Quantity, Exchange, Shift and Trajectories (QUEST) accounting enlightens raster time series class transitions

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The United States funded this research via grants from the National Aeronautical and Space Administration and the National Science Foundation.

Major Points

1. Quantity, Exchange, Shift and Trajectories (QUEST) is an accounting framework to summarize patterns in a time series of raster thematic maps in terms of five trajectories and five components to detect processes.
2. We apply QUEST to distinguish patterns associated with sea-level rise versus other processes in the Virginia Coast Reserve, USA.
3. Software and a first publication are available for free at https://onlinelibrary.wiley.com/doi/10.1111/tgis.70136



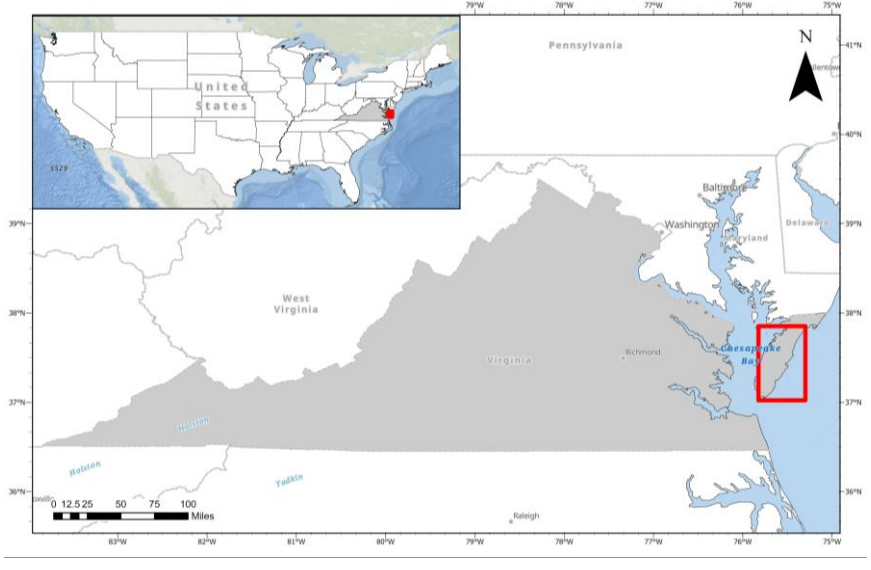


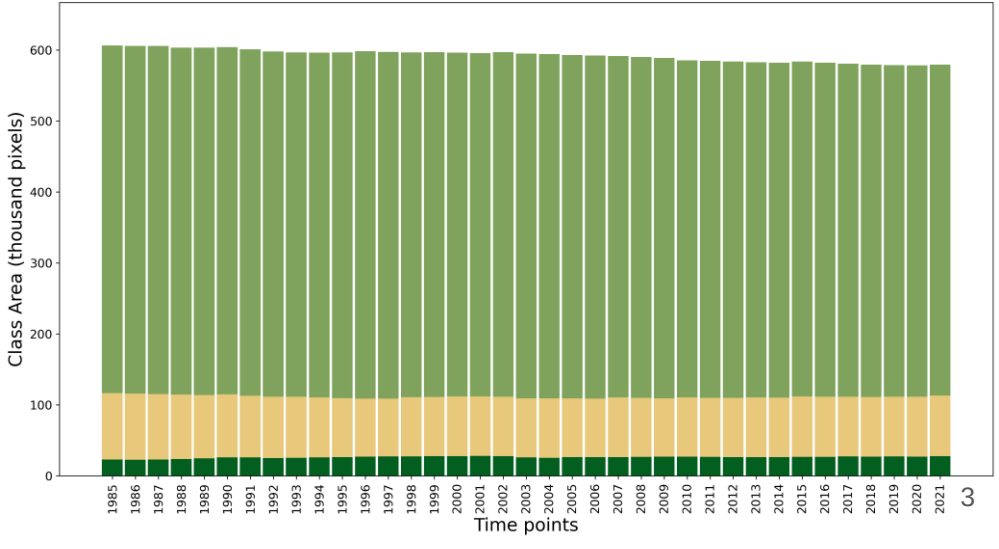
Annual maps during 1985 … 2021 show: zero quantity change of Trees & Beach, quantity loss of Marsh, and quantity gain of Water.

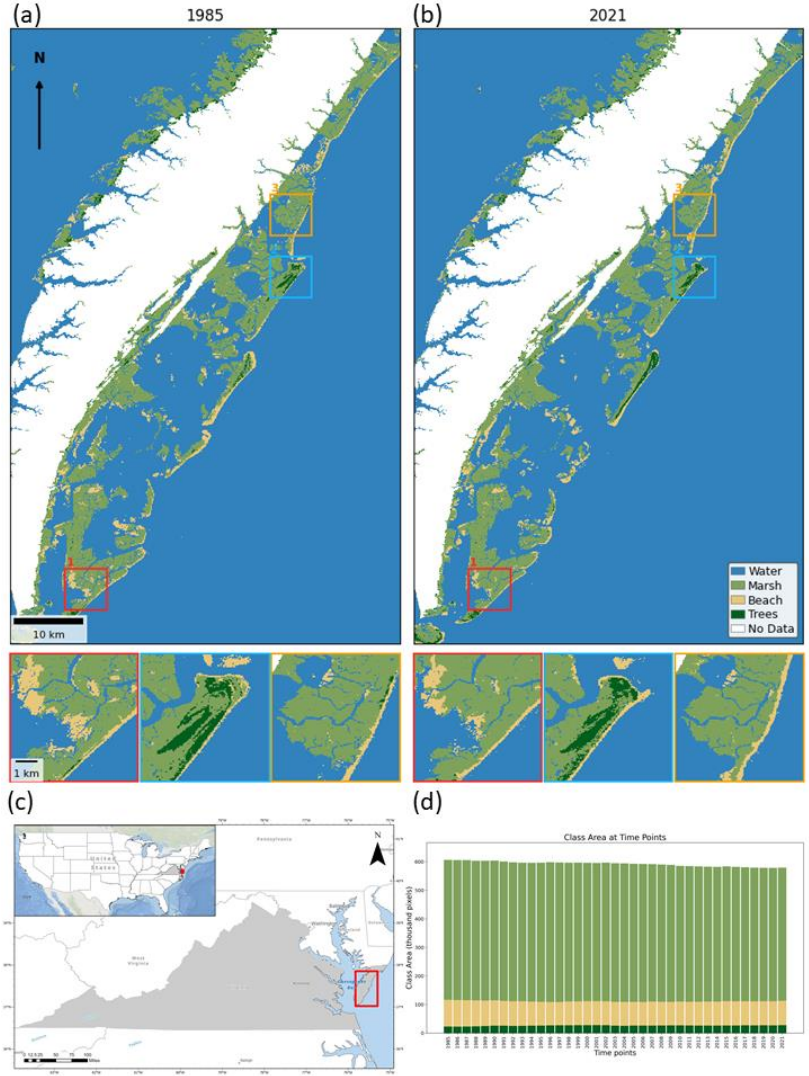


Boston University Geomorphologist Professor Sergio Fagherazzi supplied the maps.





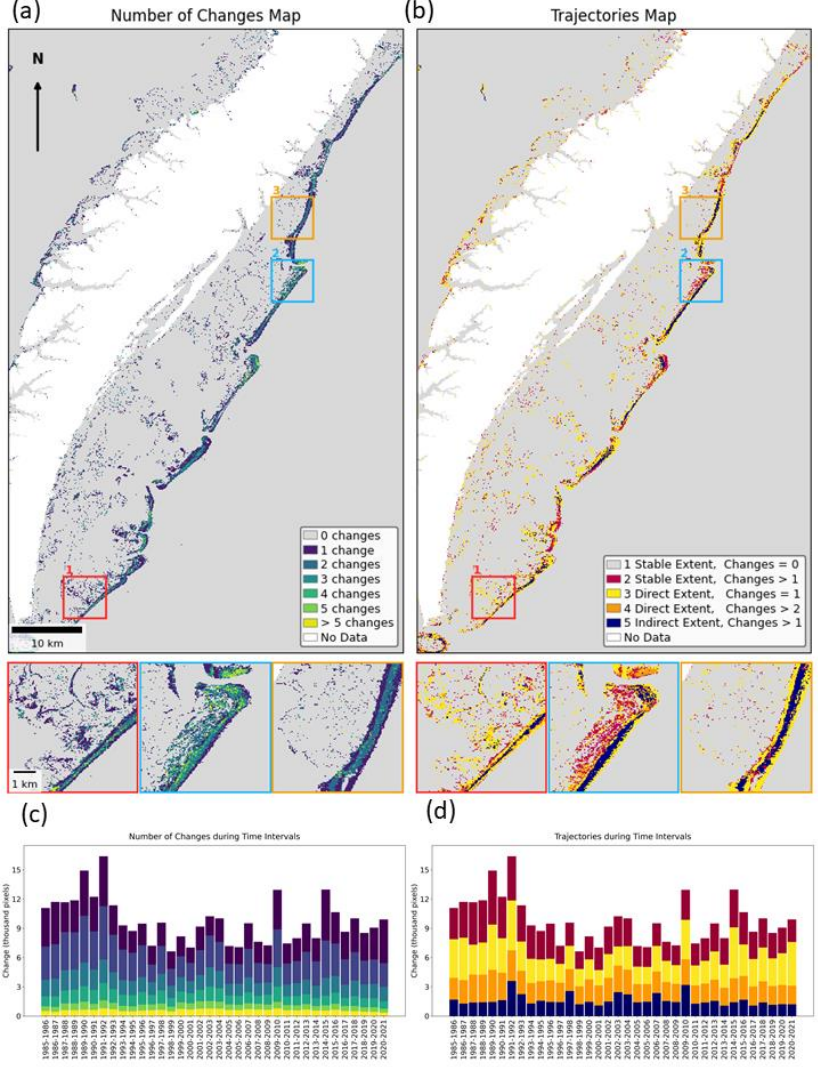




Virginia Coast Reserve has annual land cover maps 1985…2021.

Quantity change occurs when a class experiences net change in size.
Allocation change occurs when a class experiences gross loss at some locations and an equal size of gross gain at other locations.
Alternation change occurs when a class gains then loses at the same location.

QUEST measures patterns concerning the hypothesis that sea level rise causes transitions from Marsh to Beach to Water.

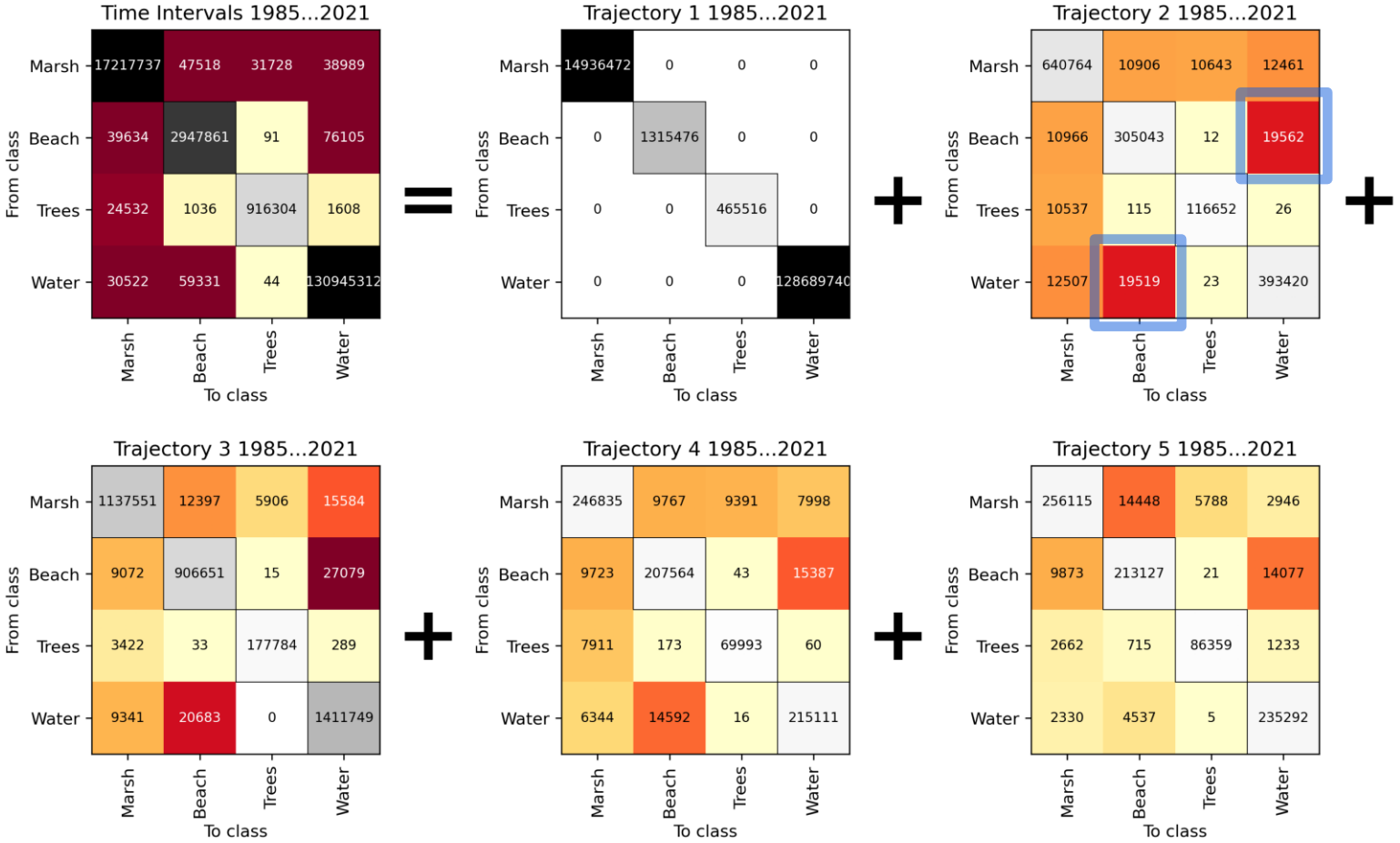


QUEST summarizes the annual time series for multiple classes.

QUEST shows the number of changes and five trajectories at each location and during each time interval.

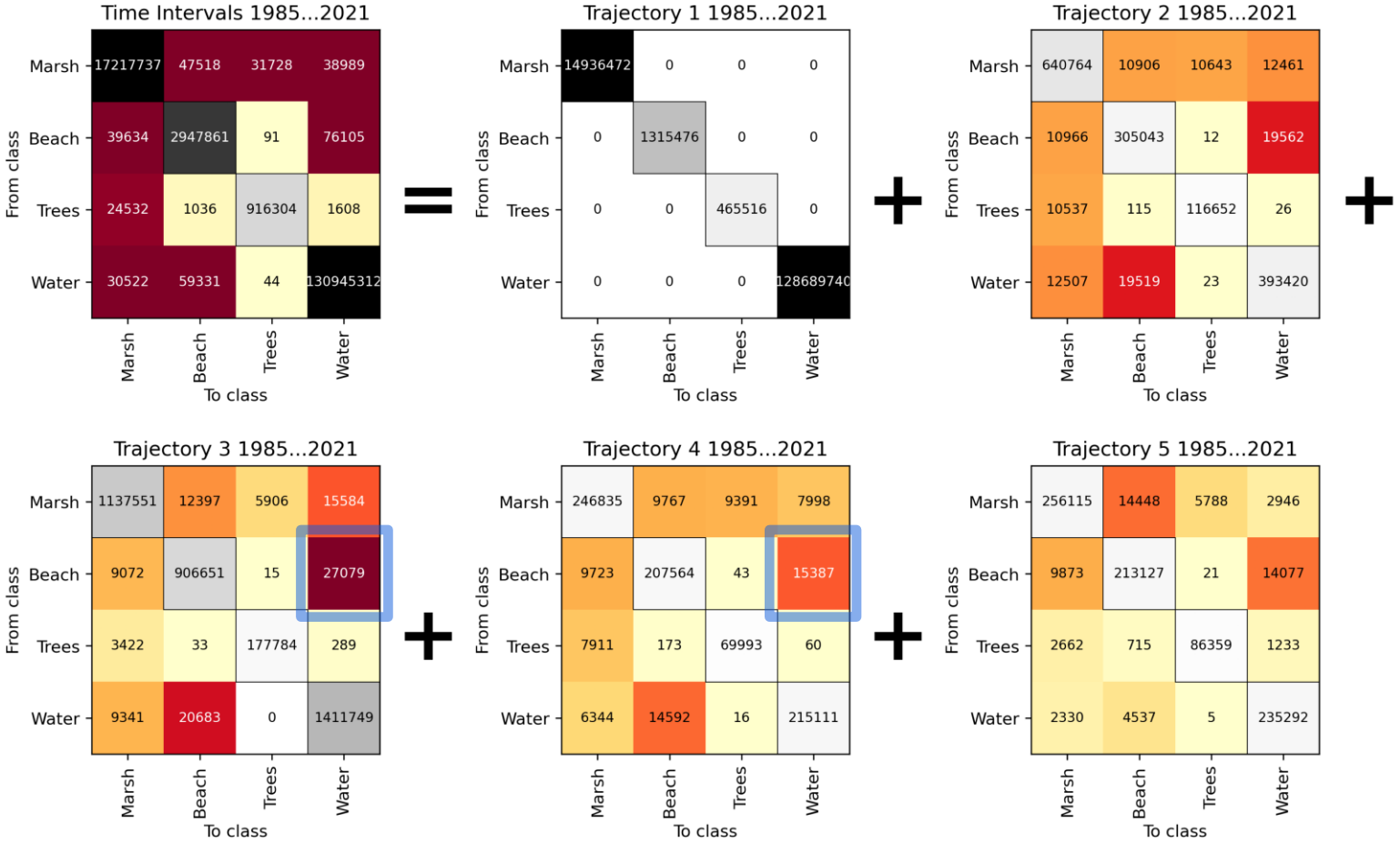
A transition from Marsh to Beach to Water contributes to Trajectory 5, which shows Indirect Change from Marsh to Water during 1985-2021 via more than one change.

All transitions are the sum of trajectory matrices.



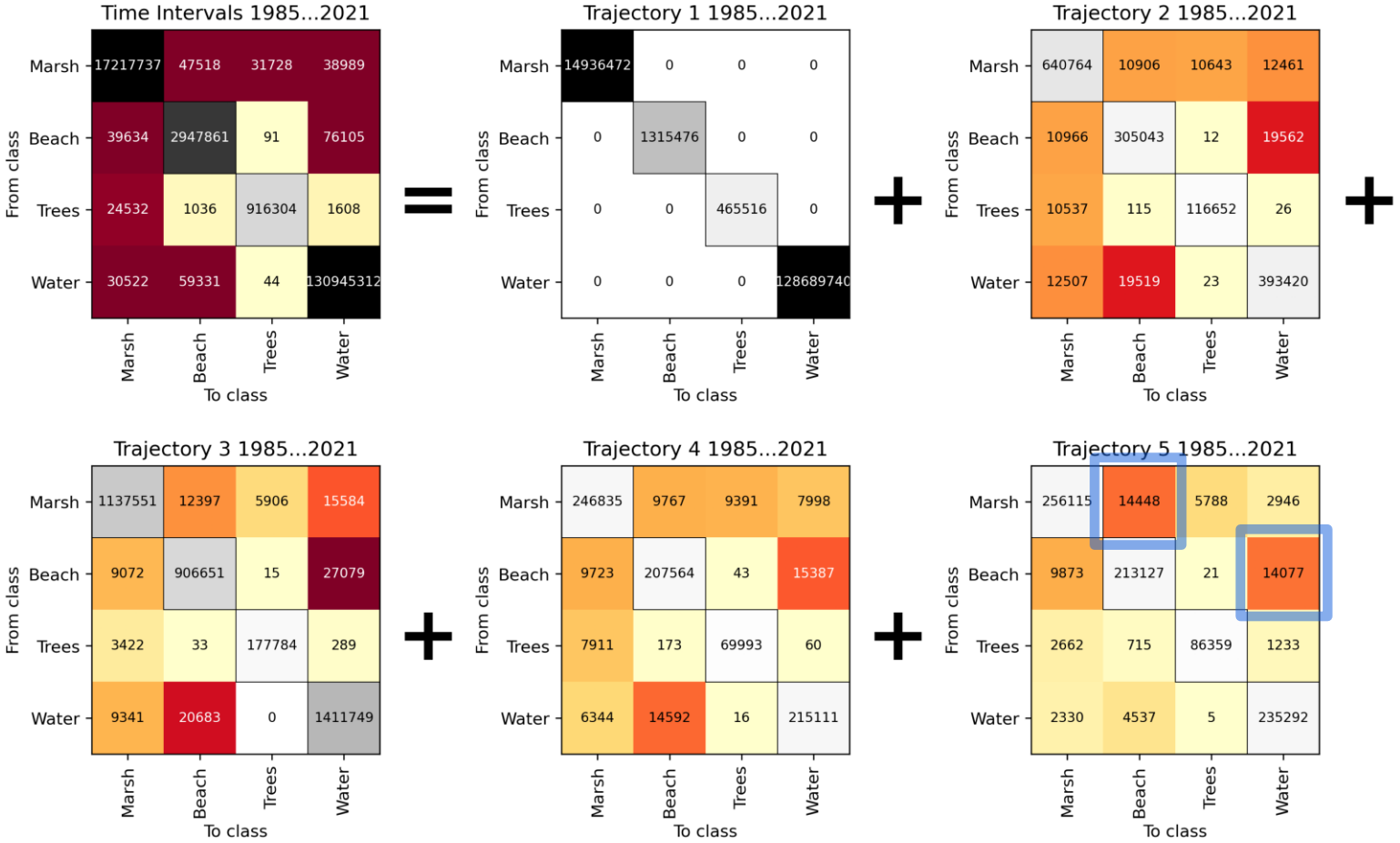
Trajectory 2 shows transitions from Beach to Water and from Water to Beach, which are likely due to tides.

All transitions are the sum of trajectory matrices.

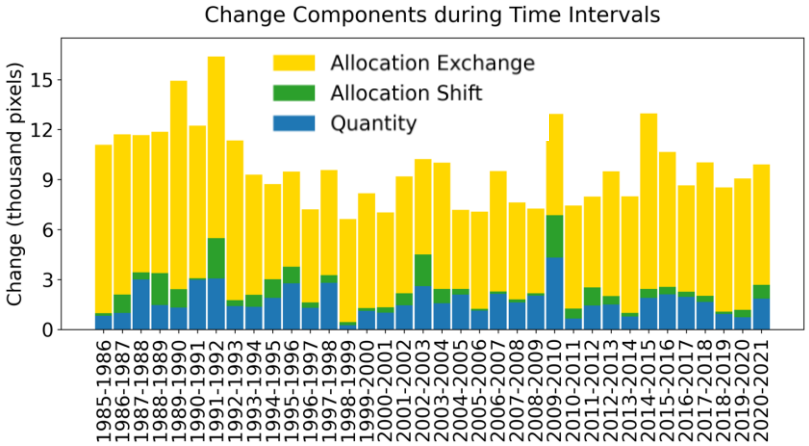


Trajectories 3 and 4 show the largest transition is from Beach to Water, which is consistent with sea-level rise.

All transitions are the sum of trajectory matrices.



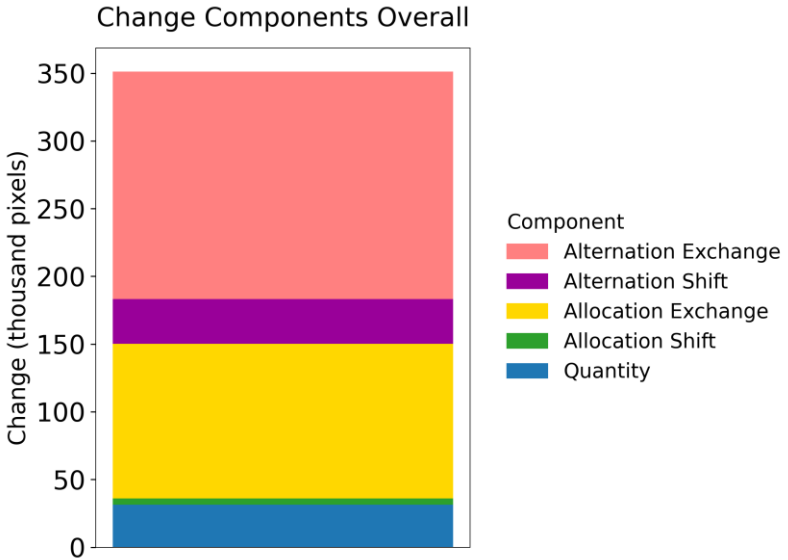
Trajectory 5 shows transitions from Marsh to Beach to Water, which supports our hypothesis.

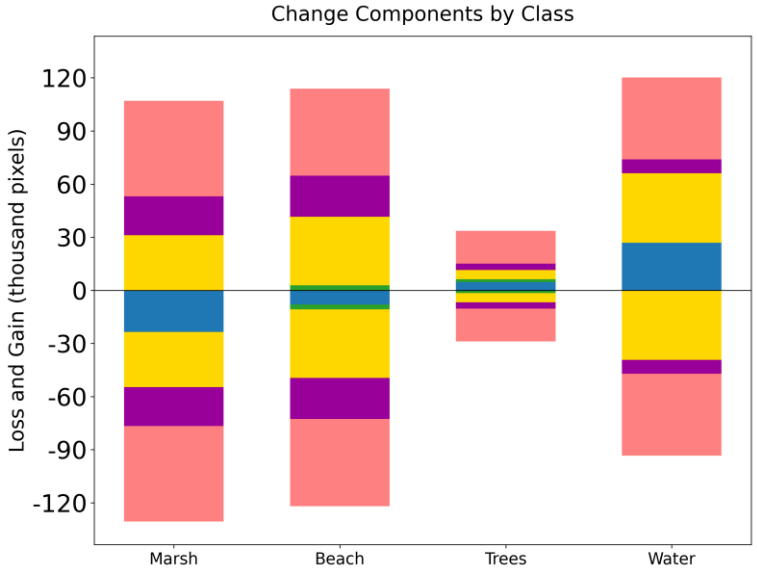


QUEST shows five components of change.

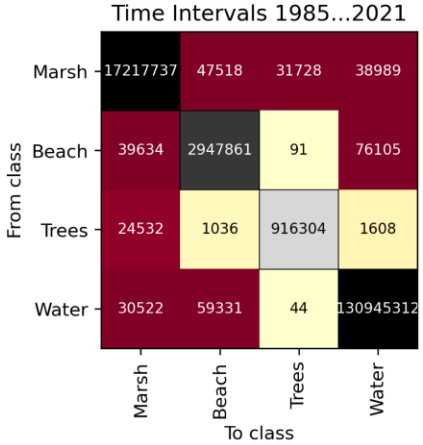
Quantity accounts for less change than Allocation.

Alternation accounts for more than half of overall change.





All transitions are a function of five component matrices.



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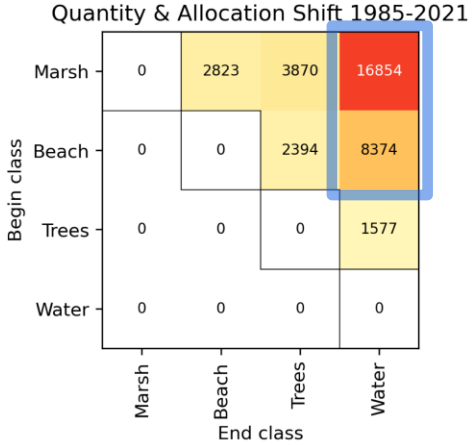

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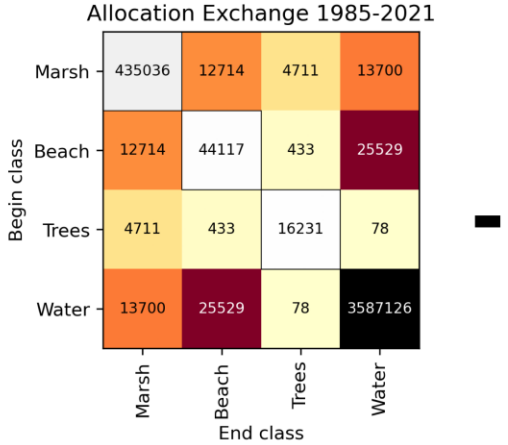

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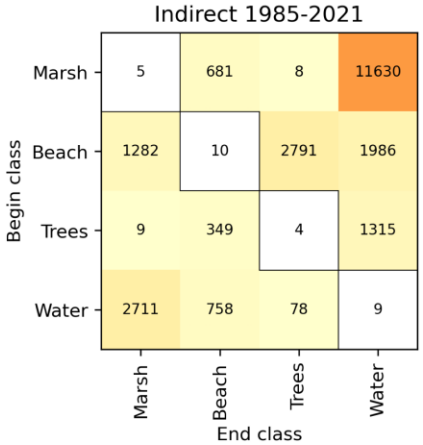

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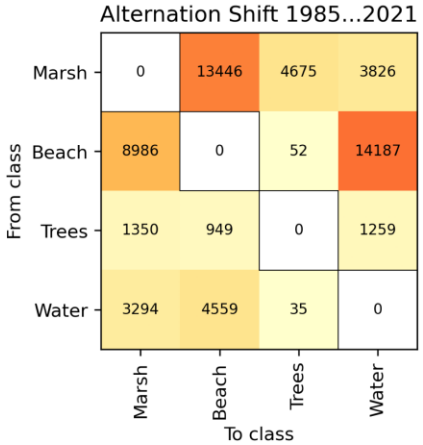

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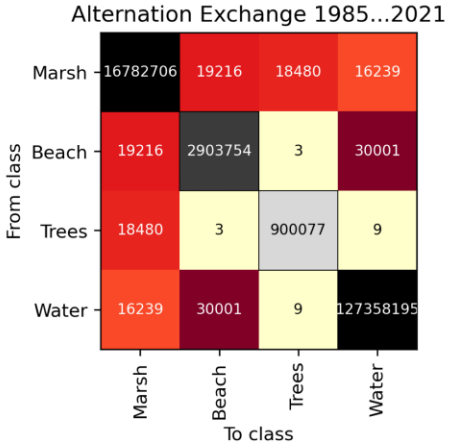
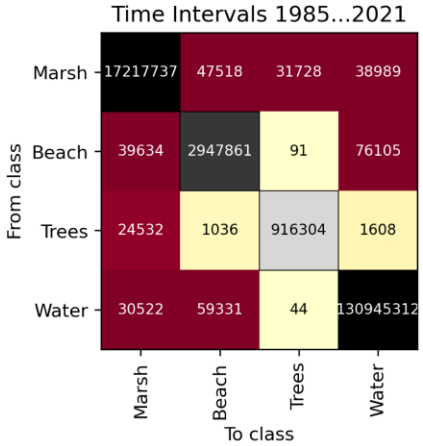


The Quantity & Allocation Shift matrix shows that the largest transitions are to Water, which relates to sea-level rise.

All transitions are a function of five component matrices.



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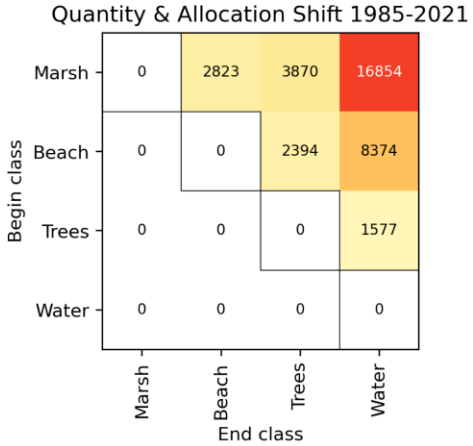

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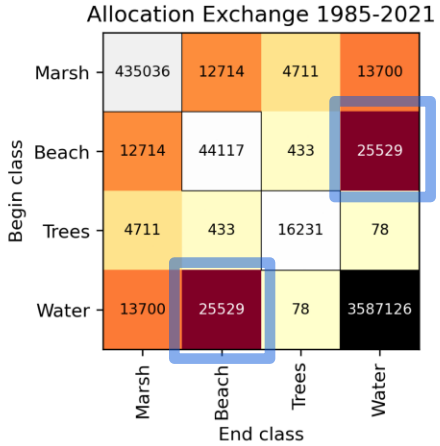

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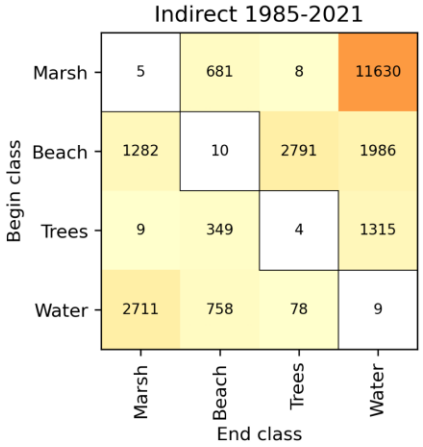
The Allocation Exchange matrix shows transitions that relate to erosion at some locations and sedimentation at other locations.



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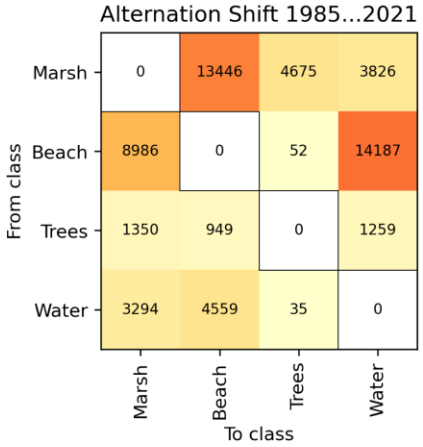

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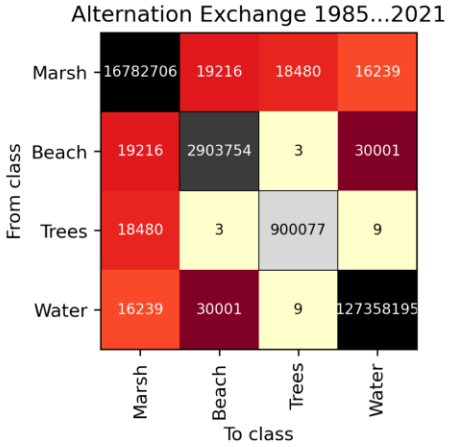

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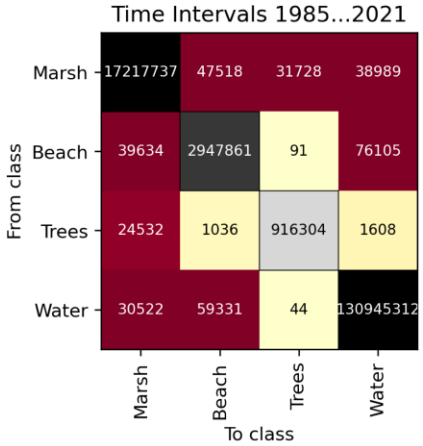

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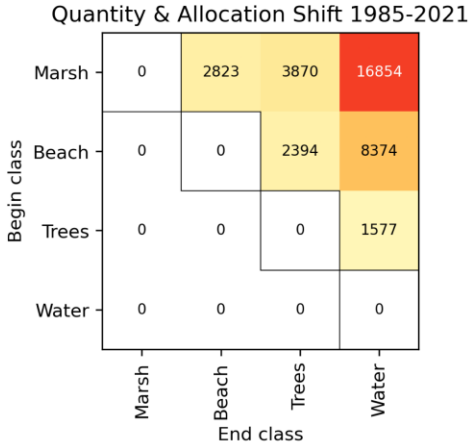

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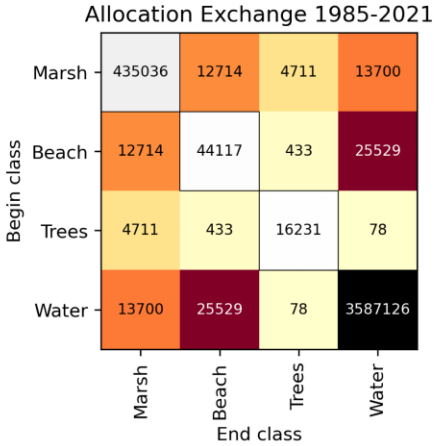

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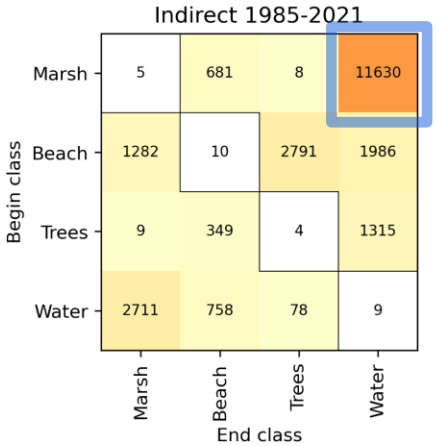

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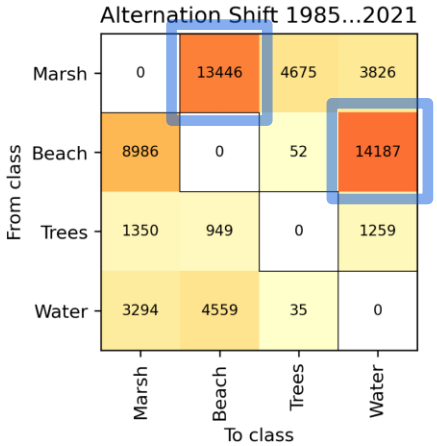

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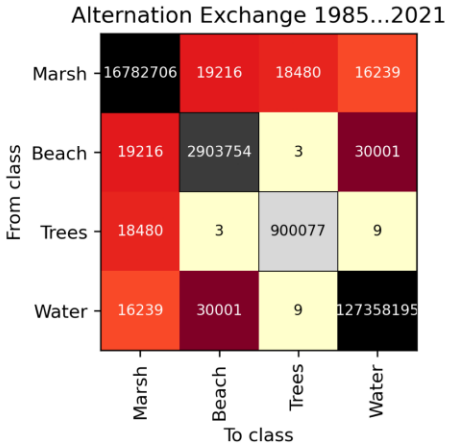
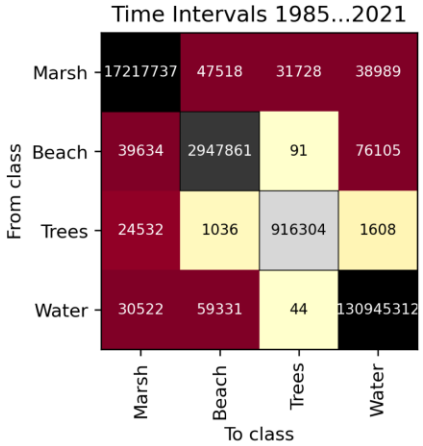


The indirect transition from Marsh to Water occurs via Alternation Shift from Marsh to Beach to Water, which supports our hypothesis.

All transitions are a function of five component matrices.



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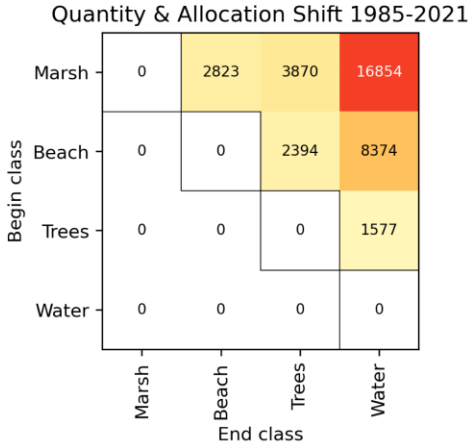

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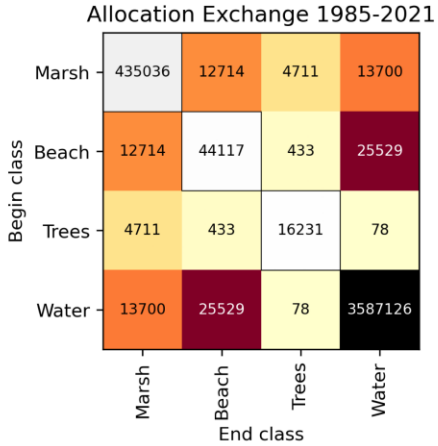

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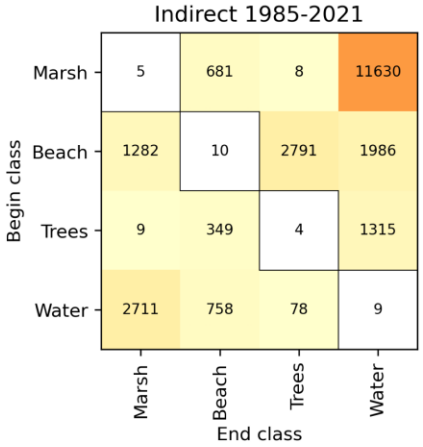
The Alternation Exchange matrix shows transitions likely due to tides.



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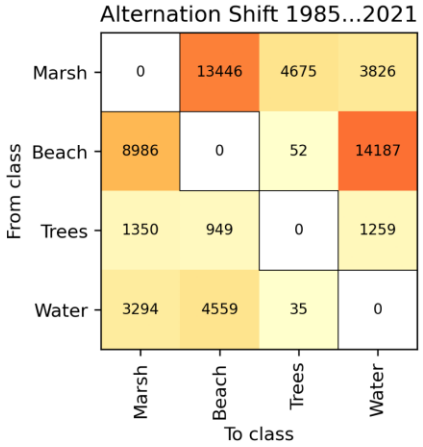

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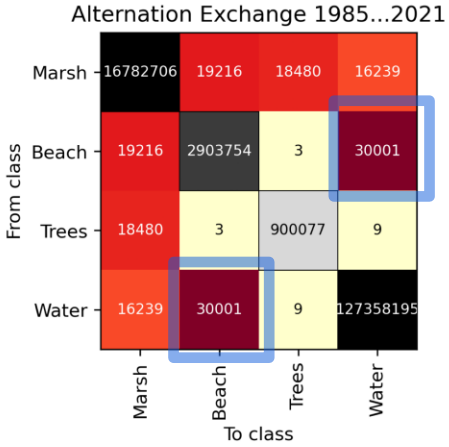

Major Points

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