

Why Passing Vessel Analysis ?

- For the effect passing vessels have on the resultant motion behaviour of moored vessels and on the forces generated in the mooring system
- The motions can interrupt loading/discharging
- The mooring system forces can result in line breakage and subsequent drift-off , and in injury to personel

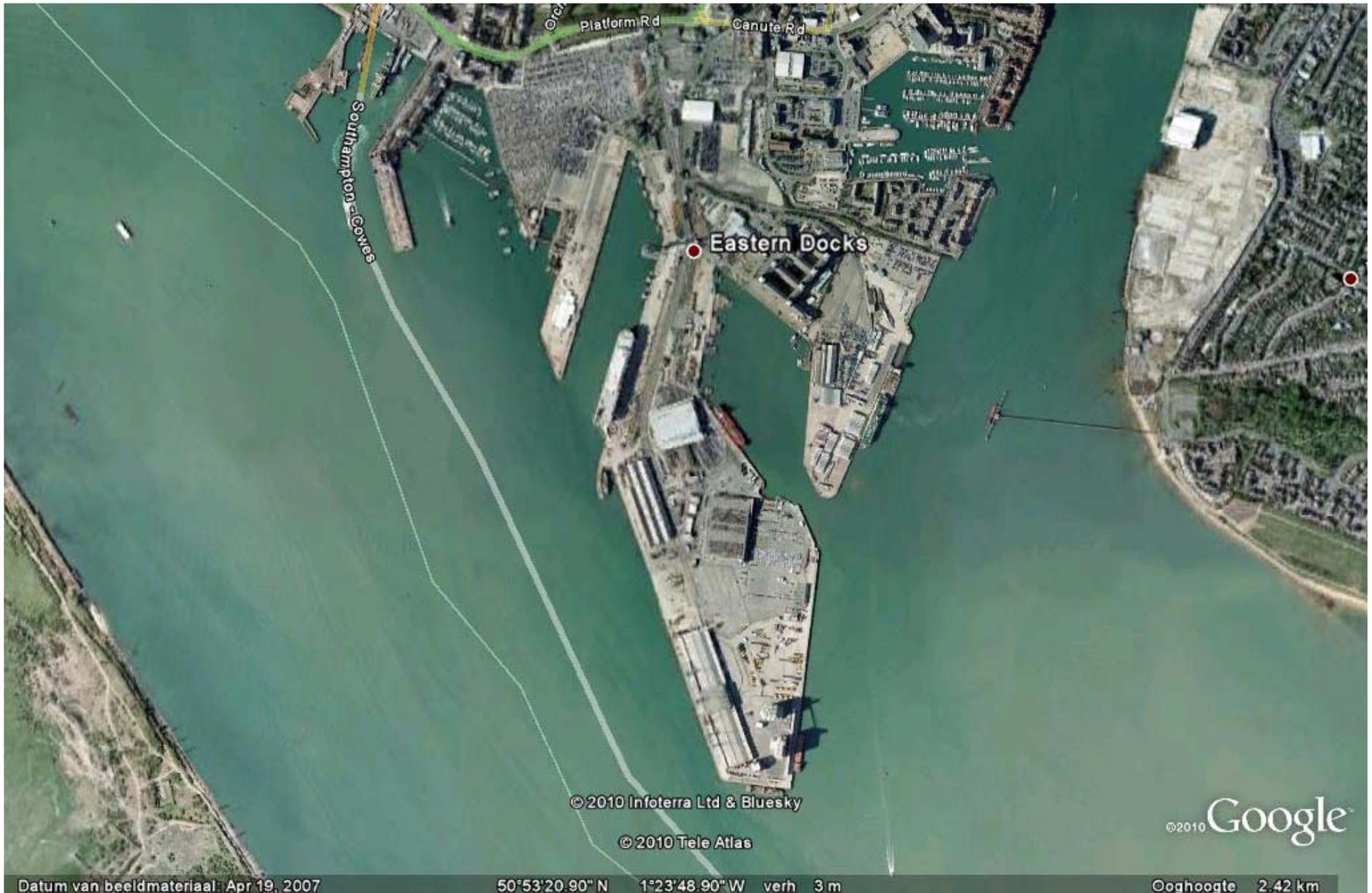
Which Complex Conditions ?

- Effect of port geometry on the flow around the vessels
- Effects of current
- Effects on more than one moored ship
- Effects due to simultaneous passing of more than one ship
- Effect of drift angle of passing ship
- Etc.

Titanic leaving Southampton April 1912

Suction effects broke mooring lines
of the liner New York. Prompt
action prevented a collision

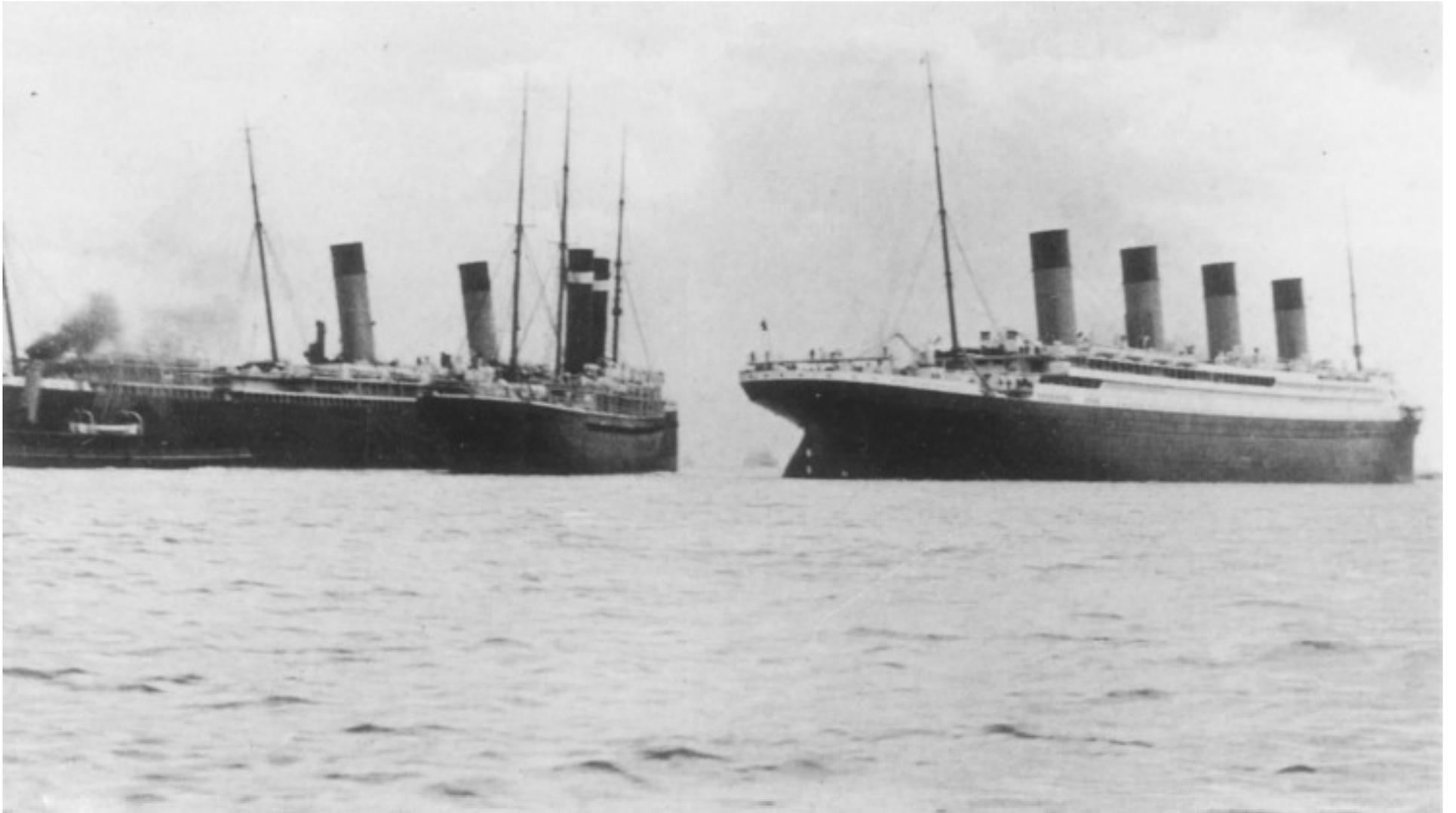
Port of Southampton



Datum van beeldmateriaal: Apr 19, 2007

50°53'20.90" N 1°23'48.90" W verh 3 m

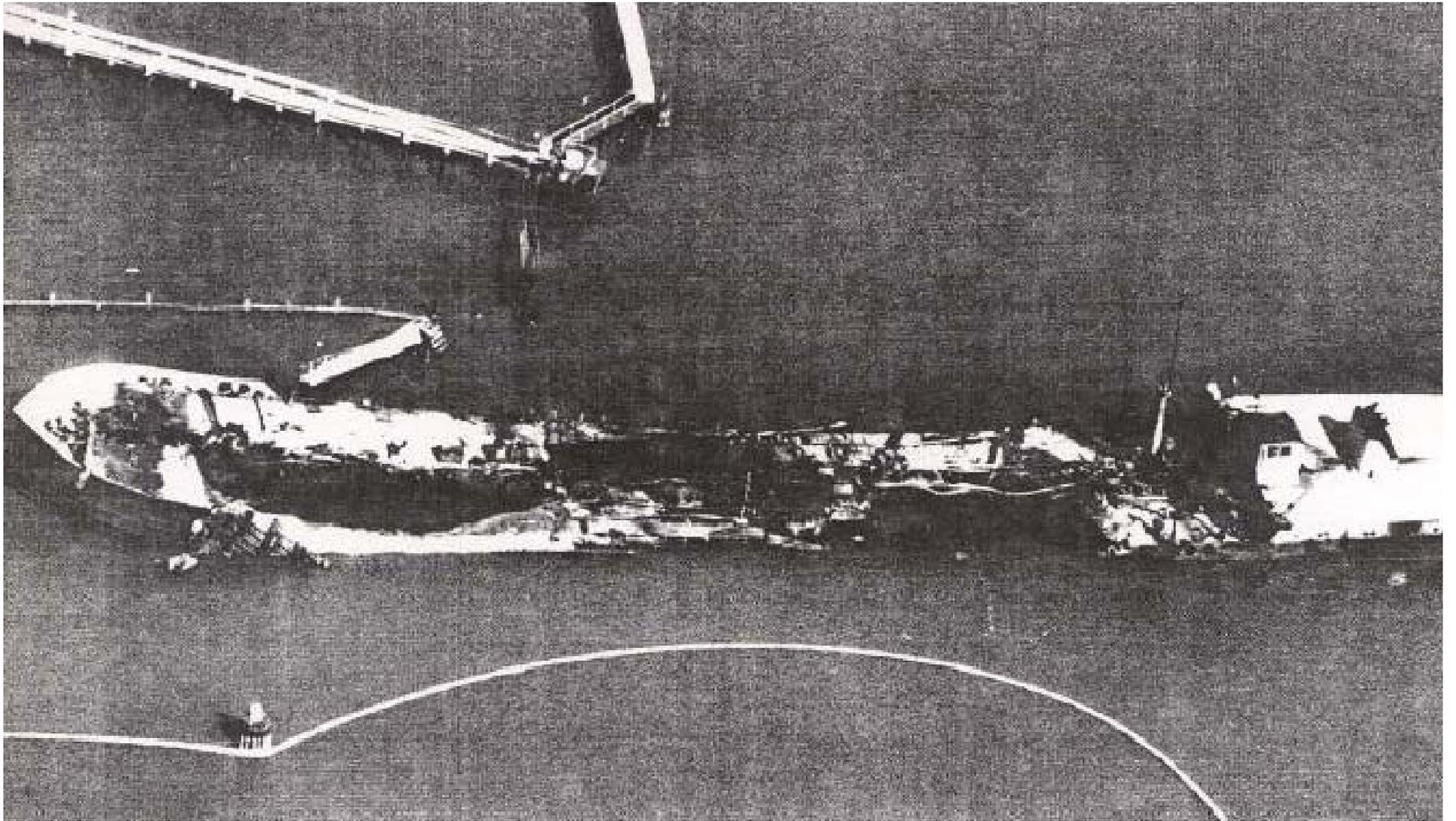
Ooghoogte 2.42 km





Tanker Jupiter devastated by fire , Bay City , Michigan ,1991

The vessel was pulled from her jetty by suction effects. The mooring lines parted and the fuel being discharged caught fire. One man killed.



PMH



Elba Island LNG terminal 2006.
Golar Freeze pulled from her moorings by a passing tanker causing emergency disconnect of the cryogenic loading arms.

Sempra LNG terminal , Louisiana.
A much debated terminal design.
Many studies carried out , among others ,on passing vessel effects before objections were dropped.
The terminal came into operation in 2010.



Numerical modeling of passing vessel effects

- Double-body flow model
- Free-surface flow model

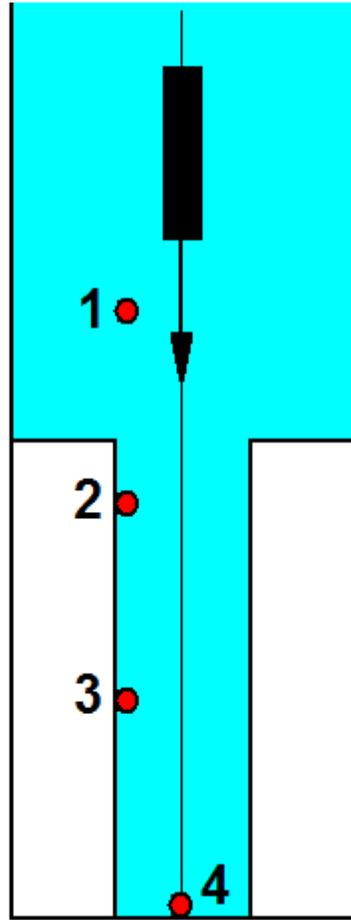
Free-surface effects :
Long waves generated by ships
moving through a port

John Scott Russel's "Wave of
Translation", 1834

Example :

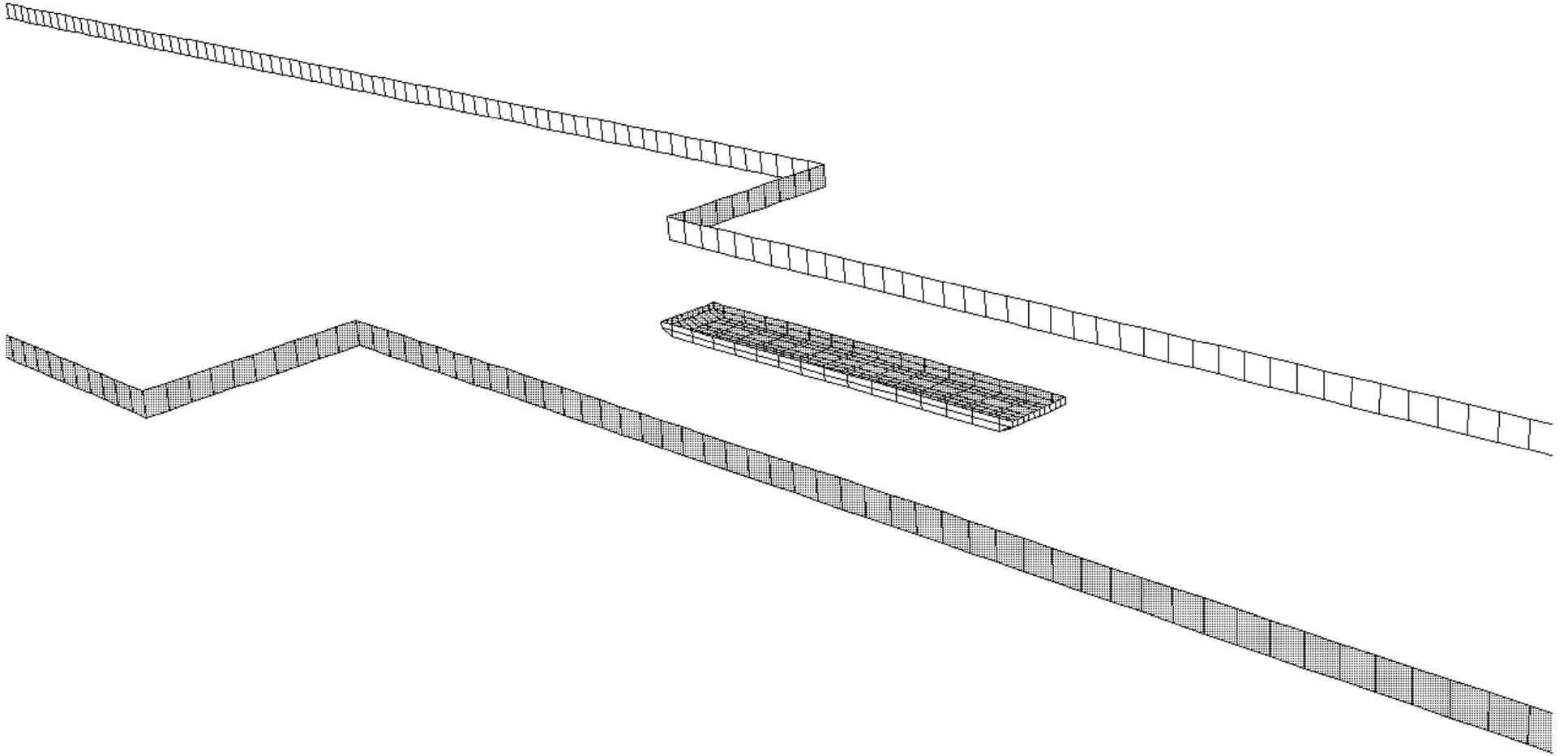
Barge sailing at constant speed into a
restriction in a canal

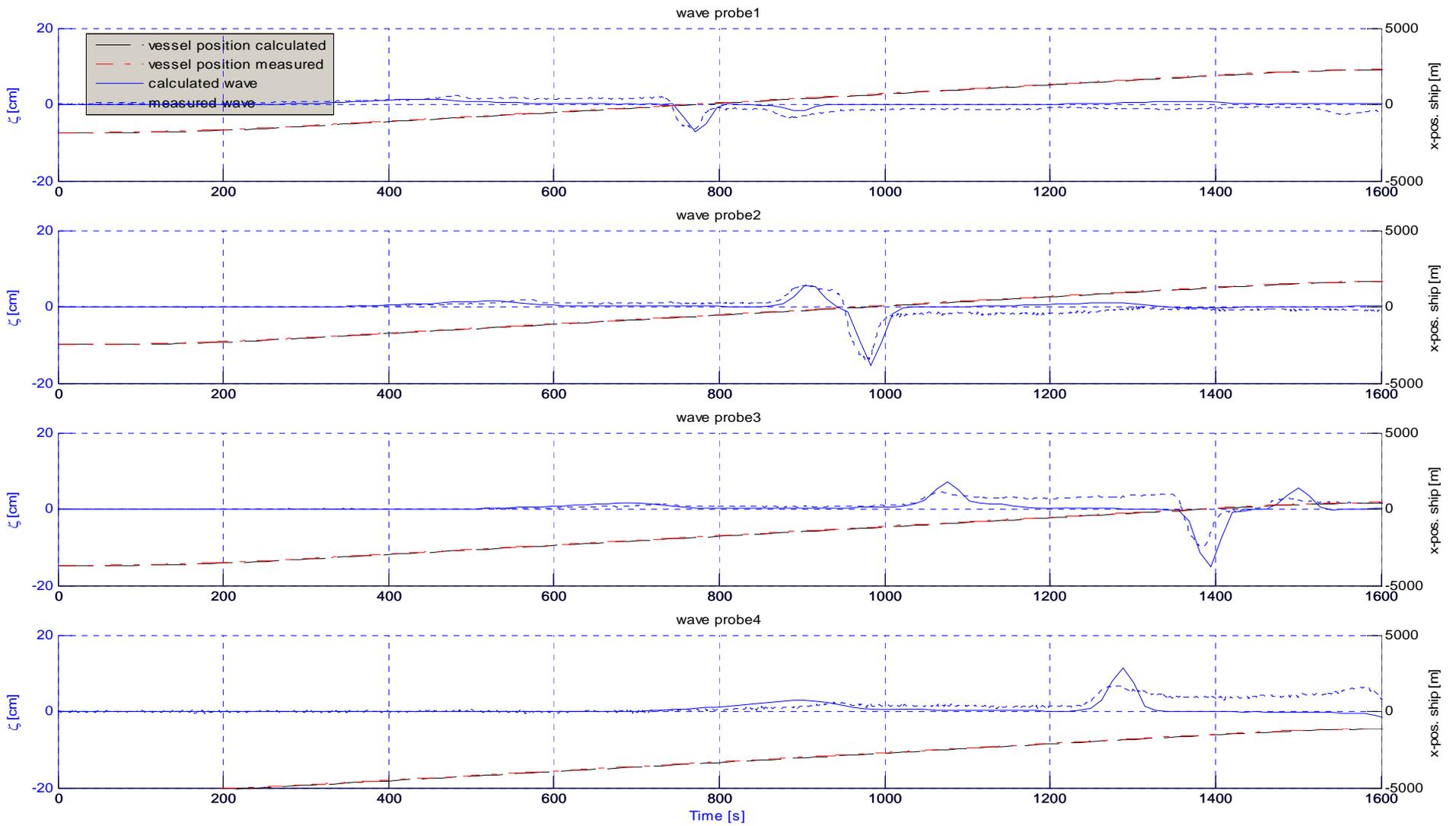
Measurements : Wave elevations





Tank #2 , Delft University of Technology (80 m x 2.70 m)

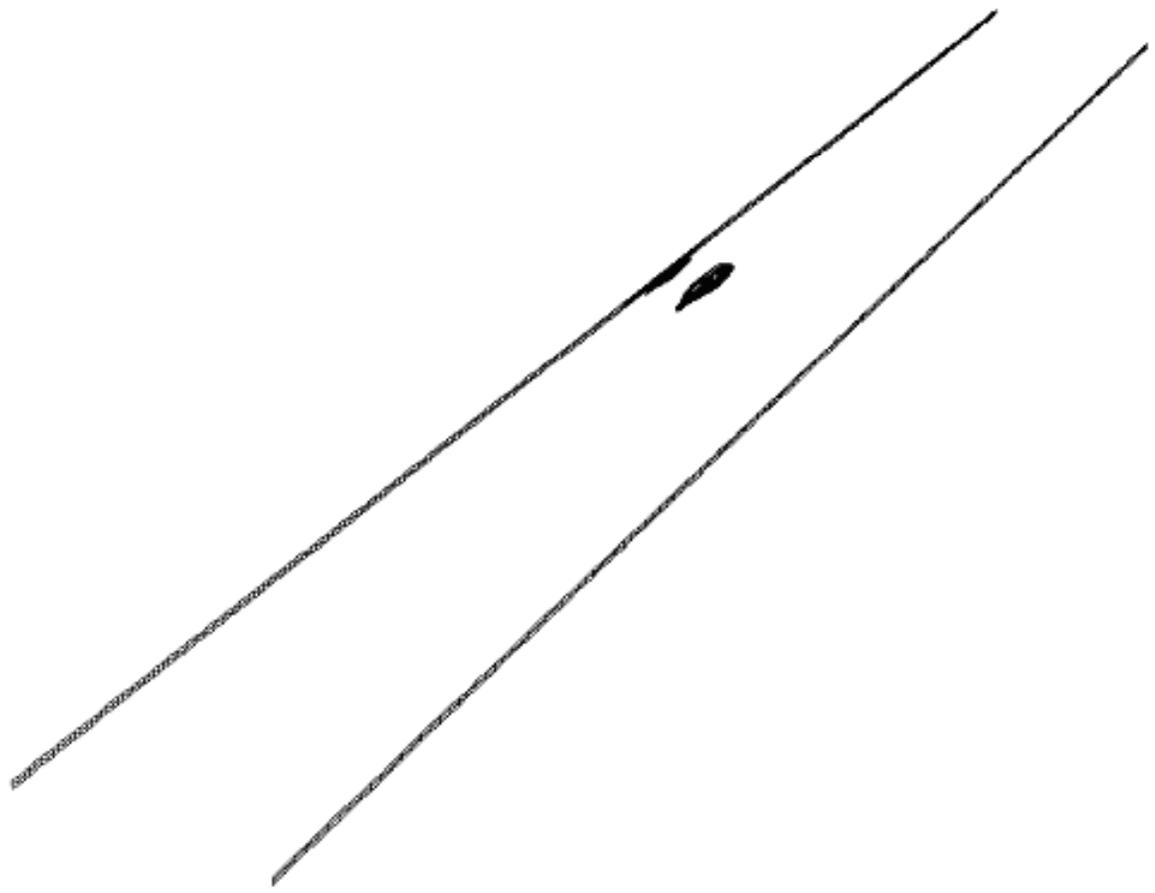


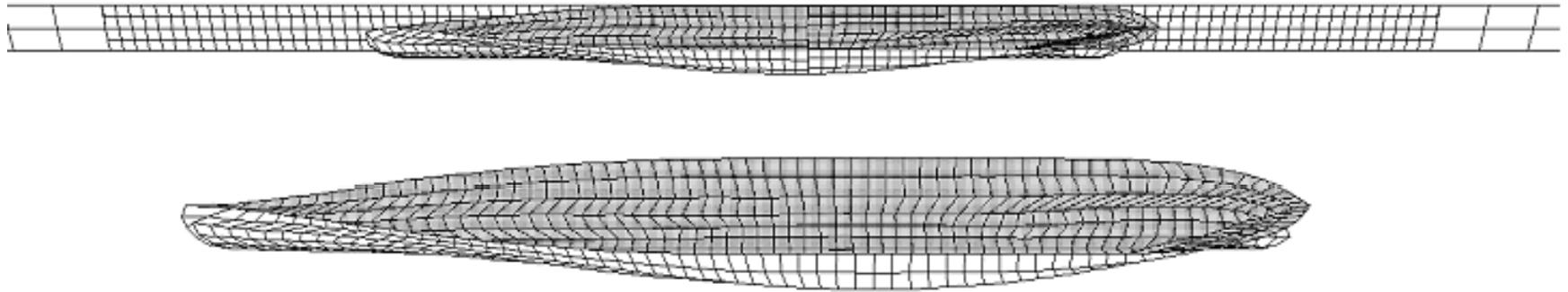


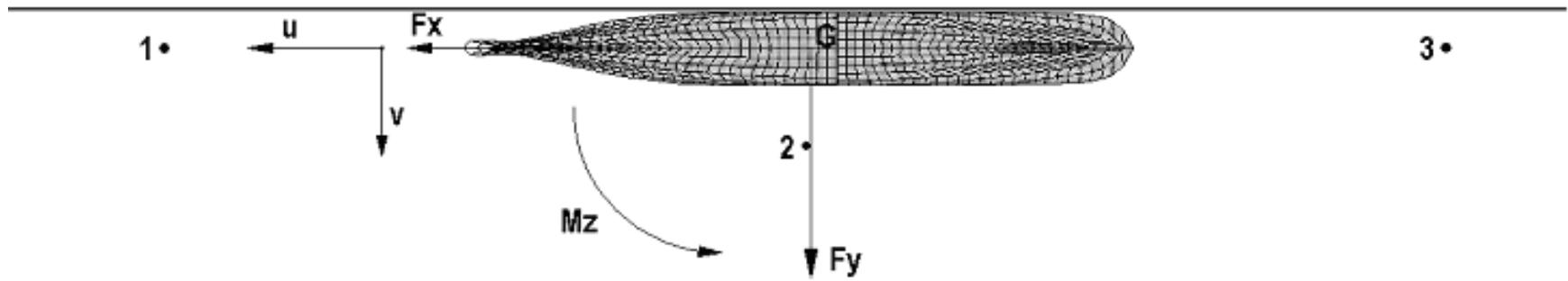
Application to a Panamax
container vessel moored to a quay
wall with a passing Emma Maersk
class vessel

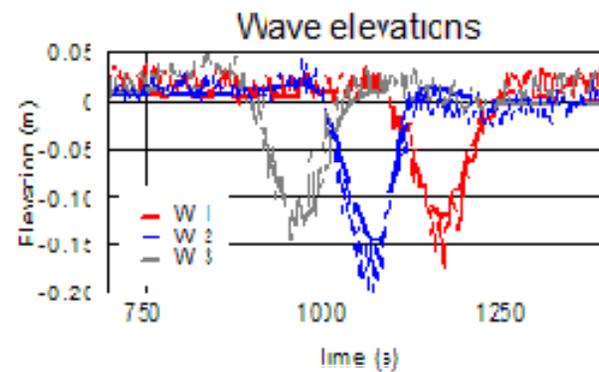
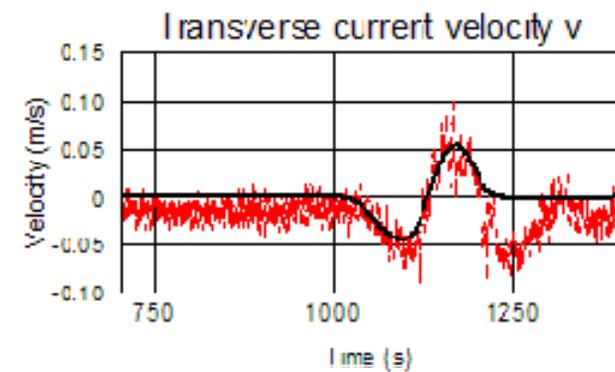
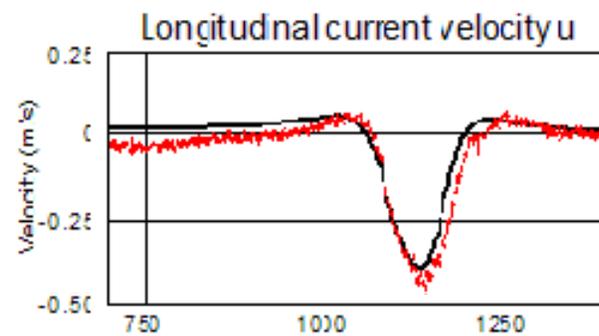
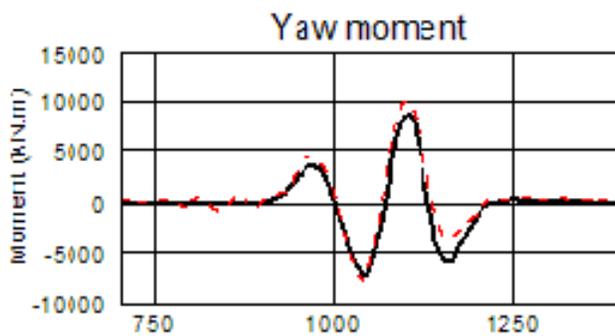
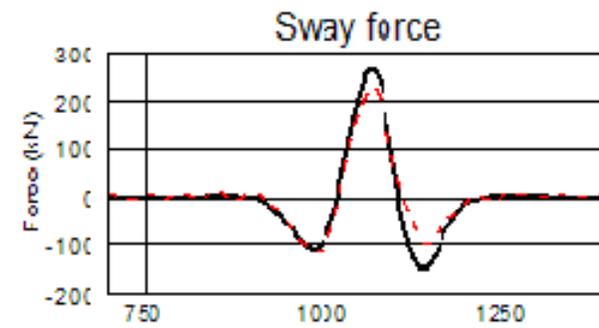
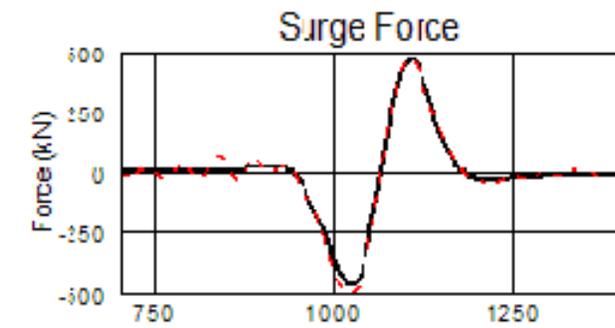
Model tests by MARIN for the
Maasvlakte II extension in the Port of
Rotterdam (Yangtze harbour)











Free-surface Model compared with full-scale measurements

- 80 m Barge moored in Noordzee canal
- Passing ship: Bulk carrier

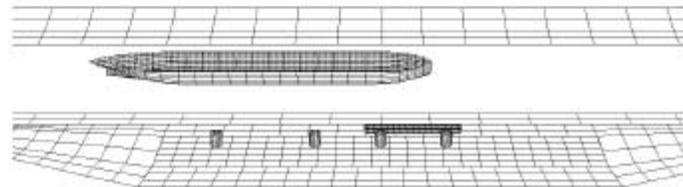
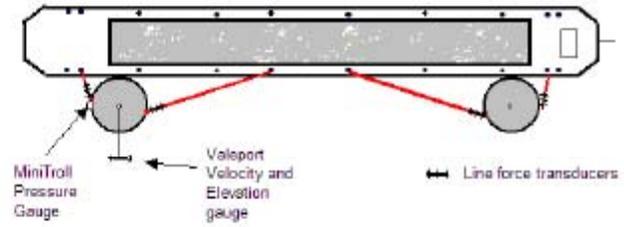
Measured data on :

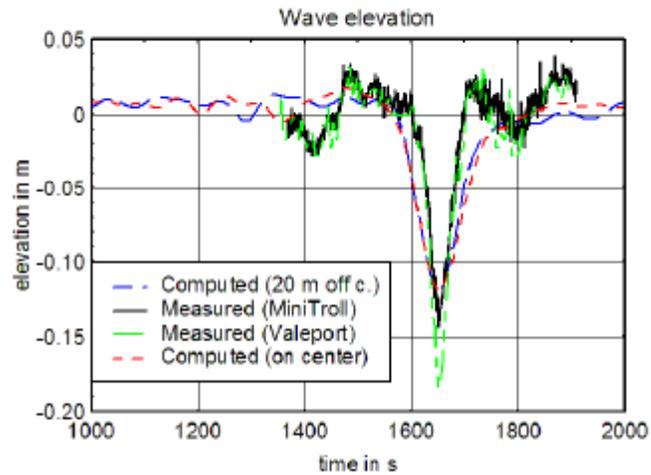
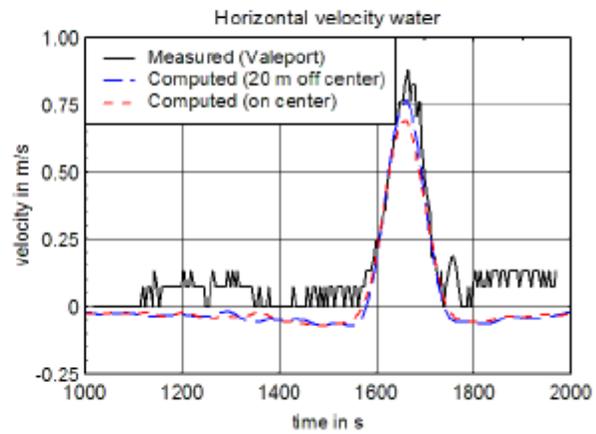
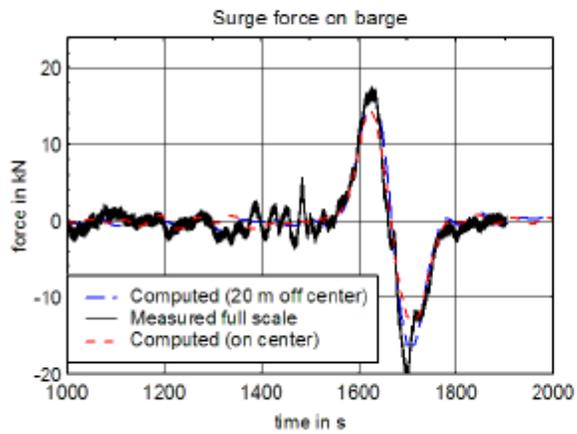
1. Line forces
2. Water velocity
3. Surface elevation

Noordzee Canal with barge in fore-ground

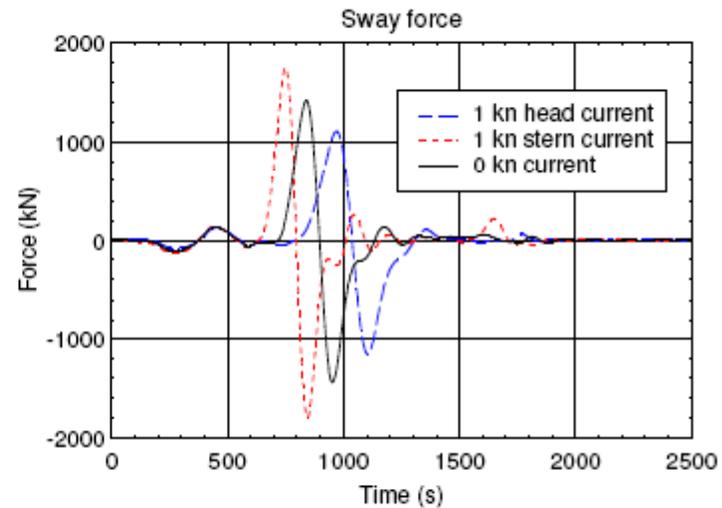
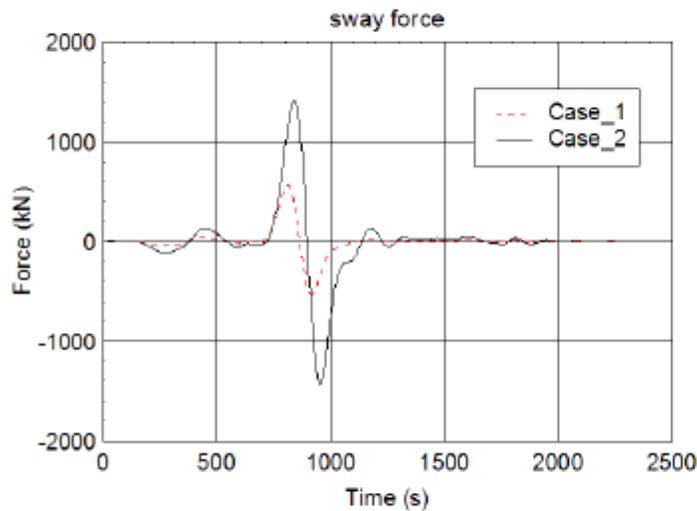
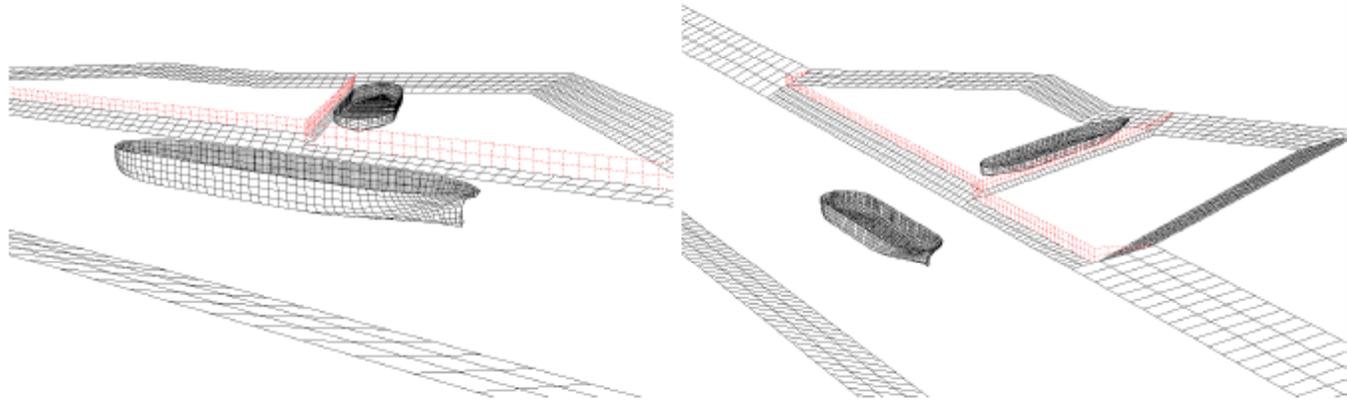


6-7-2003, Spaarnwoude, Noordzeekanaal, Grandeur of the Seas, foto RM

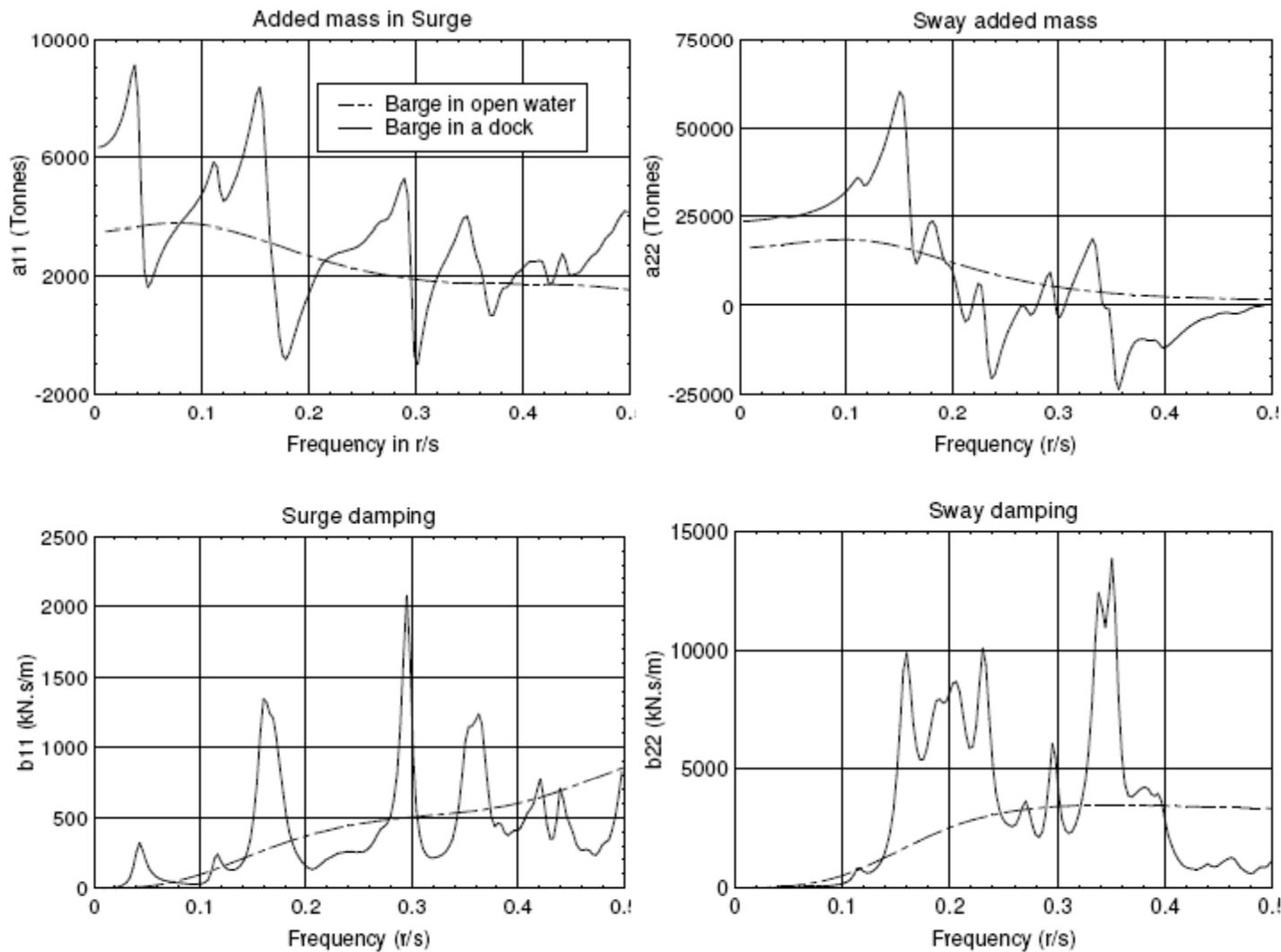




Some situations needing validation



A barge moored in a dock : Hydrodynamic reaction forces



Conclusions

- Complex conditions make a difference to the passing vessel effects
- Computational methods have been developed to account for such effects
- A number of situations have been validated by model tests / full scale measurements
- More work needs to be done in order to determine the range of applicability

Thank you !

Questions ?