

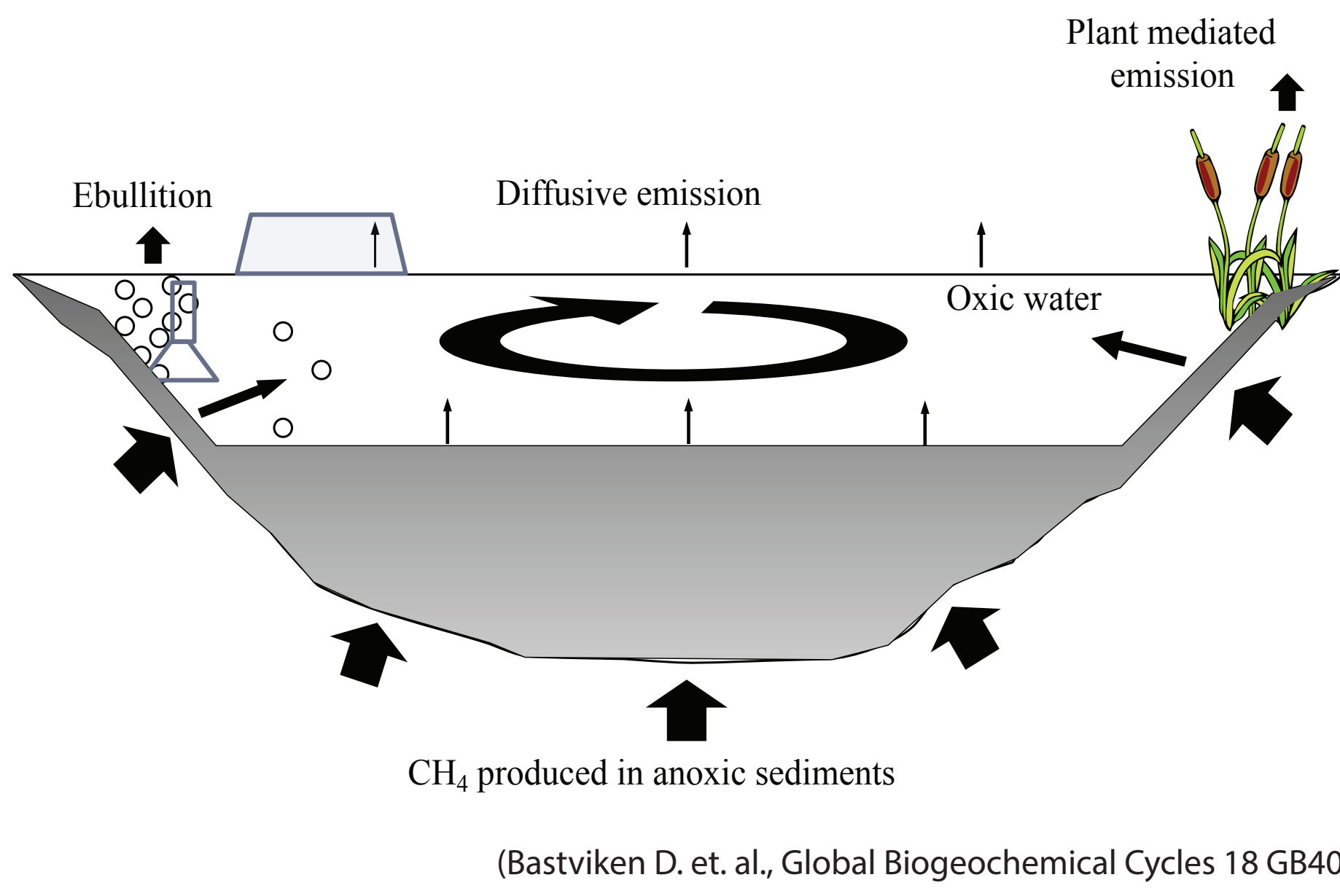
Automatic remotely web-based control equipment for investigating gas flux at water – air interfaces

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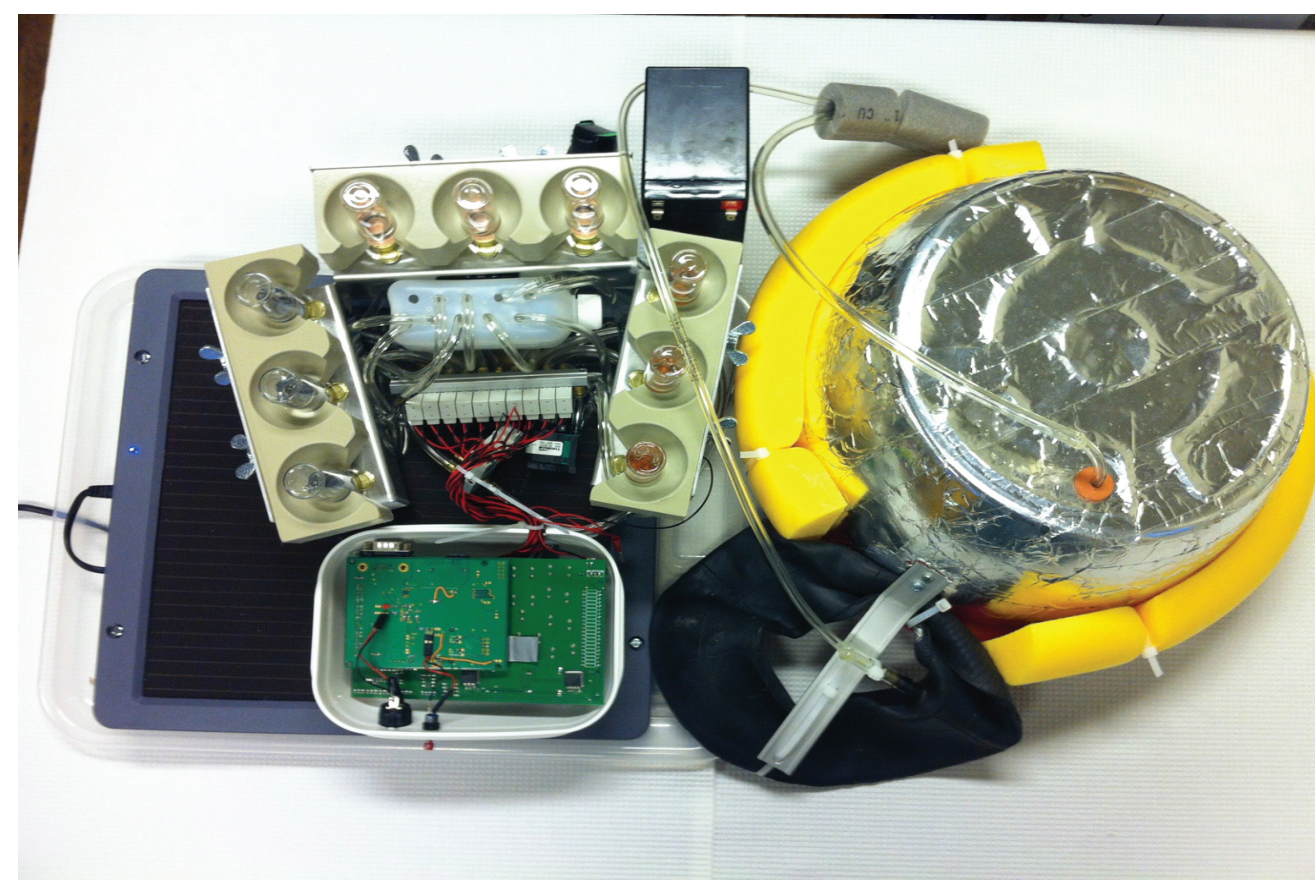
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Abstract



- Aquatic ecosystems are major sources of greenhouse gases (GHG). Robust measurements of natural GHG emissions are vital for evaluating natural GHG budgets and for assessing climate feedbacks on natural fluxes to improve climate models.
- Diffusive and ebullition (bubble) flux are two of main pathways for GHG escape to the atmosphere.
- The proper capture of high temporal variability of these fluxes calls for labor intensive manual based methods or requires expensive equipment e.g. eddy correlation methods.
- An inexpensive and easily mobile flux chamber - bubble counter has been developed with wireless data readout and web-based remote monitoring and control.
- The unit can be programmed to measure *in situ* accumulation of gas in the chamber, ebullitive gas in the funnel and equipped to collect gas samples into sample bottles for subsequent analysis in the laboratory.

- Using conventional funnel and floating chamber design as the basis to capture emissions.
- Automated with a custom wireless data logger to control and monitor the gas traps.



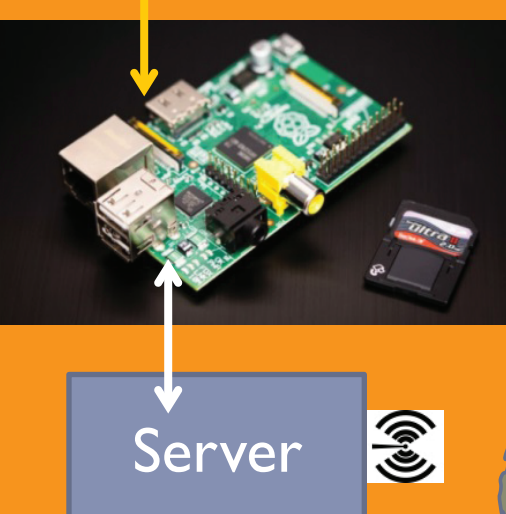
- Sensors:
- 2 CO₂ sensors
 - 1 CH₄ sensors
 - 3 temperature sensors
 - 1 pressure sensor
- Optional:
- vial sampling array

- Web-based control and monitoring via a Raspberry Pi computer connected to the internet.
- An on-shore "controller" board, connected to the Raspberry Pi computer, remotely controls and reads out clients over a wireless mesh network (DigiMesh).
- Up to 60 "clients" deployed in lakes within 1 km of the controller.

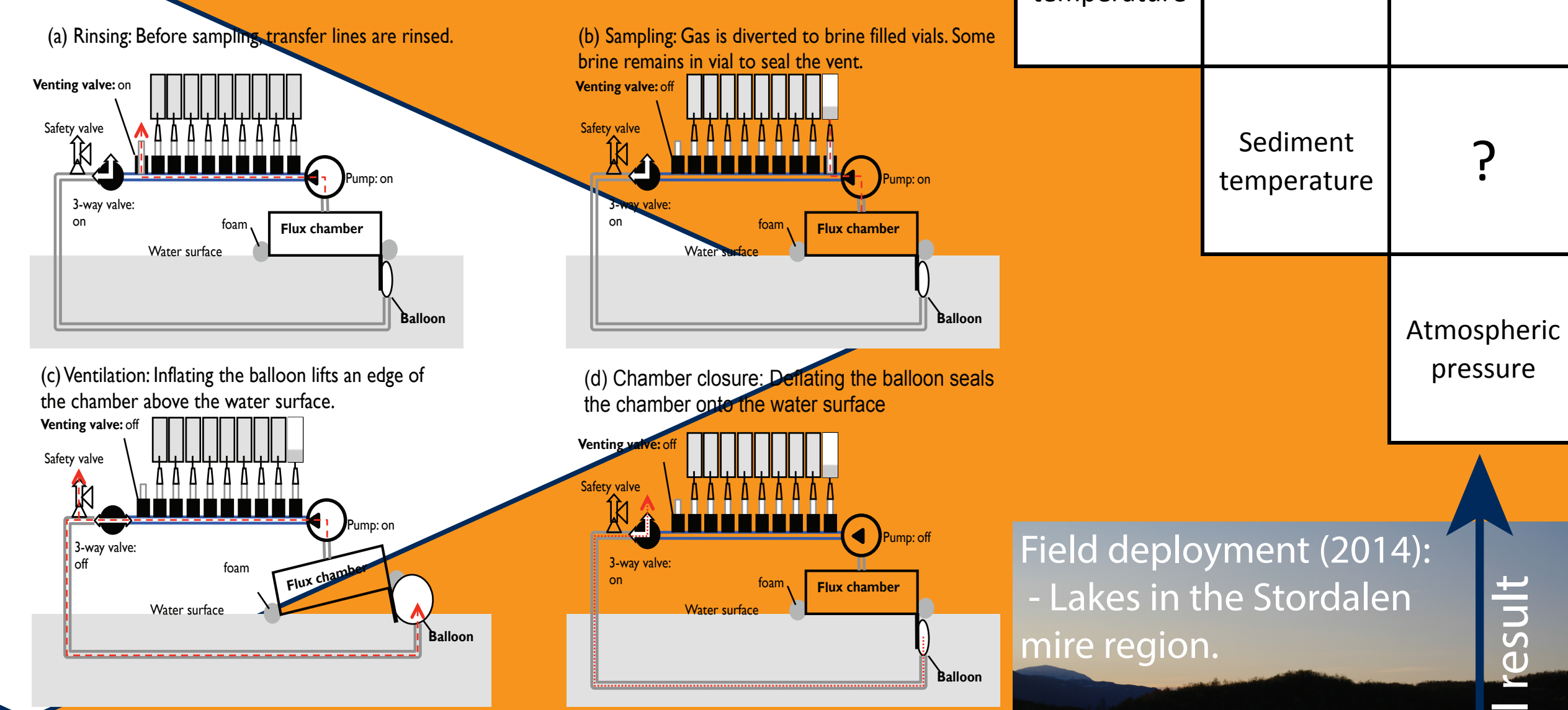
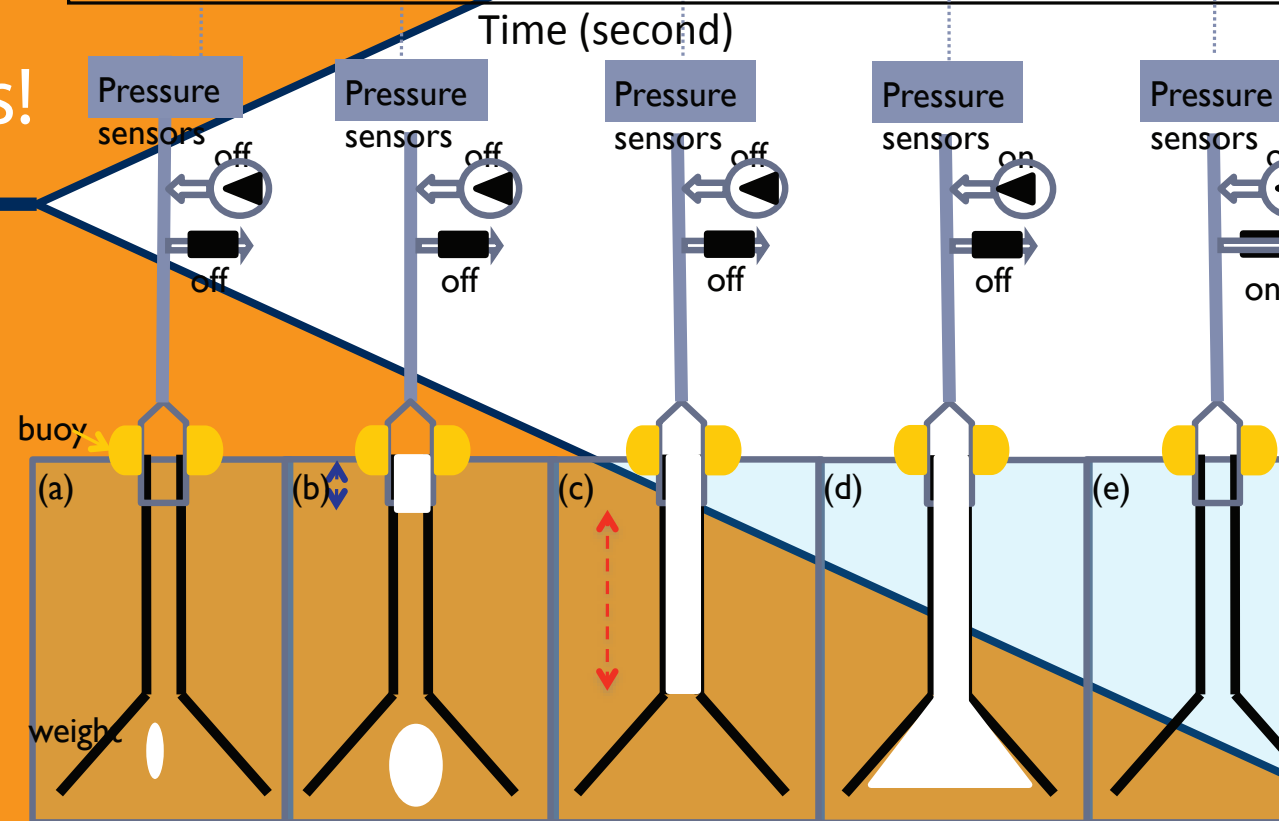
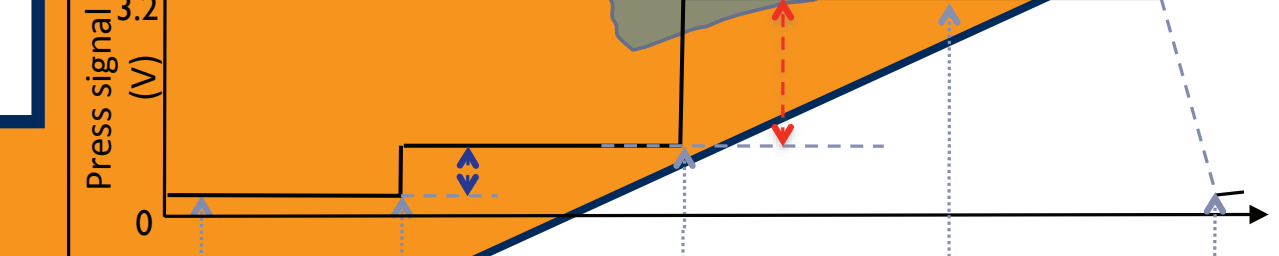
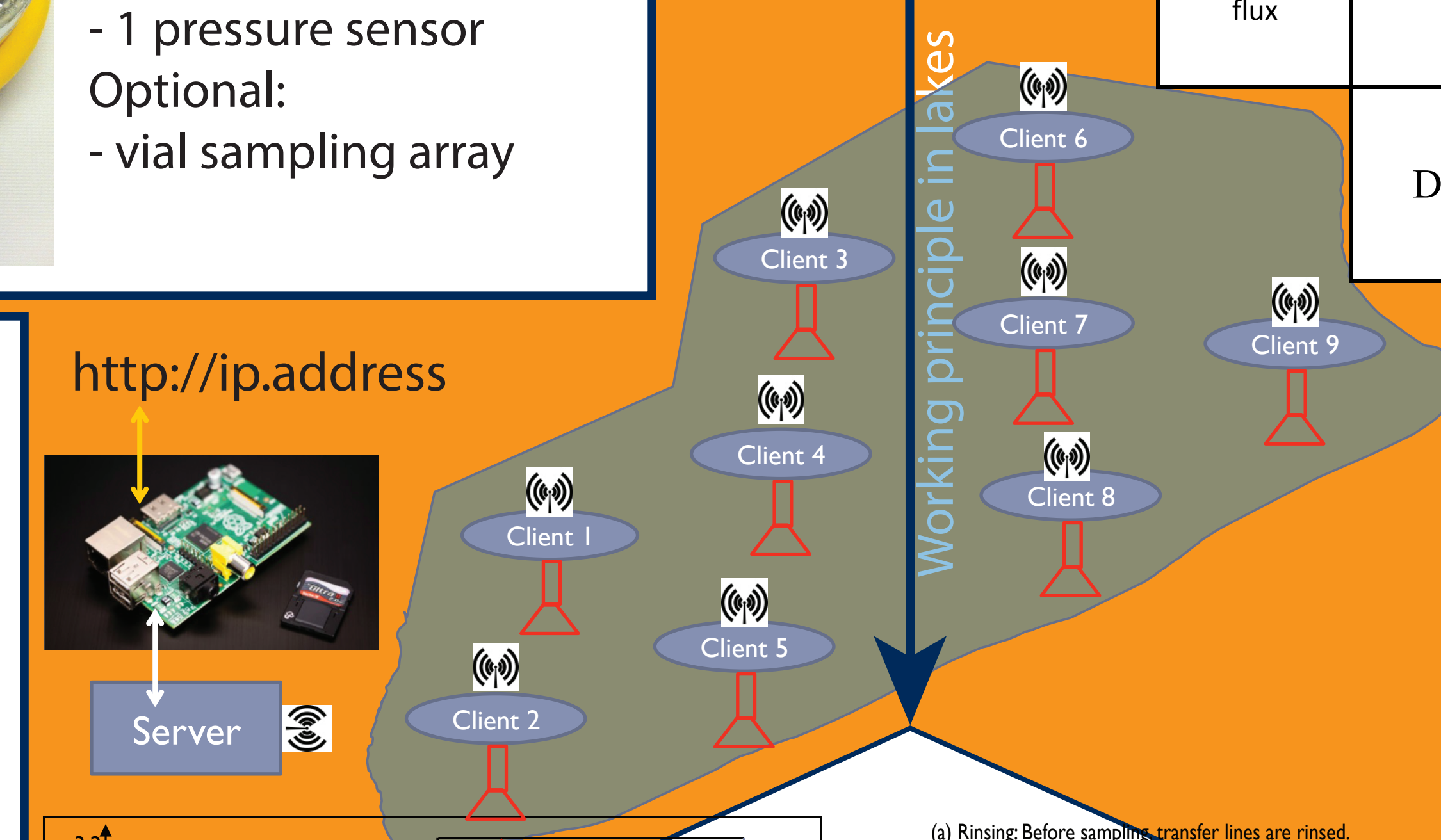
Matrix plot of high frequency correlation data

CH ₄ diffusive flux	?	?	?	?	?	?	?	?
CO ₂ diffusive flux	?	?	?	?	?	?	?	?
CO ₂ ebullition flux	?	?	?	?	?	?	?	?
Diel	?	?	?	?	?	?	?	?
DOY	?	?	?	?	?	?	?	?
Air temperature	?	?	?	?	?	?	?	?
Water temperature	?	?	?	?	?	?	?	?
Sediment temperature	?	?	?	?	?	?	?	?
Atmospheric pressure	?	?	?	?	?	?	?	?

http://ip.address



Server



Yes, it works!

Field deployment (2014):
- Lakes in the Stordalen mire region.

Potential result

Web pages for client monitoring and control

Stockholms universitet

Client Overview

Current time: Sat Feb 15 00:38:54 2014 -- Run started: Wed Dec 31 19:00:00 1969

WARNING: PRODUCER MAY BE DOWN!
(last time stamp 295 seconds ago)

Client #	Status	Voltage	Pressure	Temp 1	Temp 2	CH ₄	CO ₂	K33 Temp	K33 RH	Up since	Last read	Details	Control	Refresh
1	0	0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.00	Never	Never	View client 1	Run	Refresh
2	0	0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.00	Never	Never	View client 2	Run	Refresh
3	0	0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.00	Never	Never	View client 3	Run	Refresh
4	0	0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.00	Never	Never	View client 4	Run	Refresh
5	0	0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.00	Never	Never	View client 5	Run	Refresh

- Raw data file (in text format): sensor signals with real time stamped.
- Download from the web server.
- Post data analysis:
 - + Running R or Matlab to process: filter noise, extract emission events (as shown in graphs).
 - + Export processed data to a text file.

- Next step: identify and incorporate**
- CH₄ sensor that works at percentage level.
 - H₂ sensor that works at ppm level.

