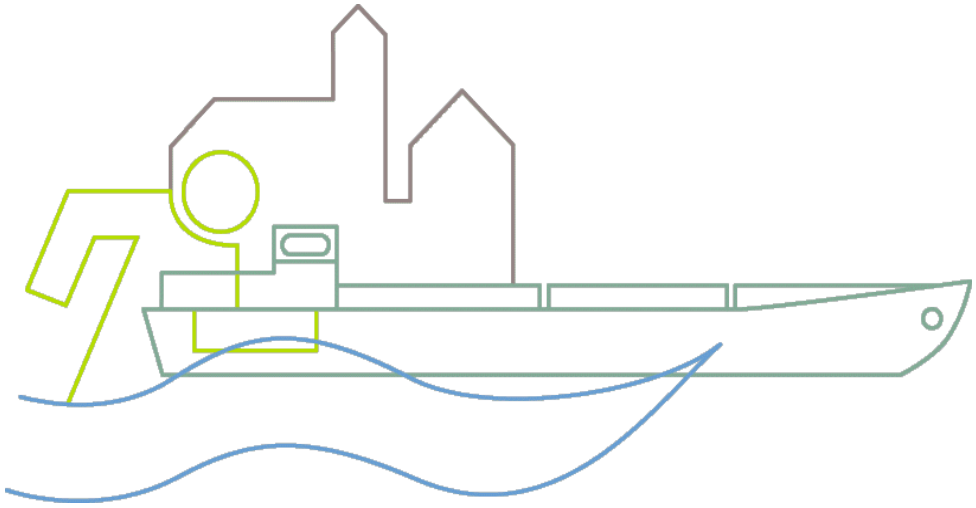

Sediment flux from the Elbe River into the Elbe Estuary
Indications from Multibeam Sonar Surveys

9th international SedNet Conference

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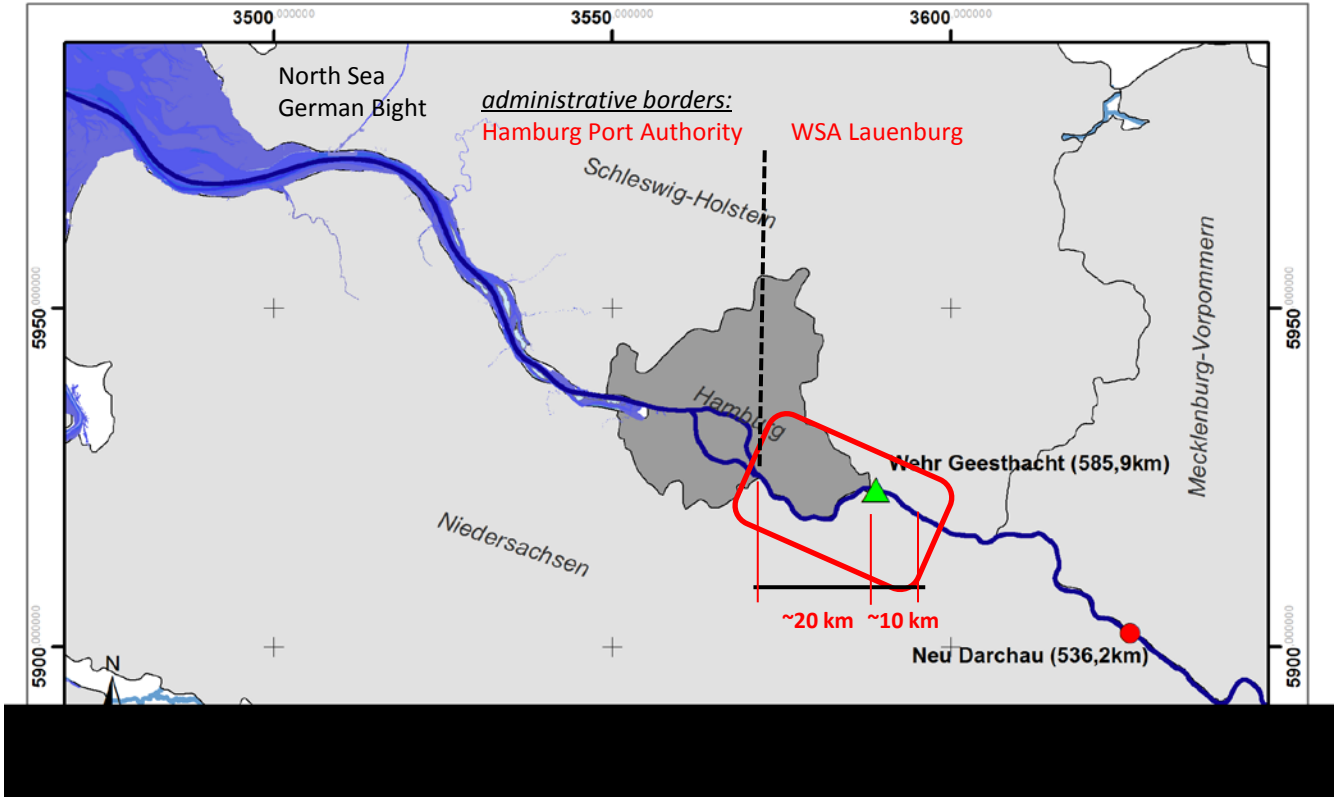
Axel Winterscheid

Department M3 – Groundwater, Geology, River Morphology
Federal Institute of Hydrology, Koblenz, Germany

Study area | up- & downstream of tidal weir Geesthacht



Methodology – determination of erosion and deposition

Data base

Multibeam sonar surveys taken by WSA Lauenburg

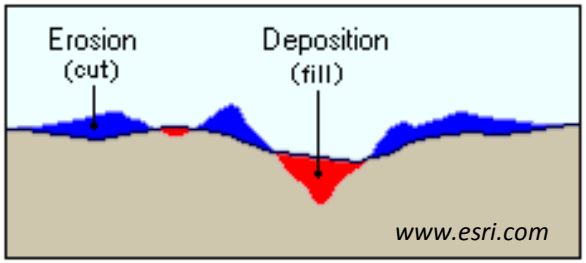
-> spatial resolution of 1 m

-> number (#) of data sets analysed:

20 upstream of weir Geesthacht (km 575 - 585, 2010 - 2014)

22 weir Geesthacht to Hamburg (km 585 - 607, 2008 - 2014)

Calculations of the volume using „cut/fill“ method in ESRI ArcGIS



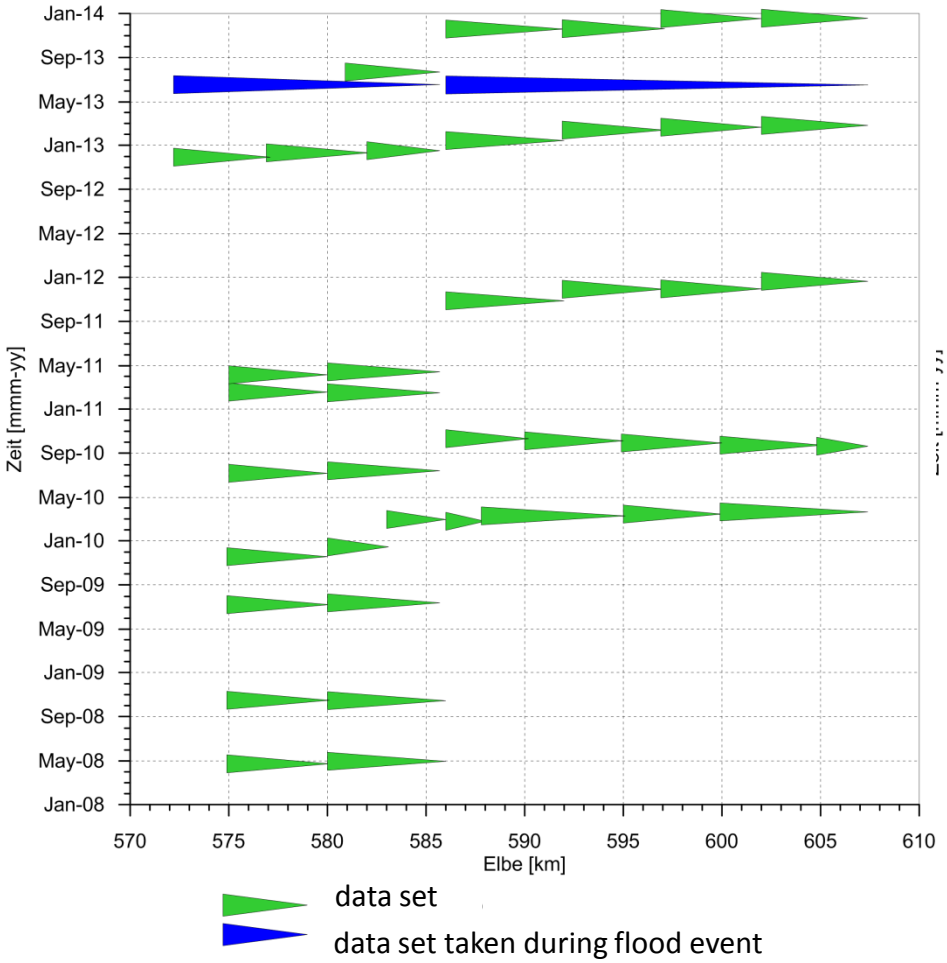
-> volumes defined by the difference between both surfaces

-> each surfaces is defined by the echo sounding data taken at a specific date

-> result of the method: total net volume, total volumes of erosion and deposition

Methodology – data analysis

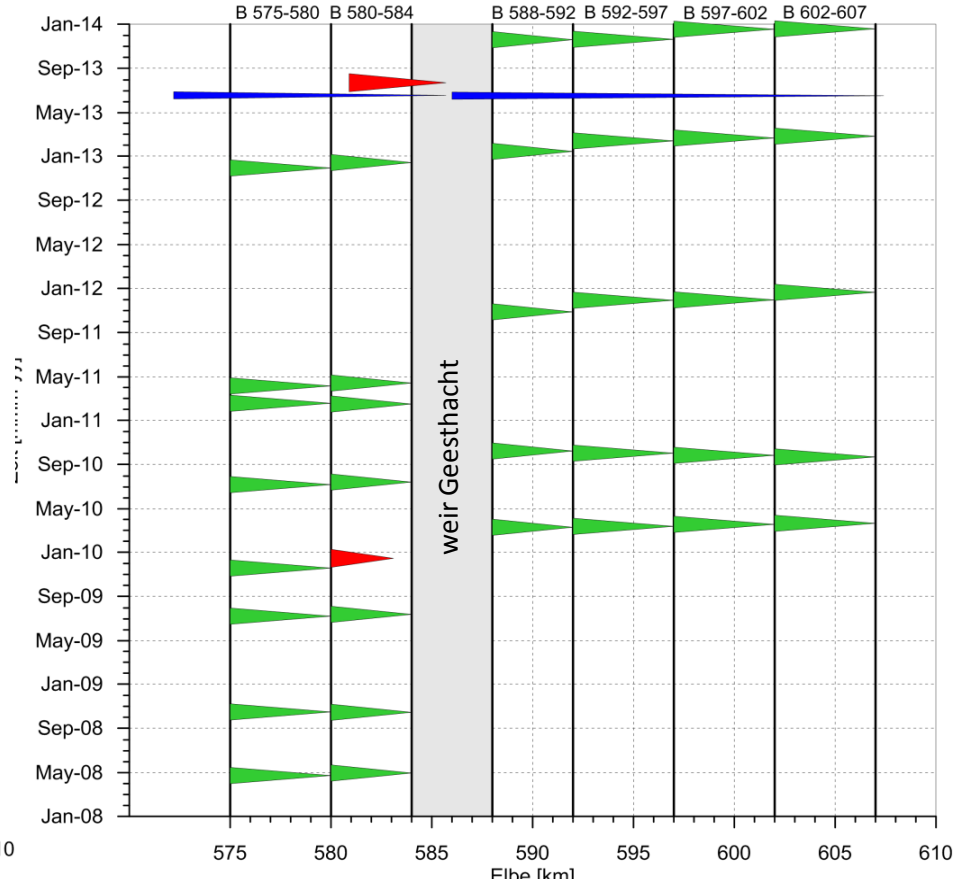
geographical extent
and time of measurement



data set

data set taken during flood event

system boundaries
and data sets



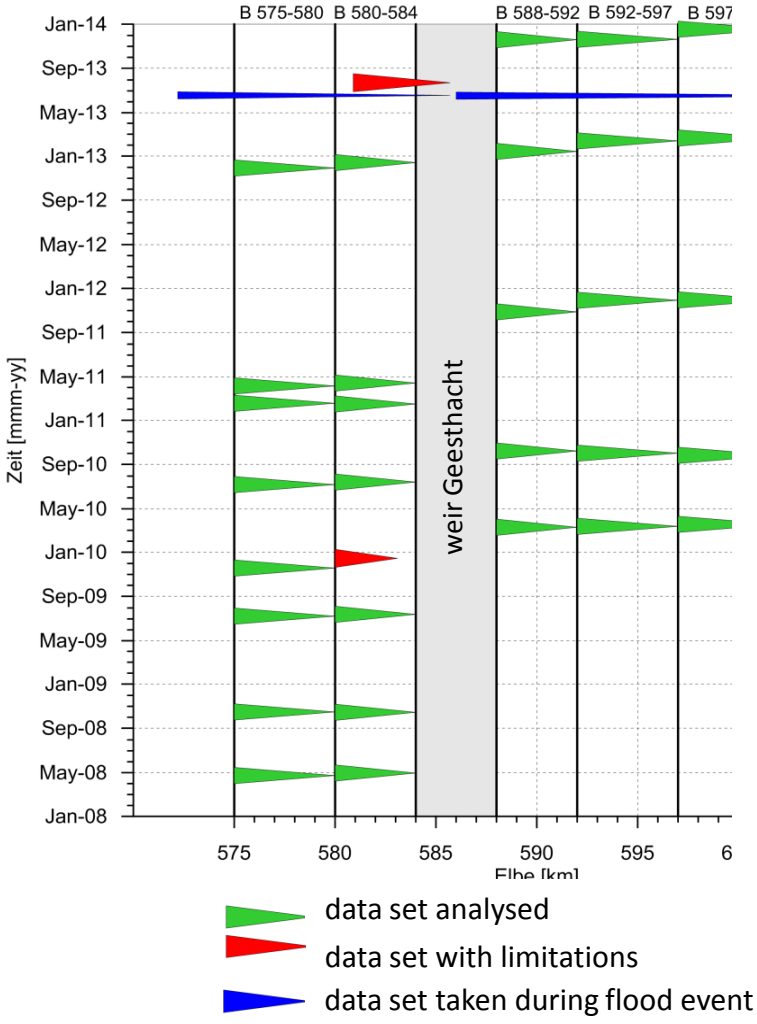
data set analysed

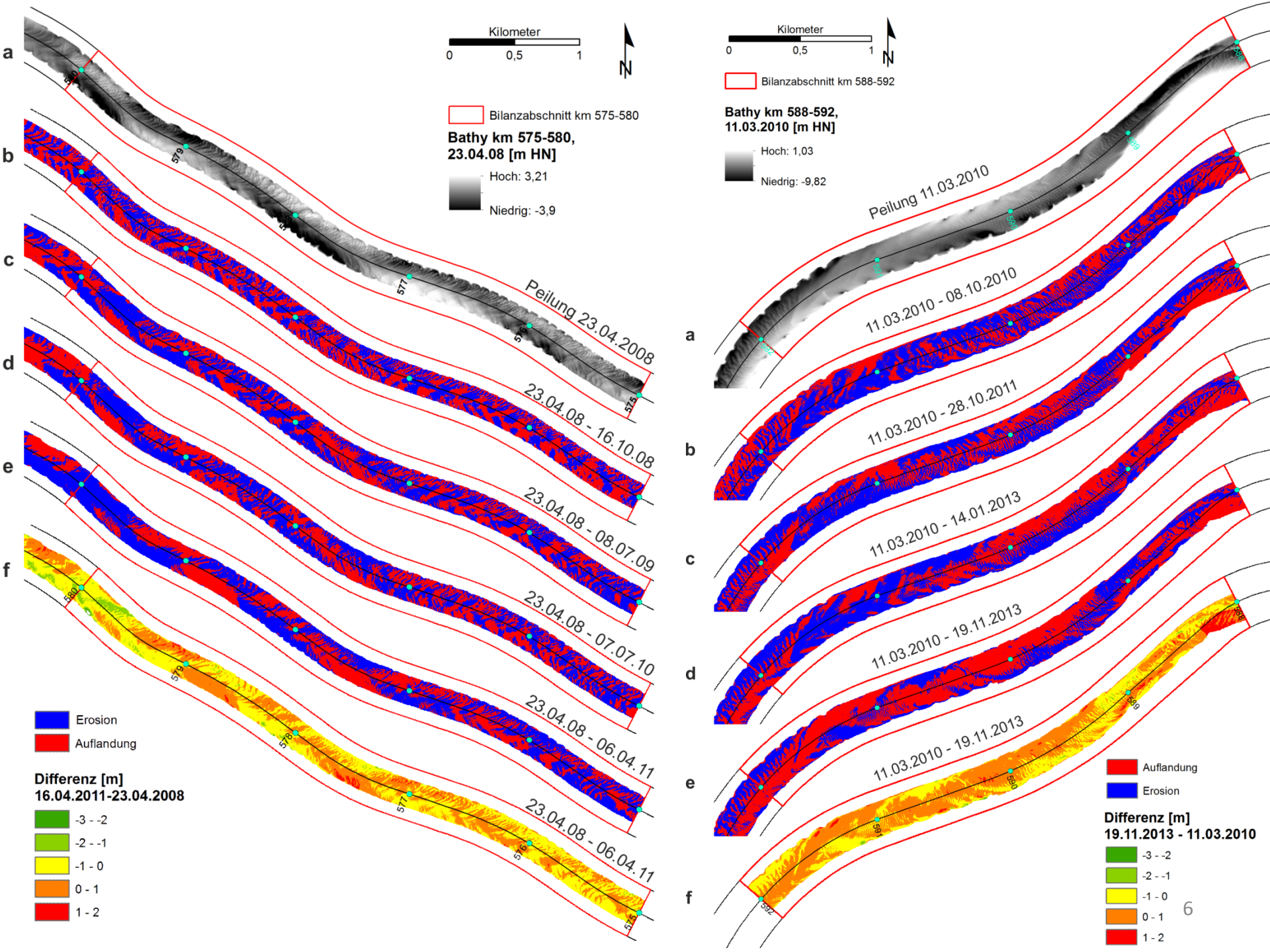
data set with limitations

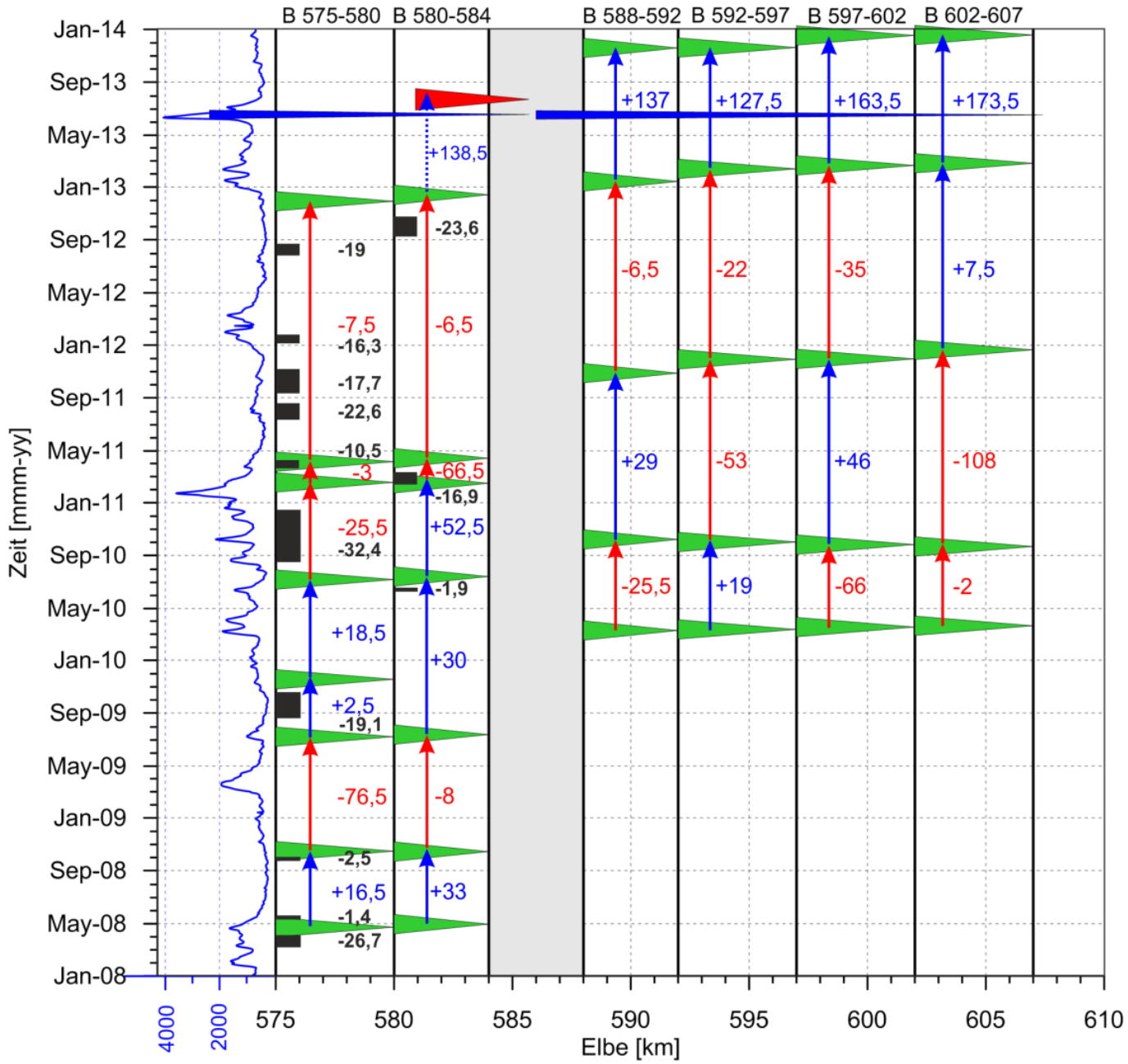
data set taken during flood event

Methodology – data analysis

system boundaries
and data sets




a
b
c
d
e
f
Kilometer
0
0,5
1
N
Bilanzabschnitt km 575-580
Bathy km 575-580,
23.04.08 [m HN]
Hoch: 3,21
Niedrig: -3,9
Peilung 23.04.2008
23.04.08 - 16.10.08
23.04.08 - 08.07.09
23.04.08 - 07.07.10
23.04.08 - 06.04.11
23.04.08 - 06.04.11
Erosion
Auflandung
Differenz [m]
16.04.2011-23.04.2008
-3 - -2
-2 - -1
-1 - 0
0 - 1
1 - 2
Kilometer
0
0,5
1
N
Bilanzabschnitt km 588-592
Bathy km 588-592,
11.03.2010 [m HN]
Hoch: 1,03
Niedrig: -9,82
Peilung 11.03.2010
11.03.2010 - 08.10.2010
11.03.2010 - 28.10.2011
11.03.2010 - 14.01.2013
11.03.2010 - 19.11.2013
11.03.2010 - 19.11.2013
Auflandung
Erosion
Differenz [m]
19.11.2013 - 11.03.2010
-3 - -2
-2 - -1
-1 - 0
0 - 1
1 - 2



Change in net volume
[10^3 m^3]

blue: deposition
red: erosion

dredged volumes

(not included in numbers indicating change in net volume)

Interim conclusions

River section weir Geesthacht to Hamburg (km 588 - 607)

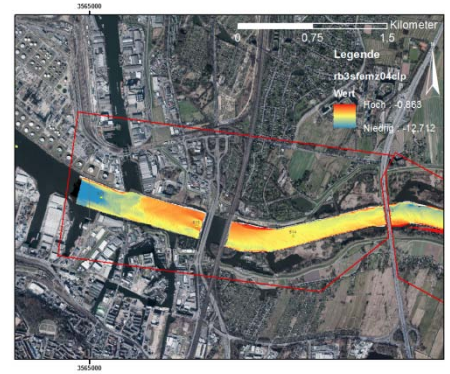
- results indicating an overall trend towards erosion (2010-2013)
- strong flood events are causing large amounts of sediments to enter the tidal influenced part of the Elbe (lower Elbe)
- e.g. June 2013 flood event (net deposition of ~600.000 m^3 between weir Geesthacht and Hamburg, km 588 - 607)

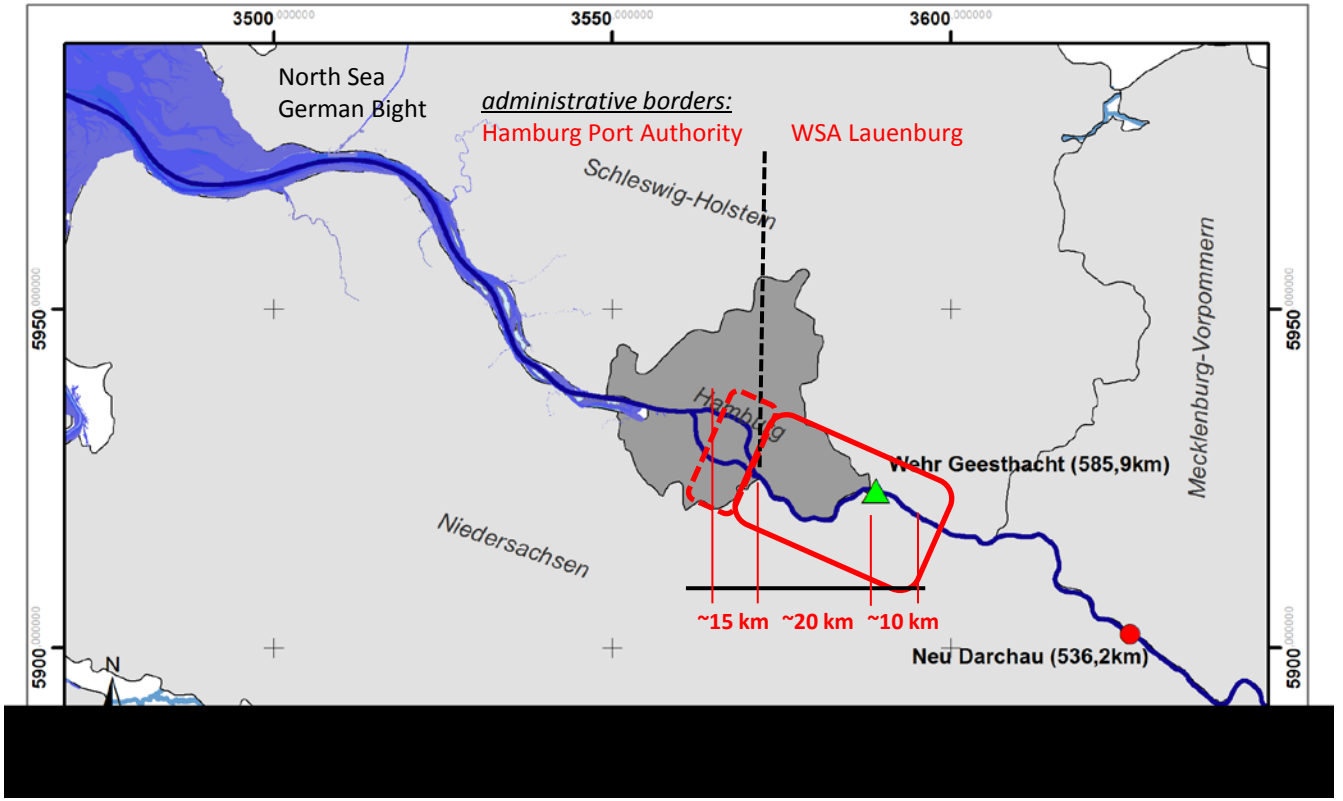
River section upstream of weir Geesthacht (km 575 - 584)

- weir is a barrier strongly effecting the bed load transport (except in situations with $Q > 1100\ m^3/s$)
- results indicate an overall trend towards deposition (2004 – 2014)
- very likely: strong deposition because of the June 2013 flood event
- dredging is required to keep a „morphological balance“

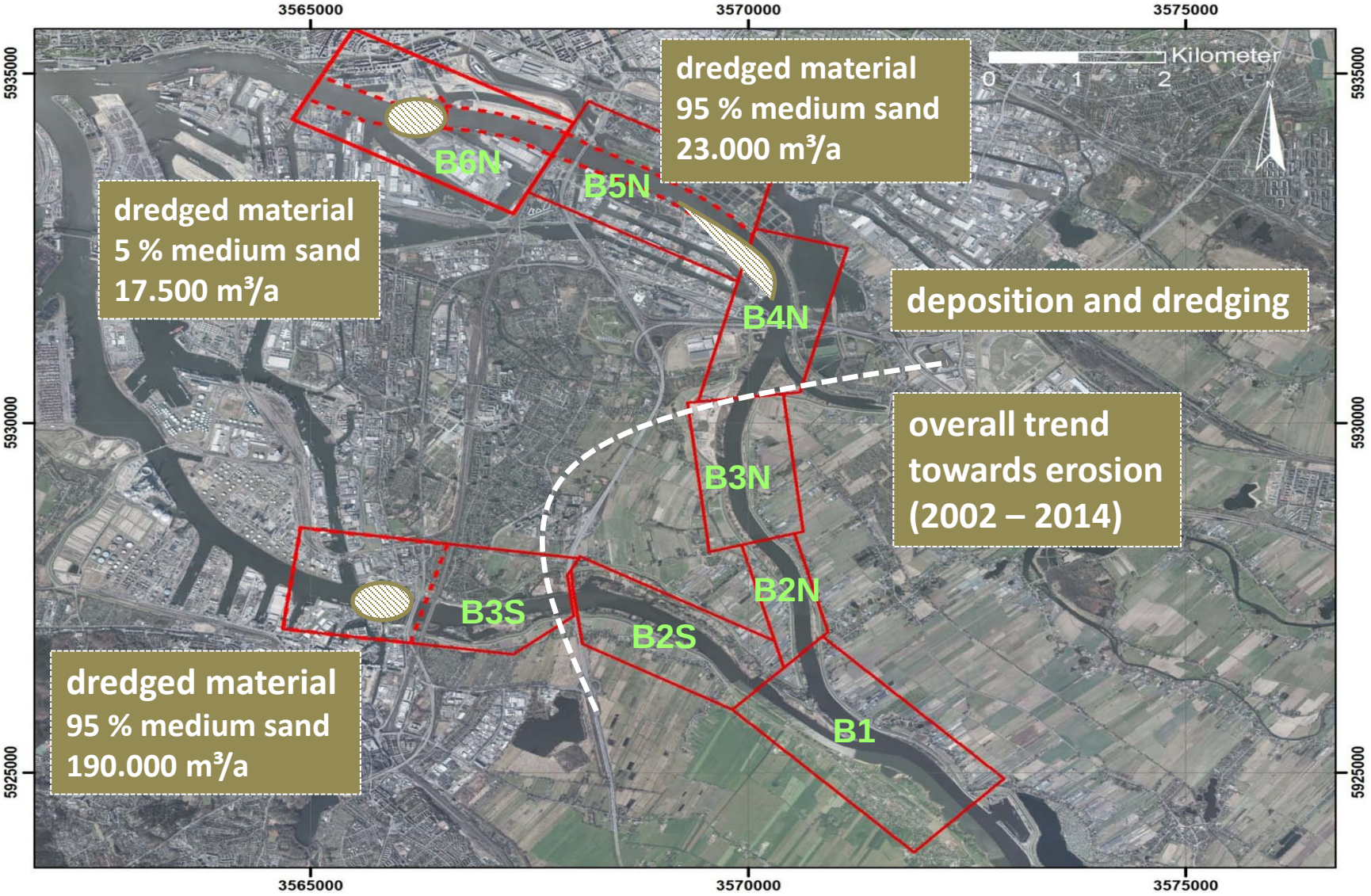
-> knowing more about erosive trend: set up of sediment balance for medium sand!

Study area | expansion downstream to Hamburg port area

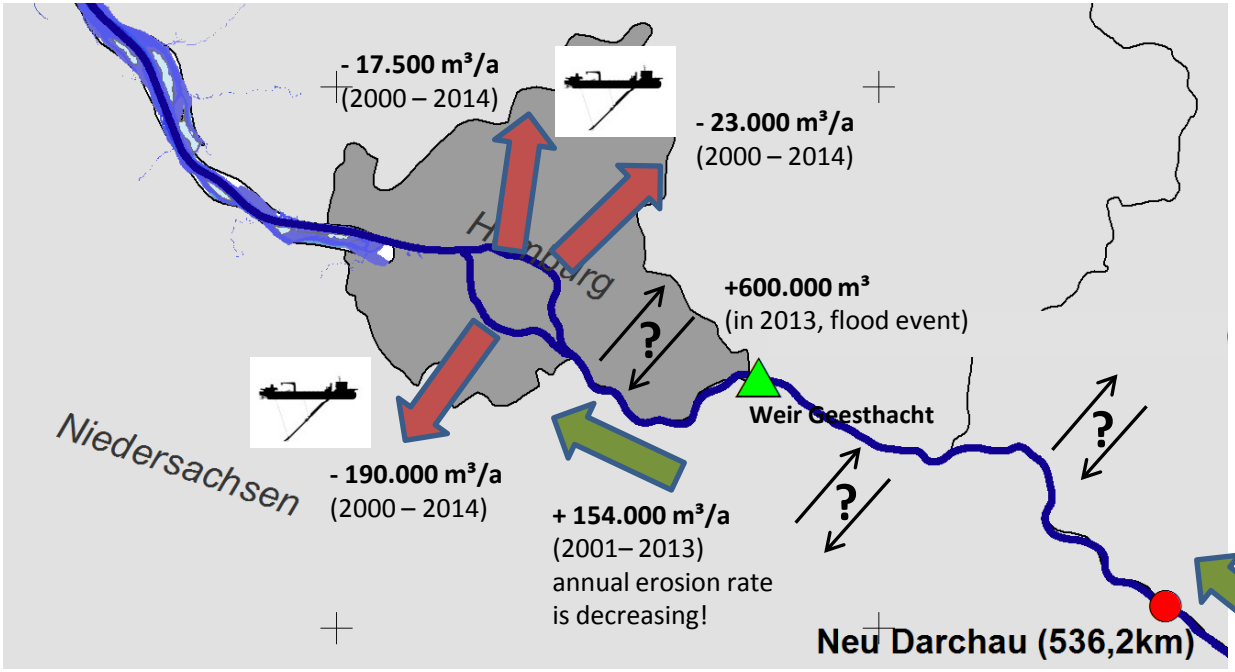


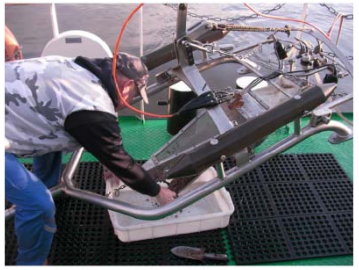


Results Hamburg port area



A first sediment balance for medium sand





+ 146.000 m³/a (max. estimated value)
(1996 – 2008)
plus 50.000 m³/a (coarse sand)

Input: 146.000 + 154.000 = 300.000 [m³/a]

Output: 17.500 + 23.000 + 190.000 = 230.500 [m³/a]

(Period 2000-2013)

Uncertainties: section Elbe-km 536-575, groyne fields, areas next to fairway, backwater of the weir (partly), conversion between volume and mass, suspended transport of medium sand, **extreme flood events**