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# Monitoring Fugitive Methane from Large Scale Shale Gas and Natural Gas Operations in Europe

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Power generation using natural gas or shale gas is less carbon intensive than coal by approximately half (IPCC, 2011 SSREN). Therefore, conventional gas and/or shale gas could be an important transition fuel to future low carbon sustainable energy systems. However, one of the main concerns surrounding (shale) gas exploitation is the leakage of methane, a strong greenhouse gas. Measurements in the US have reported total fugitive methane emission from shale gas operations ranging from 0.2% to 10% of the total produced amount of gas. In general, literature suggests that with leakage rates of 3% and higher the advantage of gas over other fuels may well be lost. To support policy makers and environmental protection we have investigated if the existing monitoring capacity for atmospheric composition in Europe can be used to detect significant leakages from a potential future shale gas industry in Europe as a contribution to the H2020 M4ShaleGas project.

Future European shale gas production will occur in a complex landscape with many different sources of methane present such as animal husbandry or wetlands. This complicates the identification of high methane leakage rates during (shale) gas production. We have identified suitable tracers in (shale) gas based on a European gas composition database and predicted tracer content based on thermal maturity data for the most promising shale gas plays in Europe. Ethane, present in natural gas and shale gas but absent in biological methane emissions, is identified as the most suitable tracer. By assuming different production scenarios in addition to a range of possible gas leakage rates, we estimate potential ethane tracer release and location. The LOTOS-EUROS atmospheric chemistry and transport model was modified to track released ethane concentrations over Europe. Using this set-up and available observational data we are able to accurately model and predict the baseline concentrations. Our results show that ethane concentrations over Europe are primarily controlled by boundary influx rather than by regional emissions. This implies that the ethane background will likely obscure the contribution from (shale) gas leakage at European background stations, except in close vicinity of the sources. Therefore, high (undesirable) leakage rates will only be clearly noticeable at close range (e.g. at $\sim$10 km from the sources). Monitoring of ethane concentrations at current European background stations only is therefore insufficient and additional monitoring closer to the Oil&Gas sources, including conventional gas, will be necessary to monitor and timely identify gas leakage. Such information will be beneficial for future independent verification of GHG reporting and understanding the methane budget over Europe.