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Tidal dynamics at junctions in the Rhine-Meuse river delta network

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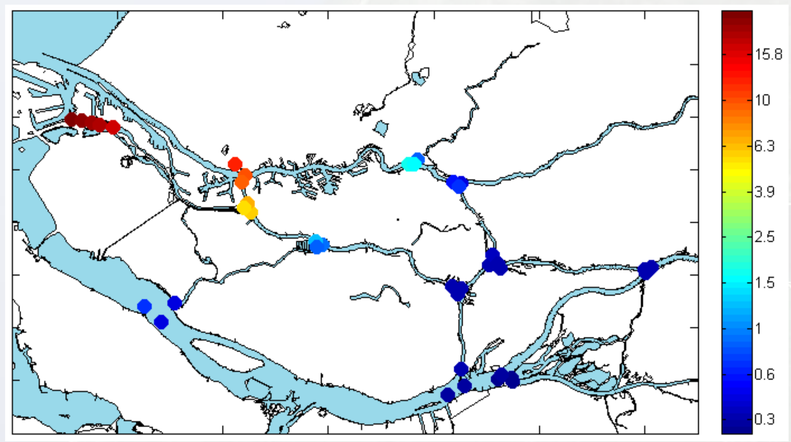
Tidal flow and junctions

At river junctions, morphology has a profound influence on the distribution of water over the different branches. Tidal and salinity influences from downstream can alter this distribution significantly. A dataset of 13-hour flow and salinity measurements at 12 different junctions, varying from strongly saline to fully fresh and from strong to weak tides, can provide insight in the influence and relative importance of morphology, tides and salinity

Aim: to understand flow dynamics at river junctions, and the influence of salinity and tides on the flow.



Salinity

Salinity measurements show a steep salt front. The combination of flow and salinity data can show how both salt- and freshwater is distributed over tidal junctions.

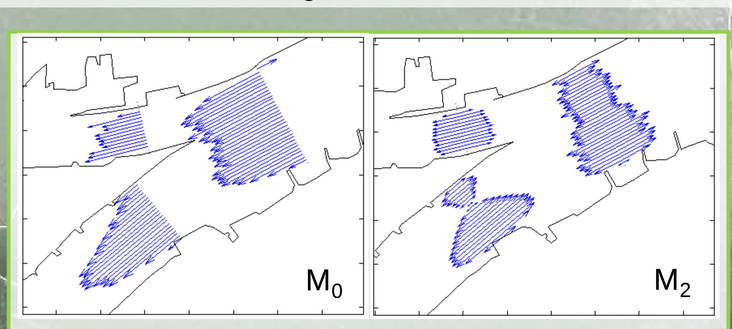
Average salinity quickly decreases with distance from sea, but surface/bed differences are large.

Tidal effects and stratification

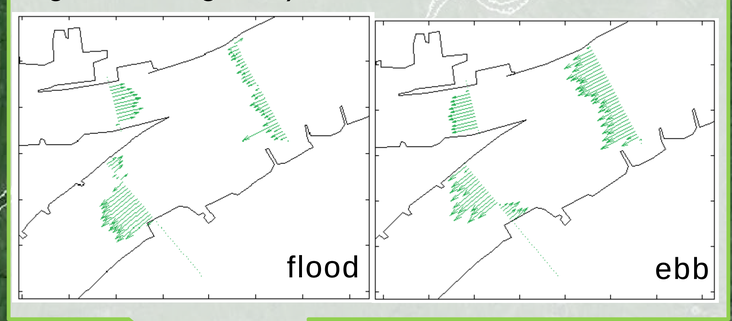
ADCP-measurements are translated to a mean flow velocity (M_0), diurnal (M_2), quarterdiurnal (M_4) and sixth-diurnal (M_6) tidal amplitude and phase.

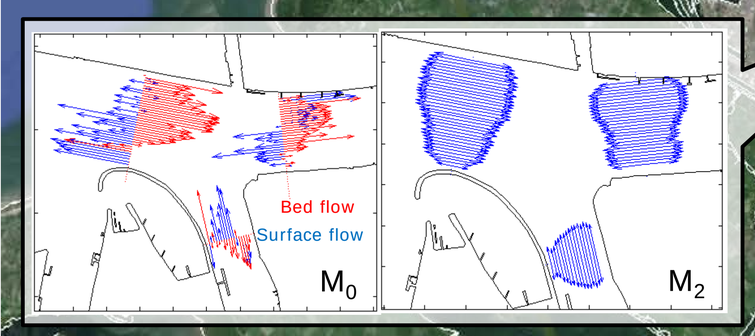
Flow structure strongly depends on distance from sea. Close by sea flow is vertically stratified. More inland, flow differs strongly over width.

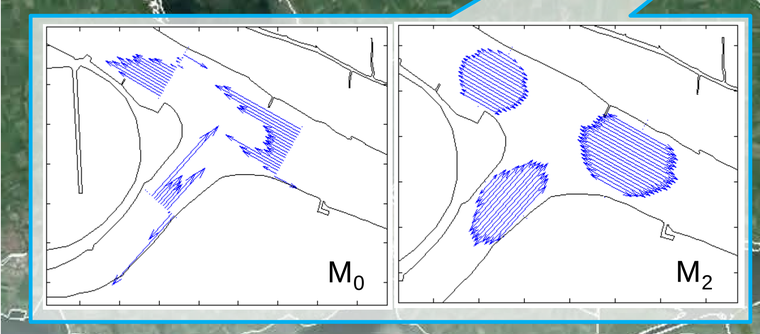
Upstream, important phase differences occur, such as near the Merwede-junction (most inland, green circle). Phase differences here cause ‘ inverse’ flow (e.g. seaward at flood), reversal of flow over the channel width and a strong net round flow.

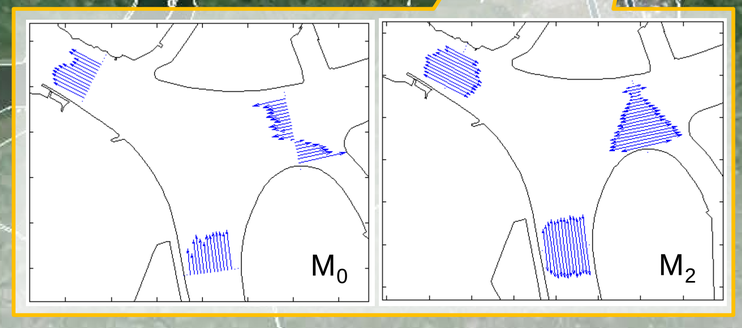


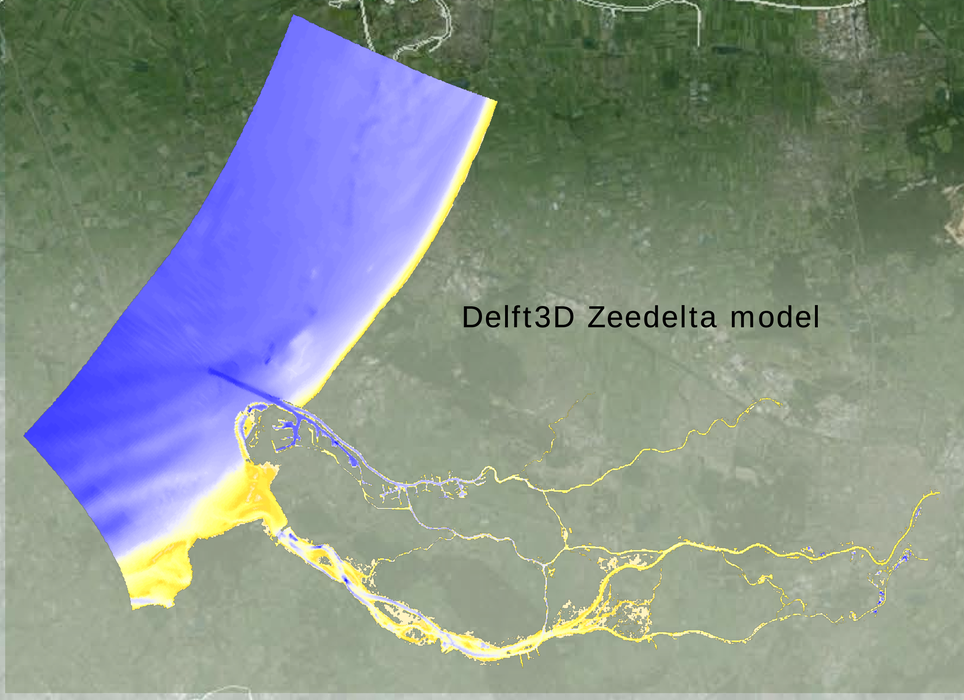
Mean flow (top left) and semidiurnal tidal flow (top right) do not show phase differences, net round flow and bidirectional flow (bottom left: during flood, bottom right: during ebb).











Next step: models

Modelling is used to gain fundamental insight in the discharge distribution and the role of salinity and tides. For the Rhine-Meuse tidal network, the Delft3D Zeedelta model is used for detailed analysis of flow and salinity intrusion.

Conclusion: vertical stratification and horizontal shear strongly differs between junctions.

Flow at tidal junctions varies from vertically stratified nearby sea to horizontally sheared at riverine junctions. Near sea, phase differences over depth are large, while upstream, phase differences within junctions and over the width of cross sections increase.