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living planet symposium | BONN 23–27 May 2022

TAKING THE PULSE OF OUR PLANET FROM SPACE

EUMETSAT ECMWF EUSPA

Coastal Change From Space

INTERCOMPARING SUB-ANNUAL TO MULTI-DECADAL SHORELINE VARIABILITY FROM OPTICAL AND SAR PUBLICLY AVAILABLE SATELLITE IMAGER

Ekbal Hussain presenting on behalf of Andres Payo
British Geological Survey

Tuesday 24 May, 4:40 PM

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Aim & references

The aim of this study is to investigate and compare the information contained on historical shorelines extracted from satellite MSI and SAR imagery in three macro-tidal (>4 m) coastal environments: estuarine, soft cliff environment, and gravel barrier beach

Open Access Article

Shoreline Change from Optical and Sar Satellite Imagery at Macro-Tidal Estuarine, Cliffed Open-Coast and Gravel Pocket-Beach Environments

Open Access Feature Paper Editor's Choice Article

Open Digital Shoreline Analysis System: ODSAS v1.0

Journal of Marine Science and Engineering

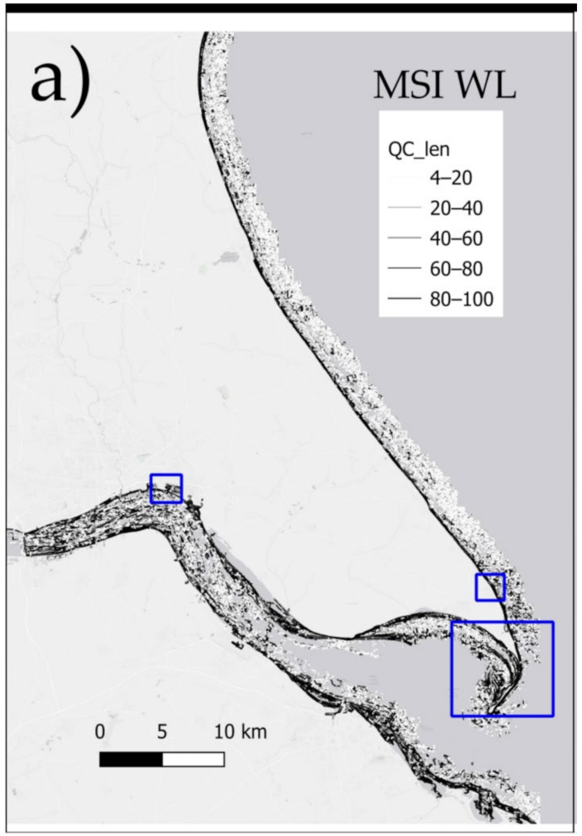
Outline

1. Study sites
2. Historical shoreline databases used
3. Two approaches to extract change information
    1. Baseline and transect approach using ODSAS
    2. Principal Component Analysis approach
4. Results
5. Lessons learned & next steps

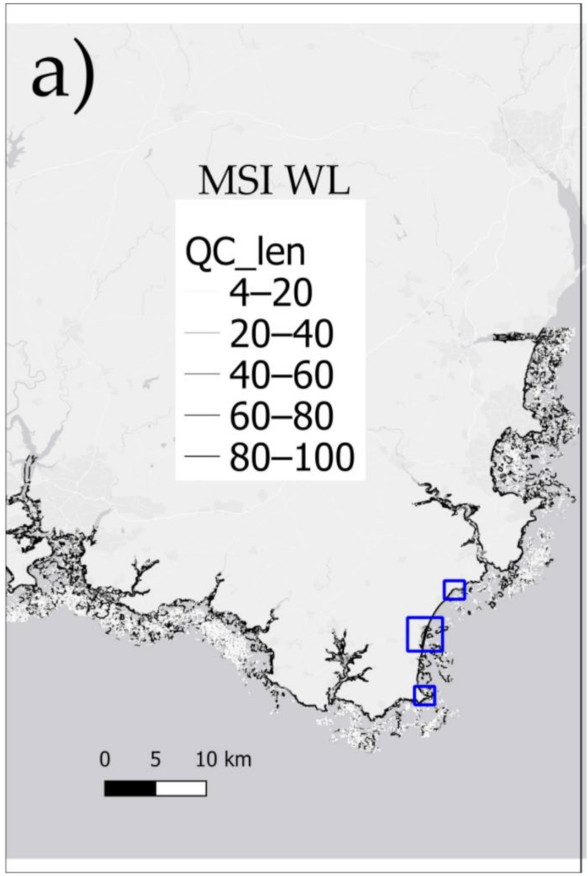
Study sites

a)
b)
Flamborough
Bridlington
Km
0 10 20
Holderness coast
Hull
Grimsby
c)
Holderness Cliffs
Humber estuary
Grimsby
Spurn Point
Km
0 5 10
d)
Blackpool Sands
Forest Cove
Slapton Sands
Beesands
Hallsands
Km
0 1 2 4

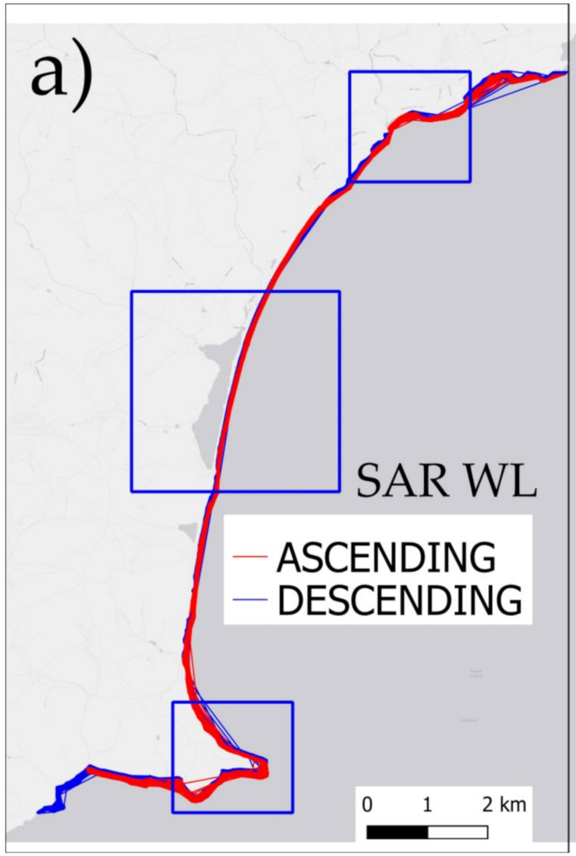
Historical shorelines DB used



55 lines from MSI



30 lines from MSI



866 lines from SAR

→ THE EUROPEAN SPACE AGENCY

Two approaches to extract change information

Transect and baseline approach

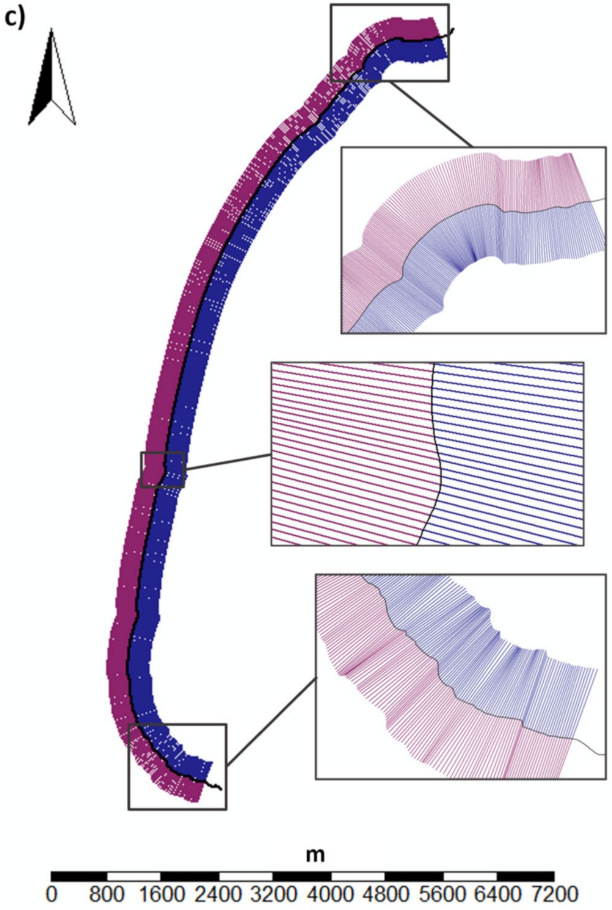


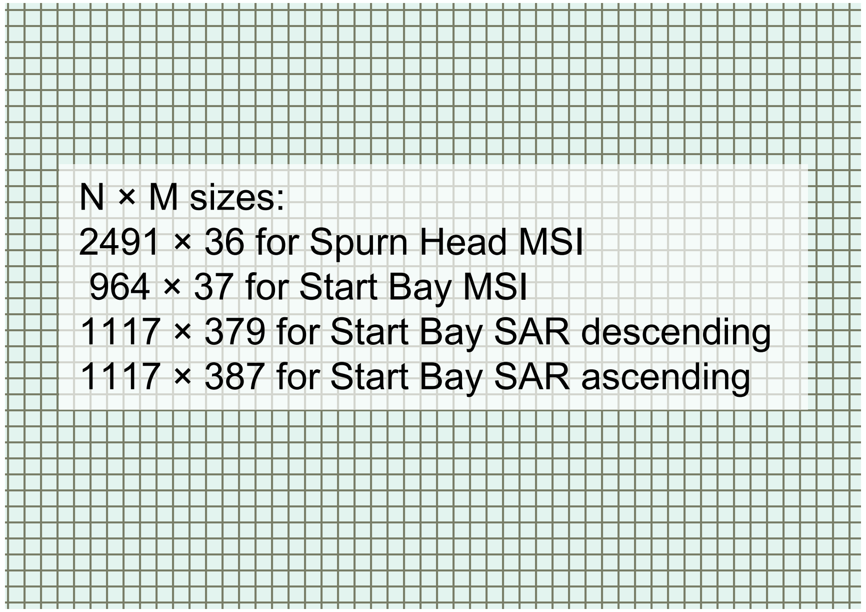
Table 2. Main statistical parameters calculated in the CoastCR module.

Parameter	Name	Definition	Units
NSM	Net Shoreline Movement	Oldest—Youngest coastline	m
SCE	Shoreline Change Envelope	Greatest distance between coastlines	m
EPR	End Point Rate	NSM/timespan	m/year
LRR	Linear Regression Rate	Slope of regression line by the sum of the squared residuals	m/year
WLR	Weighted Linear Regression Rate	Considers the variance in the uncertainty	m/year

Principal Component Analysis (PCA)

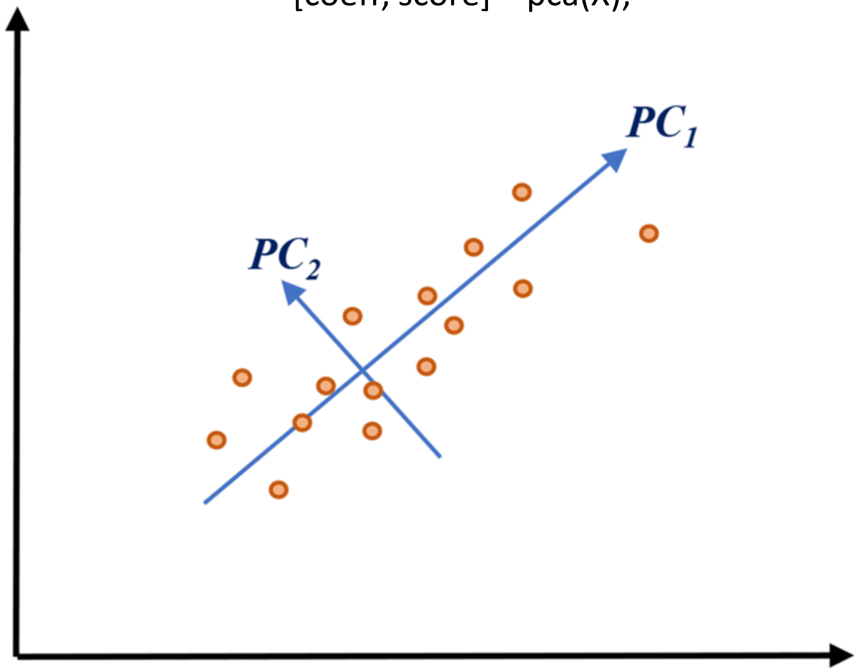
Distance matrix from ODAS $X(x_i, t_j)$

Time $t_0 - t_M$



Transect $x_0 - x_N$

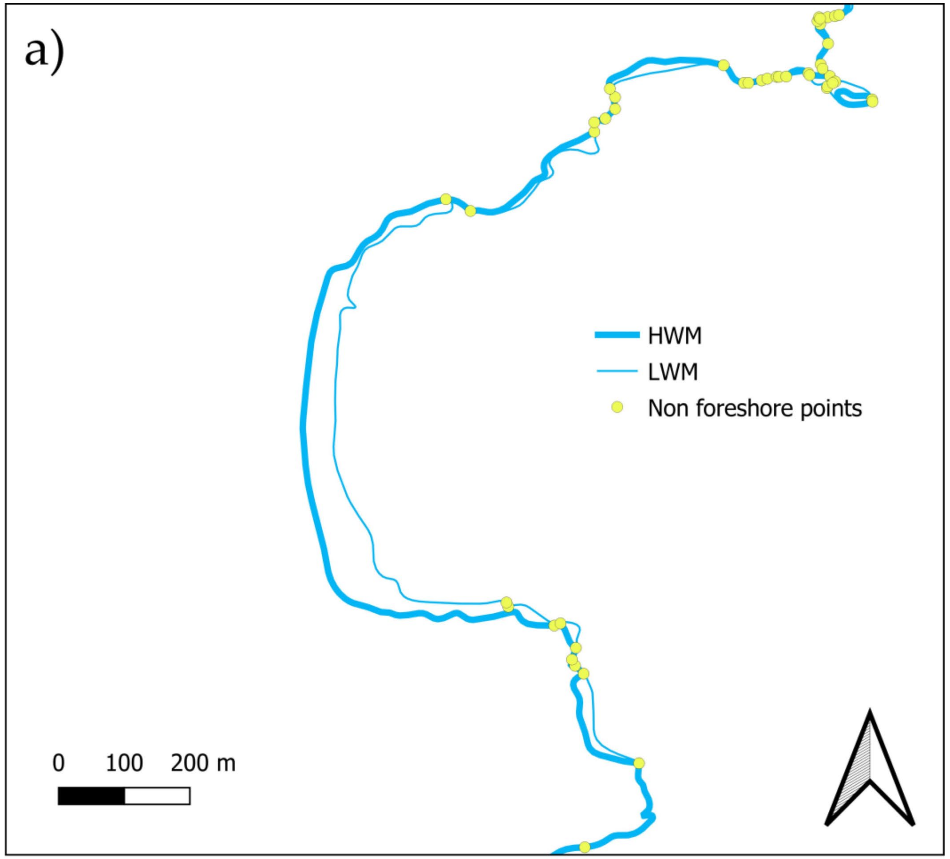
```
[coeff, score] = pca(X);
```

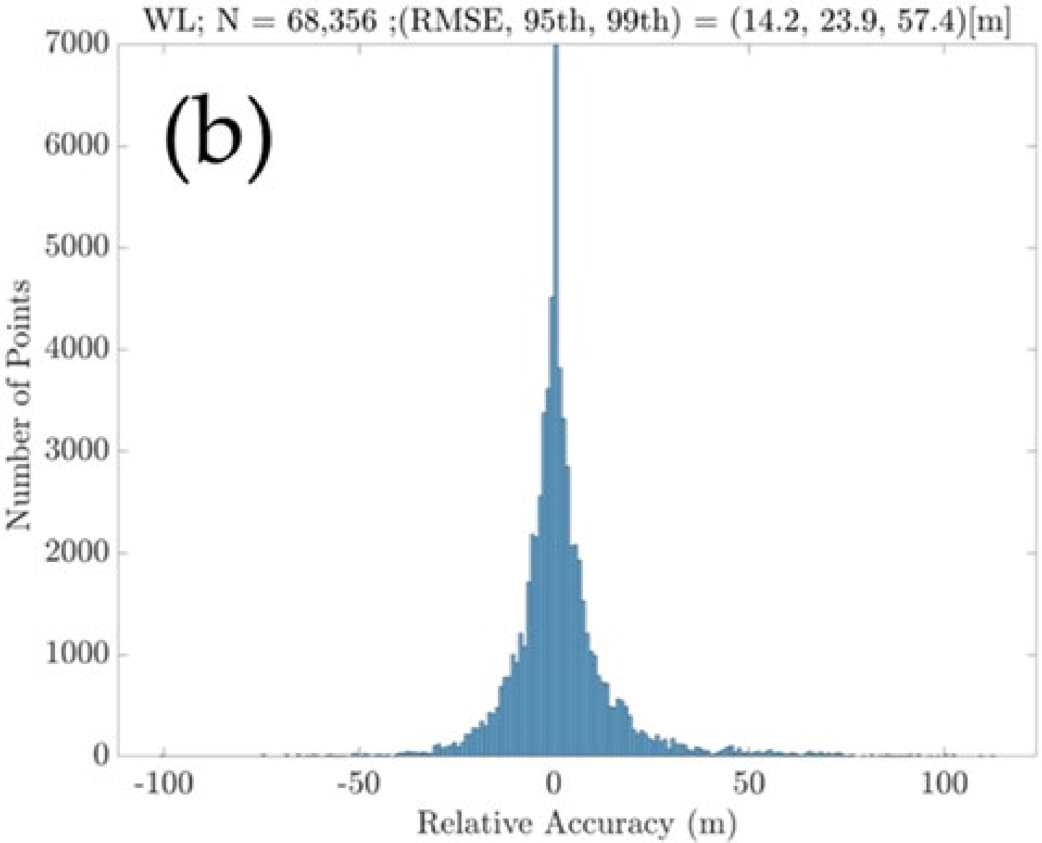


Coeff = contains spatial information (1 x N) for each PC
score = contains temporal information (1 x M) for each PC

Results

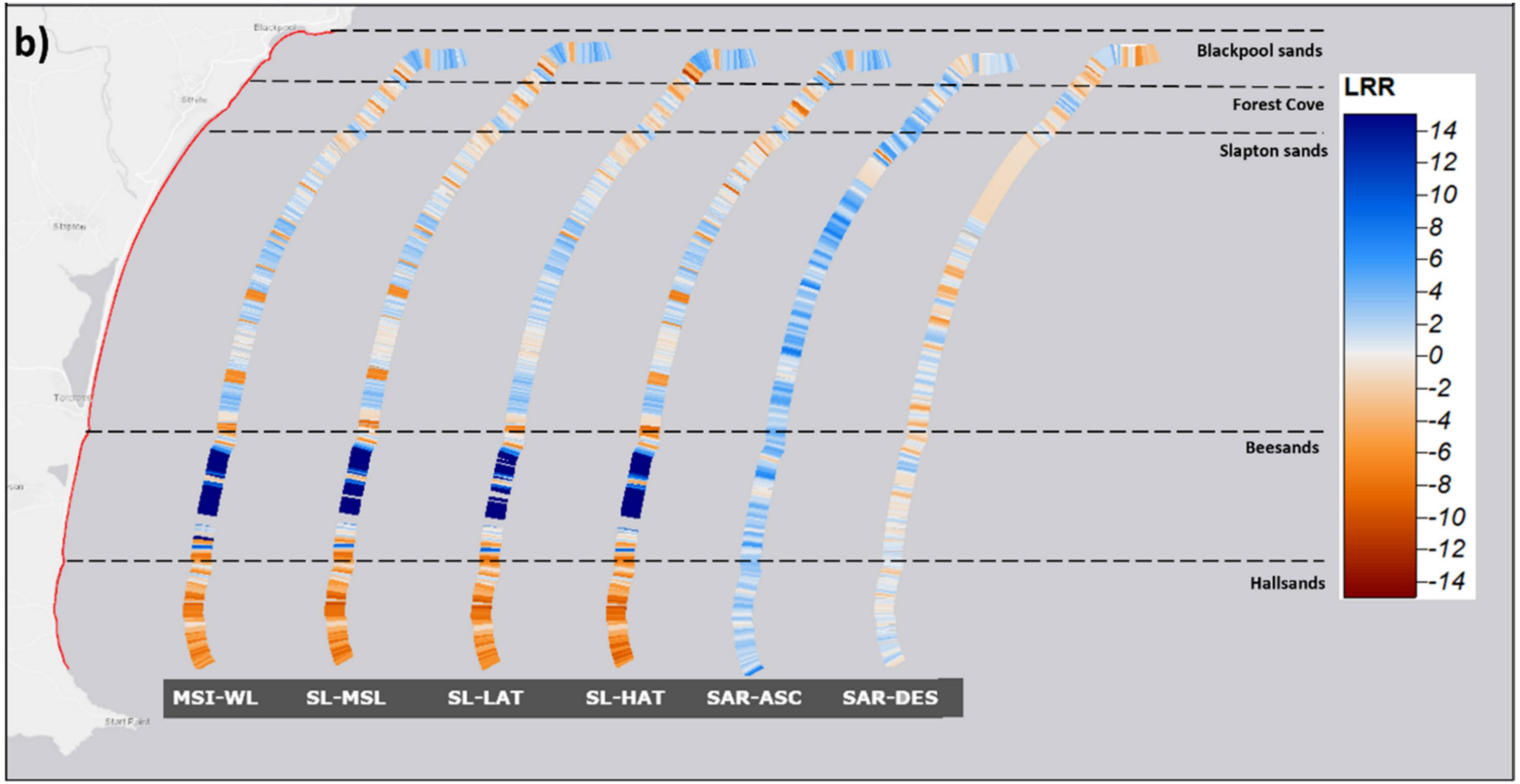
Absolute and relative accuracy of MSI assessed using a new non foreshore method





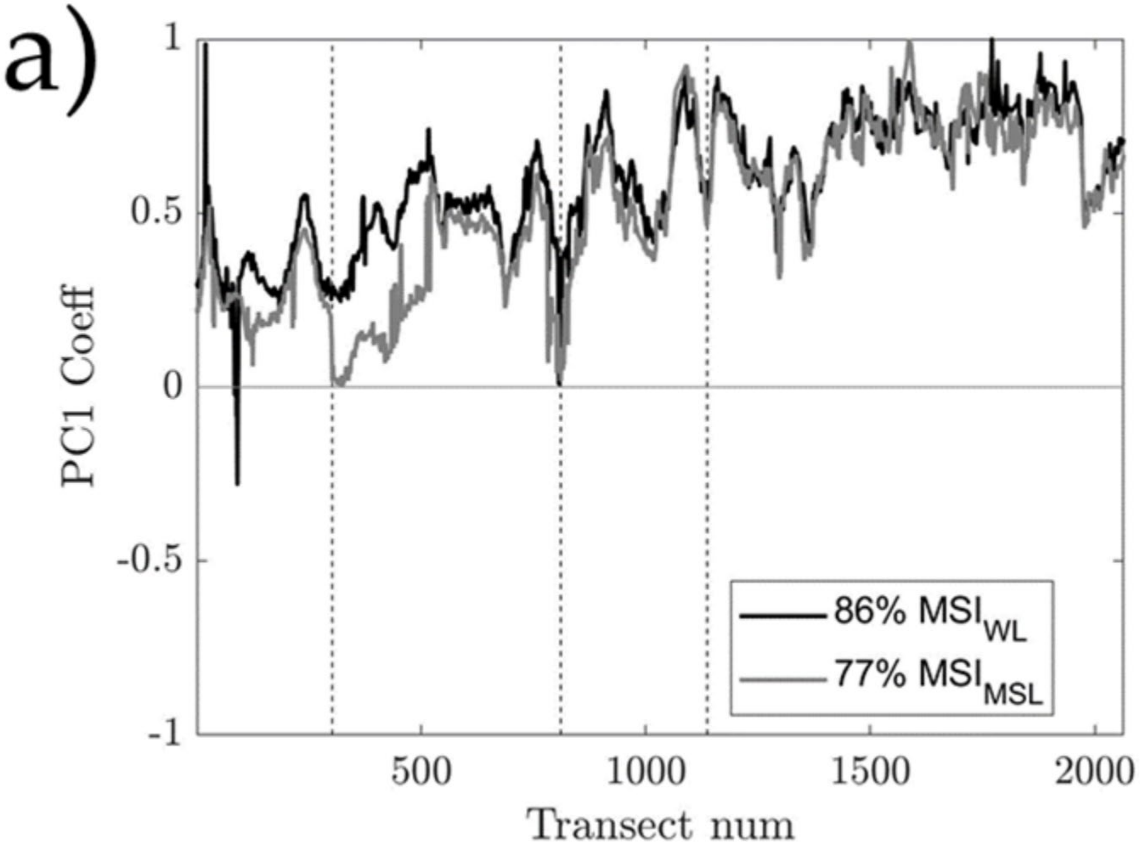
Results

Metrics of change derived rom MSI at Start Bay, where beach rotation is well documented, are not very sensitive to different datum SL but significantly different to results obtained from SAR



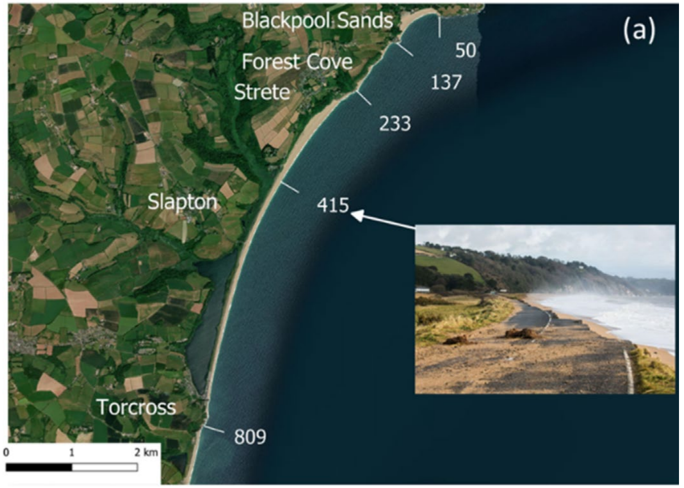
Results

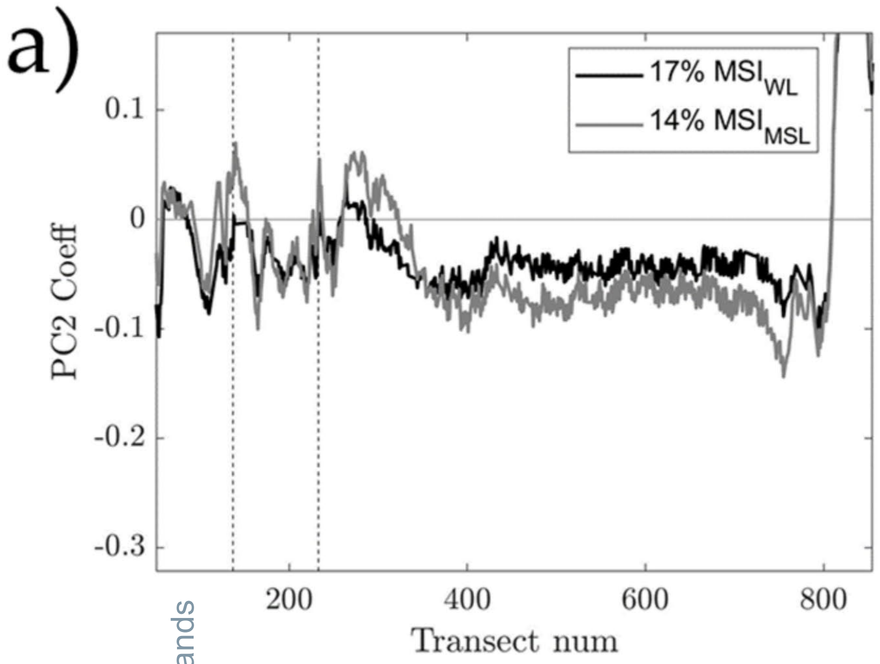
Information on MSI MSL is able to capture the trend of increased erosion from south to north and also hold the line positions



Results

MSI and SAR seems able to capture both the change of slope (PC1) and the rotation of all the embayment (PC2) at Start Bay

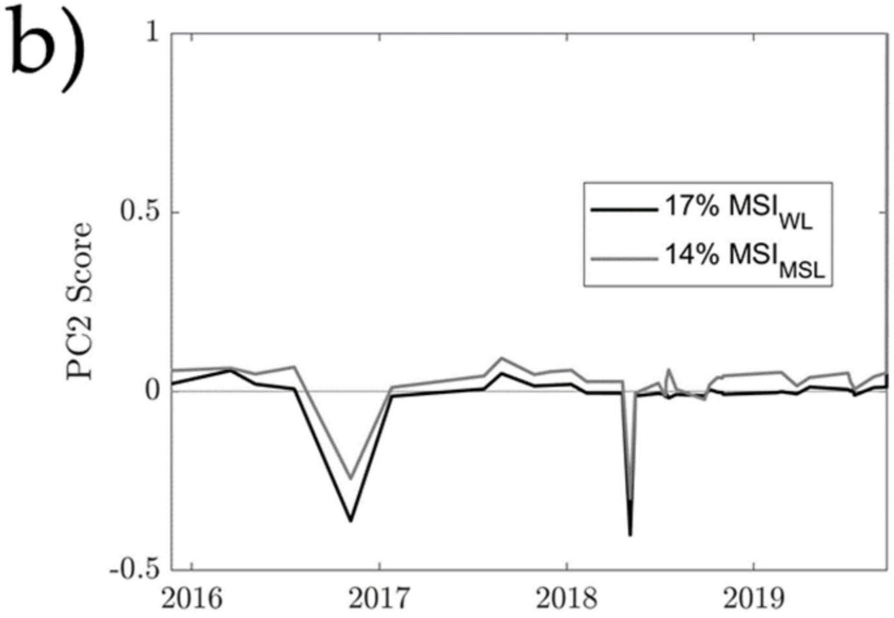




Blackpool Sands

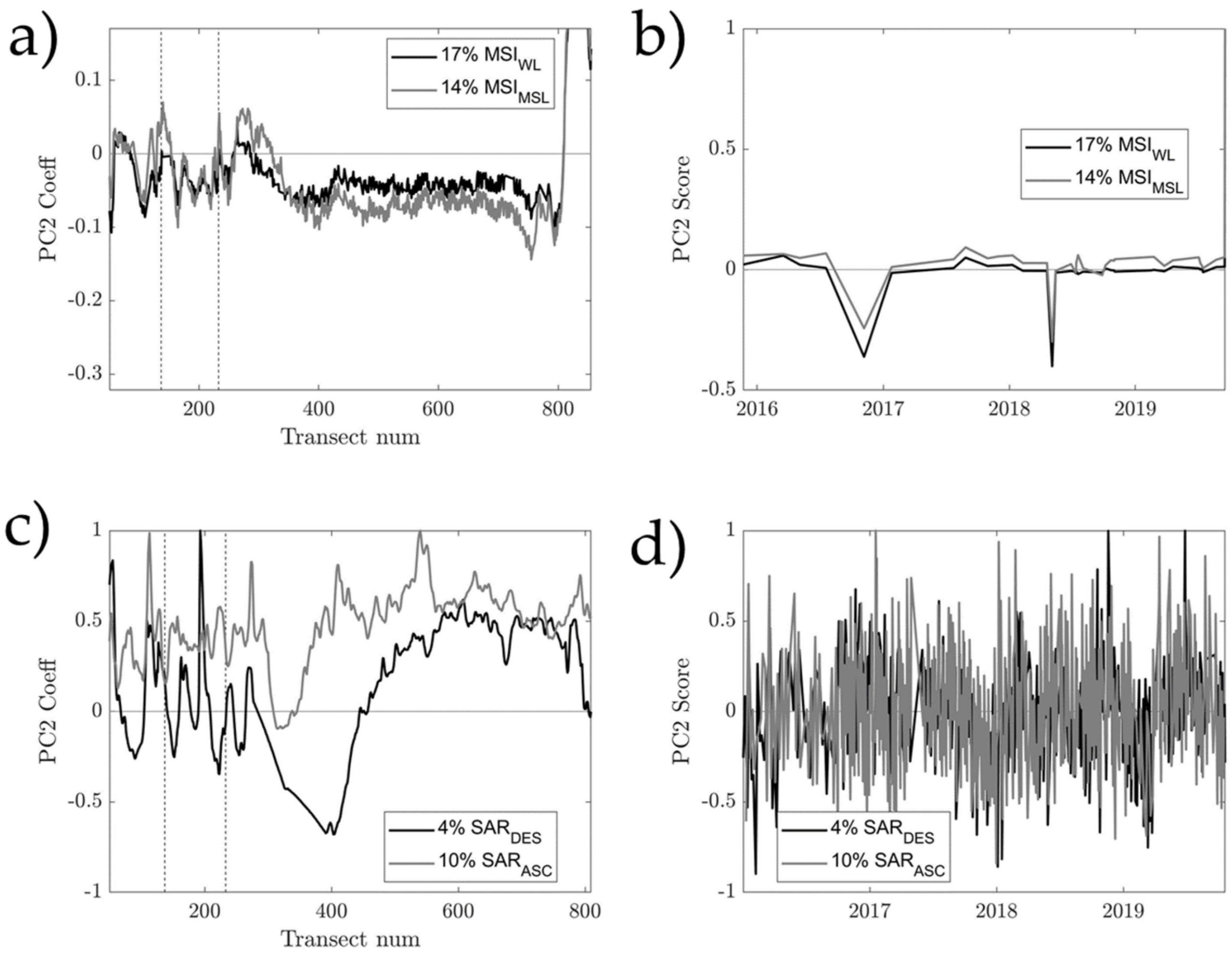
Forest Cove

Slapton



Results

SAR Ascending seems to be capturing rotation at much higher frequency than the optical signal suggests



Lessons learned

1. Mapping accuracies similar to OS VectorMap tidal boundary lines
2. Non-foreshore method suitable for all coastal typologies
3. Explicitly included resolution for transect and baseline in ODSAS
4. Extracted different scales of change from both MSI and SAR using PCA

Next step is mapping coastal change along GB using 38 years of satellite imagery

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