SWOT-UK: Calibration, UK Validation in the Severn Estuary and Liverpool Bay

National Oceanography Centre

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https://projects.noc.ac.uk/swot-uk/

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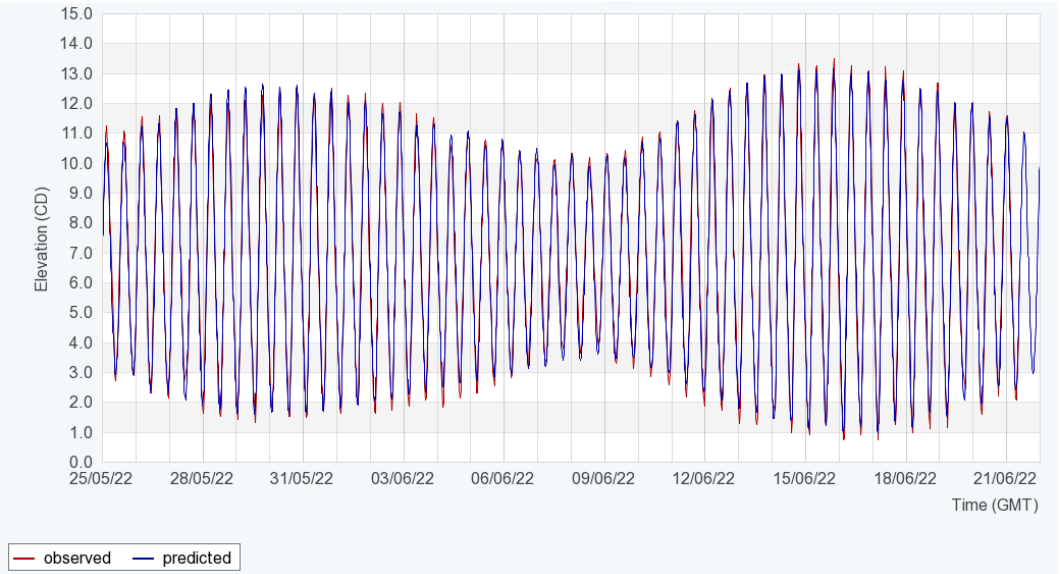
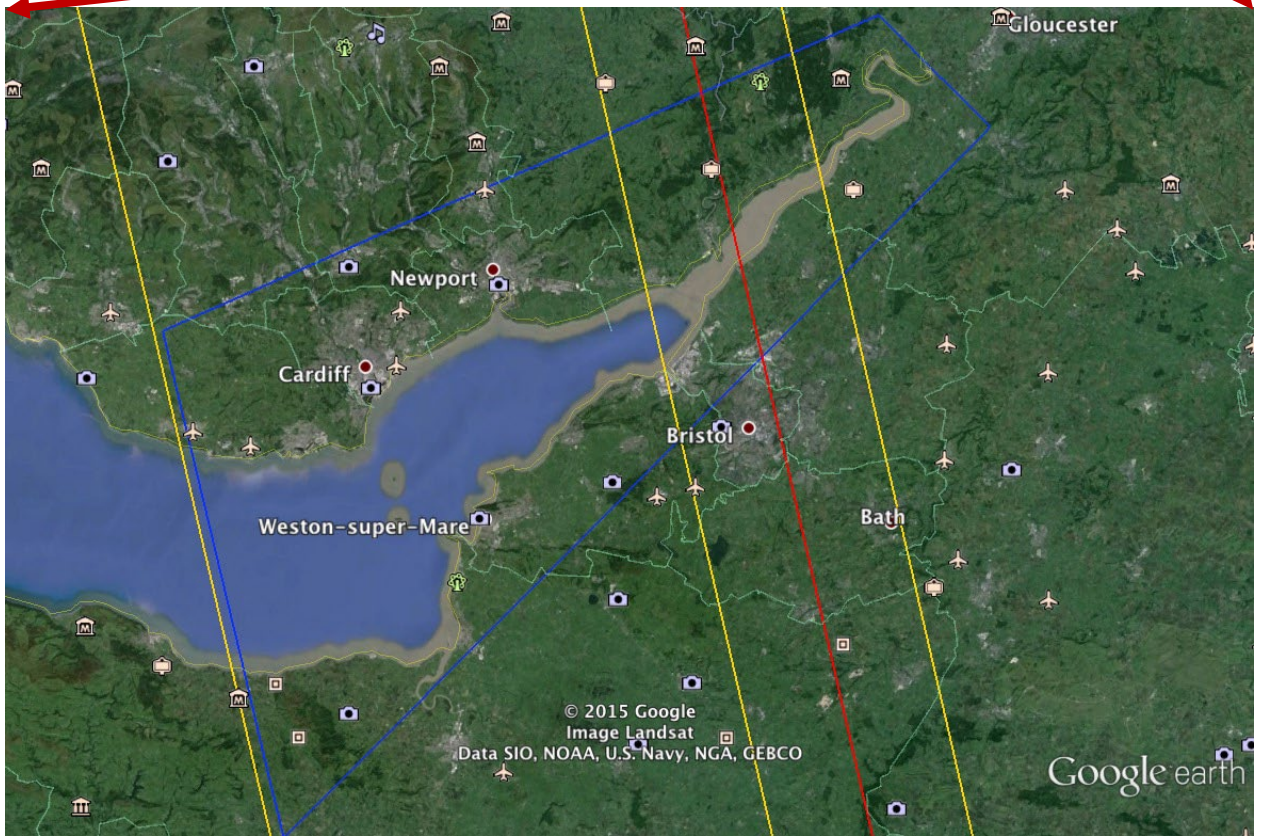
Funders:

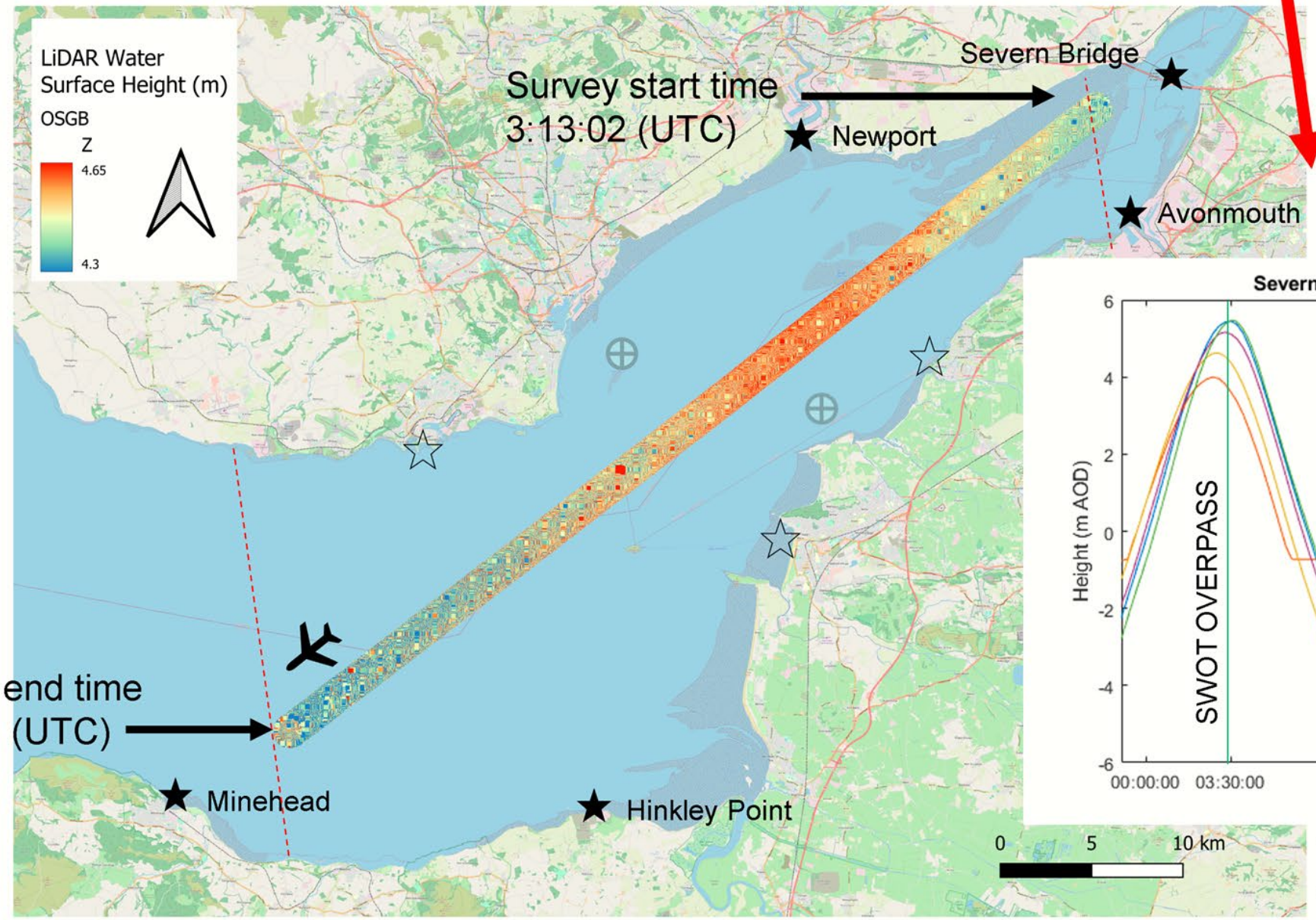
UKRI Natural Environment Research Council

UK SPACE AGENCY

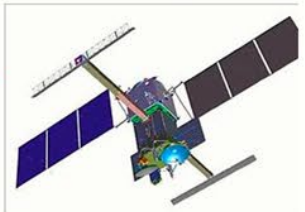


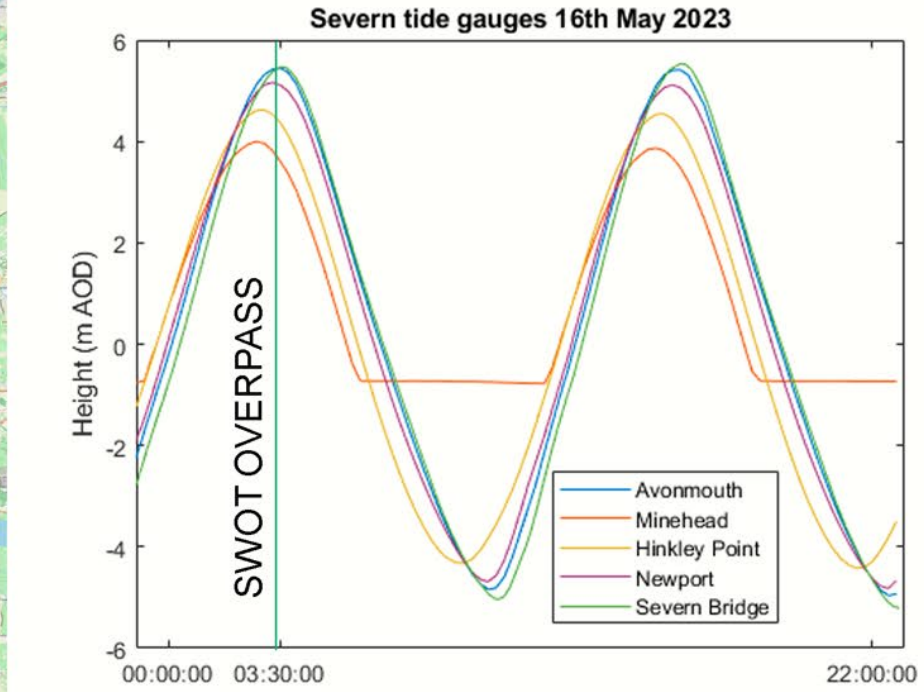


SWOT-UK Severn Estuary In-Situ Measurements



SWOT overpass time
3:27:48 (UTC) 16/05/2023





★ Tide Gauge
☆ GNSS-IR Gauge
⊕ ADCP Mooring

****SWOT LR data version C is missing northern half of site (inc most gauges) – to be fixed in next version****

Missing data in LR ‘C’ Data – Known Issue related to ‘Fill values in Reference Surface’

Very frustrating as all data workflows for this site were ready to roll on version C LR data

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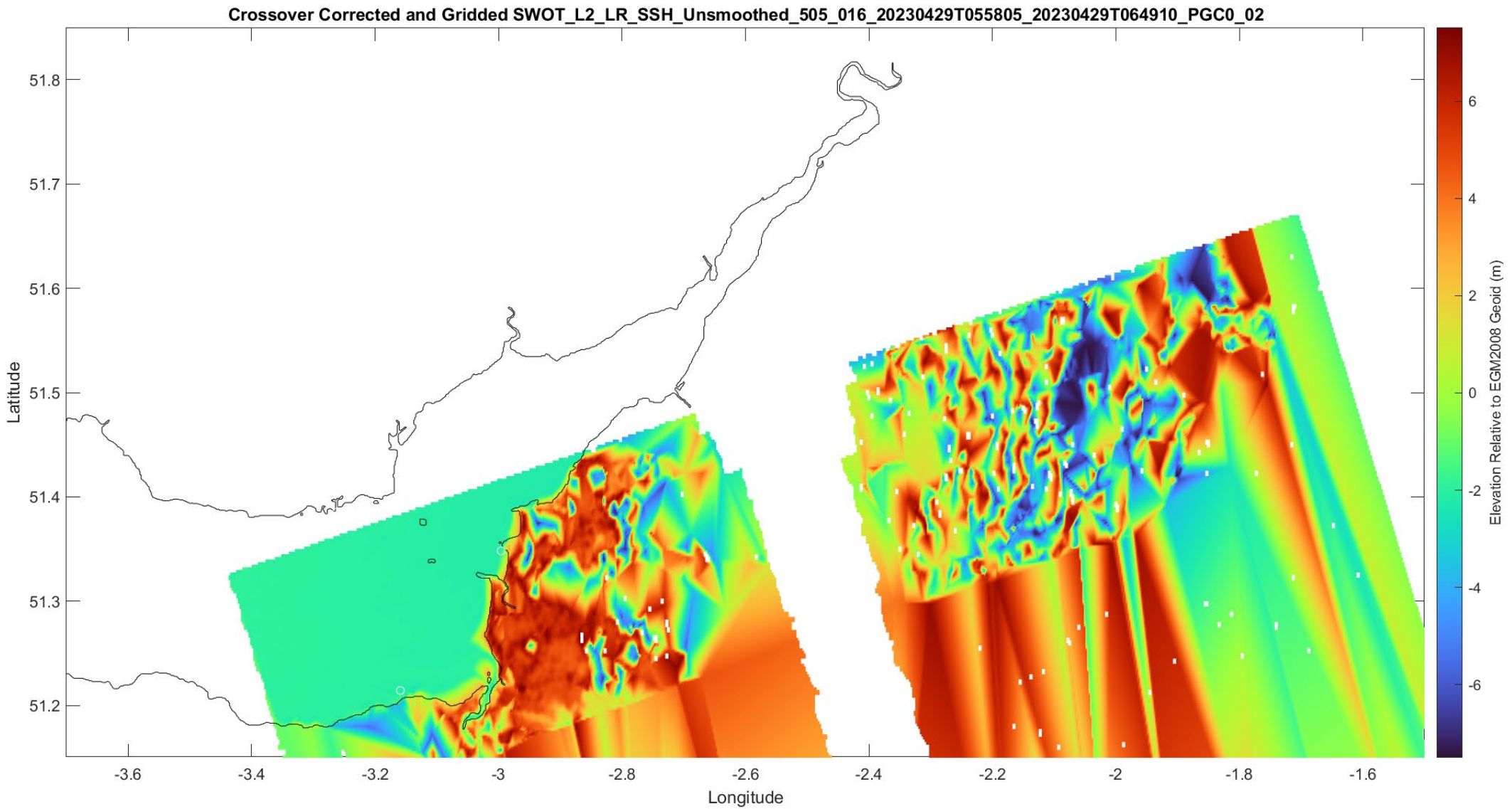

Severn Estuary Tide Gauge Comparisons (P1B0 LR 2km Data, 6km radius comparison)

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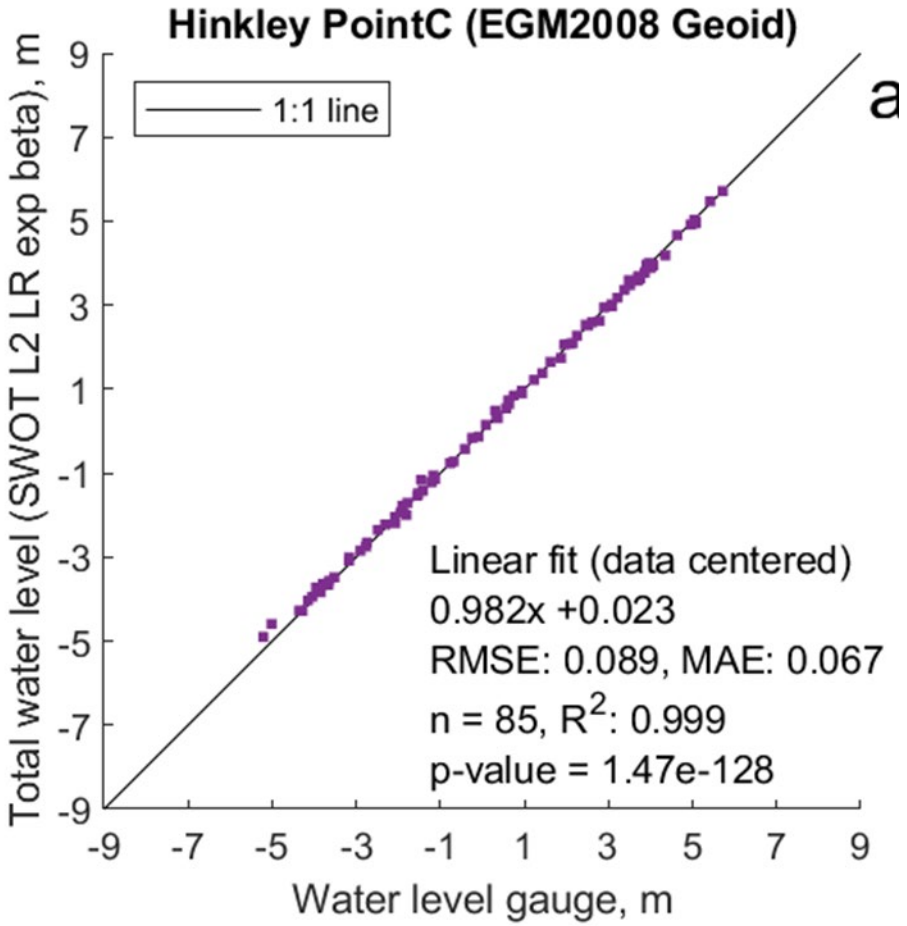
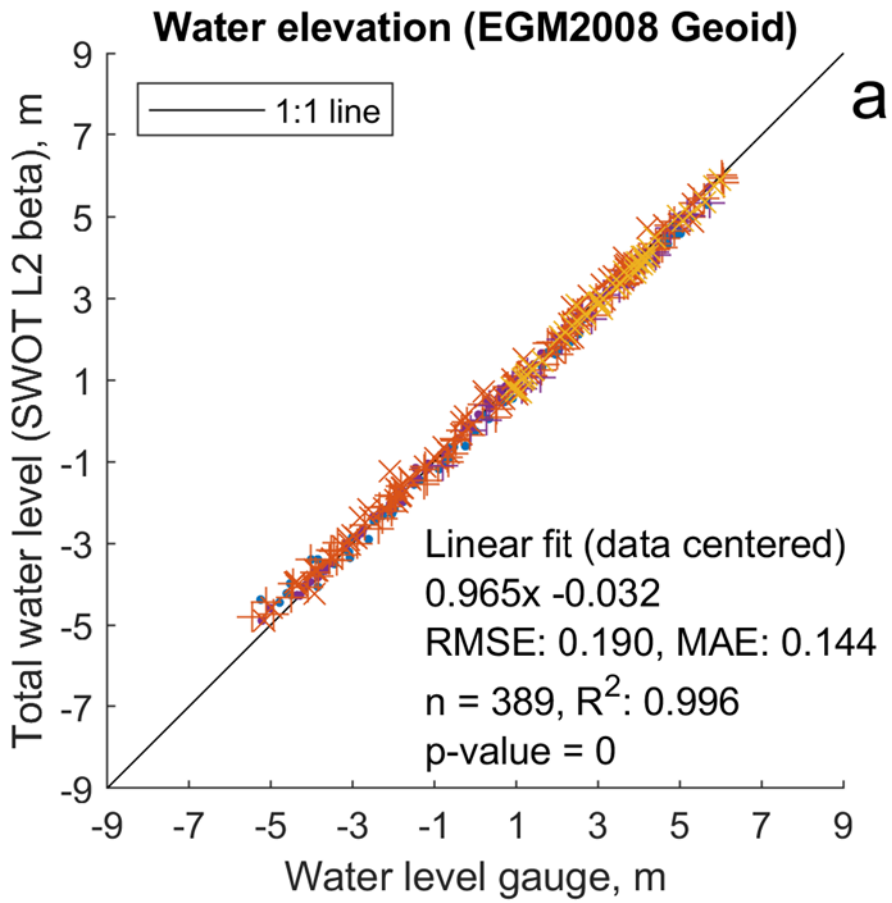
Many gauges in the Severn Estuary are located in ports and river mouths that allow the full tidal range to be captured. However, this is likely to distort the measurements compared with the open-water SWOT measurement 2km grid, so degraded comparisons are expected for those gauges





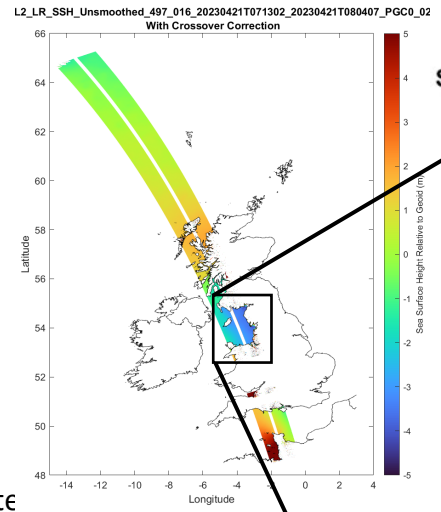
LR SWOT Data versions P1B0_01 and PGC0_02 compared with multiple tide gauges across Liverpool Bay : 10m Tidal Range, Coastal Sites & Estuaries

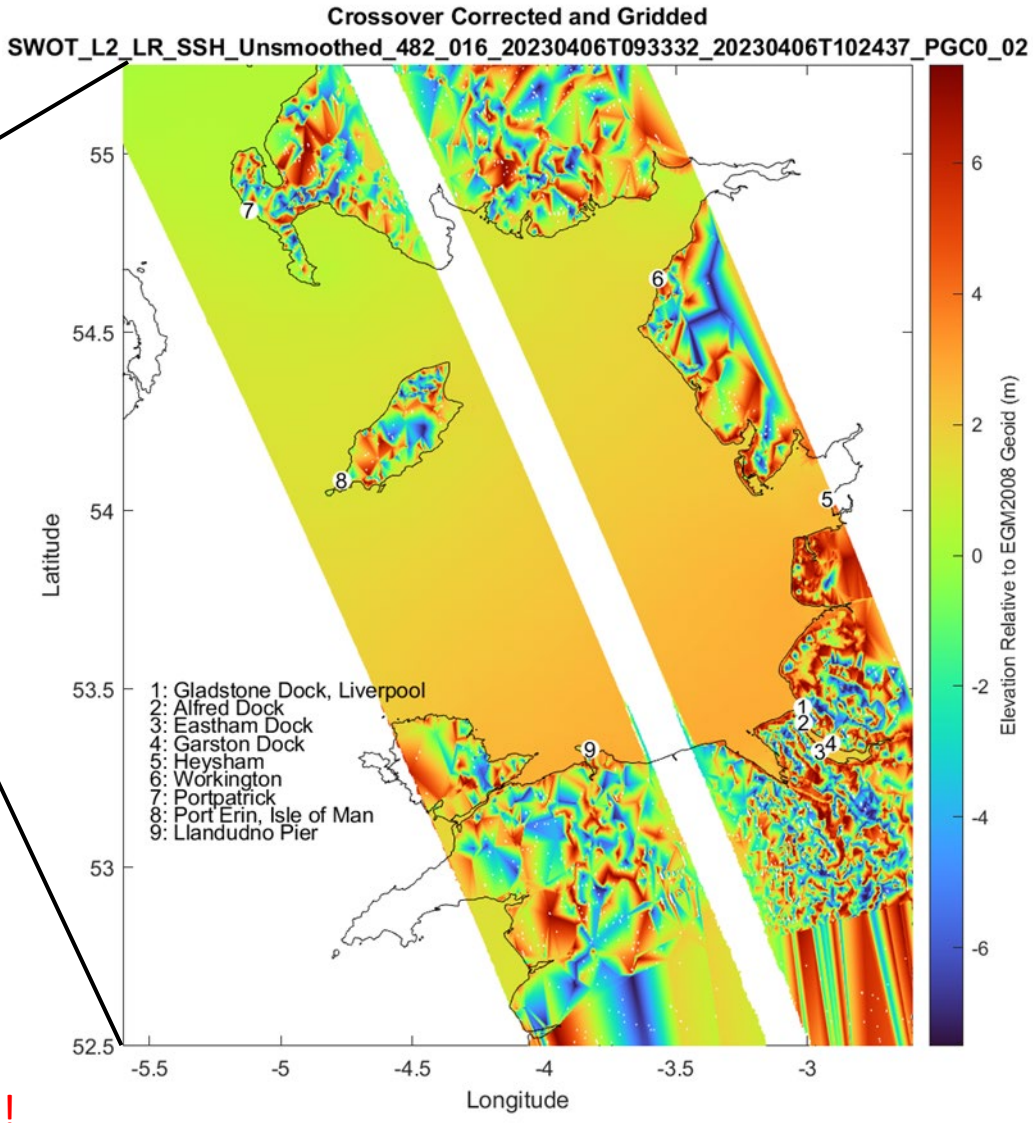
Paul S. Bell, Dougal Lichtman

National Oceanography Centre

Initial SWOT – Gauge Comparisons "Out of the Box"

Expand study area from Severn Estuary to UK NW Coast to mitigate missing SWOT data in Severn Estuary and support a UKSA SBRI project in the Mersey Estuary – migrating sandbanks impacting navigation channels.





RMS Errors are calculated after removal of mean bias levels at each tide gauge site

	LR Data Version P1B0_01		LR Data Version PGC0_02	
Tide Gauge	**Mean Bias (m)**	**RMS Difference (m)**	**Mean Bias (m)**	**RMS Difference (m)**
Gladstone	0.151	0.057	0.121	0.069
Eastham	0.112	0.065	0.104	0.069
Alfred	0.024	0.063	-0.016	0.083
Garston	0.309	0.091	0.292	0.078
Heysham	0.139	0.083	0.079	0.082
Workington	0.072	0.064	0.149	0.063
Llandudno	0.221	0.056	0.218	0.066
Port Erin	0.345	0.076	0.355	0.056
Portpatrick	0.194	0.083	0.181	0.057
Gauge Averages	**0.174**	**0.071**	**0.165**	**0.069**

Average 7cm RMSE is amazing!! I am already using this data for applications!

Liverpool Bay Tide Gauges vs SWOT LR Data Comparison – Version P1B0_01

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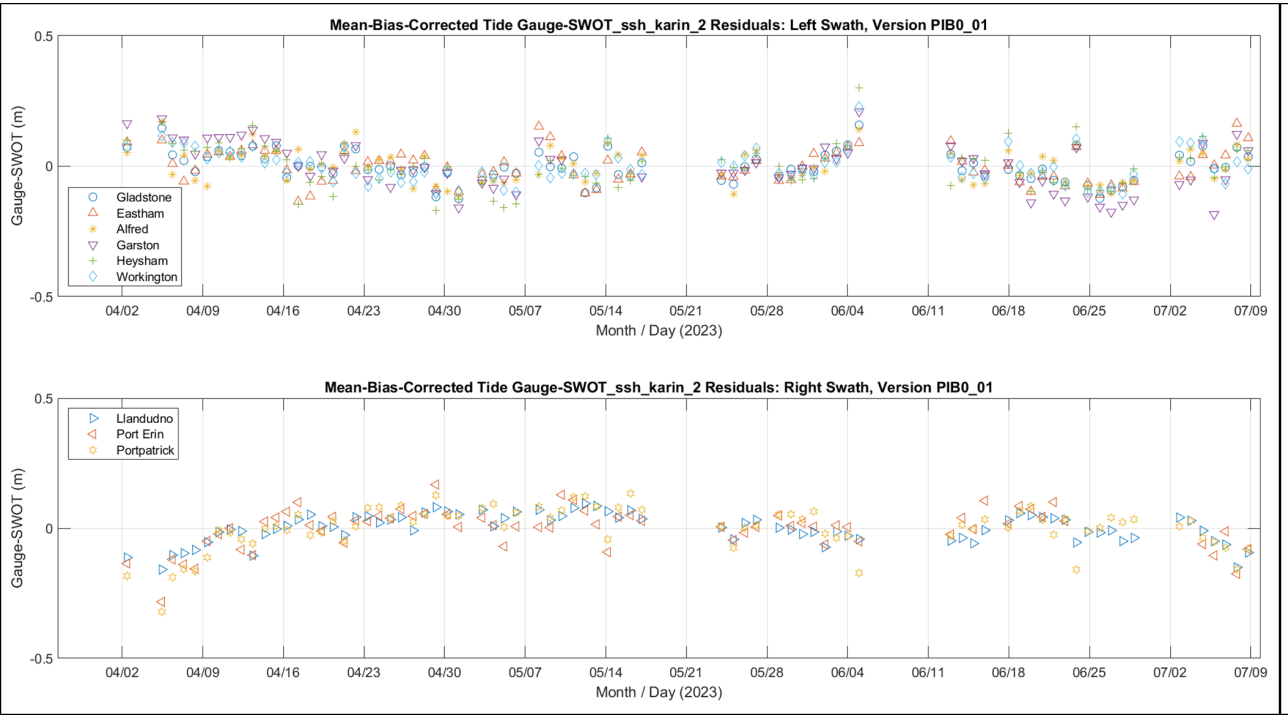
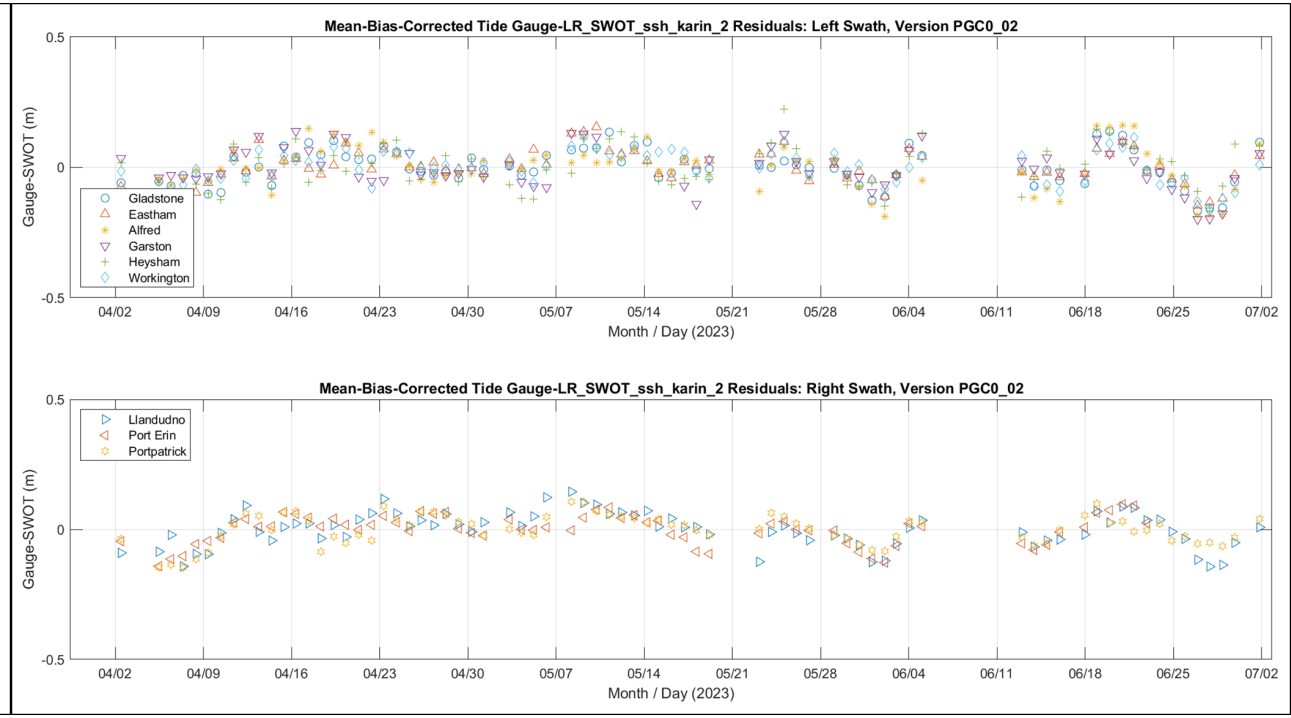
P1B0_01 (Initial Release) LR 250m Unsmoothed



PGC0_02 (Latest Release) LR 250m Unsmoothed

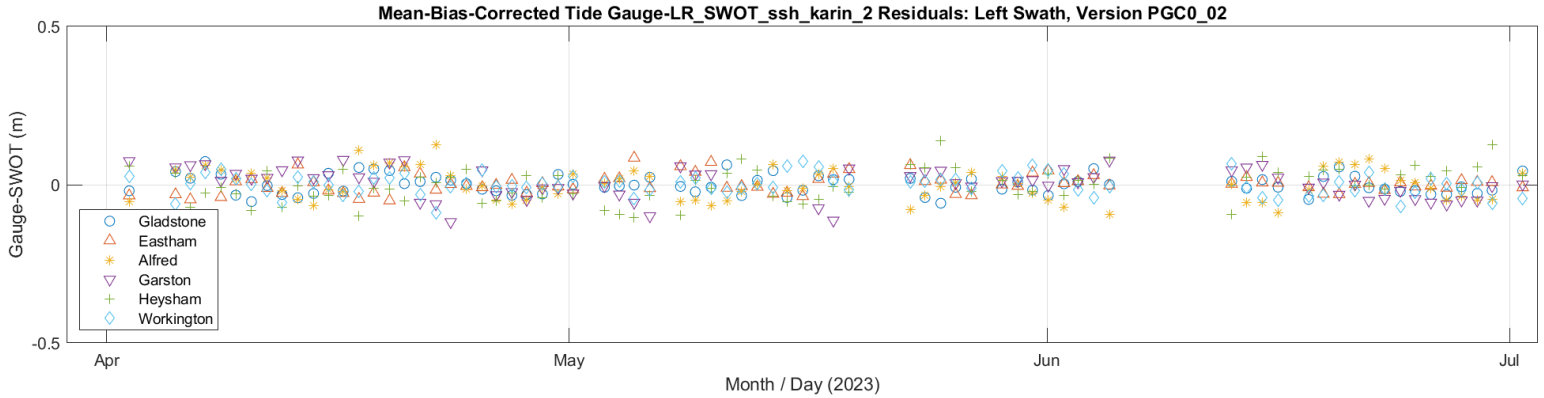


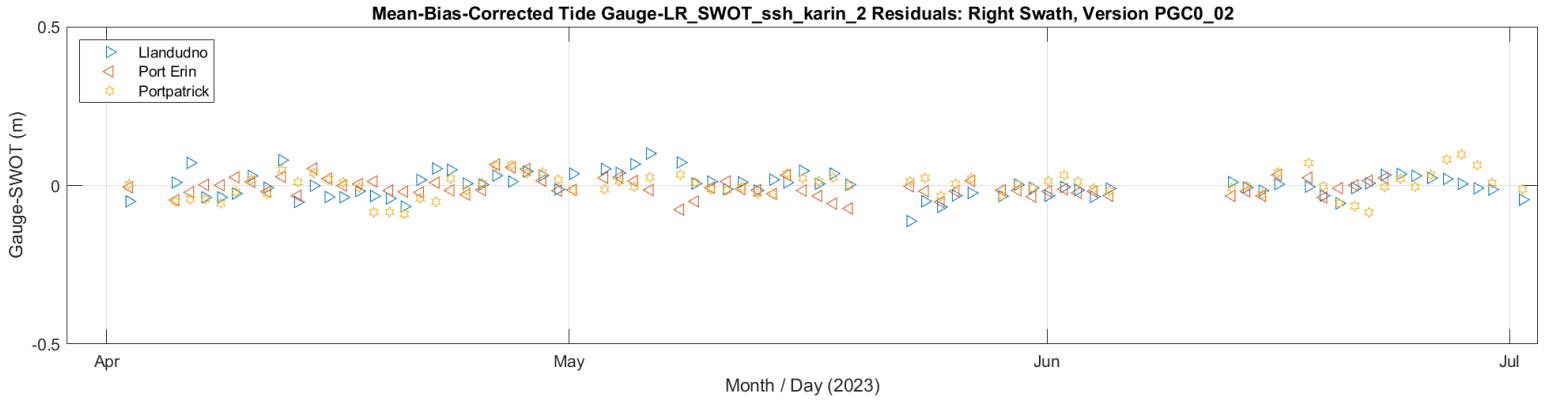
P1B0_01: Systematic Errors show **inverted** pattern of errors between left and right swaths (4-5cm variations)

PGC0_02: ***Different*** 4-5cm variations – Left and Right swath patterns no longer inverted.
Relatively consistent **offset** across all gauges on a daily basis

By removing gauge-averaged errors, RMS differences/errors reduced to 0.039m

Subtract the average systematic daily offset from the gauge comparisons:
Reduces 7cm RMSE down to 3.9cm RMSE





	LR Data Version PGC0_02	
Tide Gauge	**Mean Bias (m)**	**RMS Difference (m)**
Gladstone	0.121	0.030
Eastham	0.104	0.033
Alfred	-0.016	0.049
Garston	0.292	0.048
Heysham	0.079	0.052
Workington	0.149	0.033
Llandudno	0.218	0.038
Port Erin	0.355	0.029
Portpatrick	0.181	0.039
Gauge Averages	0.165	0.039

Discussion:

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What next :

- Expand area to whole Pass 16 UK gauges taking in Tide gauges in Scotland, Severn Estuary and English Channel (La Manche).
- Adapt data workflows to HR Raster data – *significant implications for time and data handling.*

Pre-launch expectation?

- Hoped to see realistic water levels up-estuary – delivered! **7cm RMSE in macro-tidal coastal sites – amazing!**

New results revealed?

- Nice water levels, Direct Intertidal Elevations! But evidence of the systematic errors mentioned in other talks

Challenges Remaining?

- **Data Gaps** across much of our study areas in latest versions of LR data – related to 'Fill values in Reference Surface' – will be fixed in next data revision, Will look at 100m HR Raster next – but significant data handling implications.
- **Absolute gauge elevations (pre-existing)** – remaining static biases - are biases (up to 30cm) related to inadequate Geoid/levelling/transformation from national datum to spheroid? Investigate Icesat-2 levelling
- **Crossover correction** having to be interpolated from L2 2km product to 250m unsmoothed – please include crossover in the 250m files to avoid having to load both products and interpolate!! Data are unusable without this correction!
- **Question:** Should we quote RMSE before or after removal of local systematic errors? Or both?