Leibniz-Institut für Ostseeforschung Warnemünde
IOW

Leakage at Nord Stream 1 & 2 - magnitude / possible consequences

Initial situation / assumptions:

Based on various sources, it is assumed that a total of about 500 Mio. m^3 methane (= CH_4) has been released from the damaged pipelines. This corresponds to 500 billion litres or 352,000 t CH_4 .

Benchmarking the released amount of climate gas:

Total global emission of CH_4 per year = 576,000,000 t (Saunois et al. 2020)
Nord Stream venting corresponds to 0.061 % of total natural and anthropogenic emissions

Global anthropogenic emissions of CH_4 per year = 359,000,000 t (Saunois et al. 2020)
Nord Stream venting corresponds to 0.098 % of anthropogenic emissions

Global emissions from the oceans of CH_4 per year = 18,000,000 t (Bange et al. 1994)
Nord Stream venting corresponds to 1.9 % of global ocean emissions

Baltic Sea emissions of CH_4 per year = 20,000 t (Bange et al. 1994)
Nord Stream venting equals 17 times the normal Baltic Sea emissions

Total emissions in Germany of CH_4 in 2021 = 1,900,000 t
(German Federal Environmental Agency 2022)
Nord Stream venting corresponds to 18 % of Germany's total annual emissions

Terrestrial permafrost emissions of CH_4 per year = 1,000,000 t (Saunois et al. 2020)
Nord Stream venting corresponds to 35 % of the terrestrial permafrost soil emissions

Preliminary conclusion regarding potential climate impacts:

The amount of released gas is not insignificant, especially since the greenhouse effect of methane is about 25 times stronger than that of CO2, which would be produced if the methane was burned. However, the Nord Stream leakage will not generally change current global climate developments.

Press contacts at the IOW

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Additional potential hazards:

Hazards for shipping:

1. If the methane content exceeds 5 %, the gas/air mixture is flammable and can be ignited by sparking or other causes.
2. The density of the air-water mixture at the discharge point is lower than that of water. Thus, in extreme cases, the buoyancy for ships could be too low.
3. More importantly, large ships are designed to receive the same amount of pressure from all around. If the water density is significantly lower in one section of the ship (e.g., the center), it can sink only in that area, so to speak, which can lead to fractures.

Threat to marine fauna:

Most of the gas will escape to the atmosphere due to the high discharge velocity and will not dissolve in the water. Possible effects: CH_4 (the fraction of other natural gas components is very small) may displace oxygen by stripping near the discharge site, but this effect is very localized. Mobile organisms (fish, birds, marine mammals) can probably evade it to a large extent. Passively drifting organisms (plankton) and “bad swimmers” will simply be pulled upward by the strongly entraining motion of the discharged gas. Since the Bornholm Basin suffers from oxygen deficiency at depth anyway, bottom fauna will scarcely be present and thus hardly be affected.

Where does the gas end up?

Such a short event, which also generates a large water upwelling, is expected to release most of the gas into the atmosphere. However, research on a gas leak in the North Sea shows that if the water stratification is stable (as is the case in the Bornholm Basin), some of the gas bubbles can be trapped at the density thermocline (Schneider von Deimling 2014 or 2015, Jordan et al., 2021).

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