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Testimony to the House Foreign Affairs Subcommittee on Europe, Energy, the Environment and Cyber

National Security Implications of Climate Change in the Arctic

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Thank you to the committee and in particular Representative Keating for inviting me to provide testimony for this hearing.

I am the Arctic Program Director and a Senior Scientist at the Woodwell Climate Research Center ("Woodwell"). I am an Arctic ecologist, who has been studying permafrost thaw for the past 13 years, nine of which were at Woodwell. My research focuses on permafrost thaw and northern latitude fire and the resulting effect on local landscapes and the global climate. Woodwell's Arctic research team uses on-the-ground observations, satellite remote sensing, and computational modeling to understand the impacts of these climate-driven changes across the Arctic and the rest of the world.

The Woodwell Climate Research Center is a non-profit organization based in Falmouth, Massachusetts, made up of researchers who work worldwide with partners to understand and combat climate change. Woodwell scientists helped to launch the United Nations Framework Convention on Climate Change in 1992 and shared the Nobel Prize with the Intergovernmental Panel on Climate Change in 2007. Woodwell brings together cutting edge science and more than 35 years of translating science into policy to find societally-relevant solutions to global climate change and climate risks.

While the world has already warmed 1.1°C above pre-industrial levels, the Arctic is warming at least two times faster than the global average. In the coming years, Arctic temperatures are projected to continue to rise at an accelerated pace, further exacerbating climate hazards, including wildfires, sea ice melt, coastal erosion, and permafrost thaw (Markon et al., 2018).

Permafrost, which is ground that has been frozen for at least two consecutive years and often for thousands of years, underlies about 15 percent of Northern Hemisphere land area, and approximately 85 percent of Alaska's land area is underlain by permafrost.

From a global climate change perspective, permafrost thaw is critically important because the permafrost region stores vast amounts of carbon, roughly twice as much as in the atmosphere

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(Hugelius et al., 2014). Once thawed, this previously frozen carbon can be broken down and released into the atmosphere as greenhouse gasses, methane and carbon dioxide. The release of greenhouse gasses from thawing permafrost can accelerate climate warming, leading to additional thaw, resulting in an amplifying feedback loop. As stated in the International Panel on Climate Change (IPCC)'s recently released Sixth Assessment Report (AR6), the loss of permafrost carbon is irreversible on a human-relevant timeframe, and projections of 3-41 $GtCO_2$ per 1°C of warming by 2100 likely underestimates the potential of permafrost carbon emissions (Baillargeon & Natali, 2021; Natali et al., 2021). Currently, the AR6 models do not include important thaw processes, such as thaw-induced ground collapse and fire-permafrost interactions (Turetsky et al., 2020; Natali et al., 2021). When accounting for the full scope of thaw processes, cumulative permafrost carbon emissions by the end of this century could be on par with continued emissions from a country like Japan or as high as continued emissions from the United States (Natali et al., 2021). As a result, permafrost thaw emissions could take up 25-40 percent of the remaining carbon budget allowable to stay below 2°C.

The local implications of permafrost thaw are widespread and significant. Permafrost thaw can cause the ground to sink, a phenomenon known as subsidence, which can create hazardous conditions for Arctic residents and contribute to the rising costs of climate change (Hjort et al., 2018; Melvin et al., 2017). These hazards are already being experienced across Alaska, endangering human health, destroying public infrastructure, and threatening water, cultural resources, traditional food storage, ways of living, and access to subsistence resources (Brubaker et al., 2011; Brinkman et al., 2016; Bronen, 2015; Hong, Perkins, and Trainor, 2014). In a recently published report in collaboration with the Council of Strategic Risk, Woodwell researchers found that foundations of military infrastructure are already cracking and becoming increasingly unstable, including the Northern Warfare Training Center at Fort Wainwright, Alaska (Guy et al., 2021). Military leaders at installations like Fort Wainwright must increasingly focus not only on threats from foreign actors but also on the changing conditions of their own local environments.

The risk and severity of climate impacts are particularly high for coastal communities in Alaska, where loss of land-fast sea ice is increasing storm impacts, while permafrost thaw is exacerbating coastal erosion rates (Lantuit et al., 2012). Almost a decade ago, the U.S. Government Accountability Office identified 31 Alaskan villages that face imminent threats from flooding, erosion, and permafrost thaw (GAO 2009). At the time of the GAO report, 12 villages were seeking relocation options; however, none of these villages have yet fully relocated, in large part because of a lack of a governance framework to facilitate relocation efforts (Bronen and Chapin, 2013). Woodwell is working with some of these Alaska Native villages to monitor permafrost thaw to support climate adaptation planning. Permafrost thaw and other climate-driven changes in the Arctic will, however, continue to present human security concerns, including food and

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water insecurity, and these impacts have created the need for a concerted and immediate effort to develop a national climate adaptation and relocation governance framework that respects the human rights of impacted communities (Bronen, 2021).

Permafrost thaw is occurring in the Arctic, in some situations significantly earlier than was previously projected. That thawing is having profound local and regional implications, including on the human security of Alaska Native and local residents. Permafrost thaw can endanger human health, destroy public infrastructure, threaten cultural resources, destabilize terrain, and cause community-level displacement. Domestically, we need to act now to ensure that communities in Alaska and federal agencies are prepared for these impacts and put into place aggressive mitigation policies to prevent further avoidable climate warming.

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