

UK Sea Level Variability and Sustained Measurements

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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

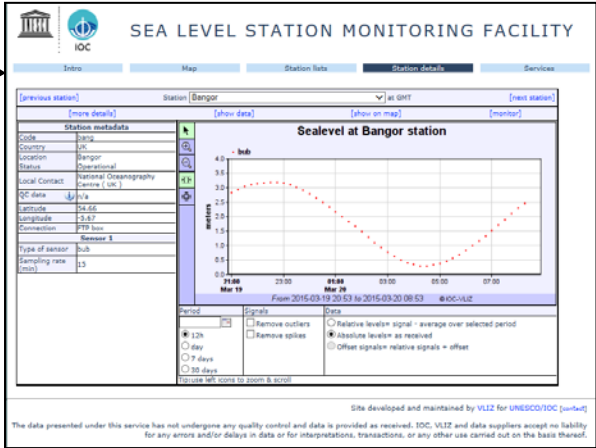
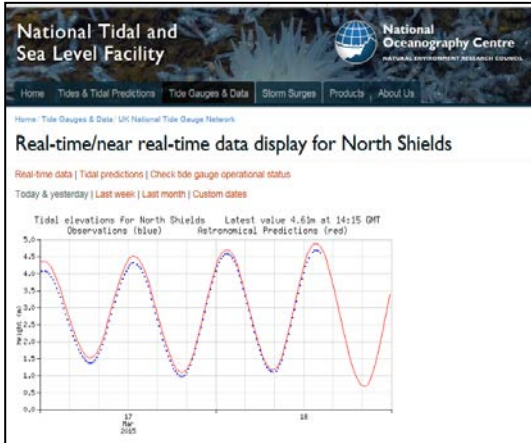


EA telemetry system (Swantel)

EA/Met Office Flood Forecasting Centre (FFC)

EA Regional forecasters EMERGENCY RESPONSE

NOC National Tidal and Sea Level Facility

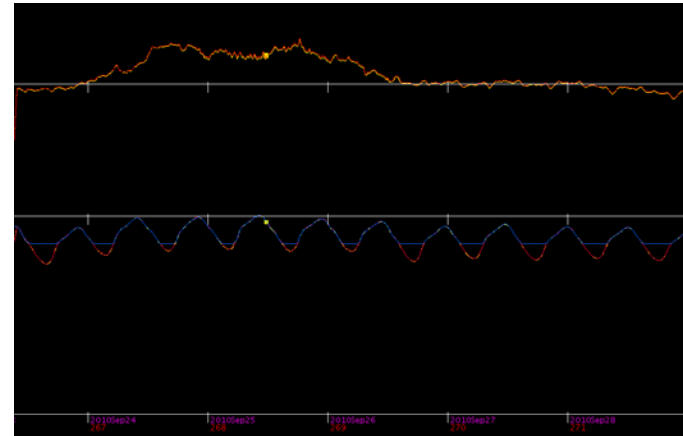
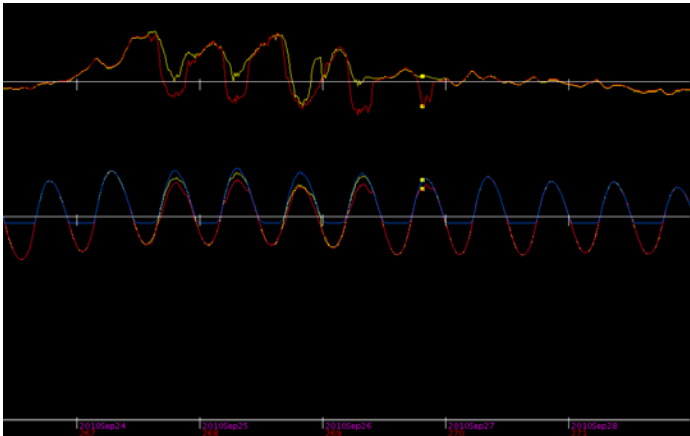


A word of caution....



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.



SEA LEVEL STATION MONITORING FACILITY

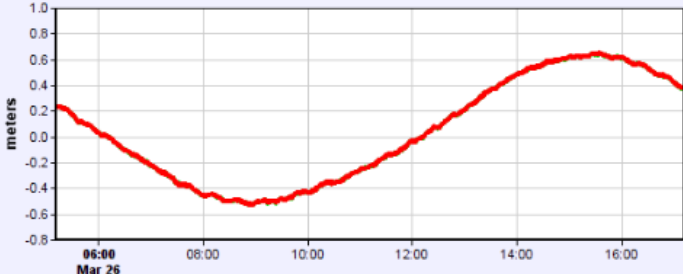
Intro | Map | Station lists | **Station details** | Services

[previous station] Station: **Lerwick (tsunami)** at GMT [next station]

[more details] [show data] [show on map] [monitor]

Station metadata	
Code	lerw
Country	UK
Location	Lerwick (tsunami)
Status	Operational
Local Contact	National Oceanography Centre (UK)
GLOSS ID	236 [goto handbook]
QC data	UHSCL (1999-01-01:2010-11-15)
Latitude	60.155316
Longitude	-1.145192
Connection	SOCKET
Sensor 1	
Type of sensor	bub
Sampling rate (min)	0.1667
Sensor 2	
Type of sensor	bub1
Sampling rate (min)	0.1667

Sealevel at Lerwick (tsunami) station - (1.1855 m)



From 2015-03-26 05:11 to 2015-03-26 17:11 ©IOC-VLIZ

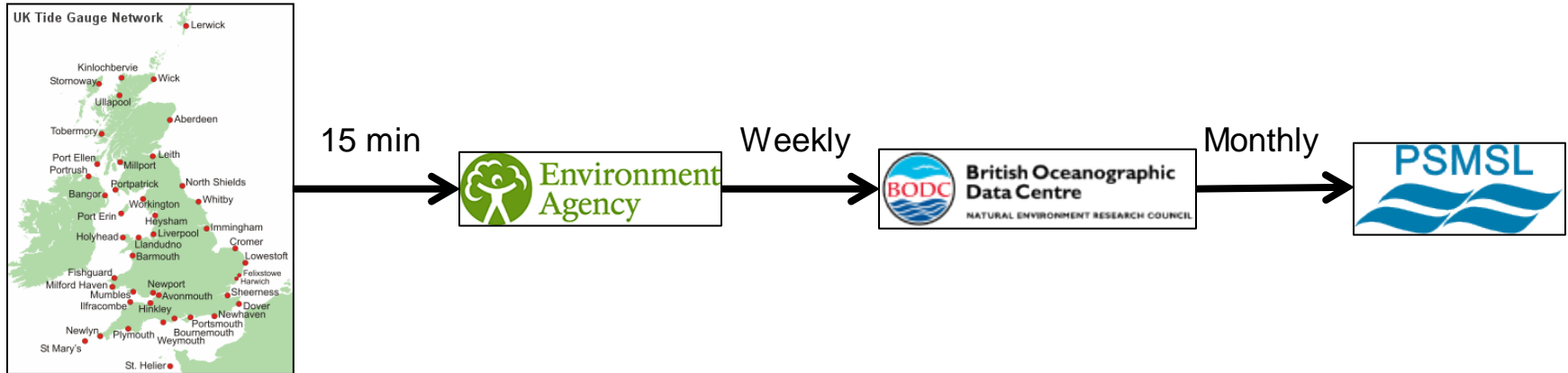
Period	Signals	Data
<input checked="" type="radio"/> 12h	<input checked="" type="checkbox"/> bub	<input checked="" type="radio"/> Relative levels= signal - average over selected period
<input type="radio"/> day	<input checked="" type="checkbox"/> bub1	<input type="radio"/> Absolute levels= as received
<input type="radio"/> 7 days	<input type="checkbox"/> Remove outliers	<input type="radio"/> Offset signals= relative signals + offset
<input type="radio"/> 30 days	<input type="checkbox"/> Remove spikes	

Tip: use left icons to zoom & scroll

Site developed and maintained by VLIZ for UNESCO/IOC [\[contact\]](#)

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Delayed Mode UKTGN Data



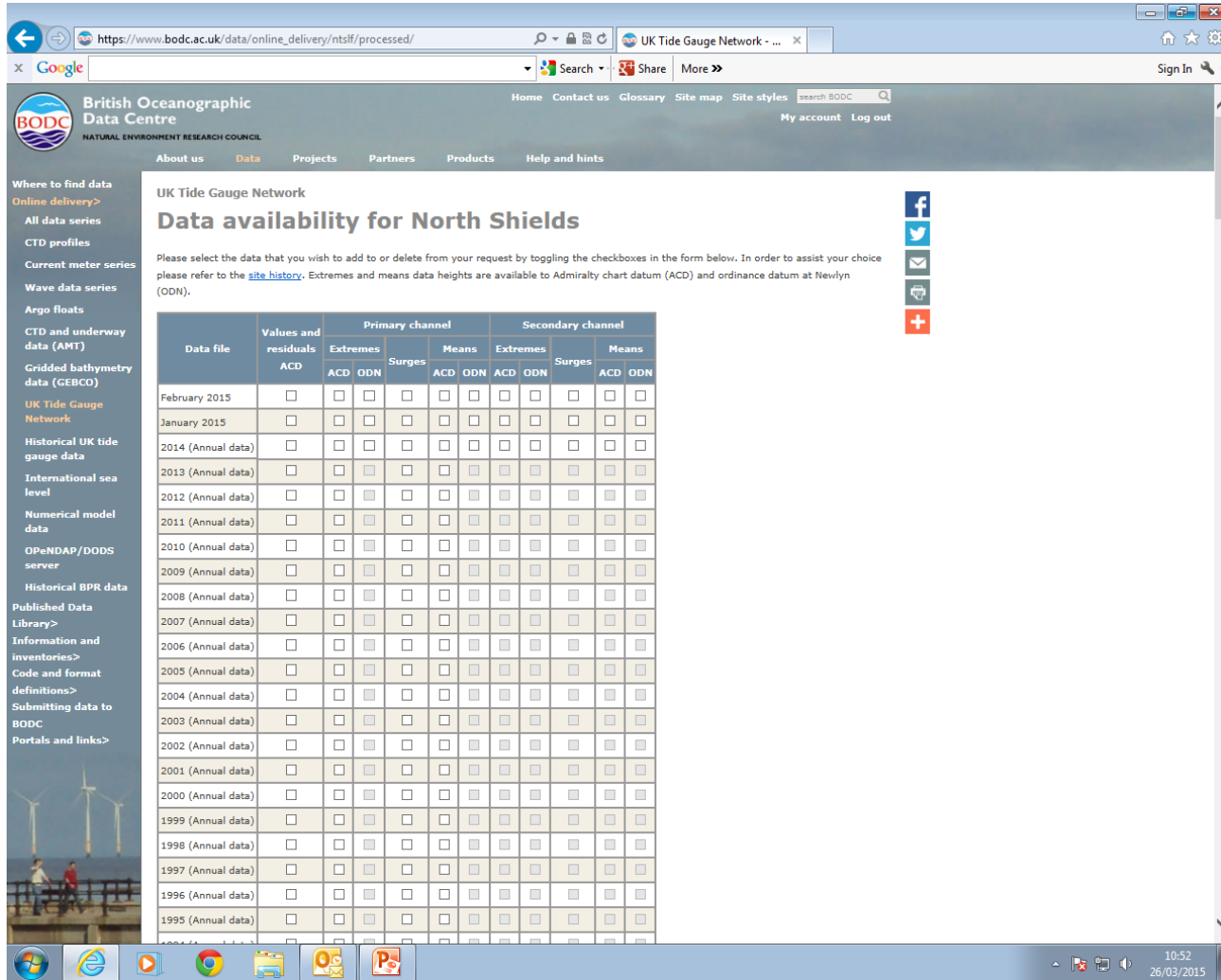
BODC Quality Control

- 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



The screenshot shows a web browser window displaying the BODC website. The page title is "UK Tide Gauge Network" and the main heading is "Data availability for North Shields". Below the heading, there is a text box asking users to select data to add or delete from their request by toggling checkboxes. The data is organized into a table with columns for "Data file", "Values and residuals", "Primary channel", and "Secondary channel". Each of these columns has sub-columns for "Extremes" and "Means", which are further divided into "ACD" and "ODN". The table lists data availability for various years from 2015 down to 1995. A sidebar on the left contains navigation links, and the bottom of the browser shows the Windows taskbar with the date 26/03/2015 and time 10:52.

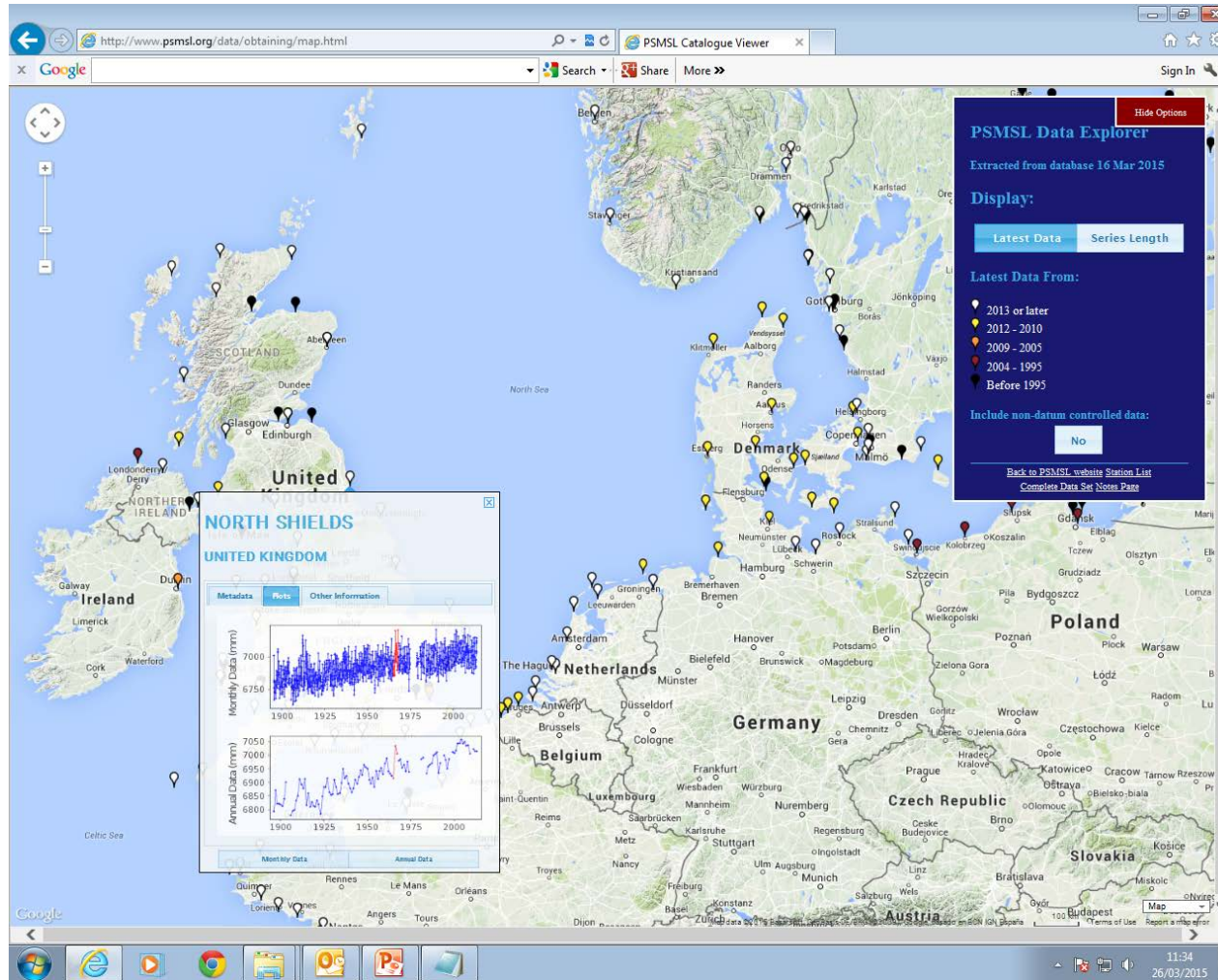
UK Tide Gauge Network

Data availability for North Shields

Please select the data that you wish to add to or delete from your request by toggling the checkboxes in the form below. In order to assist your choice please refer to the [site history](#). Extremes and means data heights are available to Admiralty chart datum (ACD) and ordnance datum at Newlyn (ODN).

Data file	Values and residuals ACD	Primary channel			Secondary channel		
		Extremes		Means	Extremes		Means
		ACD	ODN	Surges	ACD	ODN	Surges
February 2015	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
January 2015	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2014 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2013 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2012 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2011 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2010 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2009 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2008 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2007 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2006 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2005 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2004 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2003 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2002 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2001 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2000 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1999 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1998 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1997 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1996 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1995 (Annual data)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Delayed Mode UKTGN Data



Delayed Mode Data Uses

Tidal Predictions

- Annual harmonic analysis of all UK TGN 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

High and low water times and heights at North Shields

Tidal predictions are available for the next 28 days. For information beyond this period, please consider using the [POLTIPS 3](#) software package, available for purchase from the [Marine Data Products Team](#).

Times in GMT, heights in metres above chart datum. For times in BST, add one hour.
Predictions DO NOT include meteorological effects.
(H - high water, L - low water)

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	01:24	07:32	13:48	20:03
Thu 26th				
Mar 2015	1.25m L	4.54m H	1.29m L	4.46m H
Fri 27th	02:15	08:30	14:51	21:12
	1.67m L	4.25m H	1.60m L	4.13m H
Sat 28th	03:24	09:41	16:16	22:32
	2.01m L	4.04m H	1.78m L	3.95m H
Sun 29th	04:57	11:03	17:45	23:54
	2.13m L	3.99m H	1.74m L	3.98m H
Mon 30th	06:19	12:17	18:53	
	2.03m L	4.11m H	1.58m L	
Tue 31st	00:57	07:15	13:12	19:41
	4.15m H	1.81m L	4.31m H	1.35m L
Wed 1st	01:44	07:58	13:56	20:19
Apr 2015	4.35m H	1.58m L	4.52m H	1.16m L
Thu 2nd	02:21	08:33	14:32	20:53
	4.53m H	1.36m L	4.69m H	0.99m L
Fri 3rd	02:54	09:05	15:05	21:24
	4.68m H	1.17m L	4.92m H	0.86m L
Sat 4th	03:25	09:36	15:36	21:55
	4.80m H	1.03m L	4.91m H	0.78m L
Sun 5th	03:54	10:06	16:06	22:26
	4.87m H	0.94m L	4.94m H	0.76m L
Mon 6th	04:24	10:36	16:36	22:57
	4.89m H	0.91m L	4.93m H	0.81m L
Tue 7th	04:54	11:08	17:09	23:29
	4.87m H	0.93m L	4.87m H	0.91m L
Wed 8th	05:26	11:40	17:44	
	4.80m H	1.01m L	4.77m H	
Thu 9th	00:01	06:01	12:15	18:24
	1.08m L	4.70m H	1.13m L	4.62m H
Fri 10th	00:39	06:42	12:57	19:12
	1.26m L	4.55m H	1.29m L	4.44m H
Sat 11th	01:24	07:32	13:52	20:12
	1.52m L	4.38m H	1.48m L	4.25m H

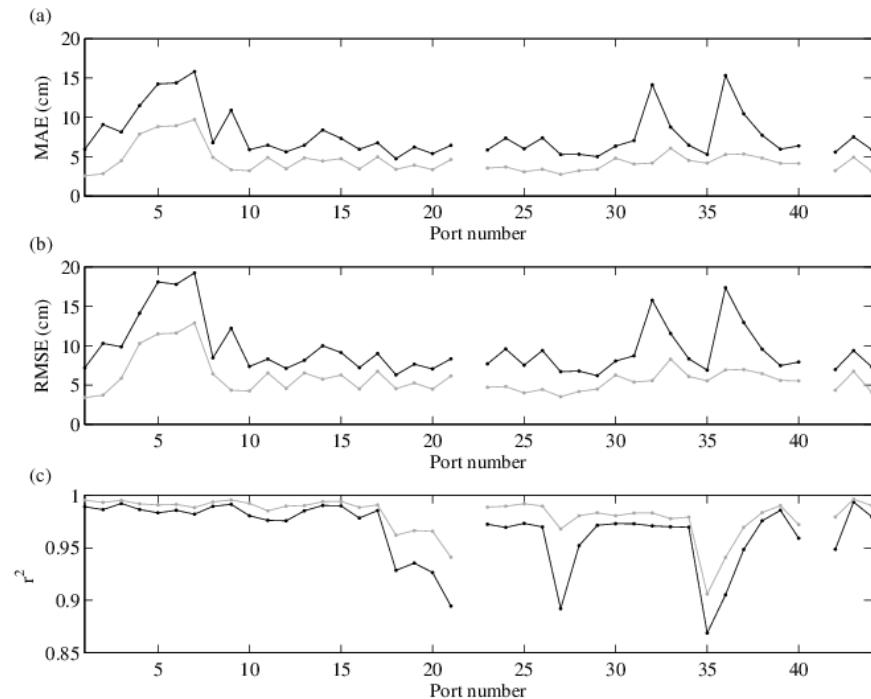
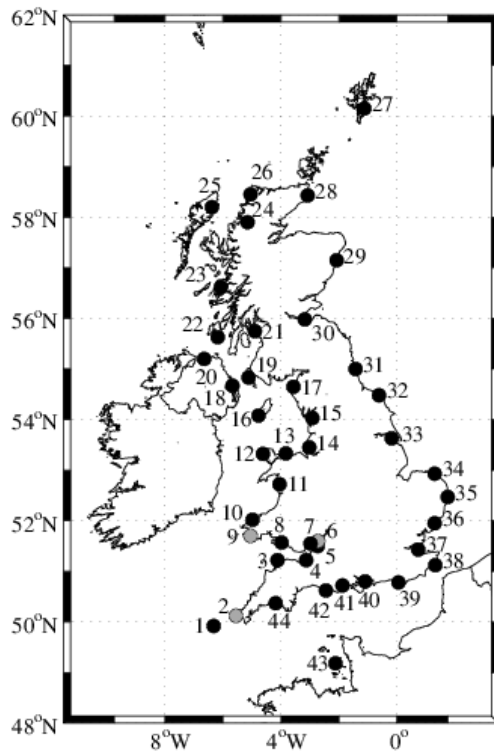
UK Tide Gauge Network

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Delayed Mode Data Uses

Tidal Predictions

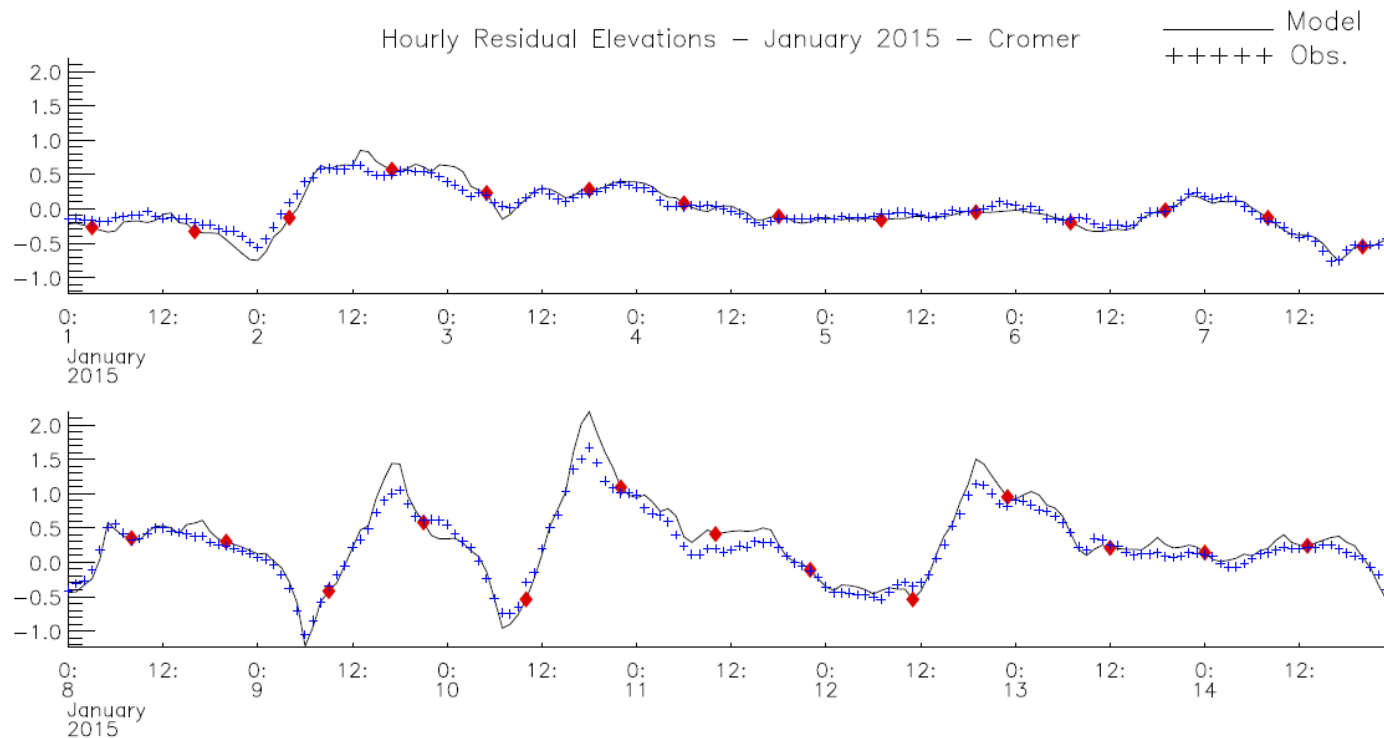
- Hibbert et al. (2015) - An empirical approach to improving tidal predictions using recent real-time tide gauge data



Delayed Mode Data Uses

Extremes

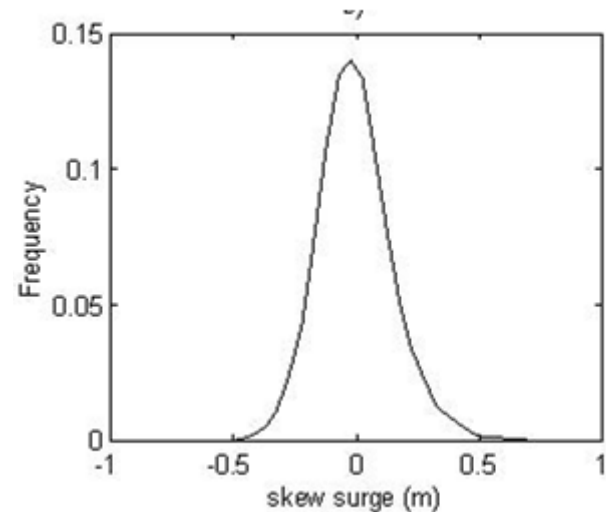
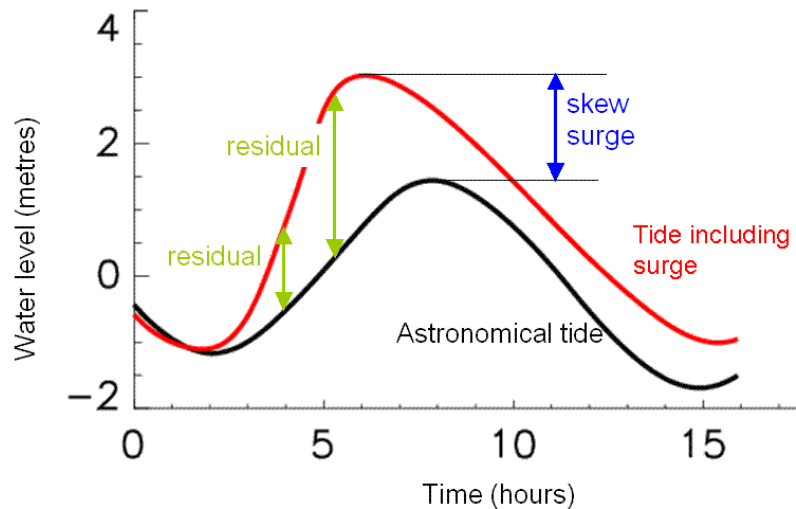
- BODC extremes products
- Validation of CS3x Operational Storm Surge Model



Delayed Mode Data Uses

Extremes (contd)

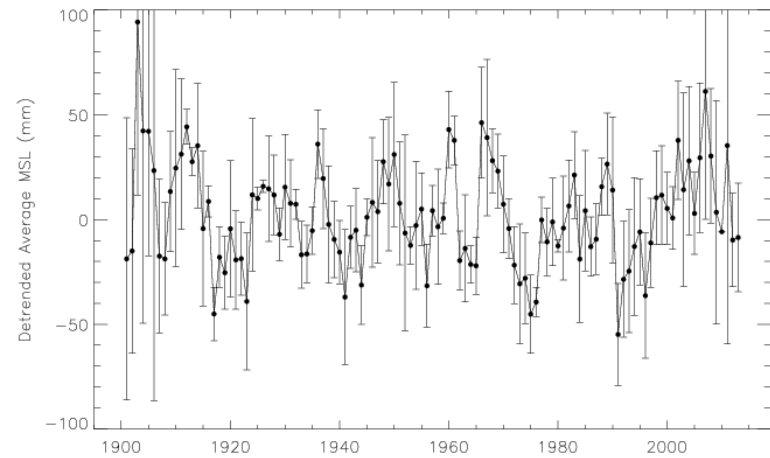
- Skew surge joint probability method (2011) to review design levels at regular intervals around the UK coast



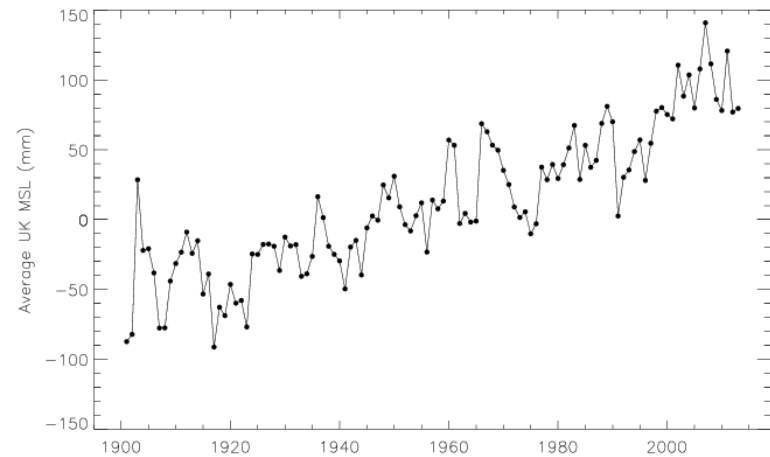
Delayed Mode Data Uses

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



(a)

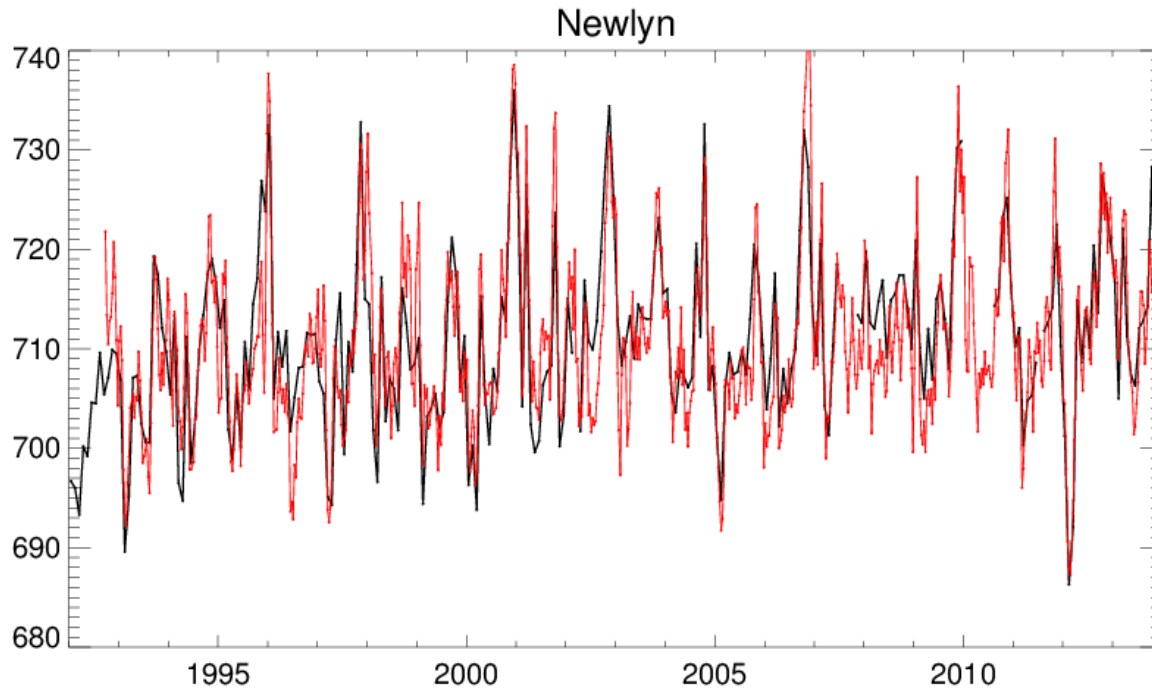


(b)

Delayed Mode Data Uses

Calibration of Satellite Altimetry

- Comparisons routinely made between tide gauges and altimetry



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

