

Catchment2Coast



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3d-numerical modelling of the hydrodynamics in a tidally energetic sub-tropical embayment



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Outline

- Background to C2C project
- Hydrodynamics of Maputo Bay
- Significance of circulation
- Conclusions

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- Background to C2C project
 - Project location
 - Project background
- Hydrodynamics of Maputo Bay
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Maputo Bay, Maputo - Mozambique

Mozambique coastline: ~ 26 °S - 12 °S



Egmond aan Zee – Lat. ~ 52.62 °N; Long. ~ 4.62 °E

C2C Background



Ecosystem scale research project

Aim: to understand the linkages between human activity in the river catchments and its impacts on coastal resources



Penaeus indicus

Maputo Bay shrimp fisheries worth ~ US\$3 million
But experiences large inter-annual fluctuations

Outline

- Background to C2C project
- Hydrodynamics of Maputo Bay
 - Seasonal
 - Intra-seasonal
 - Residual circulation
 - Residence regions
- Significance of circulation
- Conclusions

Maputo Bay



– Bathymetry

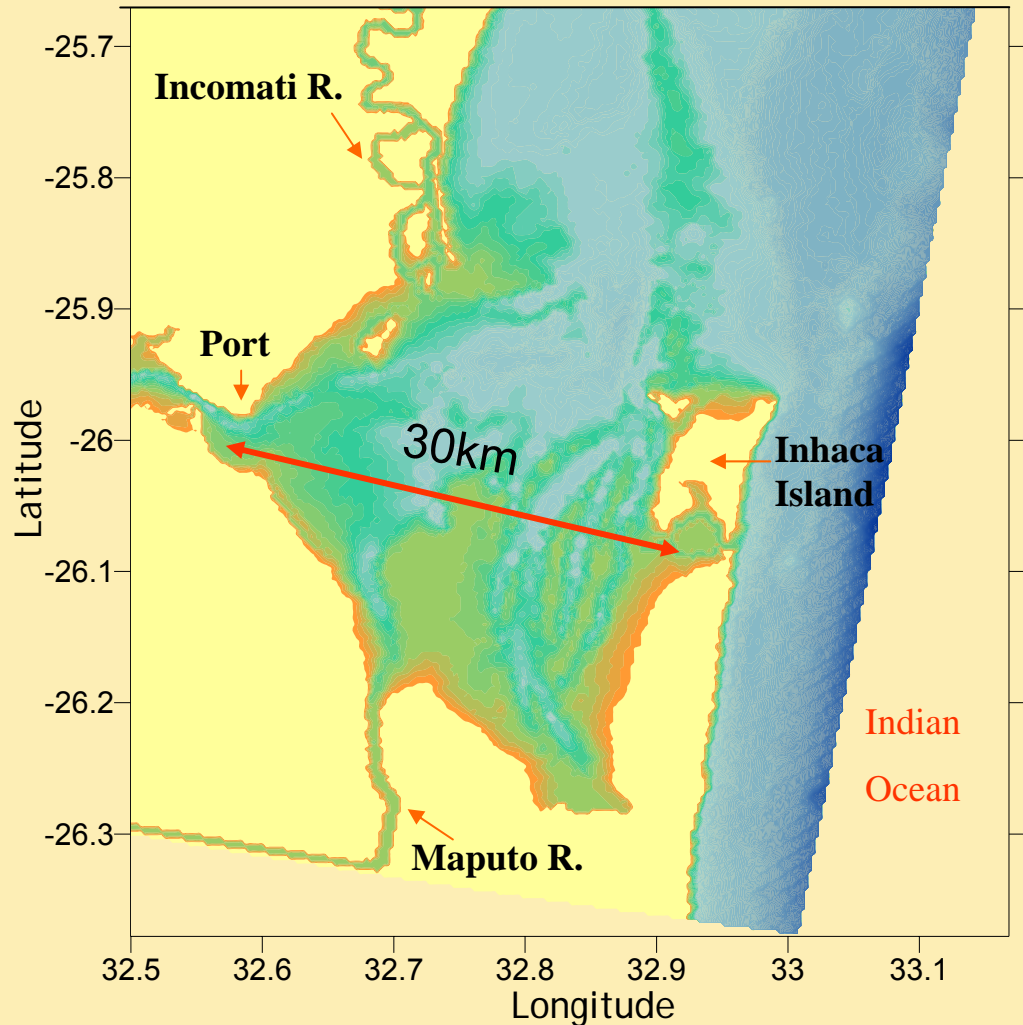
- Mean depth ~ 10m
- Max depth ~ 30m

– Tidal range:

- Springs ~ 3.0m
- Neaps ~ 0.5m

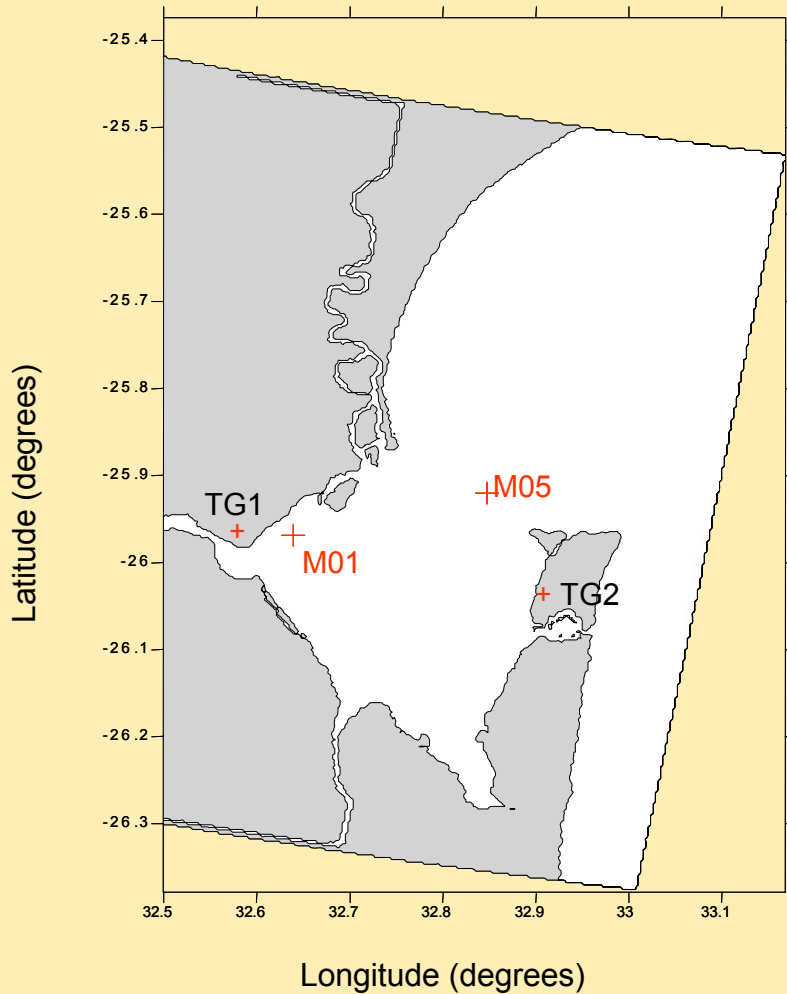
– Tidal currents:

- Springs ~ $1.00\text{m}\cdot\text{s}^{-1}$
- Neaps ~ $0.15\text{m}\cdot\text{s}^{-1}$

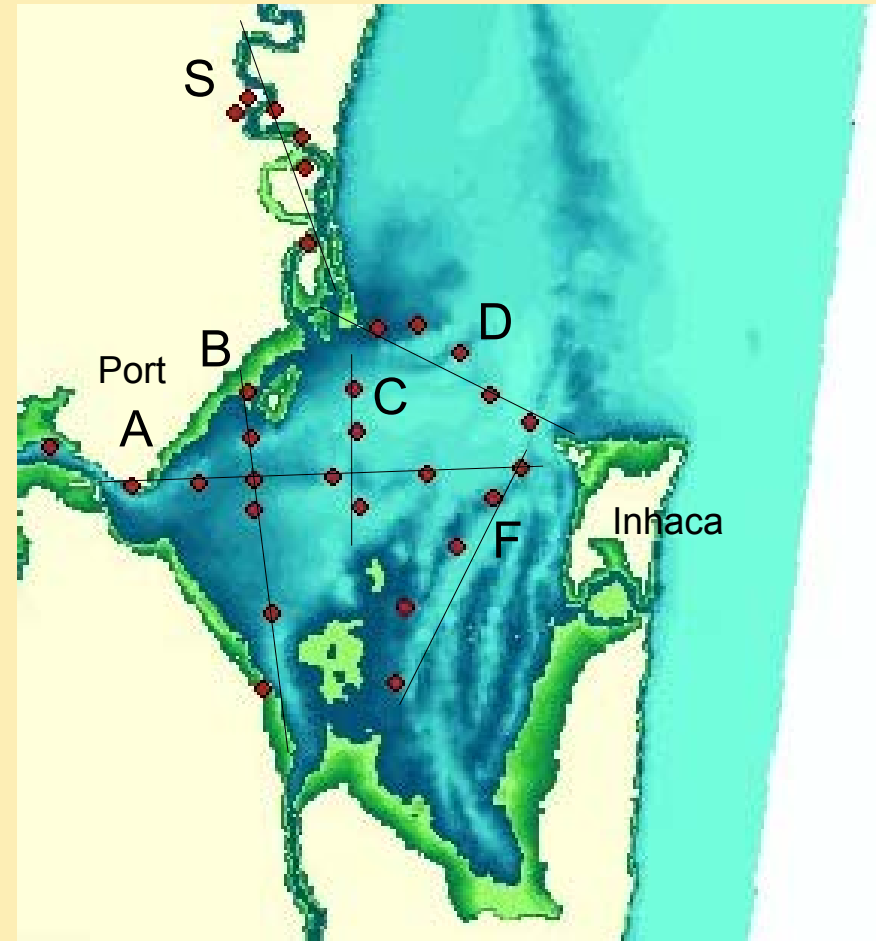


Field stations in Maputo Bay

Mooring sites



Survey grid

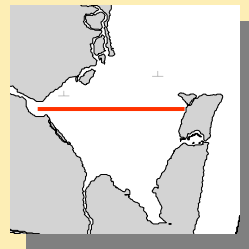


Data collected: tide gauge (TG1, TG2) and

CTD surveys

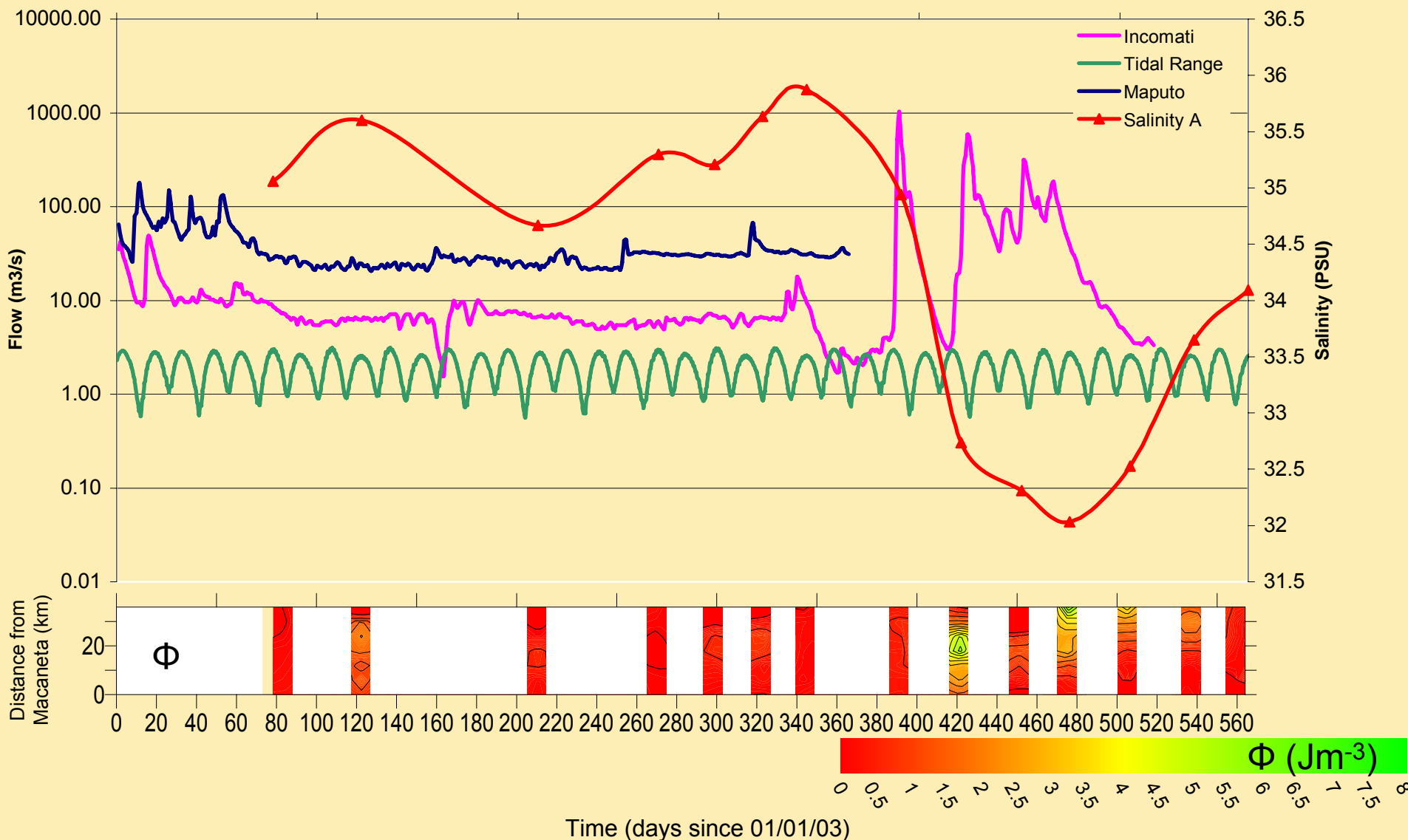
moored data (current meter, pressure, temperature, conductivity)

Seasonal pattern

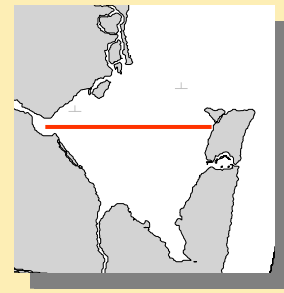


Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May

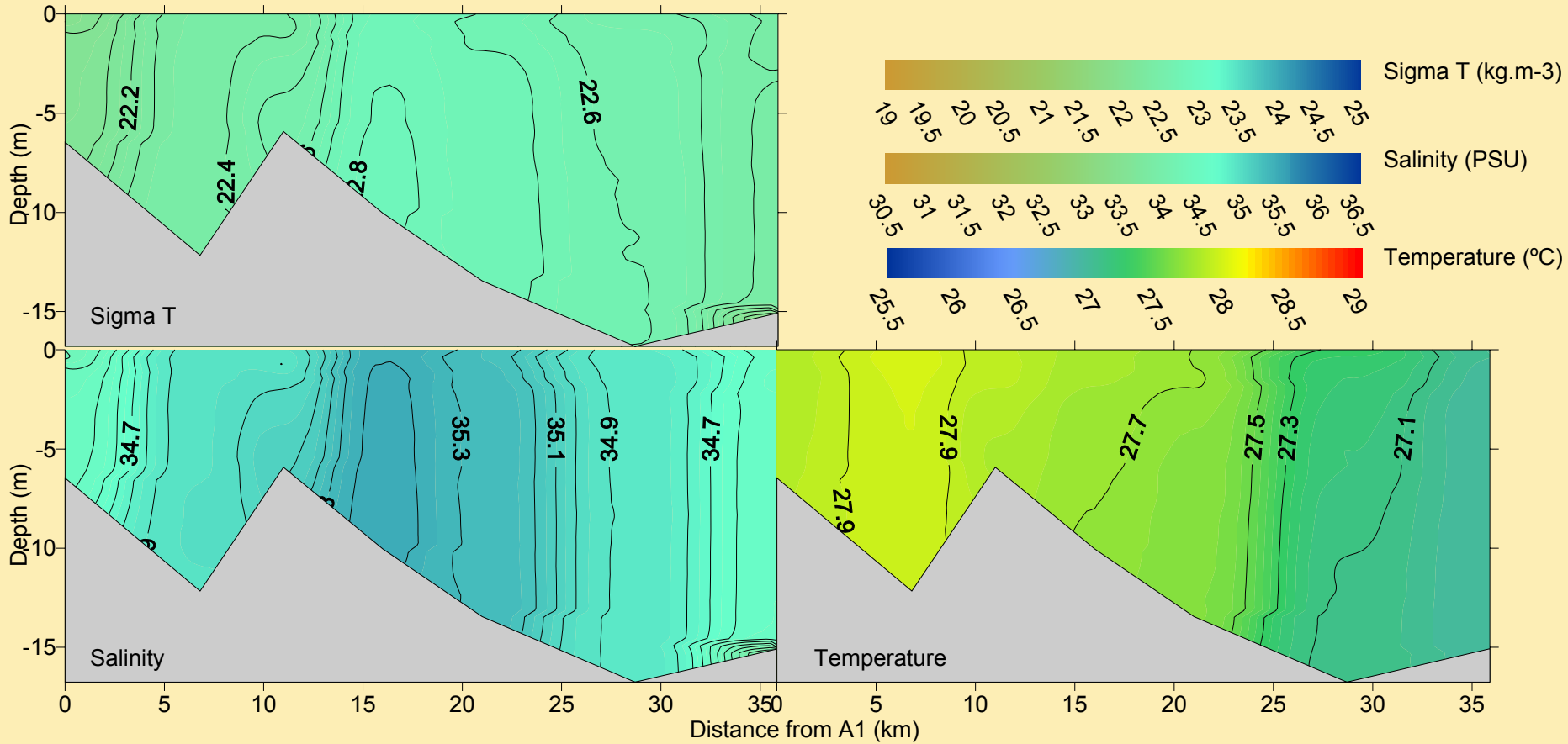
0 100 200 300 400 500



Intra-seasonal pattern



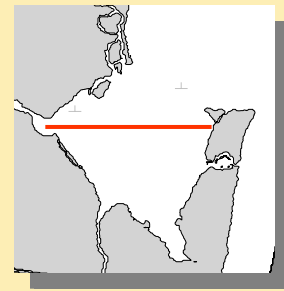
Dry season



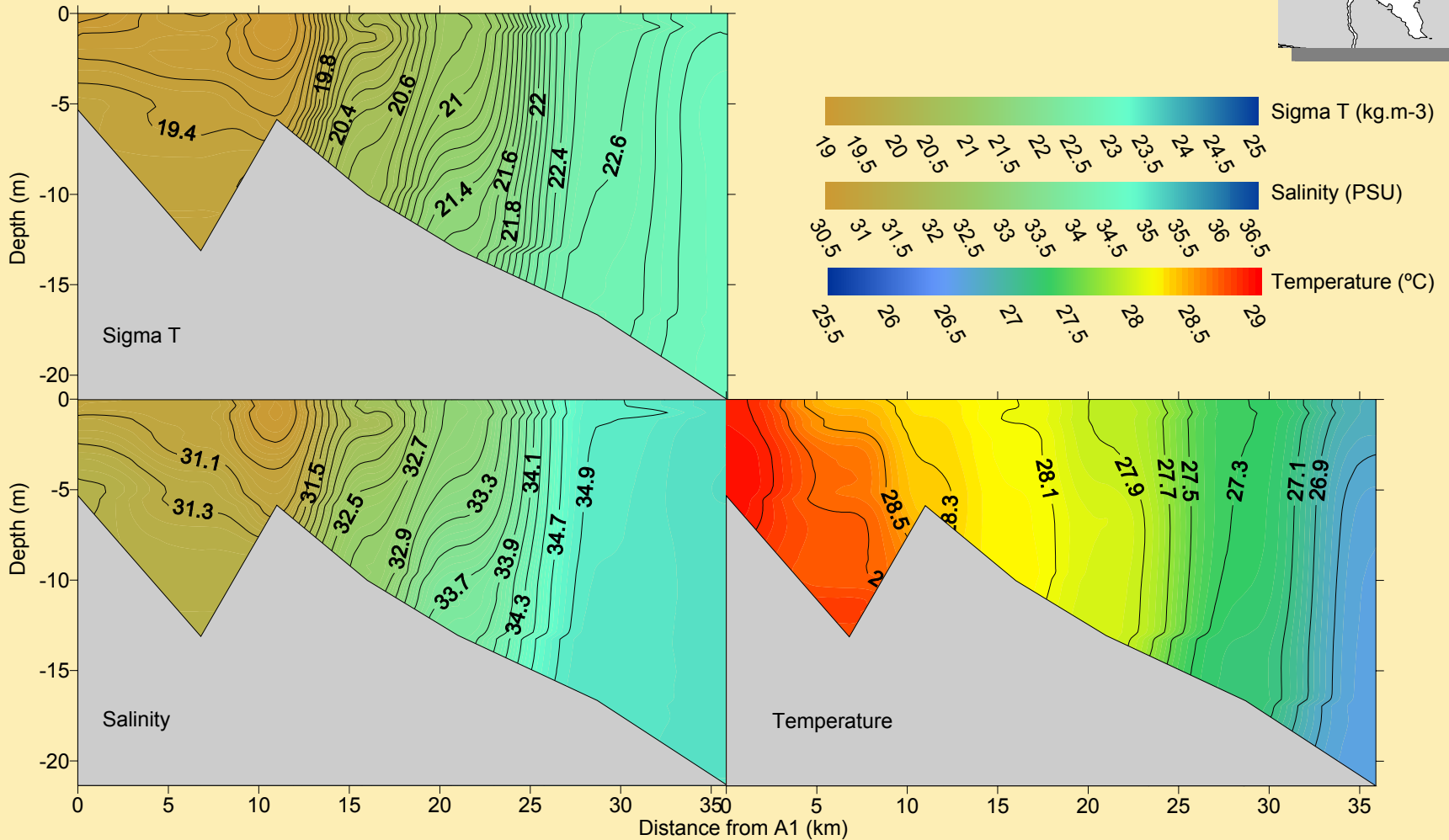
•Vertically mixed

•Very weak horizontal gradient

Intra-seasonal pattern



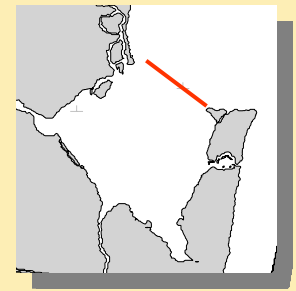
Wet season – spring tide



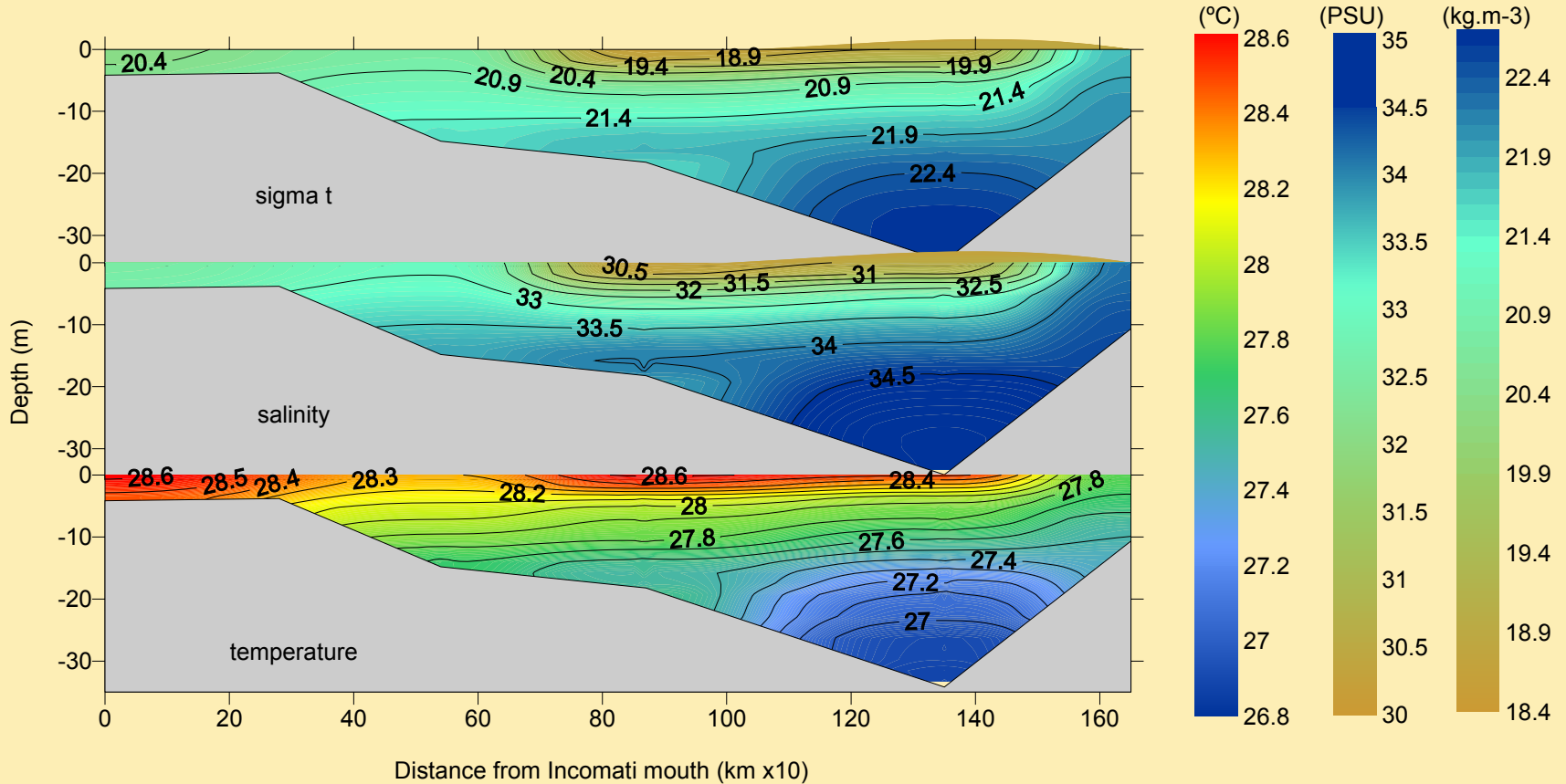
•Vertically mixed at springs

•Very strong horizontal gradient

Intra-seasonal pattern



Wet season – neap tide



• Stratified at neaps

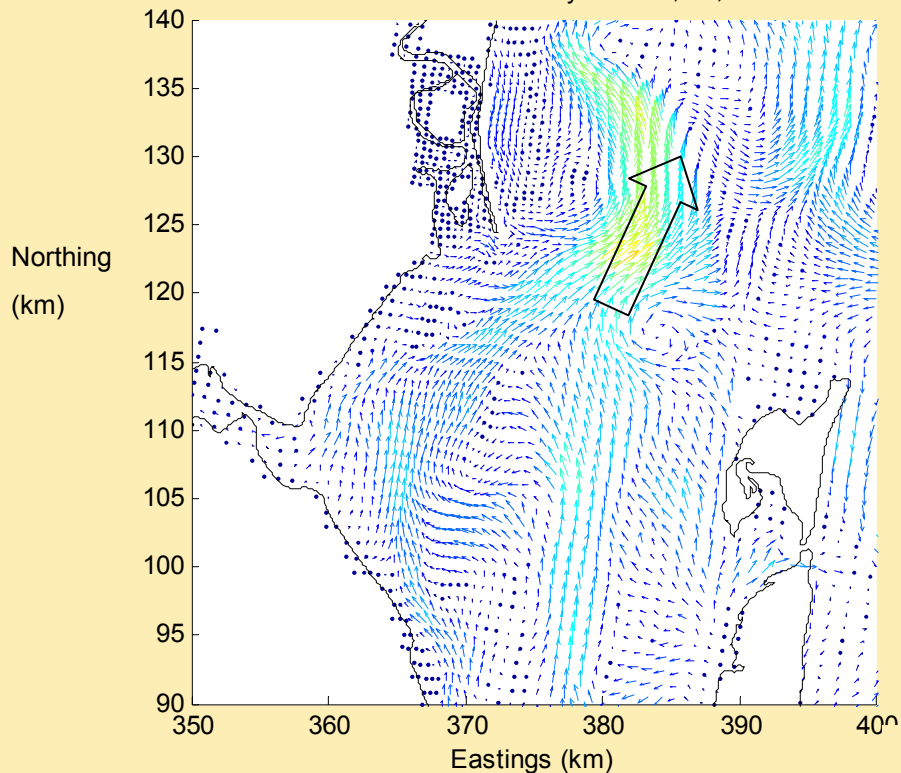
• Very strong vertical gradient

Seasonal and intra-seasonal patterns

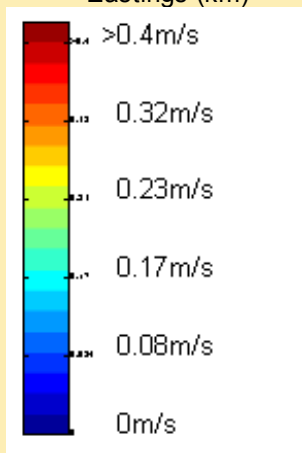
- Dry season
 - Very weak horizontal gradient
 - Complete vertical mixing
- Wet season
 - Pronounced horizontal gradient
 - Spring tide
 - Periodic vertical stratification
 - Neap tide
 - Persistent vertical stratification

Residual circulation – dry season

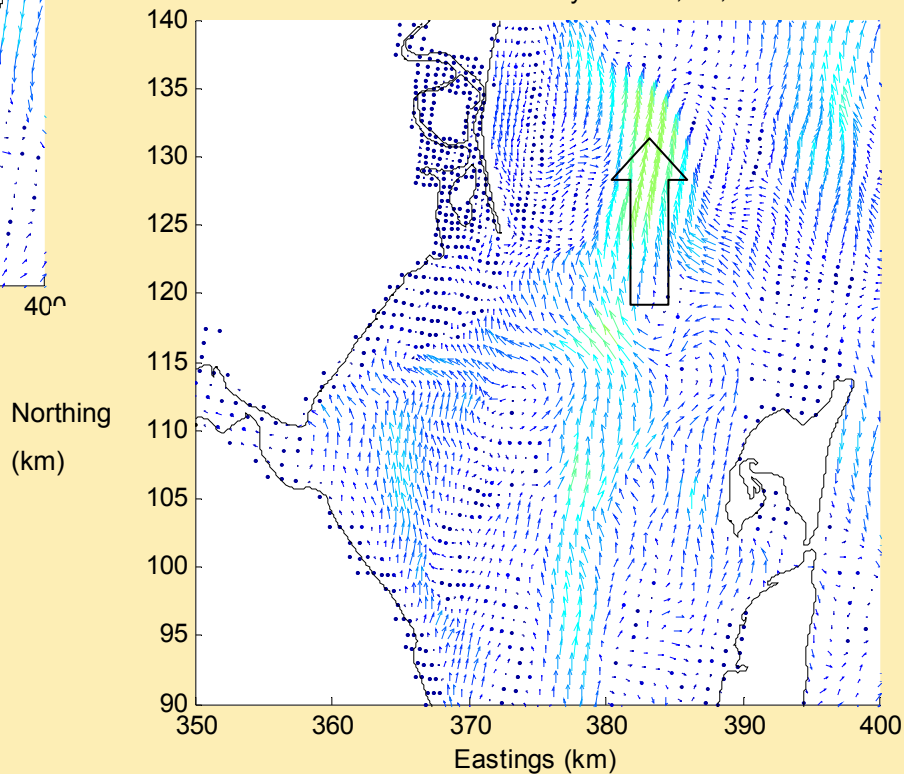
25h Residual current dry season, L1, ST



- Main transport is barotropic and at ST
- Only the very bottom layer moves into the bay

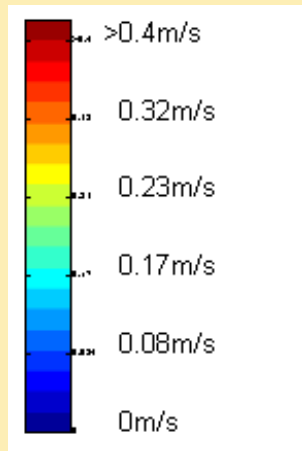
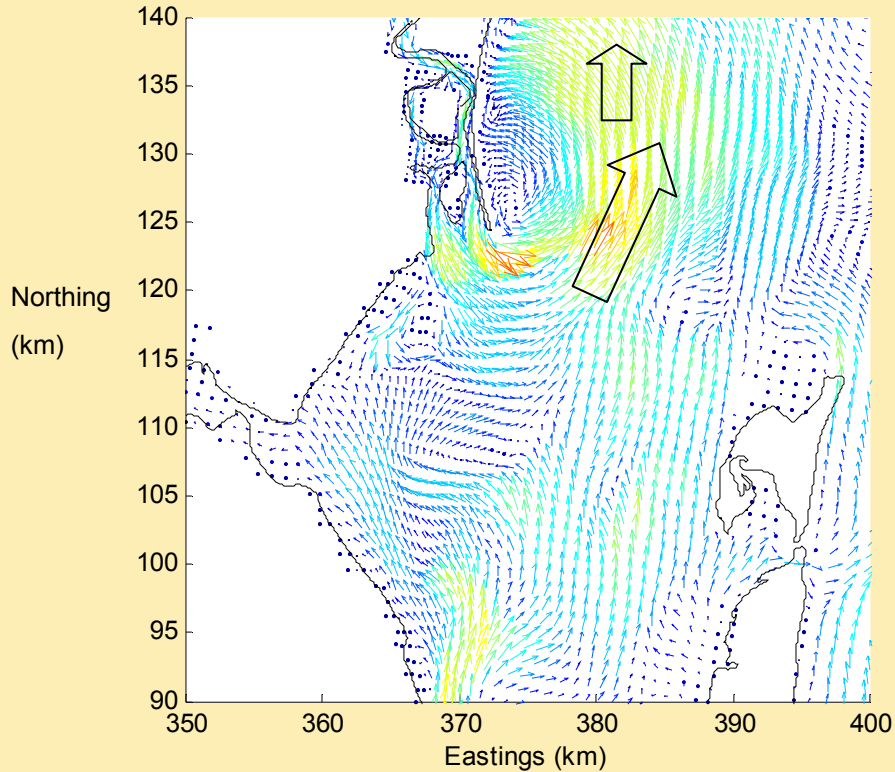


25h Residual current dry season, L4, ST



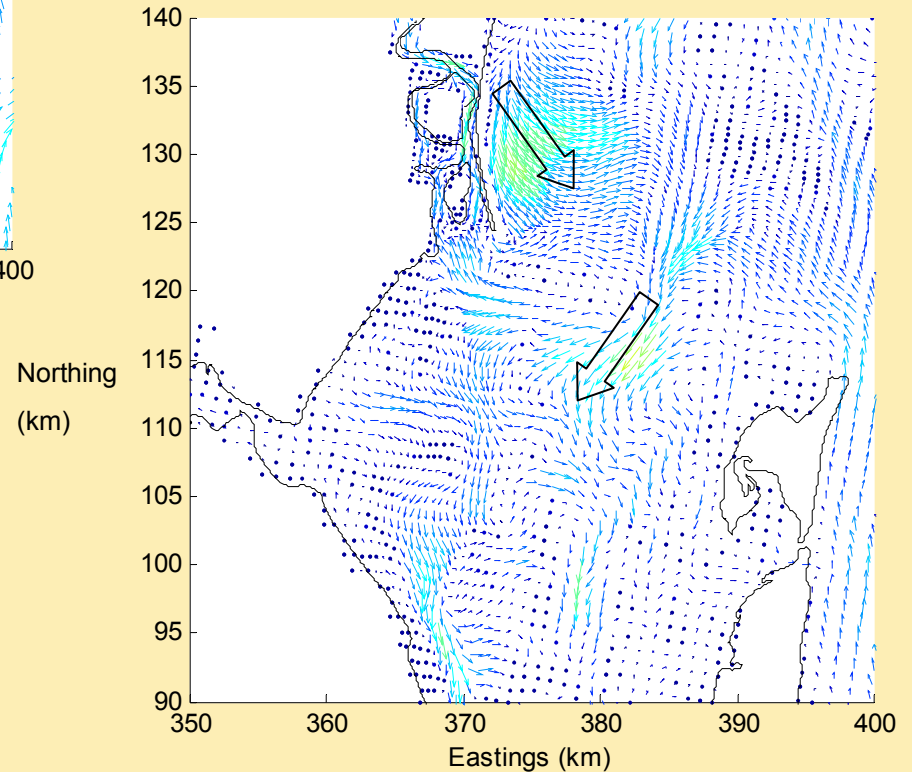
Residual circulation - wet season

25h Residual current wet season, L1, NT

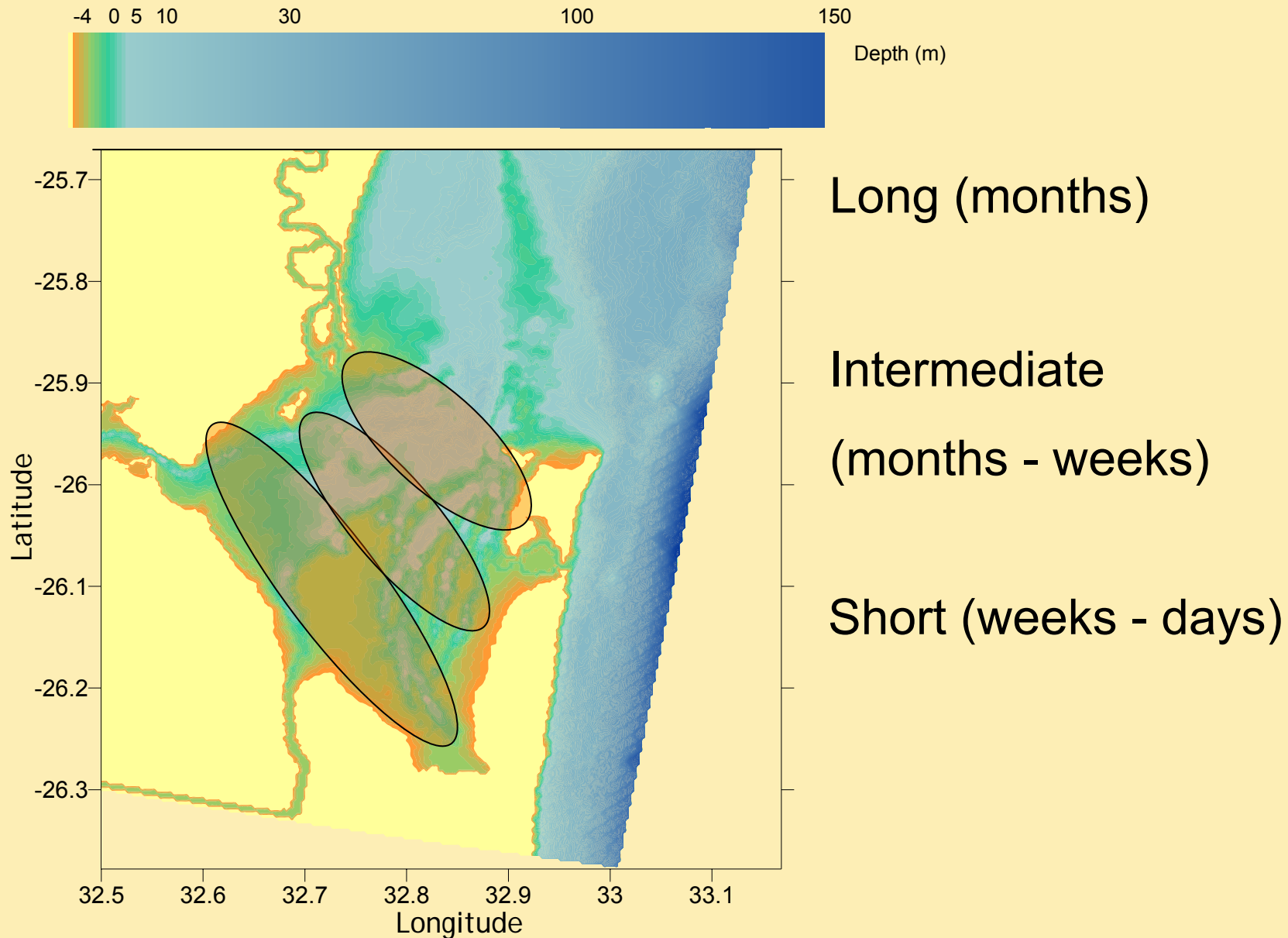


- Main transport is baroclinic and at NT
- Upper layer exporting water and lower layer importing water

25h Residual current wet season, L3, NT



Residence regions

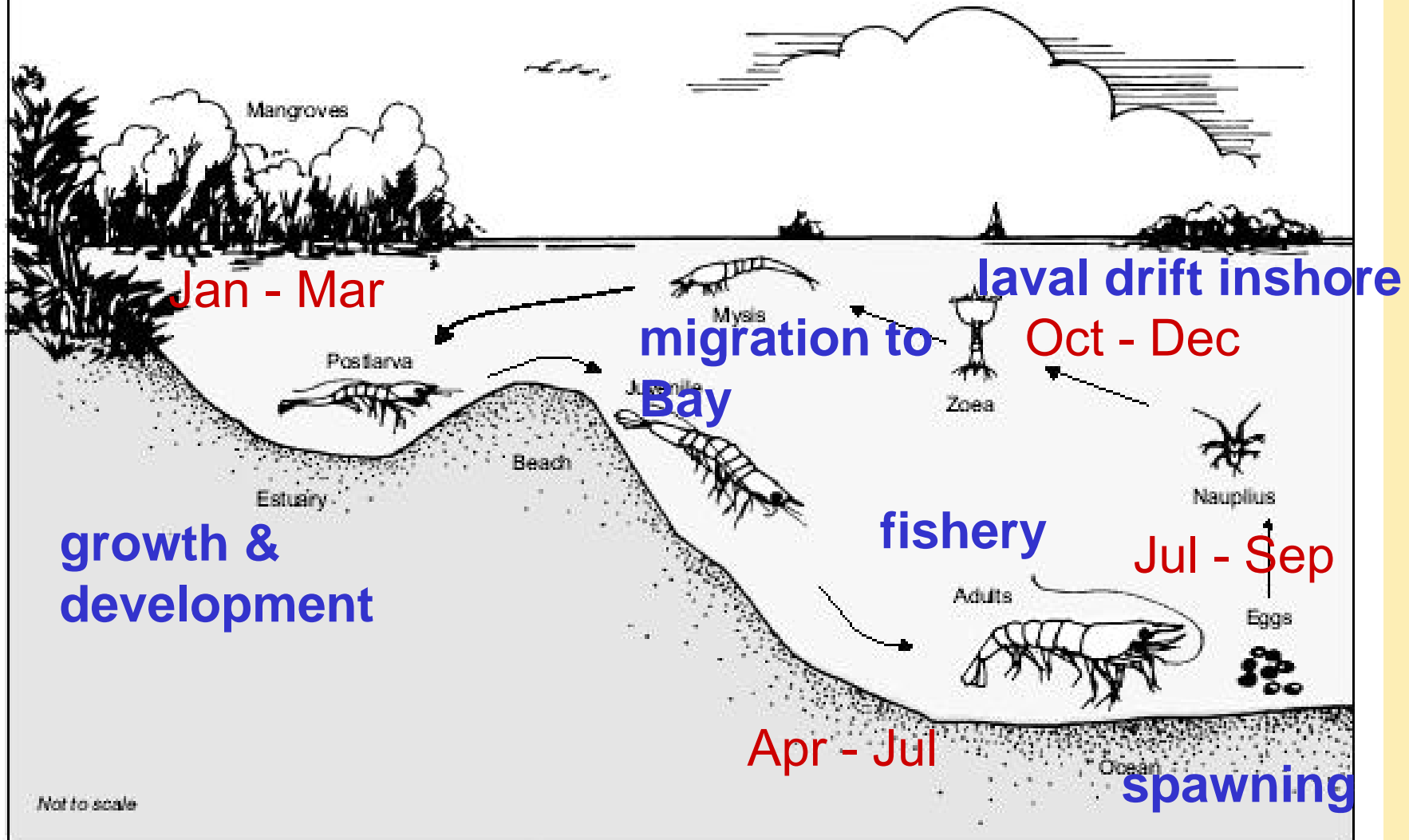


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- Significance of circulation
 - Influence on shrimp
- Conclusions

Significance - shrimp life cycle

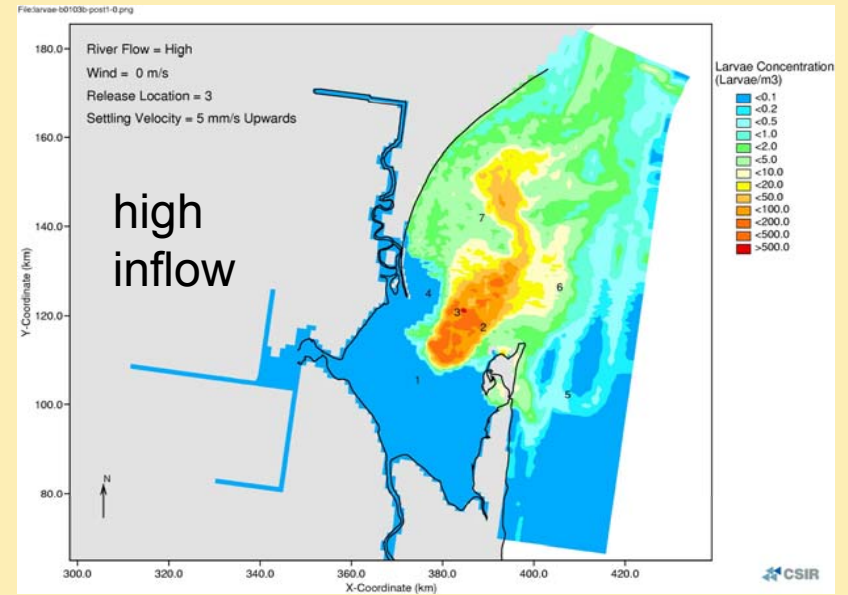
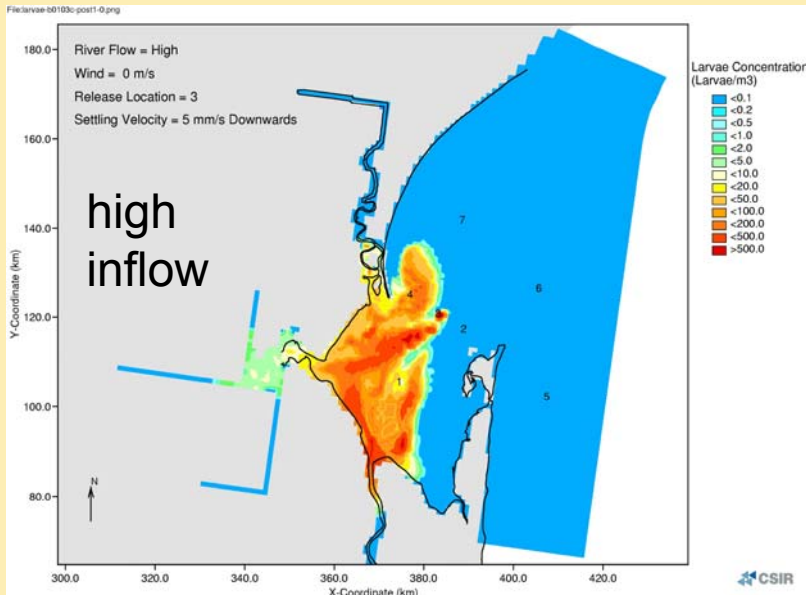
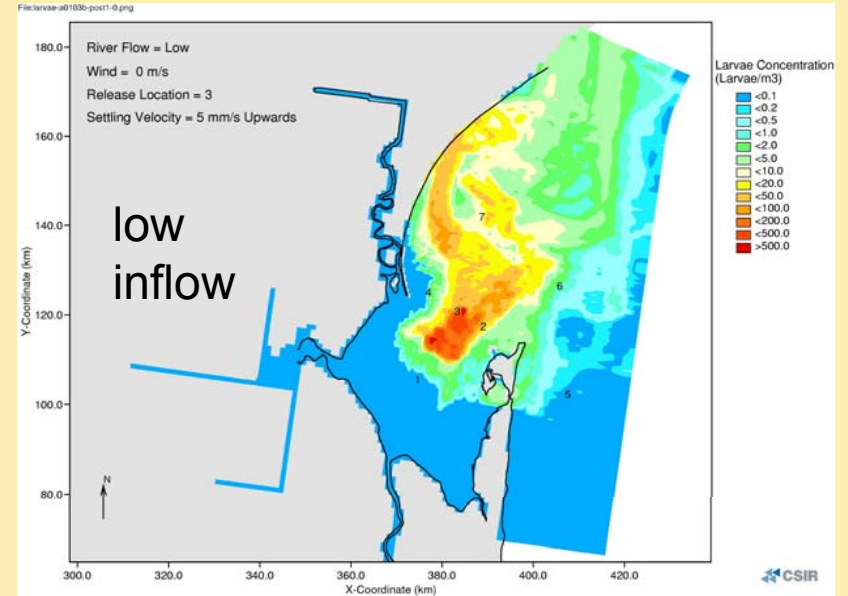
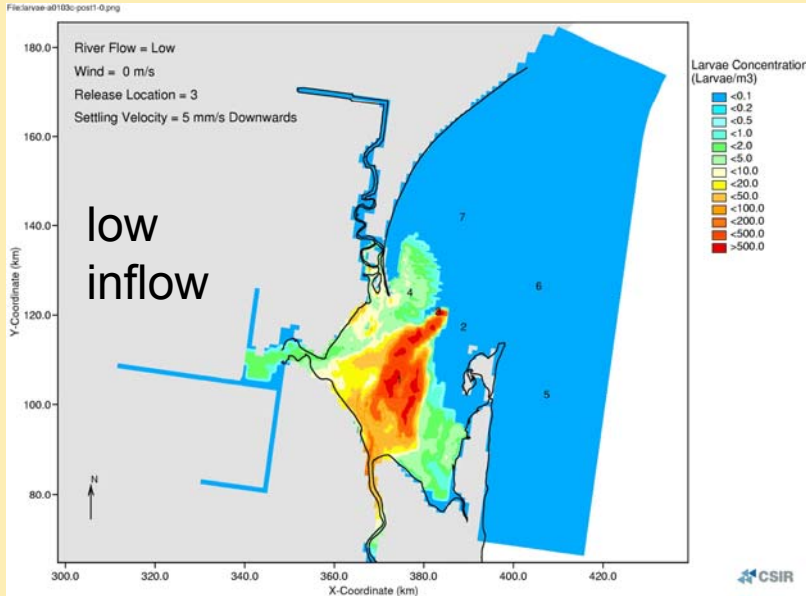
Migration from offshore to the mangrove tends to occur before the wet season (migration - Oct – Dec; wet season - Feb – April)



Significance - shrimp transport

near bed

near surface



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Conclusions

- Circulation controlled by tidal currents, bathymetry and tidal rectification
- Mixing conditions vary over spring/neap cycle
- Fresh water inflow and low tidal stirring (neap tides) leads to stratification that may result in transient density driven circulation
- Significance to shrimp
 - shrimp in estuary before rainy season
 - shrimp transported into bay (bed)
 - shrimp transported out of bay (surface)

