SCOOP
Science Review Meeting

WP6400 SAR mode performance in the German Bight

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Objectives

- To assess regionally the CryoSat-2 (S-3) sea surface height (SSH), sea wave height (SWH) and wind speed (U10) data quality (Level 2 product)
- To evaluate impact of wet tropospheric correction developed in WP7000 on the altimeter range
- To evaluate the effect of swell on the altimeter signal

Sub-Workpackages of WP6000

- Focus on the coastal zone data (WP6000), some validation activities also relevant to open ocean (WP5000)

- **WP 6100:** Product Validation Plan for coastal ocean (NOC, Noveltis, TUDa)

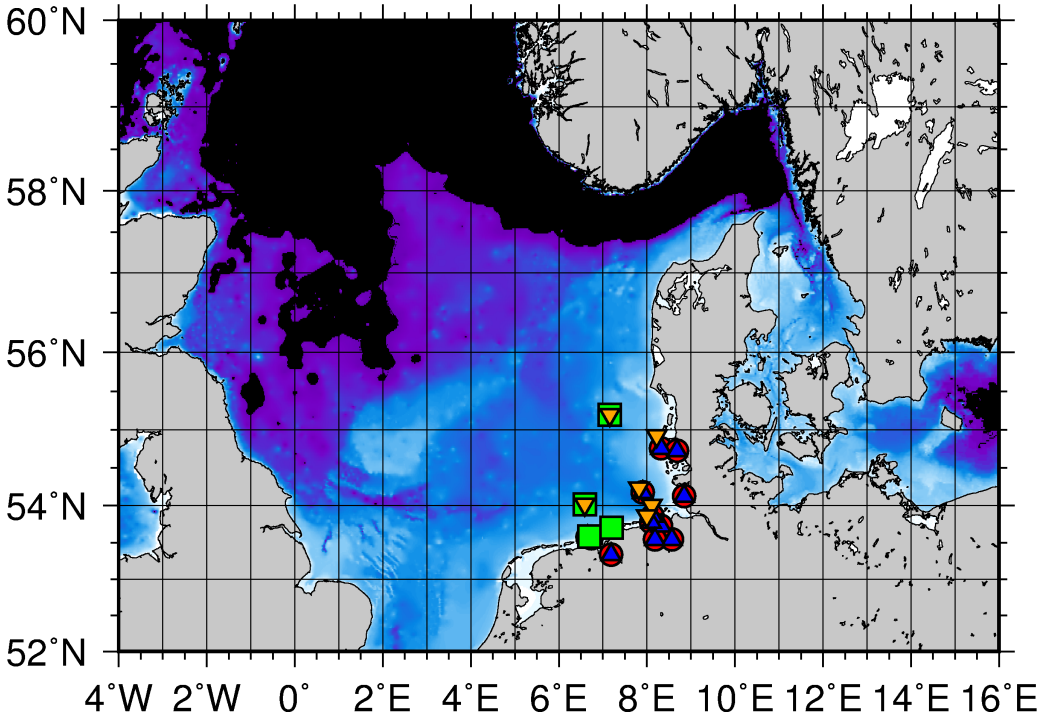
- **WP 6400:** Characterization Performance (open sea & coastal) of SAR products derived from C-2 FBR data

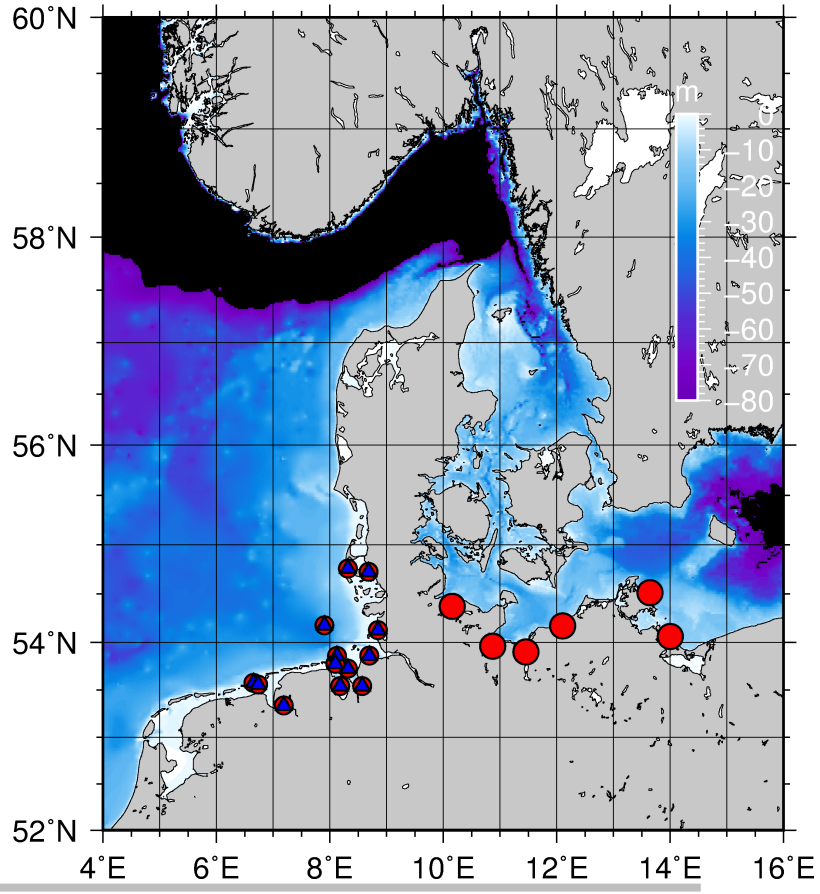
- **WP 6700:** Product Validation report

Data set specification : Region selected

Validation: German Bight & Western Baltic Sea (low sea state), T Interval: 2 y

Swell study: North Sea





(Fenoglio-Marc et al.,AdSR 2015, ESA SP-734, 2015a)

Data set specification

- From Project Team
  - CryoSat-2 SAR Data from Starlab
  - RDSAR Data from TU Delft
  - Wet Correction from UPorto (GPD+)

- From Third-party
  - Tide Gauges and Buoys data in-situ Station Network in German Bight
  - Numerical Sea Level Model from Federal Maritime and Hydrographic Agency of Germany (BSH)
  - sea state from local Numerical Wave Model (WAM & LSM) from German Weather Service (DWD)
  - Wind model data from from DWD
  - Sea state and swell and wind from WW3 wave model
  - Ocean Tide Correction OSU TPXO8-ATLAS (global & HR local),
  - Bathymetry from OSU TPXO8-ATLAS

Methodology for Objective 1: SAR/RDSAR product assessment

- **Regional Cross Validation**
  - between SAR and RDSAR, J-2 and Saral/Altika
  - against model data
- **In-situ Validation**
  - against geodetic referenced in-situ data
- **Along Track Validation**
  - against geodetic referenced in-situ data

Methodology for Objective 2: innovative products assessment (WTC)

- **In-situ Validation**
  - against geodetic referenced in-situ data
- **Along Track Validation**
  - against geodetic referenced in-situ data

Note: Regional cross-validation of altimeter products is of no interest, as the same correction will be used in both Datasets

Methodology for Objective 3: swell effect in SAR/PLRM data

- **Regional Cross Validation**
  - between SAR and RDSAR
  - against model data

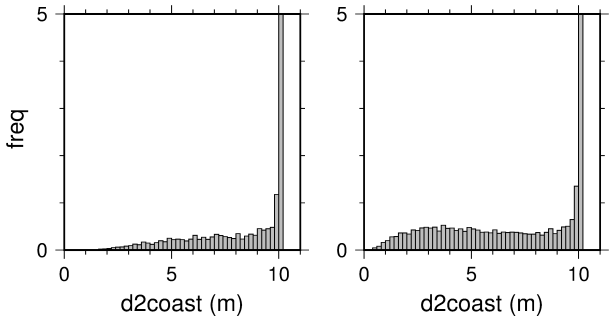
The impact of swell on L2 products is investigated by comparing in different swell conditions the C-2 SAR retrieved parameters SSH, SWH to the corresponding PLRM retrieved parameters.

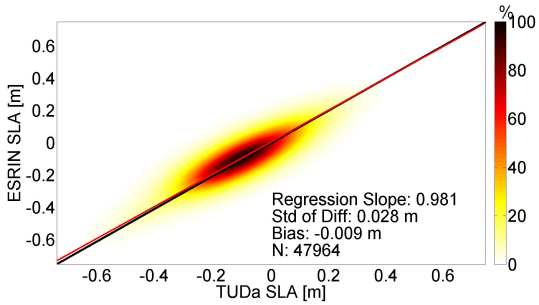
Validation strategies

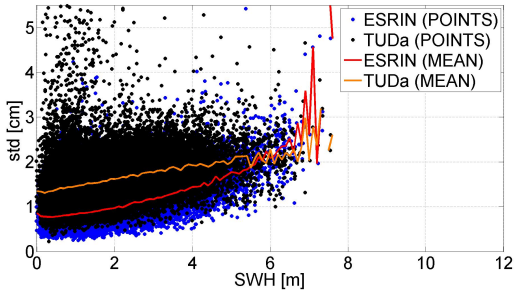
- **Definition of skill metrics**
  - Mean and std of differences
  - Correlation
  - Slope
  - Number of cycles, Points retained

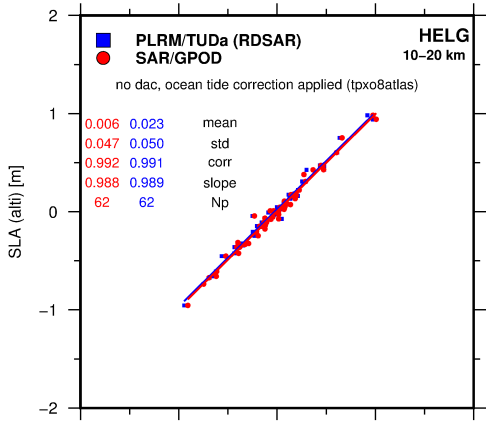
Product validation method

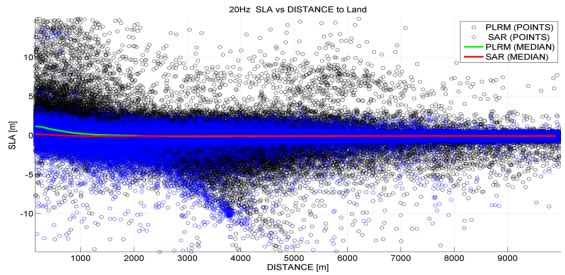
- Histogram (1 Hz)
- Scatterplots
- Misfit
- Maps (1 Hz)
- Dispersion diagrams
- Along track gain of variance
- Distance to land plots
- Time series of sea level

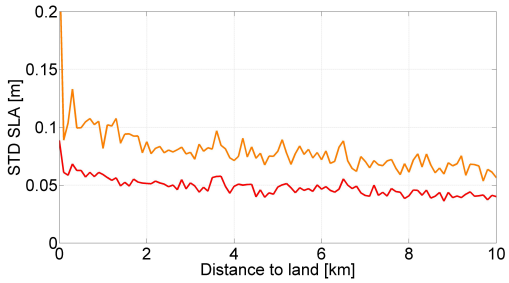












Recent developments/ methodology definition

- CryoSat-2 SAR Data from ESRIN GPOD (from FBR), SAMOSA+
- CryoSat-2 PLRM Data from TU Darmstadt (from FBR), SINC2
  - Numerical retracker based on a fast circular convolution algorithm
  - Based on RADS, but using a real Point Target Response (PTR) in the Brown model instead of a Gaussian approximation for the waveform retracking -> improved SWH

Recent developments/ methodology definition

- Data Screening Criteria:

- -15 m<SLA<15 m
- Bathymetry > 2 m
- Distance to Land >150 m
- No Inland Water Data
- Sigma0 < 30 dB

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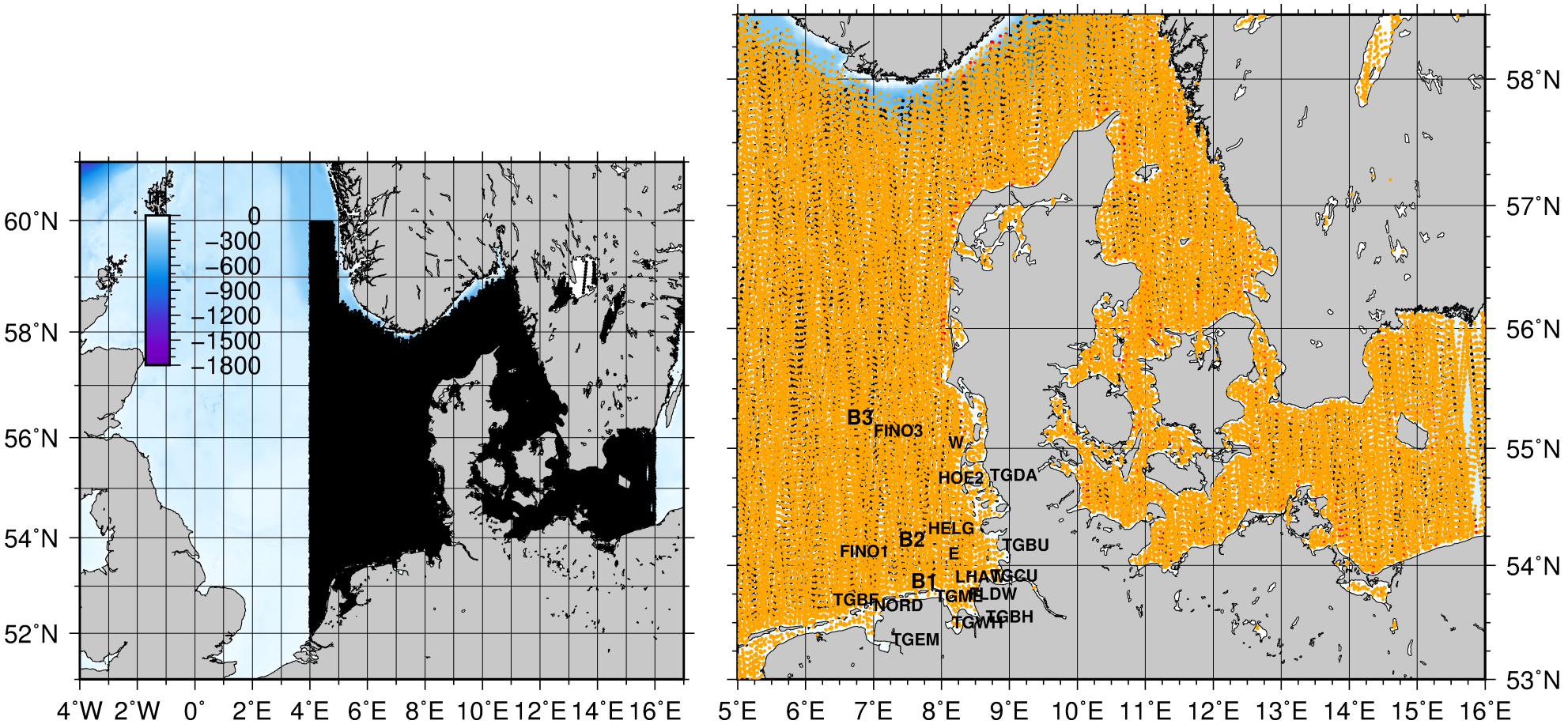
1 Hz SAR GPOD



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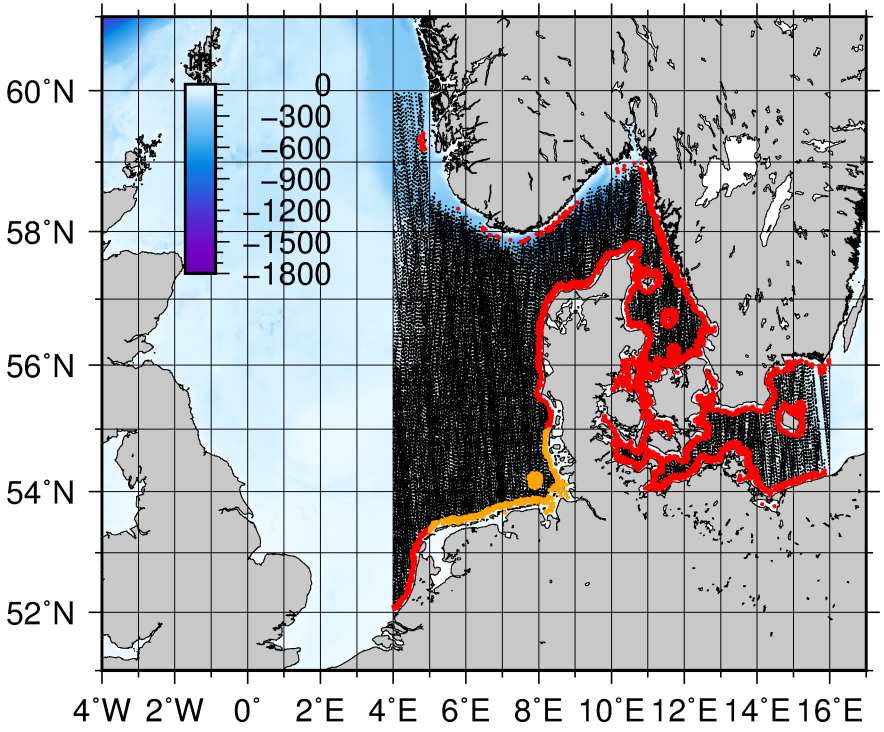
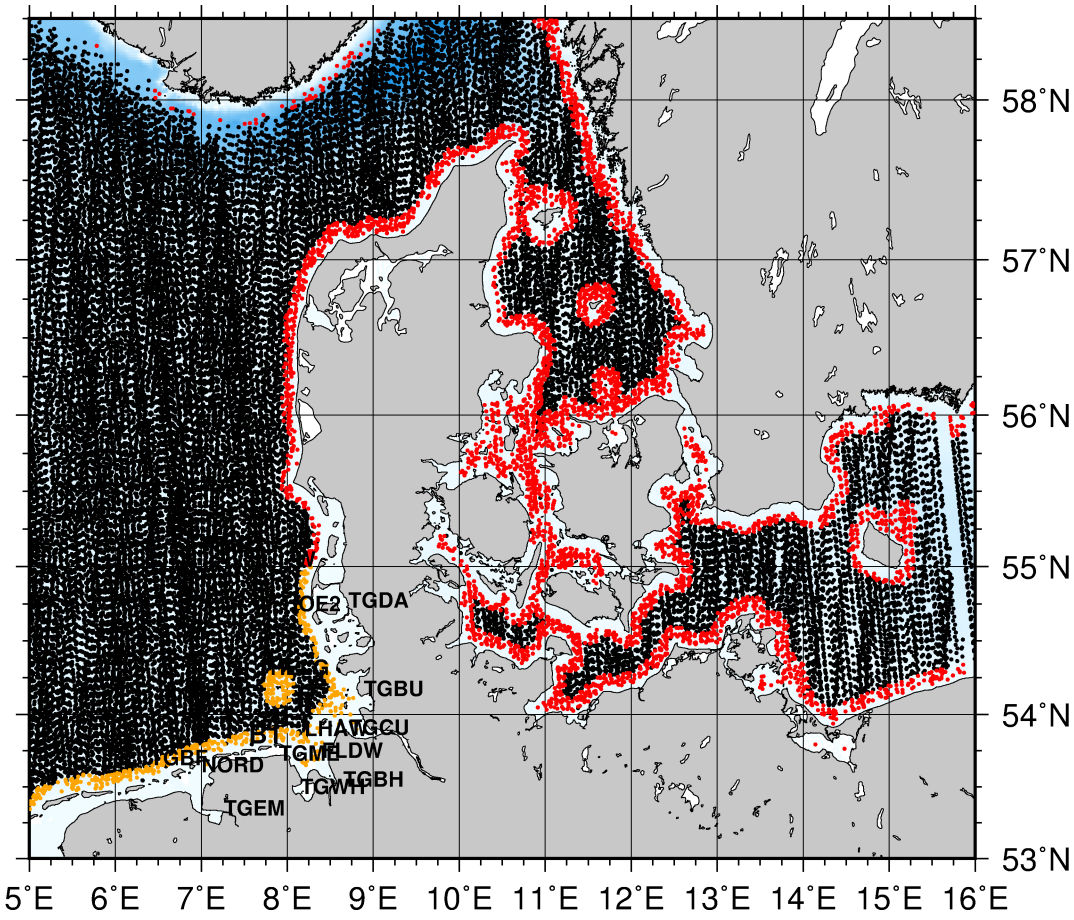
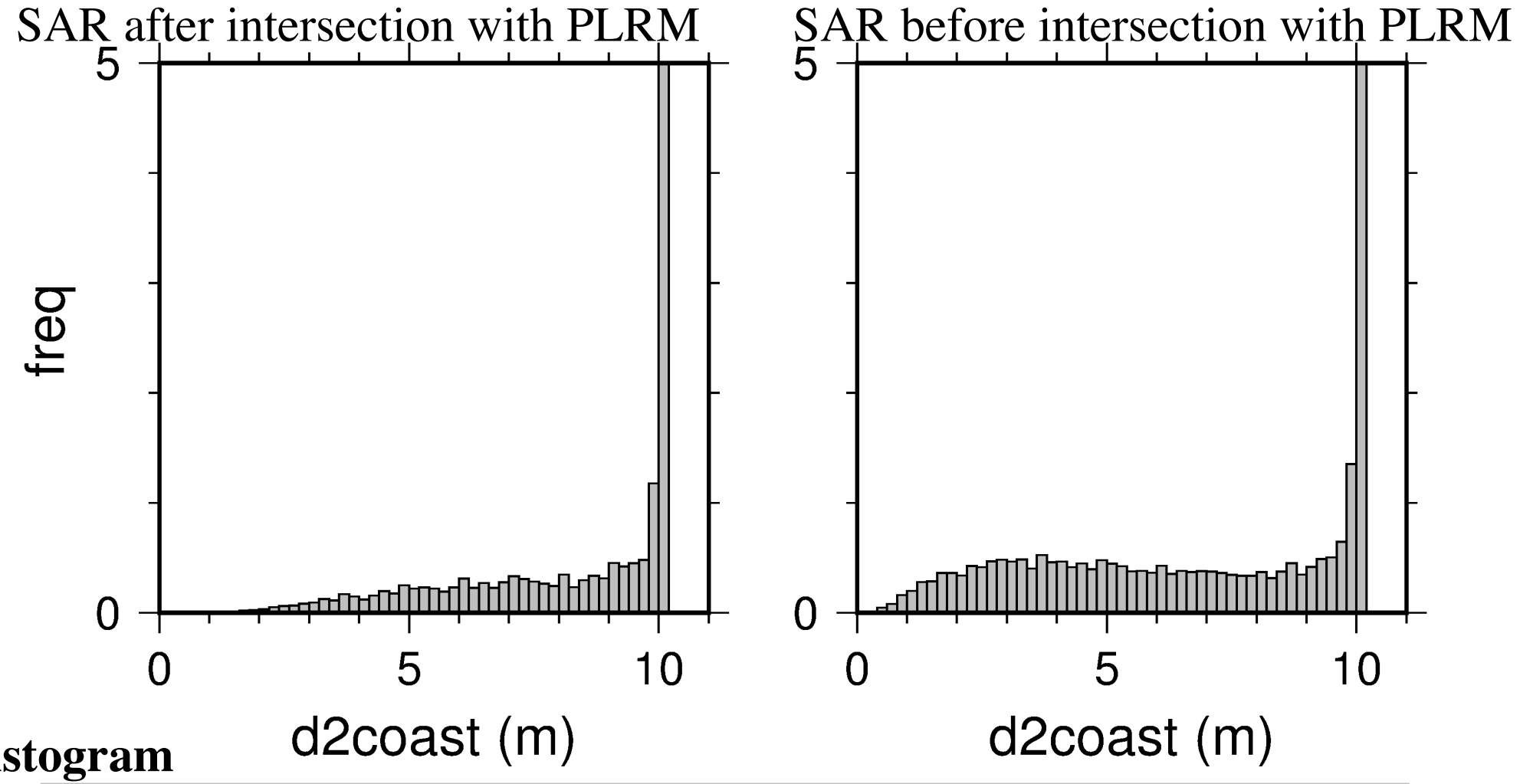
1 Hz PLRM and SAR intersection

Less points at 1Hz data in PLRM/RDSAR than in SAR



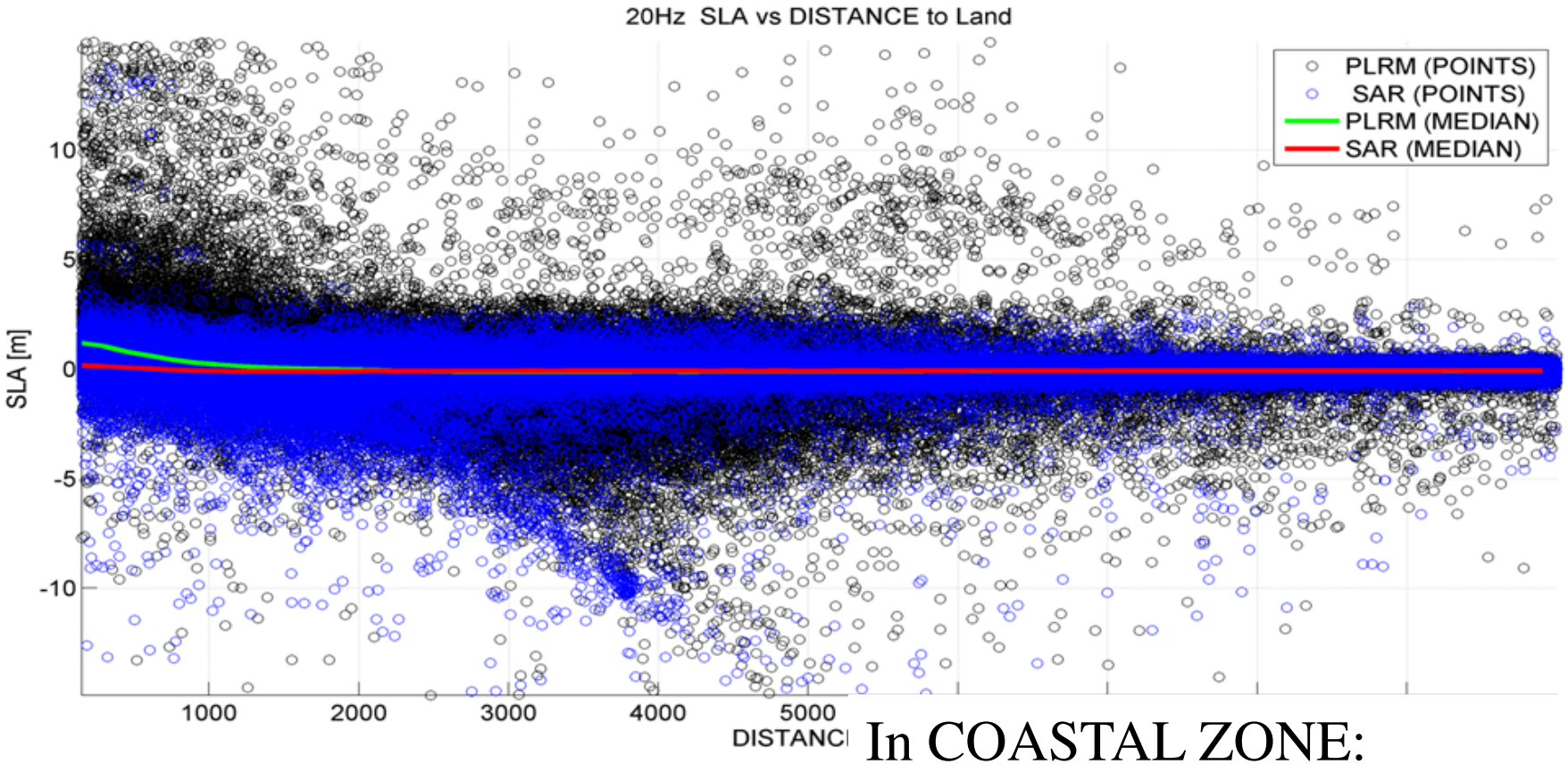


1 Hz PLRM and SAR intersection



Histogram

SLA vs. Distance to Coast for SAR and PLRM



In COASTAL ZONE:

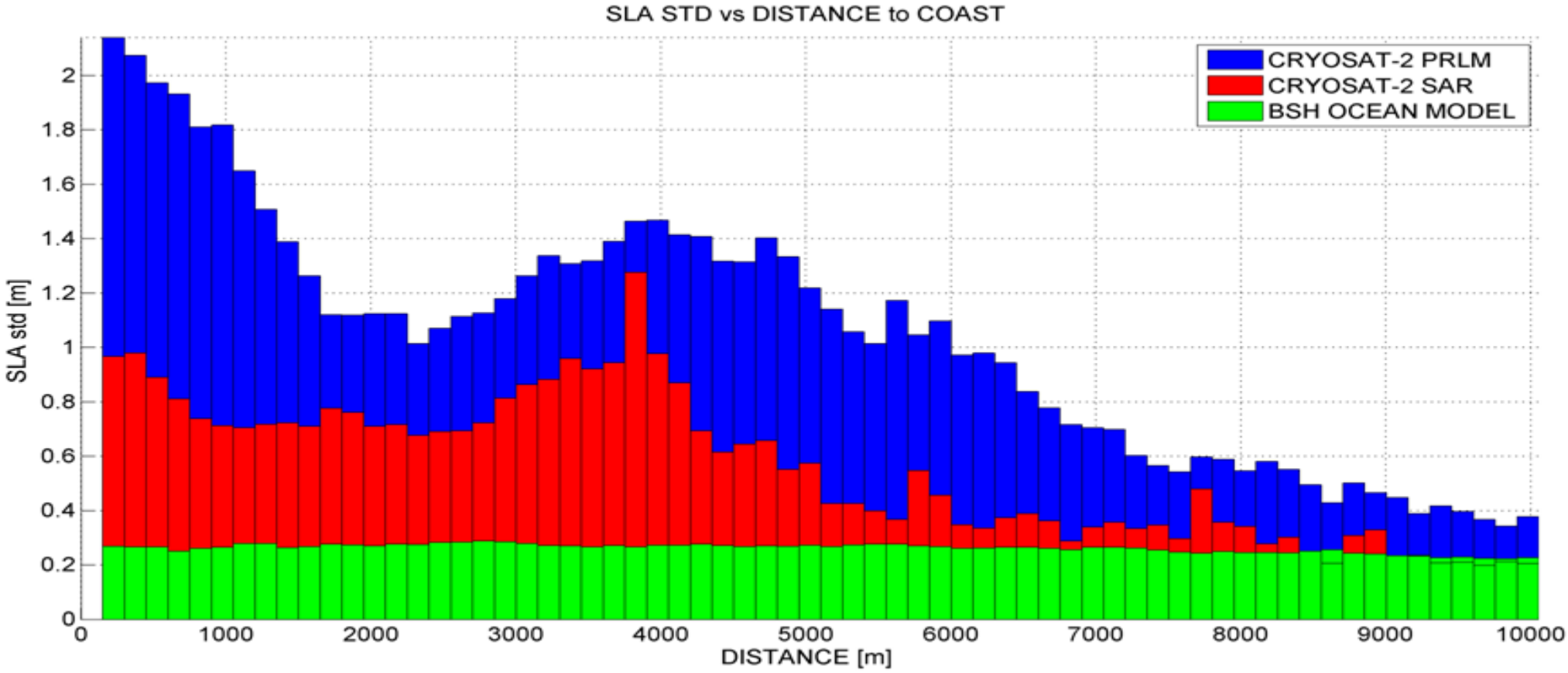
SAR SLA →96 % between ±1 m

PLRM SLA→ 85% between ±1 m

Along track gain of variance

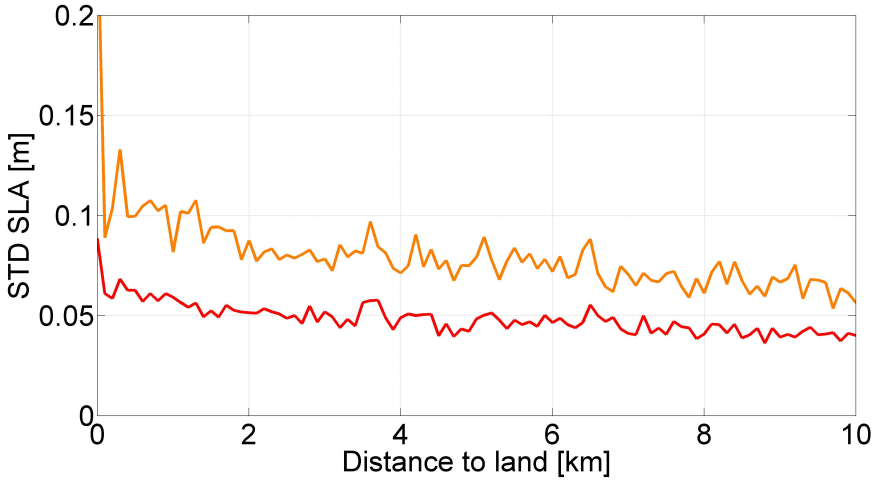
Plots vs. Distance to Land

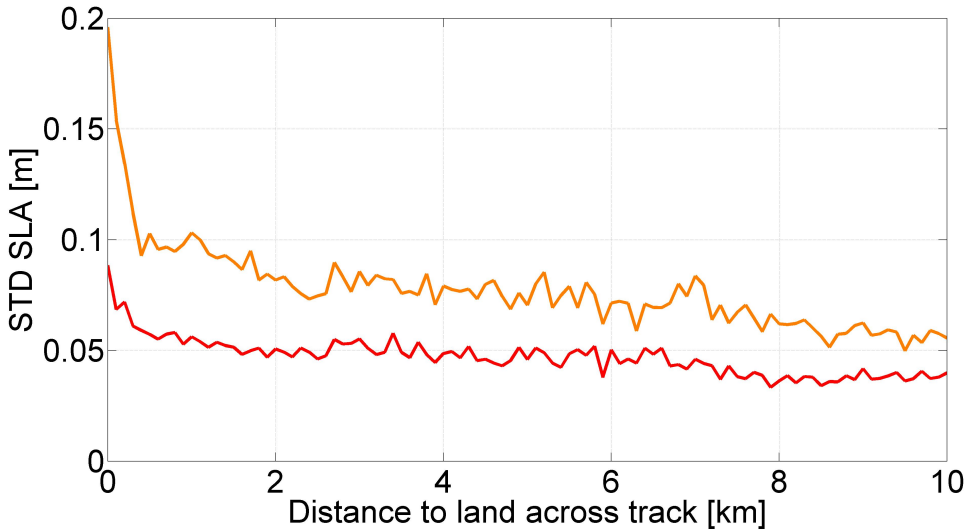
SLA STD computed every 150 meter between 0 and 10 km



Along track gain of variance

Plots vs. Distance to Land

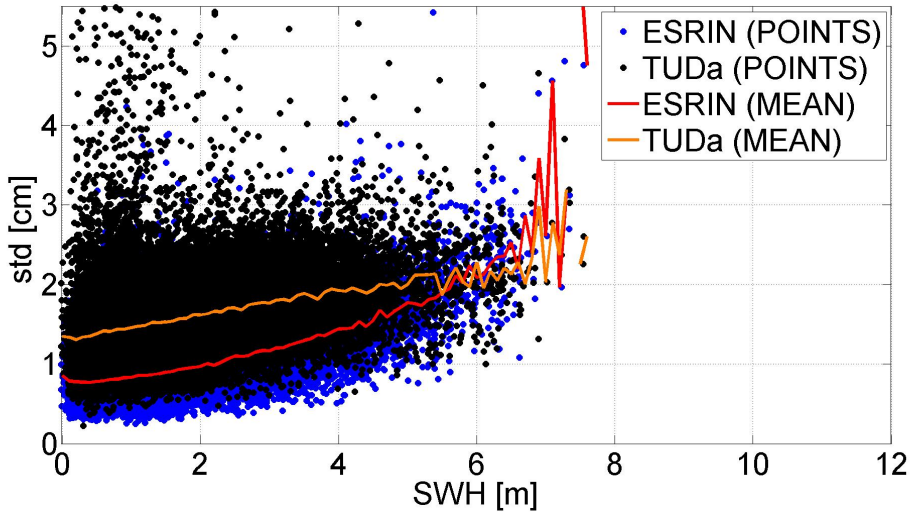




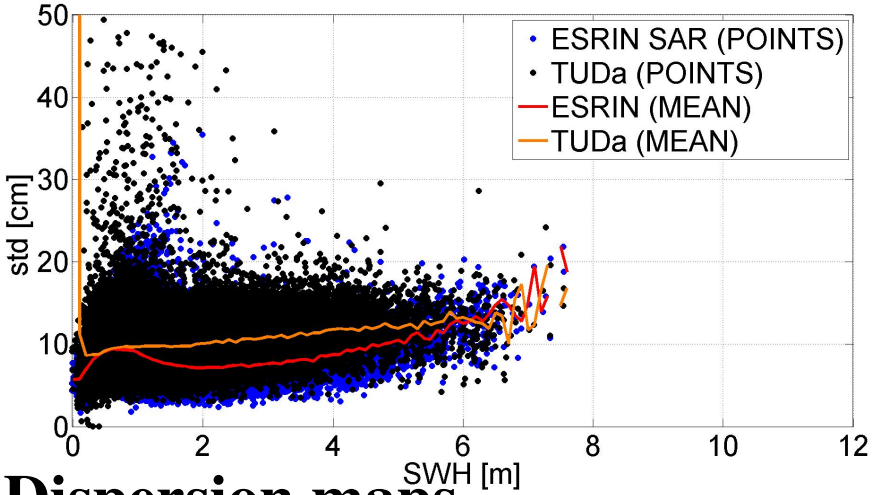
Median of absolute differences of neighboured SLA values computed at 100 meter interval between 0 and 10 km for SAR (red) and PLRM (orange)

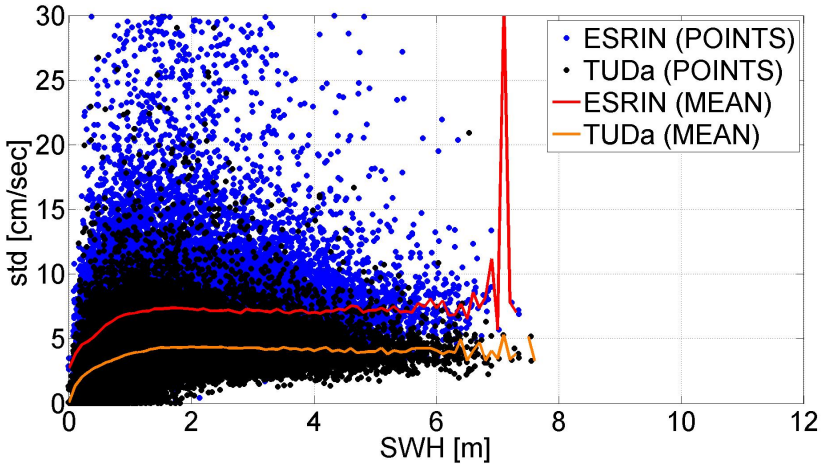
Along track gain of variance

SAR & PLRM precision in German Bight



Precision (1Hz std) of SSH (top),
SWH (bottom right)
U10 (bottom left)





Dispersion maps

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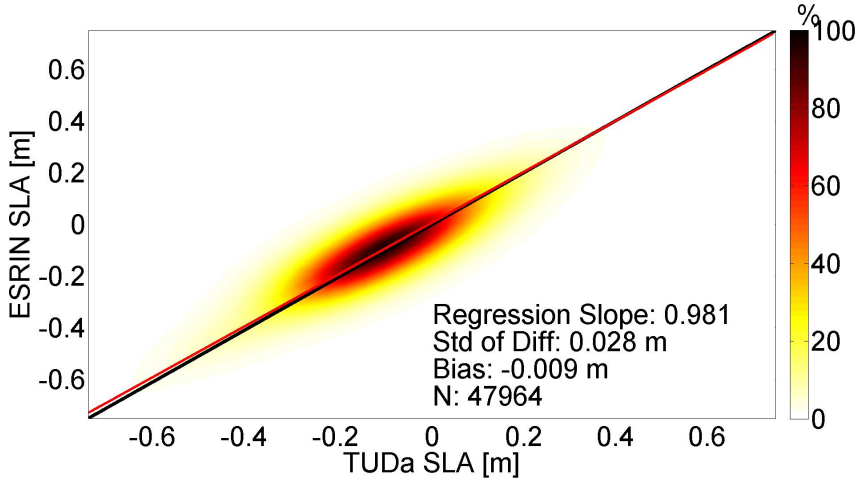
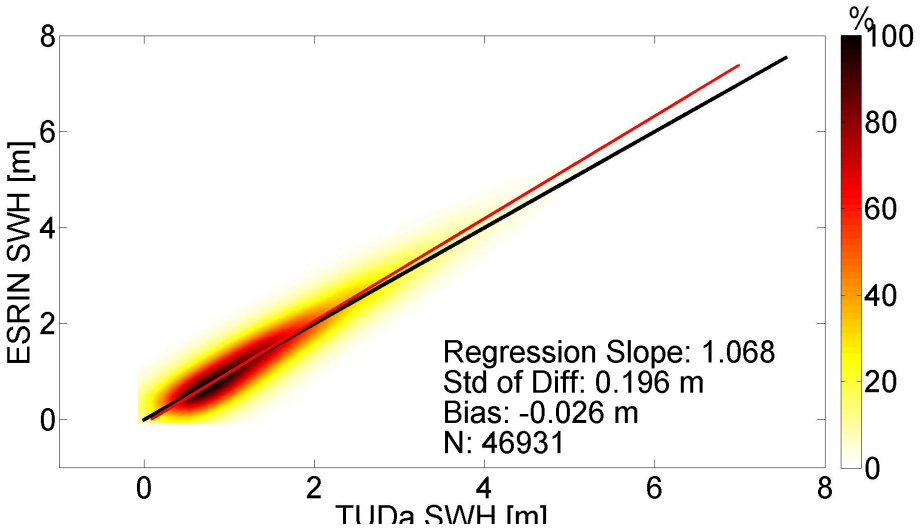
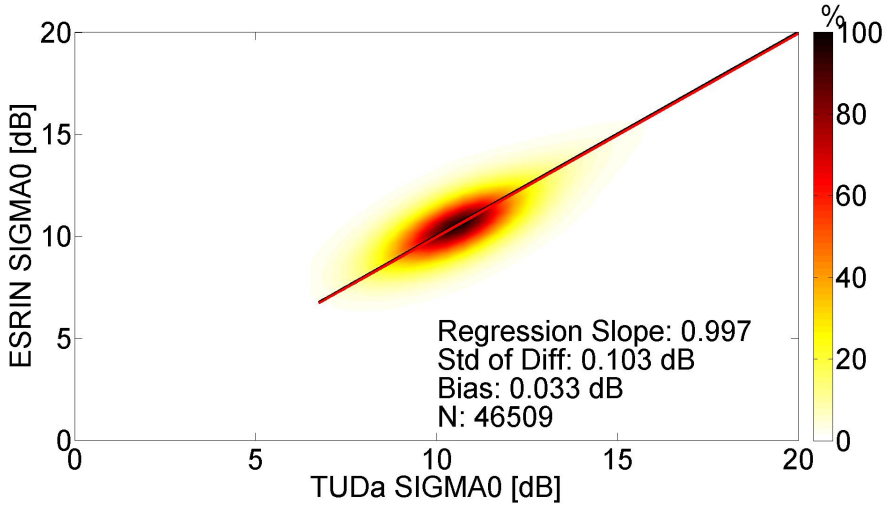
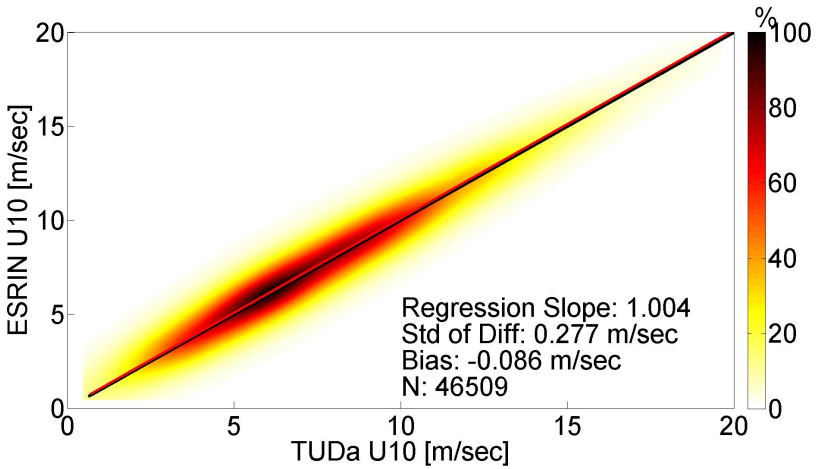
PLRM and SAR cross-validation in German Bight (4y)



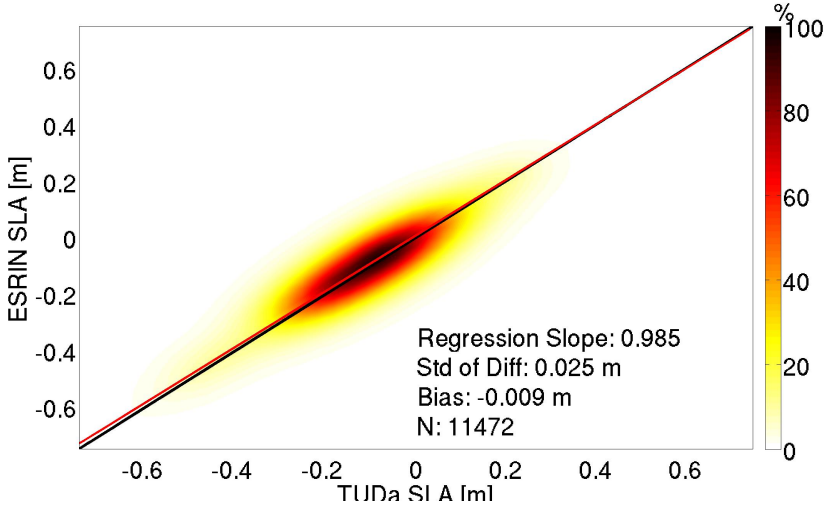


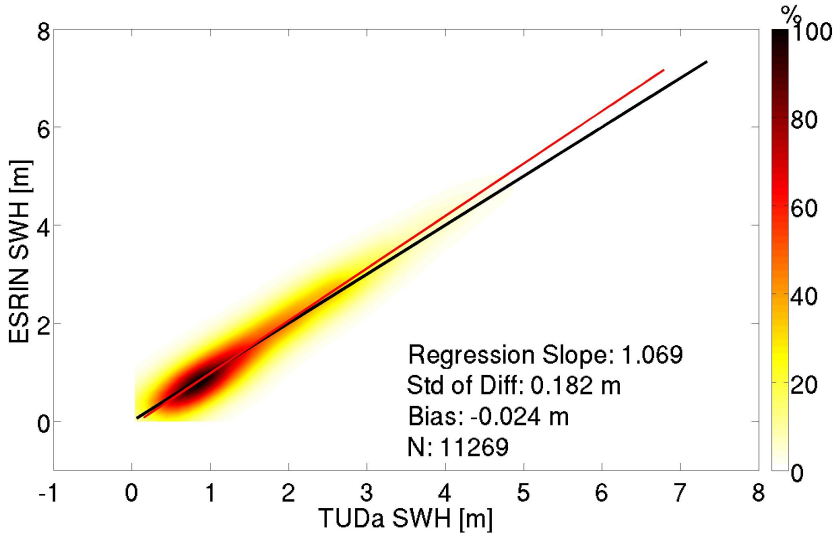


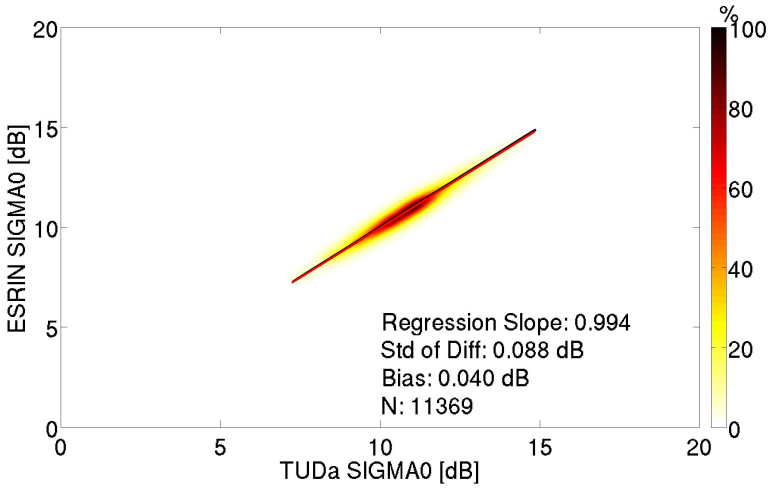


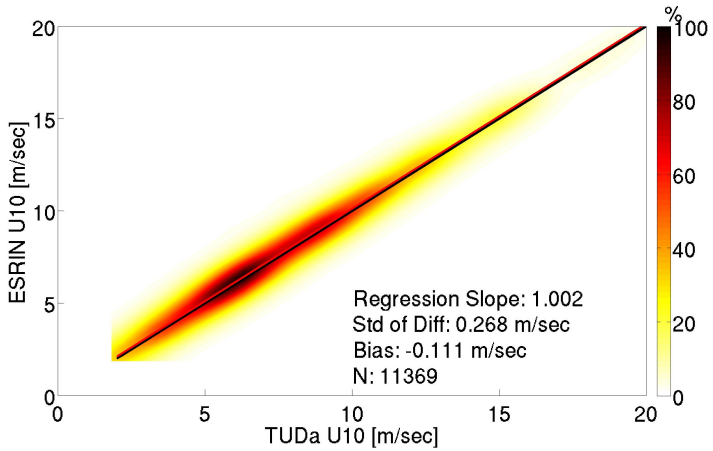
Scatterplots

PLRM and SAR cross-validation in German Bight (1y)



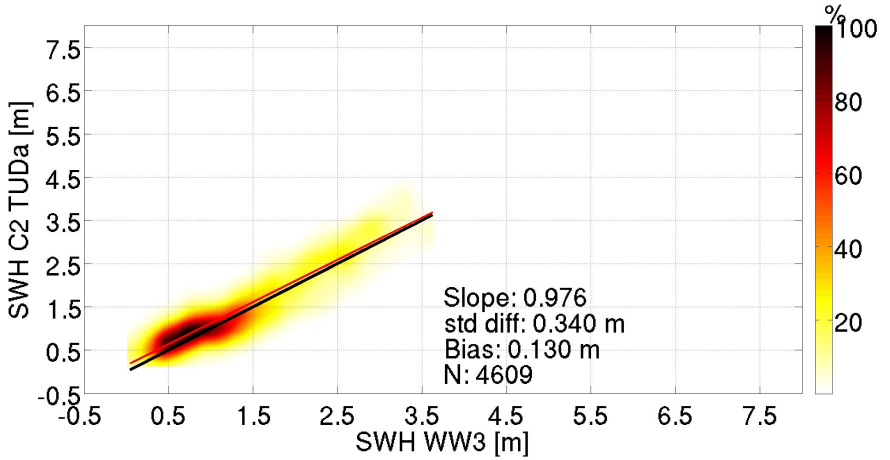


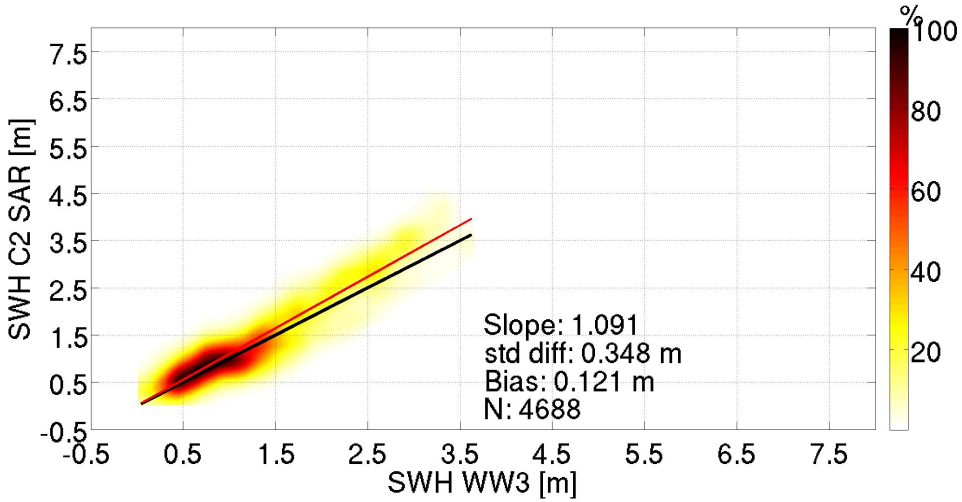


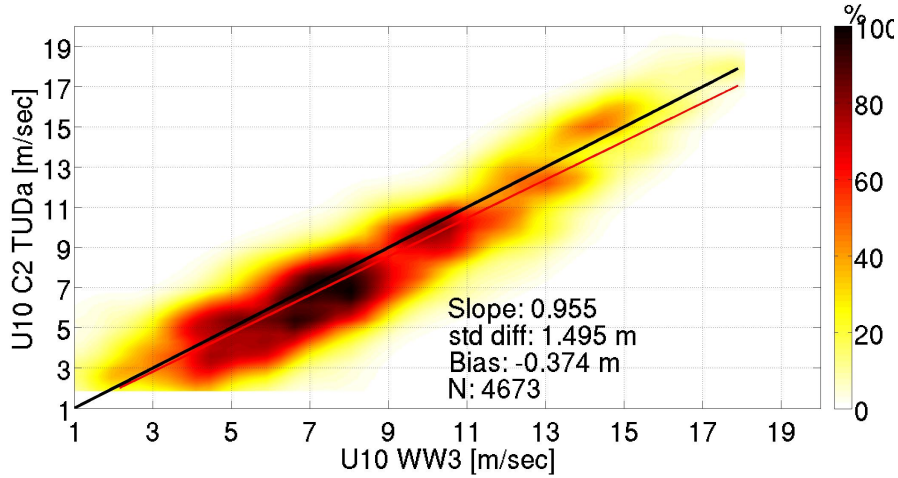


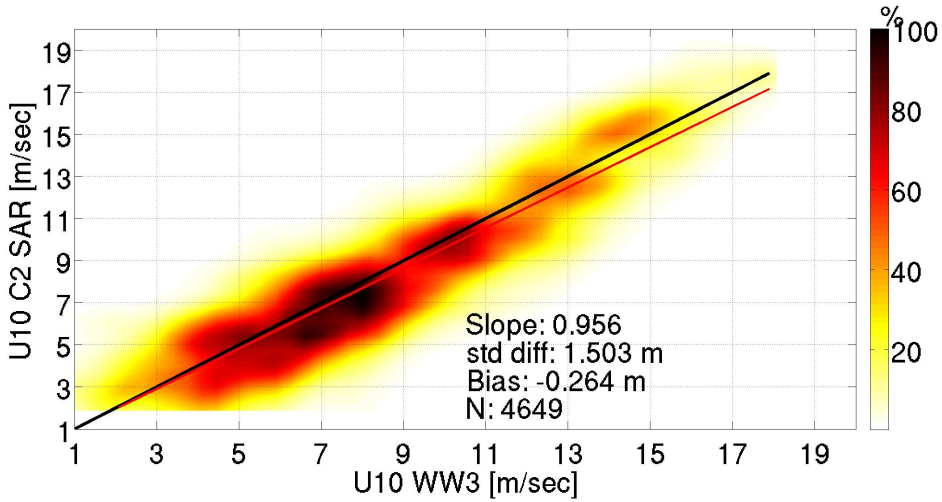
Scatterplots

PLRM/SAR against model WW3 in German Bight (1y)







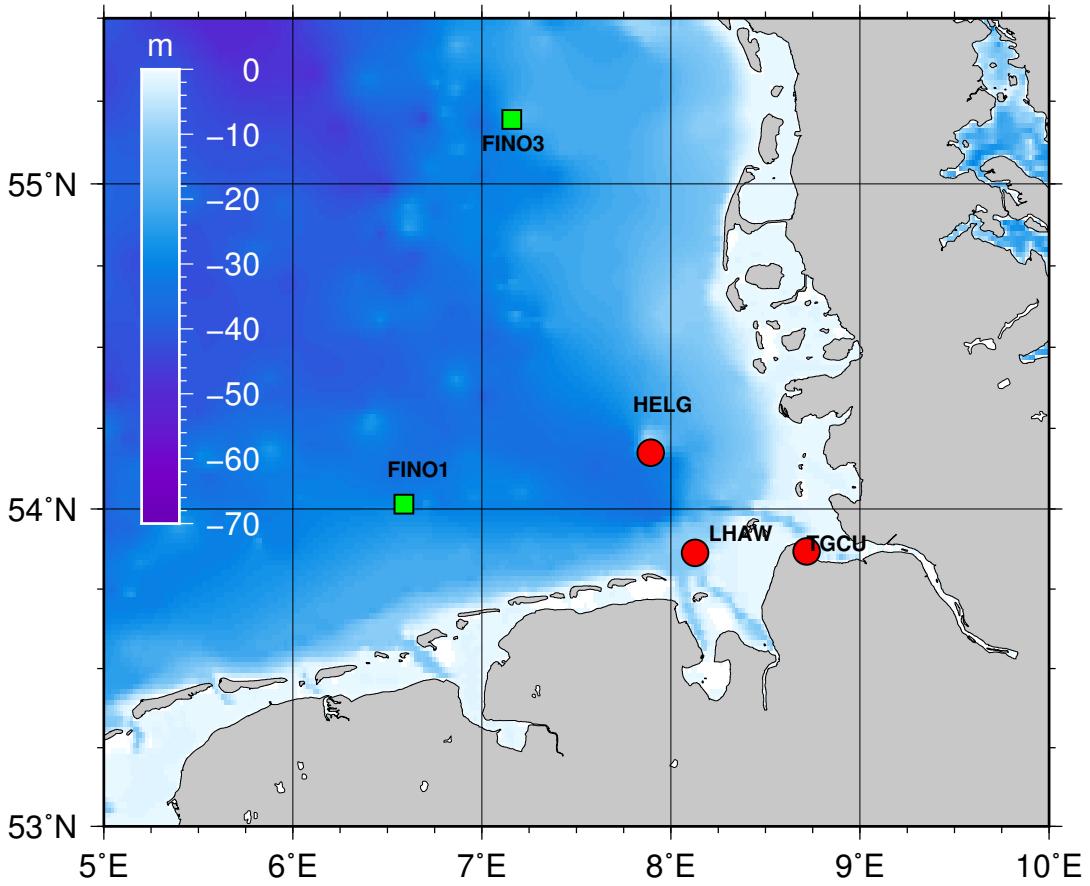


Scatterplots

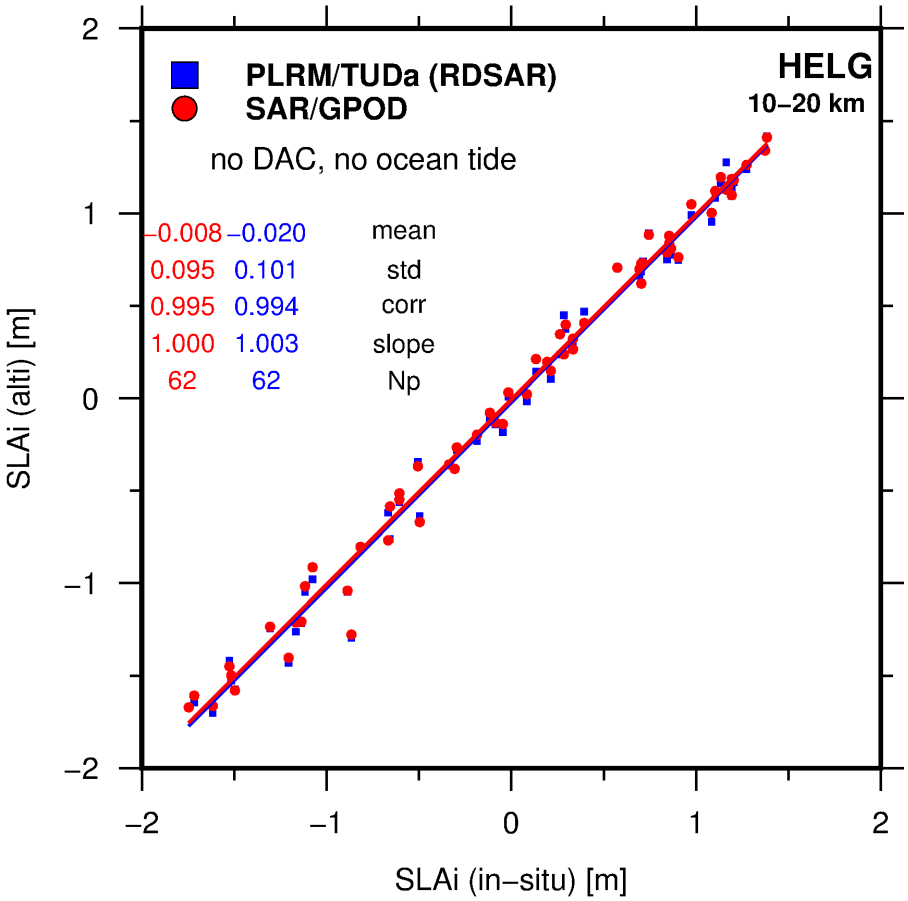
Wind from Model is underestimated, sea state model overestimated in SAR

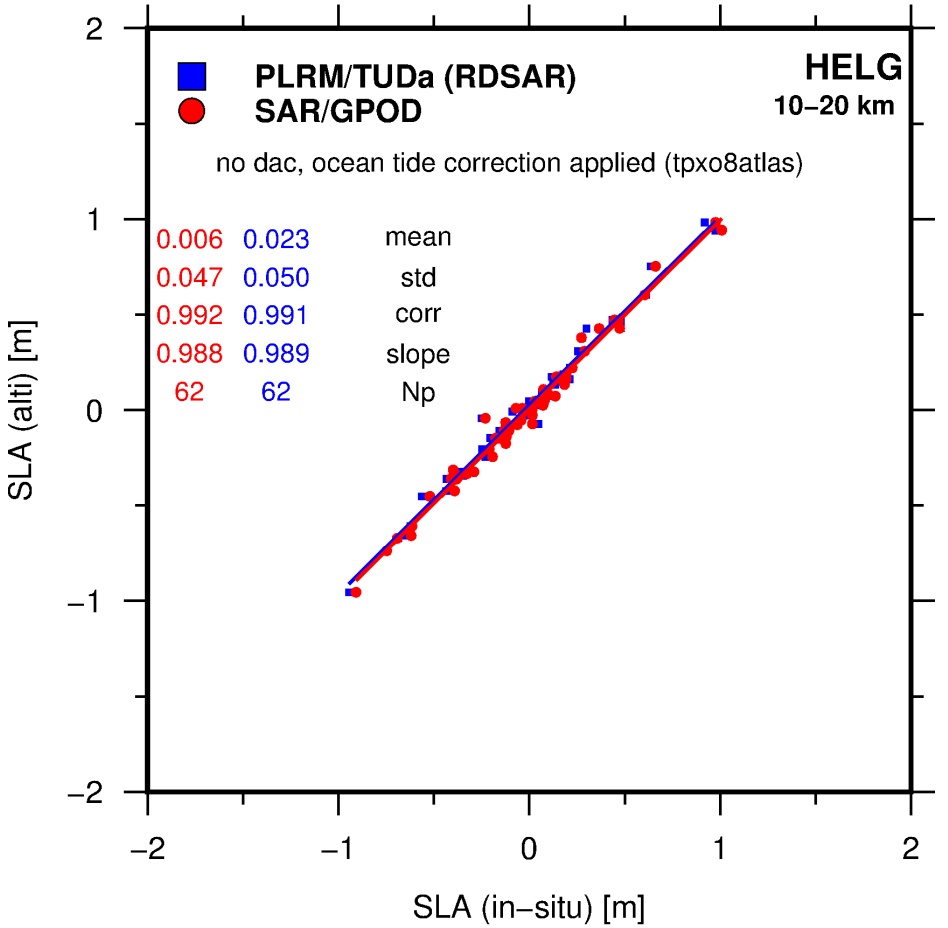
In-situ validation in the German Bight

Data: 1Hz, 20 Hz data



SSH In-situ validation 1 Hz PLRM and SAR intersection





Scatterplots Effect of tide correction in reduction of std

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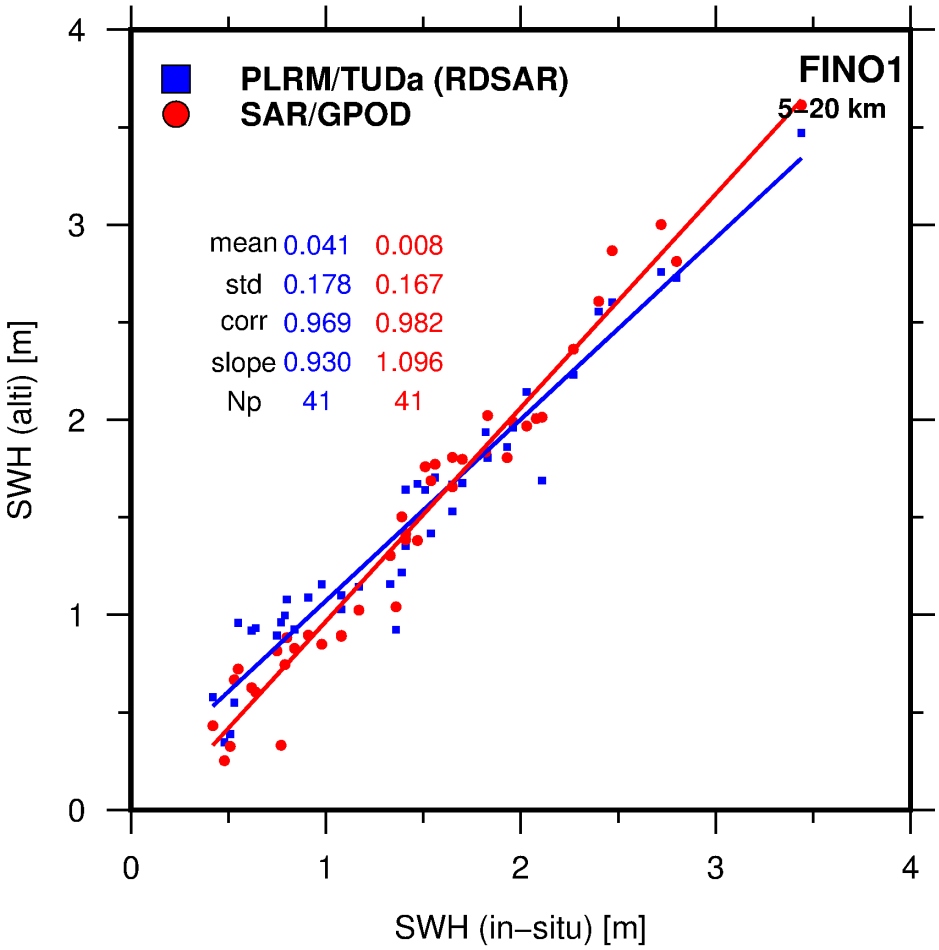
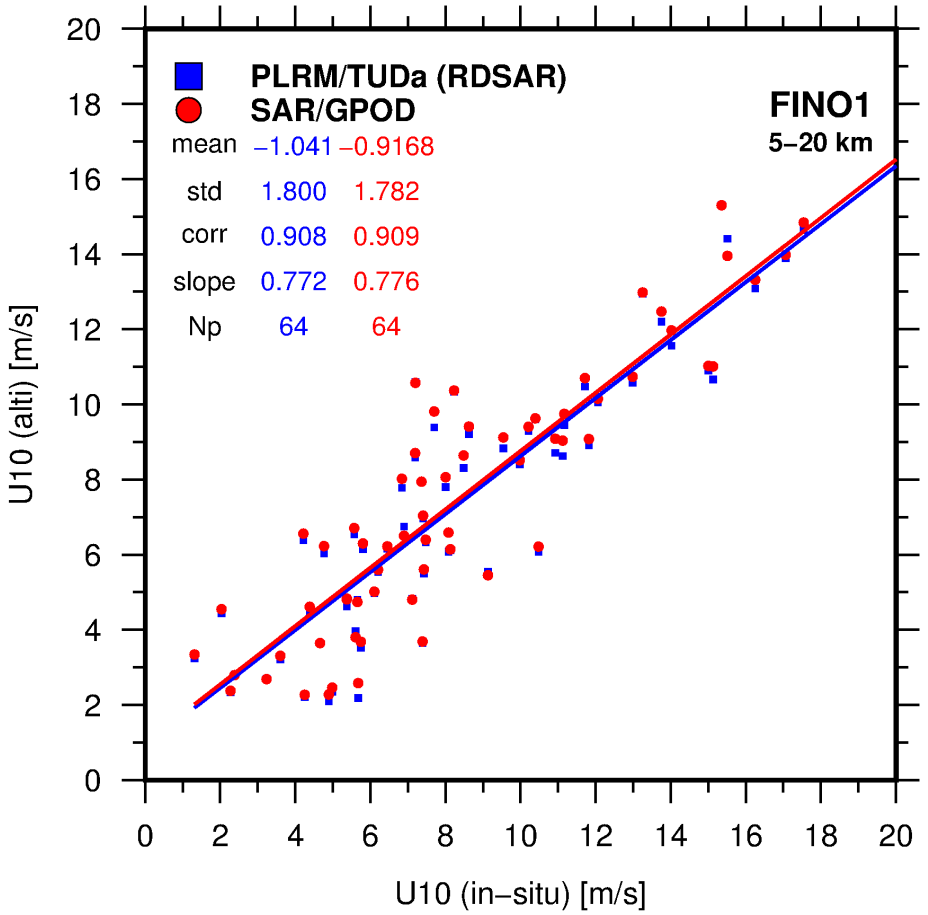
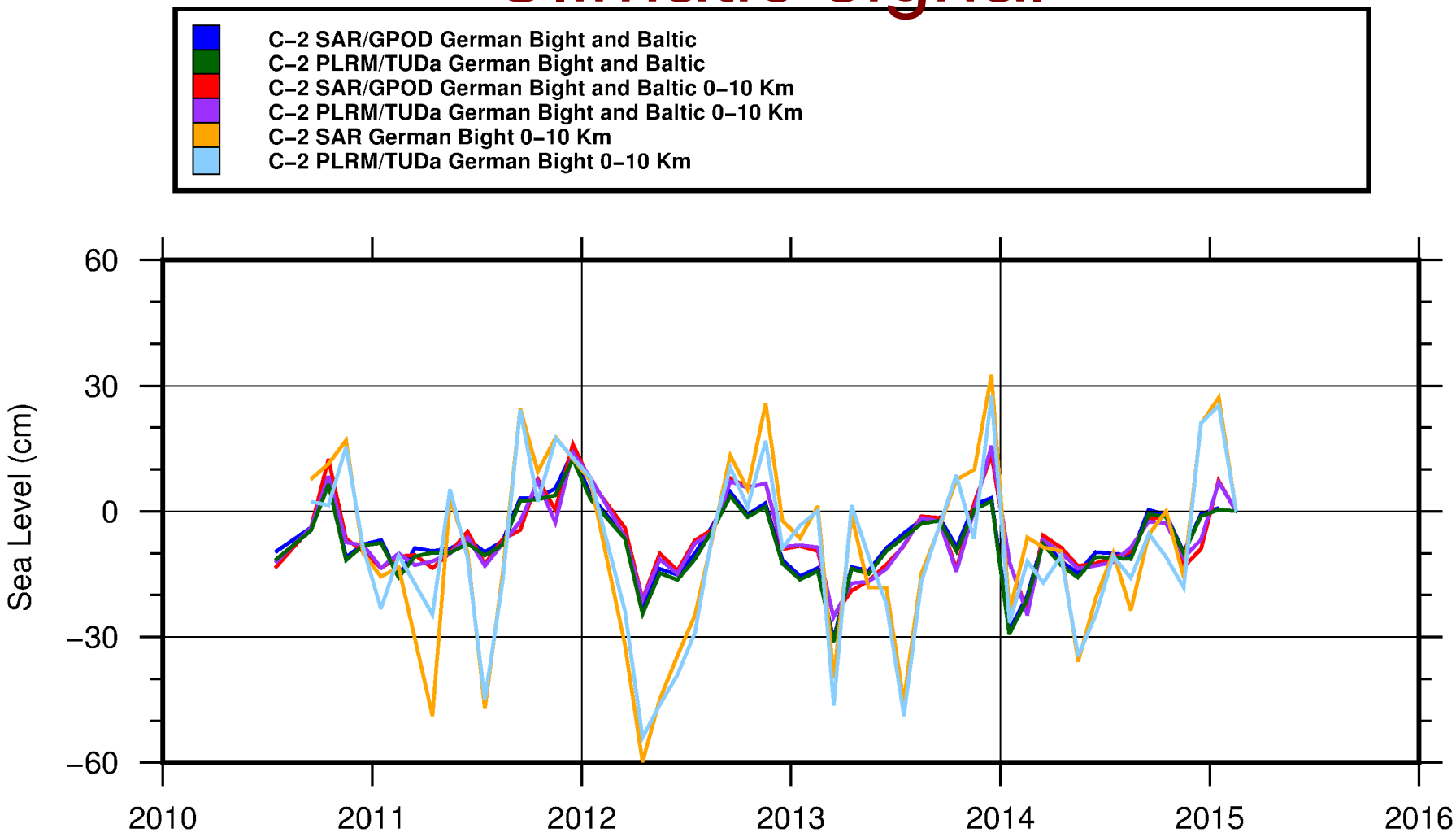
SWH and U10 In-situ validation 1 Hz PLRM/SAR intersection



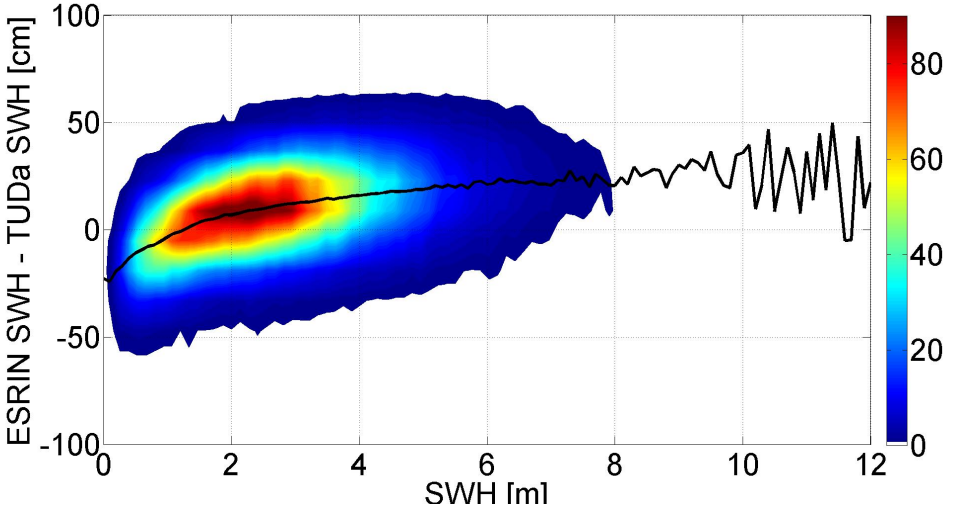


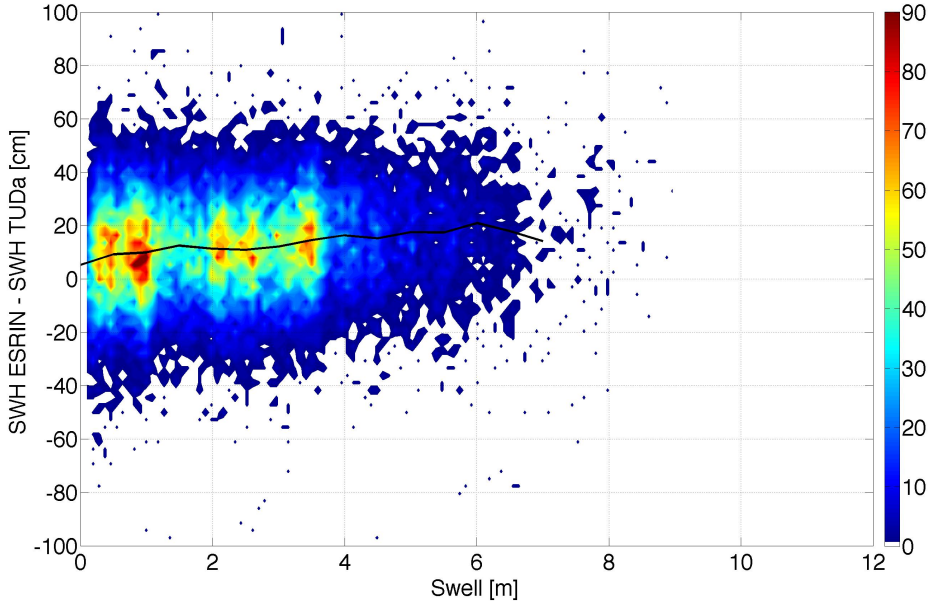
Scatterplots

Climatic signal



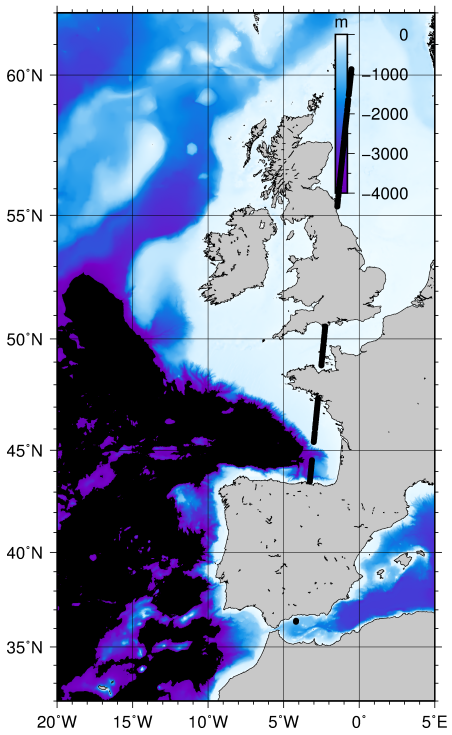
Time series of sea level





Swell detection

ATLANTIC BOX 2013



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Goals/Conclusions

- Consistency between PLRM and SAR data (cross-validation 5 y)
  - Improved for SWH< 0.8 m by application of LUT to PLRM (SP-734)
    (10% improvement in SWH due to LUT in PLRM) , SINC2 similar and slightly better results
  - No relative bias: 0.9 cm, -2.6 cm, 0.09 m/s (SSH, SWH & U10)
  - STD differences of 3 cm, 20 cm, 0.27 m/s (SSH, SWH & U10)

- Precision : for SWH < 4 m (GB)
  - For SSH and SWH higher in SAR (factor 2 in SSH and 1.4 in SWH), bump in SAR
  - for U10 higher in PLRM (factor 1.4)
  - In SAR: 0.9 cm, 6.6 cm and 5.8 cm/s for SSH, SWH and U10 (SWH@2m)
  - In SAR: noticed lower precision in SAR than in PLRM for SWH > 4 m in Atlantic Box

- Accuracy (in-situ validation):
  - Slightly higher in SAR
  - improved for SWH by application of LUT in BOTH SAR and PLRM and with numerical retracker
  - comparable for SSH and U10

- Climatic signal
  - Good agreement between SAR and PLRM/TUDa
  - Larger differences near to coast

- SWELL signal
  - Low in German Bight, dependency of PLRM/SAR differences from SWH and Swell is higher in the Atlantic Box