



Coastal Protection in Mecklenburg-Western Pomerania, Germany

Frank Weichbrodt



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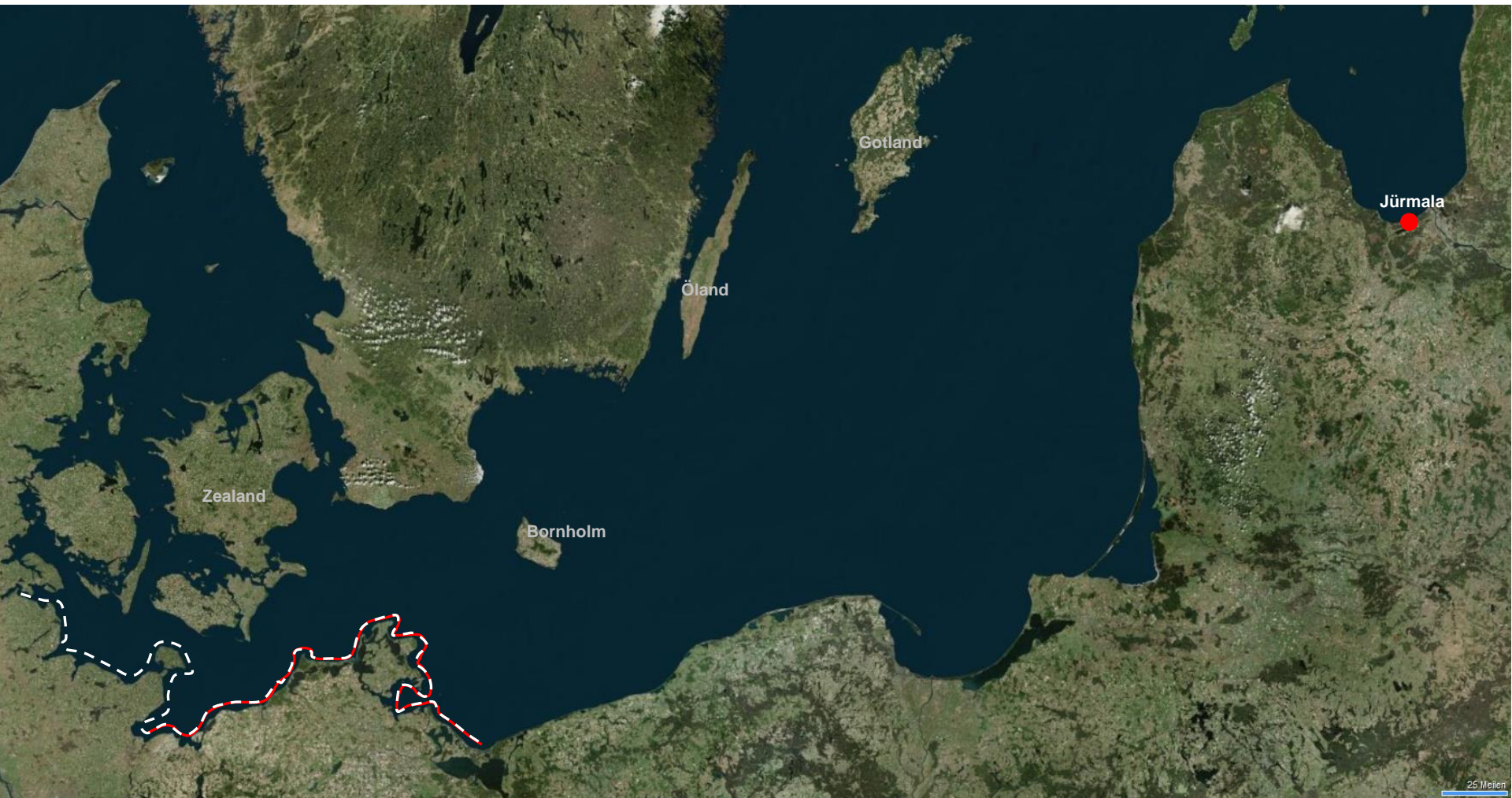
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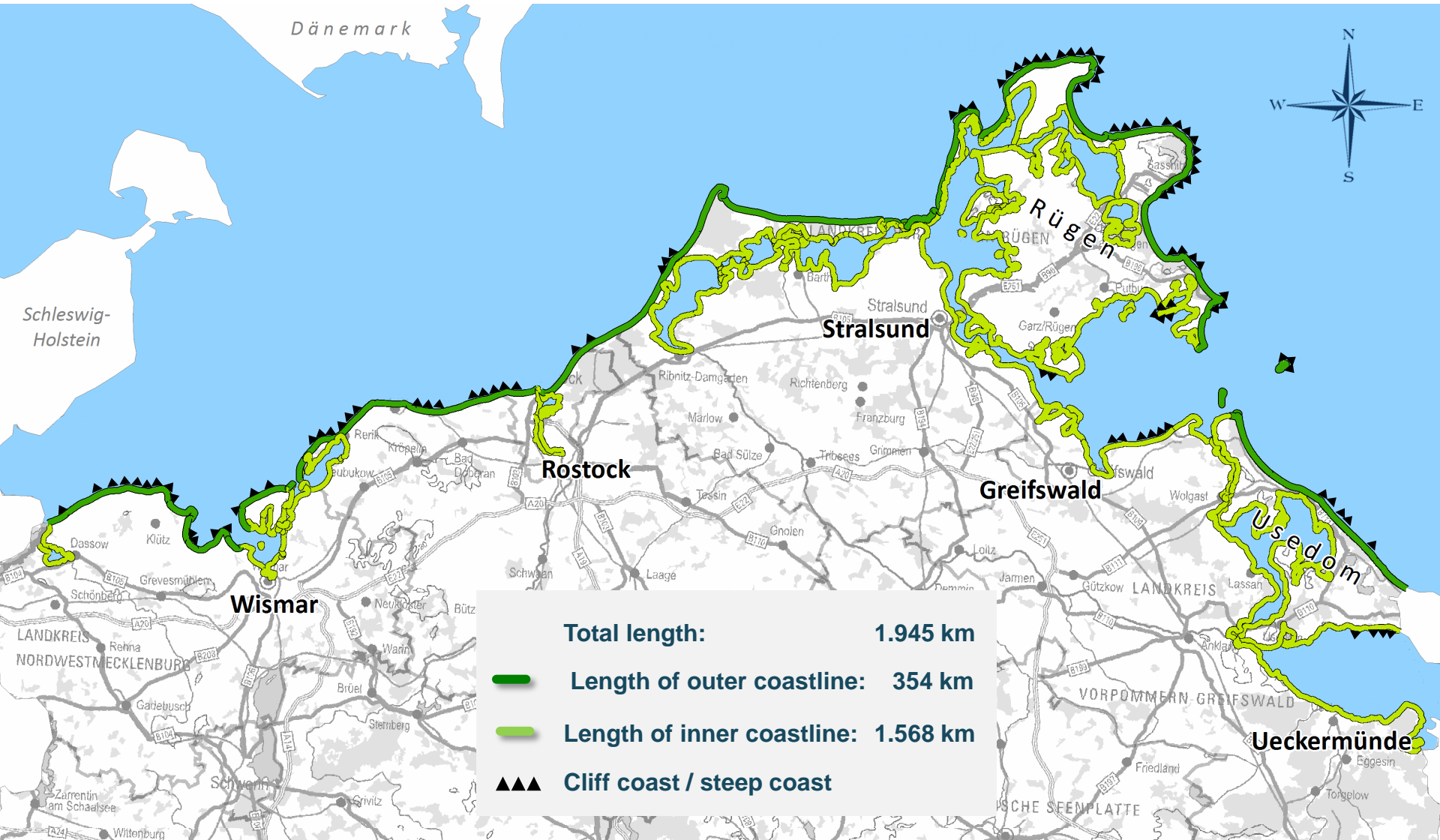
- I. The coast of Mecklenburg-Western Pomerania
- II. Coastal protection strategy and measures
 - Strategy at steep/shallow coasts
 - Water level fluctuation, waves and sea level rise
 - Coastal protection structures and beach nourishment
- III. Consideration of the requirements of inhabitants and tourists
(Organisation and financing of coastal protection; flood risk management)



The coast of Mecklenburg-Western Pomerania



The coast of Mecklenburg-Western Pomerania

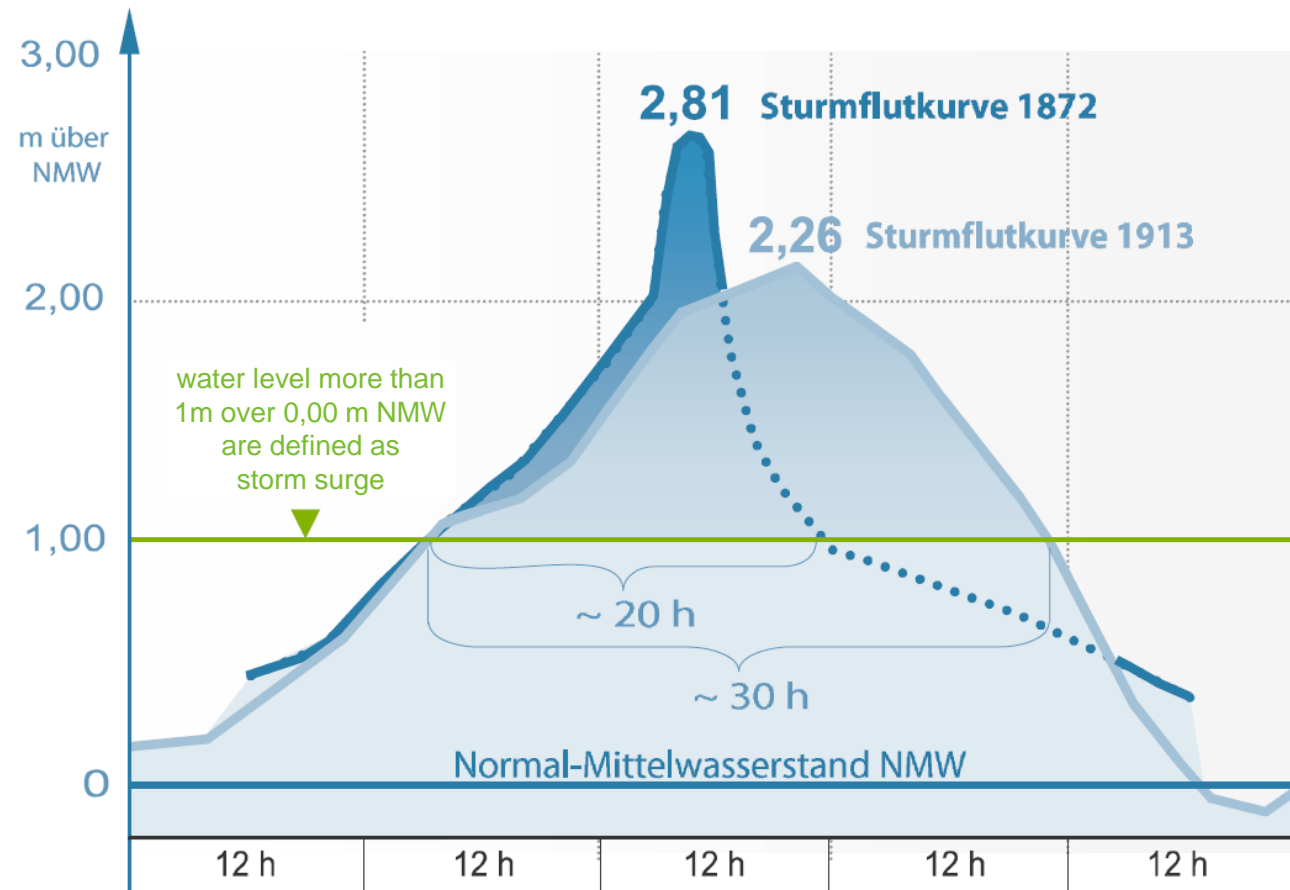


The coast of Mecklenburg-Western Pomerania



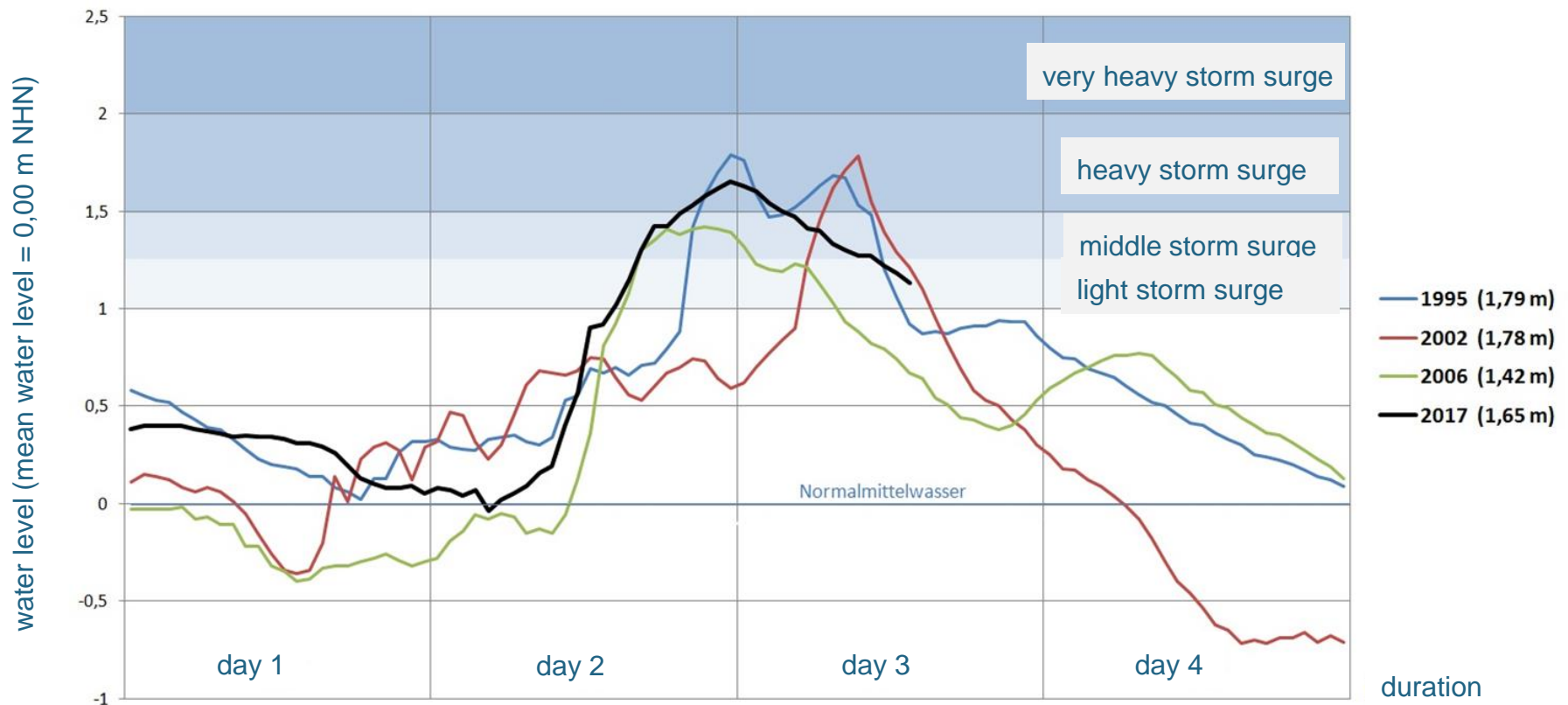
The coast of Mecklenburg-Western Pomerania

historical storm surges
at Greifswald



The coast of Mecklenburg-Western Pomerania

storm surges during the last years
at Greifswald



The coast of Mecklenburg-Western Pomerania

after the storm surge in january 2017



The coast of Mecklenburg-Western Pomerania

after the storm surge in january 2017



Coastal protection strategy and measures - strategy

Strategy and legal background

- **Public coastal protection is limited on residential areas. Main tasks are:**
 - avoid flooding due to storm surges
 - avoid reduction of residential areas resulting from coastal erosion
- **Prevention of breaches to inner coastal waters (Bodden, Haffe).**
- **The natural sediment transport processes should be preserved. That means:**
 - Don't protect undeveloped (and low developed) cliff coasts. The sand from cliff coasts is important for shallow coasts.
 - Use sandy dunes for protection of shallow areas (if possible no hard constructions at erosive sandy beaches).



Coastal protection strategy and measures - strategy

Level of protection and consideration of potential sea level rise

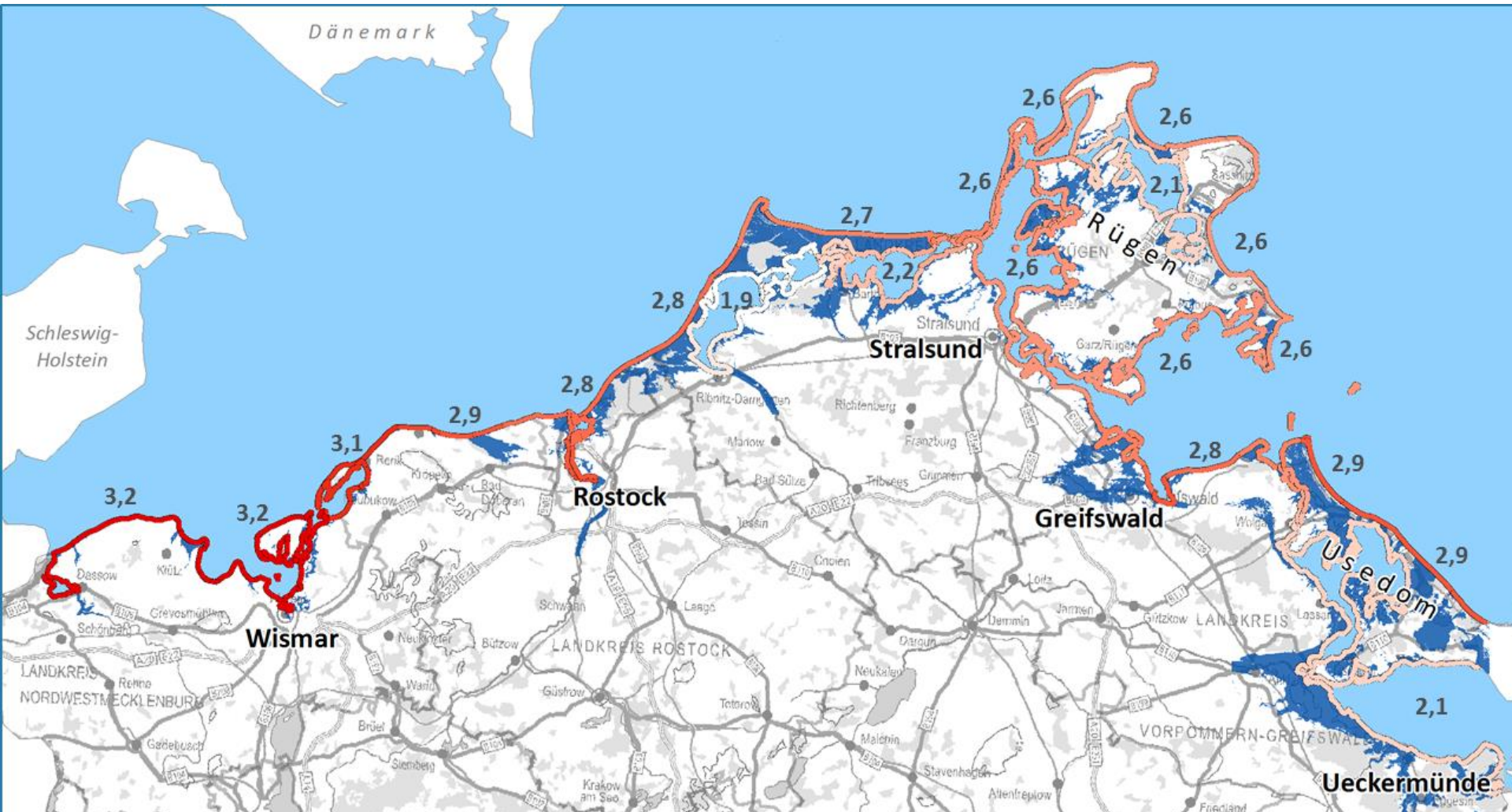
- **Design water level for flood protection** except dunes => **Probability of occurrence is 200 years** (based on long term time series)
- **Design waves** => **Determination of long term time series of sea state with numerical models** (calibration based on wave measurements)
- **Design lifetime of flood protection structures** => **100 years**
- **Assumption of relative sea level rise of 0,50 m** for the next 100 years
 - Safety check for residential areas without sea level rise



Foto: StALU MM

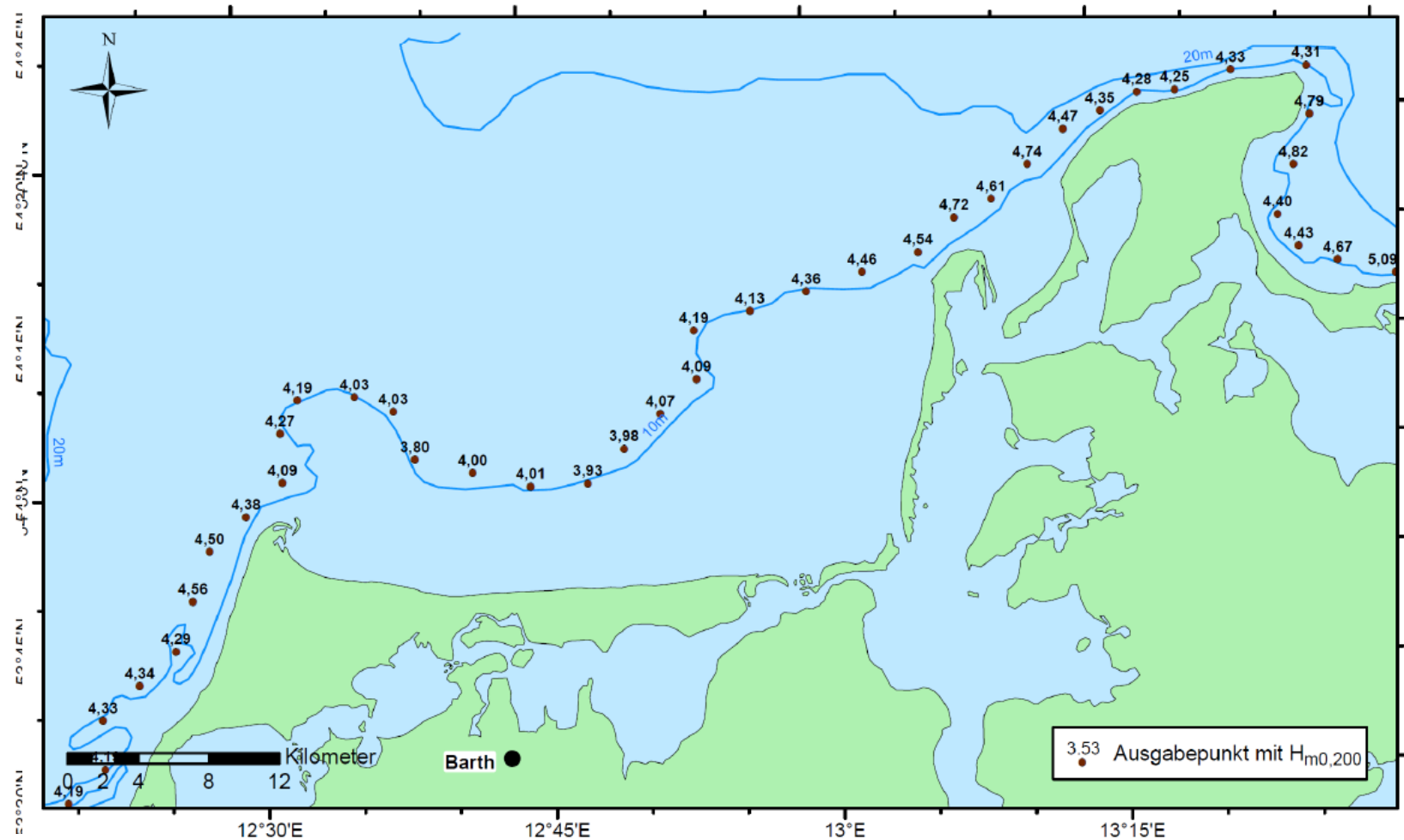
Coastal protection strategy and measures – design basics

Design water level including 0,50 m for sea level rise in future




Coastal protection strategy and measures – design basics

Design wave height at about 10m water depth, $H_{m0,200}$



Coastal protection strategy and measures - structures

Traditional system at sandy coasts



more than 100 km dunes in
Mecklenburg-Western Pomerania

Coastal protection system *Zingst*
groynes, beach, dune, wood and dike

Coastal protection strategy and measures - structures

Traditional system at sandy coasts



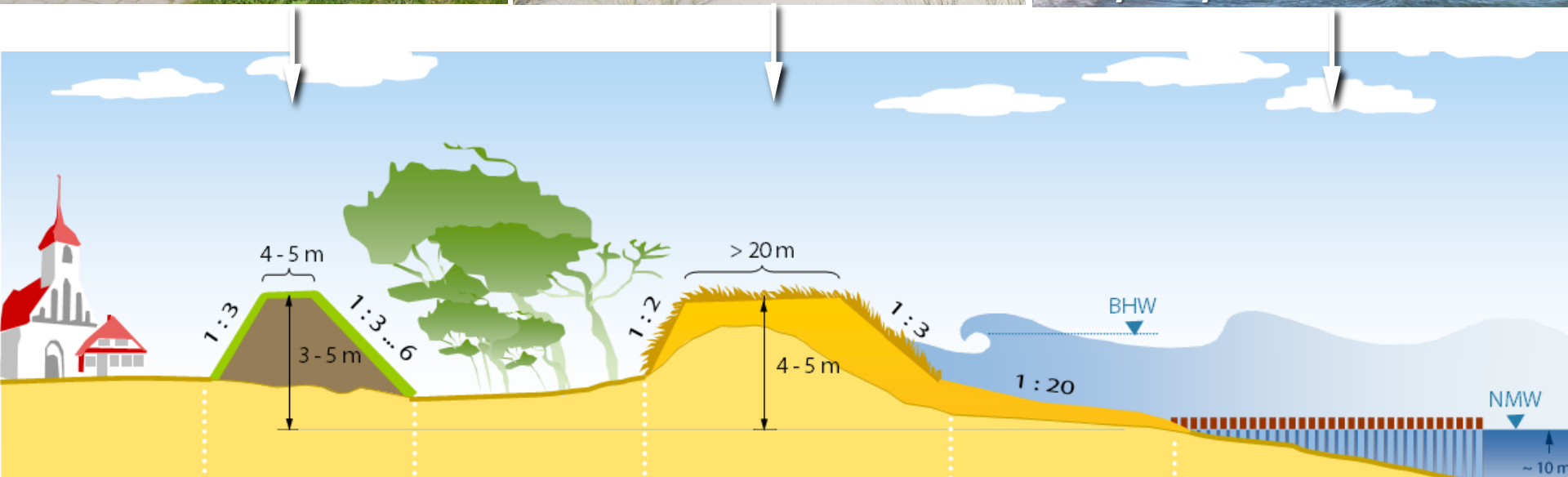
Dike



Dune

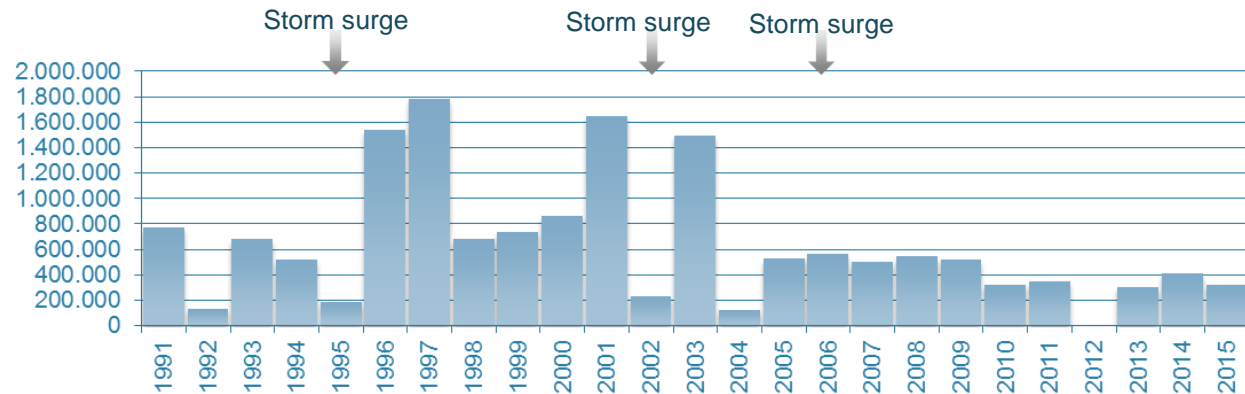


Groyne System



Coastal protection strategy and measures – sand replacement

Dune replacement and beach nourishment

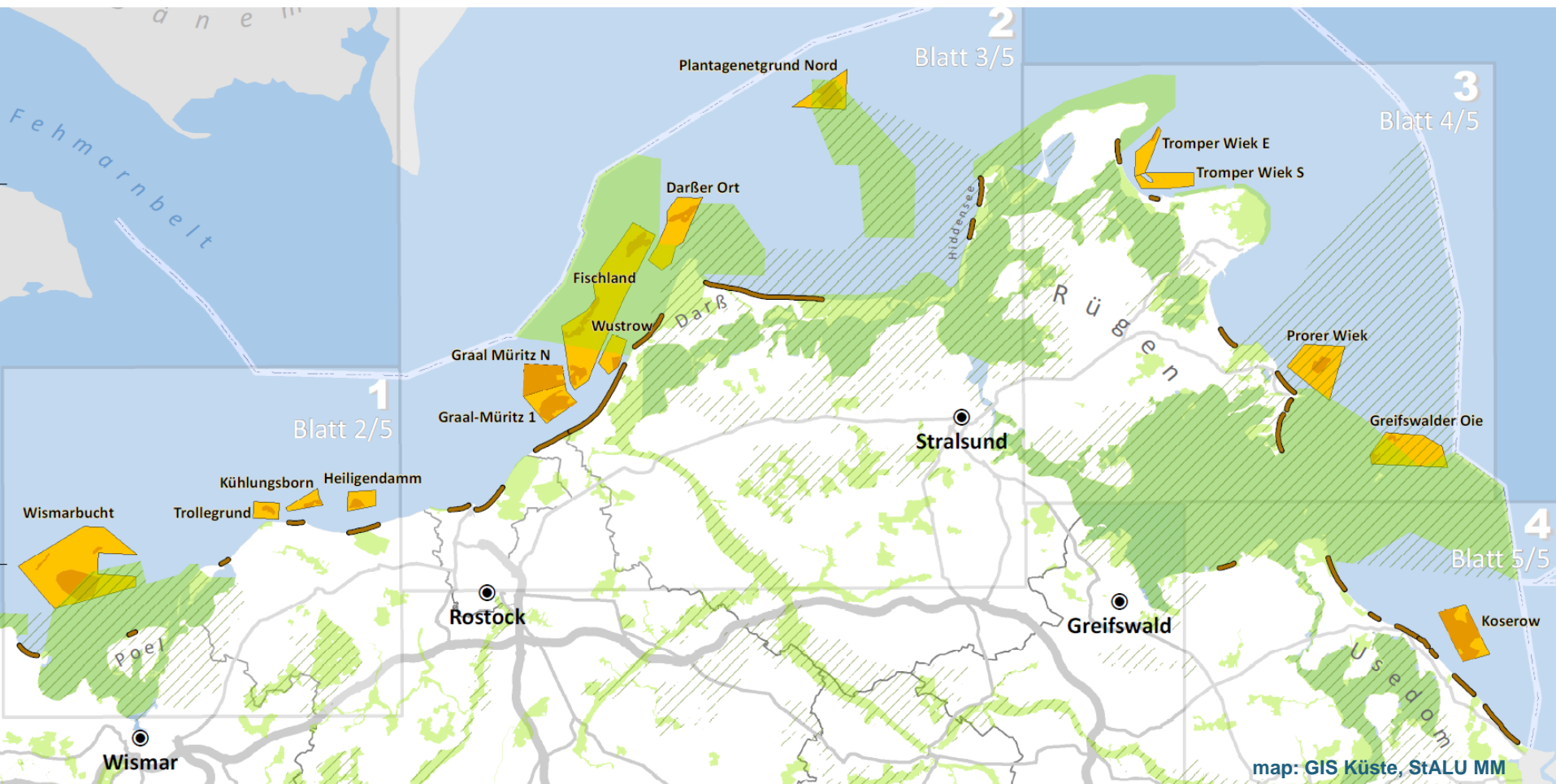


- ▶ Ø annual sand volume
500.000 m³
- ▶ Ø annual costs
approx. 5.000.000 €



Coastal protection strategy and measures – sand replacement

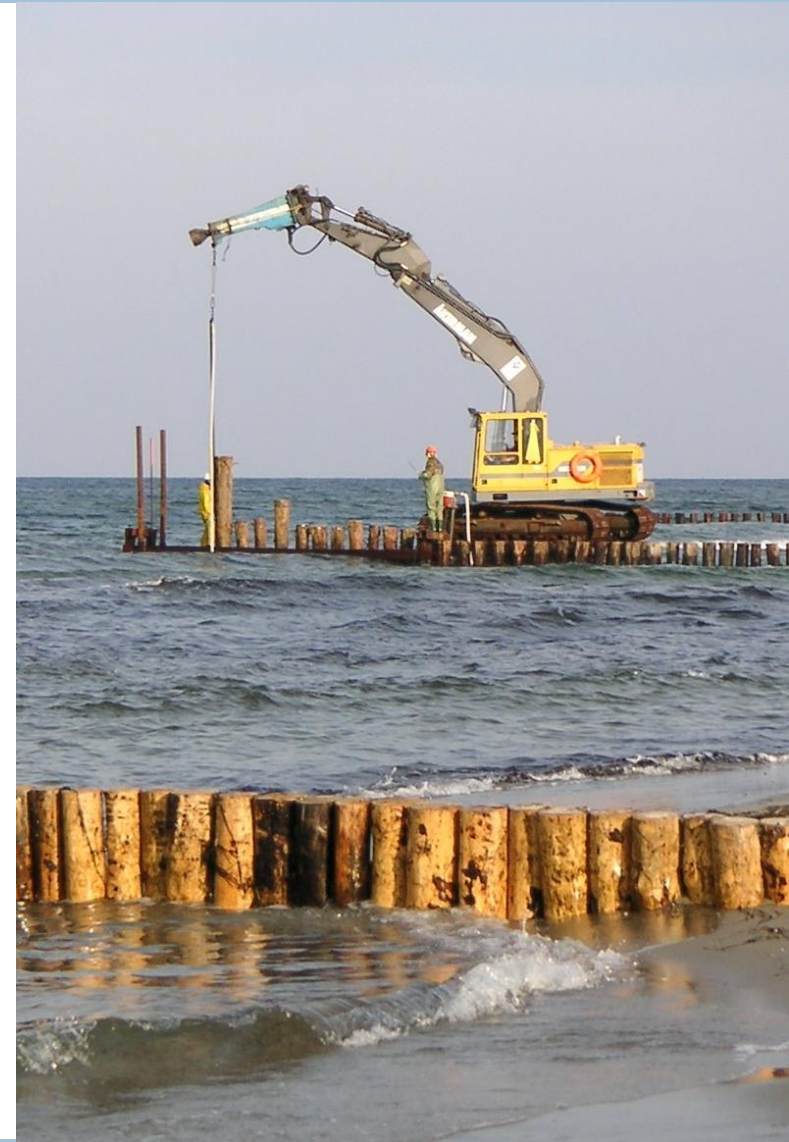
Potential sand extraction areas



Coastal protection strategy and measures - structures

Groynes

- ▶ 24 groyne systems with 1.148 groynes at about 80 km of the coastline
- ▶ Damages due to *Teredo Navalis* => *replacement with tropical wood*



Coastal protection strategy and measures - structures

Dikes and revetments



Coastal protection strategy and measures - structures

Breakwaters



Ahrenshoop



29 Breakwaters

Wustrow



Sellin, Island of Rügen

Consideration of requirements of inhabitants and tourists

Requirements:

- ▶ Unlimited access to beaches, cliff coasts and harbour areas
- ▶ Preferably invisible coastal protection => green coastal protection
- ▶ Walk/Promenade along the coast (sightseeing without disturbance by bikes)
- ▶ Catering and shopping at/near the beach or coastline (view to the sea).



Consideration of requirements of inhabitants and tourists

Solutions:

- ▶ All beaches are owned by the federal state of Mecklenburg-Vorpommern. Everybody can use the beach. The communes are able to collect charges for benefits.
- ▶ If possible use sandy dunes for protection of shallow areas (avoid hard constructions at sandy beaches).
- ▶ Boardwalks at dunes (dune promenade) are allowed with restrictions (only noncritical coastal areas (based on exception permit).
- ▶ Temporary constructions for catering, shopping, etc. (april 15th to oktober 15th)



Consideration of requirements of inhabitants and tourists



use of geotextile container, Rerik

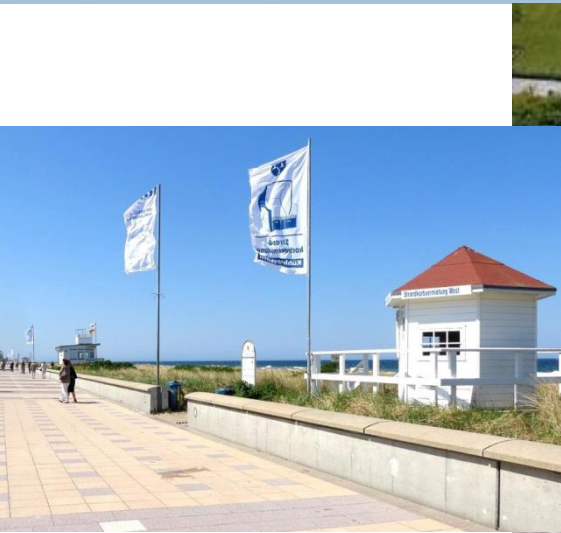


use of geotextile container, Rerik

Consideration of requirements of inhabitants and tourists



Consideration of requirements of inhabitants and tourists



Consideration of requirements of inhabitants and tourists



Warnemünde, present situation



Warnemünde, projection



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Thank you for your attention!

projected island harbour to reduce negative impact on sediment transport, picture Dr. Tiepolt

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Coastal protection strategy and measures - risk management

Flood risk management

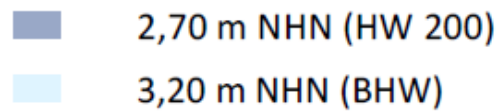
- ▶ public flood hazard maps
- ▶ public flood risk maps
- ▶ information of administration and inhabitants

example: Timmendorf



Flood risk management

- ▶ potentially flooded area
for a probability of
occurrence of 200 years

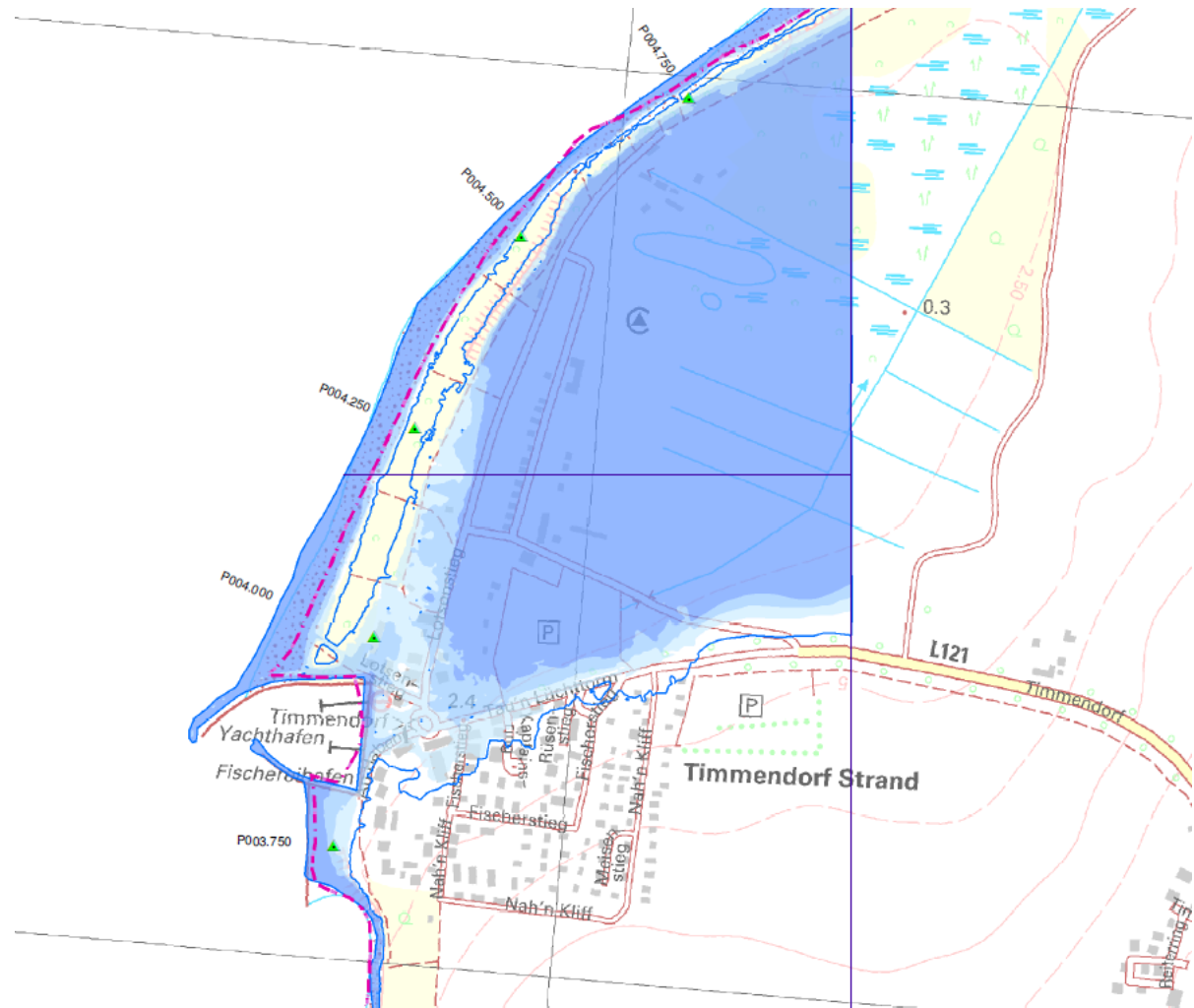


Flood risk management

- flood hazard map for a probability of occurrence of 200 years

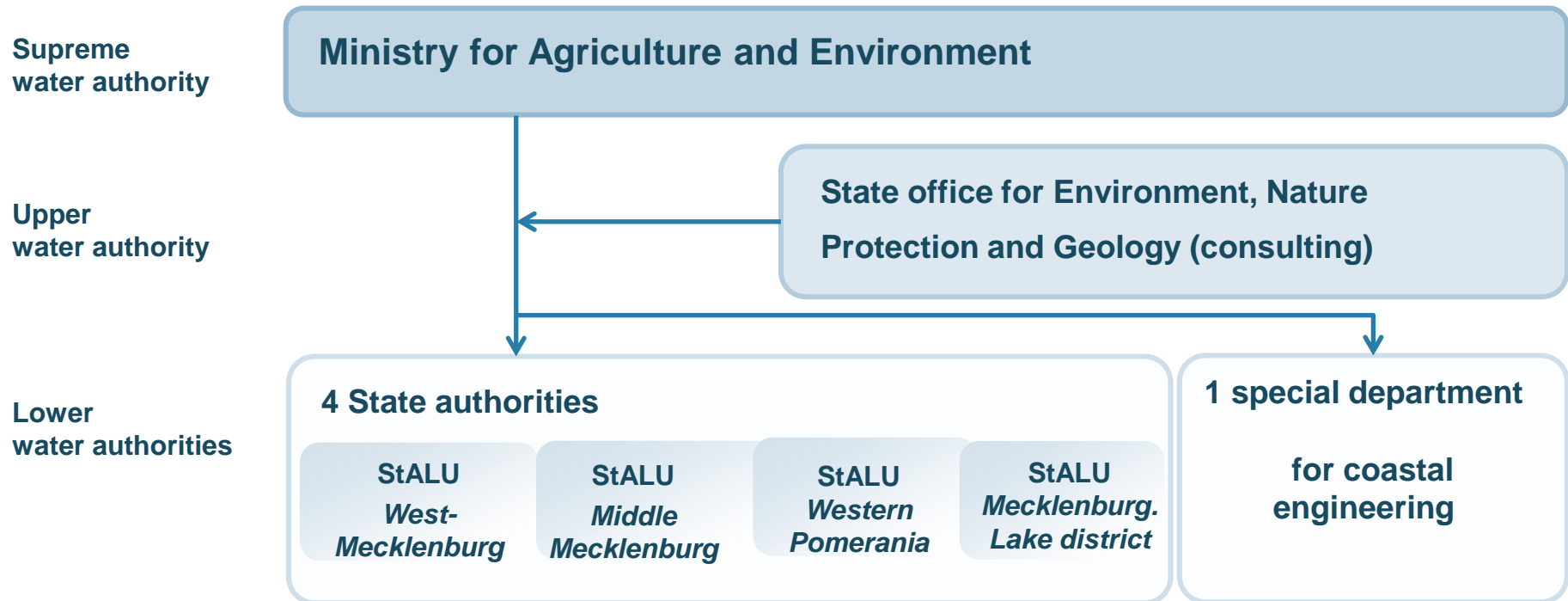
water depths:

0-0.5m
0.5-1m
>1m



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Organisation and financing



Organisation and financing for residential areas

► 4 Lower State **Authorities**

- planning and construction of coastal and flood protection structures **for residential areas**
- **maintenance** of coastal and flood protection structures

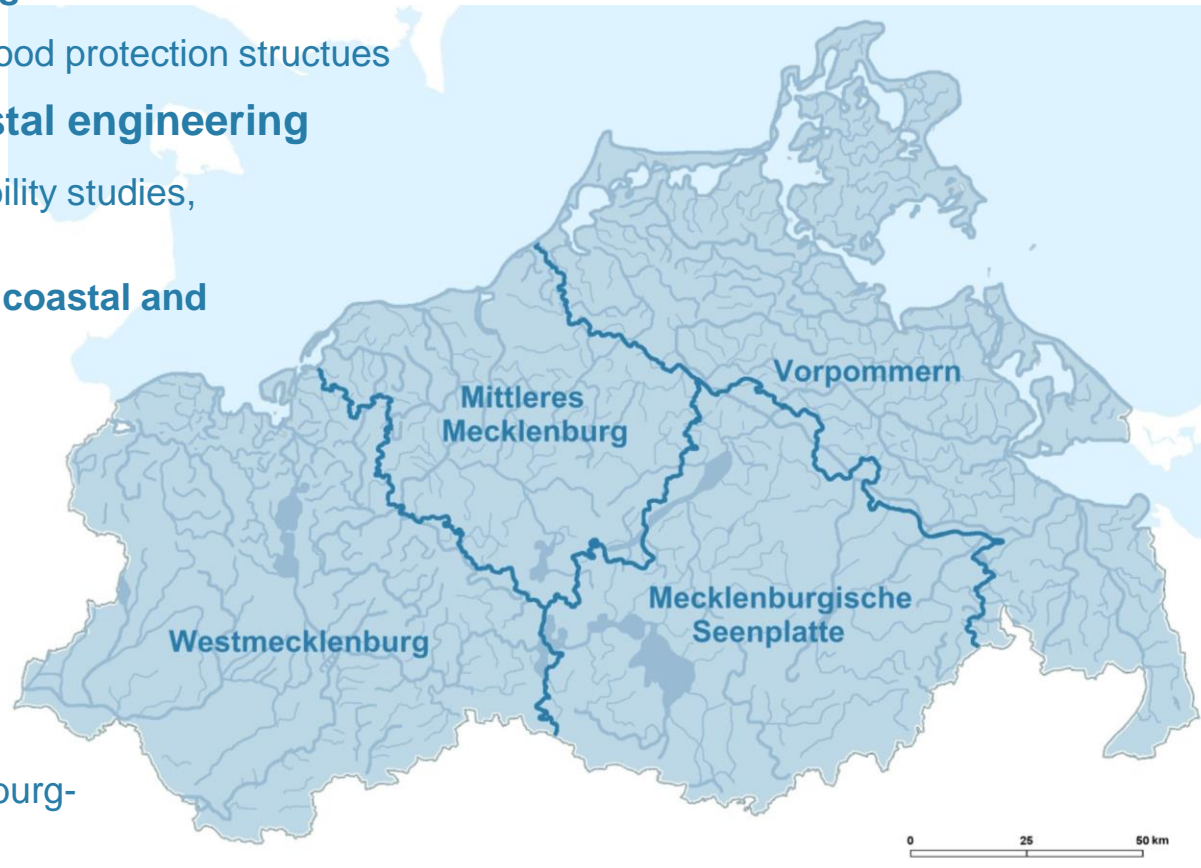
► 1 special **department of coastal engineering**

- **basics** (measurements, feasibility studies, calculations, GIS-Systems)
- planning and **construction of coastal and flood protection structures**
- planning and realisation of **dune replacement and beach nourishment**

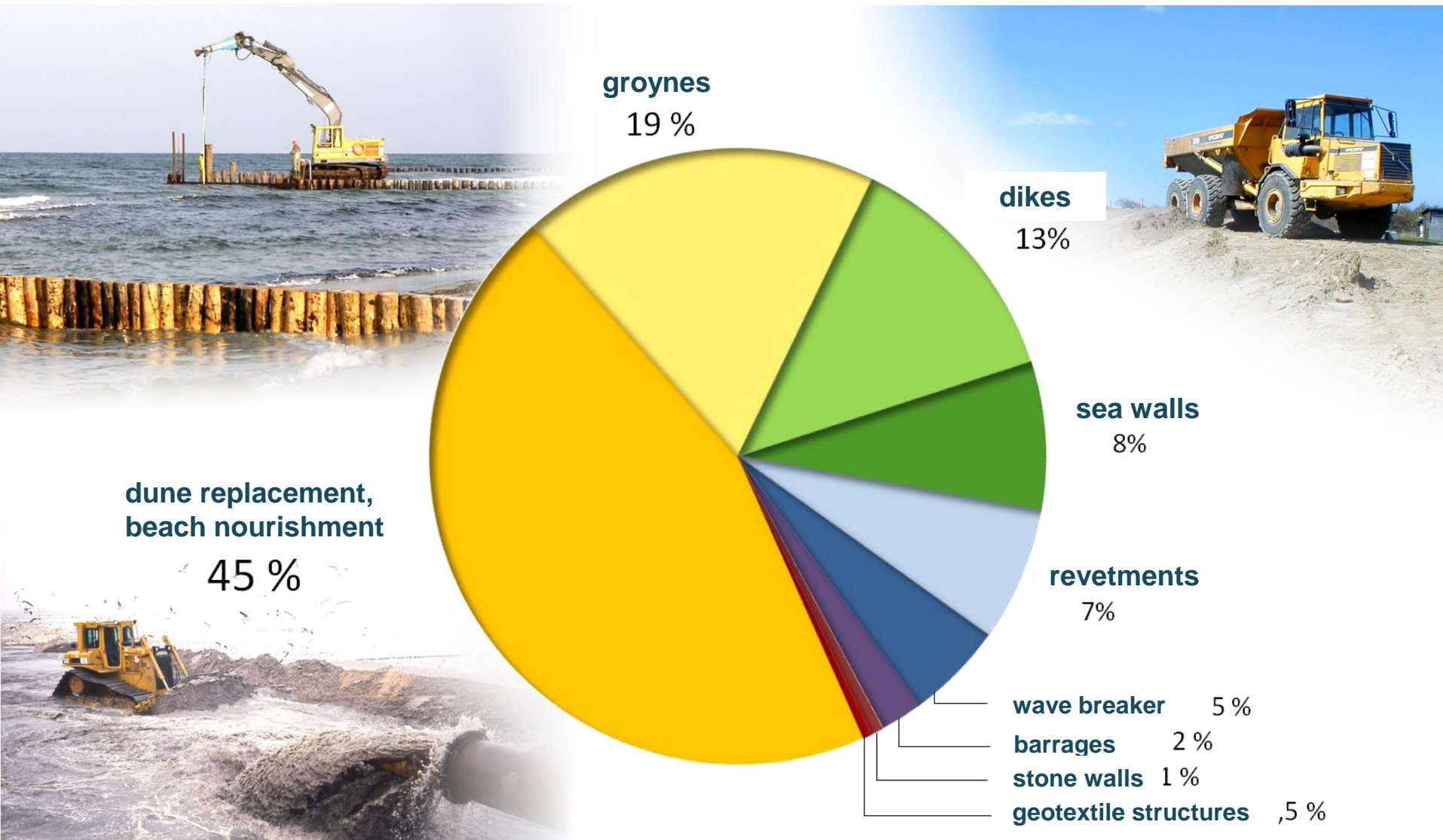
► **investment** since 1991 **about 400 Mio. €**

- new construction, reconstruction, revitalisation
- 70 % federal government
- 30 % federal state of Mecklenburg-Western Pomerania

► **maintenance about 50 Mio. € (since 1991)**



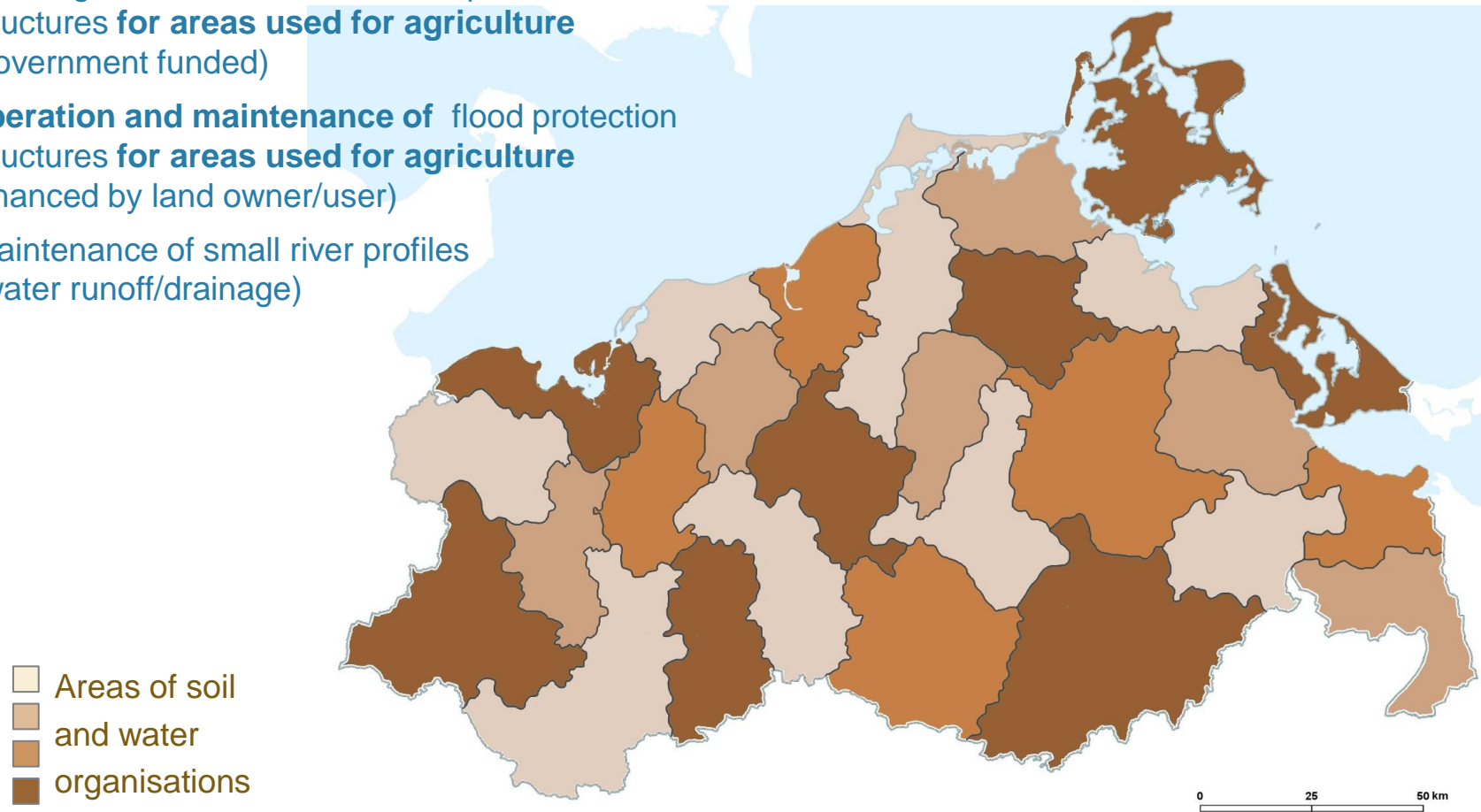
Organisation and financing



Organisation and financing for areas used for agriculture

► 27 Regional Soil and Water Associations

- planning and construction of flood protection structures **for areas used for agriculture** (government funded)
- **operation and maintenance of** flood protection structures **for areas used for agriculture** (financed by land owner/user)
- maintenance of small river profiles (water runoff/drainage)



Consideration of touristic requirements



Storm surge protection Warnemünde

- BHW 2,80 m above NHN (inkl. 0,50m for future sea level rise)
- Necessary height 3,05 m above NHN
- Construction height 2,75 m to fulfill the requirements of tourists and inhabitants
- Future adaption on sea level rise =>
Possibility for easy heightening of the wall with additional concrete elements

