Jade Bay surface sediment analysis

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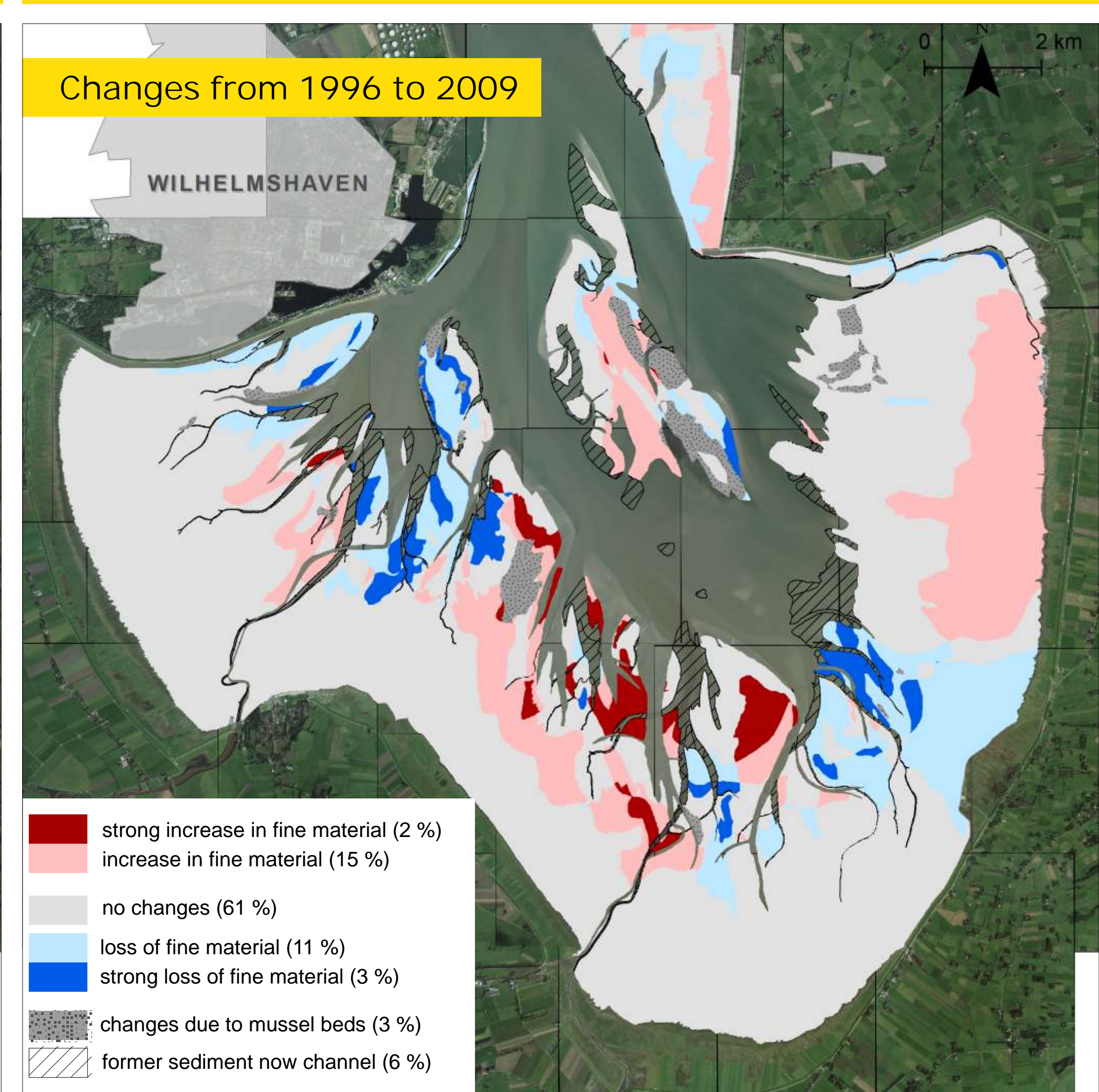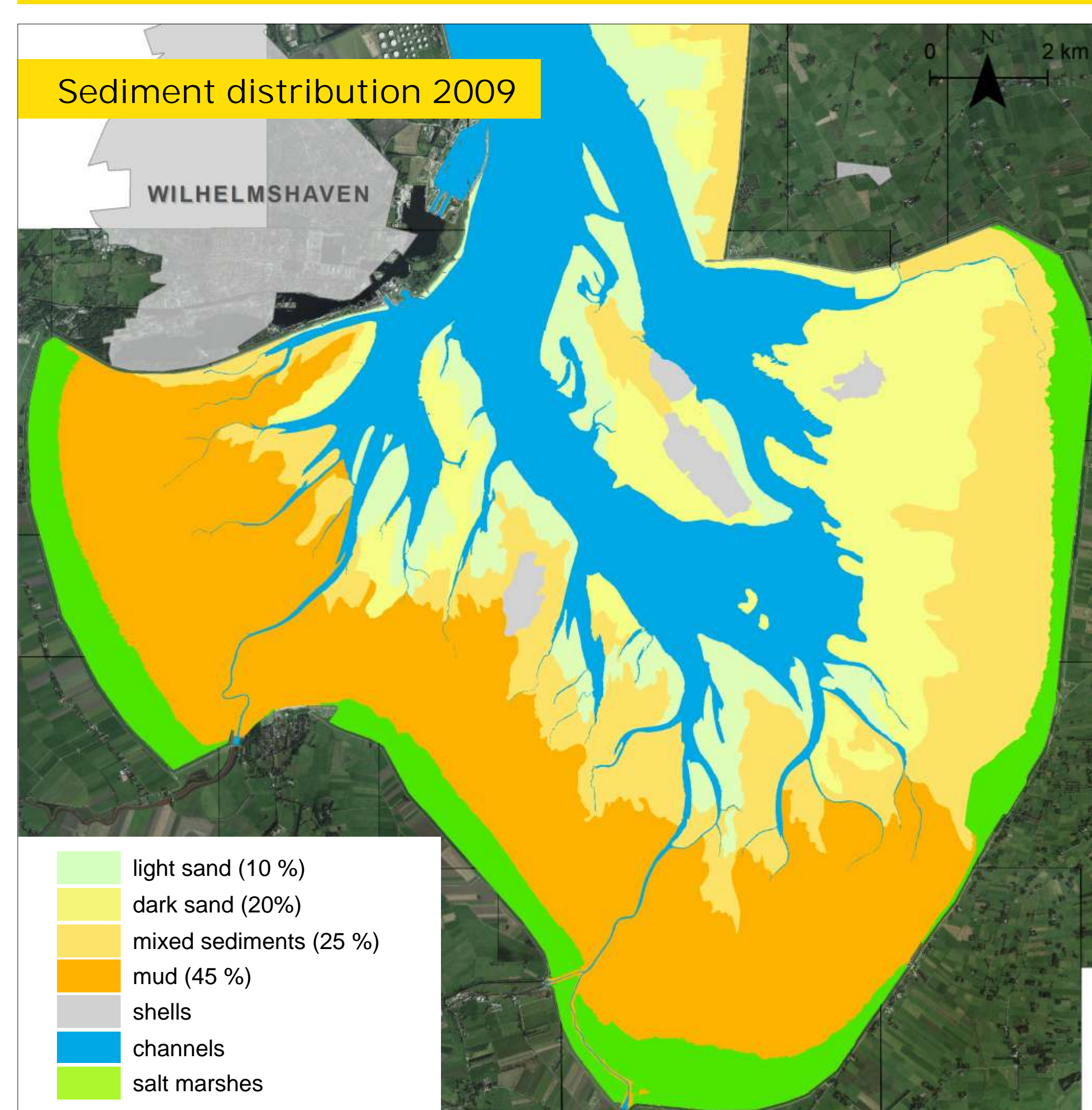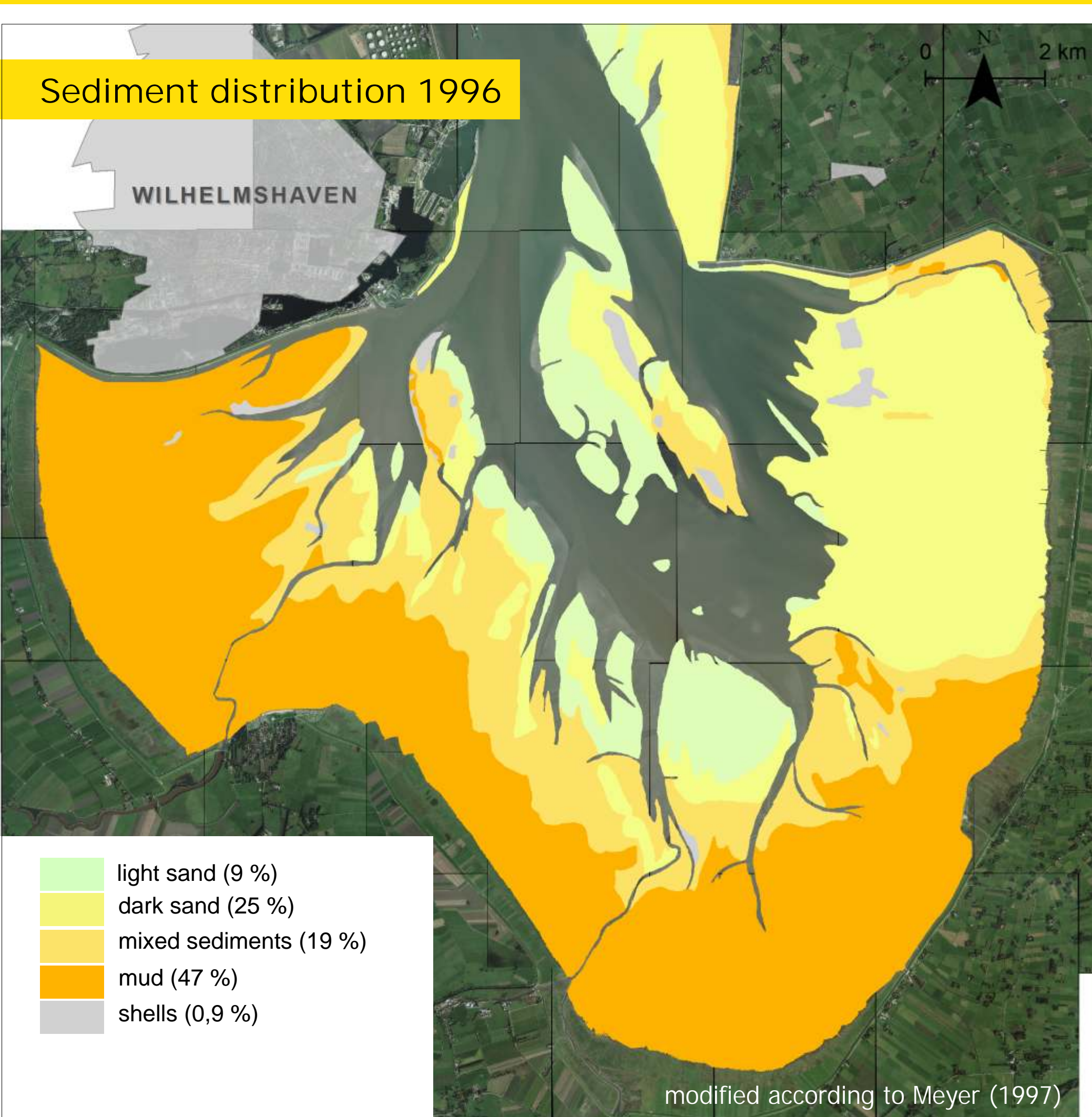
Introduction

Aim of the study was to create a digital map of the current intertidal surface sediment distribution of the Jade Bay. This shallow tidal basin is located in the Lower Saxony Wadden Sea, Germany. It covers an area of 172 km^2, whereas the littoral area is in the order of 123 km^2. The map will be used for GIS applications and as input for numerical models respectively.

Methods

For the current approach high resolution aerial images (0,3 x 0,3 m) and sediment samples by means of ground truth were evaluated for the summer of 2009. The photographs, taken at low tide, were visually interpreted in ArcGIS10. The image interpretation was verified with results of sediment core analysis, processed with a laser granulometer and a sedimentation tube in parallel. Sediment classes based on the increasing content of organic fine material were chosen as light (<8 %) and dark sand (8-12 %), mixed sediments (12-40 %) and mud (>40 %). Furthermore, channels, shells and salt marshes were identified. The classification results were compared with an existing map based on 1996 data.

Sediment distribution 1996

WILHELMSHAVEN

- light sand (9 %)
- dark sand (25 %)
- mixed sediments (19 %)
- mud (47 %)
- shells (0,9 %)

modified according to Meyer (1997)

Sediment distribution 2009

WILHELMSHAVEN

- light sand (10 %)
- dark sand (20%)
- mixed sediments (25 %)
- mud (45 %)
- shells
- channels
- salt marshes

Changes from 1996 to 2009

WILHELMSHAVEN

- strong increase in fine material (2 %)
- increase in fine material (15 %)
- no changes (61 %)
- loss of fine material (11 %)
- strong loss of fine material (3 %)
- changes due to mussel beds (3 %)
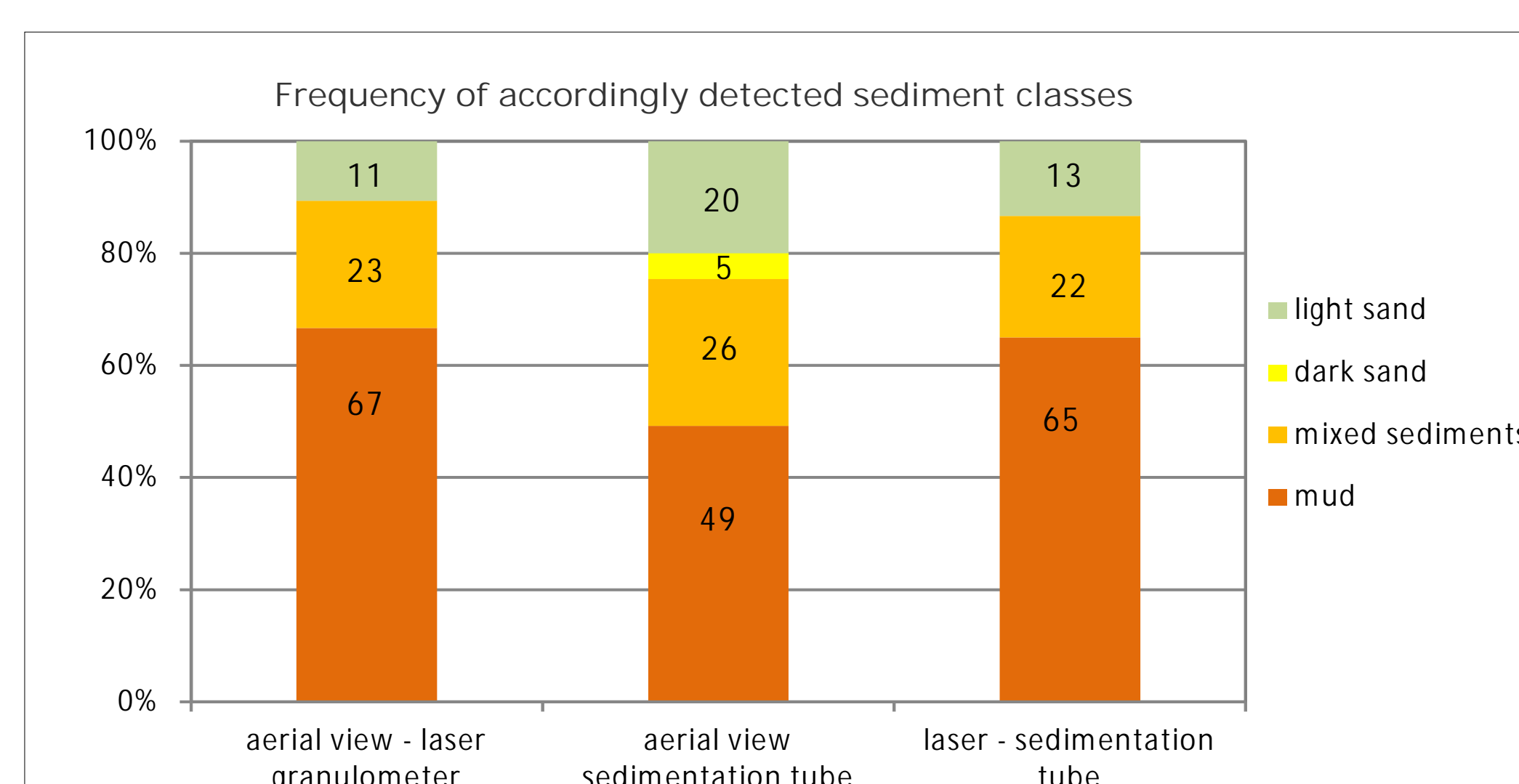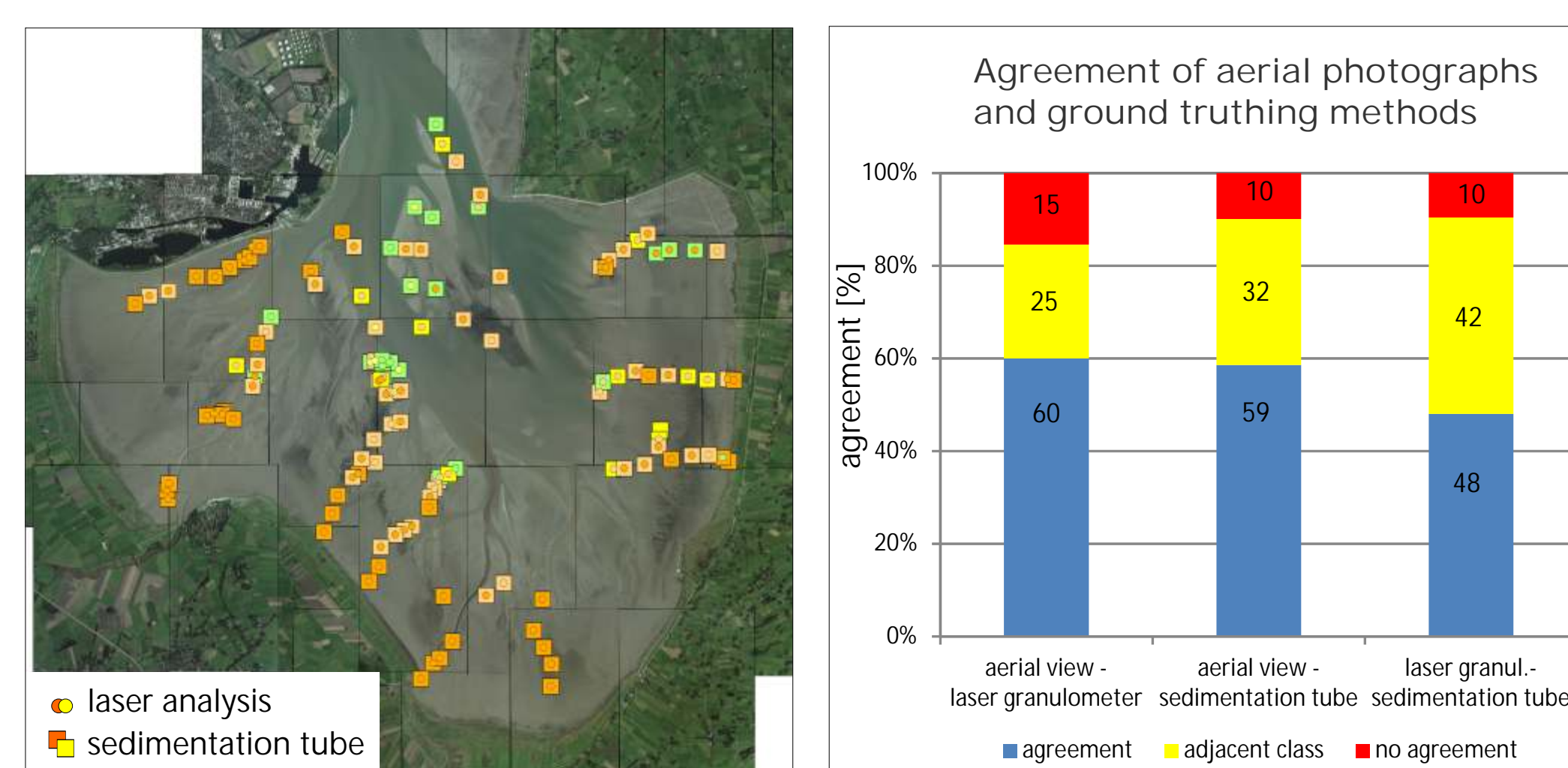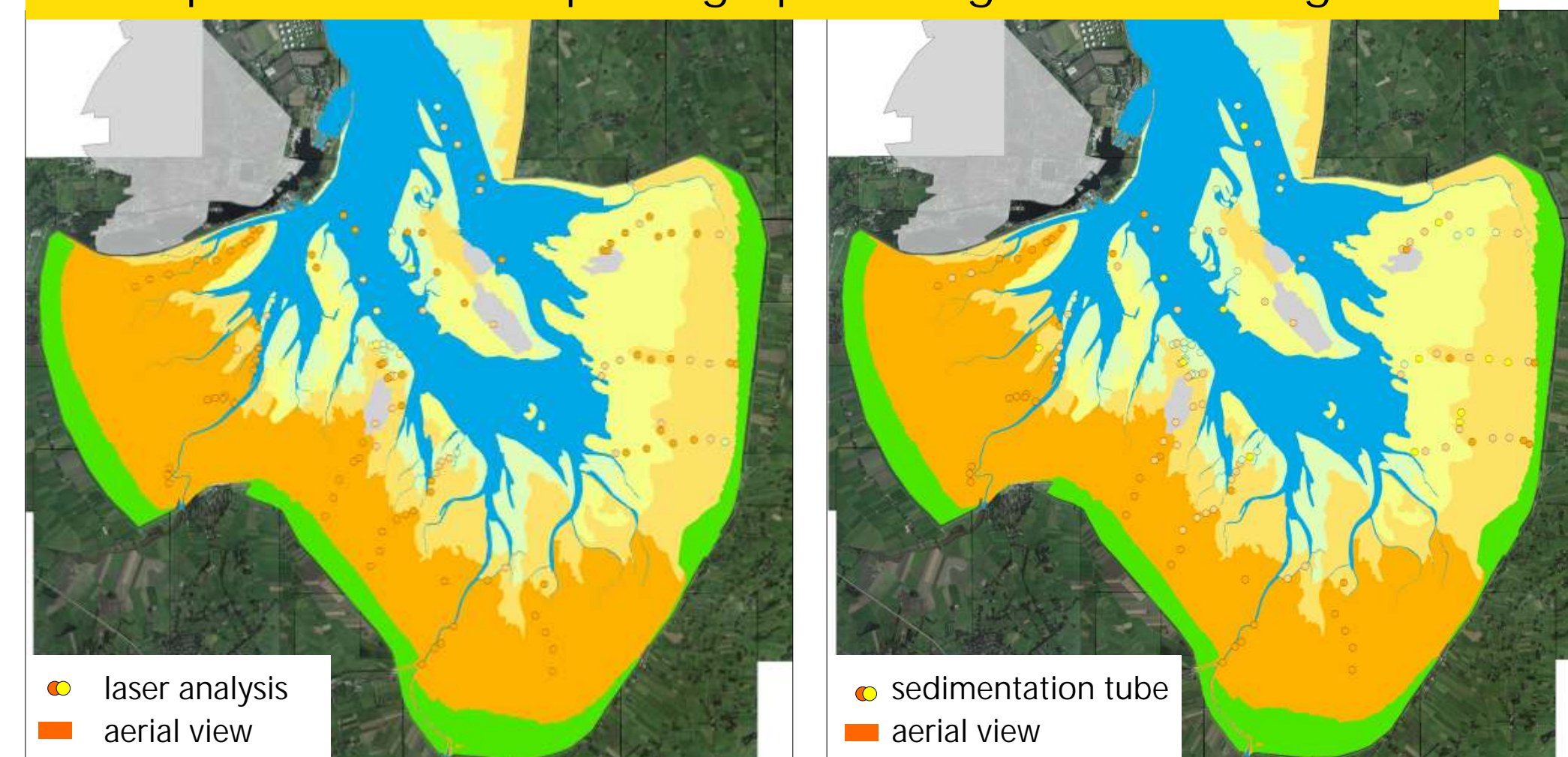- former sediment now channel (6 %)

Results - Image interpretation

The predominant sediments of the Jade Bay show a differentiated spatial distribution dependent on the local hydro- and morphodynamics, with a gradient from coarse to fine sediments towards the shoreline. The recent spatial sediment classification yields to a percentage of 45 % mud, 25 % mixed sediment and 20 % dark sand and 10 % light sand respectively.

This basically indicates a stable spatial and temporal sediment distribution for 61 % of the Jade Bay area since 1996, whereas 17 % are characterized by an increase of fine material and 13 % by a loss (6 % changed due to movement of channels and 3 % due to shells).

Comparison of aerial photographs and ground truthing results

- laser analysis
- aerial view

- sedimentation tube
- aerial view

- laser analysis
- sedimentation tube

Agreement of aerial photographs and ground truthing methods

	aerial view - laser granulometer	aerial view - sedimentation tube	laser granul. - sedimentation tube
agreement	60	59	48
adjacent class	25	32	42
no agreement	15	10	10

agreement [%]

Frequency of accordingly detected sediment classes

	aerial view - laser granulometer	aerial view - sedimentation tube	laser - sedimentation tube
light sand	11	20	13
dark sand	23	5	22
mixed sediments		26	
mud	67	49	65

Sampling methods

Classification results are in ~60 % agreement for image interpretation and ground truthing. The accordance between both sampling analysis methods is in the order of 48 %.

Issues were detected in distinguishing mixed sediments from remaining classes due to rather small differences in mud content for adjacent classes. The laser analyser tends to overestimate fine particles compared to the sedimentation tube. Mud was found to be the most reliable sediment class to determine (49-67 %).

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