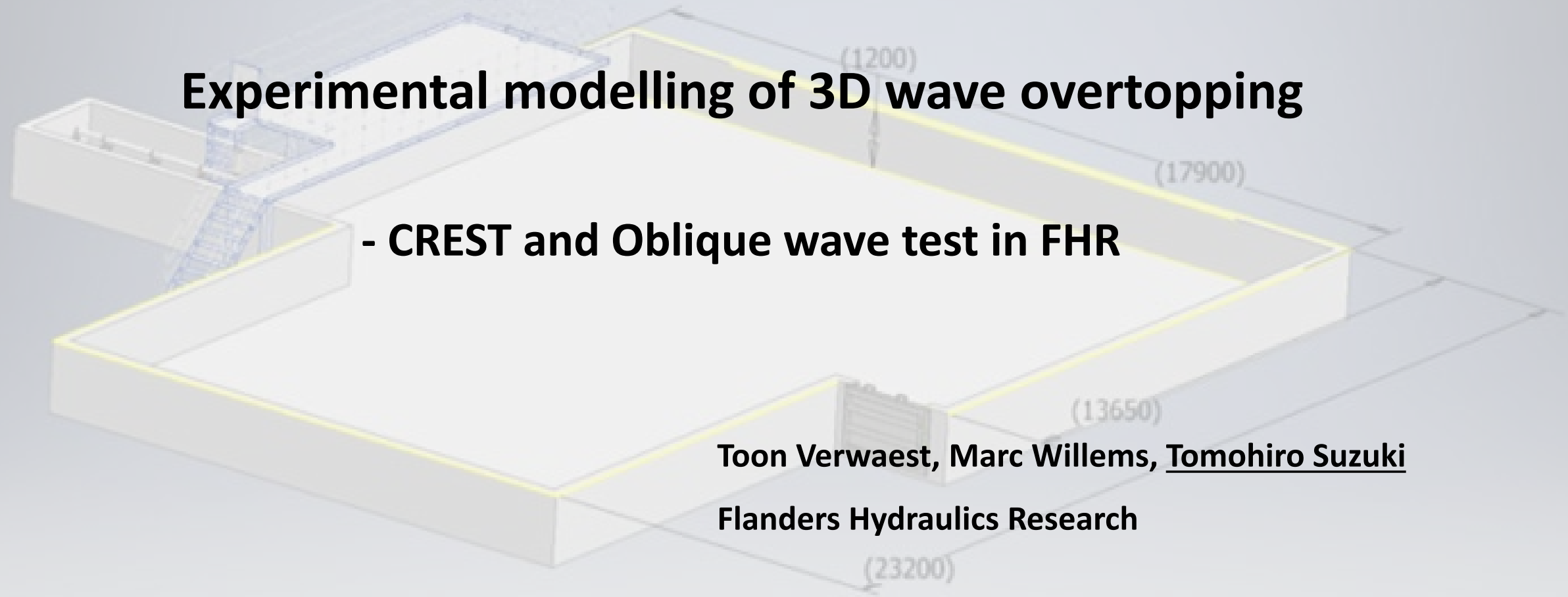
Experimental modelling of 3D wave overtopping

- CREST and Oblique wave test in FHR



Toon Verwaest, Marc Willems, Tomohiro Suzuki

Flanders Hydraulics Research

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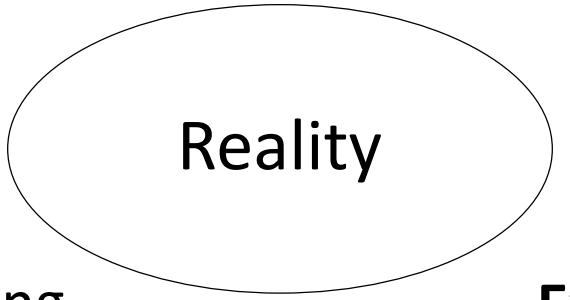
WHY

Experimental modelling of 3D wave overtopping

Theory / Empirical formula

In-situ measurement



Numerical modelling

Experimental modelling

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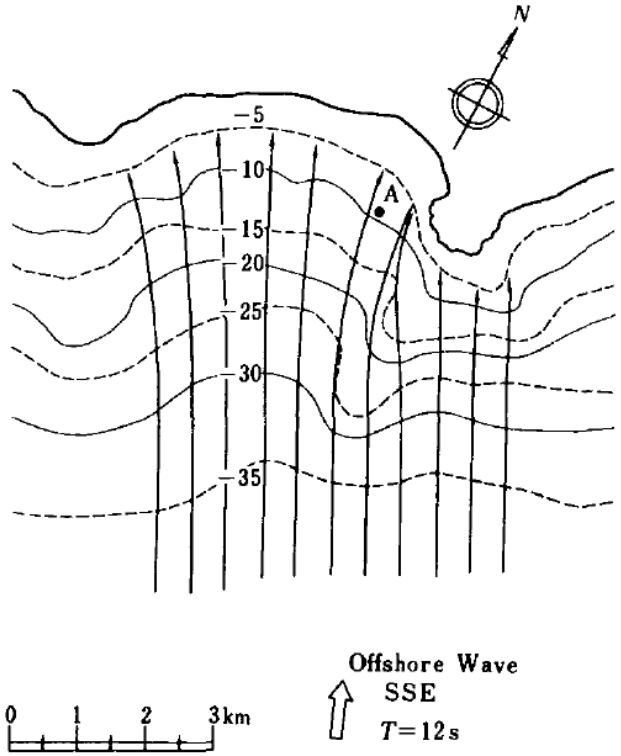
WHY

Experimental modelling of 3D wave overtopping

3D geometry



Directional spreading (3D waves)

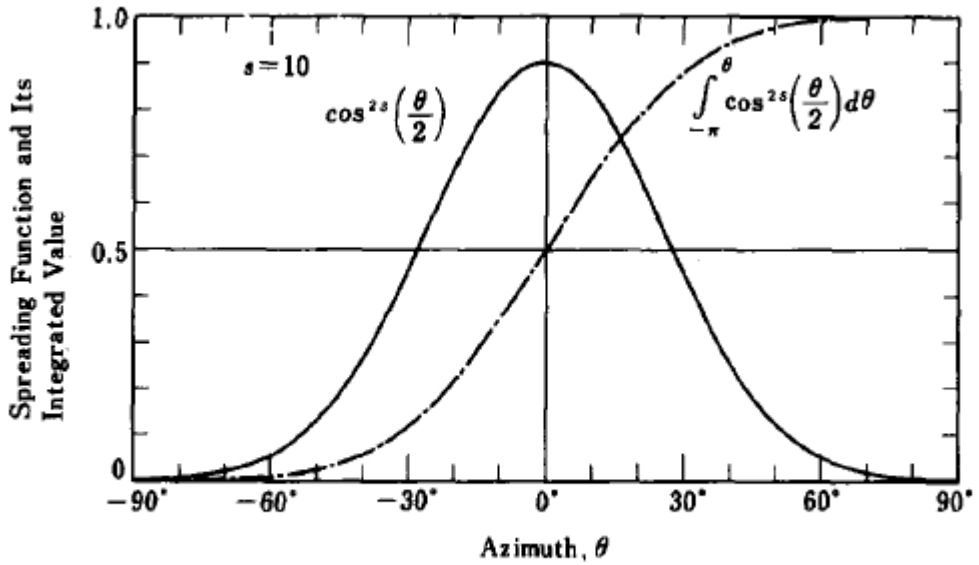


Fig. 2.11. Example of directional spreading function.

Project 1

CREST wave basin test in FHR

2D waves

3D waves

Try to understand the influence of long crested and short crested waves

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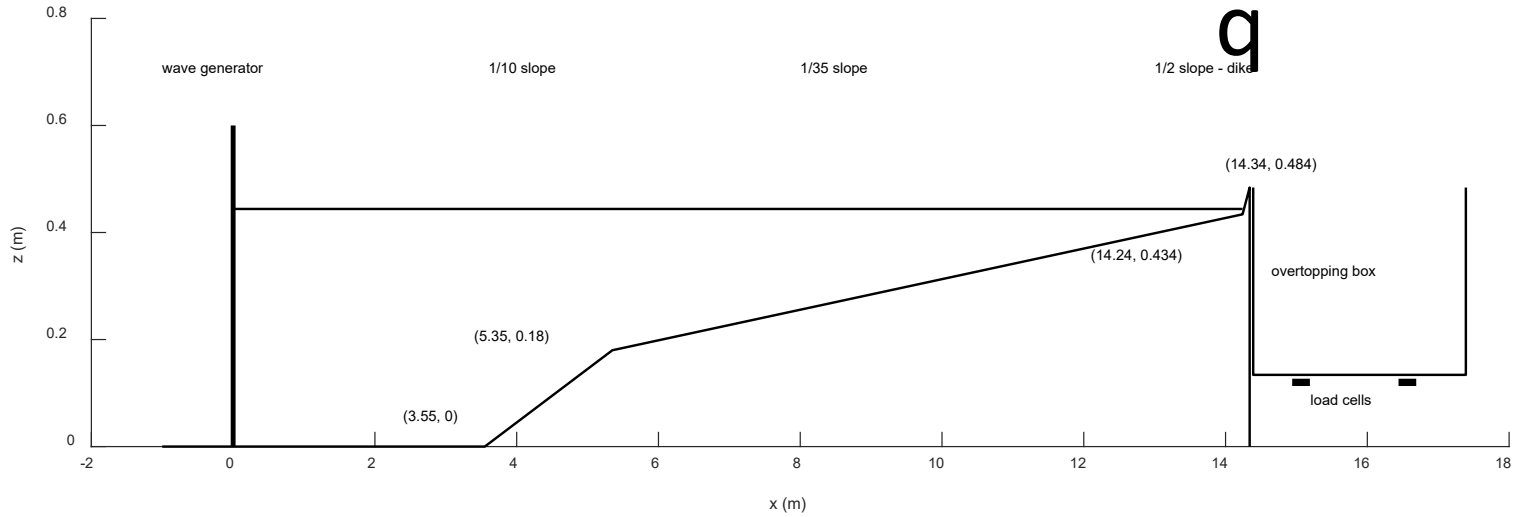
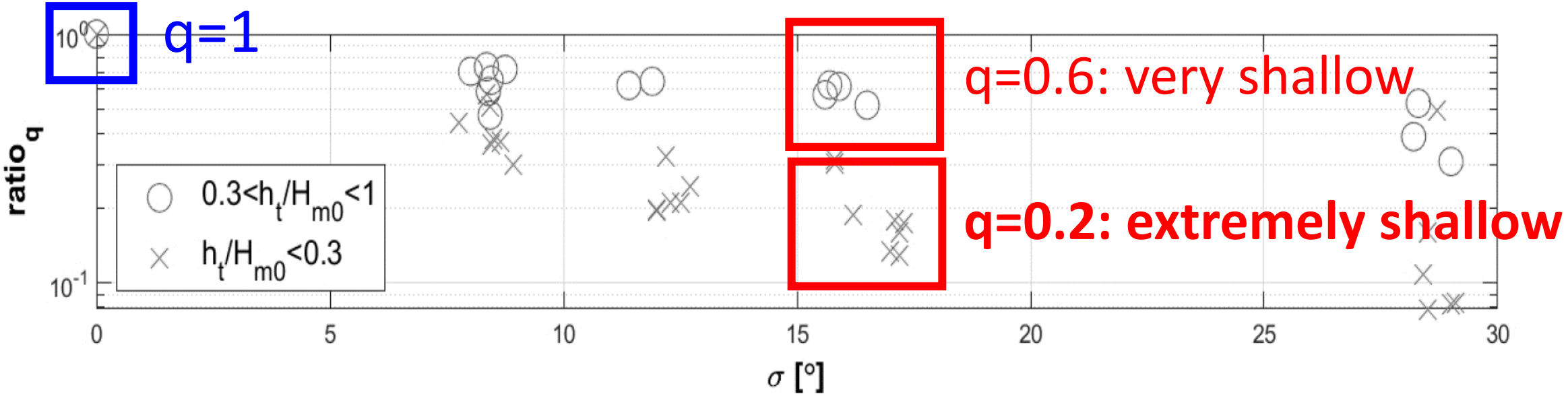




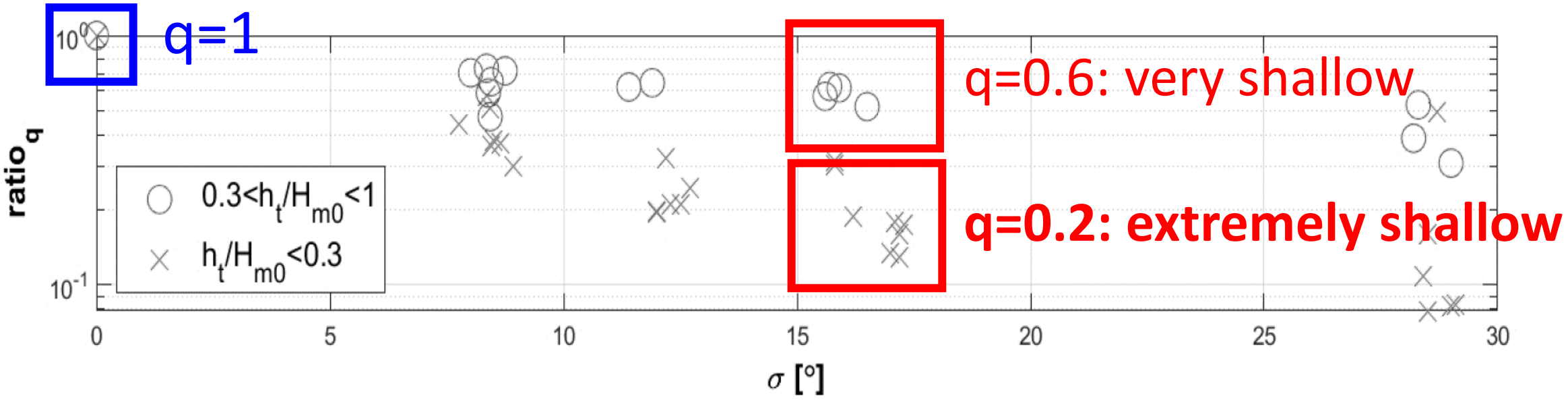
long crested

short crested

q is smaller when

1) more directional spreading

2) more shallow



long crested

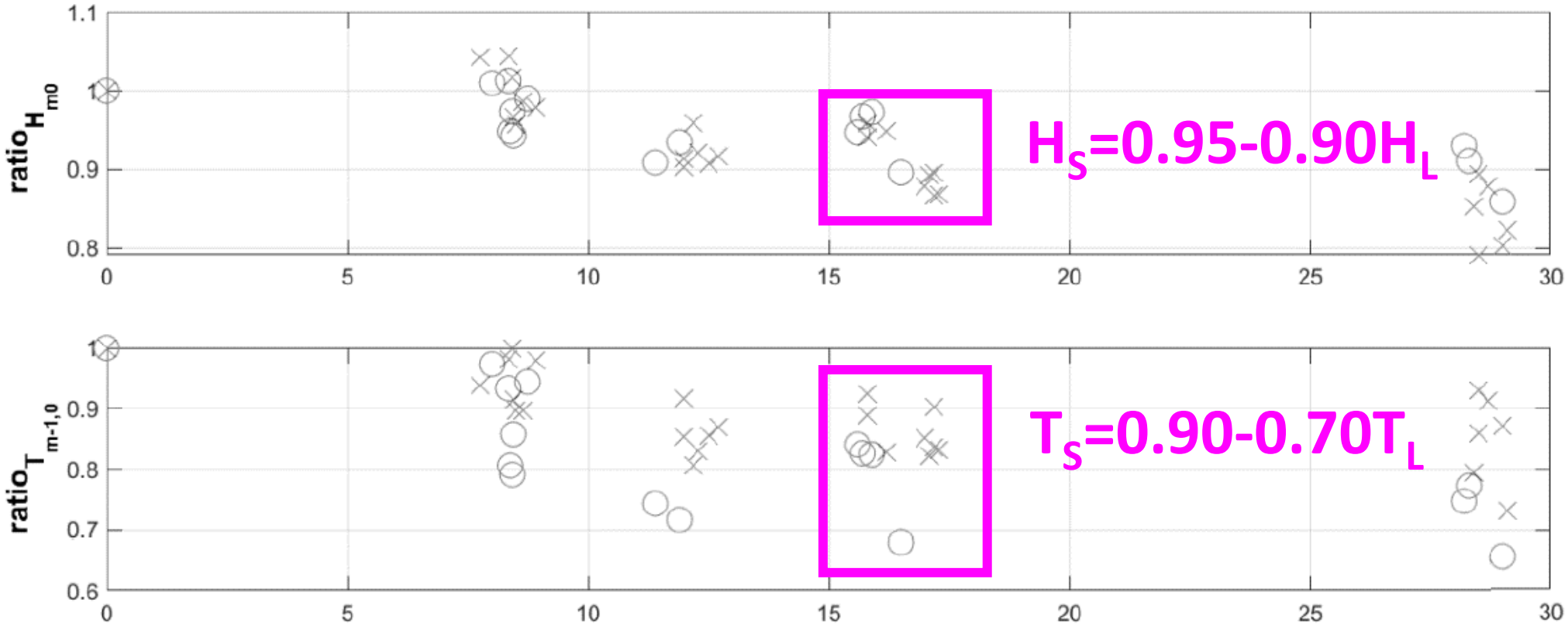
short crested

q is smaller when

1) more directional spreading

2) more shallow

Reason 1: wave height and peiod at the toe decreased

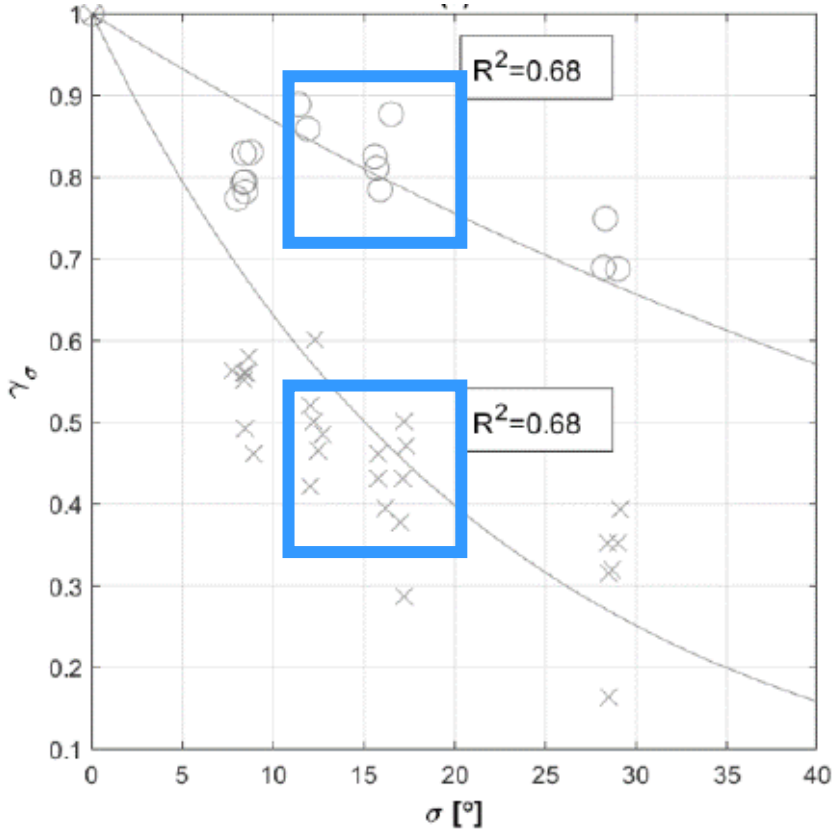


q is smaller when

1) more directional spreading
2) more shallow

Reason 2: q from the toe is decreased

$$\frac{q}{\sqrt{gH_{m0,t}^3}} = \gamma_\sigma 10^c \exp\left[-\frac{R_c}{H_{m0,t}(0.33 + 0.022\xi_{m-1,0})}\right]$$



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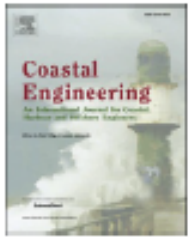

Influence of directional spreading on wave overtopping of sea dikes with gentle and shallow foreshores

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ABSTRACT

The work highlights the importance of directional spreading effects on wave overtopping estimation in shallow and mild sloping foreshores. Wave short-crestedness leads, in general, to a reduction of mean overtopping discharges on coastal structures. In the present work, the case of a sea dike with gentle foreshore in very and extremely shallow water conditions is analysed. Physical model tests have been carried out in order to investigate the effect of directional spreading on overtopping and incident wave characteristics. In the present experimental campaign, the effect of wave spreading has only been investigated for perpendicular wave attack. Results show that directional spreading is proved to cause a reduction of average discharge of sea dikes with gentle and shallow foreshore. Expressions for the reduction factor for directional spreading are derived, fitted on the tested database. The use of this reduction factor leads to more accurate prediction and avoids overtopping overestimation, however reduction-factor formulations are overtopping-formula depending.

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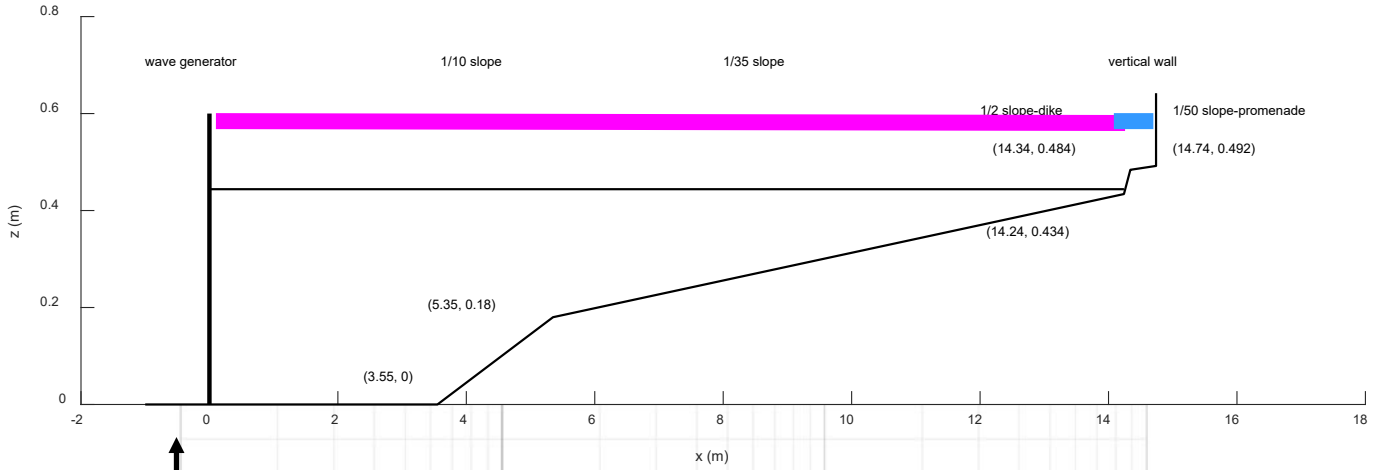
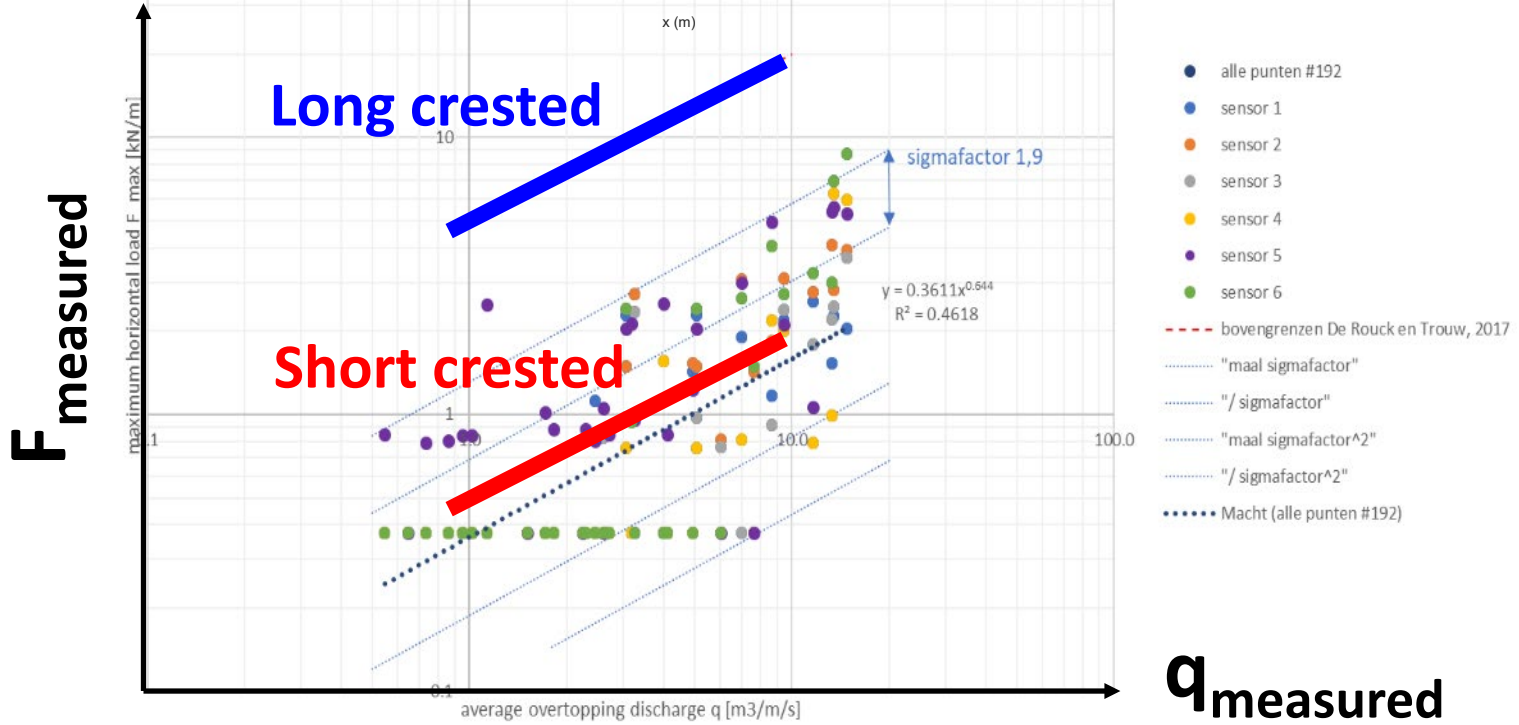
If q is reduced due to Reason 1 and 2= F is also reduced





$F_{measured}$

$q_{measured}$

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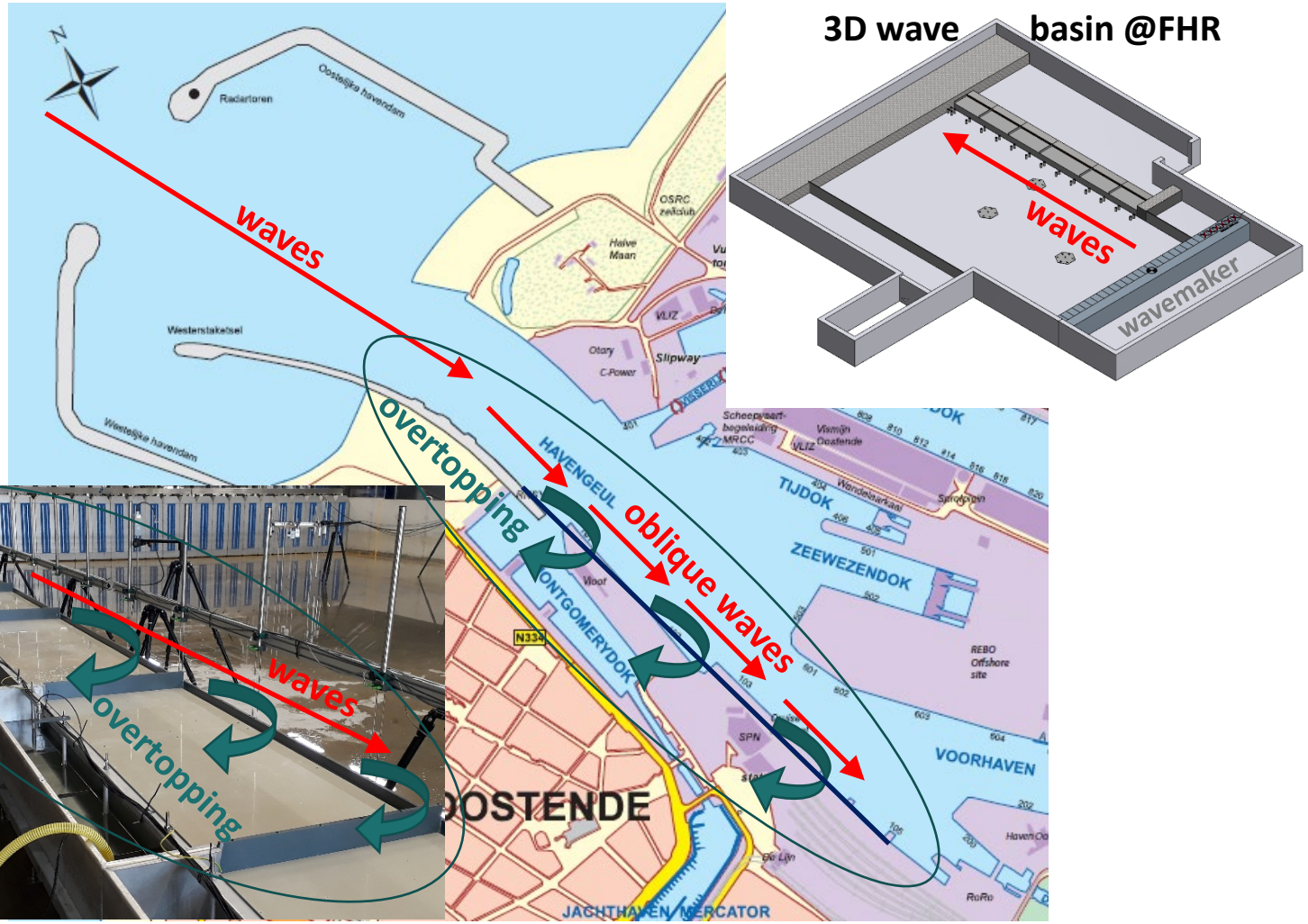
Project 2

Oblique waves test in FHR

Try to understand the influence of 3D geometry (q for very oblique wave)



3D wave basin @FHR

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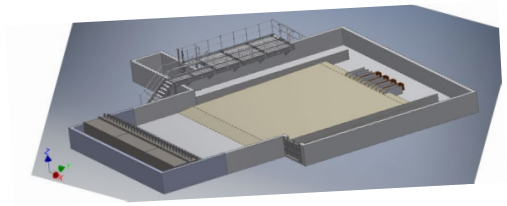
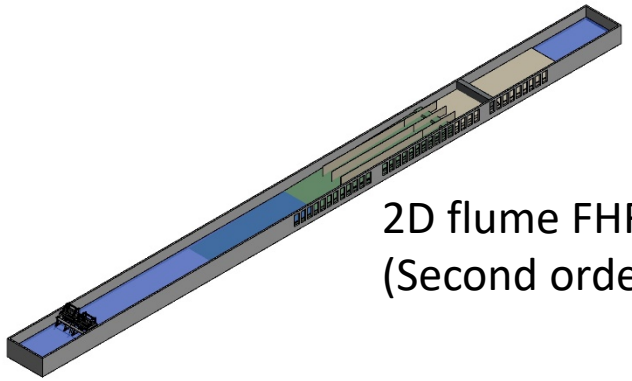
Overtopping estimation will be more and more realistic..

Applicability



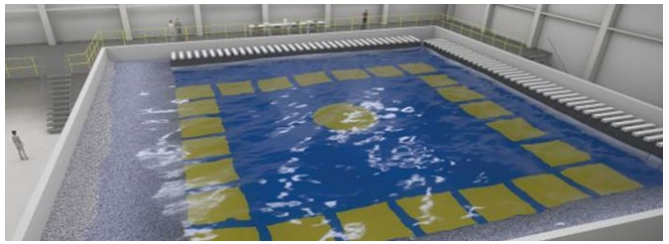
3D basin FHR
(3D effects)



2D flume FHR
(Second order wave)

2D flume FHR
(First order wave)

CREST
artificial dike*



3D basin COB*
(scale effect, wave+current, wind)

*artist impressions provided by UGent - Dept. of Civil Engineering

Now

time

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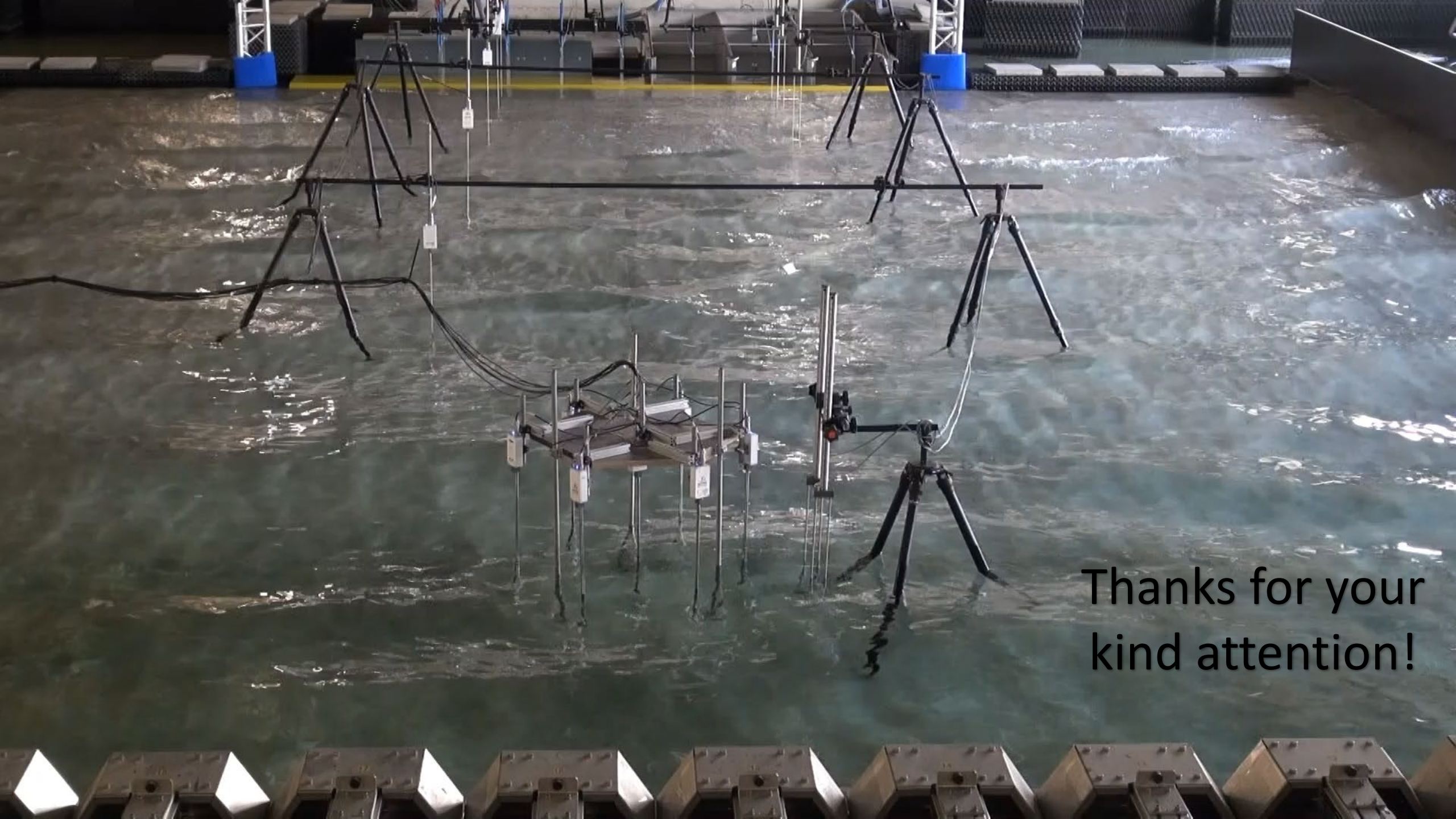
Thanks for your
kind attention!