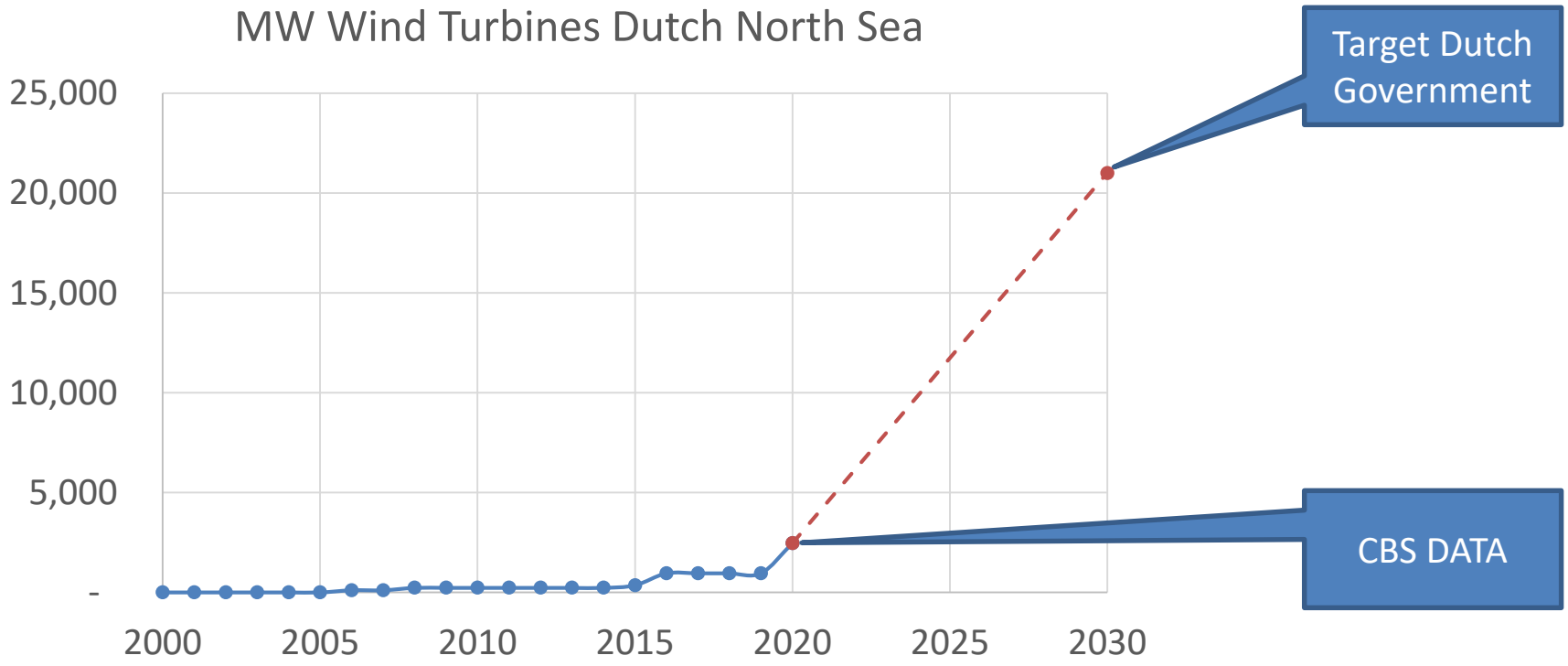
MARIN

BETTER SHIPS, BLUE OCEANS

INNOVATIVE CRASH BARRIERS TO PREVENT SHIP COLLISIONS WITH WIND TURBINES

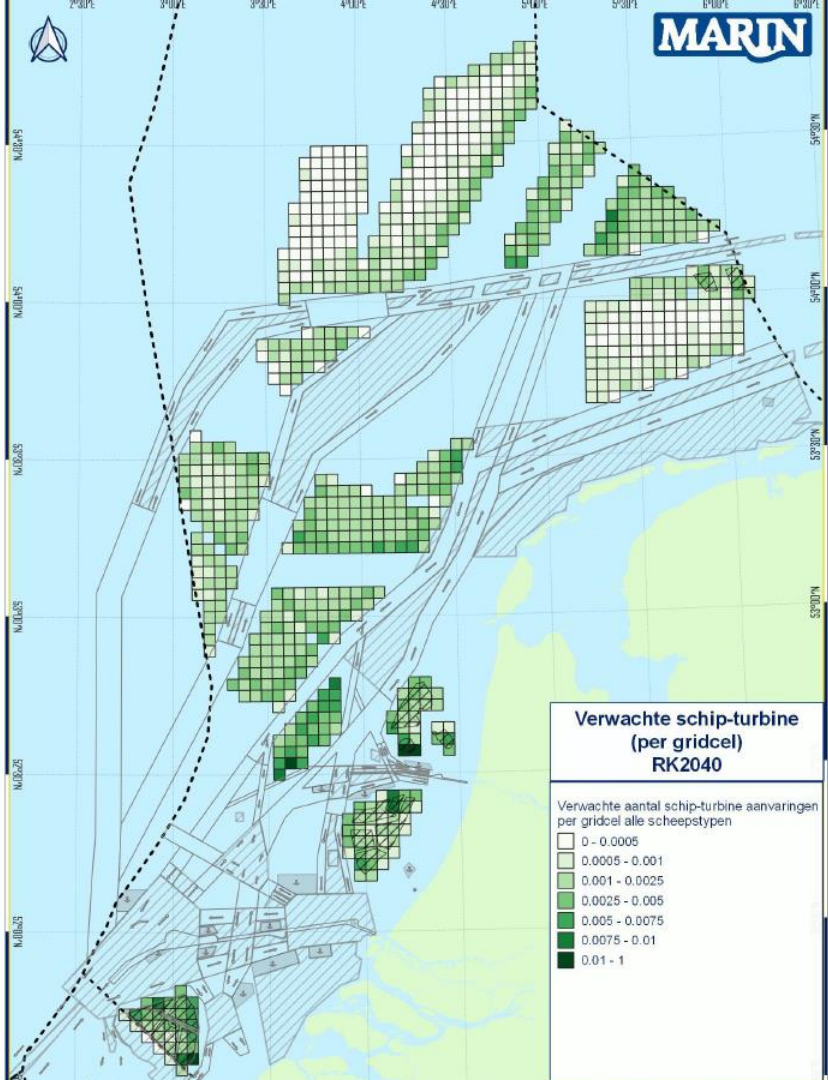
William Otto

Why?


MW Wind Turbines Dutch North Sea
25,000
20,000
15,000
10,000
5,000
-
2000
2005
2010
2015
2020
2025
2030
Target Dutch Government
CBS DATA

Probabilistic Model Ship-Turbines

- Locations for 21GW are under investigation; search areas
- Impact on maritime safety is studied at MARIN
  - Quantifying effects of passage policies
  - Quantifying risks at different locations
- Annual probability of a collision between a ship and a wind turbine will be 1.5-2.5/year in 2030



First major incident: Julietta D (2022/01/31)

- Moored in an anchorage when her anchor gave way and started to drift
- She first hit a tanker, collided with a turbine foundation and a High Voltage Platform under construction
- Narrowly missed a gas production platform.

Possible Mitigations

- Use own anchor
  - the crew might be unable to use the anchor or
  - it may not hold ground.

- Emergency Standby Vessels (ESV's) and Emergency Towing Vessels (ETV's). Response time:
  1. start drifting and requesting assistance,
  2. the notice and transit time of the ESV and
  3. the time to establish the tow.

  In case of the Julietta D this added up to approximately 9 hours

- Form of Vessel Traffic Management/Monitoring (VTM)
  - encourage vessels to choose a route with the least turbine encounters
  - help to early identify vessels in potential need of ESV assistance.

ESV Multraship Commander

Research Question

As addition to these existing measures;

Can collisions between drifting ships and offshore wind turbines be prevented with a barrier between the shipping route (or anchorage) and wind turbine parks?

Objectives

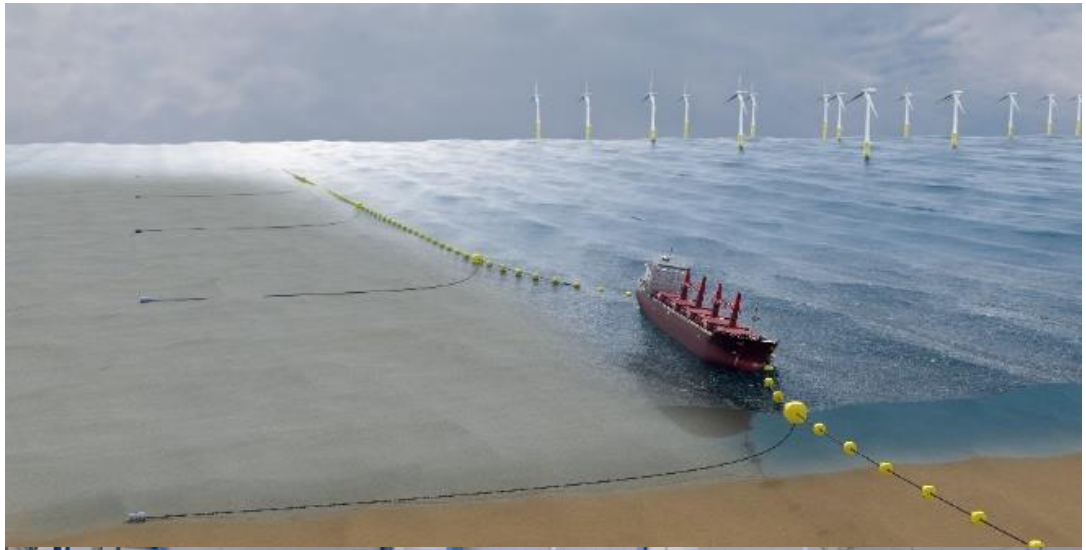
1. To develop a set of realistic conceptual physical barriers and;
2. To test their ability to stop and hold a ship.
   - Focus is on the drifting Julietta D, the reference case.
   - Larger ships and ships with active propulsion can be considered in a later stage

Although the focus is on technical feasibility, another important objective of this project is:

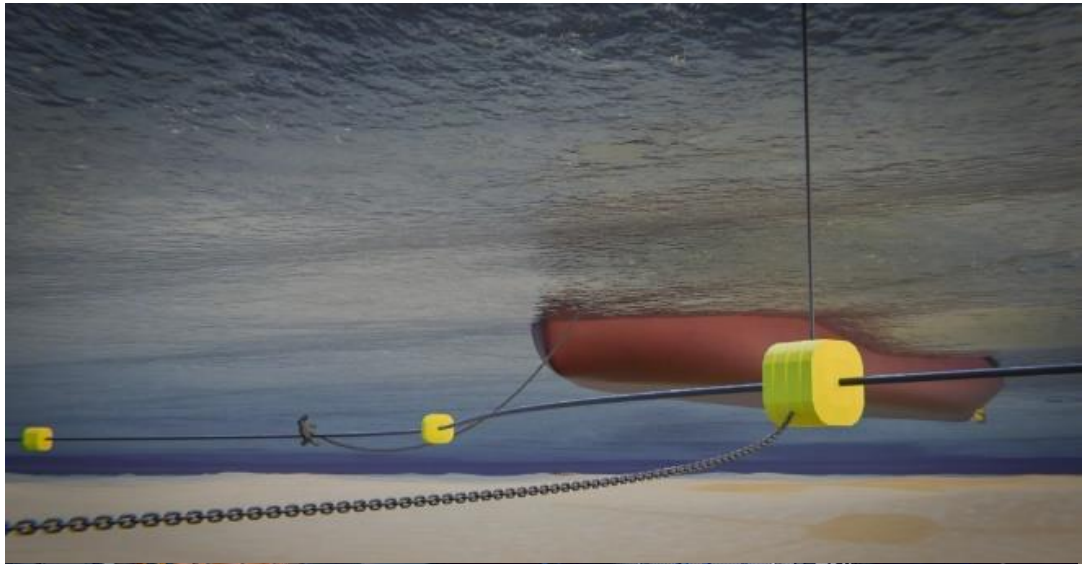
3. To obtain a high level overview of other (non-technical) aspects of the barriers which need further attention.

Concept Development

CONCEPT A



CONCEPT B



CONCEPT C

Interesting concepts not further investigated

A redundant barrier, leeward of the first barrier.

- If the first barrier is passed

A popup barrier, only activated when needed.

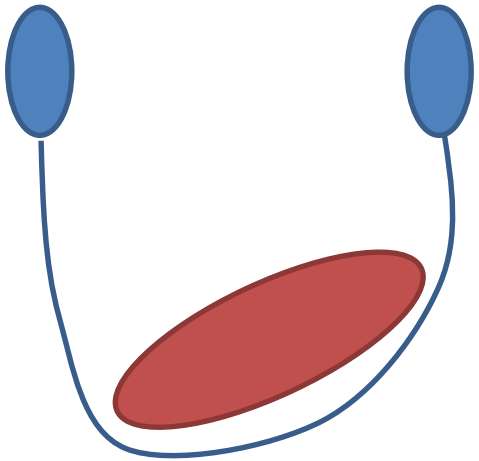
- The concepts which function in the water surface could be stored on the seabed. When a drifting vessel is approaching, an active mechanism could be triggered to re-surface the barrier.

A towed barrier.

- Instead of an earth-fixed barrier, the barrier could be fixed at either end to an ESV. The drifting vessel can be encompassed by the two ESV's. The main benefit from the existing ESV's is that this concept reduces the time to establish a safe tow.

A sand bank.

- Intentionally grounding the drifting ship on a sub-surface sand bank.



Reflections

Accessibility of the wind farm for maintenance :

- Concept A and C raised concerns, Concept B did not
- Improve access by only a barrier near high risk turbines, or by having overlapping barriers with an entrance in between.

Concept B requires an action on board of the drifting vessel to lower its anchor. This is considered non-trivial.

Concept C:

- Moving parts require maintenance
- The piles supporting the net are considered an additional risk of collision,
- The net is expected to gather litter (good) and marine life (bad).

Conclusions

Can collisions between drifting ships and offshore wind turbines be prevented with a barrier between the shipping route (or anchorage) and wind turbine parks?

- First steps were taken with very initial experiments
- Collisions can in principle be prevented with these types of barriers
- Given the scale test outcomes and expert reflections, the barriers have potential.
- But also that they need further development, validation and evaluation with all partners involved.

Recommendations

- Further engineer and dimension the tested concepts in order to mature and optimize their designs.
  - Including different vessels, different storm events
- Develop a strategy to safely connect and tow the drifted vessel out of the barrier
- Explicitly include other aspects such as ecology, logistics, business case, ownership, liability and maintenance in the development

Recommendations

- Also consider concepts which have not been investigated further,
  - in particular the towed barrier.

- Further develop a broader perspective on maritime safety around wind farms,
  - reducing the probability of a vessel starting to drift,
  - reducing the response time of ETV's/ERTV's,
  - research into the possibilities which Vessel Traffic Management could offer to further reduce reaction times.

Way forward

- Seek collaboration
  - International
  - Wind farm operators
  - Shipping companies
  - Authorities
  - Engineering companies

- Building a consortium/working group/JIP/ …
  - TBD

ACKNOWLEDGEMENTS

- Thanks to the 16 experts of the Dutch Offshore Industry, who made their contribution completely voluntarily out of a common interest of maritime safety!

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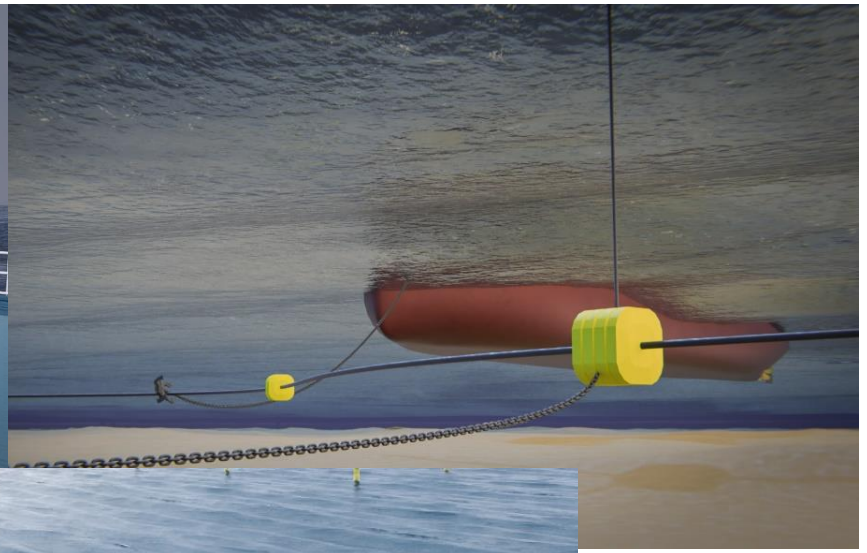
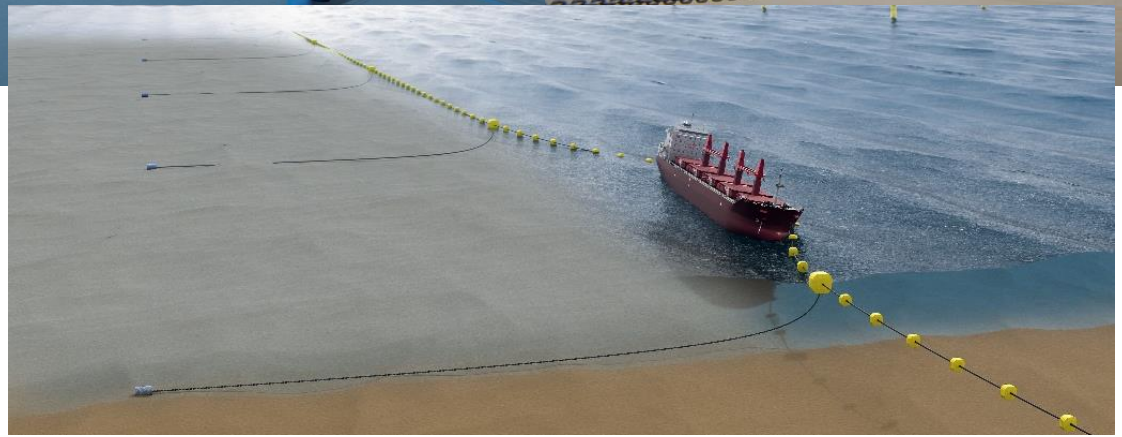
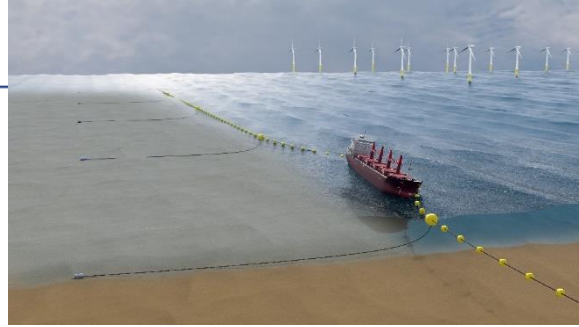
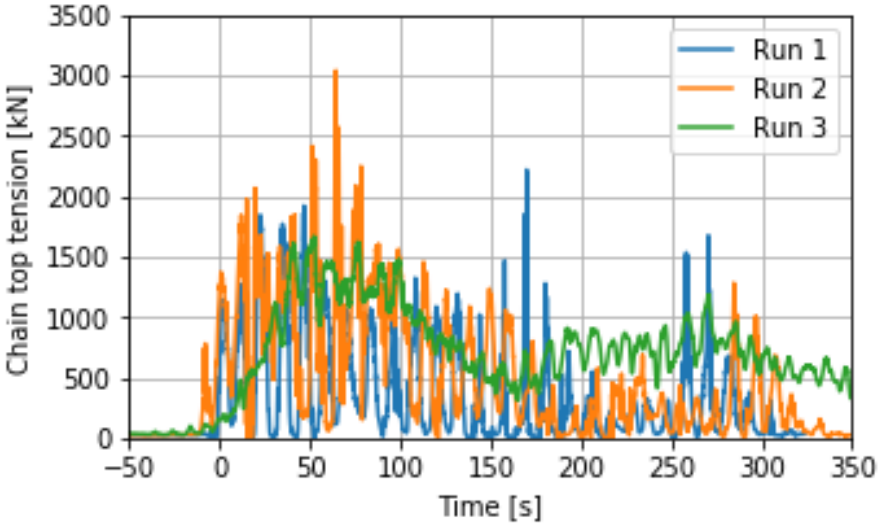


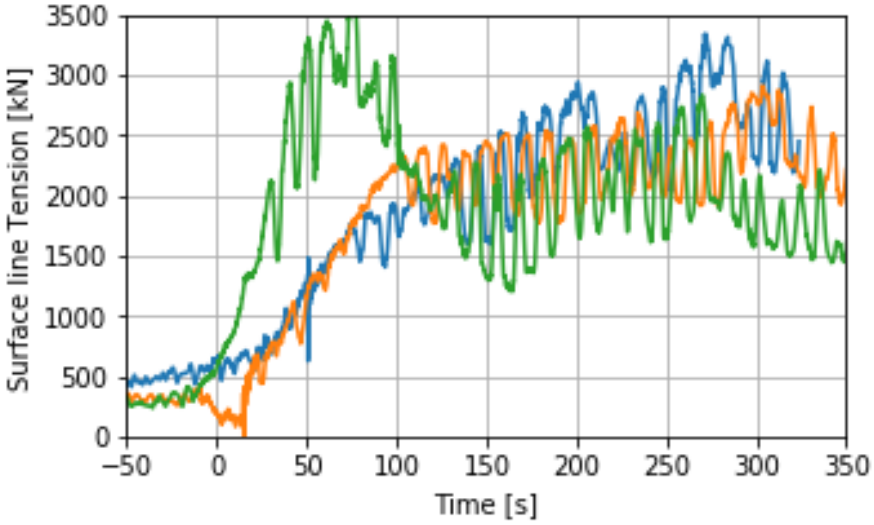


Bonus slide; Measurements A



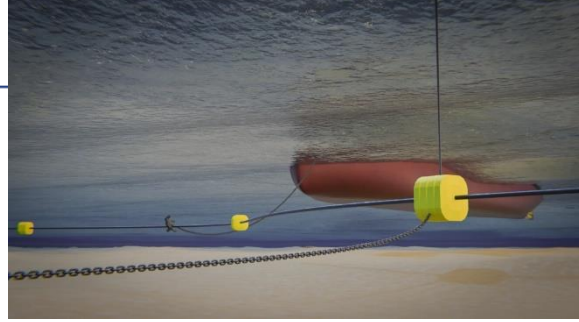


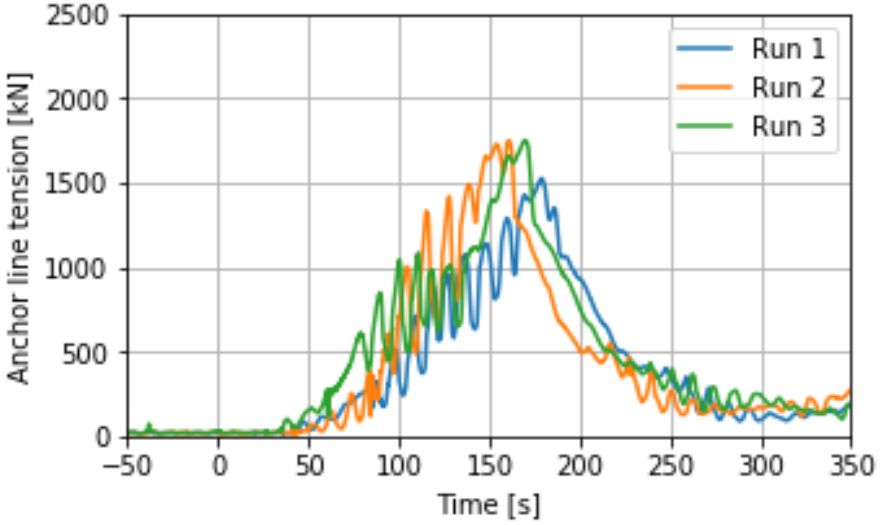
Chain Tension

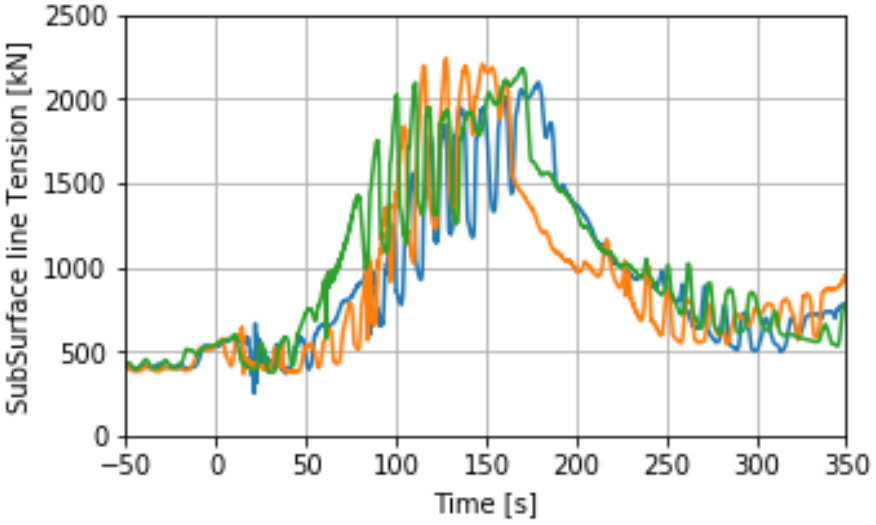


Surface Line Tension

Bonus slide; Measurements B



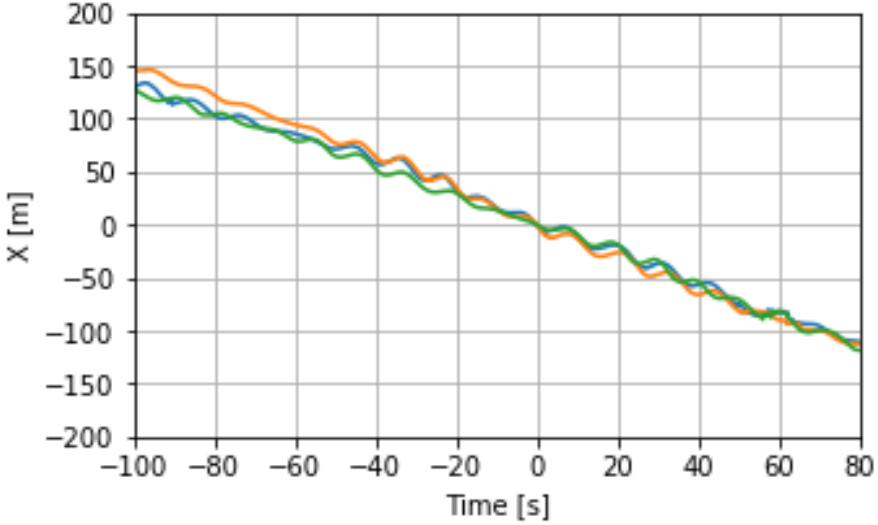




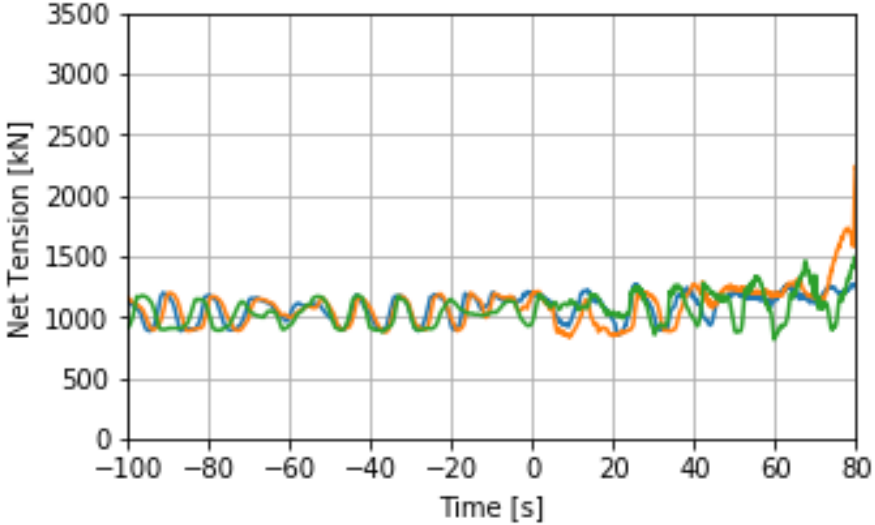
Chain Tension

Subsurface line tension

Bonus slide; Measurements C



Vessel coordination



Net Tension