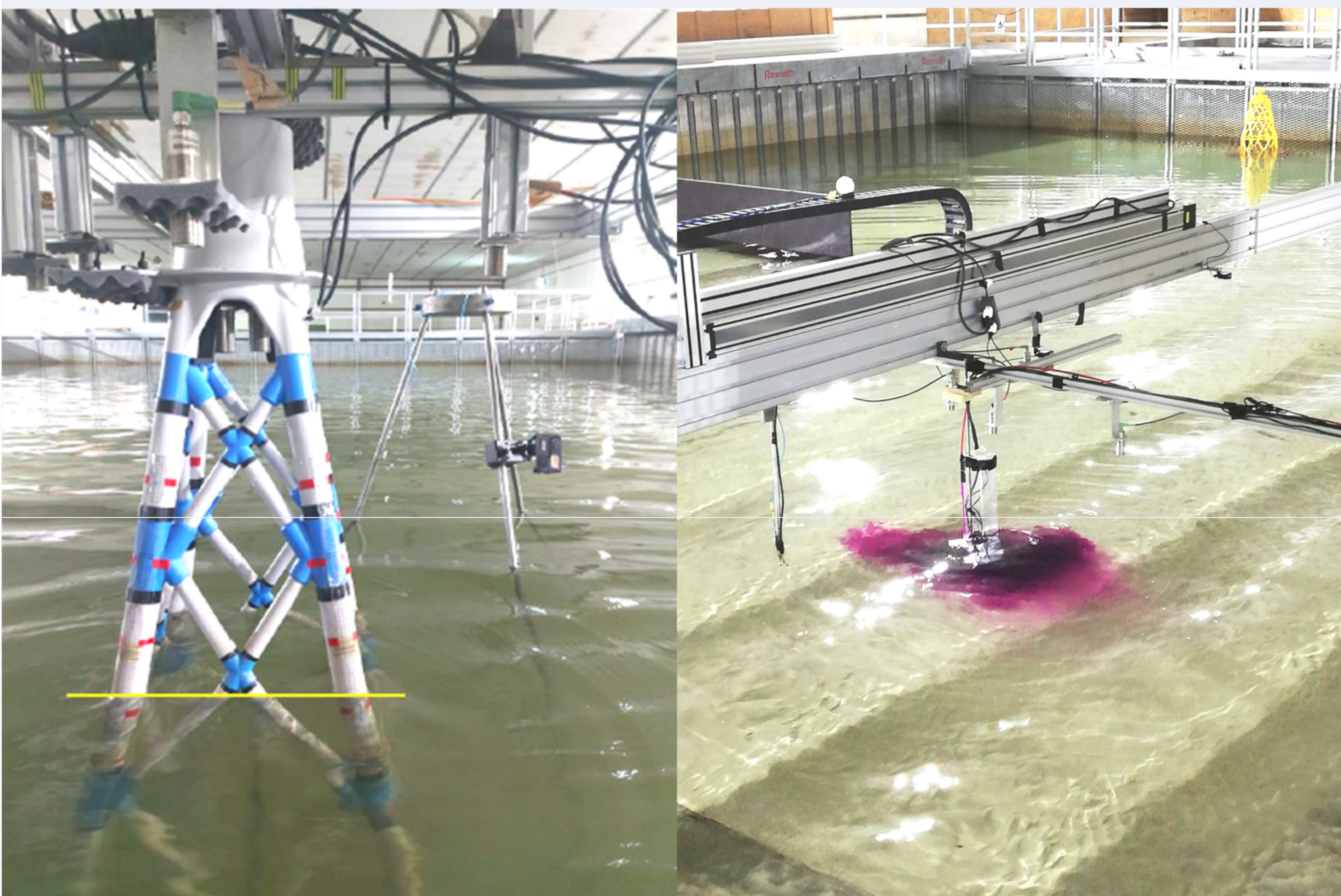




Conquering the Waves

Discovering the secrets of up-scaled Wind Energy Systems



Model test in the 3D wave basin. Left: Hydraulic transparent Jacket Structure in waves and current. Right: Monopile under wave load with red dye to highlight flow processes.

Substructures of wind energy systems (WES) need to match the trend of increasing sizes in hub heights and rotor diameters to compensate for the increasing loading. Moving WES further offshore adds the influence of increasingly rough metocean conditions to those. Therefore, new concepts are being developed in the

Collaborative Research Center (CRC) 1463

"Integrated Design and Operation Methodology for Offshore Megastructures"

Research at CRC1463

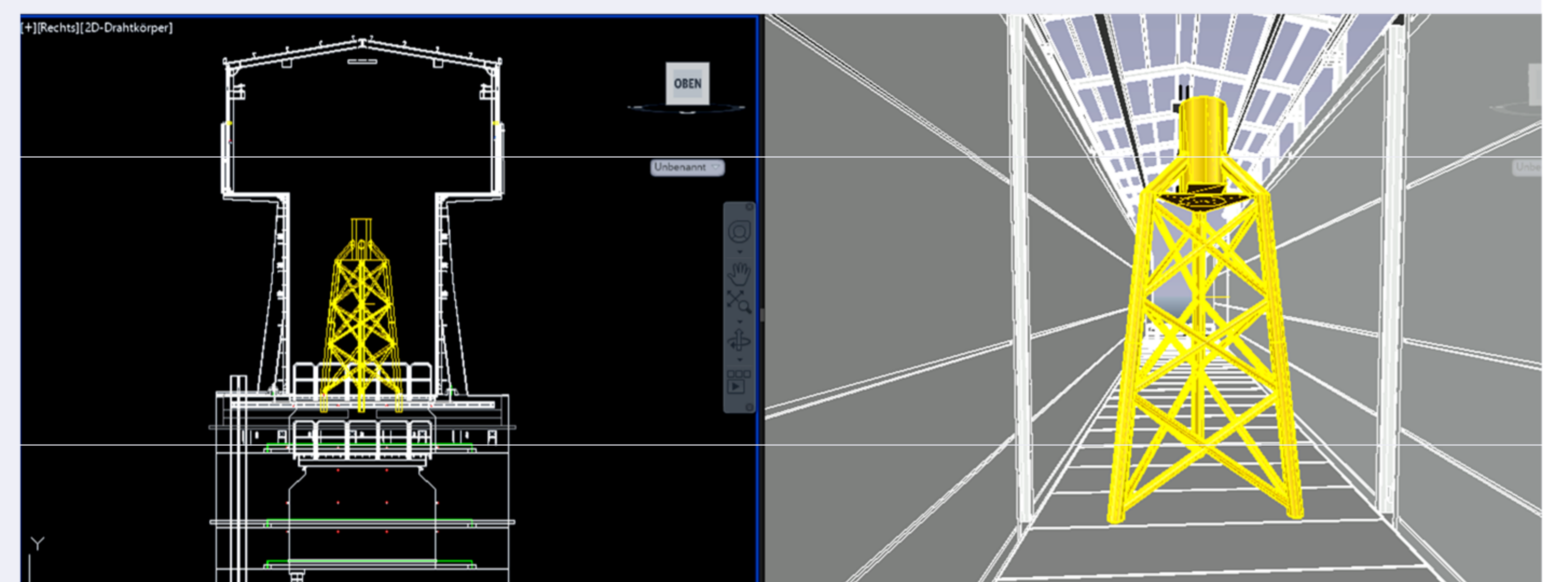
Within the framework of the CRC1463, the hydrodynamics of such increased substructure sizes in and with the marine environment are addressed in the subproject A03. The supporting analyses are sustained by scaled physical models (1:14 – 1:140) in the test facilities of the Ludwig Franzius Institute and the Forschungszentrum Küste.

Key question to be investigated is, whether the **interaction of gradually size-increased substructures with waves and currents** leads to a continuous increase in the resulting loads – or not.

The **hypothesis** of the subproject centres the assumption that the **size increase will lead to the surpassing of physical thresholds** in the nonlinear interaction system wave-current-structure. The influence of those thresholds on the resulting loads might become a key aspect to design guidelines of future WES.

What are our key research aspects?

- **Developing a Quantitative Measure** of "Growing Structure Size" for Complex Substructures (Jackets) with a Focus on Impact Assessment.
- **Examining the Impact of Resonance Effects** (Near-Trapping) Between Legs of Size-Increased Jacket Structures on Wave Heights.
- **Investigating the Implications of Size-Increased Jacket Structures** Exceeding the Assumed "Hydraulically Transparent" Interaction, and its Influence on Future Guidelines.



Planned large scale model tests set in the GWK+ (1:14). Left: Jacket in the cross section of the flume. Right: 3D Visualization.

Interdisciplinary questions

In context with the structure-design focus set above, a multitude of interdisciplinary questions can be asked:

Hydrodynamic interactions between WES and the surrounding environment have significant impacts on **nutrient and temperature distributions**. **Marine growth** on structures further affects these processes. The impact of spray water on **corrosion zones** requires further expertise on the physical details of dynamic air-water interaction. Joint research is needed to enrich our understanding of the **interactions between WES and the marine environment**.

