



**Royal  
HaskoningDHV**  
*Enhancing Society Together*

# Mathematics & Water

*Mathematical challenges in Hydraulic Engineering*

*Cock van der Lem*

*13 November 2014*

# Mathematics & Water

- Our clients are not interested in mathematics
- Our clients are interested in solutions



# Problems of real life projects

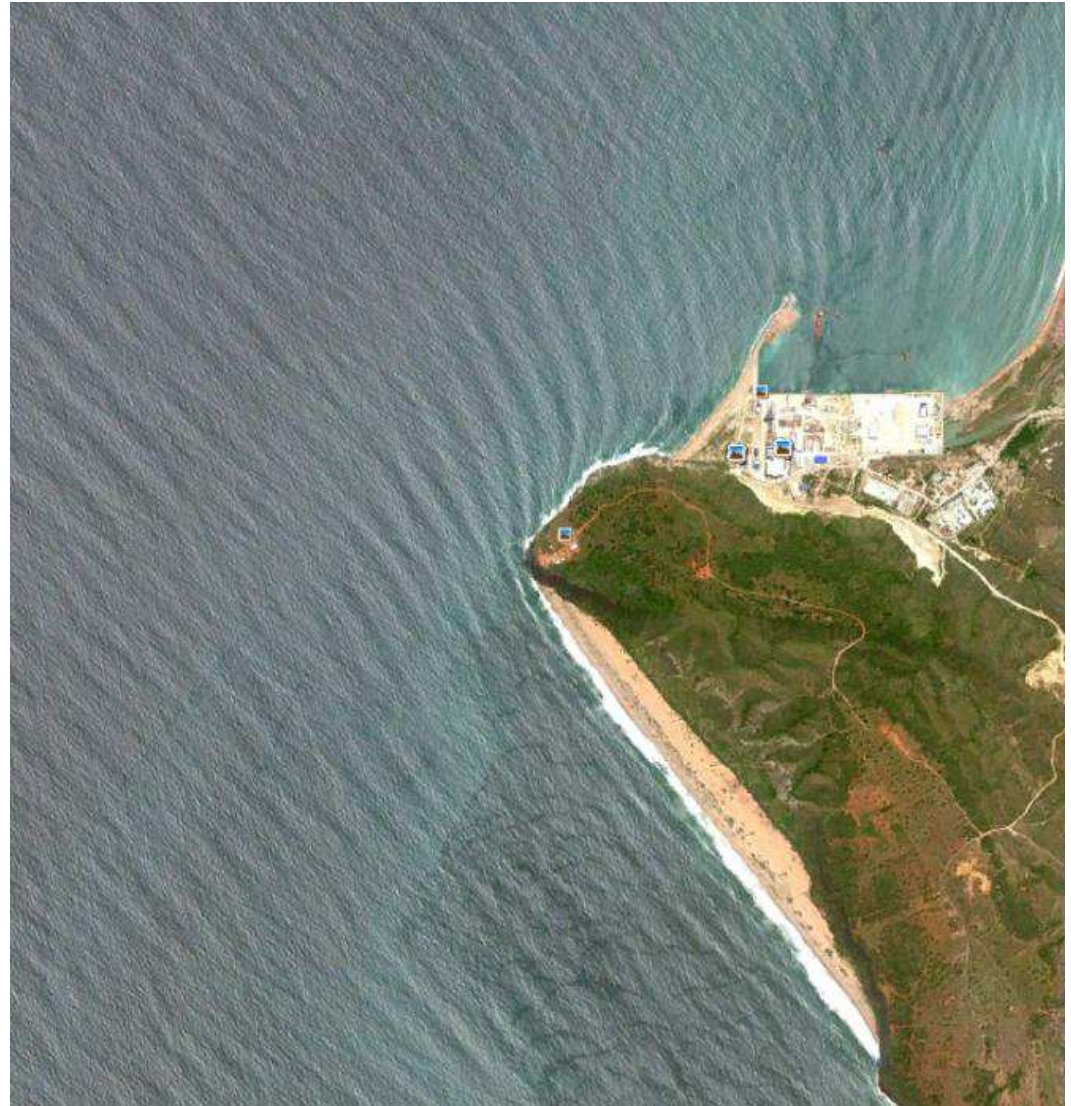
- Have a look at some real life projects (and problems)
- Formulate challenges to be solved
- Present opportunities for mathematics

# Real life problems





# Real life problems





# Real life problems

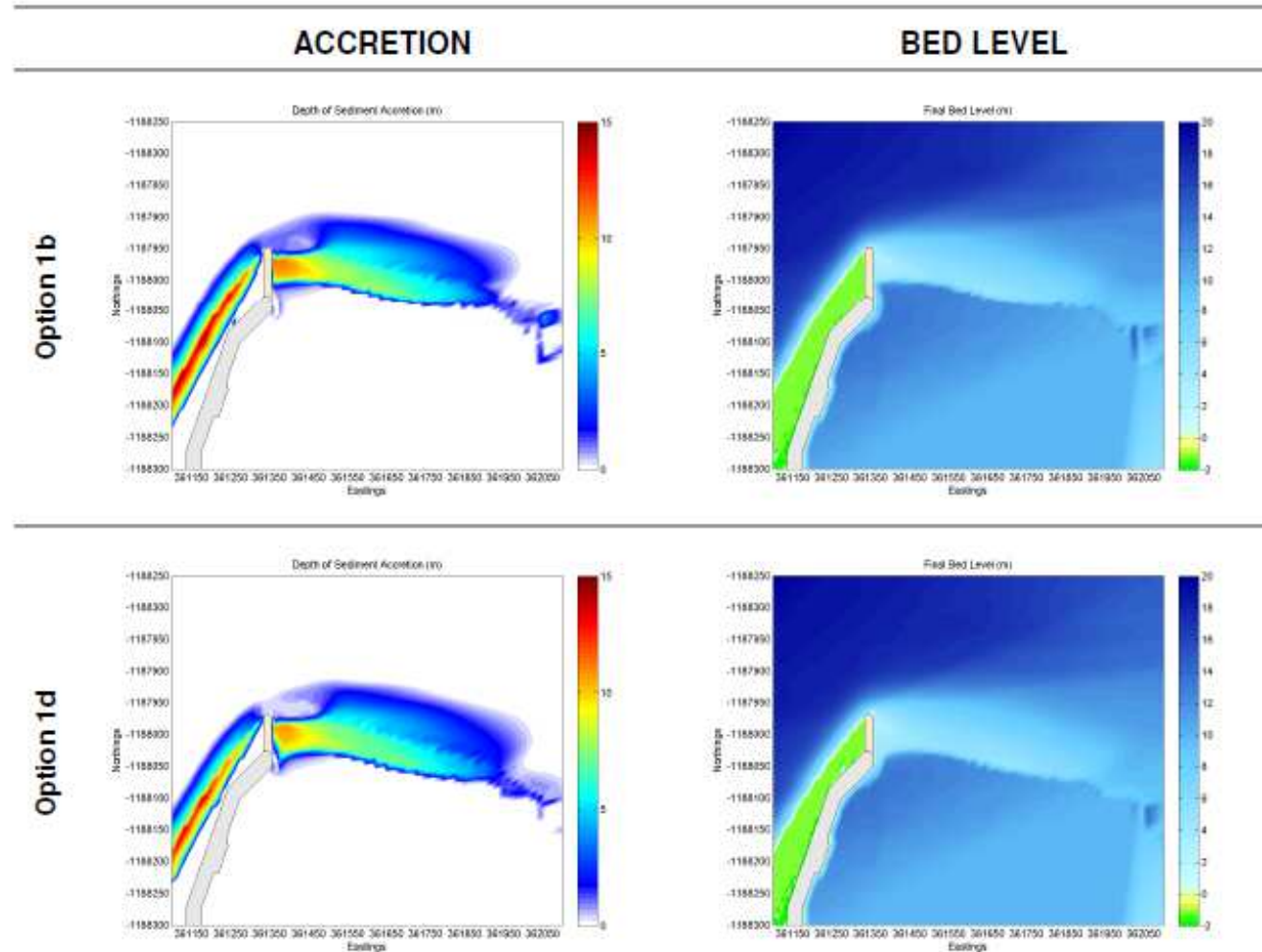


# Real life problems



# Challenge 1

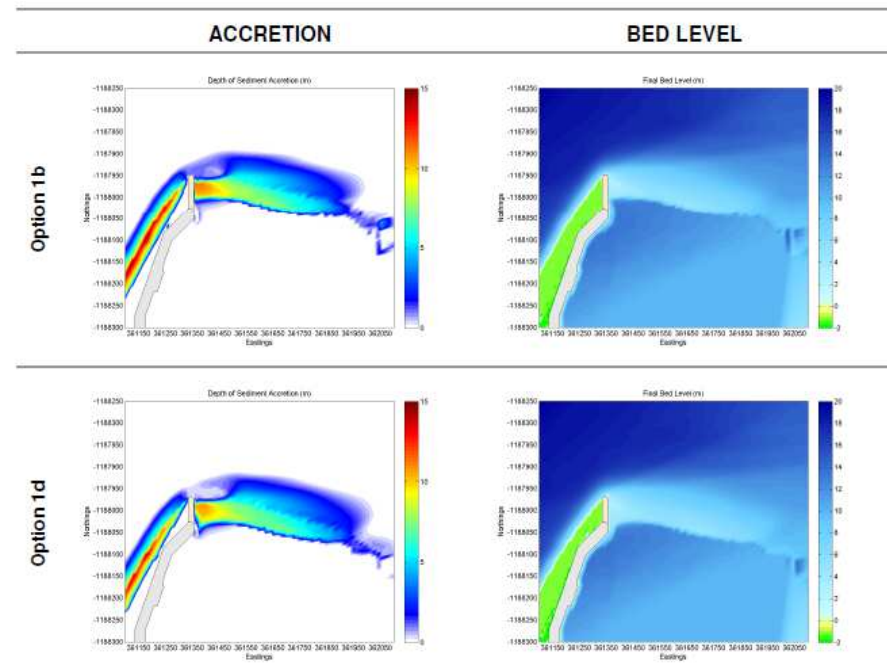
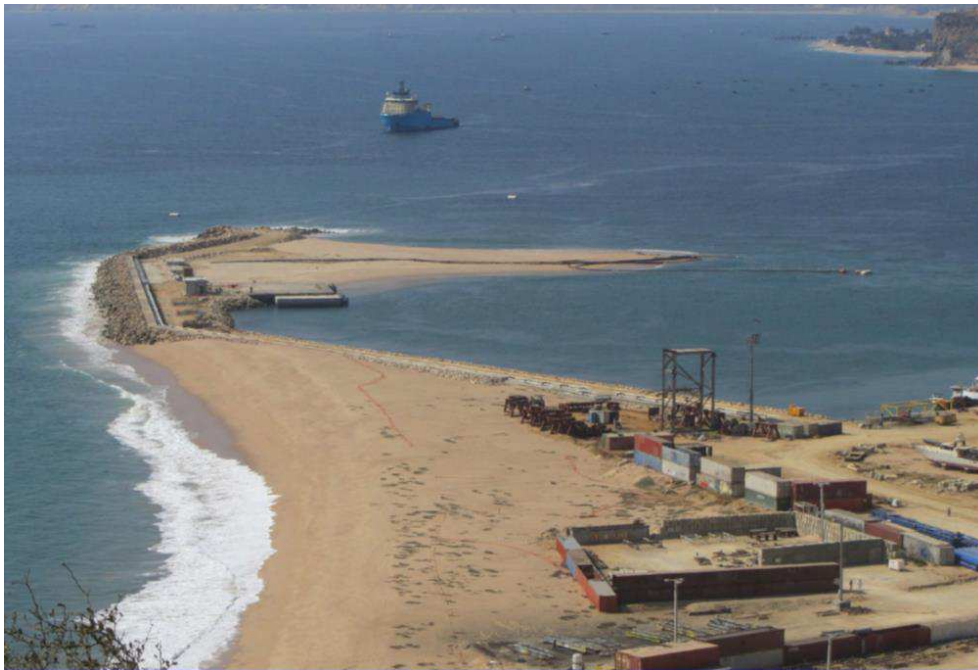
- Reliable and detailed morphological predictions



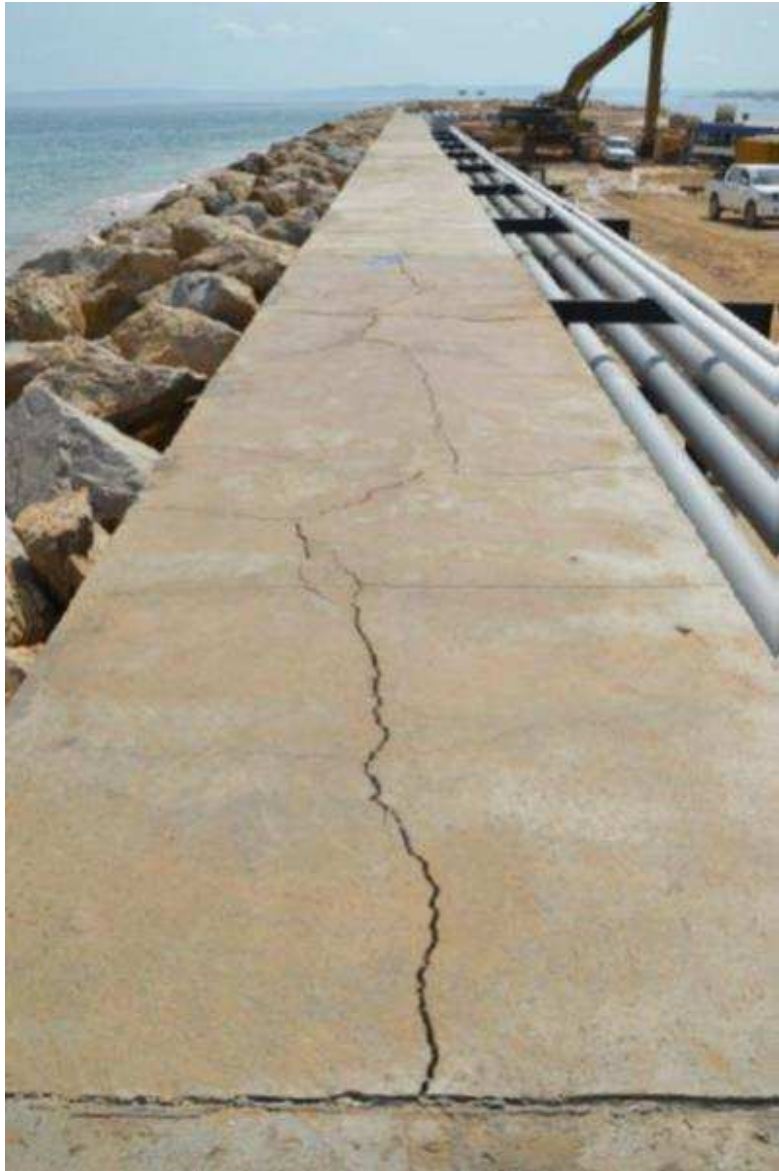


# Mathematical opportunity

- Improved description of morphological processes?
- Reliable time dependent water/sediment interaction?



# Real life problems



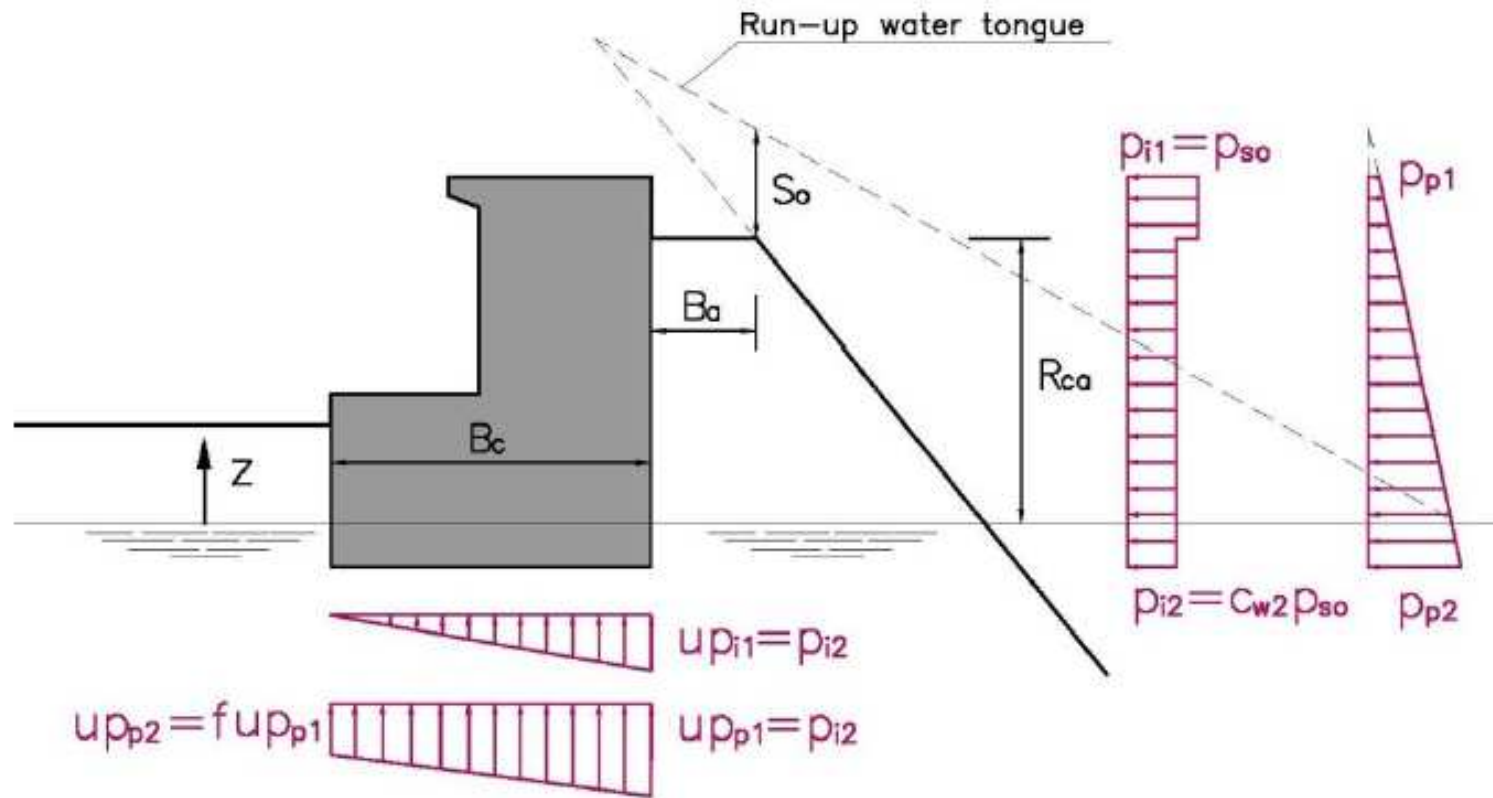
# Real life problems





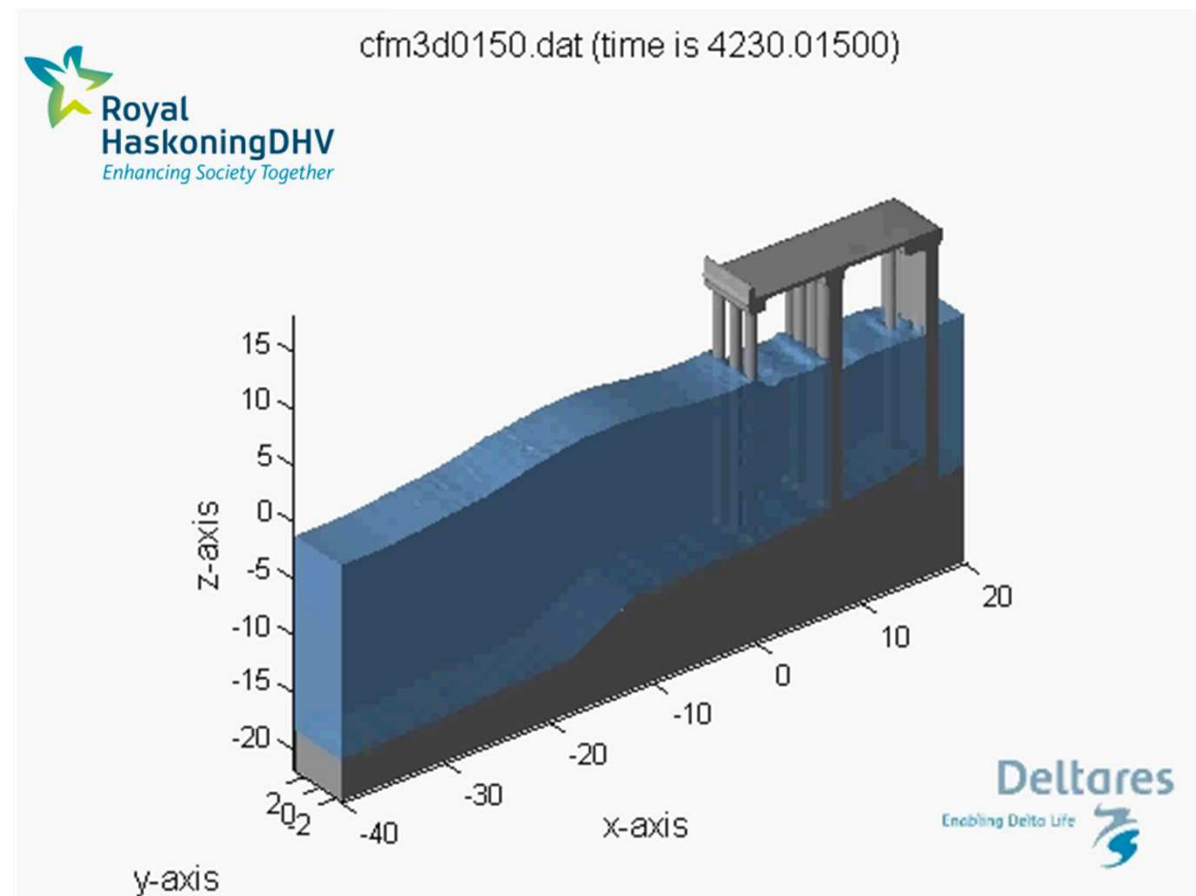
# Challenge 2

- Reliable wave loads on structures?



# Mathematical opportunity

- Pressures?
- Forces?



# Real life problems





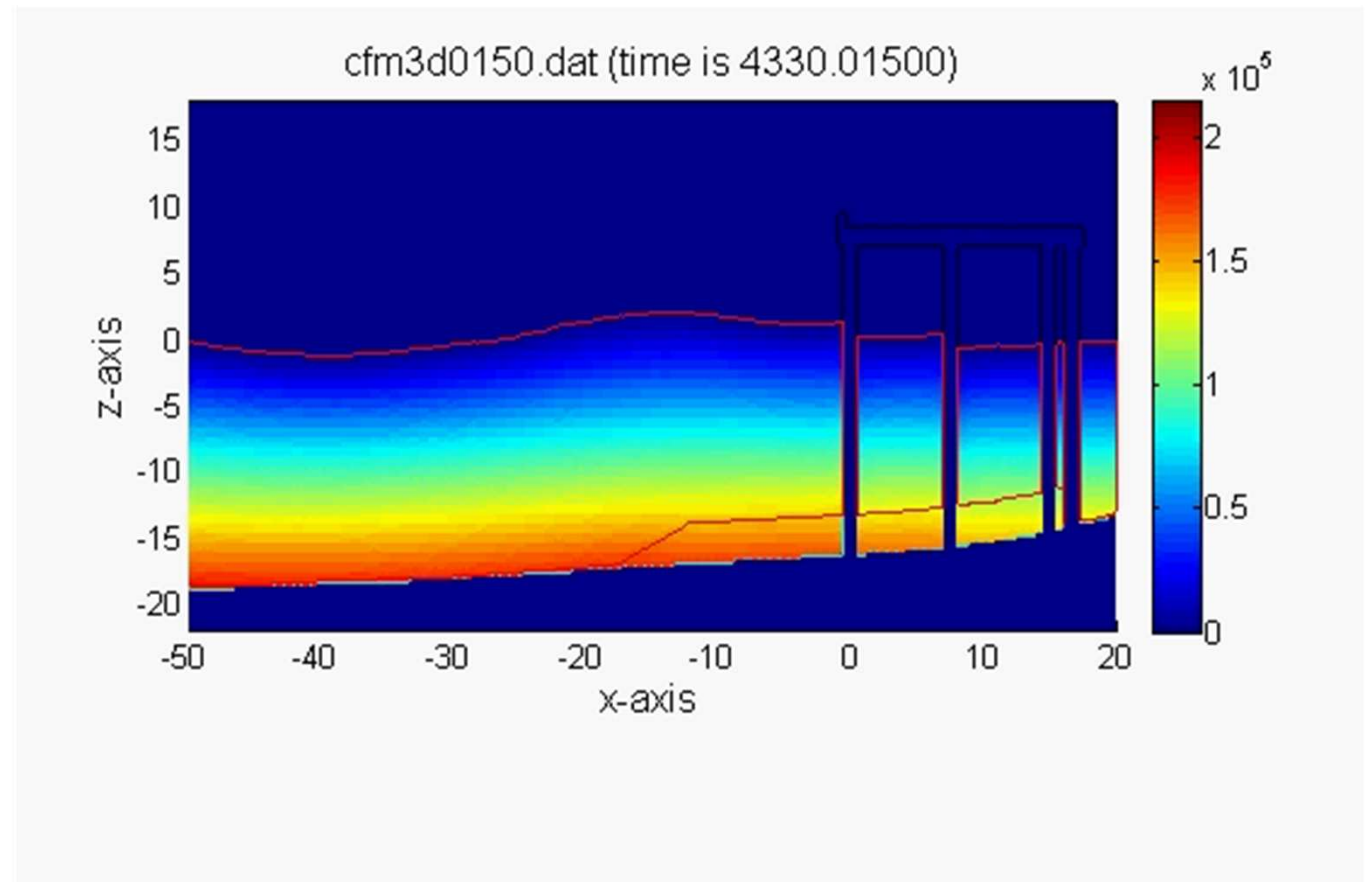
# Challenge 3

- Reliable estimate of overtopping?
- Wave loads on structures behind wave walls due to overtopping?



# Mathematical opportunities

- Overtopping?
- Velocities?
- Pressures?
- Dynamics?



# Real life problems





# Challenge 4

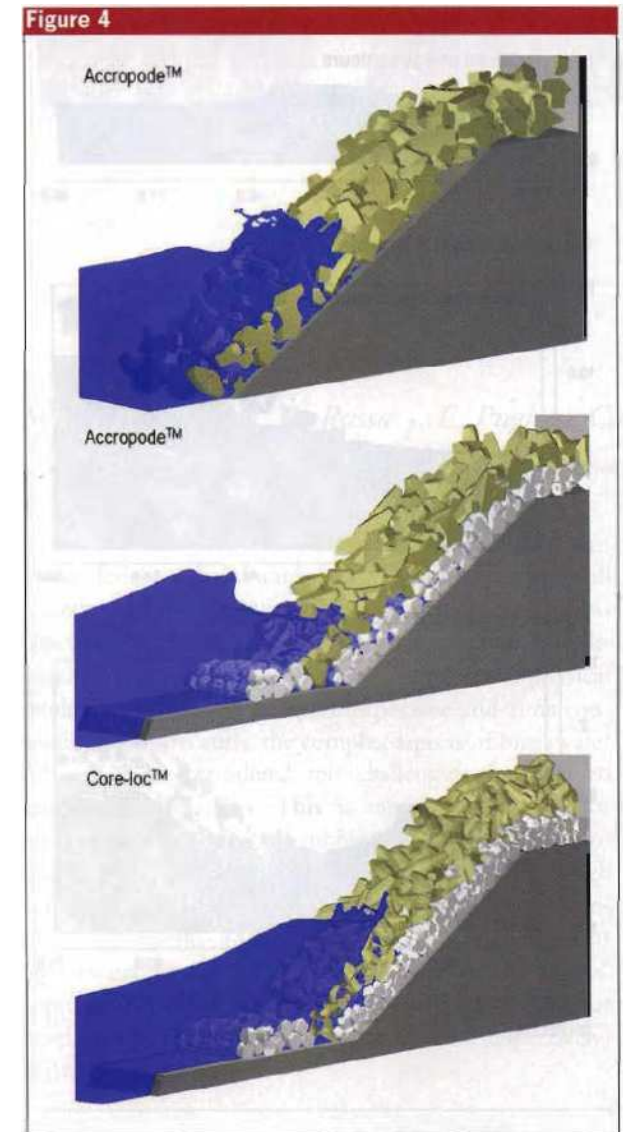
- Predict damage to breakwaters?
- Predict breaking armour units?



# Mathematical opportunity

- Wave flow through armour layers?
- Forces on armour units?
- Motions of armour units?
- Impact velocities?

Wave motion with Breakwaters and the Armor Stability  
F. Dentale, S.D. Russo, E. Pugliese Carratelli and S.  
Mascetti in Marine Technology Reporter (May 2010)



# Summary of Challenges

- Reliable and detailed morphological predictions?
- Reliable wave loads on structures?
- Reliable estimate of overtopping?
- Wave loads on structures behind wave walls due to overtopping?
- Predict damage to breakwaters and revetments?
- Predict breaking armour units?



# Our support to Mathematics and Water

- WiFi JIP  
Member
- Nostradamus JIP  
Letter of support to STW proposal
- Transwell JIP  
Expression of Interest



# Bring solutions to our clients

