

Eine multifunktionale Küstenklassifikation zur Beurteilung der Auswirkungen von Klimaänderungen auf die Küste

K. Ahrendt, Büro für Umwelt und Küste, Kiel

A. Scalise, Rosario, Argentinien

H. Sterr, Geographisches Inst. Uni. Kiel

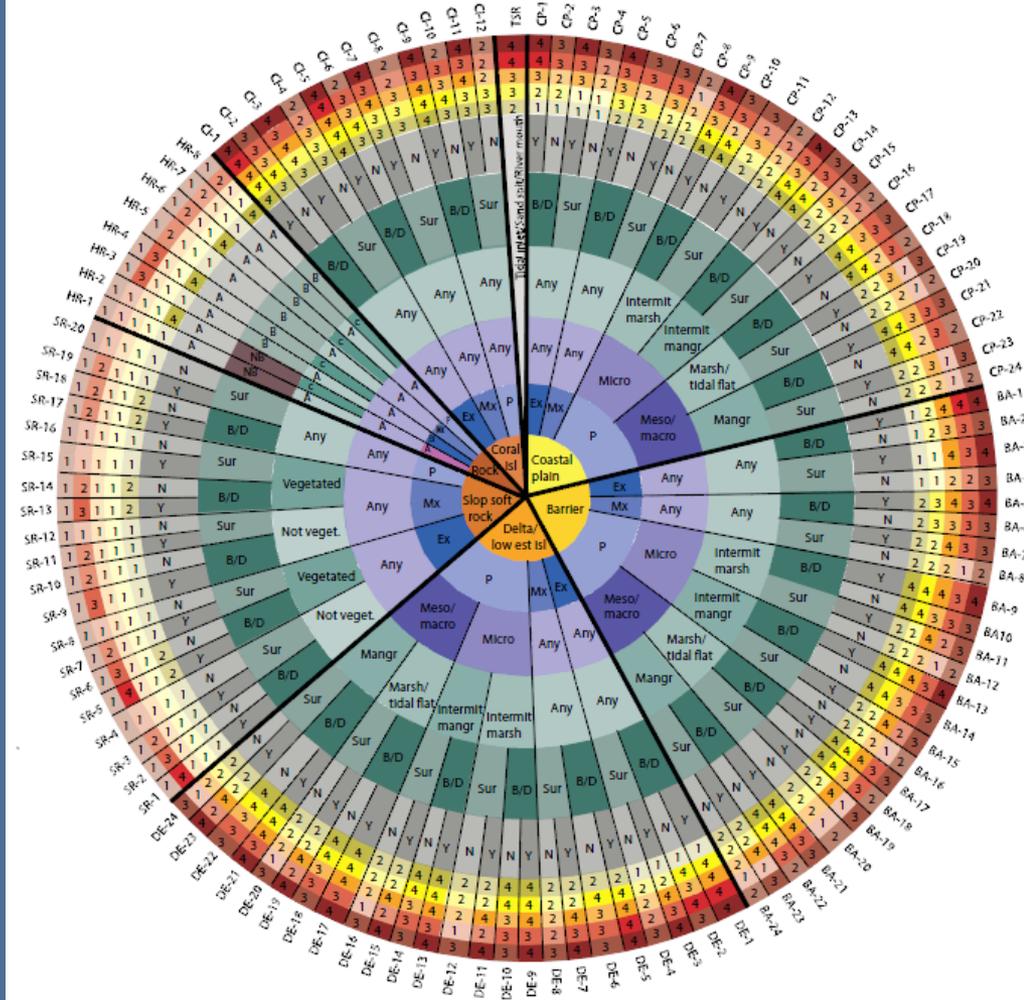
A. Vafeidis, Geographisches Inst. Uni. Kiel

Ausgangslage:

- Unterschiedliche Küstenklassifikationen für unterschiedliche Fragestellungen
- Z. B. geologische, geomorphologische etc.
- Hydrologische (tidal range, hazard index, Ω)
- Biotische
- Sozio-ökonomische

The Coastal Hazard Wheel

Ref.: Lars Rosendahl Appelquist, Generic framework for meso-scale assessment of climate change hazards in coastal environments, Journal of Coastal Conservation, Planning and Management, 2012. Available online at www.springerlink.com



COASTAL CLASSIFICATION (start in wheel center)

Geological layout
 Wave exposure
 Tidal range
 Flora/fauna
 Sediment balance
 Storm climate

■ Ex Exposed
■ Mx Moderately exposed
■ P Protected
■ P Protected
■ B/D Balance/deficit
■ Sur Surplus
■ B Beach
■ NB No Beach
■ Y Yes to tropical cyclone activity
■ N No to tropical cyclone activity

Note: A=Any; C=Coral

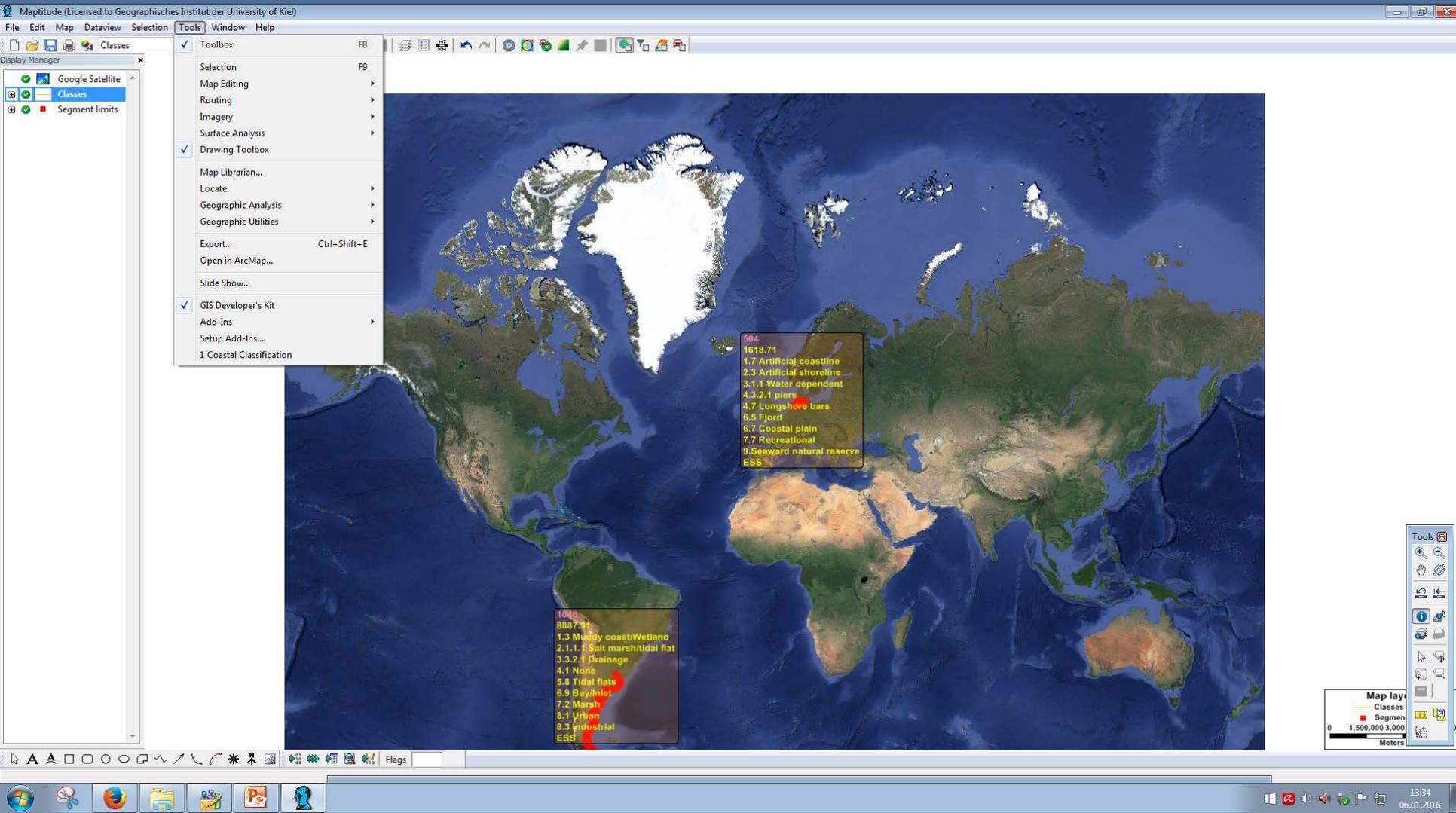
INHERENT HAZARD LEVEL

Ecosystem disruption
 Gradual inundation
 Salt water intrusion
 Erosion
 Flooding

Low	1	2	3	4
Moderate	1	2	3	4
High	1	2	3	4
Very High	1	2	3	4

Probleme:

- Keine fächerübergreifende Klassifikation
- Keine Klassifikation die die Reaktion des Systems auf den Klimawandel berücksichtigt



Drei grundlegende Schritte:

- Einteilung der Küste in Segmente +/- gleicher Struktur
- Erfassung der bestimmenden Naturraumelemente sowie der sozio-ökonomischen Bedingungen für jedes Segment
- Ermittlung und Bewertung der Ecosystem Services (ESS)

10 Kategorien für die Segmente:

- DOMINANT FEATURE
- SUBSTRATE
- DOMINANT MANMADE FEATURES
- ADDITIONAL MANMADE FEATURES
- NEARSHORE ENVIRONMENT
- SEAWARD ENVIRONMENT
- LANDWARD ENVIRONMENT
- PREDOMINANT LAND USE
- OTHER LAND USE
- ECOSYSTEM SERVICES (ESS)

Beispiel: DOMINANT FEATURE

1 Beach and dunes

2 Beach

3 Muddy coast/Wetland

4 Spit/beach ridge

5 Cliffs

5.1 Soft Cliff

5.2 Rocky Cliff

6 Barrier island

7 Artificial coastline

8 Montaineous coast

9 Reef/Atoll

10 Estuary, Rivermouth, Delta

99 Other

Beispiel: SUBSTRATE

1 SOFT COASTLINE

1.1 Muddy

1.1.1 Salt marsh/tidal flat

1.1.2 Marshes

1.1.3 Mangroves

1.1.4 Swamps

1.1.5 Sabkha

1.1.6 Chenier

1.1.7 Veneer

1.1.8 Other muddy

1.2 Clastic sediments

1.2.1 Compact sediment

1.2.1.1 Soft cliff

1.2.1.2 Beachrock

1.2.2 Loose sediment

1.2.2.1 Beach Gravel

1.2.2.2 Beach Sand

1.2.2.3 Mixed sand/gravel

1.2.2.4 Dunes

1.2.2.5 Stones and rocks

1.2.2.6 Dune cliff

1.2.9 Other Clastic

1.2.3 Soft artificial shoreline

2 HARD COASTLINE

2.1 Rocky Cliff

2.1.1 Vertical

2.1.2 Inclined

2.2 Abrasion platforms

2.3 Mountain slope

2.4 Uplifted/fossil platform

2.5 Other hard coast

2.6 Biologic concretions

2.6.1 Coral reef

2.6.2 Bivalves concretions

2.7 Permafrost

3 Artificial shoreline

3.1 Hard

3.2 Soft (nourishment/biotechnic)

Beispiel: DOMINANT MANMADE FEATURES

1 Economically functional structures

1.1 Water dependent

1.1 Non water dependent

2 Canalization structures

3 Coastal protection structures

3.1 Parallel to the shoreline

3.1.1 Seawall/promenade/steal piling

3.1.2 Revetment

3.1.3 Rip rap

3.1.4 Dike

3.1.5 Artificial reef/breakwaters

3.1.6 Road and bridge structures

3.1.7 Surge Barrier

99 Other

3.2 Perpendicular to the shoreline

3.2.1 Groins

3.2.1 Jetties

3.2.1 Drainage

3.2.1 piers

3.2.1 Slips

3.2.1 Road and bridge structures

99 Other

4 Residential and urban infrastructure

5 Nourished/Artificial beach

6 No artificial structures present

7 Land reclamation structures

99 Other type of artificial structure

Beispiel: NEARSHORE ENVIRONMENT

- 1 Lagoon
- 2 Stream mouth
- 3 Spit
- 4 Stream
- 5 Bay/Inlet/Gulf
- 6 Shoal
- 7 Longshore bars
- 8 Tidal flats
- 9 Mangroves
- 10 Coral reefs
- 11 Marshes
- 12 Rocky platform
- 13 Continuous slope
steep slope
- 14 Land reclamation structures
- 15 Breakwaters
- 99 Other

Beispiel: PREDOMINANT LAND USE

1 Urban

2 Rural (includes forestry and agriculture)

3 Industrial

4 Transport

5 Scattered settlement (villages)

6 Nature Reserve

Landward natural reserve

Seaward natural reserve

Landward and seaward natural reserve

7 Recreational

8 Military

8 None

99 Other

Beispiel: Ecosystem Service (ESS)

ESS Provisioning

ESS Regulating

ESS Cultural

1 low

2 medium

3 high

4 very high

9 none

ESS Auswahl und Ergänzung

Provisioning Services

P1: Food; products derived from plants, animals and microbes

P2: Fiber; wood, jute, cotton, hemp, silk, and wool, materials serve as sources of energy

P3: Genetic resources; genes and genetic information used for animal and plant breeding and biotechnology, bio-chemicals, natural medicines, and pharmaceuticals

P4: Mineral resources (Sand, gravel, stones etc.), Wave- and/or Thermo energy

Regulating Services

R1: Climate regulation; climate both locally and globally

R2: Water regulation; timing and magnitude of runoff, flooding, and aquifer recharge

R3: Erosion regulation; Vegetative cover plays an important role in soil retention and the prevention of landslides

R4: Water purification and waste treatment; source of impurities but also can help filter out and decompose organic wastes

R5: Natural hazard; such as mangroves and coral reefs can reduce the damage caused by hurricanes or large waves, longshore bars, active cliffs, Erosions-platform (tilt ridge), pebble, stones (on beach and foreshore), beach ridge, spit, beach wrack etc.

Cultural Services

C1: Aesthetic values; beauty or aesthetic value in various aspects of ecosystems

C2: Cultural heritage values; Many societies place high value on the maintenance of either historically important landscapes (“cultural landscapes”) or culturally significant species

C3: Recreation and ecotourism; spend leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area (bathing, diving, angling, sailing etc.)

Startmaske

Coastal Classifications V 3.0

	DOMINANT FEATUI	SUBSTRATE	DOMINANT MANMA	ADDITIONAL MANN	NEARSHORE ENVIRC	SEAWARD ENVIRON	LANDWARD ENVIRC	PREDOMINANT LAI	OTHER LAND USE	ESS
364	1.5.1 Soft Cliff	2.1.2.2.3 Mixed sand	3.6 No artificial struc	4.1 None	5.7 Longshore bars	6.1 Open sea	7.inactive cliff	8.2 Rural (includes fc	9.7 Recreational	ESS
1784										ESS
366	1.3 Muddy coast/Wc	2.1.1.1 Salt marsh/tic	3.3.1.4 Dike	4.7 Land reclamator	5.8 Tidal flats	6.Wadden Sea/Wetle	7.2 Marsh	8.Landward and sea	9.2 Rural (includes fc	ESS

Zoom to record Zoom 10k Zoom 20k Zoom 50k Show Images Hide Hide Label From Above From Below Save Reload Cancel Go ESS

Schritt eins: Segmentierung

Map Editing

Curves

	DOMINANT FEATU	SUBSTRATE	DOMINAT MANMA	ADDITIONAL MANN	NEARSHORE ENVIR	SEAWARD ENVIRON	LANDWARD ENVIRC	PREDOMINANT LAI	OTHER LAND USE	ESS
364	1.5.1 Soft Cliff	2.1.2.2.3 Mixed sand.	3.6 No artificial struc	4.1 None	5.7 Longshore bars	6.1 Open sea	7.inactive cliff	8.2 Rural (includes fc	9.7 Recreational	ESS
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Map Layers

Classes

Segments

Meters

Schritt zwei: Klassifizierung

Mapitude (Licensed to Geographisches Institut der University of Kiel) - [ClassificationMap.map - Classes]

File Edit Map Dataview Selection Tools Window Help

Display Manager

- Google Satellite
- Classes
- Segment limits

Map Editing

- Curves

DOMINANT MANMADE FEATURES

- 3.1 Economically functional structures
 - 3.1.1 Water dependent
 - 3.1.1 Non water dependent
- 3.2 Canalization structures
- 3.3 Coastal protection structures
 - 3.3.1 Parallel to the shoreline
 - 3.3.1.1 Seawall/promenade/steal piling
 - 3.3.1.2 Revetment
 - 3.3.1.3 Rip rap
 - 3.3.1.4 Dike
 - 3.3.1.5 Artificial reef/breakwaters
 - 3.3.1.6 Road and bridge structures
 - 3.3.1.7 Surge Barrier
 - 3.3.2 Perpendicular to the shoreline
 - 3.3.2.1 Groins
 - 3.3.2.1 Jetties
 - 3.3.2.1 Drainage
 - 3.3.2.1 piers
 - 3.3.2.1 Slips
 - 3.3.2.1 Road and bridge structures
 - 3.3.2.1 Other
 - 3.4 Residential and urban infrastructure
 - 3.5 Nourished/Artificial beach
 - 3.6 No artificial structures present
 - 3.7 Land reclamation structures
 - 3.9 Other type of artificial structure

Coastal Classifications V 3.0

	DOMINANT FEATUI	SUBSTRATE	NEARSHORE ENVIR	SEAWARD ENVIRON	LANDWARD ENVIRC	PREDOMINANT LAN	OTHER LAND USE	ESS
448	1.2 Beach	2.1.2.2.3 Mixed sand	5.7 Longshore bars	6.1 Open sea	7.7 Coastal plain	8.2 Rural (includes fo	9.Seaward natural re	ESS
449	1.7 Artificial coastlin	2.1.2.2.2 Beach Sand	5.7 Longshore bars	6.1 Open sea	7.7 Coastal plain	8.7 Recreational	9.Seaward natural re	ESS
450	1.4 Spit/beach ridge	2.1.2.2.2 Beach Sand	5.7 Longshore bars	6.1 Open sea	7.9 Lagoon	8.Landward and sea	9.7 Recreational	ESS

Zoom to record Zoom 10k Zoom 20k Zoom 50k Show Images Hide Hide Label From Above From Below Save Reload Cancel 450 Go ESS

Map scale: 1 Centimeter = 200 Meters (1:20,000) (10.275764, 54.411026)

15:11 06.01.2016

Schritt drei: Ermittlung der ESS

450
3877.10
1.4 Spit/beach ridge
2.1.2.2.2 Beach Sand
3.6 No artificial structures present

4.3.1.1 Seawallpromenade
5.1 Longshore bars
6.2 Spit
7.2 Marsh
8.7 Recreational
9.2 Rural (includes forestry and agriculture)

454
1154.8
1.7 Artificial coastlines
2.1.2.2 Beach Sand
3.3.1.4 Beach Sand
4.3.2.1 Beach Sand
5.7 Longshore bars
6.1 Open sea
7.7 Coastal plain
8.7 Recreational
9. Seaward natural reserve
ESS

780
1414.53
1.5.1 Soft Cliff
2.1.2.2.3 Mixed sand/gravel
3.6 No artificial structures present
4.1 None
5.7 Longshore bars
6.1 Open sea
7. Active soft cliff
8.7 Recreational
9. Seaward natural reserve
ESS

ESS for record: 448

DF:1.2 Beach

ST: 2.1.2.2.3 Mixed sand/gravel

NSE: 5.7 Longshore bars

LE: 7.7 Coastal plain

Provisioning

Food

Fiber

Genetic

Mineral

Regulation

Climate

Water Reg.

Water Purif.

Erosion Reg.

Nat Haz Reg.

Culture

Cult. Aest. V

Cult. Heritg.

Cult. Rec.

Coastal Classifications V 3.0

	DOMINANT FEATURE	SUBSTRATE	DC
448	1.2 Beach	2.1.2.2.3 Mixed sand	3.6
449	1.7 Artificial coastline	2.1.2.2.2 Beach Sand	3.3
450	1.4 Spit/beach ridge	2.1.2.2.2 Beach Sand	3.6

ESS

10.Edit

ESS

ESS

Zoom to record Zoom 10k Zoom 20k Zoom 50k Show Images Hide Hide Label From Above From Below Save Reload Cancel 450 Go ESS

Hilfreich: Images

453
1218.03
1.4 Spit/t
2.1.2.2.2
3.3.2.1 G
4.1 None
5.7 Long
6.1 Open
7.9 Lago
8.7 Rechr
9.9 None
ESS

378
1187.03
1.2 Beach
2.1.2.2.2 Beach Sand
3.3.1.1 Seawall/promenade
4.3.2.1 Groins
5.7 Longshore bars
6.5 Fjord
7.7 Coastal plain
8.7 Recreational

454
754.09
1.7 Artificial coastline
2.3 ARTIFICIAL SHORELINE
3.1.1 Water dependent
4.3.1.4 Dike
5.3 Spit
6.4 G

1154.85
1.7 Artificial coastline

780

Dominant
Substrate
ManMade
SeaWardEnv
LandWardEnv
HumandDev

Prev Segment
Next Segment

(11 of 13) : "Stakendorfer Strand"
Previous Next cancel

Dataview1 - Classes Info

ID	Value
ID	780
Length	1414.53
Dir	0
DominantForm	1.5.1 Soft Cliff
Substrate1	2.1.2.2.3 Mixed sand/gravel
Substrate2	3.6 No artificial structures present
MandMadeShoreline	4.1 None
SeawardSetting1	5.7 Longshore bars
SeawardSetting2	6.1 Open sea
LandwardSetting	7.Active soft cliff
LandUse1	8.7 Recreational
LandUse2	9.Seaward natural reserve
Simplified	
ESS	ESS
ESSProvisioninng	
ESSCultural	
ESSRegulation	
DF_prov_food	..
DF_prov_fiber	..
DF_prov_genetic	..
DF_prov_mineral	..
DF_reg_climate	..
DF_reg_water_reg	..

Coastal Classifications V.3.0

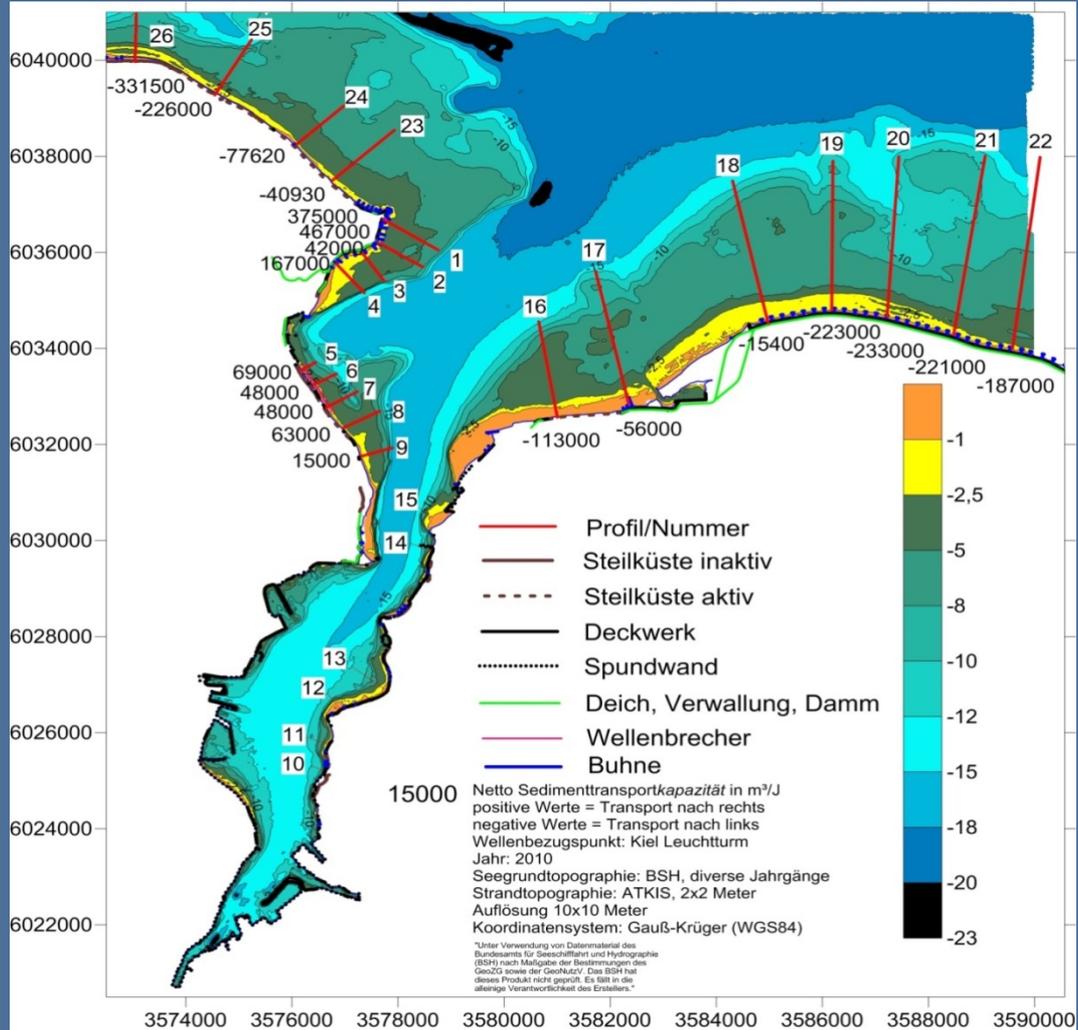
	DOMINANT FEATU	SUBSTRATE	DOMINAT MANMA	ADDITIONAL MAN	NEARSHORE ENVIR	SEAWARD ENVIRON	LANDWARD ENVIRC	PREDOMINANT LAI	OTHER LAND USE	ESS
778	1.7 Artificial coastlin	2.1.2.2.2 Beach Sand	3.3.1.2 Revetment	4.3.2.1 Groins	5.7 Longshore bars	6.5 Fjord	7.1 Dunes	8.7 Recreational	9.2 Rural (includes fc	ESS
1786										ESS
780	1.5.1 Soft Cliff	2.1.2.2.3 Mixed sand,	3.6 No artificial struc	4.1 None	5.7 Longshore bars	6.1 Open sea	7.Active soft cliff	8.7 Recreational	9.Seaward natural re	ESS

Zoom to record Zoom 10k Zoom 20k Zoom 50k Show Images Hide Hide Label From Above From Below Save Reload Cancel 780 Go ESS

Map layer
Classes

Weitere Schritte:

- Clusterung der Segmente im Ist-Zustand
- Szenarien über die Auswirkungen der Klimaänderungen im Jahre 2050 und 2100
- Szenarien für Landnutzung im Jahre 2050 und 2100 (demograph. Entwicklung)
- Abschätzung der ESS im Jahre 2050 und 2100 basierend auf den Szenarien
- Clusterung der Segmente für die Jahre 2050 und 2100
- Erstellung eines Vulnerabilitätsindex
- Ableitung von Managementplänen, Prioritätenliste
- (Erweiterung um Ergebnisse aus HN-Modellierungen, Sedimenttransport, Sedimentverfügbarkeit an sandigen Küsten etc.)



Ich danke für Ihre Aufmerksamkeit