PARTRAC MARINE DATA EXPERTISE

Survey with Science

Nearshore berms – fate and transport

History of berm placement at SPI

- 11 placements to 2014
- 4.4M CY of 'Nearshore Placement'

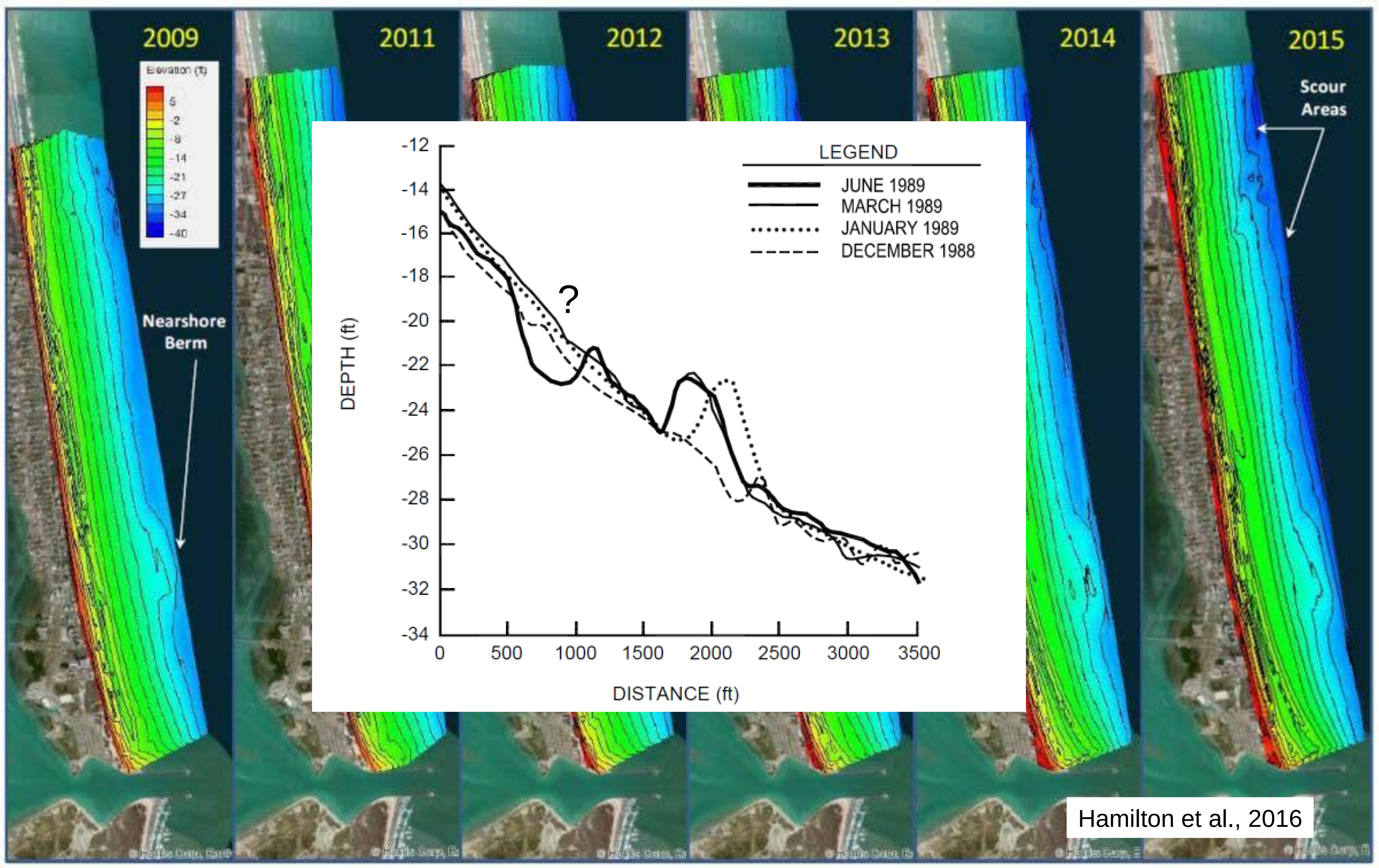
Purpose?
Wave attenuation
Beach Nourishment
Both

Table 1 - Dredged Material Placement History

Year	Type of Placement	Location [1]	Est. Dredged Volume [2] (cy)
1988	Berm	Nearshore Berm	220,000
1991	Berm	Nearshore Berm	580,000
1995	Berm	Nearshore Berm	750,000
1997	Nourishment	Stations 182+29 to 242+29	490,000
	Berm	Nearshore Berm	396,000
1999	Nourishment	Stations 80+00 to 120+00	495,000
	Berm	Nearshore Berm	195,000
2000	Nourishment	Stations 206+00 to 238+00	370,000
2002	Nourishment	Stations 184+00 to 218+00	330,000
	Berm	Nearshore Berm	329,000
2003	Berm	Nearshore Berm	356,000
2005	Nourishment	Stations 9+30 to 30+00 Stations 182+00 to 213+00	49,000 229,000
2006	Berm	Nearshore Berm	340,000
2007	Berm	Nearshore Berm	443,000
2008	Berm	Nearshore Berm	500,000
2009	Nourishment	Stations 208+40 to 255+00	407,000
2010	Nourishment	Stations 7+00 to 34+00 Stations 235+00 to 265+00	90,000 130,000
2011	Nourishment	Stations 10+00 to 25+00 Stations 240+00 to 267+00	199,000 368,000
2012	Nourishment	Stations 10+00 to 25+00 Stations 235+00 to 260+00	140,000 210,000
2014	Berm	Nearshore Berm	305,000

Hamilton et al., 2016

Berm behavior - bathymetry and profiling



Hamilton et al., 2016

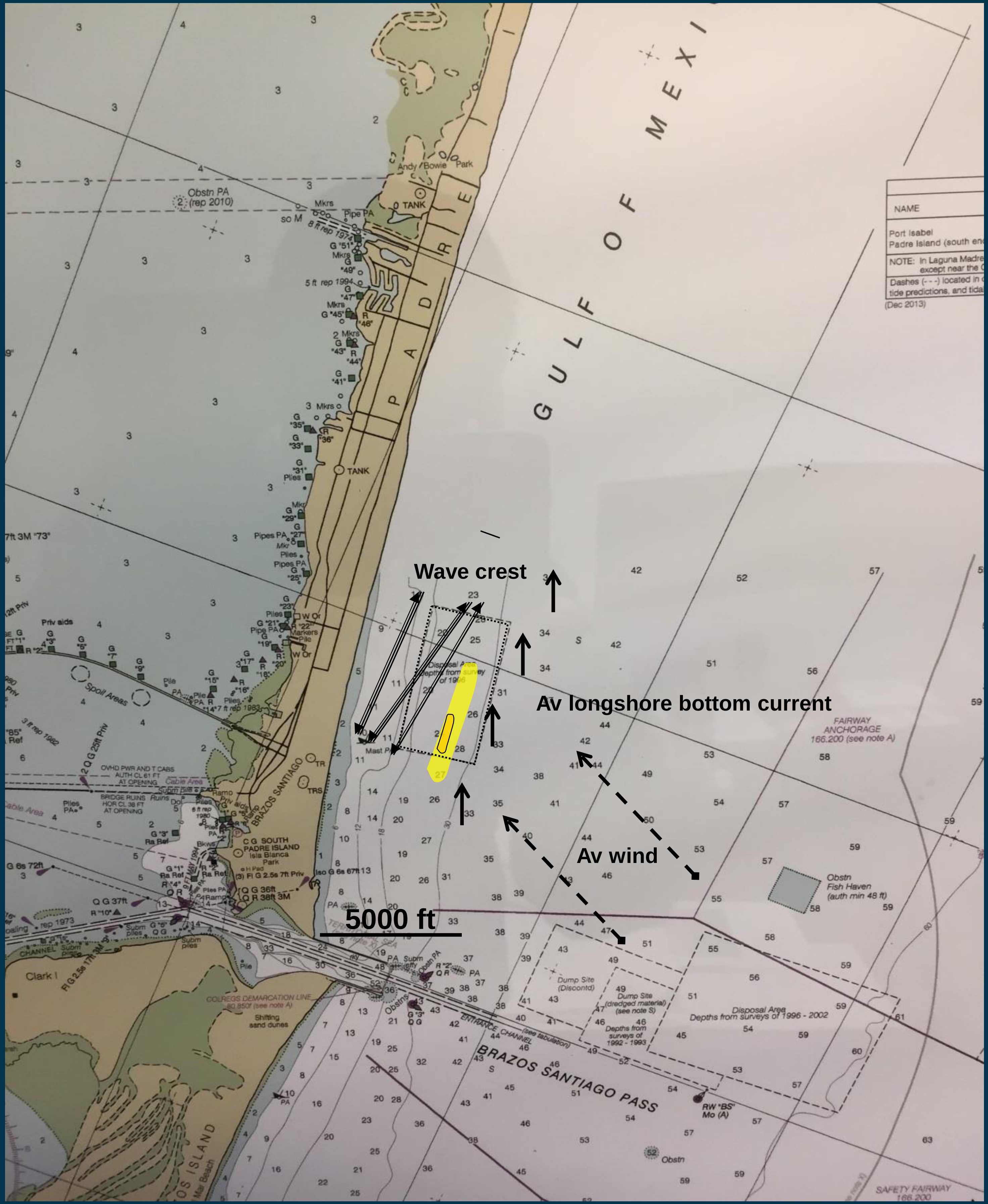
1988/1989 Berm monitoring

Parameter	Initial (Jan. 4, 1989)	Period 1 (Jan. 4 - Mar. 9, 1989)	Period 2 (Mar. 10 - Jun. 19, 1989)	Period 3 (Jun. 19, 1989 - May 14, 1990)
Berm bathymetry				
length (m)	1,220 4000 ft	975	850	460 1500 ft
width (m)	300 1000 ft	250	250	190 620 ft
area (m^2)	259,000	207,200	207,200	77,700
max. relief (m)	1.4	1.3	1.2	0.6
volume (m^3)	125,000 164,000 cu yd	94,800	88,000	26,800 35,000 cu yd
crest movement (m) & direction	--	60, onshore	none	45, offshore
centriod movement (m) & direction	--	55, onshore 90, south	7.5, onshore 4.5, south	30, offshore 180, south
Hydrodynamics				
wind speed (knots)	--	2.8	11.0	7.0
wind direction w.r.t. shoreline	--	155° (SE)	155° (SE)	145° (SE)
ave. wave ht. (m)	--	0.85	0.73	0.76
ave. wave period (sec)	--	7.1	6.5	6.5
ave. wave crest alignment w.r.t. shoreline	--	9.5°	20.7°	15.6°
bottom horz. vel. component of wave orbit. motion (mps)	--	0.27	0.24	0.24
threshod vel. (mps)	--	0.18	0.18	0.18
longshore bottom current direction & classification	--	north, weak	north, strong	north, mild
cross-shore bottom current direction & classification	--	offshore, negl.	offshore, weak	offshore, weak

Aidala et al., 1992

1988/1989 Berm

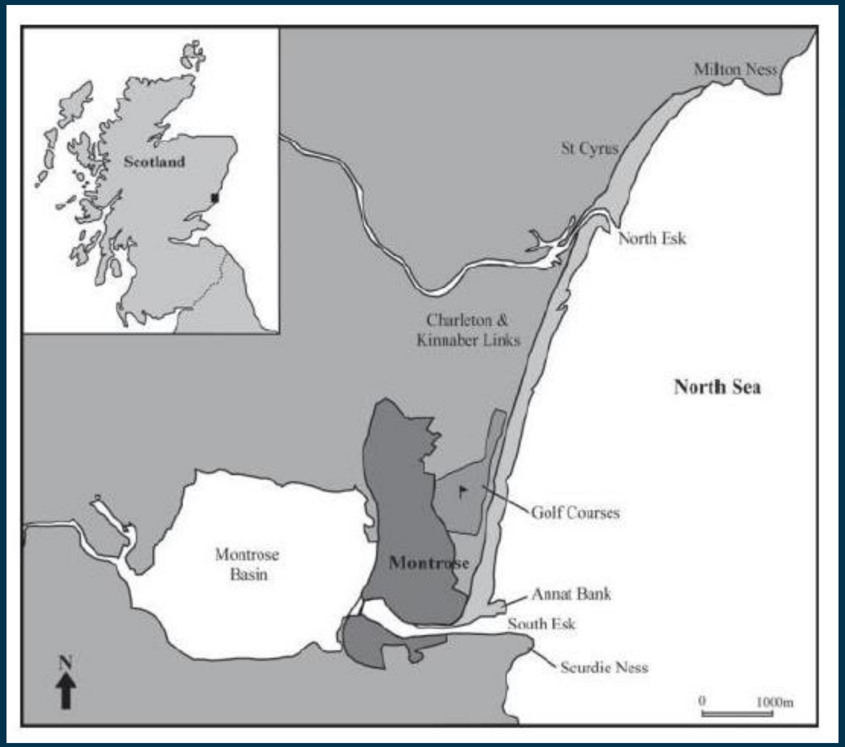
- •Average parameters and centroid position suggest northerly sediment transport
- •How much sand reached the beach?
- •What happens during cold front events?



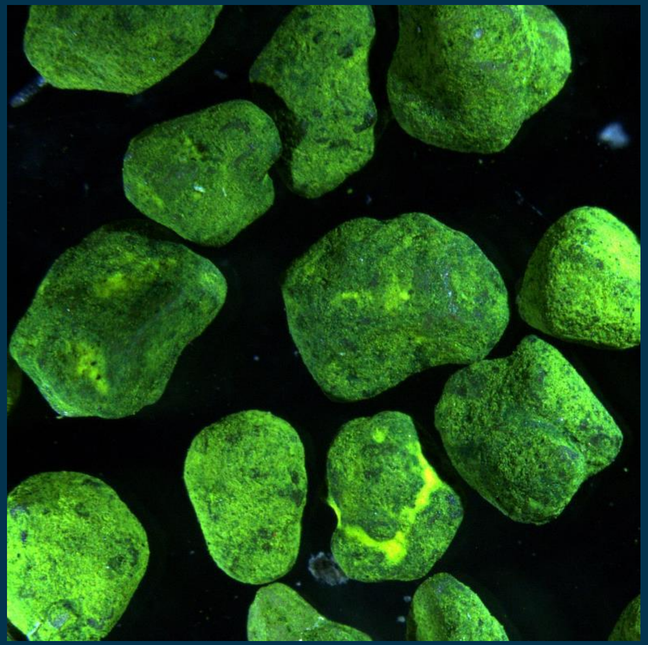
2016 Nearshore Berm tracer study – Montrose, Scotland

Aims

- Test postulated onshore sediment transport pathways for material deposited on a nearshore berm
- Examine rate, if any, of longshore beach transport

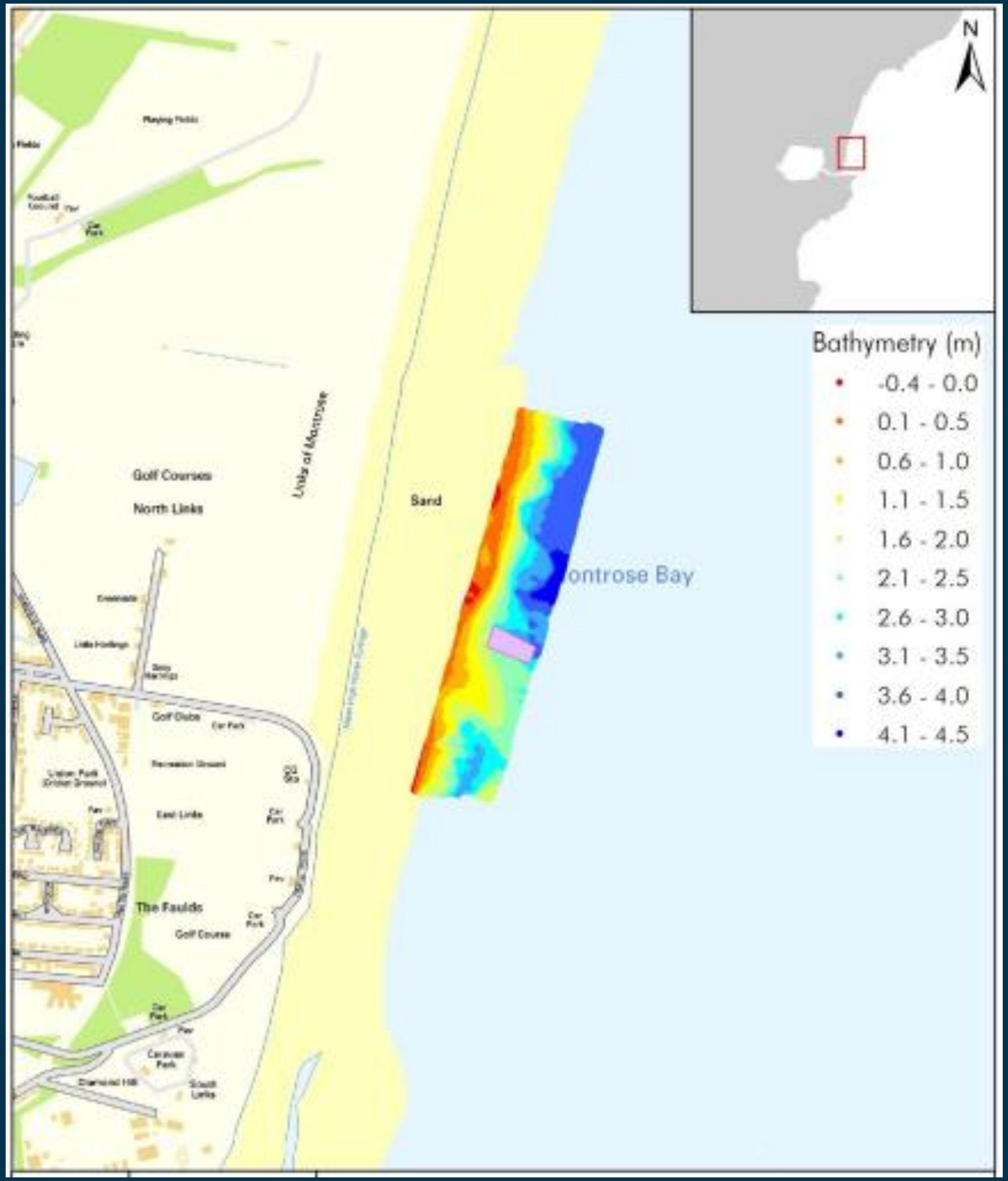


Partrac dual signature fluorescent/magnetic tracer



Deployment and sampling

- Tracer deployed in 8-10 ft water depth
- Nortek Wave and Current Sensor for one year
- Sampling campaigns: 2,4,6,8,12,18,32,48, 54 weeks after deployment



Results

Week 2

Week 4

Week 6

Week 8

Week 12

Week 18

Week 32

Week 48

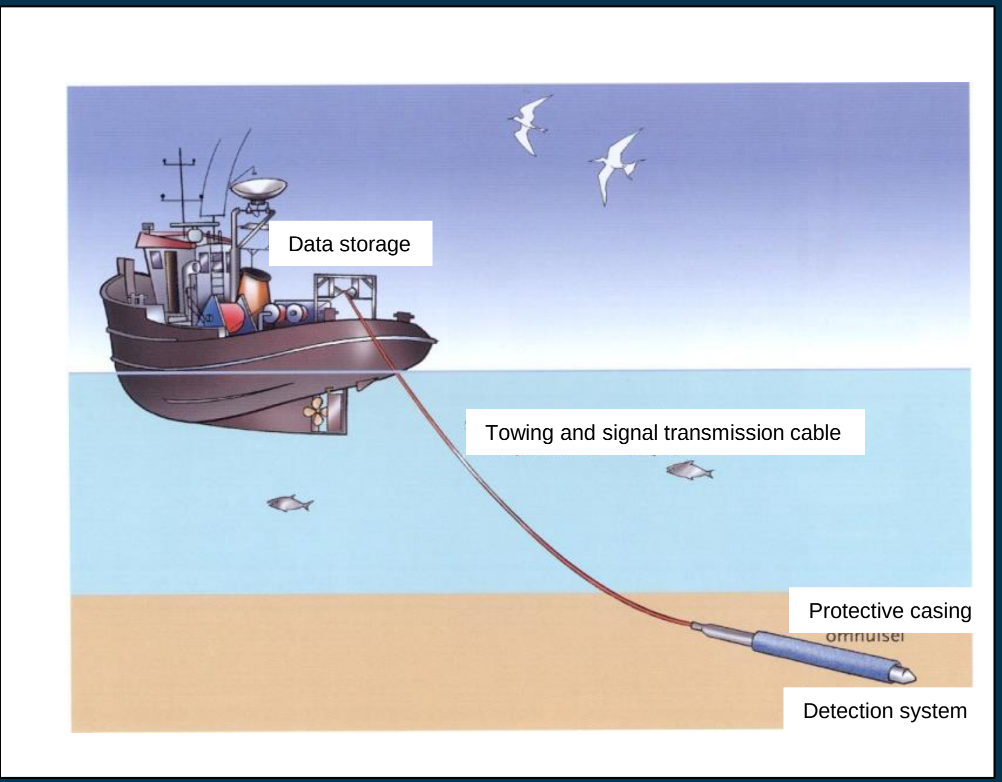
Week 52

- Tracing provides unequivocal confirmation of a number of sediment transport pathways from the shallow offshore both N & S along shore, and cross shore
- Provides information about timing of sediment movement – e.g. in winter, sediment transported preferentially subtidally, and northwards on beach face

A new type of tracing method

- In an ideal world, deploy large amount of tracer to maximise recovery – budget constraints
- Partrac is developing a new type of natural geochemical tracer that allows deployment of large amounts of tracer and tracing in quasi real time
- The tracer is natural glauconitic or granitic sand

Medusa



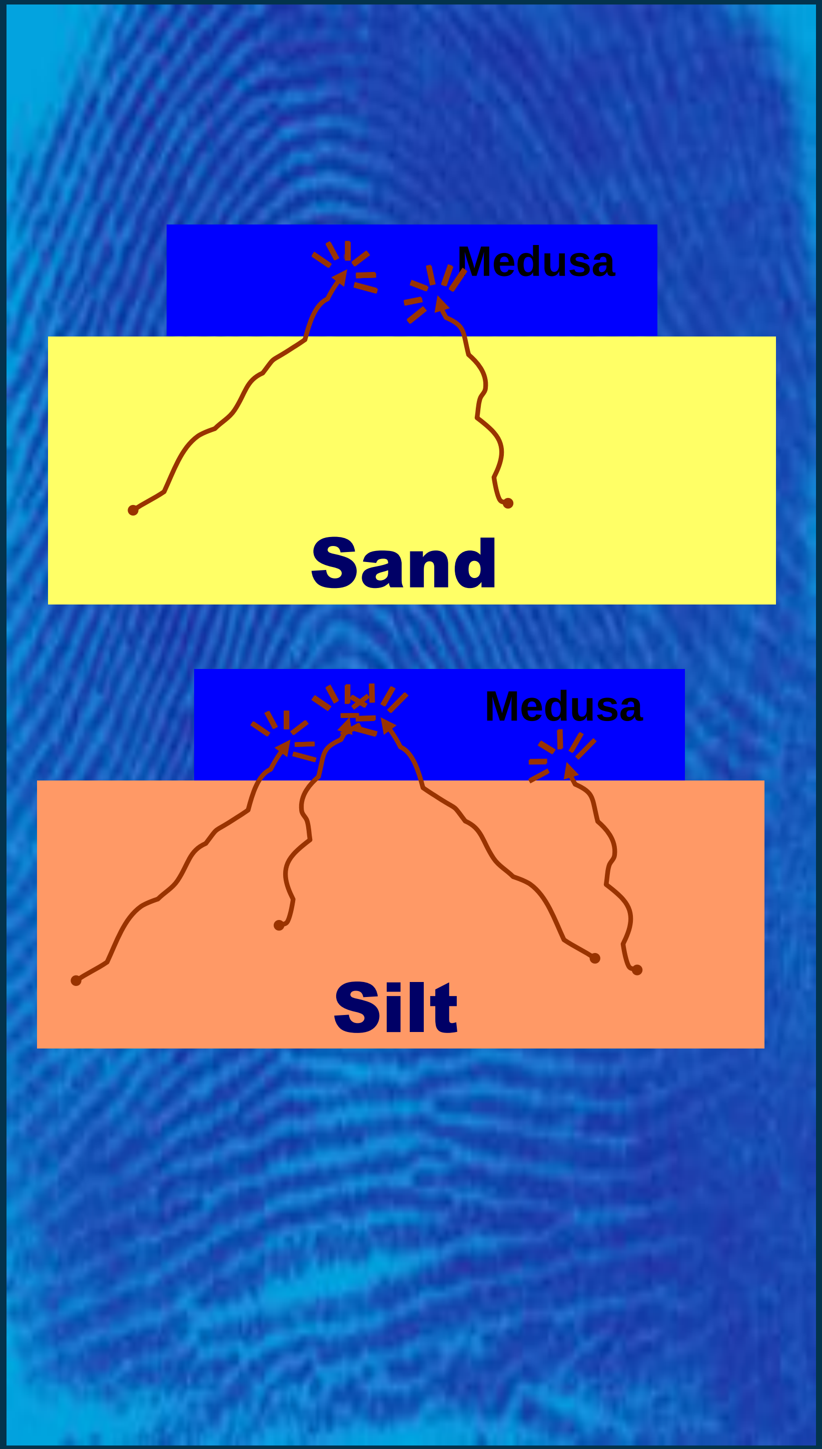
- Medusa is a gamma spectrometer

  Passive detector that measures natural background radiation

- A geochemical tool for

  Mapping sediment and soil composition
  Mapping sediment and soil pollution
  Mapping sediment transport pathways

Technology - mineral ‘fingerprinting’



- Naturally occurring K, U, Th as a proxy

  -K, U, and Th often correlated with concentrations of other heavy metals (Zn, Cd, Cu) and organic pollutants

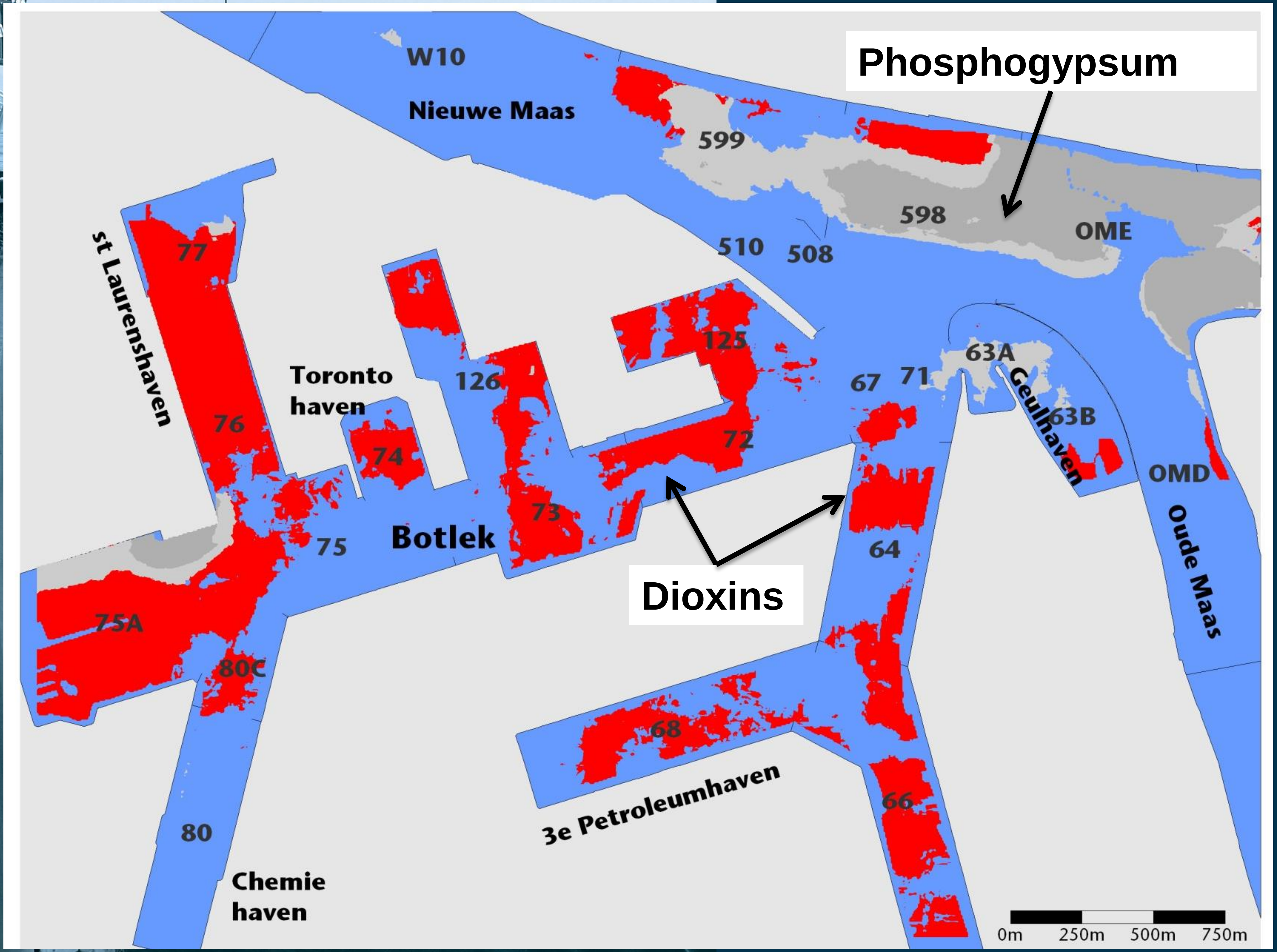
- Fingerprinting

  -Silt, clay and sand contain different concentrations of naturally occurring radionuclides (^{40}K, ^{238}U, ^{232}Th)
  -The ratio of the radionuclides is a ‘fingerprint’ of the material
  -Silt/Clay contains higher concentrations of ^{40}K, ^{238}U, ^{232}Th than sand

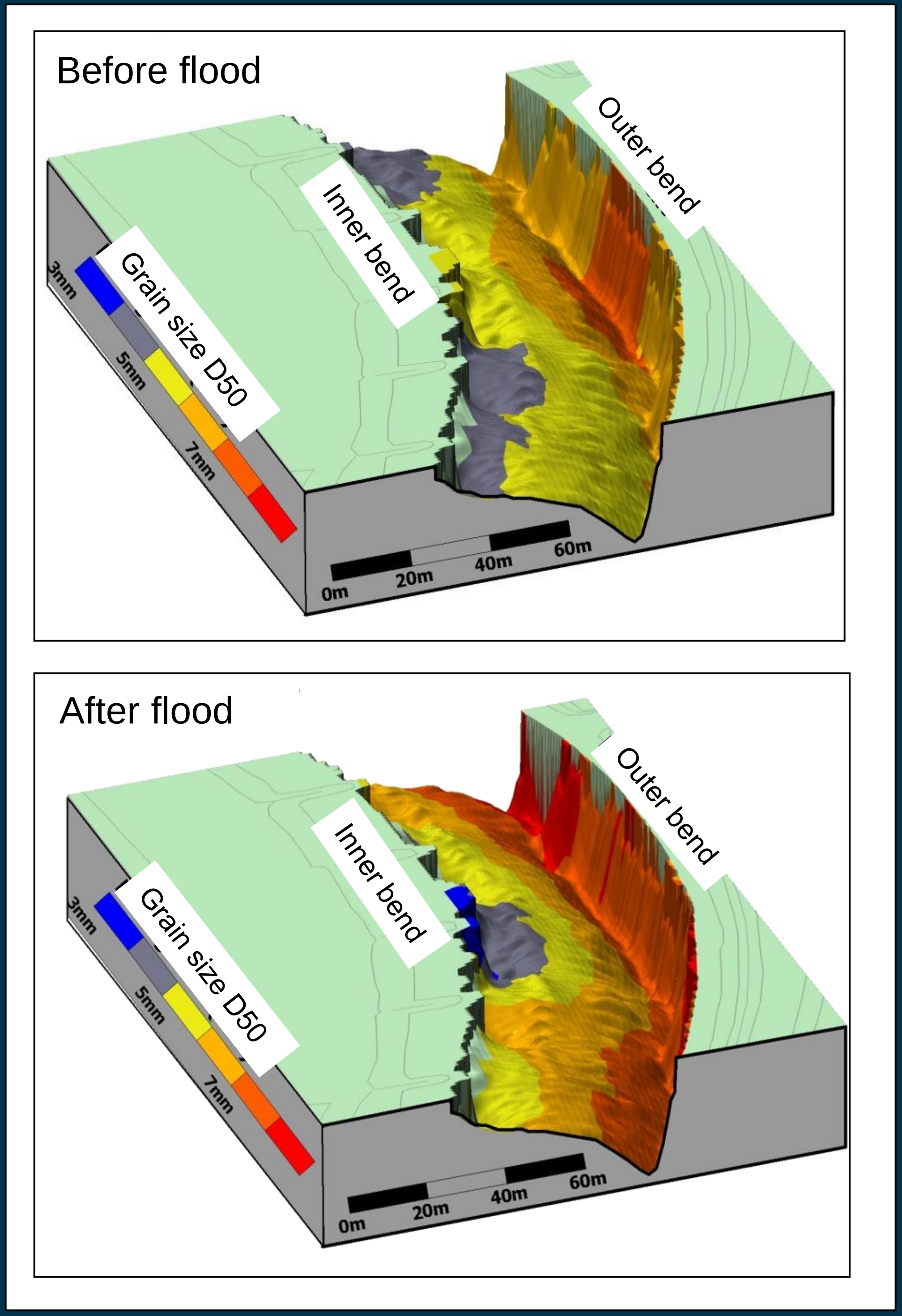
- Field Mapping

  -Concentrations of radionuclides can be measured in the field
  -The measurement is passive. Radioactive source not required
  -Measuring radionuclides is non-destructive

Pollution mapping – European Port



Grain size mapping - River Rhine



- Project

  Mapping changes in sediment grain size during a flood in the river Rhine

- Client

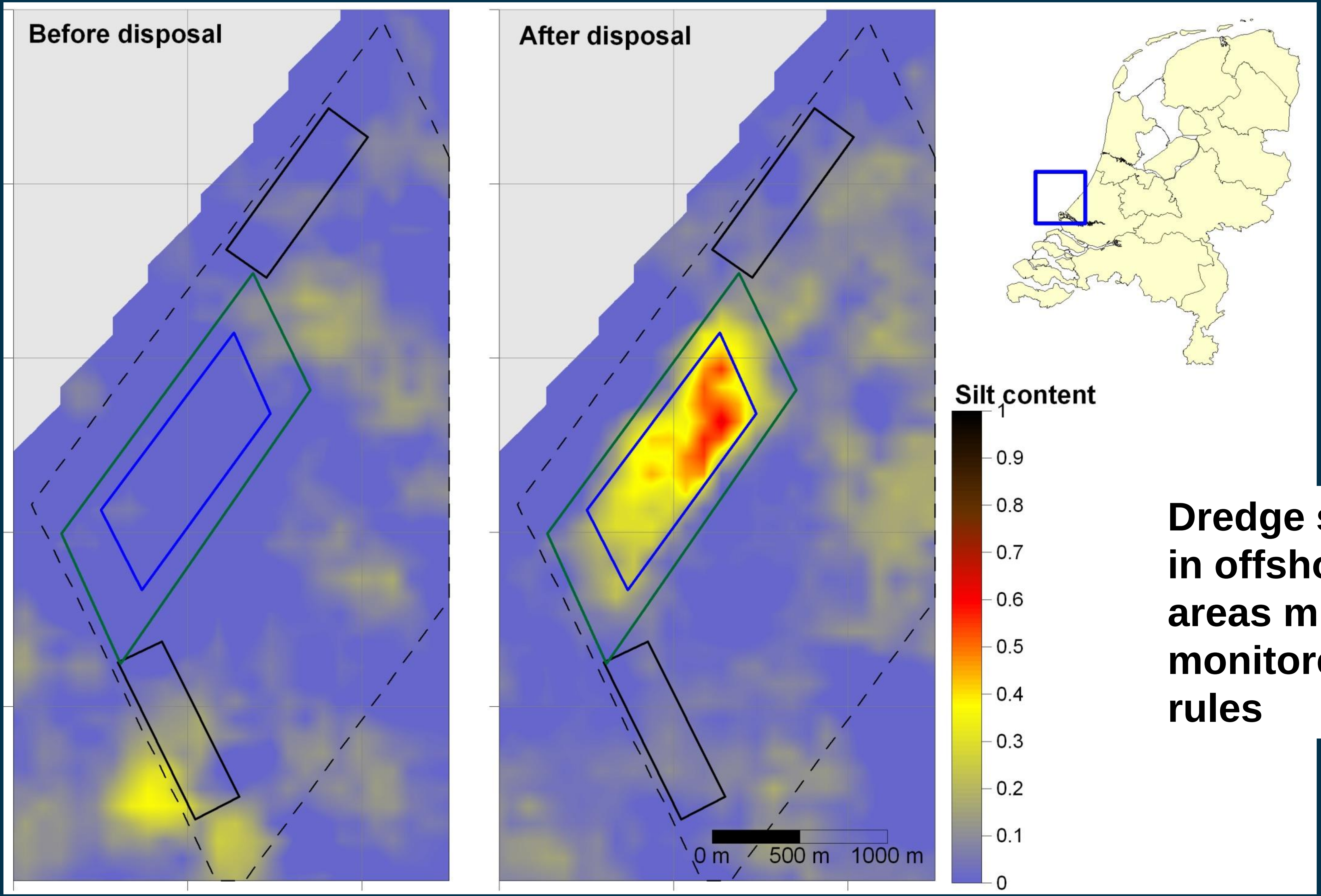
  Rijkswaterstaat (the Netherlands)

- Results

  The Medusa gamma spectrometer shows changes in median grain size within the river:

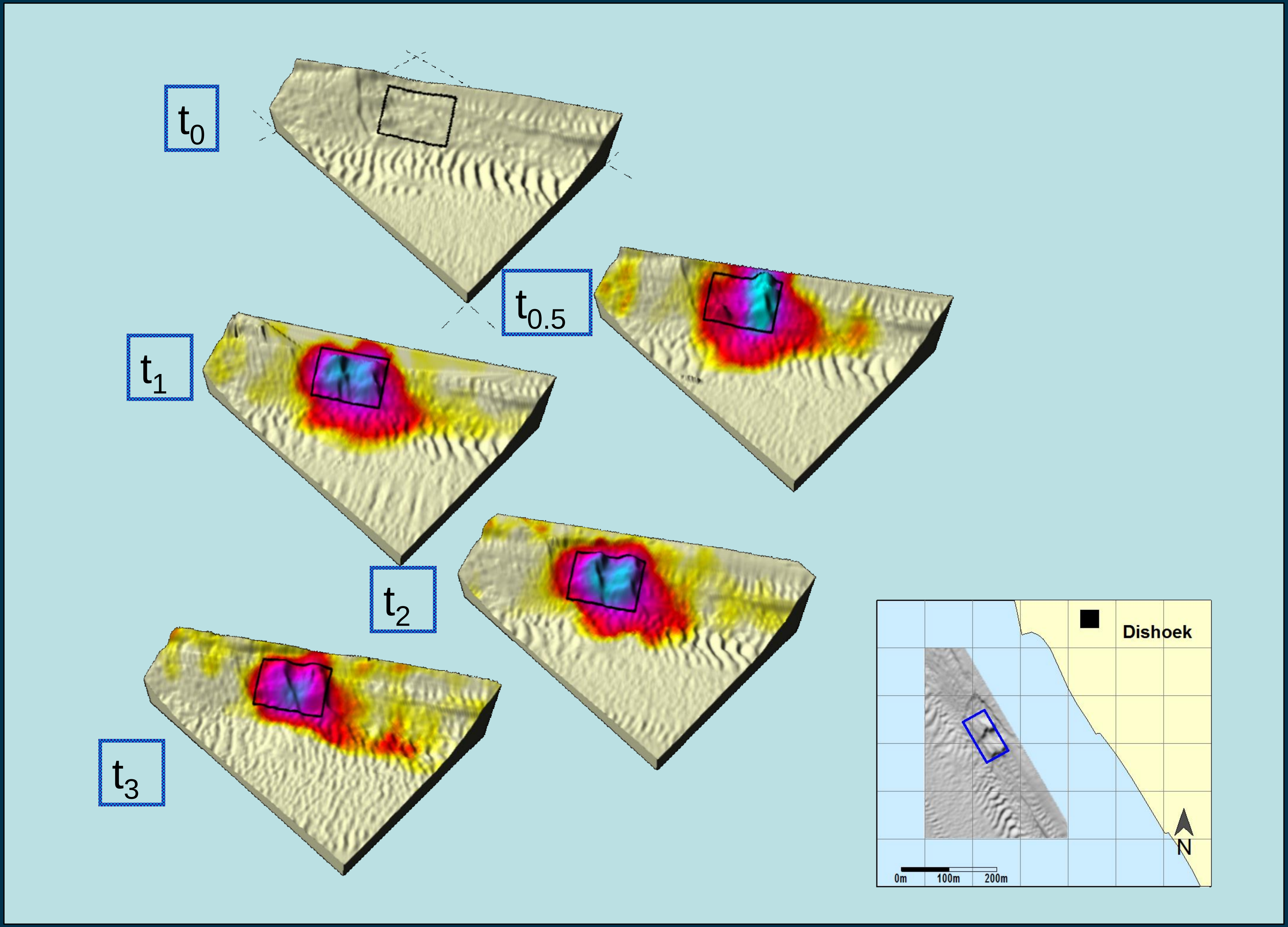
  Smaller grain size in the inner bend after the flood
  Larger grain size outer bend after the flood

Silt mapping – Sediment Transport

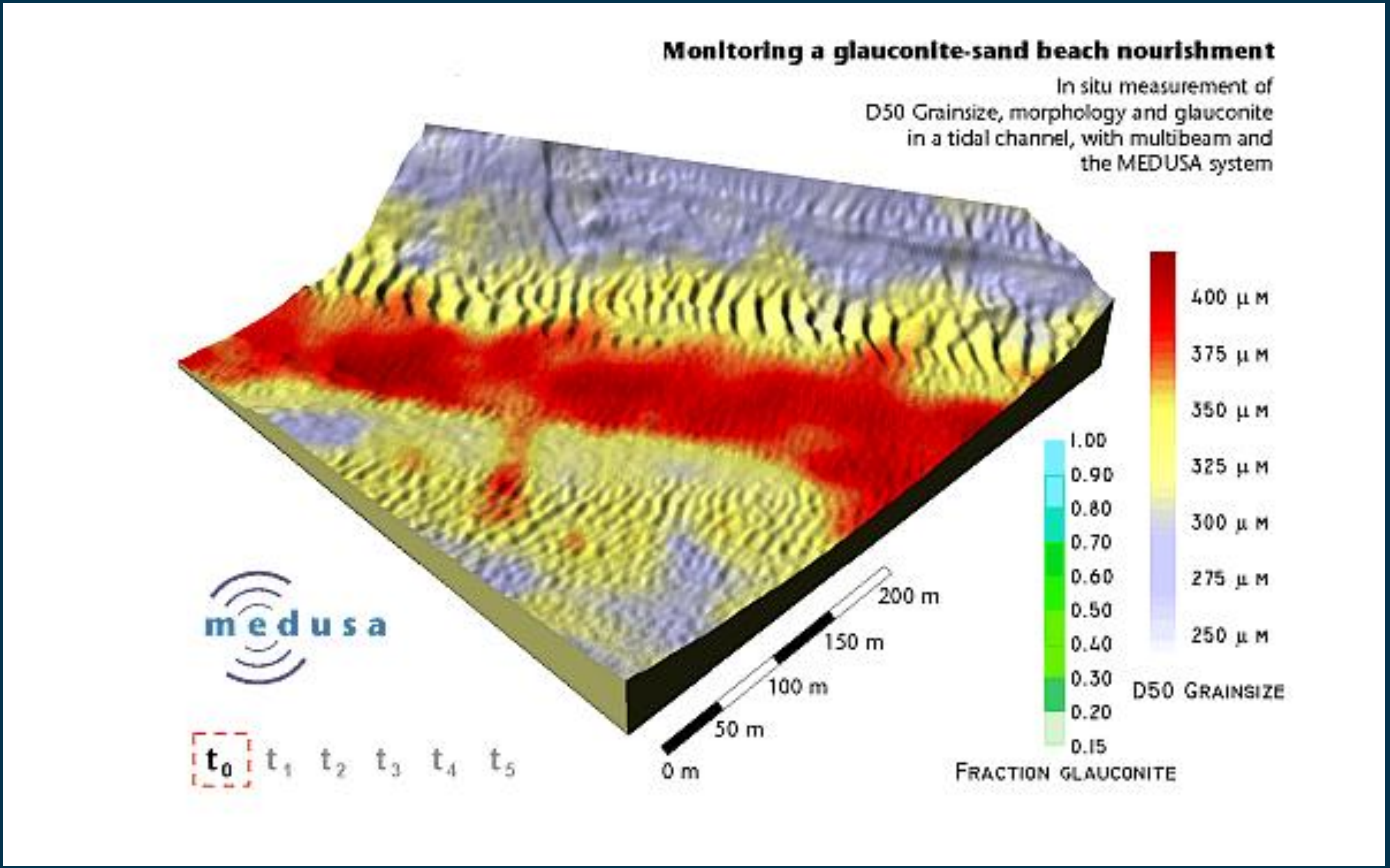


Dredge spoils placed in offshore disposal areas must be monitored under EU rules

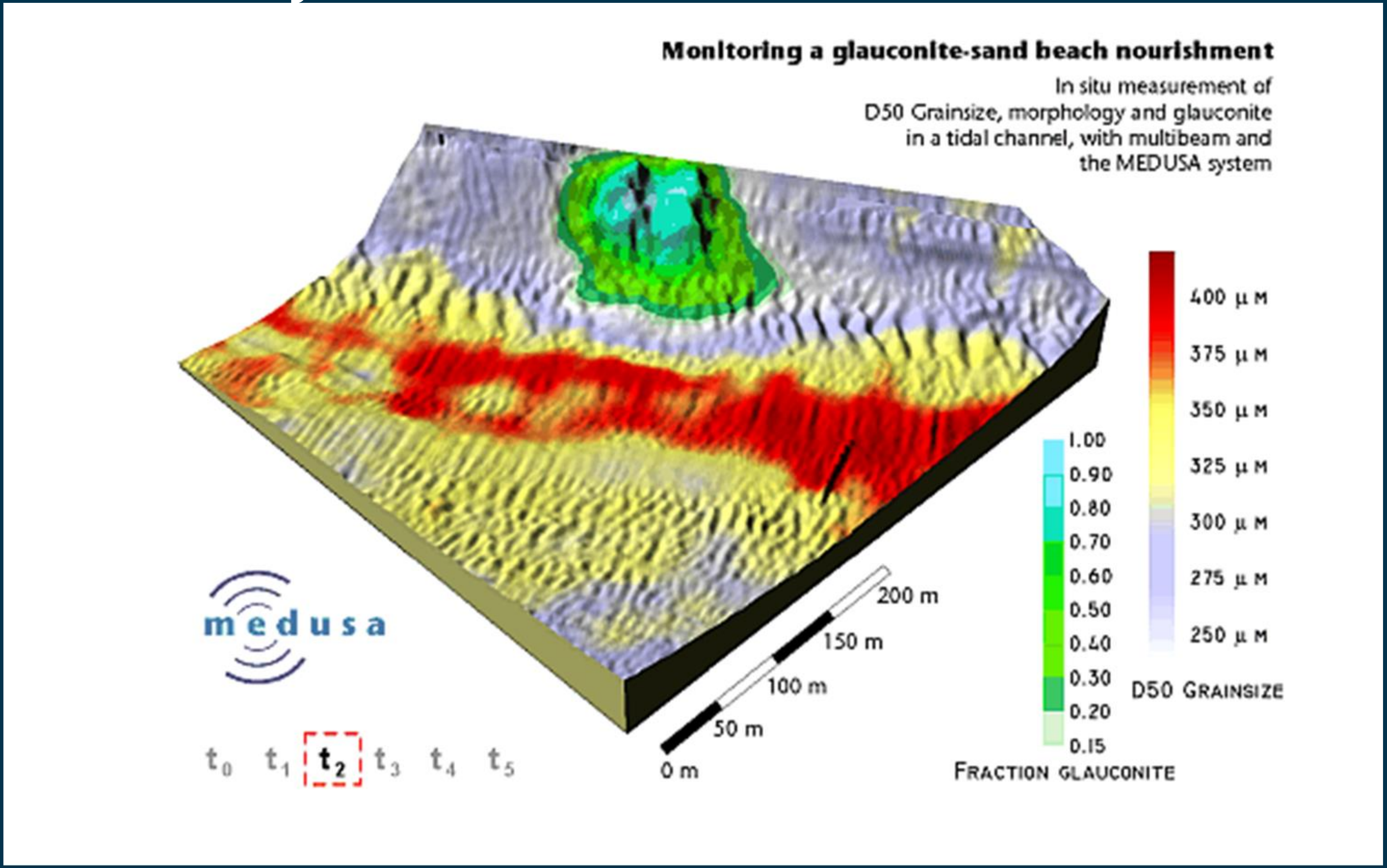
Tracer study – quasi real time mapping



Tracer study



Tracer study



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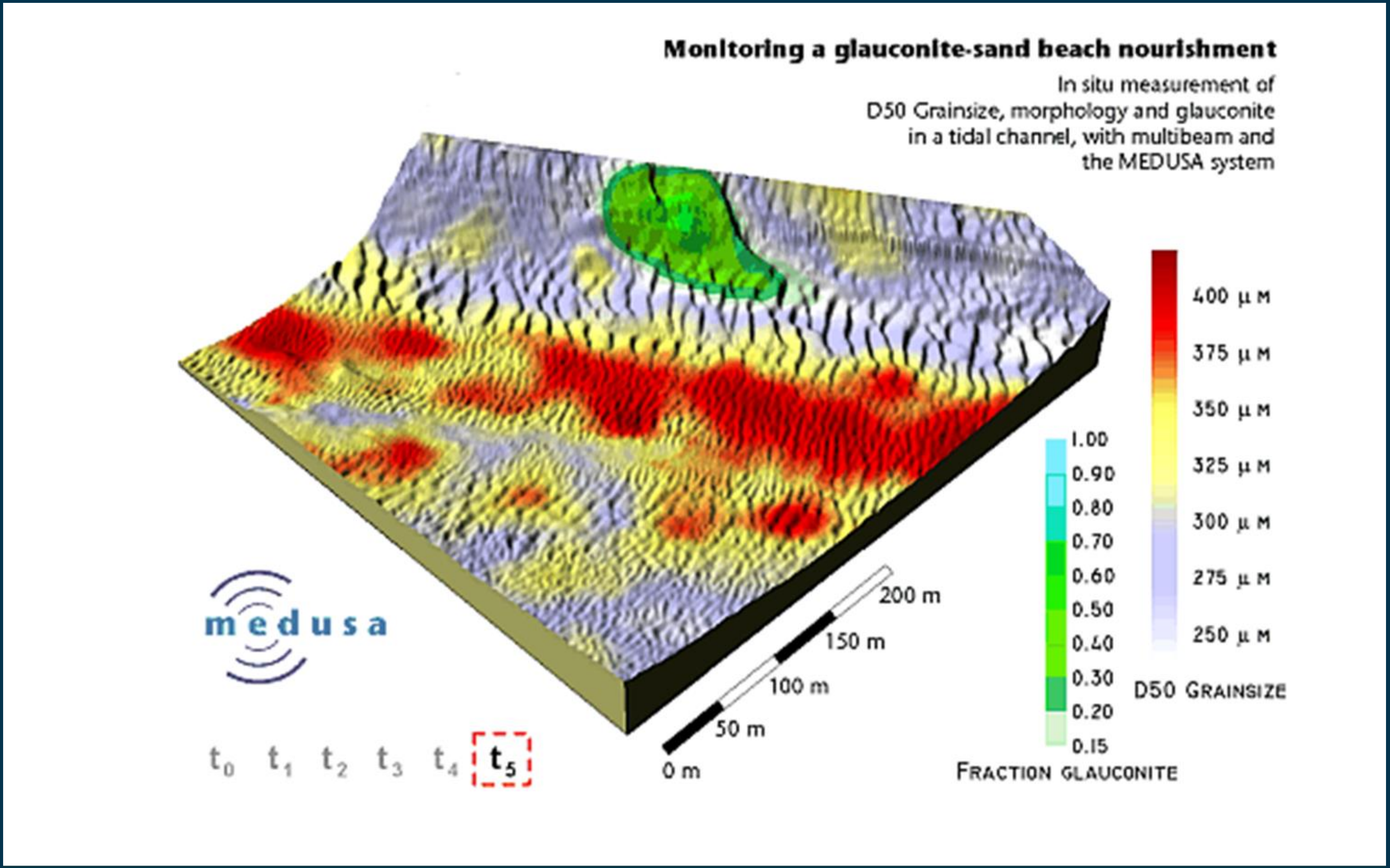

CSEC Technical workshop recognized:

- Huge progress made in the understanding of nearshore berms as feeder systems for beach nourishment
- Critical gaps remain in understanding feeder berms – longshore transport component, temporal processes, cost/benefits vs direct nourishment

SPI would like to:

Work with USACE and other CSEC collaborators to use the SPI nearshore placement area as a test bed for better understanding the science and the efficiency of nearshore berm placement

Achieve through long term (year?) multi-tool study including tracers, wave/current/wind measurements, multibeam etc.