



Recent shoreline changes and morpho-sedimentary dynamics of the Ayeyarwady Delta

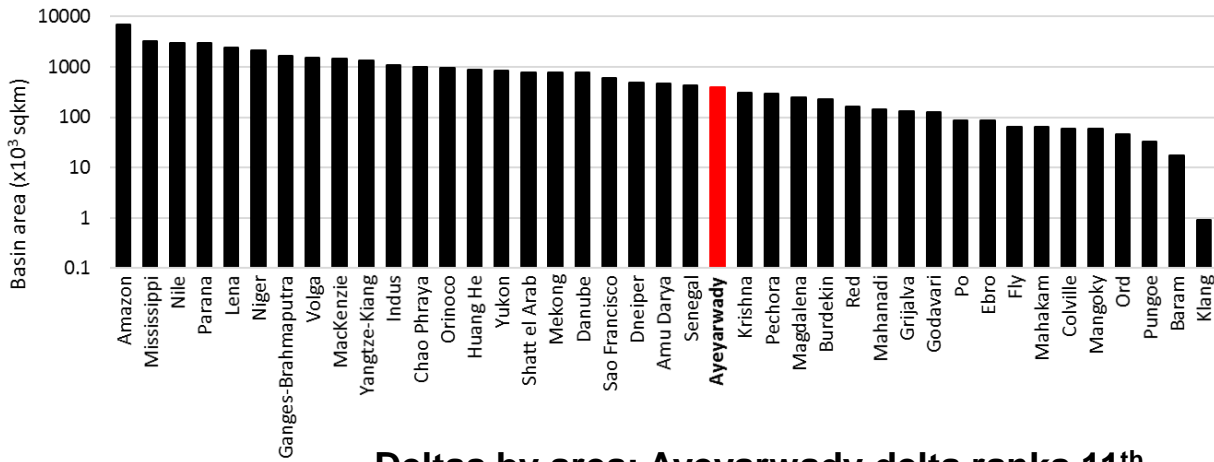
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World Water Day – Nay Pyi Taw

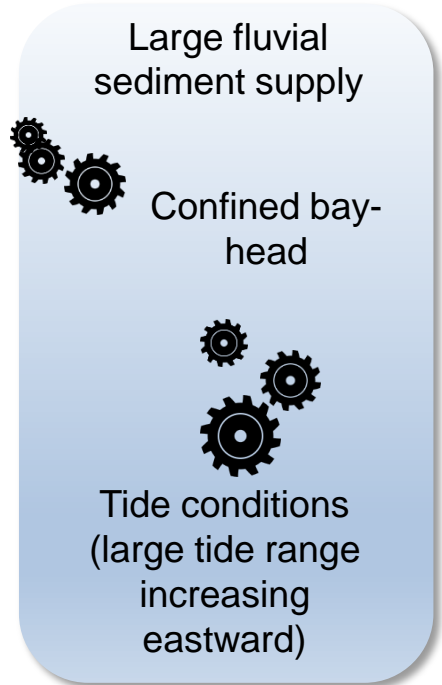
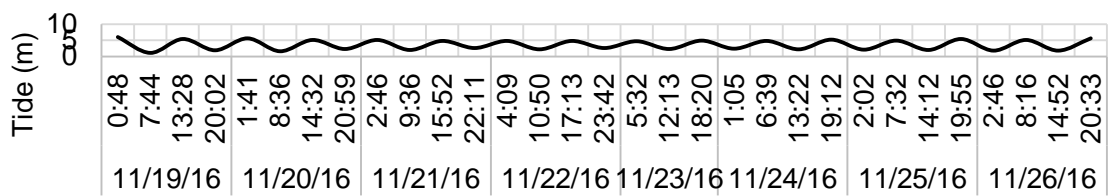
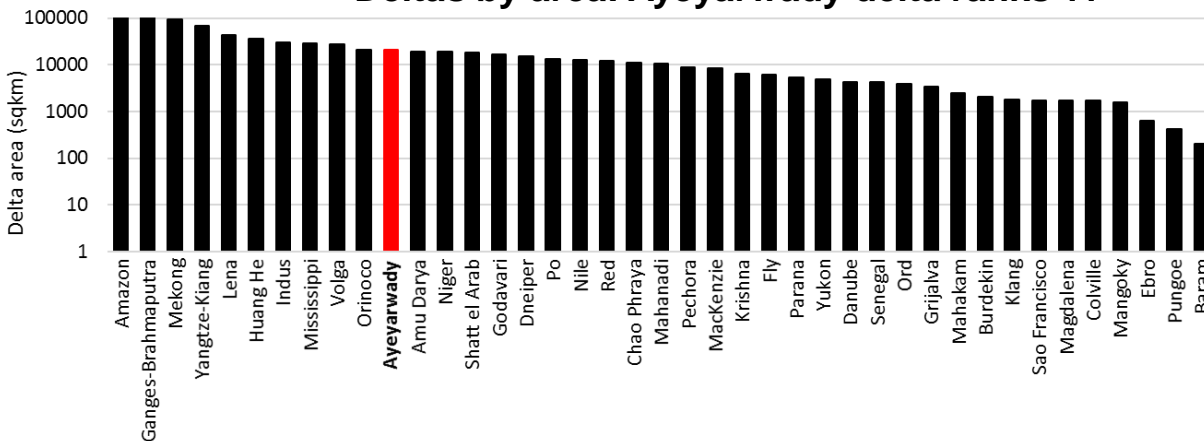
14 March, 2017



River basins by area : Ayeyarwady River basin ranks 23th



Deltas by area: Ayeyarwady delta ranks 11th



Large delta relative to the size of its catchment

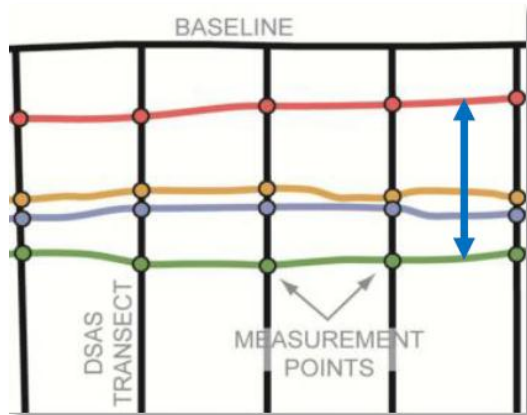


Data & Methods

Shoreline change analysis from 1974 to 2015



47 medium resolution Landsat satellite images (60 to 30 m pixel size)

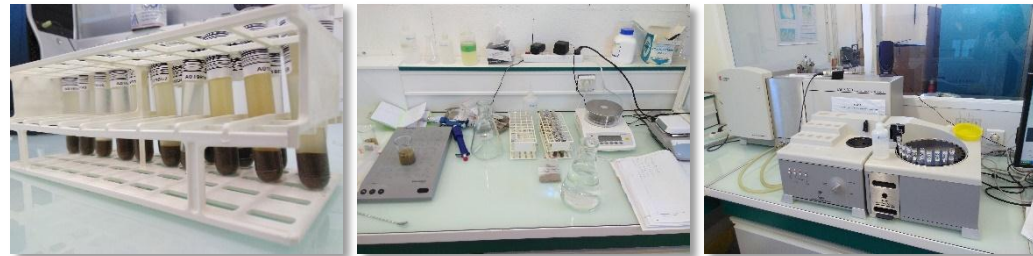


Digital Shoreline Analysis System (DSAS)

Sediment sampling and grain-size analysis



17 sites visited
10 sites sampled
34 sediment samples



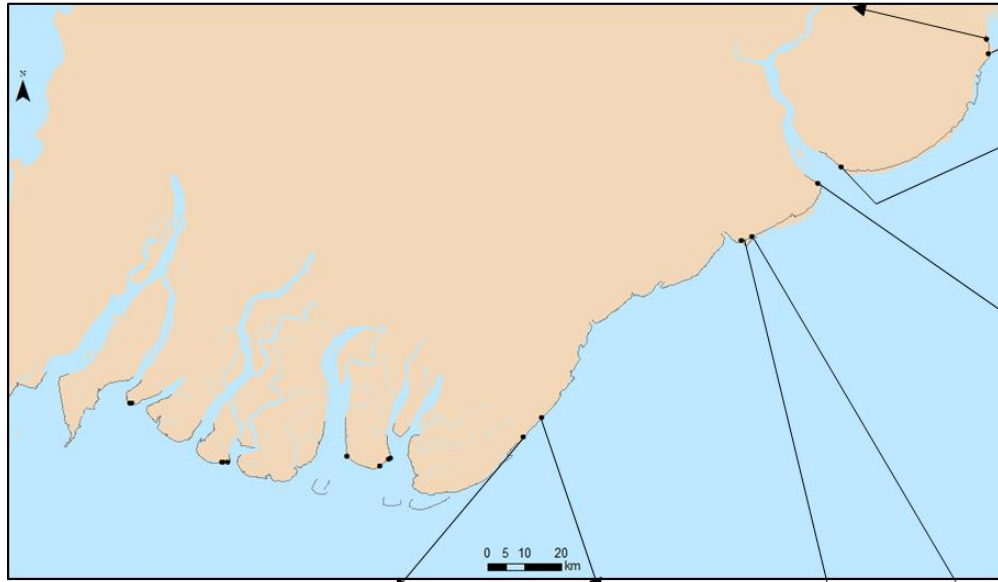
Wave data: ERA 40 & ERA Interim (1958 – 2008). 0.5° resolution.

Tide data: Yangon tide gauge.

Suspended particulate matter data: From the GlobCoast database project, using Han algorithm for coastal areas, at global scale, for MERIS sensor, with POLYMER atmospheric corrections (Han et al., 2016). 1km-resolution

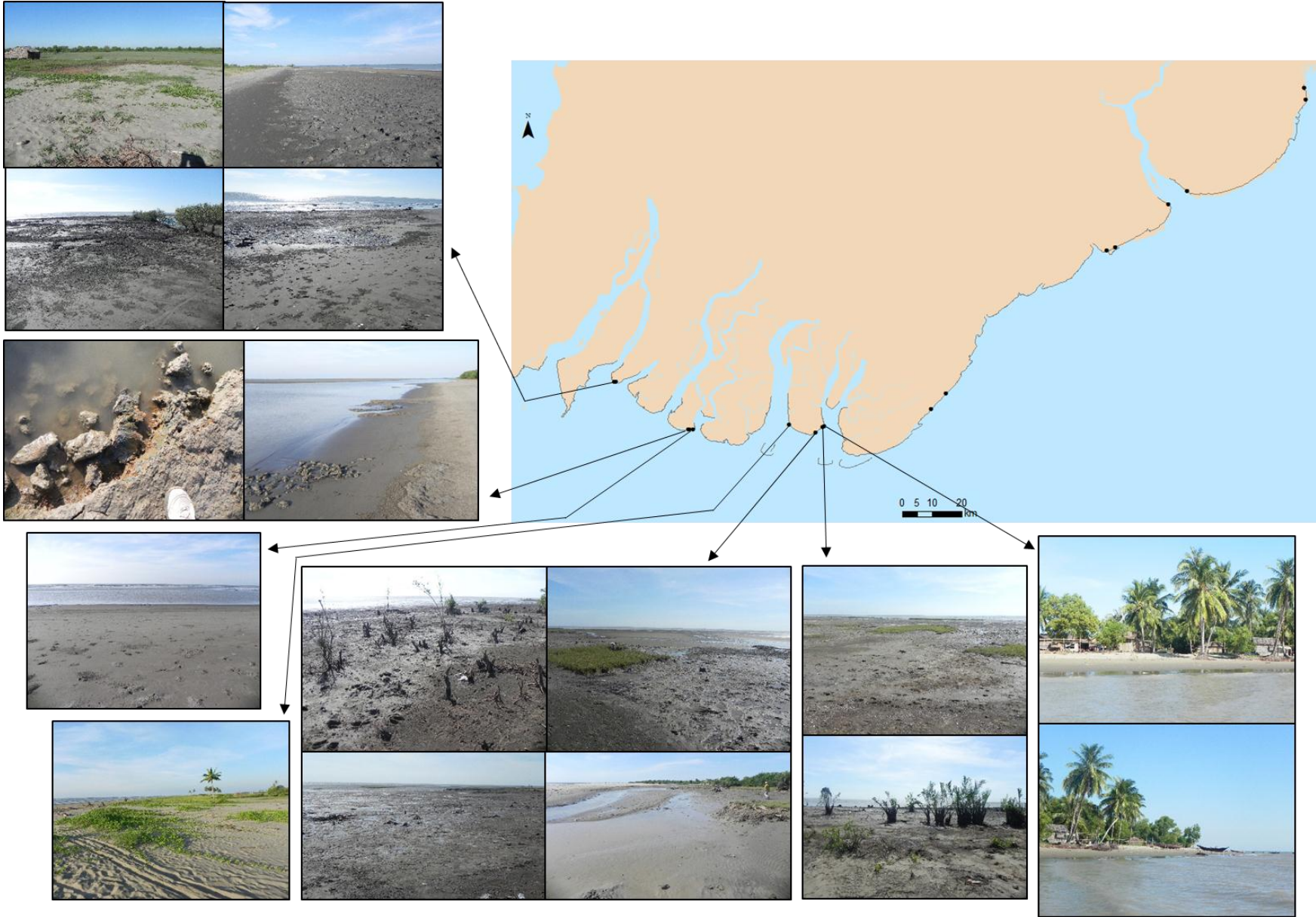


17 field sites were visited from east to west along the delta shoreline





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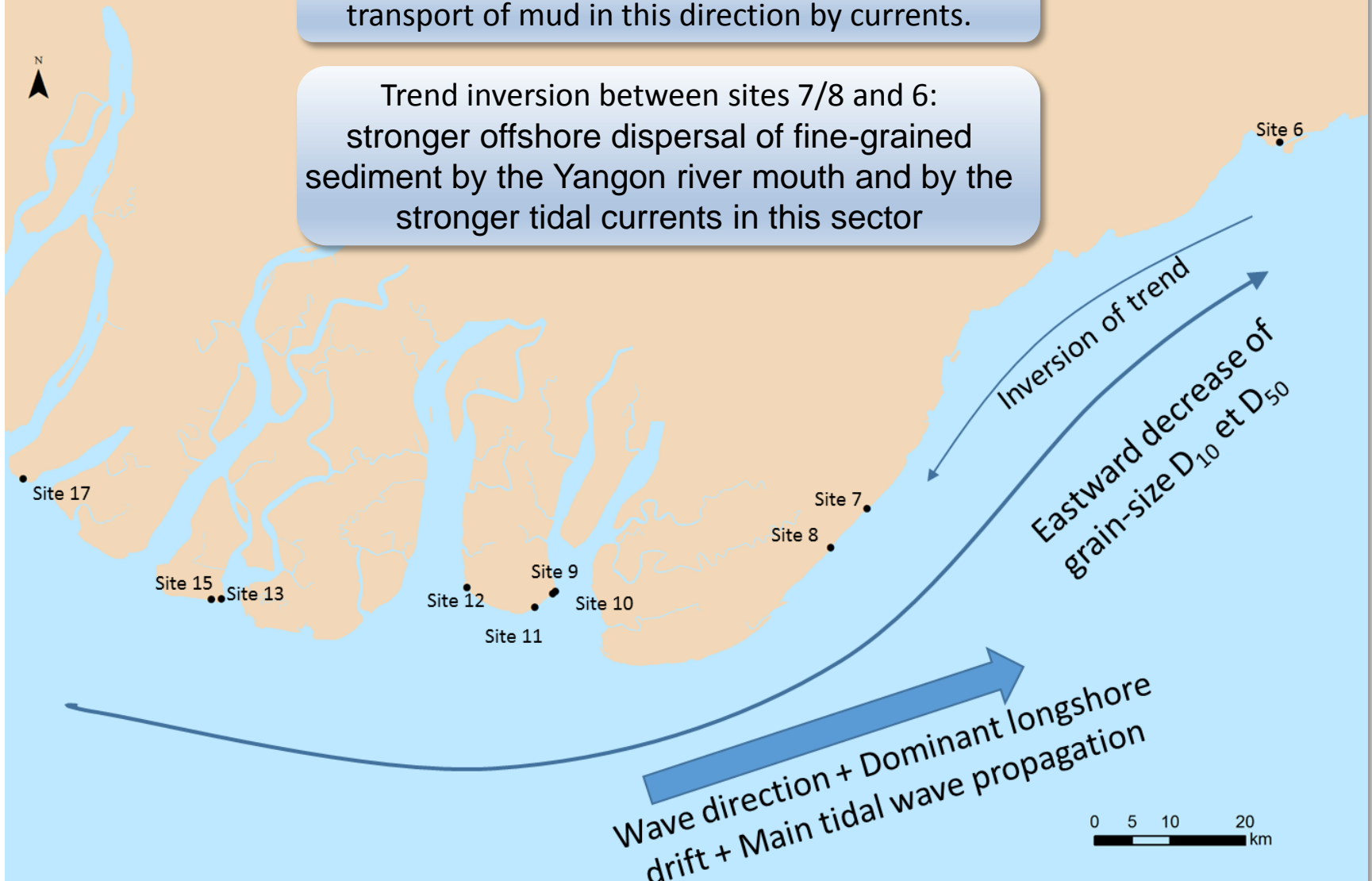




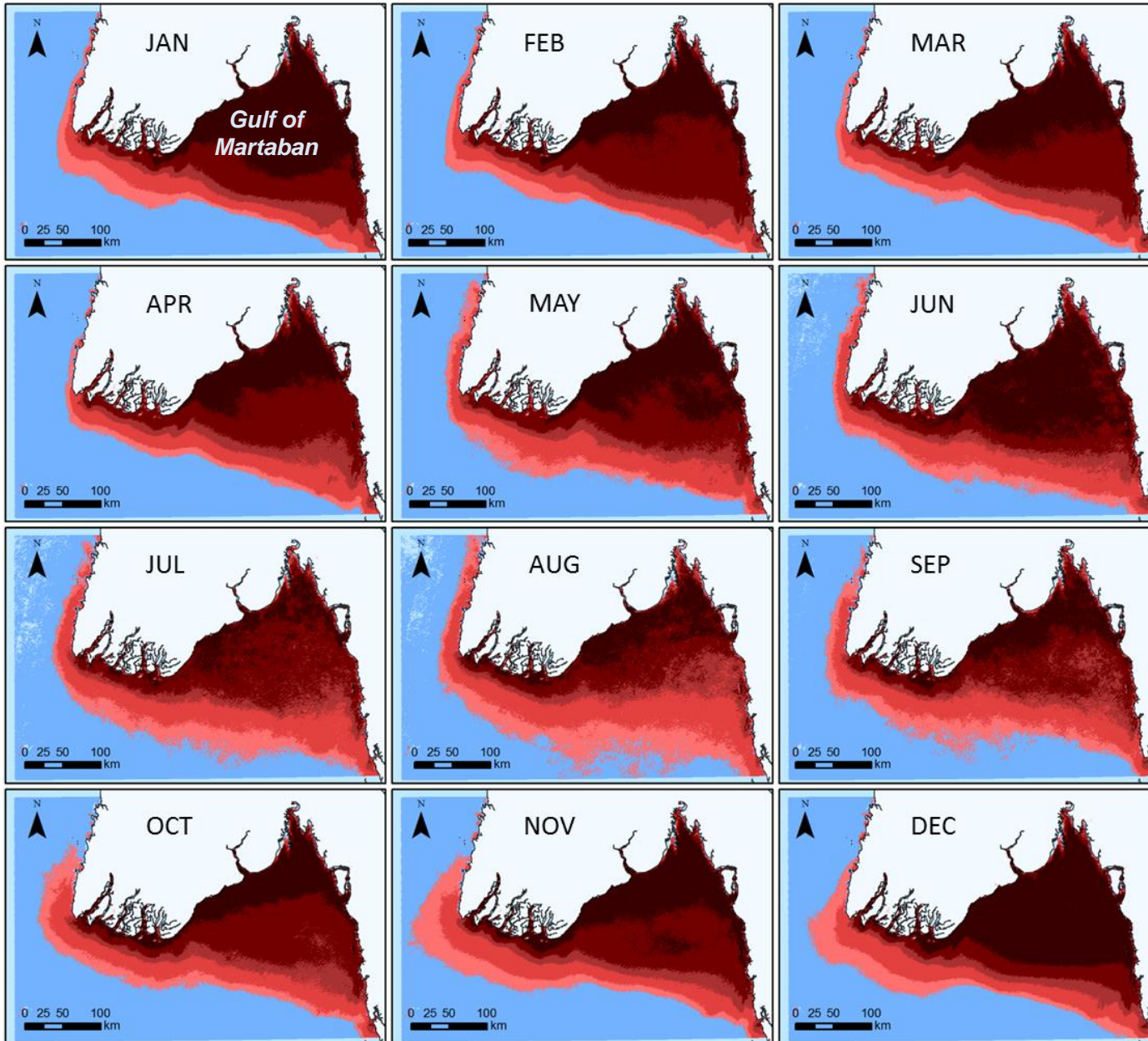
Shoreline grain-size variations

Sediment-fining trend towards the east and transport of mud in this direction by currents.

Trend inversion between sites 7/8 and 6: stronger offshore dispersal of fine-grained sediment by the Yangon river mouth and by the stronger tidal currents in this sector



Essentially muddy delta, more sand in the west



A high-turbidity delta (large sediment discharge).

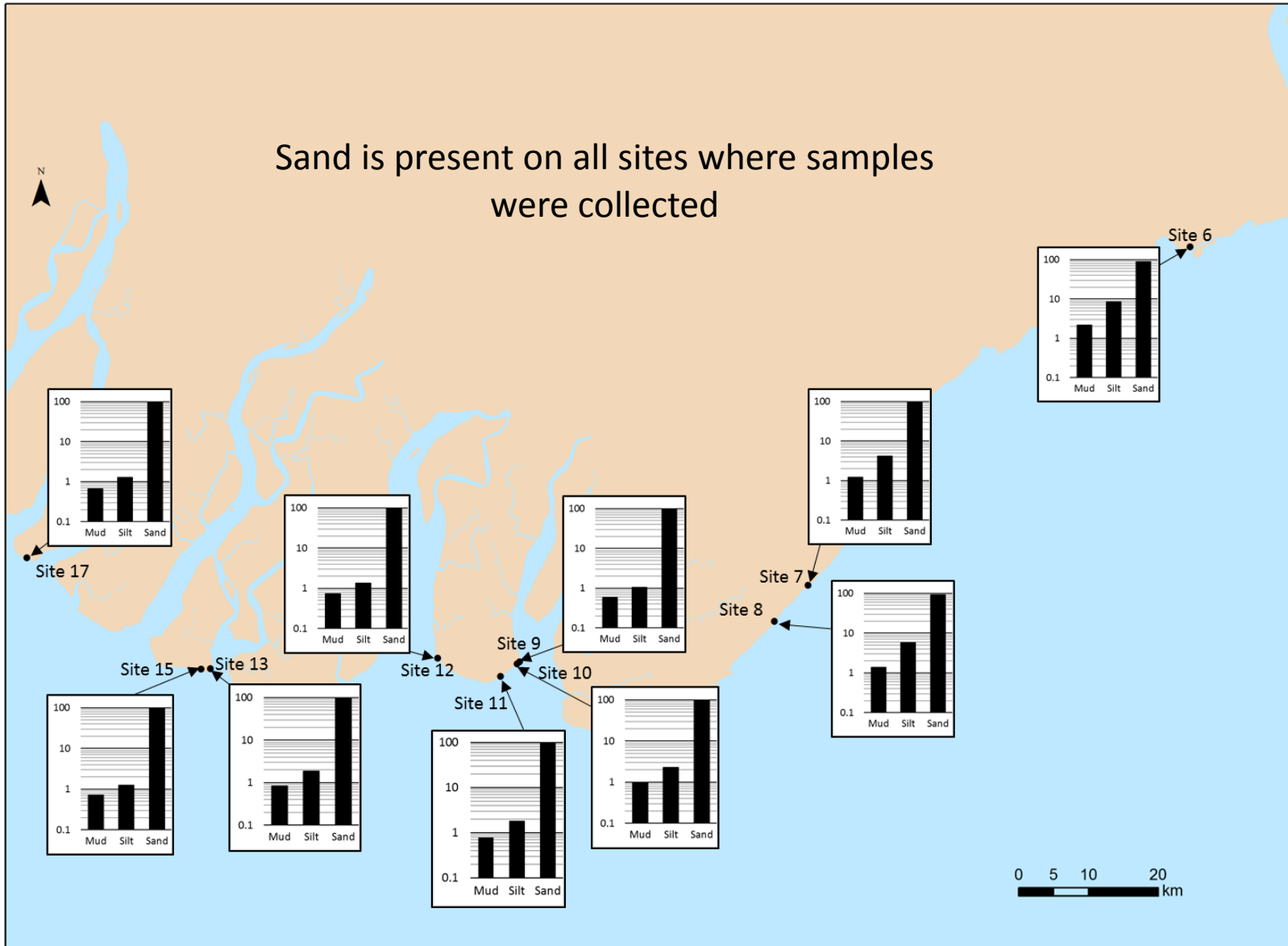
Eastwards longshore muddy transport to the east by the regional coastal wind-, wave- and tide-generated currents.

Important mud-trapping in the east (Gulf of Martaban)

Concentration in suspended particulate matter (g/cum)

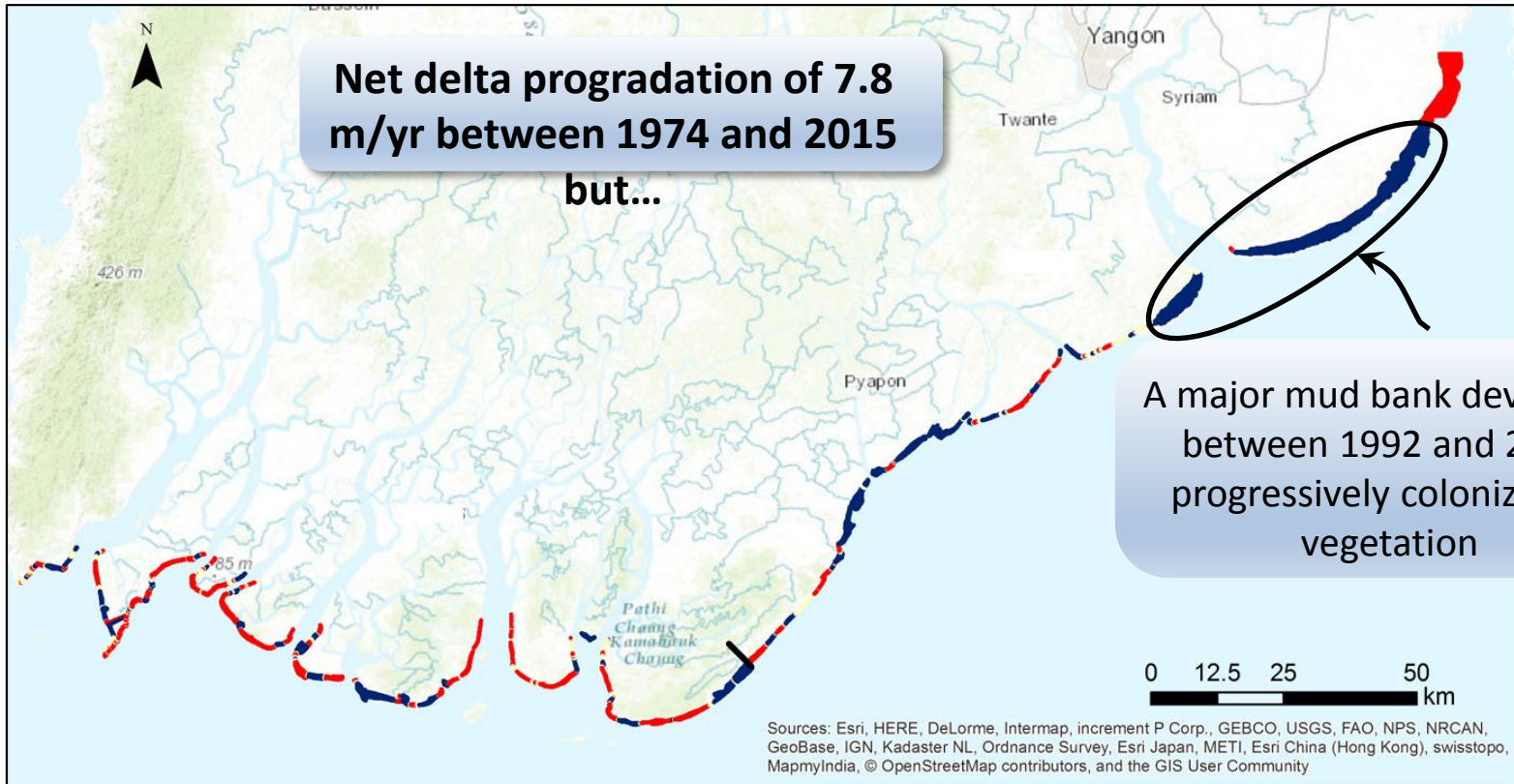
- > 200
- 100 : 200
- 50 : 100
- 10 : 50
- 5 : 10
- 1 : 5
- 0.1 : 1

Grain-size characteristics of beach deposits in the Ayeyarwady delta

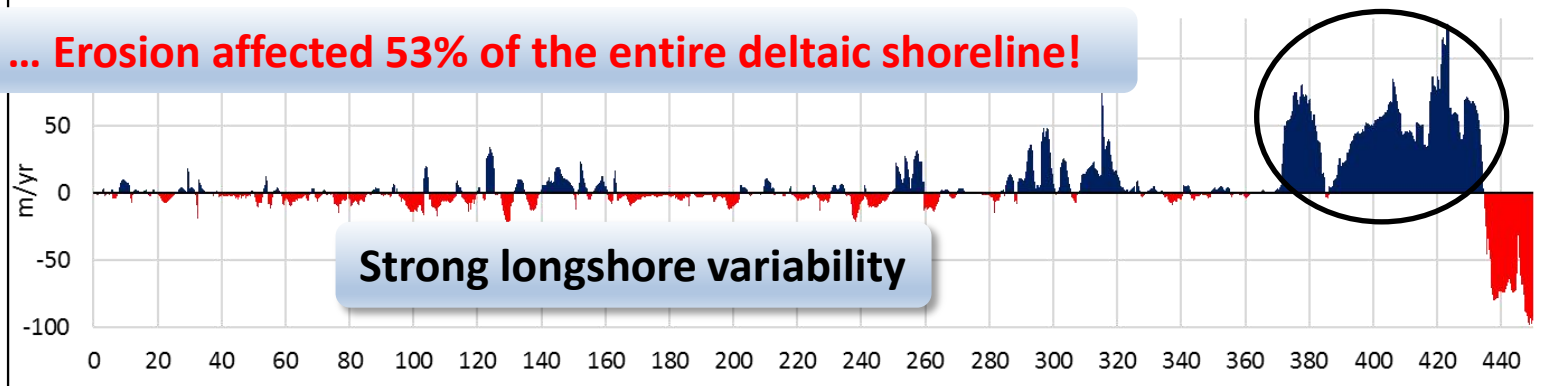




Shoreline change rates from 1974 to 2015

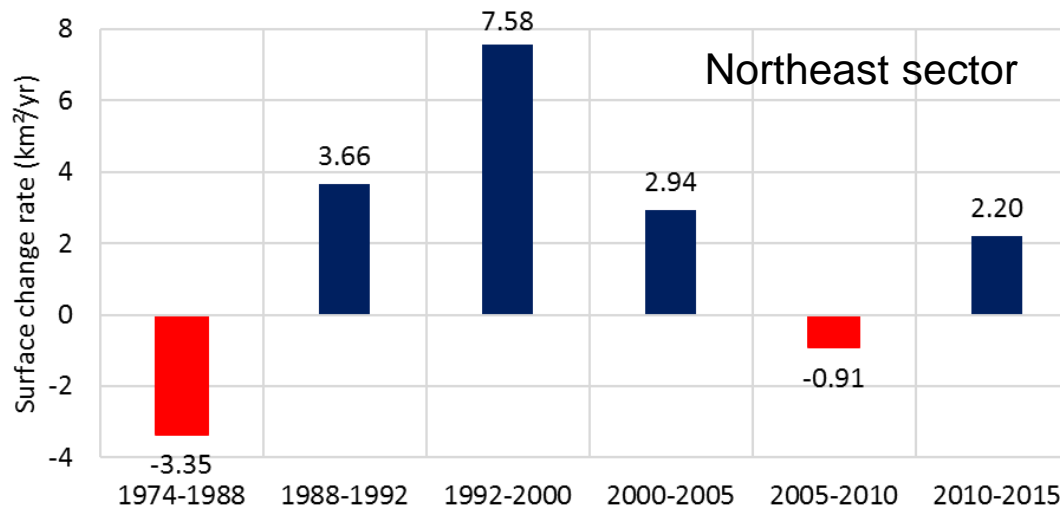
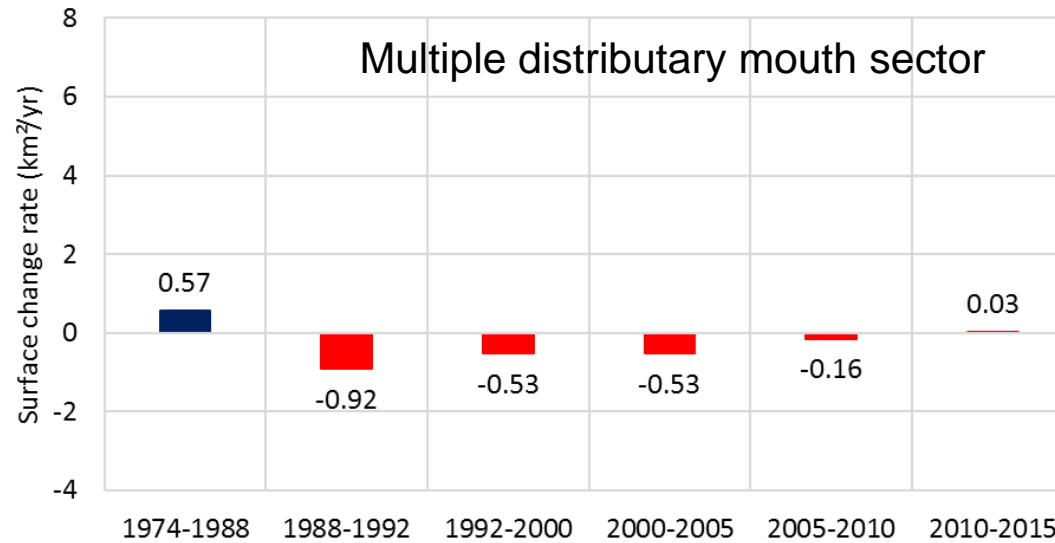


... Erosion affected 53% of the entire deltaic shoreline!





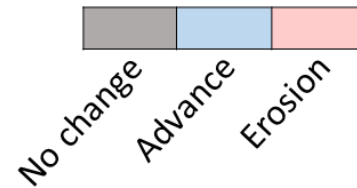
Increasing erosion in the mouth sector where sediment is in transit from the basin to the coast





Vulnerability analysis of the Ayeyarwady Delta shoreline

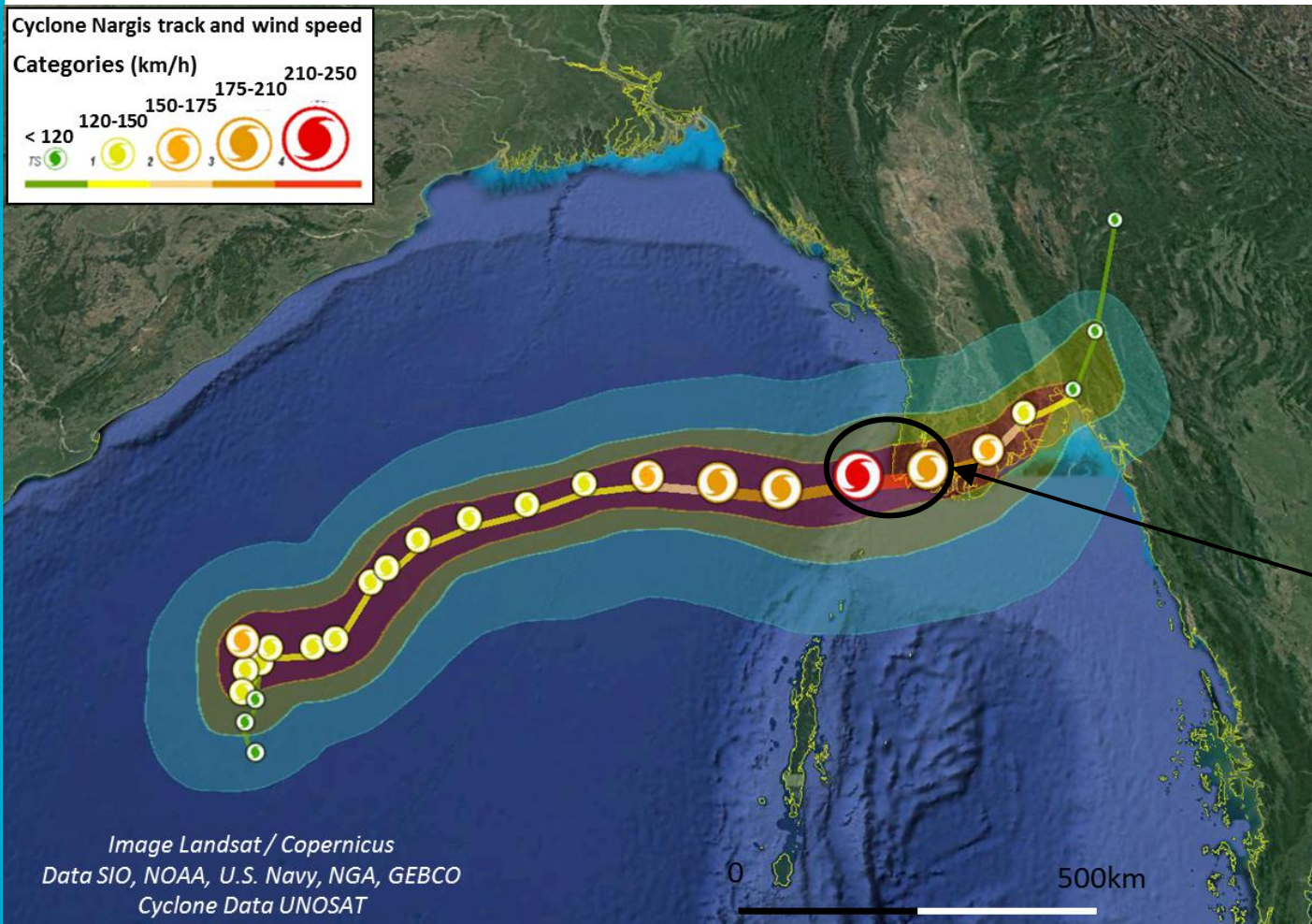
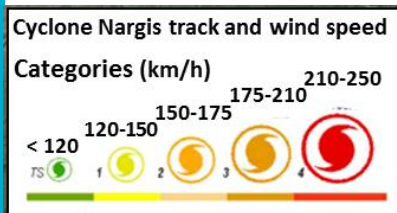
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17
1974 - 1988	No change	No change	Erosion	Erosion	Erosion	Advance	Advance	Advance	No change	Erosion	Erosion	Erosion	Erosion	Erosion	Erosion	Erosion	Advance
1988 - 1992	No change	No change	No change	Advance	Advance	No change	No change	Advance	Erosion	Erosion	Erosion	Advance	Advance	Advance	Advance	Erosion	Erosion
1992 - 2000	Erosion	Erosion	No change	Advance	No change	Erosion	Erosion	Erosion	Erosion	Erosion	Erosion	Advance	Erosion	Erosion	Erosion	Erosion	Erosion
2000 - 2005	Erosion	Erosion	Erosion	Erosion	Erosion	Erosion	Advance	Advance	Erosion	Erosion	Erosion	Erosion	Erosion	Erosion	Erosion	Erosion	Erosion
2005 - 2010	Erosion	Erosion	No change	Erosion	No change	No change	Erosion	Erosion	No change	Erosion	Erosion	Erosion	Erosion	Erosion	Erosion	Erosion	Erosion
2010 - 2015	Erosion	Erosion	Erosion	Erosion	Erosion	No change	Erosion	Erosion	Erosion	Erosion	Erosion	Advance	Erosion	Erosion	Erosion	Erosion	Erosion



Increasing long-term fragility of the delta from sites 9 to 17 (multiple distributary mouths) and sensitivity to erosion of the eastern part of the delta



Shoreline changes caused by Tropical Cyclone Nargis (May 2-4, 2008): test of delta shoreline resilience to high-energy events



Storm surge at least 3.7 m high generated up to 50 km inland across the Ayeyarwady delta

Severe flooding: 14,400 km² of deltaic land

05/02/2008, Category 4 with 215 km/h winds

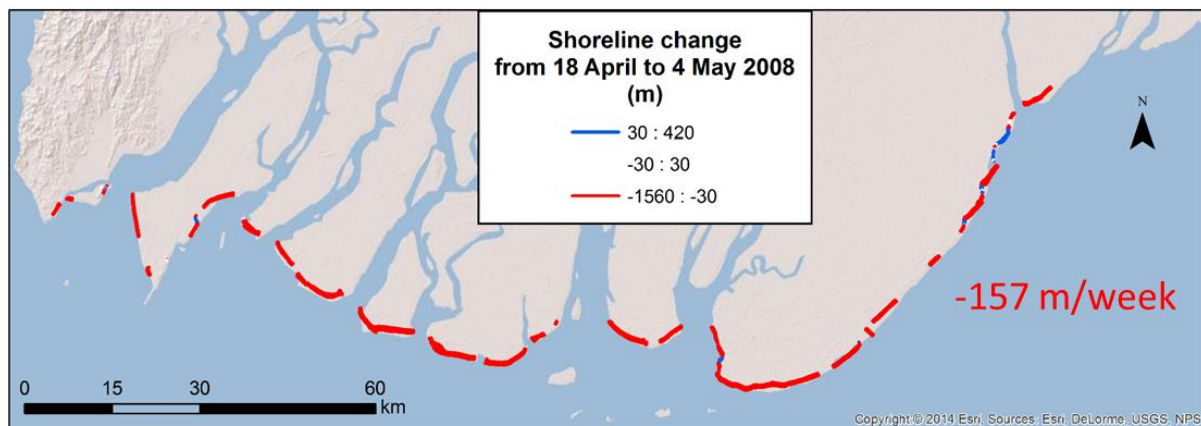
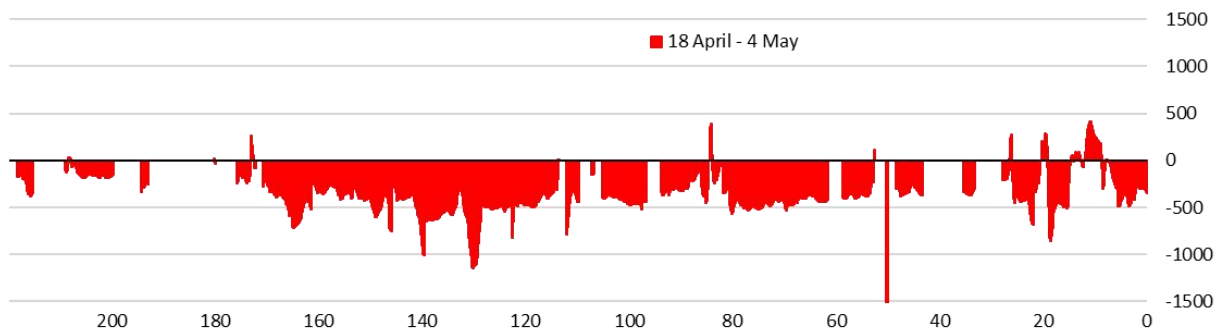
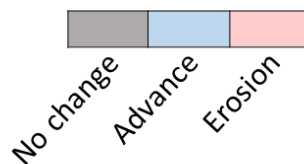
Deadly cyclone: 138,000 people killed
2.4 million people severely affected, >1 million people homeless

The Nargis storm track



Shoreline change related to Tropical Cyclone Nargis

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17
Nargis cyclone (apr-may 08)	Red	Red	Red	Red	Red	Red	Grey	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red



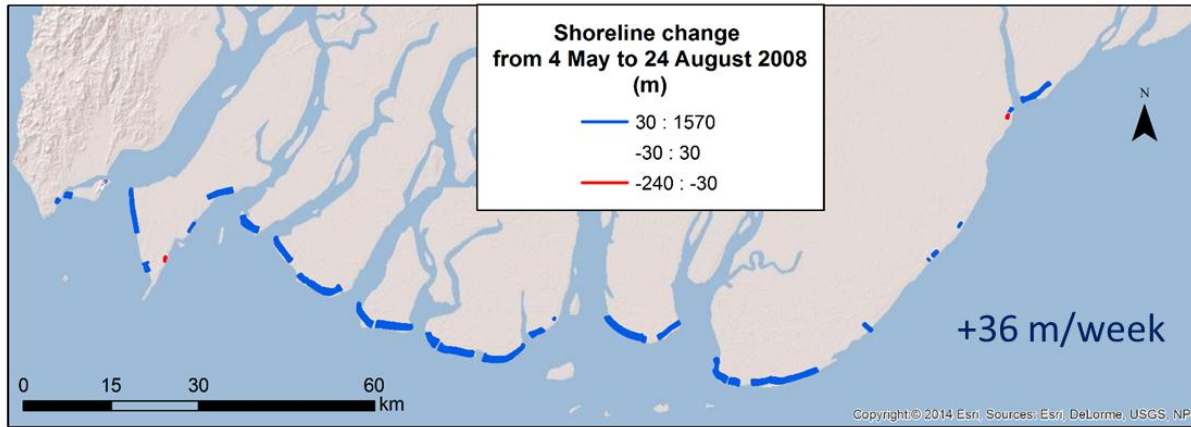
Clouded satellite images covering the passage of Nargis (>80% cloudy)

Important shoreline retreat between April 18 and May 4, 2008 (over 1 km in places)

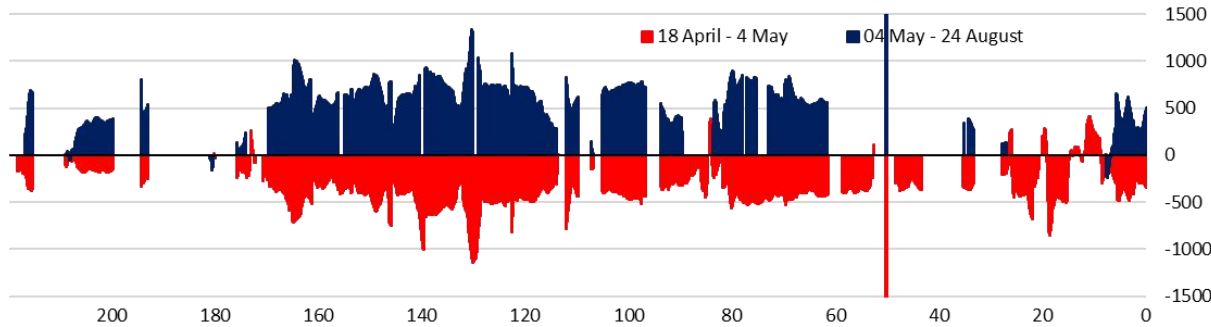


	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17
After Nargis (may-aug 08)																	

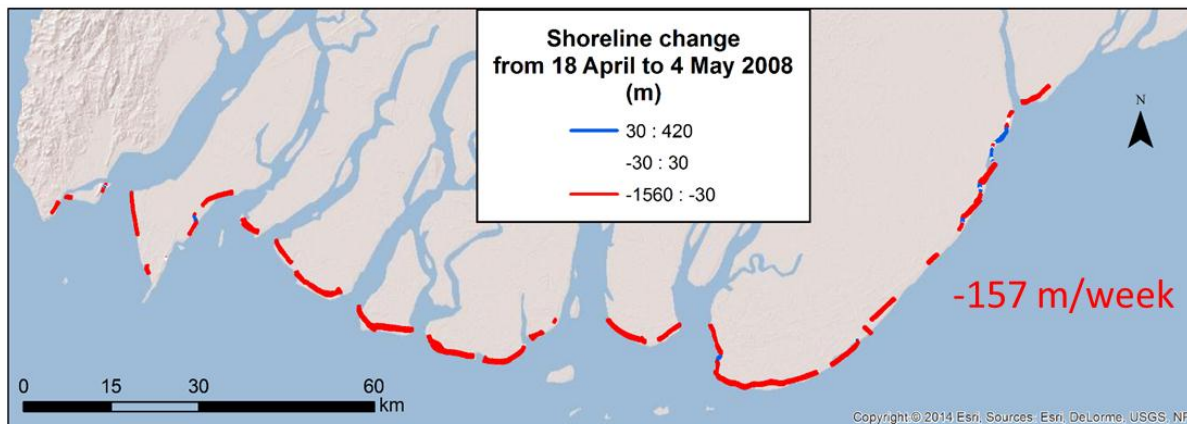
No change  Advance 



Good resilience: the shoreline position was largely recovered within 4 months



wider erosional trend = less future resilience?





Key message

Ayeyarwady Delta has grown over the period 1974 - 2015, but a deeper analysis shows clear signs this trend is changing.

We note:

- Reduced stocking of sediments near river mouths and half of the 450 km delta coast seems to experience net reduction of sediments replenishment
- Growing trend over the period 1974-2015 masks significant alongshore variability, with the sandy areas actually receding
- Predicted sea level rise & higher frequency and intensity of storm cyclones will add to this stress
- Ambitious hydropower development plan & increasing demand for sand from growing construction sector

Precautionary principle should apply while deeper analysis of basin wide sediments management are conducted
any development affecting the coastal sediment budget or mangrove cover should be considered with caution



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**Thank you
for your attention**

