

Table S3. Summary of scientific publications with direct citation of data sources (methods) and tools for shoreline change analysis and detection (1968-2022)

Studies	Location	Aim	Data sources (Methods)	Tools Used	Finding	Research Gaps	Colour cluster (See Figure 7)
[28]	Italy	To evaluate UAV photogrammetric and GNSS techniques to investigate coastal zone morphological changes due to both natural and anthropogenic factors	LiDAR data, Digital Terrain Models (DTMs), orthophotos, UAV (Remote sensing, field survey)	Multiple (Agisoft Metashape Professional Edition 1.5.5, Agisoft LLC, RTKLIB v. 2.4.3 software, QGIS)	Low cost, professional, and commercial UAVs are good tools to produce maps and detect topographical changes	Shoreline mapping techniques and accuracy	Light brown
[43]	Italy	To find a rapid way of identifying the instantaneous shoreline	WorldView-2 (Remote sensing)	Multiple (ERDAS, K-means and ISO-DATA, Active Connections Matrix systems (ACM))	The detection of greater accuracy in the Active Connections Matrix (ACM) algorithms for testing satellite images for shoreline extraction	Reliable methods and data sources for shoreline mapping	Purple
[44]	South Korea	To propose a new methodology for measuring coastline recession	Corona image (Buffering and non-linear least square)	Model- non-linear least square	The buffering and non-linear least square method is more reliable than other methods	Reliable methodologies for estimating coastline recession	Pink
[45]	Tuvalu	To examine the shoreline change of twenty-eight islands in Funafuti Atoll, Tuvalu,	Multiple-QuickBird-2, WorldView-2, WorldView-3, Landsat (Remote sensing)	Multiple (CLASlite	A decrease (0.13%) in net island area	The understanding of island geological	Light green

between 2005 and 2015 using fine spatial resolution satellite imagery, and explores the feasibility of estimating island area with no-cost moderate spatial resolution imagery

software, Terrset-IDRISI)

adjustments to sea-level rise

[66]	Finland	To locate shoreline changes in the Porttipahta Finland water reservoir	Landsat (Remote sensing)	Computer aided analysis	The importance of using digital Landsat data to generate information about environmental changes in reservoir area	The need for more information on Landsat data classification possibilities for future environmental changes studies	Blue
[67]	Australia	To evaluate temporal and spatial bias in the estimation of shoreline rate of change statistics	Beach surveys records (Field survey)	Model-Least square technique	Variations in the trends of short term beach surveys (5year records)	Stability and accuracy of the estimates of shoreline rate-of-change	Blue
[68]	Taiwan	To detect shorelines changes for tideland areas	Satellite- SPOT images, tidal measurements (Remote sensing)	Model-Triangulated Irregular Network	Error of the test sand barriers ranges between 7.6% and 12.5%	Approaches in detecting shoreline changes	Blue
[69]	Brazil	To investigate the influence of Climatic Variations on River Delta Hydrodynamics and Morphodynamics	Multiple- Landsat, field survey (Remote sensing, GIS)	ArcGIS	Most shoreline changes occurring westwards of the delta mouth	Research on river deltaic systems	Blue

[70]	Brazil	To evaluate sedimentary balance and morphological changes	RapidEye images (Remote sensing, GIS)	DSAS	Significant transformation of the natural landscape by anthropic activities	Port terminal and local shoreline change	Blue
[71]	Australia	To quantify the relative influence of SAM, SOI, PDO, and STR variability during both negative and positive IPO phases on shoreline dynamics along the southeast Queensland coast.	Landsat (Remote sensing, GIS)	DSAS	A bimodal climate control on shoreline is dependent on phase of the Interdecadal Pacific Oscillation (IPO)	Shorelines response to future climate extremes	Blue
[72]	Egypt	To analyse the pattern of shoreline changes (beach erosion) in the northwestern Nile delta	Multiple Landsat, aerial photograph (Remote sensing)	IDRISI	The detection of long-shore designs of beach erosion and accretion	The need for the study of rates of shoreline changes and transport direction to develop predictive models	Red
[73]	Canada	To analyse the spatial and temporal variability of shoreline change in the Beaufort-Mackenzie region of Canada	Multiple-Aerial photographs, GPS survey (A soft-copy photogrammetric system)	GRASS	The dominance of shoreline retreat with mean annual retreat rate of -0.6m/yr	Exploration of hydrocarbons and coastal change	Brown
[74]	U.S.A	To quantify shoreline change and coastal erosion rates	Aerial photograph (GIS)	Multiple (ArcMap, DSAS)	Annual average erosion rates of 5.6m/yr from 1955 to 2002	Historical site and infrastructure lost prediction from modern erosion rates measurement	Brown

[75]	Spain	To achieve a better understanding of artificial embayed beach morphodynamics using shoreline position and beach area data from three beaches in Barcelona City	Argus video system, dGPS survey (Field survey)	Intertidal Beach Mapper software	A general retreating trend with displacements of the shorelines which resulted from the oblique wave incidence during strong storm phenomena	Parameters involved in the determination of beach rotation	Green
[76]	France	To develop a methodology based on the baseline approach for measuring the coastline retreat/advance around Hardelot-Plage and Sainte Ce'cile-Plage, in the north of France.	Multiple- Aerial photo- graphs, GPS surveys (GIS, field survey)	Multiple (ArcGIS, DSAS)	The identification of retreat (82%) in shorelines between 1947 and 2005	Methodologies for measuring coastline retreat/advance	Pink
[77]	France	To analyse variations in the position of the coastline and variations in sediment volumes in the coastal dunes and on the beach	LiDAR data (Remote sensing)	Surfer® software	Significant declines in shorelines	The determination of the variations in the sediment balance in the littoral zone of Nord-Pas de Calais and a precise knowledge of coastal sediment stocks and their role in the stability of the coastline	Pink

[78]	France	To examine the formation of a large embryonic dune field	Multiple- Aerial photo-graphs, topographical maps, LiDAR data, field survey (Field survey)	Golden Software Surfer™	The advancement of the sea towards the coast since the 16th century	The morphology of incipient/ embryonic fore-dunes	Pink
[79]	China	To analyse the characteristics of coastline changes in mainland China	Multiple- Topographic maps, Landsat, GPS survey (Remote sensing, GIS, field survey)	ArcGIS	The dramatic change in the coastline structure of mainland China because of coastline artificialization caused by sea reclamation and coastal engineering	The need for urgent integrated management, effective environment protection and sustainable utilization of coastlines	Light blue
[80]	Poland	To describe an application of a low-cost tailless fixed-wing UAV for inland lake shoreline	Multiple- UAV, geodetic total station, RTK/GNSS survey, hydroacoustic soundings, aerial mapping (Remote sensing, GIS, field survey)	ArcGIS	Low cost UAV is an excellent tool for estimating shallow changes in lake shorelines	Reliable UAV systems for coastal water environment research	Purple
[86]	Poland	To evaluate the use of the data in the creation of electronic databases of navigational maps	Multiple- sonar and photogrammetric images, UAV, orthophotos, GNSS-RTK (Remote sensing, GIS, field survey)	Multiple (ArcGIS/ArcMap, DSAS, Pix4D software)	Best results obtained from the product of the UAV flight	Shoreline mapping accuracy and problems	Purple
[87]	Armenia	To examine the possibilities, specific features, and applications of UAV-based environmental monitoring of Lake Sevan's coastal zone	Multiple- Landsat, web-services Yandex.Maps, Google Maps, BingMaps, ArcGIS.Imagery, UAV-aerial photograph (Remote sensing, GIS, field survey)	Multiple(ArcGIS, SAGA (System of Automated Geoscientific Analyses), algorithm-	Areas and objects at risk of flooding under the projected water level rise to 1903.5 m along the west coasts of Minor Sevan	UAV surveys as a necessary intermediary between ground data and satellite imagery with different spatial resolutions for the complex	Light brown

					Support Vector Machine (SVM)				environmental monitor- ing of the coastal area and water body	
[91]	Malaysia	To utilize the Canny edge de- tection algorithm with velocity bunching model to simulate the rate change of shoreline from historical multi- SAR data (ERS-1 and RADARSAT-1 SAR data)	Multiple- SAR- ERS-1, RA- DARSAT-1, in situ measure- ments (Remote sensing)	Multiple (Algo- rithm-Canny, ve- locity bunching model- Kappa sta- tistic)	Shoreline change rate modelled from the quasi-linear wave spectra model has a significant re- lationship with one mod- elled from historical vector layers of aerial photography and SAR data			SAR utilization for shore- line change modelling	Red	
[92]	Mexico	To investigate the relation be- tween shoreline change, reefs’ geometry and hydrodynamic parameters to elucidate the physics related to how the Mes- oamerican Reef in Mexico pro- tects sandy coastlines from ero- sion	Google Earth Pro imagery, satellite images (Remote sensing, GIS)	Multiple (ArcMap, Models- Wave Propagation model, WA- VEWATCH-III model)	Reefs with shallow crests and wide flats provide the most remarkable effi- cacy in preventing beach erosion			Insights for reef restora- tion projects focused on erosion mitigation and designing artificial reefs in mi- crotidal sandy beaches	Green	