MEMO^2: MEthane goes MObile – MEasurements and MOdelling

Workshop on isotope measurement techniques and data interpretation

Lead author
Dave Lowry
Department of Earth Sciences

Royal Holloway
University of London

Telephone: 01784 443105
Email: D.Lowry@rhul.ac.uk

Milestone MS8

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1. Executive Summary

Within MEMO^2, RHUL organized a workshop on “Isotope measurement techniques and data interpretation”, held from 17 to 19 September 2018 in London.

Measurements of the isotopic composition of CH_4 are a useful and within MEMO^2 common tool to identify sources responsible for observed elevations of atmospheric CH_4. The aim of the workshop on “Isotope measurement techniques and data interpretation” was to introduce the topic in more detail, learn about sampling, and discuss how to interpret isotopic measurements from mobile measurements and how to define the suitability of data being incorporated into models.

The workshop was attended by 8 MEMO^2 ESRs plus one by Skype, and 3 additional RHUL / Imperial College postgraduates. Presenters included project co-ordinator Thomas Röckmann, and from the RHUL Greenhouse Gas group, Euan Nisbet, Rebecca Fisher, James France and Dave Lowry, plus invited guest speakers from Univ. Cambridge (Nicola Warwick), Imperial College (Giulia Zazzeri), NPL (Tim Arnold and Chris Rennick), and University of Cincinnati (Amy Townsend-Small).

The workshop consisted of morning lectures, with sampling, laboratory analysis and practical exercises in the afternoons. The presentations and practical sessions have been posted on the MEMO^2 surf drive. ESRs presented 4 talks over refreshments at the end of the afternoon sessions and 3 posters during the lunch and coffee breaks. Students and presenters met up on the evening of Monday 17th for a typical English pub meal, and on the evening of Tuesday 18th for a short tour of Windsor to see the castle and River Thames before converging on the Real Greek restaurant for another enjoyable meal.

The workshop was held the week before start of semester. This facilitated some local accommodation, including on campus at The Hub for students and teachers, and a seminar room of appropriate size for the group. This kept the costs down to a minimum so that no additional workshop fee was necessary.

2. Aim and content of the workshop

Within Work Package 2 (WP2) of the MEMO^2, measurements of the isotopic composition of CH_4 are used to identify sources responsible for observed elevations of atmospheric CH_4. Additionally, MEMO^2 makes use of the distinguishing power of isotope measurements in complex environments with many overlapping sources, e.g. such as cities. Aim is the provision of novel EU wide isotopic source signature maps, which will give input for the use of isotopic information in atmospheric models in WP 3.

In addition to their own air-sampling program, the ESRs in WP2 receive and analyse samples of CH_4 source plumes that are identified by mobile measurements from the ESRs in WP1. This provides the ESRs from WP1 with source information, and the ESRs from WP2 with EU-wide information on isotopic source signatures. The link to sampling methods in WP1 and modelling in WP3 will allow identifying possible vertical as well as horizontal variability in isotopic signature in emission plumes. The measurements in WP2 will contribute to the new European CH_4 emissions map, including isotopic information. The ESRs will exchange technical expertise by extended visits to the other laboratory, but also exchange samples and data and contribute as a team (with input from the ESRs of WP1) to the overarching goal to obtain a EU-wide map of CH4 isotope signatures.

These activities require a basis understanding of isotope measurement techniques, data interpretation and model requirements. So this workshop on “Isotope measurement techniques and data interpretation” was part of the general ESR training, aiming at the introduction of the topic in more detail, learning about sampling, and discussing how to interpret isotopic measurements from mobile measurements and how to define the suitability of data being incorporated into models.

Based on this the participants got a general introduction about isotopes, their characteristics and behaviour in different environments, and measurement techniques such as IRMS. They learned about sampling techniques and strategies, and tested it in practice.

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Basics for data analysis such as Keeling and Miller-Tans plots were discussed and exercised. After training in the measurement techniques and data interpretation the students were tasked with collecting samples of methane sources from the RHUL campus, then measuring the methane isotopic ratios of the samples and calculating the isotopic signature of the sources. This identified a gas leak and a pond within the gardens as the main sources. (Fig.1).

During the last day participants were introduced to regional, global, and temporal modelling of methane isotopes, again including a practical part to exercise using simple box modelling.

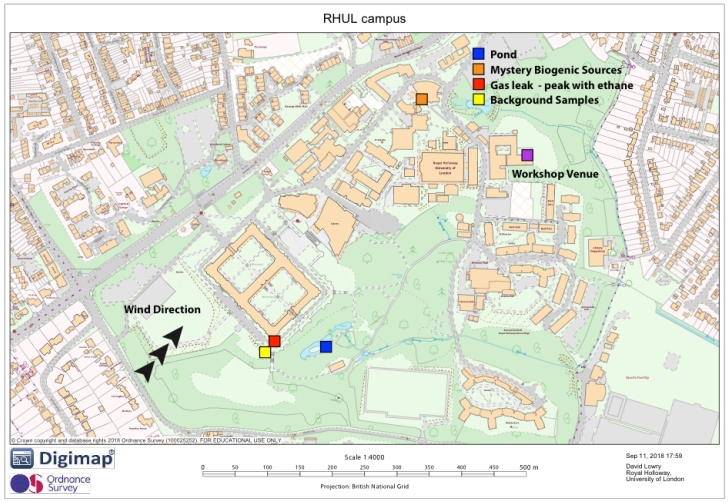

Fig. 1: Map of the campus, exercise to find and identify CH_4 sources

Impressions of the workshop: Top left – attentive audience for morning presentation. Bottom left – buffet lunch with a view across the London Plain, Top right -Rebecca Fisher explaining how the Trace Gas inlet system converts methane in air to CO_2, Bottom right – dinner in Windsor.

3. Agenda

Monday Sept 17

09:30 – 10:00: Arrival and coffee
10:00 – 11:30: Introduction to isotopes (Thomas Röckmann)
-thermodynamics, isotope units / scales, kinetic isotope effects, formation and sink pathways
Coffee break
11:45 – 12:15: IRMS analysis techniques (Amy Townsend-Small, Rebecca Fisher)
12:15 – 12:45: Measurement of isotope ratio by laser spectroscopy (Chris Rennick)
12:45 – 13:45: Lunch and posters
13:45 – 14:30: Stability, linearity, standardization, scaling, drift corrections (short presentation and practical)
14:30 – 15:30: Sampling techniques and strategies (short presentation and practical)
Coffee break
16:00 – 17:30: Sampling of RHUL campus sources, using LGR UMEA for location
17:30 – 18:00: Student presentations (Aalia al-Shallaan , RHUL)

Evening activities hosted by Julianne Fernandez (RHUL)

Tuesday Sept 18

09:30 – 10:00 Introduction to sources (Dave Lowry)
10:00 – 11:00 Identifying sources at different scales: USA – from Lakes to aircraft (Amy Townsend-Small)
Coffee break
11:30 – 12:00 Arctic – from chamber to aircraft (Rebecca Fisher)
12:00 – 12:45 Global trends in methane isotopes (Euan Nisbet)
12:45 – 13:45: Lunch
13:45 – 14:45: Source calculations – Keeling and Miller-Tans plots, error calculations (James France)
14:45 – 15:45 Group 1: sample analysis in lab, Group 2: Keeling / Miller-Tans exercises
Coffee break
16:00 – 17:00 Group 2: sample analysis in lab, Group 1: Keeling / Miller-Tans exercises
17:00 – 18:00: Student presentations and refreshments (Julianne Fernandez, Piotr Korben, Mila Stanisavljevic, Malika Menoud)

Evening activities: trip to Windsor and group meal at The Real Greek restaurant

Wednesday Sept 19

09:30 – 10:30 Radiocarbon measurement and inventory mapping (Giulia Zazzeri)
10:30 – 11:00 Introduction to clumped isotopes of methane (Tim Arnold)
Coffee break
11:30 – 12:00 Isotope modeling presentation sent by Stefan Schweitzke (Dave Lowry, Rebecca Fisher)
12:00 – 13:00 Regional / global / temporal modelling of methane isotopes (Nicola Warwick)
13:00 – 14:00 Lunch
14:00 – 16:00 Correction and source characterisation of own samples analysed Tuesday / Box modelling exercise (James France)
16:00 Refreshments and Close of Meeting

4. Participant list

Students

ESR1 – Piotr Korben
ESR3 – Mila Stanisavljevic
ESR4 – Patryk Lakomiec
ESR5 – Sara Defratyka
ESR7 – Semra Bakkaloglu (by Skype)
ESR8 – Malika Menoud
ESR9 – Julianne Fernandez
ESR 12 – Barbara Szenasi
ESR 11 – Randulph Morales

Aalia al-Shalaan (RHUL PhD student)
Max Coleman (RHUL MRes student)
Eric Schoenrock (Imperial College PhD)

Trainers

Tim Arnold (NPL)
Rebecca Fisher (RHUL)
James France (RHUL)
Mathias Lanoisellé (RHUL)
Dave Lowry (RHUL)
Euan Nisbet (RHUL)
Chris Rennick (NPL)
Thomas Rockmann (UU)
Stephan Schweitzke (NOAA, EDF)
Amy Townsend-Small (U Cinncinatti)
Nicola Warwick (U Cambridge)
Giulia Zazzeri (Imperial College)

5. History of the document

Version	Author(s)	Date	Changes
1st version	Dave Lowry	22 October 2018	First version
	Sylvia Walter	24 October 2018	Revised and implemented into template
	Dave Lowry	24 October 2018	Minor text revisions