A simple model of coupled overwash-shoreface morphodynamics reveals complex modes of barrier response to sea-level rise

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Introduction:
Barriers are known to keep pace with sea-level rise via storm overwash sedimentation. Is there a threshold sea-level rise rate beyond which barriers cannot maintain themselves?

Idealized geometry:
This morphodynamic model focuses on the interplay between shoreface evolution, overwash deposition and sea-level rise. It is simple enough to explore barrier behavior for a wide range of input parameter values.

Processes:
1) Overwash
2) Shoreface response
3) Sea-level rise

Natural behaviors under constant sea-level rise:

\[ \frac{dH}{dt} = \frac{Q_{\text{OW}}}{H} \]

Discontinuous retreat:
1) Dynamic equilibrium
Overwash and shoreface fluxes are sufficient to maintain the barrier during landward migration.
2) Height drowning
Overwash fluxes are insufficient to maintain the landward migration rate required to keep up with sea-level rise.
3) Width drowning
Low shoreface response rate, which results in a rapid loss of barrier width.
4) Periodic discontinuous retreat
Timelags in the shoreface response can lead to abrupt changes in the rate of shoreline retreat.

Exploring the parameter space:

Effect of a change in back-barrier slope:

\[ \frac{dH}{dt} = \frac{Q_{\text{OW}}}{H} \]

Effect of a change in the sea-level rise rate:

Future work:
- Changes in the frequency and intensity of storms
- Complex back-barrier topography
- Alongshore sediment transport
- Spatial changes in shoreface lithology

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