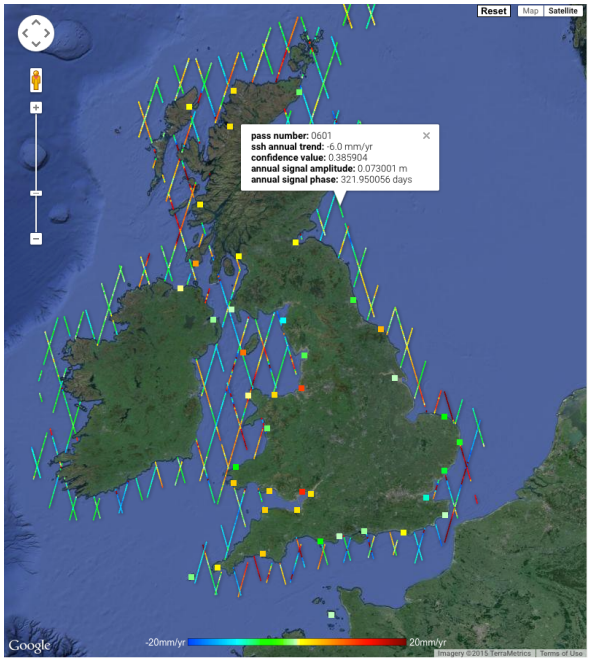
Space for
Smarter
Government
Programme



Sea Level Space Watch: Service Offering

SATOC
SATELLITE OCEANOGRAPHIC CONSULTANTS

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

General

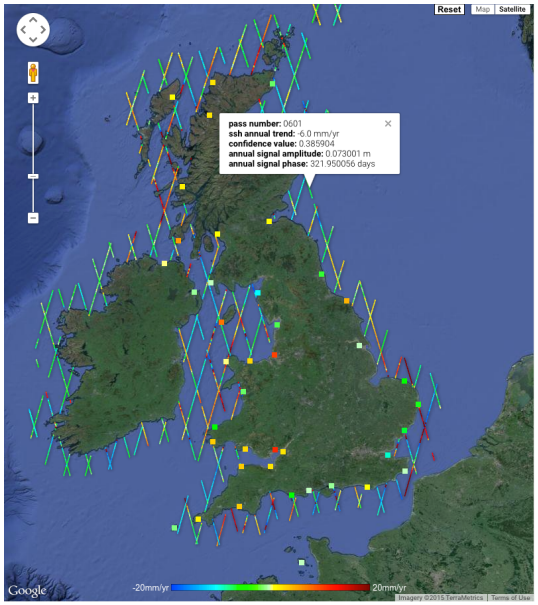
Sea Level Space Watch :

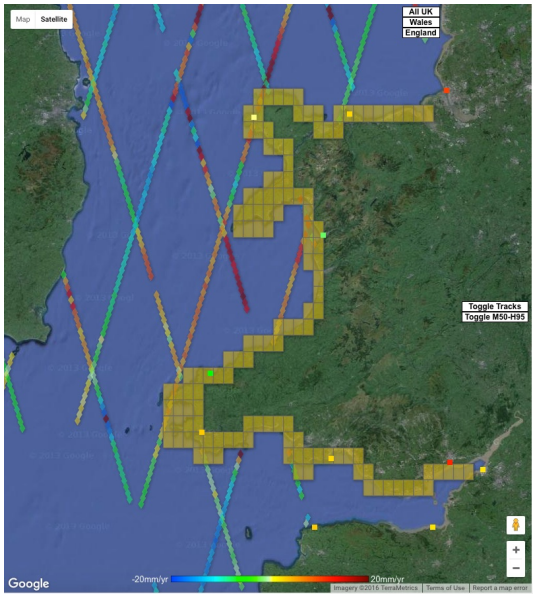
- Operational service developed to support national flood defence planning.
- Systematically updated sea level observations around the UK, using data from satellite altimeters and tide gauges.
- Tailored to meet user agencies' needs.
- Addresses priority area of Natural Hazard Risk Management - Coastal Flood Management.

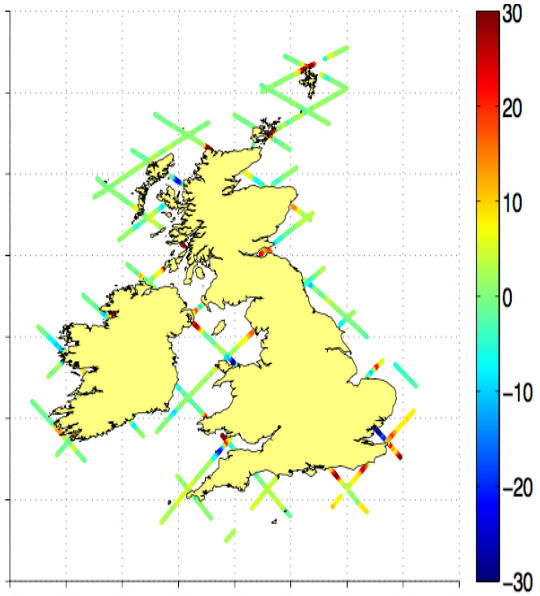
Operational Service - Overview

1. Public SLSW web-service
   - Sea level trend information, derived from analyses of satellite altimeter and tide gauge data.
   - Download Access to processed altimeter data and derived metrics on trends and variability
2. Detailed Site Specific Analyses - Accessible to Funders
   - Two sites per partner
   - Chosen on basis of data availability / strategic interest
   - Trends, uncertainties, statistics
   - Comparisons between Satellite and Tide Gauge data
   - Levelling / GPS derived information (e.g. land movement)
   - UKCP 09/18 projections
3. Further on Request Site Specific Analyses
   - As above. On request - additional cost

Web Service







[Sea Level Space Watch Web Page]

- Annual sea level trend from satellite altimeters (2002-2015) 5km intervals along track.
- Annual sea level trend from tide gauges (2002-2015).
- DEFRA coastal grid squares, selected climate projections from UKCP09 model given as annual sea level trend calculated over 2002-2015.
- User Guide: Online videos on how to navigate service

Satellite Data Sets

- Satellite Data (at all along track points)
  - Time Series (one value per satellite pass)
    - Total Water Sea Level
    - Sea Level Anomaly
    - Significant wave height
  - Single Values (calculated over time series)
    - Long term (14 year) sea level trend,
    - Annual sea level cycle (amplitude and phase),
    - Inter-annual variability (standard deviation and maxima of the annual sea level values).
  - Downloadable by clicking on track location
  - Recalculated annually

  - Will include 10 day and 35 day repeat data, and will incorporate Sentinel-3 data (27 day repeat) when they become available.

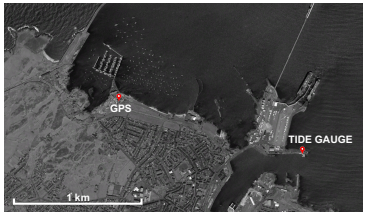
Tide Gauge Data Sets

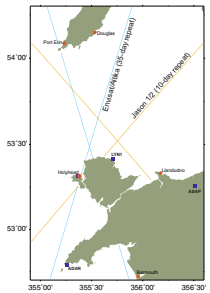
- From 42 National Tidal and Sea Level Facility and 11 Channel Coast Observatory Tide Gauges
  - Long Term Statistics
    - Long-term trends from UK Tide Gauge Network monthly mean data calculated for
      - The entire tide gauge record
      - The period of satellite data coverage (2002-2015).
    - Land movement trends, where available
  - Downloadable by clicking on track location
  - Recalculated annually

Site Analyses / Technical Guidance

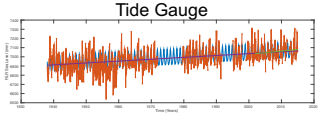
- Site Analyses
  - Two for each funding partner
  - Selected on baiss of data availability and strategic interest.
  - Satellite altimeter and tide gauge sea level trend information,
  - land movement measurements
  - modelled sea level changes over the 2002-2015 period from the most recent UK Climate Change Projections.
- Technical Guidance
  - Results of validation study between satellite altimeter and tide gauge data
  - Assessment of regional patterns of variability / coherence.
  - Analysis of errors
  - Advice on the correct usage and interpretation of the sea-level information provided in Sea Level Space Watch

Holyhead

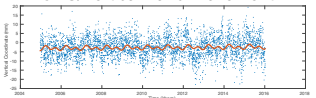




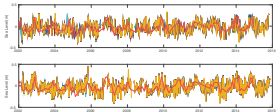
Tide Gauge



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?

Operational Service - Basis and Costing

- Consortium funding
- User Board
  - Funding partner representatives, service manager, other members as agreed.
  - Meets annually to review service and consider possible developments.
  - Subscription covers general service & site specific at analyses at 2 locations (per customer).
- Cost (per subscription)
  - Set Up Cost: £2,400
  - Annual Operational Fee: £6,500
  - Assumes a certain number of contracted funding partners. Level may be adjusted, dependent on the number of funders.
- Contracts
  - For agreed duration (3-5 years?)
  - Between funder and SatOC (provisionally)
  - Will specify length of subscription, date of contract revision, locations of site analyses

Customer Benefits

- Provision of measured trends alongside provides greater confidence for planning investment on coastal defences, and coastal habitat management.
- Cost recouped if the service results a 0.01% efficiency improvement in the management of flood and erosion risks (derived from the PCv estimate for this cost of £25bn over 100 years).
- Further savings could result from potential reduction in costs of compensatory coastal marine habitat creation

Steps to Implementation (UK)

- Technical (April-June 2016)
  - Web-site updates
  - Finalise Site Specific Analyses (content and locations)
  - Further processing of AltiKa data (to complete 35 day repeat track time series)
  - Initiate Sentinel-3 processing
- Business Plan (April – September 2016)
  - Discuss service with potential funders, visits as requested.
  - Finalise service specification and cost.
  - ***Aim for implementation in Autumn 2016***

Discussion Questions

1. Are further developments needed to the service for it to be useful, and to be something your organization would be prepared to fund?
   - Scientific issues to do with data processing and analysis
   - Technical issues to do with data / information presentation

2. Is the way the service is structured suitable? (i.e. public access to general web pages and data, more detailed analysis at a specified number of locations available to paying users, with scope for additional analyses paid for on demand).

3. Is the funding basis appropriate? (Initial set up cost, plus annual fee, become member of user board, meets annually to review service,….)

4. Are the projected costing levels at the right level?

5. Possible implementation beyond UK

Possible Service Expansion

1. **European implementation: North Sea, plus other areas?**
    - ESA (Integrated Application Programme) funding an option?
    - Need two sat technologies (altimeters for sea level, GPS for TG precise leveling / land movement.
    - 50% funded (for feasibility study / demonstration project)
    - Could expand it to cover other marine monitoring
    - Needs strong business case
    - Start with outline proposal
    - Recommend work closely with Innovate UK
2. **Beyond Europe: Low lying / Vulnerable Regions**
    - Locations?
    - Funding?: UKSA International Partnership Space Programme, Global Collaborative Space Programme, Aid programmes?