

Hydrographical Surveying of the Subaqueous Delta Plain of the River Rhine at Lake Constance



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Introduction

- Alpenrhein: Erosion - sedimentation
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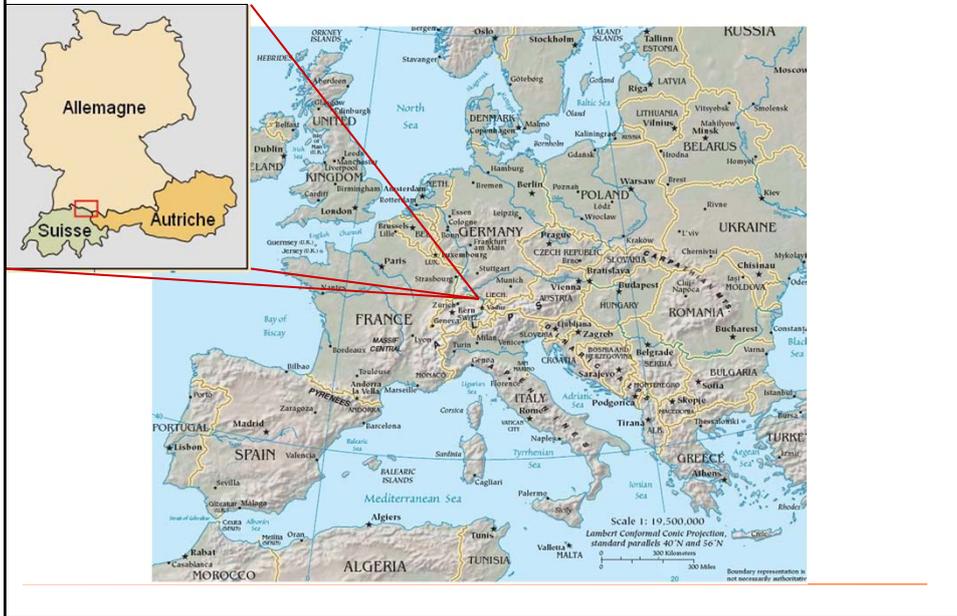
Determination of the sediment distribution

- Adjustment of the data using sediment core samples
- Volume calculation by difference DTMs 1999-2008



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Introduction: Alpenrhein



Introduction: Alpenrhein



Introduction: Alpenrhein / erosion



➤ Alpine river with huge suspension load due to

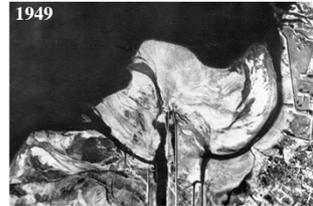
- soil erosion: rain catchment area of 7 tributaries; ~ 6.000 km²
- rock erosion: glaciers / snow



Introduction: Alpenrhein / sedimentation / delta forming



Introduction: Alpenrhein / sedimentation / delta forming



River channel extended into Lake Constance by lengthening its levees to avoid the sedimentation of the bays surrounding the alluvial delta



Objectives of the hydrographic surveying

undertaken since 1911 approximately every ten years

1. To monitor the sedimentation process
2. To verify the effectiveness of undertaken embankment dam constructions due to the sediment distribution in the lake:
 - location
 - amount
3. Campaign 2008: Obtain base data for hydraulic / numeric 2D-modelling

Methodology

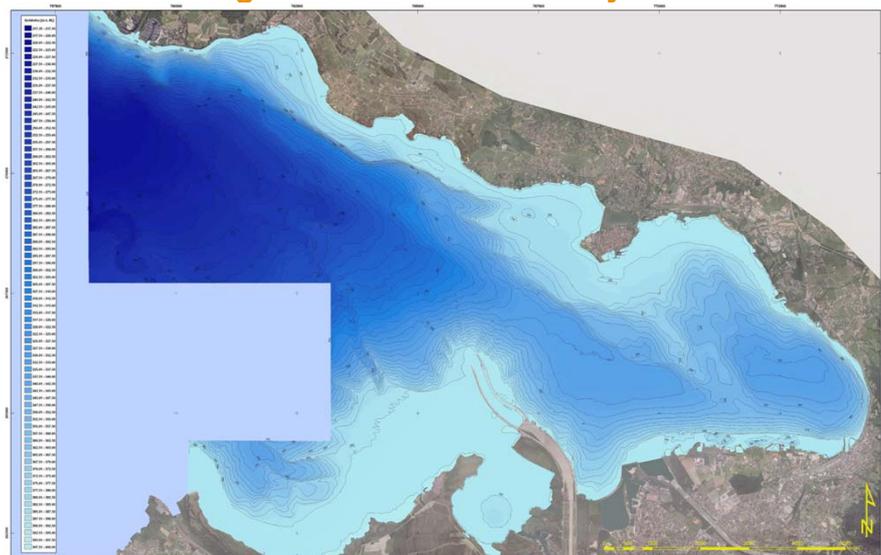
➤ Single-beam echosounding

- along predefined survey lines (1.000 km; area of 92 sqkm)
- for comparability of the depth measurements taken in former campaigns
- Multi frequency (210/38/15 kHz) for sediment thickness calculations

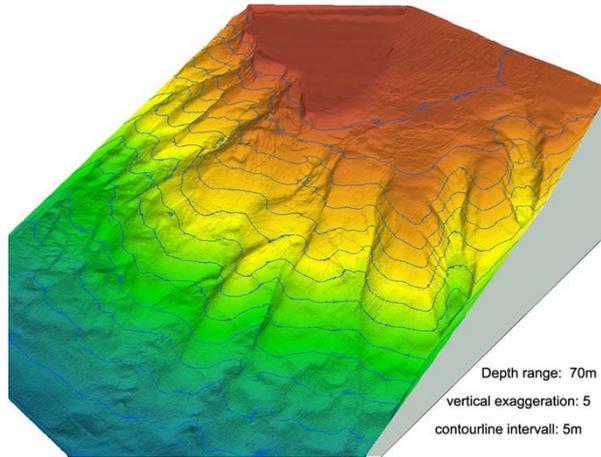
➤ Multi-beam echosounding

- High end level (equipment & staff)
 - 100% overlapping of the swath
 - Zero (reference) measurement for future MBS activities
- } to ensure quality

Map of the lakebed resulting from of the 2008 survey

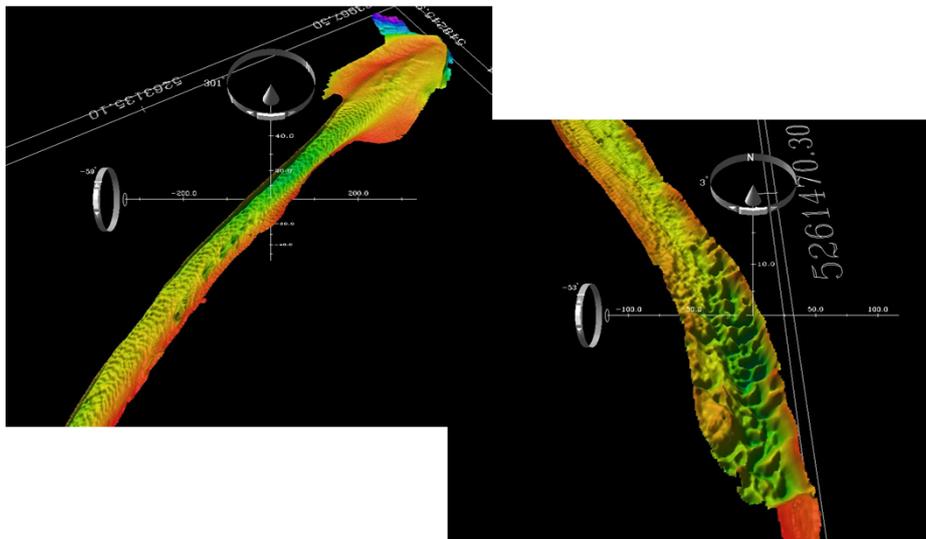


True-to-detail digital terrain model of the subaqueous delta plain of the Rhine



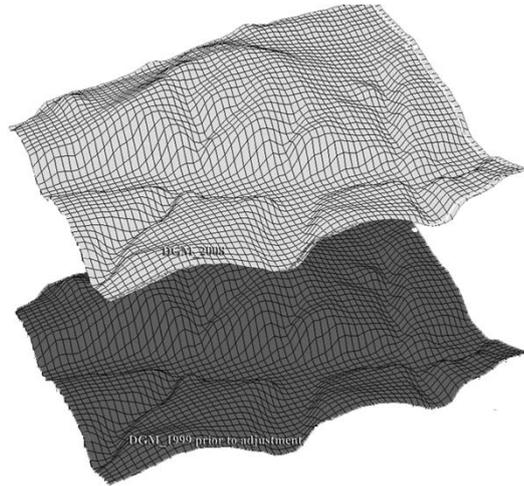
Depth range: 70m
vertical exaggeration: 5
contourline interval: 5m

Delta plain with dredging holes in the river bed



3) Determining the sediment distribution

by means of comparing the models from 1999 and 2008

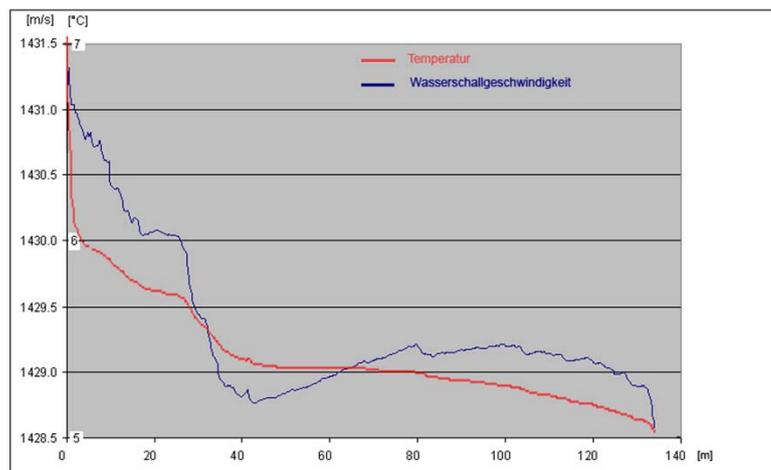


Uncertainty in 1999 depth calculation

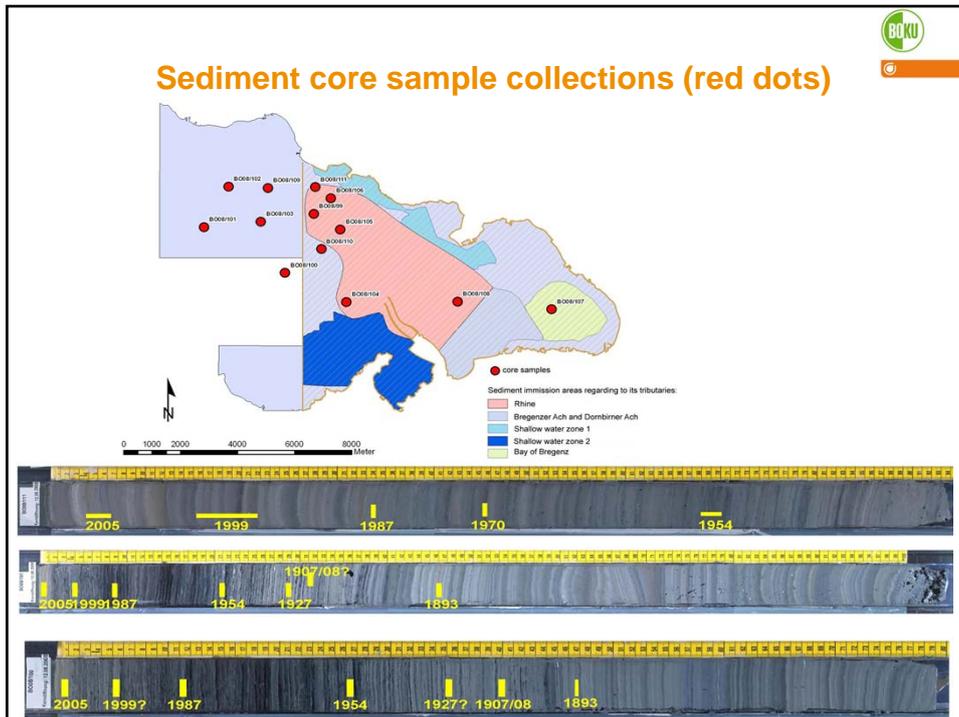
Theoretically calculated value for sound speed correction in 1999:

10-30m 1433

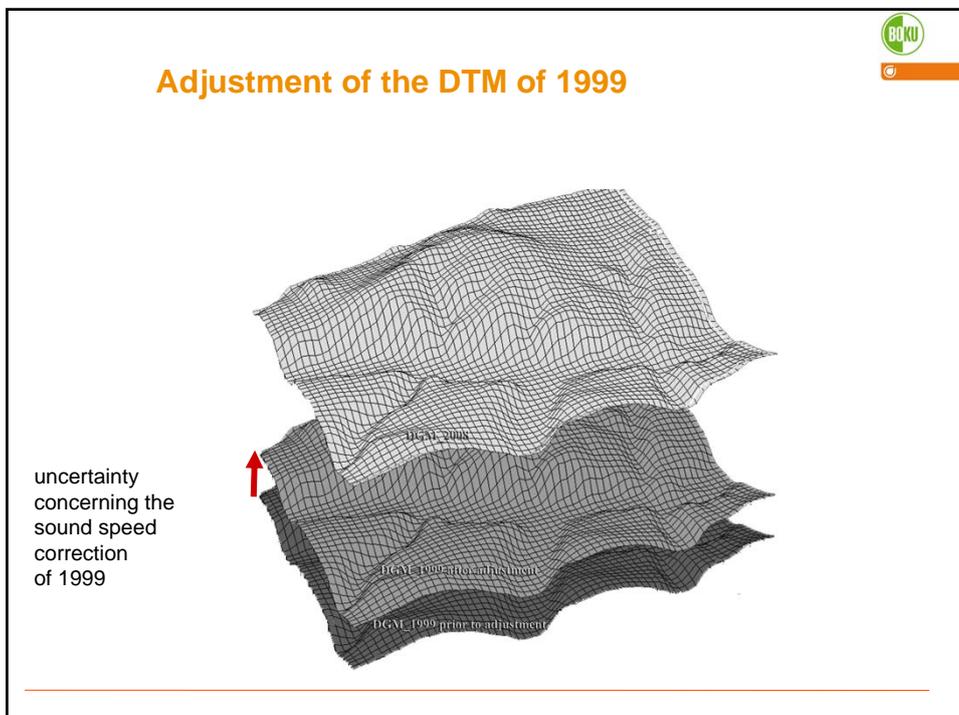
>30m 1426

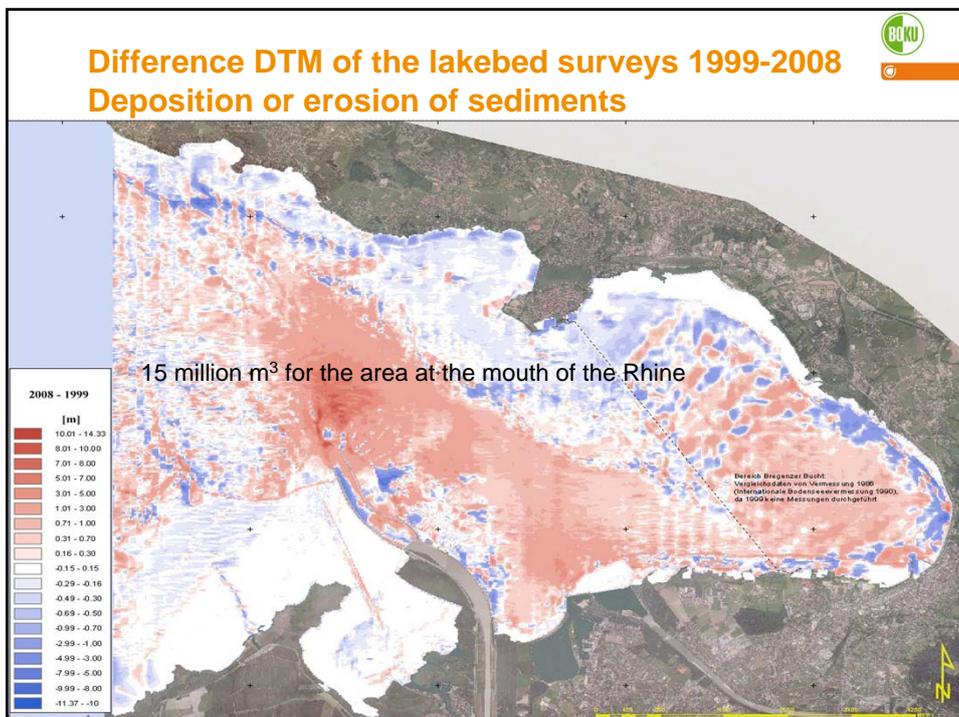
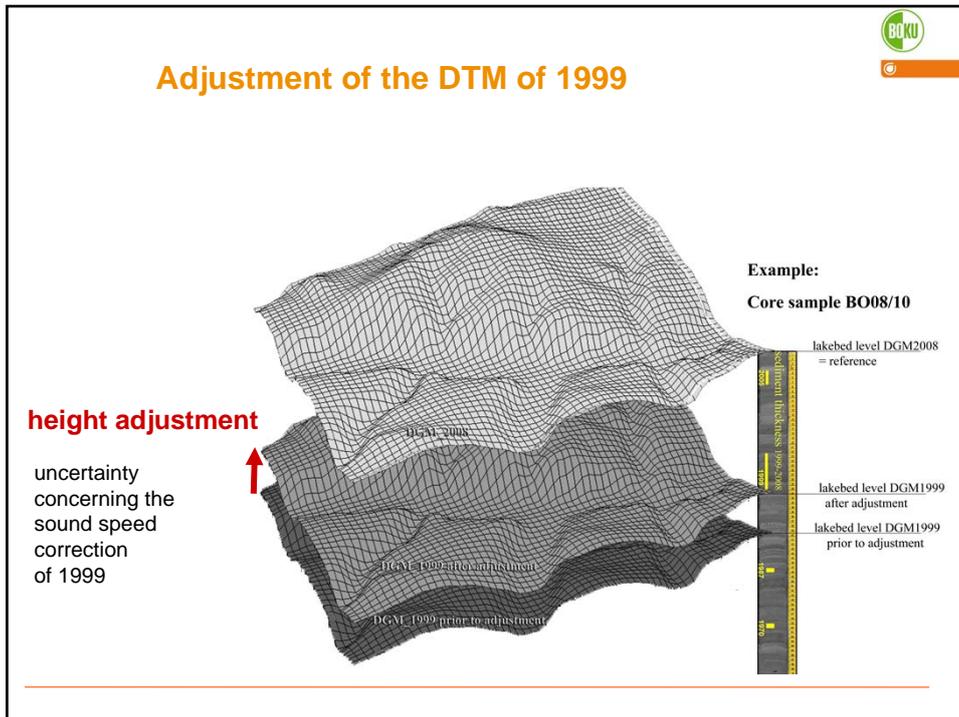


Sediment core sample collections (red dots)



Adjustment of the DTM of 1999

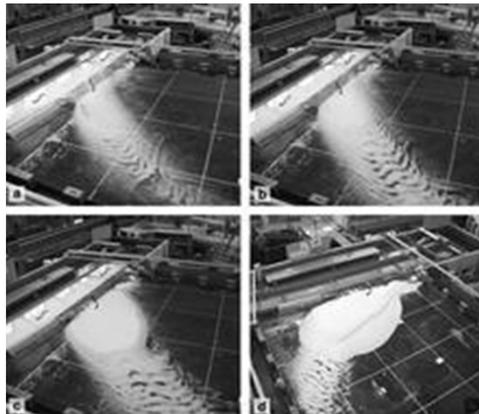




Outlook: MBS & Hydraulic modelling

Investigations on redirecting flows and sediments during floods through levee breaches

Lake sediment outside of the levee breach



after

- (a) 7 minutes,
- (b) 25 minutes,
- (c) 68 minutes,
- (d) 102 minutes - final status

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