

Development of a remote-controlled system for bioremediation and phytoextraction experiments for research and teaching purposes

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- Esslingen
 - in the heart of Europe
 - part of the Stuttgart Metropolitan Region



Esslingen
image: Esslingen University



Stuttgart Region
image: Zhenning SHI



- Esslingen University
 - University of Applied Sciences
 - 6100 Students
 - 31 Bachelor degree programmes
 - 14 Master degree programmes

- environmental engineering
 - Masters programme Environmental Protection
 - Environmental Engineering Laboratory

- research and education project D³
 - project duration: 2022 - 2026
 - multidisciplinary approach to research and didactics

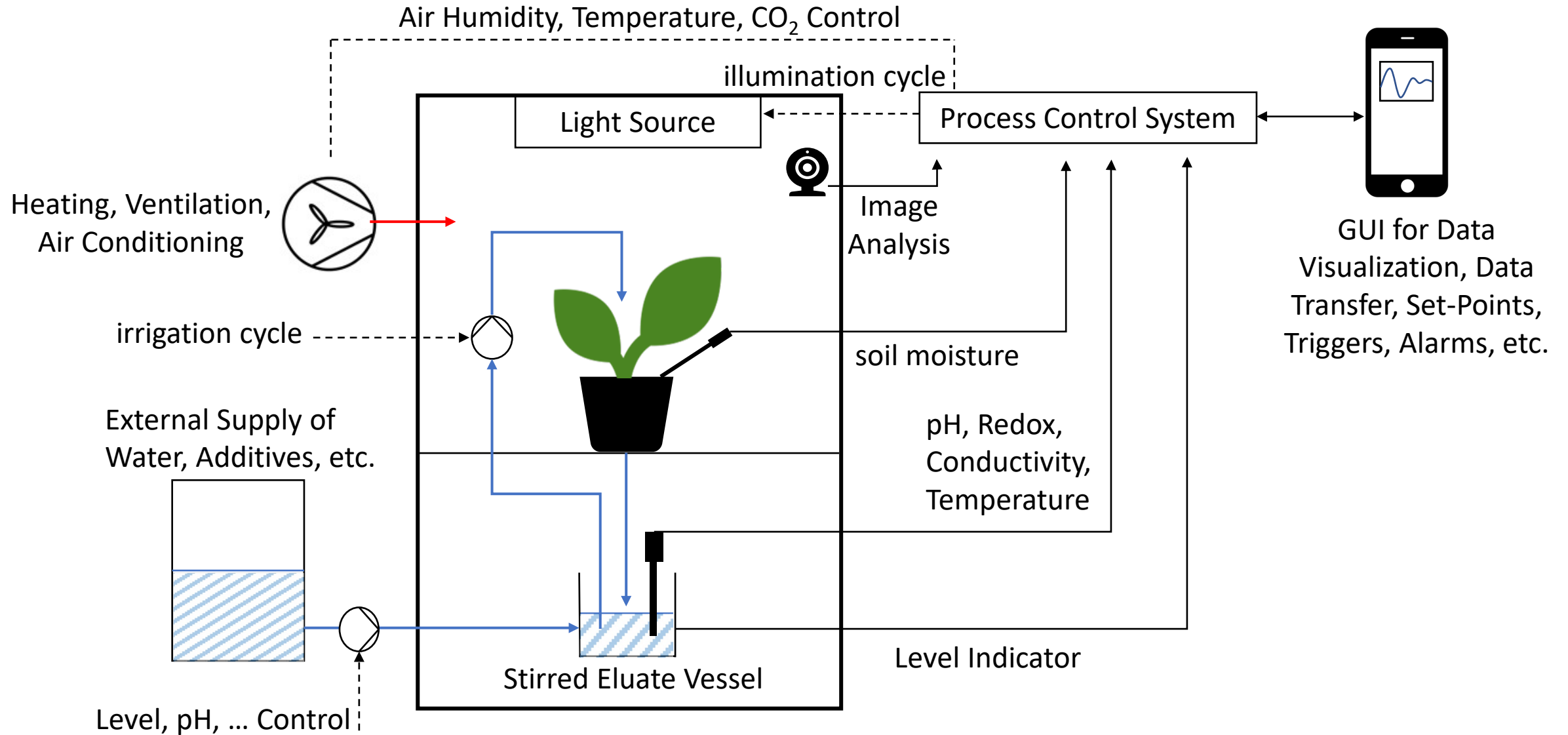


Environmental Engineering Lab
images: Esslingen University



- Hypothesis:
 - “Controlling the growth of a plant provides an accessible introduction to science and enables the cross-link between research and education.”
- didactic and educational objectives
 - creating an attractive and accessible learning environment
 - connecting different disciplines of natural science and engineering
 - lowering entry barriers for complex scientific research
 - contribute to open-science and exchange of knowledge
- engineering
 - decoupling of the experimental apparatus from test performer
 - development of a remote-controlled test-rig with full functionality control
 - utilize accessible hardware and open-source documentation and program-code



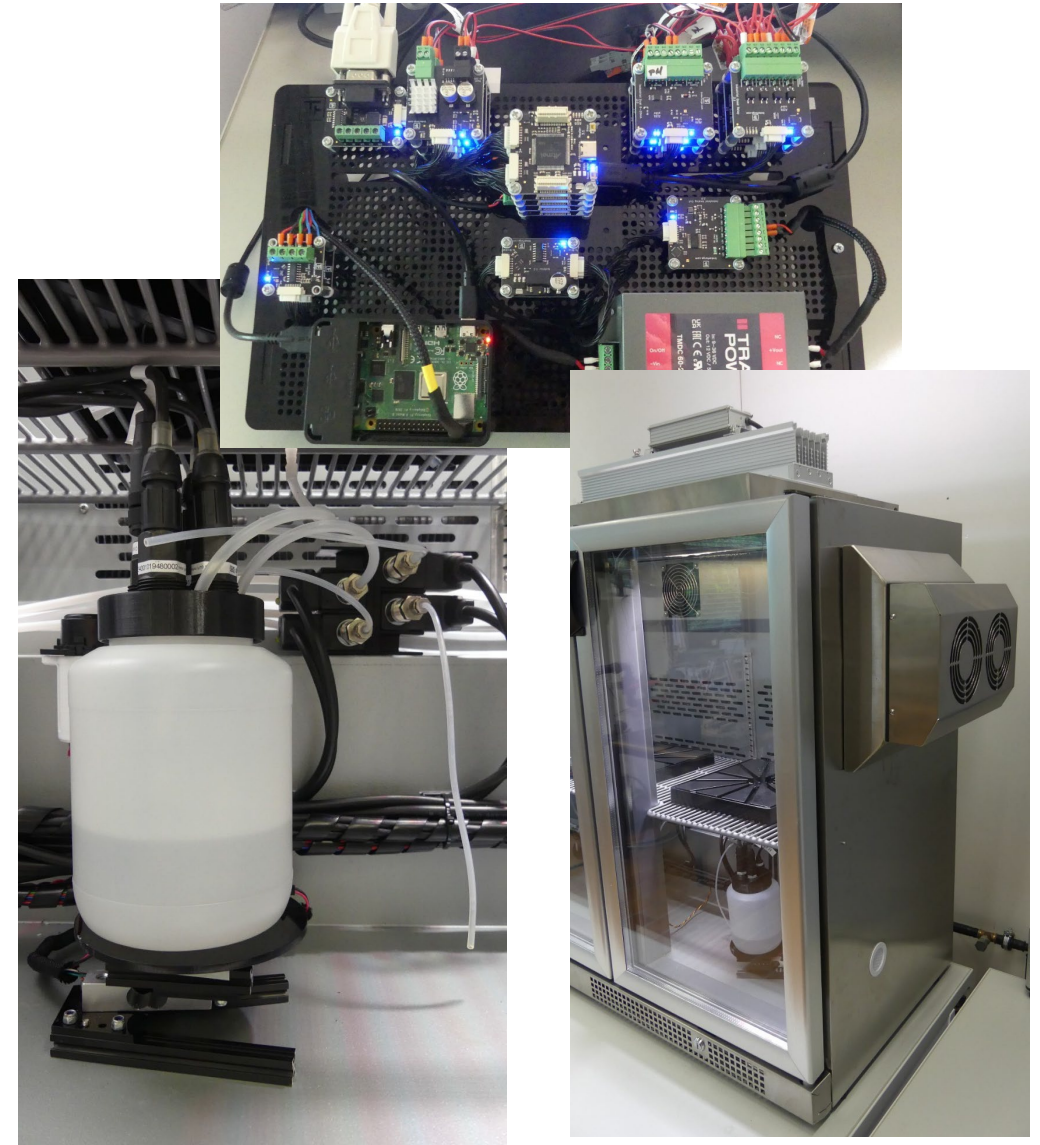




Prototype
image: Esslingen University



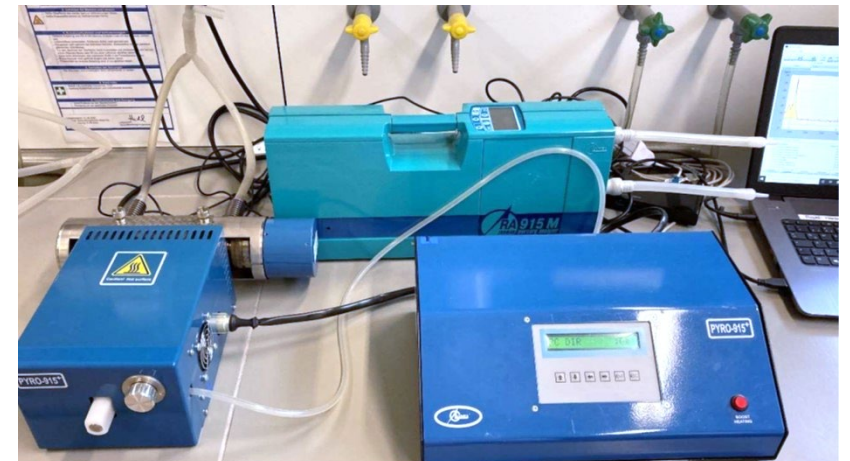
- sub-systems
 - process instrumentation and control
 - HVAC, hydraulic and illumination systems
 - data processing and communication
- priority criteria
 - accessibility, reliability, economic feasibility, modularity
 - open-source concept
- 3-stage development
 - prototype as a sandbox environment for testing of sub-systems
 - downsized clones with reduced complexity
 - extension of remote access functionality



Prototype
images: Esslingen University



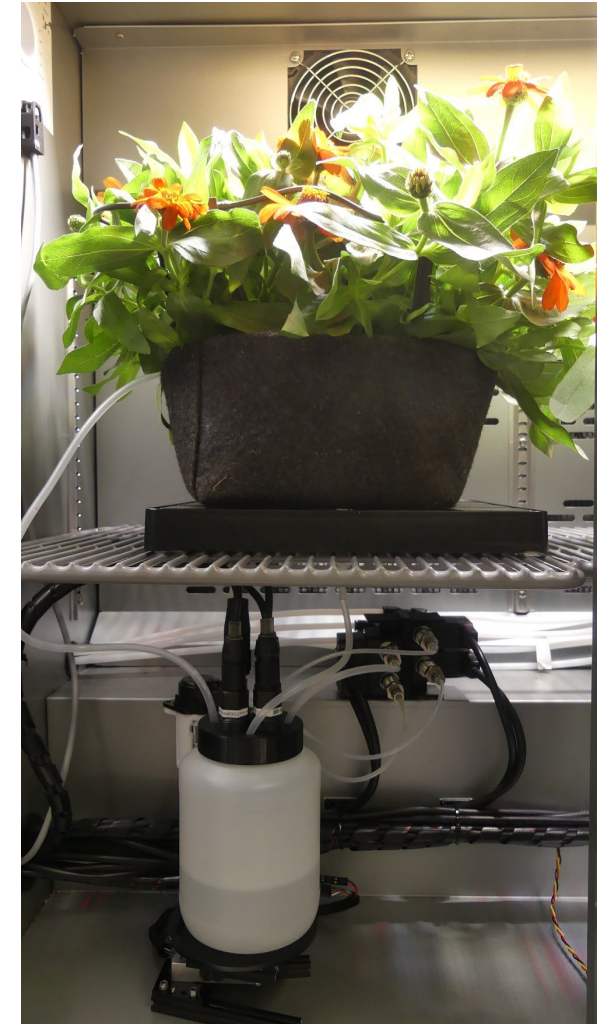
- supporting off-line chemical analysis in the lab
 - sample preparation (e.g. acid digestion, drying)
 - CVAAS for Hg
 - flame AAS for other heavy metals of interest
 - Hg thermal decomposition for most solid and liquid samples
 - wet reduction unit for trace level liquid Hg concentrations
- for remote controlled experiments, off-line analysis is performed by the lab-team



Environmental Engineering Lab
images: Esslingen University



- scientific objectives
 - cross-link between research and education
 - proof of concept of the climate chamber system
 - phytoextraction and bioremediation processes
 - various experimental conditions, substrates, plants, ...
 - soil additives and stabilizers
 - static and dynamic climate conditions
- invitation to co-operate
 - remote control enables unique opportunities
 - academia and education – virtual exchange of students
 - research collaborations – exchange of plants, samples, substrates, concepts, analytical methods, ideas
 - open and citizen science projects



Prototype
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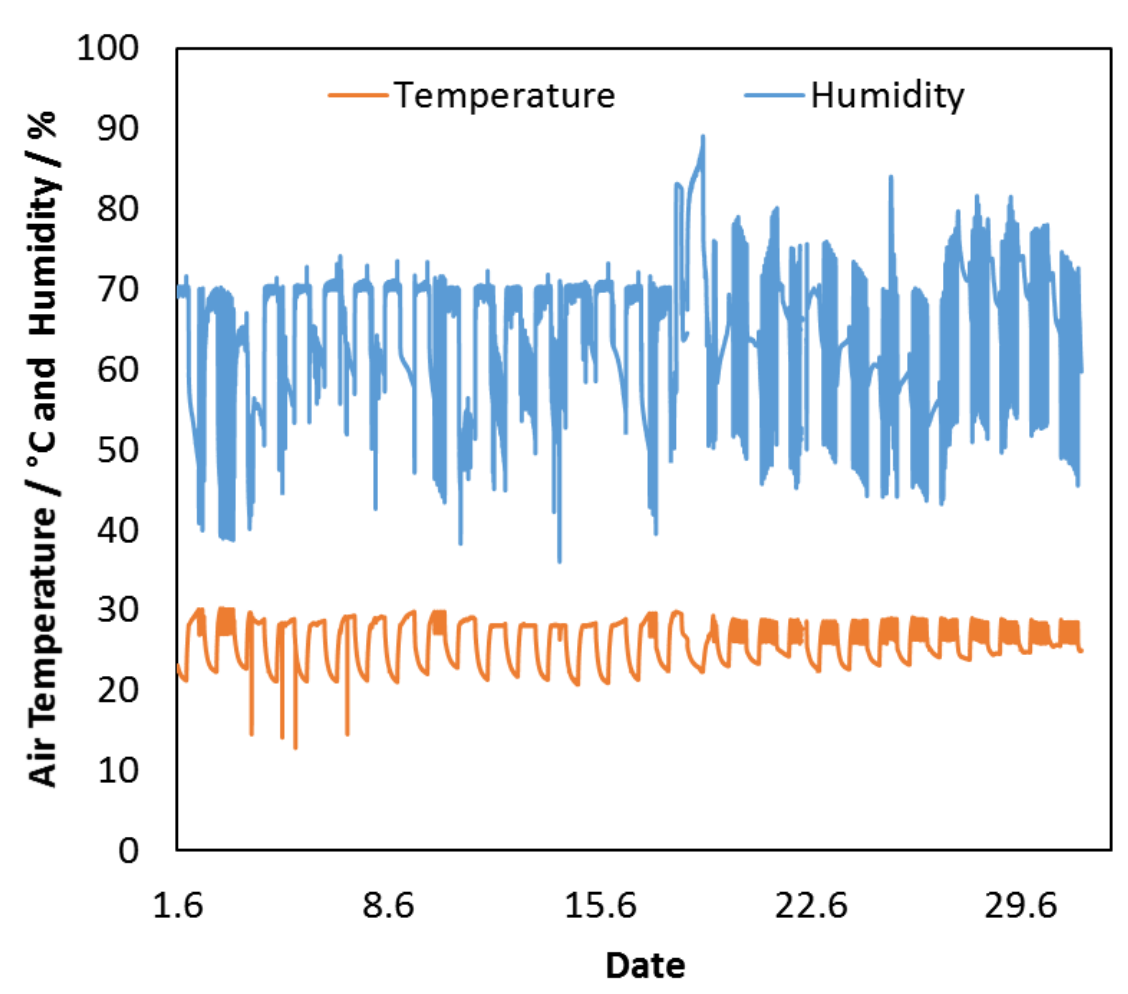
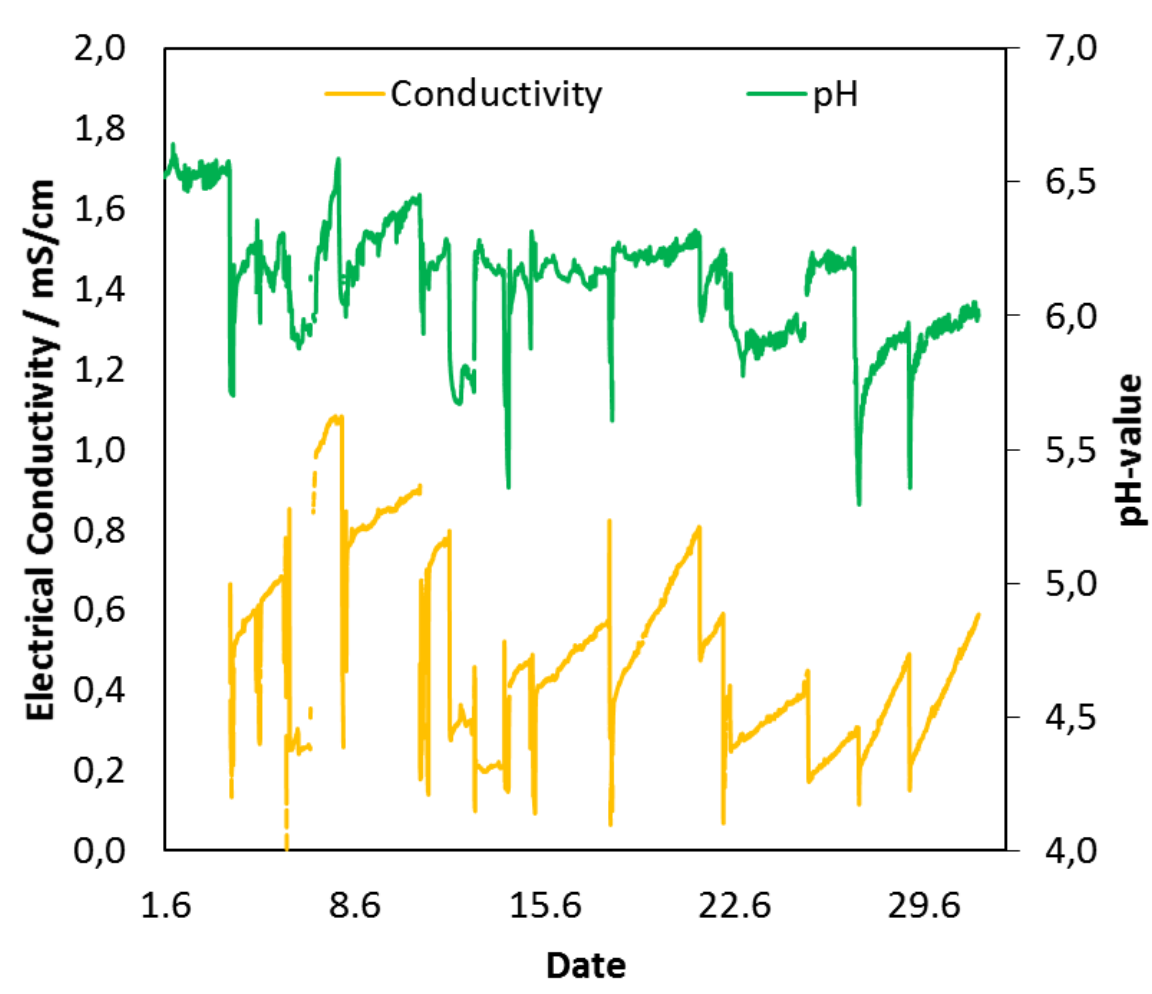


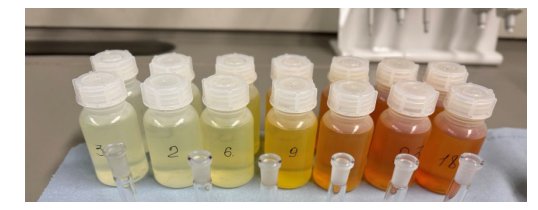
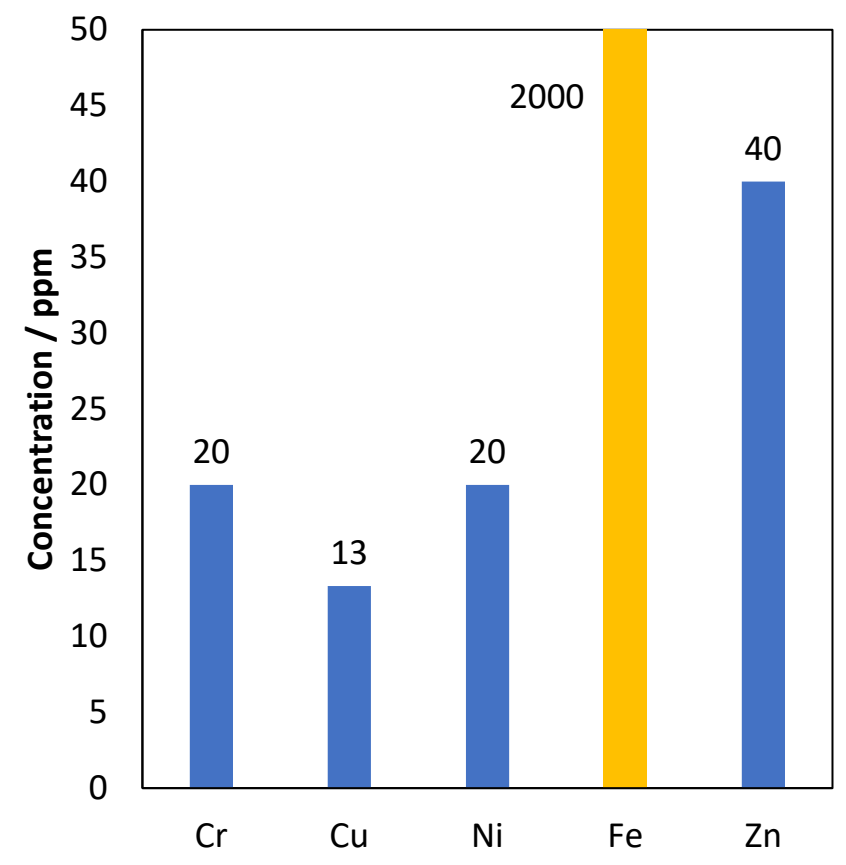
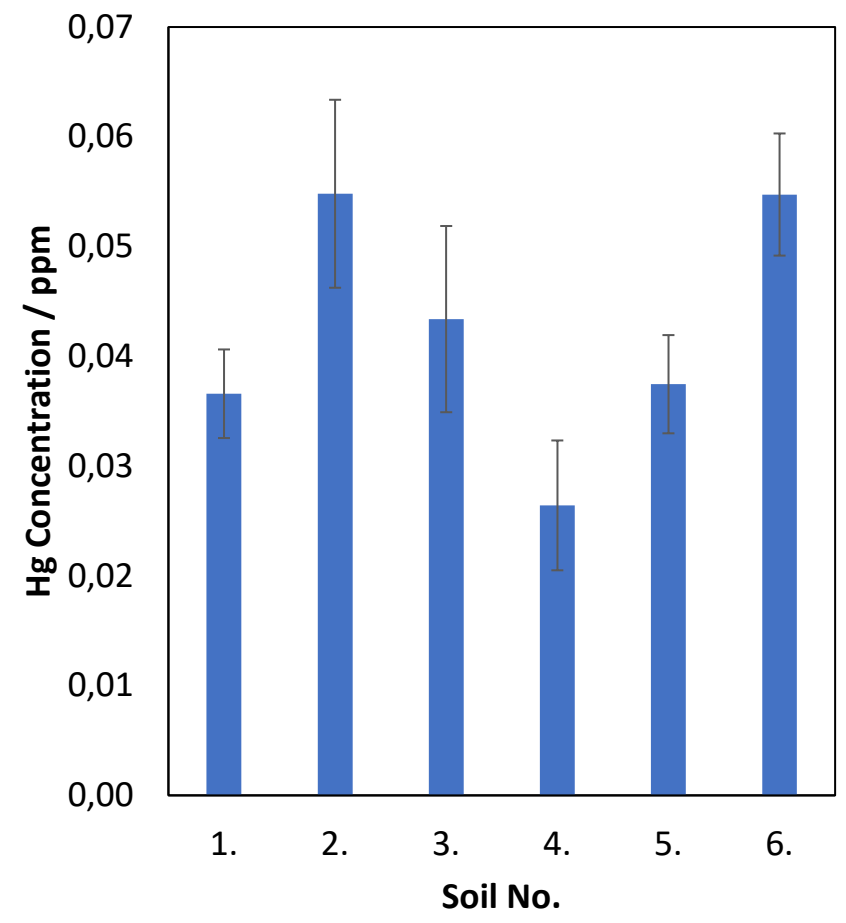
- cultivation of our first plants
 - 2 months test run with prototype
 - four plants in each section
 - real life test of core sub-systems
 - hard- and software
 - chemical analysis of eluate, soil, plant segments
- success: all plants survived the experiment
- (that is until we decomposed them in aqua regia)



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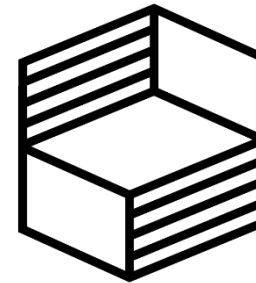


- working with the climate chamber is a lot of fun
- We're excited to find new partners and would love to share knowledge and collaborate with you!

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D **3**  Digitalisierung
Didaktisch
Denken



Stiftung
Innovation in der
Hochschullehre





