

BioSpace25 - Biodiversity insight from Space  
10 - 14 February 2025 | ESA-ESRIN | Frascati - Italy



# 5<sup>th</sup> International Polar Year - an opportunity for biodiversity assessment across scales

Gabriela Schaepman-Strub, University of Zurich

# Biodiversity in the New Arctic

**The Arctic is warming 3-4x the global average - major biodiversity and ecosystem functioning changes are expected, impacting the Arctic and the Earth system, ranging from biogeochemical cycles to Indigenous Peoples livelihoods.**

How well do we know Arctic biodiversity and its change?

Major efforts by different organizations, such as the Arctic Council/CAFF with its Circumpolar Biodiversity Monitoring Programme.

Despite these efforts..

... we see spatially heterogeneous greening and browning patterns at pan-arctic scale (from NDVI analyses), but don't understand underlying processes well.

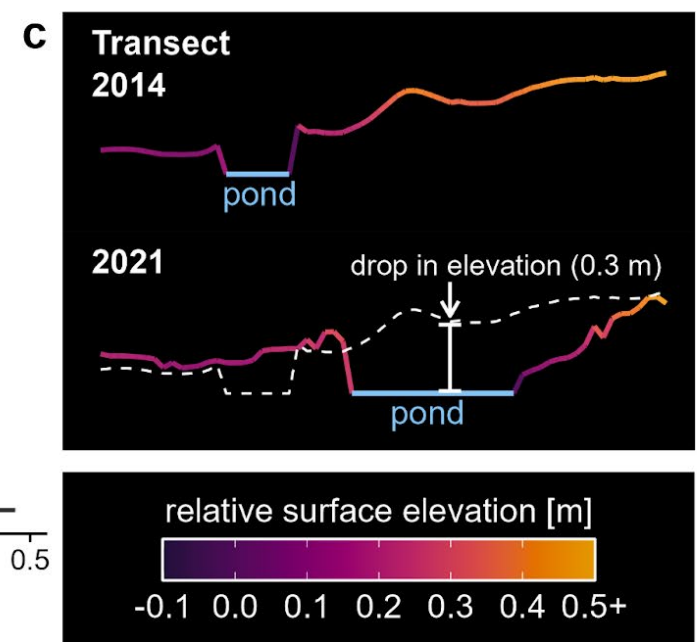
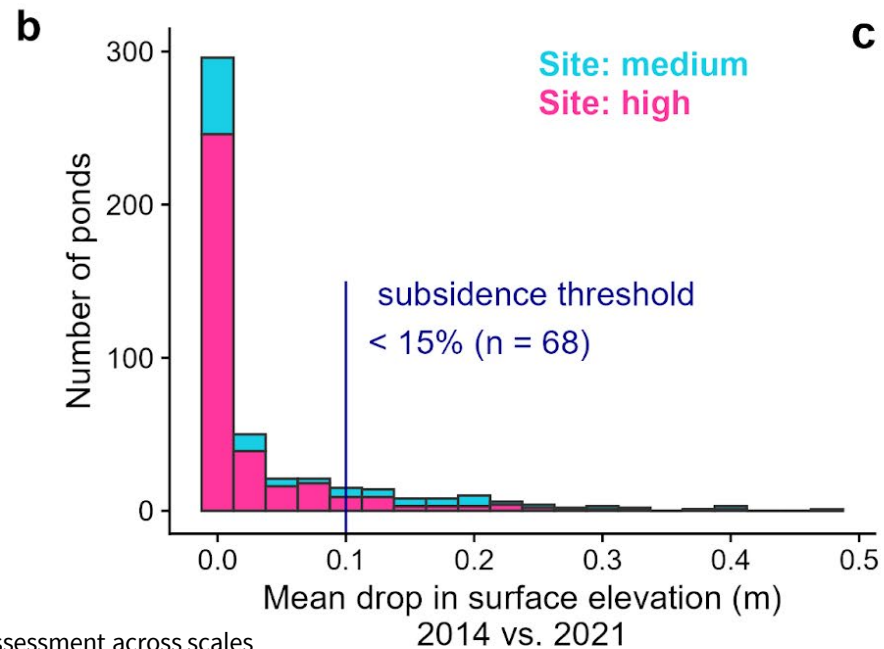
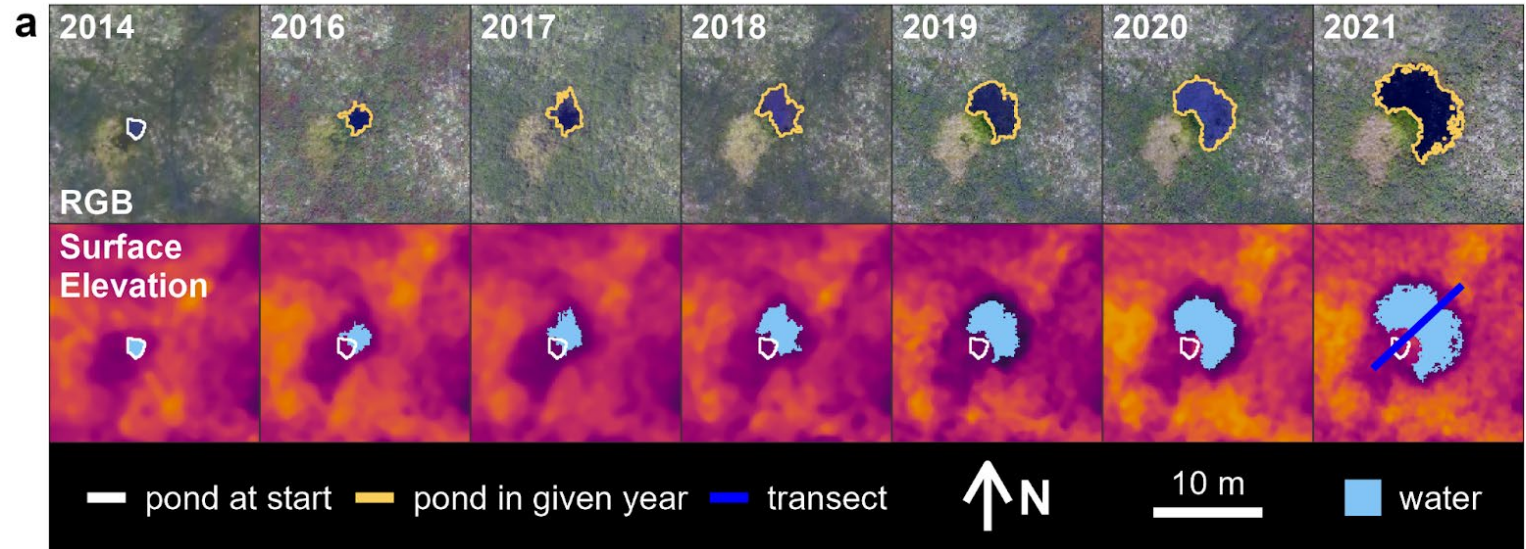
... we miss a solid baseline of polar biodiversity for most biological taxa, so assessing change becomes difficult.

... we still focus on climate warming while other drivers in the New Arctic (climate extremes, fires, industrialization, climate intervention?) are quickly becoming important for biodiversity and ecosystem functional changes, too.

However, biodiversity information is urgently needed for planning of sustainable development of the Arctic, e.g. protected areas mostly are located in regions that will not be able to serve as climate refugia for vegetation types most threatened by 2050.



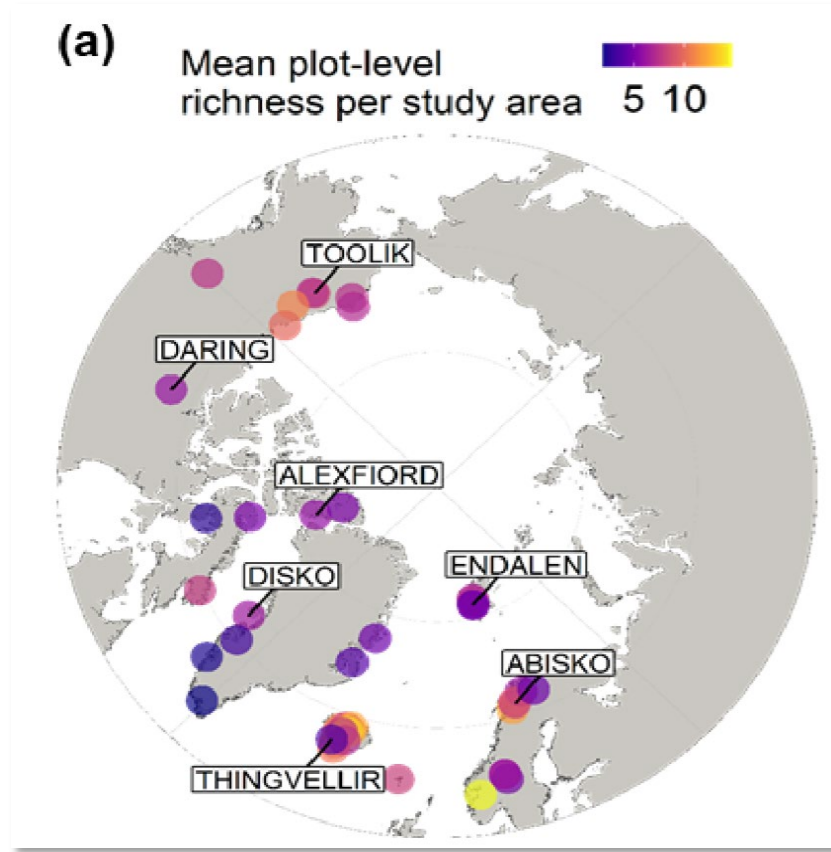
# Complexities in the greening of the Arctic...



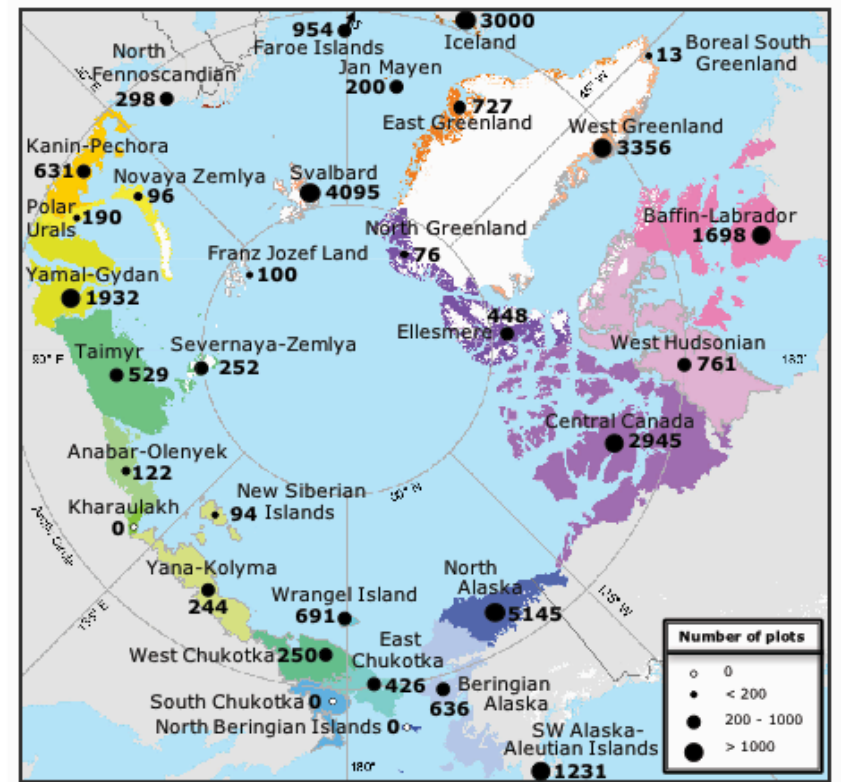
# Missing solid baseline – example of in situ vegetation plots

- Strong spatial bias in sampling and data availability
- Few repeated plots
- Most studies still focus on vascular plants only, omitting easily 50% of species (bryophytes and lichens)

- Arctic Vegetation Archive – Braun Blanquet plots
- 31'466 plots were identified for potential inclusion into AVA (Walker et al. 2019)
- 2873 open-access geobotanical recently digitized (Zemlianskii et al., 2023, DOI: 10.1111/geb.13724)



Source: Garcia Criado et al., Nature (accepted) [ecoevorxiv.org](https://doi.org/10.1038/s41586-023-04000-0)



Source: Walker et al., 2019, <https://www.caff.is/work/projects/cfg-caffs-flora-group/>



# Other drivers of change in the New Arctic – industrial development

## Method

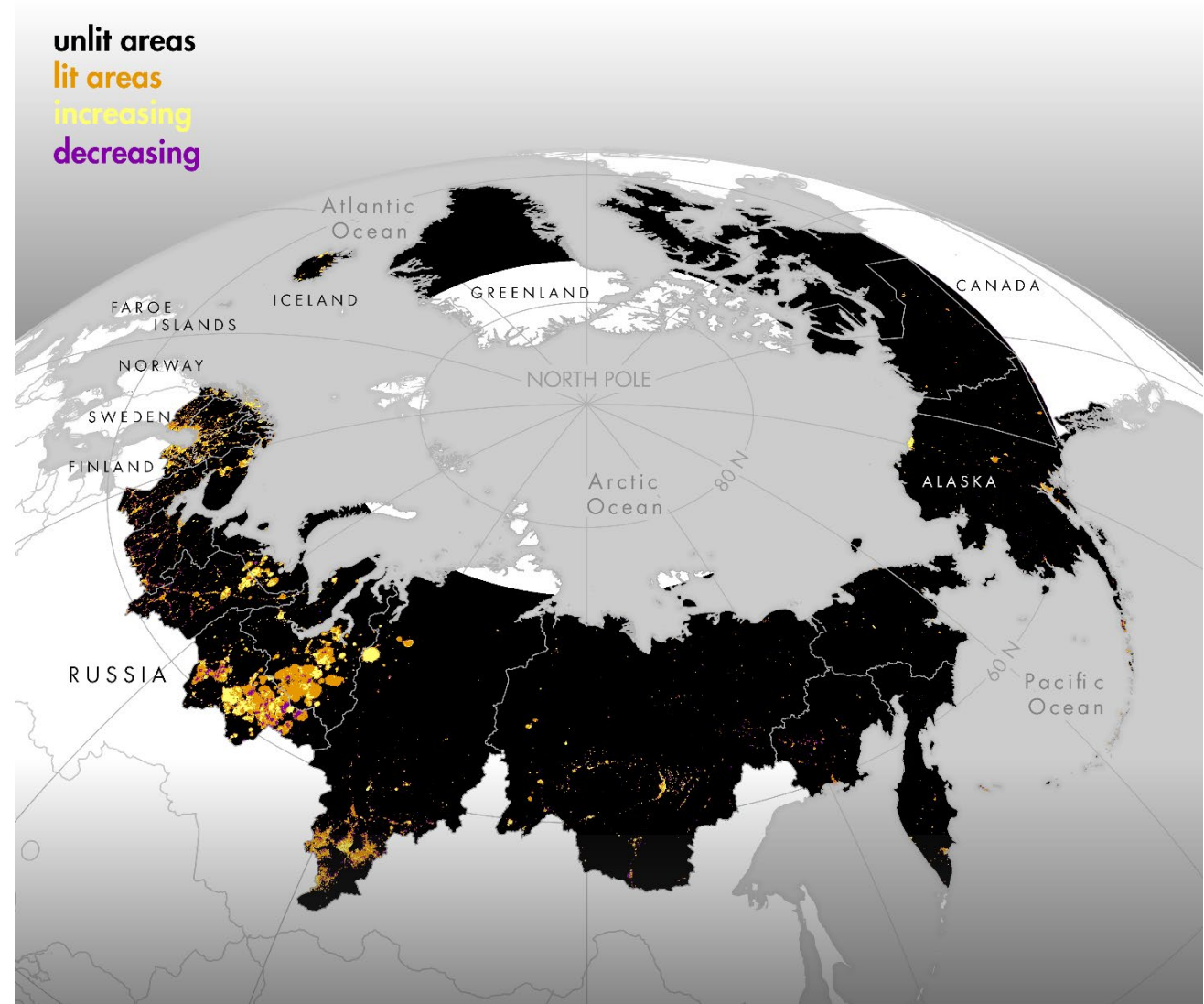
- Pixel-based trend analysis of satellite-observed nighttime light 1992-2013, 16.4 Mio km<sup>2</sup>

## Result

- 5.14% lit by human activity, 4.8% annual increase
- 15% of lit area with human settlement -> most lit area related to industrial activity

## New study submitted today 😊

- Fires occur more often in lit area (2.5 x as often as control under similar climate)

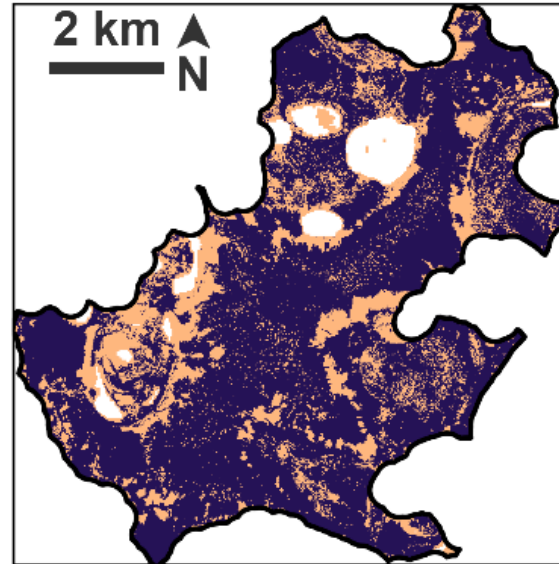


Akandil et al., PNAS, 2024; <https://www.pnas.org/doi/full/10.1073/pnas.2322269121>

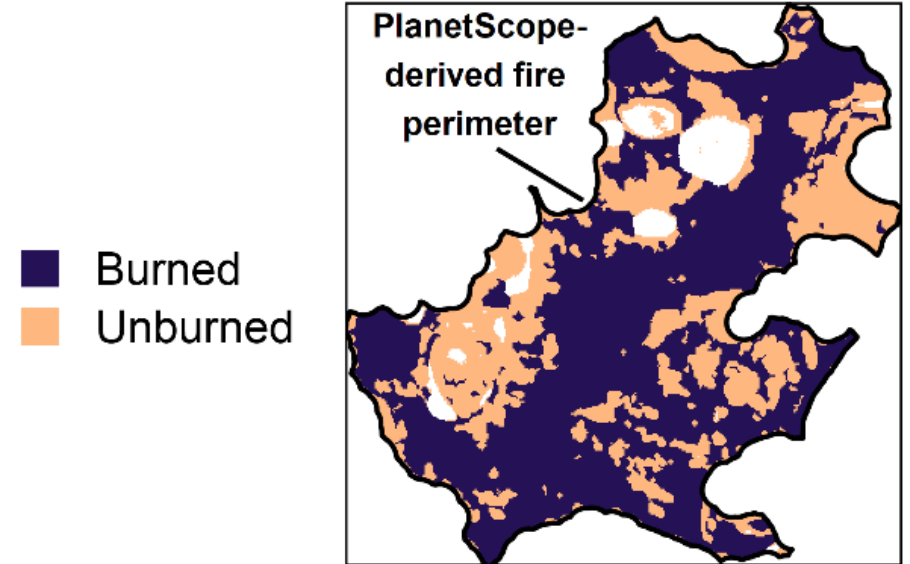
# Other drivers of change in the New Arctic - fires



**b)** Burned area PlanetScope  
(3 m x 3 m)

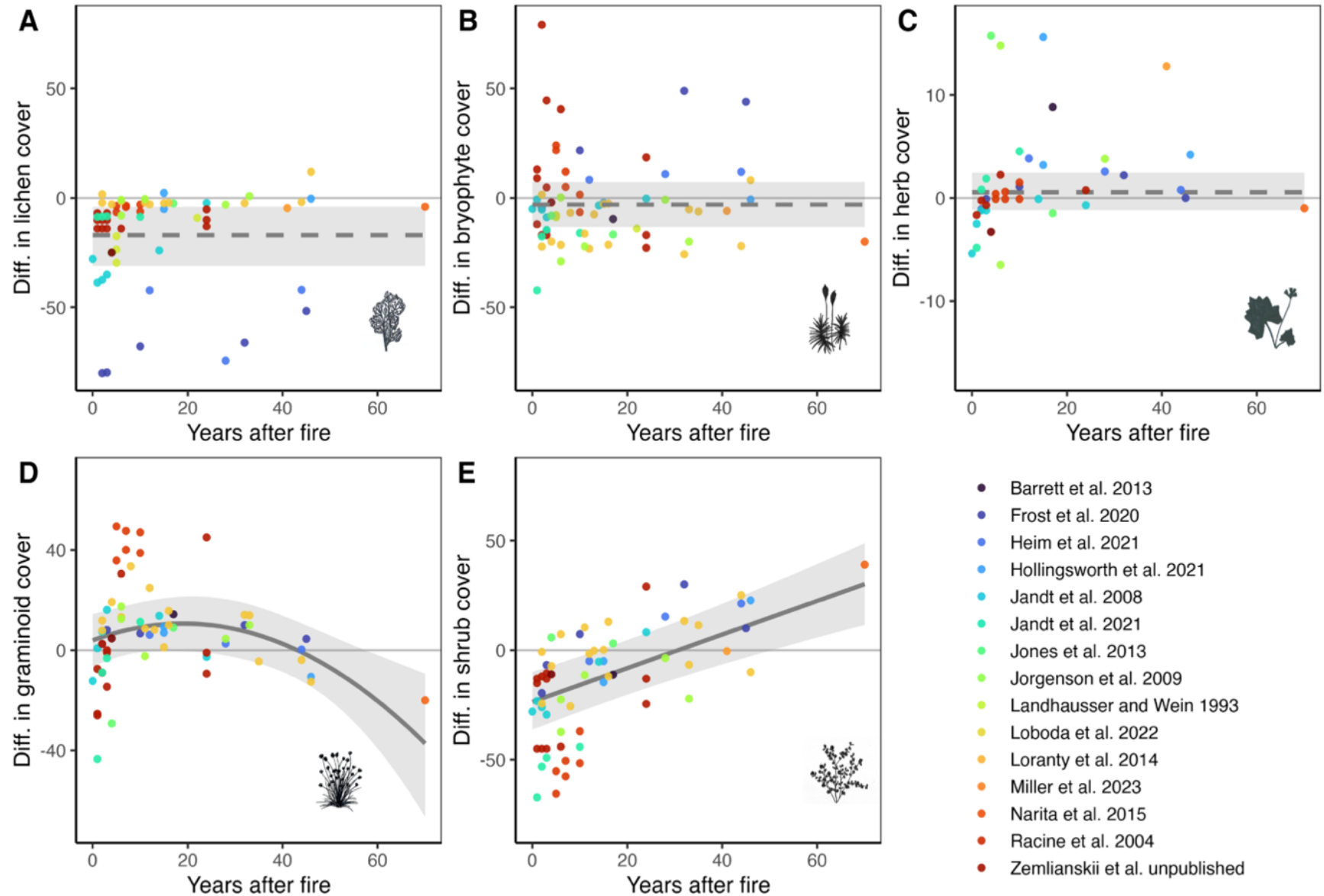


**c)** Burned area Landsat  
(30 m x 30 m)



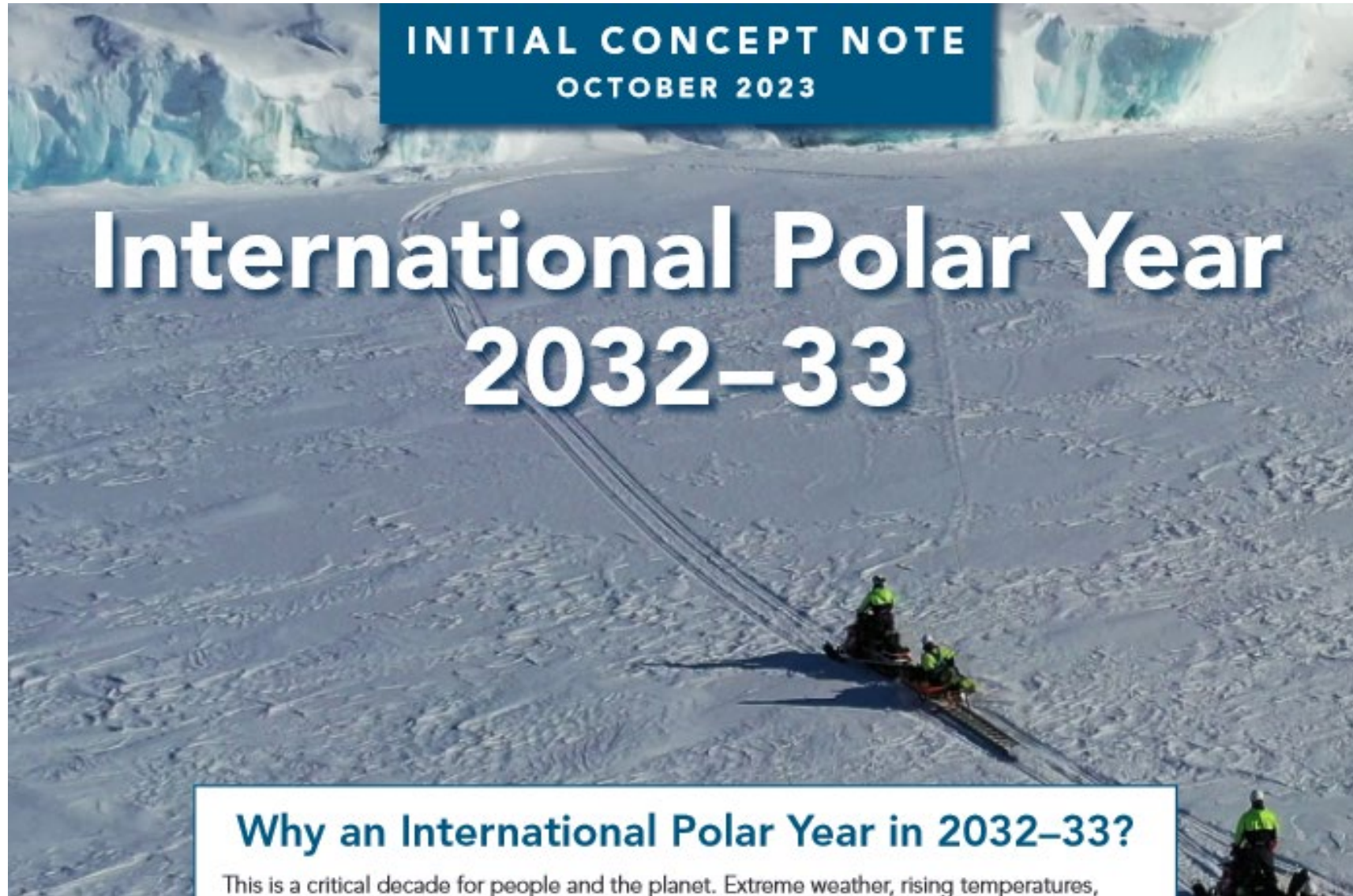
Rietze et al., Biogeosciences (accepted) DOI: [10.22541/essoar.173193589.99013195/v1](https://doi.org/10.22541/essoar.173193589.99013195/v1)

# Arctic tundra ecosystems under fire – alternative ecosystem states in a changing climate?





# International Polar Year 2032/33





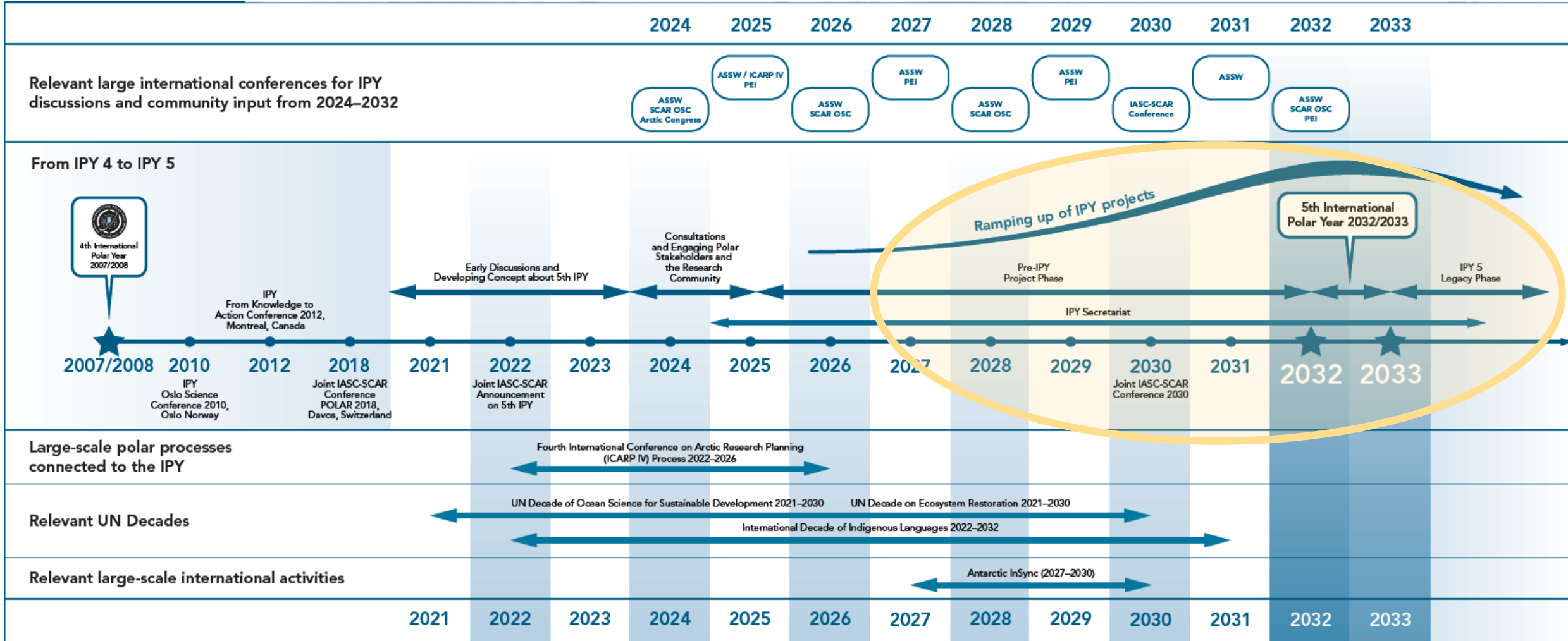
# International Polar Year (IPY) – a short history

- IPY every 50 years since 1883, 4<sup>th</sup> IPY 2007/2008
- 13 December 2022 – announcement of 5<sup>th</sup> IPY by the International Arctic Science Committee (IASC) and the Scientific Committee of Antarctic Research (SCAR), supported by WMO, IASC, UArctic, IASSA, APECS and other partners worldwide representing both poles.
- 19 October 2023 – initial concept note

“By 2032 or even before we may be crossing tipping points in the Earth’s System that will cause irreversible environmental changes in the polar regions and around the globe, with dramatic consequences for all life on Earth. Consequently, a shorter (25-year) interval for coordination of a 5th IPY is essential.”<sup>1</sup>

<sup>1</sup>Source: Initial IPY Concept Note

# Time-line leading up to 5<sup>th</sup> IPY 2032/33



Source: Initial IPY Concept Note



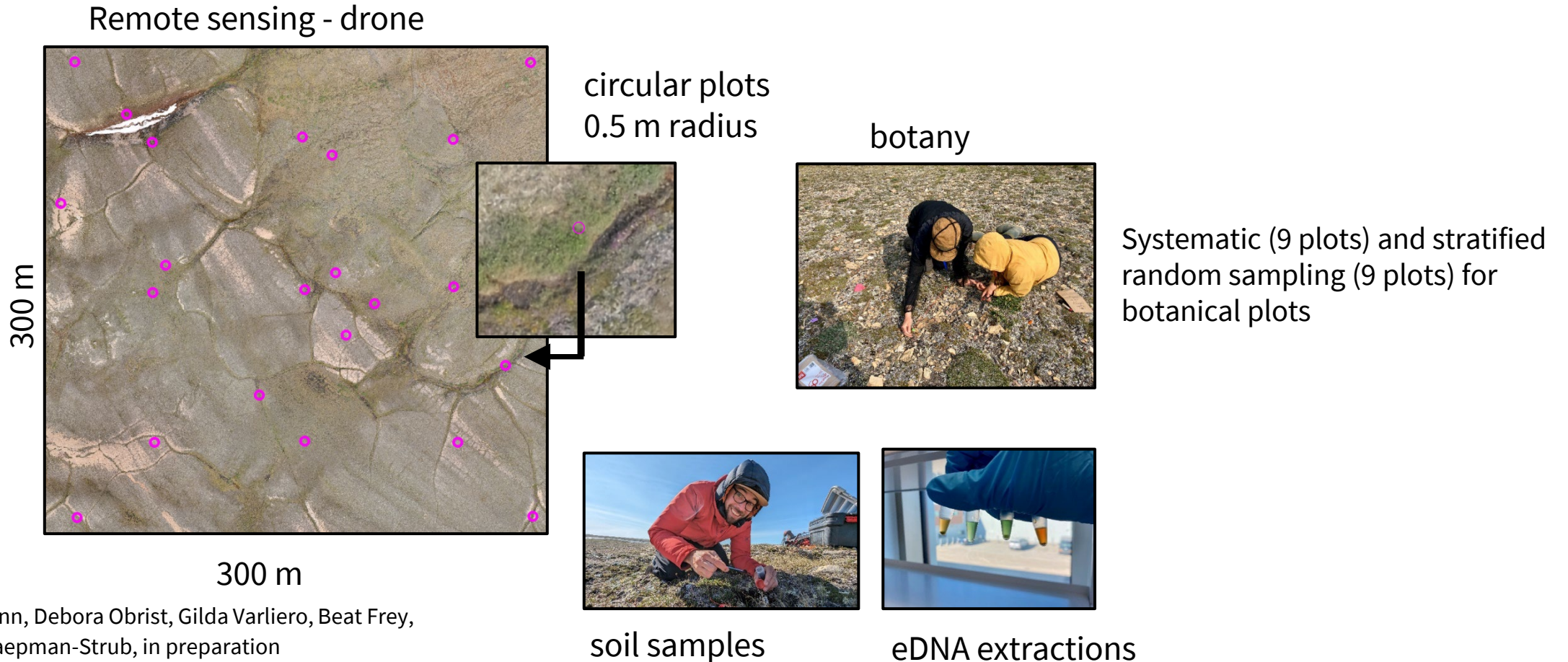
### Guided by a broad set of principles

The 5th IPY will be guided by a broad set of principles, including:

- Fostering international collaboration;
- Encouraging open data and open science;
- Striving for holistic, systemic, transdisciplinary research approaches;
- Producing knowledge for action with direct societal relevance;
- Co-producing policy-relevant knowledge and research and engaging with decision makers;
- Including rights holders, stakeholders, and civil society in research processes;
- Committing to inclusive, diverse, and equitable research practices;
- Encouraging effective science communication, polar education, and public engagement
- Ensuring balanced involvement and information flow, areas of common interest and knowledge exchange across Arctic and Antarctic polar science communities and networks
- Co-designing research programs and co-producing knowledge across knowledge systems, with particular focus on meaningful partnership between academic research and Indigenous knowledge holders; while making sure that the programs are building Arctic Indigenous Peoples' capacity to contribute and participate in a constructive way; and
- Engaging in capacity building for early-career and previously unrelated disciplinary researchers and knowledge holders.

# Opportunities for International Polar Year 2032/33 - towards rapid assessment of vascular plant, moss (and lichen) diversity

- Develop methods for standardized rapid assessment of Arctic plant and microbial diversity.
- Testing combination of eDNA, drone and satellite imagery to assess biodiversity.



Jakob Assmann, Debora Obrist, Gilda Varliero, Beat Frey,  
Gabriela Schaeppman-Strub, in preparation  
Edwards et al. 2018 & Parisy et al. 2023  
University of Zurich | 5th International Polar Year - an opportunity for biodiversity assessment across scales



# Key Recommendations

**5<sup>th</sup> International Polar Year is unique opportunity for biodiversity assessment across scales. Major field measurement effort at the Earth's poles co-occurring with a suite of new sensors up in space by 2032/33!**

What is needed to leverage IPY for improving Polar biodiversity information?

1. Evaluation of changing biodiversity across biological, spatial and temporal scales – what are most meaningful/urgent biodiversity indicators needed for polar areas that can be informed by 5<sup>th</sup> IPY and remote sensing? Collaboration with existing organizations working on Arctic & Antarctic biodiversity and Indigenous Peoples to identify exceptional opportunities and most pressing questions.
2. Development of common measurement protocols (Arctic & Antarctic), involvement of research community across disciplines and local communities in the Arctic to collect in situ data using standardized, easy protocols to generate training and validation data for RS algorithms and products tuned to polar conditions.
3. Based on identified opportunities and pressing questions: identification of representative core sites, coordination of satellite acquisitions (e.g. CHIME, SBG, Landsat Next) across space agencies and disciplines, combining assessment not only of direct biodiversity indicators, but also its drivers (climate extremes, fires, industrial activity, shipping, etc.).

**It's a challenging mission - time is short!**



# Let's make it a biodiverse 5<sup>th</sup> International Polar Year!

<https://ipy5.info/>

