# The SailingBox

A miniaturized and flexible multiparameter measurement system

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Helmholtz-Zentrum Hereon

12th FerryBox Workshop, Helsinki

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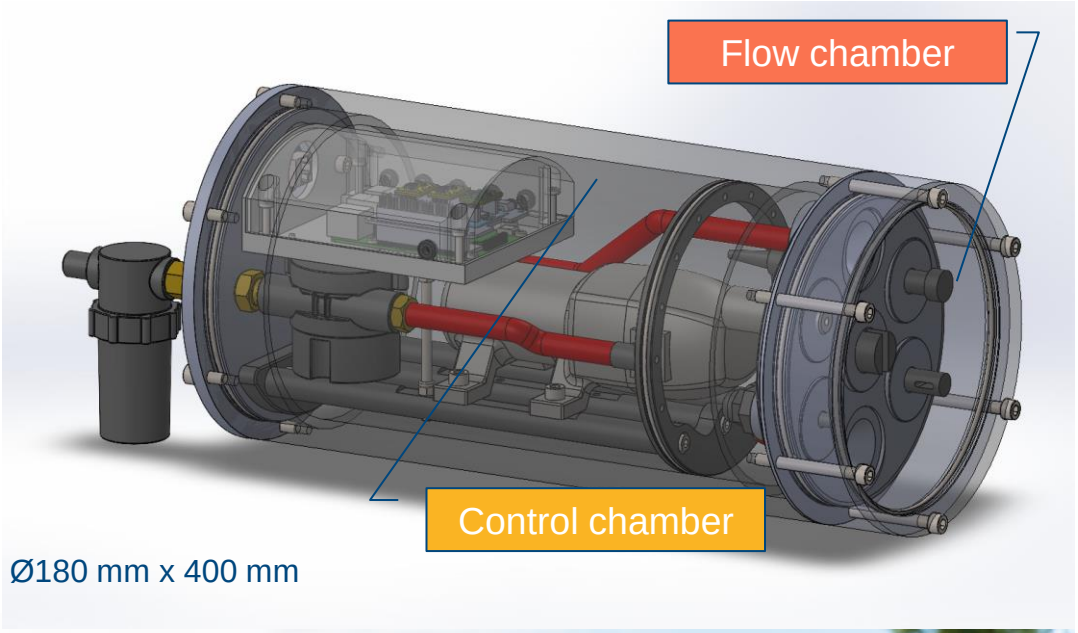
# Concept and basic functionality

- Pumped Multiparameter system
- Relatively inexpensive
- Choice in applying various sensors with sufficient accuracy
- Easily maintainable
- Modular hardware

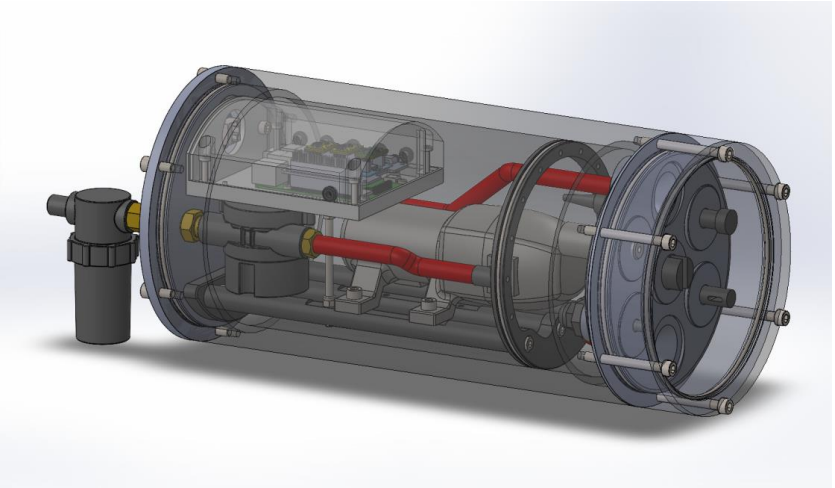
- Compact, system integrated control- and flow chamber
- Well known measuring principle (similar to Ferry Boxes)
- Easily extendable based on modular design concept



Ø180 mm x 400 mm

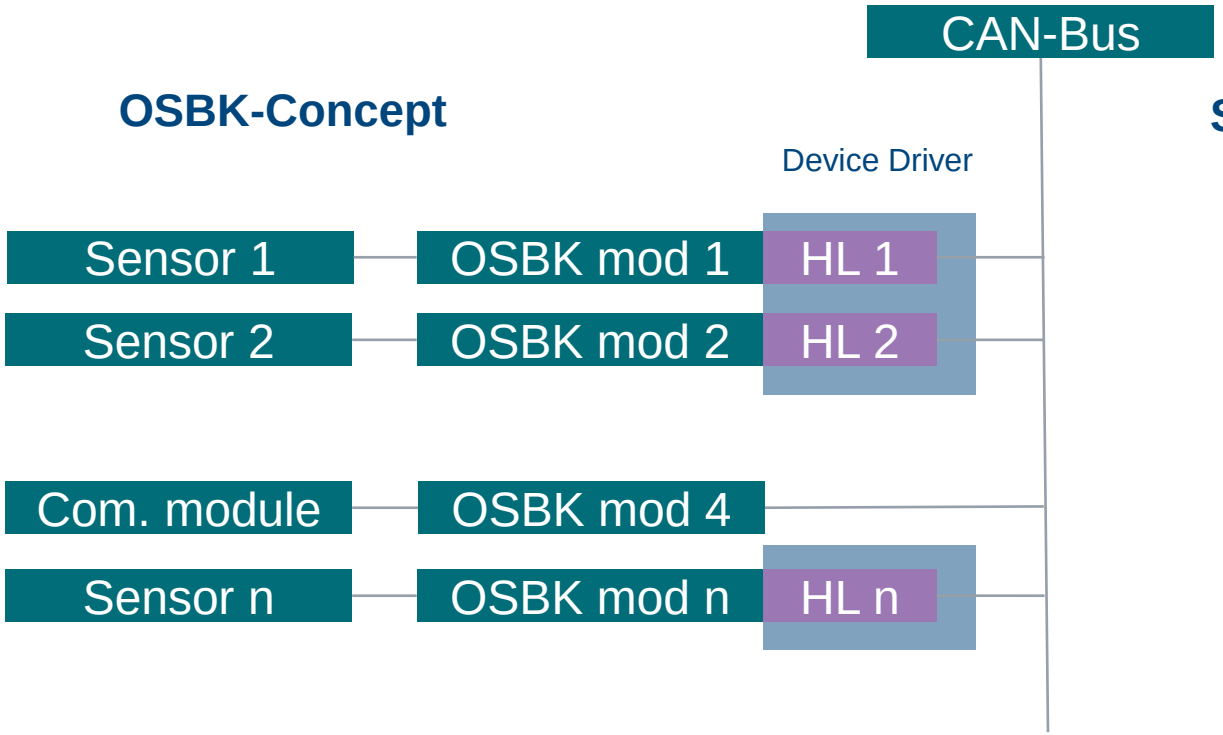
# Concept and basic functionality

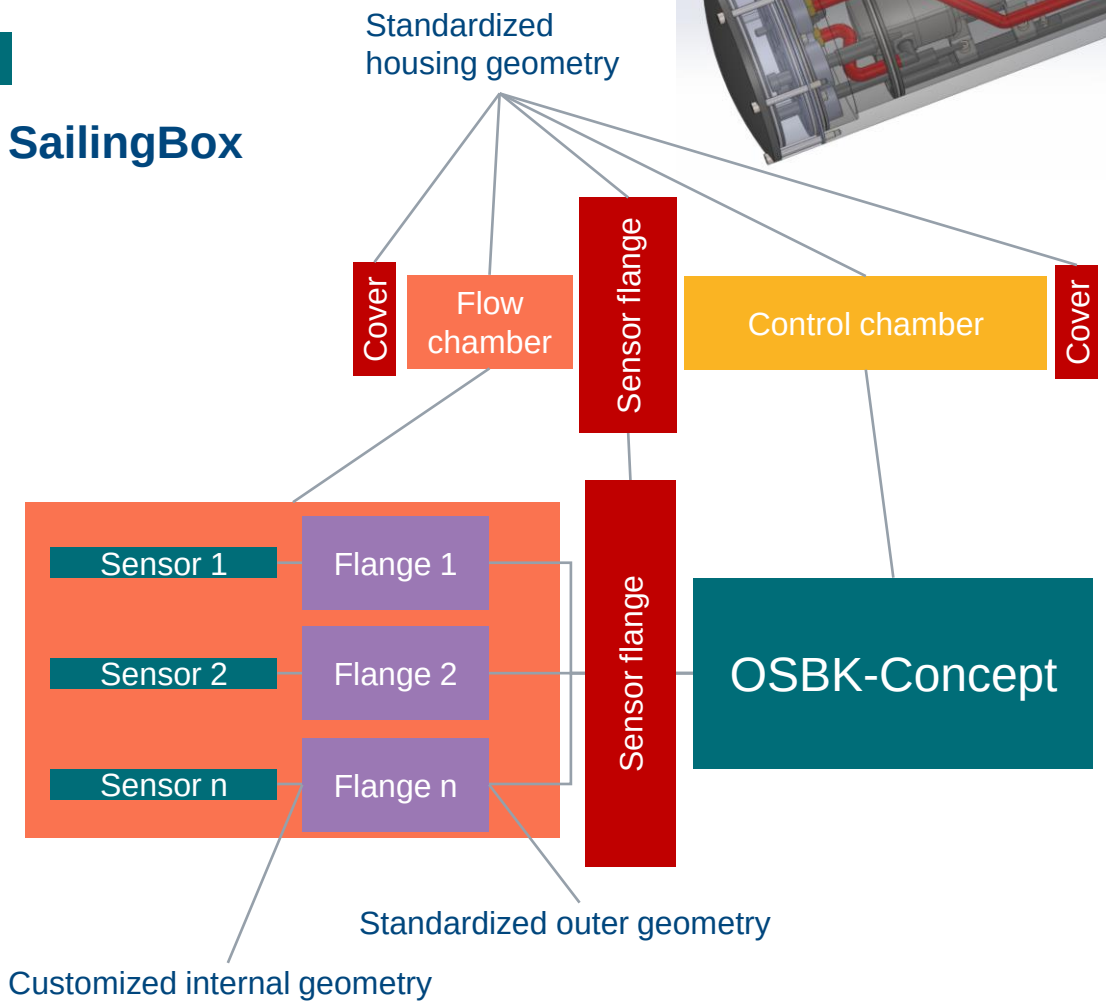
| | Installed | Possible additions |
|---|---|---|
| EOV | Conductivity | pH (pH, Salinity, Temperature) |
| | Temperature | GPS/GLNSS |
| | Pressure (optional) | Microplastic filter (MPF, µm bis nm) |
| | Dissolved Oxygen | CO2 |
| | | Methane |
| | | |
| | | |
| QC | Turbidity | UV-biofouling prevention |
| | Humidity (air) | Temperature (reference; checking inflow and flow chamber temperature |
| | Temperature (air) | |
| | Total Power (V, A) | |
| | Flow velocity | |
| | Particle filter (mm) | |



Communication:
Satellite, Starlink, LoRaWan, **LTE**

# Concept and basic functionality




- Each sensor has own OSBK module & uses same device driver but with an adjusted hardware layer (HL)
- Intercommunication over CAN
- Modular, flexible, easily adding/ removing new sensors
- Allows for multiparameter systems



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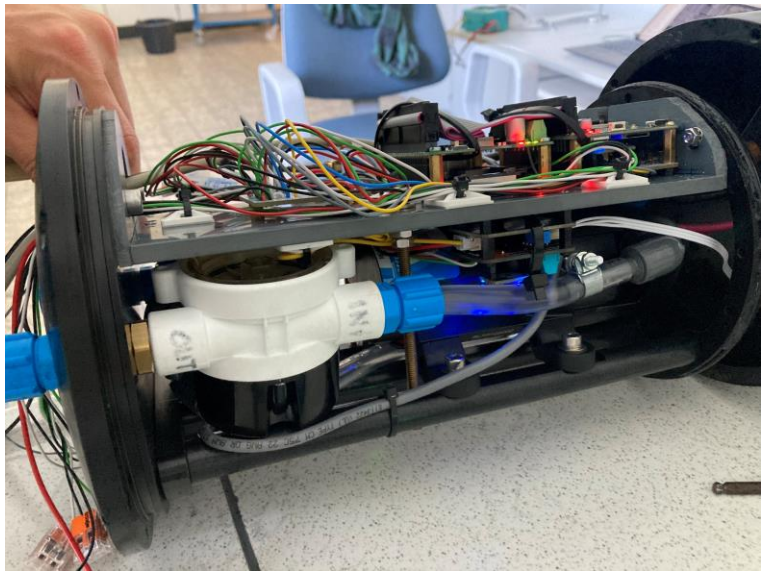
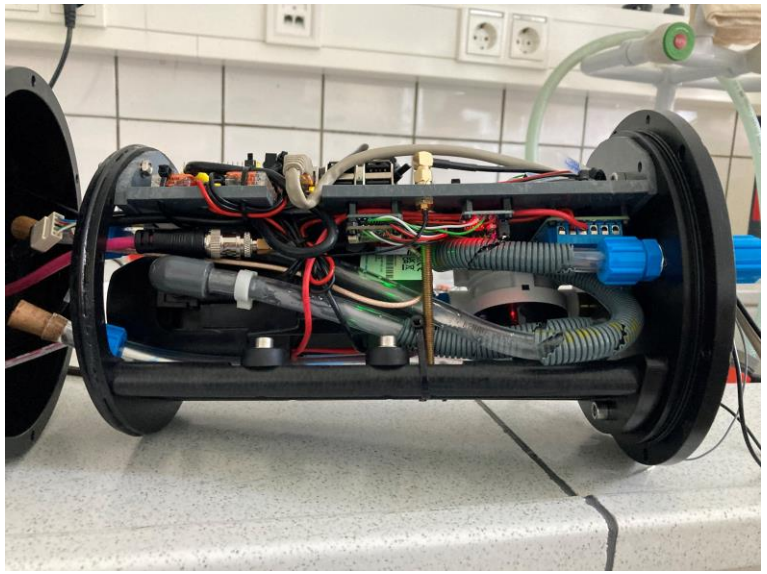
# Concept and basic functionality

**Electronics**
- OSBK is still under development!
- Freely available electronics (Pi-hats), sensors and simple circuits

**Hardware parts**
- Standard hardware parts
- Freely available design: drawings and 3D CAD data





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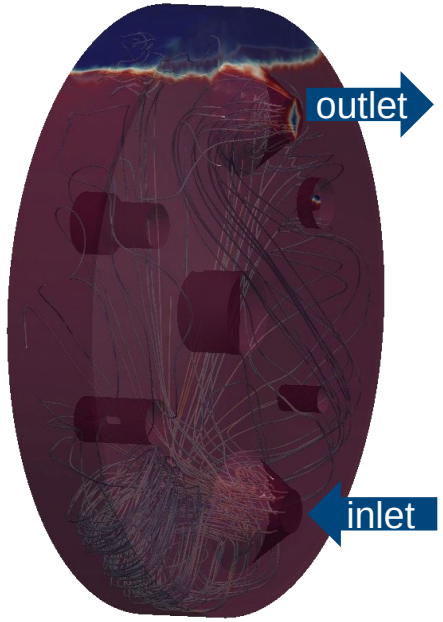
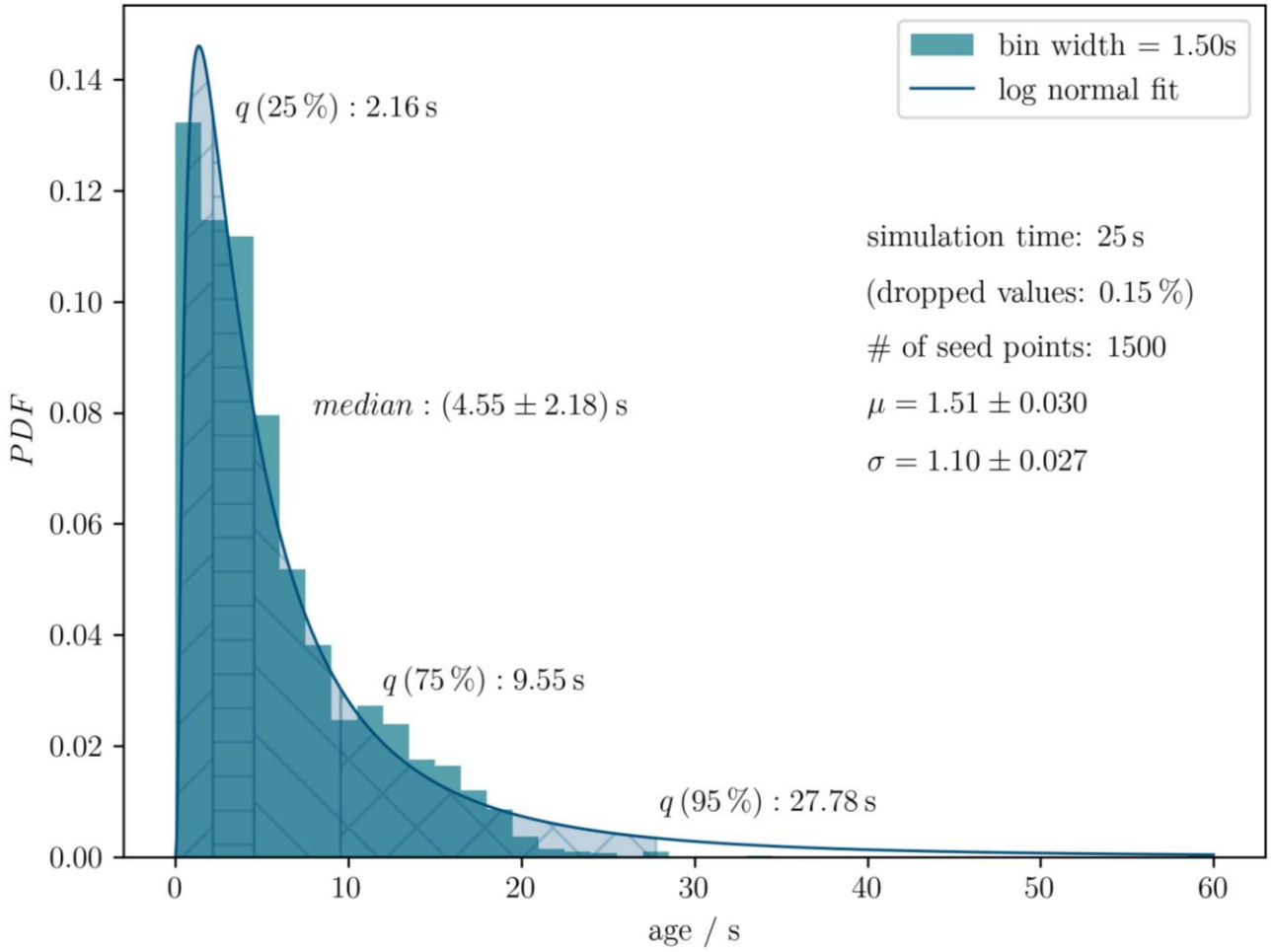
# Simulation results of conditions in the flow chamber

**Simulations** (VoF, OpenFoam) **confirm**

- Proper design
- Proper functionality
- Minimum sampling rate etc.



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# Control-interface and data-transfer

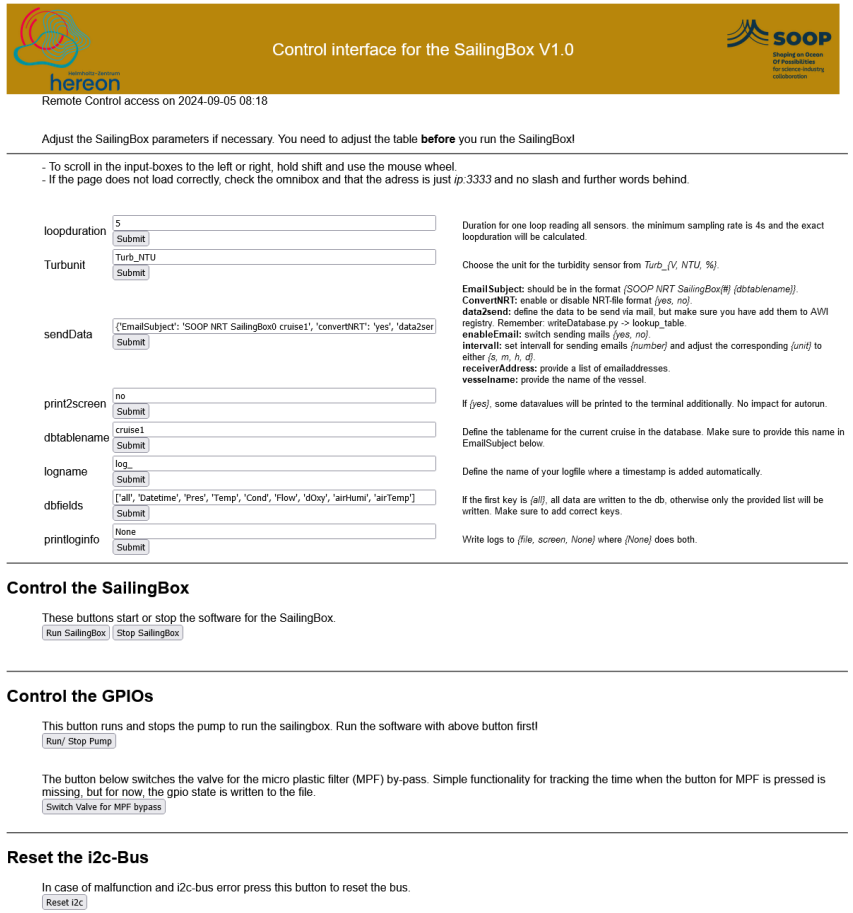
## Controls

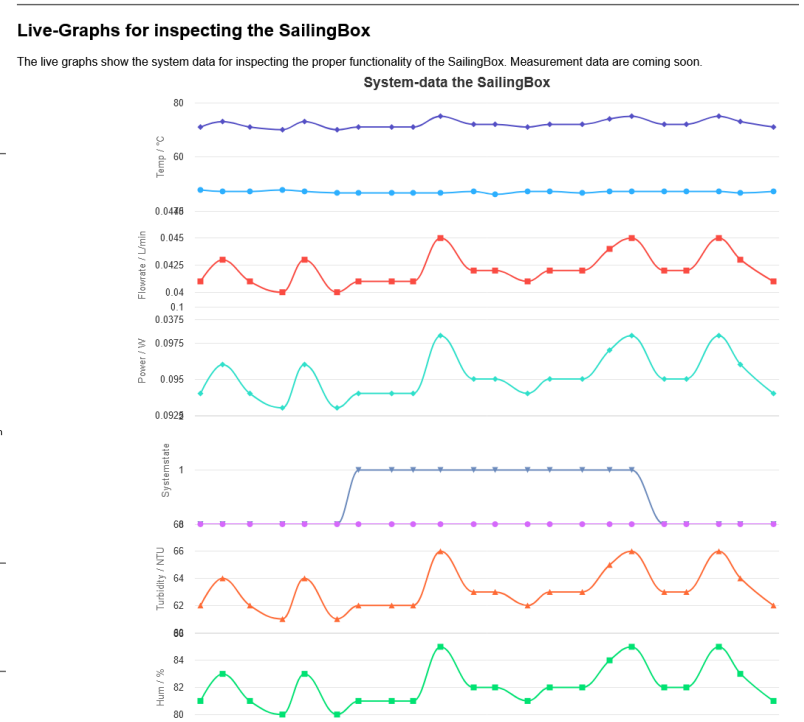
- Adjusting relevant parameters
- Start/ stop the measurement , the pump etc.
- Additional control functionality
- Inspection of system-data

## Data transfer

- by email in NRT-format via LTE
- In adjustable intervals

⇒ Connection via hotspot
⇒ Interface via IP and a browser
⇒ Accessibility with any device



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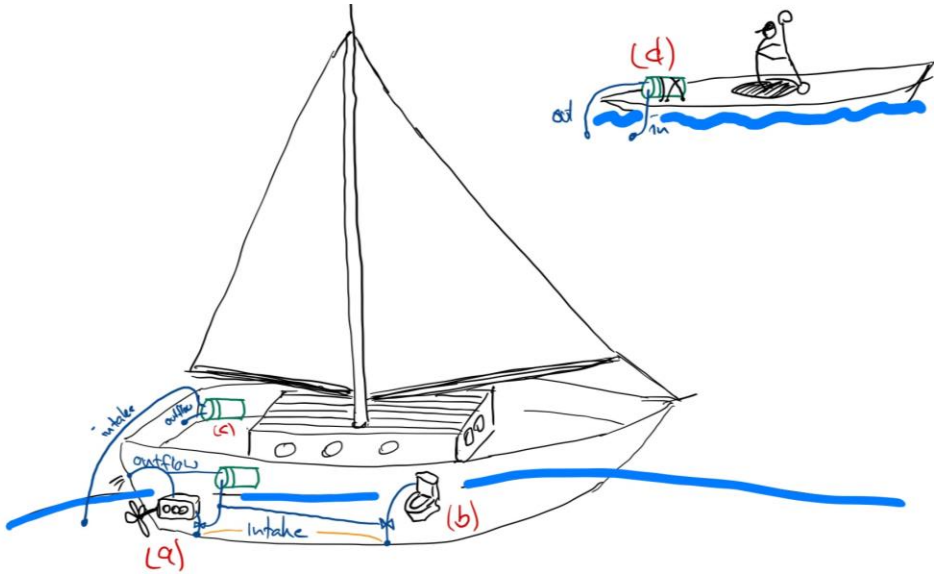
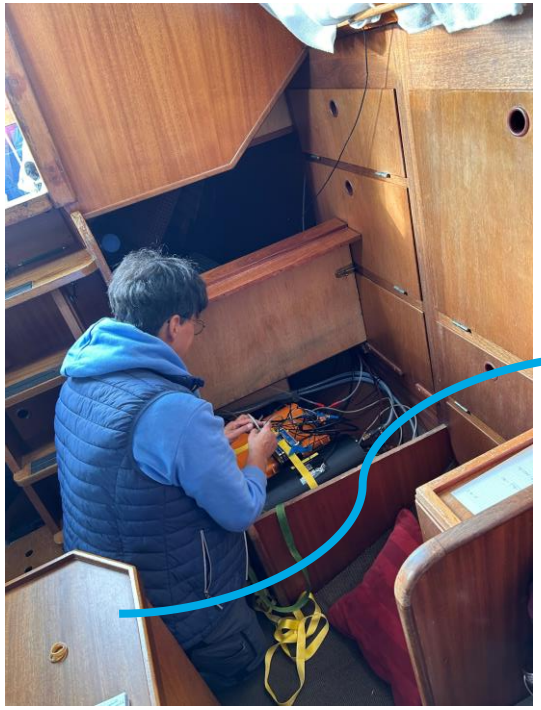
# Installation examples

**Installation**

- bypass cooling water for motor
- Bypass toilet flushing system
- mount it on deck, Kajaks, SUPs





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# Test cruise with Kerry Blue


© M. Gehrung (Hereon), Kerry Blue



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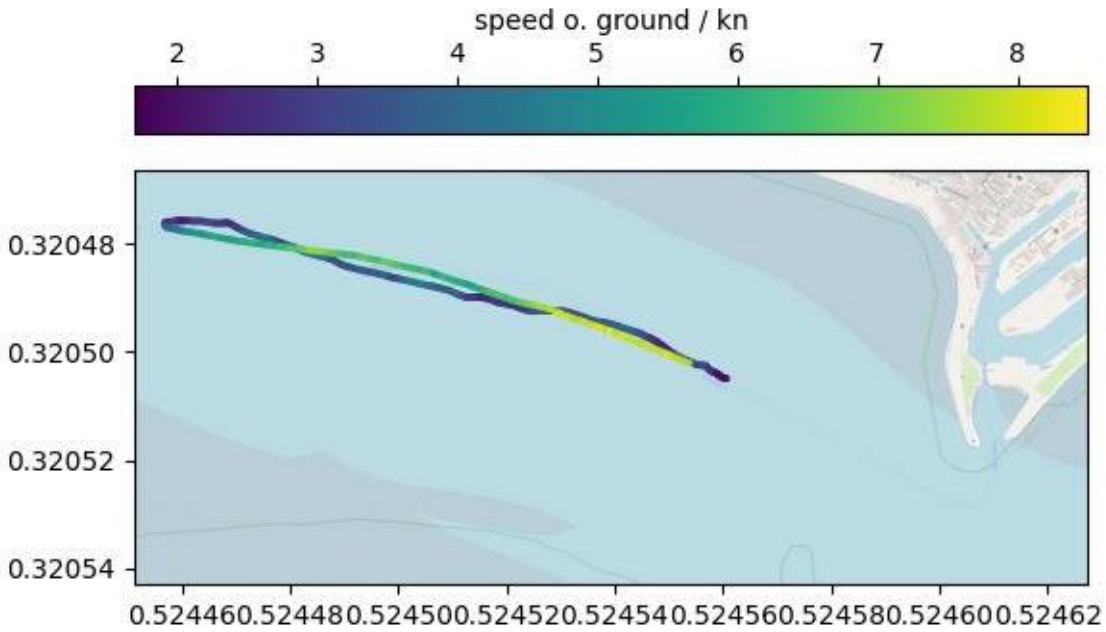
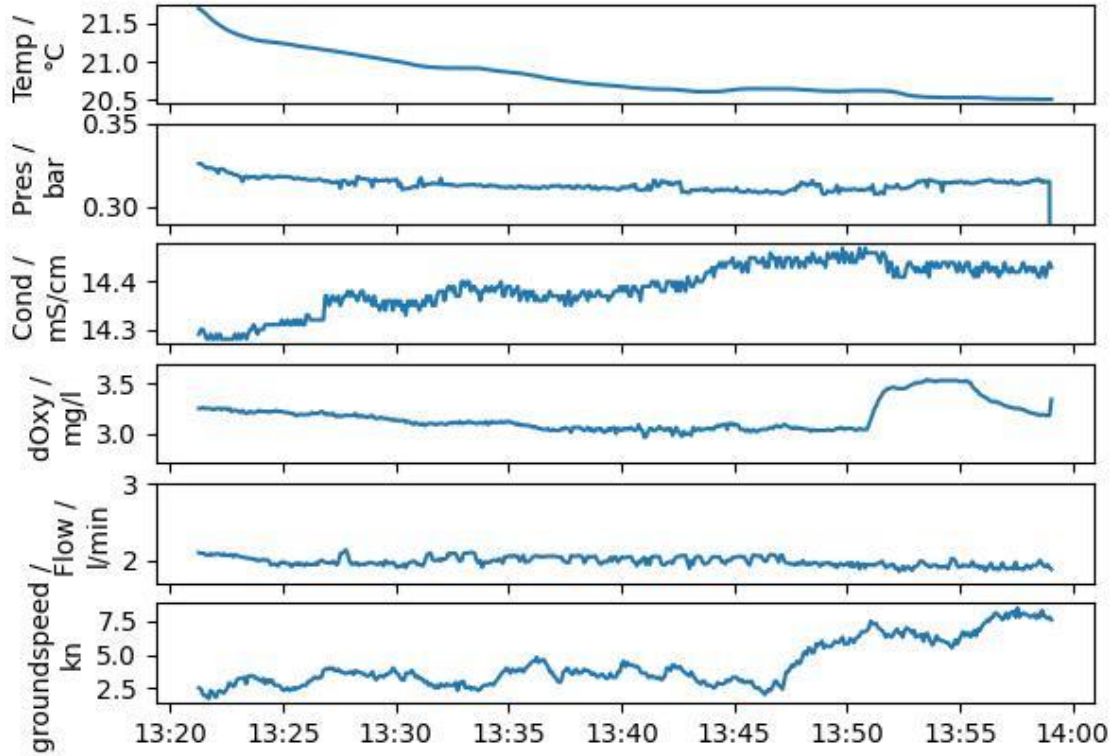
# Test cruise with Kerry Blue




Sensors are not calibrated yet!



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# Additional Instruments

**Ability to combine three different systems, the MetBox, Camos  and the SailingBox**
Communication currently via LTE, but openCAN is planned
Additional sniffer (**MOPY**) being able to collect the data of the boxes and read additional NMEA systems on board

**MetBox** (Hereon, A. Ordonez, J. Horstmann)
- Windspeed and –direction
- Air temperature, humidity, pressure

**CAMOS** (AWI, L. Pünter, A. Herber)
- CO2+CO, NO, SO2 and/or O3



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# Cooperations and plans

- Developing a high-precision SailingBox in cooperation with *Sea &Sun Technology*
- Sharing experiences and ideas with 4H Jena regarding the OSBK-module
- Cooperation with the *material science department at hereon* regarding aluminum housing for cost reductions

- Ongoing tests on Kerry Blue
- Planned cruise on Avontuur (2 yrs southern Atlantic ocean)
- Robust data communication with LoraWan (currently LTE)

- New dashboard for controls and data visualization almost finished
- Improvements and cost reductions of housing parts including 3D prints
- Investigation of sensor accuracy, response times etc.

# Thank you for your attention

## The SailingBox - A miniaturized and flexible multiparameter measurement system


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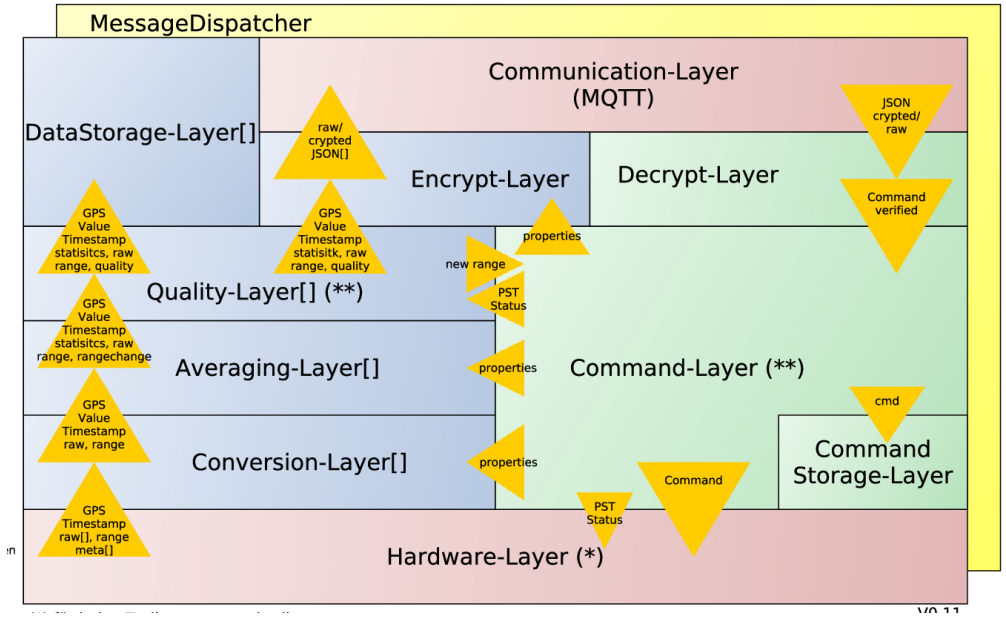
# Installation Necessaires for the SailingBox

- Available space for the sailingbox (18x45cm): apprx. Min 30x70cm (there is an additional particle filter)
- Reduction to 8x1,5mm pipe (schlauch) (inner diameter 8mm, outer 11mm)
- Power 12-24V DC
- A possibility to bring the GPS-mouse/ LTE-Antenna outside of the boat
- Accessibilty for maintenance (regular cleaning of flow chamber, eg weekly(?) cycle)

# Concept Software architecture

## Planned

- Devicedriver, each running an OSBK-module
- No additional computer
- If a RPi is needed, it can be integrated similarly to a sensor

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M. Puzhakkarayillath (Hereon)

## Currently

Devicedriver reused on Raspberry Pi

- Instead of specific HL per sensor, the HL reads all sensors at once

Pros

- reuse of software
- Reuse of custom HL for more complex systems
- Prepared to easily apply OSBK-modules when available

Cons

- Takes a bit more time to get used to this software architecture

**We have implemented a simple testing software and are integrating this into a HL.**



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