Optimization theory applied to the modeling of sandy beach dynamics

with Frédéric Bouchette, Bijan Mohammadi, and Nicolas Fraysse

Megan Cook

megan.cook@umontpellier.fr, megancook.fr

Géosciences, University of Montpellier – BRLi, Nîmes, France

PhD student day 2021, Géosciences Montpellier – 4th June 2021

MOTIVATION

Understanding **coastal dynamics** (beach, cliffs, harbors, ...) is of great importance:

Motivation

Understanding **coastal dynamics** (beach, cliffs, harbors, ...) is of great importance:

Protection of beach users

MOTIVATION

Understanding **coastal dynamics** (beach, cliffs, harbors, ...) is of great importance:

Protection of beach users

Study of the risks of coastal flooding

Motivation

Understanding **coastal dynamics** (beach, cliffs, harbors, ...) is of great importance:

Protection of beach users

Study of the risks of coastal flooding

Monitoring of coastal erosion

MOTIVATION

Understanding **coastal dynamics** (beach, cliffs, harbors, ...) is of great importance:

Protection of beach users

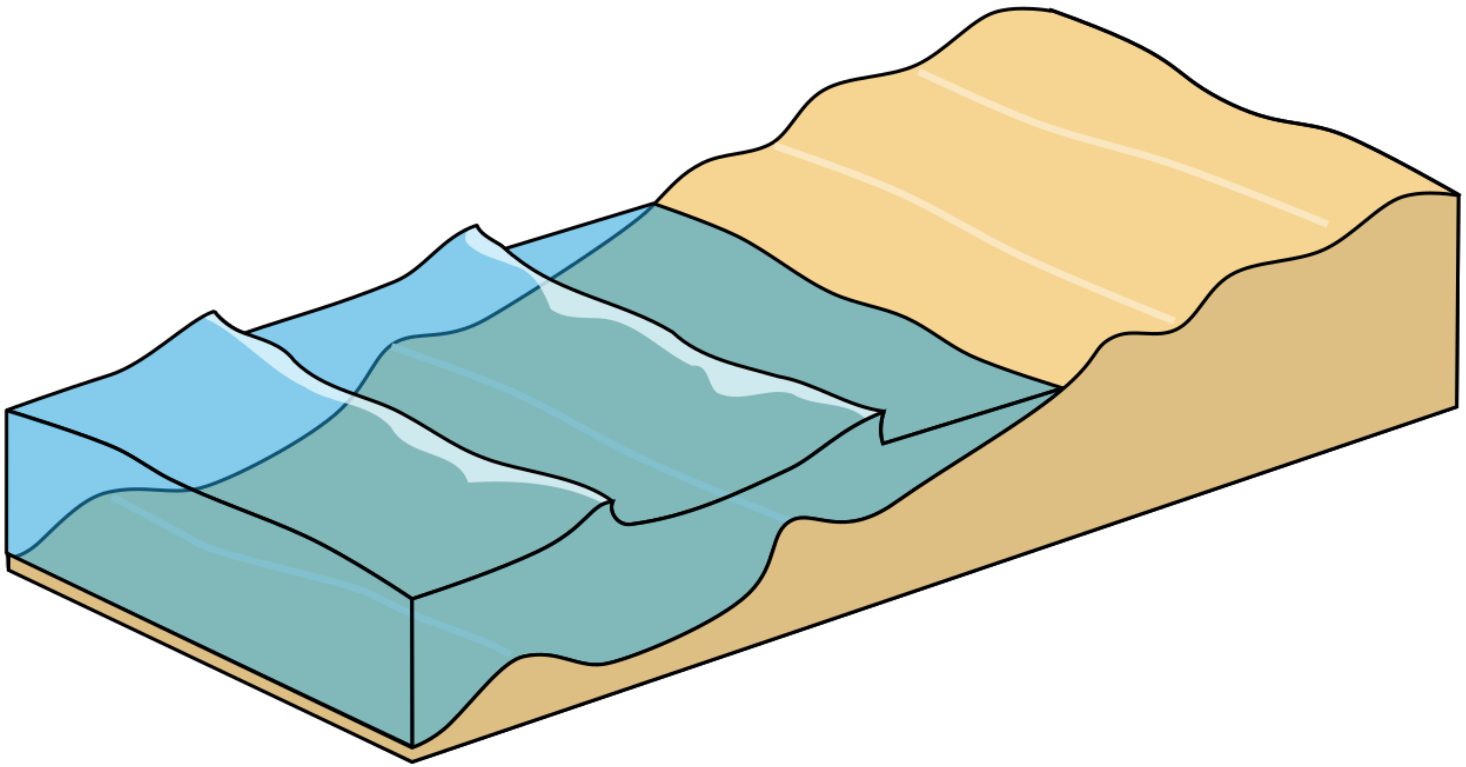
Study of the risks of coastal flooding

Monitoring of coastal erosion

Development of coastal protection structures

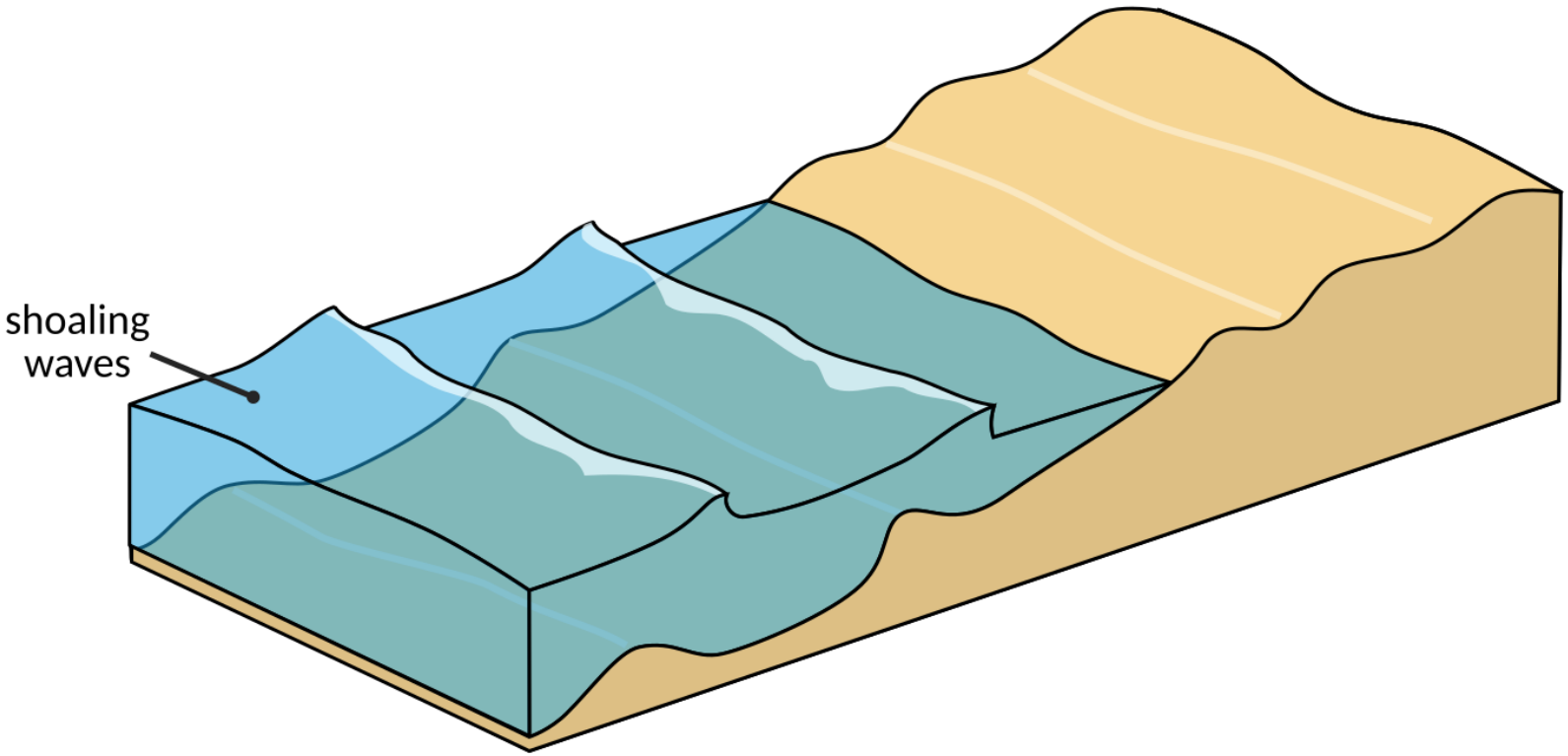
Settings

Morphodynamic models are used to predict the movement of the sand at the coast.



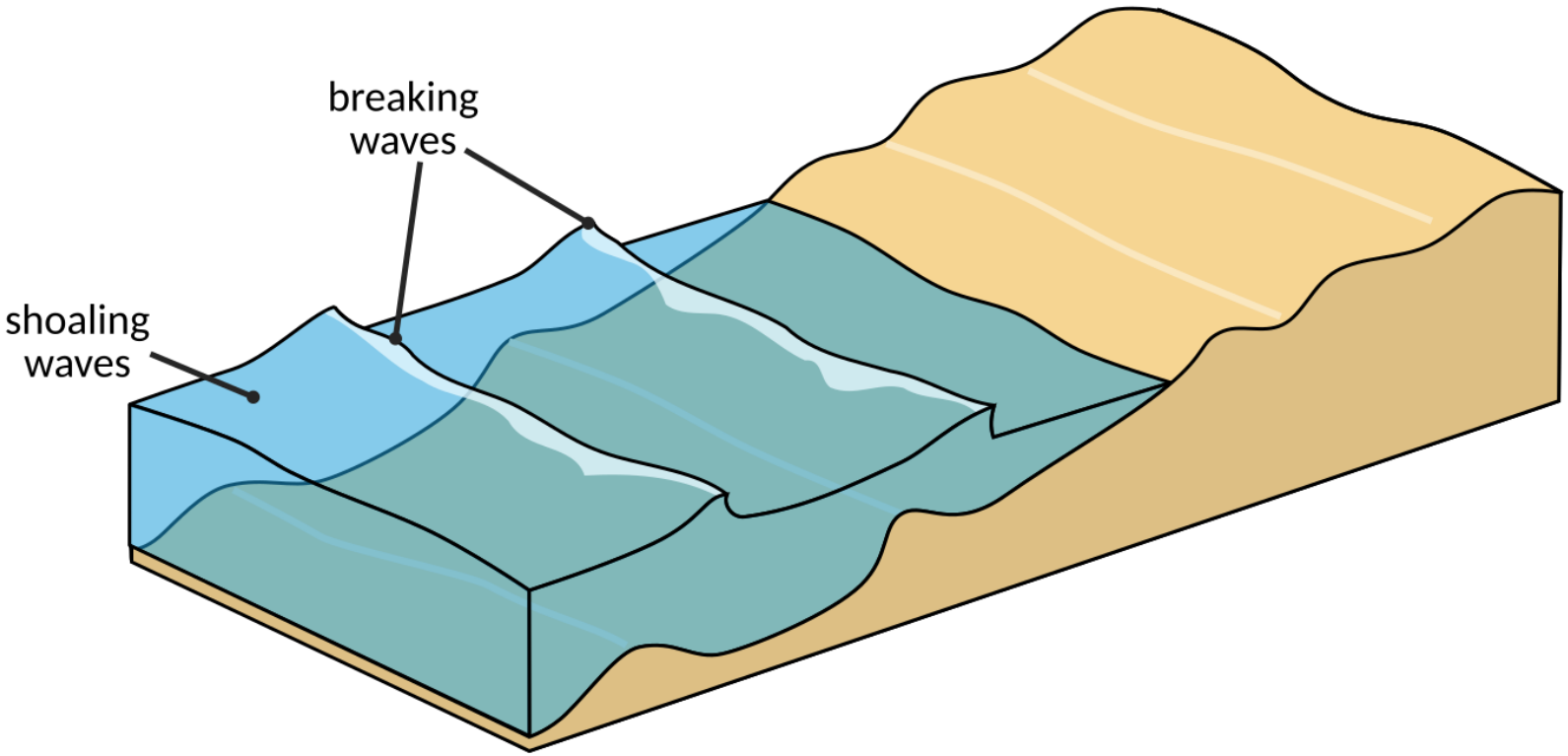
SETTINGS

Morphodynamic models are used to predict the movement of the sand at the coast.



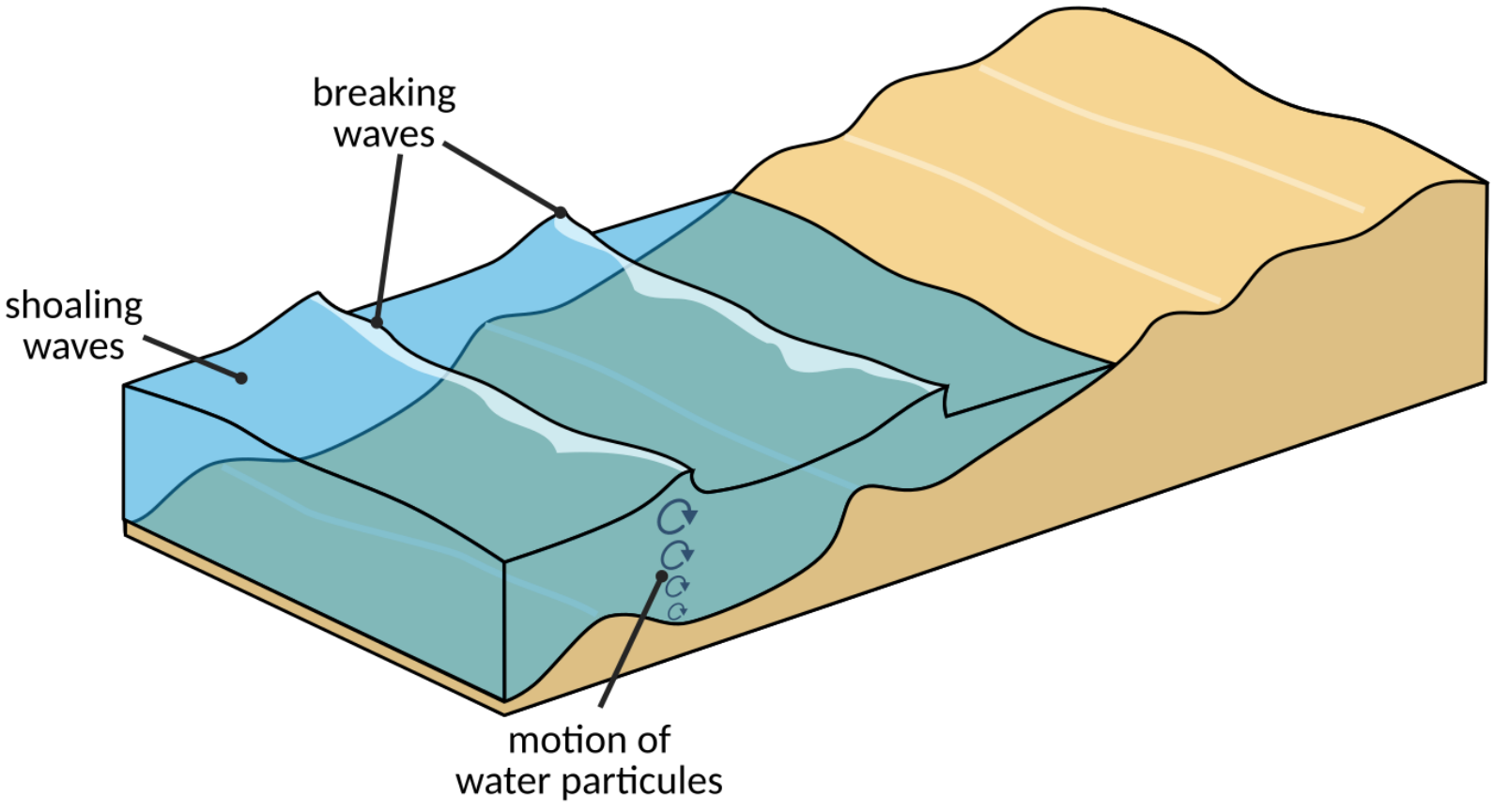
SETTINGS

Morphodynamic models are used to predict the movement of the sand at the coast.



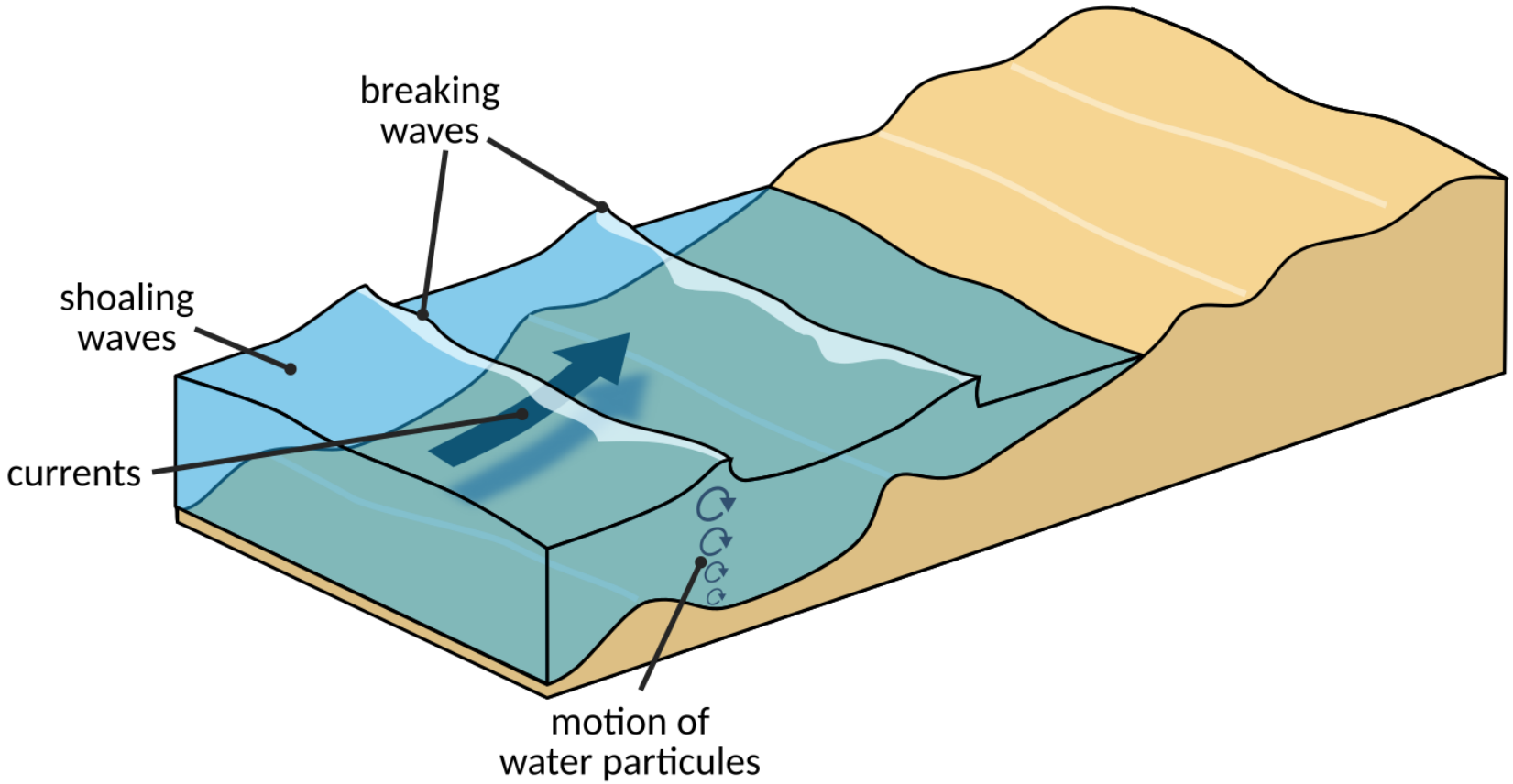
SETTINGS

Morphodynamic models are used to predict the movement of the sand at the coast.



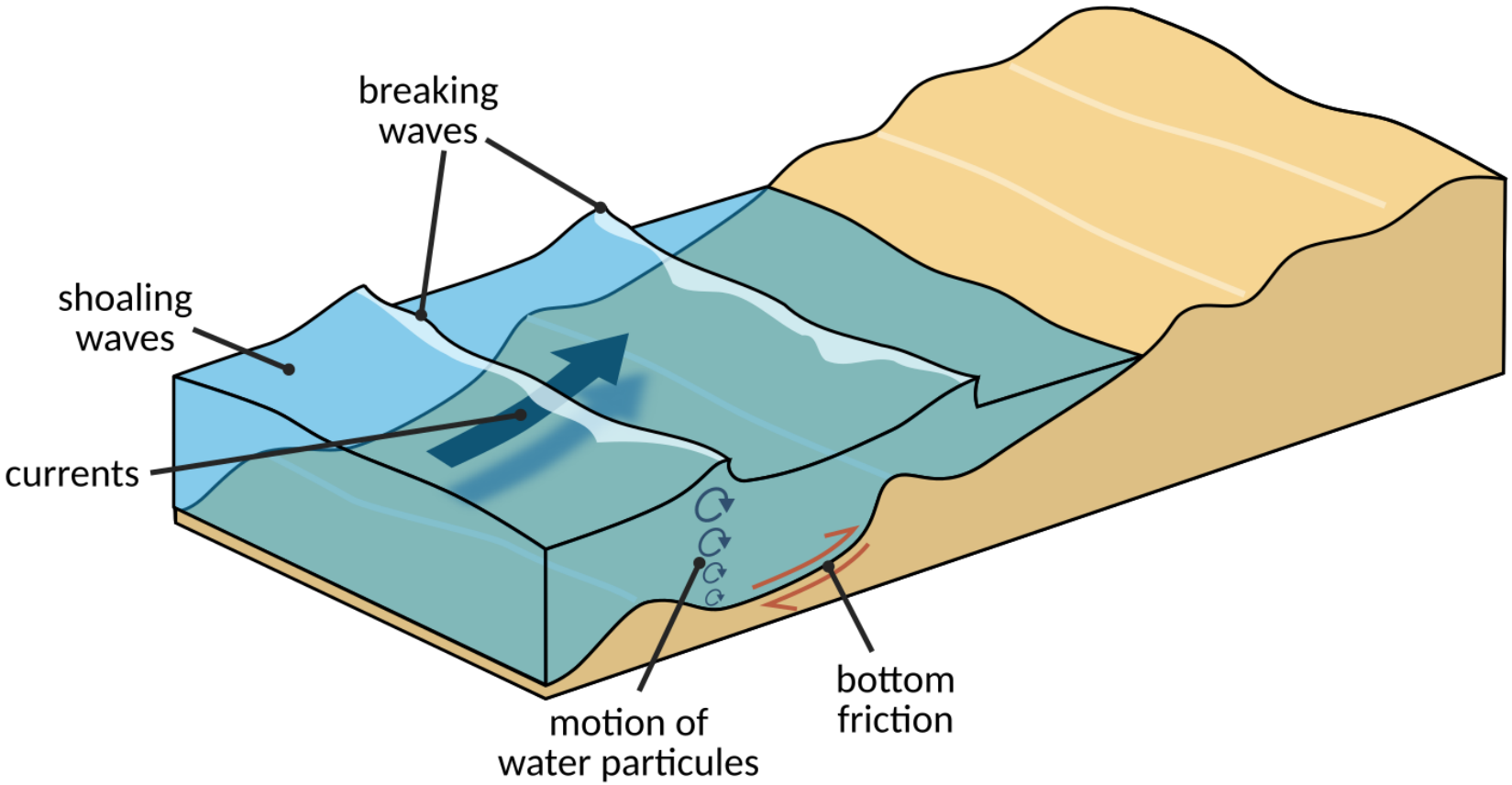
SETTINGS

Morphodynamic models are used to predict the movement of the sand at the coast.



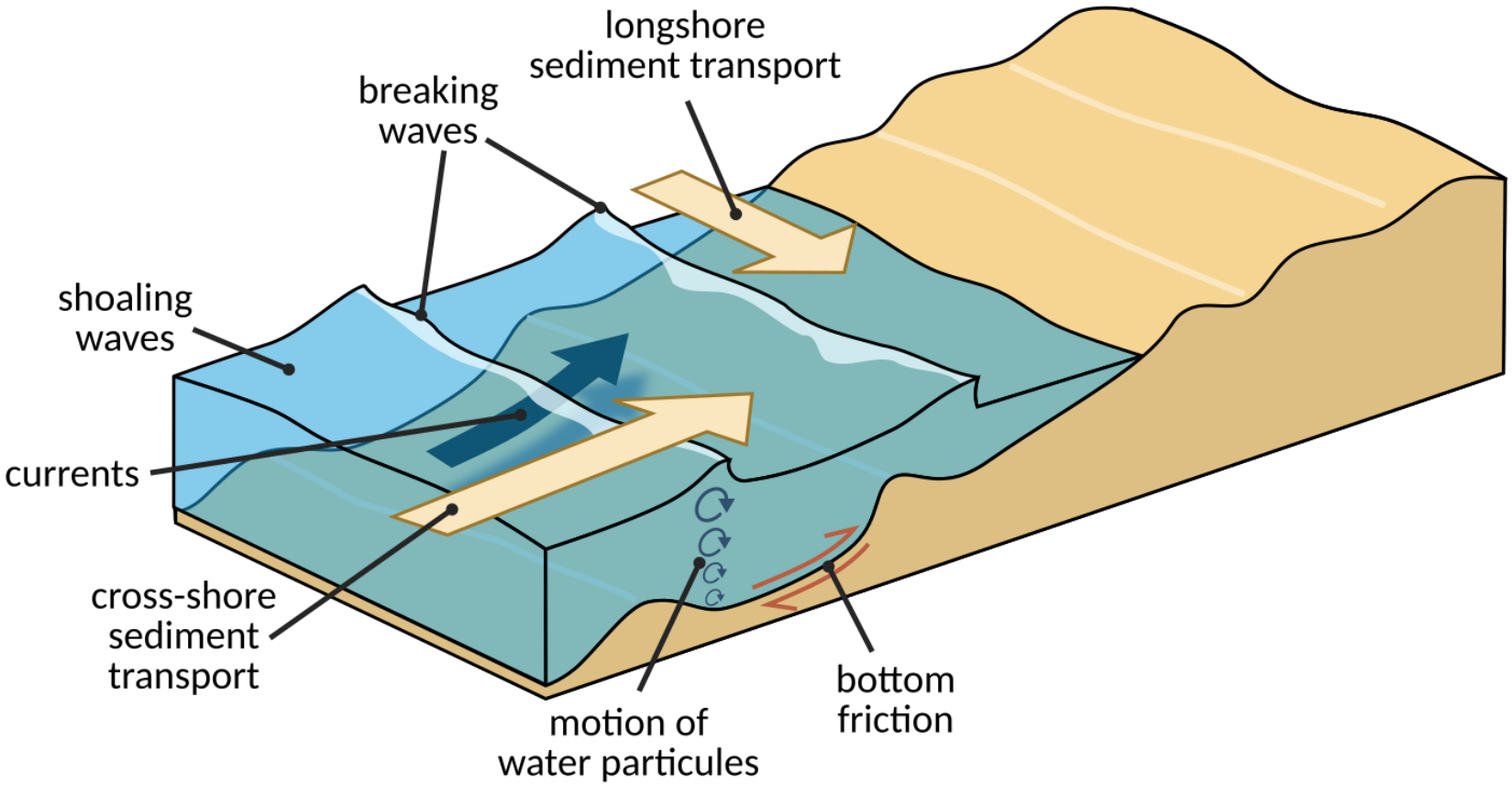
SETTINGS

Morphodynamic models are used to predict the movement of the sand at the coast.



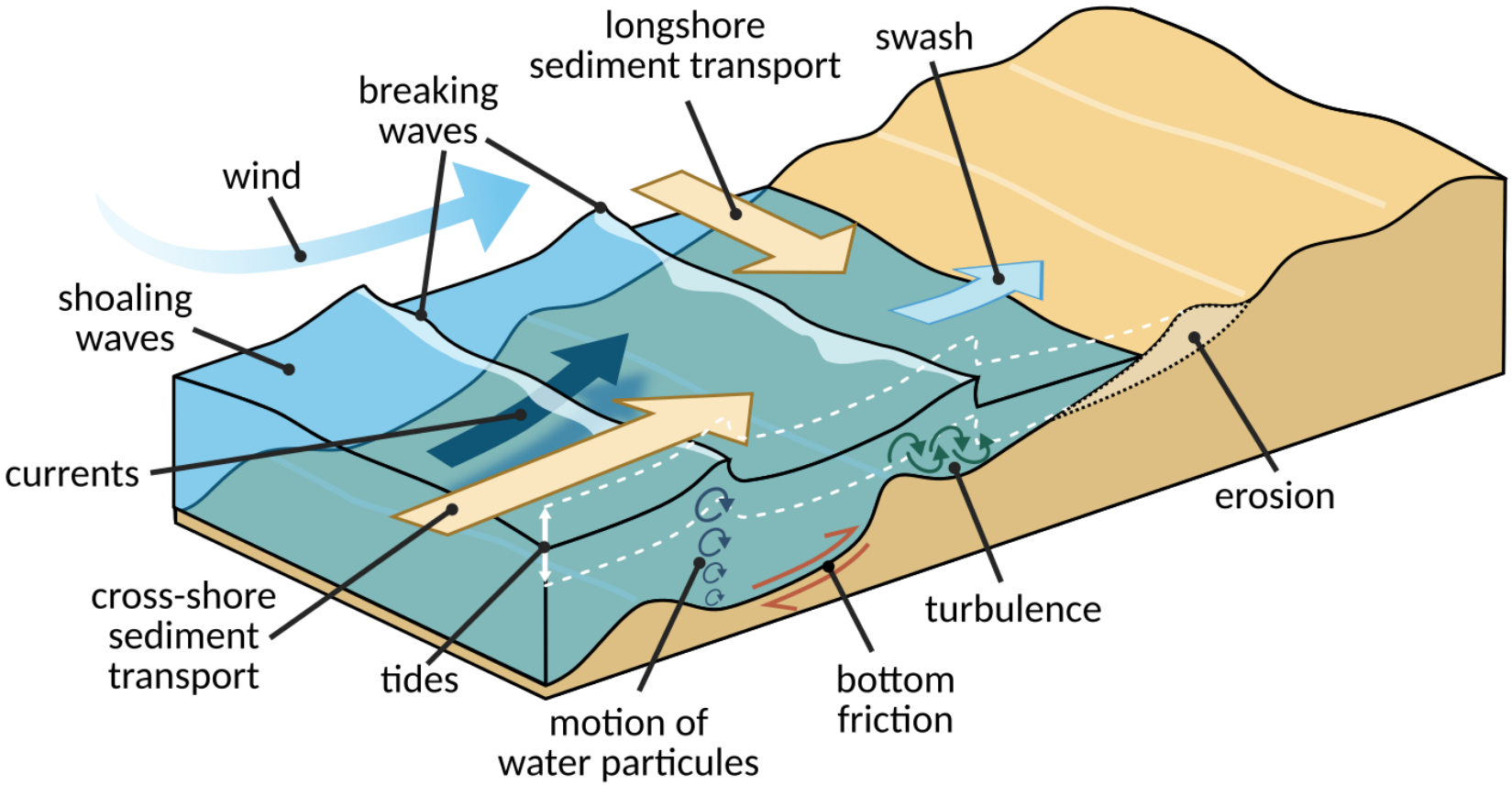
SETTINGS

Morphodynamic models are used to predict the movement of the sand at the coast.



SETTINGS

Morphodynamic models are used to predict the movement of the sand at the coast.



OPTI-MORPH

Opti-Morph is a new hydro-morphodynamic model for coastal dynamics.

Features:

- Unique in its kind.
- Based on natural optimization theory.
- Fast, robust and low complexity.

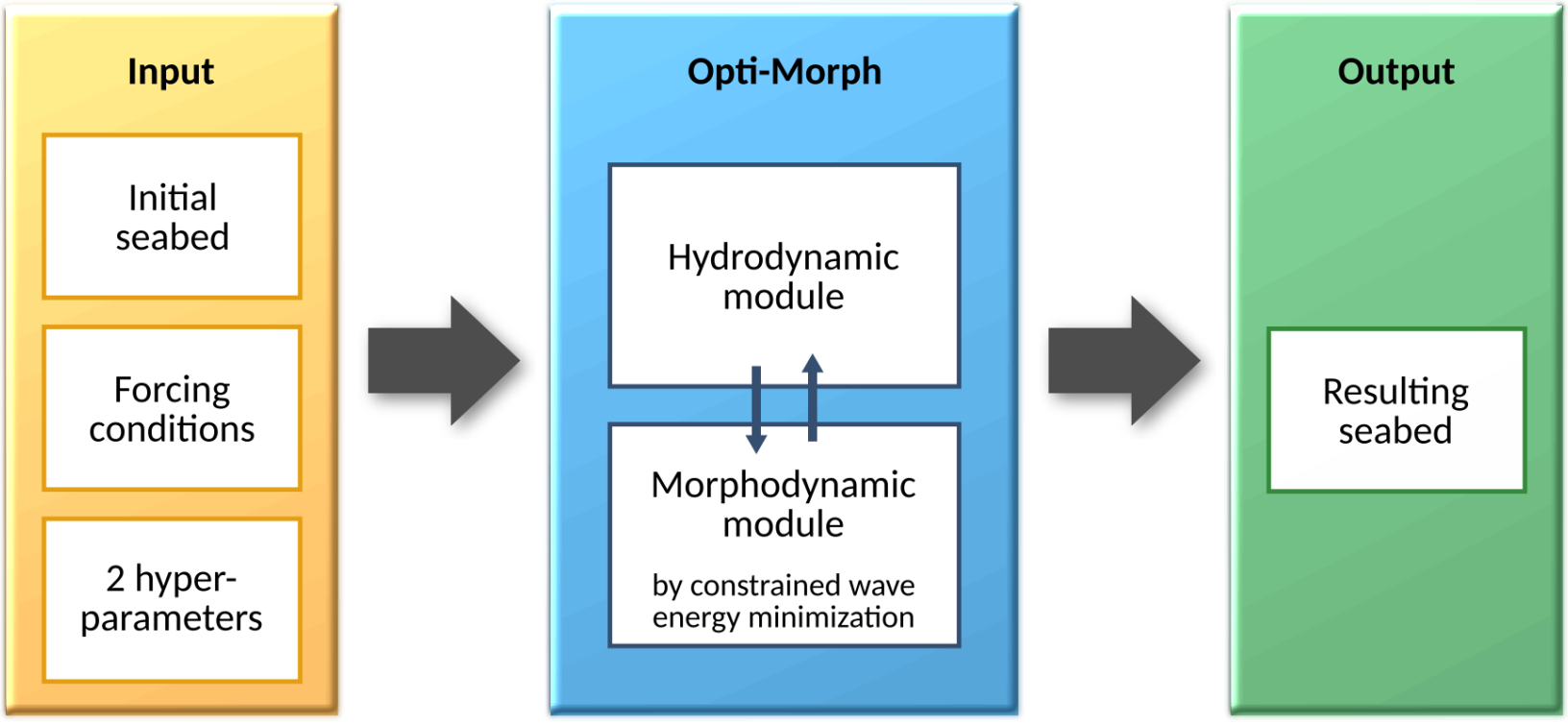
Fundamental assumption:

> The shape of the seabed evolves over time in an effort to **minimize** the energy of the surface waves.

OPTI-MORPH

Opti-Morph is a new hydro-morphodynamic model for coastal dynamics.

Characteristics:



RESULTS: SHORT TERM SIMULATIONS

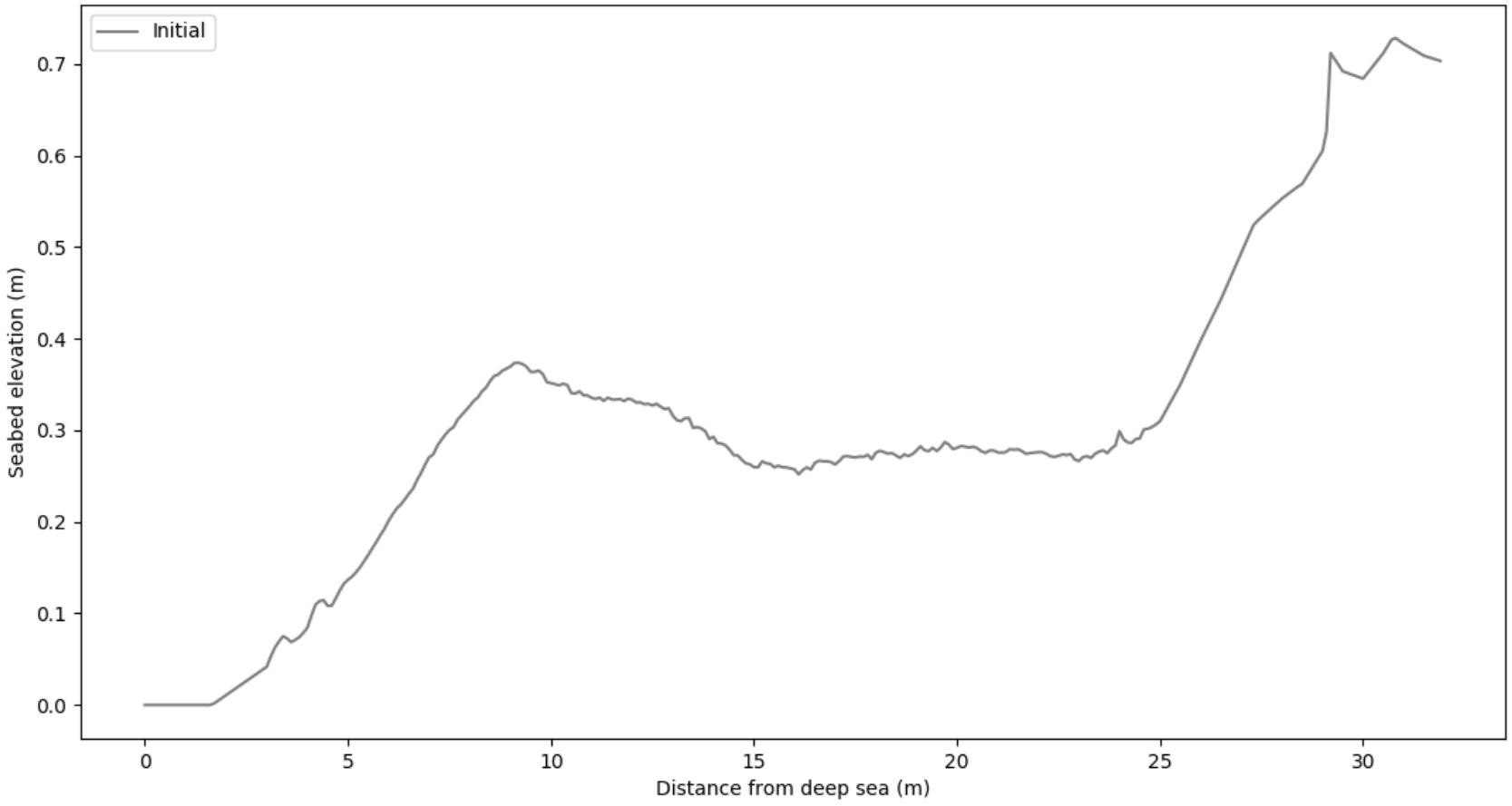


Figure: Numerical and experimental results of flume configuration.

RESULTS: SHORT TERM SIMULATIONS

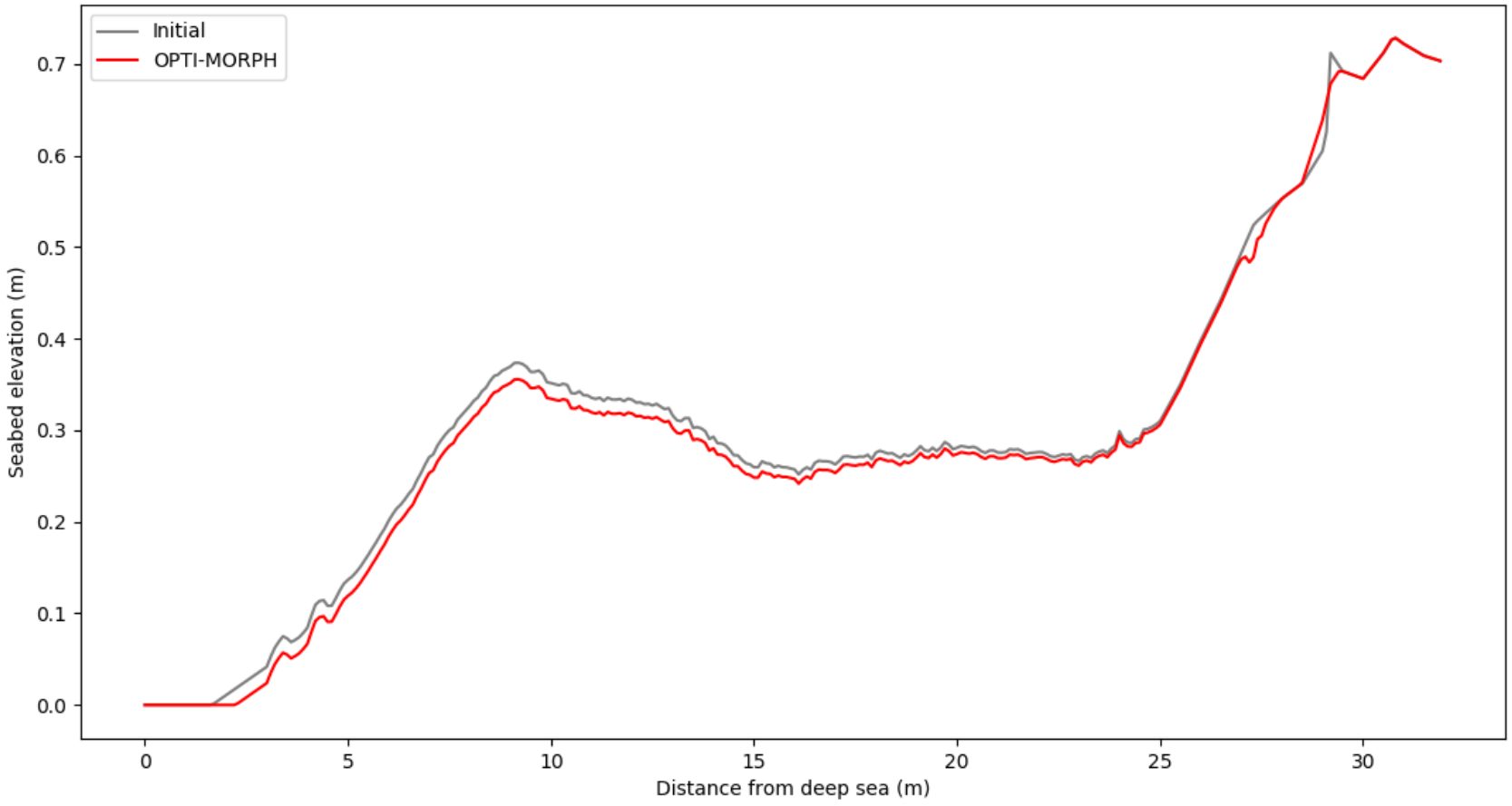


Figure: Numerical and experimental results of flume configuration.

RESULTS: SHORT TERM SIMULATIONS

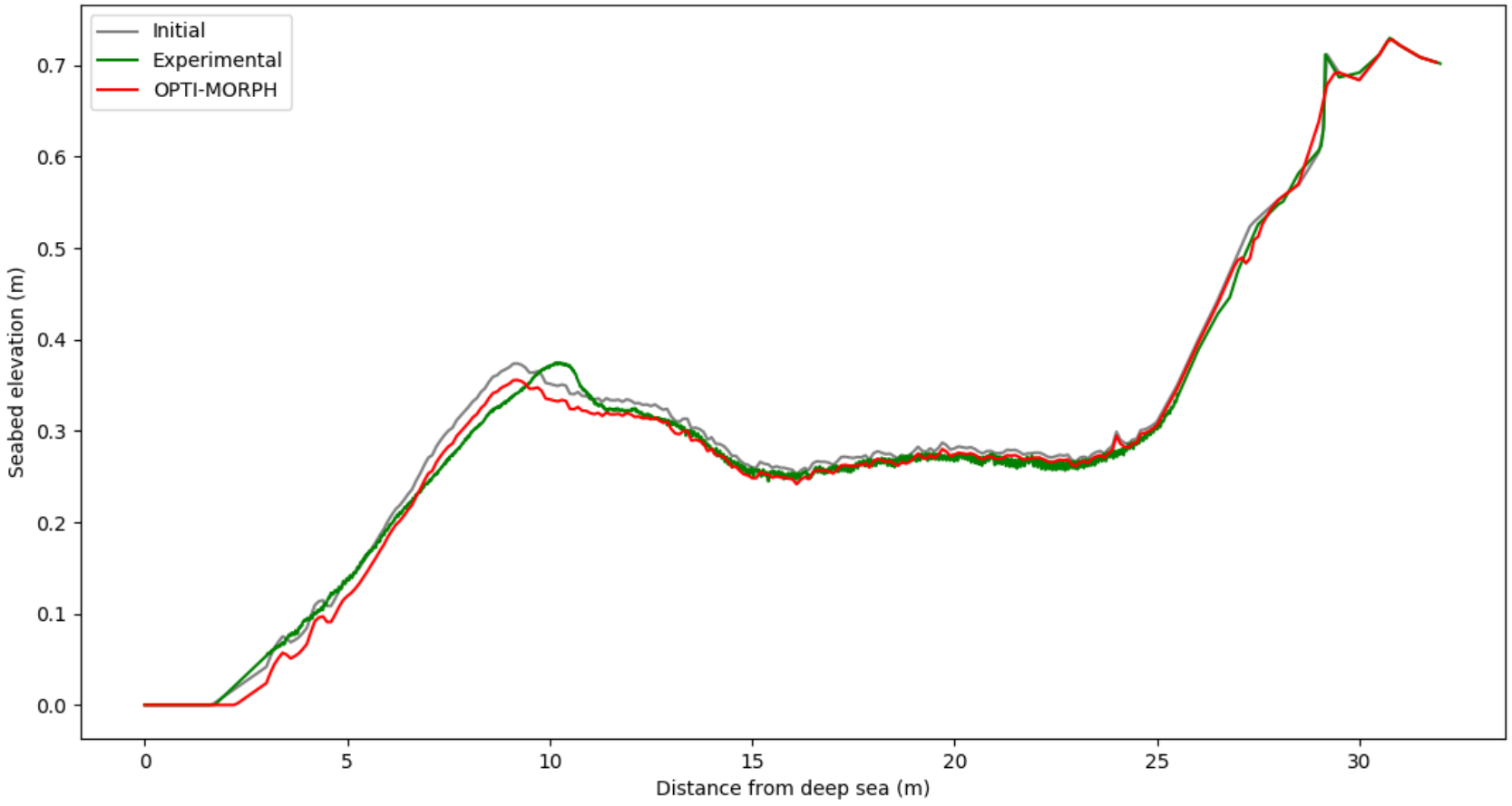


Figure: Numerical and experimental results of flume configuration.

RESULTS: SHORT TERM SIMULATIONS

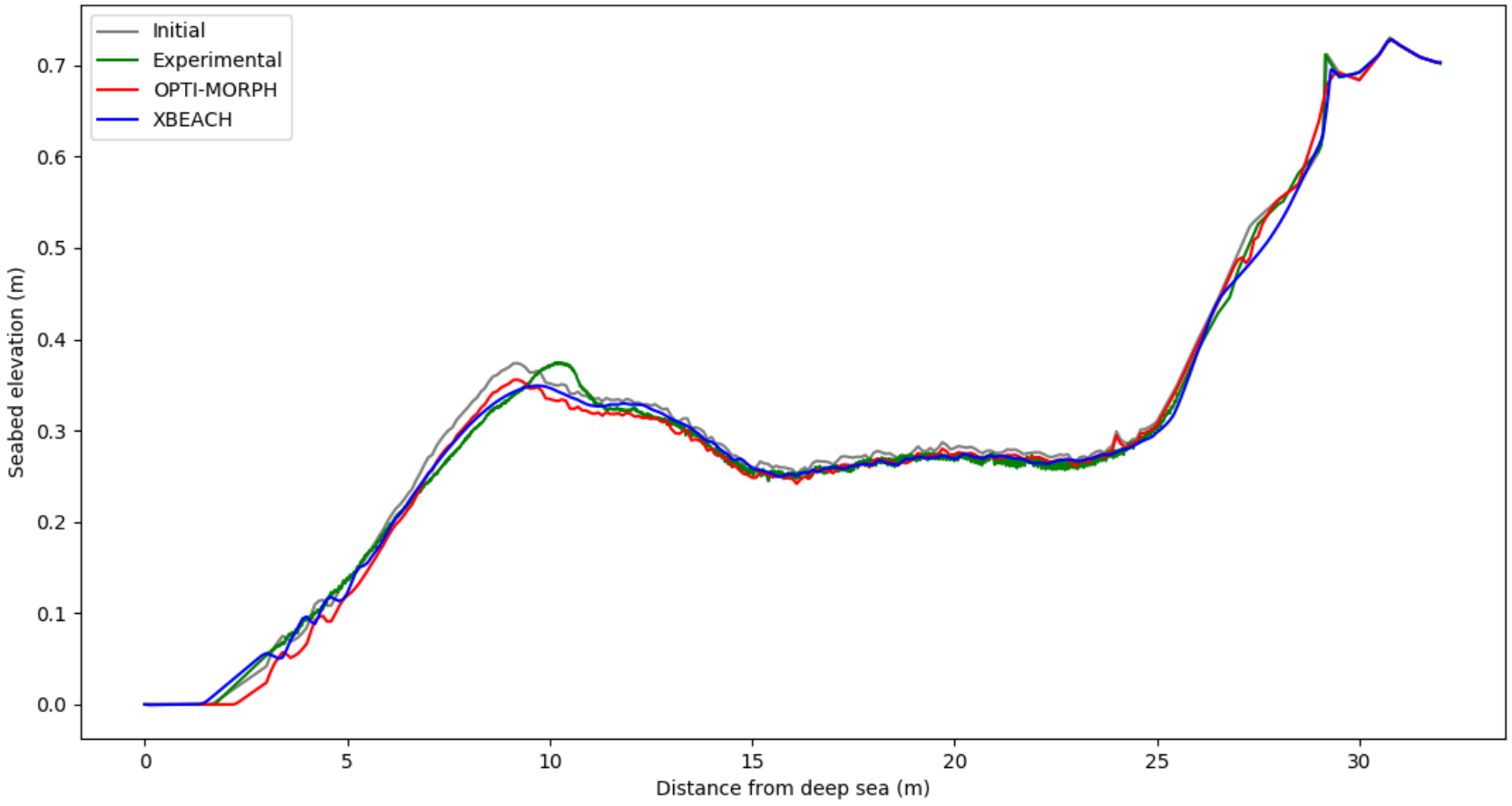


Figure: Numerical and experimental results of flume configuration.

RESULTS: SHORT TERM SIMULATIONS

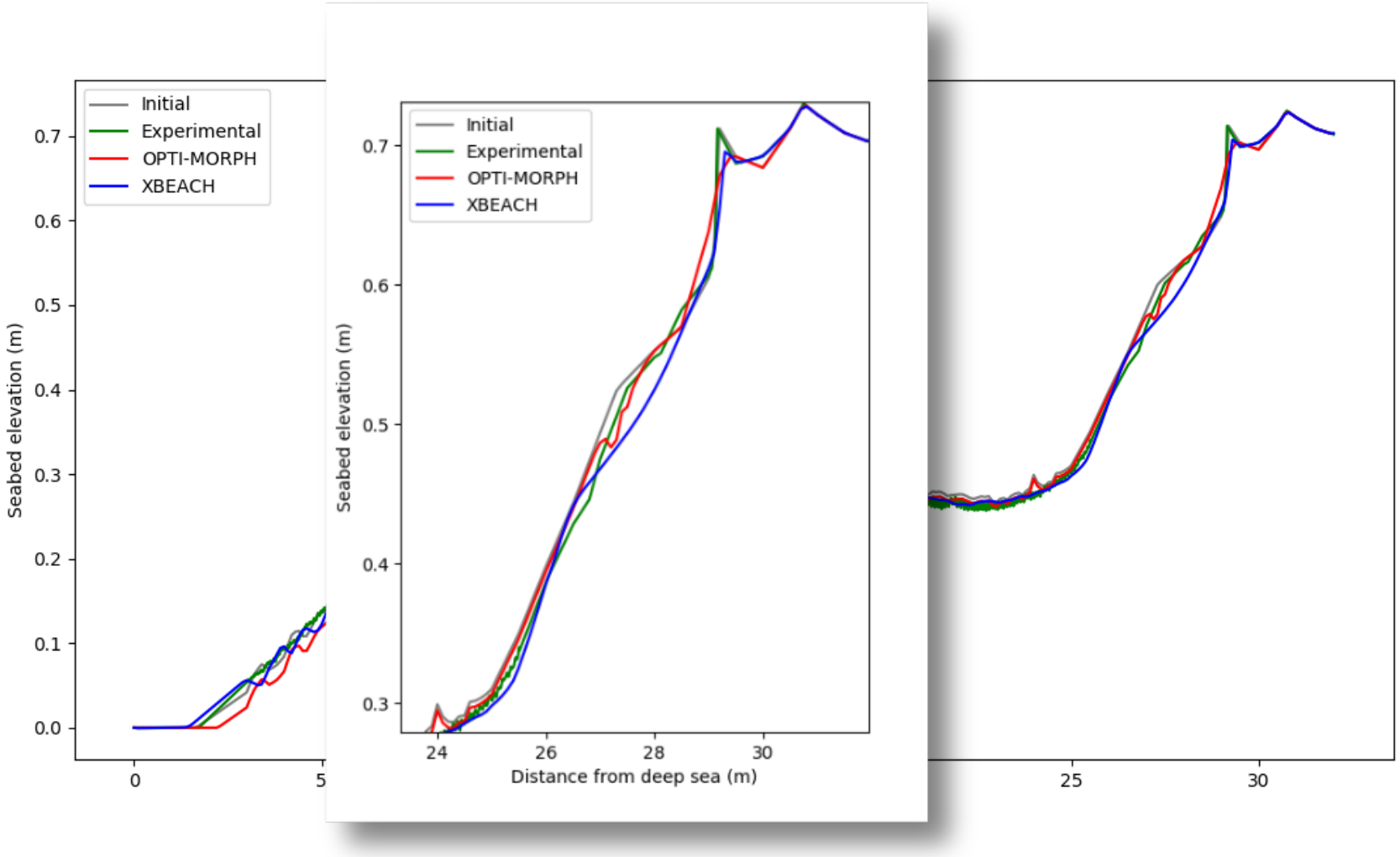


Figure: Numerical and experimental results of flume configuration.

RESULTS: SHORT TERM SIMULATIONS

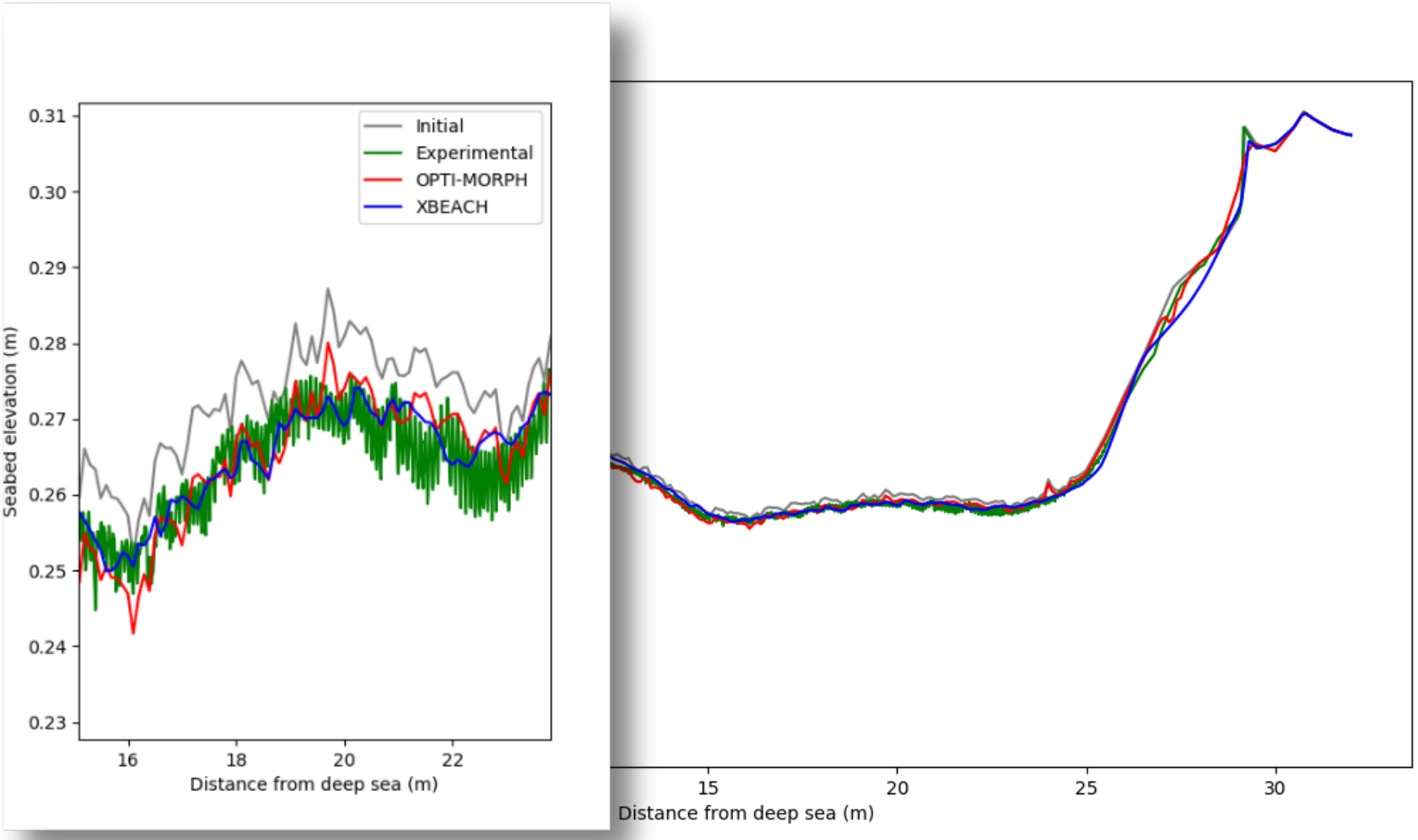


Figure: Numerical and experimental results of flume configuration.

RESULTS: SHORT TERM SIMULATIONS

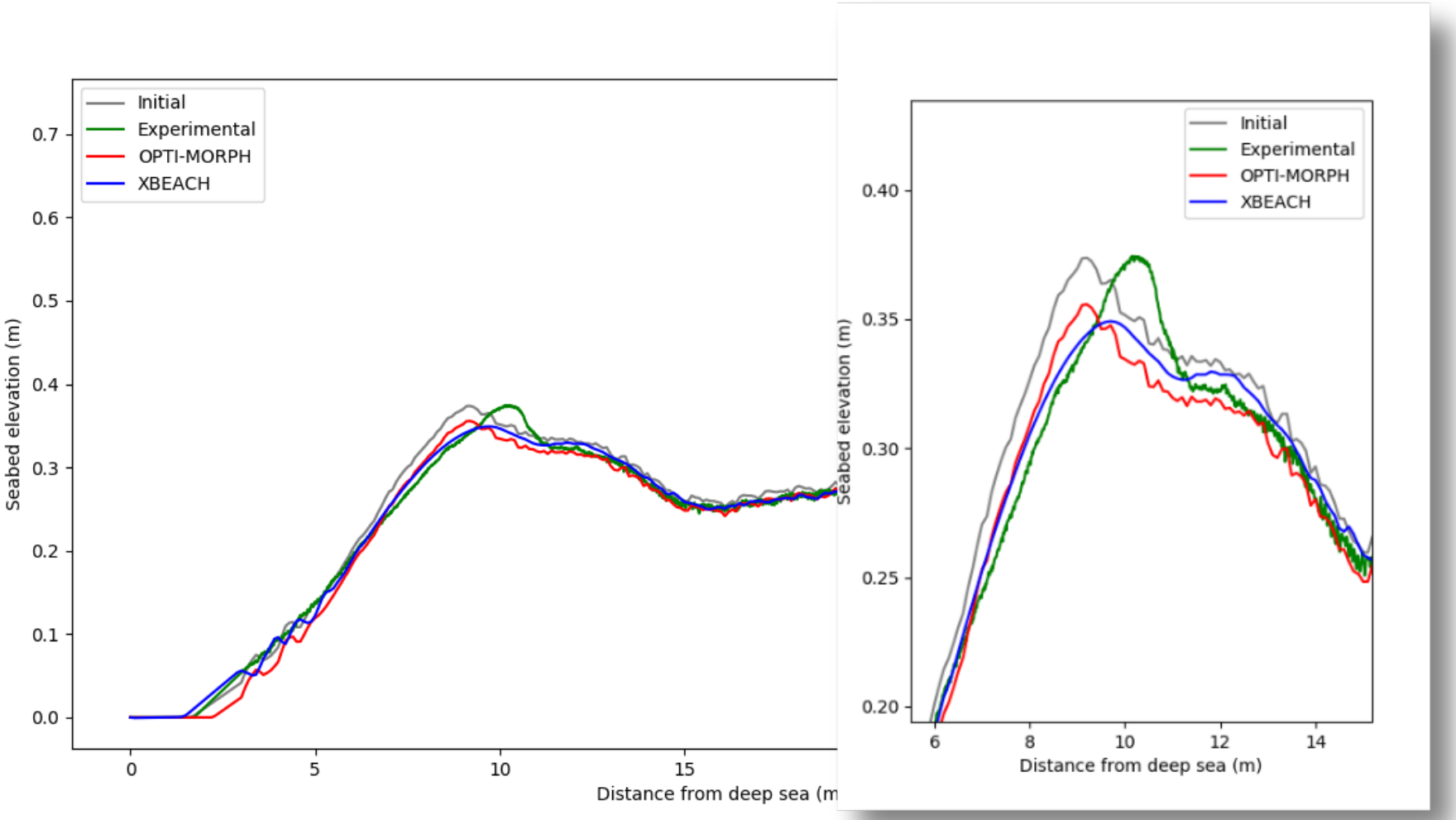


Figure: Numerical and experimental results of flume configuration.

RESULTS: LONG-TERM SIMULATIONS

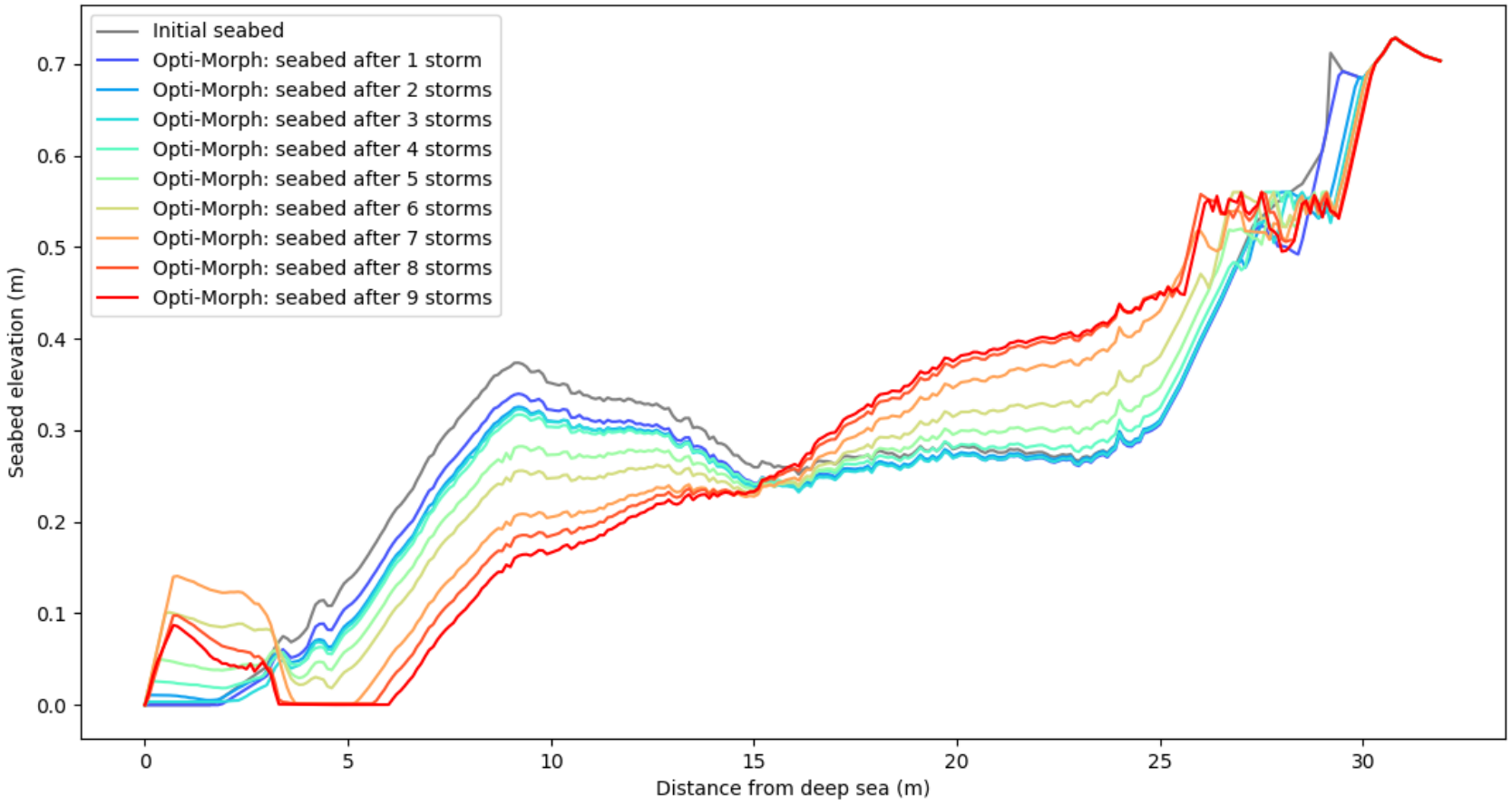


Figure: Long-term behavior of numerical models.

RESULTS: LONG-TERM SIMULATIONS

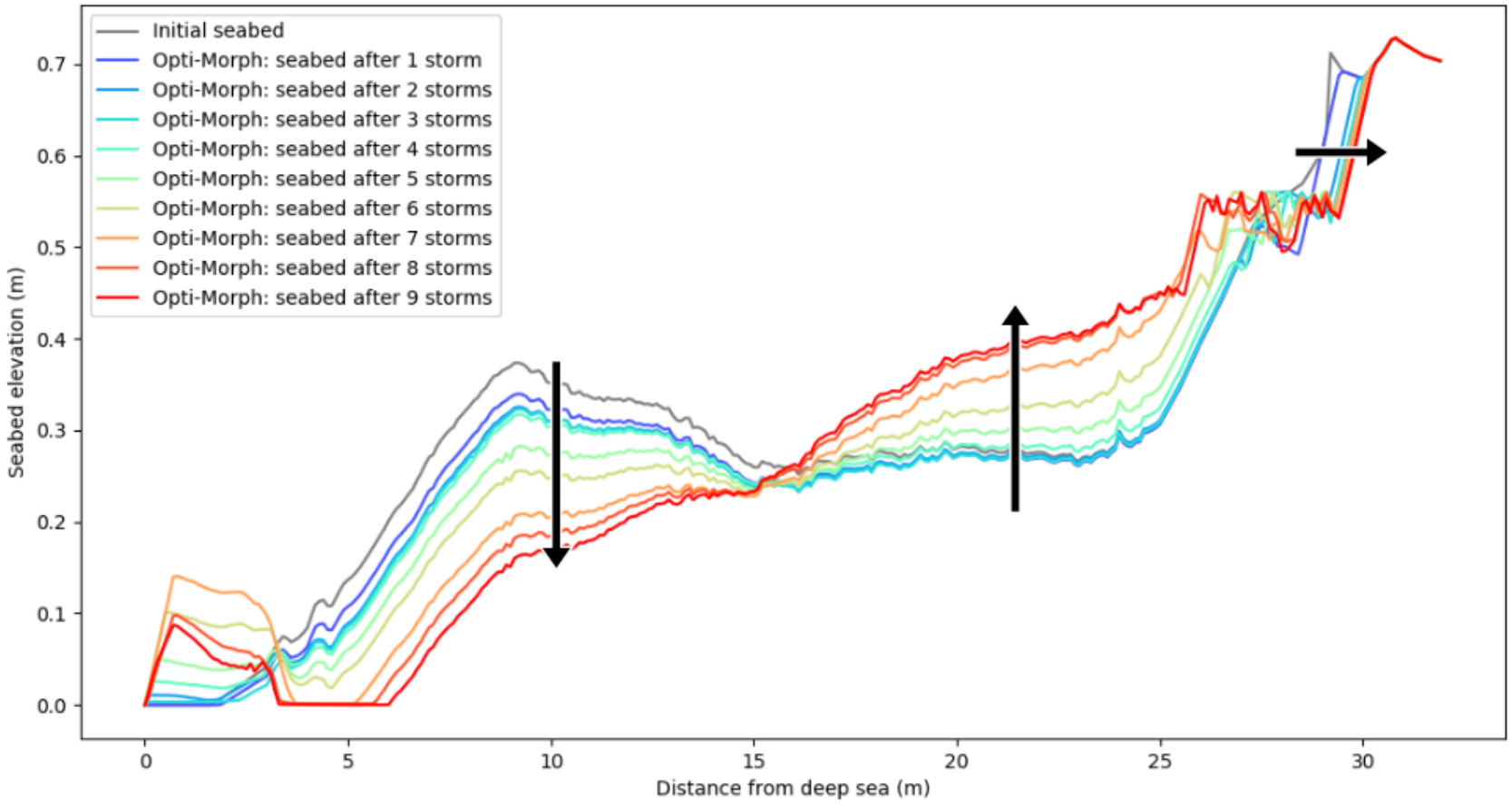


Figure: Long-term behavior of numerical models.

RESULTS: LONG-TERM SIMULATIONS

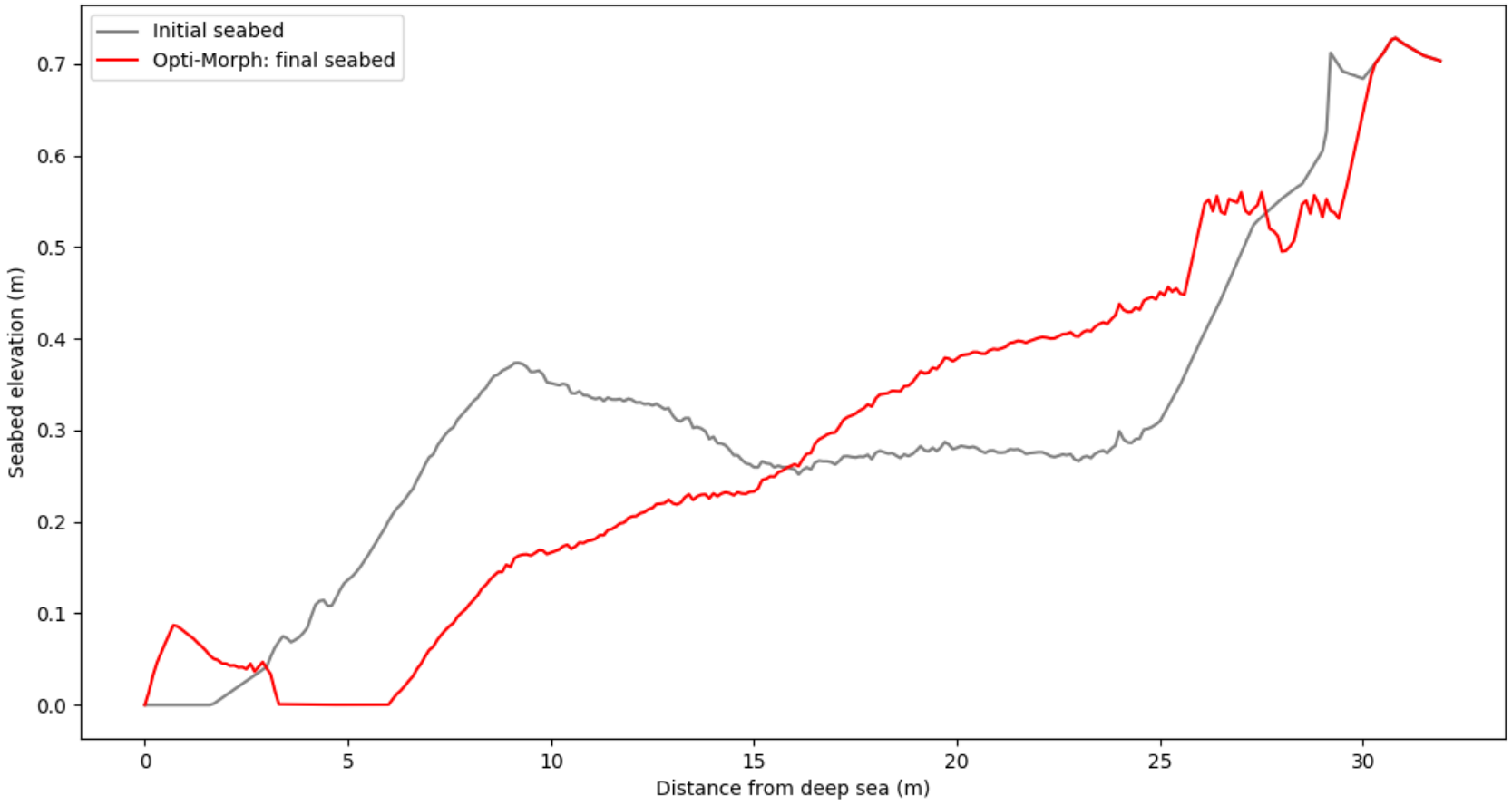


Figure: Long-term behavior of numerical models.

RESULTS: LONG-TERM SIMULATIONS

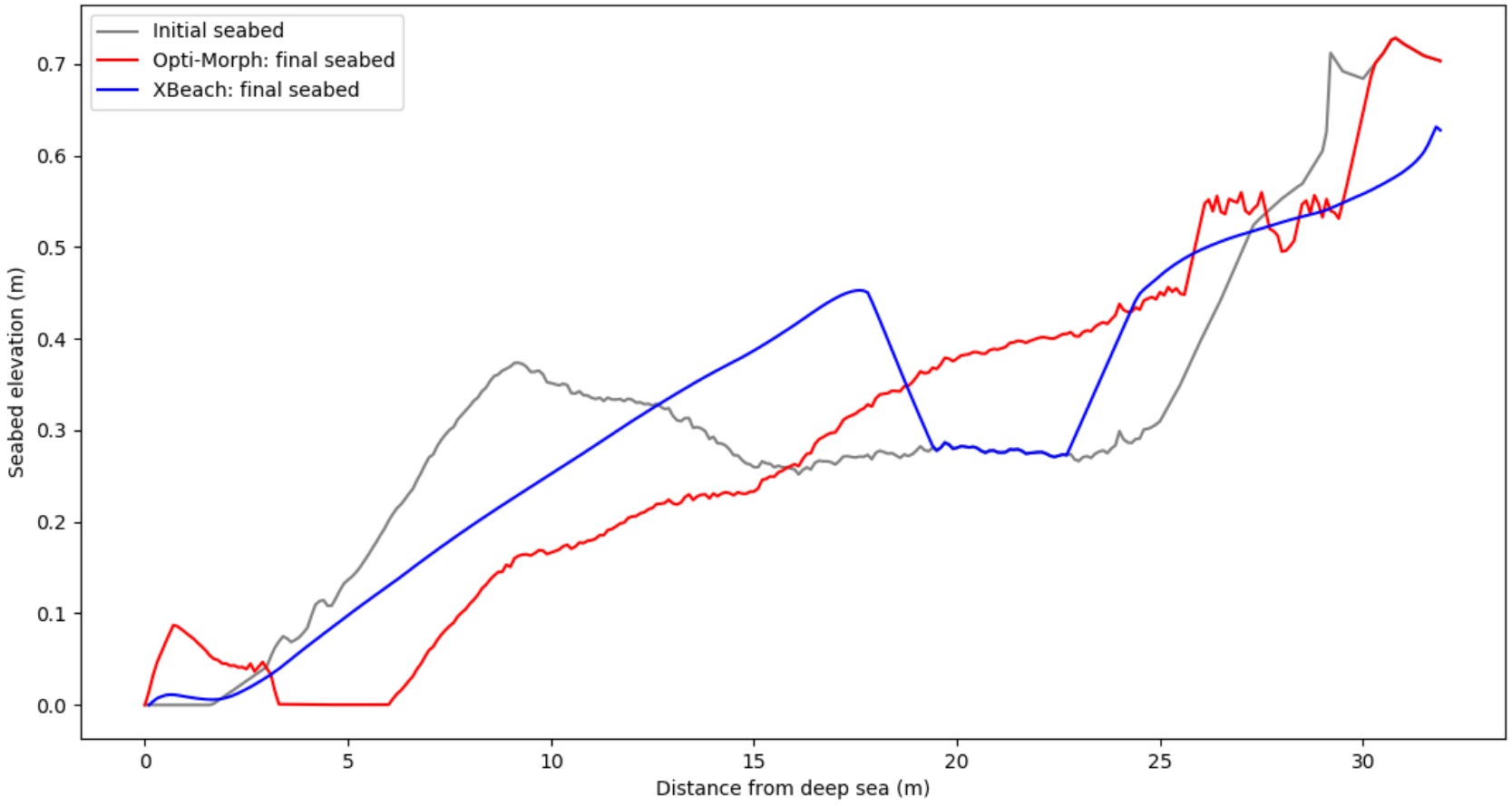


Figure: Long-term behavior of numerical models.

Conclusion

Conclusion:

- Opti-Morph shows promising results as a **fast**, **robust**, **low complexity** hydro-morphodynamic model.
- It demonstrates the potential of natural models by **energy minimization**.
- With its **short computational time**, Opti-Morph can be advantageous for coastal engineering studies.

Thank you for your attention!