

Understanding methane and carbon dioxide emissions in the Mackenzie Delta region

Dr. June Skeeter [they/them/theirs]

Introduction: My Background

I specialize in measuring greenhouse gas (GHG) exchange in permafrost environments.

- PhD in Geography from UBC in 2023
- I started as a research scientist with the GSC in summer 2024
 - “Cross posted” between GSC Northern and Pacific



2024 Fish Island Field Campaign

Framing the Problem

The Arctic is warming ~3x faster than the global average.

CMIP6: SSP5-8.5 Mean Temperature Change
(34 models) 2021-2040 rel. to 1981-2010

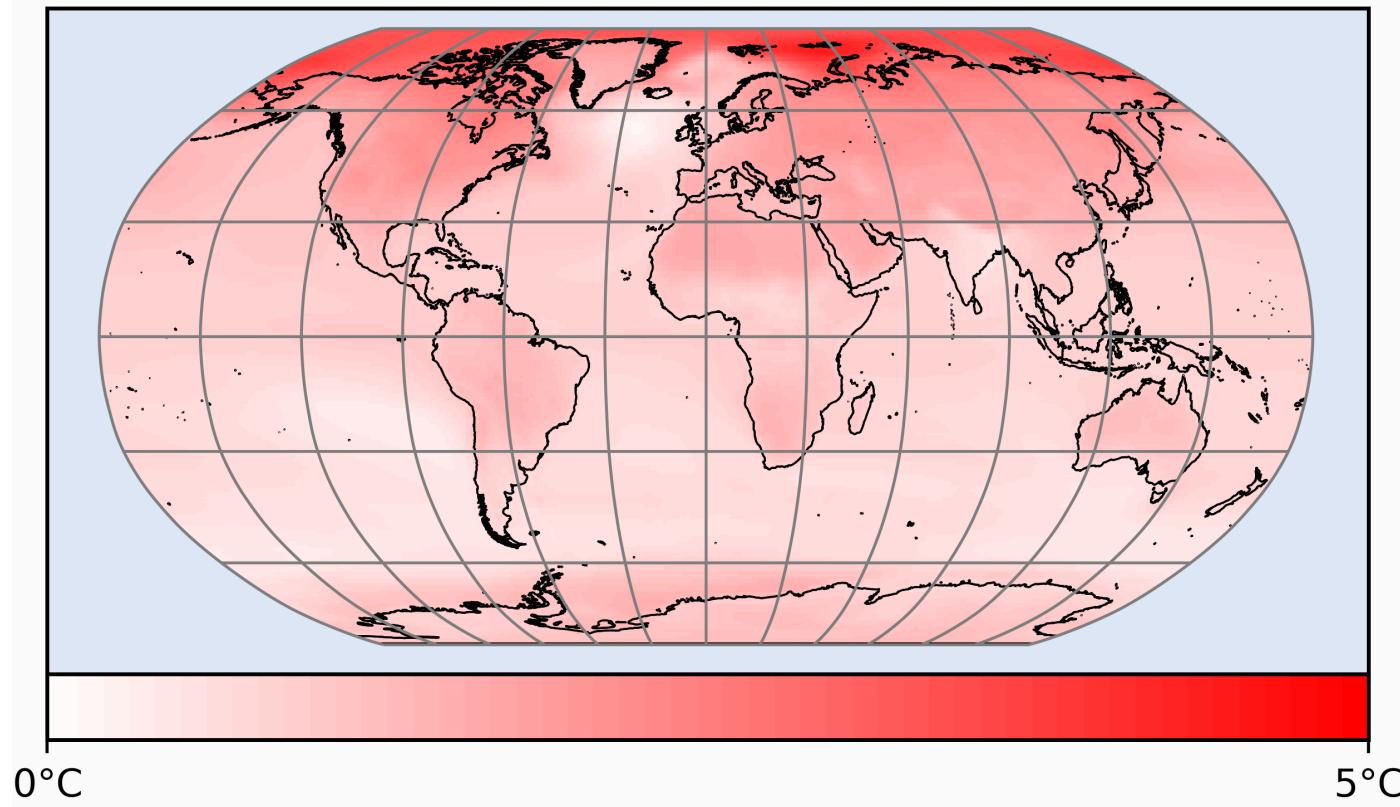


Image source: Skeeter 2022

Carbon-Climate Feedback

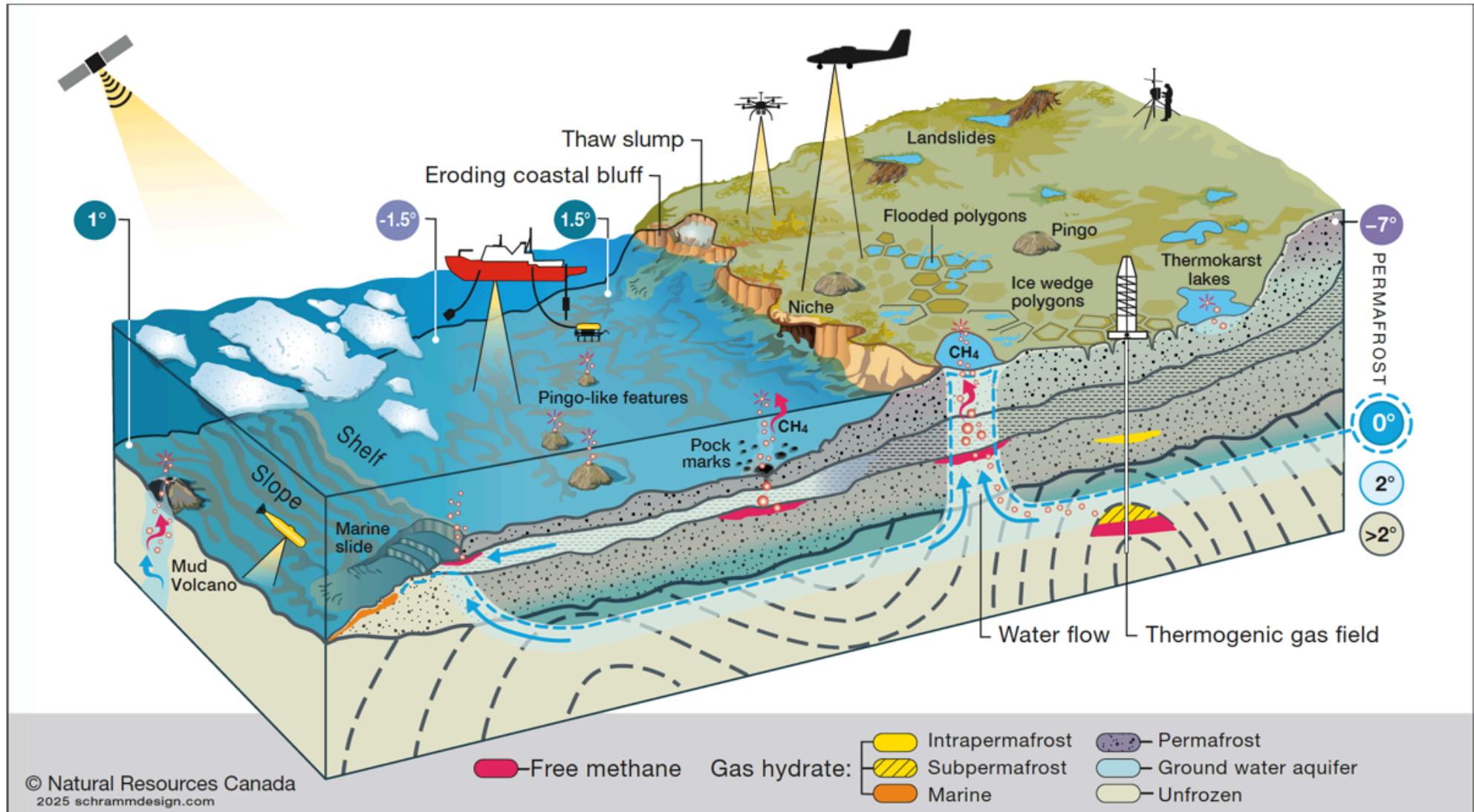
Climate change is shifting the carbon balance of the Arctic, which has far reaching global implications.

- Extended growing seasons
 - ↑ Carbon *uptake*
- Permafrost degradation
 - ↑ Carbon **emission**
- Flooding & coastal erosion
 - ↑ Carbon **emission**



Niglintgak thaw slump

Importance of Methane

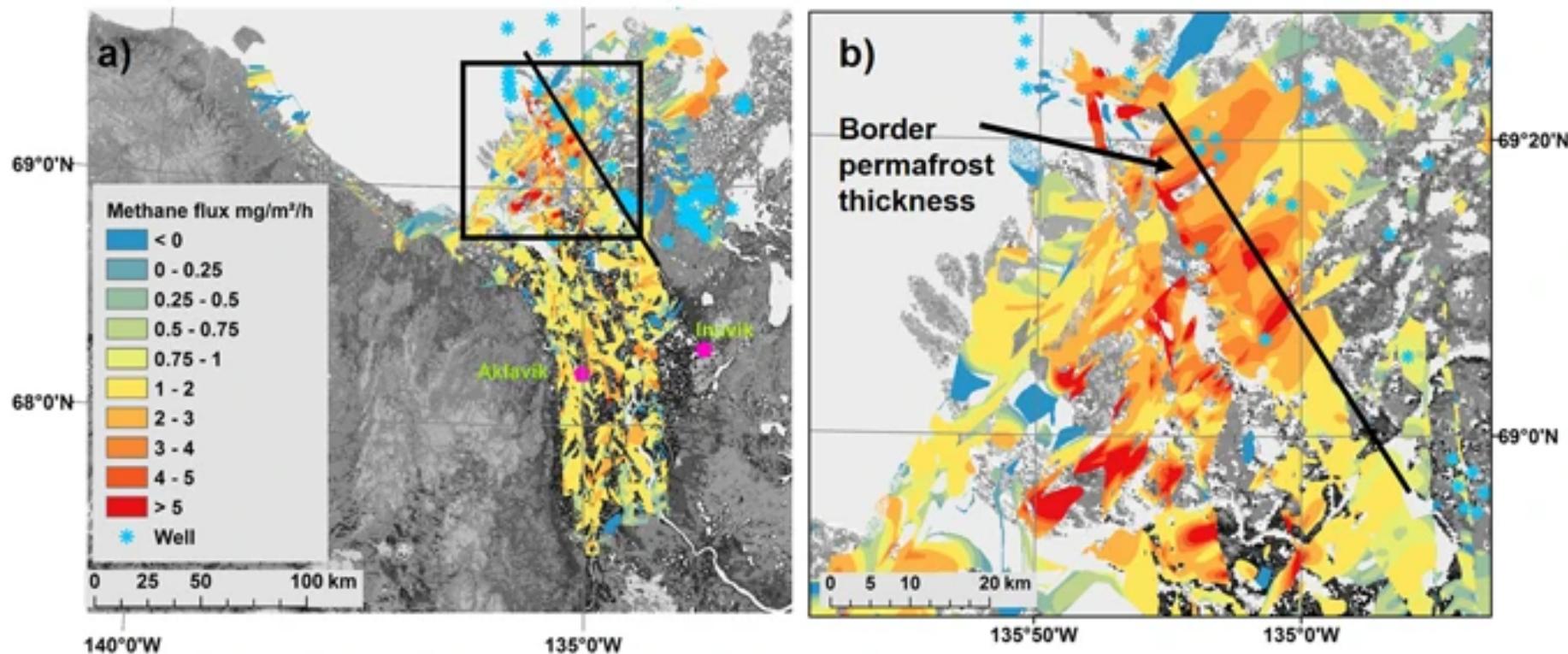


Source: GRID-Arendal, 2020

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A Methane Hot-spot

The Mackenzie River Delta is hot-spot for methane in the Canadian Arctic. Aircraft and satellite have detected significant methane emissions



Source: [Kohnert et al. \(2017\)](#)

Biologic Emissions

The limited field based measurements available suggest of substantial growing season emissions over where permafrost is continuous.

Canadian Science Publishing

OPEN ACCESS | Article

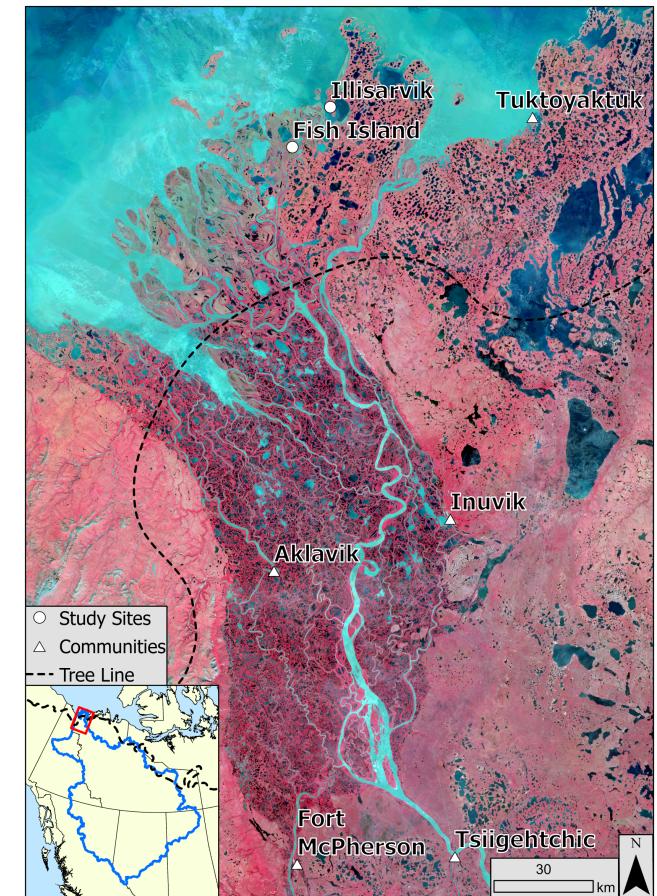
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Controls on carbon dioxide and methane fluxes from a low-center polygonal peatland in the Mackenzie River Delta, Northwest Territories

Authors: June Skeeter, Andreas Christen, and Greg H.R. Henry | AUTHORS INFO & AFFILIATIONS

Publication: Arctic Science • 3 February 2022 • <https://doi.org/10.1139/as-2021-0034>

3 2,007



Source: Skeeter 2023

Geologic Methane

In discontinuous permafrost, some gas seeps are visible to the naked eye!

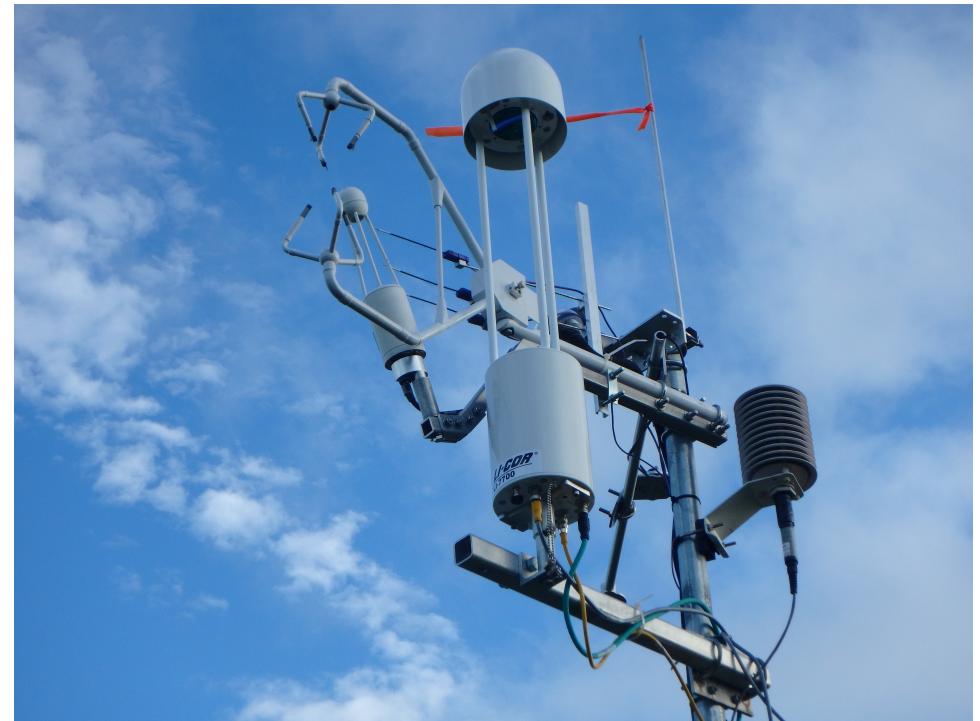
- More work is needed:
 - Map sources
 - Quantify emissions
 - Identify potential remediation strategies



How do we measure emissions?

Eddy covariance (EC) is a principal method to monitor landscape-scale fluxes.

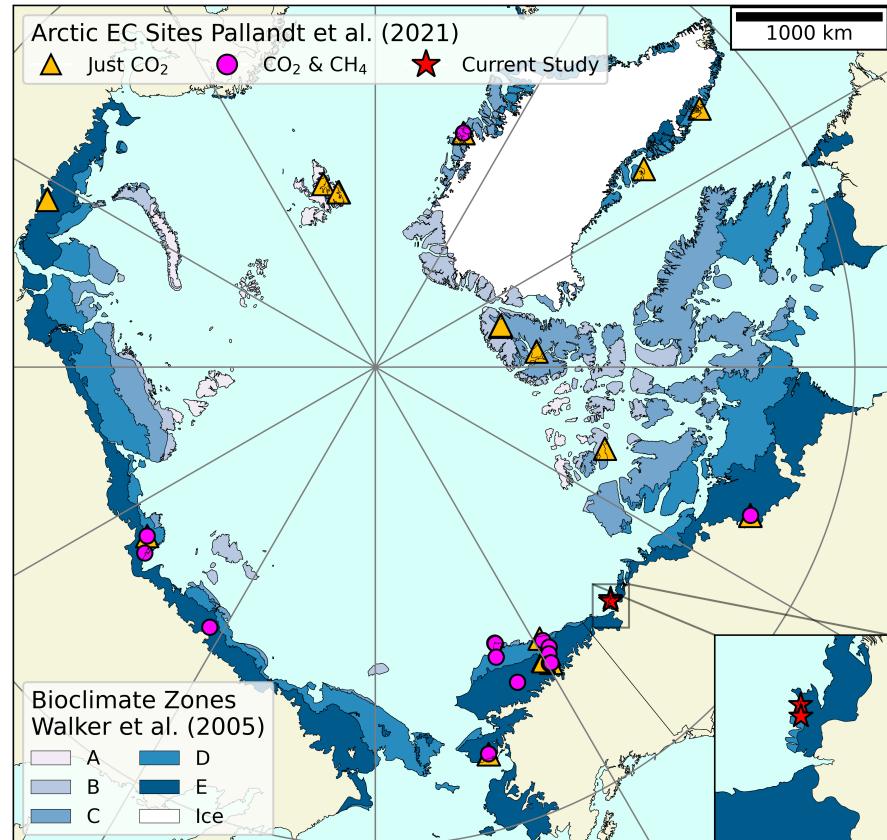
- Measures wind velocity and gas concentration at high frequency (20 Hz)
- Gives a semi-continuous time series of half-hourly fluxes



Limited Observations

EC systems are expensive, difficult to operate in remote environments, and require meticulous analysis.

- Bias towards accessible sites
- Canadian Arctic is under-represented



Source: Skeeter 2023

Swiss Cheese Lake

Established in summer 2024
to study the discontinuous
permafrost zone.



In a sedge wetland ecosystem
“typical” of the outer delta.

Swiss Cheese Lake

Objective is to help understand emissions associated with biologic production and diffuse geologic sources in discontinuous permafrost.



- Understand drivers of emission
- Measure non-growing season emissions

Analysis

Eddy covariance produces large volumes of data which are requires complex, computationally expensive processing.

- This poses a significant challenge to researchers.
 - Only ~10% of EC sites in Canada have published open-access datasets.
- I am collaborating on an open-source data processing pipeline with other Canadian researchers.

Next steps

Installing upgraded sensors and upgrading the power system to support non-growing season measurements.

- 2024 was an exploratory campaign conducted using borrowed sensors.
- 2025 will be run using GSC sensors.



Further work

Swiss Cheese Lake can serve as an “anchor point” for more spatially targeted investigations.

- Flux chambers to investigate fine-scale patterns
- Use drone to target hot-spots in the surrounding area
- Temporary EC systems in natural and disturbed areas



Thank you

Questions?

