



Ship-based methodologies to investigate methane emissions from abandoned wells and natural sources: a case study from the Dutch North Sea

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Methane is commercially exploited at continental margins (worldwide/globally) from drilled wells. Typically, these are sealed with concrete once exploitation becomes commercially unprofitable. However, such wells may leak methane to the overlying water column and potentially to the atmosphere. Tailored towards the shallow water depth of the Dutch EEZ (Exclusive Economic Zone) of the North Sea, we developed four ship-based methods to detect methane in the water column or to measure methane emissions from the sea surface to the atmosphere.

1. Online measurements of methane in the water column. Water from a few meters above the seabed was pumped up via a weighted hose ("SLURF") and the concentration and composition of gases in the water (CH₄, C₂H₆, N₂O, CO₂ and CO) were measured with a laser spectrometer.
2. Floating chamber to quantify the flux of CH₄ coming from the water phase into the atmosphere. Trace gases in the sampled air from a custom build floating chamber for offshore measurements were transported in a closed loop to the same laser spectrometer as the water phase measurements for concentration measurements. A known amount of a tracer gas was added to the return line with a controlled flow to estimate fluxes.
3. Gradient measurements. A 3D sonic anemometer and a frame equipped with three inlets positioned at three heights above sea level were mounted at the ship's portside. Gradient measurements for determining gas emissions were conducted by using a valve system that alternated between the inlets, allowing to measure CH₄, CO₂ and CO at each height with a gas analyzer for 5 min intervals.
4. Plume measurements. The multibeam (MBES) was used to detect the bubble plumes and to detect the exact location where the bubble plume exit the water (exit point). Fluxes of bubble plumes from the water column to the atmosphere were then assessed by sailing downwind of the bubble plumes with the gradient system facing towards the exit point upwind. Emission rates were then determined by using a Gaussian plume model.

In this presentation, we will show preliminary data sets collected with these methods showing that bubble plumes rising from the seabed can be indicated next to dissolved methane and we will provide estimates of methane fluxes from individual bubble plumes into the atmosphere.