Dynamic Coast

Learning from Loss SUII

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.

Golspie, 2014

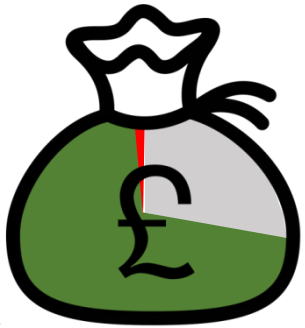
Nature's defences protect more than ours do

Within 50m of MHWS…

£13bn protected by natural defences

£5bn protected by sea walls

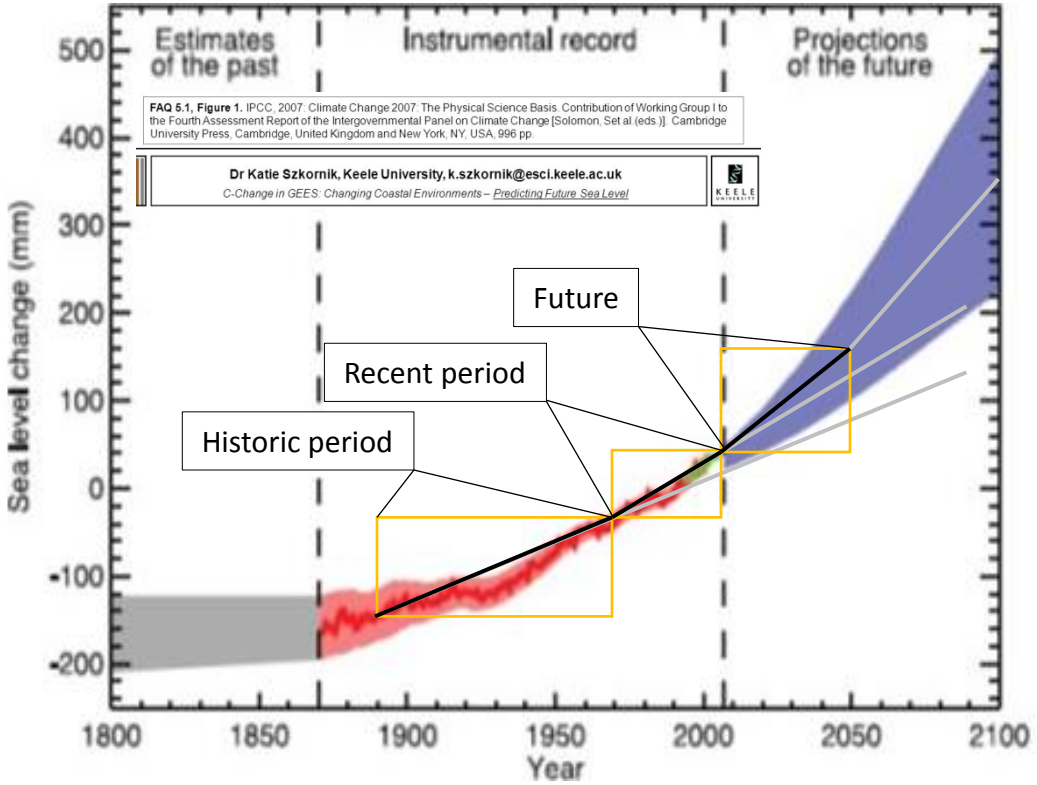
At least £240m of assets are at risk in next 30 years if recent erosion continues



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)

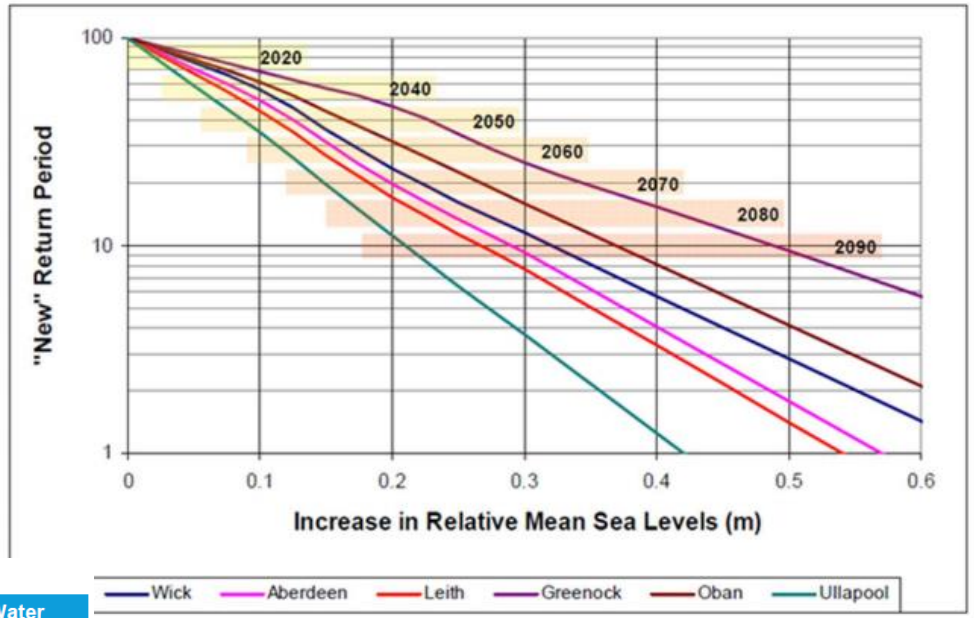


Table 3-2: Estimated increase in total properties at risk for a 10% AP flood

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%

ɔn 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)

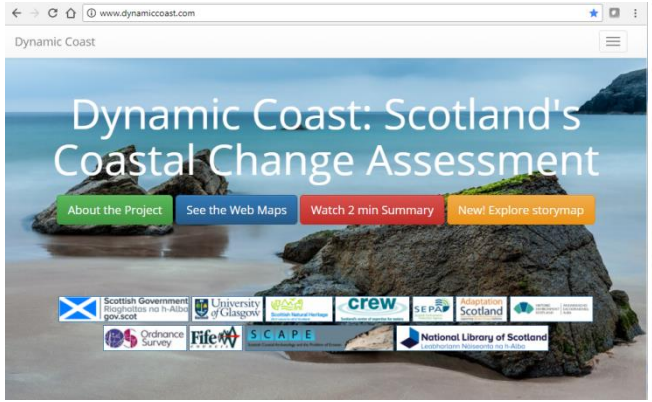
We have a window of opportunity to prepare mitigation, adaptation and resilience plans

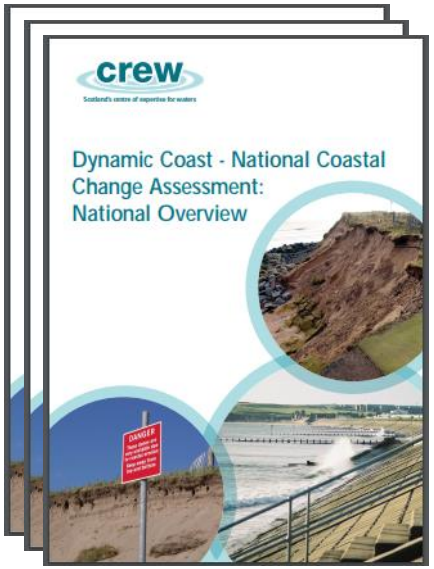
"Dynamic Coast gives Scotland it's most advanced nationally consistent and locally informed understanding of the causes and consequences of coastal change that it has ever had, so we have to use it and build on it now."

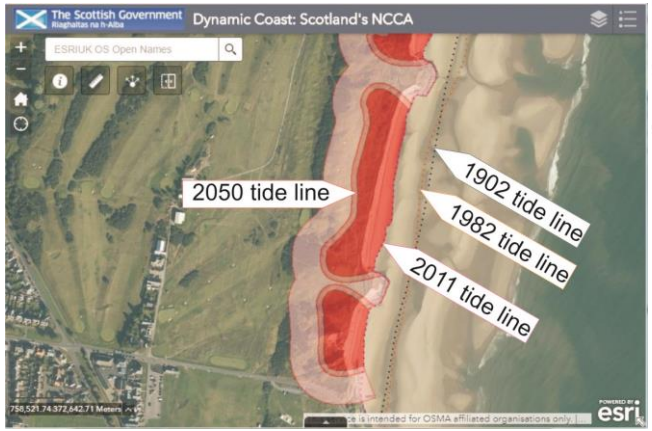
Environment Secretary Roseanna Cunningham

(August 2018)

Evidence base available to all… www.DynamicCoast.com



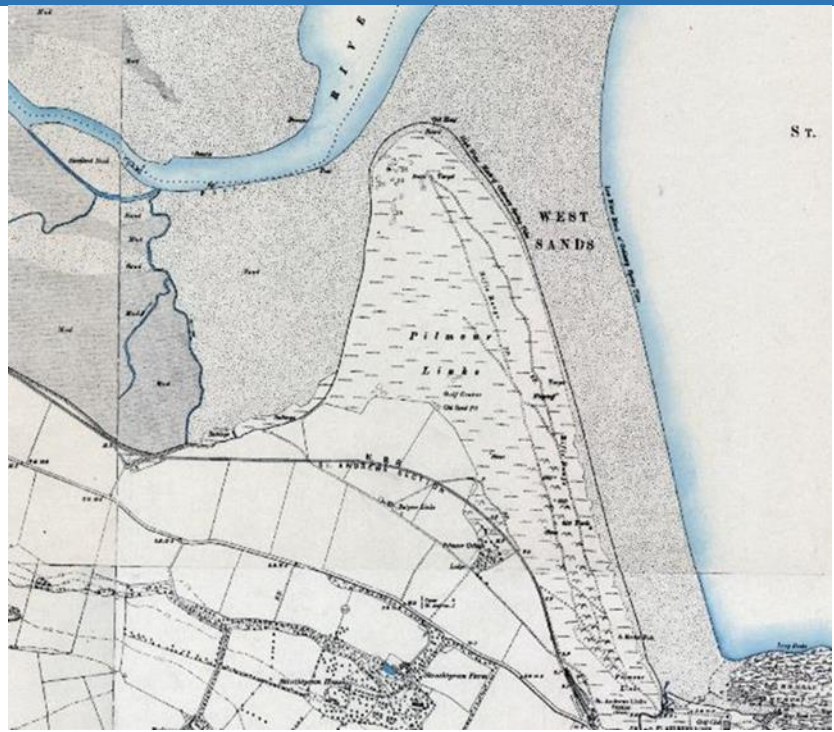




Maps of all beaches (past, recent and anticipated change),
21 reports & summaries, guidance and videos

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



St Andrews

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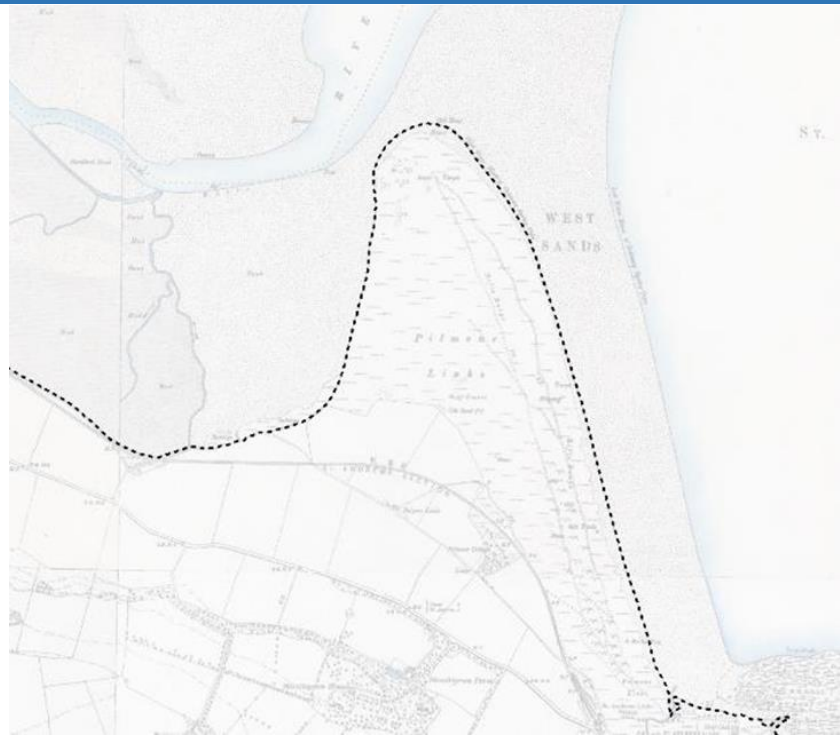

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Results

- 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 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)

Results

- HES's interests:

Areas include:

Erosion

Erosion Influence

Erosion Vicinity

Scheduled Monuments	Ha
Tofts Ness, Sanday	20.1
Tentsmuir CDefen, Fife	18.5
Broughy Ferry, Tay	3.2
Dysart House, Kirkcaldy	1.6
Kirkcaldy, Fife	0.4

Properties in Care	Ha
Kirkcaldy, Fife	0.4
Broughy Ferry, Tay	0.1
Dysart House, Kirkcaldy	0.0

Gardens of Designed Lanscape	Ha
Toward, Clyde	5.0
Wemyss Castle, Fife	4.7
Ardgowan, Clyde	3.3
Carsethorn, Solway	2.8
Dalmeny, Fife	2.5
Dunrobin Castle, Sutherland	2.3
Kirkcaldy, Fife	2.0
St Andrews Links, Fife	1.9
Eden Estuary, Fife	1.4
Dysart House, Kirkcaldy	1.1
Balmacara, Kyle of Lochalsh	0.9
Southerness, Solway	0.3

Designed for partnership working

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

Next steps? Dynamic Coast (phase 2)

1.	**Where are nature's defences & how resilient are they?**	Analyse the topography of our erodible coast to evaluate resilience & find breach points. (National)
2.	**Climate change accelerations**	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.	**Improved monitoring**	Improved understanding of change of vegetation edge monitoring & historical photographic surveys (10 sites)
4.	**Develop Resilience & Adaptation Plans at 7 Super Sites**	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.	**Increase adaptation awareness**	Provide bespoke risk summarise for key partners
6.	**Social Vulnerability to coastal erosion**	Investigate the societal vulnerability to anticipated coastal erosion to produce a Coastal erosion disadvantage map of Scotland.

Improved monitoring

Vegetation edge surveys …. DynamicCoast collaborating with partners

Questions?

Special thanks to our funders:

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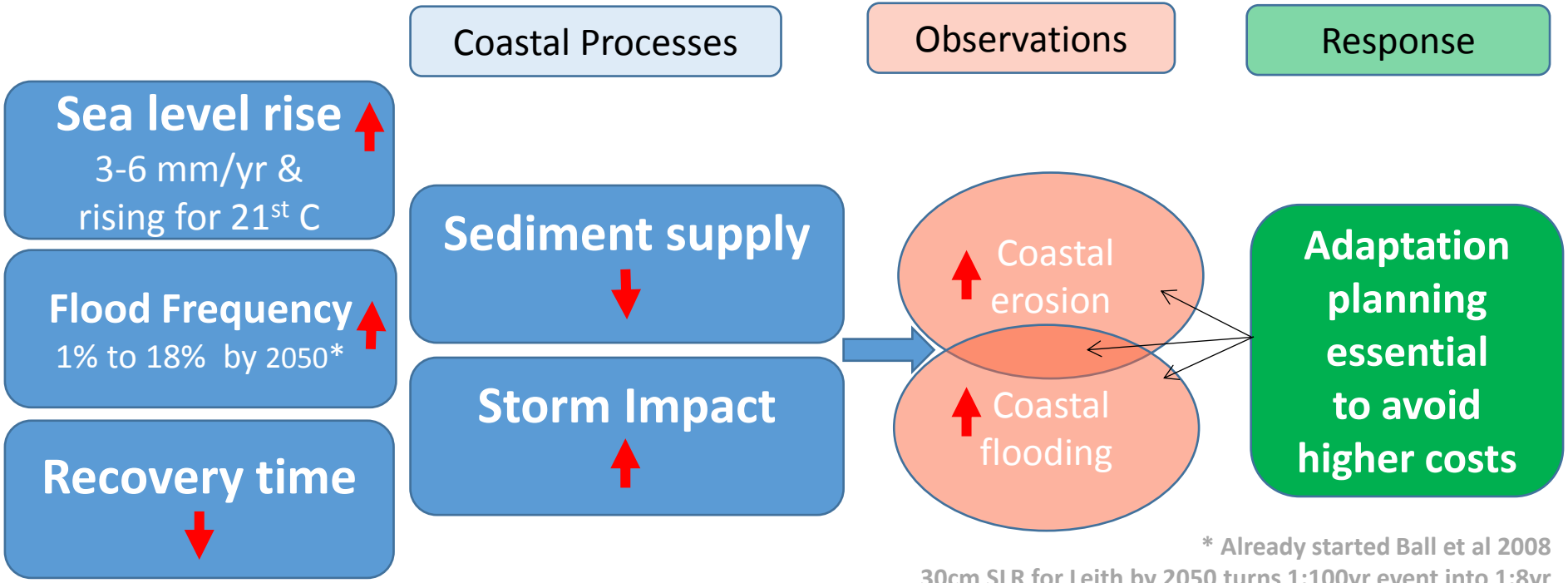


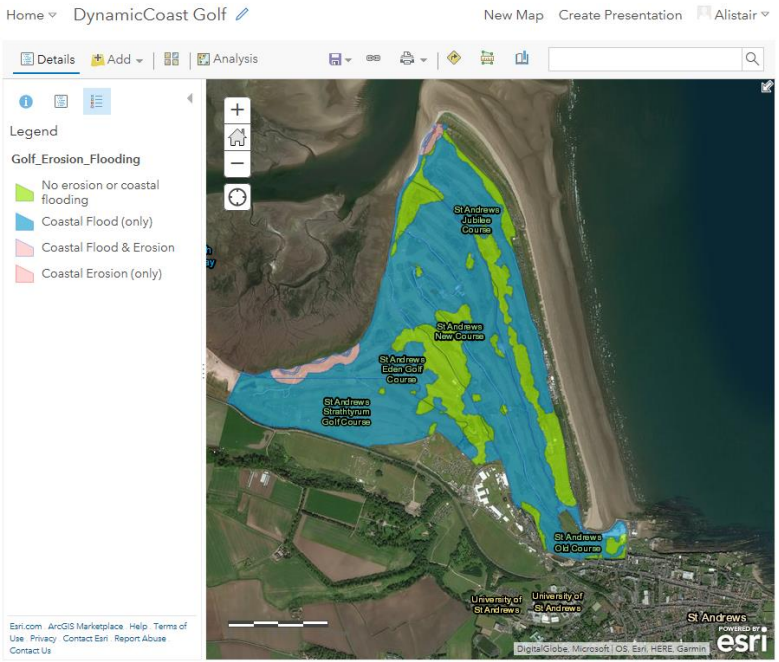
* Already started Ball et al 2008
30cm SLR for Leith by 2050 turns 1:100yr event into 1:8yr
(UKCP09 High Emission Scenario 95% level for Leith & Defra (2012) UKCCRA for Scotland)

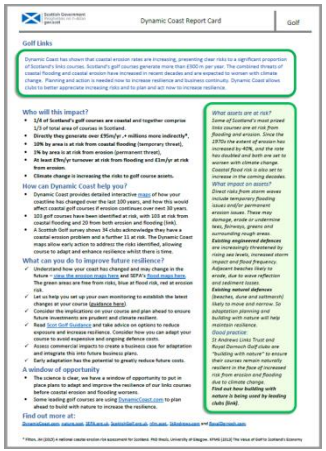
Implications for businesses:

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.**

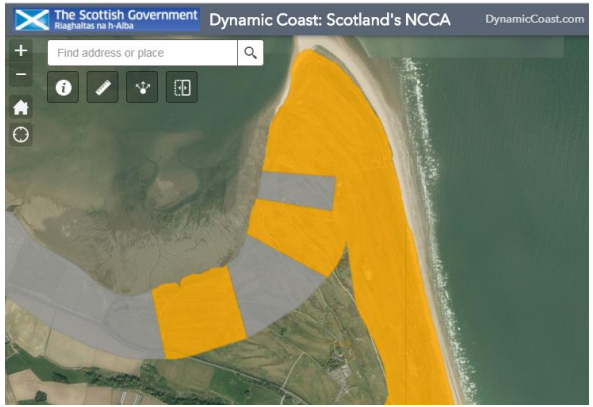


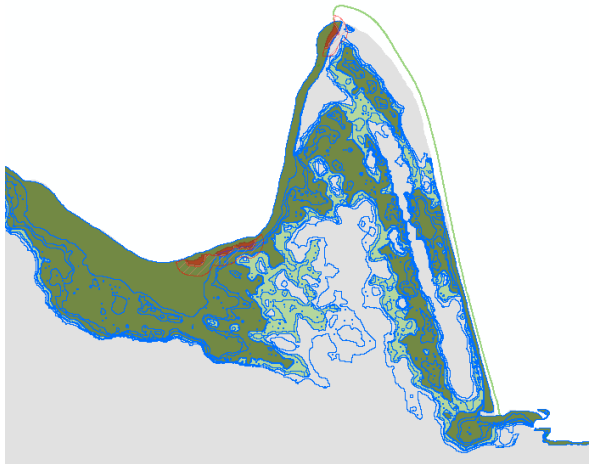


1a. Erosion enhanced flooding: Identify natural features the removal of which may increase flood or erosion risk.

- 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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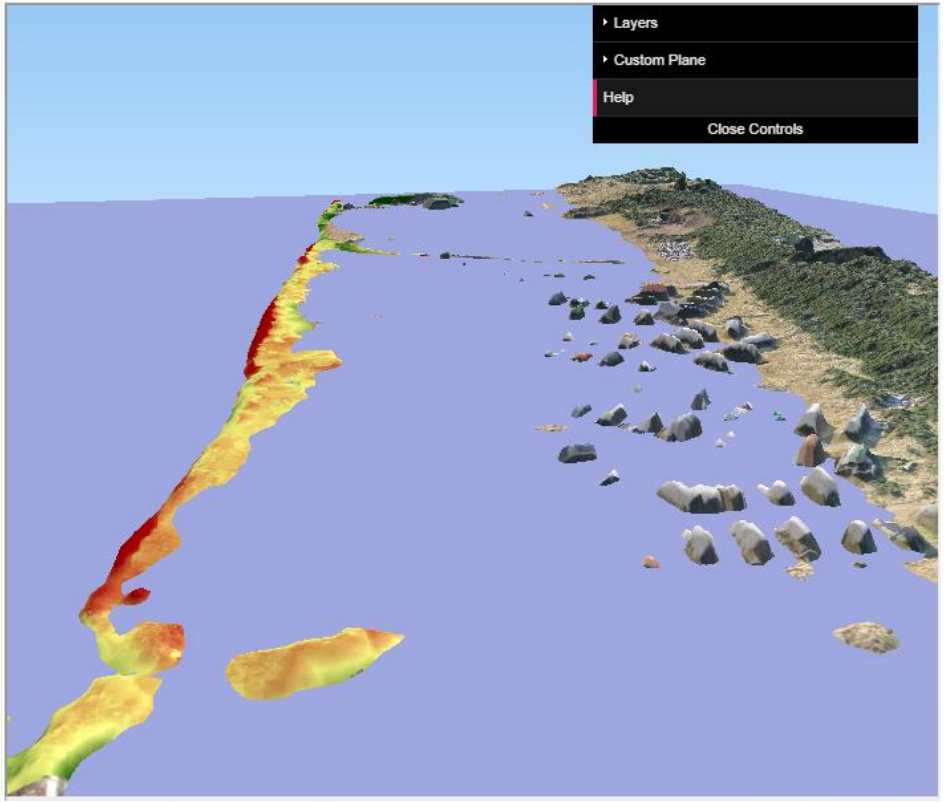

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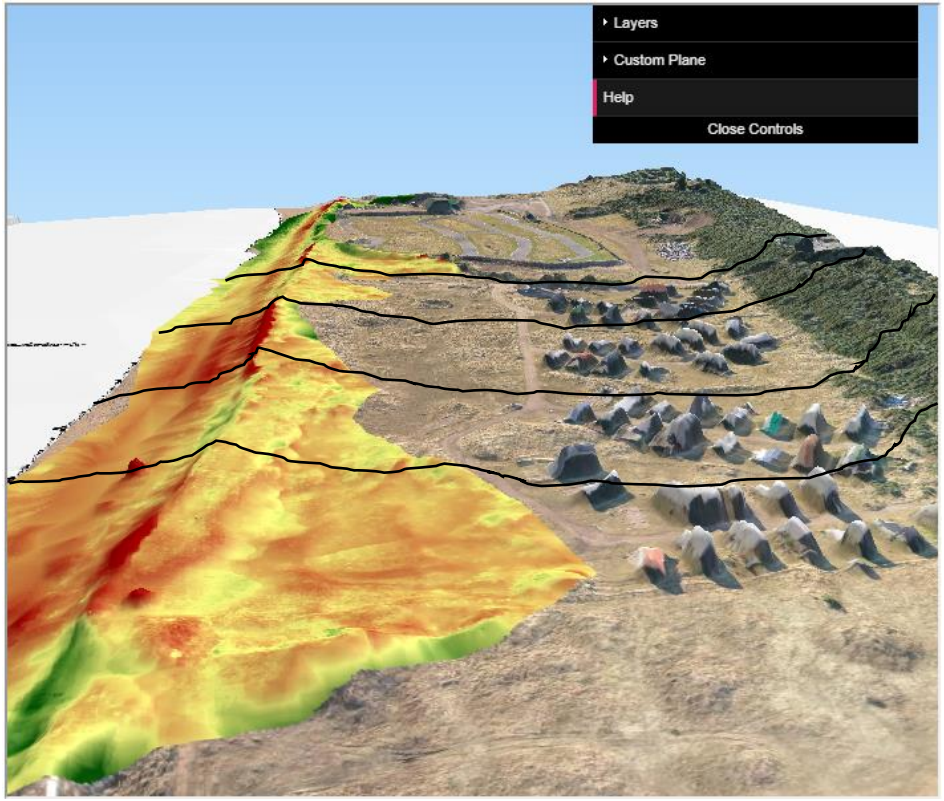
- Extract coastal cross-sections from DTMs and develop automated approaches to characterise the morphometric properties of the natural defences (width, height, volume)
- Where time-series data exists, identify where protective function is being lost.



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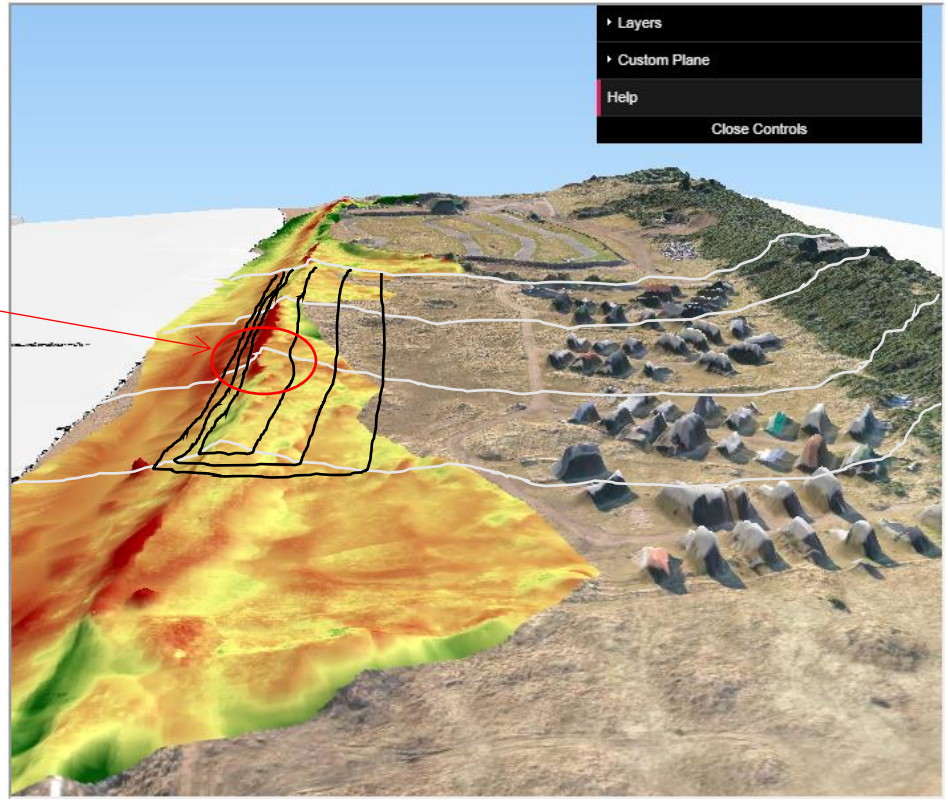
@ transects what are the:

- 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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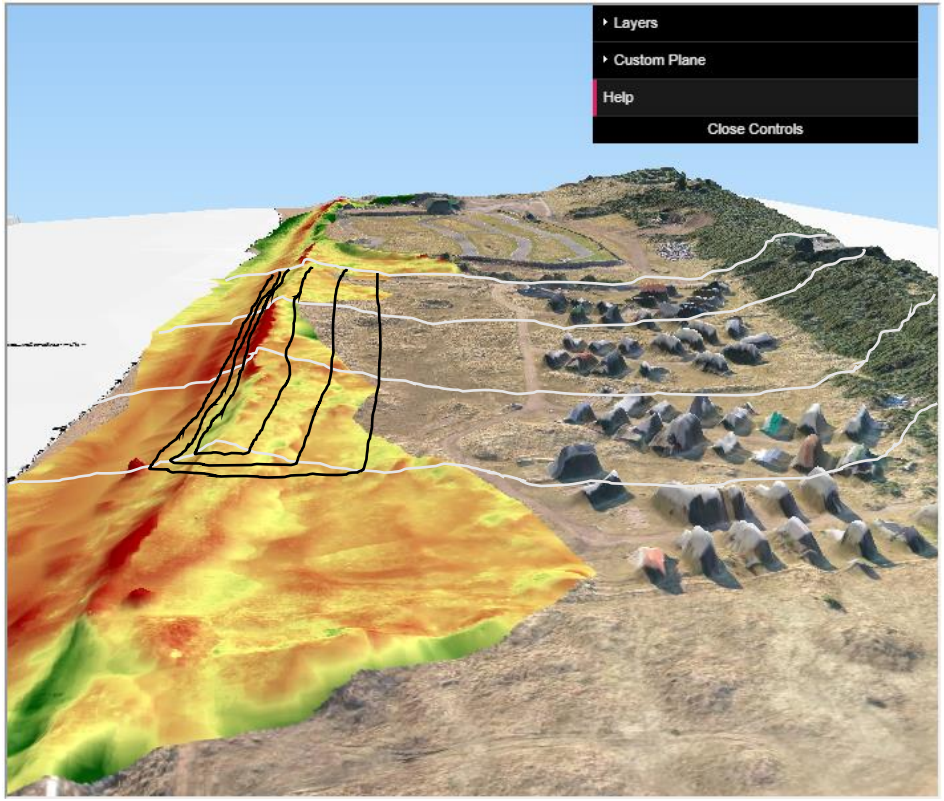
Factors to be established:

- 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)



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Maximise impact of results:

- How to link with NFRA2
- Building with Nature?