UK Sea Level Variability and Sustained Measurements

ANGELA HIBBERT
NATIONAL OCEANOGRAPHY CENTRE, LIVERPOOL

The UK Tide Gauge Network (UKTGN)

- Developed in response to 1953 North Sea Storm Surge
- Operated on behalf of the Environment Agency by the Tide Gauge Inspectorate (TGI) at the NOC's Liverpool site
- Comprises 43 tide gauges, each with:
  - 2 full tide instruments (primary and secondary/back-up)
  - 1 half tide instrument
- Primarily bubbler systems, but there are also 4 float gauges, several direct pressure transducers and 1 radar

Bubbler System

Instrumentation primarily above water level – easier to maintain
Mid-tide sensor – used for levelling purposes

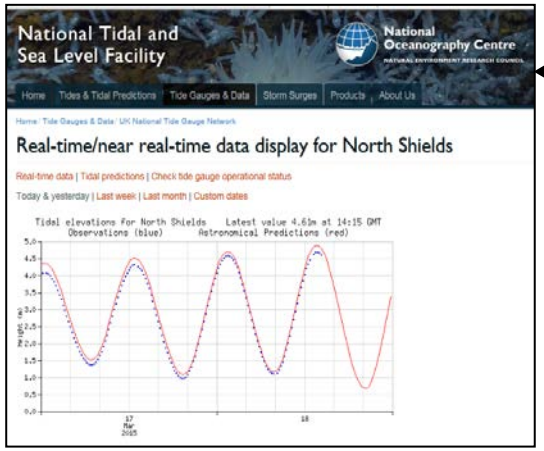
Real Time UKTGN Data

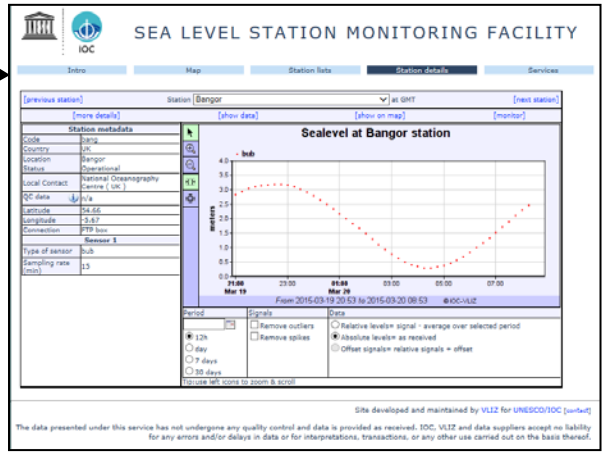
EA telemetry system (Swantel)

EA/Met Office Flood Forecasting Centre (FFC)

EA Regional forecasters EMERGENCY RESPONSE

NOC National Tidal and Sea Level Facility

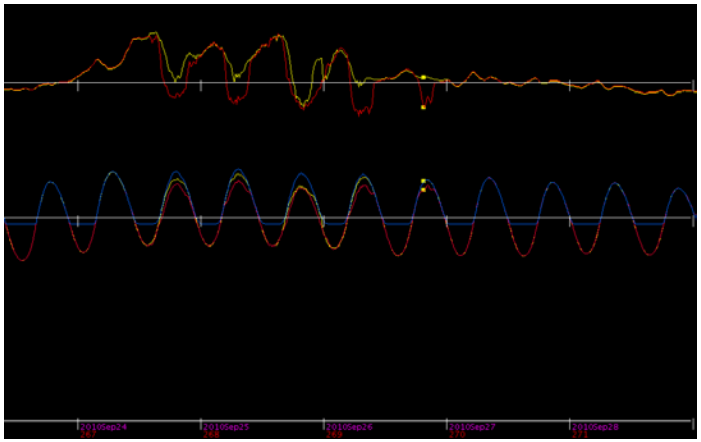


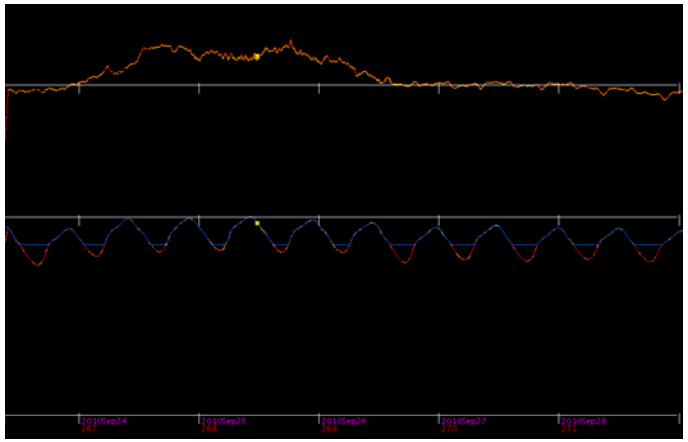


A word of caution….

Cromer

- Under-recording of High Waters during strong Northerly swell
- Direct pressure transducer installed alongside bubbler to assess the problem

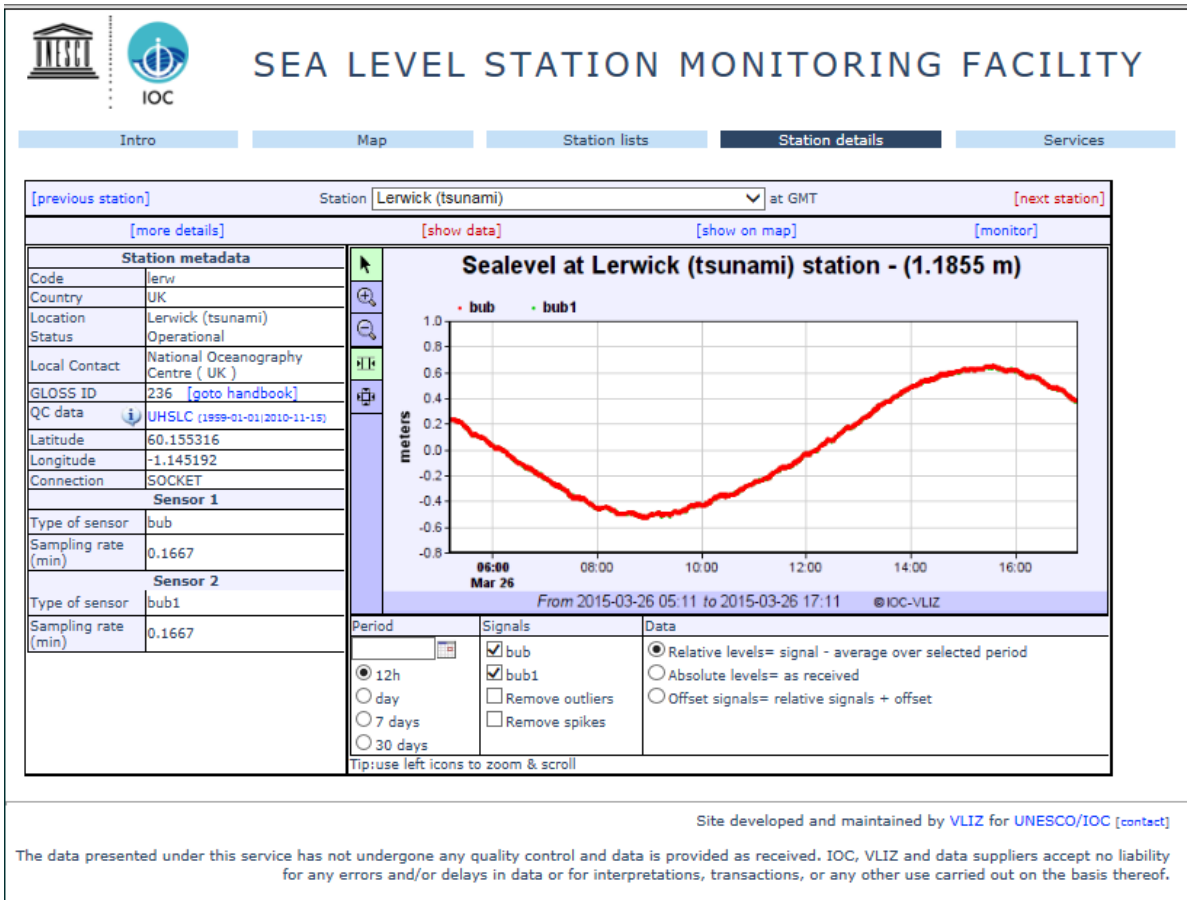




Real Time UKTGN Data

Tsunami Early Warning Systems

- Stornoway, Lerwick, Holyhead, Gibraltar equipped with pressure sensors sampling every 10 seconds. Newlyn and Liverpool to be installed this year.



Delayed Mode UKTGN Data

15 min → Environment Agency → Weekly → BODC British Oceanographic Data Centre, Natural Environment Research Council → Monthly → PSMSL

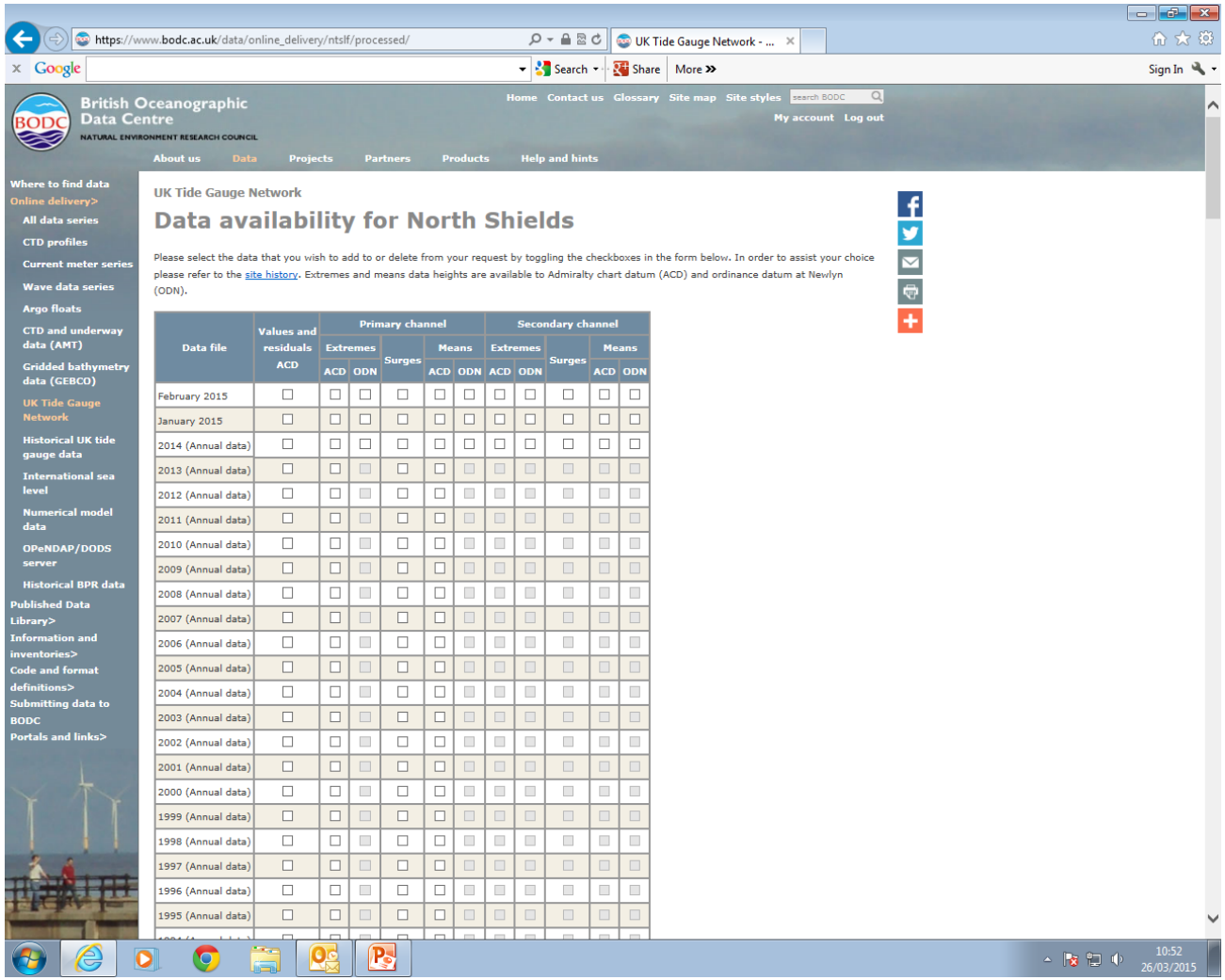
BODC Quality Control

- Weekly screening – comparison between channels, neighbouring ports, earlier data, >20mm channel differences flagged
- Monthly checks performed
- Primary channel posted to website
- Filtered to monthly means

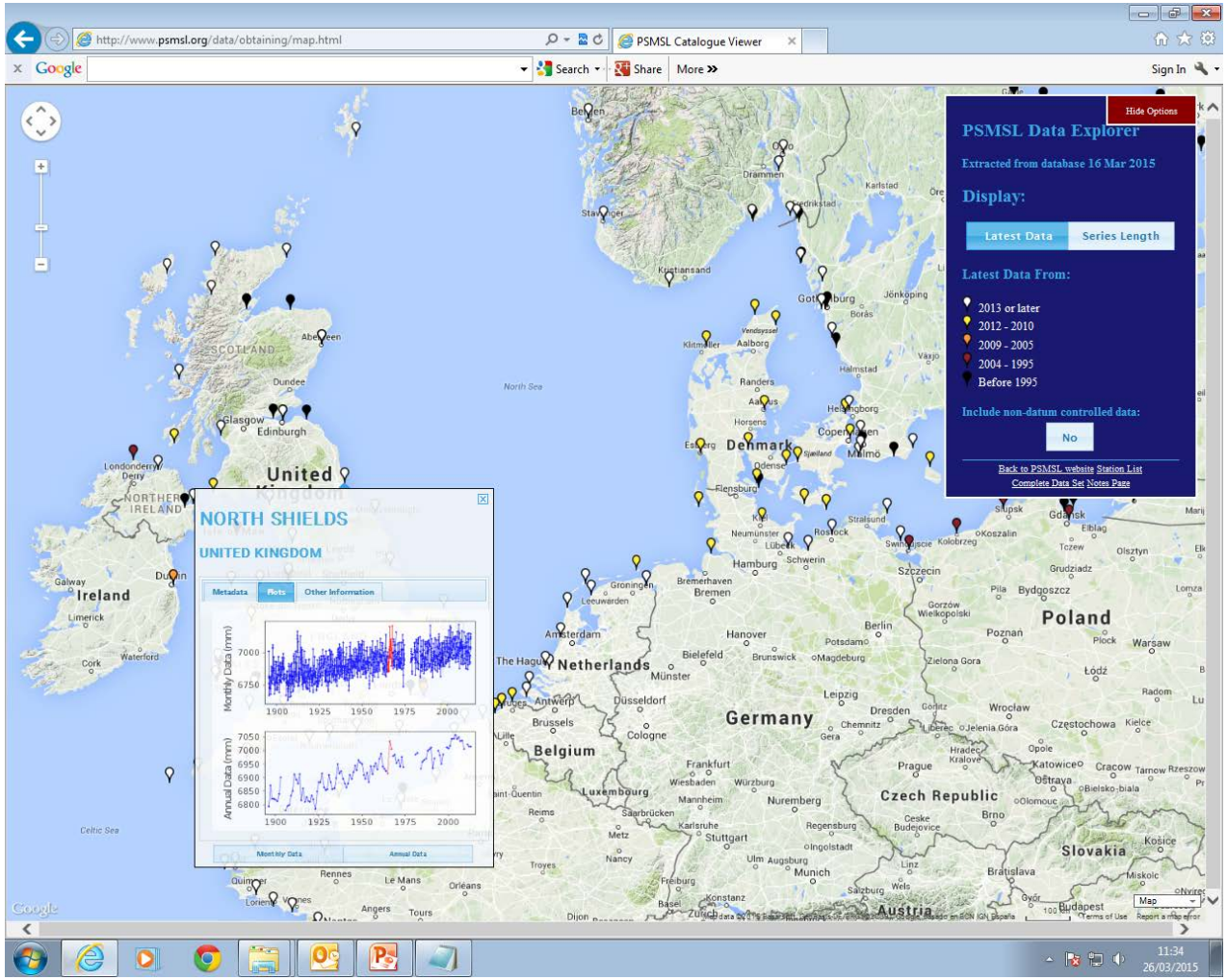
PSMSL Data

- Monthly means from BODC posted to PSMSL website annually.

Delayed Mode UKTGN Data



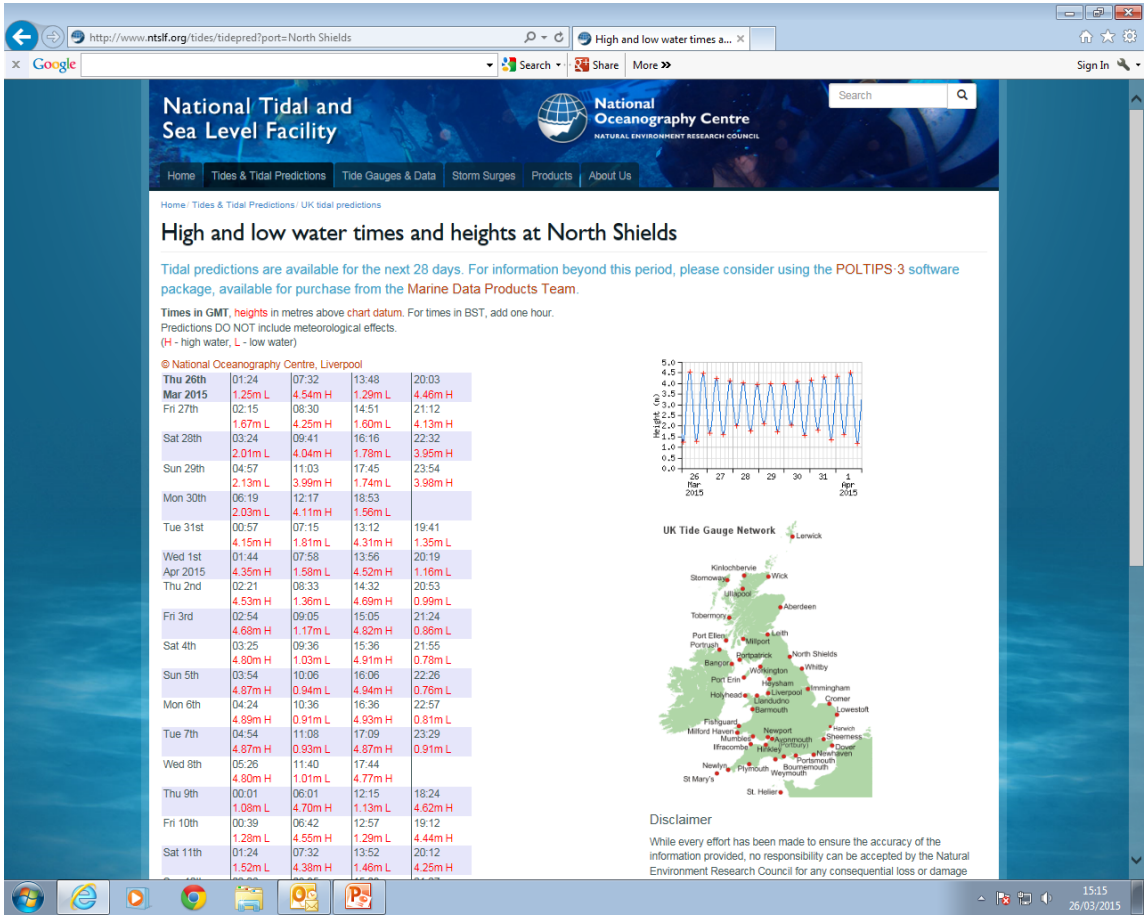
Delayed Mode UKTGN Data



Delayed Mode Data Uses

Tidal Predictions

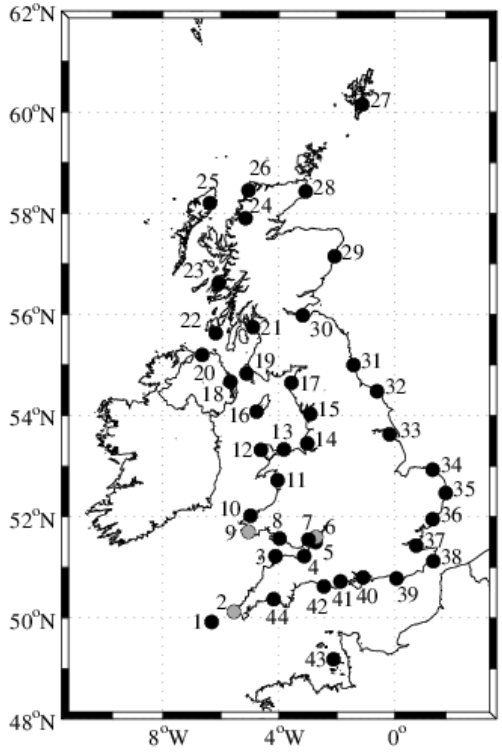
- Annual harmonic analysis of all UKTGN ports using most recent 19 years of data
- Updated constants used to construct predictions for EA Coastal Forecasting and for NTSLF web-based tidal predictions

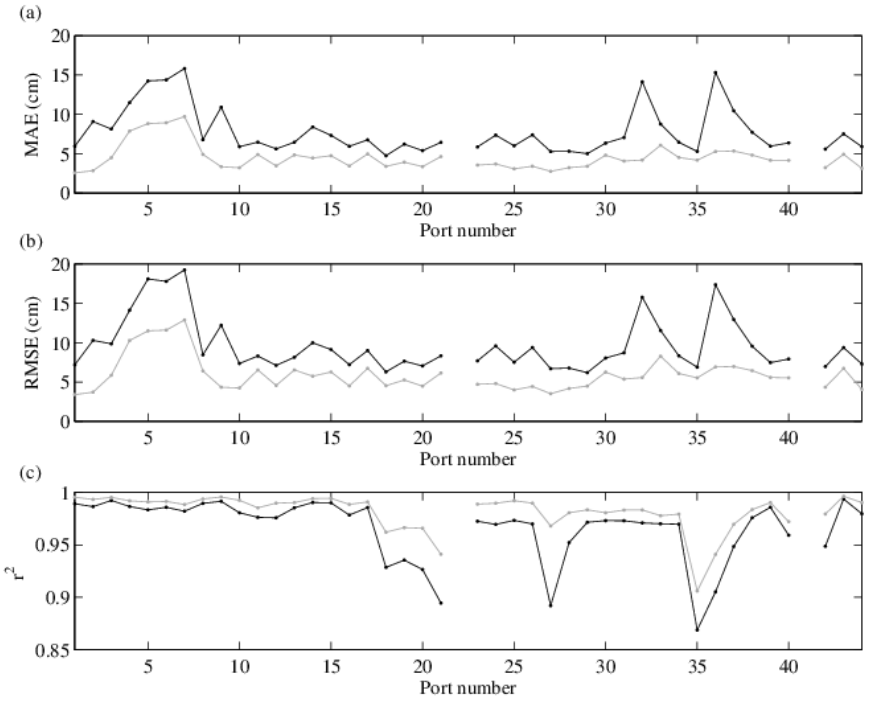


Delayed Mode Data Uses

Tidal Predictions

- Hibbert et al. (2015) - An empirical approach to improving tidal predictions using recent real-time tide gauge data

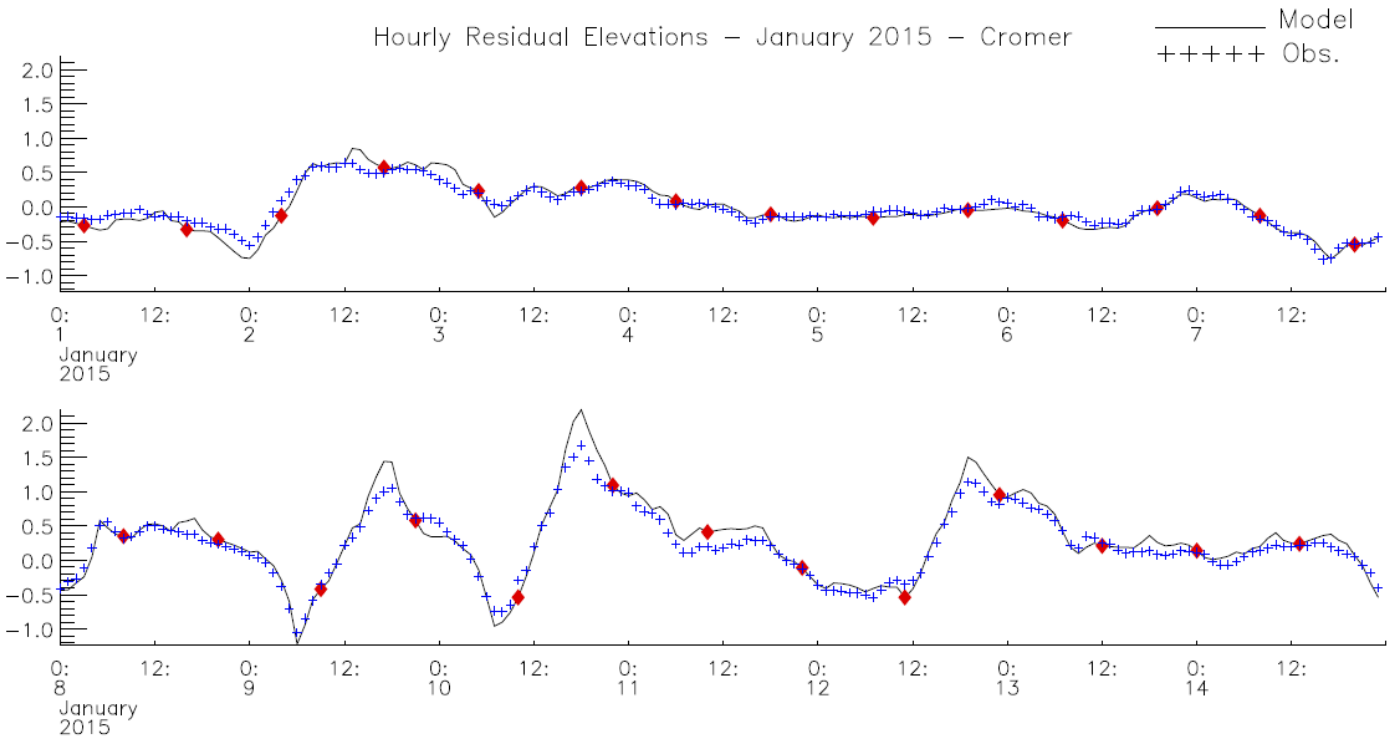




Delayed Mode Data Uses

Extremes

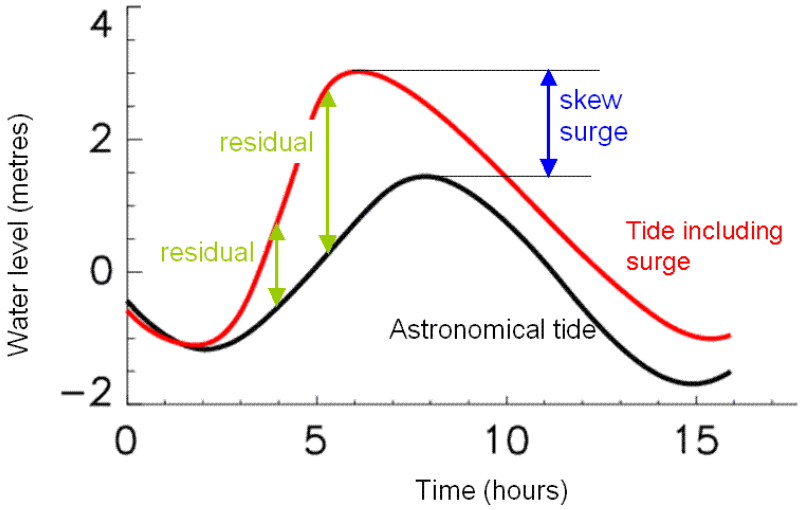
- BODC extremes products
- Validation of CS3x Operational Storm Surge Model

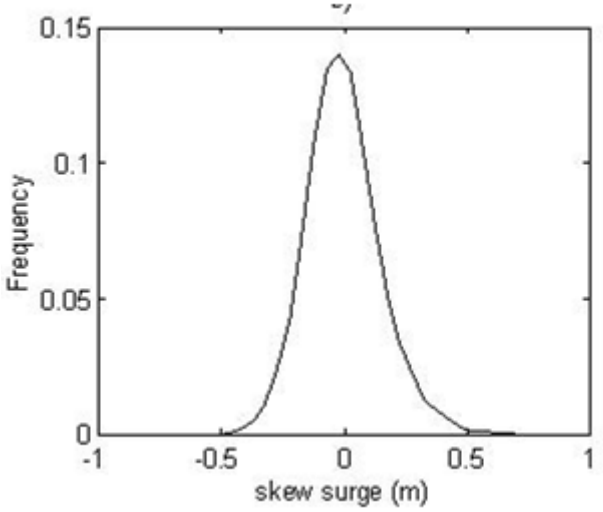


Delayed Mode Data Uses

Extremes (contd)

- Skew surge joint probability method (2011) to review design levels at regular intervals around the UK coast





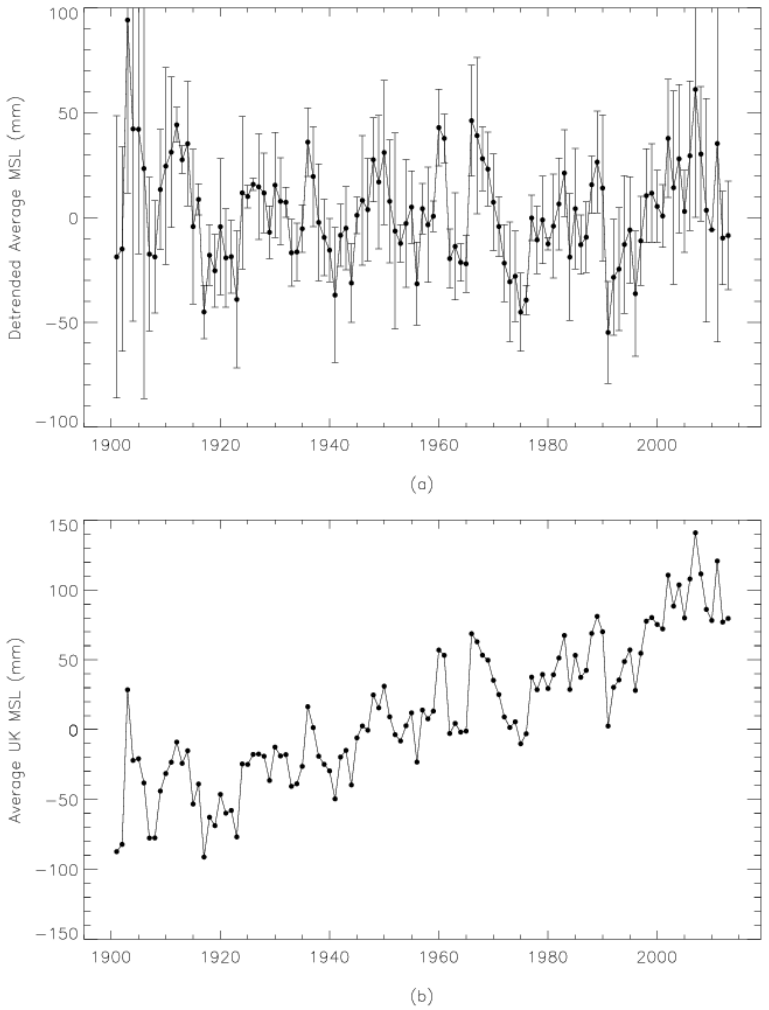
Delayed Mode Data Uses

Long Term Trends

- Re-evaluated typically every 10 years – most recently Woodworth et al. (2009)
- Made use of CGPS at key sites
- Figure shows UK Sea Level Index from 5 key stations (Sheerness, North Shields, Newlyn, Liverpool & Aberdeen) updated to 2013

  (a) Shows average anomalies detrended over 1921-1990

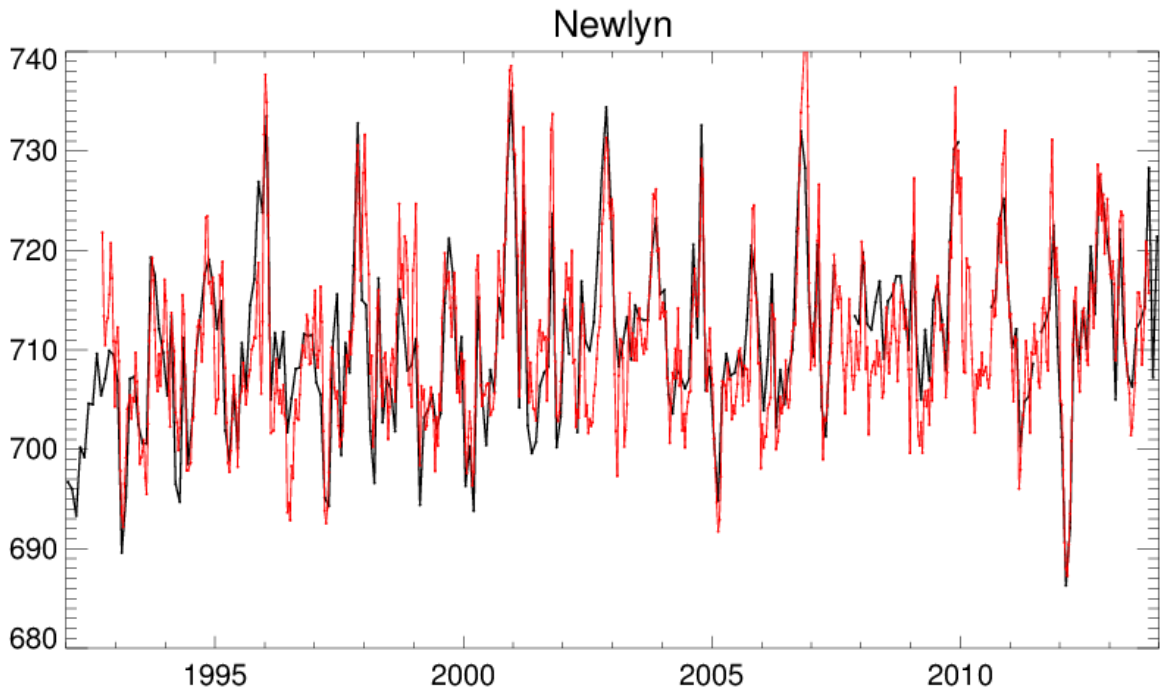
  (b) Shows (a) plus 1.4 mm/y average trend



Delayed Mode Data Uses

Calibration of Satellite Altimetry

- Comparisons routinely made between tide gauges and altimetry



Records of monthly mean sea level (MSL, cm) at each site from tide gauges (black) and non-IB-corrected altimetry (red).

South Atlantic Tide Gauge Network

- 30th Anniversary 2015
- Many technological developments were made here, such as use of mid-tide sensors, communications for Indian Ocean Tsunami Monitoring System
- Key scientific studies examining sea level and ACC transport variability
- Ideally-suited to calibration of altimetry