SESSION: OPEN SESSIONS ON COASTAL AND SHELF SEAS

EGU General Assembly

This project is part of the SALTISolutions programme

The importance of interactions between intratidal processes for the evolution of stratification in a dynamic salt wedge estuary

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CONTEXT

The Rhine-Meuse estuary (RME)

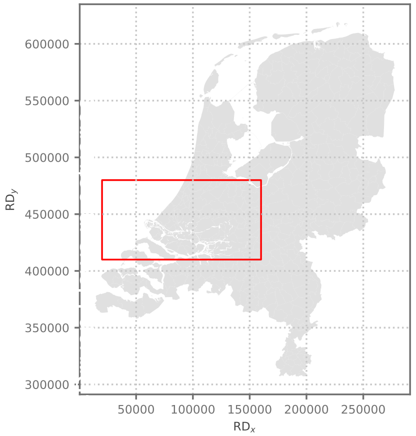


Fig. 2: Overview of The Netherlands and the location of the Rhine-Meuse estuary.

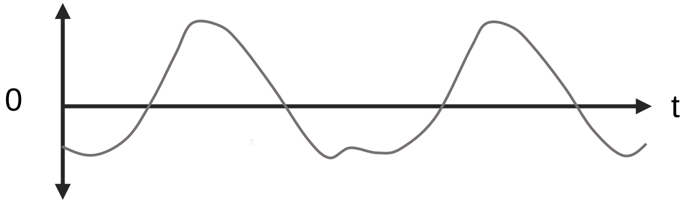


Fig. 3: Overview of the tidal signal at the mouth of the Rhine-Meuse estuary. The tidal signal is asymmetric because the tidal wave is deformed as it travels through the North Sea basin due to the basin's geometry.

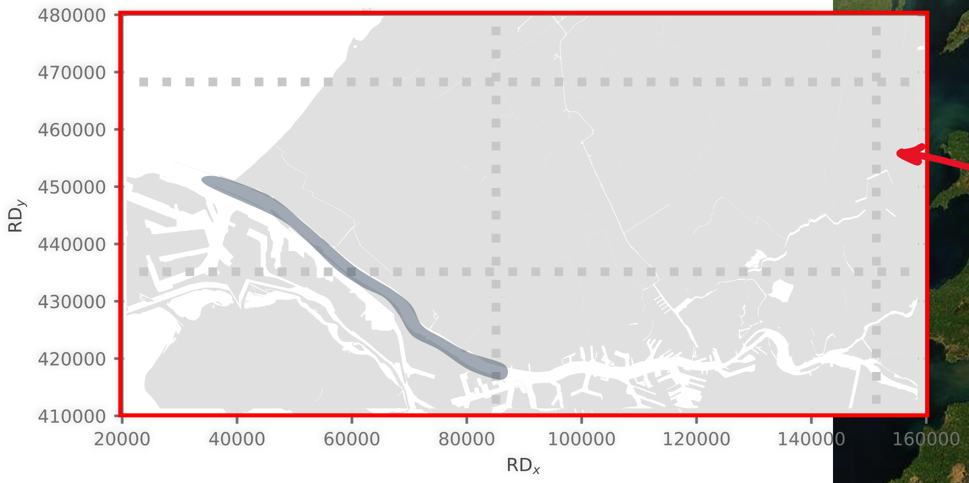


Fig. 4: Map view of The Rhine-Meuse estuary.

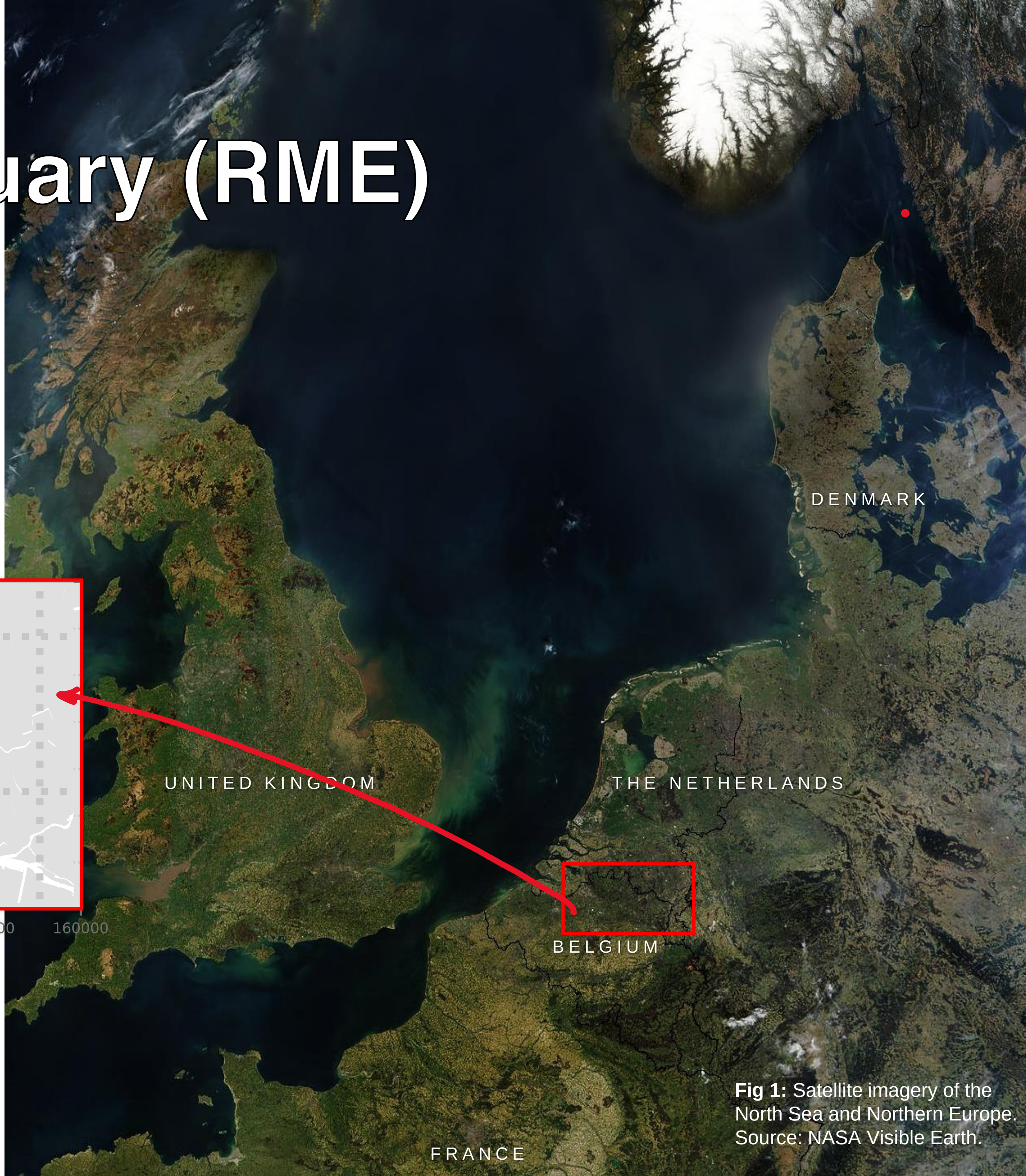
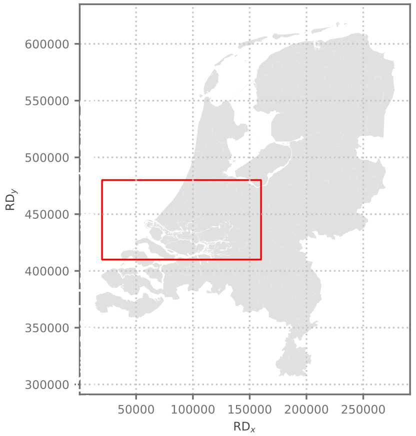


Fig 1: Satellite imagery of the North Sea and Northern Europe. Source: NASA Visible Earth.

The Rhine-Meuse estuary (RME)



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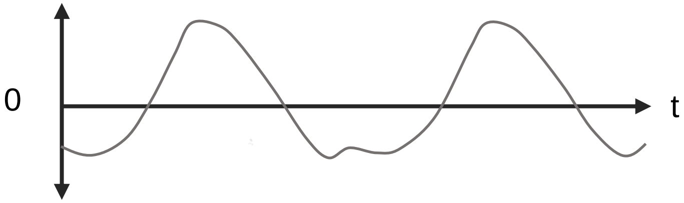


Fig. 3: Overview of the tidal signal at the mouth of the Rhine-Meuse estuary. The tidal signal is asymmetric because the tidal wave is deformed as it travels through the North Sea basin due to the basin's geometry.

Main question:

What are the governing processes inside the estuary, and how are these connected to the processes inthe near-field region of the plume?

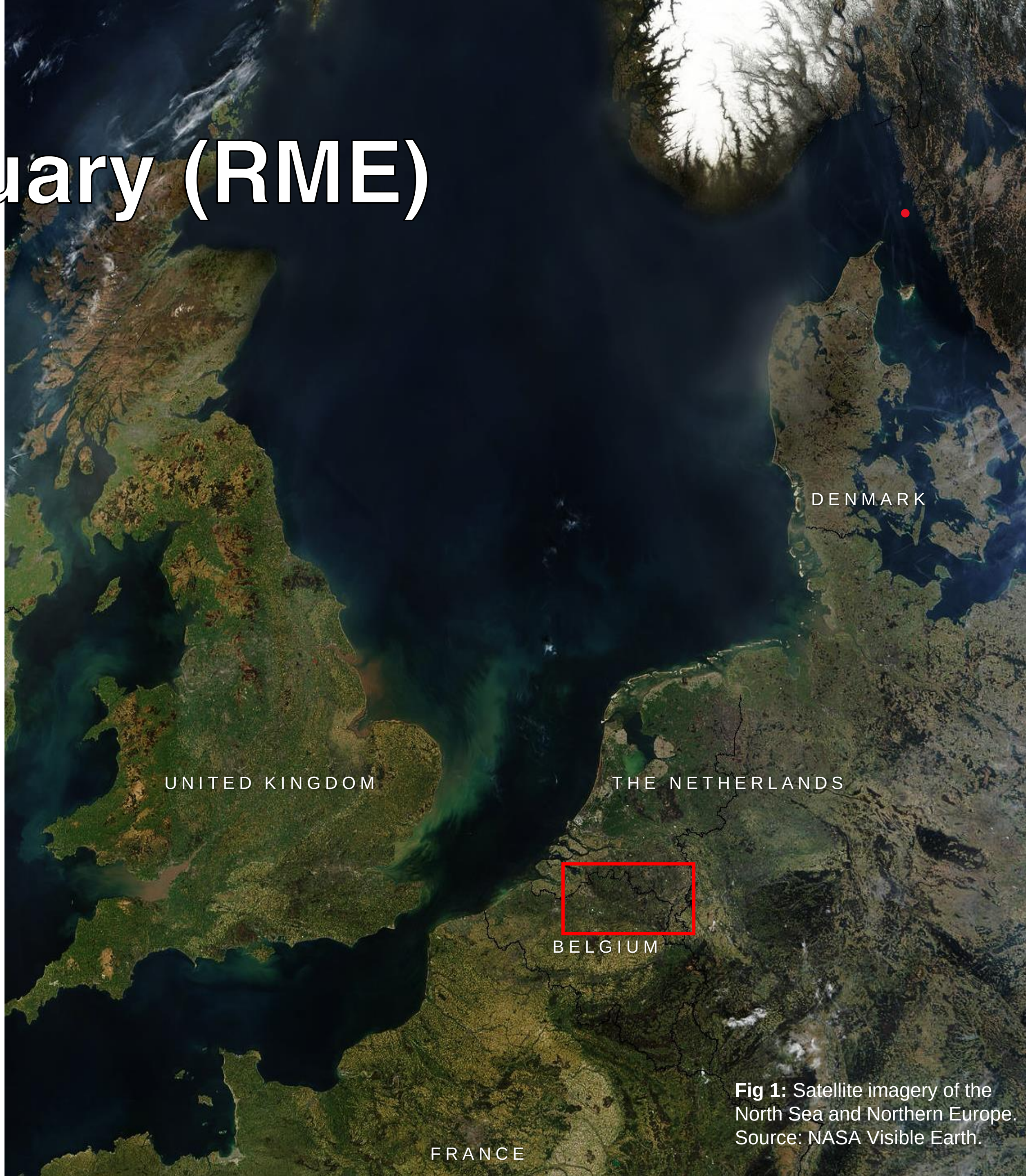


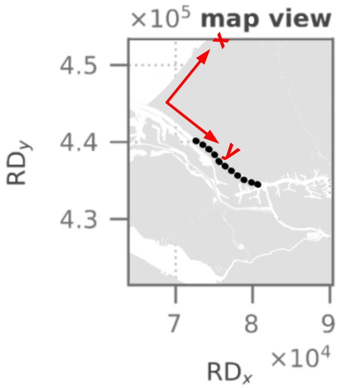
Fig 1: Satellite imagery of the North Sea and Northern Europe. Source: NASA Visible Earth.

Measurement surveys and analysis

- CTD and ADCP measurements:
  - Inside the estuary (Rotterdam Waterway) on 13th of August, 2019;
  - Outside of the estuary, at Monster

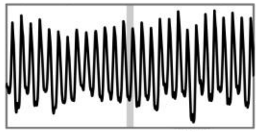
Fig. 5: Processed sentinel 6 imagery showing the Rotterdam Waterway and urbanised area. Photo credit: ESA/NASA - SOHO/LASCO.

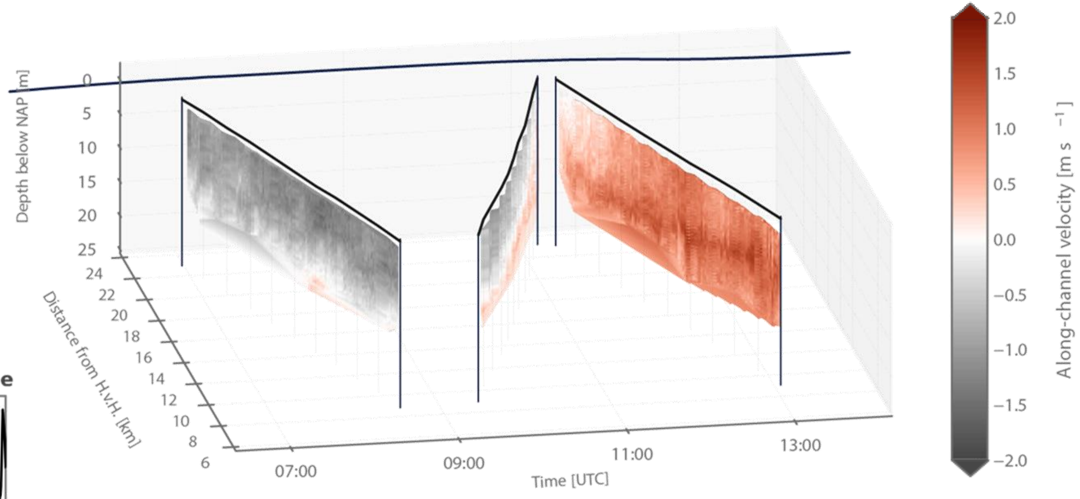
Along-channel velocity structure



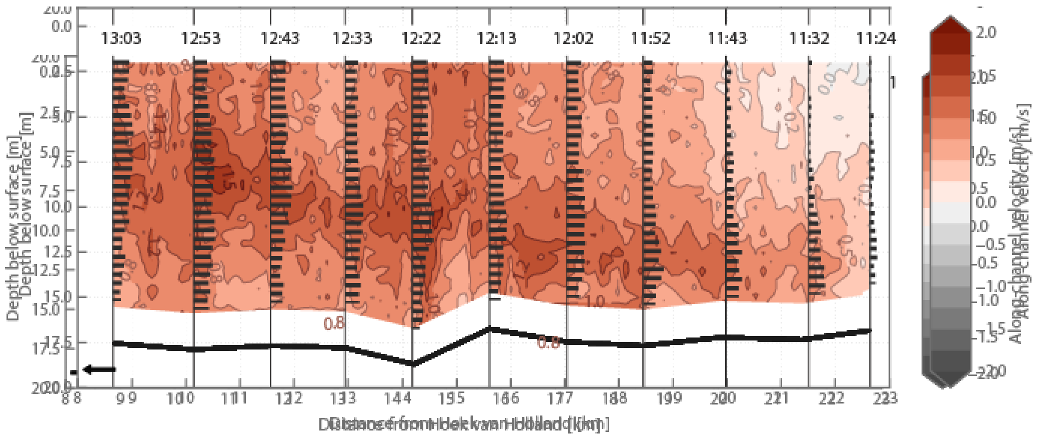
Visible effects:

- Influence of **barotropic tidal asymmetry** and **baroclinic exchange flows;**
  - Second transect shows flood starting in lower part water column while upper part is still ebbing;





- Influence of **turbulence damping**;
  - Formation of mid-depth jets as a result of baroclinic driving force and turbulence damping at pycnocline.



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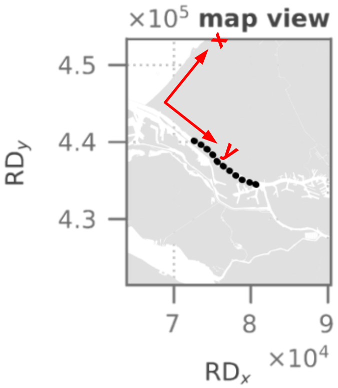
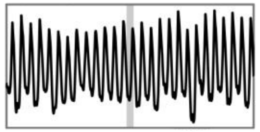
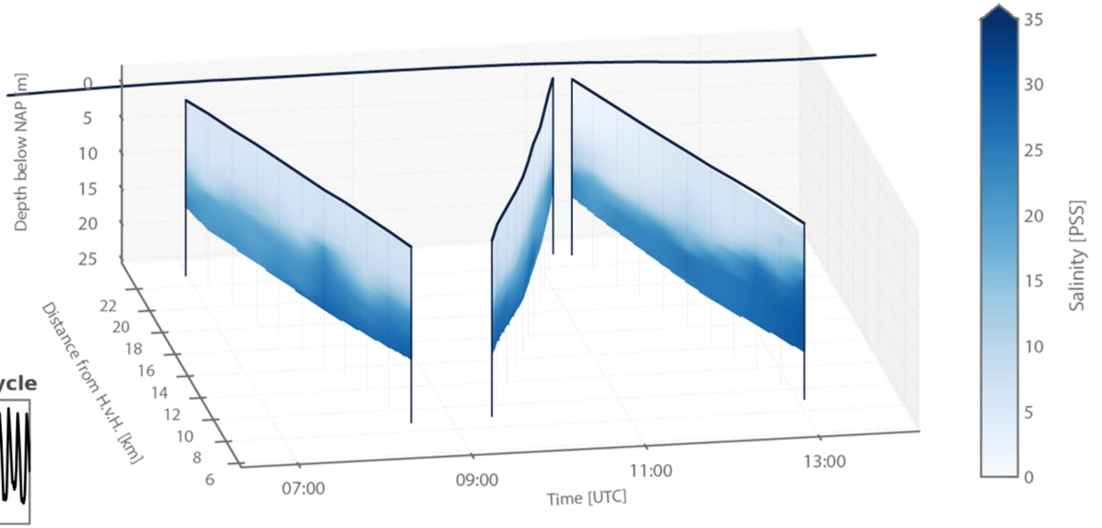
Salinity structure

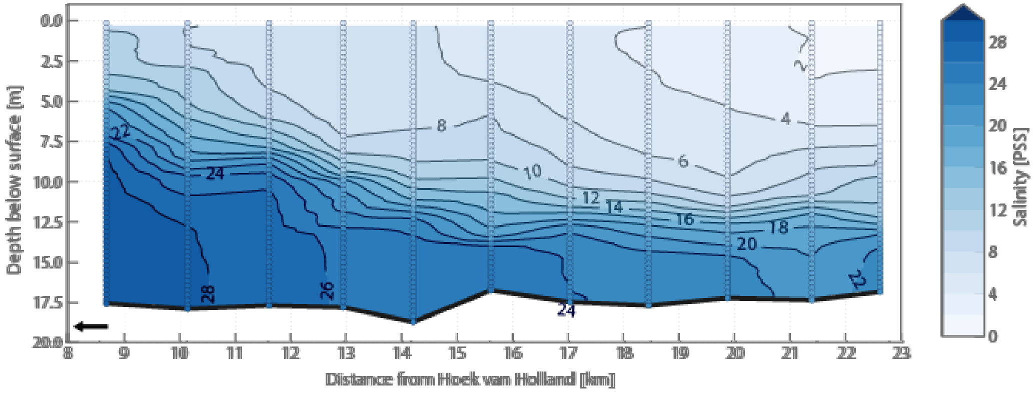


Visible effects:

- Stable pycnocline over course of survey;
- Influence of **baroclinic exchange flow** processes;
  - “Stronger” pycnocline during second transect as result of flattening of isohalines.







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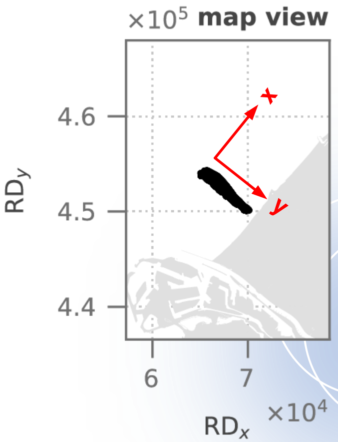
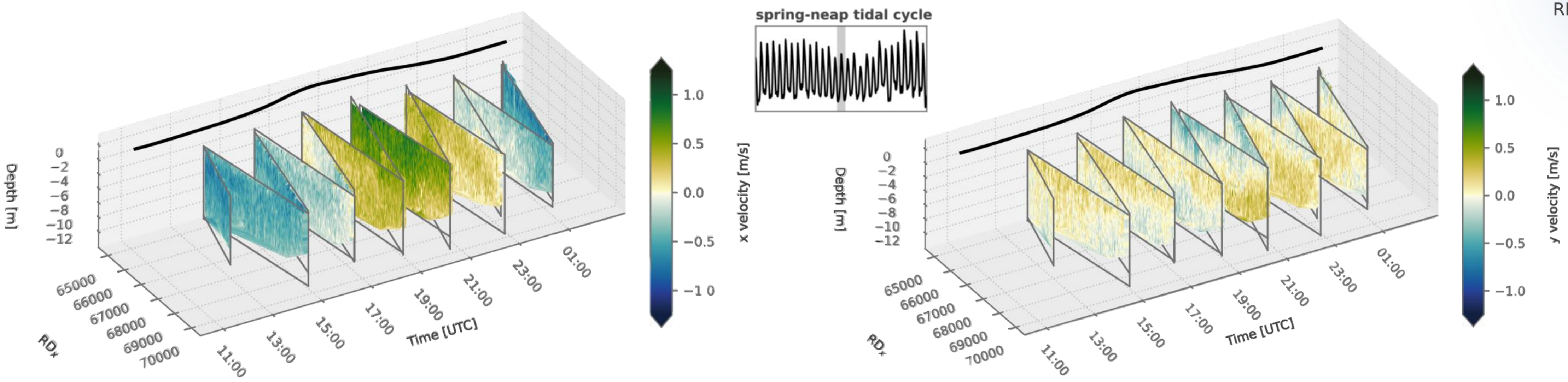
Alongshore and cross-shore velocity structure





Visible effects:

- Larger velocities in upper part of the water column than in the lower part of the water column.

Visible effects:

- Opposite directed velocities in upper part of the water column compared to the lower part of the water column.

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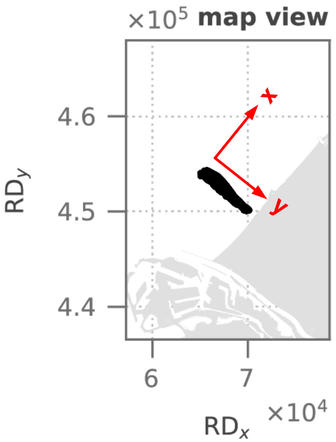
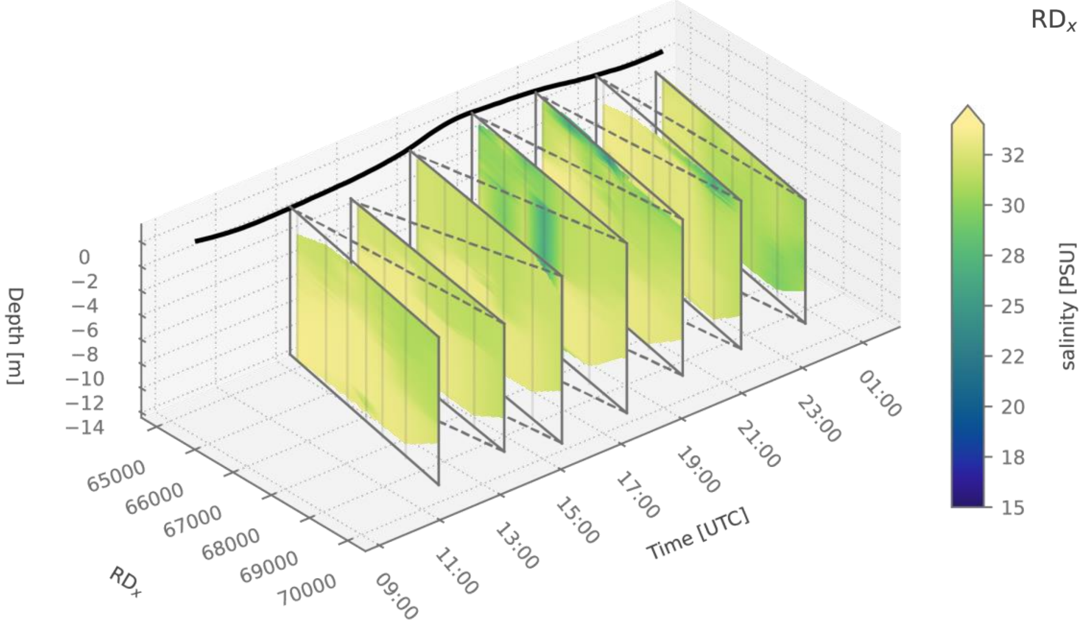
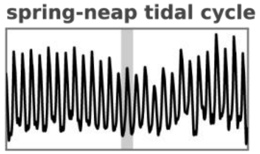
Salinity structure

Visible effects:

- Front first passes around flood tide;
- Front propagates alongshore, front seems to get thinner;
- Final transect seems more saline and well-mixed.







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Conclusions

1. The interaction of the baroclinic pressure gradient with turbulence damping at the pycnocline leads to mid-depth jets, which are important for the evolution of stratification;
2. Barotropic and baroclinic forcing are governing, although advection also plays a key role in the evolution of stratification.

Next steps

1. What's the connection between near-field plume dynamics and forcing on salt intrusion in a salt wedge estuary?
2. Can we quantify this?

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References

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