Dynamic Coast : collaboration for enhanced coastal resilience

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1 = Ordnance Survey 2 = University of Glasgow 3 = Scottish Natural Heritage 4 = Scottish Government

"Change is coming"

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What is Dynamic Coast?

- Dynamic Coast is an award-winning Scottish Government project, funded by CREW, managed by SNH, delivered by University of Glasgow and supported by OS and underpinned by OS data.

- It is a publicly available evidence base of changes to Scotland's erodible coast that aims to improve the decision making and resilience of coastal infrastructure, assets, and communities.

Some of the Dynamic Coast team with Ms Cunningham (Cab Sec Climate change)
Some of the Dynamic Coast team with Mr McKee (Minister for Innovation)

How ‘change’ turned from a risk to an opportunity

Prior to the Dynamic Coast project:

- No national awareness of coastal erosion,
- No awareness of the currency of coastal mapping,
- No awareness of implications of change and associated flooding,
- Or how effective our policies are to keep assets and development sustainable.

With the Dynamic Coast project:

- We now have the best (and public) understanding of coastal change Scotland has ever had,
- We now know where past change may continue to affect society’s assets,
- We now incorporate change intelligence to efficiently update datasets to appreciate our changing world.

Top: before DC St Andrews OS MHWS (1995) & aerial (2018)
Bottom: after DC St Andrews OS MHWS (2018) & aerial (2018)

Why does this matter?

A successful, resilient and plan-led economy needs a reliable evidence base in a changing world.

Climate change is occurring most rapidly at the coast yet coast falls between two stools (not the land not the sea) … ironic that the most changeable is most overlooked.
We need regularly updated data from a trusted adviser.

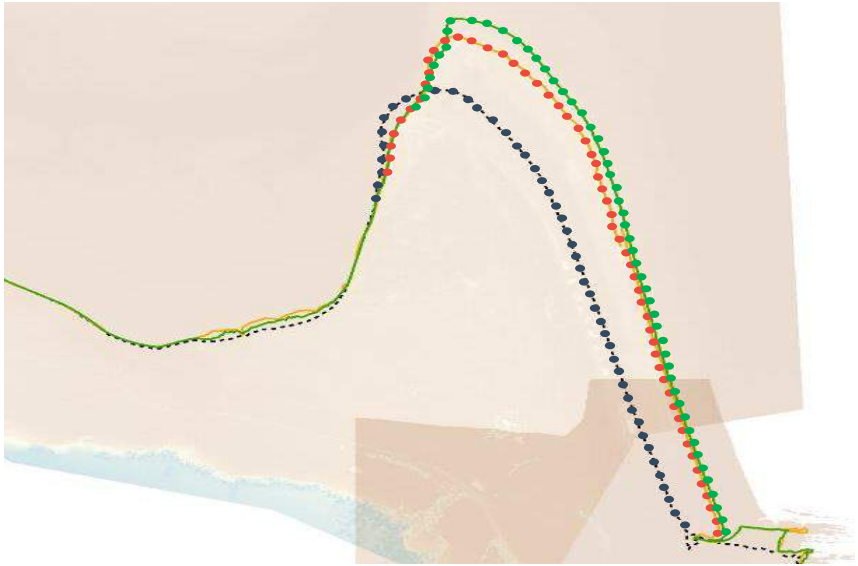
Given the scale of the task the Dynamic Coast partners (OS, SG, SNH, SEPA and UoG) have collaborated to innovate and deliver the coastal data improvements needed.

OS updated 2000km+ of tidal mapping, but two-way change intelligence protocol now informs future collaboration.

Top: Scottish Government
Bottom: 3D analysis now common-place (OS HQ)

Method

- Compared the past, recent and current position of High Water tide line (MHWS).
- Projected coastal position and erosion rates landward to intersect coastal assets
- Consider future implications for society and communities.
- 1million data points, 130 years, 3 periods
- One set of maps at DynamicCoast.com
- So how have we partnered with OS to deliver Dynamic Coasts datasets?



OS role

- OS has been a National Coastal Change Assessment/Dynamic Coast partner and Steering Group member since inception in January 2015.
- Aim to capture contemporaneous data to underpin the evidence base which supports more sustainable coastal and terrestrial planning decisions in light of a changing climate.
- We generally capture and deliver data across the whole of GB in the national interest.
- Dynamic Coast presented opportunity for OS to align our data capture to a nationally important programme with specific outcomes.
- Support key government policies, including the implementation Climate Change (Scotland) Act 2009 which requires the development of an Adaptation Programme.
- Collaborative working, creative and informed approach to updating data is key.

Collaboration

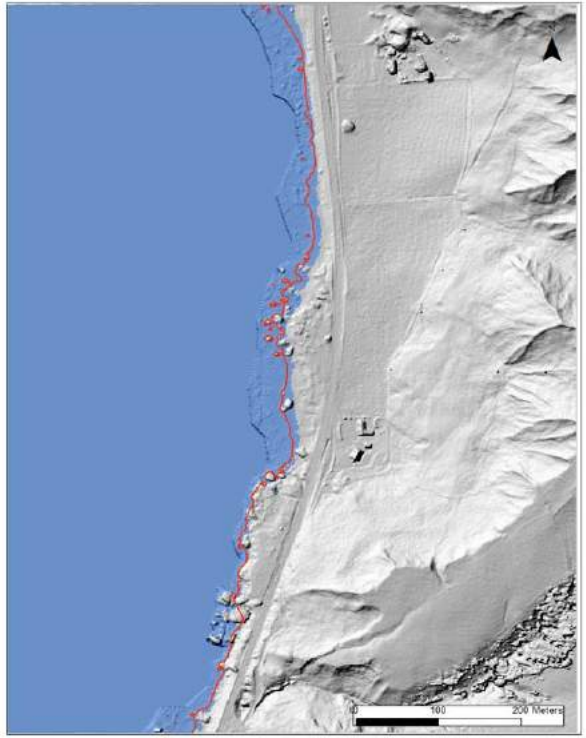
- Great things happen when we work together
- By collaborating we enable our OSMA customers to innovate and get maximum value from our data and serve the wider public interest
- Exemplar of cross public sector collaboration in support of government policy
- The importance of working together recognized by Roseanna Cunningham MSP, Cabinet Secretary for the Environment, Climate Change and Land Reform who launched Dynamic Coast in August 2017
- Dynamic Coast was awarded 2019 Spotlight Award at the Scottish Knowledge Exchange Awards recognising cross sector partnership and innovative solution to a challenge.

OS data

- In support of Dynamic Coast (Phase 1) OS provided updated topographic and terrain data for specified soft coast sites areas.

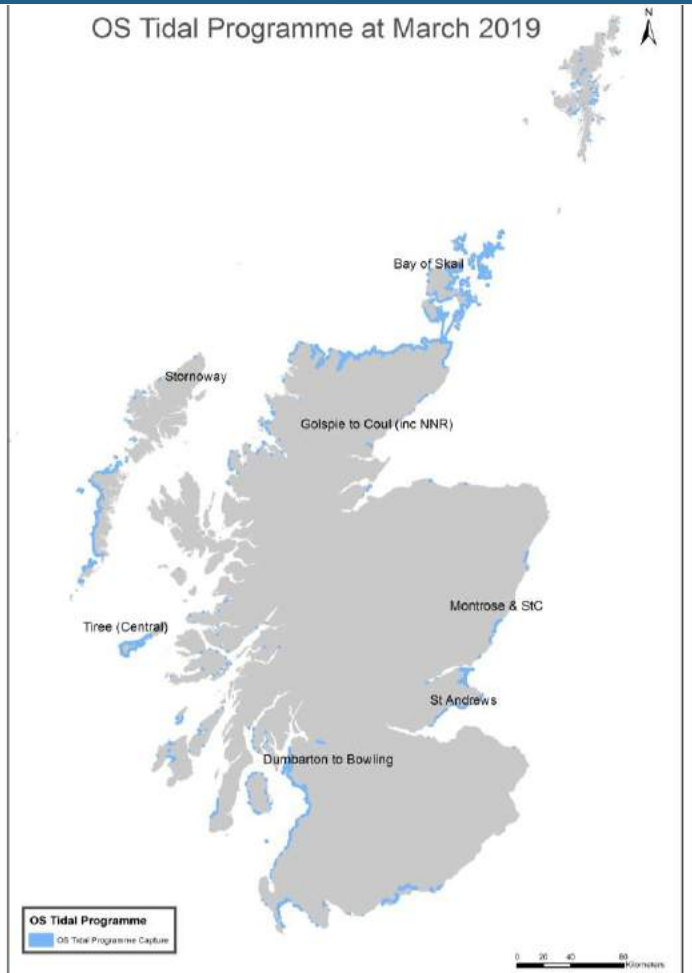
- In addition, for a number of key sites, such as Arbroath, Solway, Aberdeen and Beauly Firth, ground capture of MHW(S) and MLW(S) was carried out to supplement aerial methods.

Image: OS DSM Hillshade below 'MHWS_elev' raster and the output MHW(S) in red



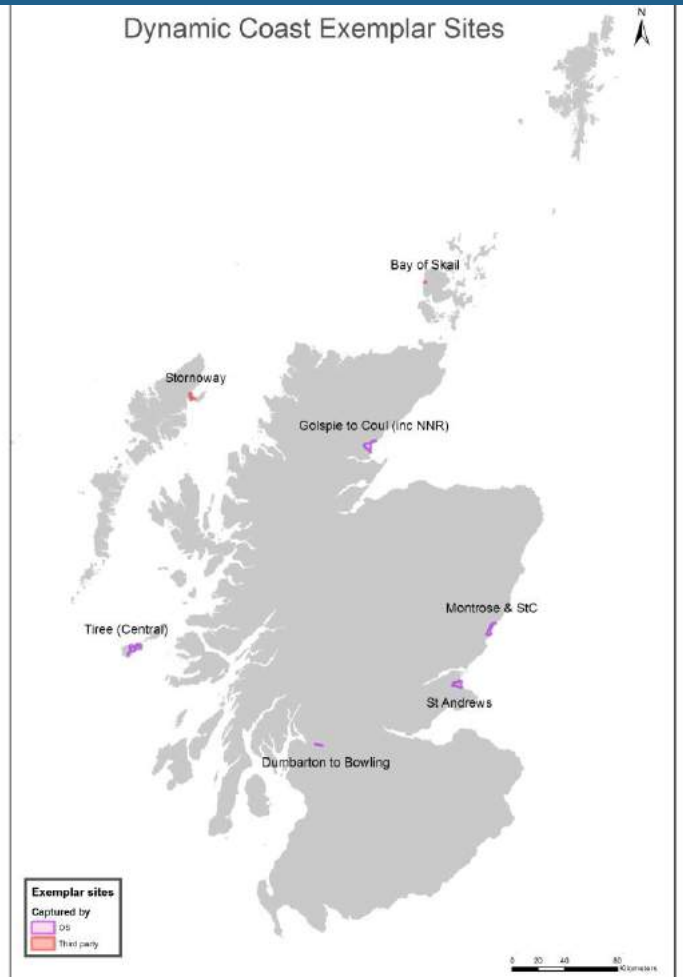
OS geospatial capture production

- DynamicCoast.com has delivered a strategic tool that includes OS topographic and tideline data to assess areas at risk from coastal change and climate change
- Over 2,200km captured and updated in Scotland, almost 4,500km for England & Wales since start of programme
- We continue our tidal work as part of our rolling revision programme
- Potential to utilise third party data, such as Scot Gov and EA's LiDAR



Dynamic Coast 2: exemplar sites

- Enhance the evidence from Dynamic Coast 1 using 3-D techniques to calculate volumetric changes in the intertidal zone via 7 key exemplar sites selected based on mitigation and adaptation potential.
- Accurate terrain and topographic data critical to establishing future coastal change due to climate change.
- Utilising existing OS data store as well as new capture at spring low tide to enable 3D analysis.
- Targeted data capture for St Andrews, Montrose, Tiree, Dumbarton to Bowling and Golspie.



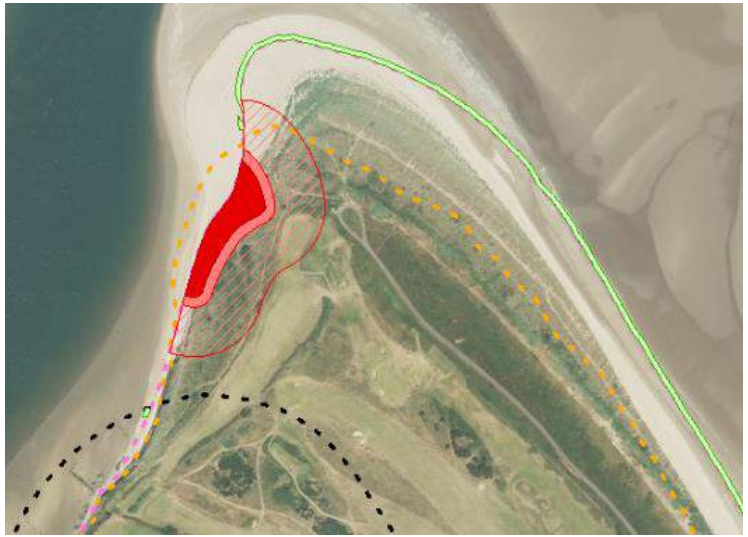
Innovation

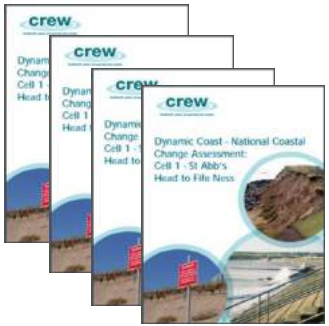
- Innovation and new data collection essential for an NMA in a rapidly changing world
- Explorative use of innovative technology, such as UAV, EO and IoT
- Use of satellite derived EO data to efficiently observe coastal change
- Trial seaward vegetation edge to track coastal change and derived a methodology to monitor coastal vegetation, using established spectral indices, such as NDVI, NDWI
- Continue to support the evolving needs of the partnership

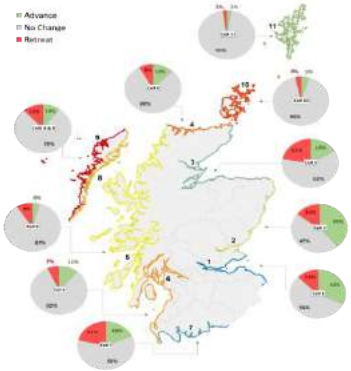
DMC-3 vegetation edge.
Ground truth (black line); NDVI >0.2 (red line); NDVI >0.3 (green line); NDVI >0.4 (blue line)

Dynamic Coast 1 Results

- Our soft shoreline is much more dynamic than before.
- Changes are now routinely updated by OS.
- 19% (3,802km) of Scotland's 21,305km long shoreline is soft and potentially erodible.
- Since the 1970s on the potentially erodible coast
  - 11% has accreted (423km)
  - 12% has eroded since 1970s (442 km)
  - Extent of accretion is reducing (↓ 22%)
  - Extent of erosion is increasing (↑ 39%)
  - Erosion rate has doubled (now 1m/yr average)
  - Strong spatial dimension (east/west)







% of soft coast change since 1970s

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- Consistent with climate change which is anticipated to worsen in coming decades

S. golf course

MHWS

Year	change (m)	rate (m/yr)
1902 - 1982	-12.4	-0.2
1982 - 2013	-48.2	-1.6
2013 - 2018	-11.6	-2.3

MLWS

Year	change (m)	rate (m/yr)
1902 - 1982	-103.2	-1.5
1982 - 2018	-57.8	-1.2

Dynamic Coast 1 Results

- Using cultural heritage sites as exemplar:
- 26ha of cultural heritage sites are anticipated to erode in next 30 years if recent rates continue.
- 43% of cultural heritage sites are on soft shores.
- Natural defences protect 4x the length of road/rail, and almost 4x the area of key cultural heritage sites that are currently protected by built defences.

Whole Coast Assessment Results

e.g. 156km of roads lie within 10m of MHWS, 53km on soft

Total number of assets within 50m of MHWS

	Anticipated (2050) recent rate	Anticipated (2050+) double rate	All	Hard & Mixed	Soft	% in soft coast	Artificial	
	52	150	33,494	14,359	9,503	27%	9,632	Buildings
	5	10	1,336	733	497	37%	107	Roads (km)
	2	2	104	27	58	56%	18	Rail (km)
	1	4	3	2	0	11%	1	Runways (ha)
	26	27	1,029	471	438	43%	120	Cultural (ha)
	447	670	23,430	14,873	8,424	36%	133	Natural (ha)

All results available via webmaps and regional reports on www.DynamicCoast.com

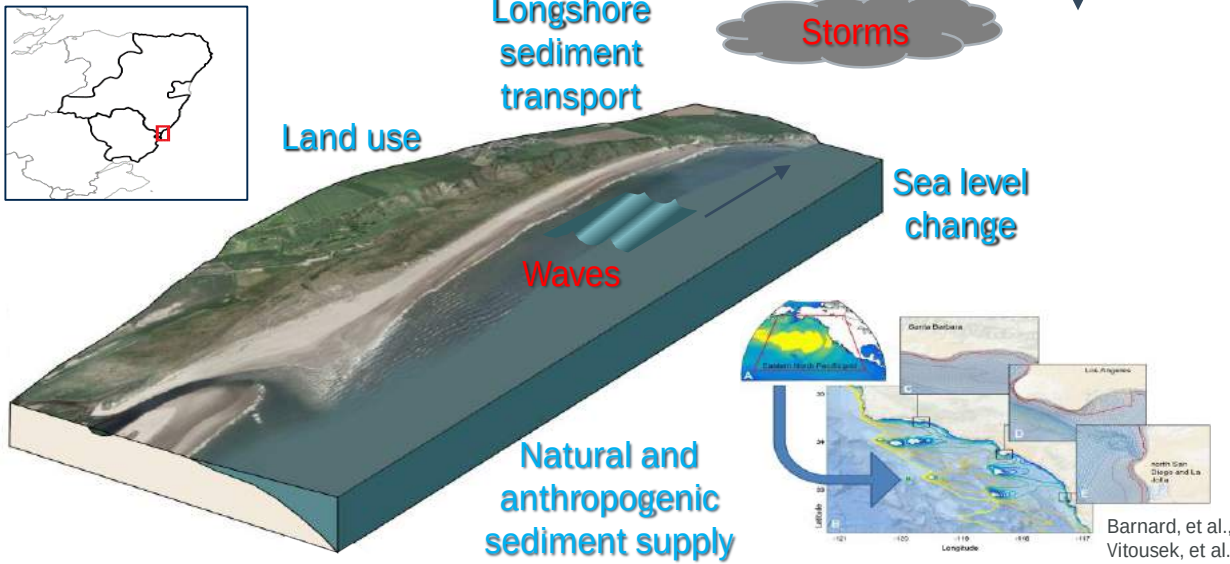
If current erosion trends continue, £240m of assets are at risk over next 30 years, all sectors at risk within all coastal cells

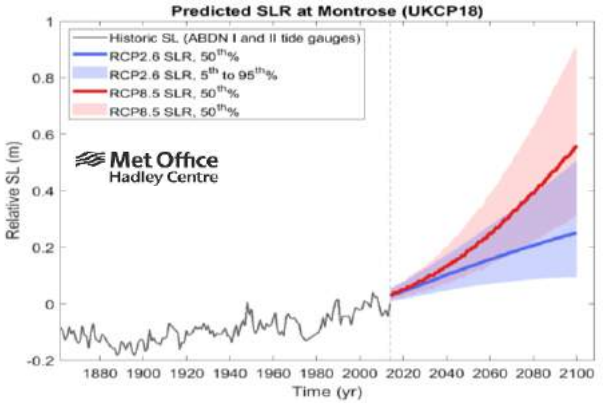

£13bn protected by natural defences.

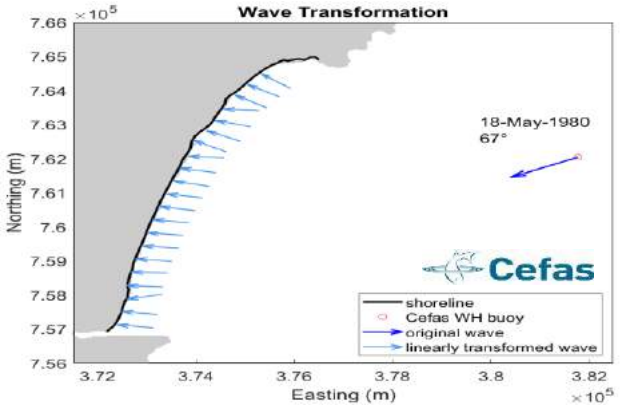

£5bn protected by sea walls.

Climate change expected to exacerbate future change. What is Dynamic Coast 2 doing now?

At key sites we are modelling climate change influences to establish pace of anticipated coastal change and develop adaptation plans to help safeguard assets: results due 2020.







Barnard, et al., 2014
Vitousek, et al., 2017

Scottish Government
Riaghaltas na h-Alba
gov.scot

crew
Scotland's centre of expertise for waters

Scottish Natural Heritage
Dualchas Nàdair na h-Alba

University of Glasgow

Ordnance Survey

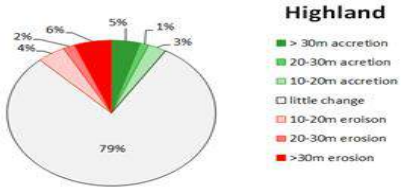
Conclusions: a greater future need?

- None of this is possible without GIS and current high quality OS and third party data in every Local Gov, SEPA, HES office computer, open access on www.

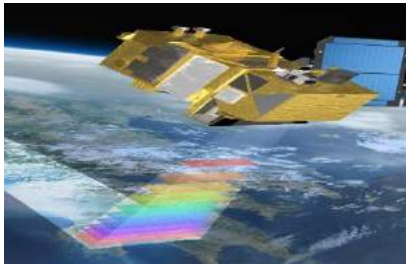
- Dynamic Coast has shown that collaboration is key and can deliver a step change in our shared understanding and approach to better managing future risk at the coast.

- Ongoing collaboration with OS and partners exploring efficiencies and options merging EO, LiDAR, Aerial, Drone & Ground Survey.

- Our world is changing (physically, societally & technologically), we need to invest now to fully understand the coastal impact and implications to inform and implement adaptation planning.



unit	Residential property	Non-Res. property	Septic Water	Roads	Roads	Clean water network	Clean water network	Rail	Rail	Cultural heritage	Natural heritage
	#	#	#	#	m	#	m	#	m	#	#
At risk	-	1	-	8	229	3	322	1	1,478	3	21
Adjacent	20	8	8	17	2,600	9	1,936	4	1,229	-	-
e.g.		Kylerhea, Kilmuir	Loch Eil, Duntes	Ard Everton, Kyle of Durness, Kinlochbervie, Beauly Firth,		Beauly Firth, Sandwick, Loch Eil		Loch Eil & Beauly Firth		Dunrobin Gardens	Moray Firth & Loch Fleet



We have a window of opportunity to prepare mitigation, adaptation and resilience plans

"Dynamic Coast gives Scotland it's most advanced, nationally consistent and locally informed understanding of the causes and consequences of coastal change that it has ever had, so we have to use it and build on it now."

Environment Secretary Roseanna Cunningham

(August 2017)

Thanks to the Dynamic Coast 2 steering group

Special thanks to our funders:

Webmaps and regional reports on www.DynamicCoast.com