→ 7th COASTAL ALTIMETRY WORKSHOP

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Validation of Coastal CryoSat-2 Data in SAR Mode data in the German Bight

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Outline

- Method of validation
- Results of validation in open sea

- Coastal CryoSat-2 data (10 Km from coast)
- Preliminary results in coastal zone

- Conclusion and outlook

Method of regional and IN-SITU comparison

We compare SWH
SSH (SLA),
WIND SPEED (U10), Backscatter coeff. (SIGMA 0)

- **Inter-comparison of Altimetry data** :
  C2/PLRM versus C2/SAR along tracks

- **In-situ data**:
  SWH C2 versus in-situ SWH AWAC data (Acoustic Wave and Curre
  SSH C2 versus in-situ GPS@TG at Helgoland tide gauge

- **Model data->**

- **Model data**

Model data

Table 1. Characteristics of models used for Regional Validation of SWH ***in open ocean****:*

	WAM-**DWD**	**WW3-IOWAGA**
Wave Model Name	**LMD**	WW3_ATNE
Wind in wave model	COSMO-EU	**ECMWF**
Spatial resolution	0.1°x0.17°	0.17°x 0.17°
Spectral resolution	25 freq. 25 directions	31 freq., 24 directions
Forecast range	78 h	144 h
Numerics	WAM	WW3
nesting global model	Nesting in model GSM	NO
2-way coupling with global	NO	**Yes with model WW3**
Assimilation of SWH from satellite altimetry as initial state	sea state of GSM adapted to assimilate wind field over last 12 h, assimilation of SWH/J2	NO
Assimilation of U10 from alti in wind model	NO	NO

> 10 Km

- SAR 1Hz (0.9 cm for SSH **&** 6.5 cm for SWH **&** 0.05 db for sigma0, @SWH=2m)
- PLRM 1Hz (2.1 cm for SSH **&** 15.2 cm for SWH **&** 0.1 dB for sigma0 @SWH=2m)

- **SWH**

➢ **Cross-cal PLRM-SAR**

➢ Bias=2 cm, std=30 cm, **r=0.96**, slope=0.96 (SAR C2 under-estimates PLRM)

➢ **IN SITU**: FINO3 data

- bias=0 cm, std=30 cm, **r=0.95**, slope=1.02 (SAR C2 over-estimates FINO-3)

➢ **Models:**

- **C-2 *& LSM/DWD***: best agreement with SAR (9/34/0.95/0.98),
- **SAR C-2 over-estimate WW3** (13/38/1.09)

Cont. Res. > 10 Km

➢ WIND U0

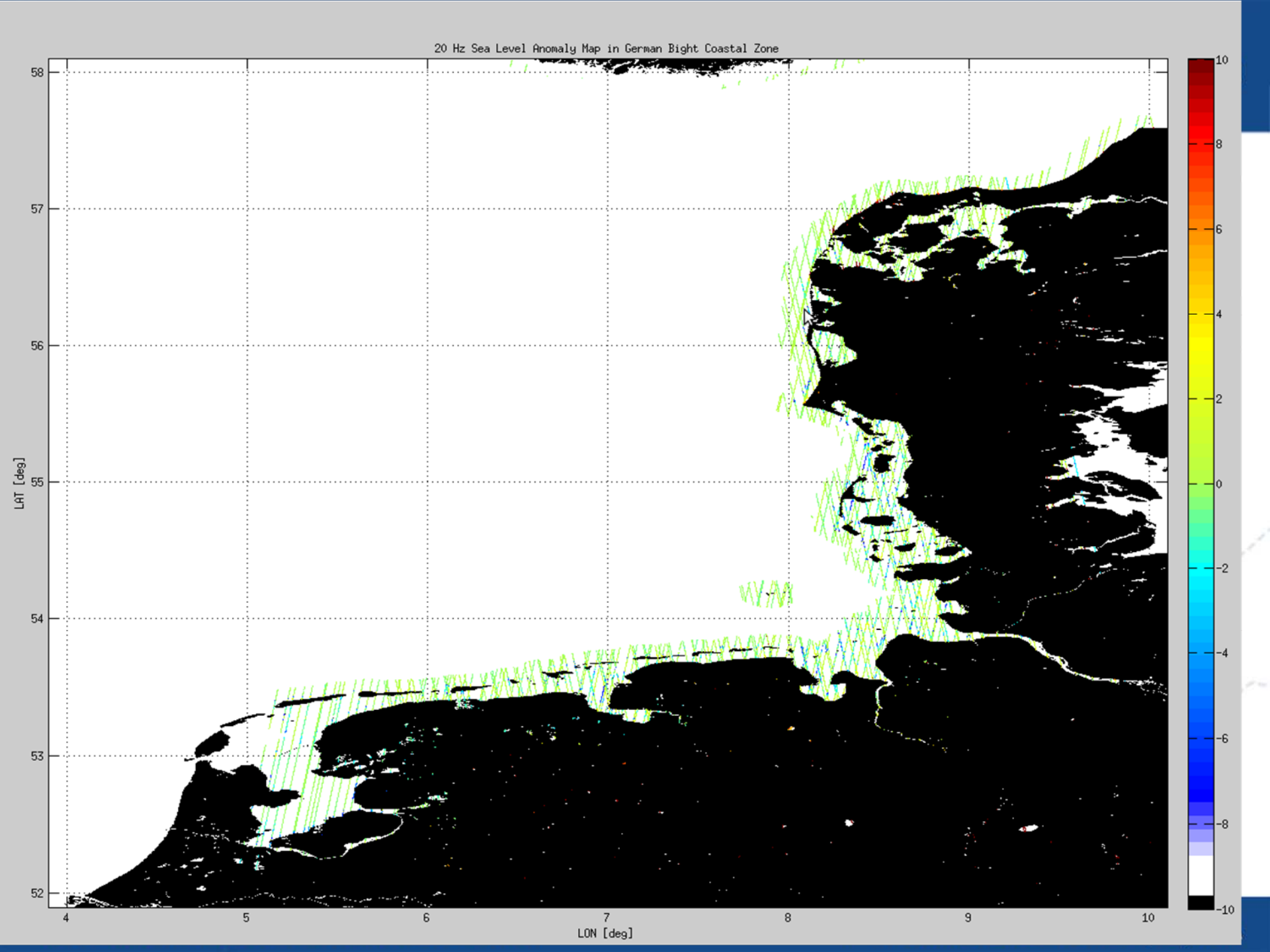
- **Cross-cal PLRM & SAR**
  - Bias=-0.05 m/s, std=0.4 m/s**, r=0.99**, slope=0.99 (SAR = PLRM)
- **Cross-cal Cosmo-EU & ECMWF**
  - Bias=-0.11 m/s, std=1.6 m/s**, r=0.92,** slope=0.8 (**ECMWF under-estimates** COSMO-EU)
    - **C2/PLRM & ECMWF :** best agreement
      - Bias=-0.55 m/s, std=1.3 m/s, r=0.94, slope=0.94 (C2 PLRM **under-estimates** ECMWF)
      - **C2/PLRM & COSMO-EU :** C2 PLRM under-estimate > COSMO-EU U10 than ECMWF

(however the **SWHs of PLRM** agree better with LSM of DWD/BSH - probably due to the assimilation)

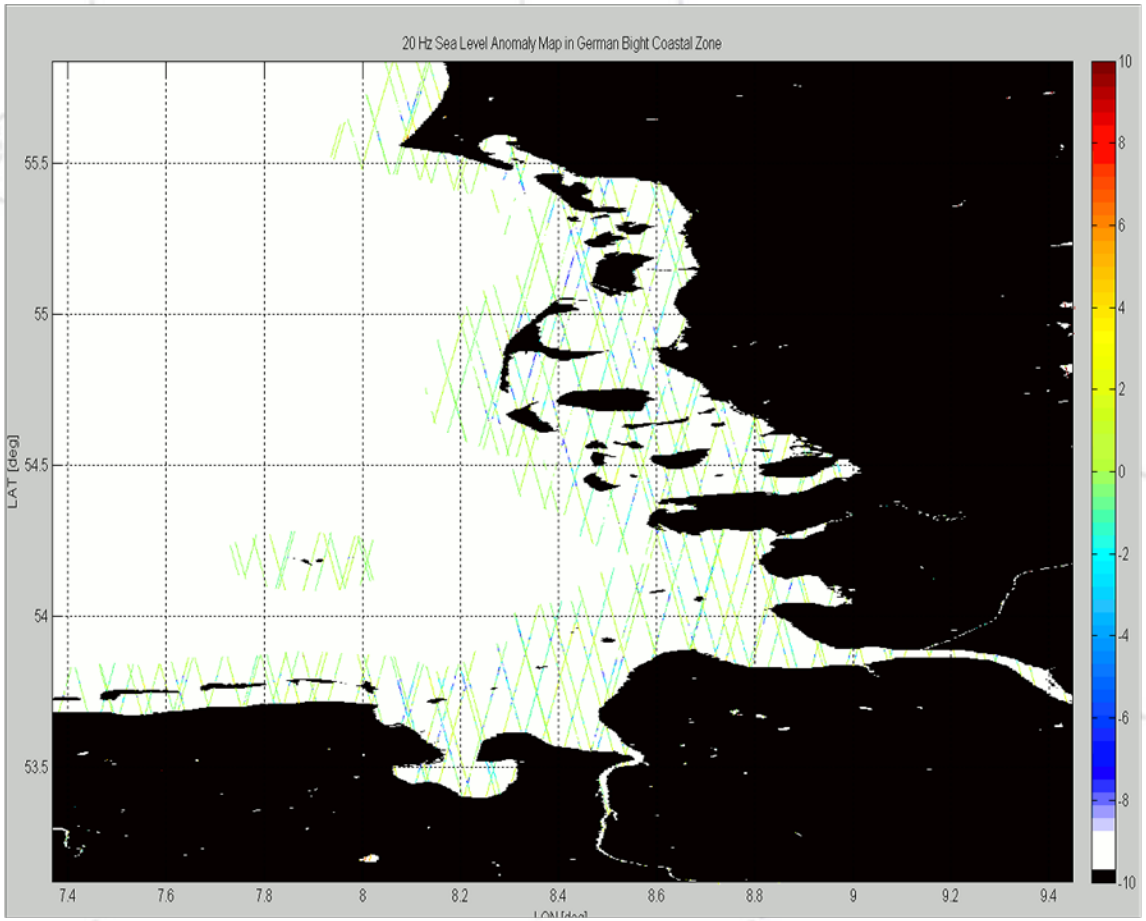
▪ SSH

- **Regional** SSH uncorrected PLRM and SAR (**mean/std 0.2/4 cm)**
- **In-situ** Helgoland instantaneous SSH : C2 under-estimation wrt TG

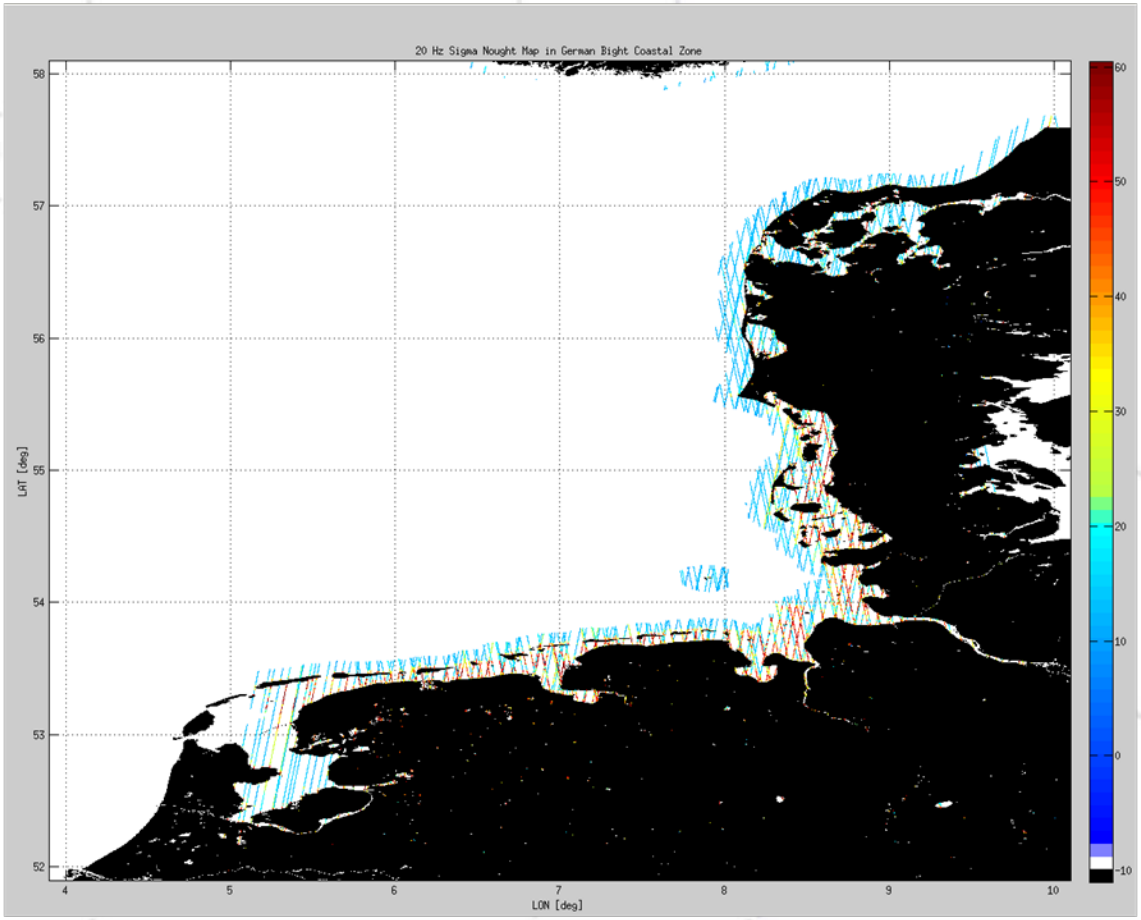
  bias/std : **0/20.6 cm (PLRM), -2/19.8 cm (SAR)**


20 Hz Sea Level Anomaly Map in German Bight Coastal Zone
LAT [deg]
LON [deg]
58
57
56
55
54
53
52
4
5
6
7
8
9
10
10
8
6
4
2
0
-2
-4
-6
-8
-10

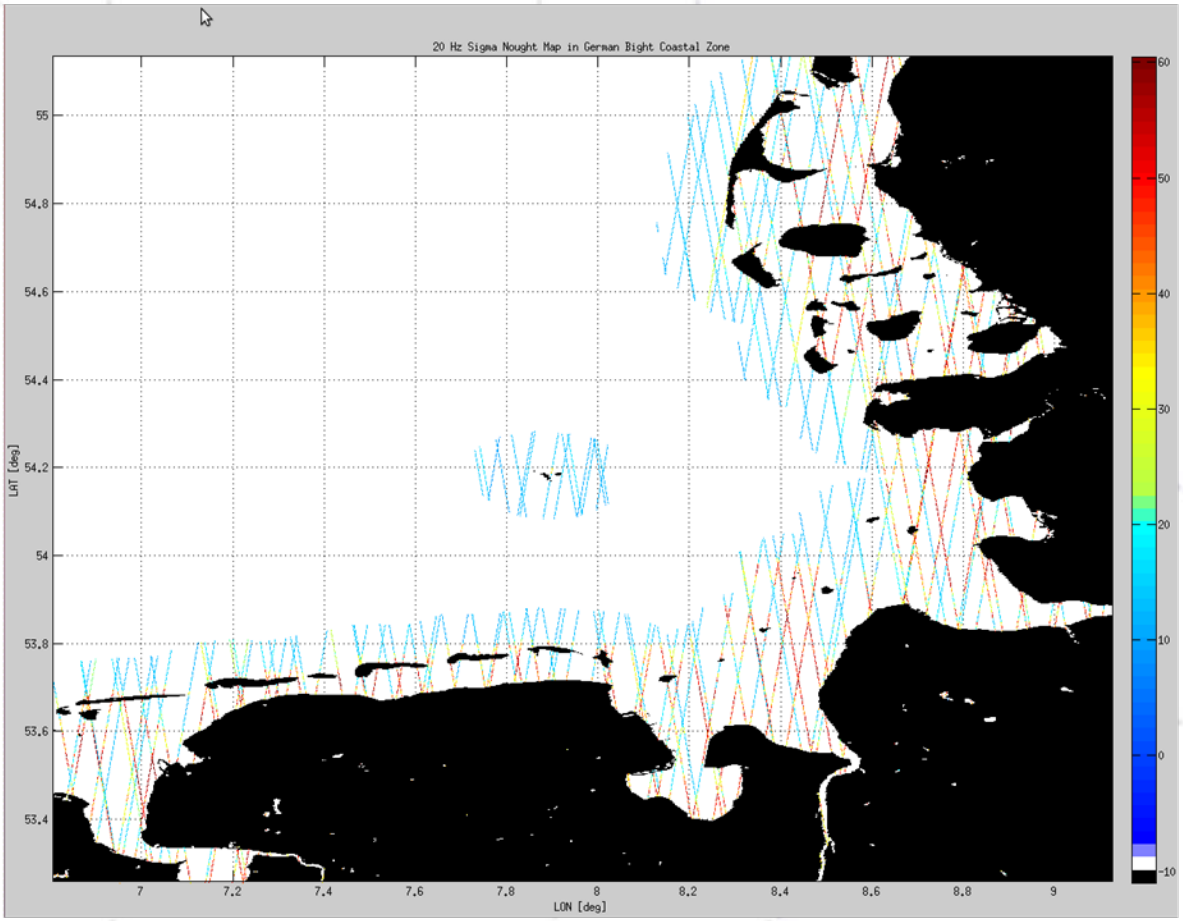
SLA (m)


20 Hz Sea Level Anomaly Map in German Bight Coastal Zone
LAT [deg]
55.5
55
54.5
54
53.5
7.4
7.6
7.8
8
8.2
8.4
8.6
8.8
9
9.2
9.4
10
8
6
4
2
0
-2
-4
-6
-8
-10

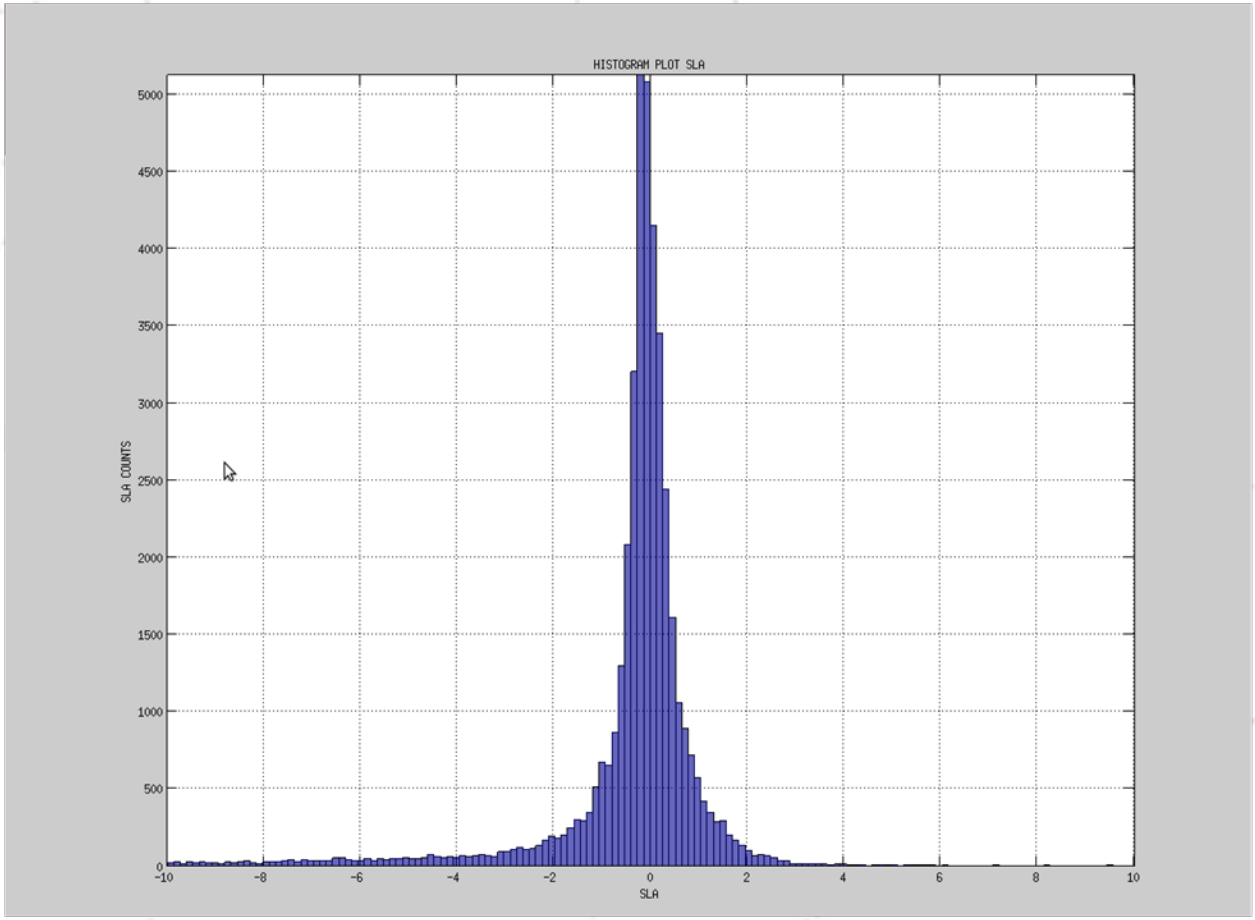
Sigma nought (dBar)



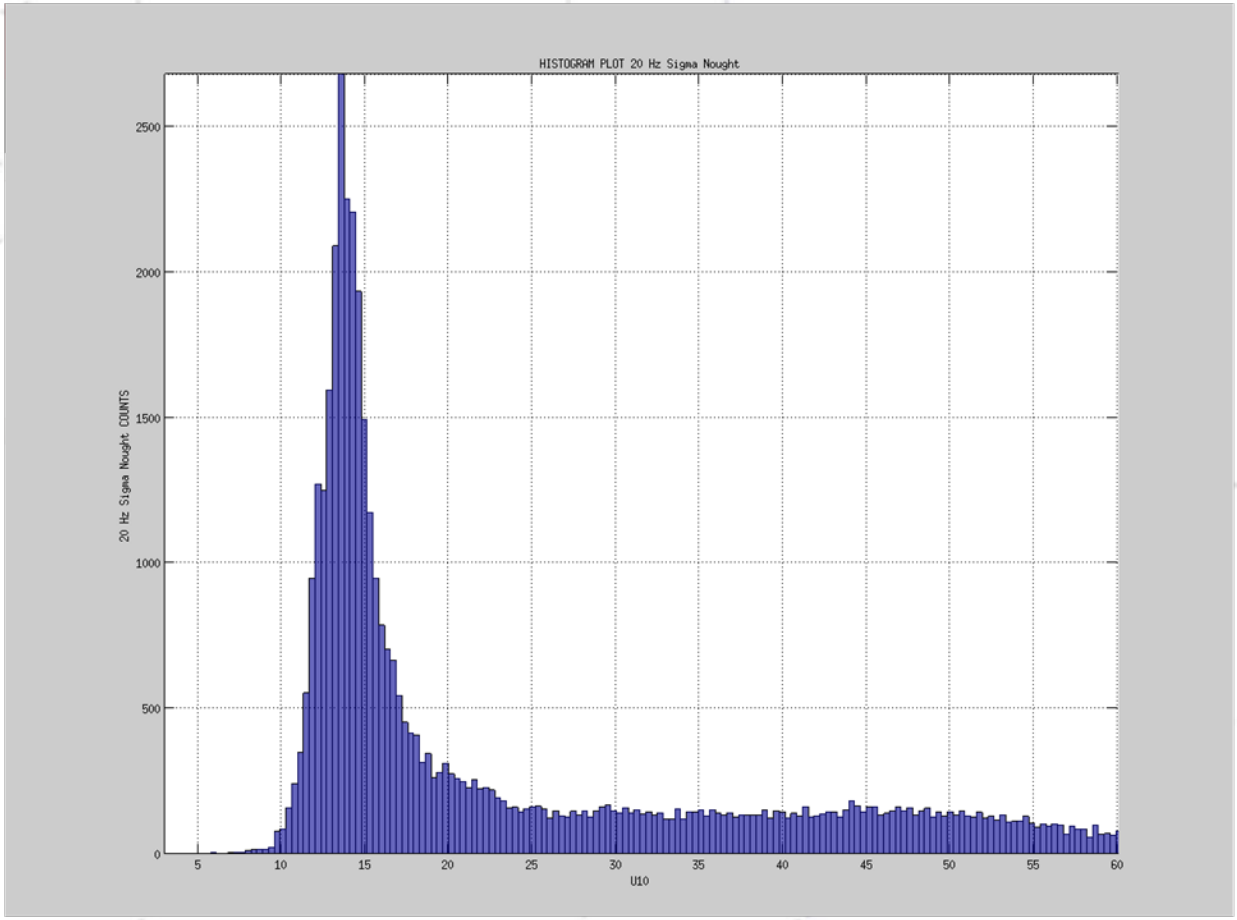
Sigma nought (dBar)



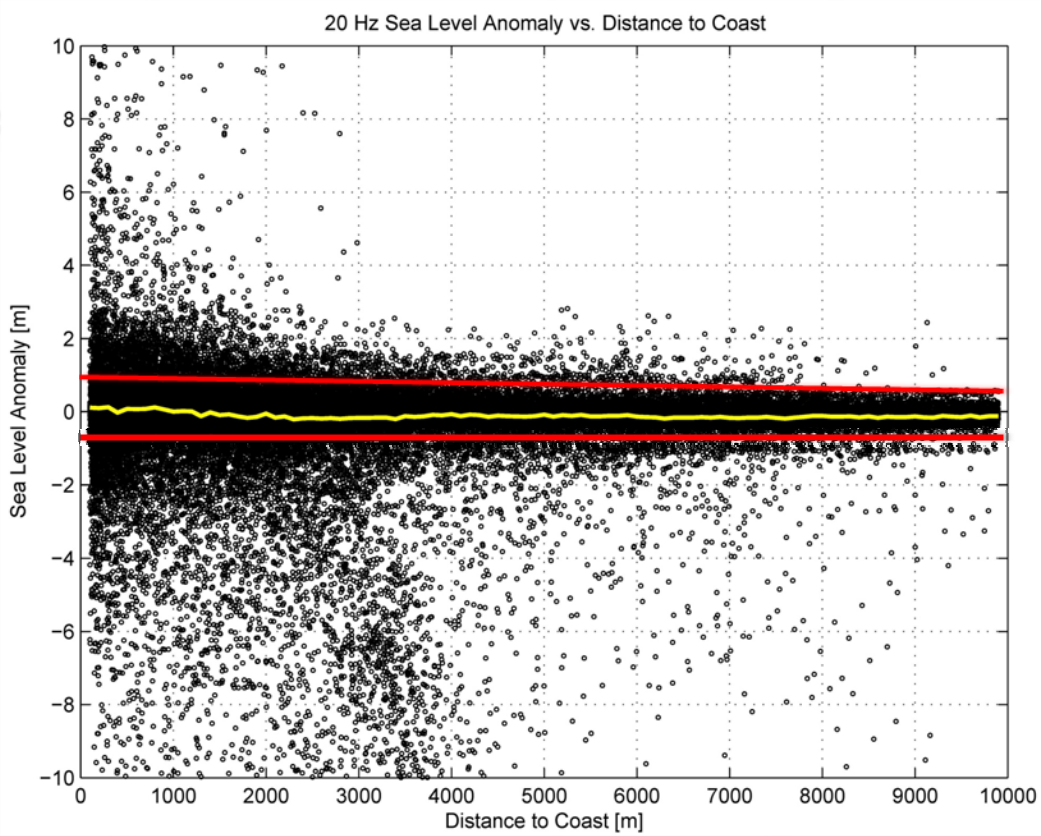
SLA Coastal Zone



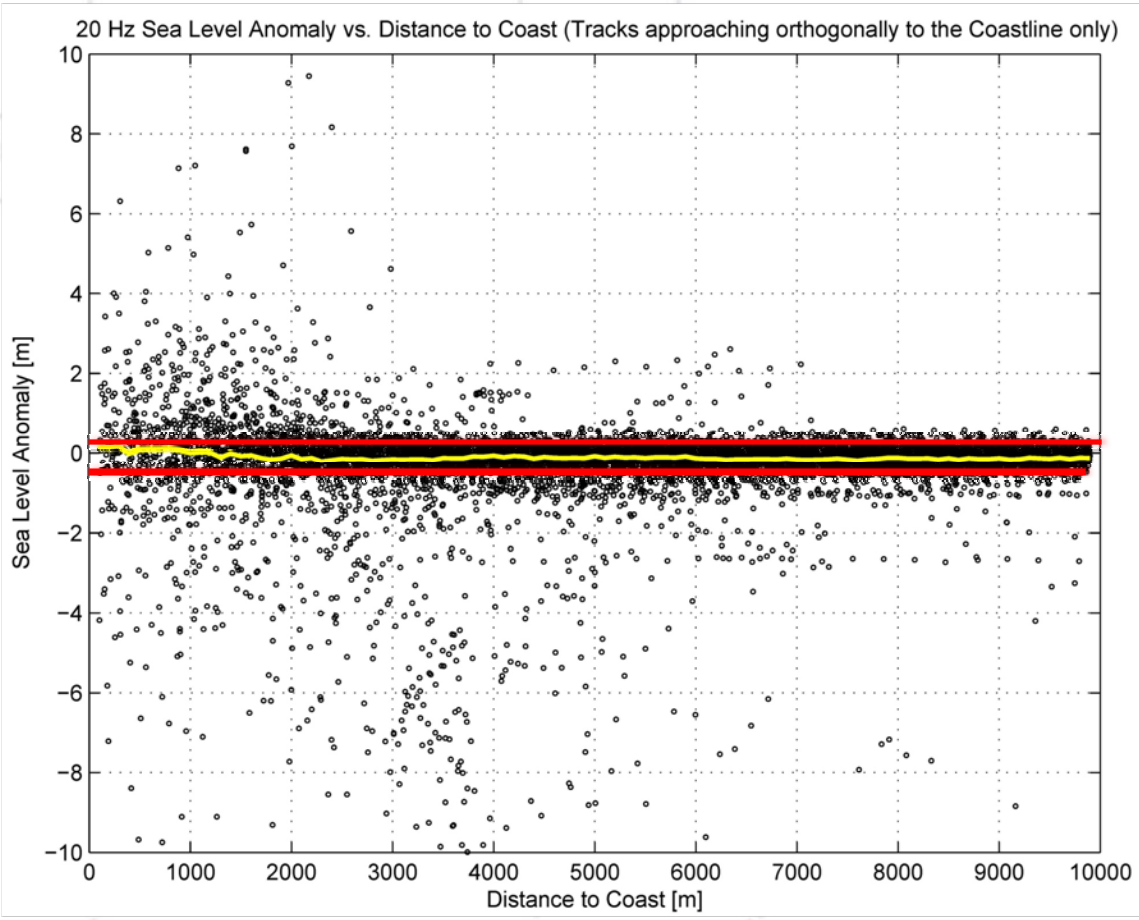
Sigma0 Coastal Zone



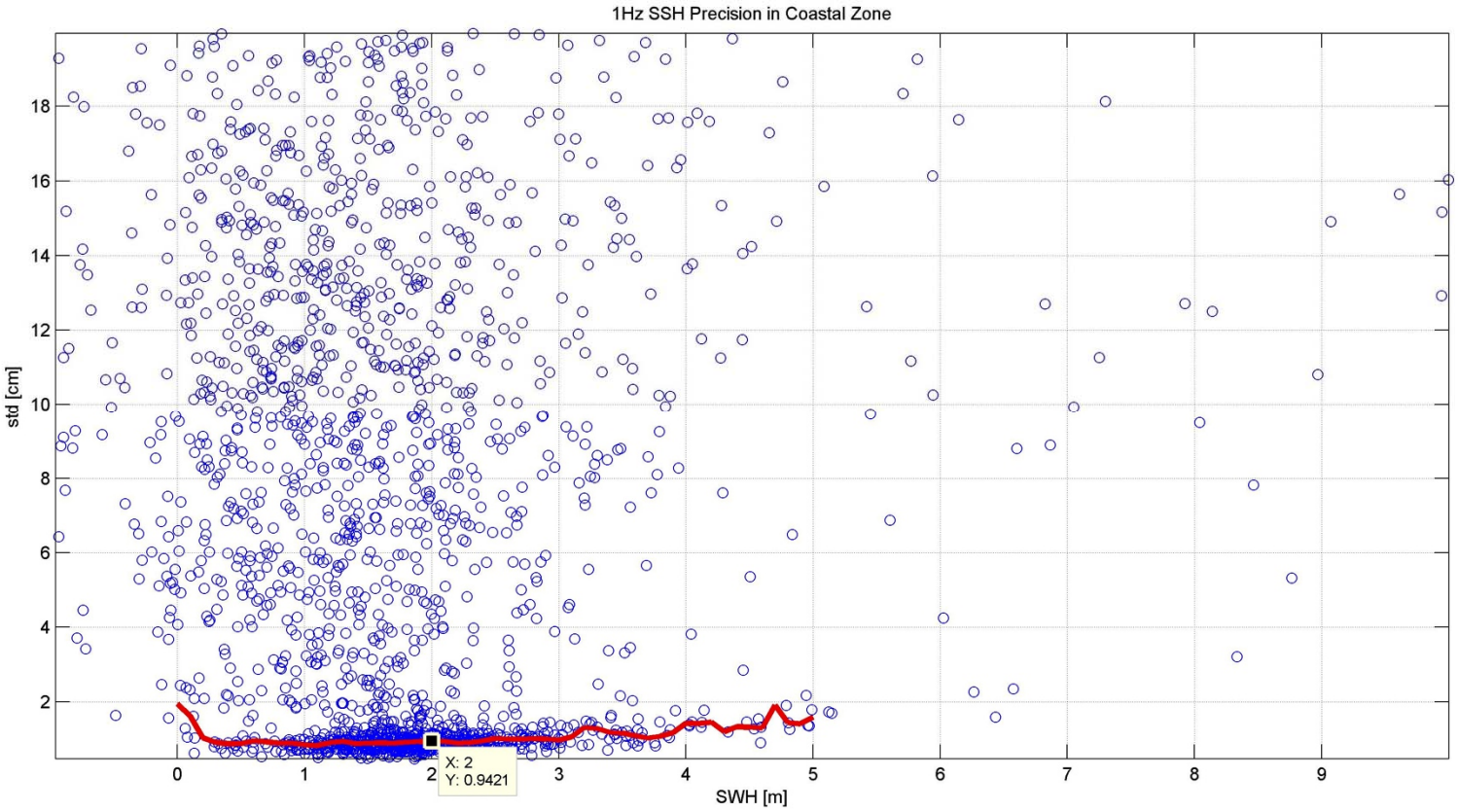
SLA


20 Hz Sea Level Anomaly vs. Distance to Coast
Sea Level Anomaly [m]
Distance to Coast [m]
10
8
6
4
2
0
−2
−4
−6
−8
−10
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000

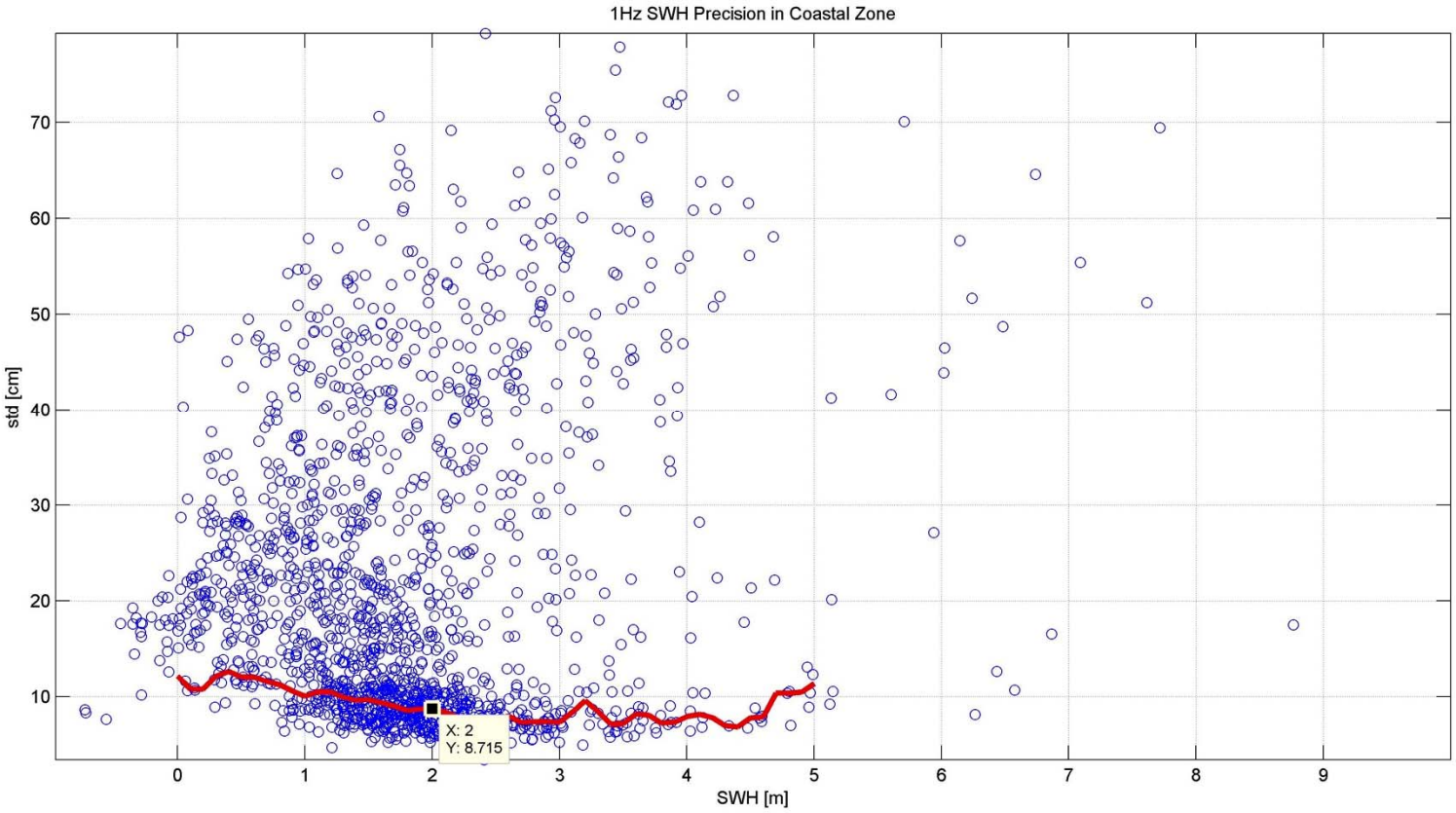
SLA tracks orthogonal to the coast



SSH Precision



SWH Precision

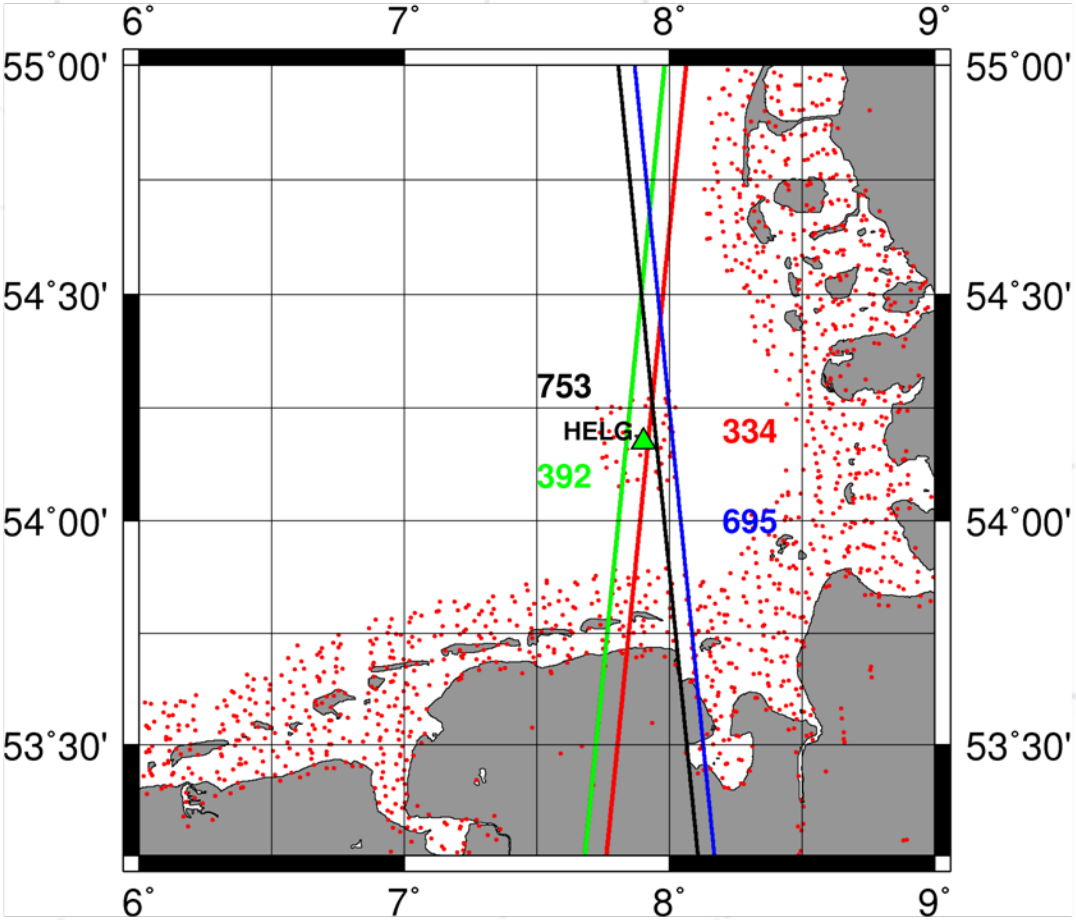


Precision

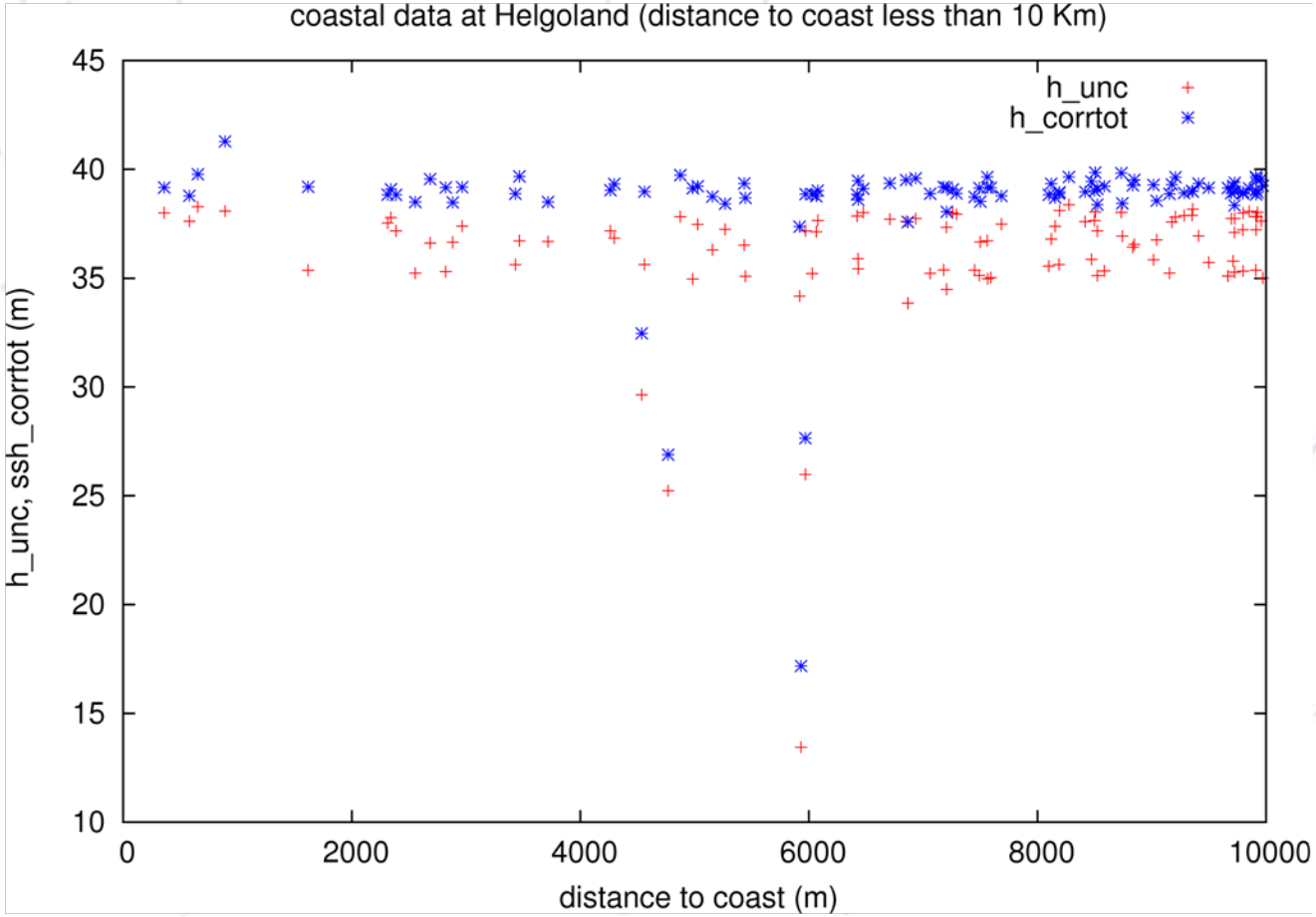
Table 1. Precision of 1Hz quantities ***@SWH=2m***

	PLRM open	SAR open	SAR coast (orthogonal to coast)
SSH (cm)	2.1	0.9	0.94
SWH (cm)	15.2	6.5	8.7
Backscatter (dB)	0.1	0.05	
Wind Speed (cm/s)		15	

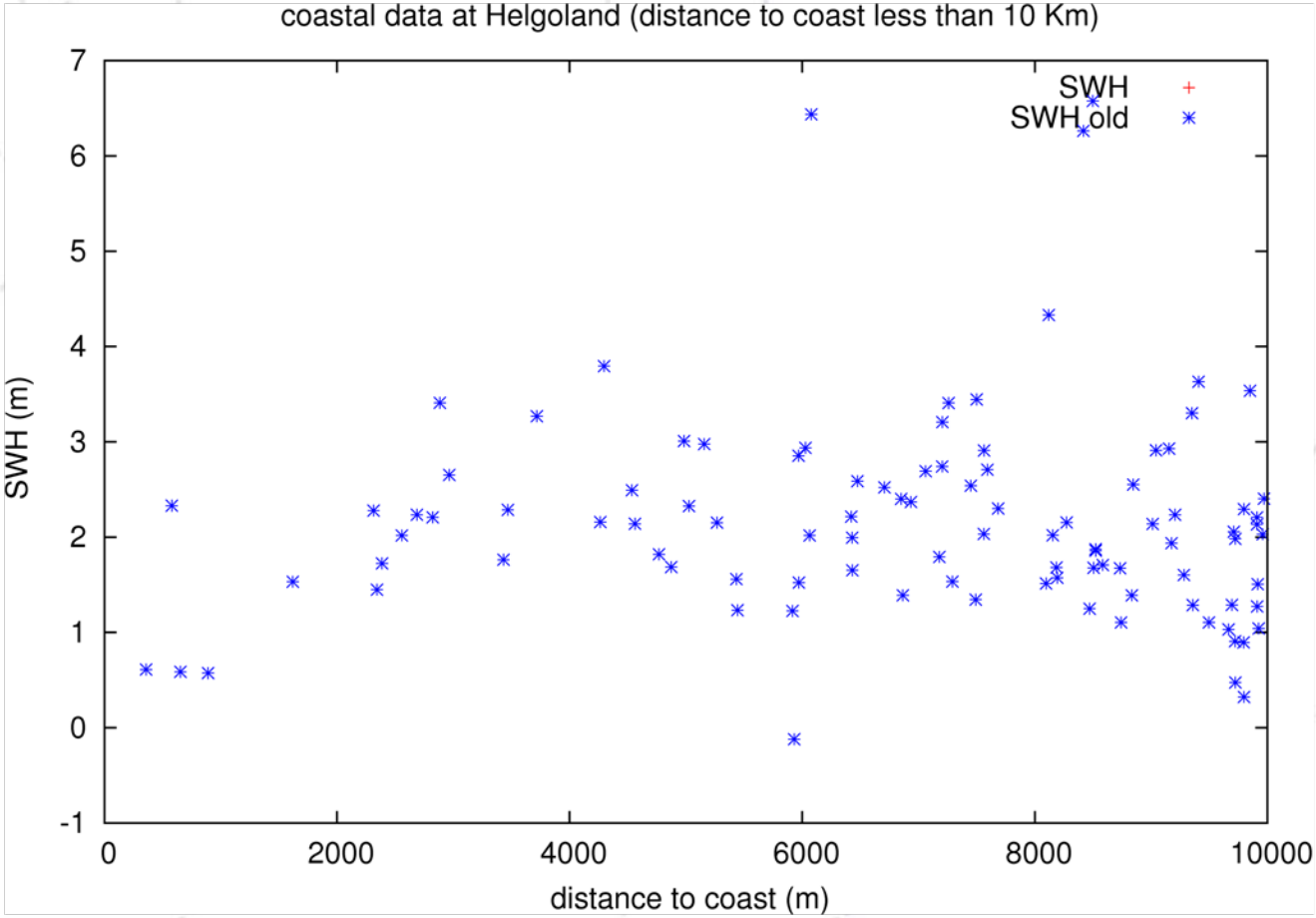
Coastal Zone



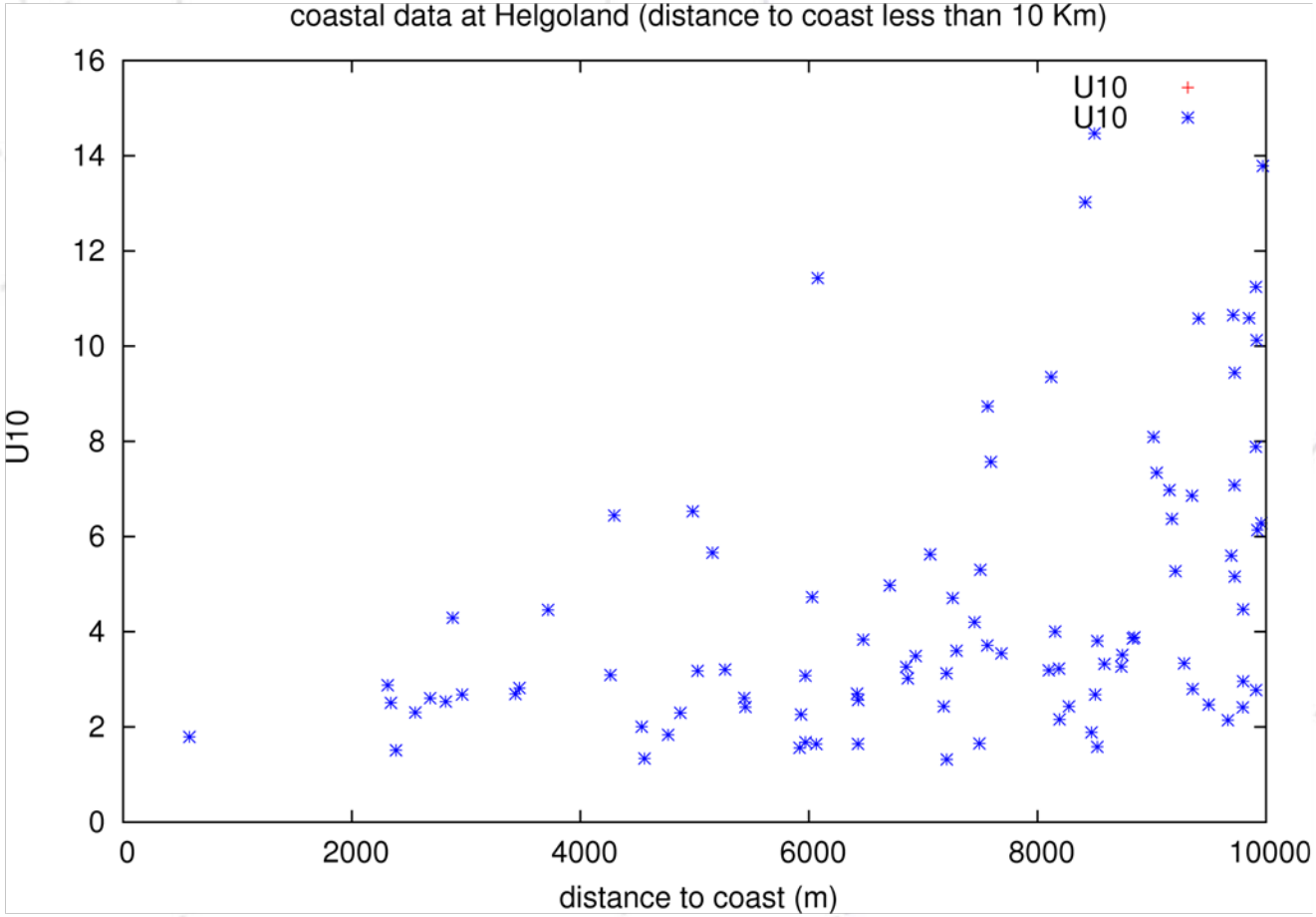
SSH Helgoland (1Hz SAR data)



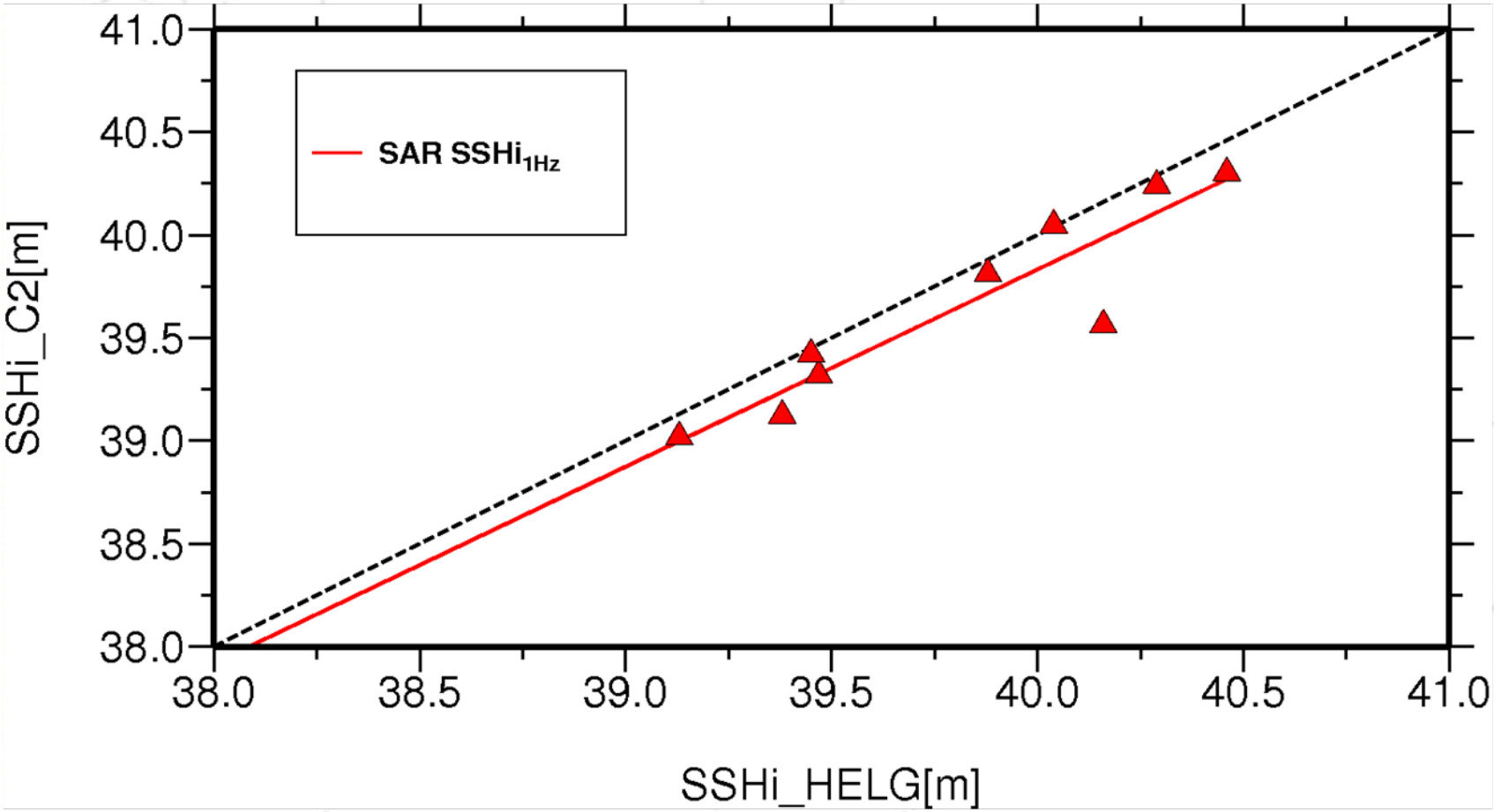
SWH Helgoland (1Hz SAR data)



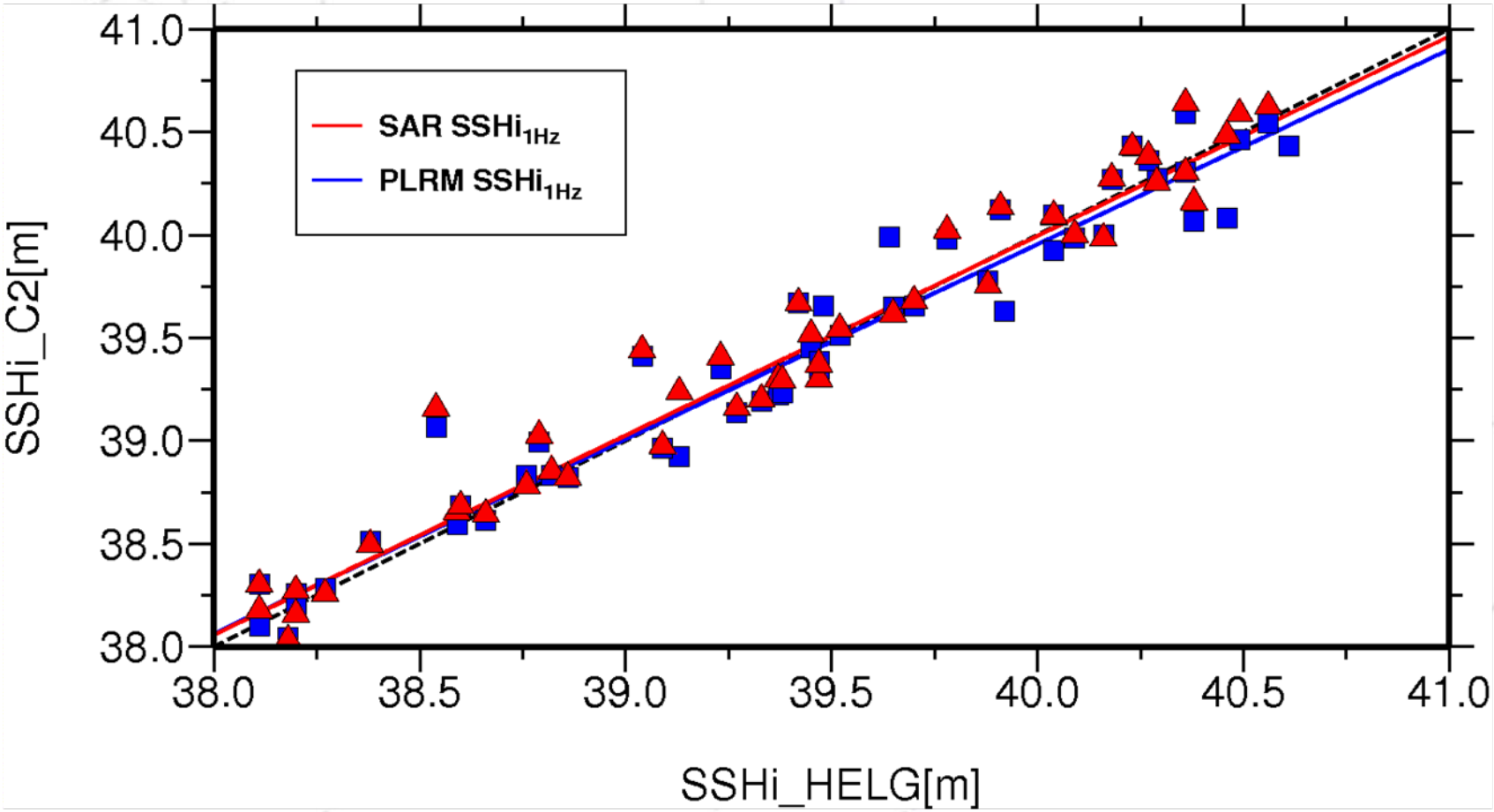
U10 Helgoland (1Hz SAR data)



In-situ Helgoland coastal data (1Hz)



In-situ Helgoland open ocean (1Hz)

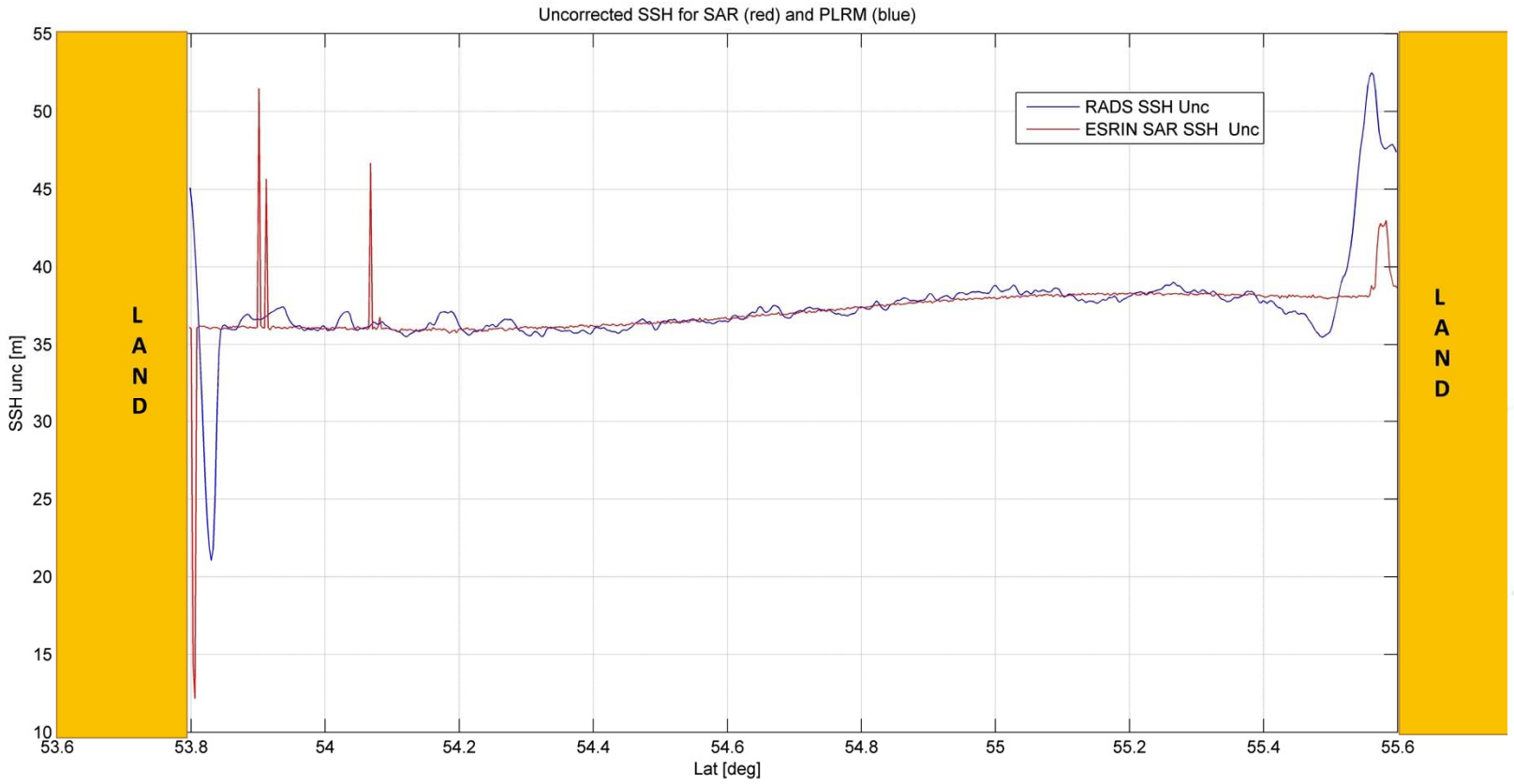


In-situ comparison at HELG

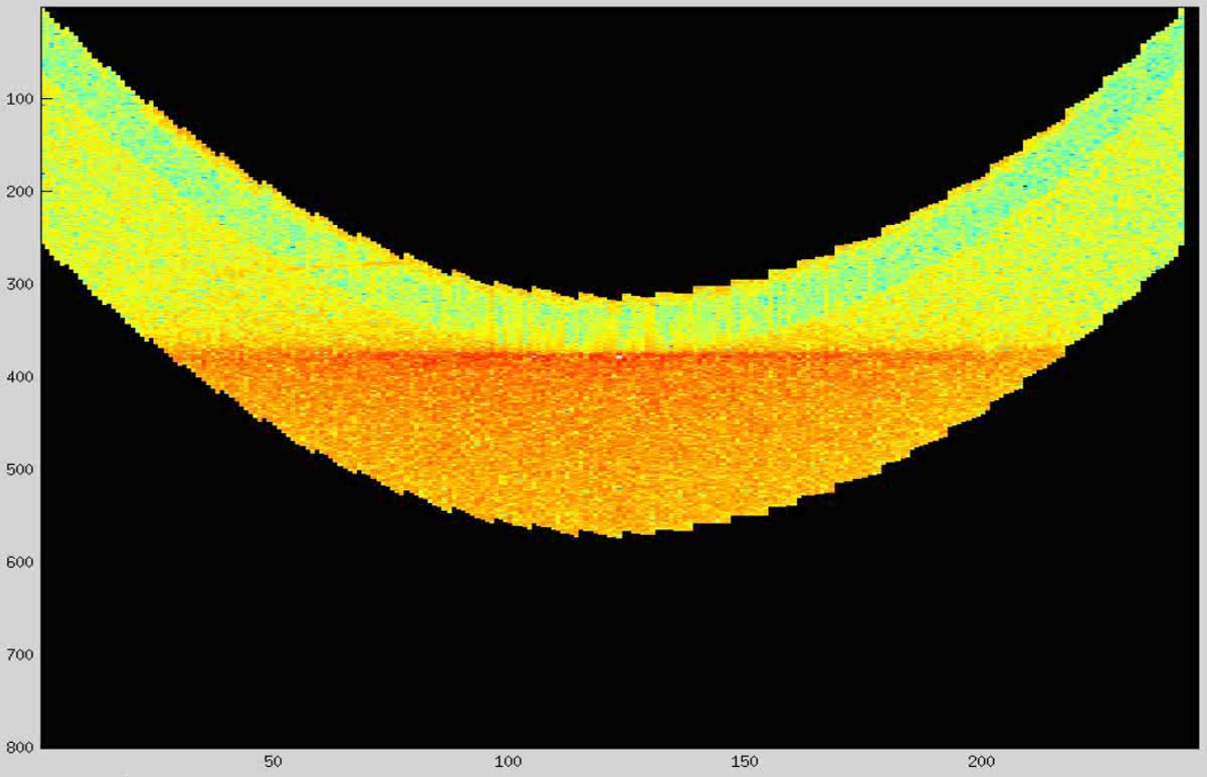
1 Hz comparison – open sea/coastal zone

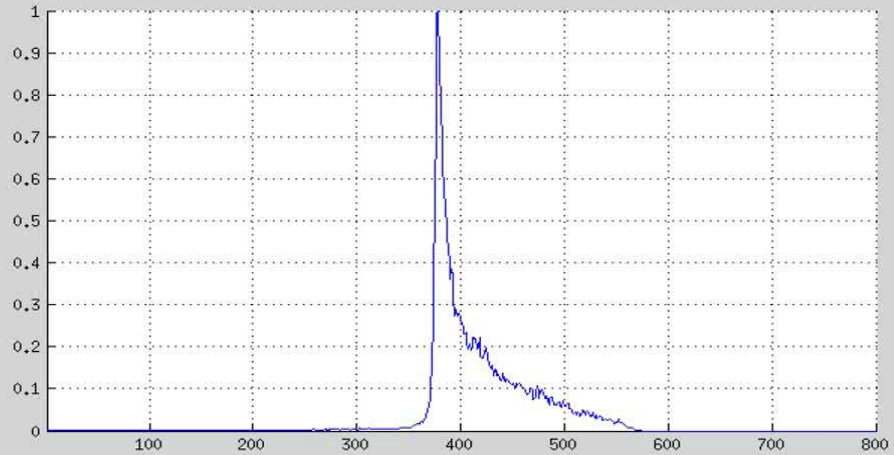
SSH	mean (m)	std (m)	rms (m)	cor	slope	SI	NP
Open Sea SAR-HELG	0.023	0.196	0.195	0.978	0.969	0.005	57
Open sea PLRM-HELG	-0.002	0.208	0.206	0.976	0.946	0.005	57
Coastal SAR – HELG	**-0.133**	**0.166**	**0.208**	**0.988**	**0.956**	**0.004**	**14**

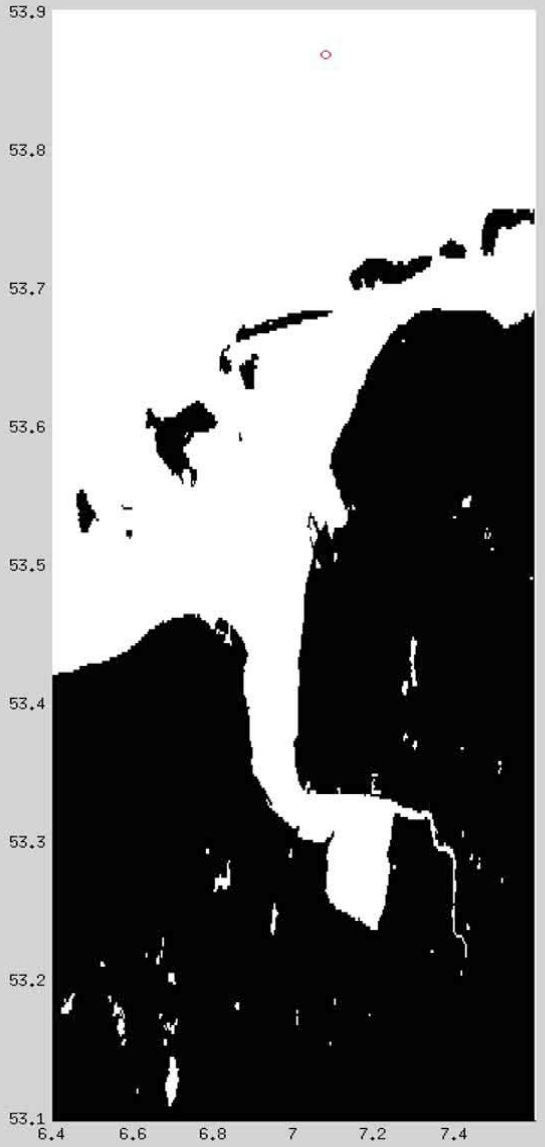
SAR versus PLRM



STACK Evolution approaching the coast







Conclusion

- The precision in coastal zone for SSH/SWH (0.94/8.7) is lower than in open ocean but still higher than PLRM (orthogonal tracks)
- In-situ Validation of SSH in Helgoland is lower but still in good agreement with results for open ocean
- First comparison with PLRM 20Hz show small differences

- Outlook: Deterioration in coastal zones on the continent to be analysed