EGU24-2030

National Oceanography Centre

Validating SWOT in the coastal zone: a radar altimetry and tide gauge case study in the Bristol Channel and Severn River-Estuary system

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Sharing is encouraged

Contents

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Introduction to the SWOT-UK project

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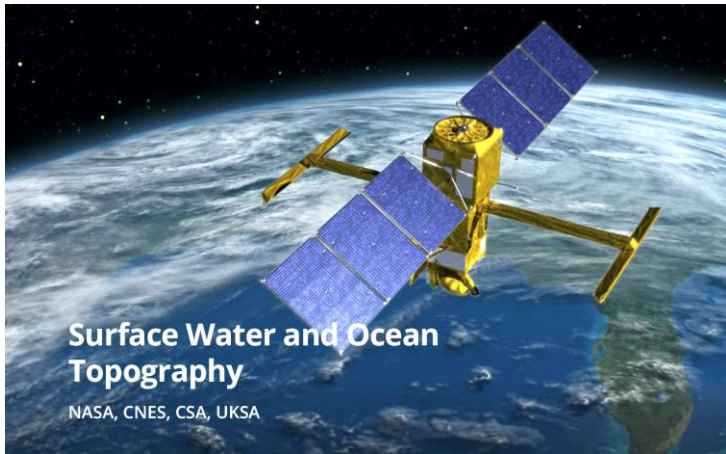
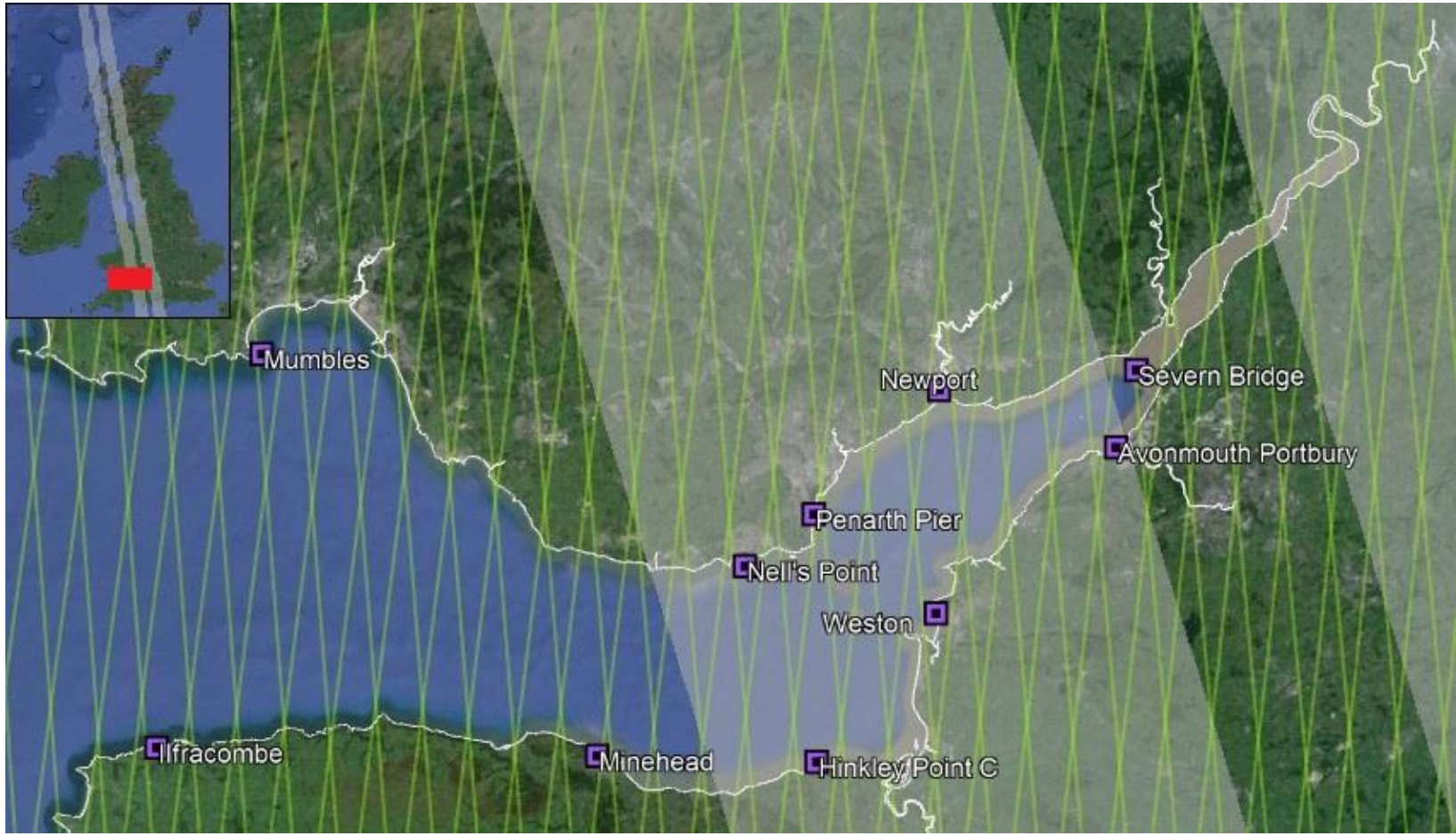
- Validate SWOT data with in-situ data and numerical models for spatial variability of water level and marine-fluvial interactions
- By assembling a dataset of quality-controlled in-situ and satellite water levels
- Additional GNSS-IR water level gauges were deployed, to complement existing observations
- Investigating SWOT performance in coastal and estuarine settings (SWOT is not designed for these environments and they are challenging)
- SWOT-UK seeks to distribute validation datasets and engage with the UK science and stakeholder communities

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



Bristol Channel and Severn Estuary

- Huge tidal range (>14m), strong currents and a tidal bore in the upper reaches (see poster 7832)
- Waves can be over 7 m at the western limit but are small up the estuary
- Highly mobile sedimentary bedforms ranging from mud ridges to gravel waves and dunes



Credit: CNES, CLS, UK EA, SIO, NOAA, U.S. Navy, GEBCO, Landsat, Copernicus

Sources of uncertainty

Gauge levelling and structure movement	0.1 m (Ordnance Survey, 2023)
Along & across channel water slope	A few cm to tens of cm
Nearshore processes due to waves, wind and river outflow	Up to tens of cm (Woodworth et al, 2019; Abessolo et al, 2023)
Vertical land movement	~ 0.01 m over 10 years (www.sonel.org)
Quality of sea state bias correction (based on wave and wind data and algorithm not tuned to coastal areas)	Should be a few cm at most, as waves are small in the study area (Andersen and Scharroo, 2011; Dhoop, 2019)
Residual error in spacecraft attitude, baseline length and phase drift	A few cm (Esteban-Fernandez, 2017; SWOT project, 2024)
Motion of the water currents and waves	< 1 cm (Esteban-Fernandez, 2017)

A comparison of satellite altimetry and in situ gauges

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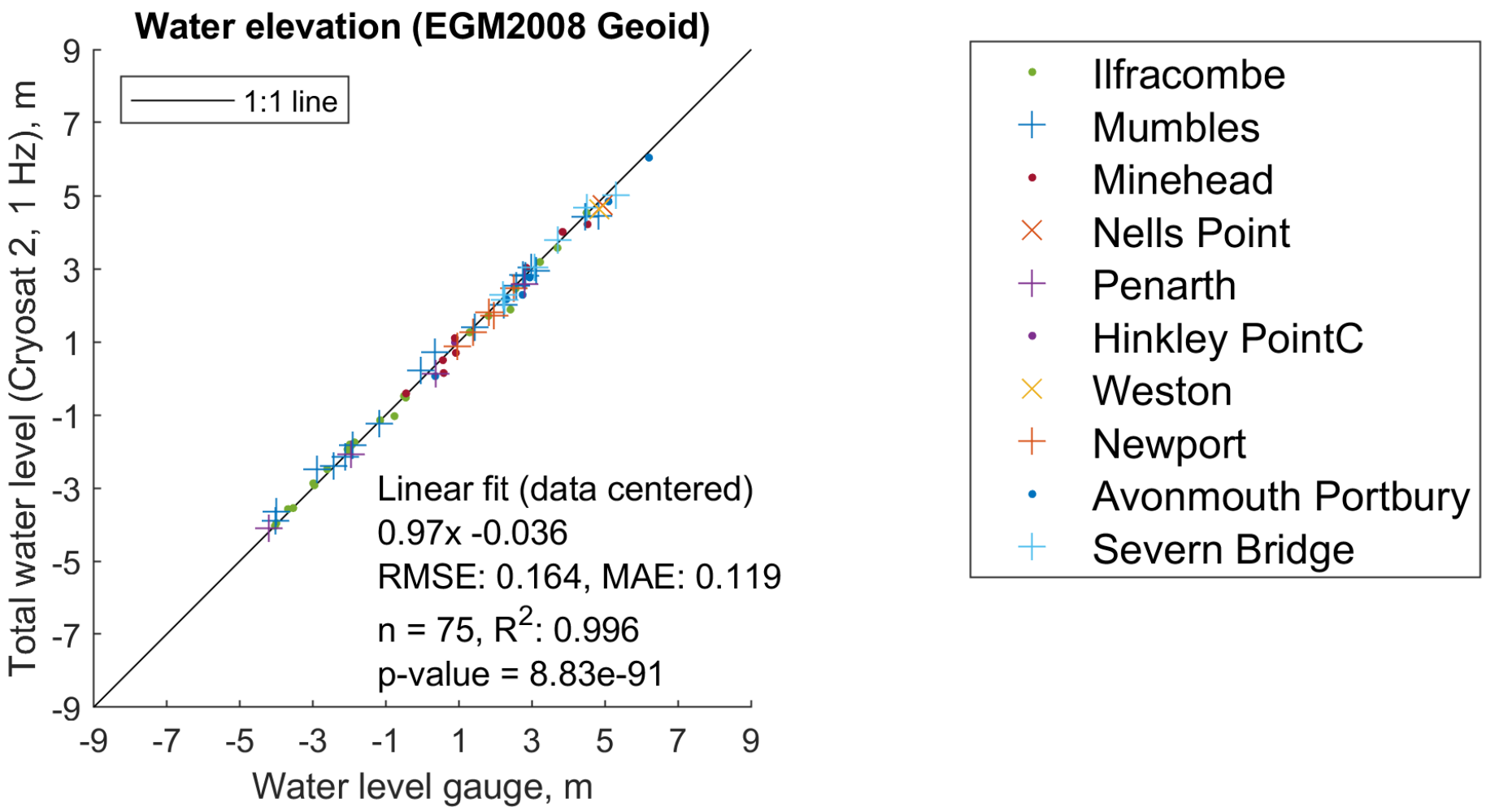
- Total water level (TWL) is used
- No corrections for tide or air pressure effects
- Geoid corrected (EGM 2008)
- Gauge data were interpolated to the time of the passes
- 6 km radius used to match gauge and satellite data
- Standard QC flags not used, as can remove coastal data
- Median filter (reduces the effects of water slope & extremes)
- Crossover correction is applied to the SWOT data

Corrected Range = Range + Wet Tropo. + Dry Tropo. + GIM Iono.

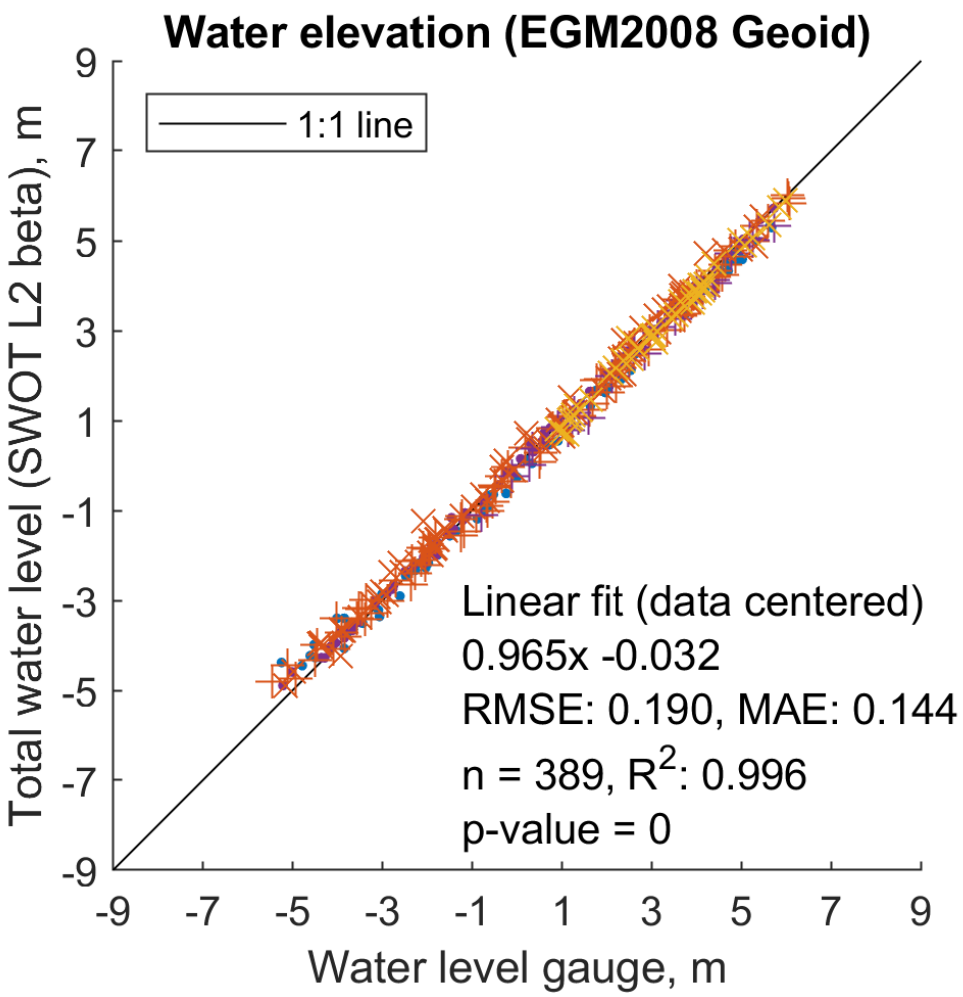
Total Water Level = Altitude - Corrected Range - Solid Earth Tide - Pole Tide - Sea State Bias

A comparison of Cryosat 2 altimetry and in situ gauges



- Cryosat 2, 2012-2023, 1 Hz (QCV data, quality control for ocean not coast)

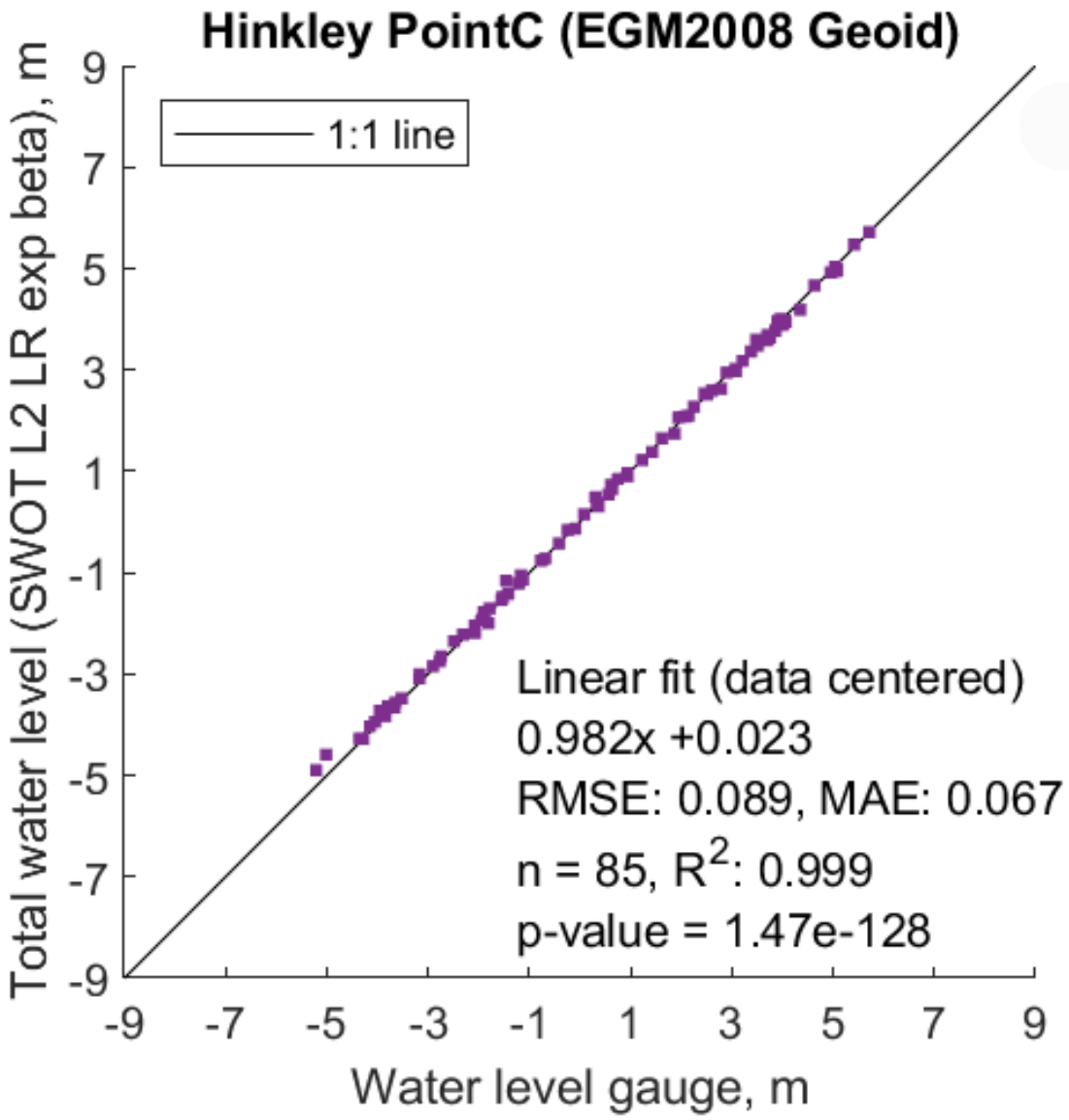
A comparison of SWOT KaRIn altimetry and in situ gauges



- SWOT KaRIn L2 LR Expert, 2 km, 1 April – 11 July 2023

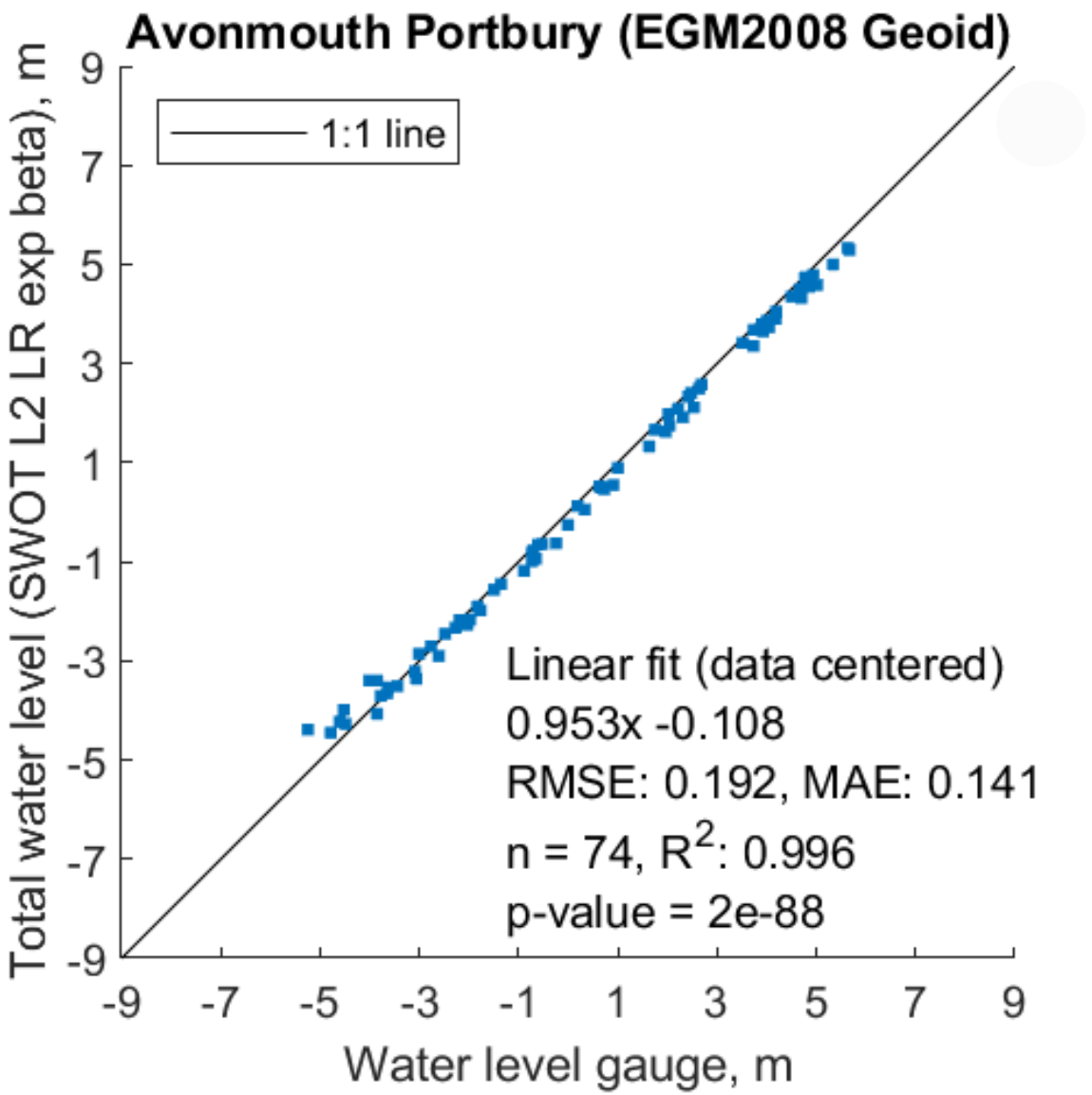
A comparison of SWOT KaRIn altimetry and in situ gauges

- Hinkley Point C – best site
- SWOT KaRIn L2 LR Expert, 1 April – 11 July 2023, 2 km
- On the end of a 460 m pier
- No major rivers nearby
- Installed 24/05/2022
- Levelling unknown, but probably GNSS



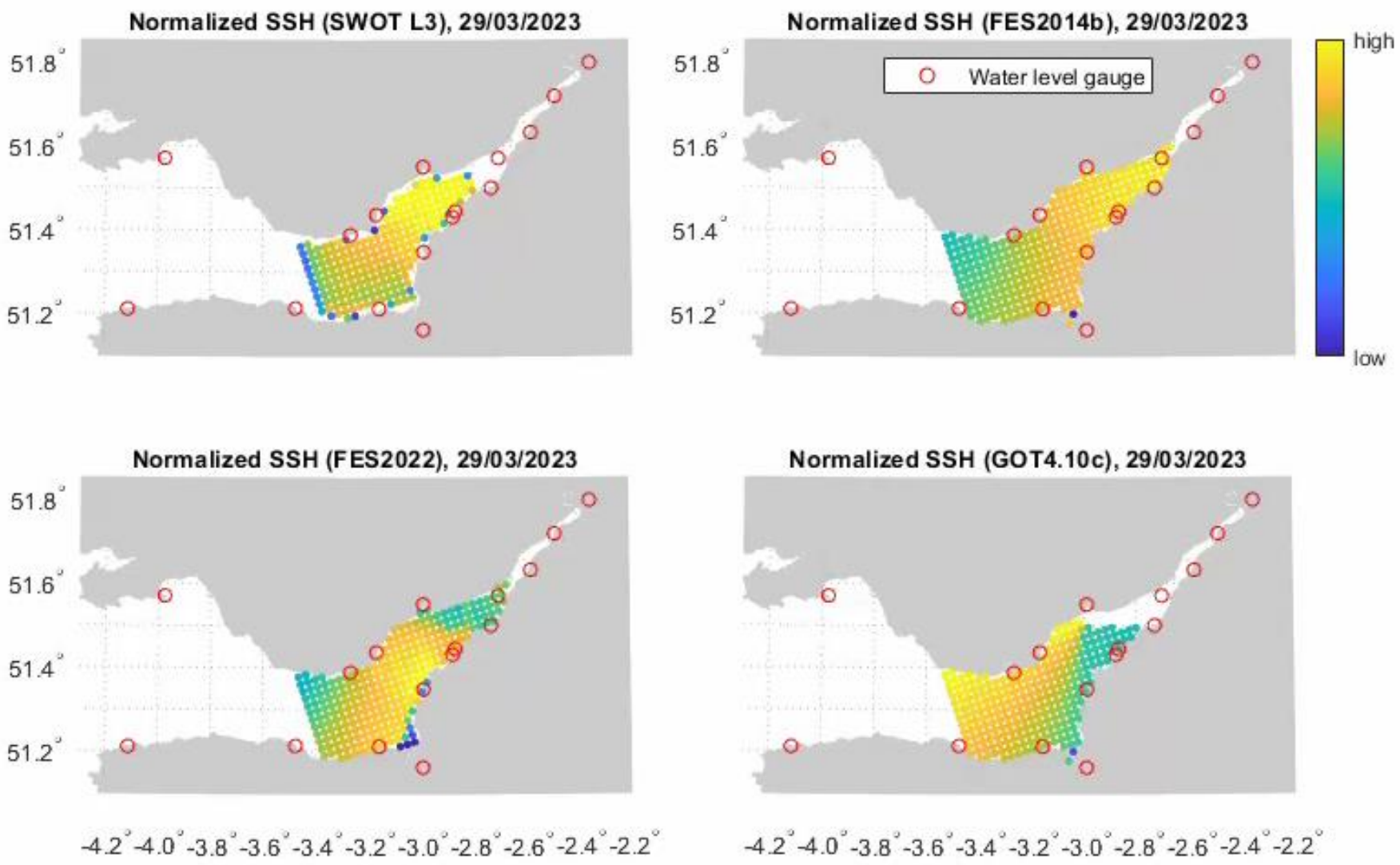
A comparison of SWOT KaRIn altimetry and in situ gauges

- Avonmouth – worst site
- SWOT KaRIn L2 LR Expert, 1 April – 11 July 2023, 2 km
- Close to the edge of the swath
- Near intertidal flats and a river mouth
- Furthest up estuary of all the sites in the study
- Last levelled 2021, levelling unknown, but probably GNSS

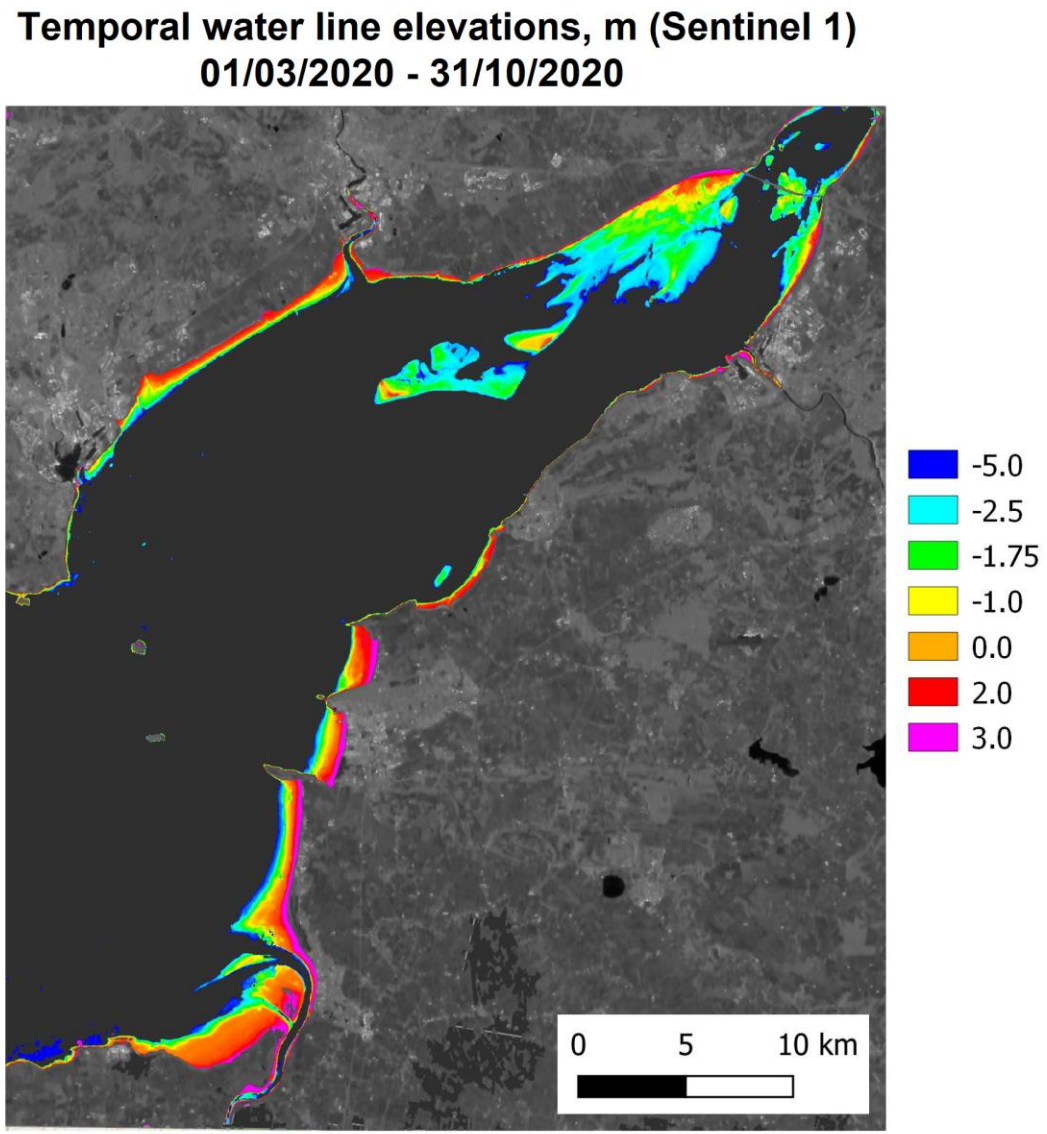


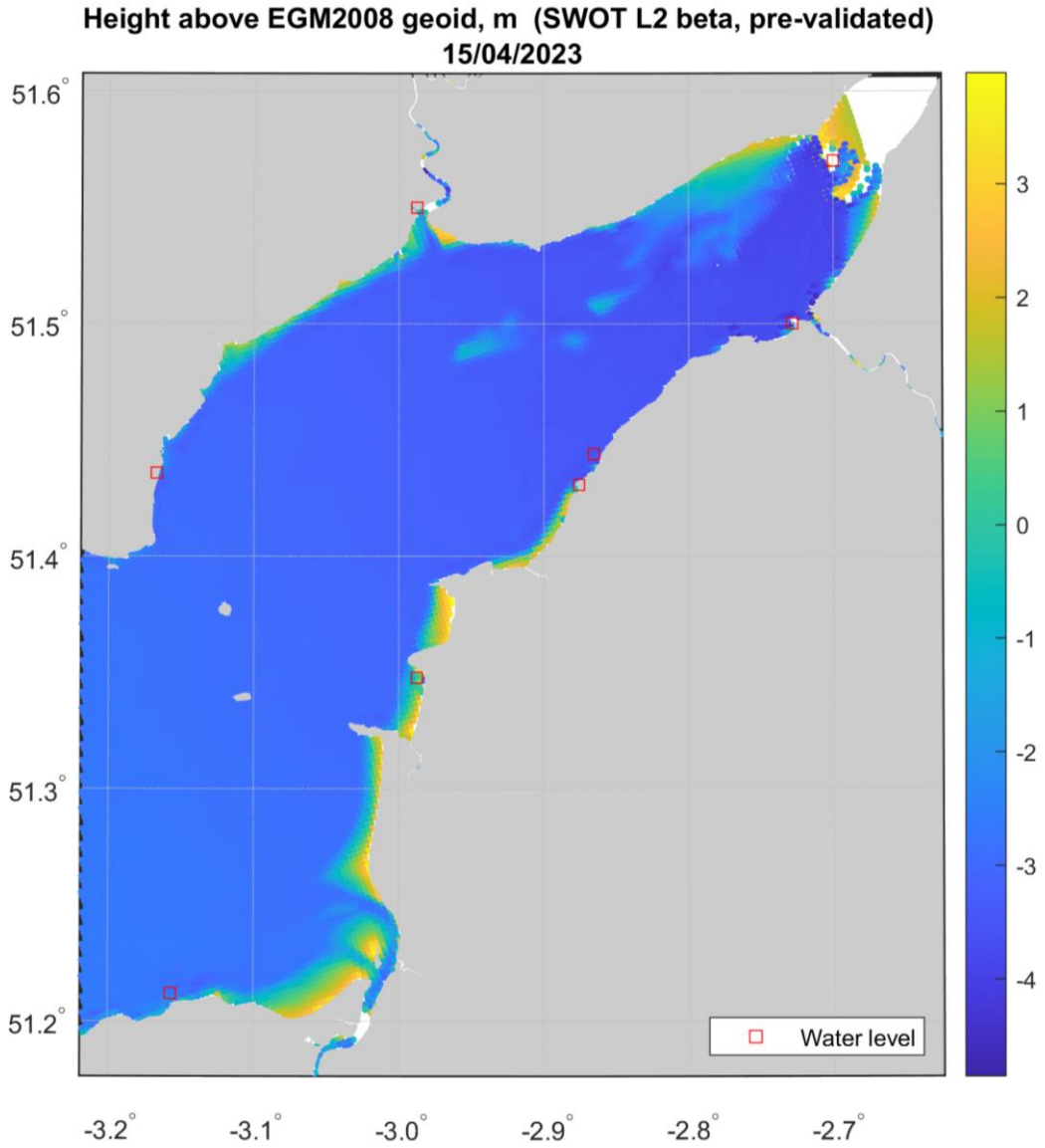
A qualitative look at SWOT KaRIn compared to model data

- SWOT L3 LR 2 km unedited v0.3
- L3 data filtered for extreme values using median absolute deviation for 3 SD
- Intertidal areas show up in SWOT data



Intertidal morphology – KaRIn L2 unsmoothed and TWL





Summary

- The SWOT data look very good in the Bristol channel and Severn Estuary
- The expected features tidal features are seen, compared to models
- Intertidal areas that remain ‘damp’ can be mapped and measured

Thank you for listening

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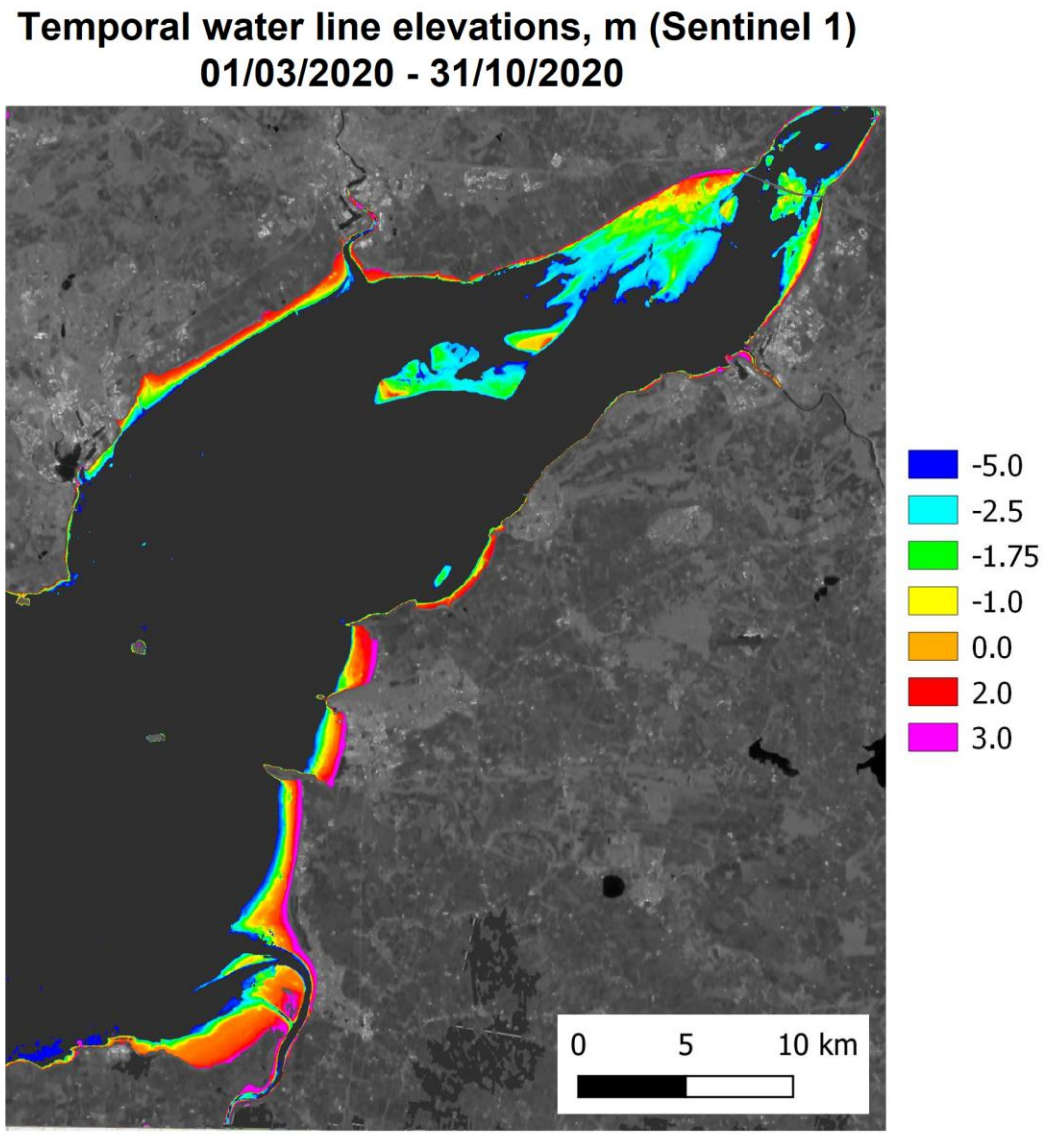
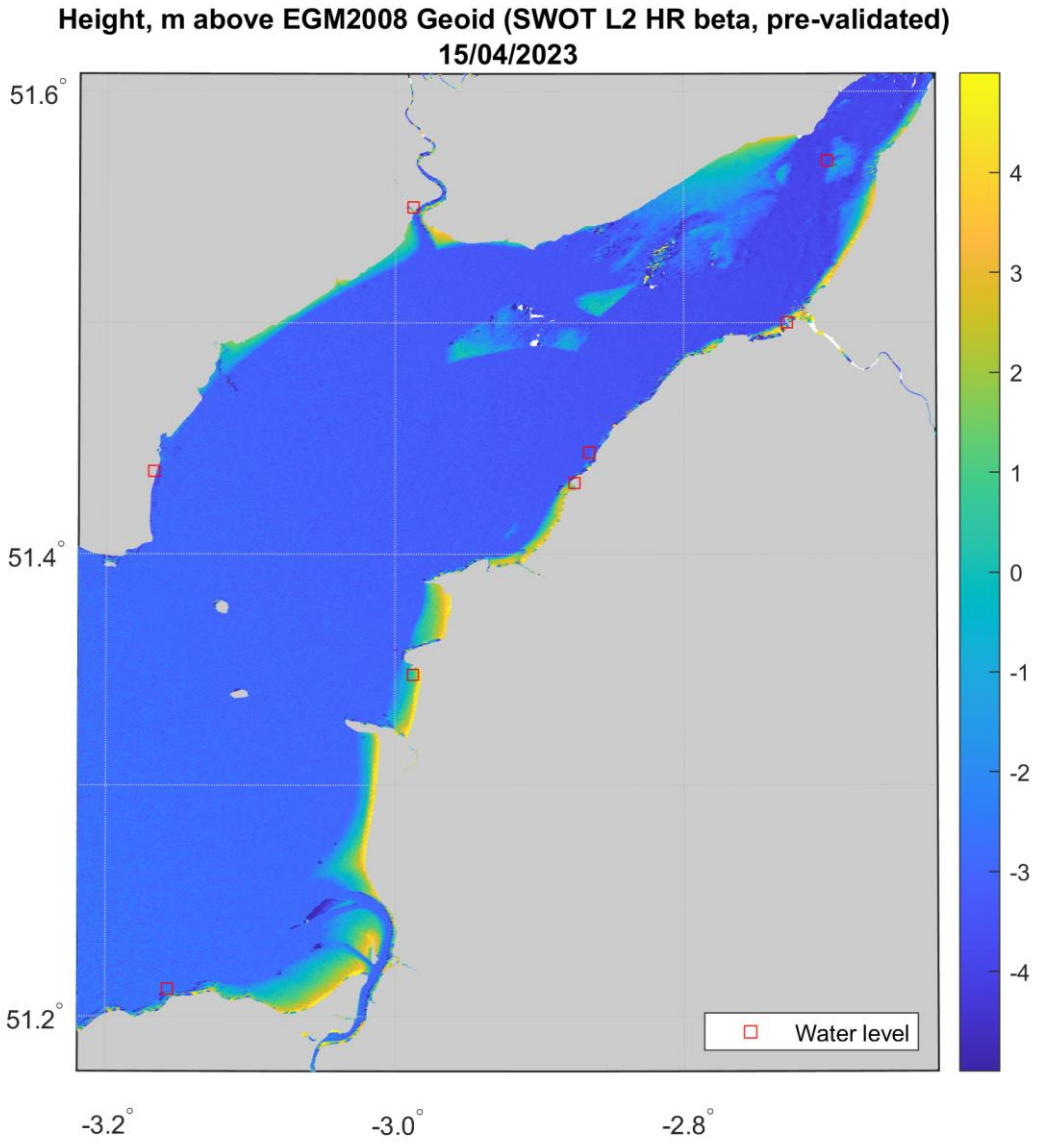
Intertidal morphology – KaRIn L2 HR and TWL





A comparison of Cryosat 2 altimetry and in situ gauges

- Ilfracombe – best site for C2 (not in swath)
- Cryosat 2, 2012-2023, 1 Hz (QCV data, quality controlled for ocean not coast)
- At mouth of the Bristol Channel
- No major rivers nearby
- Satellite tracks are perpendicular to land
- Lots of matches