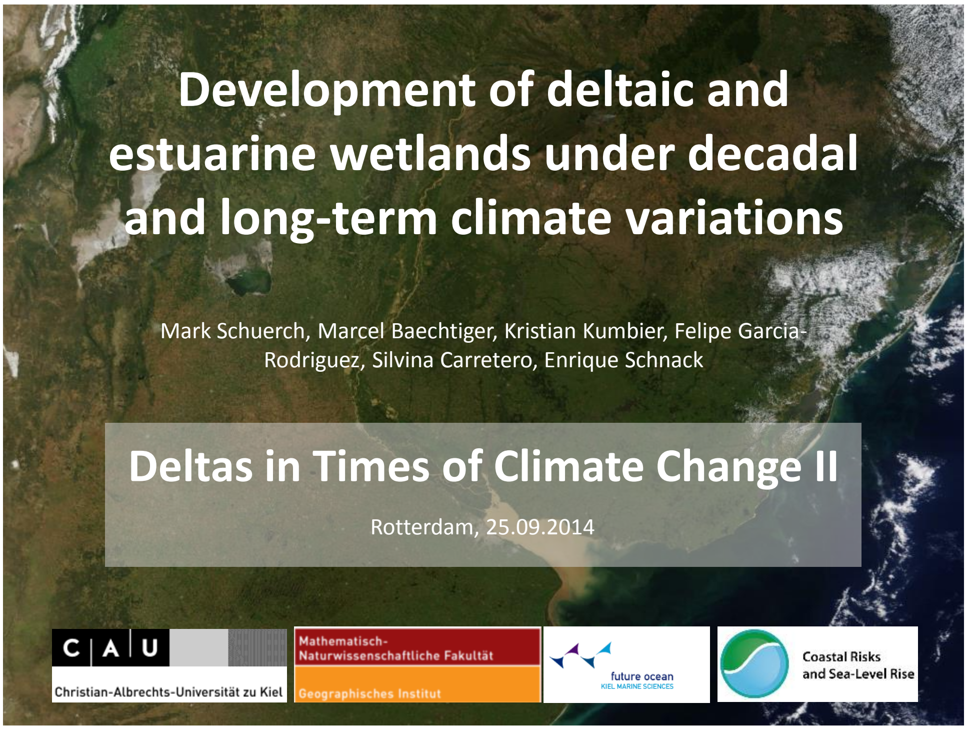

Development of deltaic and estuarine wetlands under decadal and long-term climate variations

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Deltas in Times of Climate Change II

Rotterdam, 25.09.2014

C | A | U
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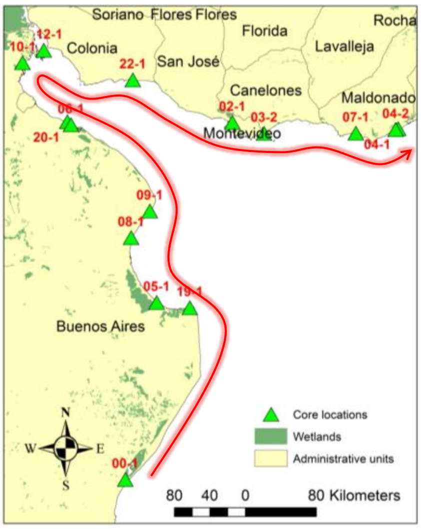
KIEL MARINE SCIENCES
Coastal Risks and Sea-Level Rise

Aims and objectives

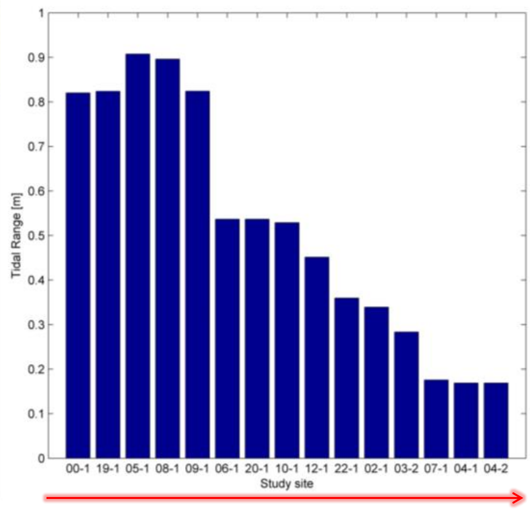
- How do decadal climate variations interfere with long-term sea level rise (SLR) with respect to the ability of deltaic and estuarine marshes to survive future SLR?
- Can we identify a spatial dependency of these interferences within the estuary?
  - Assessment of spatial variability of sediment characteristics and vertical estuarine and deltaic marsh accretion rates.
  - Quantification of the relative importance of riverine and marine environmental drivers (tides and waves).
  - Investigation on how decadal variability of riverine and marine drivers (e.g. driven by ENSO) affect estuarine marsh accretion rates.

Study area: Rio de la Plata (RdlP)

Coring sites:

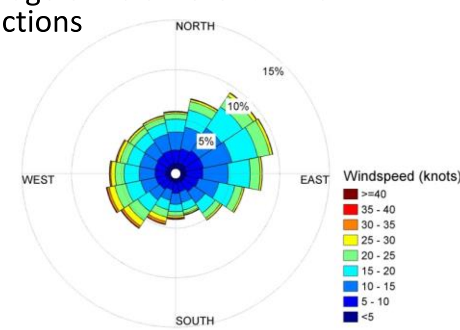


Tidal range:

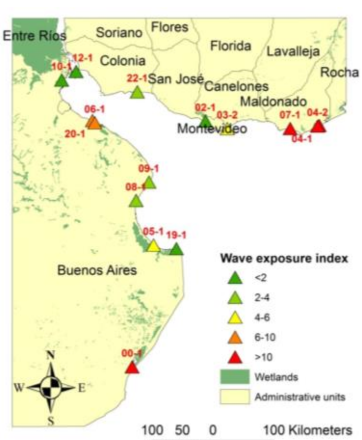


Wave exposure

- After Hill et al. (2010), wave exposure is calculated as a function of:
  - Fetch length (max. 250 km)
  - Seabed topography
  - Wind climate
- Average of 16 different wind directions

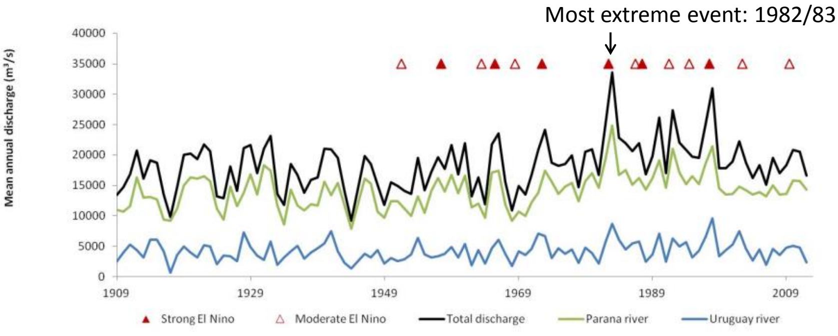


NCEP/DOE AMIP-II Reanalysis (Reanalysis-2) Data



River discharge

Most extreme event: 1982/83



– Oceanic Niño Index (ONI): running 3-month mean SST anomaly for the Niño 3.4 region (i.e., 5°N-5°S, 120°-170°W).
– Weak (with a 0.5 to 0.9 SST anomaly); Moderate (1.0 to 1.4) ; Strong (≥ 1.5) .
– Thresholds must be exceeded for at least 3 consecutive overlapping 3-month periods.

- Peak river discharge of Paraná and Uruguay river is strongly influenced by the El Niño Southern Oscillation (ENSO).
- Paraná river contributes about 77% of the total RdlP discharge.
- Discharge is higher in the 1980s and 1990s.

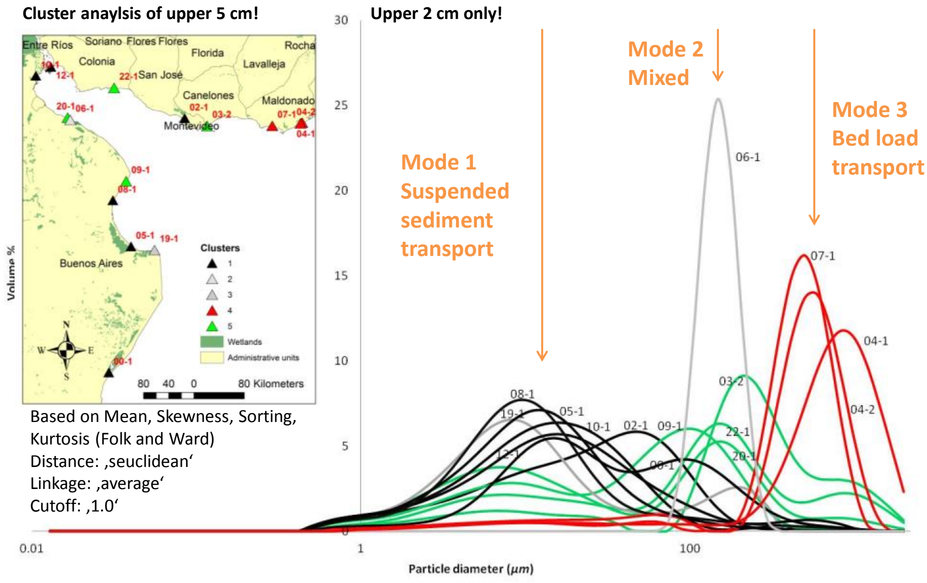
Methodology

Coring:
Total of 15 cores
Avg. core length: 79cm
Ranging from 49-115cm

Slicing scheme:
0-20 cm: 2cm
20-50 cm: 3cm
50 cm-end: 5cm

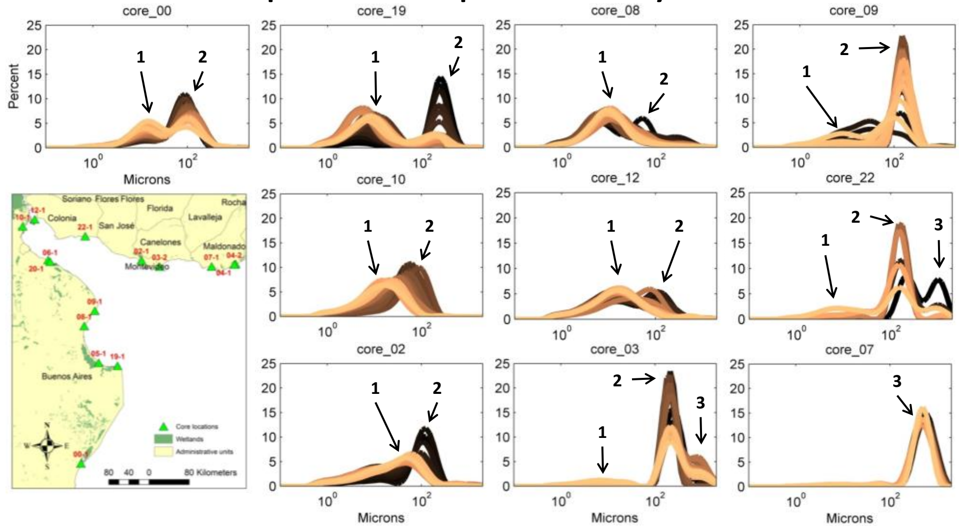
- Water content and dry bulk density
- Grain size analysis (Malvern Mastersizer 2000)
- Data analysis, using the Folk and Ward (1957) method (geometric)
- Organic carbon content (CN analyzer)
- Radioisotope analysis, using α- and γ-spectrostopy (^{210}Pb, ^{137}Cs)

Grain size data: Surface distribution



Based on Mean, Skewness, Sorting, Kurtosis (Folk and Ward)
Distance: ‚seuclidean'
Linkage: ‚average'
Cutoff: ‚1.0'

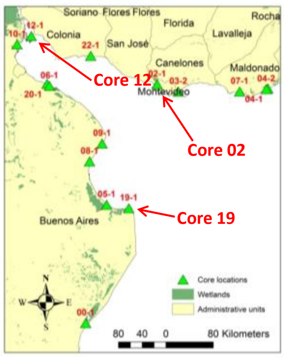
Spatio-temporal analysis

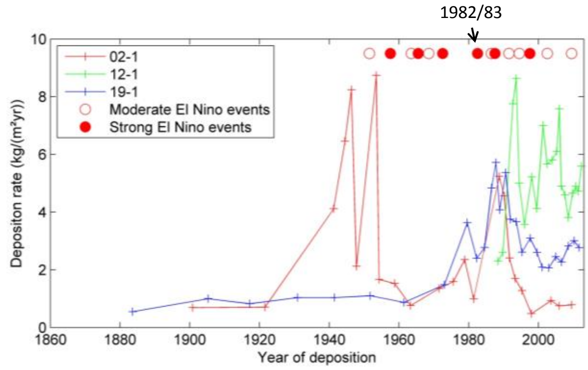


Dark brown: Deeper layers -> Light brown: Upper layers

Transition from bed-load (3) / mixed (2) transport mode towards suspended transport (1) mode!
-> High accretion rates and / or increased riverine sediment discharge

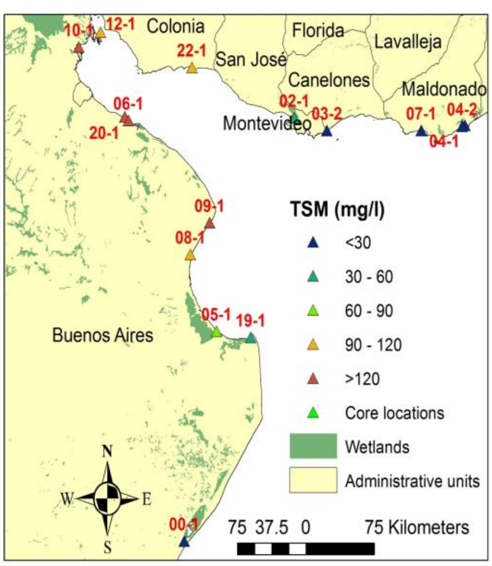
Deposition rates





- Sudden increase in accretion and deposition rates around early 1980s in core 19-1 and 12-1.
- Very strong signal of 1982/1983 El Niño in core 12-1, strong signals in cores 19-1 and 02-1.
- Variability in recent years (with frequent El Niños) highest in core 12-1, followed by core 19-1, and 02-1.

Local long-term sediment supply



- MERIS satellite data on total suspended matter (2005-2012).
- Increased sediment supply along Argentinean coast.
- Riverine sediment is transported into the bay of Samborombon.

Findings

- Large spatial variability in grain size distributions are controlled by wave exposure and riverine sediment input.
- Riverine sediments are transported along the Argentinean coast into the bay of Samborombon.
- Highest recent deposition rates are measured in the inner estuary, followed by the bay of Samborombon; deposition rates are lowest along the Uruguayan coast.
- Extreme El Niño events impact accretion rates; most affected are the inner estuarine marshes, least affected are the outer Uruguayan marshes.

Conclusions

- Decadal variations in river discharge may significantly increase marsh depositions rates in parts of the estuary, overruling the effect of long-term SLR.
- These effects, however, may be subject to large spatial variability, depending on local hydrodynamics and climatic conditions.


Thank you for your attention
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