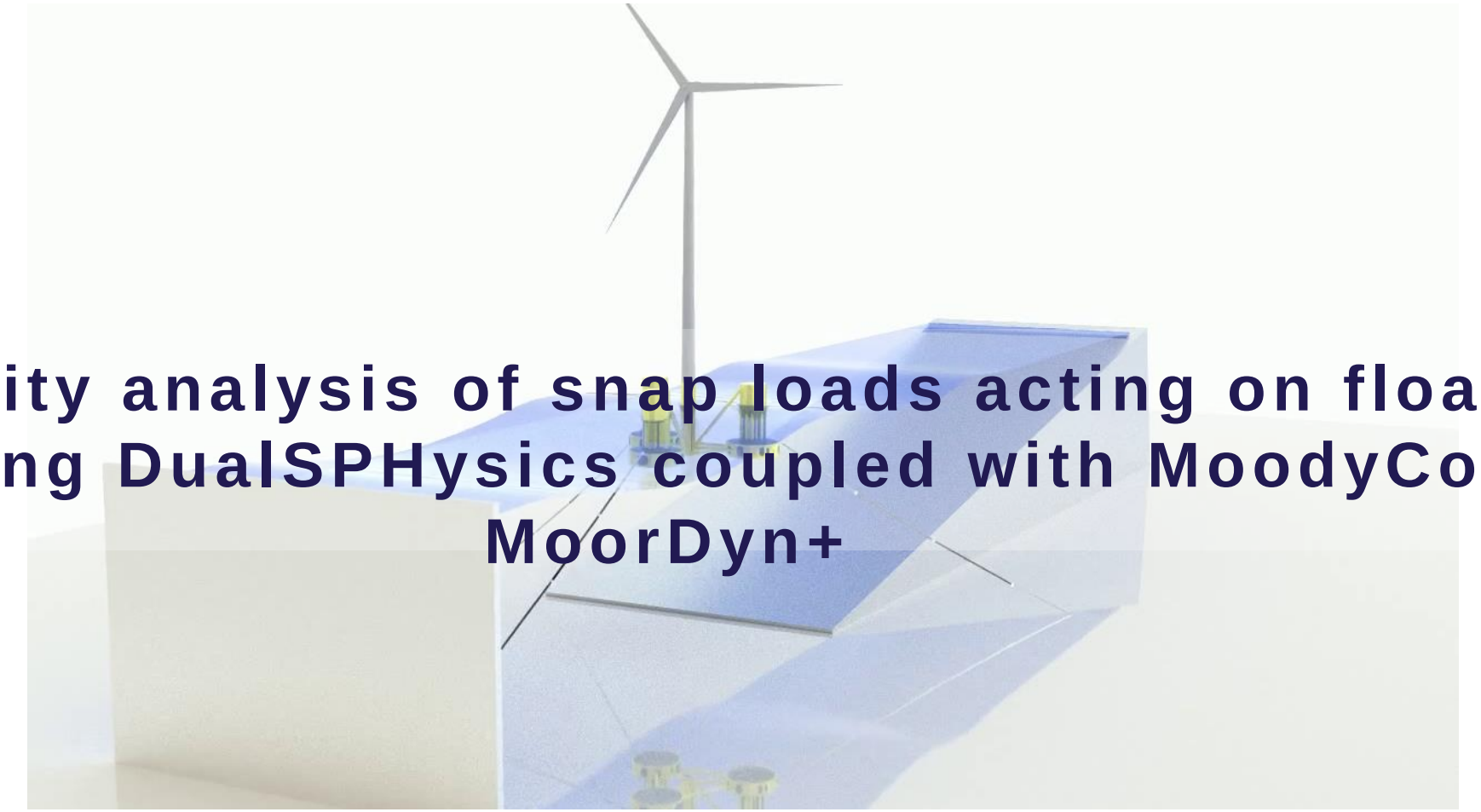

Sensitivity analysis of snap loads acting on floating bodies using DualSPHysics coupled with MoodyCore and MoorDyn+

Gael VERAO FERNÁNDEX, Iván MARTÍNEZ ESTÉVEZ, Johannes PALM, Claes ESKILSSON, Corrado ALTOMARE, Lorenzo CAPPIETTI, Alejandro CRESPO

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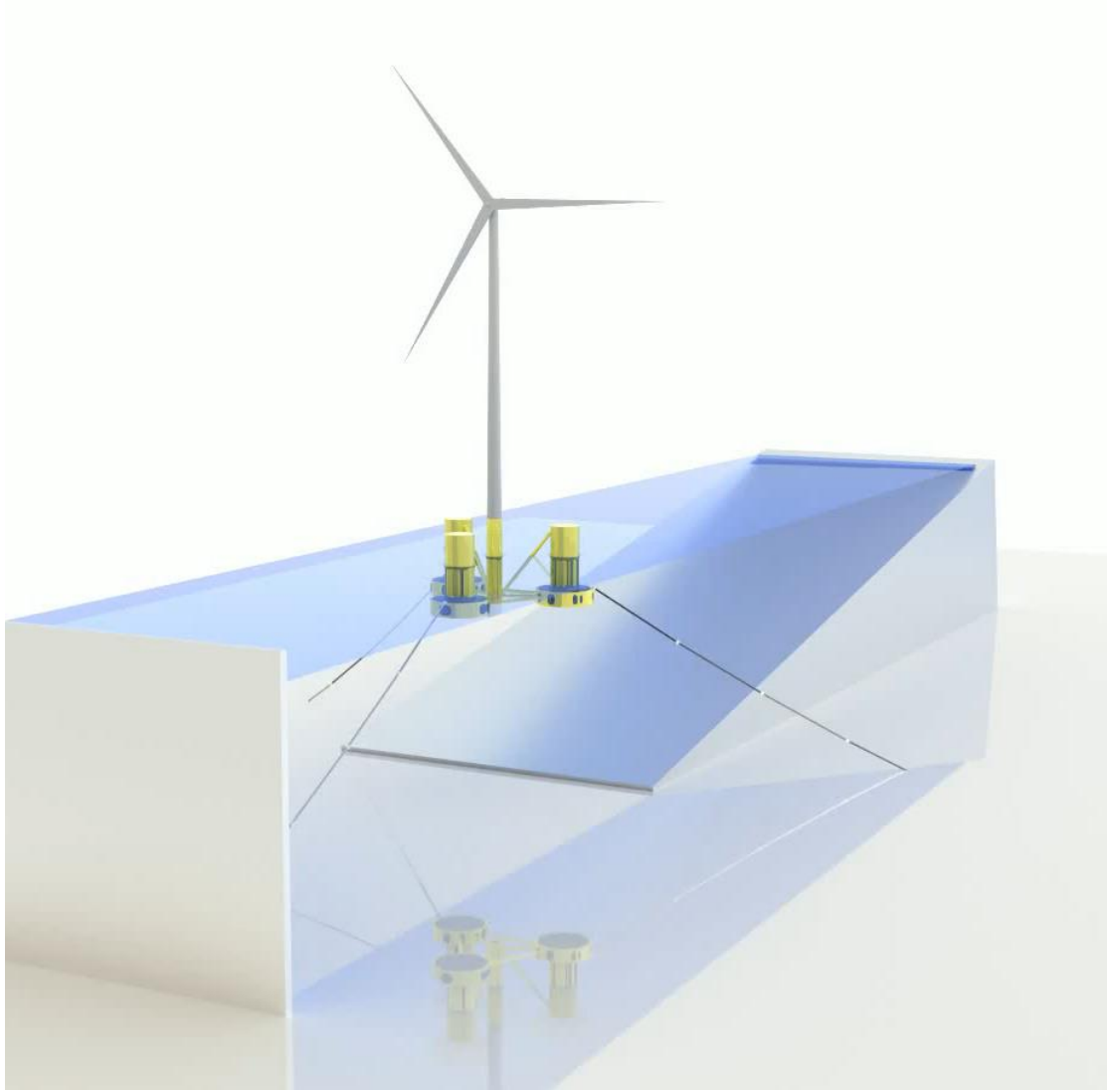
DENMARK

INTRODUCTION

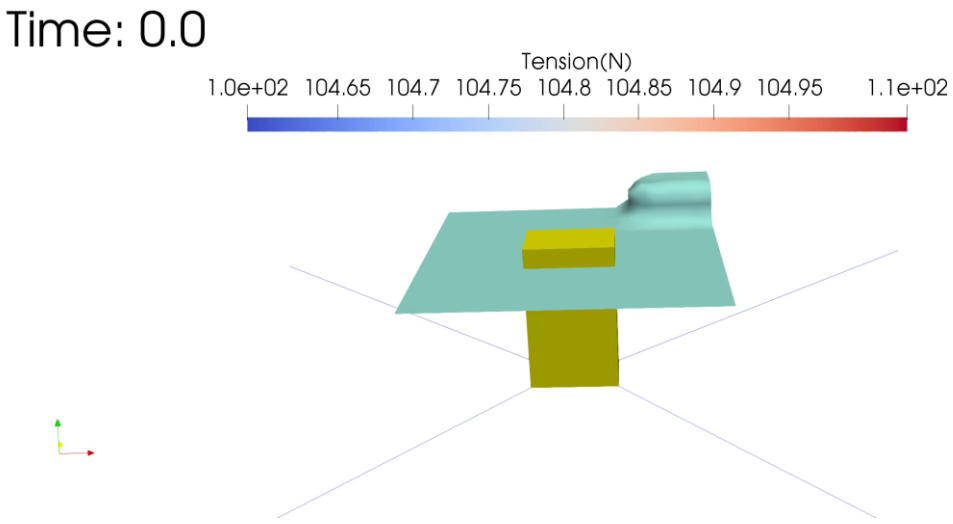
- DualSPHysics uses MoorDyn+ as its mooring line solver library
- Reliable solver based on the lumped mass approach
- Theoretically does not perform good capturing shock loads as snap loads
- Study the implementation of a high order finite-element mooring line solver



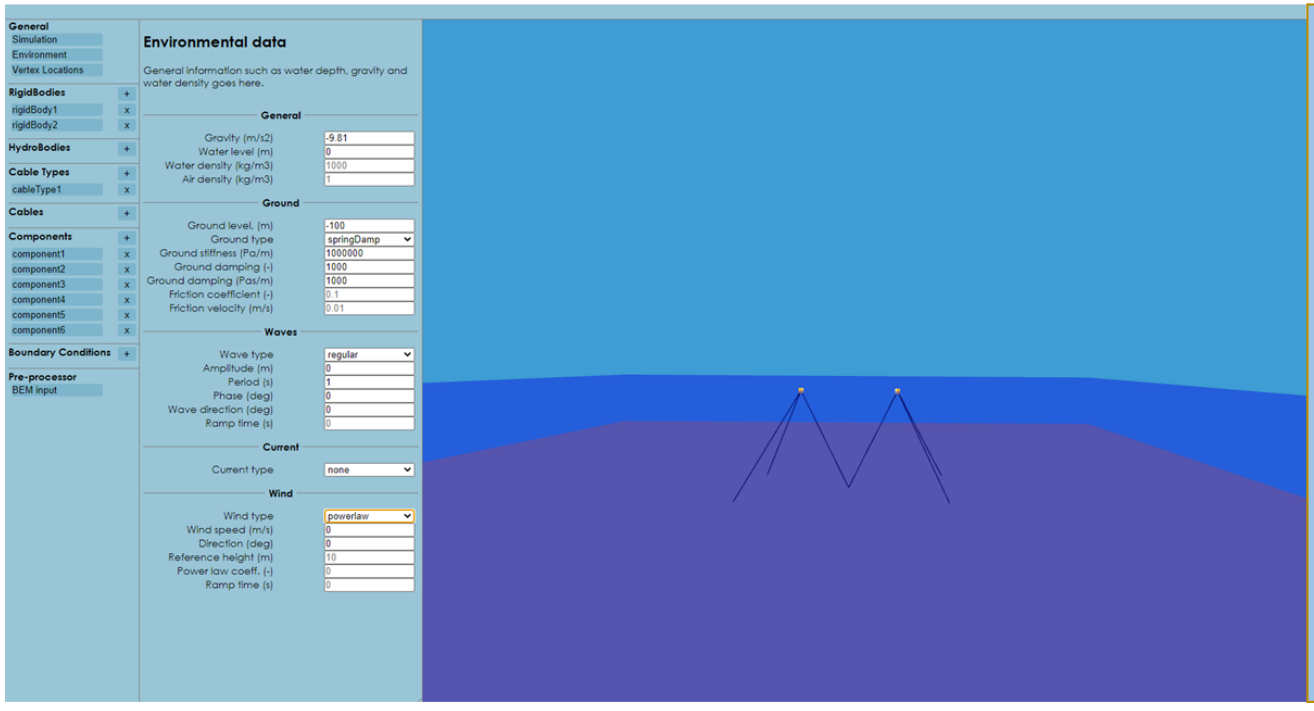
Tutorial: floatingObject

MOODY

Mooring Dynamics

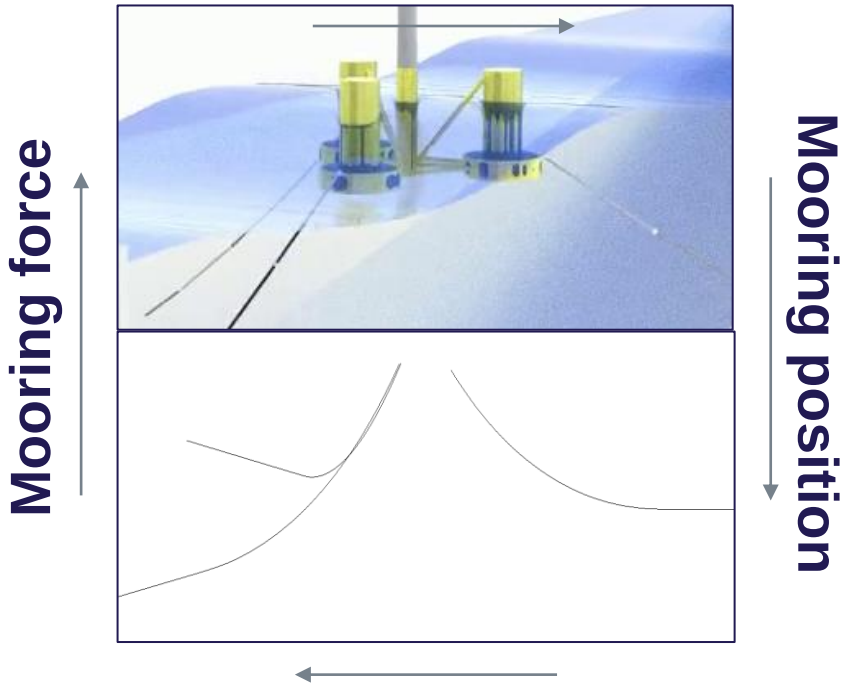


- In development since 2012. First presentation at Marine 2013 (Palm et al 2013)
- High-order finite elements (discontinuous Galerkin method in conservation form)
- API for coupling to hydro-models
- Moody-1.0: Original release following the implementation in Palm et al (2017). Released freeware 2018-05-21.
- Moody-2.0: Rigid body library introduced, enabling submerged buoys and clump-weights according to Palm & Eskilsson (2020). Released freeware 2019-09-20.
- MoodyCore-3.0: Bending stiffness included. Components included. Hydrodynamic bodies (incl. NFKF) added.

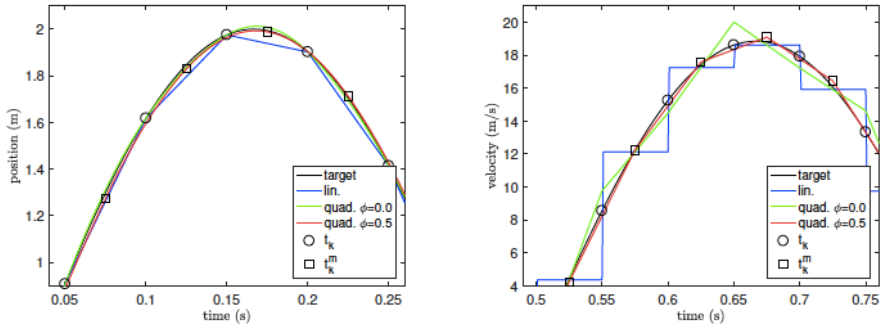


MOORING - DualSPHysics COUPLING

DualSPHysics: Fluid solution and 6DoF



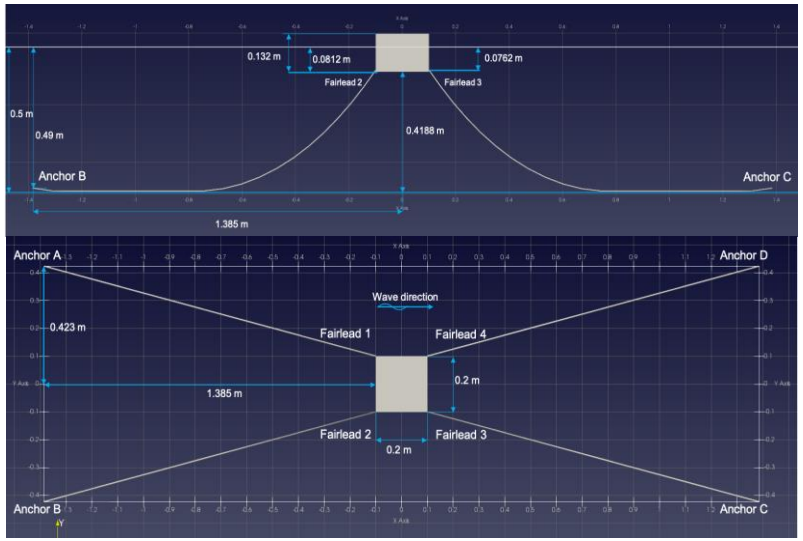
Moody: interpolation and solution by sub-stepping

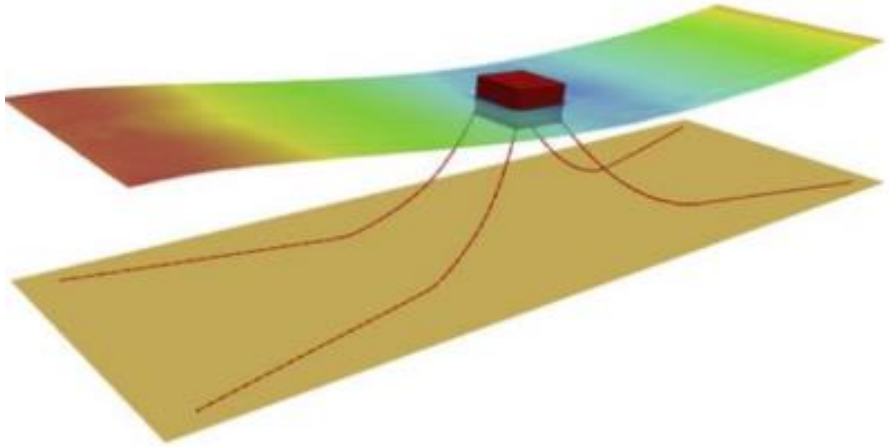


(a) Position (b) Velocity

Case 1

- Experimental data-generated during the MaRINET2 EsflOWC project [1]
- Validated in Domínguez et. al.(2019) [2]





[1] D. Kisacik et al., "Efficiency and Survivability of a Floating Oscillating Water Column Wave Energy Converter Moored to the Seabed: An Overview of the EsflOWC MaRINET2 Database," Water, vol. 12, no. 4, 2020.

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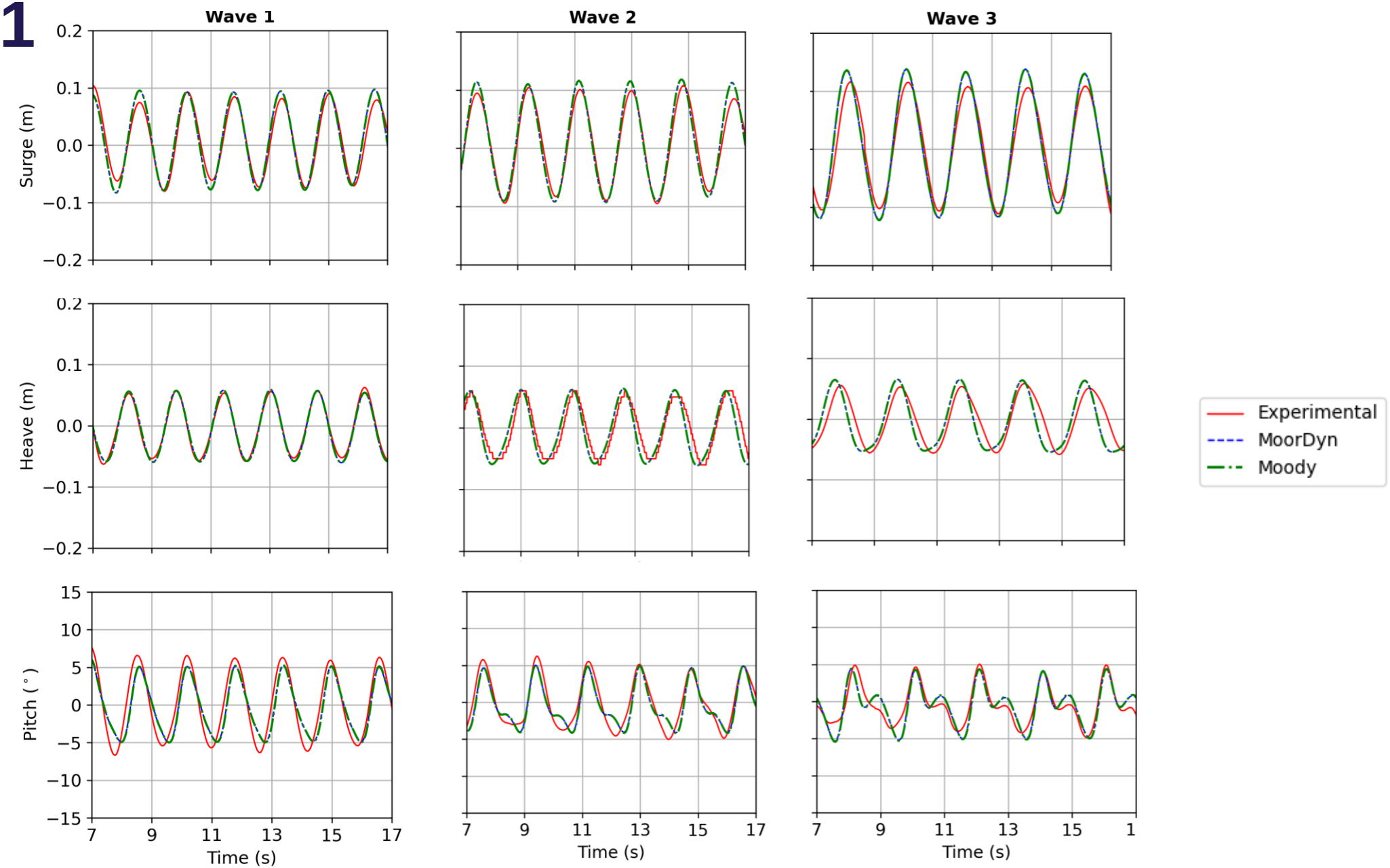
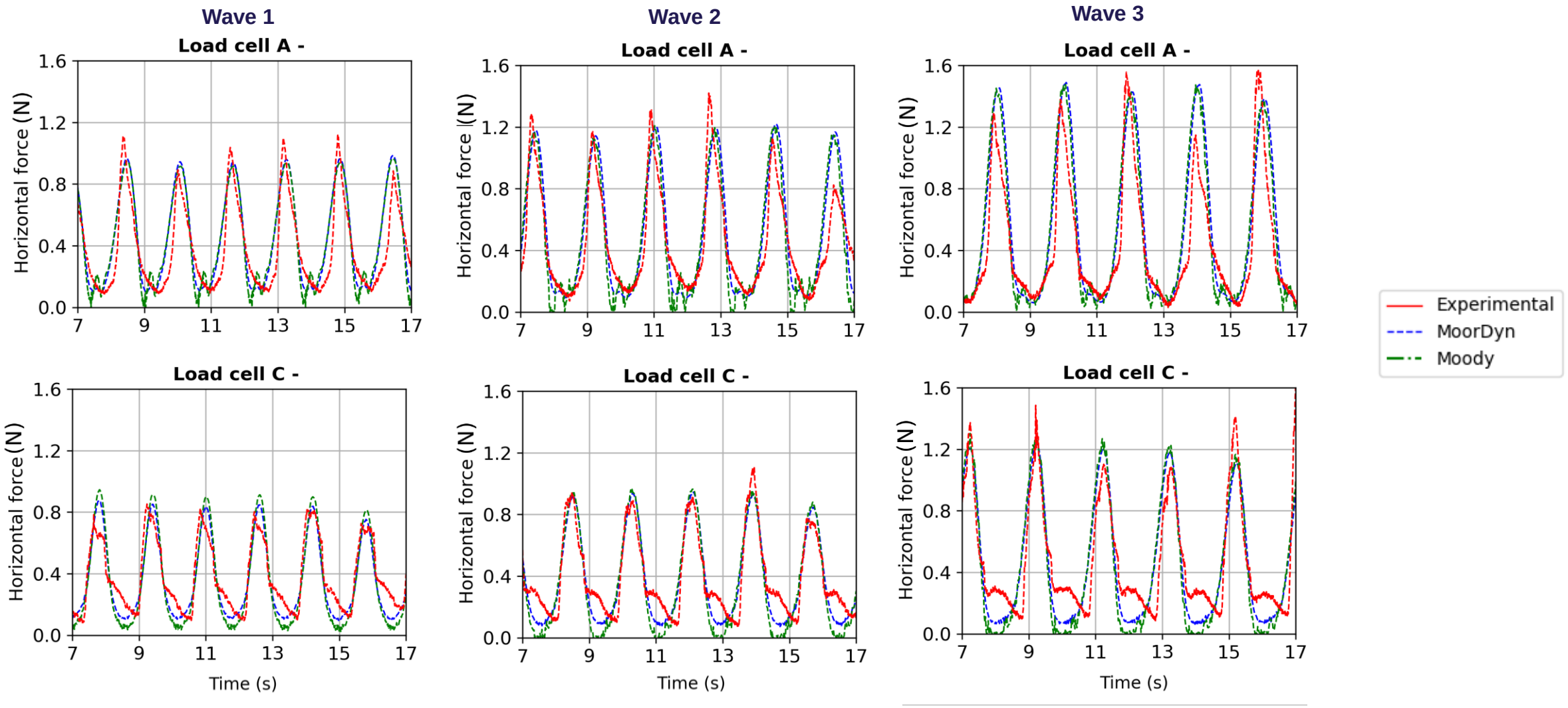
[2] Domínguez, J. M., Crespo, A. J. C., Hall, M., Altomare, C., Wu, M., Stratigaki, V., … Gómez-Gesteira, M. (2019). SPH simulation of floating structures with moorings. COASTAL ENGINEERING, (153). https://doi.org/10.1016/j.coastaleng.2019.103560

Case 1

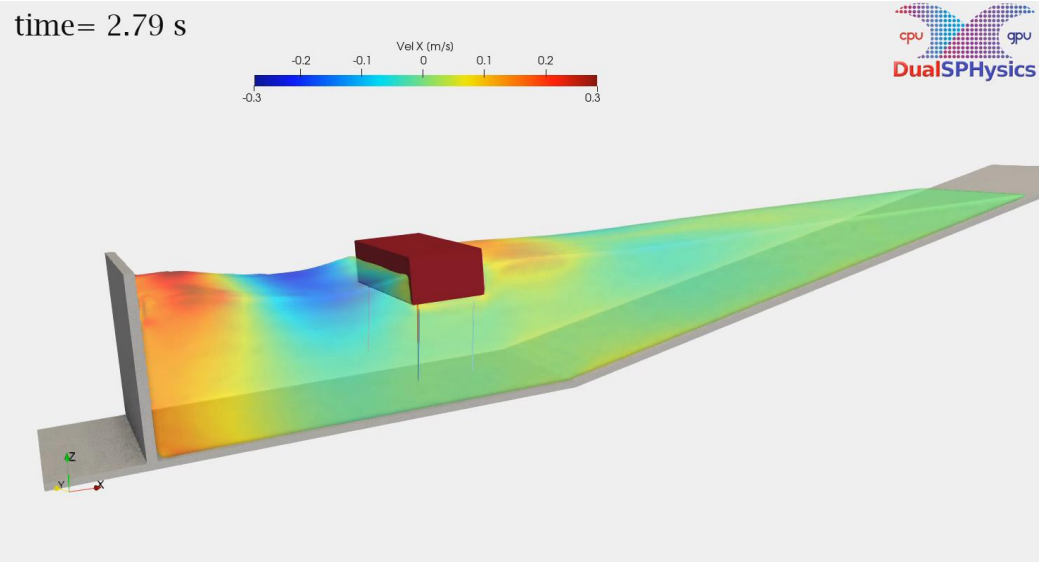

Wave 1
Wave 2
Wave 3
Surge (m)
Heave (m)
Pitch (°)
Time (s)
Experimental
MoorDyn
Moody

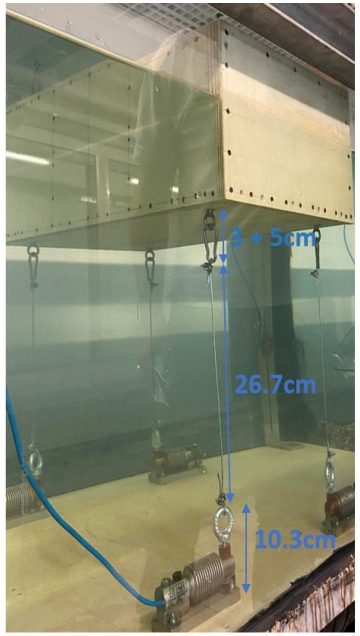
Case 1


Wave 1
Wave 2
Wave 3
Load cell A -
Load cell C -
Horizontal force (N)
Time (s)
Experimental
MoorDyn
Moody

Case 2

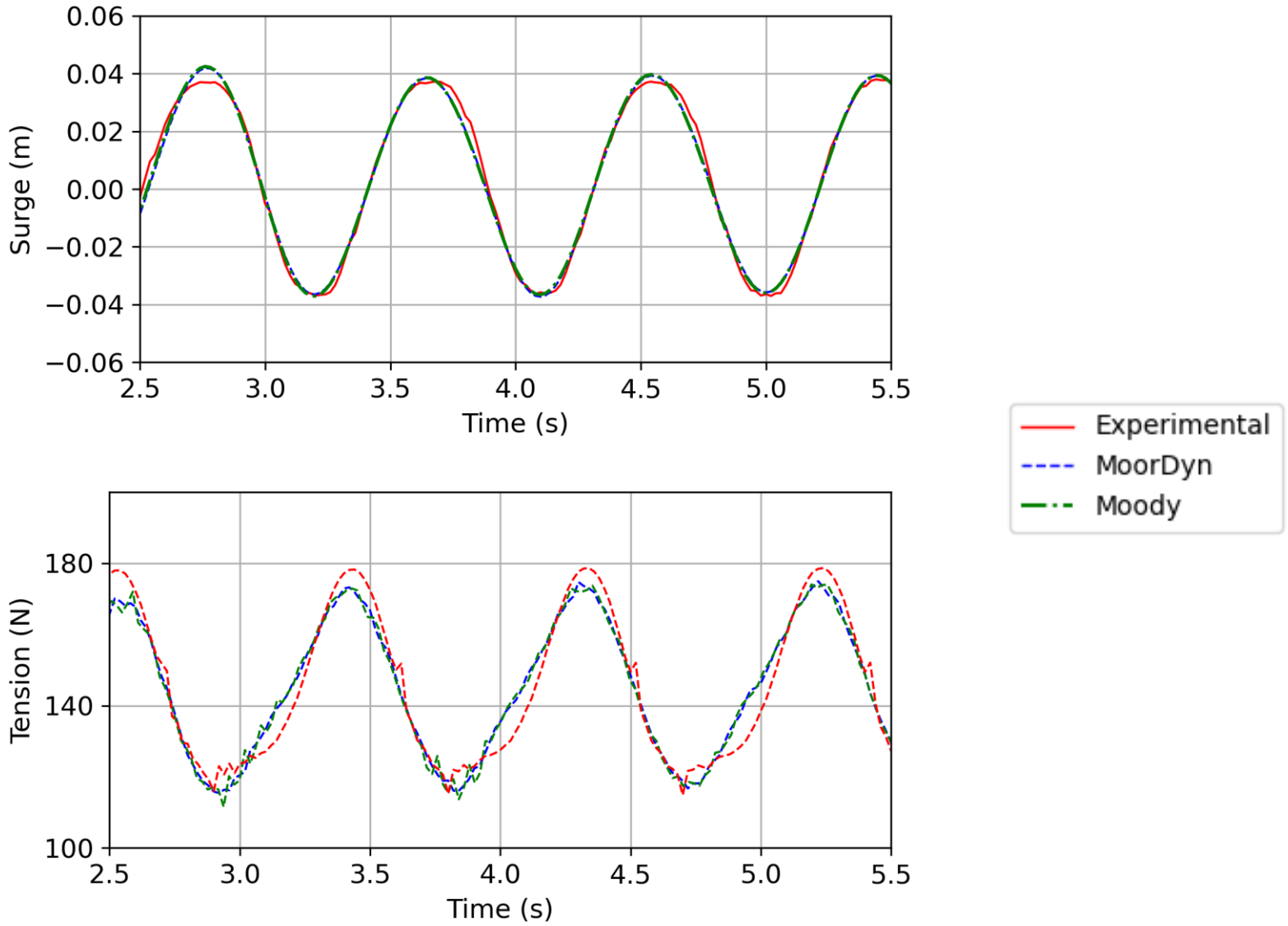
- Experimental data from LABIMA
- Taut moored box
- Modelled in 2D





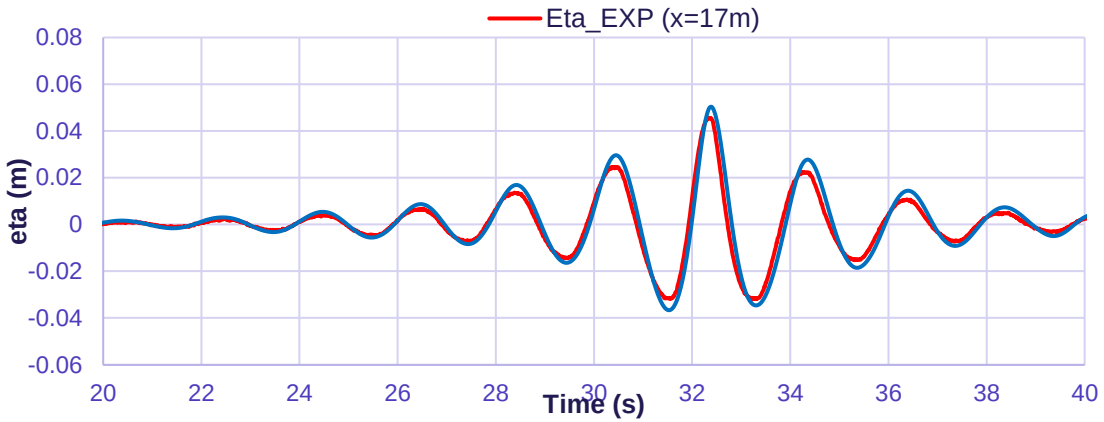
[3] Bonaventura Tagliaferro. (2021) Numerical modeling of a moored box: moving to a 2D environment.

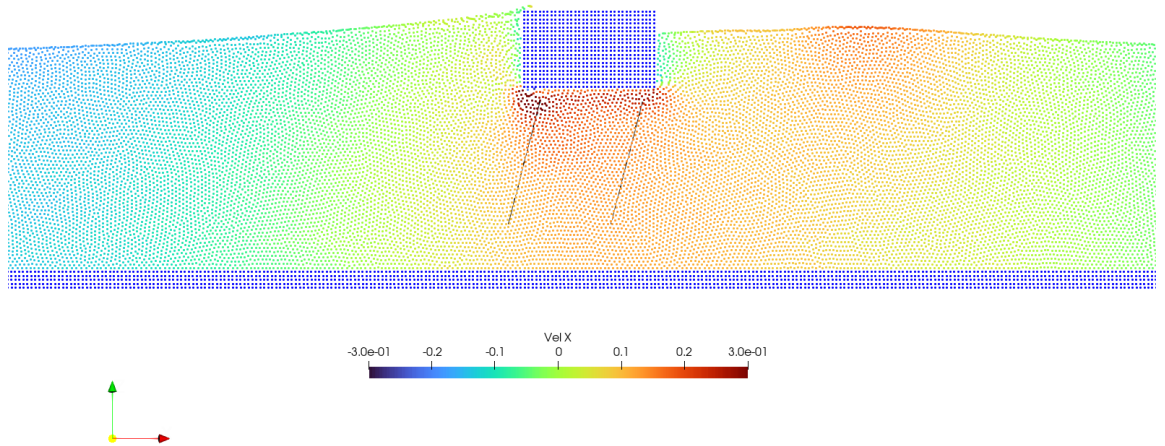
Case 2


0.06
0.04
0.02
0.00
−0.02
−0.04
−0.06
Surge (m)
2.5
3.0
3.5
4.0
4.5
5.0
5.5
Time (s)
180
140
100
Tension (N)
2.5
3.0
3.5
4.0
4.5
5.0
5.5
Time (s)
Experimental
MoorDyn
Moody

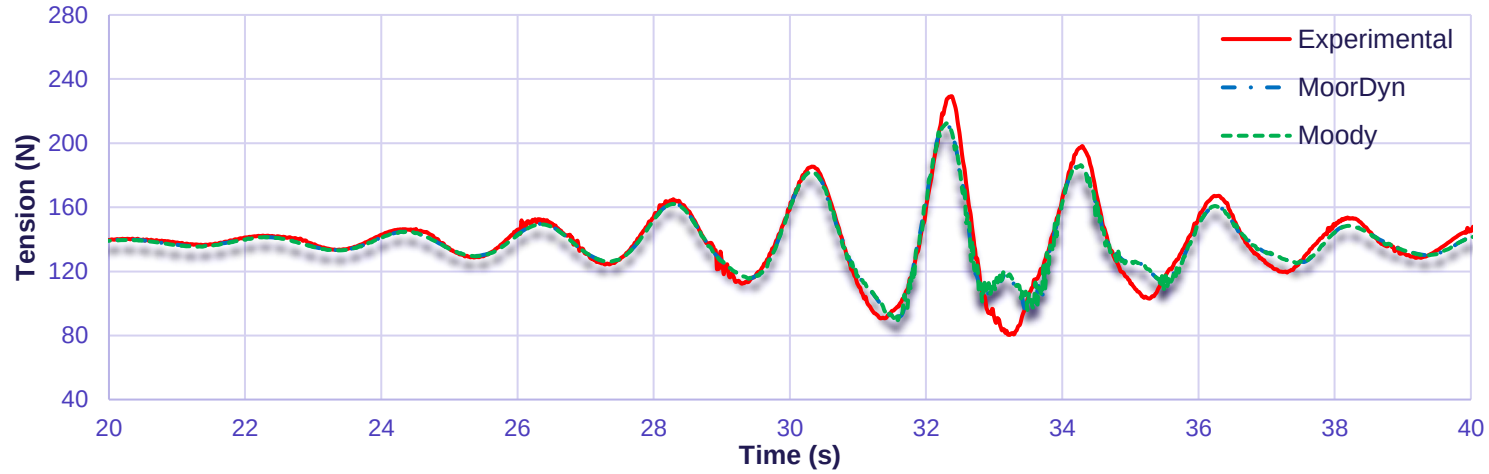
Case 3

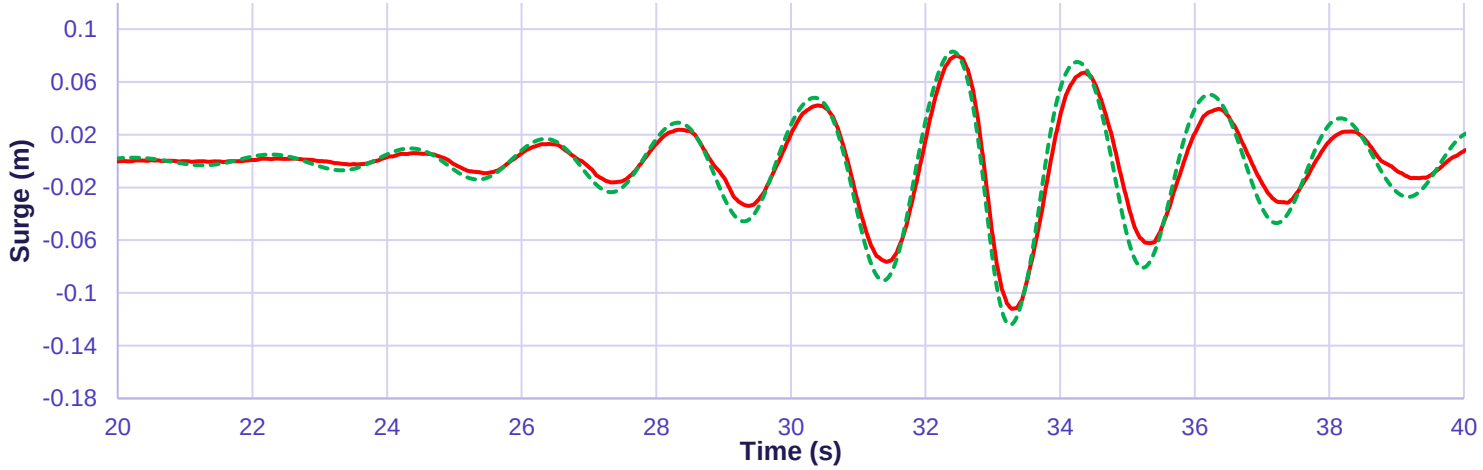
- Experimental data from LABIMA
- Taut moored box
- Modelled in 2D
- Focused Wave





Case 3


Experimental
MoorDyn
Moody
Tension (N)
280
240
200
160
120
80
40
20
22
24
26
28
30
32
34
36
38
40
Time (s)


Surge (m)
0.1
0.06
0.02
-0.02
-0.06
-0.1
-0.14
-0.18
20
22
24
26
28
30
32
34
36
38
40
Time (s)

CONCLUDING REMARKS AND FUTURE WORK

- All tested cases show a good capture of the body dynamics.
- Experimental mooring forces are hard to capture due to uncertainties in the experiments that are not included in the numerical model.
- For the studied cases, no differences were found between MoorDyn+ and Moody .
- Continue the validation study using numerical or experimental data which includes snap loads.