

# Dynamic Coast

Coastal erosion / Management Briefing to THC



## What is Dynamic Coast?

Dynamic Coast is a Scottish Government project, funded by CREW, managed by SNH, with a research team from the University of Glasgow.

It provides a publically available evidence base of changes to Scotland's erodible coastline, to inform better decision making to improve the resilience of our coastal infrastructure, assets, businesses and communities.

'Dynamic Coast' includes the National Coastal Change Assessment phase 1 & 2.



## Climate change is affecting Scotland's erodible coast



Since 1970s: 22% ↓ extent of accretion, 39% extent of ↑ erosion, and x2 of erosion rates.



## Nature's defences protect more than ours do

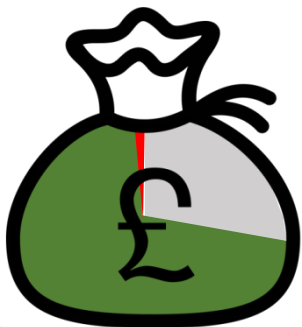
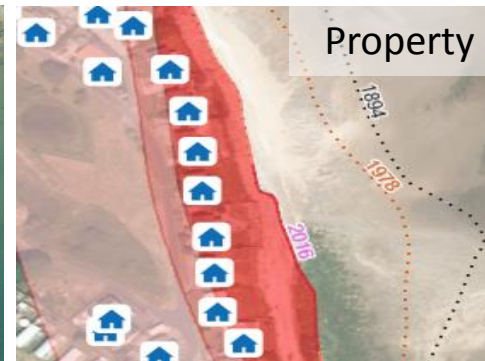
Within 50m of MHWS...







## At least £240m of assets are at risk in next 30 years if recent erosion continues

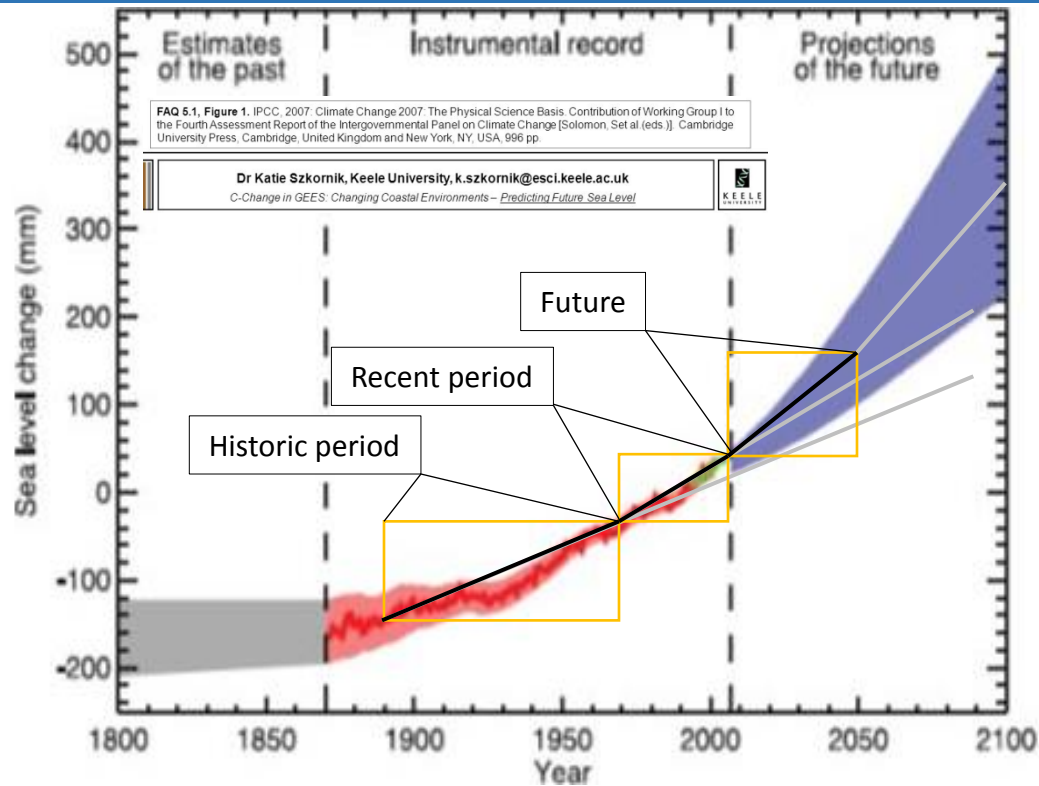


All sectors are at risk within all coastal cells  
(buildings, roads, rail, runways, water supply, cultural & natural heritage).

These are likely to be underestimates...



Not just sea level rise: Storm  
freq., Human factors etc are also  
relevant.



Vulnerability assessment (ie £240m) based on past rates rather than faster future rates & erosion expanding into adjacent areas. Flooding & erosion expected to increase significantly.

In many areas asset damage is not imminent, but we must start to plan now.



## Why is this important?

erosion enhanced flooding is one of the key ways climate change will be manifested.

SLR will have big impact on  
flood frequency.

M.E.S. Leith +0.3 m  
of sea level by 2090 =  
1:100 yr event → 1:8 yr  
(1% or 12.5% probability)

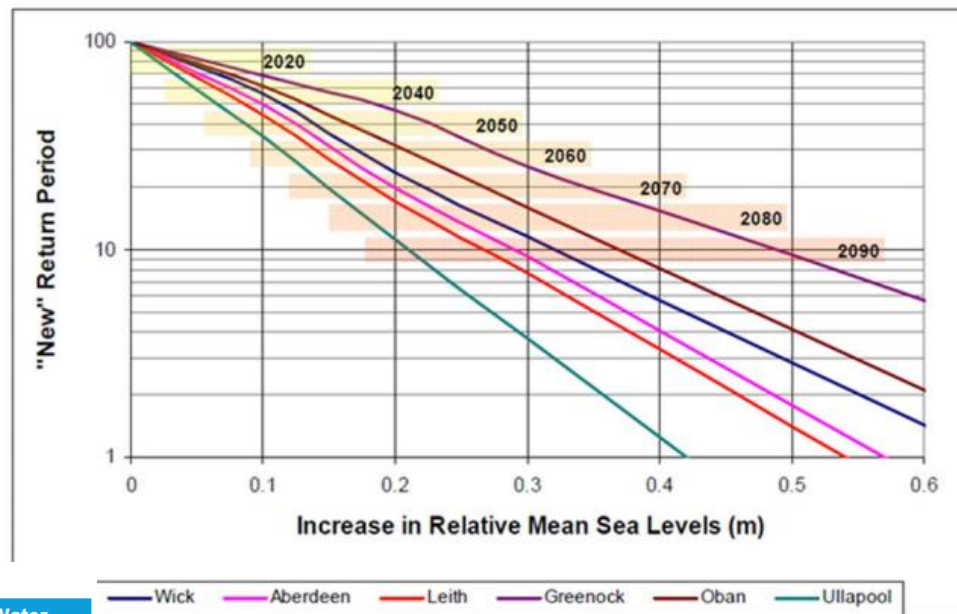


Table 3-2: Estimated increase in total properties at risk for a 10% AP flood

10% AP (10yr)	Fluvial	Coastal	Surface Water
Current estimates	15,420	4,121	9,672
2035 estimates	18,456	6,107	12,052
Increase	3,036	1,986	2,380
% increase	19.7%	48.2%	24.6%

on in flood return period given increases in mean sea level (Defra (2012) UKCCRA for Scotland – Technical based on the central estimate of the Medium Emissions Scenario, locations are approximate)

## 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 2018)







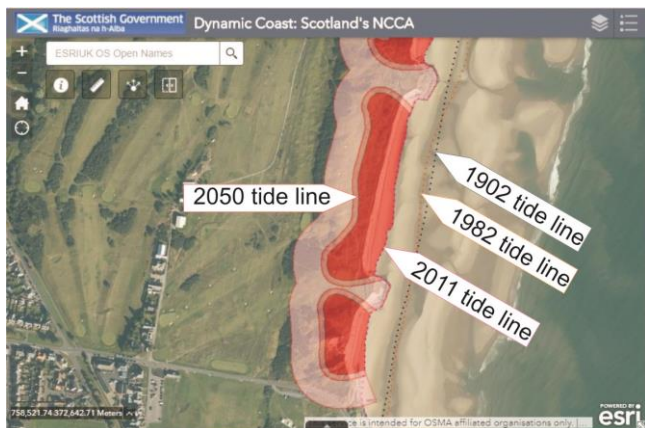
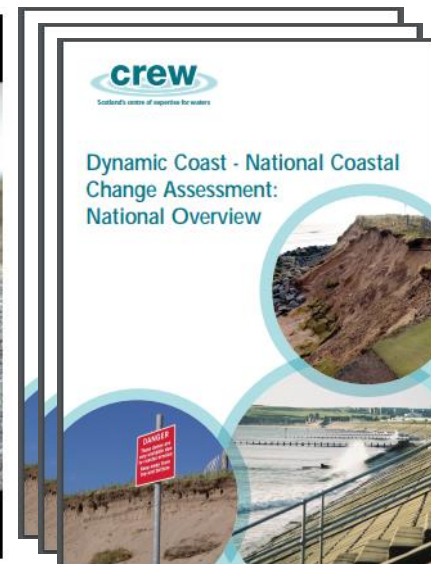
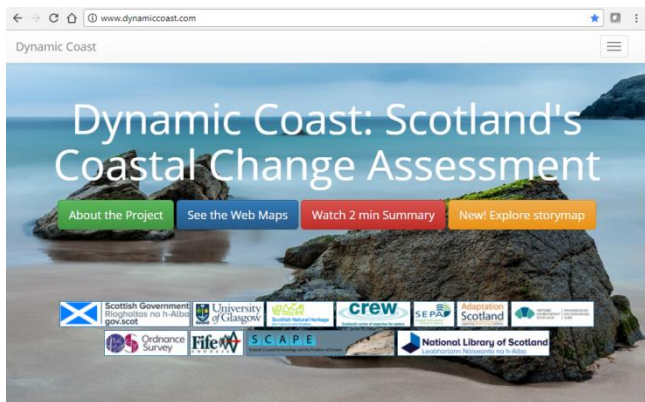
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Scottish Natural Heritage  
Dualchas Nàdair na h-Alba  
All of nature for all of Scotland  
Nàdair air fad seirson Alba air fad



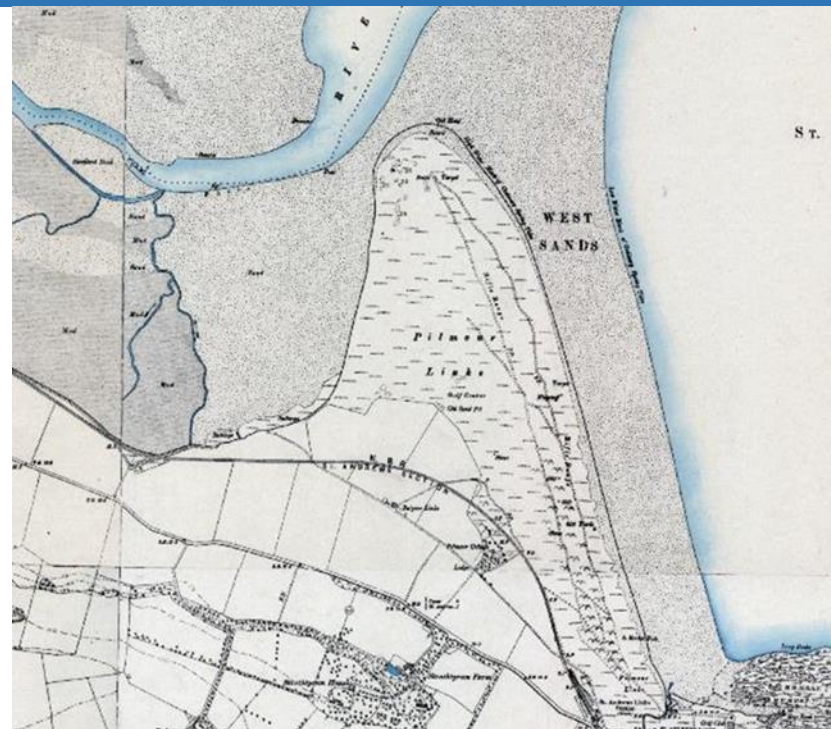
## Evidence base available to all... [www.DynamicCoast.com](http://www.DynamicCoast.com)



Maps of all beaches (past, recent and anticipated change),  
21 reports & summaries, guidance and videos

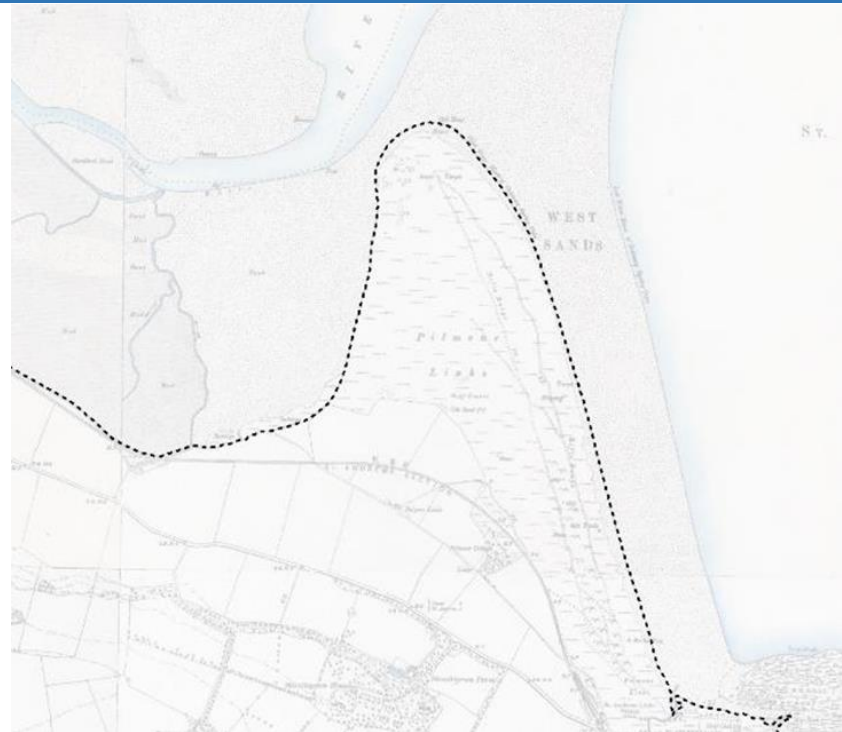
## What where the methods?

- Geo-rectified historical maps
- Semi-automated extraction of tide lines
- 1 million points on the 3 shorelines
- Semi-automated calculation of distance between points
- Analysis of change
- Future projection where change is real
- Vulnerability Assessment (what is at risk)
- Whole Coast Assessment (what is elsewhere)
- Publish results online via AGOL, website & reports



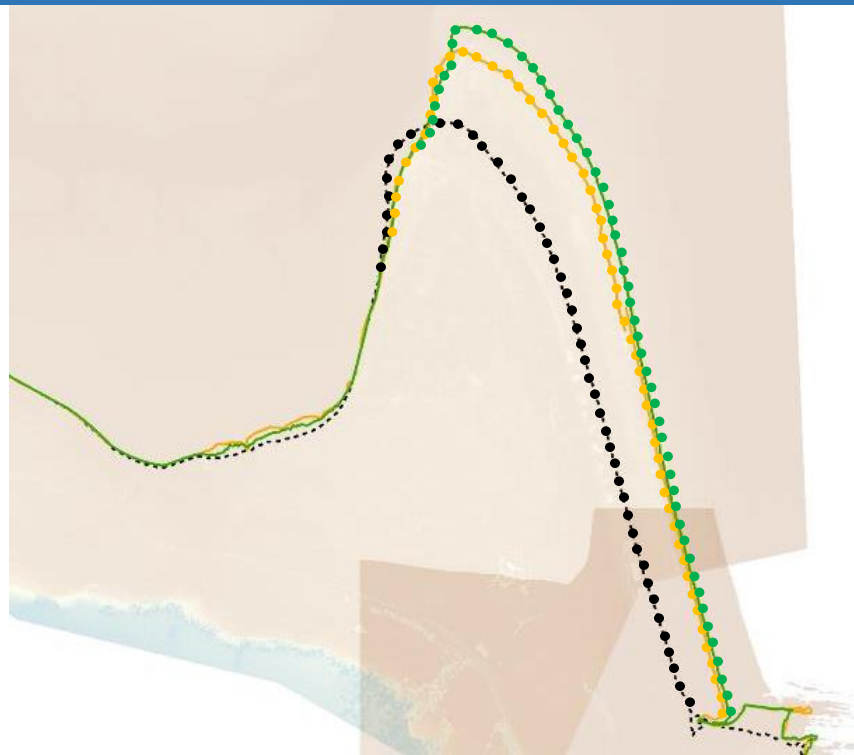
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## Results

- 37% of coastal roads are on soft coast,
- Almost 5x more than defended shores,
- Same number of buildings behind soft coast as defended shore &
- 5km of roads at risk in next 30 years.



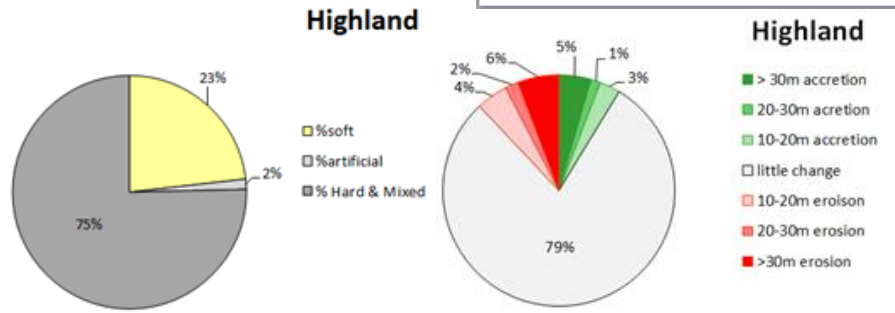
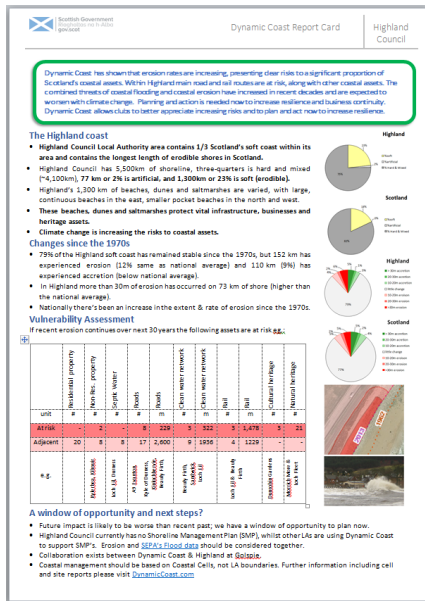
Total number of assets within 50m of MHS

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)

# Highland Council Results

1/3 of Scotland's beaches and salt marshes are within THC area,  
 The soft coast protects important assets: road, rail, businesses & community assets,  
 152 km effected by erosion (ca. Inverness to John O'Groats ... same % as Nat. Average)  
 110 km accretion (less than national average, not likely to improve)  
 Since 1970s: More erosion, less accretion, rate of erosion x2 to 1 m/yr on average.

	Residential property	Non-Res. property	Septic Water	Roads	Roads	Clean water network	Clean water network	Rail	Rail	Cultural heritage	Natural heritage
unit	#	#	#	#	m	#	m	#	m	#	#
At risk	-	1	-	8	229	3	322	3	1,478	3	21
Adjacent	20	8	8	17	2,600	9	1,936	4	1,229	-	-
e.g.		Kylreha, Kilmuir	Loch Eil, Durness	A9 Evanton, Kyle of Durness, Kinlochbervie, Beauly Firth,		Beauly Firth, Sandwick, Loch Eil		Loch Eil & Beauly Firth		Dunrobin Gardens	Morrich More & Loch Fleet





## Designed for partnership working



SNH, SEPA, HES,  
Local Authorities (N&S Ayrshire, Montrose, Highland etc)  
ClimateReadyClyde



## Policy areas

- *The **Climate Change (Scotland) Act (2009)** requires the development of an Adaptation Programme.*
- *The **Adaptation Programme** takes forward the necessary work identified in Scotland by the UK Climate Change Risk Assessment.*
- *Under the Climate Change (Scotland) Act (2009), public bodies have duties to help deliver the Adaptation Programme.*
- ***UKCCRA Risks (2012):** increased coastal flooding, erosion and loss of coastal features*
  - *Maps of past erosion, current state and future erosion conditions are required.*
- ***UKCCRA2 (2016)** more research to consider risks to communities, businesses and infrastructure from coastal flooding and erosion.*
  - *It also highlighted accelerated rates of coastal erosion putting increasing lengths of the UK rail network at risk, as well as sea walls that protect coastal settlements*
- ***SCCAP(2014)** “Action to adapt to the changing climate is required across society. Many actions are most appropriately undertaken at a local level, where impacts will primarily be felt.” 23 Actions.*

## Policy areas

- **NPF3** *“4.25 Adaptation requirements will need to be wide ranging...Planning authorities have a role to play within cross-boundary and multi-sectoral working.. As they emerge, we expect flood risk management plans to become an integral part of strategic and local development planning*
- **SPP (2014)** *states that:*
  - *the planning system should support an integrated approach, where terrestrial and marine planning overlaps.*
  - *Policies and decisions should support climate change mitigation and adaptation.*
  - *New developments requiring coastal defenses should generally not be supported.*
  - *Development plans should identify areas at risk and areas where managed realignment would be beneficial.*
  - *A precautionary approach to flood risk should take account of the predicted effects of climate change.*
- **Local Development Plans** *state that new development sites should not be at risk from coastal erosion.*

## Next steps? Dynamic Coast (phase 2)

1.	<b>Where are nature's defences &amp; how resilient are they?</b>	Analyse the topography of our erodible coast to evaluate resilience & find breach points. (National)
2.	<b>Climate change accelerations</b>	Appreciate the implications of climate change on the extent and rate of erosion. How much should we increase the £240m estimate of damage due to climate change? (National)
3.	<b>Improved monitoring</b>	Improved understanding of change of vegetation edge monitoring & historical photographic surveys (10 sites)
4.	<b>Develop Resilience &amp; Adaptation Plans at 7 Super Sites</b>	Understand past 3D change at Super Sites alongside distribution of assets. Project future change and consider implications, then develop plans to mitigate and or adapt to risks.
5.	<b>Increase adaptation awareness</b>	Provide bespoke risk summarise for key partners
6.	<b>Social Vulnerability to coastal erosion</b>	Investigate the societal vulnerability to anticipated coastal erosion to produce a Coastal erosion disadvantage map of Scotland.



## Vegetation edge

### Remote sensing & ground survey add extra change intelligence



Sarah Miller  
@semiller88

Follow

Alastair Rennie shows us his EOS Arrow kit to map shorelines- look for one on my head coming soon;) Perfect use at the Zulu graveyard at Loch Fleet to map shoreline, drop points for boats, and overlay survey maps. @RennieAlistair @nature\_scot @scotinsight #learningfromloss



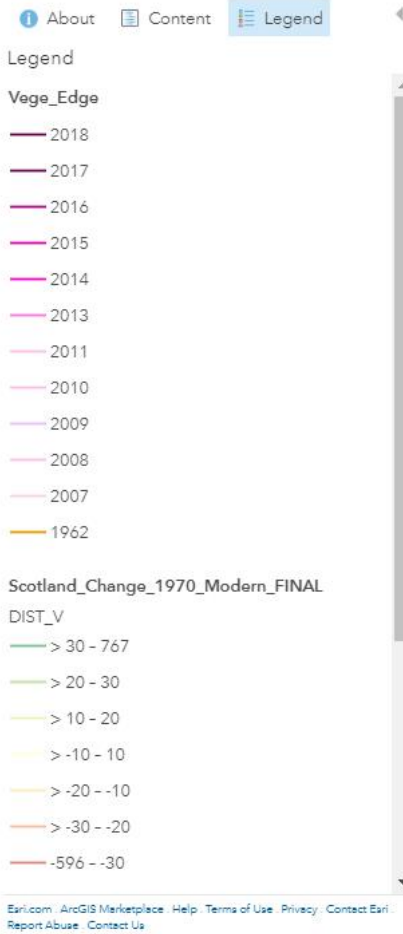
4:30 am - 20 Jun 2018

2 Retweets 6 Likes



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<https://arcg.is/9ySHz>





## Collaboration

Super Site – Golspie links

Spatial planning for Climate Change



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# Questions?

[alistair.rennie@nature.scot](mailto:alistair.rennie@nature.scot)

## Special thanks to our funders:

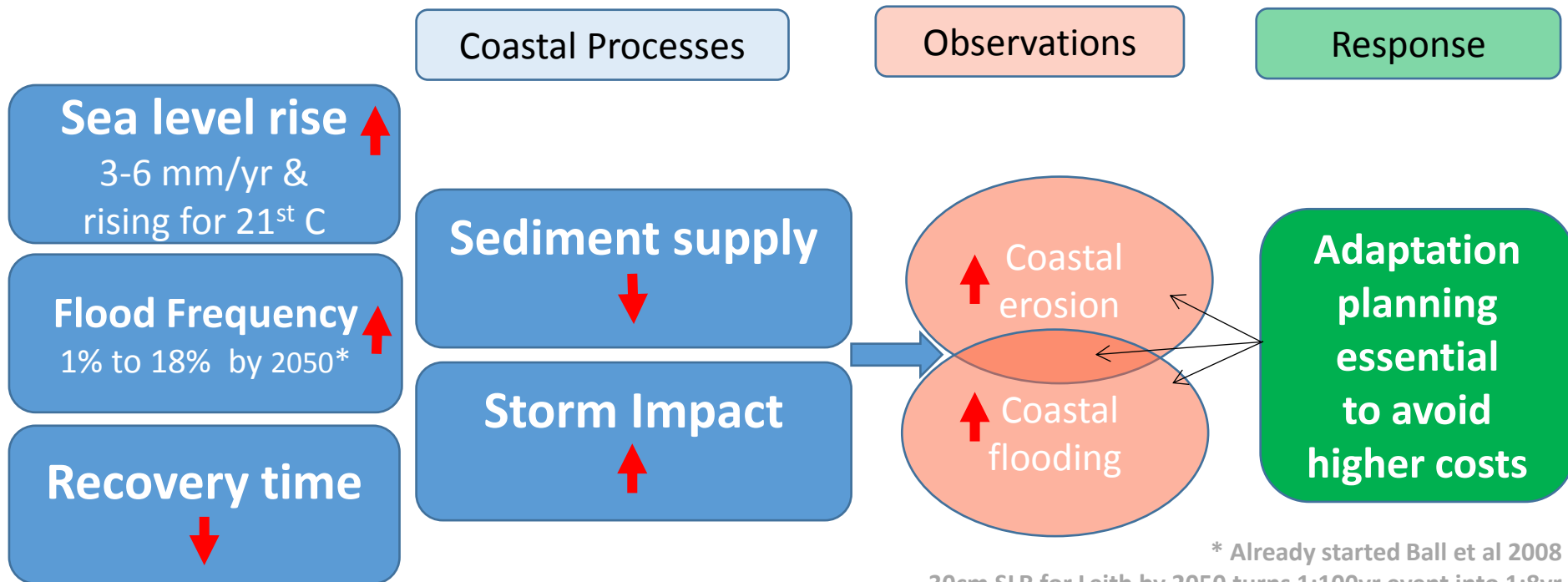


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## Why is this important?

erosion enhanced flooding is one of the key ways climate change will be manifested.



\* Already started Ball et al 2008

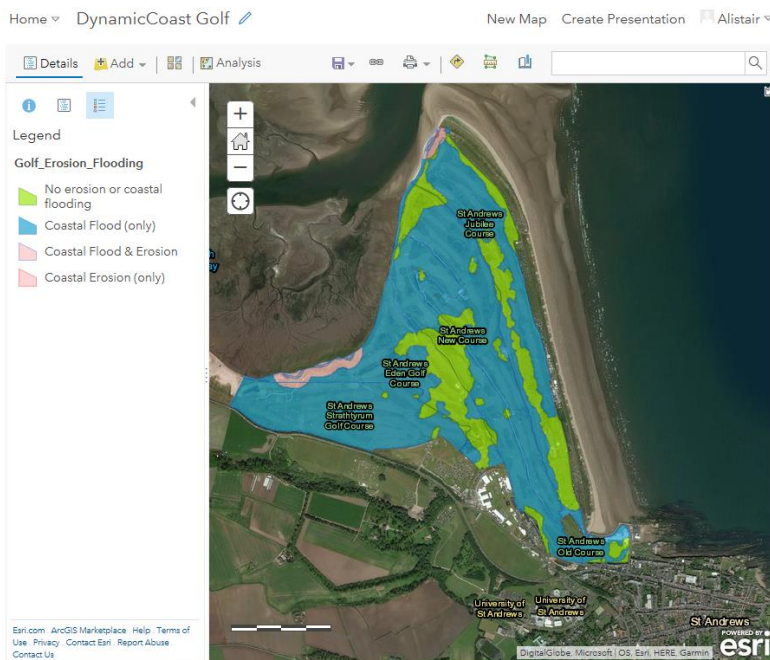
30cm SLR for Leith by 2050 turns 1:100yr event into 1:8yr

(UKCP09 High Emission Scenario 95% level for Leith & Defra (2012) UKCCRA for Scotland )

# Implications for businesses: Sector Summary (Draft) – GOLF

## Who will this impact?

- 1/4 of Scotland's golf courses are coastal and together comprise 1/3 of total area of courses in Scotland.
- Directly they generate over £95m/yr ,+ millions more indirectly\*,
- 10% by area is at risk from coastal flooding (temporary threat),
- 1% by area is at risk from erosion (permanent threat),
- At least £9m/yr turnover at risk from flooding and £1m/yr at risk from erosion.
- Climate change is increasing the risks to golf course assets.



DynamicCoast Report Card

Golf Links

Dynamic Coast has shown that coastal erosion rates are increasing, presenting these risks to a significant proportion of Scotland's golf courses. Scotland's golf courses generate more than £100m per year. The economic threat of coastal flooding and erosion means that the golf industry is at risk of significant damage and is at risk of losing its assets. Planning and action is needed now to increase resilience and business continuity. Dynamic Coast offers a better approach to managing the risks to golf courses and to help them to become resilient.

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How can Dynamic Coast help you?

- Dynamic Coast provides detailed information (2020) of how your coastline has changed over the last 100 years, and how this should affect coastal golf courses (coastline confidence over next 10 years).
- All golf courses have been identified as at risk, with 10% at risk from coastal flooding and 10 from both erosion and flooding (risk).
- A further 10% of courses show 10% risk, indicating that there is a coastal erosion problem with a further 10% at risk. The Dynamic Coast maps show areas where to address the risk (identified, defined, defined, works to adapt and enhance resilience while there is time).
- What can you do to improve future resilience?
- Understand how your coast has changed and what change in the future - [Coastal Erosion and Flood Risk](#) and [Coastal Flood Risk](#).
- The green areas are free from risk, low at flood risk, not at erosion risk.
- Let us help you set up your own monitoring to enable the risk changes at your course (Appendix B2020).
- Consider the implications of your coastline and plan ahead to reduce future investments are prudent and climate resilient.
- Invest in coastal flood and erosion risk reduction to reduce exposure and increase resilience. Consider how you can adapt your course to avoid exposure and ongoing erosion.
- Assess commercial impacts to create a business case for adaptation and resilience via the Natural Green Group.
- A wide range of opportunity.
- The climate is clear, we have a window of opportunity to plan in place prior to adapt and improve the resilience of our golf courses before coastal erosion and flooding worsens.
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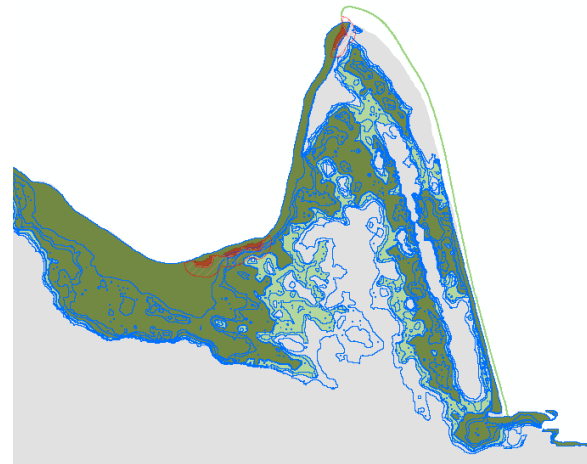
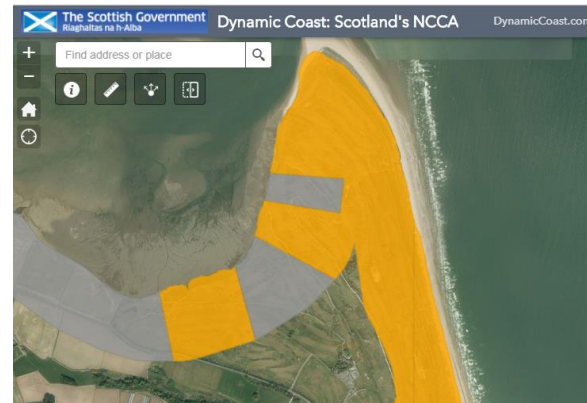
Find out more at: [DynamicCoast.co.uk](#) [DynamicCoast.co.uk](#) [DynamicCoast.co.uk](#) [DynamicCoast.co.uk](#) [DynamicCoast.co.uk](#)

\*Data in 2020 is based on data from the Department for Environment, Food and Rural Affairs (DEFRA) and the Scottish Government.



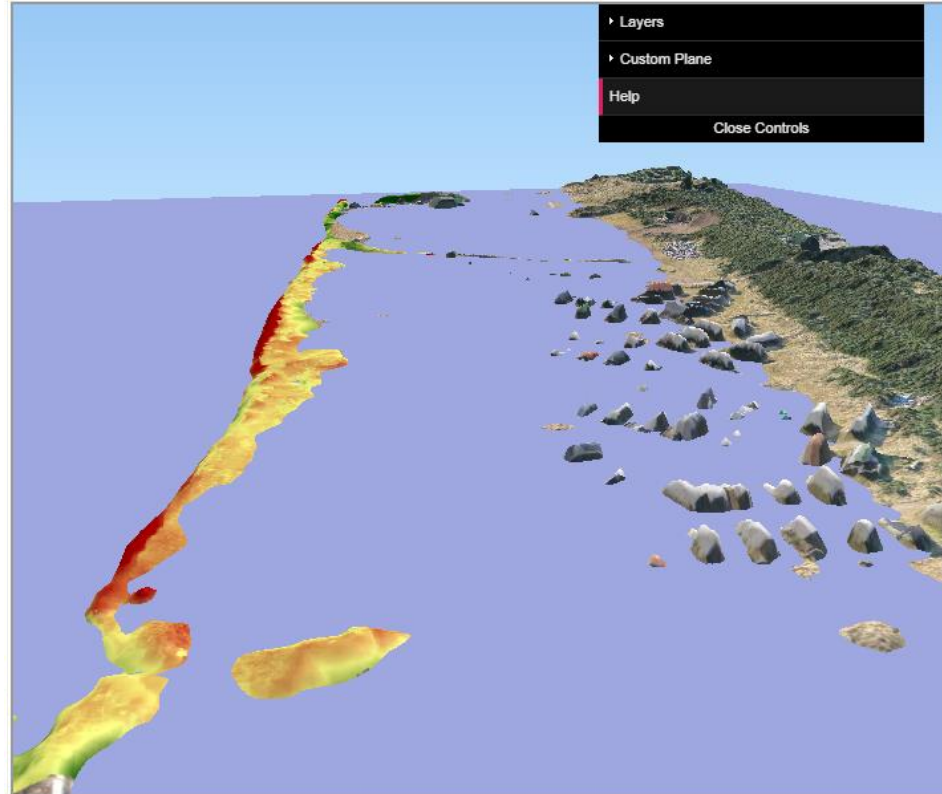
## 1a. Erosion enhanced flooding: Identify natural features the removal of which may increase flood or erosion risk.

- Tiered approach:
  - Hard & Artificial coast excluded, leaving soft coast
  - ID low-lying coast (containing 1:1,000yr flood level?)
  - Start supersite coasts to develop workflows, then roll out across other DTMs.
- What is the implication of erosion enhanced flooding?



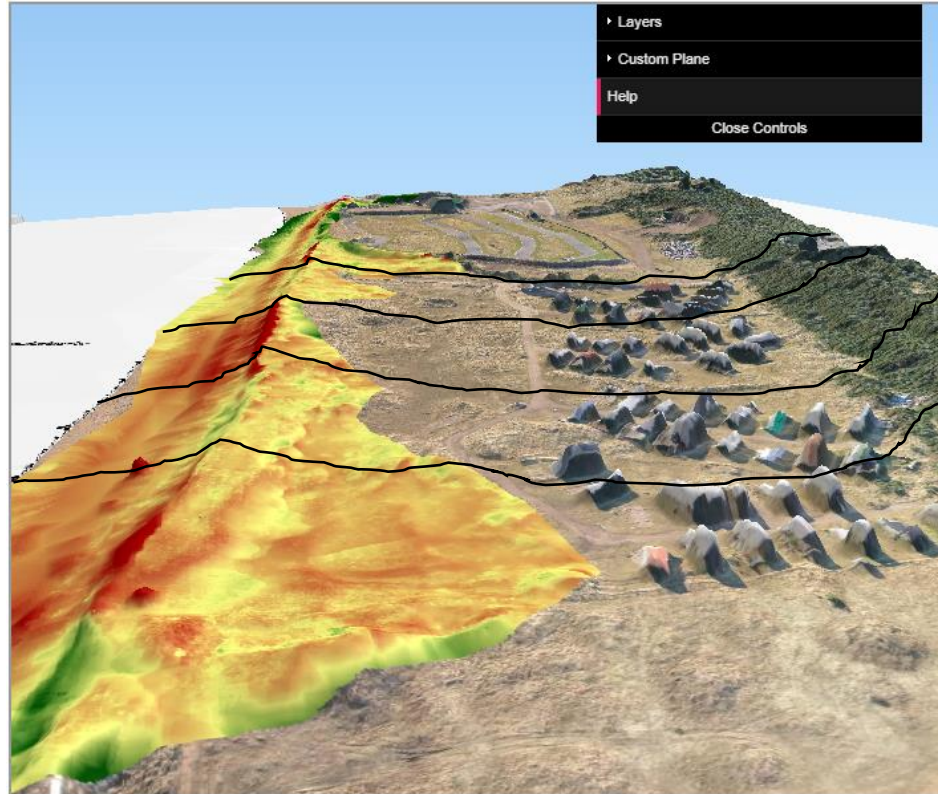


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- Extract coastal cross-sections from DTMs and develop automated approaches to characterise the morphometric properties of the natural defences (width, height, volume)
- Where time-series data exists, identify where protective function is being lost.

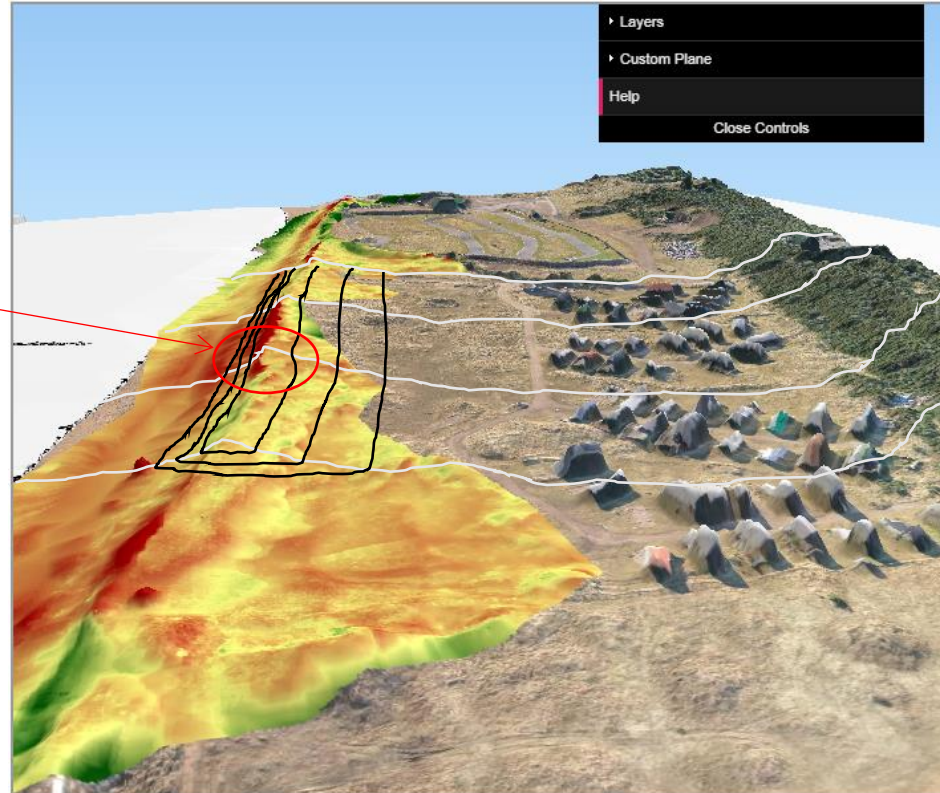


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@ transects what are the:

- heights, widths, cross-sectional area above key altitudes?

Metrics tagged to transects, for assimilation and further analysis including inland flooding extents if features were removed.

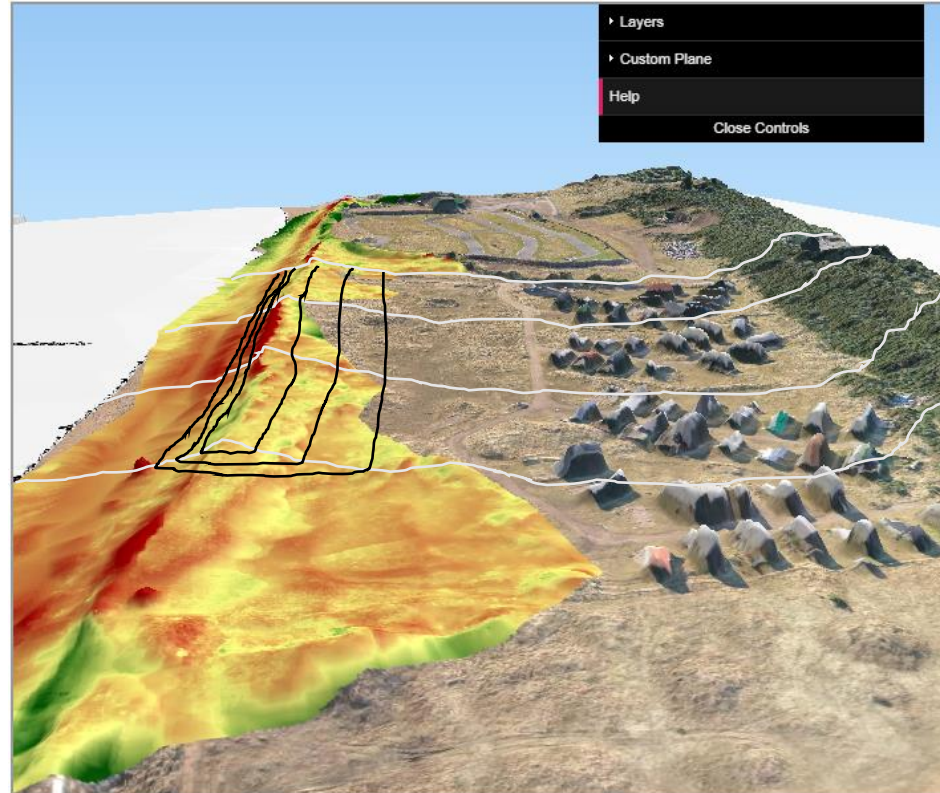




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Factors to be established:

- Design of spatial database for results
- Transect spacing
- Which key levels:
  - LAT, MLWS, MT, MHWS, HAT,  
T:1, 10, 100, 200, 200cc etc?
- Wave overtopping risk?
- External pressure (Sedi. Supply etc)





## 1a. Erosion enhanced flooding: Identify natural features the removal of which may increase flood or erosion risk.

Maximise impact of results:

- How to link with NFRA2
- Building with Nature?

