TITLE: Vegetation traits and biogeomorphic complexity shape the resilience of salt marshes to sea-level rise - Dataset

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Source Data

~/SourceData/Fig1

Walsoorden_2006.tif
Walsoorden_2017.tif
Digital Terrain Models (DTM) of the Walsoorden intertidal bar in the Western Scheldt estuary, provided by Rijkswaterstaat and openly accessible under CC0 1.0 Universal license.

Fig1C.xlsx
Data from four transects taken across the DTMs in both 2006 and 2017. For each transect, data provided are:

- Distance (m): distance along the transect in meters
- Elevation (m NAP): Elevation according to NAP in meters, in 2006 and 2017

~/SourceData/Fig2

Fig2a.csv
Fig2b.csv
Fig2c.csv
Fig2d.csv
Fig2e.csv
Fig2f.csv
Fig2g.csv
Simulation results (2D-arrays) of sediment bed elevation, water flow speeds and suspended sediment concentrations, using different initial vegetation parameters, as shown in Fig. 2a-c and Fig. 2e-g. Grid cells are 0.1 m by 0.1 m in size.

~/SourceData/Fig3

Fig3b_LowComplexity.csv
Fig3b_HighComplexity.csv
Fig3a_Lower_aboveground_strong_belowground.csv
Fig3a_High_aboveground_weak_belowground.csv
Results (2D-arrays) of transported sediment deposition across four simulations: vegetation traits representing either higher friction but weak belowground effects, or lower friction but strong belowground effects, in the same given creek network, and

simulations with the same initial vegetation traits placed in either a highly branched (high complexity) or parallel (low complexity) creek network. Grid cells are 0.1 m by 0.1 m in size.

Fig3_ProcessedData.csv
Results of sediment trapping efficiency (total sediment deposited on the marsh platform divided by total sediment input in percentage) in the four simulations mentioned above.

~/SourceData/Fig4

Fig4_SourceData.csv
Results of 2D-averaged sediment deposition rate in simulations with different combination of drag coefficient C_d (2 and 12) vegetation height H_v (0.1 and 0.5 m) and erosion protection potential p_E (0.1 and 0.9). The values under each column represent the parameter combination used in the simulation.

Fig4_ProcessedData.csv
Based on the results in the above csv file, this file describes the average percentage change in sedimentation when each of the vegetation parameters is increased. The data points are those shown in Figure 4.

~/SourceData/Fig5

Fig5_Field_data_Sedimentation.xlsx
Results of field experiments carried out in Baarland and Hoofdplat sites, and compared with the outcome of model simulations.

The results are presented in different sheets ('Sediment deposition rates', 'Flow velocities in creeks', 'Sediment transport in creeks'), showing data on:

- Sediment supply through creeks (g/m^2), representing the amount of sediment transported through the creeks to the marsh
- Sediment deposition on marsh plateau (g/m^2), representing the amount of sediment deposited on the marsh plateau.
- Absolute peak flood/ebb velocities (m/s) measured in the main creeks and in side creeks
- Suspended sediment concentrations (g/L) in main creeks and side creeks

~/SourceData/Fig6

Fig6a.csv
Fig6b.csv
Fig6c.csv
Fig6d.csv
Fig6e.csv
Fig6f.csv
Results (2D-arrays) of sediment bed elevation for higher-friction vegetation but weak belowground effects (a – c) and lower-friction vegetation but strong belowground effects

(d – f) for reference simulations and for two simulations with moderate and rapid water level increase. Grid cells are 0.1 m by 0.1 m in size.

Fig6g-j.csv
Results of final average salt marsh elevation (m), vegetation cover (%), channel network efficiency (-) and bifurcation ratio (-) for higher-friction vegetation but weak belowground effects, and lower-friction vegetation but strong belowground effects, across three water level increase scenarios (reference, moderate and rapid water level increase).

~/SourceData/Fig7

Fig7a_SourceData.xlsx
Excel sheet showing the value of salt marsh resilience (represented as percentage change in the average slope of water level increase over sediment input (H_{in} / S_{in})) for different combinations of parameter values (drag coefficient C_d, vegetation height H_v, and erosion protection potential p_E).

Fig7a_ProcessedData.csv
Based on the results in the above Excel sheet, this file describes the average percentage change in resilience when each of the vegetation parameters is increased. These data points are those shown in Figure 7a.

Fig7b.csv
Final salt marsh elevation (m) (column 'Elevation') in simulations with different annual rates of increase in water level (column 'WaterLevelIncrease') and decreasing sediment input rates (column 'SedimentInput).

Model scripts and related codes

For the manuscript, several model simulations of salt marsh development were carried out. Each model version has a different parameter setting, used to create a different manuscript figure.

The following model scripts (Jupyter Notebooks) are used to create the manuscript figures:

- ~/Fig2/clPy.SaltMarsh_Fig2a_c.ipynb
- ~/Fig2/clPy.SaltMarsh_Fig2d_f.ipynb
- ~/Fig3/clPy.SaltMarsh_Fig3a_left.ipynb
- ~/Fig3/clPy.SaltMarsh_Fig3a_right.ipynb
- ~/Fig3/clPy.SaltMarsh_Fig3b_left.ipynb
- ~/Fig3/clPy.SaltMarsh_Fig3b_right.ipynb
- ~/Fig4/clPy.SaltMarsh_Fig4_Cd2_Hv1e-1_pE1e-1.ipynb
- ~/Fig4/clPy.SaltMarsh_Fig4_Cd2_Hv1e-1_pE9e-1.ipynb
- ~/Fig4/clPy.SaltMarsh_Fig4_Cd2_Hv5e-1_pE1e-1.ipynb
- ~/Fig4/clPy.SaltMarsh_Fig4_Cd2_Hv5e-1_pE9e-1.ipynb
- ~/Fig4/clPy.SaltMarsh_Fig4_Cd12_Hv1e-1_pE1e-1.ipynb

- ~/Fig4/clPy.SaltMarsh_Fig4_Cd12_Hv1e-1_pE9e-1.ipynb
- ~/Fig4/clPy.SaltMarsh_Fig4_Cd12_Hv5e-1_pE1e-1.ipynb
- ~/Fig4/clPy.SaltMarsh_Fig4_Cd12_Hv5e-1_pE9e-1.ipynb
- ~/Fig6/clPy.SaltMarsh_Fig6a.ipynb
- ~/Fig6/clPy.SaltMarsh_Fig6b.ipynb
- ~/Fig6/clPy.SaltMarsh_Fig6c.ipynb
- ~/Fig6/clPy.SaltMarsh_Fig6d.ipynb
- ~/Fig6/clPy.SaltMarsh_Fig6e.ipynb
- ~/Fig6/clPy.SaltMarsh_Fig6f.ipynb

To run each of these Jupyter Notebook, an auxiliary script is needed:

- HydroFunctions_iPy.cl

This auxiliary script defines standard functions (diferential operators, boundary conditions) and should be in the same folder as each Jupyter Notebook.

In the case of Fig. 3, two compressed NumPy archive files are provided:

- Structure_complex_creeks.npz
- Structure_simple_creeks.npz

These files contain the initial bathymetry for the high-complexity and low-complexity creek systems used as the initial condition for the sediment deposition simulations shown in Fig. 3.

For the simulations in Fig. 7, the same scripts as those in Fig. 6b-c-e-f can be used to simulate the yearly water level increase. However, different combinations of water level input and sediment input should be set at the beginning (the exact values used can be found in the manuscript text or in ~/SourceData/Fig7/Fig7b.csv).
The following Jupyter notebook contains the script to create the 'resilience' contour plot as shown in Fig. 7b:

- ~/Fig7/Fig7b.ipynb