DUNE EVOLUTION AT DECADAL TIMESCALES

AND ITS RELATION WITH POTENTIAL AEOLIAN TRANSPORT

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INTRODUCTION & METHODOLOGY

While short-term aeolian sediment transport rates and wind speed are correlated by a modified Bagnold model, it seems of particular interest to study its relation with annual to decadal dune behavior. The purpose of this study is:

1. To get insight in the long-term dune development at the Belgian coast based on the analysis of airborne photogrammetric and, airborne Laser Scanner (LiDAR) data of the dunes from 1979-2018.
2. To get insight in annual potential aeolian sediment transport quantities and how it behaves on decadal timescales (long-term). Annual potential aeolian sediment transport is estimated by the use of a modified Bagnold model applied to a wind data set from 2000-2017.
3. To get insight in the correlation between observed and predicted dune volume on an annual to decadal timescale.
4. To explain longshore variations of the correlations by distinguishing between 'natural' and 'managed' beach sections of the Belgian coast featuring dunes.

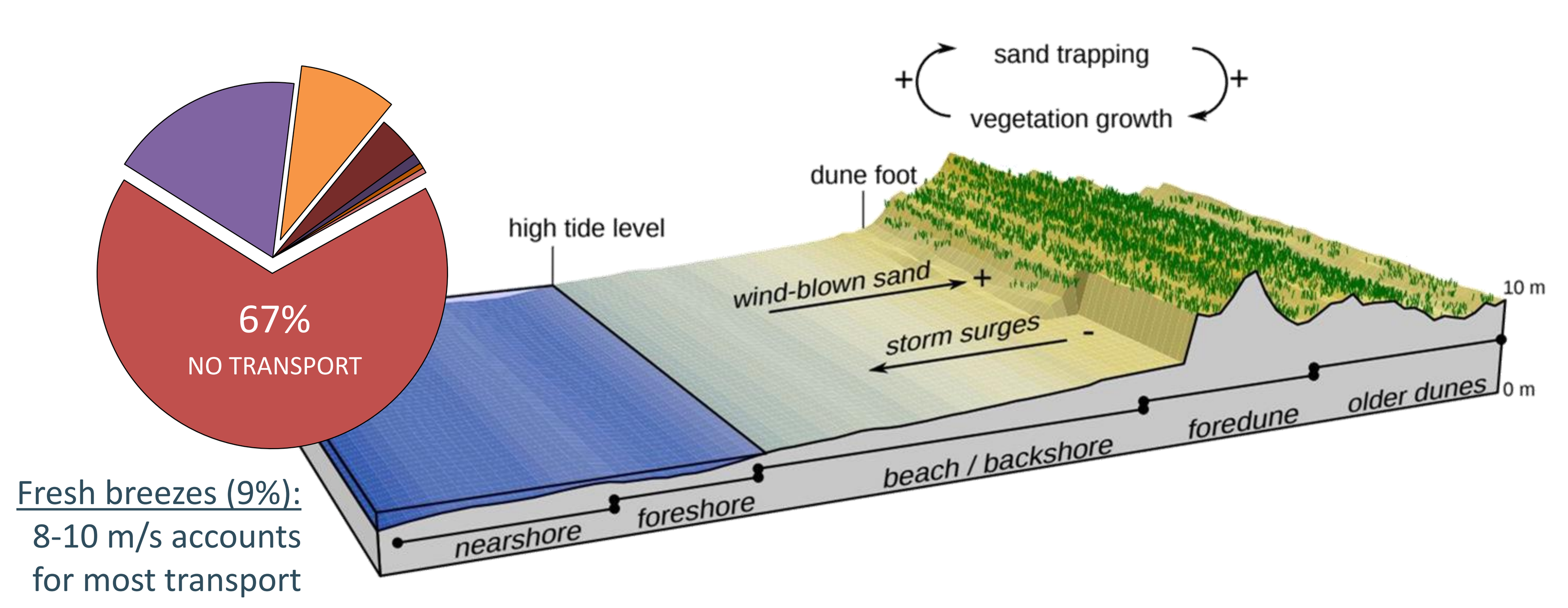

Figure 1. Scheme showing the main principles of coastal dynamics in a beach-dune system.

• DECADAL DUNE BEHAVIOR AT THE BELGIAN COAST

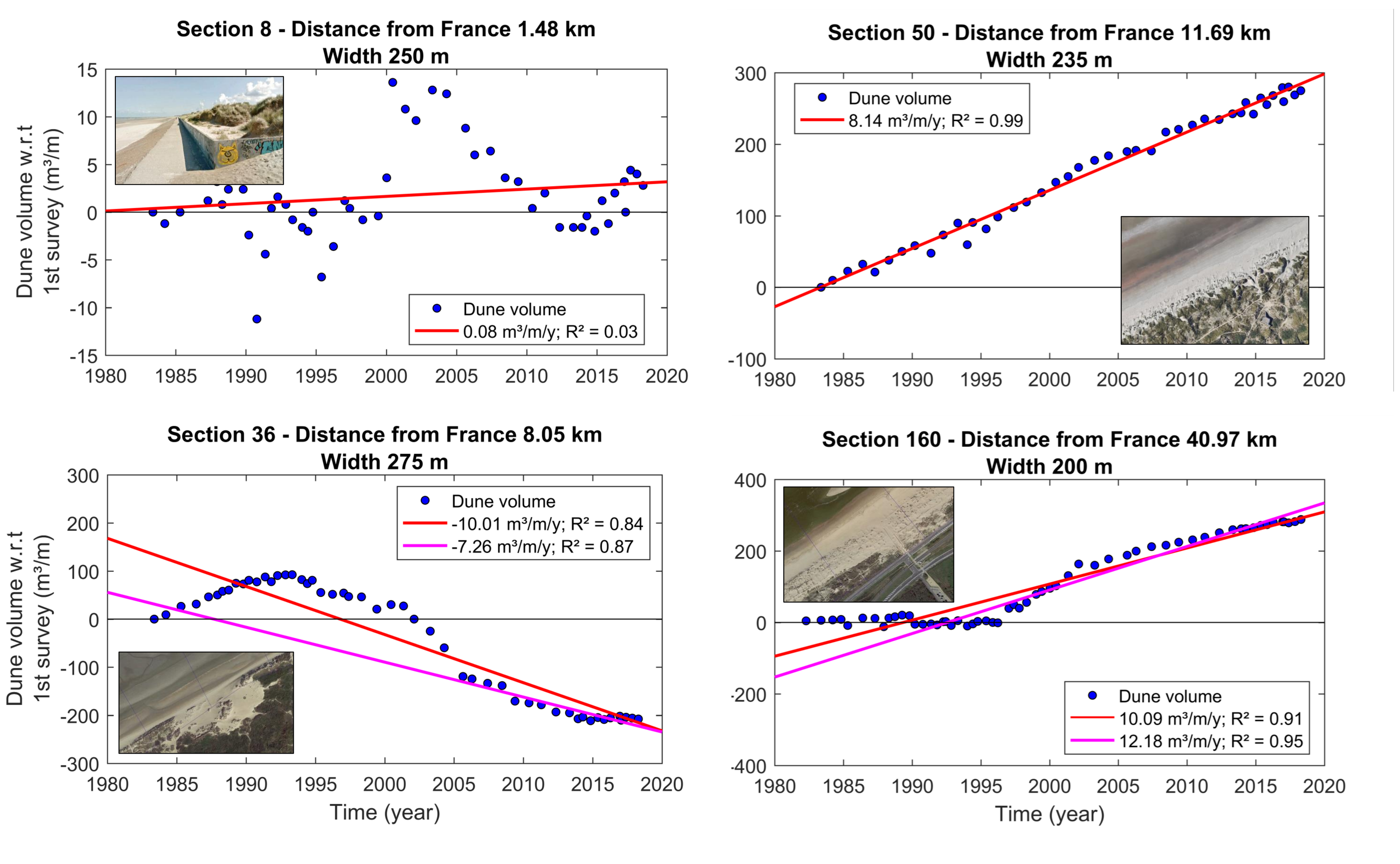

Figure 2. Decadal dune evolution of some Belgian dunes.

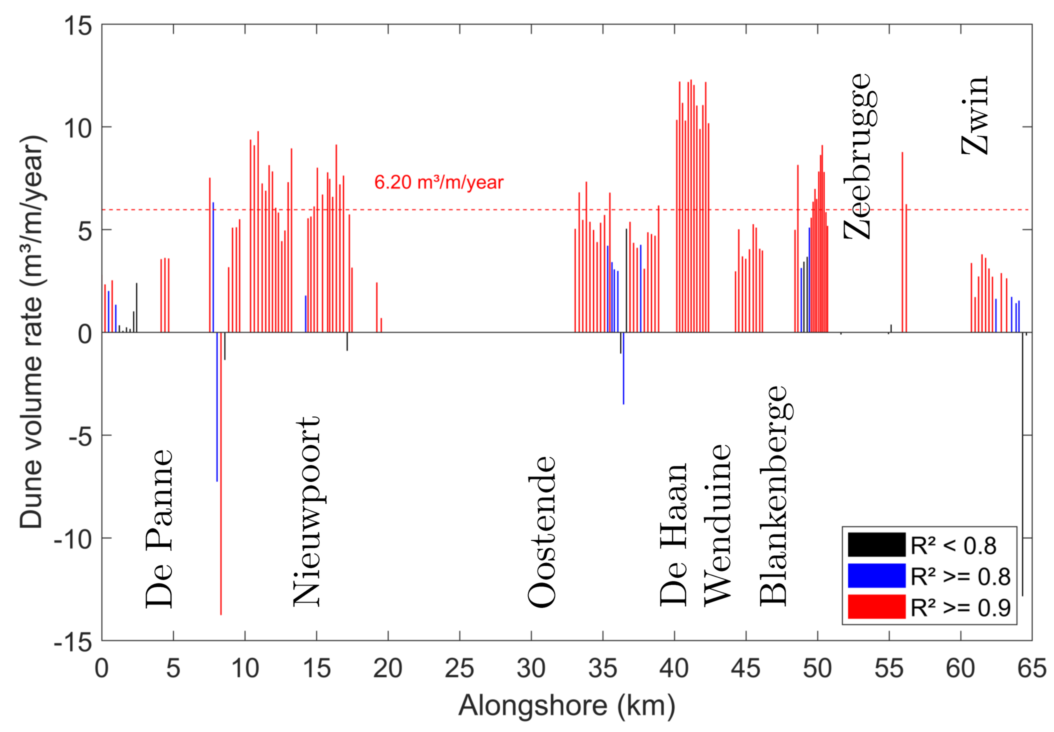

Figure 3. Dune behavior along the Belgian coast. Red bars indicate the places where the correlation coefficient of the linear trend analysis is higher than or equal to 0.9.

• POTENTIAL AEOLIAN SAND TRANSPORT

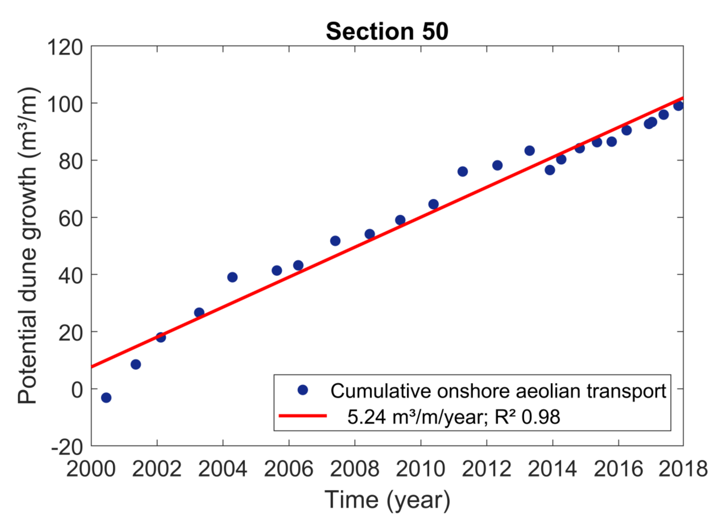

Figure 4. Decadal evolution of potential dune growth at Section 50 .

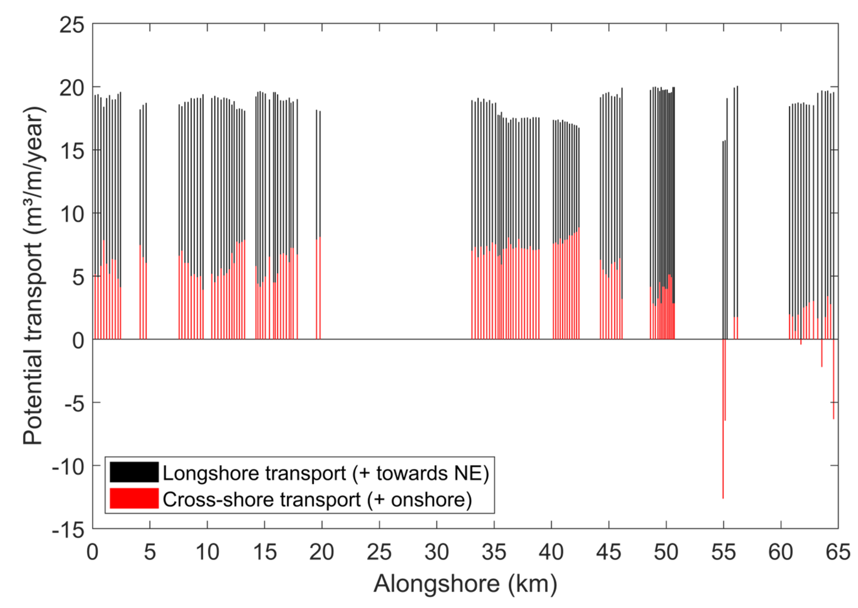

Figure 5. Annual potential longshore and onshore aeolian sediment transport .

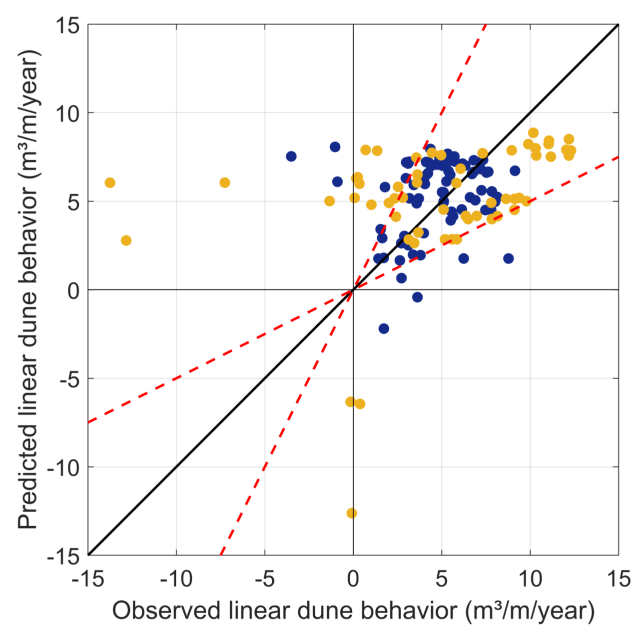

Figure 6. Comparison between observed and predicted linear dune development. Diagonal lines represent the 1 to 1 correspondence. Red dashed lines show factor 2 variance. Yellow dots represent the locations where managing activities are carried out.

CONCLUSIONS

1. The Belgian dunes grow linear in time. 80% of the dune sections have $R^2 > 0.9$. There is alongshore variability in linear dune growth rates and they are found to be in the order 0-12.3 m^3/m/year. An average dune growth of 6.2 m^3/m/year is found.
2. Onshore aeolian transport = max. 9 m^3/m/year. Longshore aeolian transport = max. 20 m^3/m/year. Total aeolian transport = 15 m^3/m/year. The main is from west to south-west.
3. No significant relationship between annual wind and dune volume change in the alongshore direction is found. However, a significant correlation is found between potential and observed dune volume development on a decadal timescale. Most of the predicted data are within a factor 2 of the measured values.

KU LEUVEN

AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

CREST CLIMATE RESILIENT COAST