

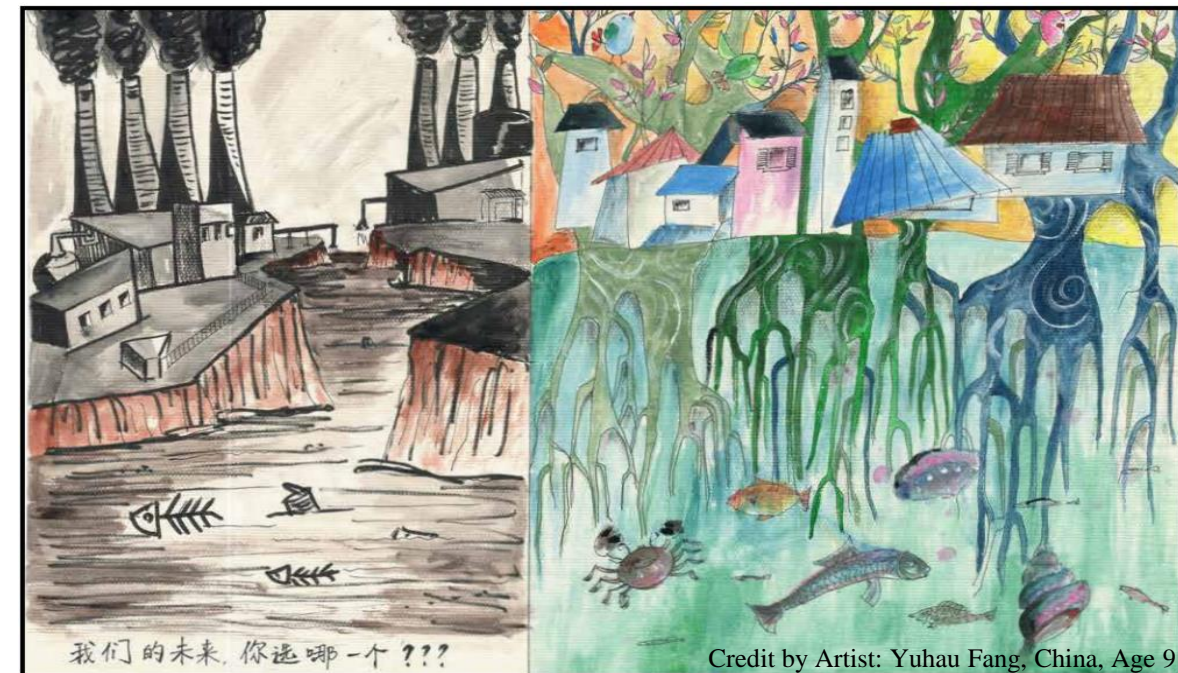
Mangrove diversity loss may be inevitable under sea level rise and human pressure

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Mangroves – A multifunctional coastal ecosystem

- Biodiversity reserves and organisms' habitats.
- Coastal protection from natural hazards
- Water and air purifier
- Carbon storage and sequestration
- Food production (fish, shell fish and algae)
- A source for food, medicine and fuelwood
- Tourist and recreation



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Climate change and human actions – 2 potential threats



Sea

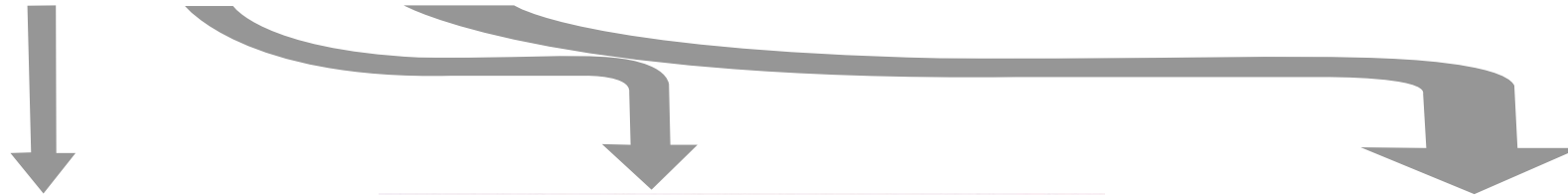
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Climate change and human actions – 2 potential threats



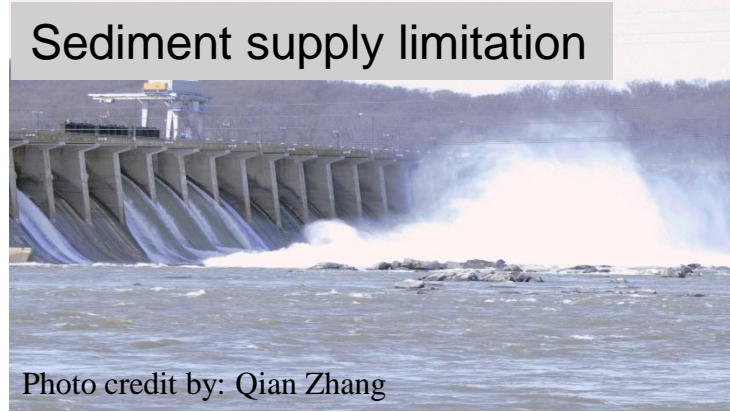
- How do mangrove forests respond to different combinations of sea level rise rates, sediment supplies, and the presence of barriers?



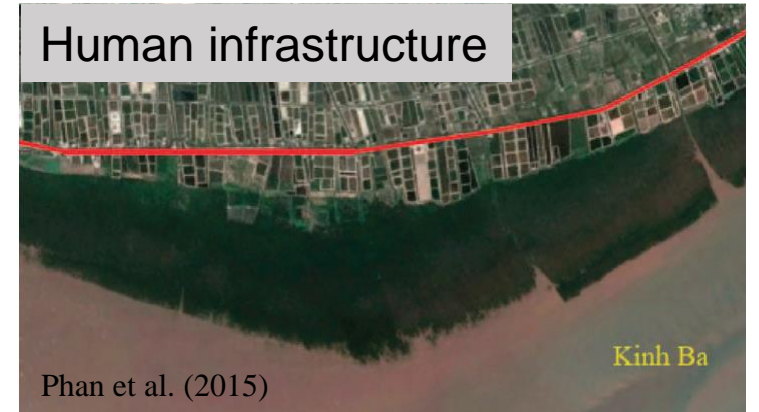
Sea level rise



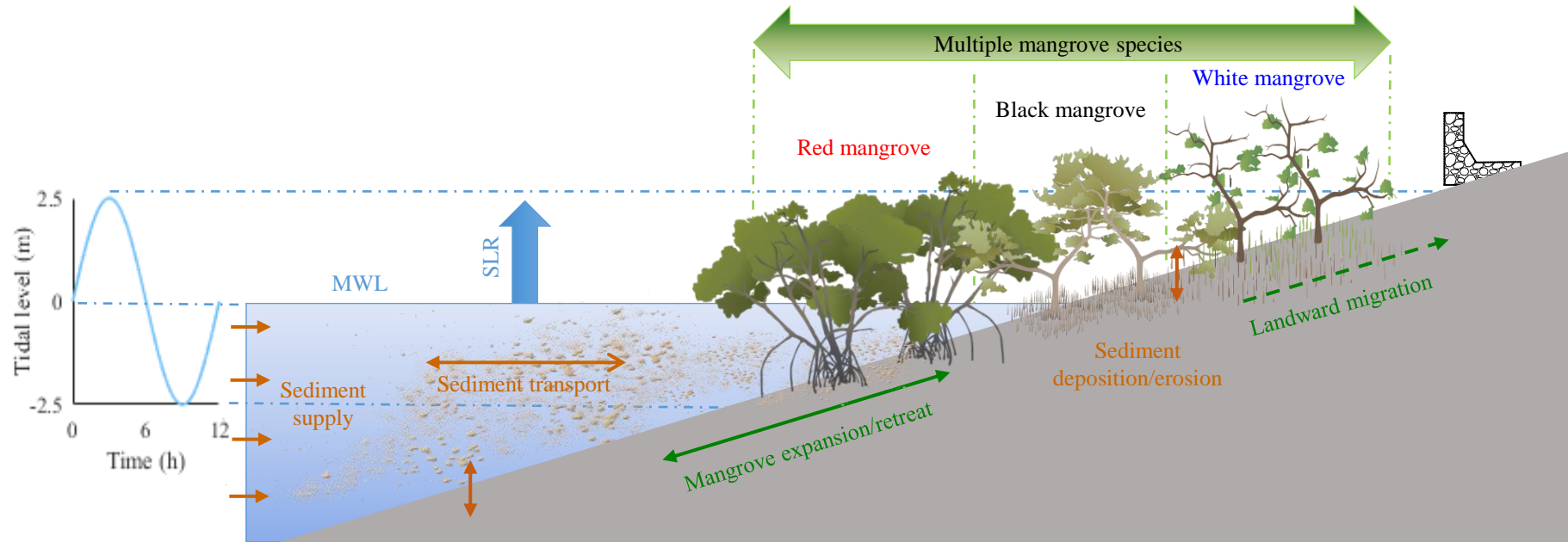
Sediment supply limitation



Human infrastructure



Schematic of 1D eco-morphodynamic model:

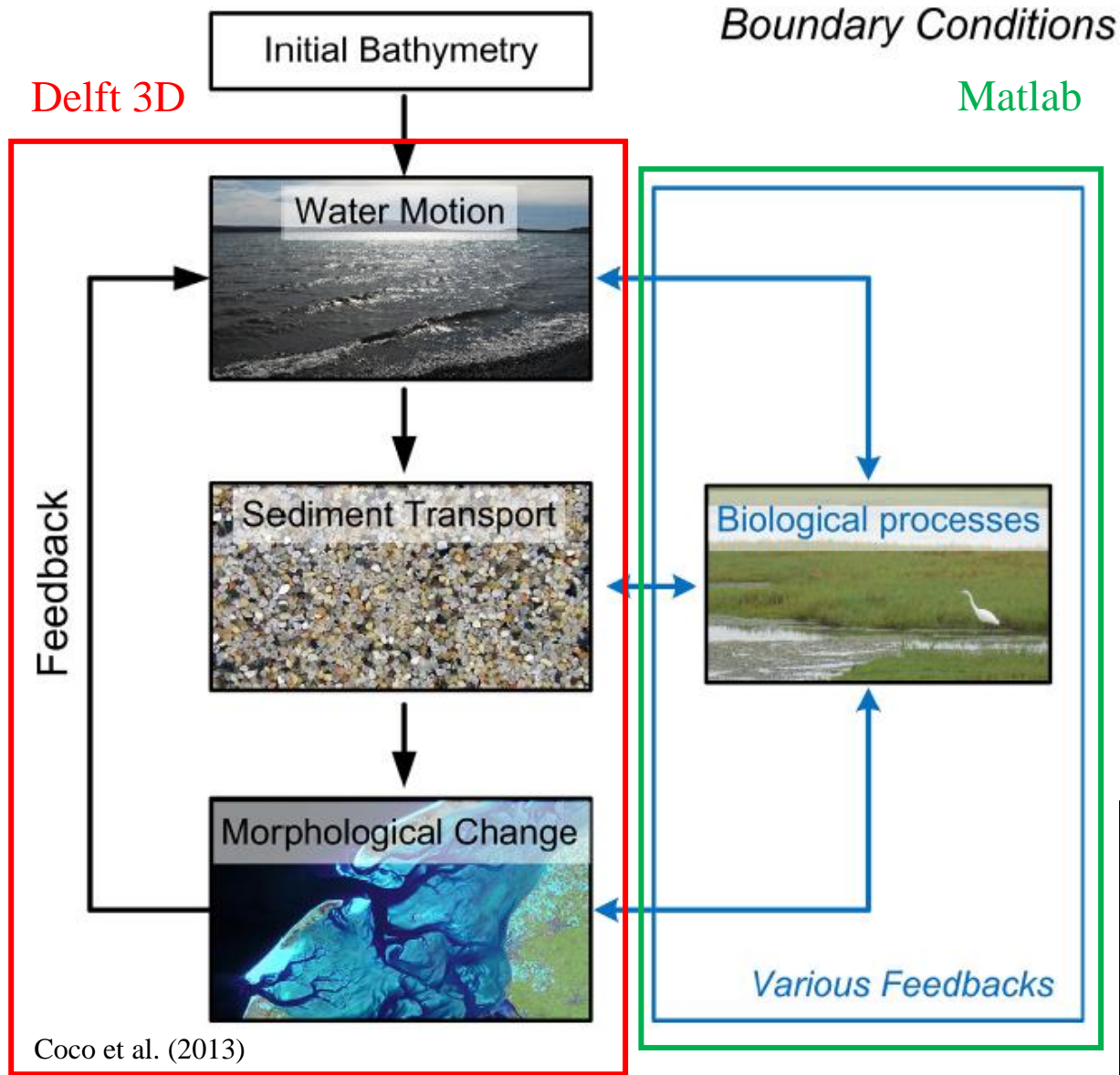


Comprehensive treatment of sediment transport processes:
Erosion/deposition and transport of sediment between regions

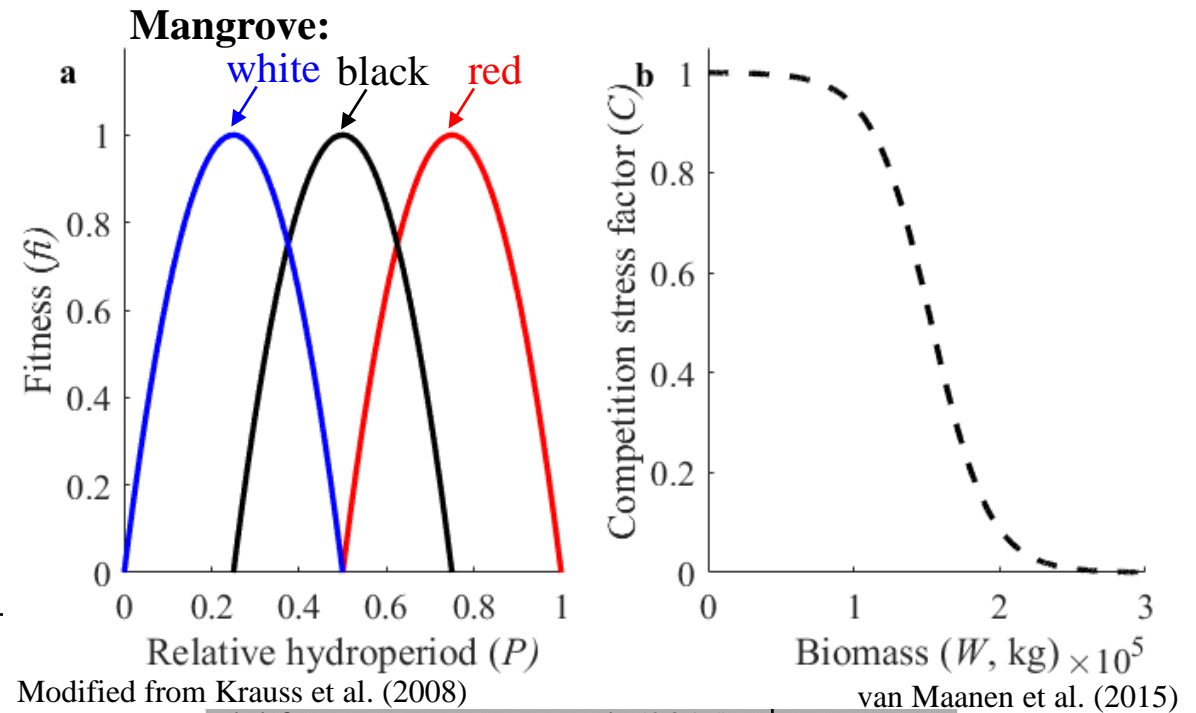
Multiple mangrove species:
Dynamic growth of red, black and white mangroves

Human barriers:
Barriers are incorporated in the model, restricting the upland movement of water and vegetation

Working structure of eco-morphodynamic model:



Vegetation life processes: Colonization, growth and mortality Fitness and competition

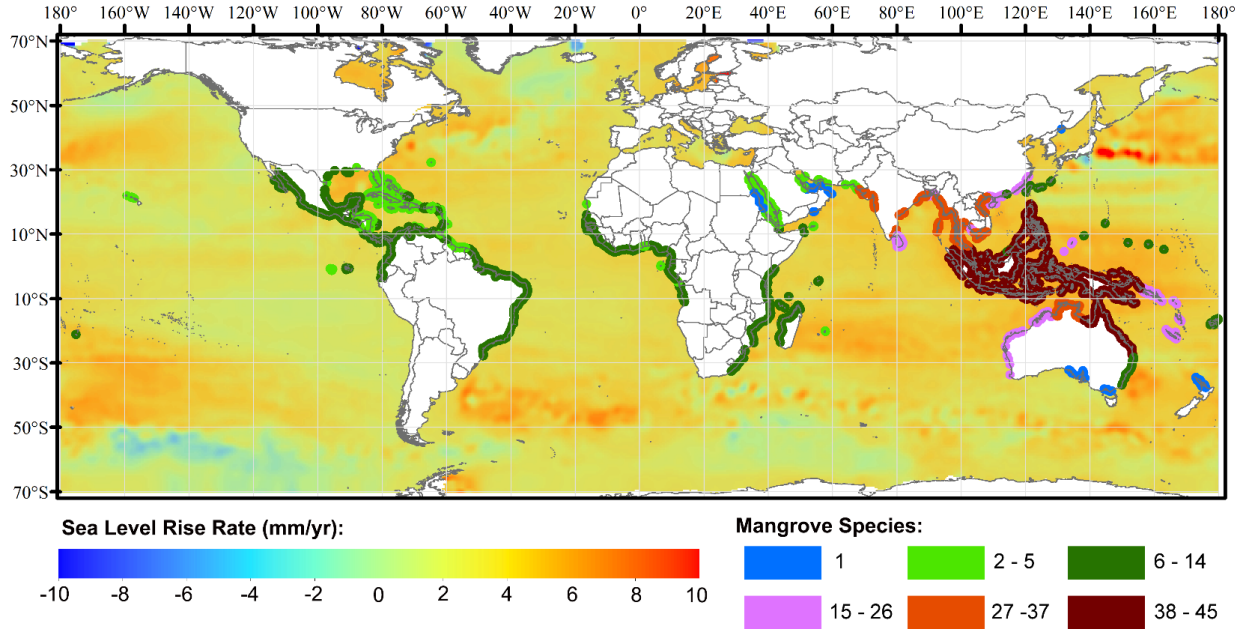


Mangrove model from van Maanen et al. (2015)

Vegetation model from van Oorschot et al. (2016)

Saltmarsh model from Brückner et al (submitted)

Mangrove assemblage diversity index (ADI):

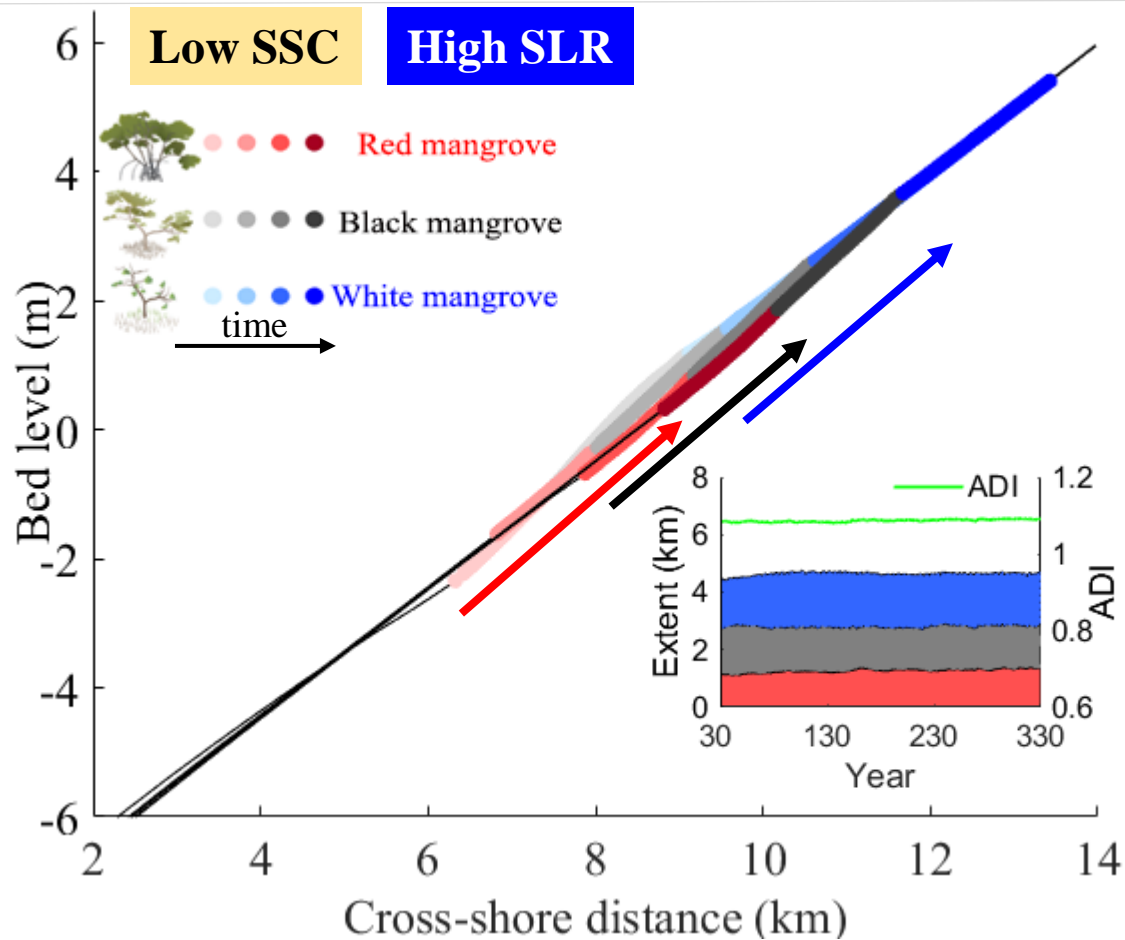


$$ADI = - \sum_{i=1}^n p_i \cdot \ln p_i$$

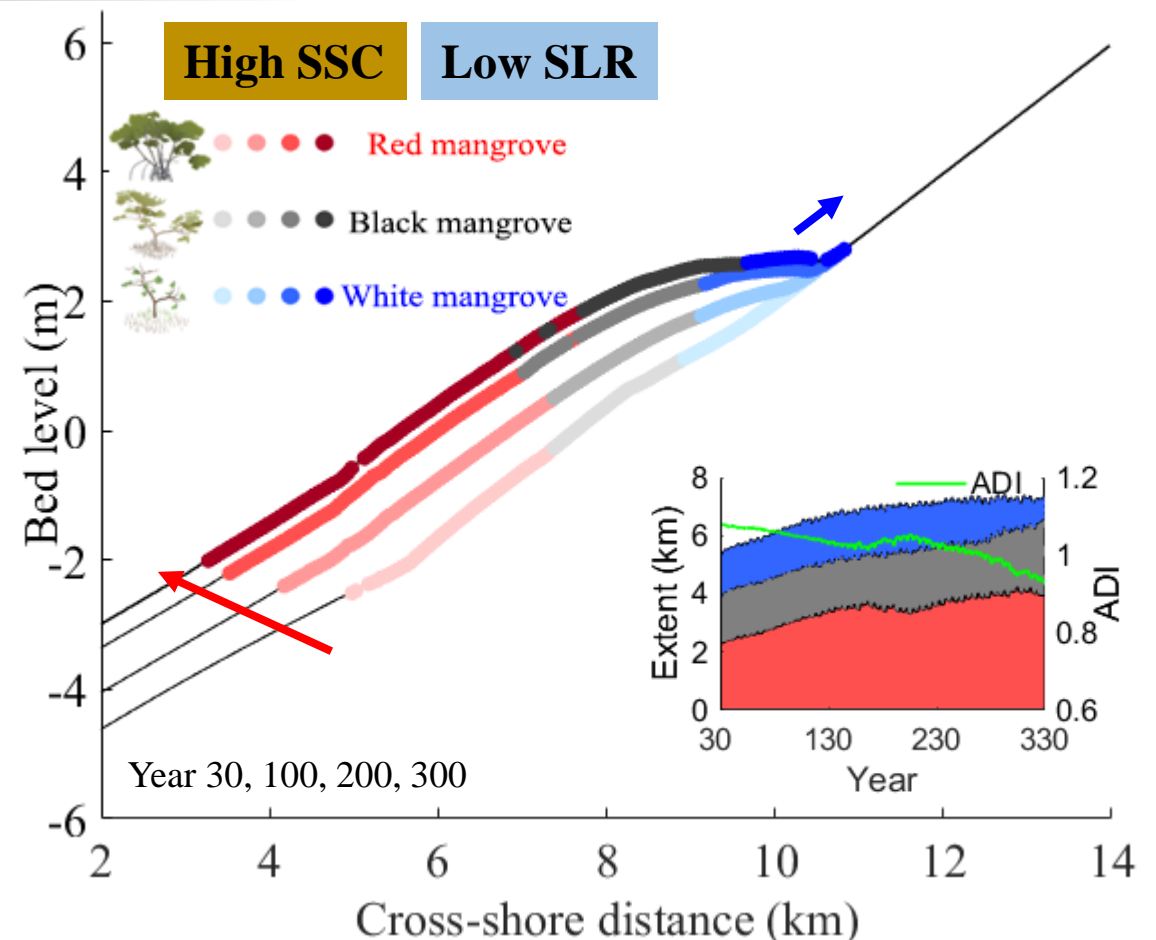
where p_i is the proportional extent of species i relative to the total forest extent.



Impacts of sediment supply concentration and sea level rise



All mangrove species shift to upland

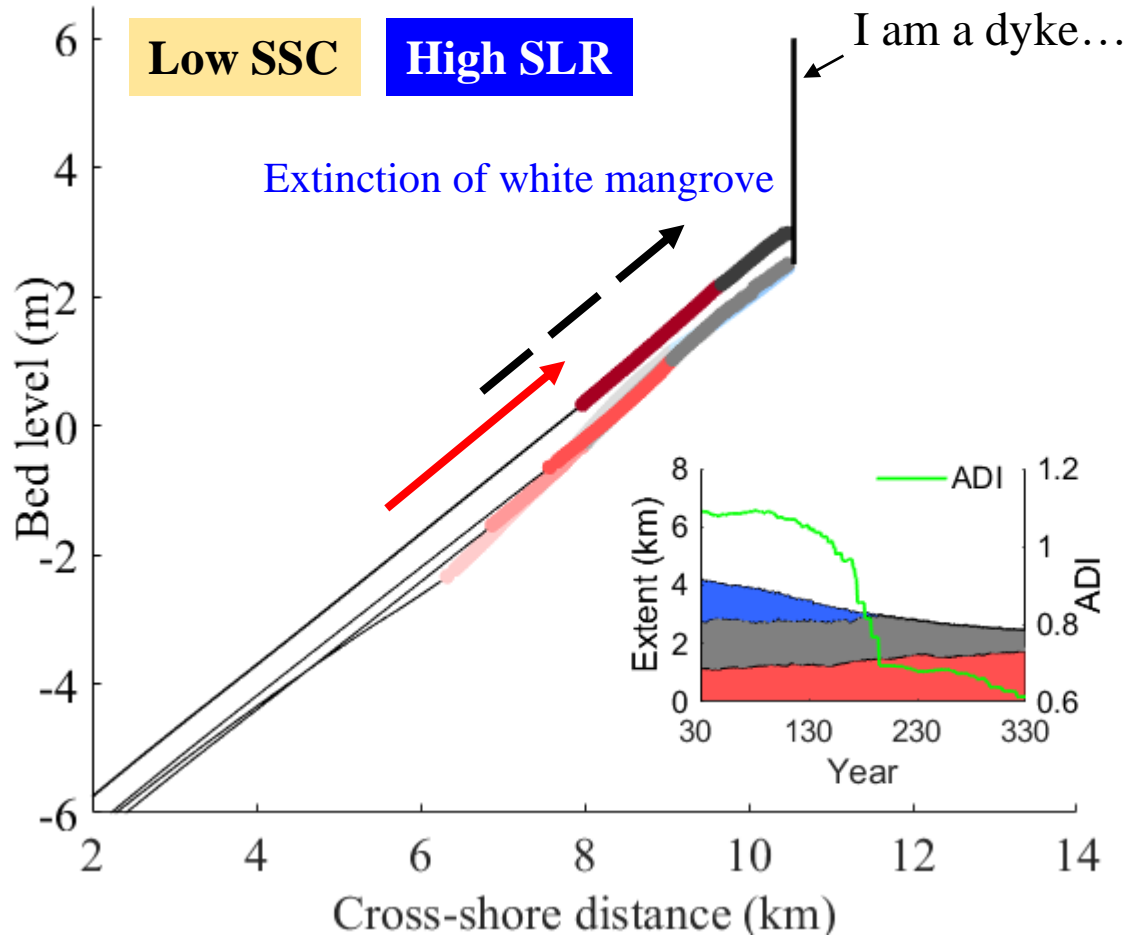


Mangroves expand to both seaward and landward

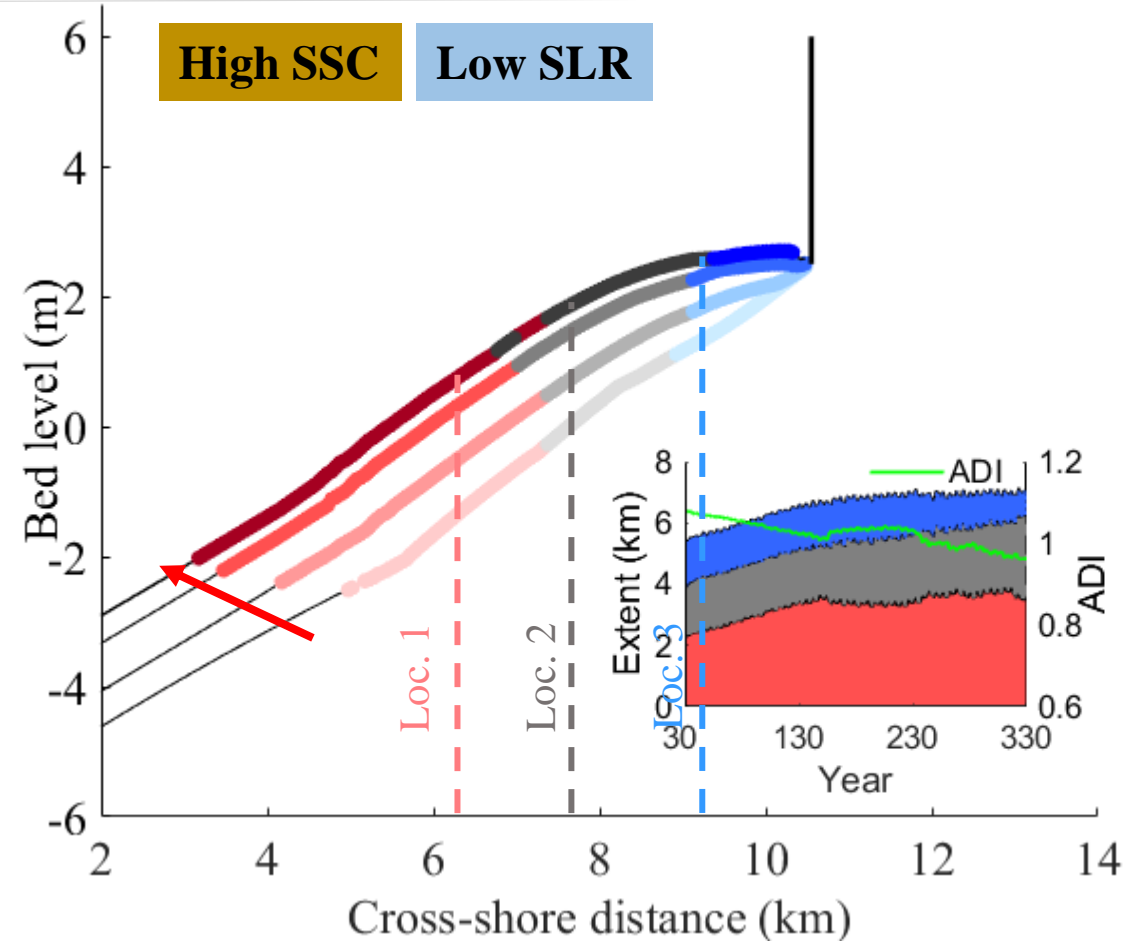
* **SSC**= Sediment supply concentration; **SLR**=sea level rise



Impacts of human barriers



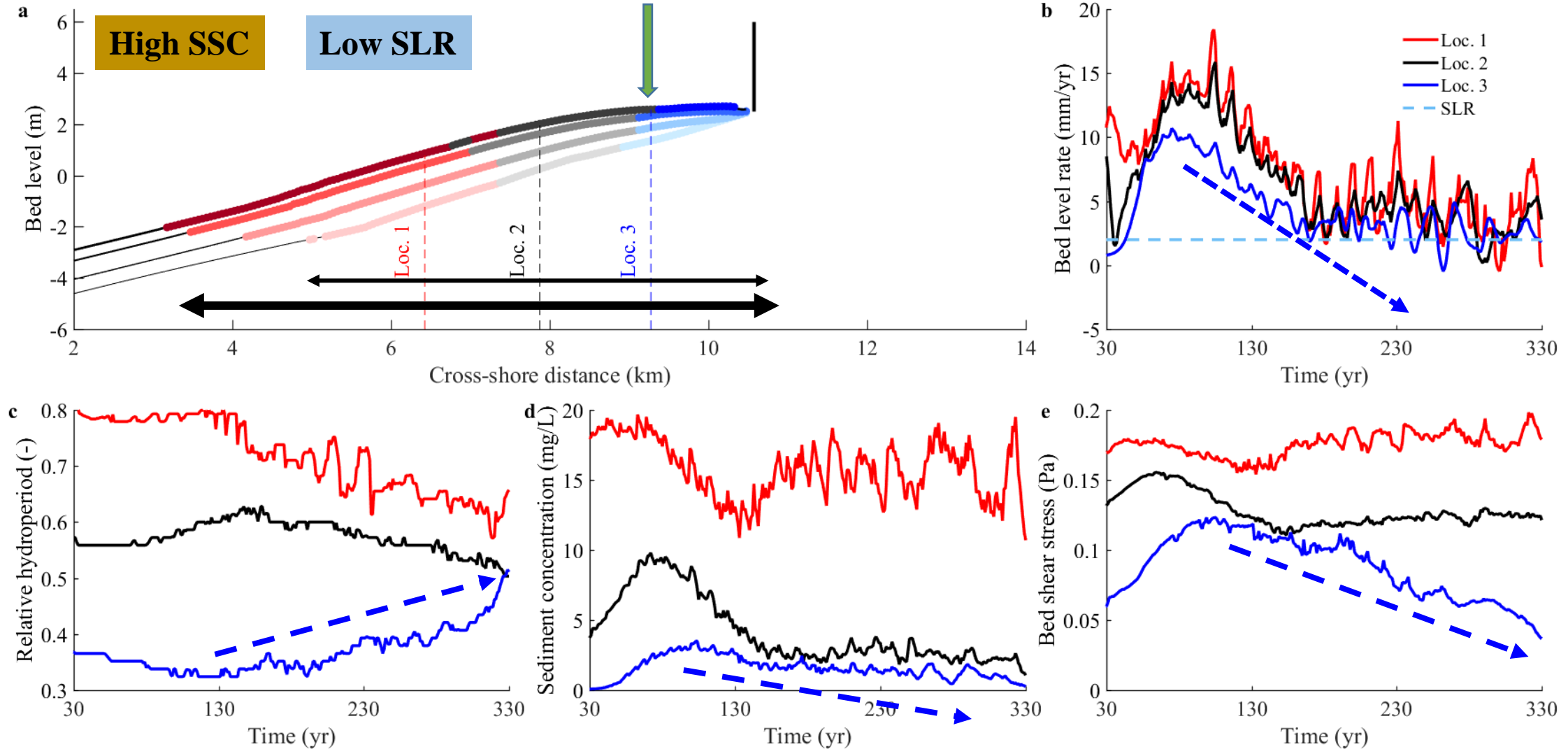
All mangrove species shift to upland, extinction happens



Mangroves expand to seaward but blocked on upland



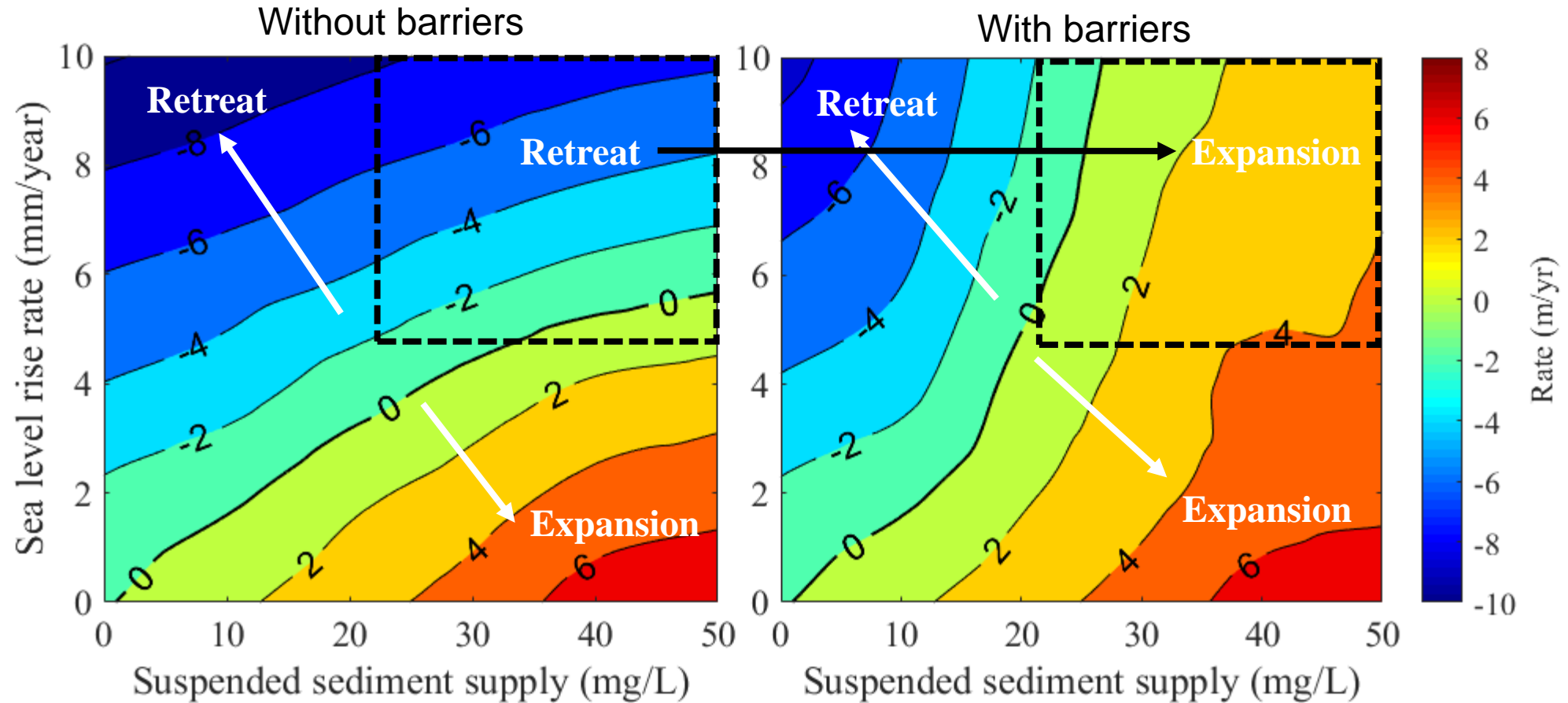
Impacts of human barriers



Bed level accumulation rate decreases while inundation period increases → species are linked!!!



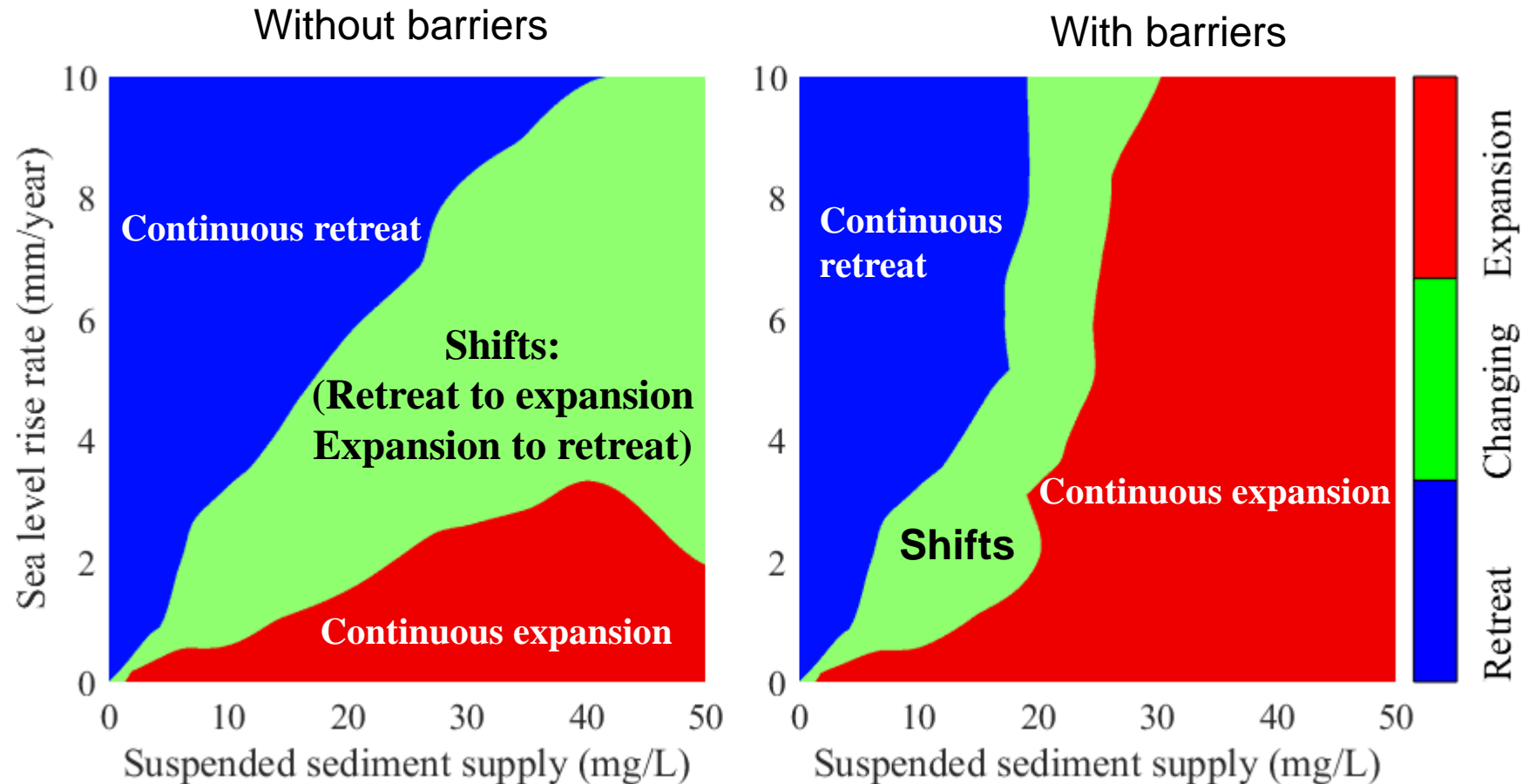
Movement of seaward forest edge averaged over 300 years



Barriers play a role in promoting vertical accretion!



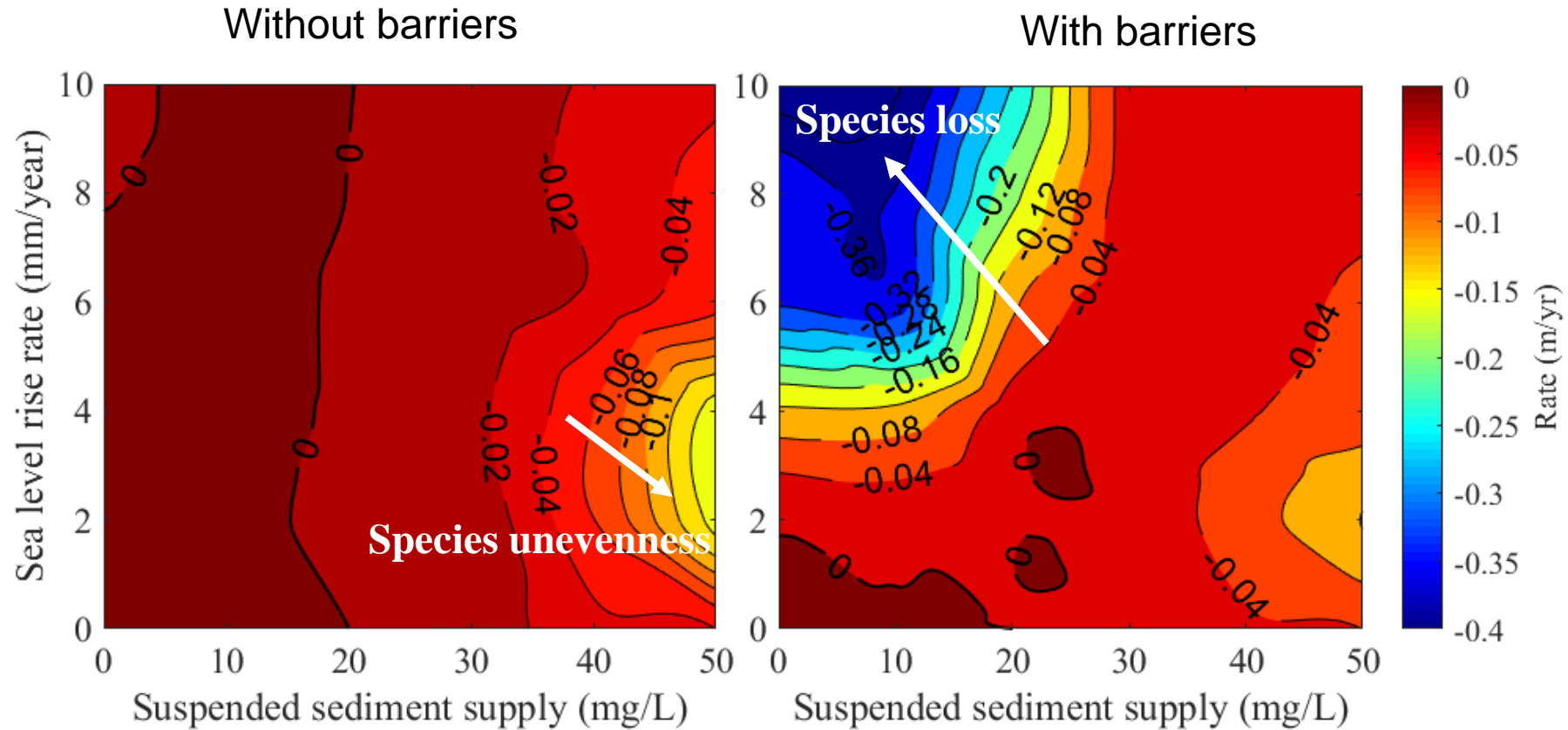
Temporal evolution of the seaward forests edge



Movement of the seaward forest edge may reverse!



Changes of mangrove assemblage diversity in 300 years



Losses in mangrove diversity with rising sea level might be inevitable!



Key messages



Forest extent can increase under high SSC despite SLR, but it does not necessarily mean an increase in diversity.

Barriers may enhance sediment accretion but obstruct mangrove landward migration, potentially causing extinction of species.

Mangrove species are linked through complex biophysical interactions and play a critical role in defining forest structural changes.

Sediment accretion across the intertidal area may vary over time...
(historical/current accretion rates may be misleading).

Want to know more?

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Questions?