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The sensitivity of bay morphology to wave conditions: application of a new vector-based coast line evolution model.

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We developed the COastal Vector Evolution (COVE) model in order to explore the behaviour of crenulate-shaped bays forced by differing directional wave climates. COVE is intended to simulate the evolution of sandy coastlines over decadal to centennial timescales. The model coastline is described by a vector in a Cartesian reference frame, and the shoreface evolves perpendicular to its local orientation, allowing simulation of coasts with complex planform geometry. Similar to previous published models, shoreline evolution is driven by gradients in alongshore transport, but following newly developed algorithms that facilitate evolving high planform-curvature coastlines whilst conserving mass. We demonstrate the models capabilities by simulating the evolution of bays to an equilibrium condition from a straight coast, fixed between two headlands with no external sediment inputs, forced by an ensemble of directional wave climate conditions. We find that planform bay aspect ratio increases with the directional obliquity of the wave climate, and decreases with the spread of wave directions. Varying bay size over two orders of magnitude (0.1-16 km), the model predicts that bay shape is independent of bay size. Bays attain equilibrium over a time period that was found to scale with the square of bay size, suggesting that small bays are likely to respond to and recover from perturbations rapidly (over just a few years), whilst large bays require much longer timescales (hundreds of years). Empirical expressions predicting bay shape may be misleading if used to predict their behaviour over planning timescales.