

Sub-sea releases of light hydrocarbons such as ethane, propane, and methane are a relatively poorly constrained source of these gases to the atmosphere. The release of methane (CH_4) presently stored in vast hydrate deposits under the seafloor is also a potential climate tipping point.

Significant hydrate deposits are located in shallow waters in the Arctic where they may destabilise and be released to the atmosphere due to surface warming. Therefore the Methane Emissions from Arctic Ocean to Atmosphere (MOCA, <http://moca.nilu.no/>) project was established. Here we investigate ocean-atmosphere light hydrocarbon emissions and compare measurements from Zeppelin Mountain Observatory with ship-borne measurements in the Svalbard region from the RV *Helmer Hanssen* performed as part of the MOCA project.

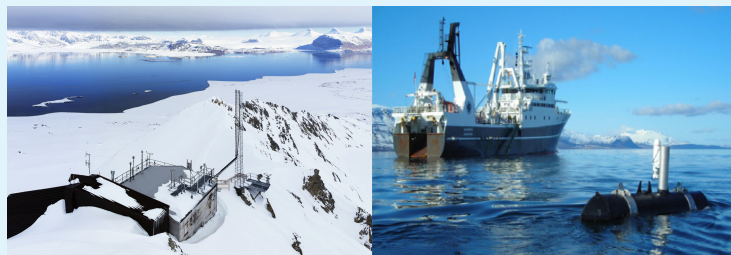


Figure 1: Left: the Zeppelin Mountain Observatory (474 m), long term measurement of CH_4 and other trace gases. Right: the RV *Helmer Hanssen*, $\text{CH}_4/\text{CO}_2/\text{CO}$ measurement (Picarro G2401), offline analysis of light hydrocarbons e.g. ethane/propane, water column measurements of CH_4 and other variables.

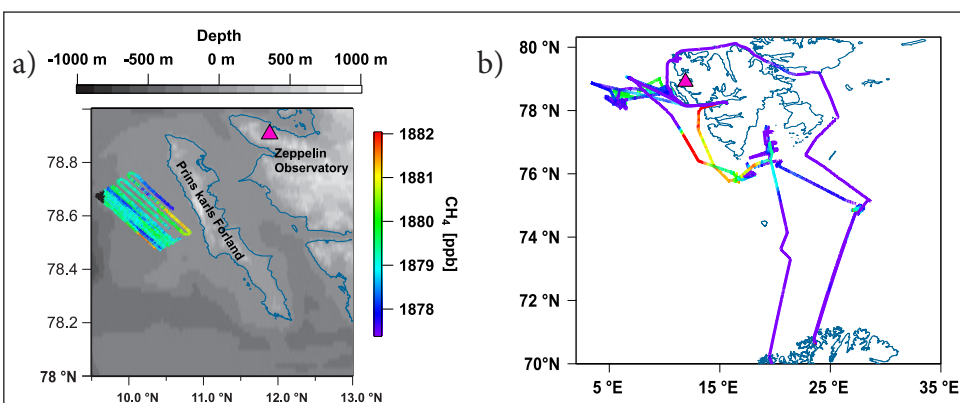


Figure 2: a) CH_4 concentrations over a 'hotspot' region of shallow waters (~200m depth, indicated by grey-scale) where gas bubbles have been observed escaping from the sea floor with the location of the nearby Zeppelin observatory shown b) CH_4 concentrations measured along the route of the RV *Helmer Hanssen* during measurements in summer 2014 (colour-scale).

Conclusions

- Emissions from the region with previously observed flares west of Prins Karl's Forland do not appear to be the main drivers of variations CH_4 in concentration, suggesting only a small flux from the ocean
- There is evidence of ocean-atmosphere emissions of ethane and propane
- Measurements at the Zeppelin Mountain Observatory are representative of the broader region around Svalbard

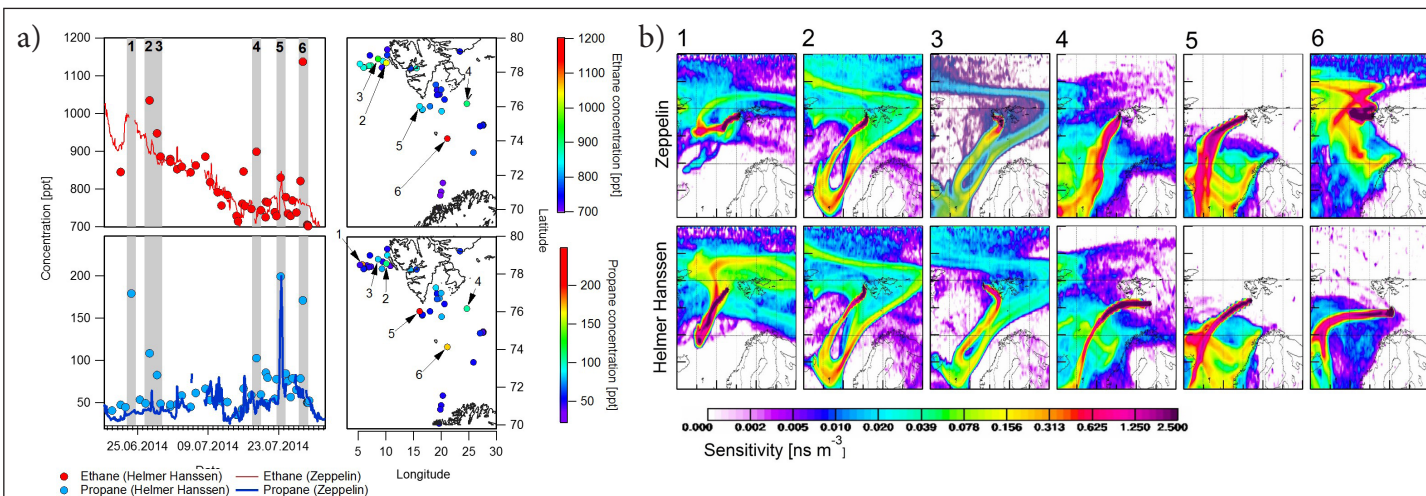


Figure 3: a) Concurrent ethane and propane concentrations around Svalbard and at Zeppelin, with 6 elevated concentrations identified as possible oceanic emissions b) FLEXPART footprint sensitivities for the measurements with elevated concentrations. While elevated concentrations may be due to emissions over land e.g. for point 5, FLEXPART indicates sensitivity to ocean regions for most points. Sensitivities are similar for Zeppelin and the *Helmer Hanssen*. Analyses are still ongoing, and complementary campaigns took place in summer 2015 and will take place in late October 2015.

References

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Acknowledgements

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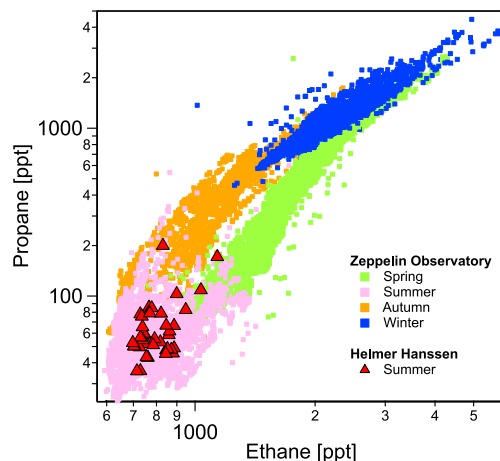


Figure 4: Comparison of the propane/ethane ratio at Zeppelin and from the RV *Helmer Hanssen*. Zeppelin data appear consistent with the wider Svalbard region (the area where the *Helmer Hanssen* measurements were performed).