Arctic Methane — Situational Awareness, Assessment & Policy Directions

Results of the June 23rd, 2022 Arctic Methane Workshop

Summary Report
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Sherri Goodman
Peter Davies
Marisol Maddox
Jack Durkee
Wilson Center Polar Institute

Wilson Center

Sandia National Laboratories

The following report summarizes the results of an Arctic methane science and policy workshop, created by an ongoing collaboration of the Wilson Center Polar Institute and Sandia National Laboratories. This virtual workshop was held on June 23rd, 2022. The workshop was conducted under Chatham House Rule, so no particular statements are attributed to any particular individual.

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Introduction

The recently released IPCC Sixth Assessment Report highlights the increased occurrence and growing impacts of accelerating climate change, and explicitly calls out the complexity of climate systems, interconnections and the importance of system-level assessments. Recent COP26 proceedings and the Global Methane Pledge brought focused attention to methane as a significant contributor to global warming, requiring urgent assessment and corresponding action. Rigorous assessment requires data and analysis of multiple methane sources and pathways across multiple regions of the globe.

While the Arctic contains potentially significant natural and anthropogenic sources of methane, assessment of these sources faces complex challenges and data is currently severely limited. Important progress is being made at local and sub-regional scales of permafrost thaw and methane release, but it is far from comprehensive and larger scale regional flux measurements and assessments are quite limited. The IPCC's Sixth Assessment Report (AR6) highlights the importance of assessing the potential for self-reinforcing feedback of accelerated permafrost thaw and methane release in higher temperature climate scenarios. The tipping point potential of Arctic permafrost thaw is explicitly recognized as carrying this heightened risk.

Anthropogenic methane release from oil and gas operations in the Arctic is significant but difficult to assess. Of particular concern are the lack of transparency and assessments of releases from Russian oil and gas operations, and the fact that Russia did not sign on to the Global Methane Pledge. Until Russiaʹs war on Ukraine, Russian participated in Arctic Council activities. Indeed, permafrost change, including methane releases, was a priority of Russia's current chairmanship of the Arctic Council. When Putin commenced war on Ukraine, the Arctic 7 paused activities with Russia in the Arctic Council. As a result, information about permafrost changes in the Russian Arctic are less accessible today as the urgency of the information increases with soaring Arctic temperatures.

The Wilson Center's Polar Institute and Sandia National Laboratories collaborated to bring together a diverse group of high-level science and policy expertise for a workshop focusing on a stocktake of current and planned Arctic methane measurement, monitoring and modeling capabilities, and the challenges of bringing these components together in an integrated system that is positioned to inform future policy decisions and action.

The June 23rd, 2022 workshop featured speakers and discussants from a broad cross section of technical and policy organizations, including: U.S. Department of State; OSTP Arctic Executive Steering Committee; U.S. Arctic Research Commission; The Harvard Arctic Initiative; Woodwell Climate Research Center; Environmental Defense Fund; NASA Jet Propulsion Laboratory; NASA Goddard Space Center; NOAA Earth System Research Laboratory; U.S. Department of Energy; National Science Foundation; Sandia National Laboratories and the Wilson Center Polar Institute. Invited workshop participants came from multiple universities, national labs, U.S. Geological Survey, Department of Defense, intelligence community, Office of Science Technology and Policy, indigenous communities, and representatives of the international community (Canada, Norway and Iceland).

Workshop Findings

The following findings reflect major themes that emerged over the course of the workshop presentations, panel discussions and participant Q&A. These findings ak provide a useful, cross-cutting framework for future Arctic methane work.

Arctic methane is underestimated in current carbon budgets, increasing its already significant global climate impact. Arctic methane should play an important role in global climate policy decisions and actions. However, the Global Methane Pledge does not fully address permafrost sources of methane release and warming.

Methane already in the atmosphere today accounts for 0.5° C warming, therefore, nearly half of the current 1.1° C of warming is caused by methane in the atmosphere. Growth of atmospheric methane is currently tracking ʹworst case climate scenarios. Current carbon budgets undercount methane emissions in the Arctic, particularly from thawing permafrost, but also from oil and gas infrastructure, including flaring, venting, and other leakages.

Arctic terrestrial permafrost contains circa 2 times as much carbon as is currently in the atmosphere. Under ongoing rapid warming in the Arctic, which is occurring 3-4 times as rapidly as the global average, shallow permafrost is starting to thaw, exposing the contained organic carbon to decomposition. Most pre-2021 carbon-budget estimates did not account for future carbon emissions from thawing permafrost. The oil and gas sector is the largest anthropogenic contributor to atmospheric methane, and the fastest opportunity for mitigating anthropogenic methane is to focus on this sector. Current estimates indicate Arctic countries account for 17 percent of global methane emissions, and 37 percent of global oil and gas production. Therefore, the Arctic region is an important player in mitigation of methane from oil and gas.

Permafrost methane has significant potential to drive accelerated warming. There are no direct technical solutions for mitigating permafrost methane release. We currently have no integrated, strategic approach to track and predict carbon emissions from thawing permafrost.

Arctic permafrost currently stores massive amounts of carbon. Recent estimates indicate on the order of 1100 gigatons of carbon within three meters of land surface, and another 600 gigatons below three meters. Putting this into perspective, total carbon emissions to the atmosphere since 1850 are estimated at 400 gigatons. Understanding the current pattern and future trajectory of these emissions is relevant to global climate policy in two main respects: 1) the degree to which this positive feedback will accelerate warming worldwide affects the timing and magnitude of adaptation needs, and 2) emissions of CO_2 and CH_4 from permafrost could significantly reduce future societal emissions consistent with not exceeding global average temperature targets (ʹcarbon budgetsʹ). We currently have no integrated, strategic approach to accurately track and predict carbon emissions from thawing permafrost.

Oil and gas are an important methane source with technically feasible solutions. The recently launched Global Methane Pledge is a major international effort, focusing on this important source of anthropogenic methane.

Eliminating methane emissions from oil and gas operations is the fastest way to limit near-term warming that we have available. Oil and gas is the highest technically and economically feasible sector for reducing anthropogenic methane. The United States and the European Union partnered to launch the Global Methane Pledge at the Conference of the Parties (COP) in November 2021. This initiative seeks to mobilize the world to reduce methane emissions by at least 30 percent by 2030. This objective is a major challenge because current trends show a projected increase of 10 percent by 2030. To meet this objective by 2030, the world must control this growth and significantly curb emissions well below current levels. At this point, 120 countries have signed on to the Global Methane Pledge, covering nearly half of global methane emissions, and three quarters of the global economy. As noted previously, Arctic countries account for 17 percent of global methane emissions, and 37 percent of global oil and gas production. All Arctic countries, accept Russia, have committed to the Global Methane Pledge.

Major scientific and technical gaps in measurement, monitoring and modeling capabilities produce large uncertainties in current and future trajectories of Arctic methane emissions.

Across all scales, multi-tiered observing systems and effective collaboration are needed to address scientific and technical gaps. For permafrost, challenges in forecasting changing Arctic climate include limited data on seasonal wetting, drying and thaw patterns, abrupt thaw disturbances including fire and altered structure and hydrology of the landscape. In-situ/local scale studies are important for building process-level understanding. Indigenous knowledge of on-the-ground developments and long-term permafrost insights are also important. Airborne capabilities provide an important first step in bridging methane observations and integrating across multiple scales. Given the importance of developing pan-Arctic scale emissions assessments, increasing capabilities of satellite systems will play a major role in monitoring change.

In the oil and gas realm, an ecosystem of methane detecting satellites is emerging, providing a range of capabilities for measuring, monitoring and quantifying medium to large point sources, as well as quantifying dispersed area sources. These satellites include a mix of private and public sector capabilities. MethaneSAT is a major system that will focus on 200x200 km oil and gas targets around the globe. This capability will include multiple important targets in the Russian Arctic for which emissions data are currently quite limited.

Systematic data integration and analysis are needed. Current earth system models have very limited capability for modeling permafrost thaw and associated methane emissions. The United Nations Environmental Program and Climate and Clean Air Coalition have launched an initiative to gather, integrate and publish comprehensive, oil and gas methane data.

In addition to significant advances in ground-based studies, measurement and remote monitoring, major improvements in data integration and model-based analysis are required in order to project future emissions with much smaller uncertainties than current model-based assessments. Integrated data management and model analysis must be well-tuned to inform needed policy decisions. Multiple promising technologies and platforms are emerging. However, these emerging platforms would benefit from overarching coordination and a more integrated, strategic approach. Centralized access and shared architecture would also provide significant benefits. Strong coordination and cooperation will facilitate open and transparent estimates of emissions.

Modeling and analysis improvements are needed at multiple scales. Specific needs include representing permafrost dynamics in earth systems models; improved methane chemistry and transport models; and significant improvements in spatial and temporal resolution. In addition to improvements in multiple scales of physical/chemical models, Arctic Council AMAP coordinated research is further developing Integrated Assessment Models that combine environmental and socioeconomic modeling.

In the oil and gas methane emissions arena, the International Emissions Observatory (IMEO) project sponsored by the United Nations Environment Program is focusing on development of a comprehensive methane data management system. This system will collect data from multiple sources including: companies participating in the Oil & Gas Methane Partnership 2.0 (OGMP) to gather industry reported methane data; national inventories; science measurement studies and satellite data. The intent is to assess, analyze and integrate these data sources, making this data available in an annual methane data report.

Putinʹs war in Ukraine has reduced access to critical data, information, and scientific collaborations for both Russian permafrost and Russian oil and gas operations

Fallout from Russiaʹs war in Ukraine has included the fracturing of relationships, including government-to-government collaborative efforts to monitor and quantify carbon emissions from thawing permafrost. Numerous researchers are reporting an inability to collect data from already existing installations in Russia, and monitoring planned for the Russian Arctic by international entities is largely having to be re-oriented.

Because of the significant contributions that Russian territory holds for methane and carbon emissions — both from thawing permafrost which underlies 60 percent of Russia, as well as their outsized methane contributions from their Arctic oil and gas activity — it will be important to evaluate other options for monitoring, including greater use of space-based assets.

Despite constraints that exist for scientific research on Russian territory, there are numerous opportunities in other parts of the Arctic which, in addition to greater use of atmospheric and space-based assets, could and should be pursued for increasing methane emissions detection and monitoring in other parts of the Arctic.

Science assessments and policy decisions at pan-Arctic scale need accelerated and integrated focus in order to provide the basis for implementing actions at time scales required to meet global climate targets.

Lags in producing the most comprehensive assessments (notably those of the IPCC), and the urgency of having national decisions and policy actions reflect up-to-date understandings, warrant efforts to bring persuasive new findings about CO_2 and CH_4 emissions directly to the attention of policymakers. This will require rapid upgrades in spatial and temporal coverage of ground-based, aircraft based and satellite-based monitoring of ongoing processes of permafrost thaw and resulting CO_2 and CH_4 emissions across the Arctic. This will also require significant upgrades in both voluntary reporting and independent assessment of Arctic oil and gas methane emissions, particularly from Russian oil and gas operations. Incorporation of improved understanding of the processes and pace of permafrost thaw, as well as oil and gas emissions, into more rigorous methane-capable models is a critical step toward developing future projected emissions with much smaller uncertainties than current models are capable of producing.

Pan-Arctic collaboration is critical. The US could play an important leadership role in bringing together scientists and policy makers on Arctic methane monitoring and assessment. The U.S., through the Office of Science and Technology Policy (OSTP) and the National Security Council (NSC) should work with the Arctic 7 and others to ensure robust integration of methane monitoring and assessment into appropriate climate and national security decision making forums.

Monitoring and assessment of Arctic methane sources will become increasingly important, both to meet climate requirements under international agreements and for national security purposes. Pan-Arctic science cooperation has long been an important feature of better understanding Arctic environmental change. Until Russia′s war on Ukraine, Russia participated in Arctic science activities through the Arctic Council and other for fora. Now that formal collaboration with Russia is paused in light of their aggression in Ukraine, the urgency of continuing collaboration among Arctic nations becomes greater. Additionally, the integration of the Arctic science community with the Arctic policymaking community across both climate and national security policy can be strengthened so that science fully informs policymaking, and policymakers more fully understand the impact of new scientific discoveries, such as the underestimating of Arctic methane from potential rapid permafrost thaw. The U.S., through the Office of Science and Technology Policy (OSTP) and the National Security Council (NSC) should work with the Arctic 7 and others to ensure robust integration of methane monitoring and assessment into appropriate climate and national security decision making forums.

Conclusions and Recommendations

Arctic methane could derail efforts to reduce the worst effects of climate change. Both permafrost, and oil and gas methane are important. Accelerating permafrost methane thaw could be the tipping point that sends the earth system beyond the climate balance currently projected. Assessment of pan-Arctic methane is highly complex and data are currently severely limited. Most current climate budgets do not account for the large potential of methane from permafrost thaw. Formal Arctic science and policy collaboration with Russia has been paused in light of their aggression in Ukraine, and therefore, the urgency of continuing collaboration among Arctic nations is even greater. Scientific assessments and policy decisions need accelerated and integrated focus at the pan-Arctic scale.

Important recommendations emerging from this Arctic methane workshop include:

- Accelerate collaboration among scientists and policymakers on the needed upgrades in spatial and temporal coverage of various monitoring and modeling assets.
- Effective Arctic change monitoring requires collaboration across scales, including: in situ (permanent and mobile), airborne and satellite. Relationship building is an essential ingredient for effective collaboration.
- In addition to accelerating monitoring improvements, rigorous assessment also requires improved modeling, both in terms of fundamental methane physical/chemical/biological processes and at multiple spatial and temporal resolutions.
- Systematic data integration and analysis should be informed by policy decisions.
- Reducing methane emissions is currently the fastest available way to limit near-term warming. The oil and gas sector is the fastest opportunity for this mitigation, and the Arctic region will be an important player. In addition to engaging industry in solutions to methane leakage, independent validation of industry data is key to assurance of data fidelity from oil and gas emissions monitoring.
- The U.S. Arctic Research Commission should support efforts to enhance, coordinate and integrate advanced observing networks for Arctic methane.
- Improved international coordination and cooperation are needed to increase coverage and sharing of data sets and modeling results, facilitating open and transparent estimates of emissions. Technical collaborations enabled by the Arctic Council have played, and will continue to play, an important role in developing pan-Arctic methane assessments.