Choices and Applications of 2D/3D models for supporting harbour & coastal management

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Terug naar overzicht

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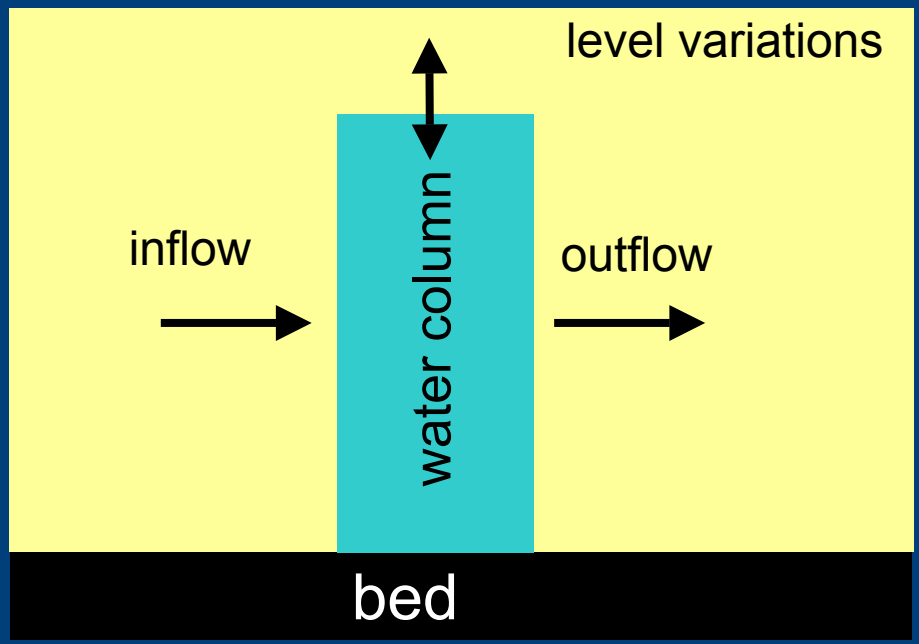
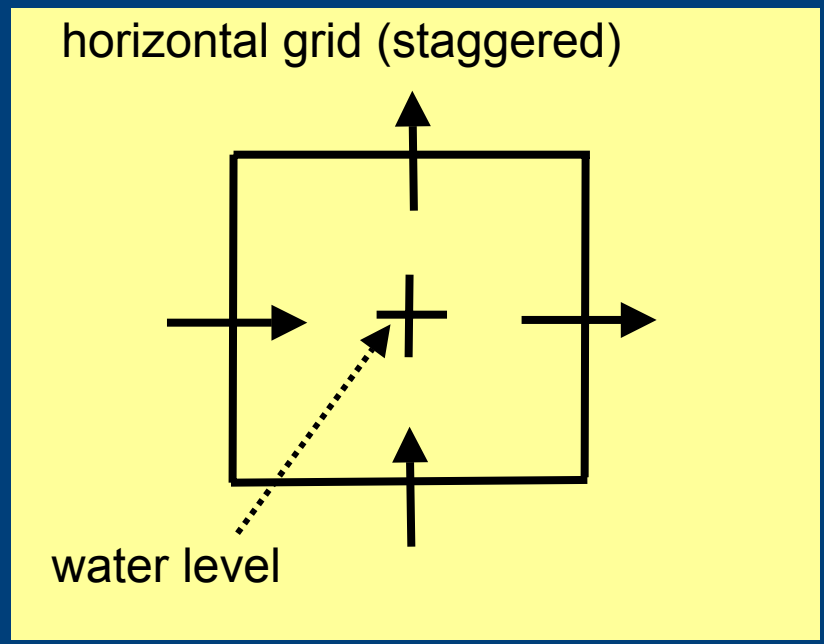
Contents:

Mass Balance





Force Balance in SOBEK and DELFT3D-Flow

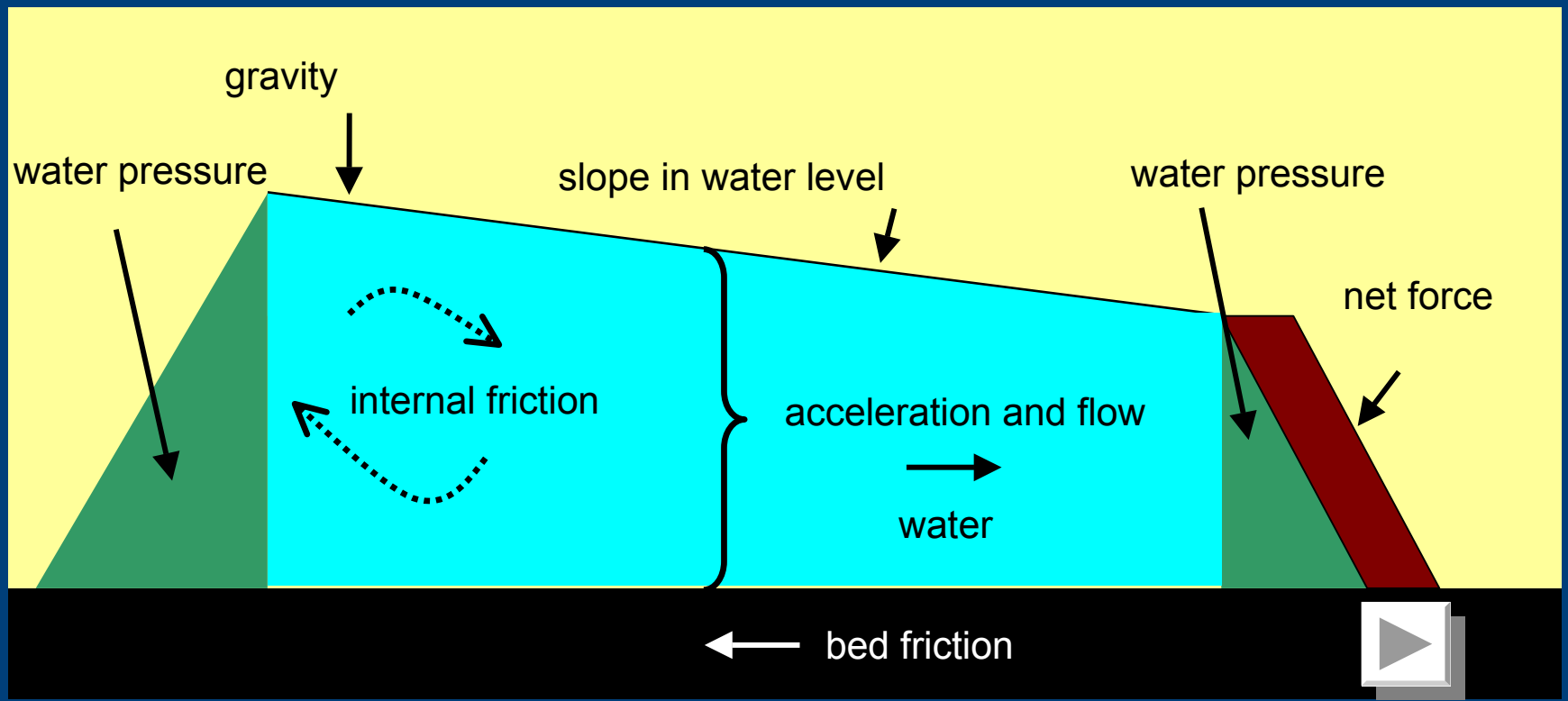
Difference in Water Level yields a Force

Force yields Acceleration (Newton)

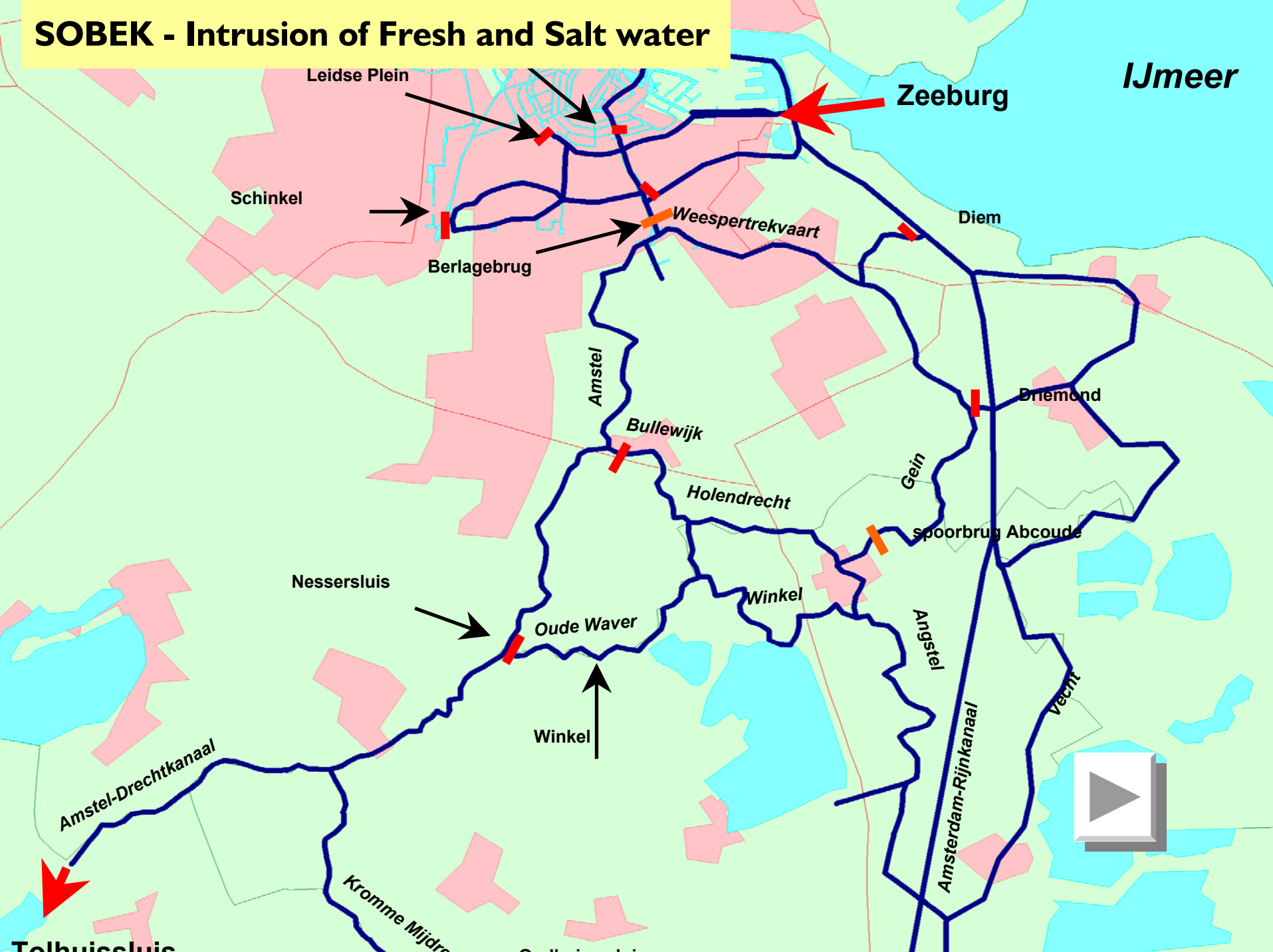
Acceleration amounts to Flow

Flow causes Friction Force

Friction Force in balance with Difference in Water Level



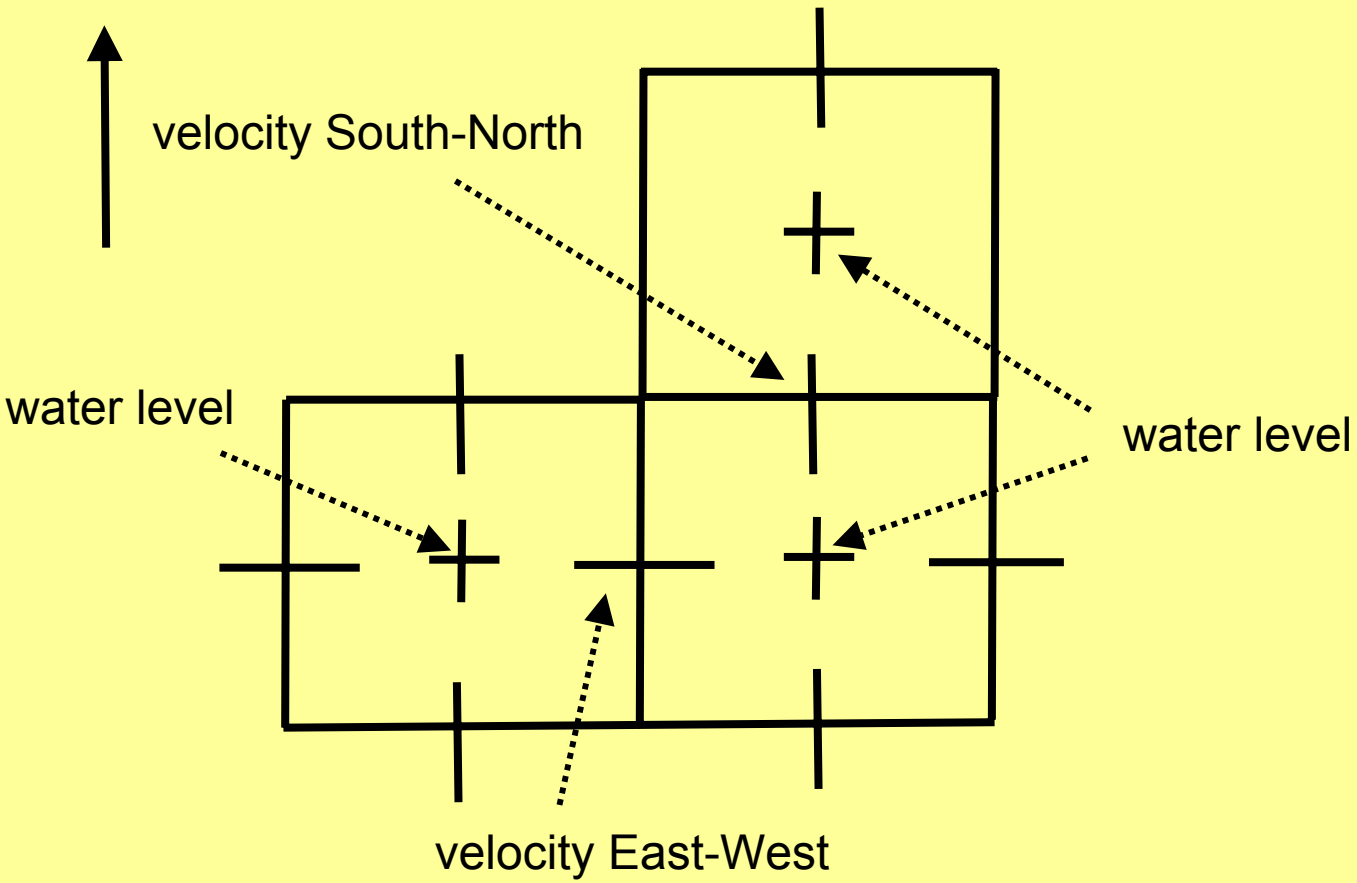
SOBEK – Currents modelled as a Network (1D)


SOBEK - Intrusion of Fresh and Salt water
Leidse Plein
Zeeburg
IJmeer
Schinkel
Berlagebrug
Weespertrekvaart
Diem
Amstel
Bullewijk
Driemond
Holendrecht
Gein
spoorbrug Abcoude
Nessersluis
Winkel
Oude Waver
Angstel
Vecht
Amsterdam-Rijnkanaal
Winkel
Amstel-Drechtkanaal
Kromme Mijdr

DELFT3D-FLOW : depth-averaged 2D and 3D simulations

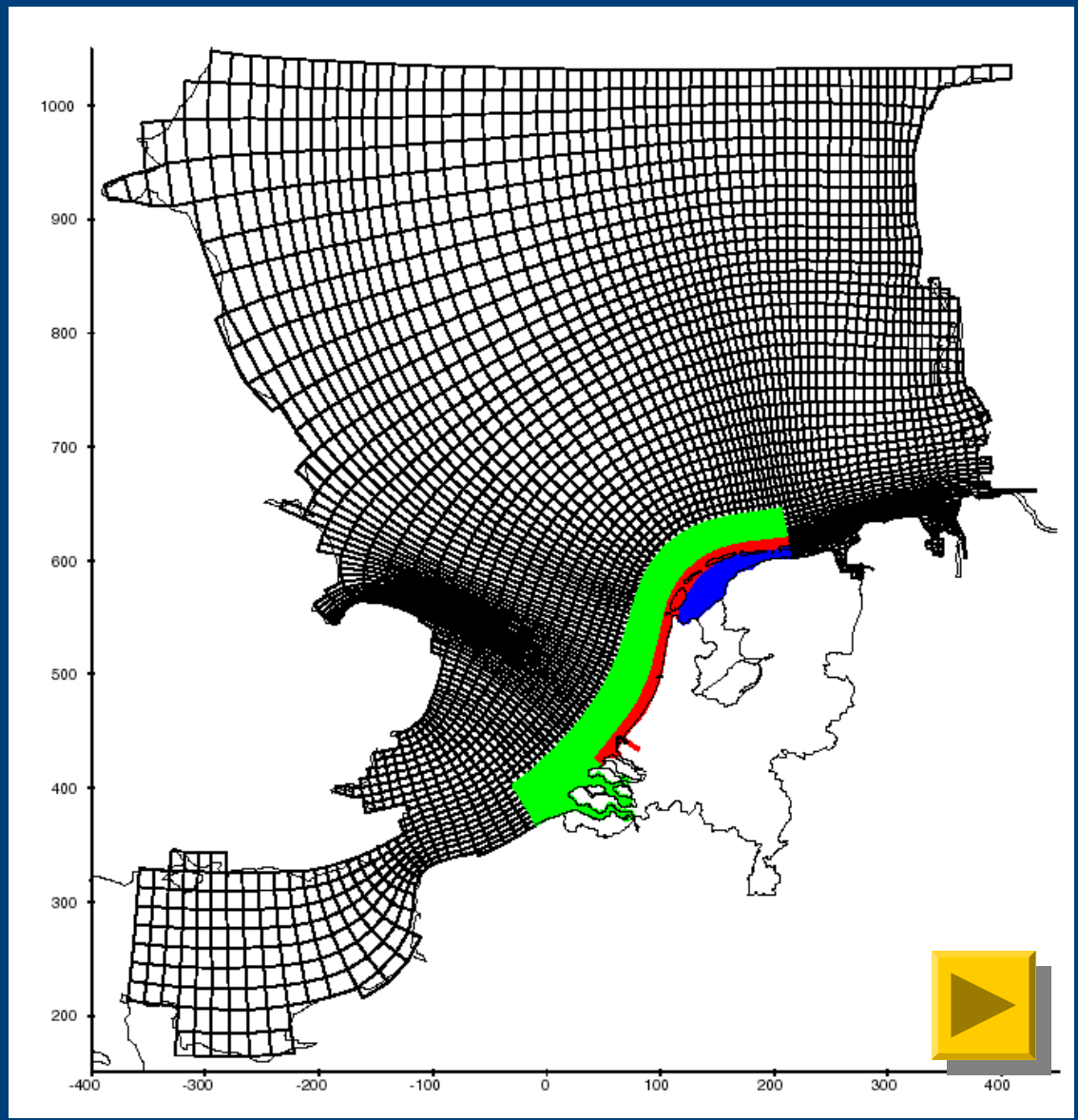
Delft3D-Flow

horizontal grid (structured)



Domain Decomposition:

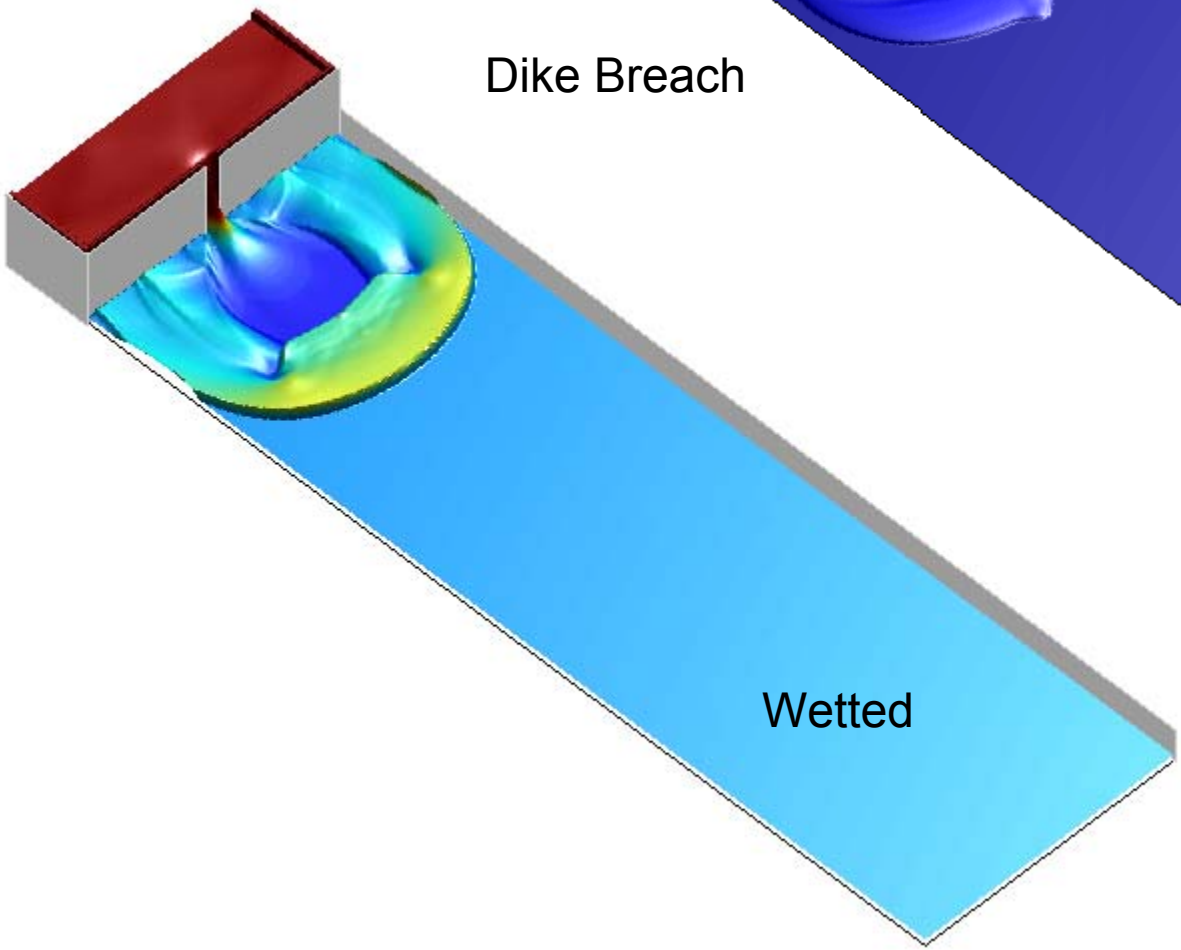
- Continental Shelf
- Southern North Sea
- Coastal Sea
- Estuary
- River



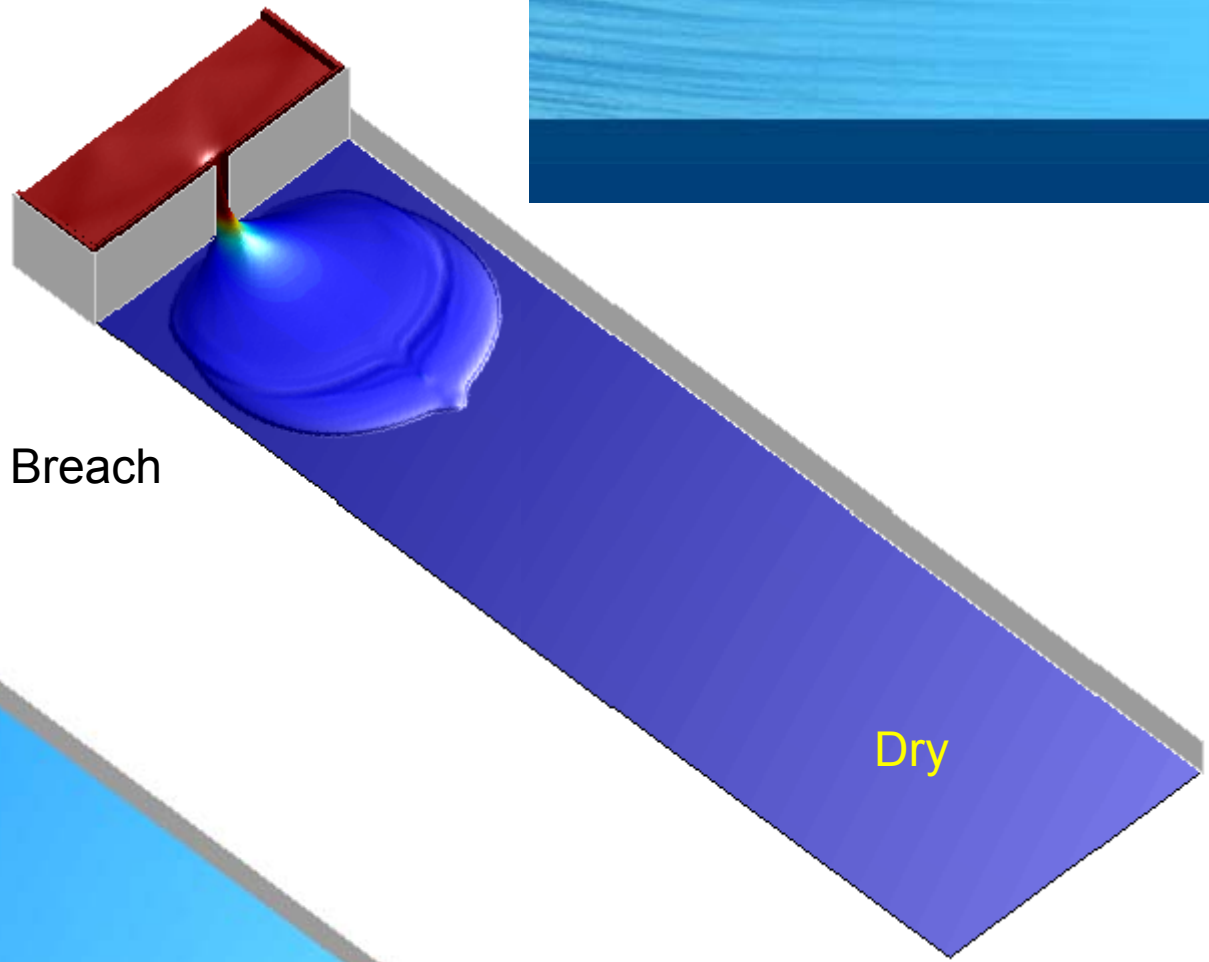
Flooding by Dike Breach

Prof. Stelling (Delft University)

2D Simulation of Flooding



Dike Breach



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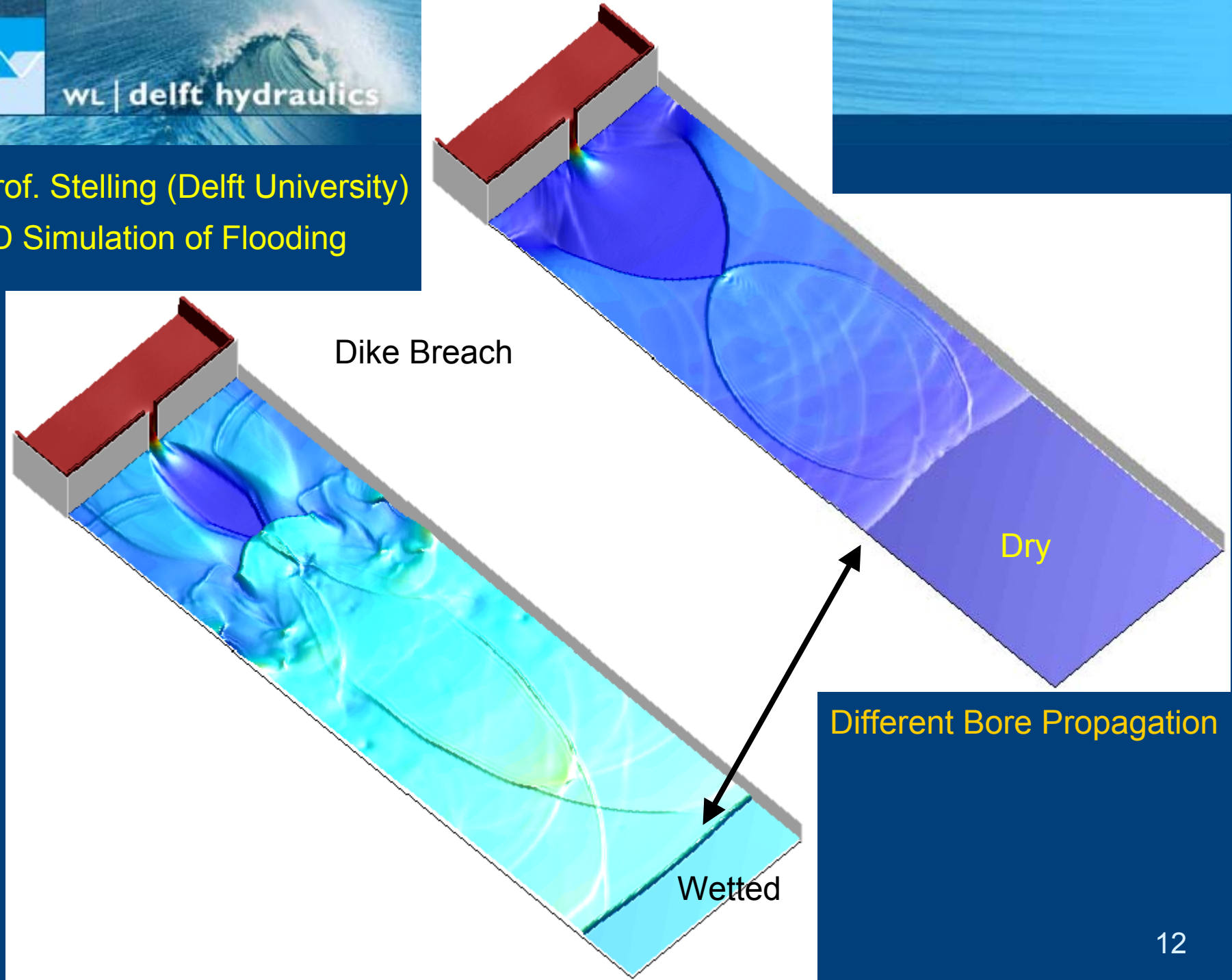
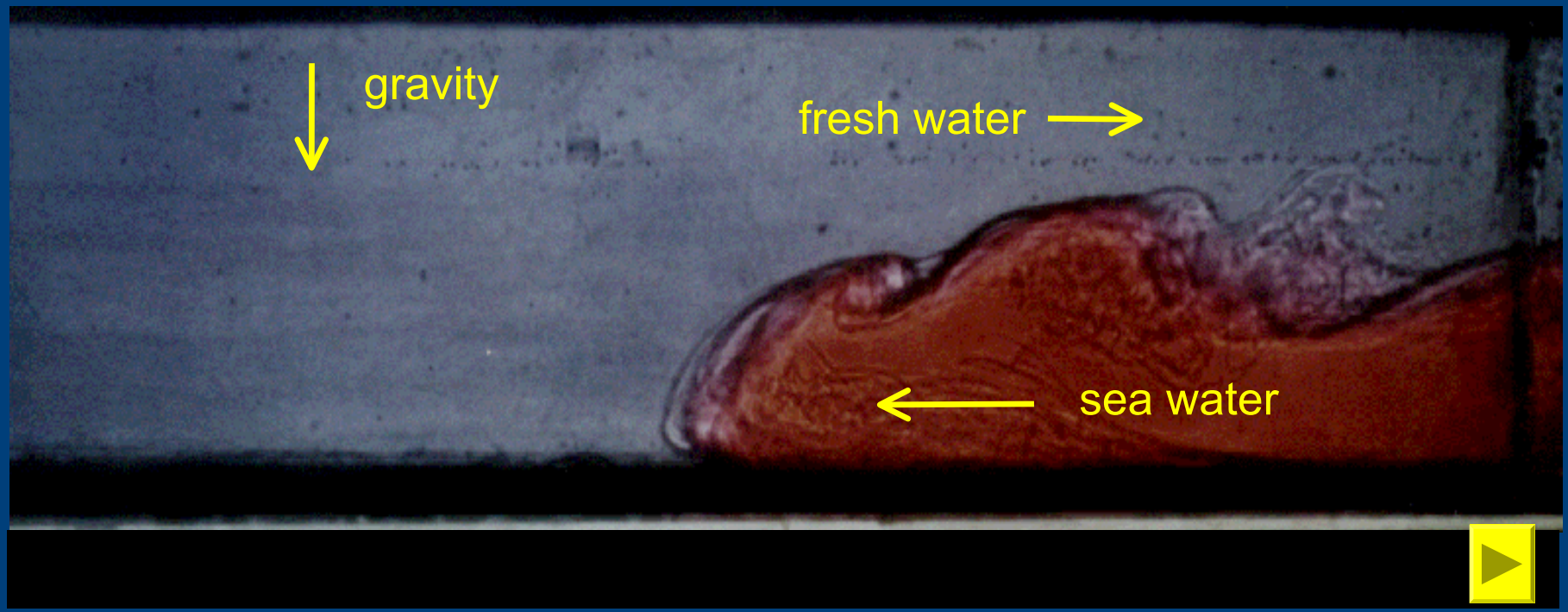
2D Simulation of Flooding

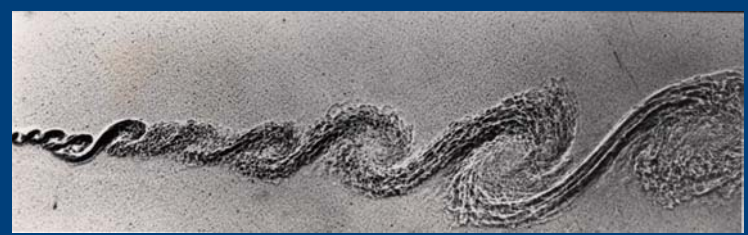


Different Bore Propagation

Gravity Currents



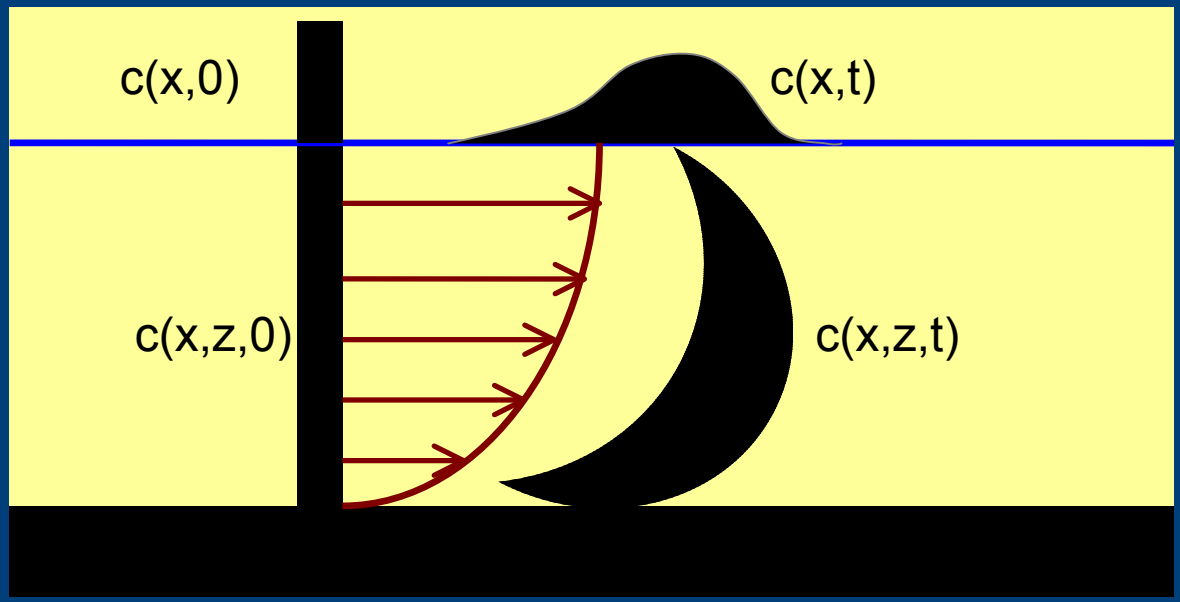
Stratified Shear Flow :



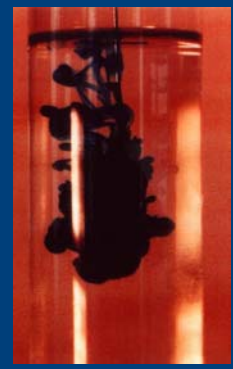
Kelvin-Helmholtz Instability

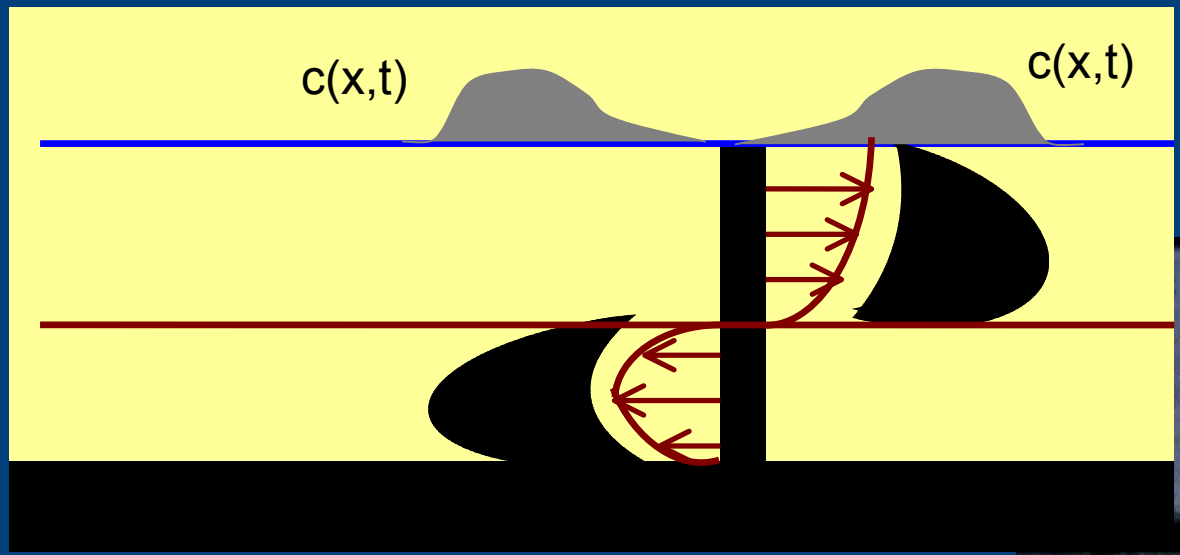
Shear Dispersion

depth-averaged model (2Dh) or vertical resolution (3D) ?

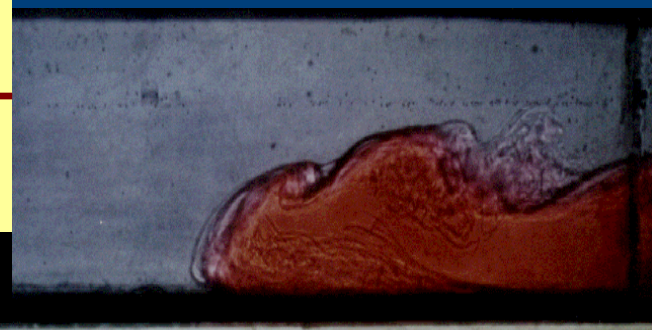


weak dispersion
in homogeneous
flows





strong dispersion
in stratified tidal or
wind-driven flows



wl | delft hydraulics

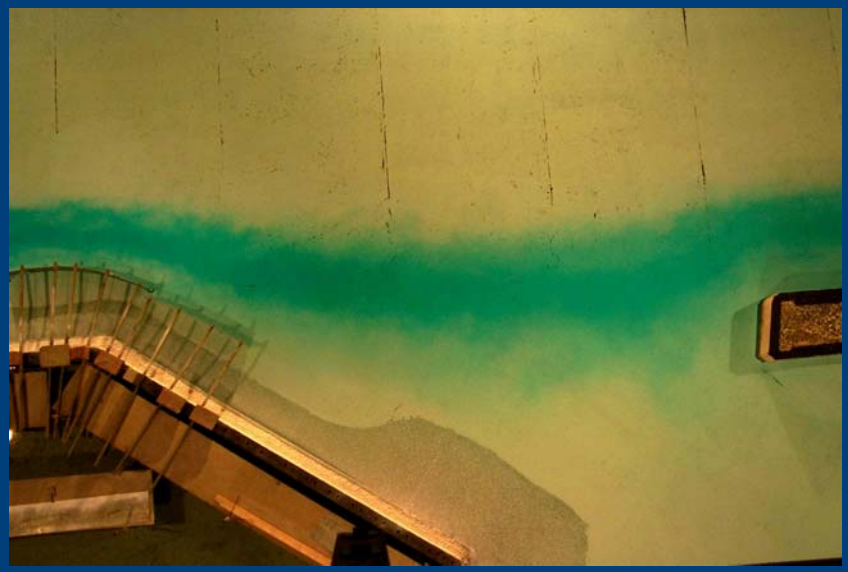
Design of a Current Deflecting Wall in Stratified Flows

Horizontal and Vertical Distribution of the Current

Particles floating on Water Surface

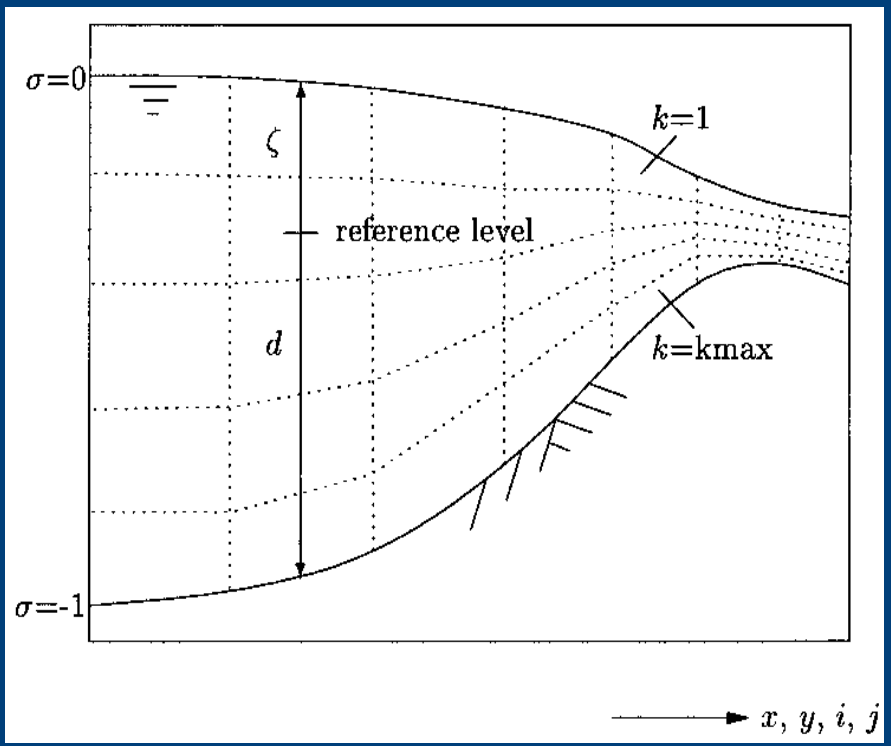
Velocity derived from Particle Paths

Vertical Distribution of Current and Transport

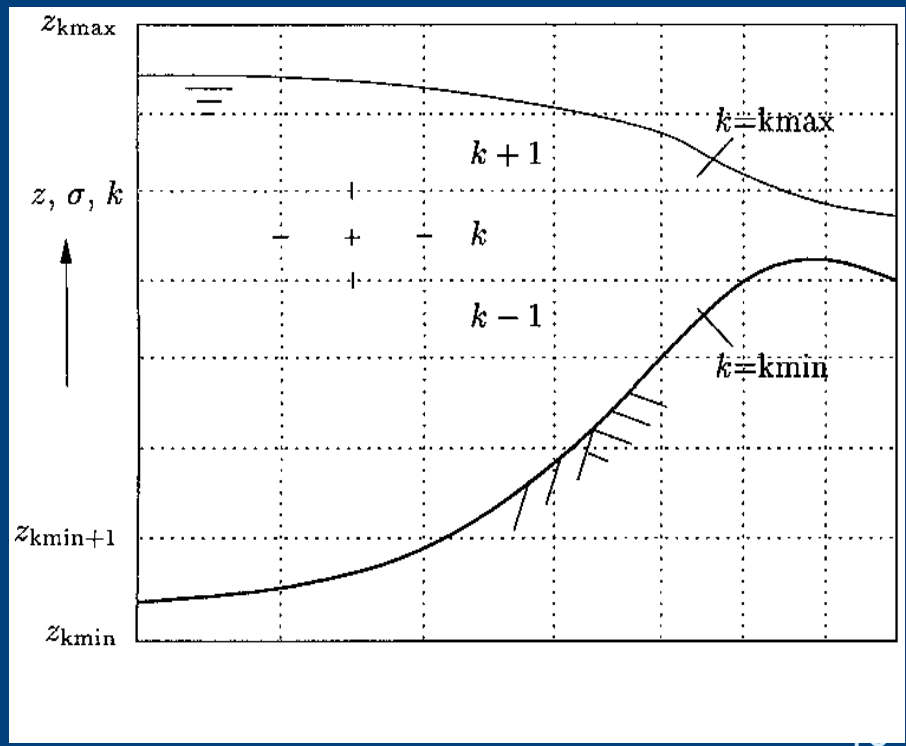


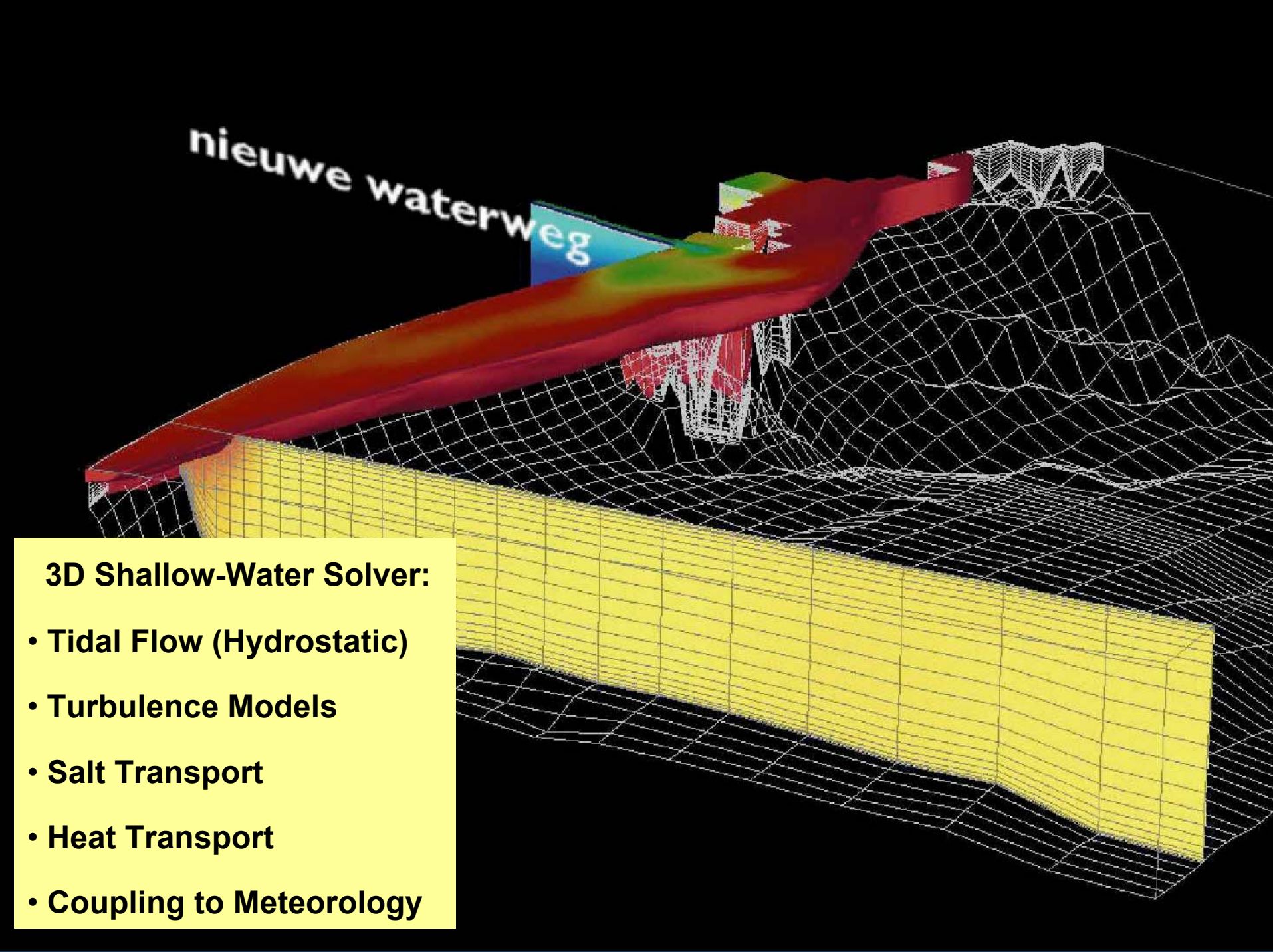
Vertical Resolution of Flow & Transport

Scaling with Local Water Depth



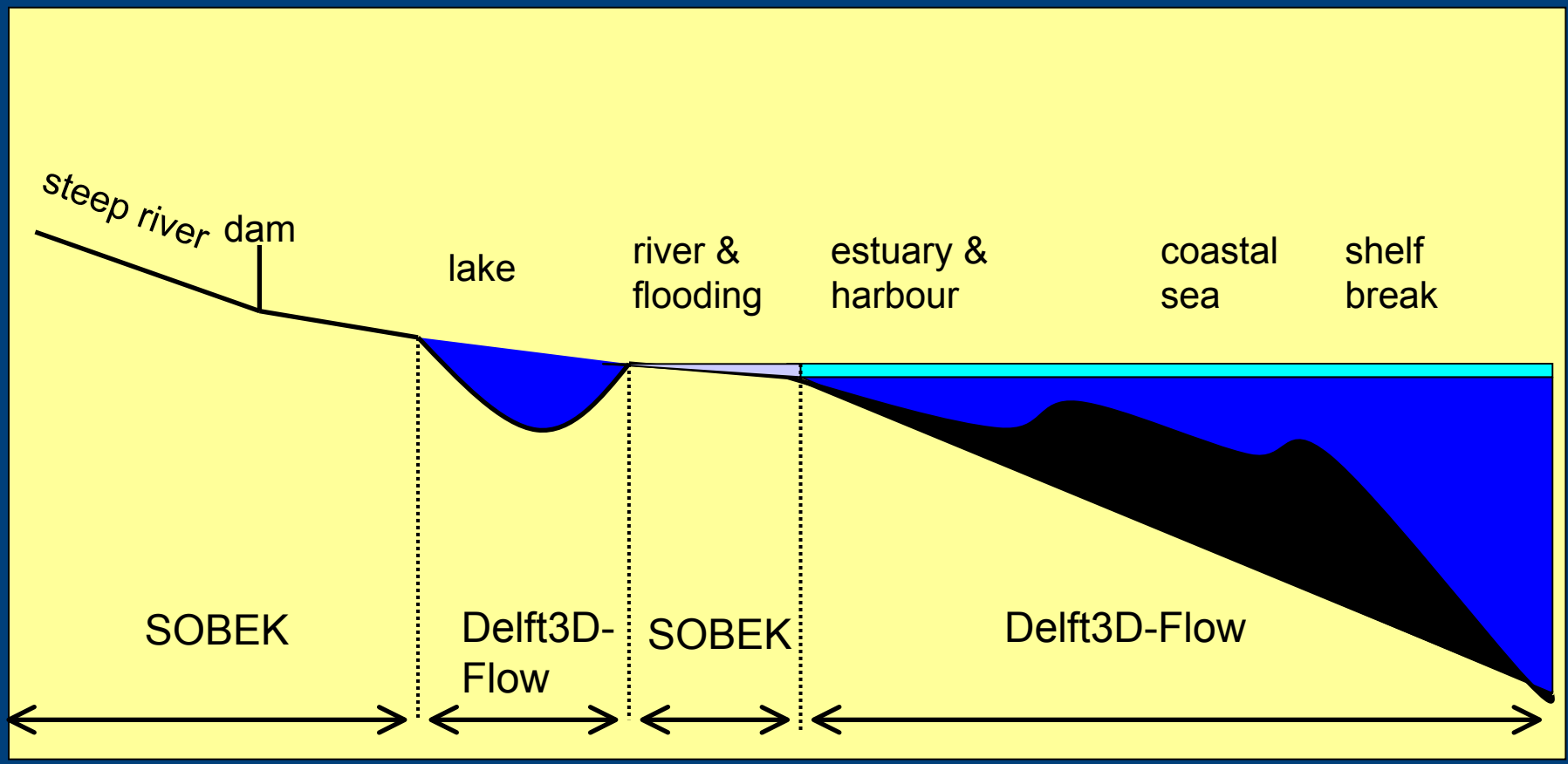
Horizontal Layers



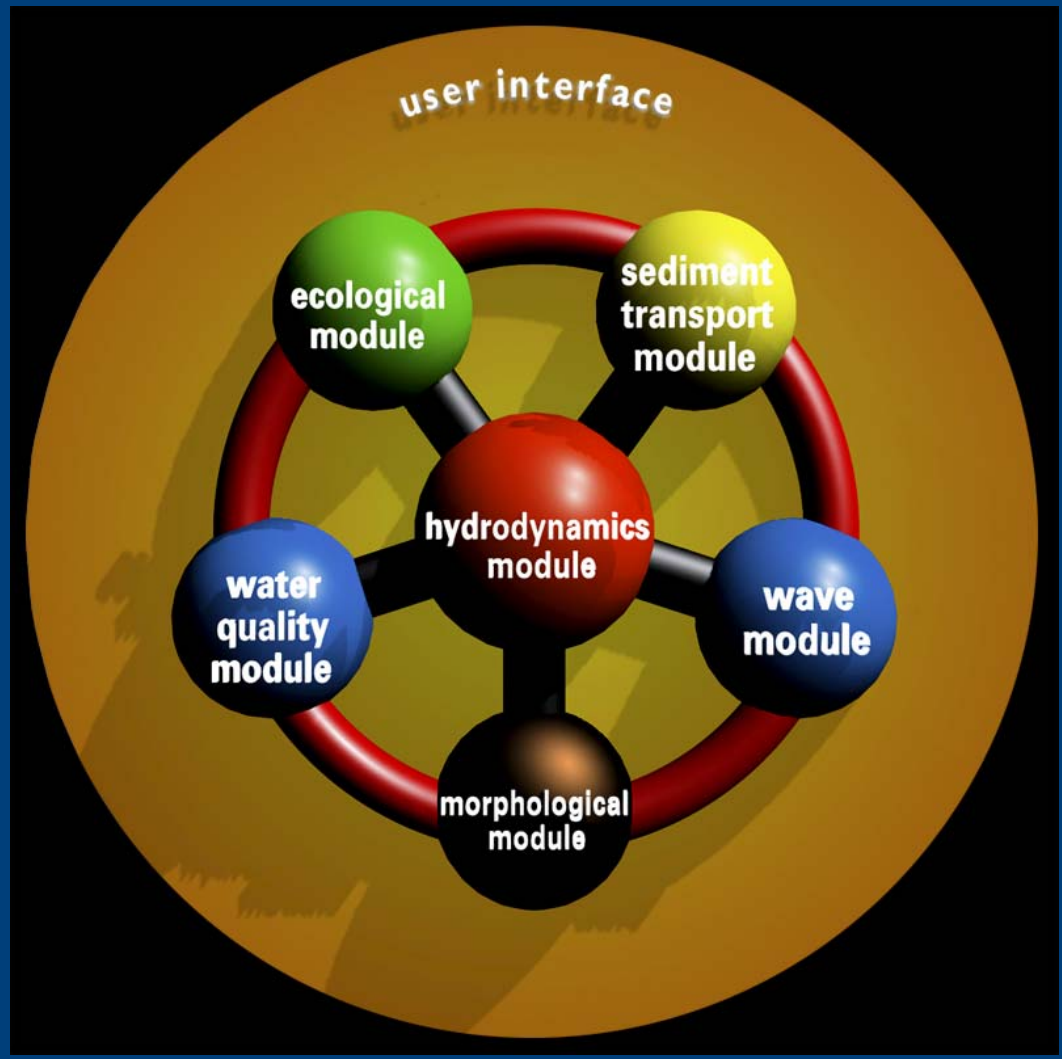


3D Shallow-Water Solver:

- **Tidal Flow (Hydrostatic)**
- **Turbulence Models**
- **Salt Transport**
- **Heat Transport**
- **Coupling to Meteorology**

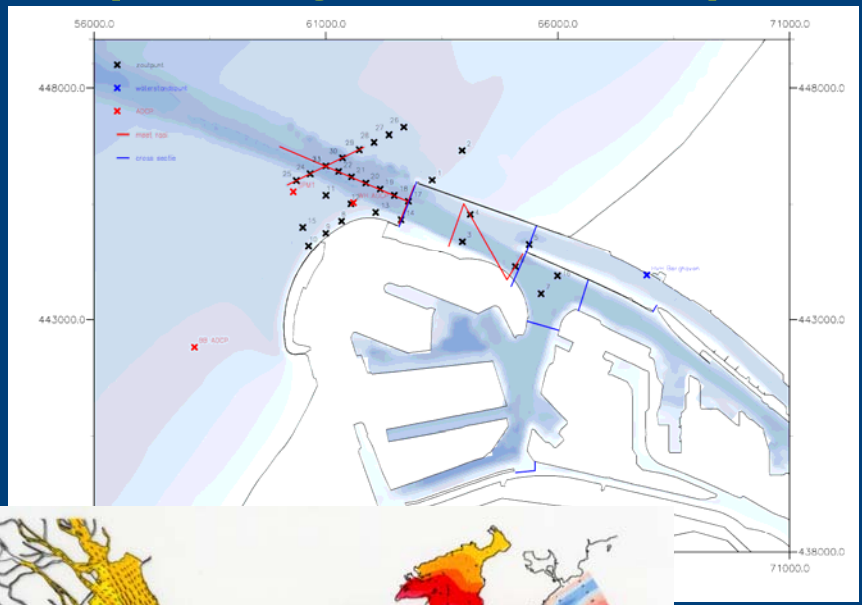

steep river
dam
lake
river &
flooding
estuary &
harbour
coastal
sea
shelf
break
SOBEK
Delft3D-
Flow
SOBEK
Delft3D-Flow

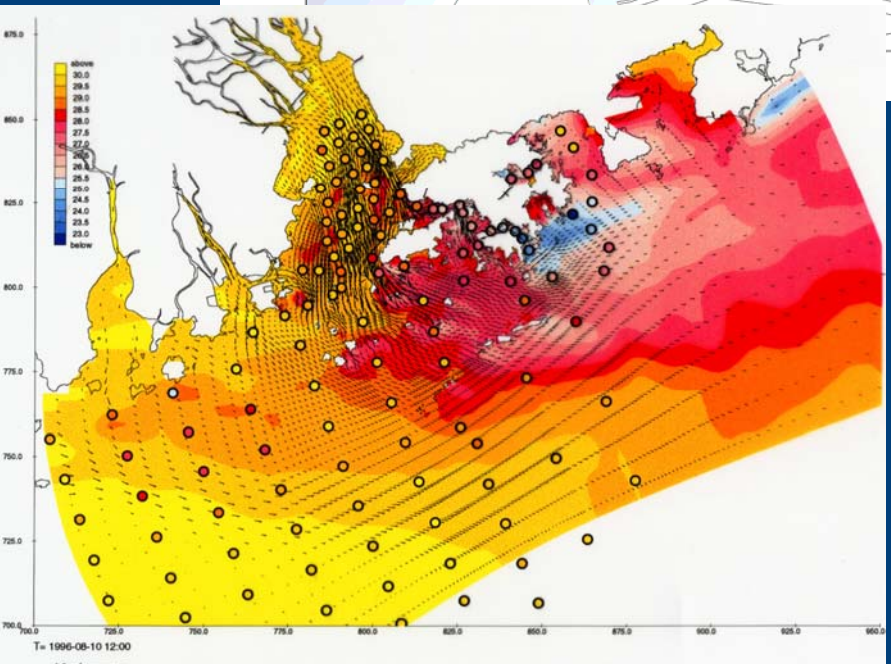
The Delft 3D System



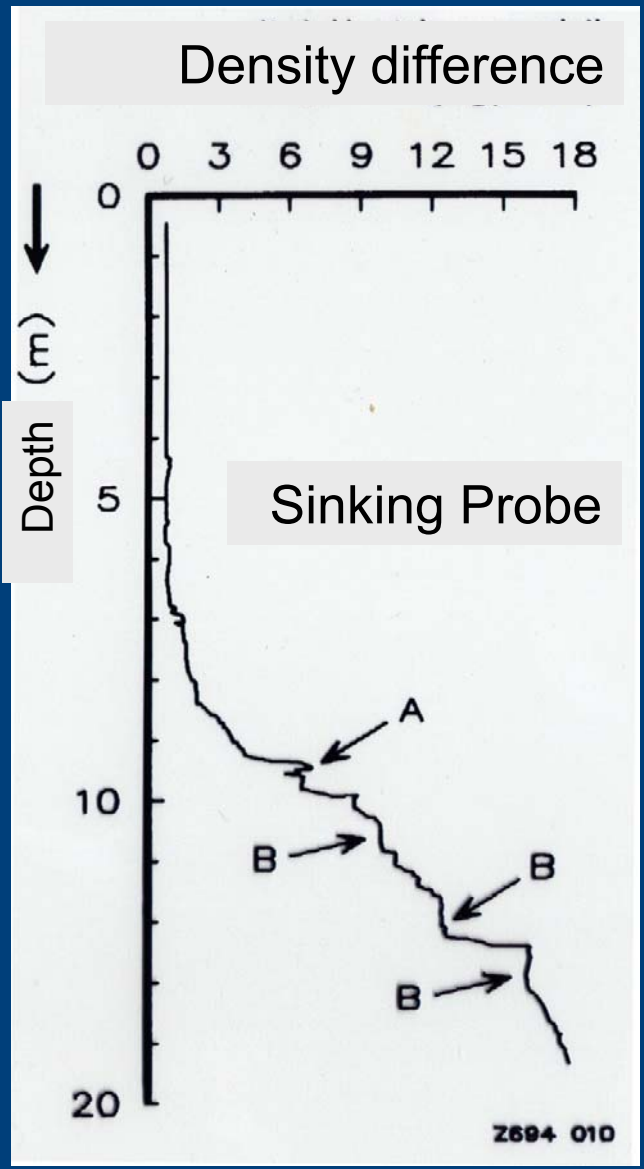
Observations – Measurements

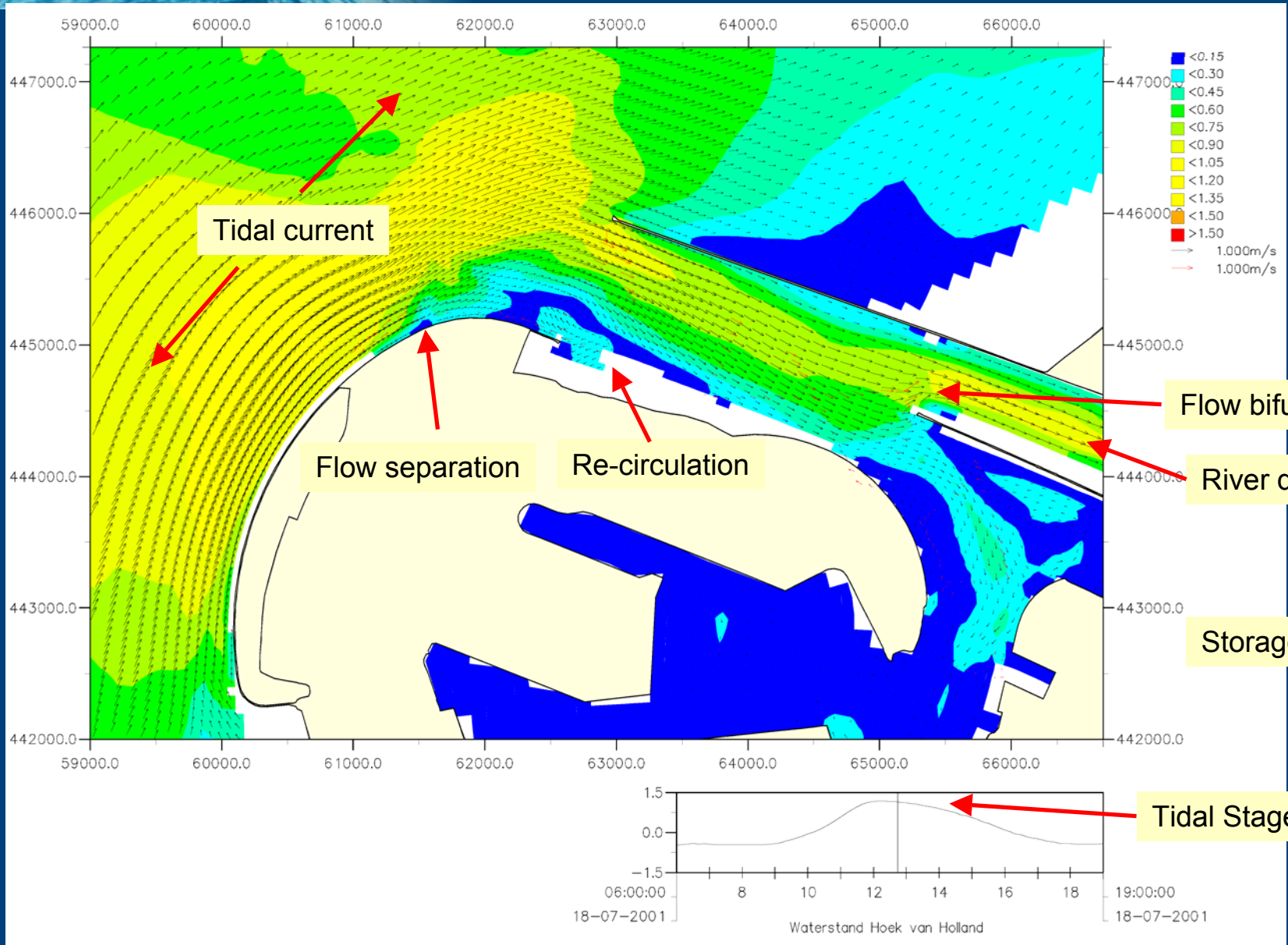
Ships Sailing Transects & Z-paths

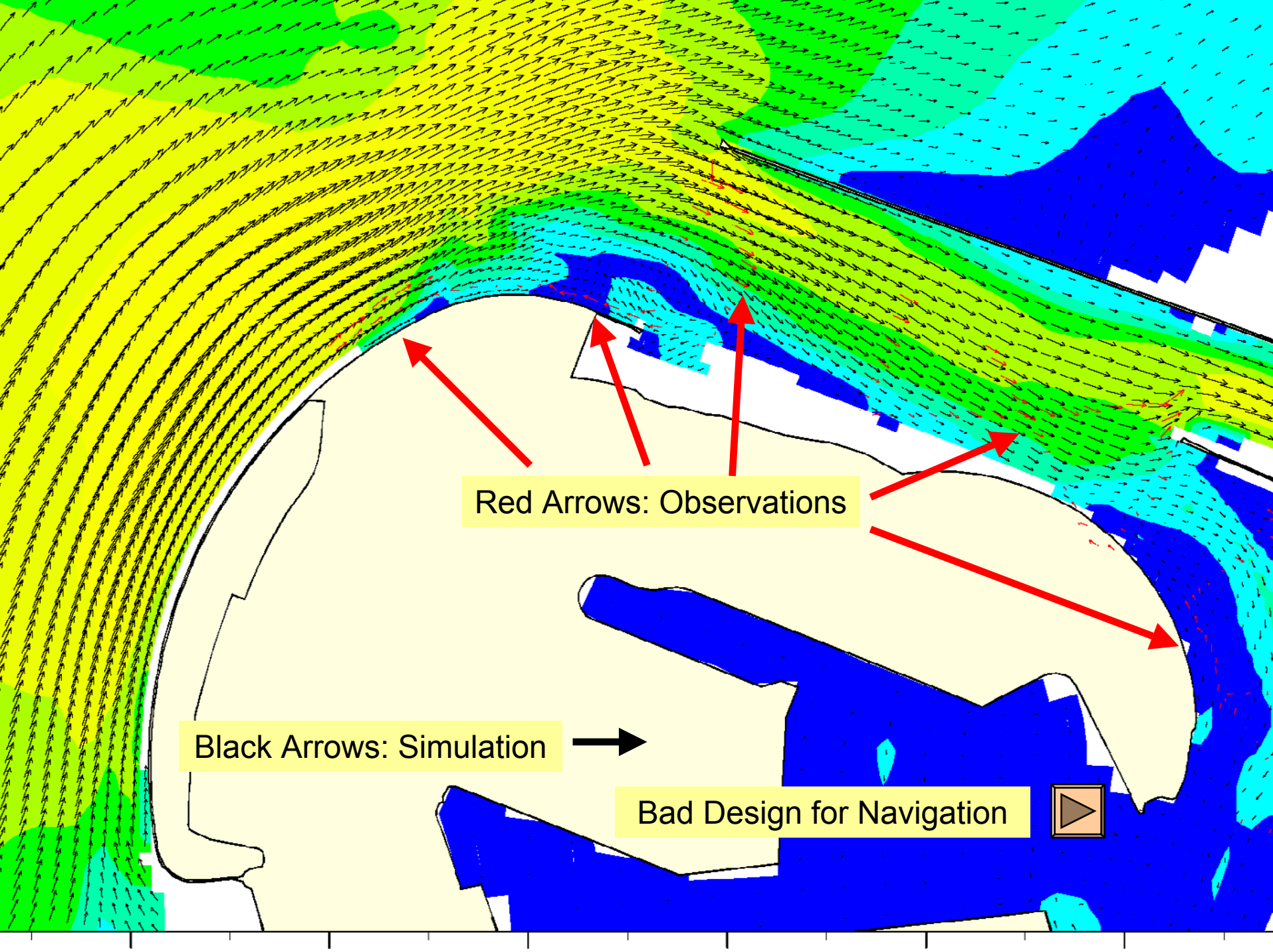




Point Sampling

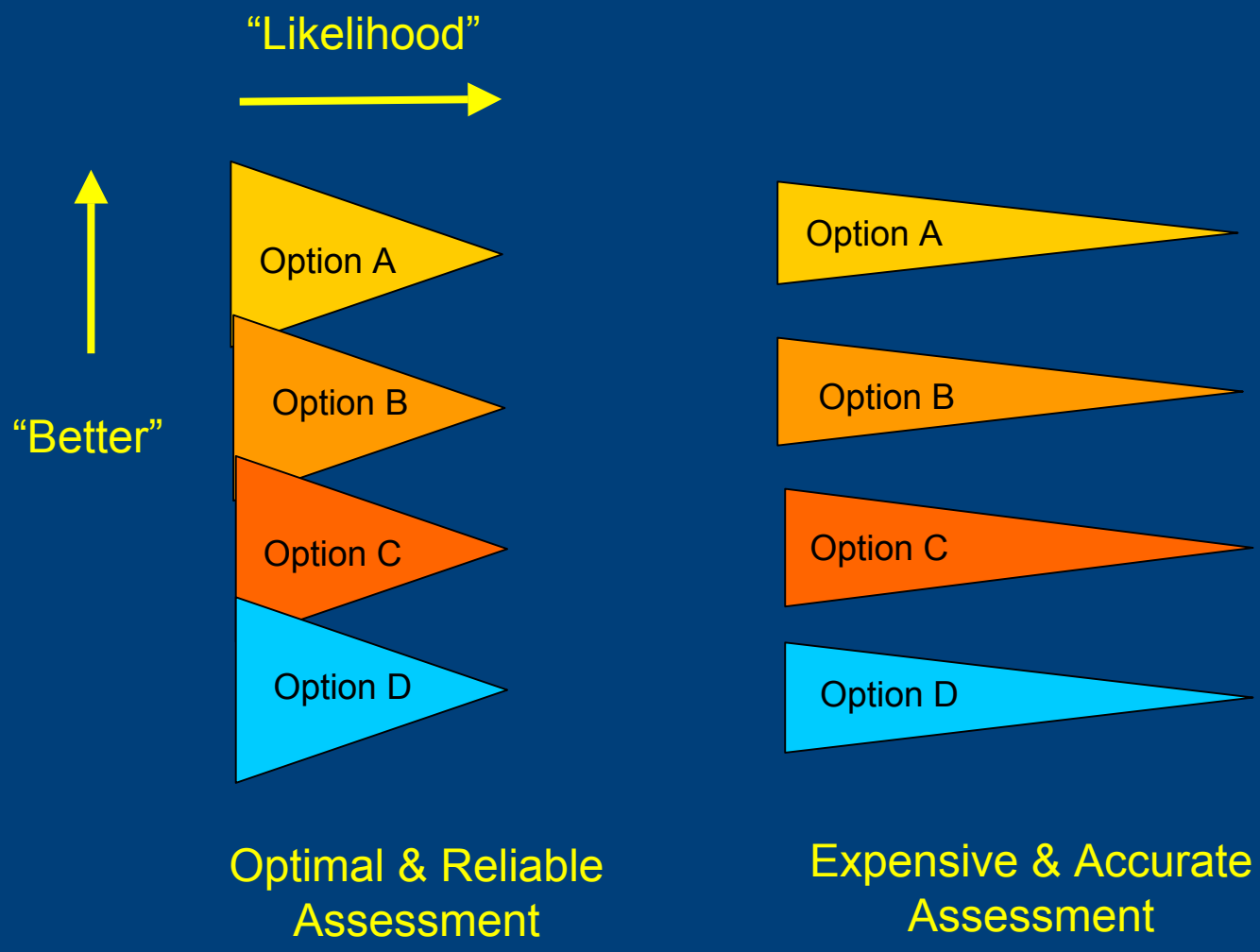



Tidal current
Flow separation
Re-circulation
Flow bifurcation
River discharge
Storage flow
Tidal Stage water level
<0.15
<0.30
<0.45
<0.60
<0.75
<0.90
<1.05
<1.20
<1.35
<1.50
>1.50
1.000m/s
1.000m/s
59000.0
60000.0
61000.0
62000.0
63000.0
64000.0
65000.0
66000.0
447000.0
446000.0
445000.0
444000.0
443000.0
442000.0
1.5
0.0
−1.5
06:00:00
18-07-2001
8
10
12
14
16
18
19:00:00
18-07-2001
Waterstand Hoek van Holland


Red Arrows: Observations
Black Arrows: Simulation
Bad Design for Navigation

Project Objectives

- Choice between alternative designs or solution strategies?
- Optimalisation of the (selected) design/solution strategy?
- The gravity/importance/impact of the project?
- Interpretation of Project Costs: “insurance” or “competition”



Optimal & Reliable Assessment

Expensive & Accurate Assessment

Where New Harbour/Extension ?

Constraints:

Sewage Outfall

Drinking-Water Intake

Cooling-Water Inlet

Cooling-Water Outlet

Navigation

Maintenance Dredging

Safety Flooding

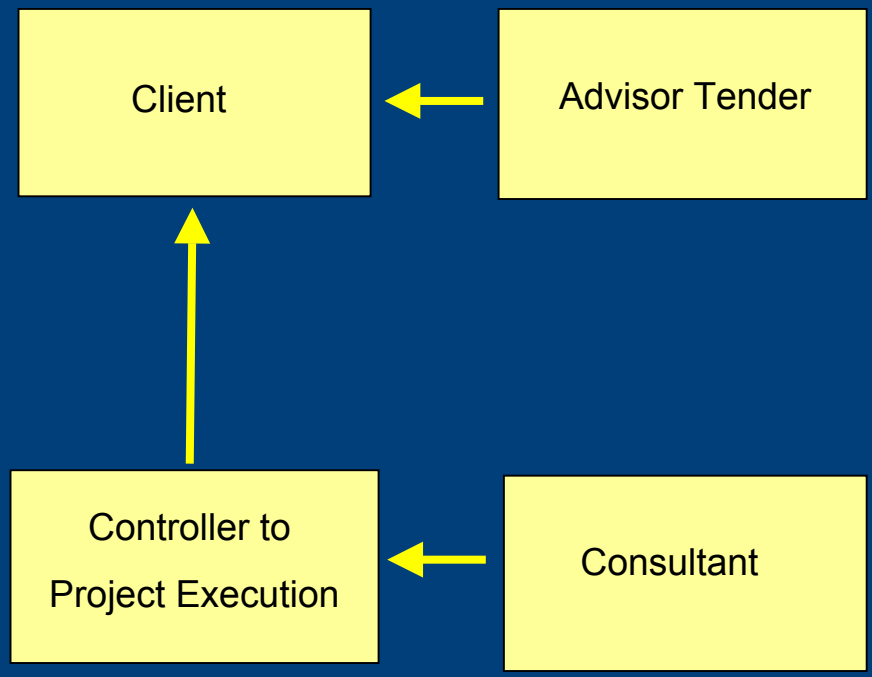
Safety Industry

Bridges & Roads

Toolbox : Manual Selection of Imagined Options

Constraint Logic Programming : Exclusion of Impossible Locations

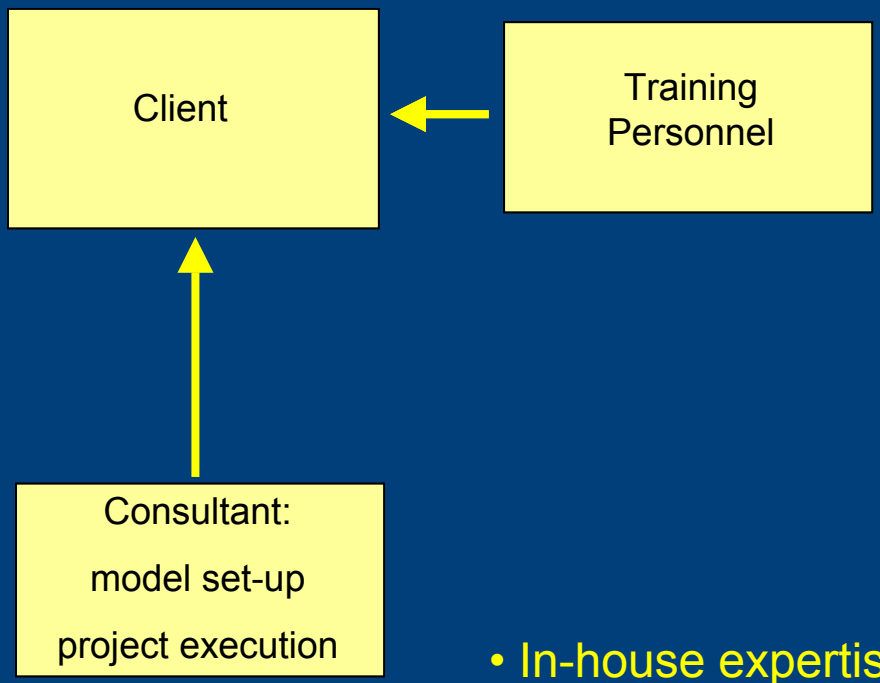
Single / Unique Project



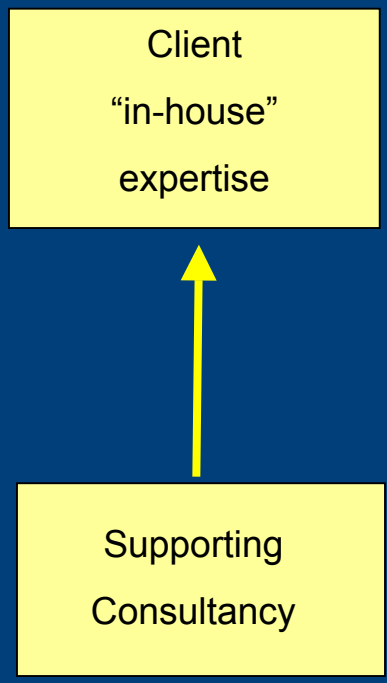
- No in-house expertise
- Not flexible
- Time Consuming
- Costly

Multiple Projects

First (pilot) Project



Subsequent Projects



- In-house expertise
- Flexible
- Responsibility "in-house"
- Cheaper and faster with subsequent projects

Training Personnel

WL|Delft Hydraulics:

- Delft-Water Fundamentals
- Hands-on Training
- Model Set-up
- Personal Contacts

Delft Knowledge City:

IHE : large int'l network

Delft University Technology

Thank You !

Questions ?