

Methane in and above the polar oceans: how much is there, where is it coming from, and is it changing?

Supervisors: Dr Anna Jones (British Antarctic Survey), Dr James France (RHUL), Dr Rebecca Fisher (RHUL), Dr Mingxi Yang (Plymouth Marine Laboratory), Dr Katrin Linse (British Antarctic Survey)

Project description

Methane is a potent greenhouse gas, with a global warming potential ~85 times that of carbon dioxide on a 20-year timescale. Atmospheric methane concentrations are rising, but the global sources and sinks of methane are inadequately defined. Global ocean emissions remain highly uncertain: aerobic and anaerobic production mechanisms have been observed, as has direct seepage from the sea floor. A recent study reported the first observations of methane seepage from shallow nearshore waters in Antarctica, but little is known about the atmospheric significance of such seeps. Mechanistic understanding and quantification of ocean methane sources is critically needed to accurately project future marine emissions and atmospheric methane levels as Earth's climate changes.

Research methodology

You will:

- i) Investigate existing ship-board methane observations from past Arctic/Antarctic campaigns plus from north-south Atlantic latitudinal transects. You will study ambient methane concentrations as well as derive methane emission fluxes.
- ii) Establish the first polar-wide assessment of methane isotopic fingerprints using air samples provided by partner Arctic/Antarctic stations/ships.

We aim for your participation in a measurement cruise, sampling from the UK to Antarctica, observations in Antarctica targeting oceanic seeps, plus broader spatial surveys around algal blooms; concurrent air sampling to enable isotopic fingerprinting of methane sources using established ($\delta^{13}\text{C}$) and novel (δD) techniques. The project does not rely on cruise participation, and this project aspect is not guaranteed. Should circumstances prevent overseas deployments, an alternative fieldwork component, quantifying specific UK anthropogenic methane sources is possible, using novel techniques from BAS and RHUL.

Training

You will be based primarily at BAS, but will work with leading scientists at 3 UK institutes to achieve the project goals. Regular meetings with supervisors by video-conference and, where possible, in person will keep the project on track and ensure smooth development of your scientific skills. You will learn cutting-edge data analysis techniques, instrument operation, analytical techniques, and fieldwork/planning skills. We will link to policy experts to provide exposure to policy development, aiming for a 3-month placement.

Person specification

For this exciting project we seek applicants with a degree in Chemistry, Physics, or equivalent subjects, who can demonstrate strong numerical ability.

Key references

E. G. Nisbet, M. R. Manning, E. J. Dlugokencky, R. E. Fisher, D. Lowry, S. E. Michel, C. Lund Myhre, S. M. Platt, G. Allen, P. Bousquet, R. Brownlow, M. Cain, J. L. France, O. Hermansen, R. Hossaini, A. E. Jones, I. Levin, A. C. Manning, G. Myhre, J. A. Pyle, B. H. Vaughn, N. J. Warwick, J. W. C. White, "Very Strong Atmospheric Methane Growth in the 4 Years 2014–2017: Implications for the Paris Agreement", <i>Global Biogeochemical Cycles</i> , Vol 33, Issue 3, https://doi.org/10.1029/2018GB006009 , 2019.
James L. France, Prudence Bateson, Pamela Dominutti, Grant Allen, Stephen A. Andrews, Stephane Bauguitte, Max Coleman, Tom Lachlan-Cope, Rebecca E. Fisher, Langwen Huang, Anna E. Jones, James D. Lee, David Lowry, Joseph Pitt, Ruth Purvis, John A. Pyle, Jacob T. Shaw, Nicola J. Warwick, Alex I. Weiss, Shona Wilde, Jonathon Witherstone, and Stuart Young et al., "Facility level measurement of off-shore oil & gas installations from a small airborne platform: Method development for quantification and source identification of methane emissions", <i>Atmospheric Measurement Techniques</i> , https://doi.org/10.5194/amt-2020-165 , in review, 2020.
M. Römer, M. Torres, S. Kasten, G. Kuhn, A.G.C. Graham, S. Mau, C.T.S. Little, K. Linse, T. Pape, P. Geprägs, D. Fischer, P. Wintersteller, Y. Marcon, J. Rethemeyer, G. Bohrmann, and shipboard scientific party ANT-XXIX/4: "First evidence of widespread active methane seepage in the Southern Ocean, off the sub-Antarctic island of South Georgia", <i>Earth and Planetary Science Letters</i> 403,166–177, http://dx.doi.org/10.1016/j.epsl.2014.06.036 , 2014.
Yang, M., Bell, T. G., Brown, I. J., Fishwick, J. R., Kitidis, V., Nightingale, P. D., Rees, A. P., and Smyth, T. J.: "Insights from year-long measurements of air–water CH ₄ and CO ₂ exchange in a coastal environment", <i>Biogeosciences</i> , 16, 961–978, https://doi.org/10.5194/bg-16-961-2019 , 2019.
Platt, S. M., Eckhardt, S., Ferré, B., Fisher, R. E., Hermansen, O., Jansson, P., Lowry, D., Nisbet, E. G., Pisso, I., Schmidbauer, N., Silyakova, A., Stohl, A., Svendby, T. M., Vadakkepuliambatta, S., Mienert, J., and Lund Myhre, C.: "Methane at Svalbard and over the European Arctic Ocean", <i>Atmos. Chem. Phys.</i> , 18, 17207–17224, https://doi.org/10.5194/acp-18-17207-2018 , 2018.

Application details

This project has been shortlisted for funding by the ARIES NERC DTP and will start on 1st October 2021. The closing date for applications is 23:59 on 12th January 2021.

Successful candidates who meet UKRI's eligibility criteria will be awarded a NERC studentship, which covers fees, stipend (£15,285 p.a. for 2020-21) and research funding. For the first time in 2021/22 international applicants (EU and non-EU) will be eligible for fully-funded UKRI studentships. Please note ARIES funding does not cover visa costs (including immigration health surcharge) or other additional costs associated with relocation to the UK.

ARIES students benefit from bespoke graduate training and ARIES provides £2,500 to every student for access to external training, travel and conferences. Excellent applicants from quantitative disciplines with limited experience in environmental sciences may be considered for an additional 3-month stipend to take advanced-level courses in the subject area.

ARIES is committed to equality, diversity, widening participation and inclusion in all areas of its operation. We encourage enquiries and applications from all sections of the community regardless of gender, ethnicity, disability, age, sexual orientation and transgender status. Academic qualifications are considered alongside significant relevant non-academic experience.

All ARIES studentships may be undertaken on a part-time or full-time basis, visa requirements notwithstanding

For further information, please contact Anna Jones aejo@bas.ac.uk