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Long-term monitoring of marine gas leakage

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The sequestration of CO2 in sub-seabed geological formations is one of the Carbon Capture and Storage (CCS) strategies currently under study. Although offshore operations are significantly more expensive than comparable onshore operations, the growing public resistance against onshore CCS projects makes sub-seabed storage a promising option. Even after a thorough review of the geological setting, there is always the possibility of leakage from the reservoir. As part of the EU-financed project CO2ReMoVe (Research, Monitoring, Verification), which aims to develop innovative research and technologies for monitoring and verification of carbon dioxide geological storage, we are working on the development of submarine long-term gas flow monitoring systems.
The basic design of the monitoring system builds on our experience in volcano monitoring. Early prototypes were composed of a raft floating on the surface of a mud volcano, carrying sensors for CO2 flux and concentration, data storage and transmission, and power supply by battery-buffered solar panels. The system was modified for installation in open sea by using a buoy instead of a raft and a funnel on the seafloor to collect the gas, connected by a flexible tube. This setup provides a cost-effective solution for shallow waters. However, a buoy interferes with ship traffic, and it is also difficult to adapt this design to greater water depths. These requirements can best be complied by a completely submersed system.
A system for unattended long-term monitoring in a marine environment has to be extremely durable. Therefore, we focussed on developing a mechanically and electrically as simple setup as possible, which has the additional advantage of low cost. The system consists of a funnel-shaped gas collector, a sensor head and pressure housings for electronics and power supply. Since this setup is inexpensive, it can be deployed in numbers to cover larger areas. By addition of multi-channel data loggers, data transmission by acoustic modem or cable, relay stations on the seafloor or buoys etc. the infrastructure can be adapted to the environmental setting and financial budget.
Prototype tests under laboratory conditions as well as field tests on natural submarine gas vents as an analogue to leaking storage sites have demonstrated the capabilities and robustness of the systems.