

# A strategy for calibrating the roughness of tidal flats and tidal marches in a 3D tidal model for the Scheldt estuary



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# Introduction





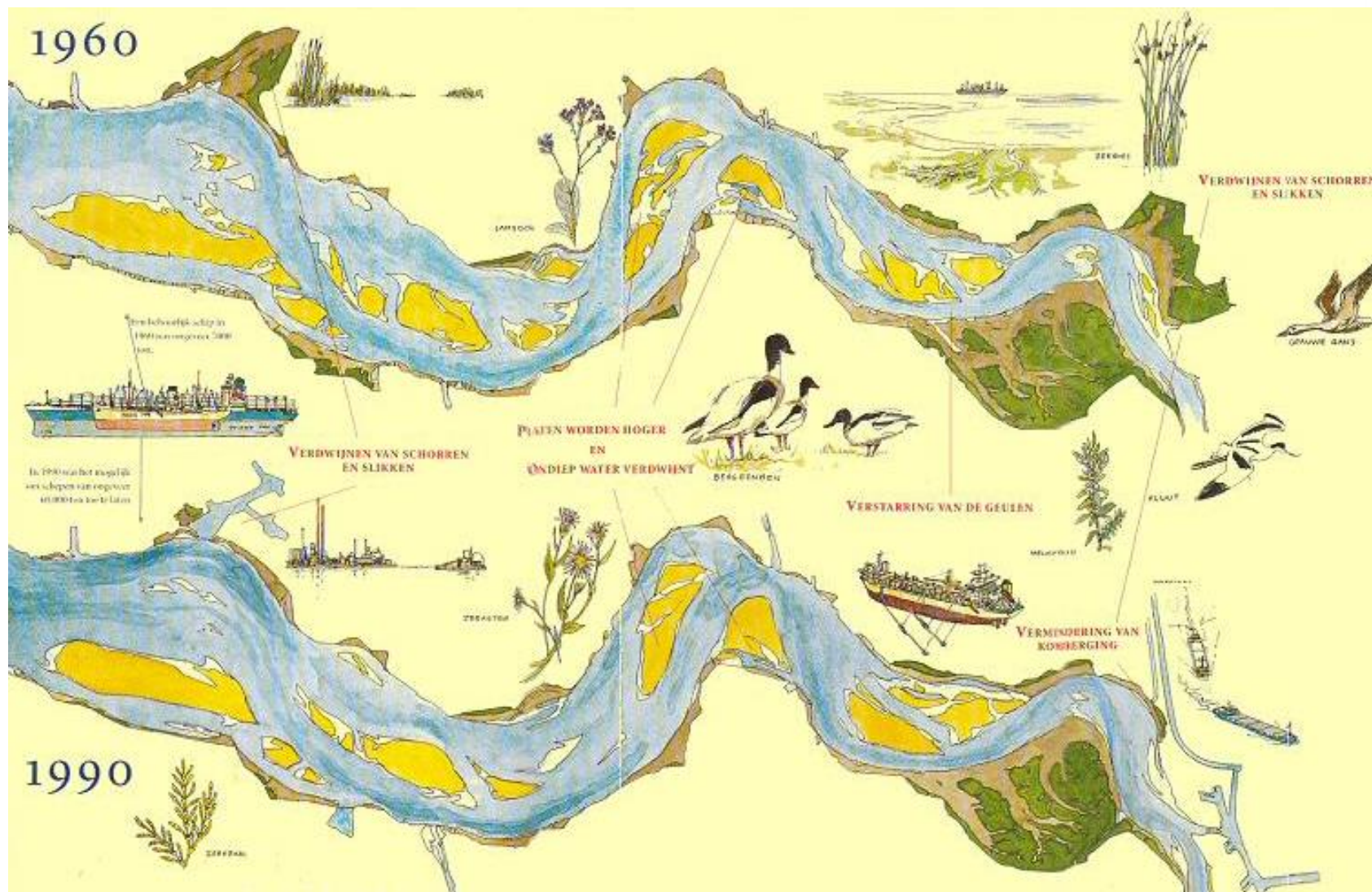
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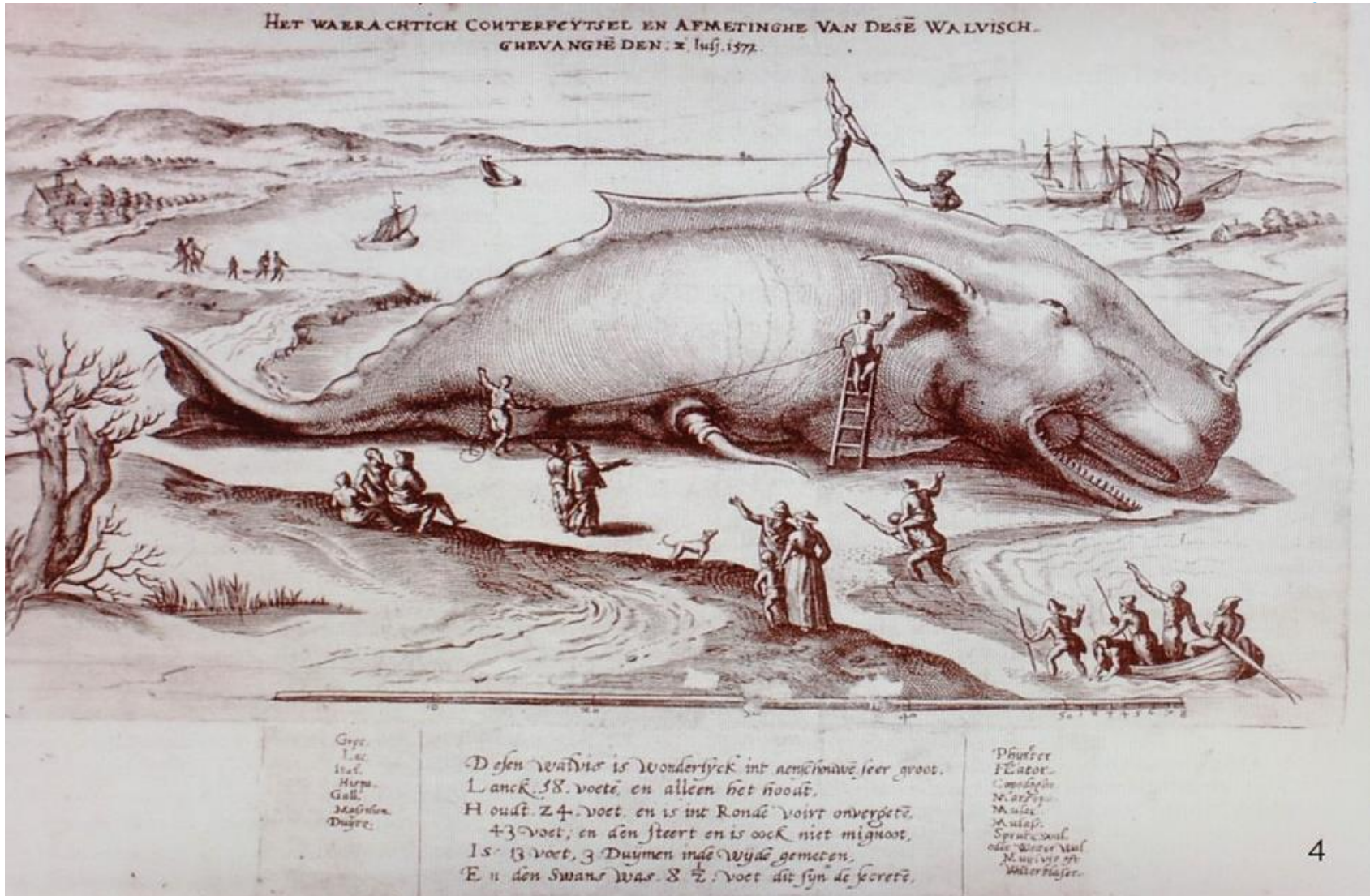


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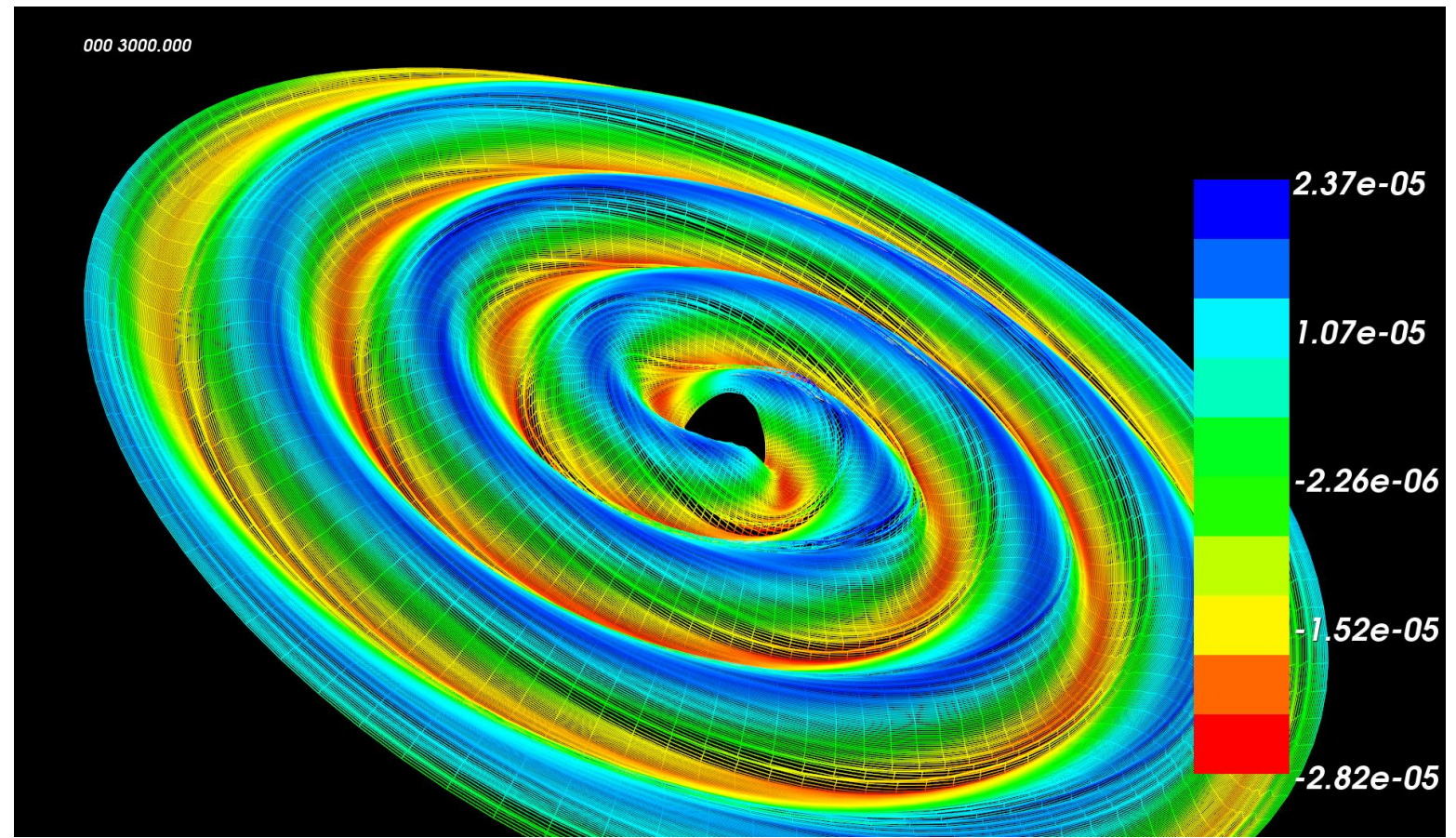






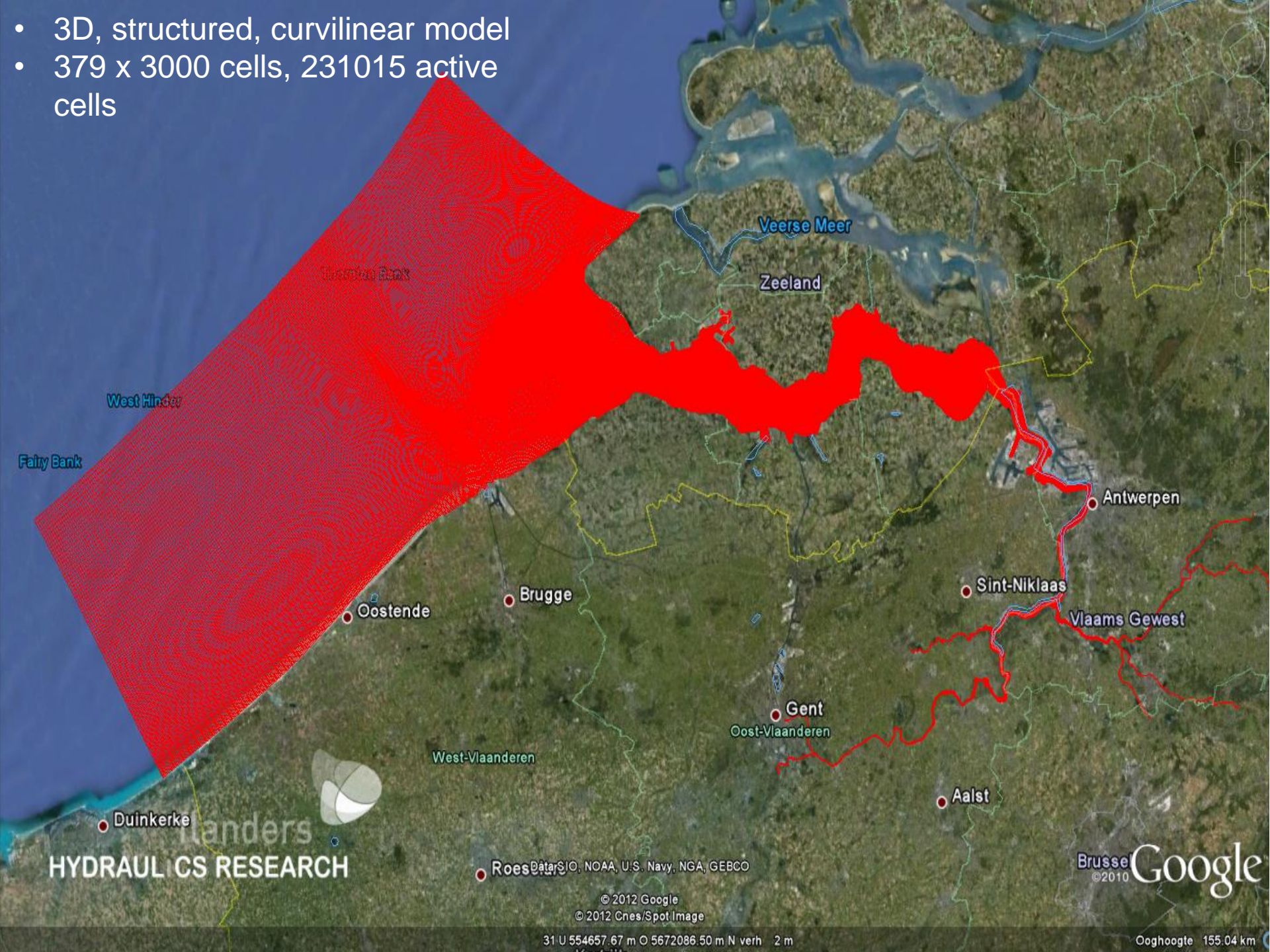


# The NEVLA model

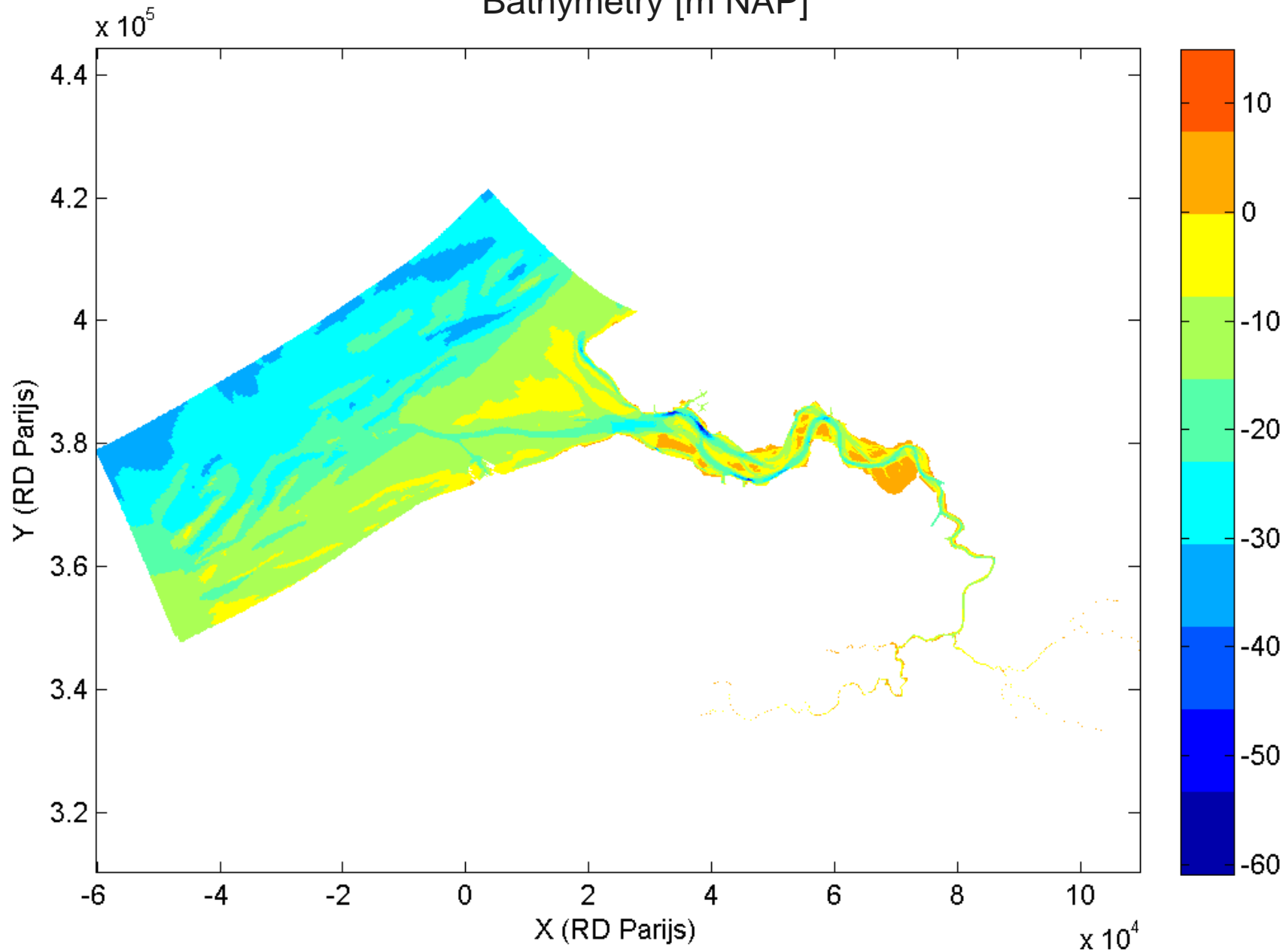




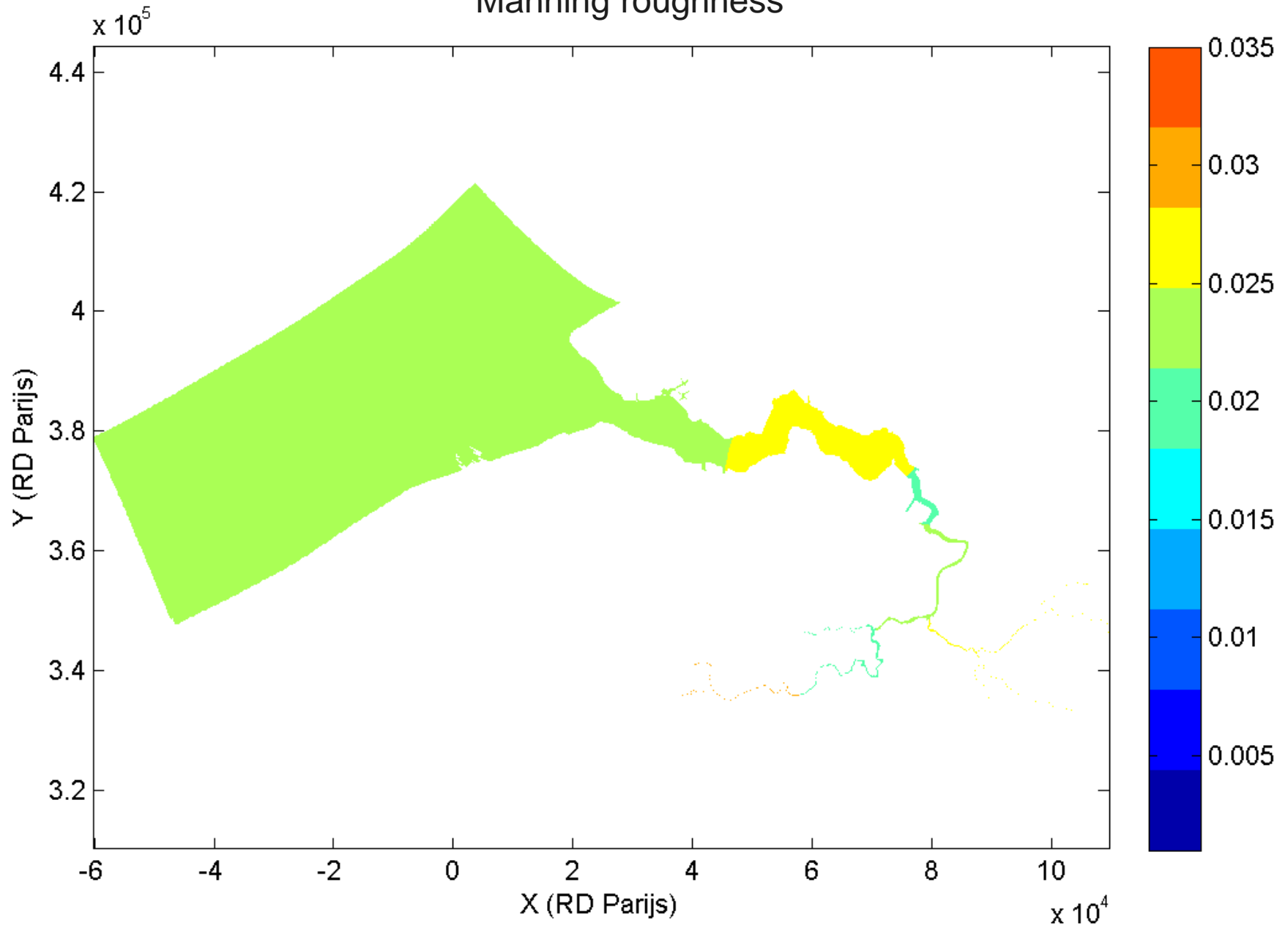
- 3D, structured, curvilinear model
- 379 x 3000 cells, 231015 active cells



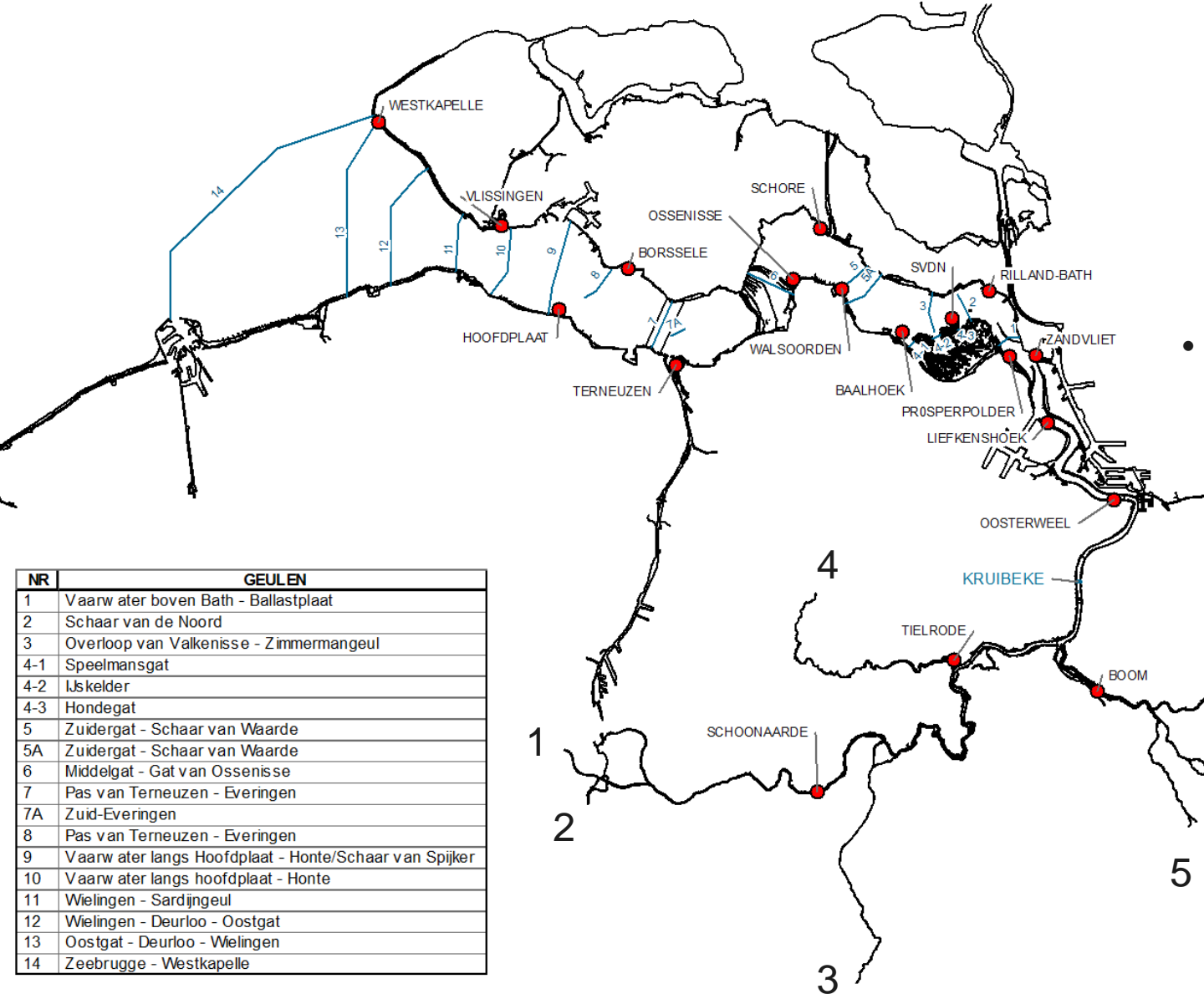
# Bathymetry [m NAP]



# Manning roughness

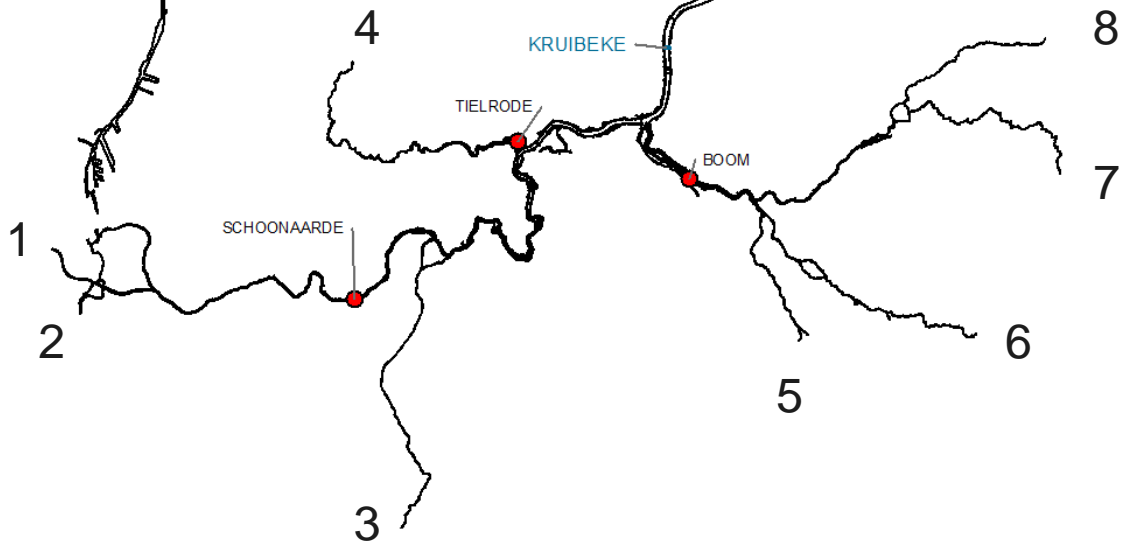


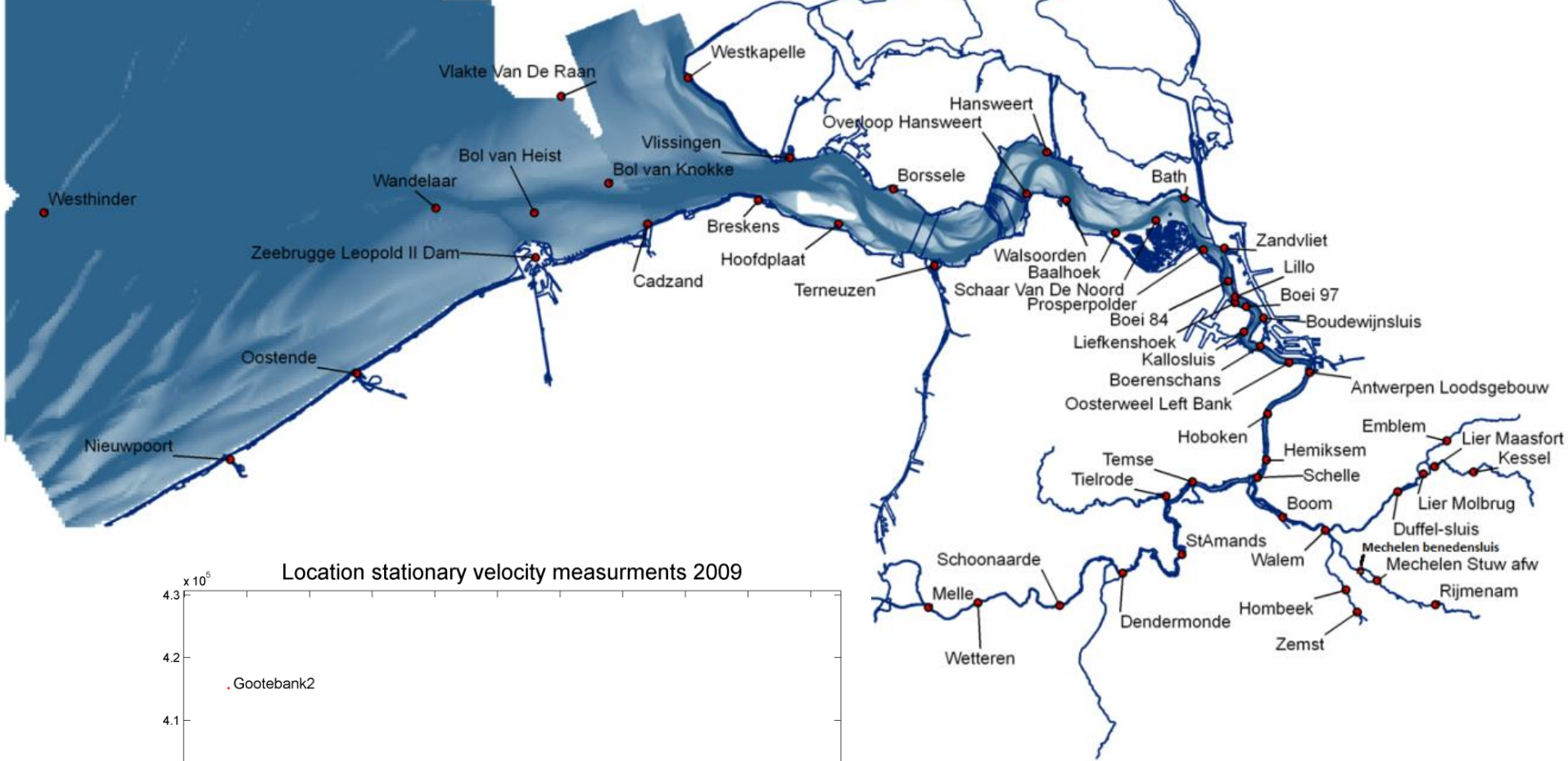
# Upstream boundaries: C(urrent)R(iemann)Current extracted from the ZUNO model (Zuidelijke Noordzee)



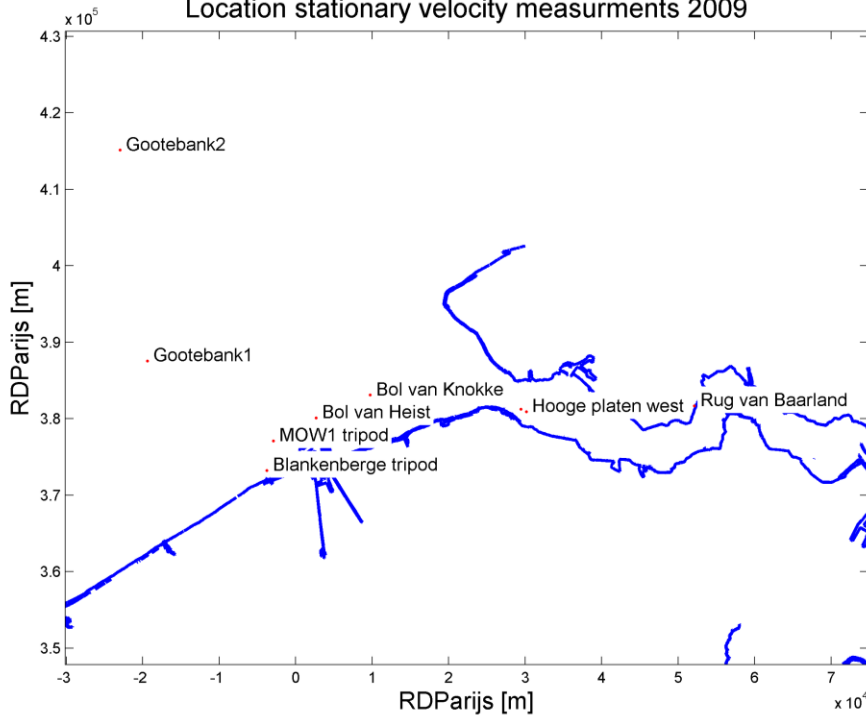
- 8 upstream discharge boundaries (daily averaged discharge measurement series)

NR	GEULEN
1	Vaarwater boven Bath - Ballastplaat
2	Schaar van de Noord
3	Overloop van Valkenisse - Zimmermangeul
4-1	Speelmansgat
4-2	IJskelder
4-3	Hondegat
5	Zuidergat - Schaar van Waarde
5A	Zuidergat - Schaar van Waarde
6	Middelgat - Gat van Ossenissee
7	Pas van Terneuzen - Everingen
7A	Zuid-Everingen
8	Pas van Terneuzen - Everingen
9	Vaarwater langs Hoofdplaat - Honte/Schaar van Spijker
10	Vaarwater langs hoofdplaat - Honte
11	Wielingen - Sardingeul
12	Wielingen - Deurloo - Oostgat
13	Oostgat - Deurloo - Wielingen
14	Zeebrugge - Westkapelle





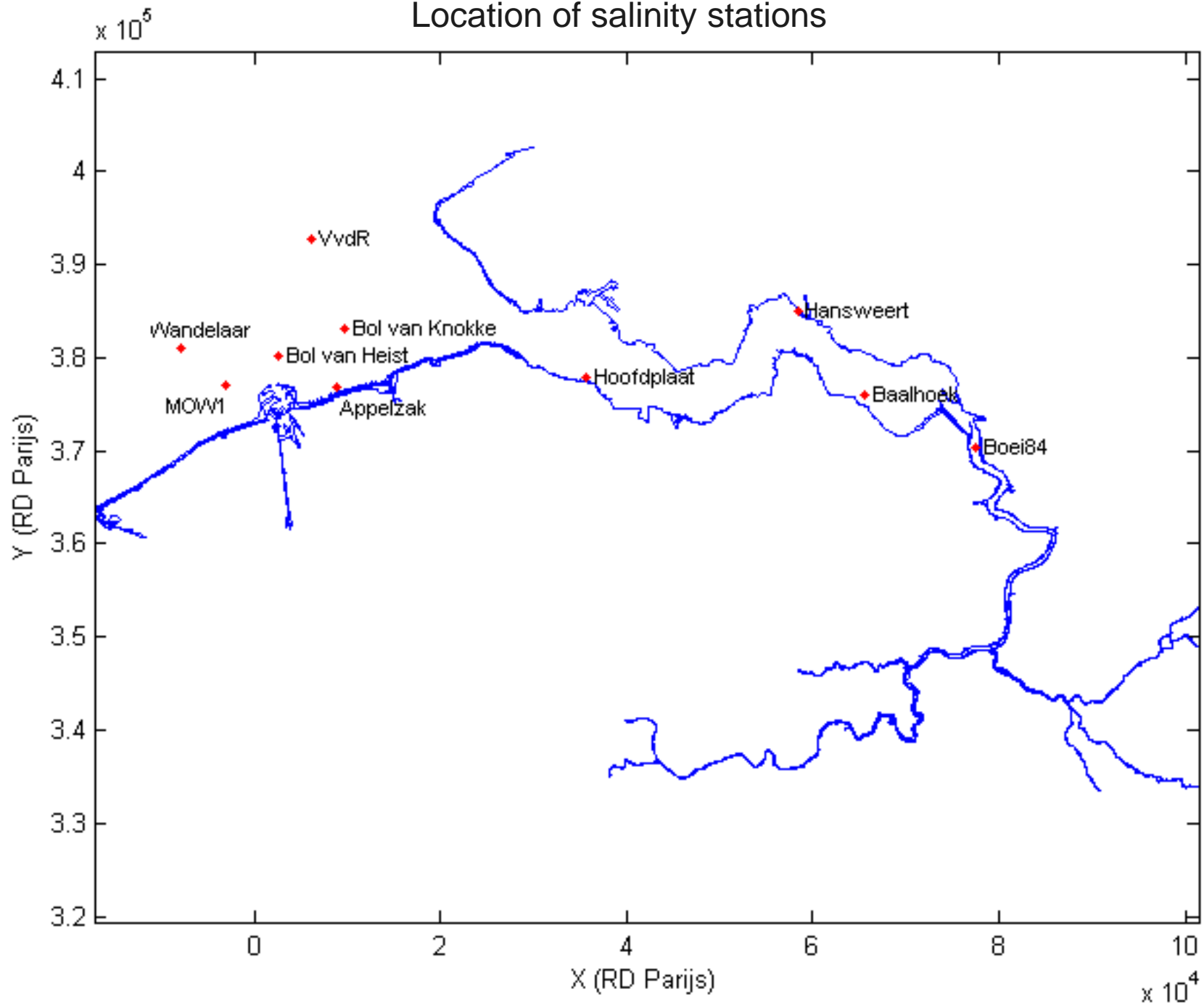
Location stationary velocity measurements 2009



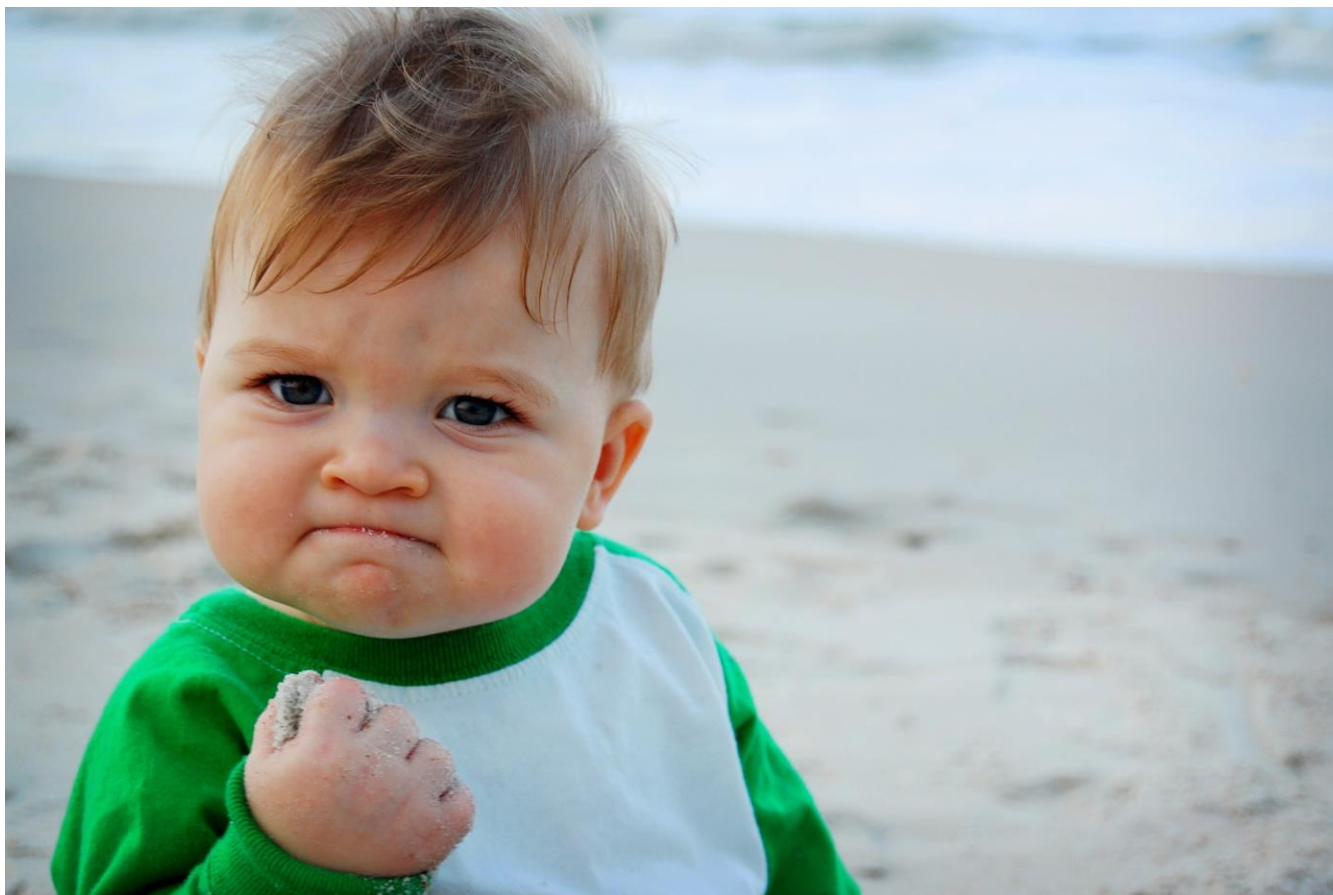
## Measurements

- Water level: 48 stations
- Velocity (2009): 13 datasets in 7 stations
- ADCP discharge data (MONEOS, 13h measurements) in 18 transects
- Salinity in 10 stations

# Location of salinity stations



# Results calibration phase 1

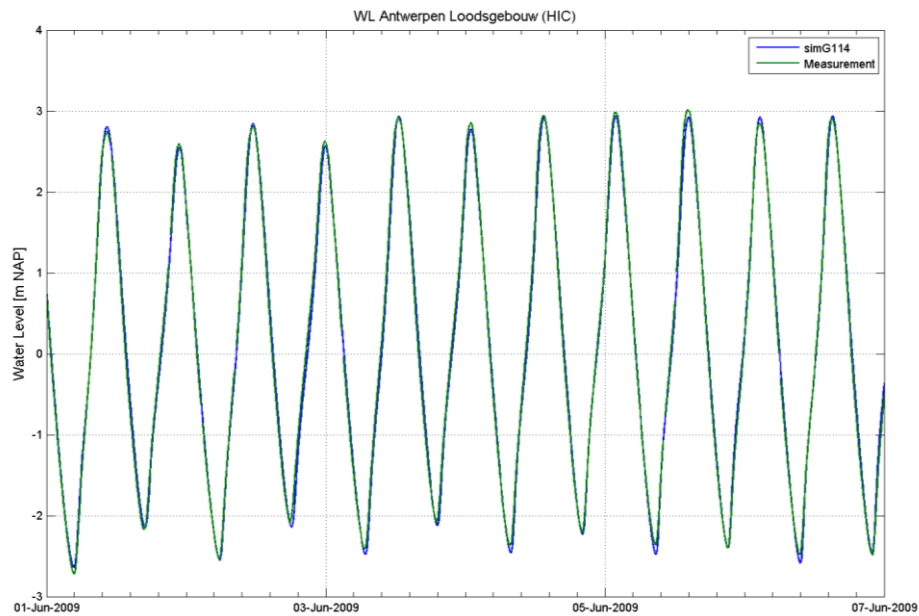




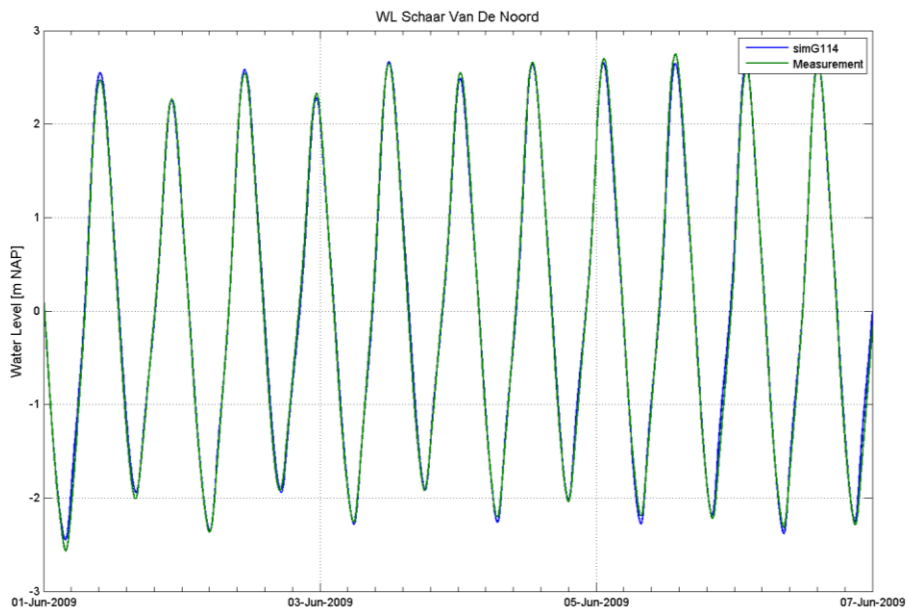
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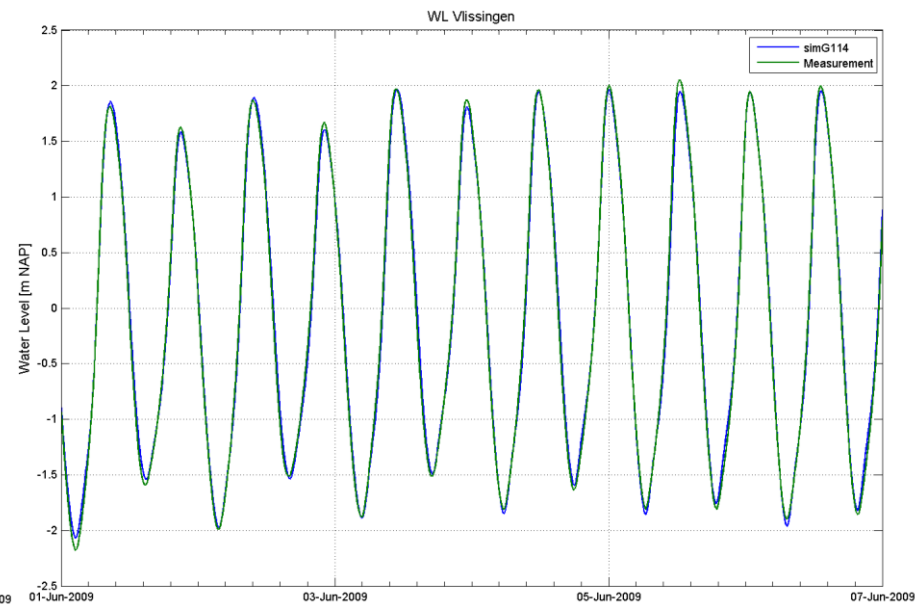
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VIMM version 753\_09\_NEVLA3D  
(c) Waterbouwkundig Laboratorium 2013

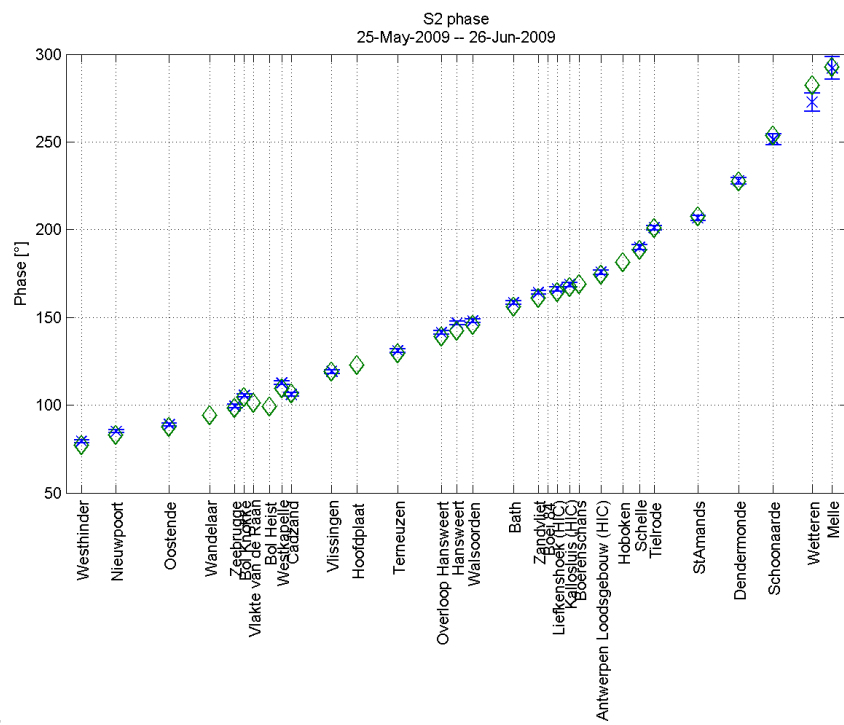
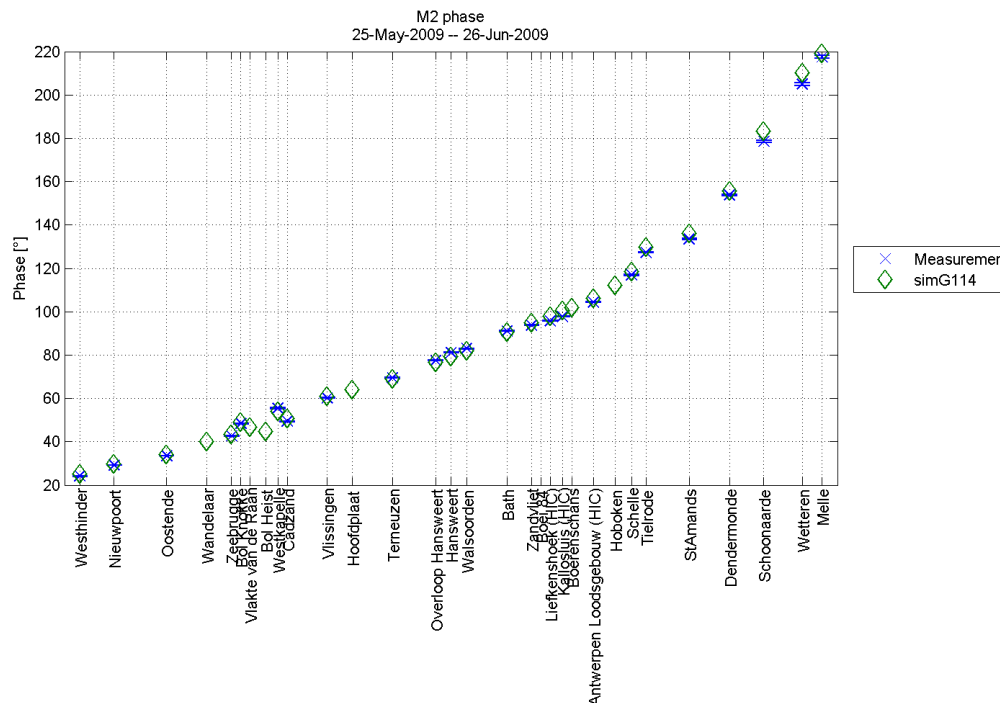
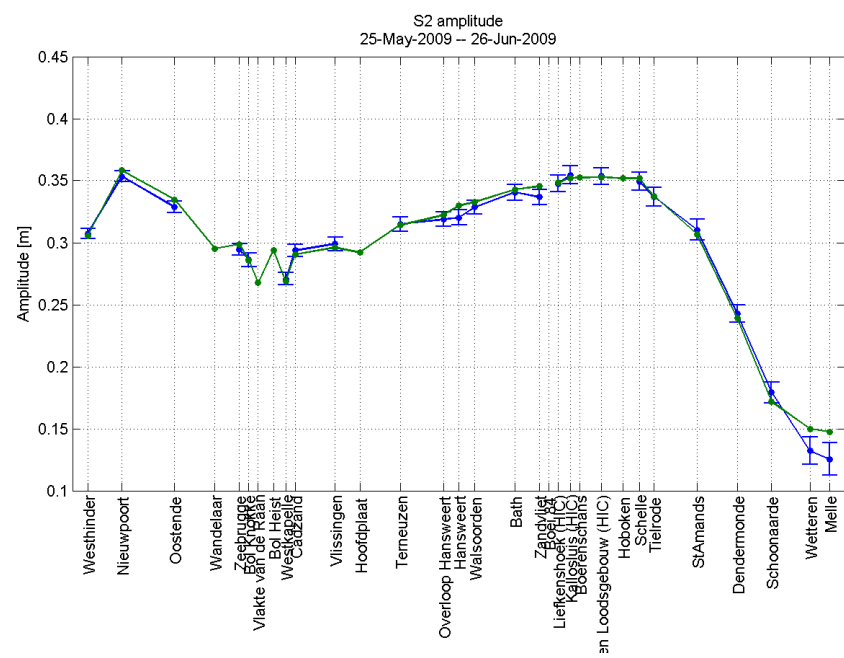
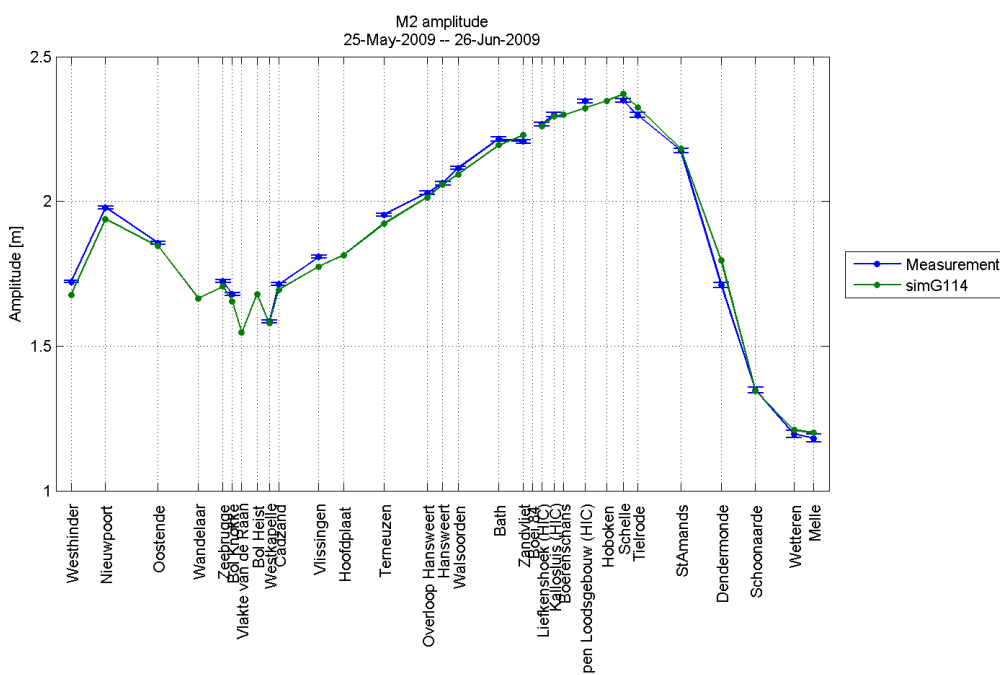


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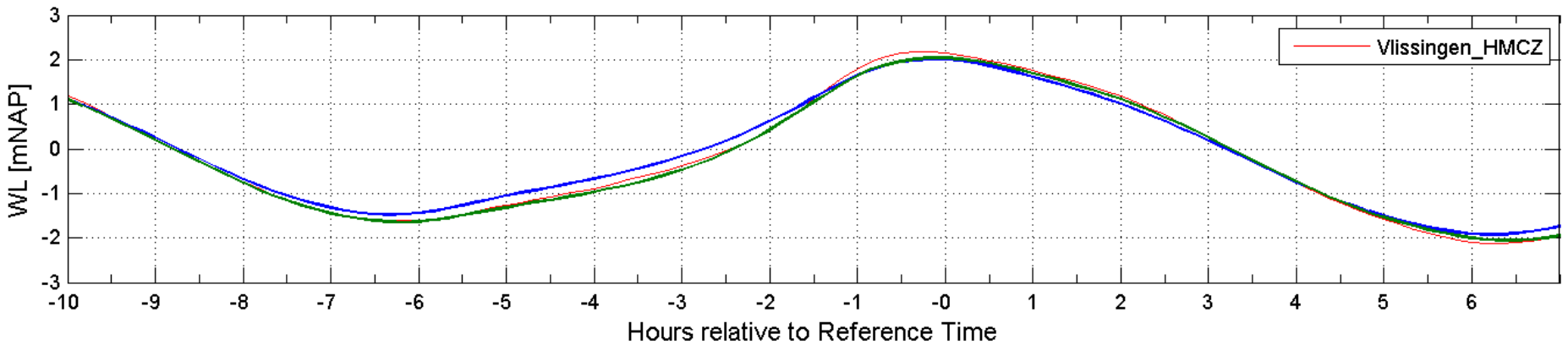
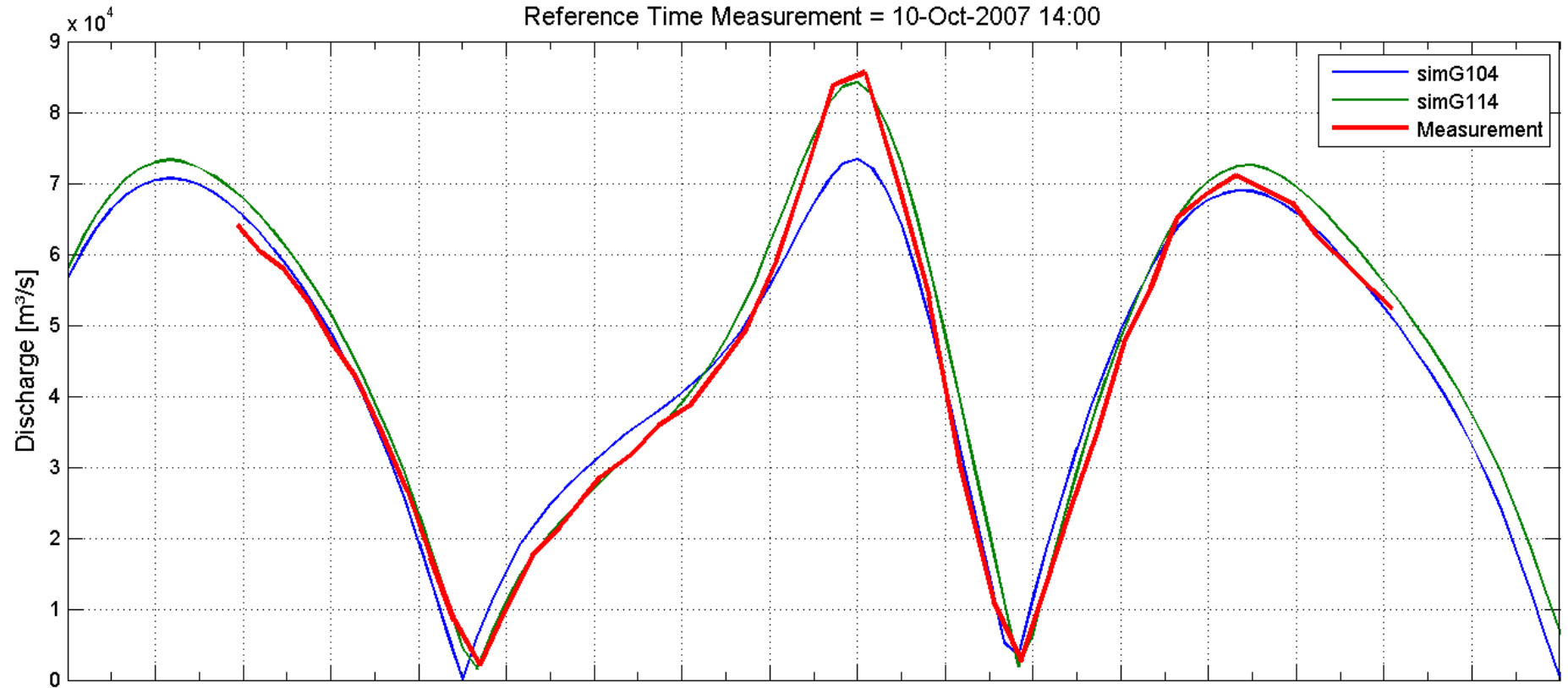


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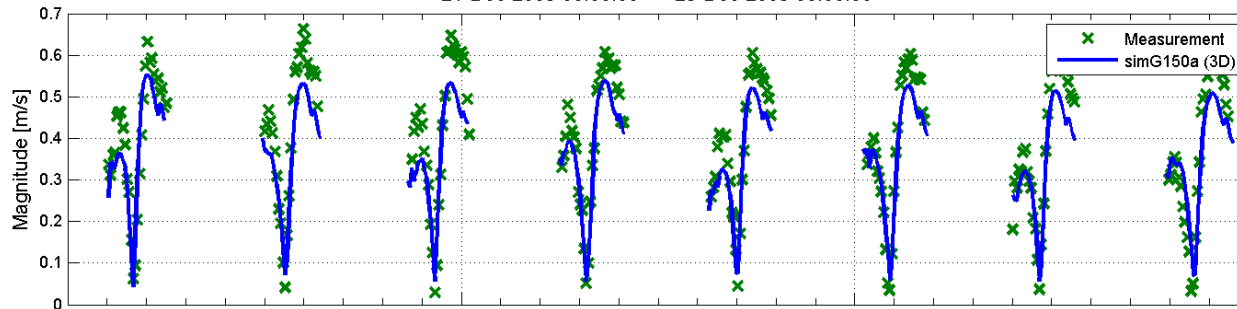




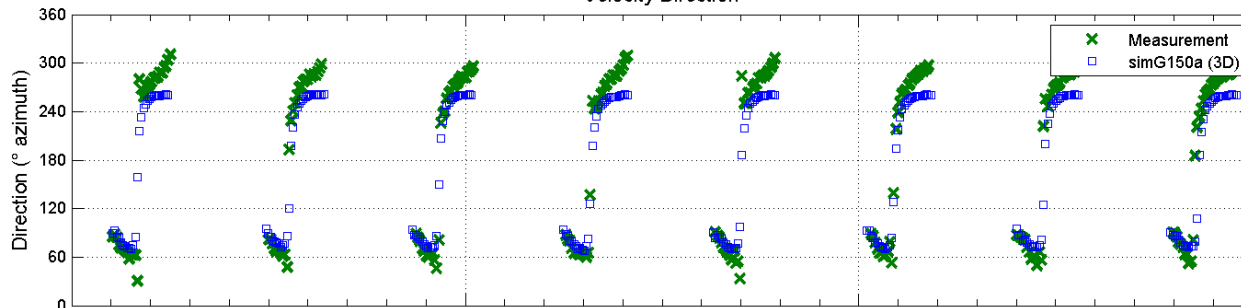
Discharge R10 Honte schaar van spijker plaat  
Reference Time Model = 10-Jun-2009 16:00  
Reference Time Measurement = 10-Oct-2007 14:00



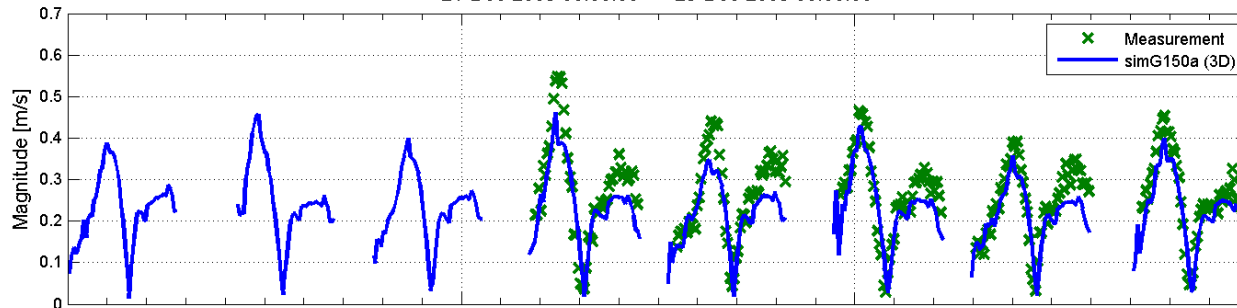
Velocity: RVB0311 2 at 0.60mNAP.  
21-Dec-2009 00:00:00 --> 25-Dec-2009 00:00:00



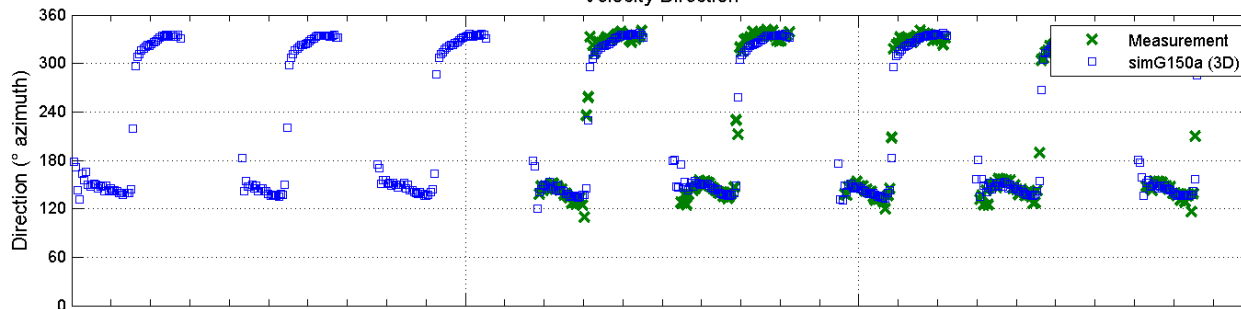
Velocity Direction



Velocity: HPW03 1 at -0.89mNAP.  
21-Dec-2009 00:00:00 --> 25-Dec-2009 00:00:00



Velocity Direction





## Calibration phase 2



## Calibration phase 2

- Goal: Improving the velocity prediction in shallow areas (near tidal marshes and tidal flats)
- Problem: only limited amount of measurement data available on velocity in shallow areas
- Strategy: add roughness correction to calibrated field of phase 1.
  - Calibrate on limited dataset, and deploy in entire estuary

## Roughness correction (1)

- $R=R_1+R_2$
- $R_1$ : Roughness value (manning) at end of phase 1
- $R_2$ : Roughness correction
  - Vegetation
  - Bedforms
  - Sediment type
  - ...

## Roughness correction (2)

- Problem: how to find a roughness correction term that can be deployed over the entire estuary?
- Solution:
  - Combine bathymetry (known) with frequency distribution of HW/LW (calculated) to determine depth classes.

Class	
Sublitoral	< 99,9% LW
Litoral	
Supralitoral	> 5% HW

- Calibrate a roughness correction per depth class

## Methodology

- 1. Focus on classes “litoral”, “sublitoral”, “supralitoral”
- 2. Water level data in 12 year period
- 3. Filter out the HW and LW peaks in all the stations
- 4. Determine water levels that coincide with certain flooding frequencies: sublitoral = 99.9%, supralitoral = 5%
- 5. Interpolate these station values across the grid from downstream to upstream
- 6. Determine litoral, sublitoral and supralitoral zones by comparing bathymetry with WL from step 3
- 7. Appoint roughness correction to these 3 zones





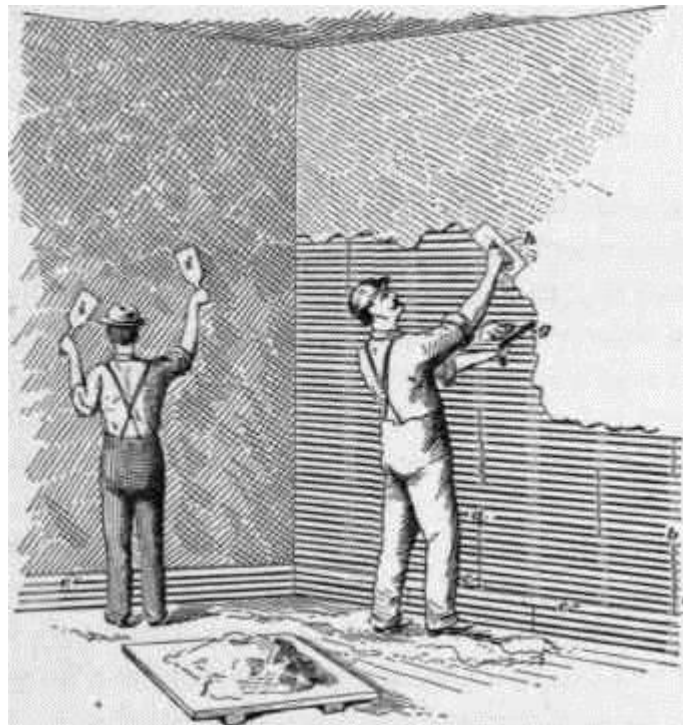
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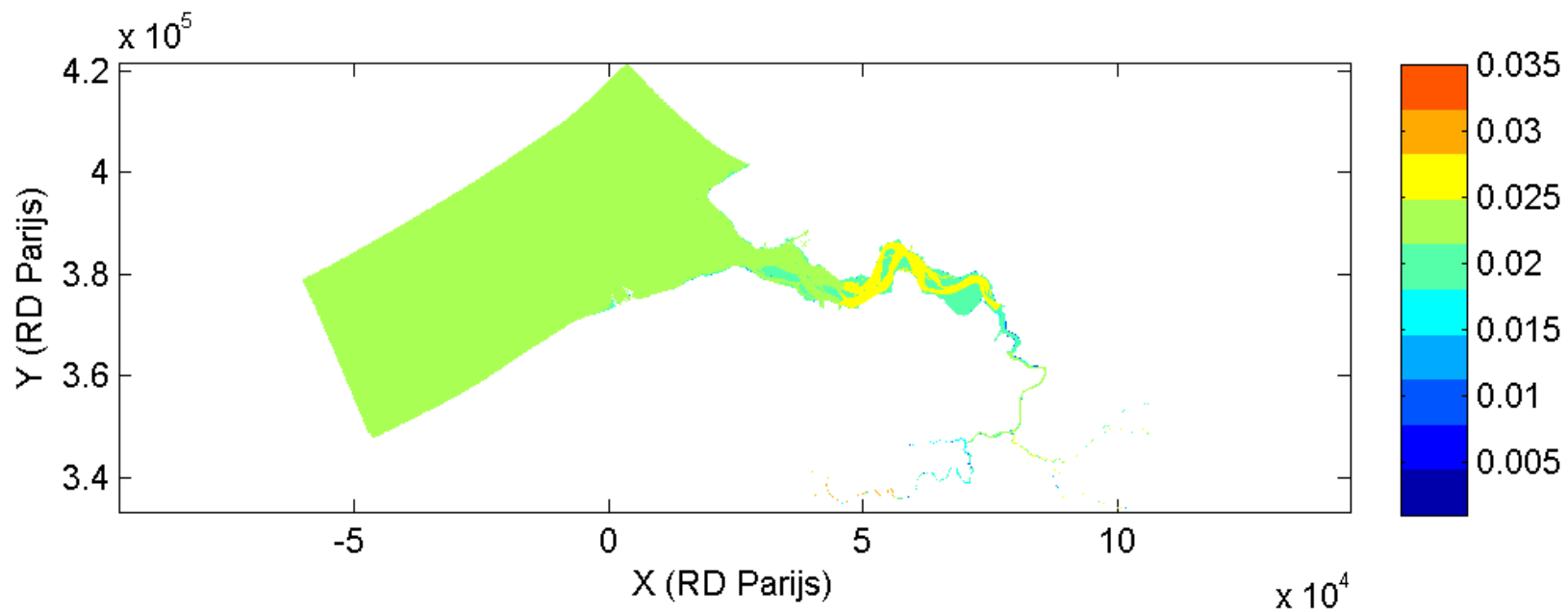
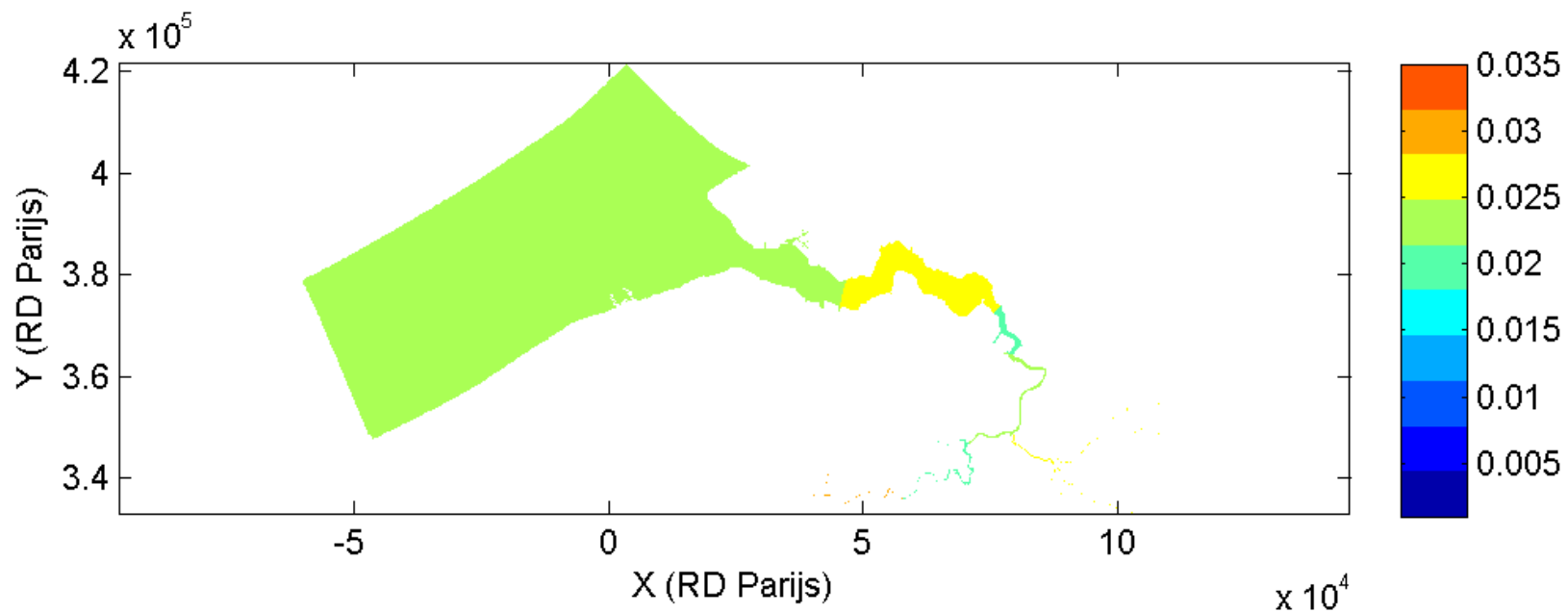


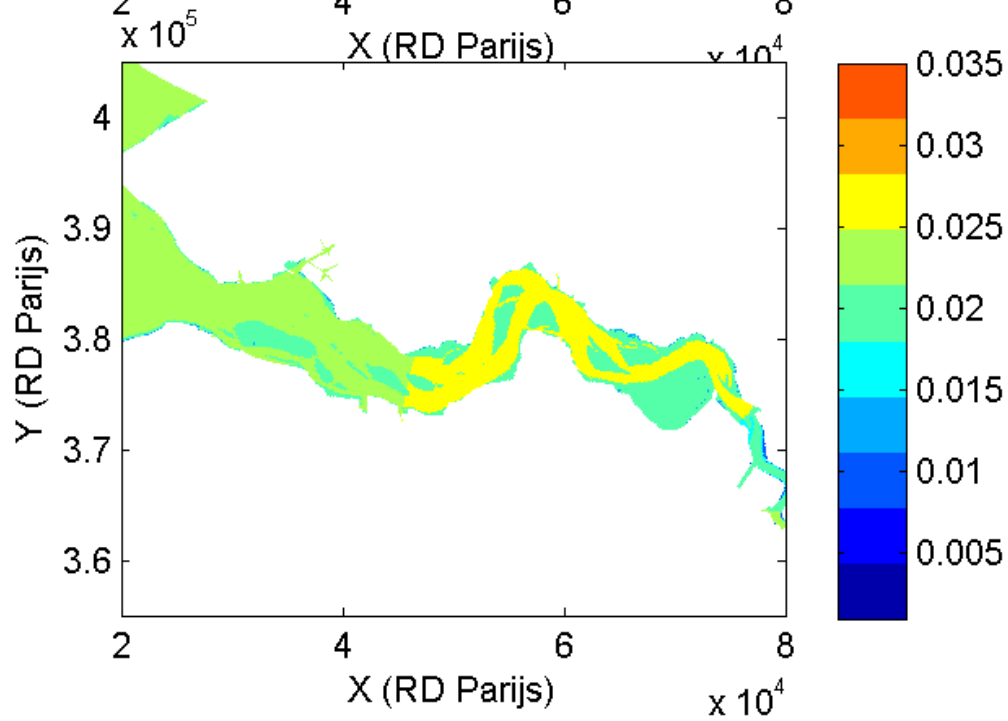
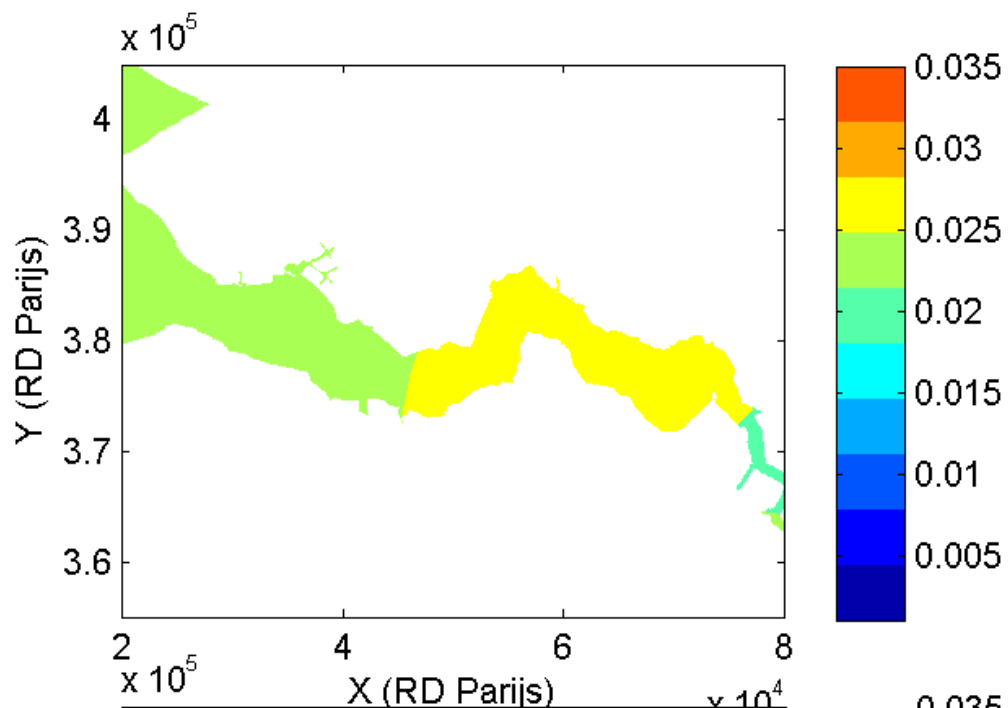
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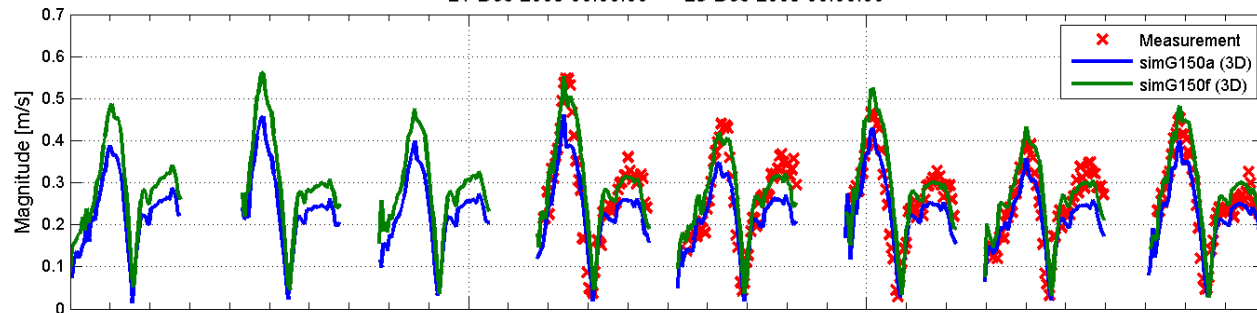
# Preliminary results



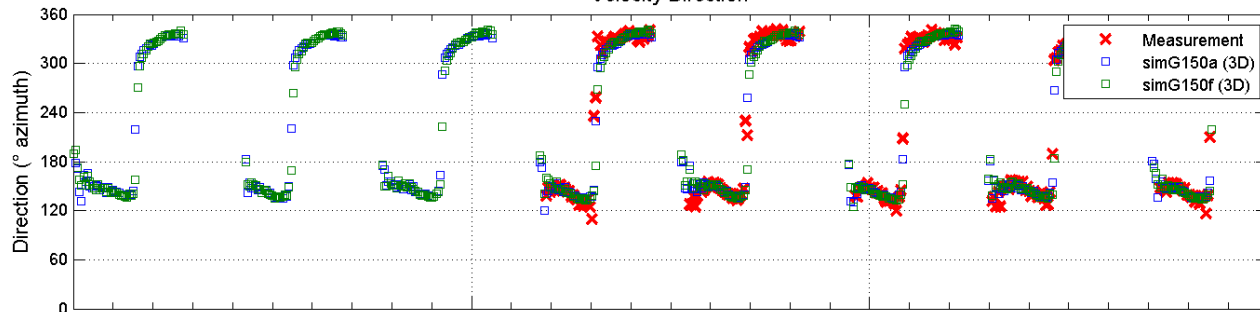




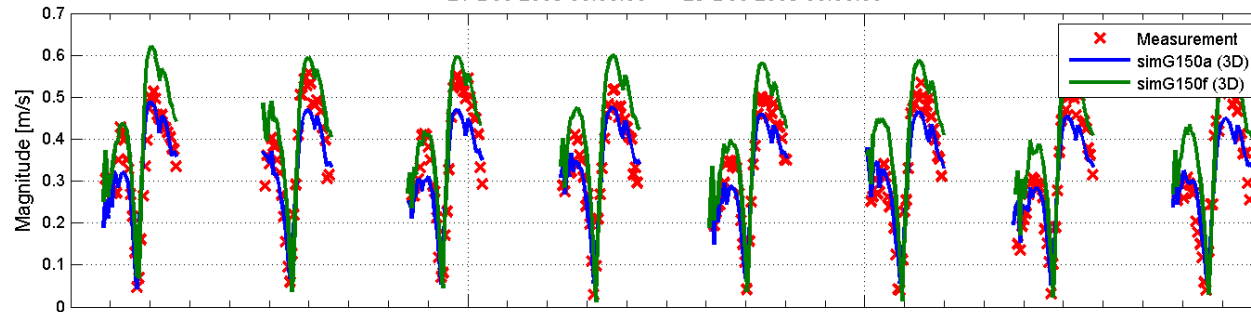
Velocity: HPW03 1 at -0.89mNAP.  
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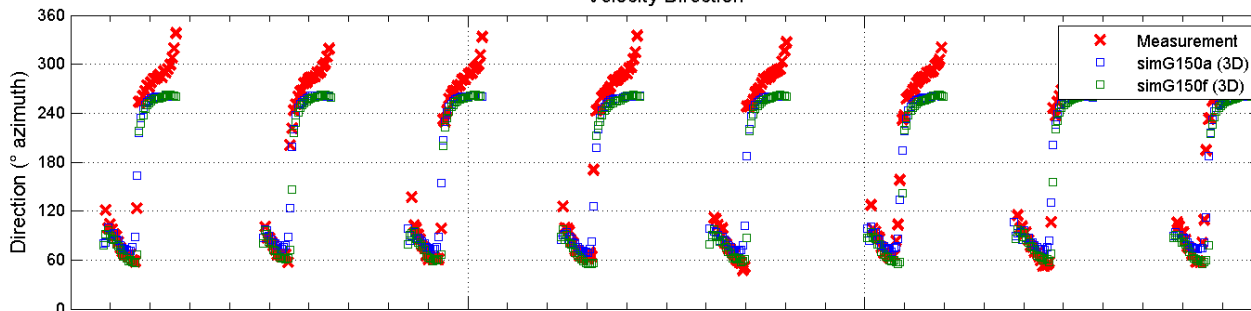
Velocity Direction



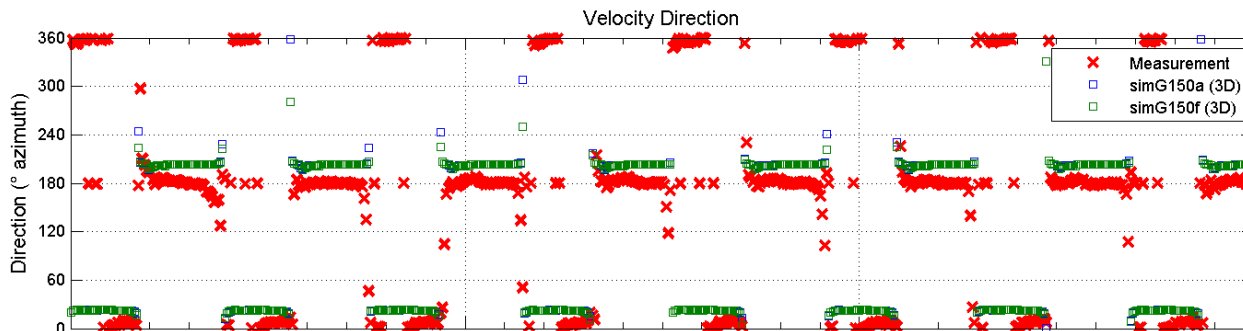
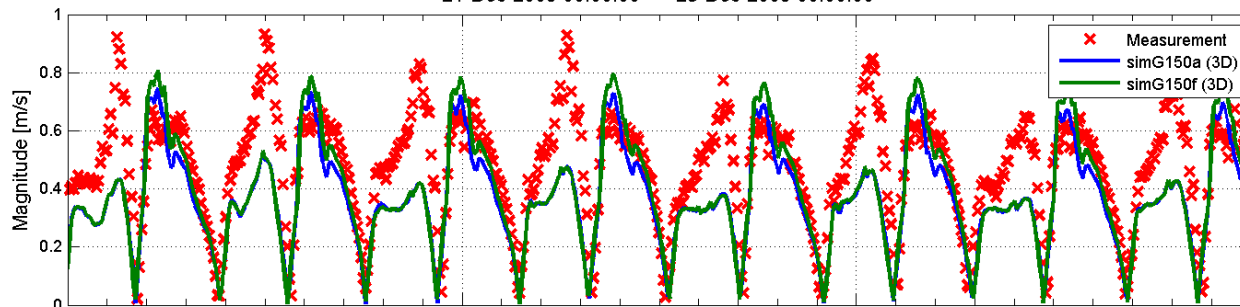
Velocity: RVB0311 1 at 0.10mNAP.  
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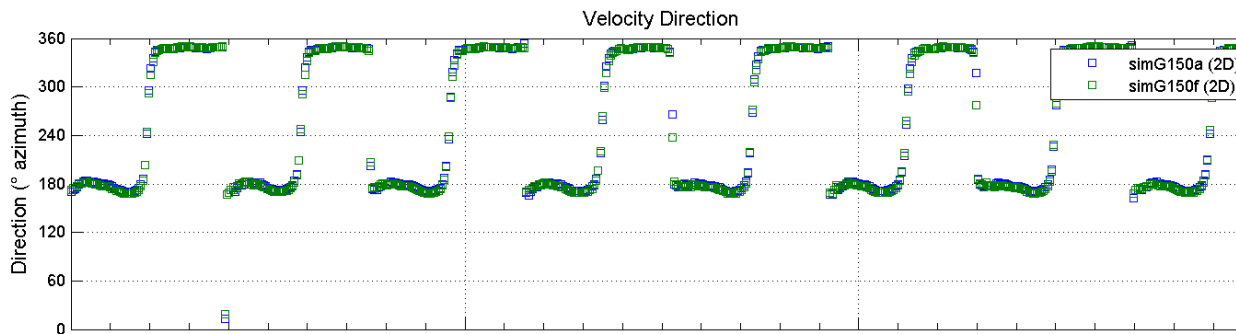
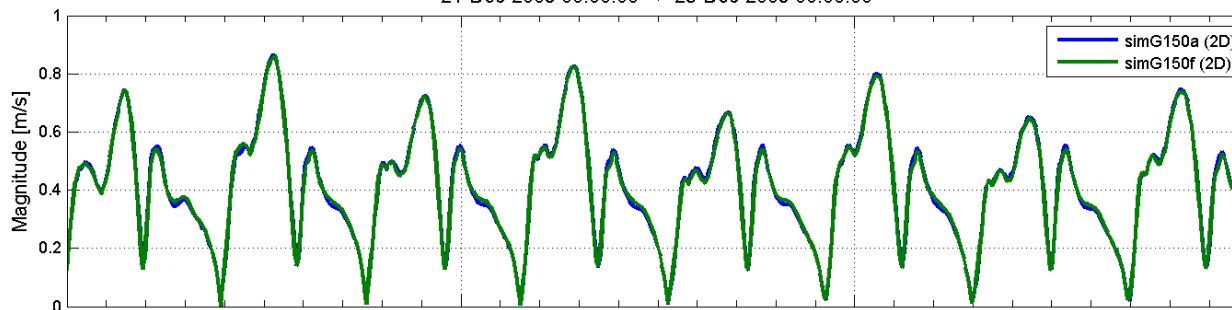
Velocity Direction



Velocity: RVB0309 2 at -4.00mNAP.  
21-Dec-2009 00:00:00 -> 25-Dec-2009 00:00:00



Velocity: PVW0101 1 at -4.25mNAP.  
21-Dec-2009 00:00:00 -> 25-Dec-2009 00:00:00



## Conclusions

- Depth-based roughness correction shows promising results
  - Velocities in area right next to tidal flats is still unaffected
  - Some corrections worsen the agreement with measurements
- Further differentiation of the roughness correction to better steer velocities and have global improvement