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THE THAWING OF PERMAFROST, CONSEQUENCES AND SPACE MONITORING POSSIBILITIES

Abstract

Permafrost thawing emissions; a manifestation of "carbon cycle positive feedback", are estimated to having reached 0.3 to 0.6 billion tonnes yearly while forecasted to add 150 billion to the atmosphere by 2100. Lack of accessibility of permafrost metadata/standardization of collection protocols among scientific expeditions, research centers/governmental/private organizations, hinder efforts to understand and tackle permafrost thawing. There is a lost cost-saving opportunity due to lack of collaboration on things like borehole data collection that could have allowed covering a larger geographical span. The European Space Agency (ESA), via the Envisat and the Sentinel Program are helping provide input for Europe's Global Monitoring for Environment and Security (GMES). Ground soil temperatures of the permafrost is detected via ground field work sampling via boreholes. Borehole collection and analysis protocols vary in a way that may affect attempts to establish thawing models that predict how much time is left before methane leakage becomes too critical for humanity's survival. It is worth noting that due to the complexity of Earth, a multiplicity of data sources are needed, not only to validate and bridge gaps in ground field-acquired data, but also to augment a multiplicity of satellite data resources, like Sentinel 2 whose camera could provide data on the changing shape of topography due to thawing with Sentinel 1 allowing radar detection of land changes and Sentinel 3 with its thermal sensory instruments and as such, a more holistic approach to monitoring and detection would be possible. Utilization of advanced artificial intelligence consolidation of satellite data imagery, via machine learning models can augment the knowledge gaps we have about the structure of permafrost, as per the findings facilitated by funding from the US National Science Foundation that identified 1.2 billion ice wedge polygons within surveyed permafrost. With such modeling abilities enabled by supercomputers and deep leaning, there could be a chance for building models for cracking and methane venting thawing permafrost. Aside from the dangers of converting a geologically ancient carbon vault into a canon source, there is a problem with the effects on collapsing trees due to soil instability and landslides as well as the jeopardized integrity of human infrastructures due to the thawing of permafrost. Satellite-driven monitoring of permafrost conditions may be necessary to advise infrastructure planners whether in corporate, or at state levels. This shall be necessary as part of the "climate adaptation" effort to make human activities more resilient to climate change.