# Humans and deltas: defining evolutionary pathways

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**Hypothesis: Deltas across the globe follow a similar trend in terms of the development of their engineered adaptations**

## Purpose of study

Populated deltas coevolve with the population. There are many environmental and anthropogenic issues that pose a threat to deltas and engineered adaptations have evolved because of this. It is necessary to study and understand how and why humans have altered the delta environment in order to assist with future management of these areas.
This project aims to analyse the engineered pathways that a sample of deltas have followed, comparing and contrasting different locations across the globe.

## Why are engineered adaptations in deltas necessary?

Deltas are incredibly vulnerable environments which are home to a large amount of people. Many people earn a living from the land with some global megacities being located in these areas, this is a key reason why the delta has been engineered. Deltas are also prone to natural disasters such as storm surges and cyclones which bring with them exceptional consequences for the people and the infrastructure located in the area. In order to protect the delta, humans have engineered the delta to attempt to reduce the risk of damage associated with these events.

## Which deltas will be studied?


## Some of the key drivers of delta evolution

- Extreme events- storm surge/ cyclone
- Change in land use- industrialisation and urbanisation
- Population increase/ migration
- Land reclamation
- Economic investment
- Designated areas of protection – UNESCO World Heritage

## Delta Characteristics

| Delta | Delta formation | Climate | Hazards | Land use | Large cities | Current engineered adaptations | Future plans |
|---|---|---|---|---|---|---|---|
| **Sacramento San Joaquin** | River/tide[1] | Hot dry summers and cool wet winters but with highly variable annual precipitation[2] | Flooding-coast/river[3]<br>Earthquakes [3]<br>Storms | -Agriculture [4]<br>-Small tourist towns [2]<br>-Cross road of critical transport infrastructure[5] | Sacramento, Iselton, Tracey, Pittsburg[4] | Polders[6]<br>Levees[4]<br>Rip rap [2]<br>Weirs[2]<br>Flood control bypass [2] | Abandonment of certain areas which are frequently flooded to a high level [4] |
| **Yangtze** | Tide[1] | Subtropical monsoon[7] | Flooding-coast/river[8]<br>Cyclones/typhoons[8]<br>Storm surges[8] | -Agricultural: rice production[8]<br>-Industrial/service trade[8] | Wuhan, Changsha, Nachang, Shanghai[7] | Polders[10]<br>Levees[9]<br>Weirs[10]<br>Seawalls[11]<br>Flood control bypass[10] | Implementation of soft engineering[11] |
| **Rhine** | Tide/river[1] | Temporal maritime[12] | Storm surges[13]<br>Flooding-coast/river[13]<br>Erosion | -Agriculture[13]<br>-Industry- rapid urbanisation has occurred here[13] | Amsterdam<br>Rotterdam | Polders[14]<br>Levees[14]<br>Sluices[14]<br>Storm surge barrier[15]<br>Drainage canal[14] | Hard engineering with maintenance of current structures in place[16] |
| **Chao Phraya** | Tide[1] | Southeast monsoon climate[17] | Flooding[18]<br>Tropical storm[18]<br>Coastal erosion[18] | -Intensive agriculture- cash crops[19]<br>-Manufacturing, construction and tourism [19] | Bangkok[20] | Polders[22]<br>Levees[21]<br>Breakwater[20]<br>Pumping station[17] | Reopening of canals<br>Creating a bypass channel[22,23] |
| **GBM** | Tide[1] | Equatorial monsoonal[24] | Cyclones[25]<br>Earthquake[26]<br>Storm Surge[26]<br>Flooding-coast/river[25] | -Agriculture- rice production[27]<br>-Fishing[25] | Calcutta<br>Dhaka[28]<br>Khulna | Polders[25]<br>Levees[25]<br>Cyclone/storm shelter[25]<br>Flexible barriers[29]<br>Closure dam[29] | Maintenance and rebuilding embankments[30]<br>Reforestation[28,31] |
| **Nile** | Wave/fluvial[32] | Mediterranean with hot summers and mild winters[33] | Coastal flooding[33]<br>Erosion[33] | -Industrial activities- petroleum, chemicals[33]<br>-Agriculture<br>-ports[33] | Alexandria, Damietta[33]<br>Cairo | Levees[34]<br>Seawalls[34]<br>Jetties[34]<br>Groynes[34] | Maintenance and building protective works along the coastline[34] |

## What next/future work?

In the upcoming months, a timeline of development for each of the deltas will be produced, identifying the key drivers of evolution. This will primarily involve carrying out a review of the current literature that is available, with particular focus on the engineered adaptations that have been implemented and how they have been maintained and developed over time. The size of the delta and the areas that are most at risk will be identified using GIS maps. This information will then be compared between each of the deltas in order to prove or disprove the above hypothesis. The results of this will then be applied to all of the DECCMA deltas.

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