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# Stuck on an island: land area during Holocene sea-level rise and implications for species evolution

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## Main Problem

Global models for biogeography are essential for reconstructing paleo-environments and understanding species evolution and its connection with modern biodiversity. Present state-of-the-art models include the effects of sea-level rise and isostasy on Holocene biogeography but so far do not take sediment deposition and erosion rate into account. This could be a major issue near river deltas, where the pronounced morphologic change due to high fluvial sediment fluxes have large potential effects for species evolution.

## Aim

Here we attempt to resolve that knowledge gap by using sediment cores to reconstruct the Holocene evolution of the Mekong river delta in divided 22 timeslices of 500 years from 11ka BP to present. For each timeslice on a gridded surface, we calculate terrestrial and marine sedimentation rate and include this dynamic topography in a paleobiogeographic model. Model results show important effects on the regional past wetland extent and connections between fresh-water environments.

## Method

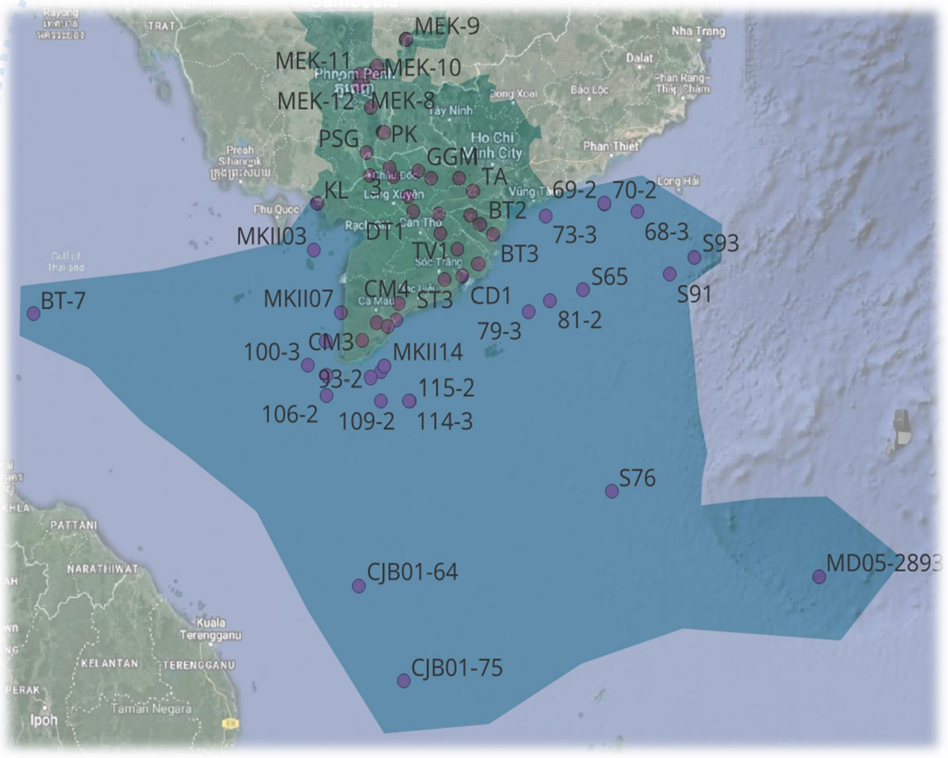

Figure 1
The location of the drilling cores and the interested area in this study

Figure 2
Interpolation of sedimentation rate between 1500-1999 BP

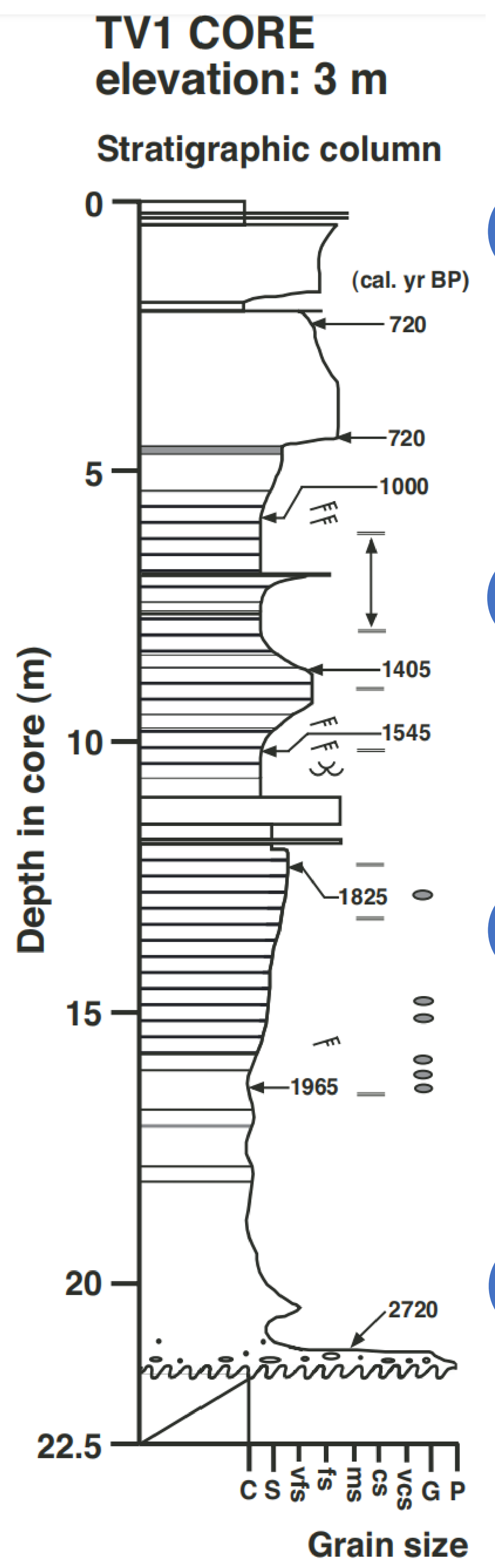


Figure 3
Example TV1 drilling core for data extraction.[4]

| | Input | Method | Output |
|---|---|---|---|
| 1 | Onshore and offshore drilling cores age data from 11 ka BP to present and its depth with respect to mean sea level(Fig.1&3) | Compilation and calculation | Each layer's sediment rate (m/yr) |
| 2 | | Data sorting and cleaning by Python | Accumulative sediment thickness of each 500 year for 22 timeslices(Fig.2) |
| 3 | 1.DEM map 2. Soil type map | Create a polygon that includes all of the cores and include the area where elevation is lower than 15m | Mask of the alluvial delta and relevant offshore area (Fig.1) |
| 4 | 1.Sediment thickness data 2. Interested area raster | IDW interpolation in QGIS | Interpolation rasters (22 rasters) |
| 5 | 1.Interpolation raster 2. DEM map | Raster subtraction from modern DEM | Elevation map of every 500 year |
| 6 | | Contour function | Coastal environment for each period(Fig.4) |

## Result

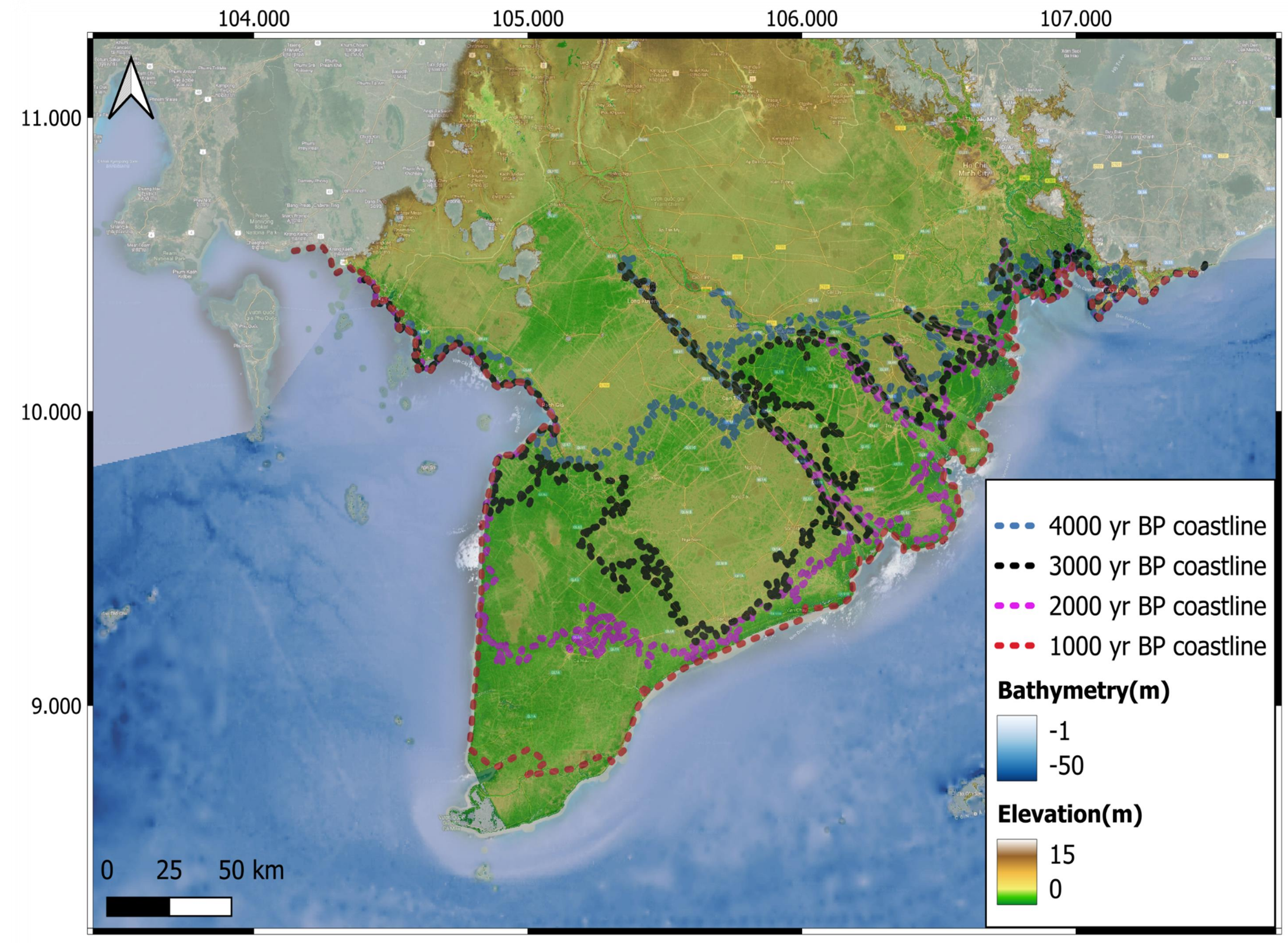


Figure 4
Migration map of the calculated paleo-coastlines of the Vietnamese Mekong Delta (VMD) from this study

Validating reconstruction with published studies by comparing coastline positions in different timeslice.
The coastline reconstruction in this study approximately matches the previous study.(Fig.4&Fig.5)

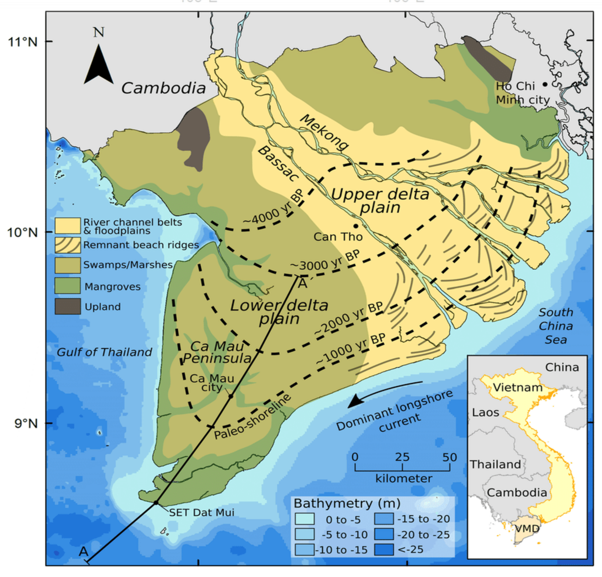

Figure 5
Map of the approximate paleo-coastlines of the Vietnamese Mekong Delta (VMD) [1]

## Discussion

- Application
  -Implications for Biogeography and Evolutionary Biology.
  -Investigating the long-term effects of sediment dynamics on species diversity and ecosystem functioning.
  -Foresee future geomorphodynamic circumstances and give timely response to changes.

- Accuracy of dataset
  -Ice-loading(isostasy ),sediment mass redistribution and sea level rise is included in the model.[2]
  -Outlier of extremely high value has been averaged out by Python.

- Improvement
  -Does not include tectonic uplift.
  -Does not include erosion rate.
  -Does not have enough sediment core data from the western part of the delta.
  -Does not include subsidence rate.

## Conclusion

- This study solves the knowledge gap and generates a more precise paleo-environment of the Sunda Shelf that includes sedimentation and erosion.
- Putting sediment deposition rates into the paleobiogeographic model has strengthened the understanding of the Holocene evolution of the Mekong river delta. The interplay of sea level rise slow-down period and significant sediment deposition cause delta progradation moving southwestern more than 200 km from around the Cambodian border to the present coastline in the last 6 ka.
- Mekong delta dynamics might have influenced the timing of the disappearance of the land bridge between Peninsular Malaysia and Sumatra, Borneo, and Java. It illustrates the maximum potential existence in terms of exposed land bridges(so-called "Sundaland") as biogeographic crossroad or marine barriers between the Mekong Delta and other lands.[3] And affects the biodiversity and species revolution in this area.

## Reference

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