



Arab Academy
for Science Technology & Maritime Transport

The International Maritime
Transport and Logistics Conference

“Marlog 11”

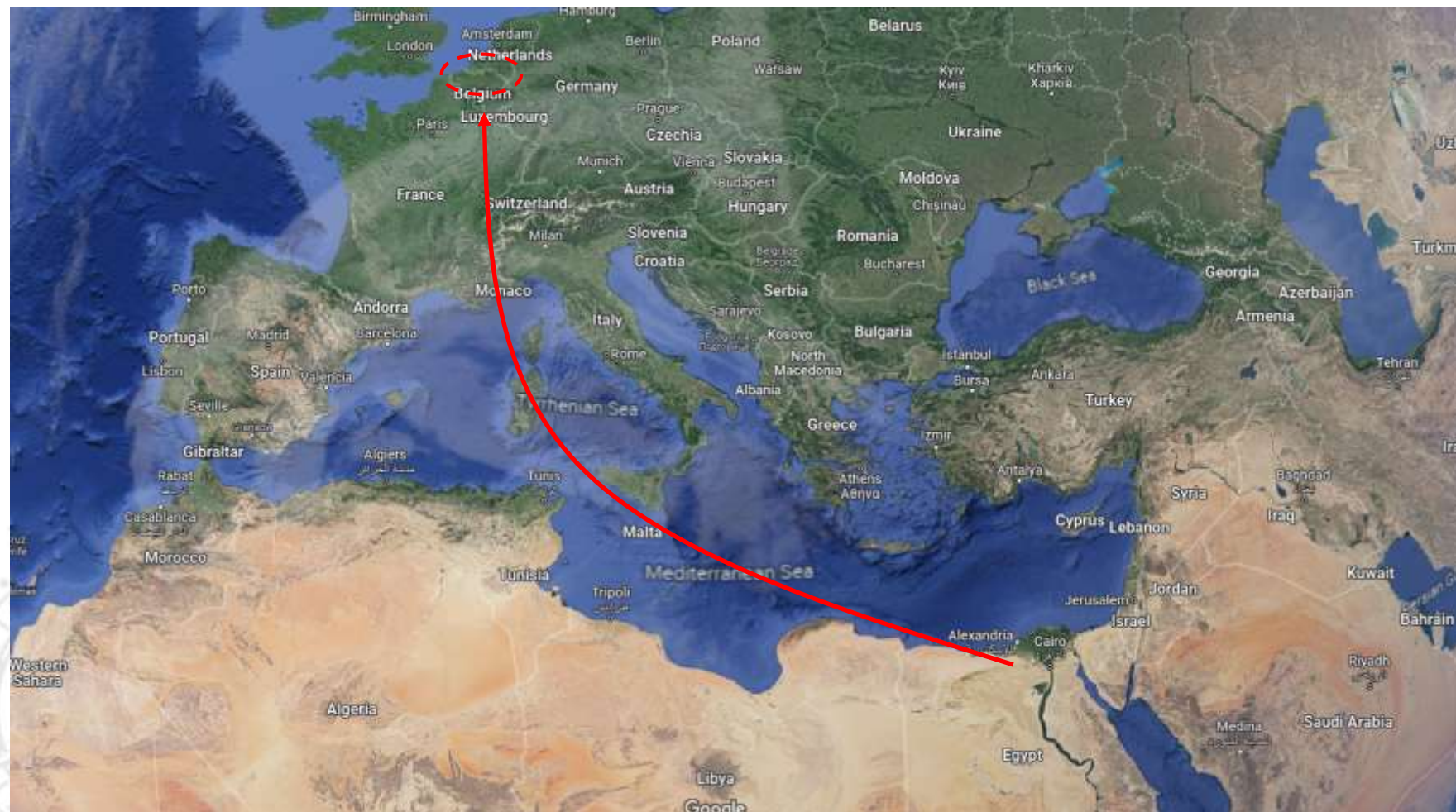
Smart Ship Controllers for Accessibility Optimization

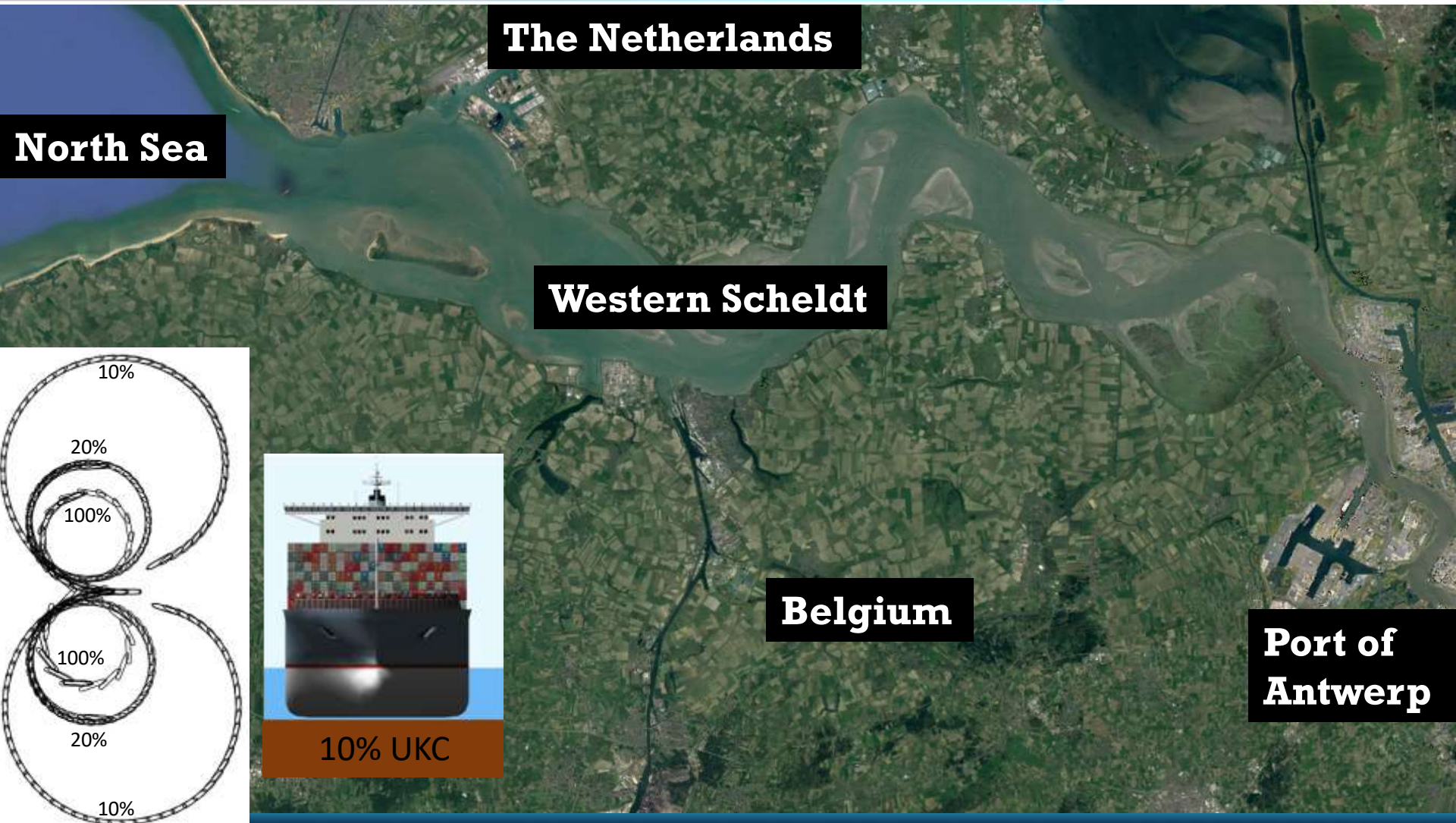
Thibaut Van Zwijnsvoorde
Flanders Hydraulics Research



Towards a
SUSTAINABLE **BLUE**
ECONOMY

20 - 22 March, 2022
Hilton Green Plaza Hotel





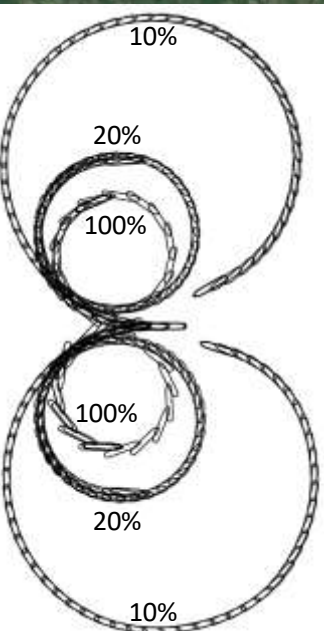
The Netherlands

North Sea

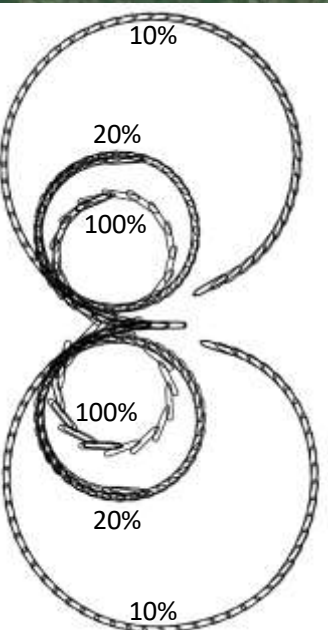
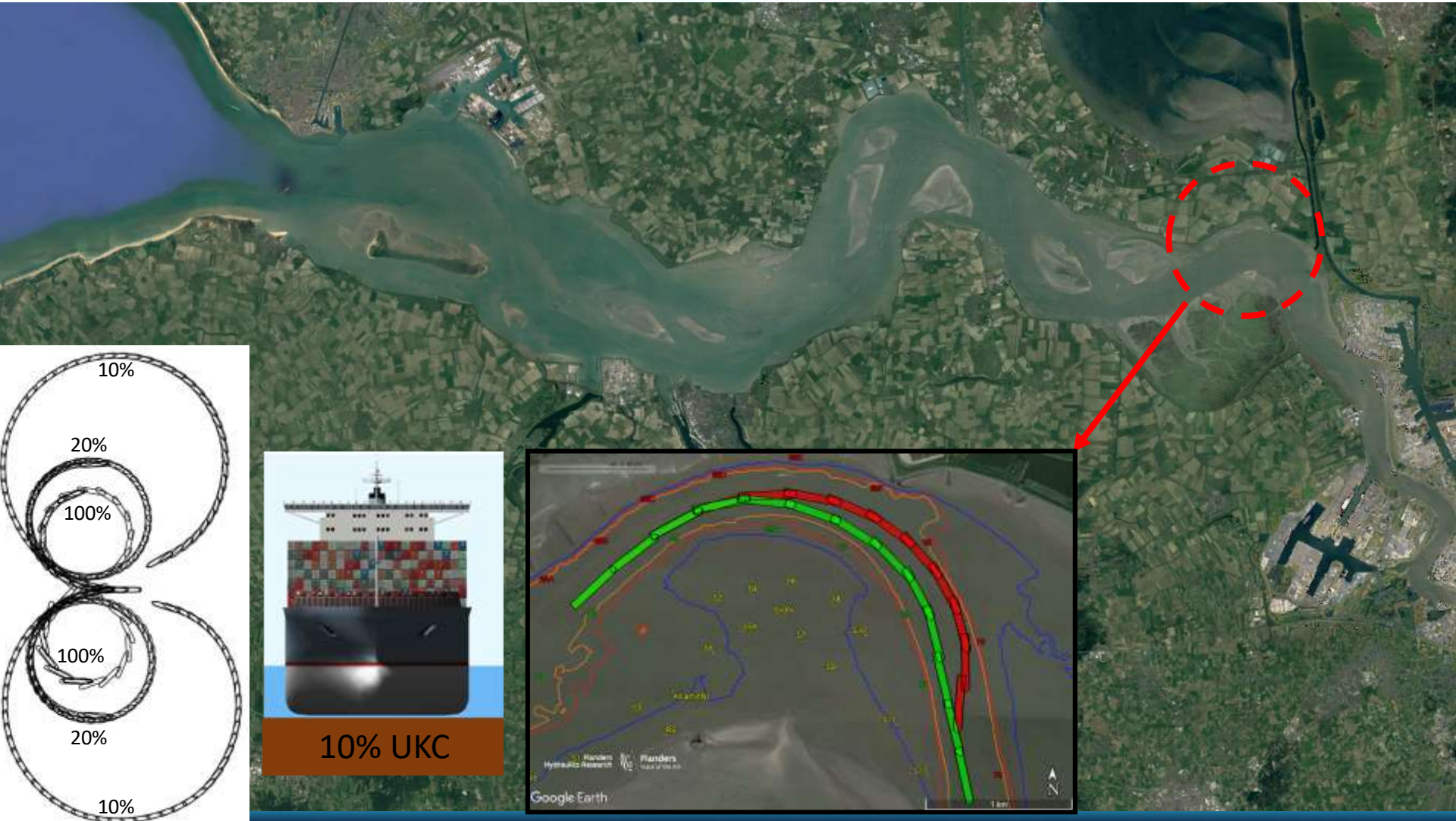
Western Scheldt

Belgium

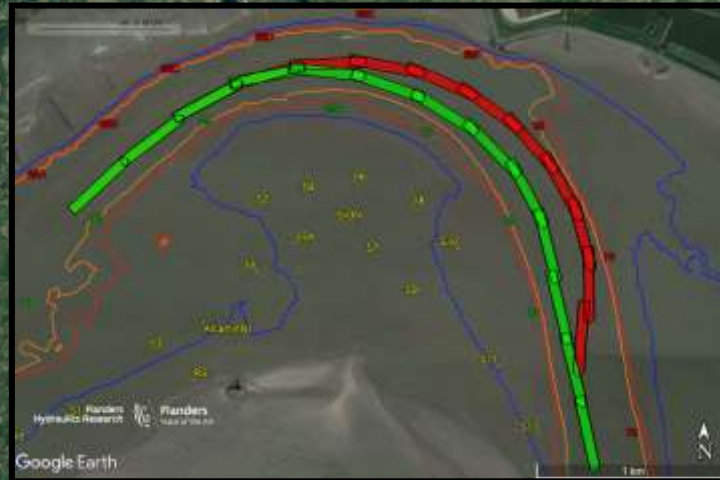
**Port of
Antwerp**



10% UKC



10% UKC



Knowlegde centre for **MA**noeuvring in **SH**allow and **CON**fined water

MASHCON

Flanders
Hydraulics Research



Flanders
State of the Art



TOWING TANKS



CONFINED



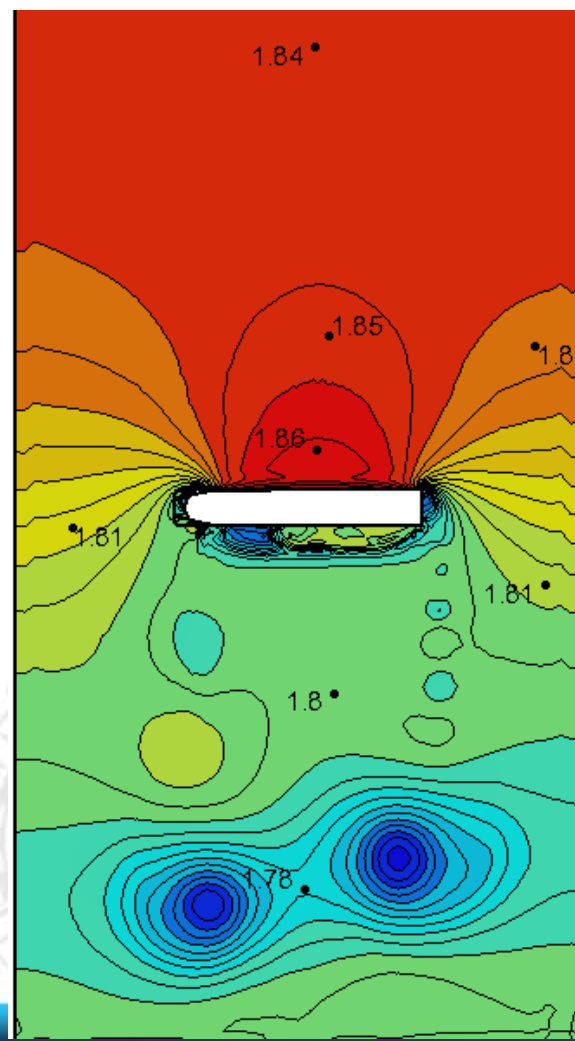
SHALLOW

SIMULATORS

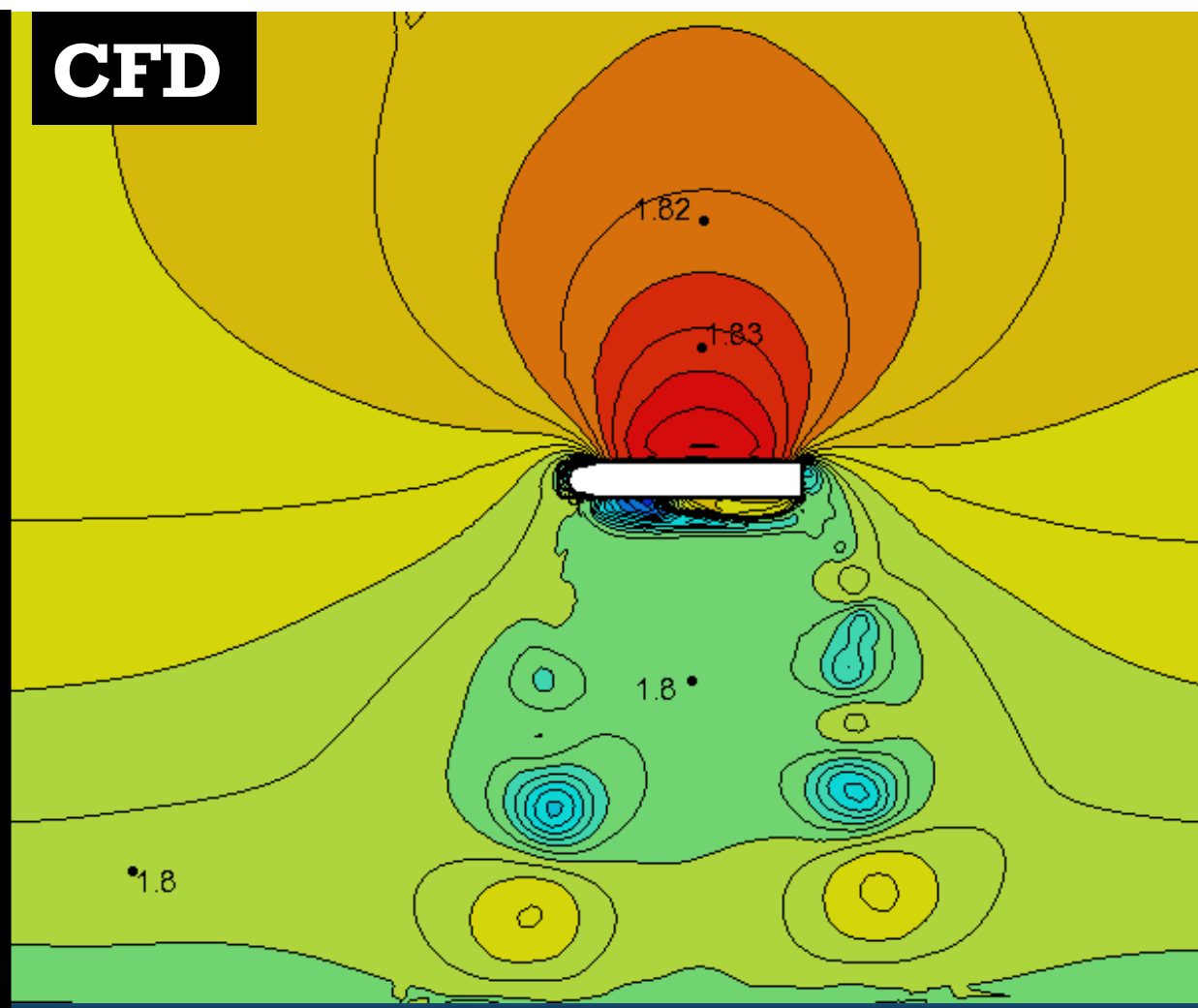
360+

225

INLAND



CFD





Arab Academy
for Science Technology & Maritime Transport

The International Maritime
Transport and Logistics Conference

“Marlog 11”

Smart Ship Controllers for Accessibility Optimization

Thibaut Van Zwijnsvoorde
Flanders Hydraulics Research



Towards a
SUSTAINABLE **BLUE**
ECONOMY

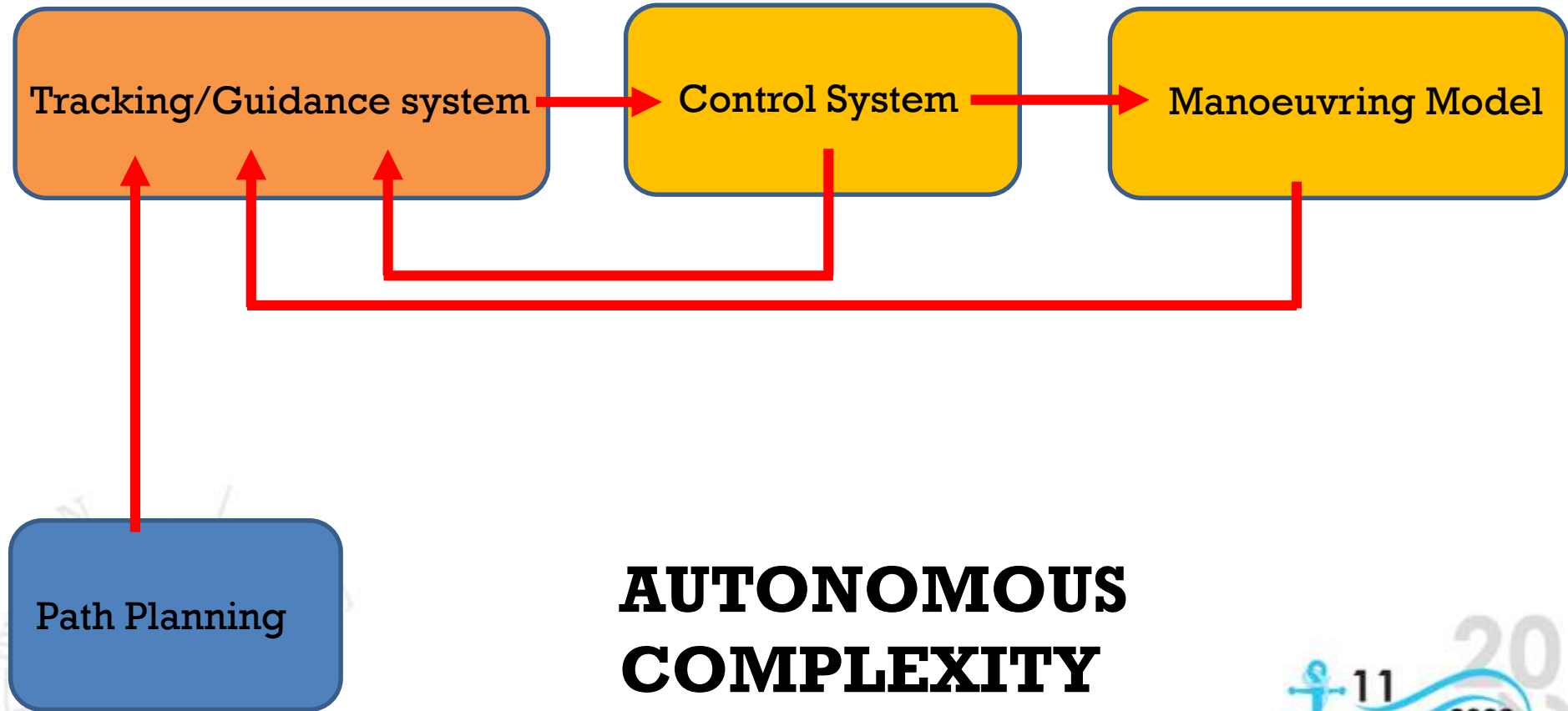
20 - 22 March, 2022
Hilton Green Plaza Hotel

Smart ship controllers

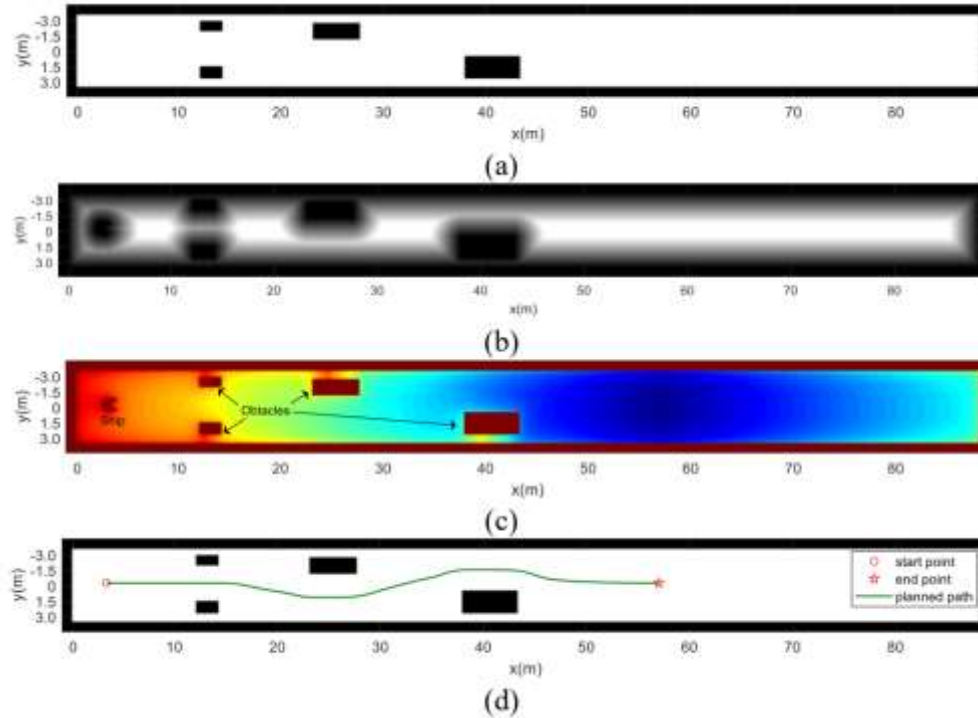


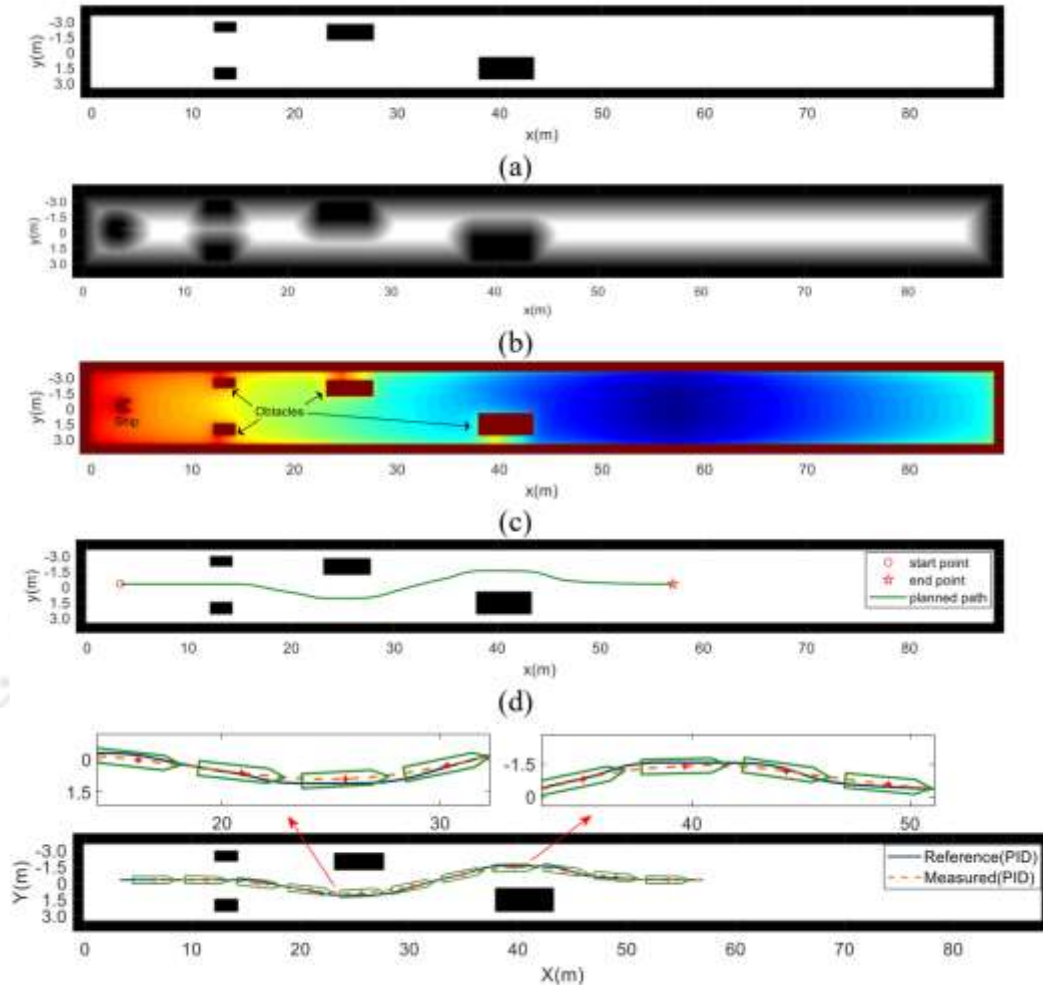
Towards a
SUSTAINABLE **BLUE**
ECONOMY

20 - 22 March, 2022
Hilton Green Plaza Hotel



AUTONOMOUS COMPLEXITY







https://www.youtube.com/watch?v=_3NElcqjrLM



Accessibility Optimization



Towards a
SUSTAINABLE **BLUE**
ECONOMY

20 - 22 March, 2022
Hilton Green Plaza Hotel



Towing tank

Captive tests
or
Free running tests



Physical model

Ship mathematical model

$$X = m[\dot{u} - vr + wq - x_G(q^2 + r^2) + z_G(\dot{q} + pr)]$$

$$Y = m[\dot{v} + ur - wp + x_G(\dot{r} + pq) + z_G(-\dot{p} + qr)]$$

$$Z = m[\dot{w} + uq - vp + x_G(-\dot{q} + pr) - z_G(p^2 + q^2)]$$

$$K = -mz_G(\dot{v} + ur - wp) + (I_{xx}\dot{p} - I_{xz}\dot{r}) - I_{xz}pq + (I_{zz} - I_{yy})qr$$

$$M = m[-x_G(\dot{w} + vp - uq) + z_G(\dot{u} - vr + wq)] + I_{yy}\dot{q} + (I_{xx} - I_{zz})pr + I_{xz}(p^2 - r^2)$$

$$N = mx_G(\dot{v} + ur - wp) + (-I_{xz}\dot{p} + I_{zz}\dot{r}) + I_{xz}qr + (I_{yy} - I_{xx})pq$$



3D view mathematical model

Ship manoeuvring simulators



Real time simulator

Pilot or
Captain



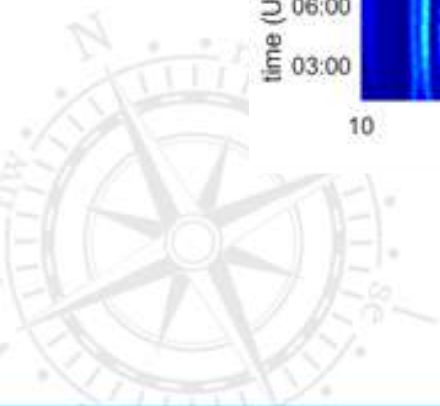
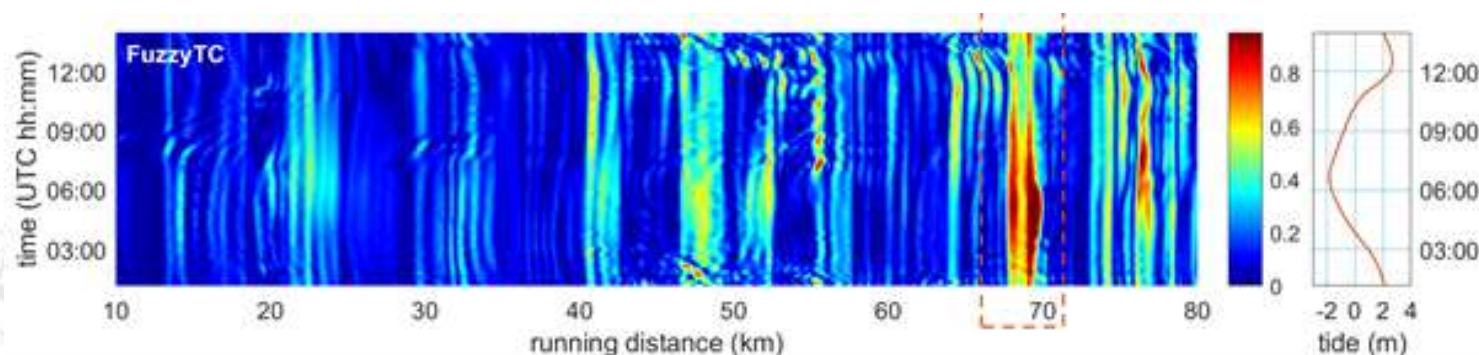
Track
controller



Fast time simulator









<https://youtu.be/TAHs6-J3AAw>



Thank YOU



Towards a
SUSTAINABLE **BLUE**
ECONOMY

20 - 22 March, 2022
Hilton Green Plaza Hotel

References

Chen, C.; Verwilligen, J., Mansuy, M.; Eloot, K.; Lataire, E., Delefortrie, G., 'Tracking controller for ship manoeuvring in a shallow or confined fairway: Design, comparison and application.', *Applied Ocean Research*, volume 115, October 2021.

Chen, C., 'Numerical and experimental study on ship motion control systems in shallow water', *PhD thesis*, June 2021.

