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Methane and carbon dioxide variability and emissions in the Middle East during AQABA

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The oil and gas sectors account for a significant fraction of global anthropogenic emission of CO_2 and CH4. Emissions from oil and gas production can be strongly underestimated. The large uncertainty in CH4 emissions typically depends on the diversity of country and site-specific emission factors.
The Middle East, a large oil and gas producer, represents about 10% of global anthropogenic CO_2 and methane emissions. Here we aim at characterizing the regional distribution of these species to better constrain regional sources.
In situ CH4 and CO_2 mixing ratio were measured in the Middle East as part of the AQABA campaign. A 2-month ship survey took place traveled across the Mediterranean, Red Sea, and Persian Gulf in summer 2017. To assess oil- and gas-related emissions (natural gas leakage or venting), ethane and other VOCs were measured. We simulate the atmospheric variability of CH4 with the Lagrangian model FLEXPART. The ship sampled air masses with well identified regional potential influence (Iraq and Koweit, Iran), and air influenced by local sources in oil and gas fields in the Persian Gulf. The median mixing ratio in the Persian Gulf (1980 ppb) contrasted with the Arabian sea median (1820 ppb). Large enhancements were found in the oil field areas. Little CH4 excess occurred in the Qars area, the largest reservoir of natural gas. The model study, and the ethane to methane ratios, suggest that only a fraction of the strong CH4 variability in the Persian Gulf can be attributed to oil and gas activity. Other sources (and/or atmospheric processes) must be accounted for to explain the observed variability.