Space for Smarter Government Programme

Sea Level Space Watch: An Operational Service for Monitoring UK Sea Level

Workshop

SATOC Satellite Oceanographic Consultants

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

Environment Agency

Cyfoeth Naturiol Cymru
Natural Resources Wales

Sea Level Space Watch

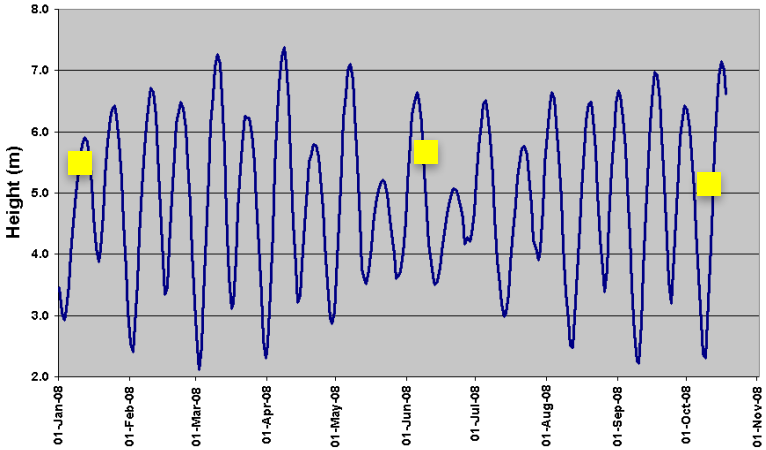
Short term project Funded (Jan-March 2016) by UK Space Agency's **Space for Smarter Government Programme (Phase 2)**

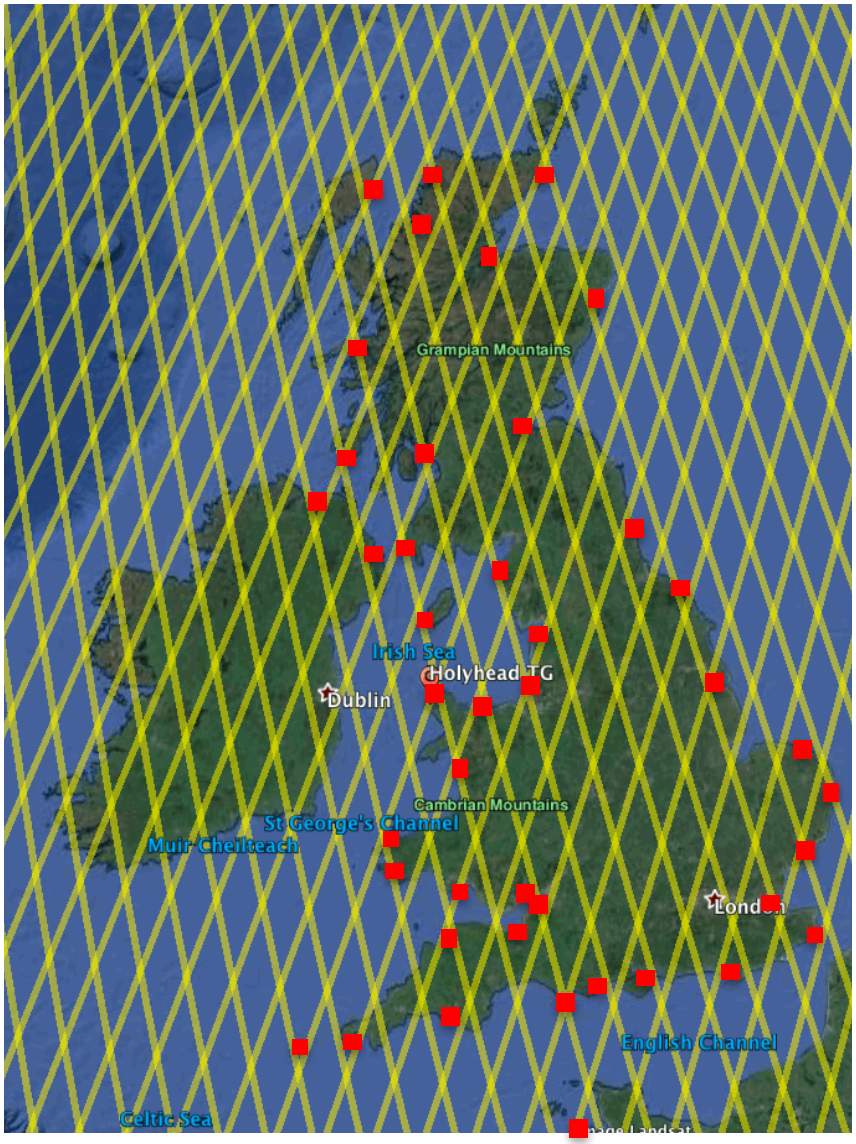
- Sea level monitoring service for UK seas, sea level variability from space-borne altimeter data, combined with tide gauge data.
- Support for national flood defence planning.
- Supplements UK Climate Projections with information on seasonal, regional variability

Tide Gauges and Satellite Altimeters

Tide Gauges
(ntslf.org)

Altimeter tracks
(Envisat / AltiKa)





Sea Level Measurements – Characteristics of Satellite Altimeter and Tide Gauge Data

- Tide gauges:
  - Continuous measurements at a fixed number of sites.
  - Long term record (> 100 years for some sites).
  - Current basis for monitoring tides, surges, flooding, long term trends.
  - Limited, site specific, spatial coverage.
- Satellite Altimeters:
  - Global coverage, supporting spatial mapping.
  - Intermittent sampling (revisits each location every 10-35 days, depending on orbit).
  - Sea Level climate quality record since 1992. Continuation missions confirmed to 2030.

Sea Level Space Watch

- Open ocean applications have been the historical focus of satellite altimeter research, because of difficulties of retrieving valid data close to the coast.
- NOC has led the international community in developing schemes to bring altimeter data to the coast – can now provide reliable coastal sea level products from altimetry.

Sea Level Space Watch

- Brings together altimeter data and tide gauge to combine the key characteristics of each
- A sea level advice service to support agencies responsible for planning coastal flood defences.
- Process altimeter data to provide regional variability of non-tidal sea level signal – referenced to equivalent tide gauge measurement.

Meeting Objectives

- Consider the context
  - What do we know about sea level variability around the UK
  - What are the needs for sea level information by Coastal Managers
- Presentation of the Sea Level Space Watch service.
  - Data and analyses
  - Patterns of variability
  - Errors and confidence levels
- Proposal of an operational service.
- Consider possible overseas implementation

Workshop Agenda

1. The need for monitoring sea level rise in a changing climate

2. Sea Level SpaceWatch: Variability in UK Coastal Sea Level from Satellite Altimetry and Tide Gauges

Lunch

3. Sea Level SpaceWatch Implementation – Business Plan

4. Summary / Conclusions

Agenda

Session 1 – The need for monitoring sea level rise in a changing climate

1.What we know about sea level variability around the UK.

- UK Sea Level Variability from Tide Gauge Data: Angela Hibbert (NOC)
- Spatial footprint and temporal clustering of storm surges around the UK: Ivan Haigh (University of Southampton)

2. User Needs: The Environment Agency, Natural Resources Wales, The Climate Change Committee, Scottish Environment Protection Agency

Announcement of SSGP Showcase 7th June

Break (11:00 – 11:30)

Space for
Smarter
Government
Programme

SSGP Showcase Event: 7th June 2016

Session 2 – Variability in UK Coastal Sea Level from Satellite Altimetry and Tide Gauges 11:30 – 13:00

1. Constructing model projections of century-scale change in extreme sea level for UKCP09 and UKCP18. (Tom Howard, Met Office)

2.Sea Level Data from satellites and tide gauges

- Tide Gauge Data Processing for Sea Level SpaceWatch (Angela HIbbert, NOC)
- Processing of coastal altimetry data for Sea Level SpaceWatch (Paolo Cipollini, NOC)

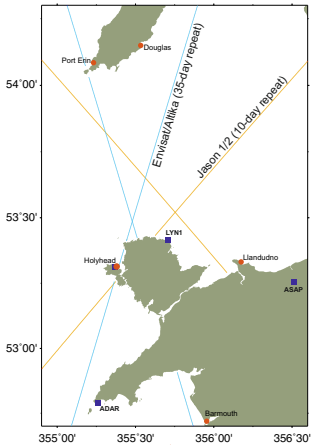
3. Analysis: Variability (in time and space) and errors / confidence levels

- Analysis of seasonal to interannual sea level variability from altimetry and tide gauge data (Francisco Calafat, NOC)
- Stochastic modelling of the tide gauge, altimeter and GPS time series for realistic uncertainties in derived parameters (Simon Williams, NOC)

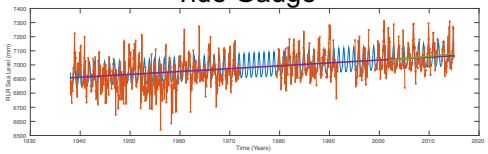
4.4. Example of a possible Site Specific Analysis - Discussion

Lunch (13:00 – 14:00)

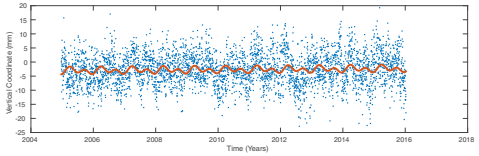
Holyhead



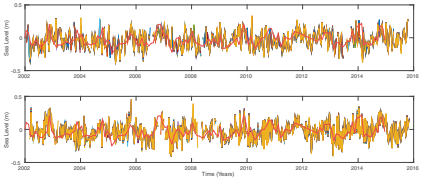
Tide Gauge



GPS/Vertical Land Movement



Jason1/2 Altimeter



Red Line is the monthly PSMSL record at Holyhead. Coloured Lines are the 10 closest altimeter points on track #163

Tide Gauge : Holyhead; PSMSL ID : 5

Sea Level Rate Over Entire Period (purple line above) : 2.0 ± 0.4 mm/yr*
Sea Level Rate Over Altimeter Period (green line above) : 3.5 ± 2.6 mm/yr

Jason1/2 Track #163 Crosses Over Anglesey and Holyhead. Two Altimeter SSHA plots are shown, one west of the tide gauge (top) and another east of the tide gauge (bottom). The average trends for the 10 nearest west and east nominal altimeter points are

Western set : 3.9 ± 3.6 mm/yr
Eastern set : 1.6 ± 3.6 mm/yr

* Data from pre 1960 was not used in the calculation of trend because it was flagged in the PSMSL database

GPS and Vertical Land Movement

Site	Distance from TG (km)	Rate (mm/yr)
HOLY	1.5	0.07 ± 0.35
LYN1	24.7	0.05 ± 0.58
ASAP	58.9	0.31 ± 0.34
ADAR	76.1	0.05 ±0.39

Predicted VLM at tide gauge from model : 0.26 mm/yr

Main Holyhead Tidal Constituents

Name	Amplitude (m)	Phase (degrees)
M2	1.8	292
S2	0.6	329
N2	0.4	267
K2	0.2	327
K1	0.1	176
O1	0.1	29

UKCP09 and other altimeter stuff here?

Session 3 – Sea Level SpaceWatch Implementation 11:30 – 13:00

1. The Sea Level SpaceWatch Service Offering and Business Plan, David Cotton, SatOC
2. User response and Discussion
   - Identification and discussion of options
   - Further developments necessary before implementation
3. Possible Future Developments: Extensions outside UK
   - Within Europe
   - Internationally – identification of vulnerable regions
4. Round up and next steps (15:40 – 16:00)

Close 16:00