20180414T055139_20180509T202346_3029_030_090_____MAR_O_NT_003.nc, samplus-coral (gpod), record#: 46403

— y_{I2} , misfit=5.06, misfit_selective=nan, misfit=5.06, SWH=-0.449m,
— $y_{retrack}$, misfit=5.51, misfit_selective=3.70, misfit=5.51, SWH=-0.127m,
- - - Dynamic First-Guess Epoch (DFGE)
— interference reference waveform



CORALv2 Coastal Retracker

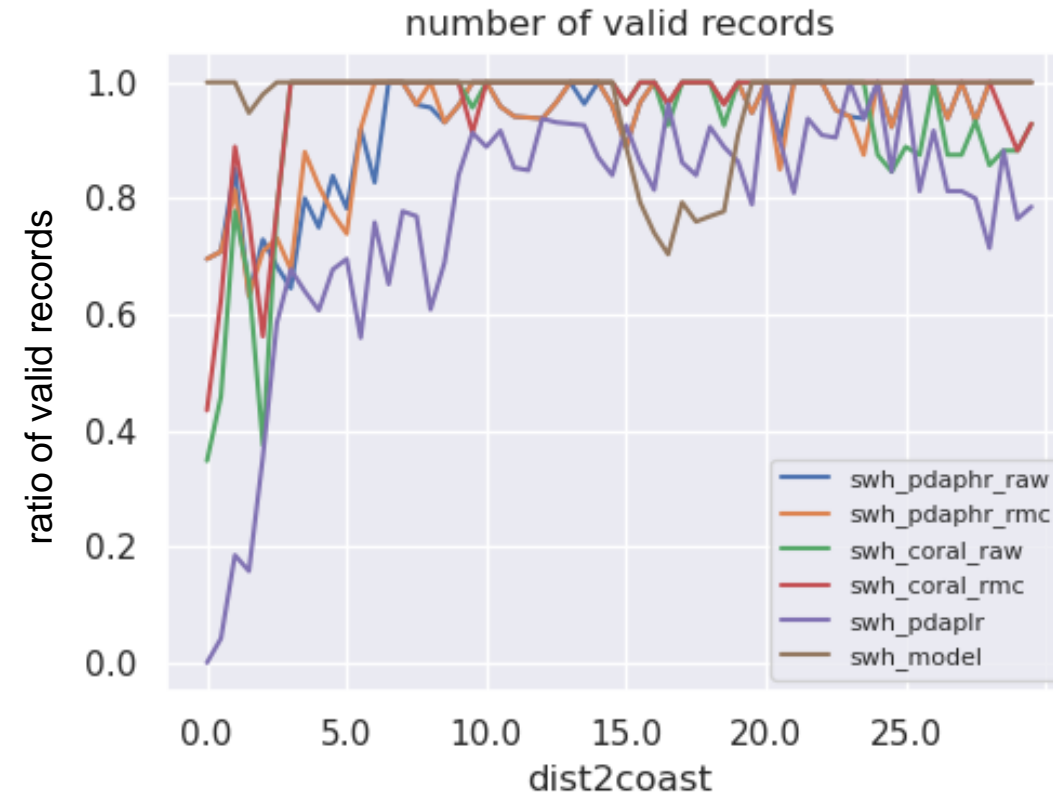
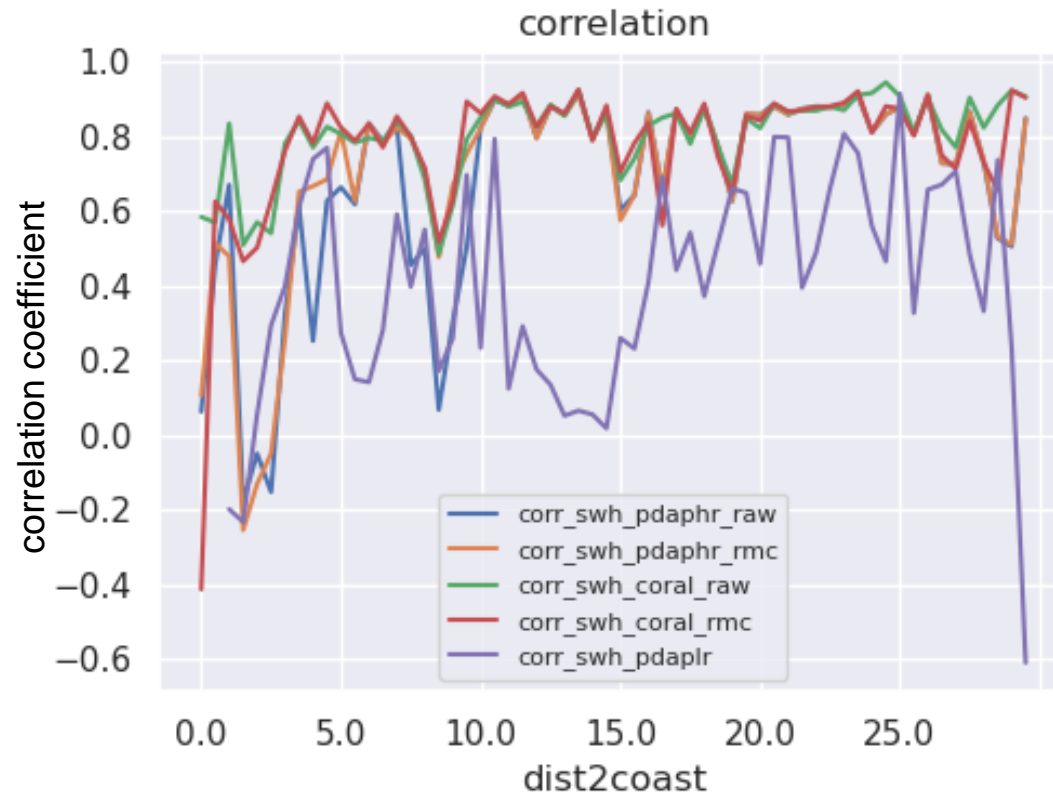
Retracking waveforms with strong coastal interference by CORALv2 in comparison with SAMOSA+



→ **quantity** of the SWH estimates is increased significantly

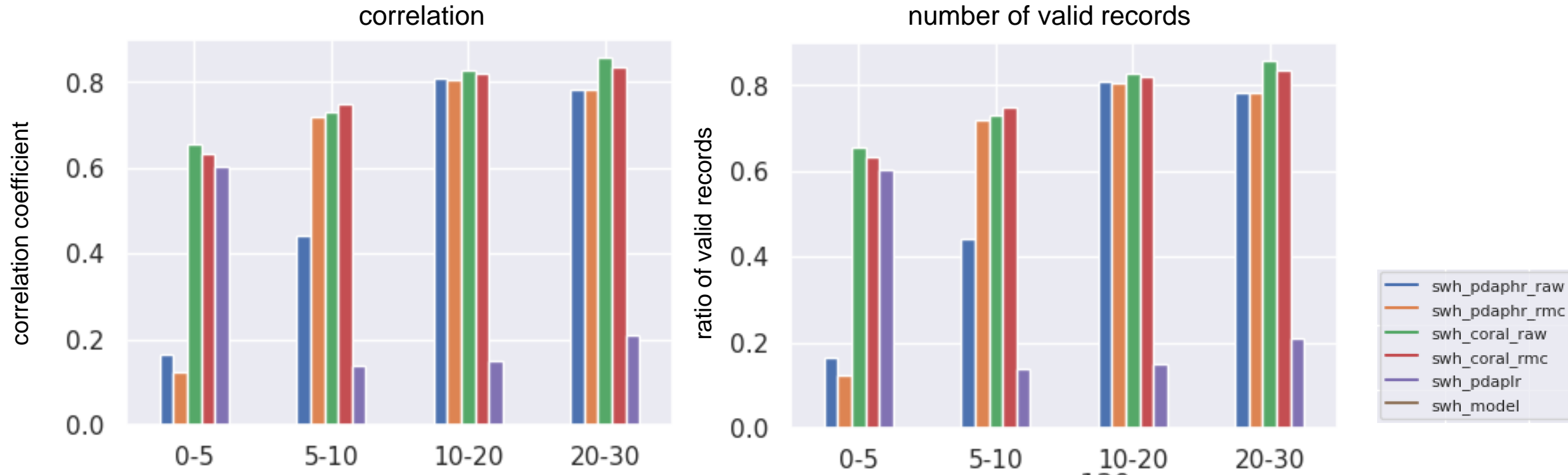
Results vs Model: Distance-to-coast

- correlation, number of valid records (qual_flag)



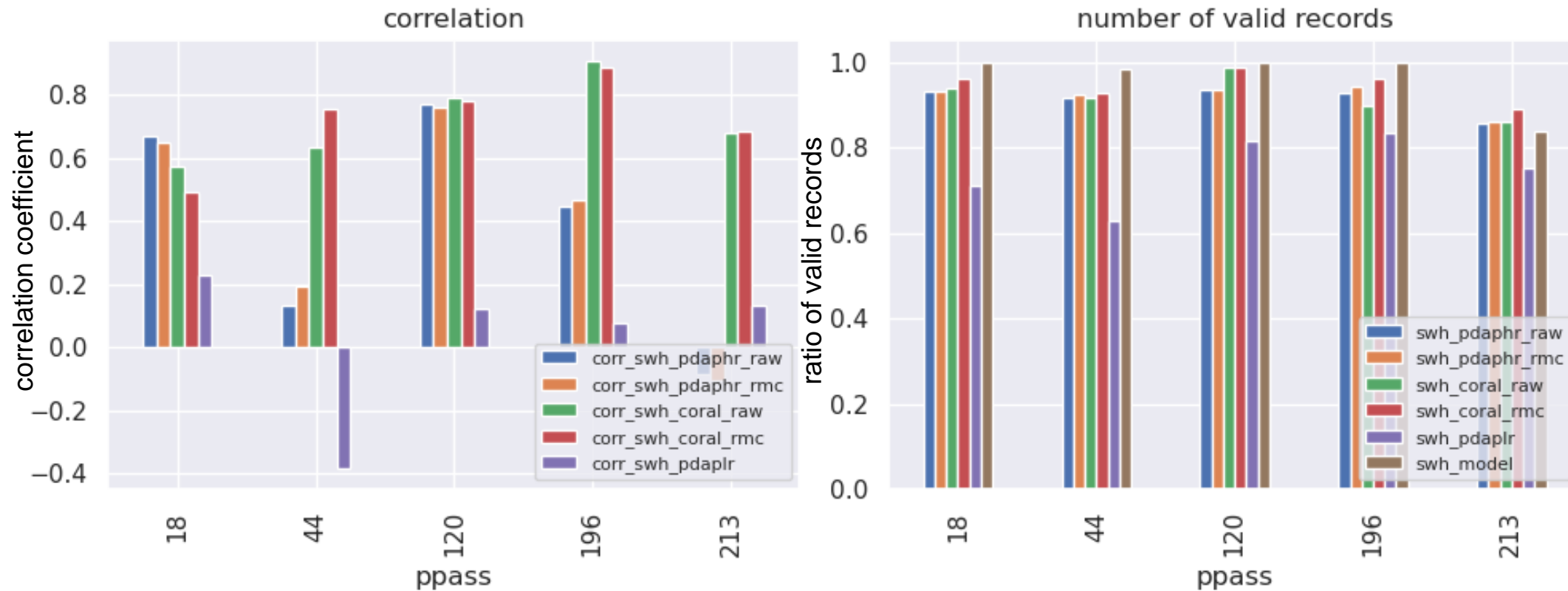
Results vs Model: Distance-to-coast-bands

- All passes vs distance-to-coast bands



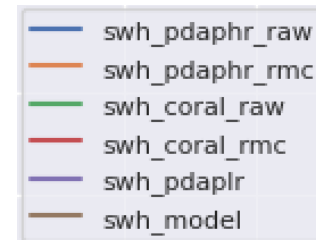
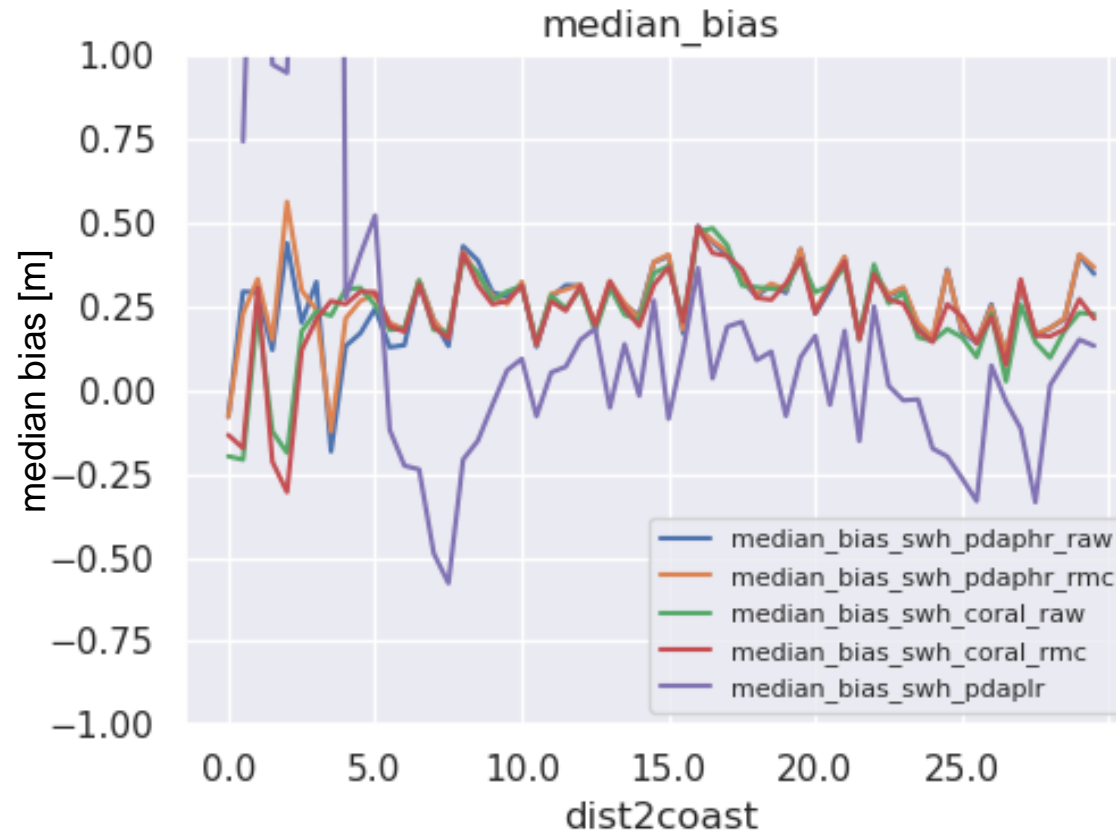
Results vs Model: Passes

- correlation, number of valid records (qual_flag)



Results vs Model: Bias

- The „known“ bias (due to vertical wave motions) between HR and LR is observable w.r.t. the model



→ ~20cm bias (HR overestimates) @low sea states

Conclusion

- Only 3 cycles of 5 coastal crossings along the Dutch Wadden See and Eastern/Western Scheldt have been compared with a high-resolution operational (forecast) model from Deltares (SWAN-Kuststrook)

Key messages

- The PDAP_HR products outperform the PDAP_LR product
- No significant differences between PDAP_HR-RAW and PDAP_HR-RMC (quality and quantity)
 - With slight advantages of PDAP_HR-RMC over PDAP_HR-RAW
- The HR-LR bias is observed also in the coastal zone (~20cm @low sea states)

- In general, CORALv2 outperforms the PDAP products in both quality and quantity
- In a more challenging coastal crossing (pass 213), CORALv2 strongly outperforms the PDAP_HR products
- No significant difference between CORALv2-RAW and CORALv2-RMC

Spare Slides

2. CORALv2: AIM (cont'd)

CORALv2 improves the quality flag by using the **selective misfit**
→ excluding of interference gates \mathbf{k}_{inf} from the misfit calculation

$$\text{misfit}_{\text{selective}} = 100 * \sqrt{\frac{1}{N} \sum_i^N (w_{r,i} - w_{\text{SAM2},i})^2}$$

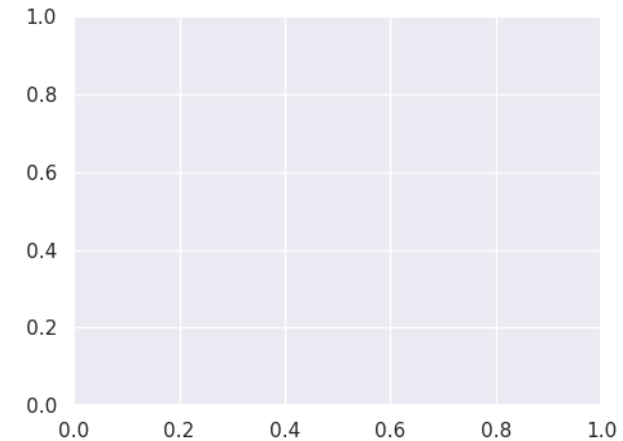
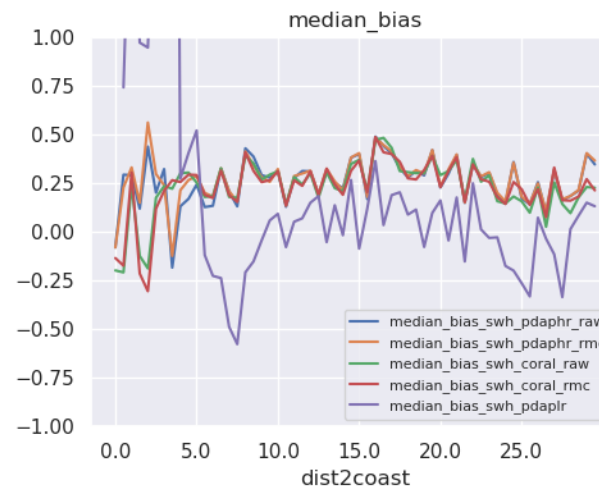
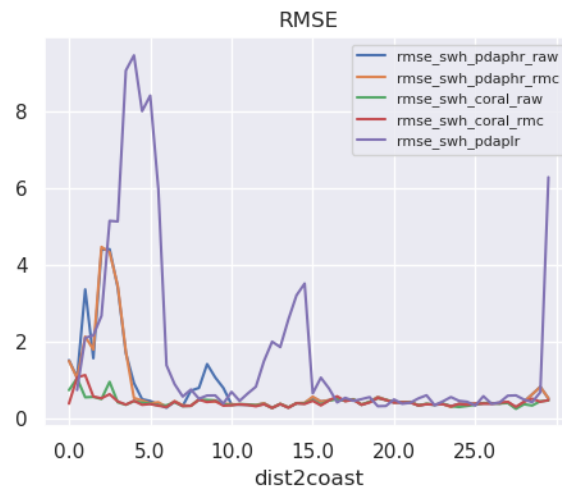
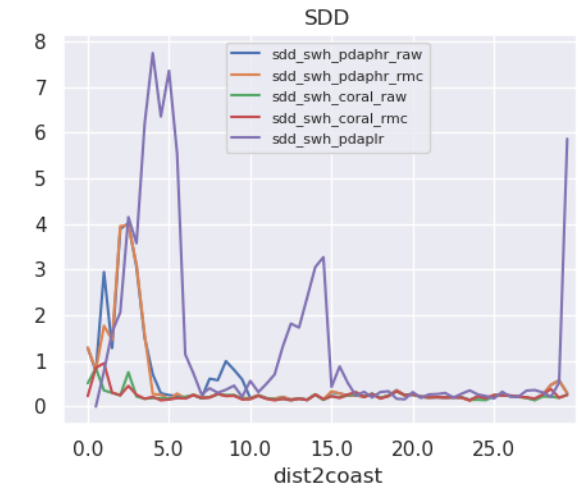
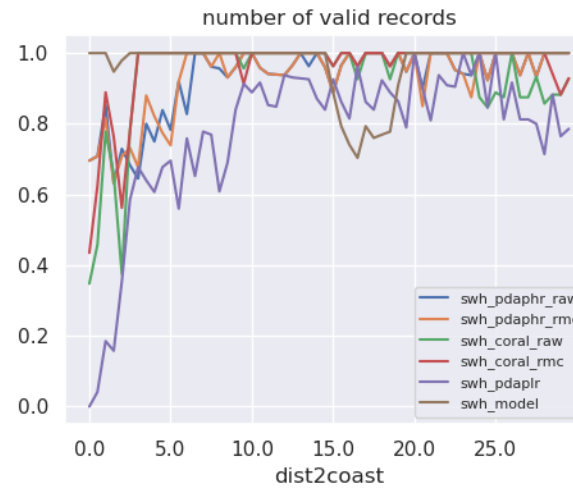
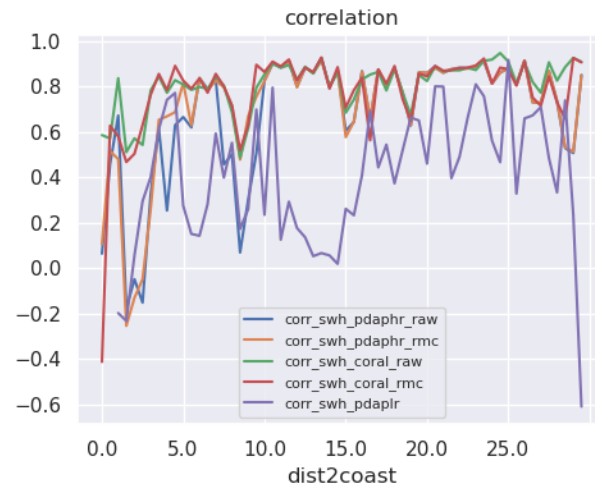
$$i \notin \mathbf{k}_{\text{inf}} = \text{True}(\mathbf{w}_r > \mathbf{w}_{\text{IR}})$$

$$q_{\text{CORALv1}} = \text{misfit}_{\text{selective}} > 4$$

→ AIM better determines the goodness of the fit and recovers strongly interfered waveforms → **quantity** of records ↗

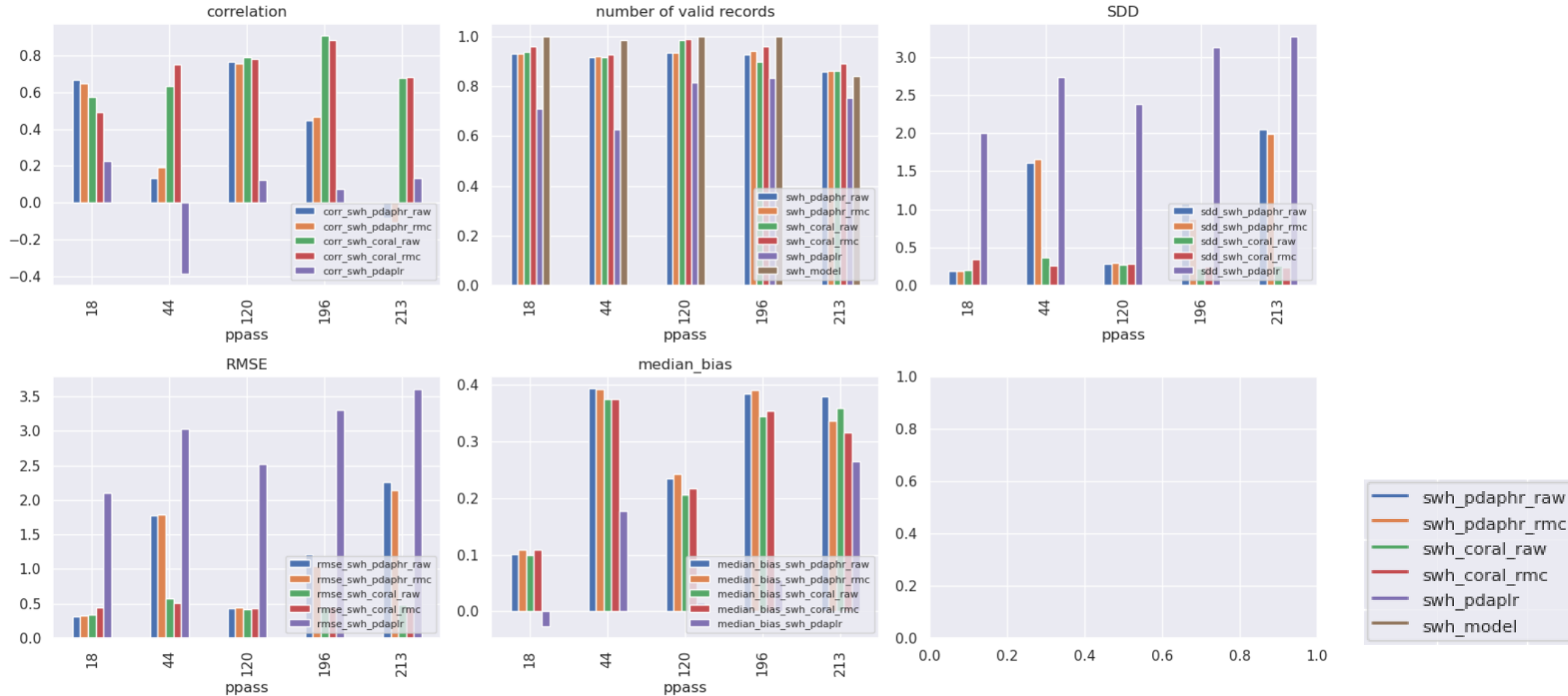
Results vs Model: Distance-to-coast

- correlation, number of valid records (qual_flag), SDD, RMSE, median_bias



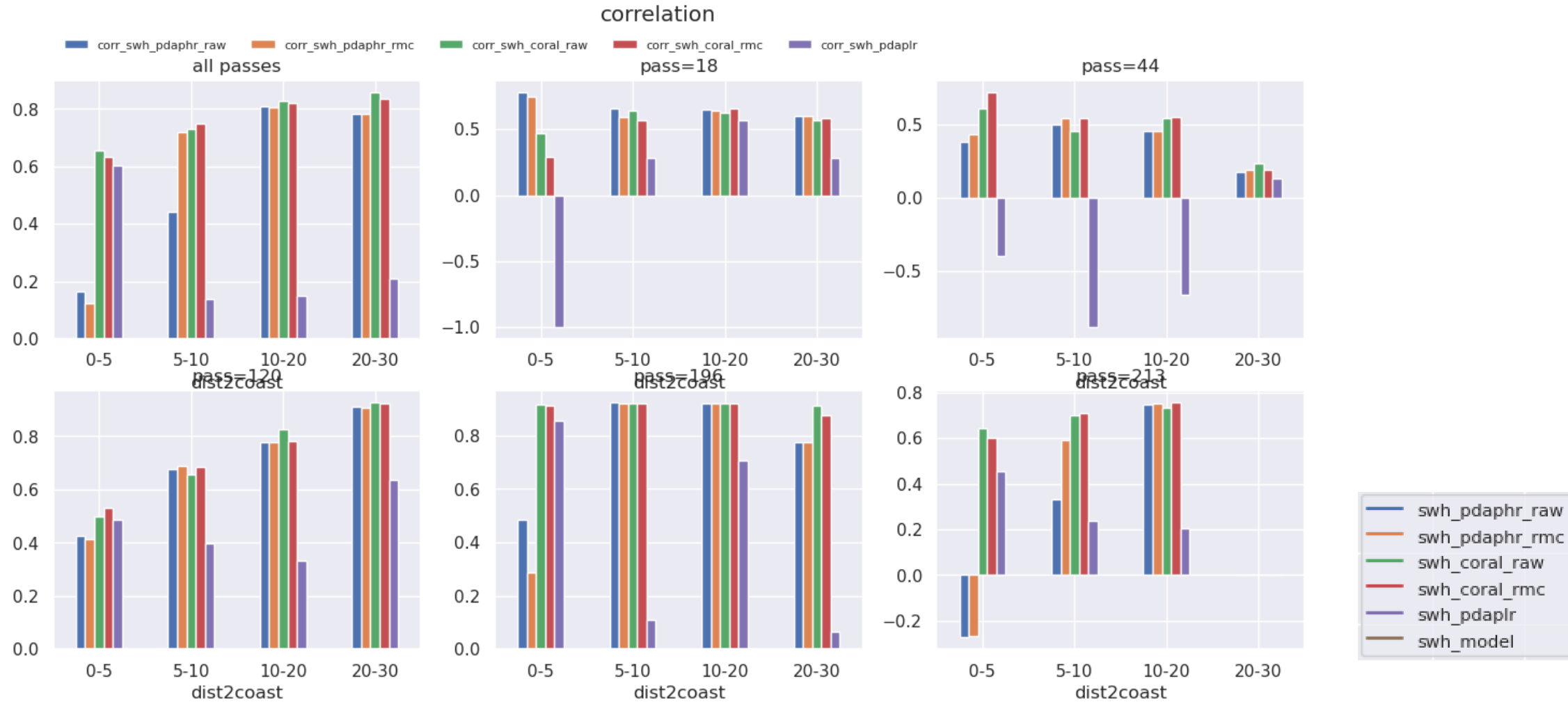
Results vs Model: Passes

- correlation, number of valid records (qual_flag), SDD, RMSE, median_bias



Results vs Model: Distance-to-coast-bands

- correlation



Results vs Model: Results vs Model: Distance-to-coast-bands

- number of valid records (qual_flag)

