Outline

➤ Assessment of Jason-3 and Sentinel-3A precision at six tide gauge stations in the German Bight (SE North Sea)

➤ Sea level in the area is dominated by semidiurnal tides

➤ tidal and barotropic dynamic is not known with sufficient accuracy: comparison of total water level envelop (including tides and inverse barometer/barotropic ocean dynamic)

➤ Estimation of RMS errors, Correlation coefficients and drifts

Tide Gauge Stations and Satellite Tracks
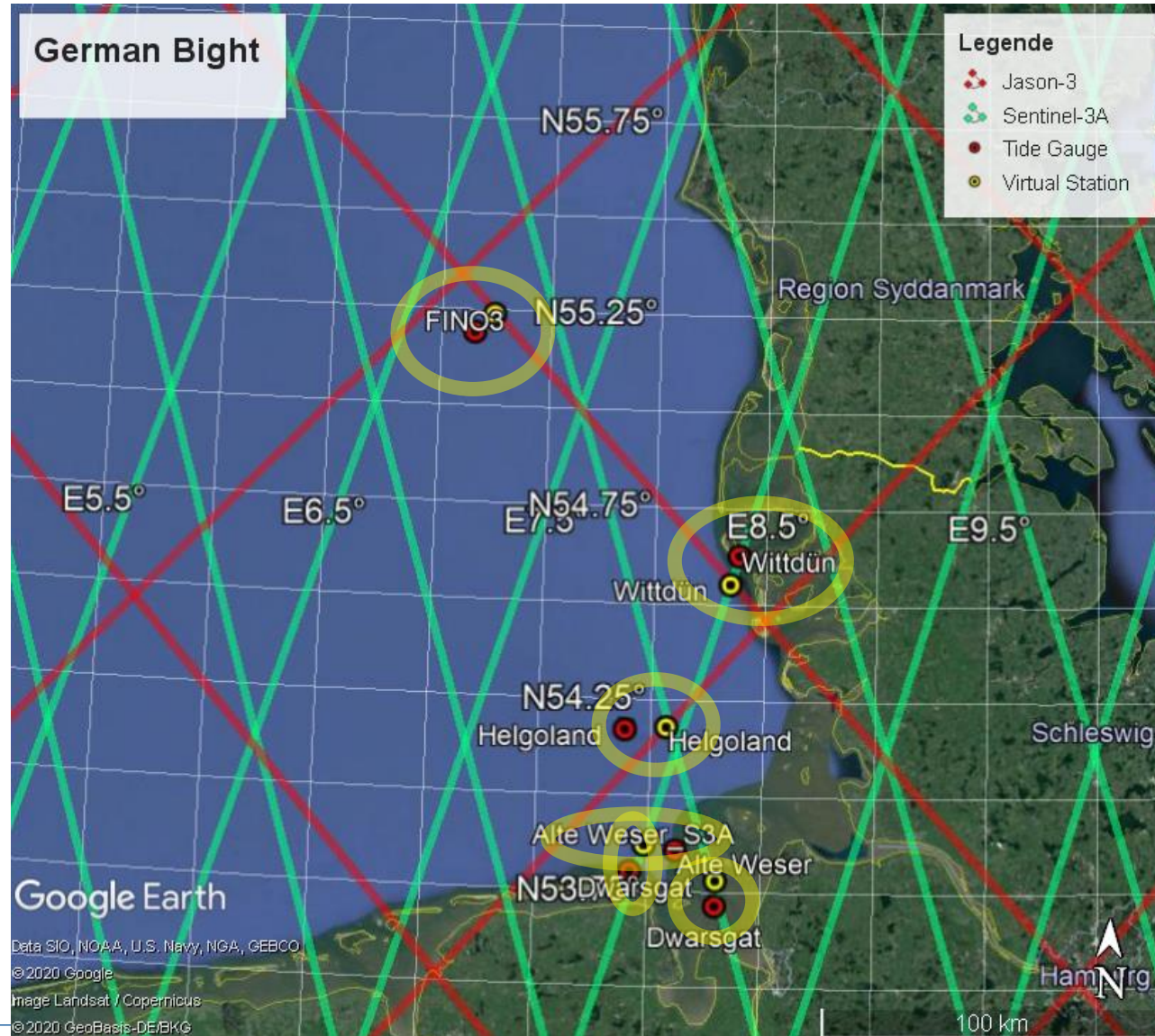
Jason-3 (02/2016-12/2019): **139** overflights

Sentinel-3A (04/2016-12/2019): **52** overflights

Red dots: tide gauges
Yellow dots: virtual altimetry stations

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Data

Altimetry: Jason-3 and Sentinel-3A (2016-2019)

➢ 20 Hz level 2 altimetry data

➢ OCEAN and SEAICE retracker

➢ GIM for ionospheric and ECMWF for wet tropospheric correction

➢ no corrections for ocean tides and dynamic atmosphere (TWLE)

➢ Interpolation (over 20 km) to virtual stations (2-13 km from tide gauges)

Tide gauges: Fino3, Helgoland, Wittdün, LT Alte Weser, Wangerooge, Dwarsgat

➢ georeferenced by GPS

➢ data every minute

➢ outliers eliminated

Tidal Correction

Tide gauge and altimetry are not exactly collocated, giving rise to slight differences in amplitude and phase of the dominant M_2 tide
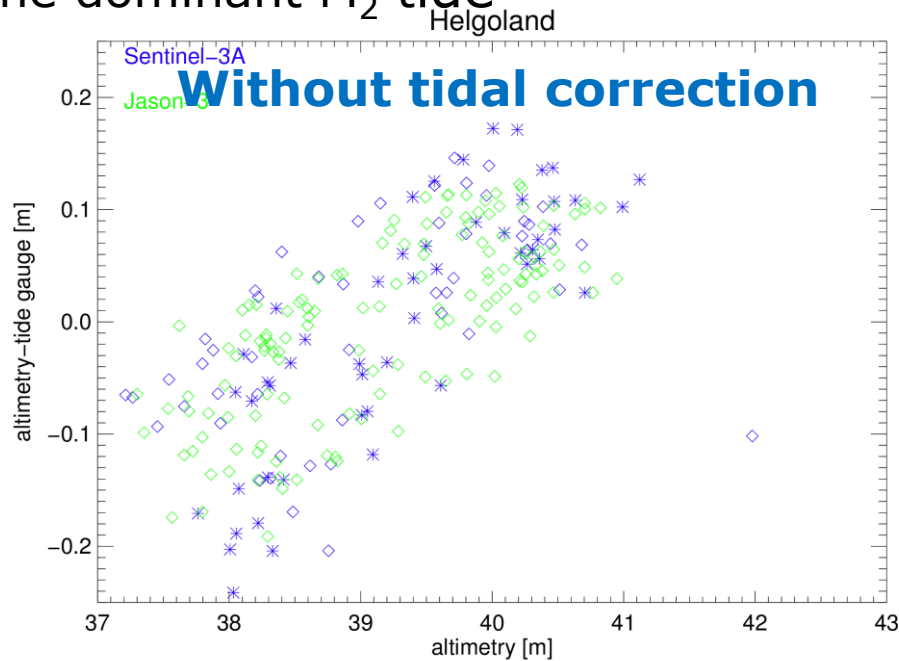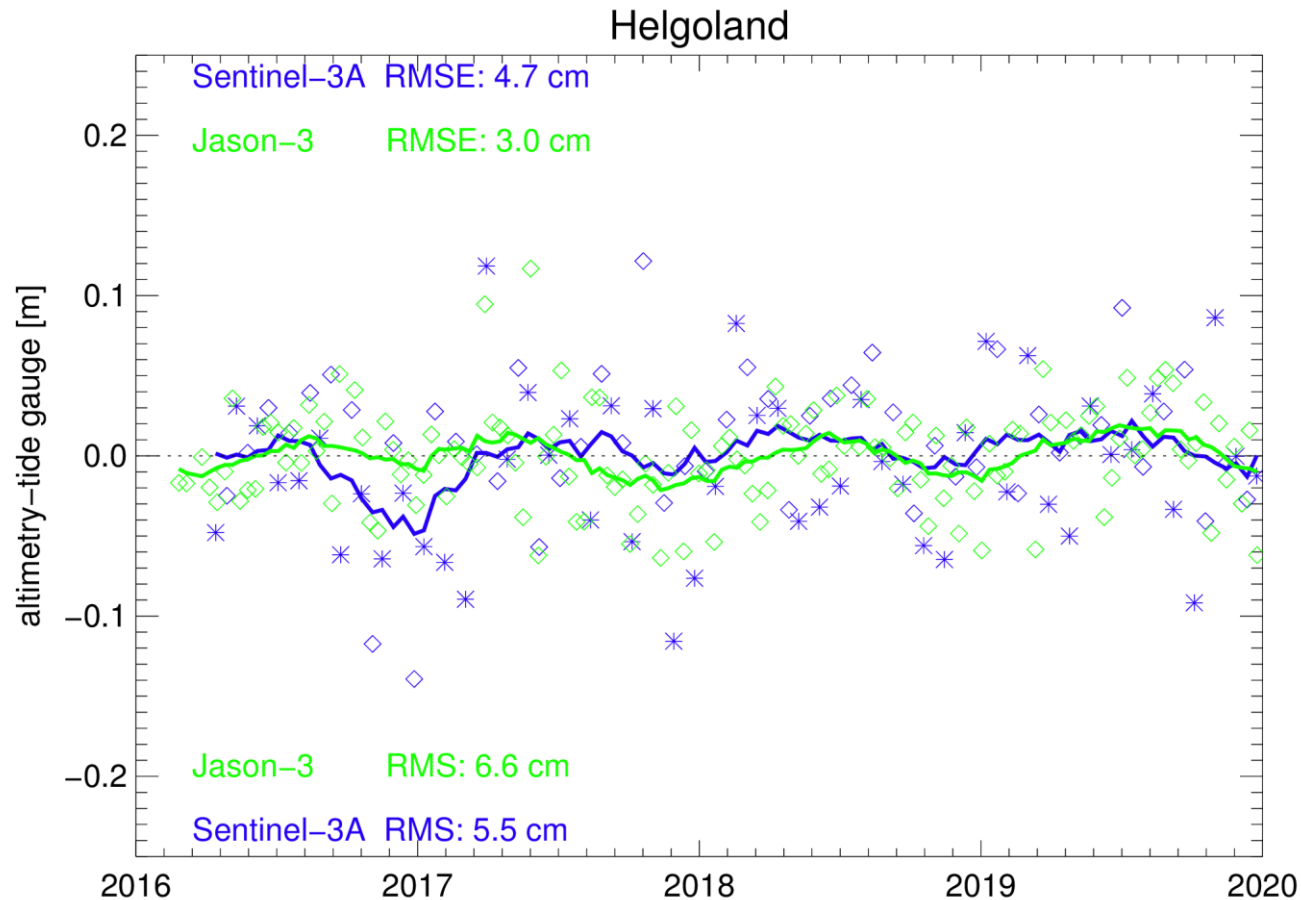
Scale, time shift, bias and drift are estimated by minimization of the RMS errors and maximization of the correlation coefficient between gauge and altimetry.

Without tidal correction

With tidal correction
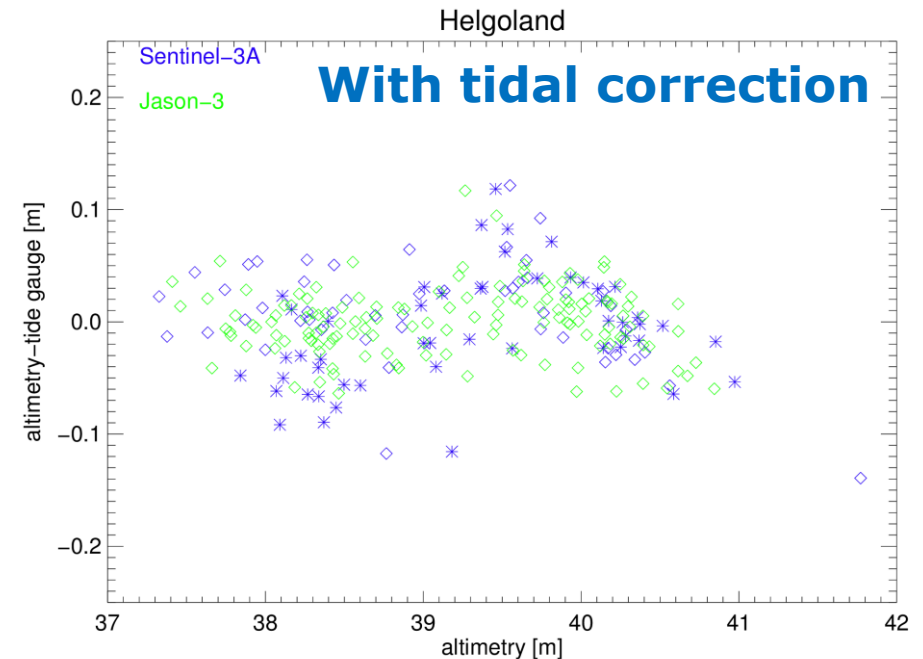
$SL_{alti}-SL_{gauge}=F(SL_{alti})$ -> scaled tidal amplitudes ellipse instead of straight line -> phase shift

Sentinel-3A: $\Delta t=7$ min, scale=0.93

Jason-3: $\Delta t=6$ min, scale=0.94

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Helgoland: Difference Gauge/Altimetry (tidal correction applied)

Helgoland

Sentinel–3A RMSE: 4.7 cm
Jason–3 RMSE: 3.0 cm

Jason–3 RMS: 6.6 cm
Sentinel–3A RMS: 5.5 cm

altimetry–tide gauge [m]

Diamond: ascending

Star: descending

Solid line: 3-month boxcar

RMSE: RMS error

RMS: 20 Hz internal RMS

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Dwarsgat: Difference Gauge/Altimetry (tidal correction applied)

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Statistical Values

Tide gauge	Mission	RMS error [cm]	Correlation coefficient	Distance [km]	Collocated values
Fino3	J3	2.9	0.997	2	138
Helgoland	S3A / J3	4.7 / 3.0	0.999 / 0.999	13	101 / 137
LT Alte Weser	S3A	3.1	0.999	9	52
Wangerooge	S3A	3.5	0.999	9	52
Wittdün	S3A / J3	6.1 / 7.4	0.998 / 0.998	8	49 / 49
Dwarsgat	S3A	4.1	0.997	7	23

Summary

➤ The precision of Jason-3 (02/2016-12/2019) and Sentinel-3A (04/2016-12/2019) altimetry is assessed at 6 collocated tide gauge stations in the German Bight

➤ Tide gauge stations are georeferenced by GPS, data every minute

➤ 20 Hz level 2 altimetry data, standard retrackers, no corrections for ocean tides and dynamic atmosphere (TWLE), interpolation over 20 km, distance to gauges: 2-13 km

➤ Slightly different tidal phase and amplitude at gauge and altimetry locations -> correction for scale and time shift improves the RMS errors by 15-75%

➤ Excellent correlation at all stations (≥ 0.997)

➤ RMS error: 2.9-3.0 (7.4) cm for Jason-3 at the open ocean (coast), 3.1-6.1 cm for Sentinel-3A

➤ Drift: not significant for Jason-3, positive drift for Sentinel-3A 6-13 ±5 mm/year depending on location

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