



Ecobeach Study

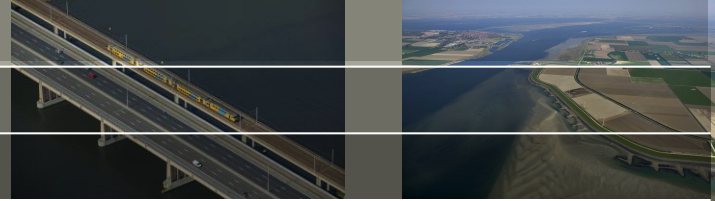
Study Overview & Preliminary findings

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Objectives & Approach



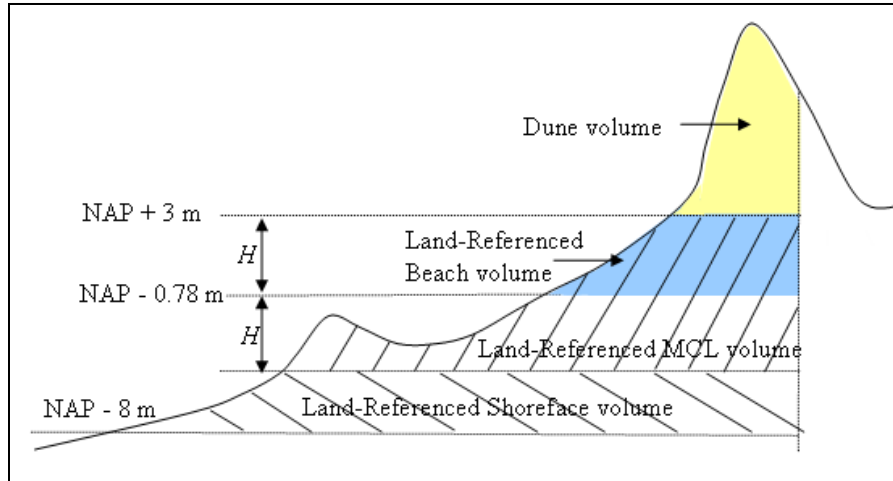
The overall objective to provide an independent qualitative and quantitative analysis of the morphological impact the PEM's at Egmond.

Sub-Objectives (& Approach):

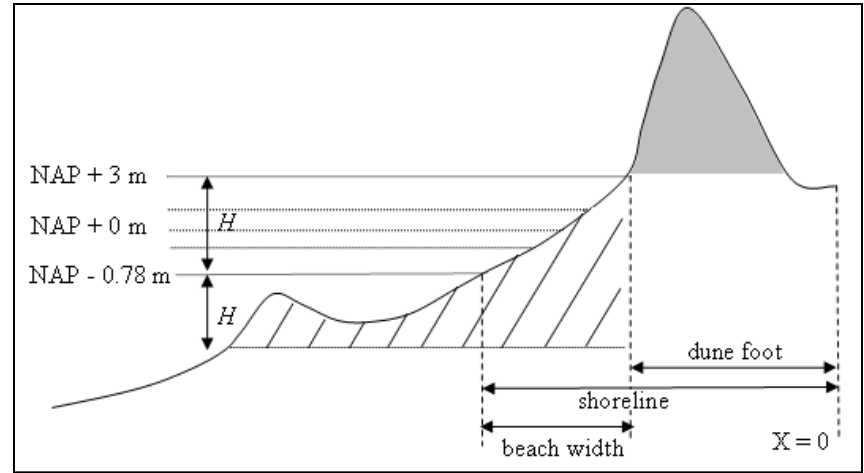
1. Identify and quantify data errors
2. Define and calculate relevant coastal state indicators
3. Quantification of the temporal variability
4. Address the influence of beach and shoreface nourishments
5. Evaluation of the Ecobeach system

Step 2: Define and calculate relevant coastal state indicators

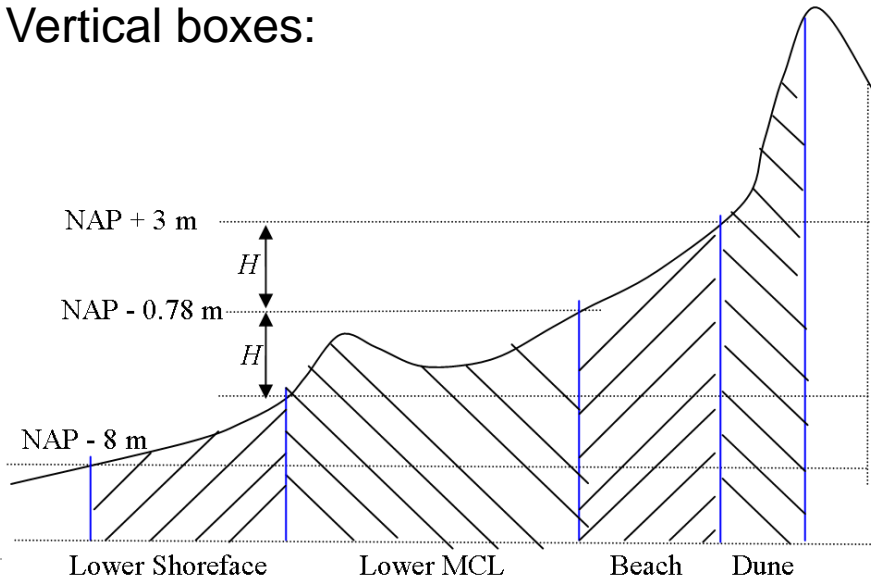
Horizontal boxes:



Others:



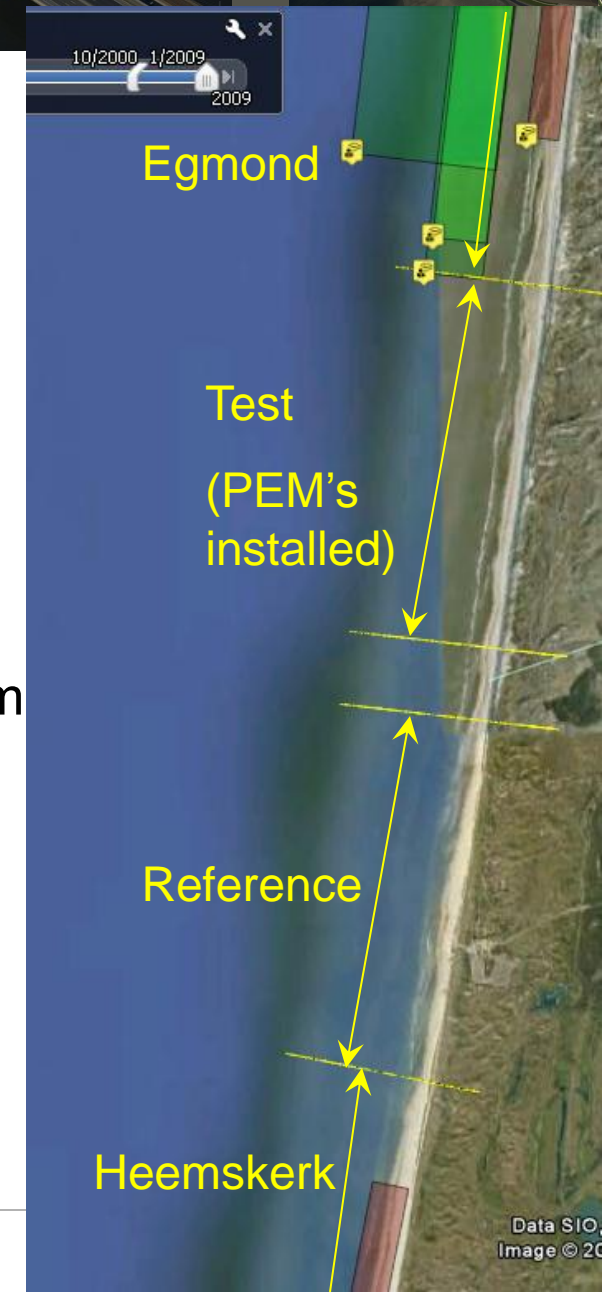
Vertical boxes:



& ShapeIndex

Step 2: Define and calculate relevant coastal state indicators

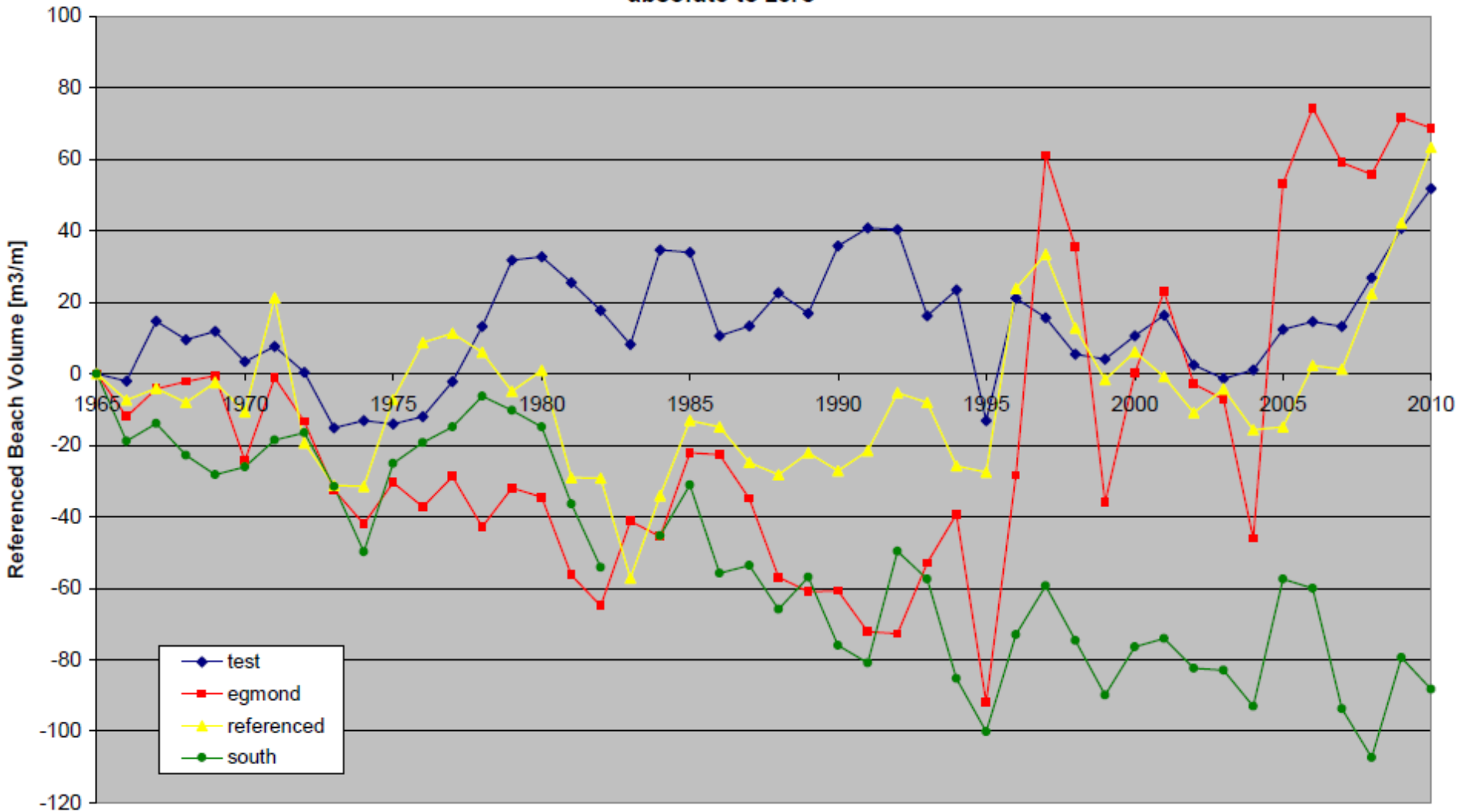
- Horizontal and Vertical Boxes (Dune, Beach, Lower MCL and Lower Shoreface)
- Longshore aggregation is required to address the research questions
 - Identification & Quantification of temporal morphological evolution
 - > Horizontal Boxes → 2.5 km's with 500 m buffer
 - Impact of nourishments & Interpretation of morphological evolution
 - > Vertical Boxes → 3 km boxes without buffer



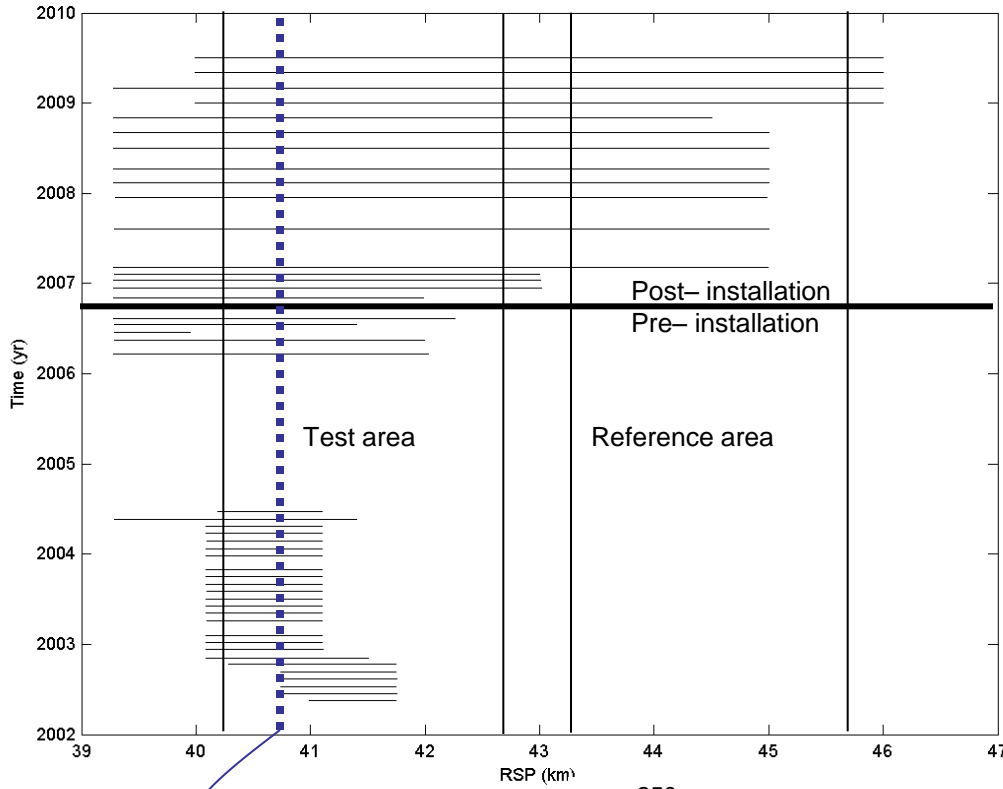
Step 3: Quantification of the temporal variability (1/3)



Averaged 'referenced beach volume'
absolute to zero



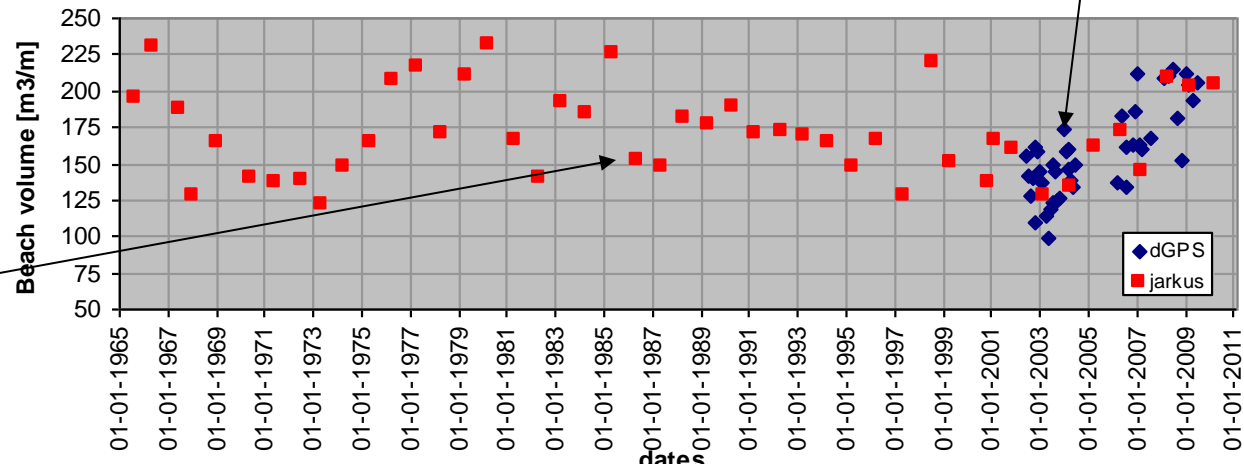
Step 3: Quantification of the temporal variability (2/3)



DGPS - Measurements

DGPS

Transect 40.75

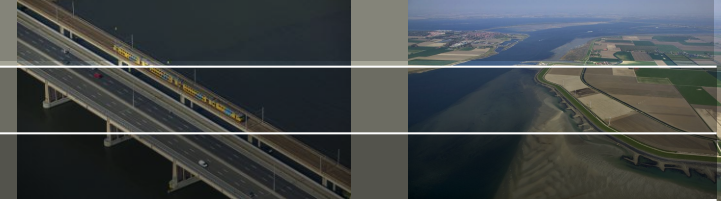


Jarkus

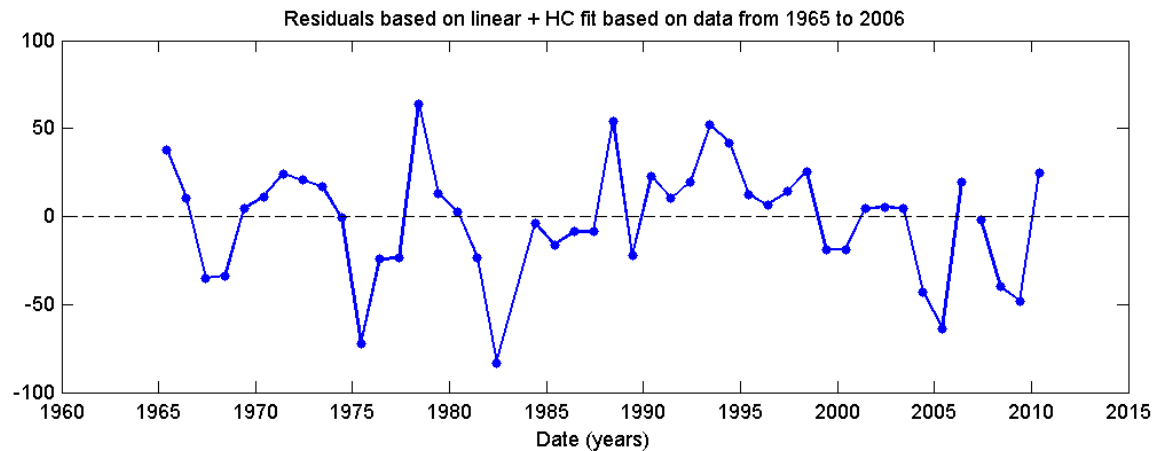
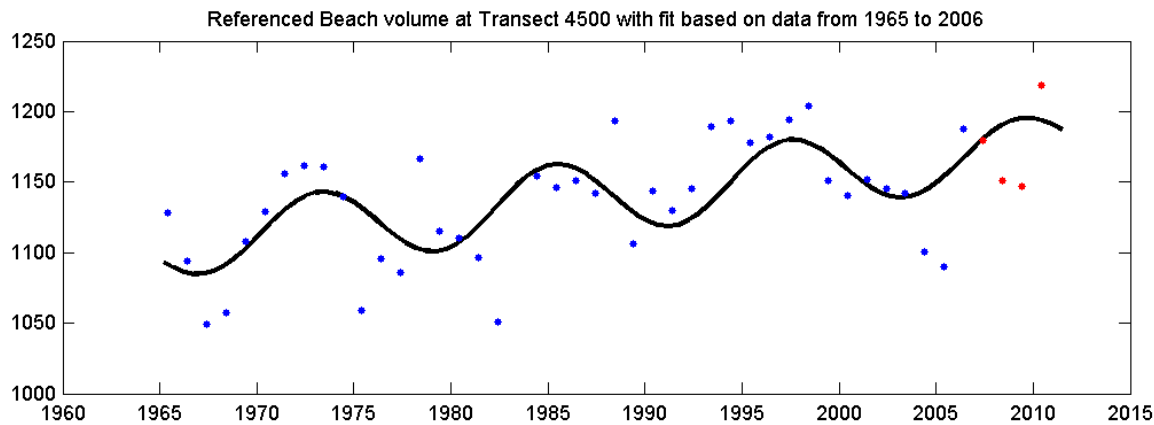
Step 3: Quantification of the temporal variability (3/3)

- Statistical Evaluation Procedure
 - Objective method with Minimization of a Minus LikeLihood function
 - Criteria of use: Residuals (“observations – model”) → Best fit
 - Applied for Egmond, Test Area, Reference & Heemskerk with aggregated values (longshore averaging over 2.5 km)
- Applications (3 fitting methods)
 - linear fit for 1990-2006,
 - linear fit for 1965-2006 data,
 - linear fit + harmonic component for 1965-2006 data

Statistical quantification



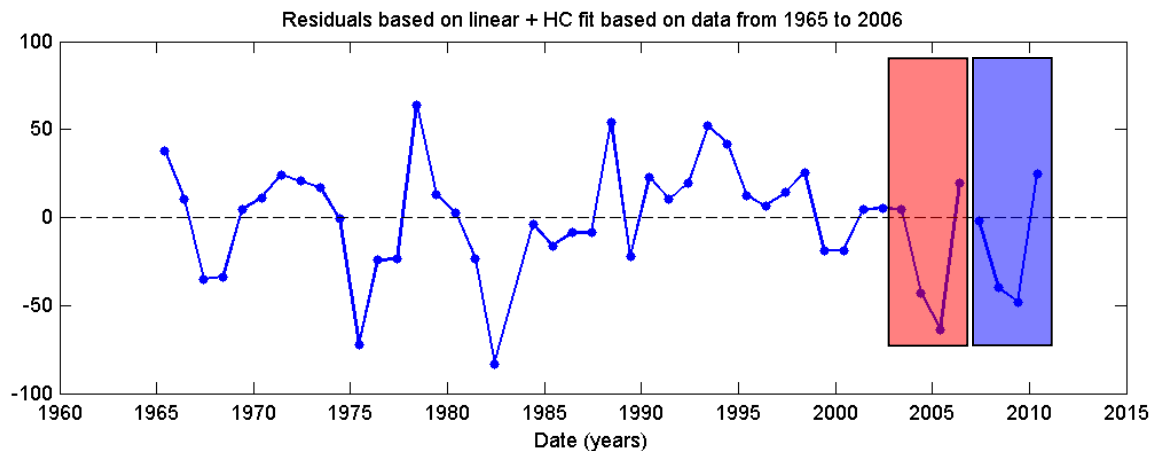
- Methodology
 - Computation of residuals (“= observation – statistical fit”)



Statistical quantification

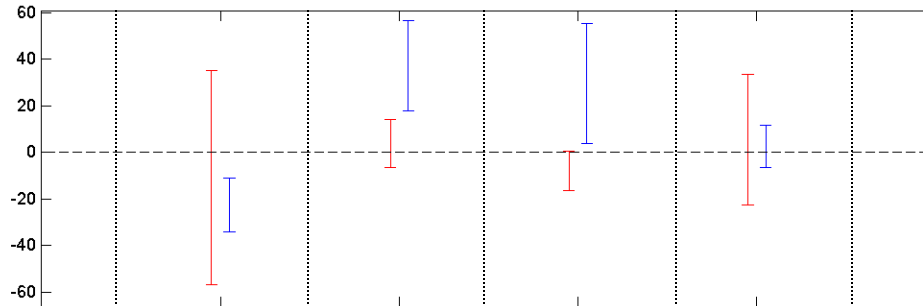
- Methodology

- Computation of [pre- and post- Ecobeach installation] residuals
- Computation 4-yrs average of [pre- and post- Ecobeach installation] residuals
- Computation of standard deviations
- Analysis (i.e. comparison pre- and post- [avg] and [std]) for
 - > each CSI (4)
 - > each method (3)
 - > each area (4)



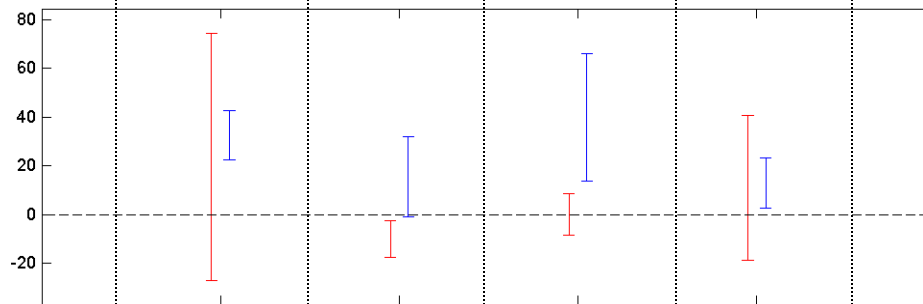
Statistical Evaluation (Beach Volume)

Linear Fit
1990-2006



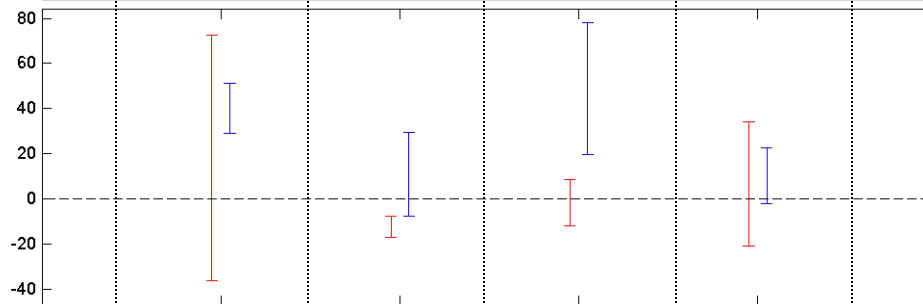
Pre 2003-2006

Linear Fit
1965-2006



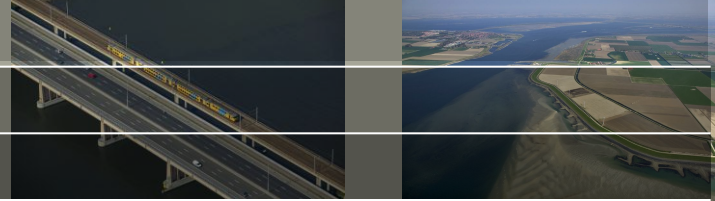
Post 2007-2010

Linear +
Harmonic Fit
1965-2006



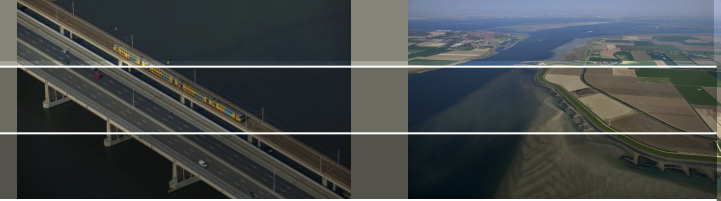
Egmond Test Ref Heemskerk

Findings

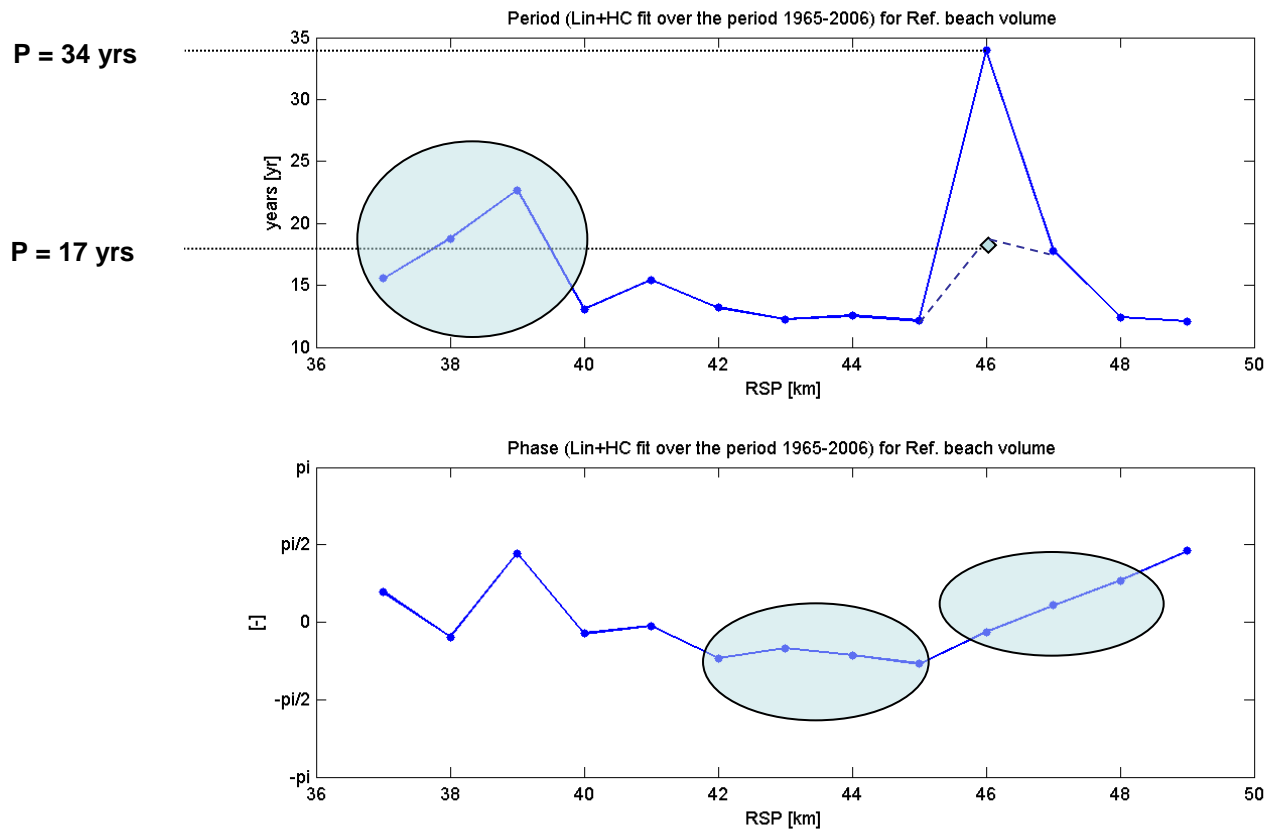


- Similar pattern found whatever the fitting technique used
- Test and Reference areas are characterized by a statistically significant increase of the Beach Volume.
- Increase up to 15 m³/yr above the “natural” trend in Reference area → influence of coastal bar and/or nourishments?
- Similar findings for the MCL Volume
- Test and Reference areas have different pattern than Egmond and Heemskerk → phasing of the coastal bar and/or nourishments?

Fitting method : Lin+HC



- Referenced Beach volumes
 - Extended to all transects, insight in the HC parameters



Step 4: Address the influence of nourishments

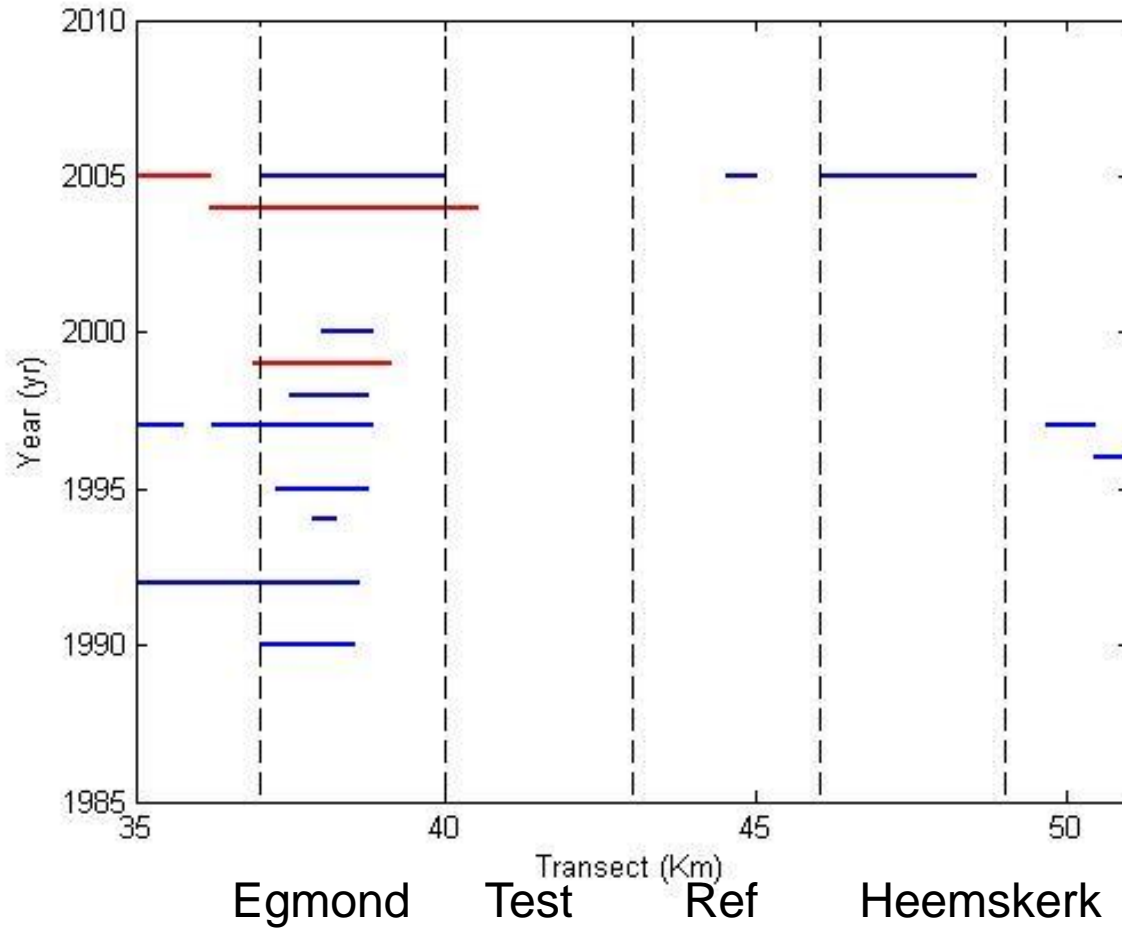
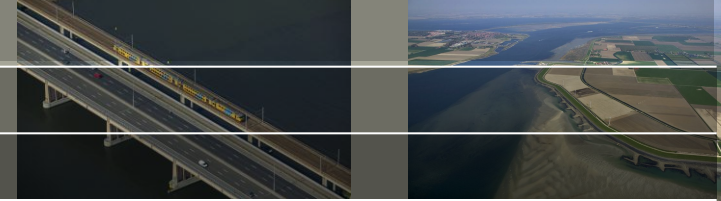


Overall sediment budget of the study area

Approach

- Use 1965 – 2010 Jarkus data
- Define areas (vertical boxes without bufferzones)
- Temporal analysis of measured volume changes

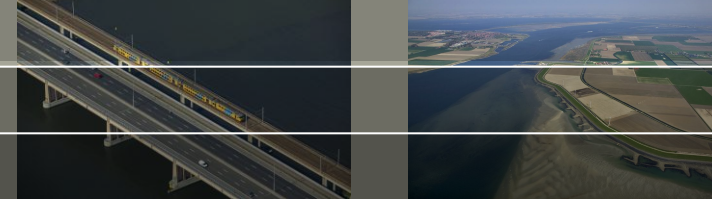
History of nourishments



Shoreface
Nourishments

Beach
Nourishments

Jarkus data (referenced)

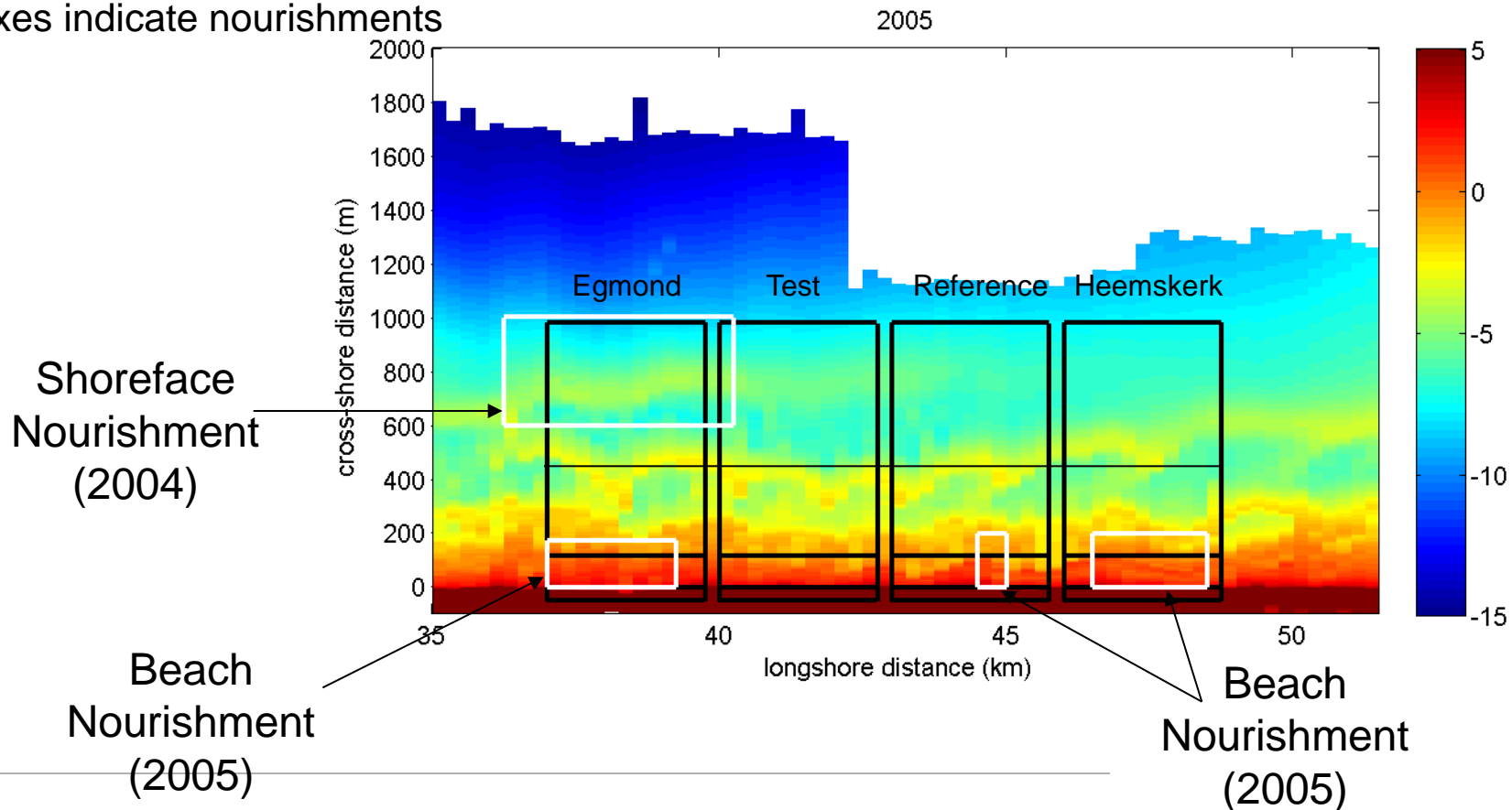


Jarkus transect data (no longshore interpolation)

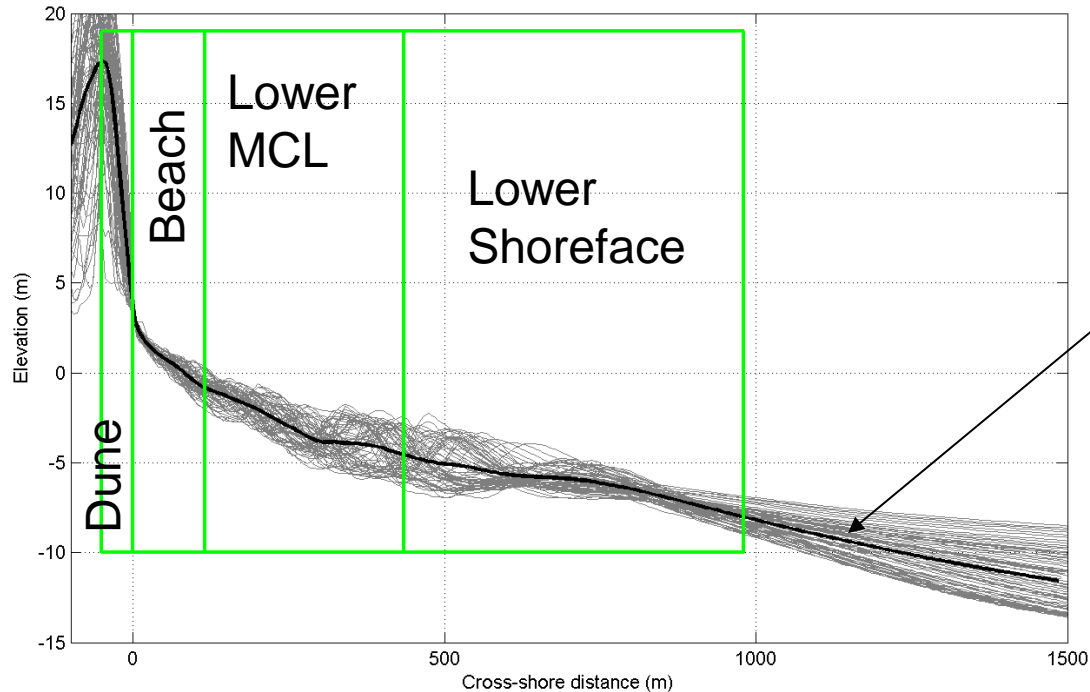
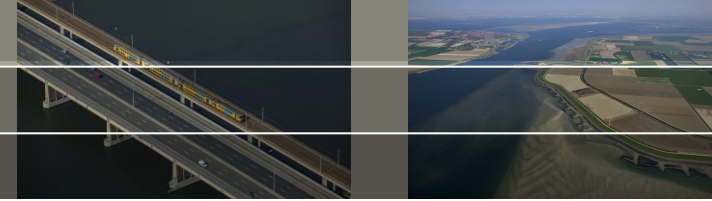
Dune foot (2003) referenced as $x=0$ to remove coastal curvature

Volumes in black boxes (Dune, Beach, Lower MCL and Lower SF)

White boxes indicate nourishments



Definition of vertical boxes



Longshore
averaged
profile (2003)

Based on longshore averaged profile (2003)

- Dune: $x(h)=[-50, 0 (+3)]$ m
- Beach: $x(h)=[0(+3), 115 (-0.78)]$ m
- Lower MCL (LMCL): $x(h)=[115 (-0.78), 435 (-4.56)]$ m
- Lower Shoreface (LSF): $x(h)=[435 (-4.56), 980 (-8)]$ m

Dune, Beach, Lower MCL and Lower Shoreface combined

Volume changes from 2004 to 2010 in Millions m³

Egmond

Test

Reference

Heemskerk

All Areas

2004: +1.8 Mm³ Shoreface nourishment

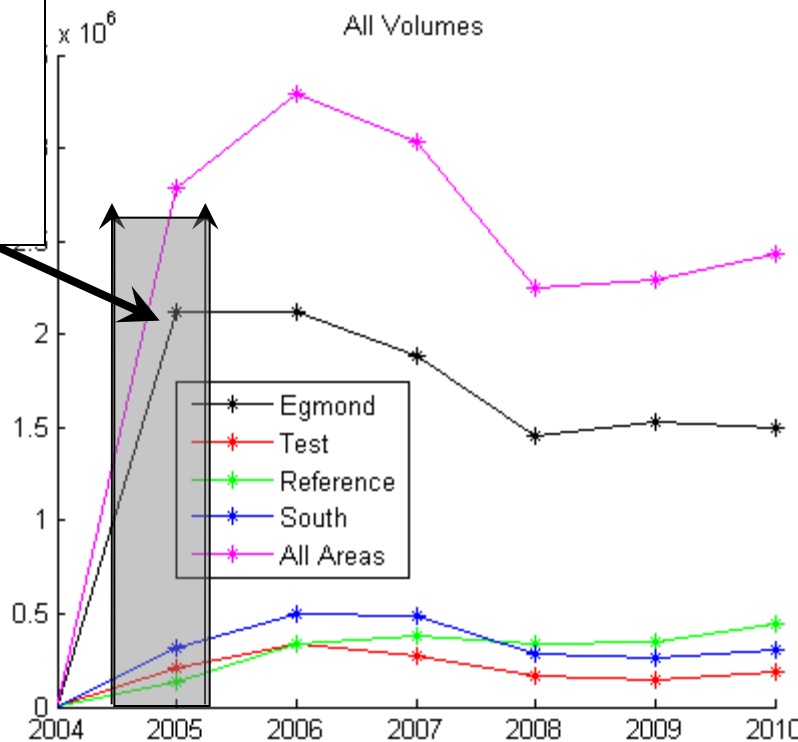
2005: 1.0 Mm³ Beach nourishments

2004: SF 1.61 Mm³

2005: BN 0.49 Mm³

Total measured volume increase 2004-2010

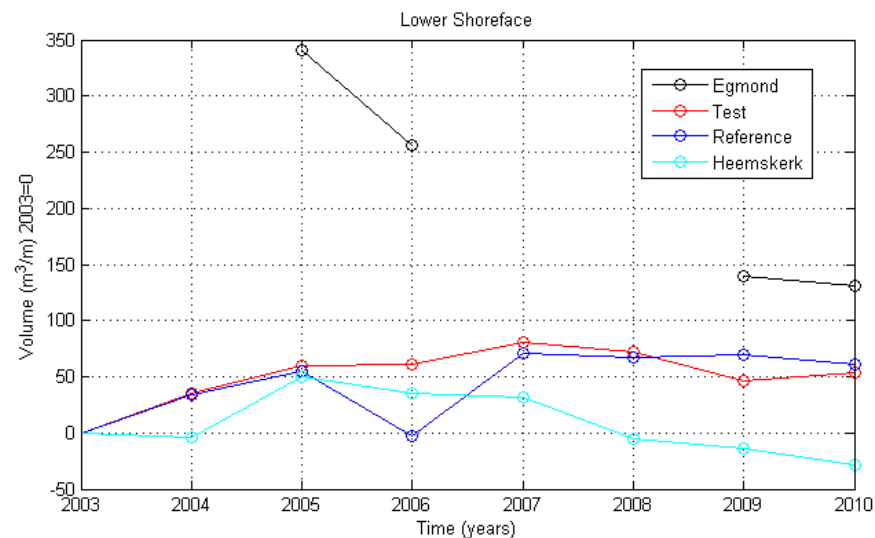
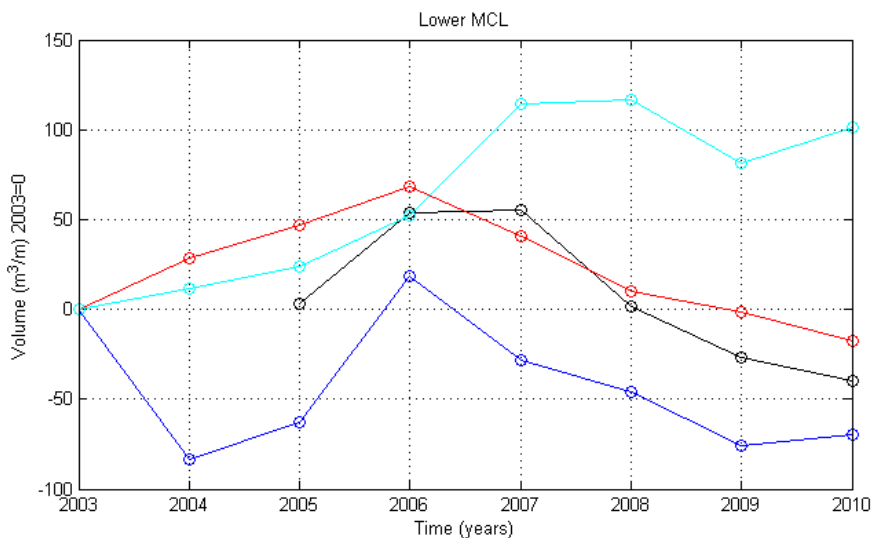
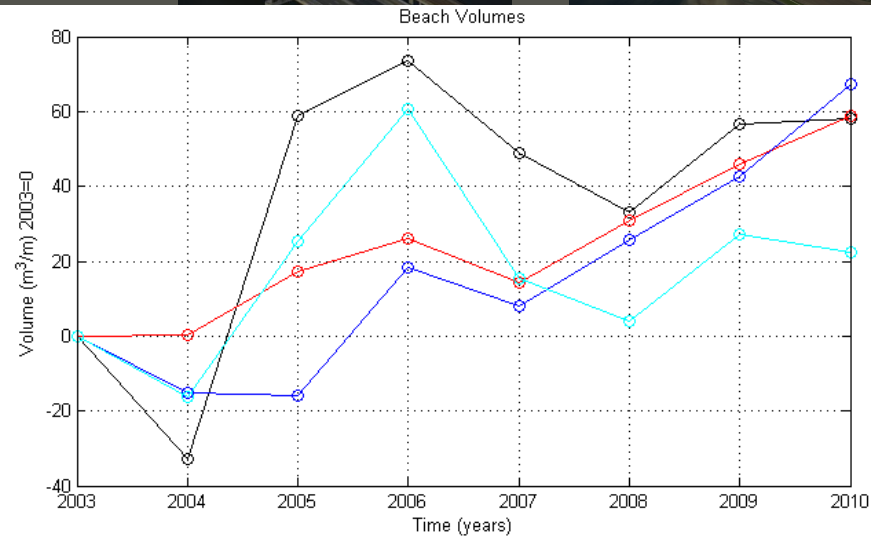
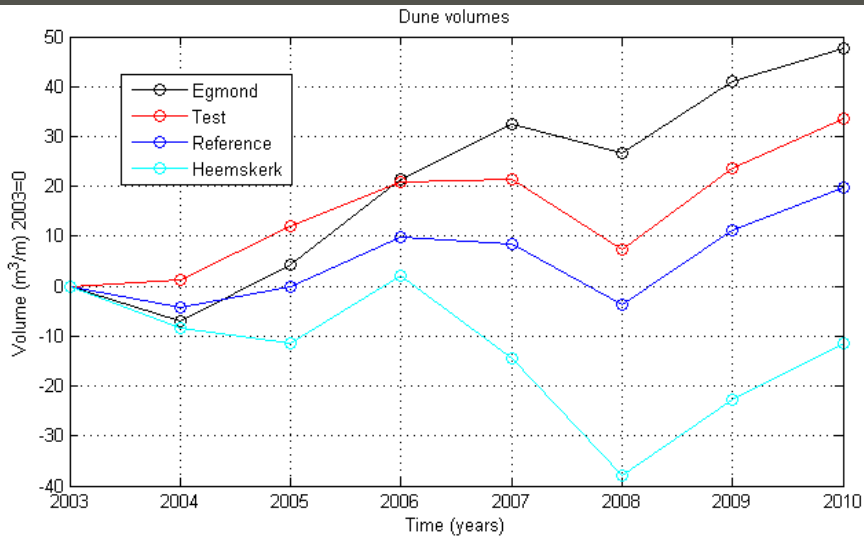
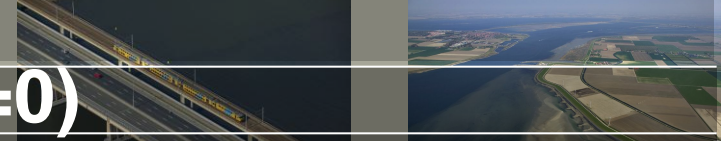
Total Nourishment volume 2004-2005 = 2.65 Mm³



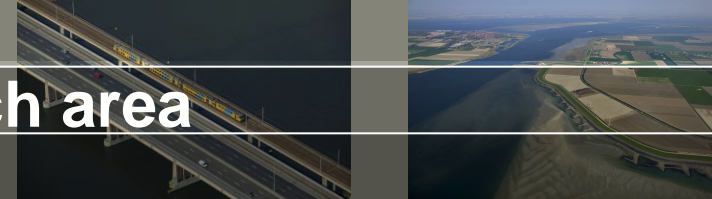
0.2 Mm³

SS:

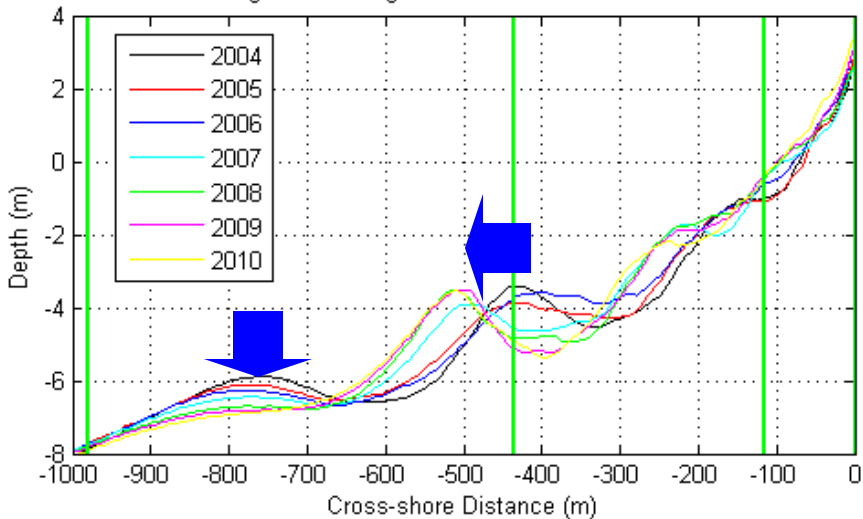
Comparison of Volumes (2003=0)



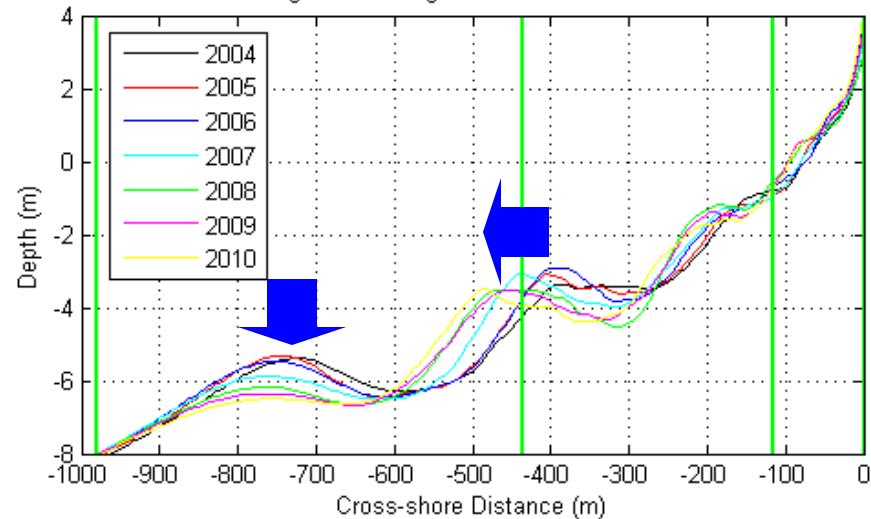
Longshore averaged profiles for each area



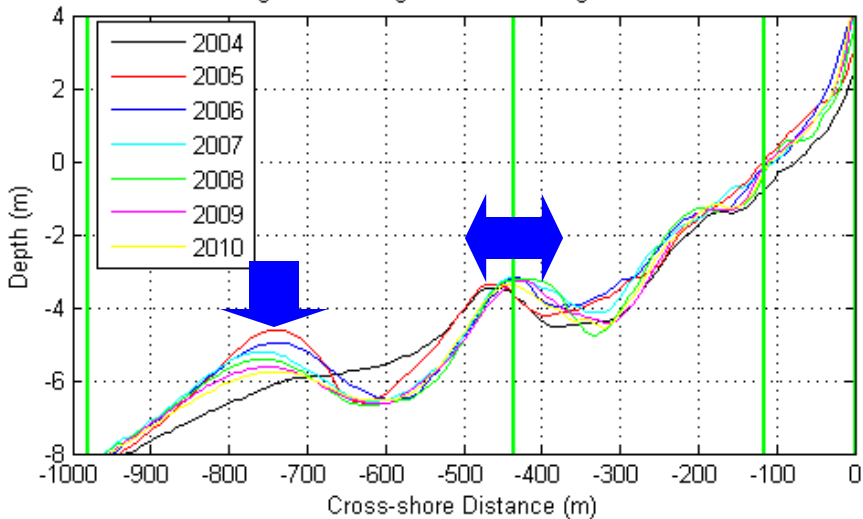
Longshore-Averaged Profiles for Reference Area



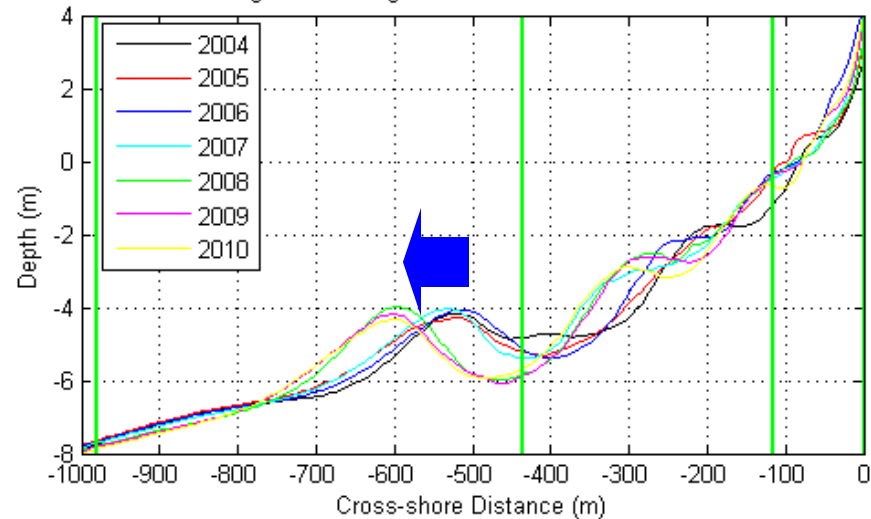
Longshore-Averaged Profiles for Test Area



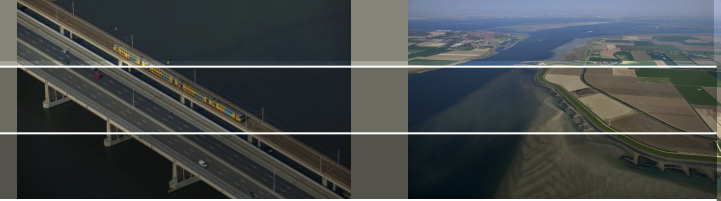
Longshore-Averaged Profiles for Egmond Area



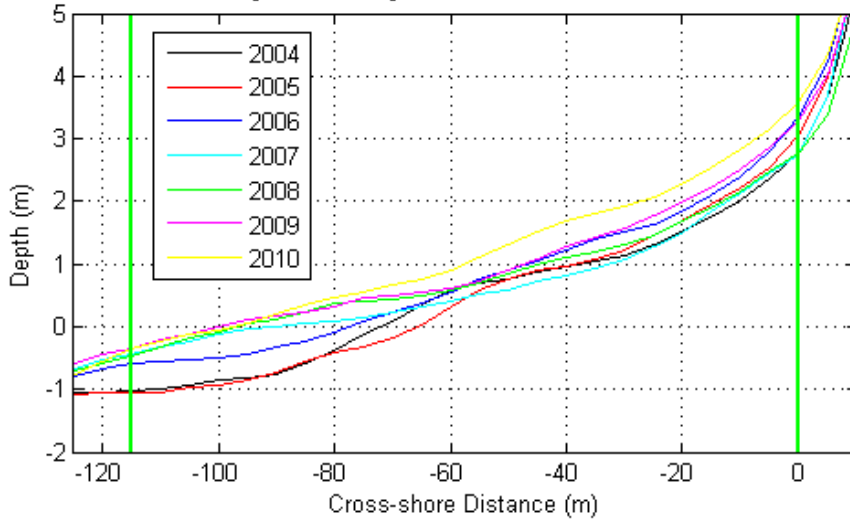
Longshore-Averaged Profiles for Heemskerk Area



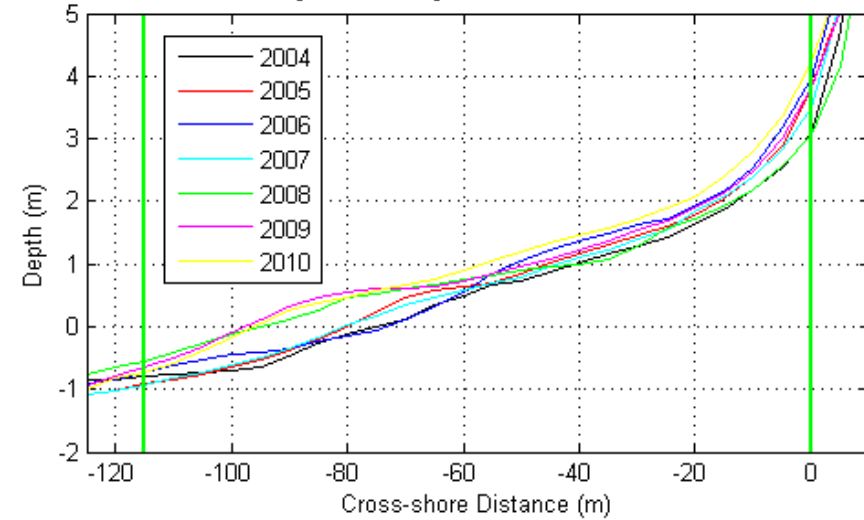
Zoom in on Beach



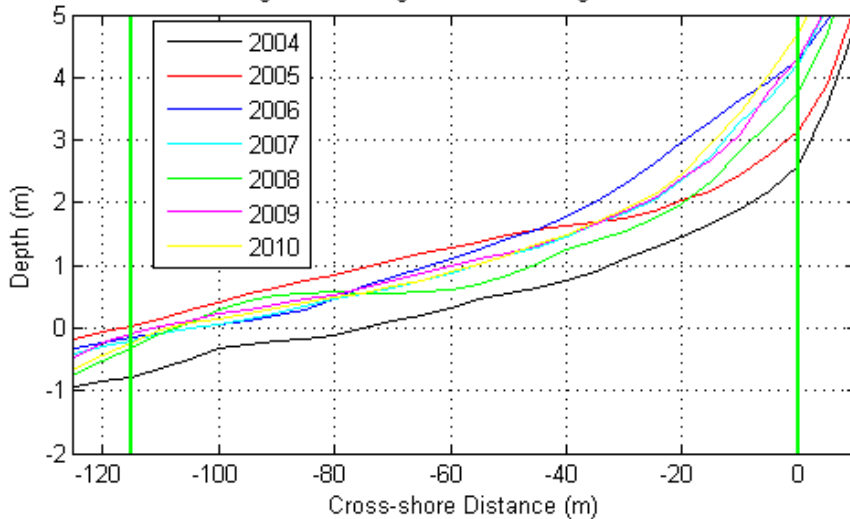
Longshore-Averaged Profiles for Reference Area



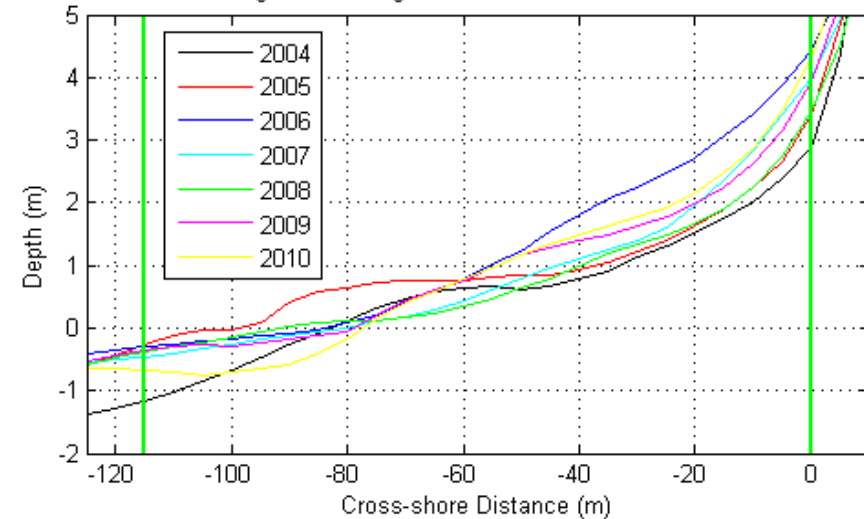
Longshore-Averaged Profiles for Test Area



Longshore-Averaged Profiles for Egmond Area



Longshore-Averaged Profiles for Heemskerk Area



Step 5: Evaluation of the Ecobeach system



- No noticeable morphological impact of PEM's could be found
(Based on Step 3: both Test and Reference show significant Beach and MCL volume increase).
- Nourishments create additional uncertainty for the analysis, e.g.:
 - The Reference Area benefitted more from Nourishments than Test Area →Vs.← Entire study area is impacted by nourishment activities
- Our (preliminary) interpretation:
 - The test and reference area are similarly impacted by the nourishments
 - Multi-annual bar behavior is dominant since 2007
 - The impact of the PEM's is significantly smaller than the multi-annual bar behaviour
 - Based on this study the working of the PEM's is inconclusive