Written evidence from the Met Office (MET0050)

Introduction

The Met Office is the UK's National Meteorological Service (NMS), a Public Sector Research Establishment (PSRE) and an Executive Agency of the Department for Science, Innovation and Technology. In the context of this inquiry, our atmospheric and climate science capabilities are particularly relevant.

The Met Office Hadley Centre provides climate science and services to help governments, industries and people understand and prepare for climate change, including the monitoring of global and national climate variability and change. Within this, the Met Office Hadley Centre Climate Programme (MOHCCP) delivers policy relevant scientific evidence and advice for the UK Government and beyond to address the societal challenges of climate change, helping to build a more resilient, net-zero future, and is a core part of the UK's involvement in the United Nations Framework Convention on Climate Change (UNFCCC).

Met Office Fellow, Dr Fiona O'Connor presented evidence to the Environment and Climate Change Committee during their first oral evidence session for this inquiry on 13 March 2024. This submission builds on the evidence Dr O'Connor presented.

International commitments

- **What is the UK doing to lead and facilitate international action on methane reduction? Could this be enhanced?**

The UK is a world leader in many aspects of climate change, including on best practice on emissions monitoring, reporting and inverse modelling. The Met Office plays an important part in this through its global engagement as a NMS, its scientific leadership and contributions to the Intergovernmental Panel on Climate Change (IPCC) and its role within the UN World Meteorological Organisation (WMO). For example, the Met Office facilitates informing other nations in best practice inversion methods for national emission estimation through engagement with the WMO and the EU Horizon project – PARIS.

In addition to inverse modelling, the Met Office has developed forward modelling capability of the methane cycle. By developing an Earth System Model with methane emissions-driven and including interactive wetland methane emissions, it places the Met Office in a unique position to quantify the impact of methane emission changes on climate and air quality. This world-leading capability can provide essential evidence to underpin climate mitigation policy from methane reduction strategies. Ongoing research includes an assessment of the COP26 Global Methane Pledge, understanding the role of climate feedbacks on the methane cycle,

and whether changes in the methane cycle are reversible with climate mitigation measures. The Met Office is facilitating the development of methane emissions-driven capability in other European Earth System Models through the EU Horizon 2020 project called ESM2025. The UK is also coleading other international initiatives on the role of methane in future climate and air quality (e.g., MethaneMIP, AerChemMIP2).

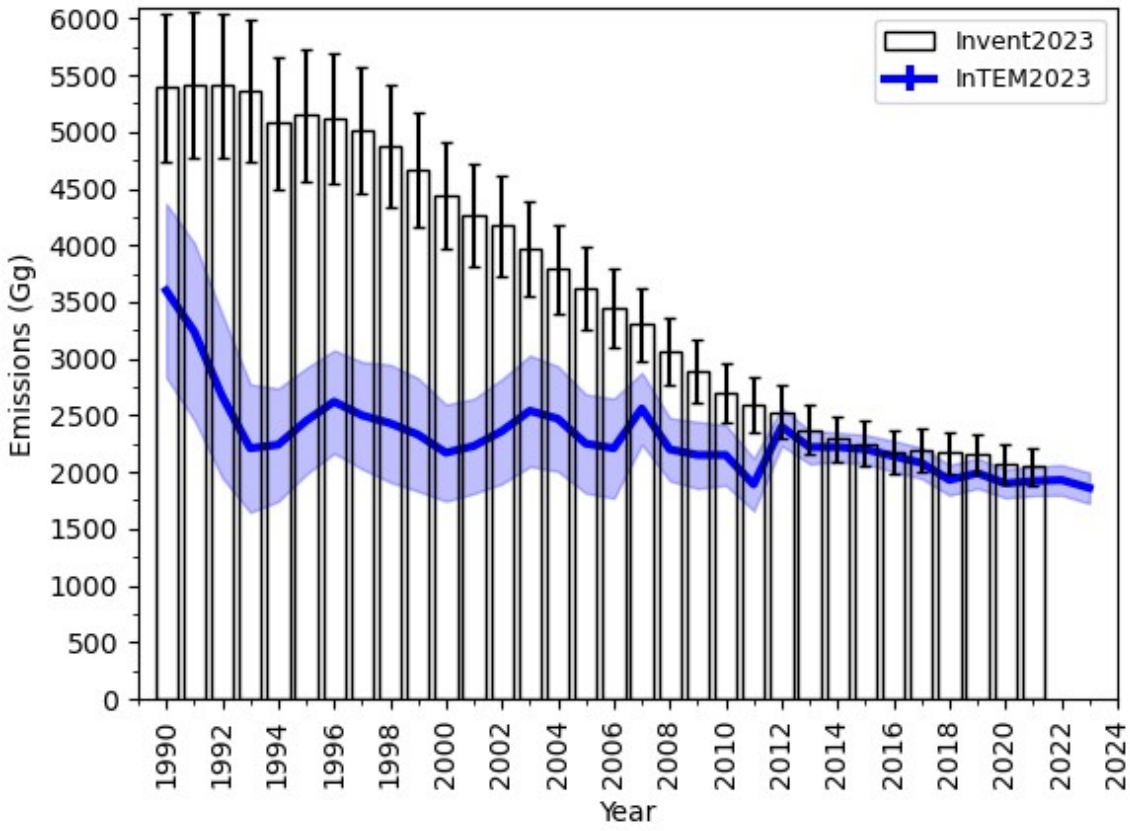
Data, measurement, and monitoring

- **What is the status of methane accounting, monitoring and reporting in the UK at present and how does it compare internationally? Is UK accounting and reporting considered to be accurate and robust? What improvements, if any, are possible and what benefits would these deliver?**

As highlighted above, the UK are world leaders in inverse modelling and national emission estimation from atmospheric measurements (led by the Met Office). The UK was the first country to officially report – through the National Inventory Report to the UNFCCC, a comparison between inverse modelling estimates using atmospheric measurements and the UK reported inventory in 2003.

The Met Office pioneered the use of atmospheric measurements to infer national emissions through the development of a model called InTEM (Inversion Technique for Emission Modelling) as part of a government-funded (currently DESNZ) project which has been running for over twenty years.

In 2012 the UK invested in 4 additional atmospheric measuring stations, all on telecommunication towers – Herefordshire, Sussex, Norfolk and Yorkshire. These additional stations allow greater detail and more accuracy in the InTEM emission estimates.



The plot above shows the latest comparison between the Met Office inverse modelling estimates (InTEM) in blue and the UK inventory as reported in 2023 (Invent2023), shown as black bars. The InTEM estimates until 2007 rely upon just two atmospheric stations, one on the west coast of Ireland and the other in the Netherlands. Between 2007 and 2011 InTEM uses data from a range of other stations in Europe, one of which is in the UK (Scotland). From 2012, InTEM additionally uses data from the UK DECC network of 4 tall tower stations and a NERC facility. Note, if only the original two stations are used in InTEM throughout the time-period (1990-2023) then the InTEM results are aligned, albeit with larger uncertainties. The UK inventory has been substantially revised over the last two decades. In 2005 the UK inventory and InTEM estimates were aligned.

- **What progress is being made on methane monitoring and data collection in the UK using technologies such as satellite data and drones?**

Surface (tall tower) measurements are currently the most robust method for estimating emissions of non-CO2 gases. Satellite data are unavailable on cloudy days and only currently measure columns of CO2 and CH4. Surface measurements

can observe all reported gases (CO2, CH4, N2O, HFCs, PFCs, SF6, NF3) and therefore allow UK emission estimates of all of these gases with the exception of CO2. However, satellite data (GHGSat) were useful in identifying a significant methane gas leak near Cheltenham Mar-Jun 2023.

Further Reading

- Atmospheric Chemistry and Physics – 'Evidence of a recent decline in UK emissions of hydrofluorocarbons determined by the InTEM inverse model and atmospheric measurements' – A.J. Manning et al (2021).
- Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences – 'Methane removal and the proportional reductions in surface temperature and ozone' – S. Abernethy, F. M. O'Connor, C. D. Jones and R. B. Jackson (2021)
- Journal of Advances in Modelling Earth Systems – 'Description and Evaluation of an Emission-Driven and Fully Coupled Methane Cycle in UKESM1' – G.A. Folberth & F.M. O'Connor et al. (2022)
- EOS – 'A Significant Advancement in Modeling the Global Methane Cycle' – Jiwen Fan (2022)
- npj Climate Atmospheric Sciences – 'The role of future anthropogenic methane emissions in air quality and climate' – Staniaszek, Z., Griffiths, P.T., Folberth, G.A. et al. (2022)
- Atmospheric Chemistry and Physics – 'Western European emission estimates of CFC-11, CFC-12 and CCl4 derived from atmospheric measurements from 2008 to 2021' – A.J. Manning, A.L. Redington et al (2023)