

The SailingBox

A miniaturized and flexible multiparameter measurement system

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Helmholtz-Zentrum Hereon

12th FerryBox Workshop, Helsinki



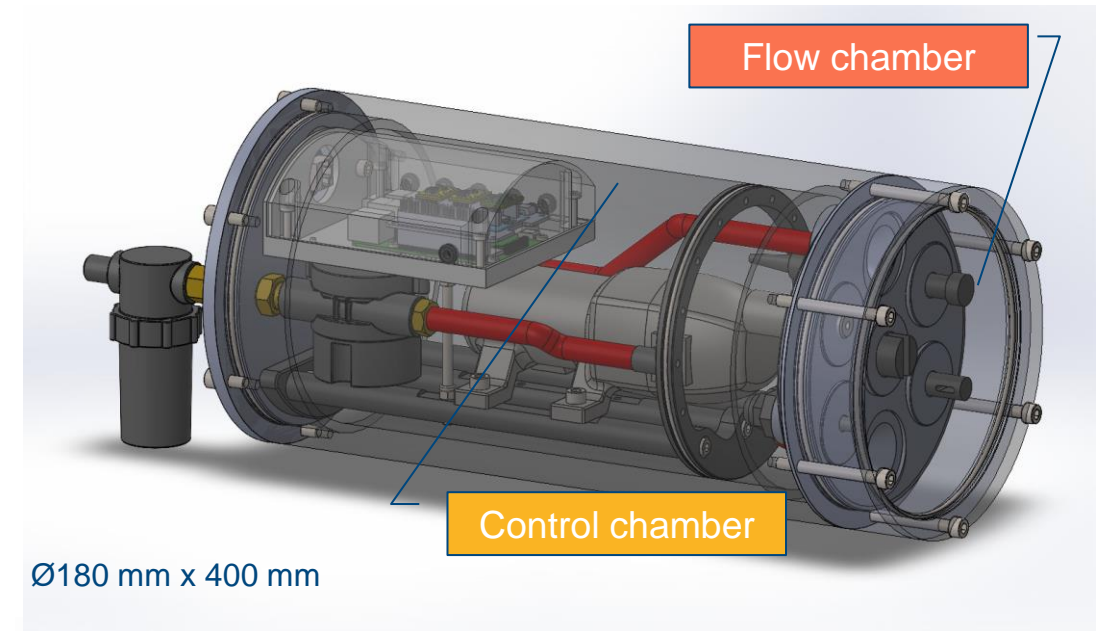
<https://www.soop-platform.earth/>

Shaping an Ocean Of Possibilities
for science-industry collaboration



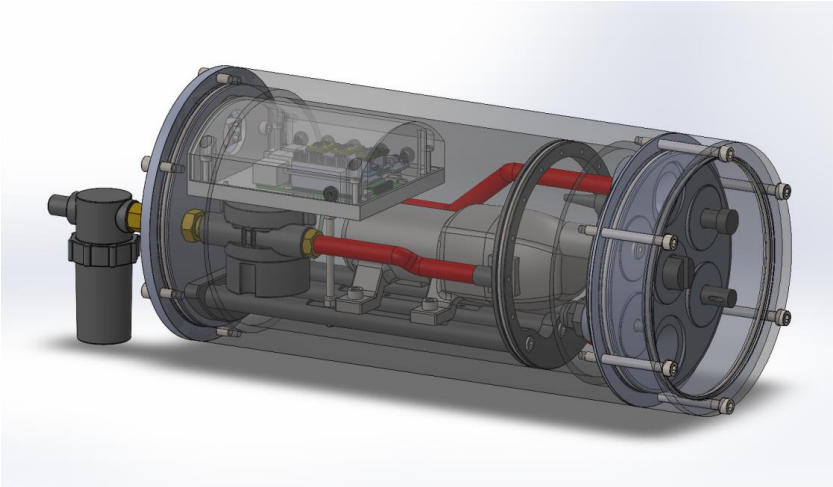
Concept and basic functionality

- 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



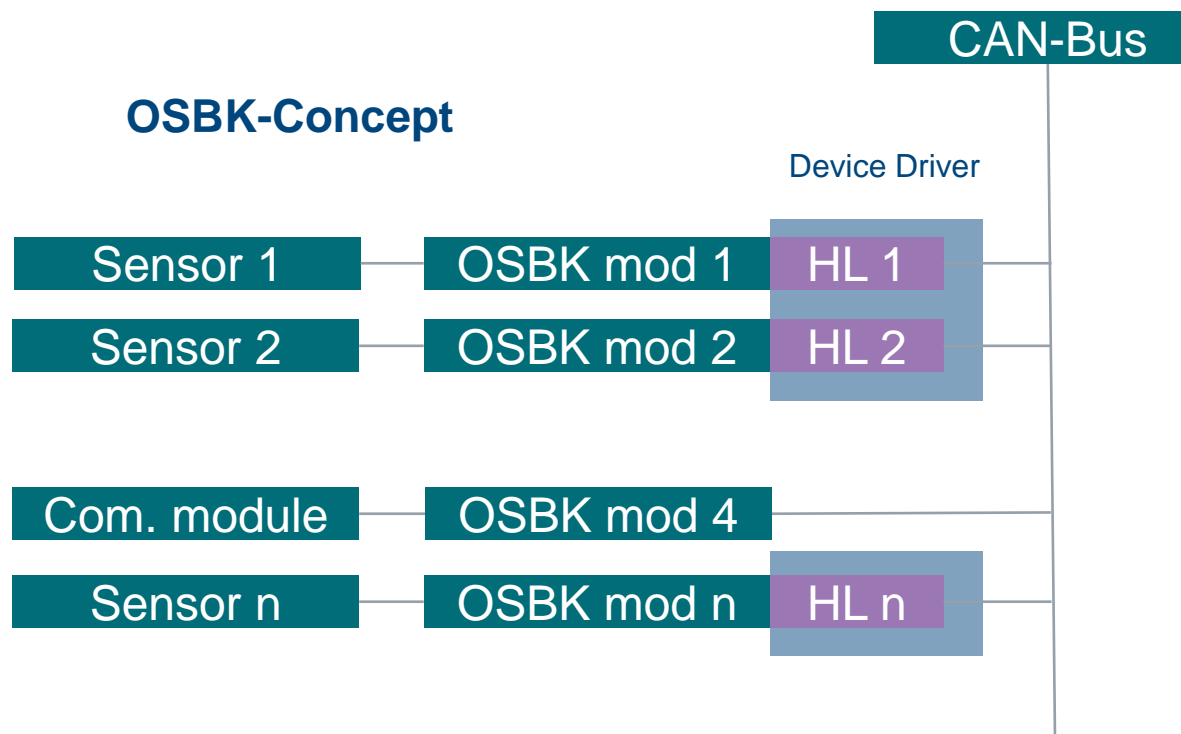
Concept and basic functionality

	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)	

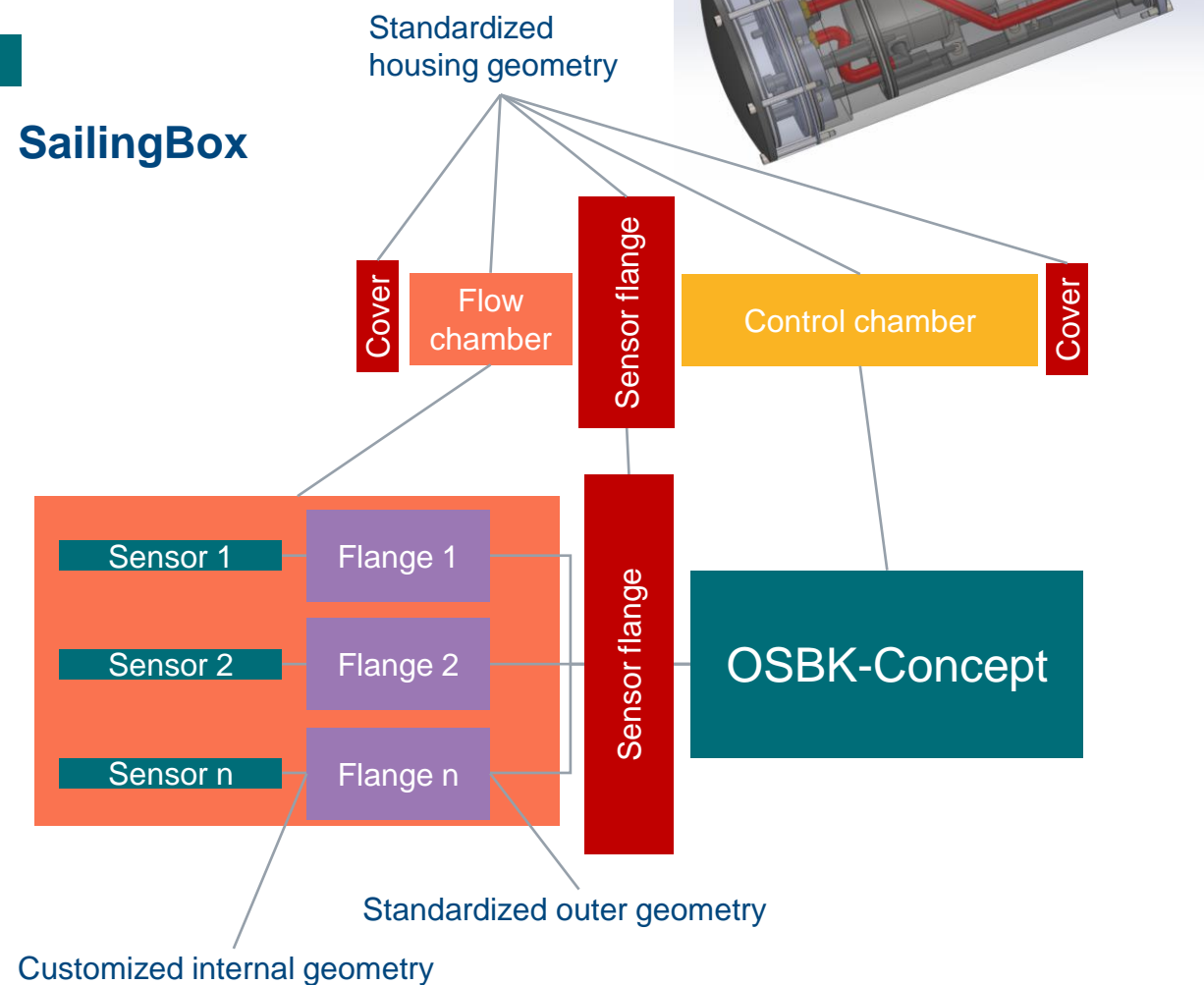


Communication:
Satellite, Starlink, LoRaWan, **LTE**

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



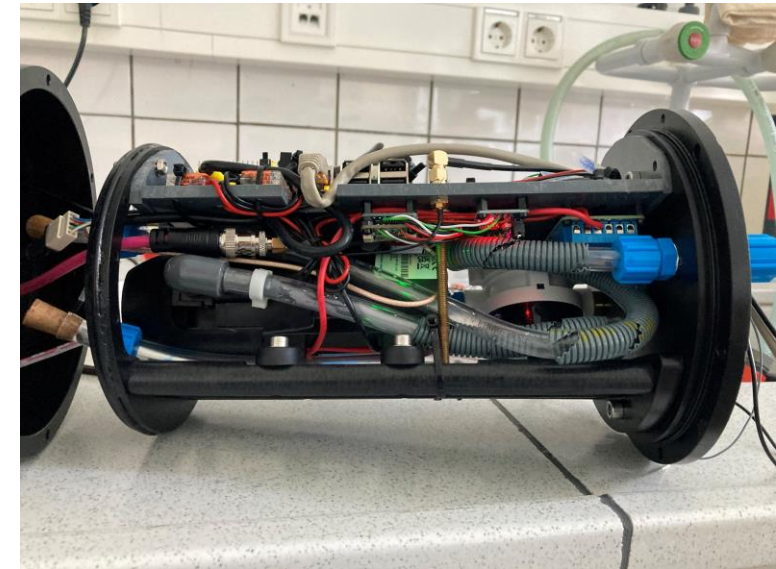
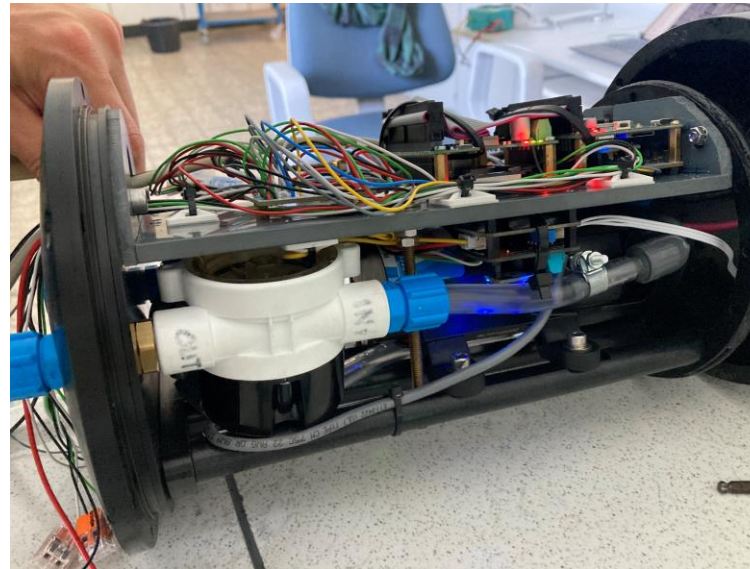
Concept and basic functionality

Electronics

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

Hardware parts

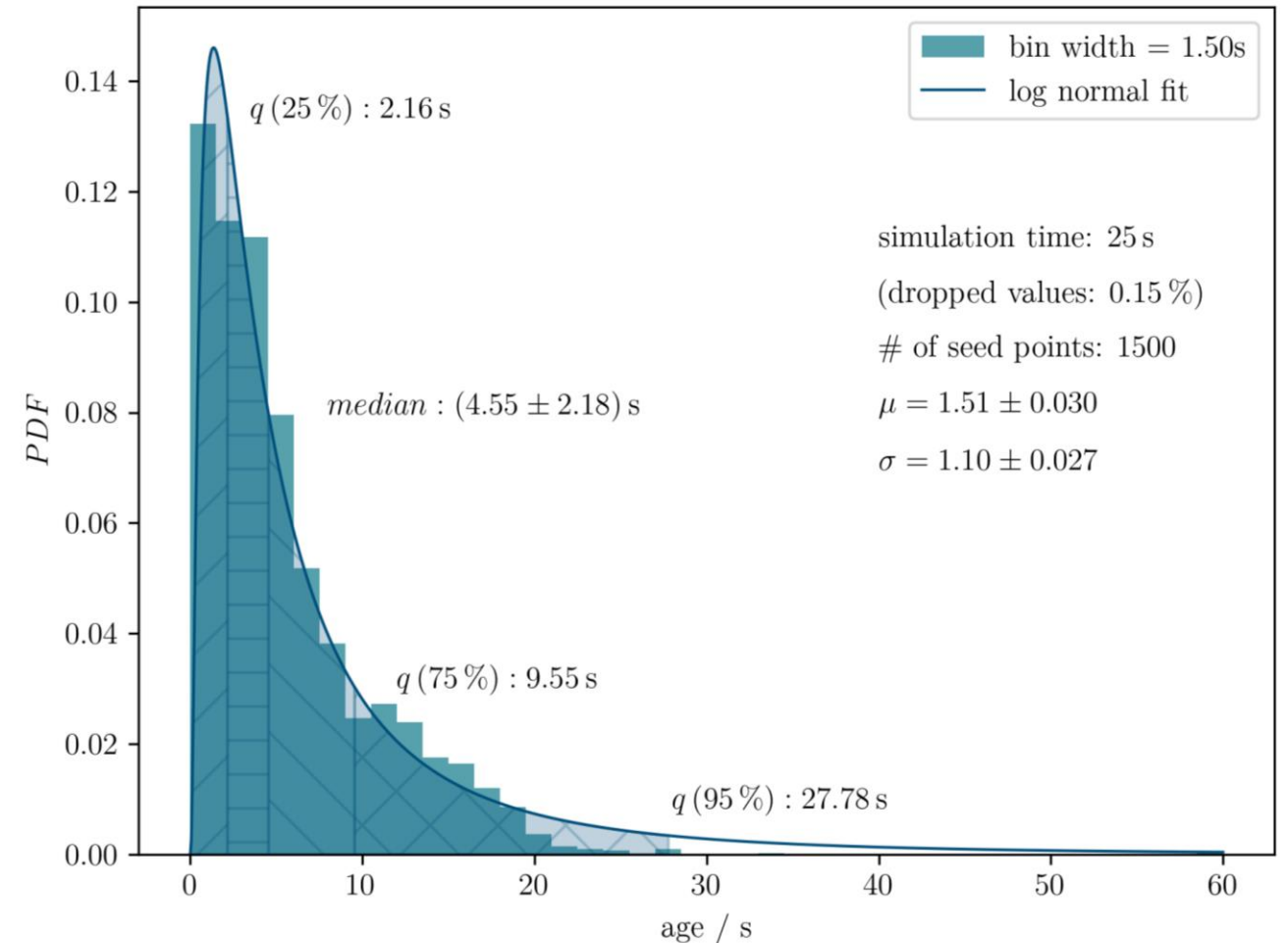
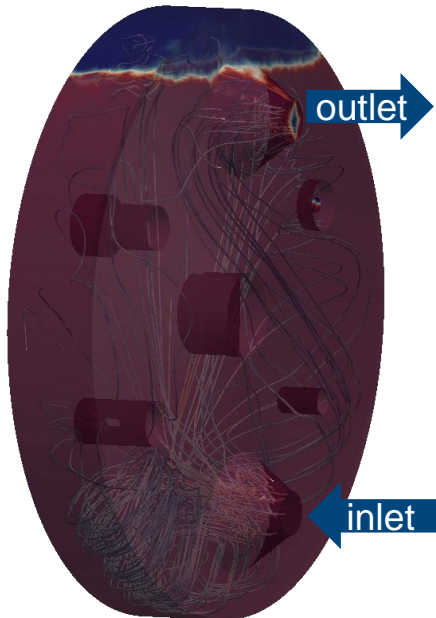
- Standard hardware parts
- Freely available design: drawings and 3D CAD data



Simulation results of conditions in the flow chamber

Simulations (VoF, OpenFoam) confirm

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



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



Control interface for the SailingBox V1.0

Remote Control access on 2024-09-05 08:18

Adjust the SailingBox parameters if necessary. You need to adjust the table **before** you run the SailingBox!

- To scroll in the input-boxes to the left or right, hold shift and use the mouse wheel.

- If the page does not load correctly, check the omnibox and that the address is just `/p.3333` and no slash and further words behind.

loopduration

5

Submit

Turbunit

Turb_NTU

Submit

sendData

("EmailSubject": "SOOP NRT SailingBox0 cruise1", "convertNRT": "yes", "data2ser")

Submit

print2screen

no

Submit

dbtablename

cruise1

Submit

logname

log_

Submit

dbfields

["all", "Datetime", "Pres", "Temp", "Cond", "Flow", "dOxy", "airHum", "airTemp"]

Submit

printloginfo

None

Submit

Duration for one loop reading all sensors. the minimum sampling rate is 4s and the exact loopduration will be calculated.

Choose the unit for the turbidity sensor from Turb_[V, NTU, %].

EmailSubject: should be in the format (SOOP NRT SailingBox[#] [tablename])
ConvertNRT: enable or disable NRT-file format (yes, no)
data2ser: define the data to be send via mail, but make sure you have add them to AWI registry. Remember: writeDatabase.py -> lookup_table
enableEmail: switch sending mails (yes, no)
Interval: set interval for sending emails (number) and adjust the corresponding (unit) to either (s, m, h, d)
receiverAddress: provide a list of emailaddresses.
vesselname: provide the name of the vessel.

If (yes), some data values will be printed to the terminal additionally. No impact for autorun.

Define the tablename for the current cruise in the database. Make sure to provide this name in EmailSubject below:

Define the name of your logfile where a timestamp is added automatically.

If the first key is (all), all data are written to the db, otherwise only the provided list will be written. Make sure to add correct keys.

Write logs to (file, screen, None) where (None) does both.

Control the SailingBox

These buttons start or stop the software for the SailingBox.

Run SailingBox

Stop SailingBox

Control the GPIOs

This button runs and stops the pump to run the sailingbox. Run the software with above button first!

Run/ Stop Pump

This button below switches the valve for the micro plastic filter (MPF) by-pass. Simple functionality for tracking the time when the button for MPF is pressed is missing, but for now, the gpio state is written to the file.

Switch Valve for MPF bypass

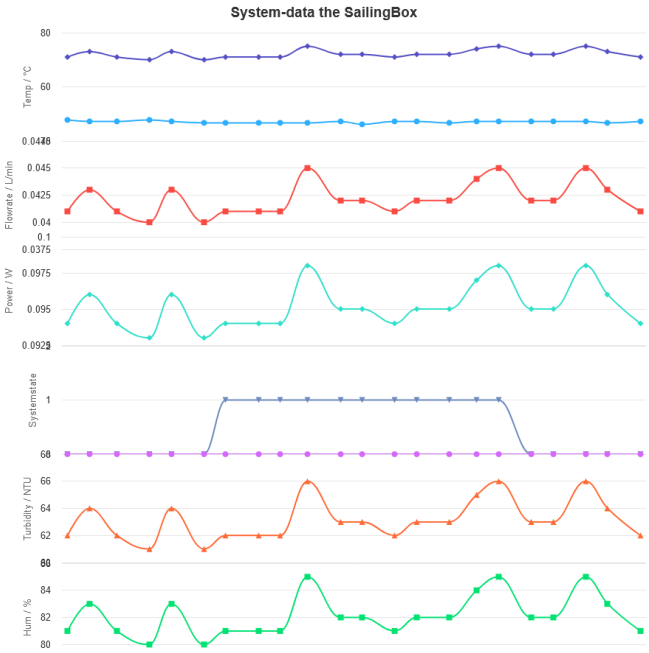
Reset the i2c-Bus

In case of malfunction and i2c-bus error press this button to reset the bus.

Reset i2c

Live-Graphs for inspecting the SailingBox

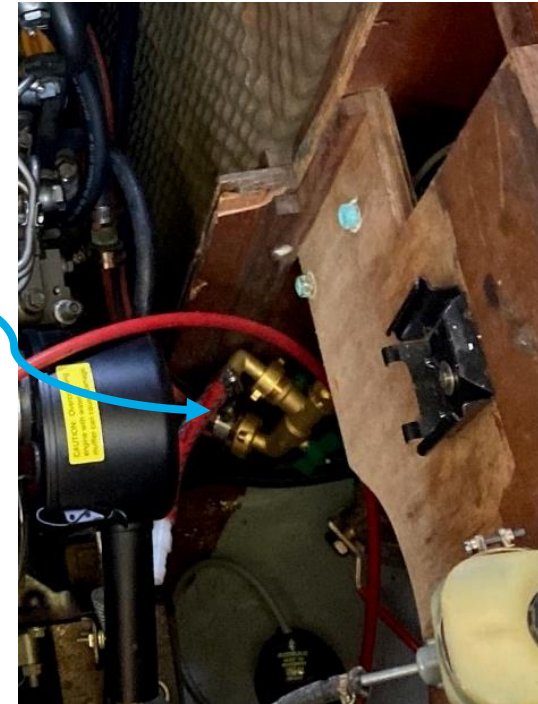
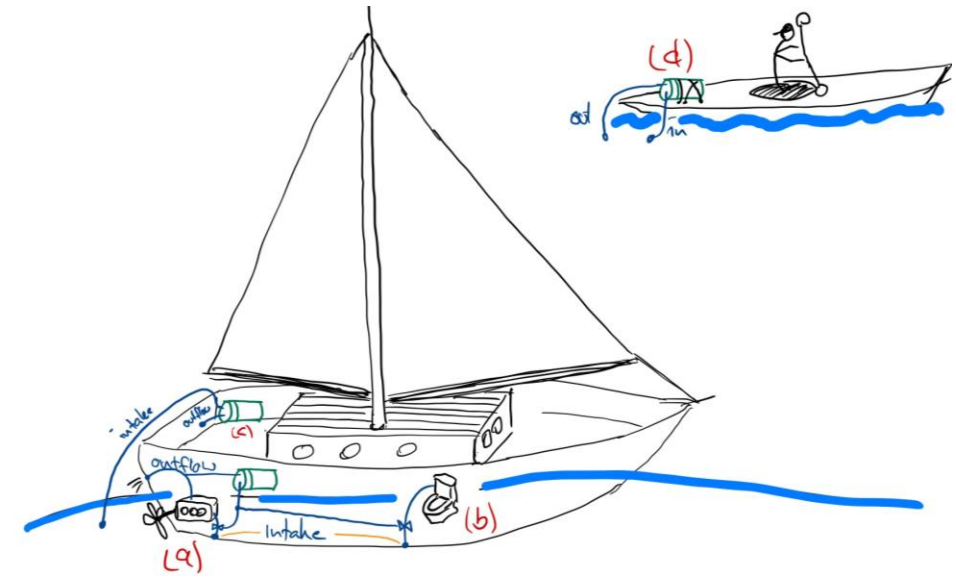
The live graphs show the system data for inspecting the proper functionality of the SailingBox. Measurement data are coming soon.



Installation examples

Installation

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



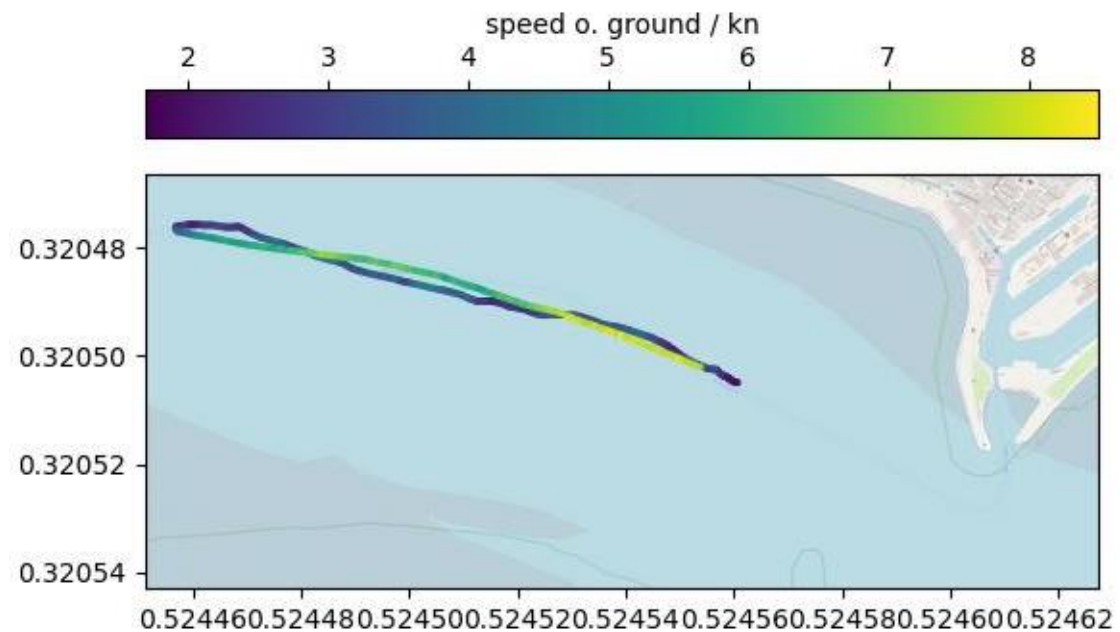
Test cruise with Kerry Blue



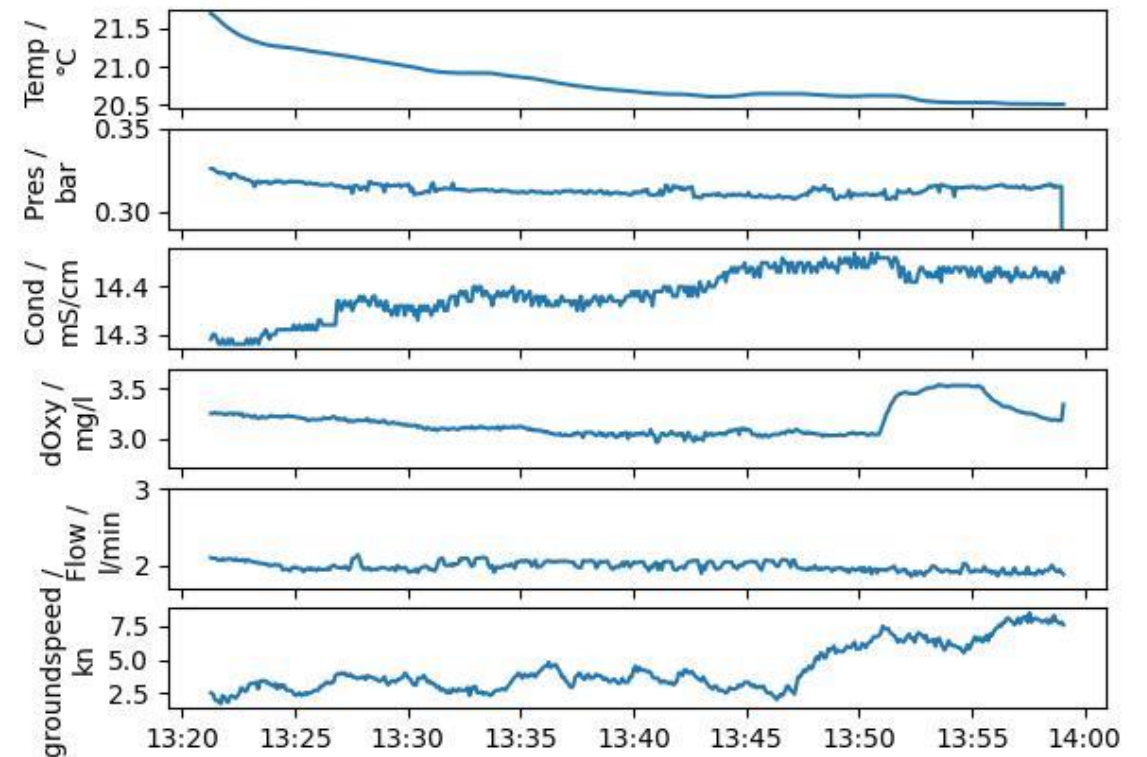
© M. Gehrung (Hereon), Kerry Blue



Test cruise with Kerry Blue



Sensors are not calibrated yet!



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



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

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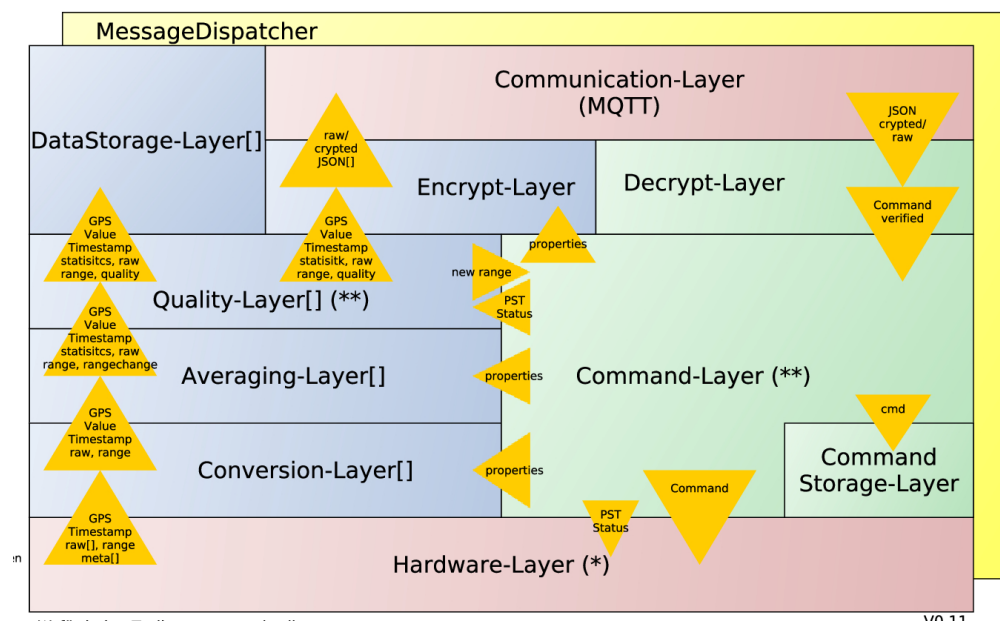
Installation Necessaires for the SailingBox

- 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



© O.Listing (Hereon),
M. Puzhakarayillath (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.