Zooming out:

From local snapshots to a pan-arctic inventory of Arctic ponds and lakes

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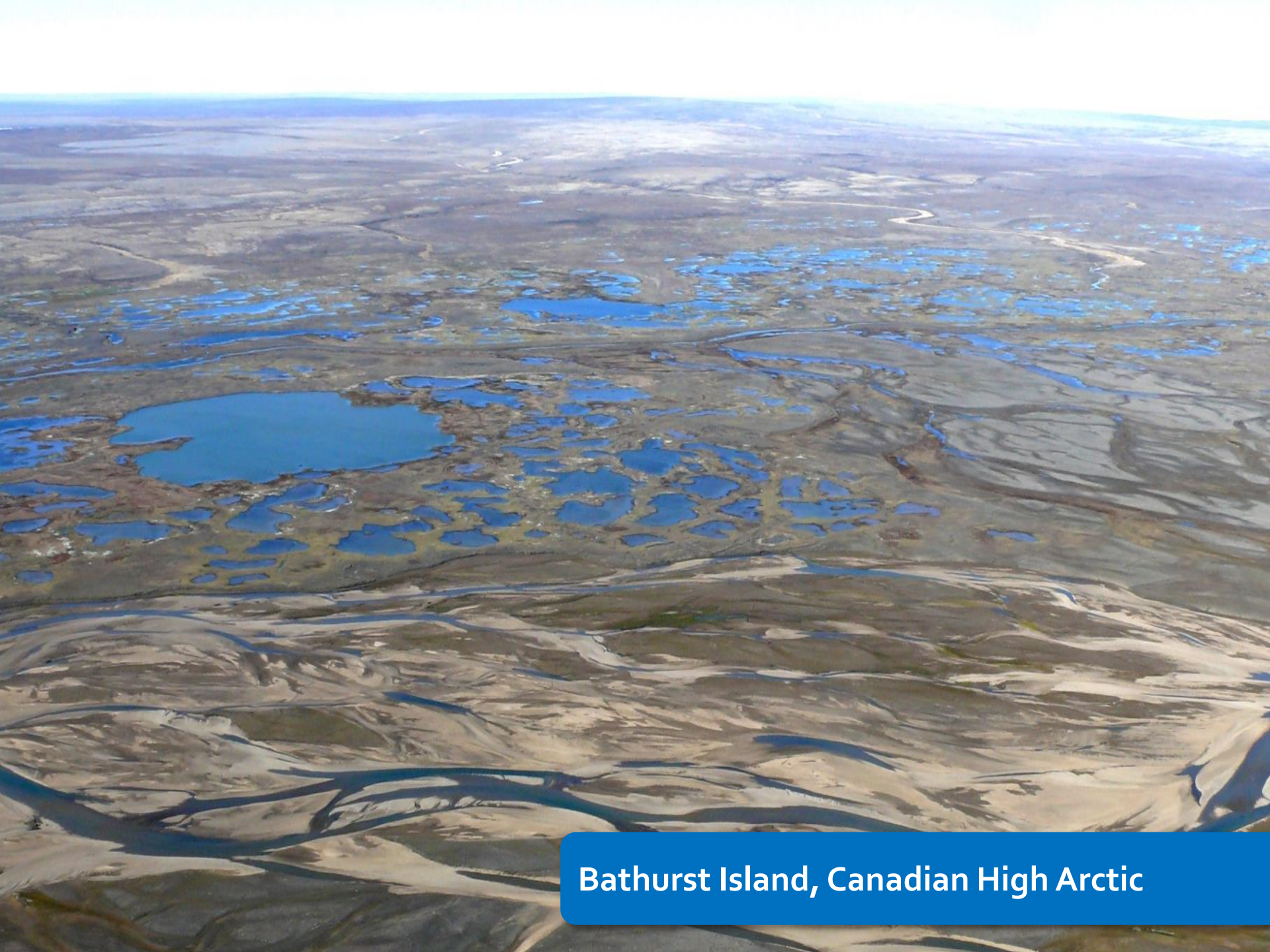
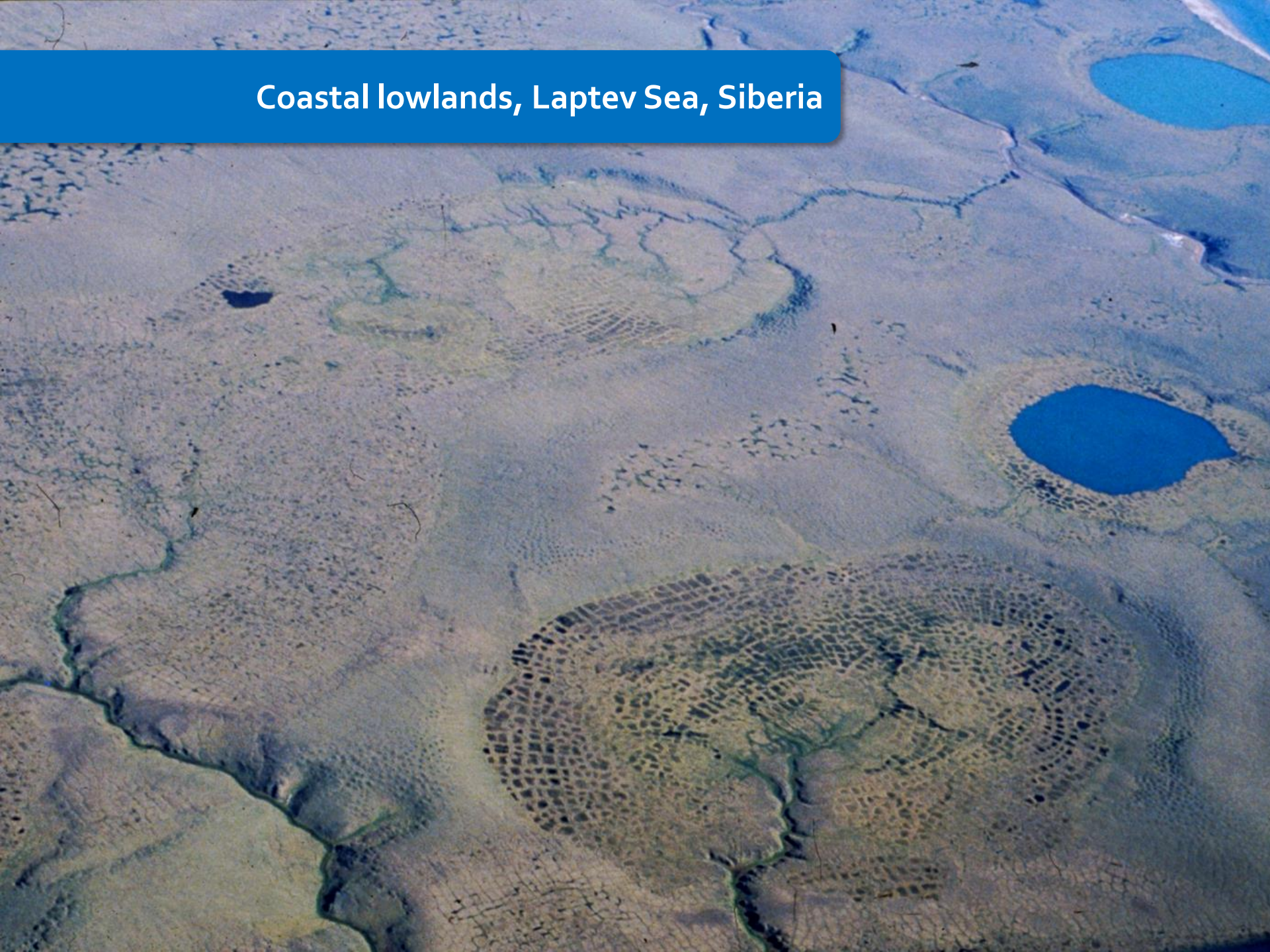


Bathurst Island, Canadian High Arctic


Lena Delta, Siberia

Mackenzie Delta, Canada

Baffin Island, Canadian High Arctic


Coastal lowlands, Laptev Sea, Siberia

Ponds as biogeochemical hotspots

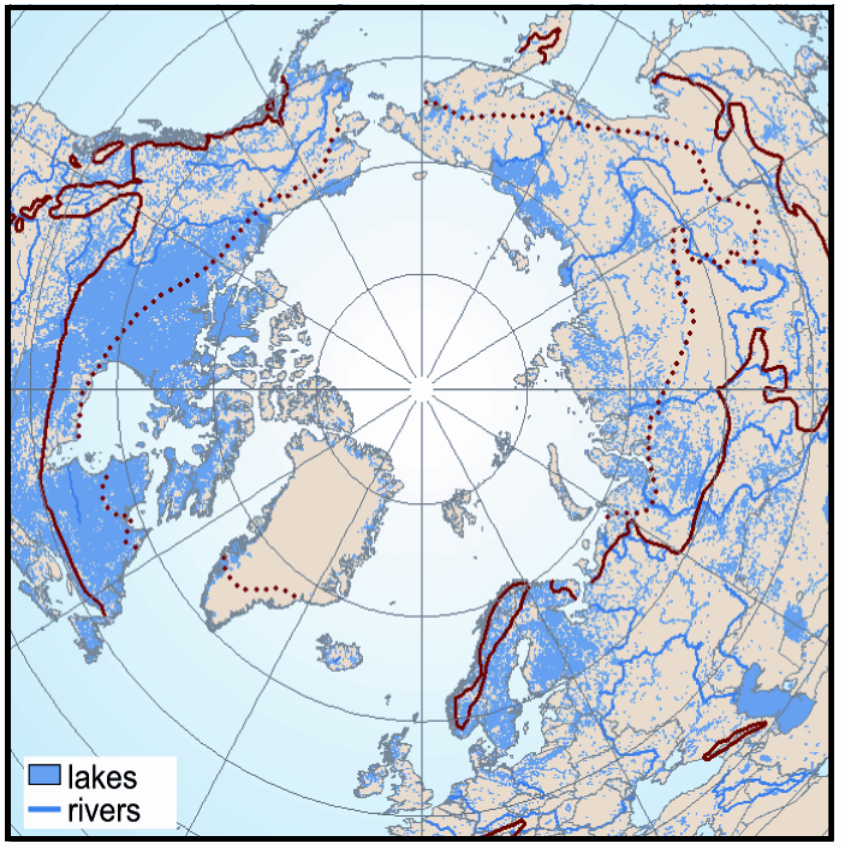
Ponds = water bodies with surface area smaller than 100x100 m

Ponds emit 40% of landscape–scale CO_2 emissions in Siberian polygonal tundra in the Lena Delta.
(Abnizova et al., GBC 2012)

During freezing ponds produce as much CH_4 per square meter as the average tundra landscape during summer
(Langer et al., RSE, 2014)

Limits of Global Inventories

- Ponds and small lakes are not mapped on the pan-arctic scale
- Global lakes and wetland database (GLWD) maps lakes larger 0.1 km² (100*1000 m)
- MODIS water mask has a resolution of 250 m -> yields confident lake areas larger 0.25 km² (500 x 500 m)



Source: Lehner & Döll, 2004

Scientific questions

1. How many ponds and small lakes are there?
2. How can we scale high-resolution but local water body maps to the global scale?

Sites

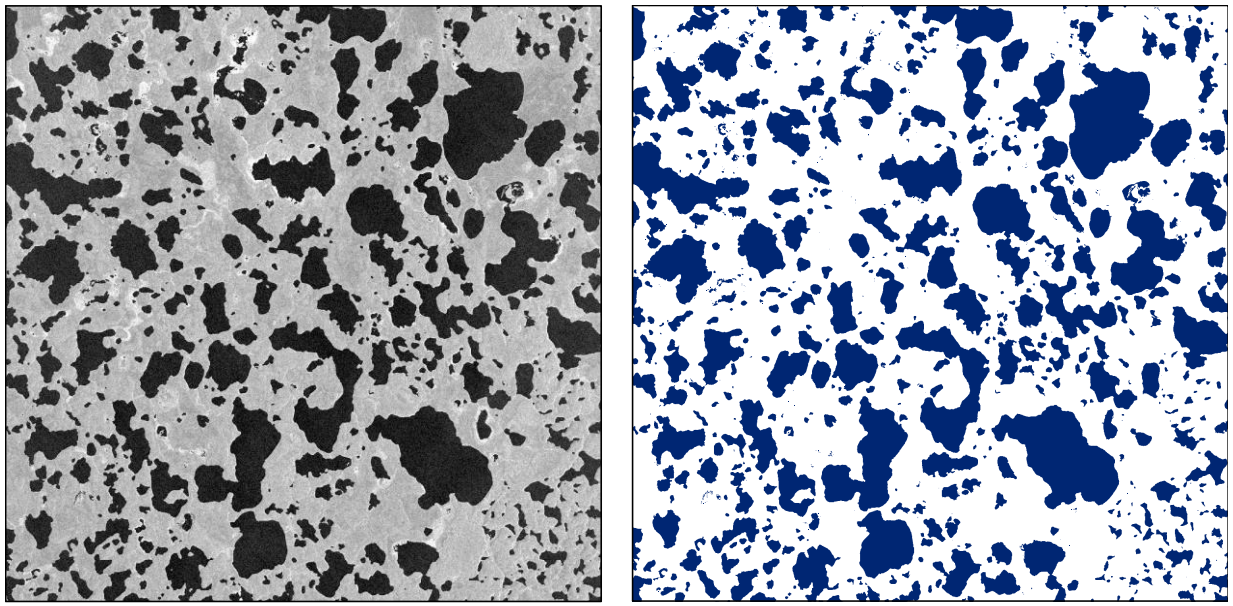
Permafrost

- continuous (90-100%)
- discontinuous (50-90%)
- isolated patches 0-10%)
- sporadic (10-50%)

(after Brown et al. 1997)

High-resolution mapping

- Kompsat-2, TerraSAR-X, Geoeye, aerial photos
- 0.3 m to 4 m resolution
- 2 km² to 500 km² coverage

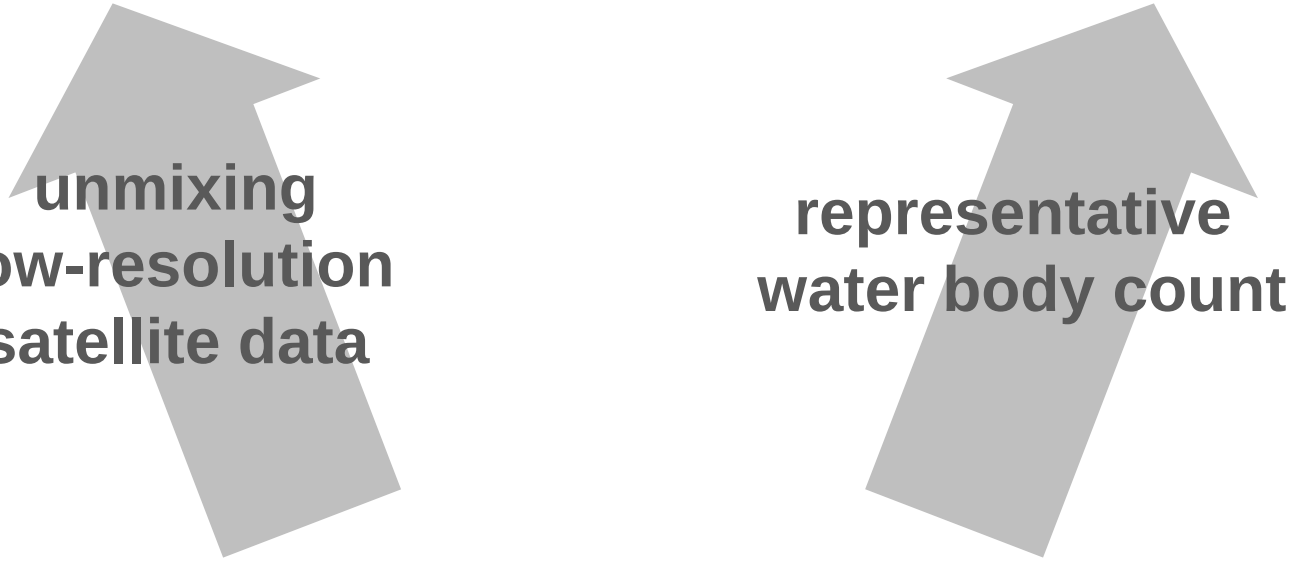


5 km

Upscaling scheme

regional fraction of water surface

regional size distributions

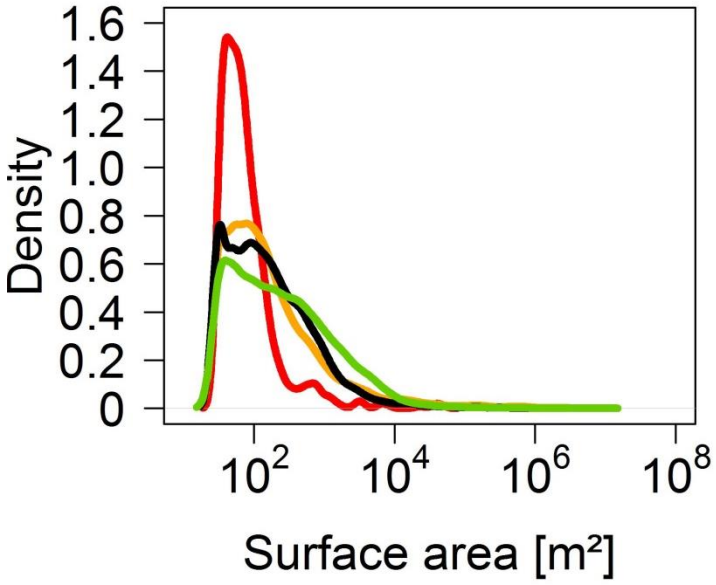


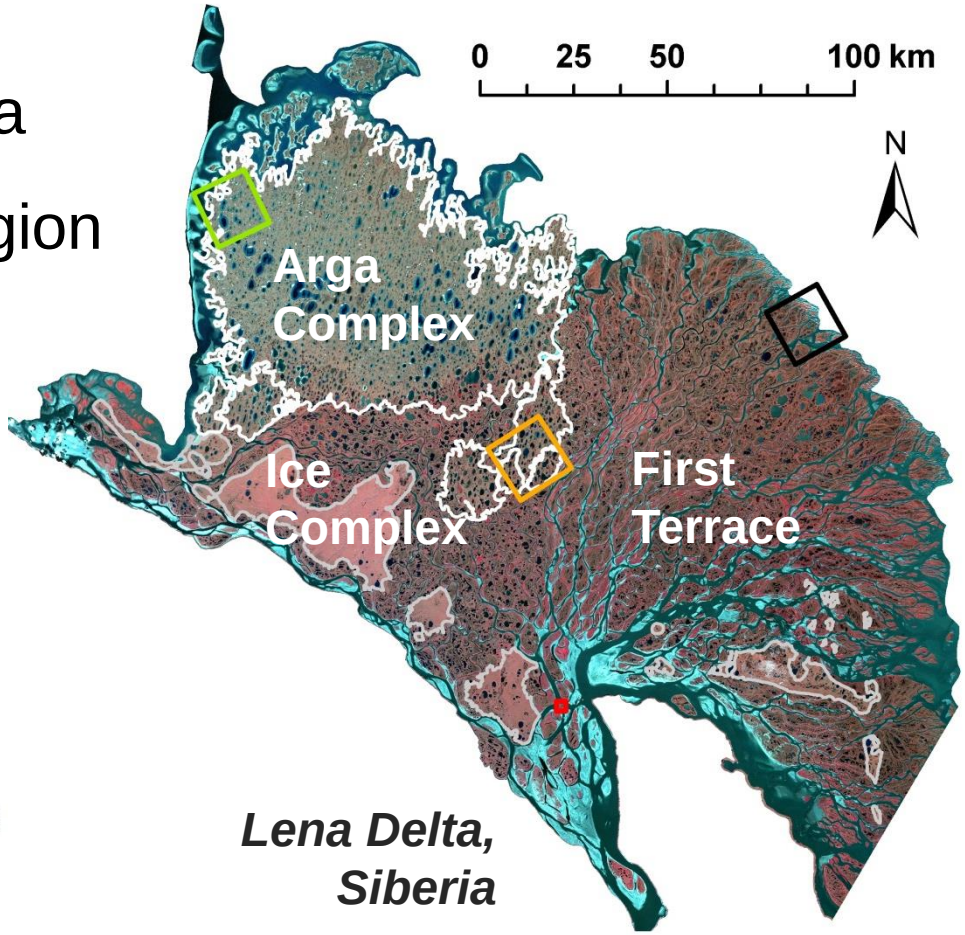
High-resolution maps

Representative water body count

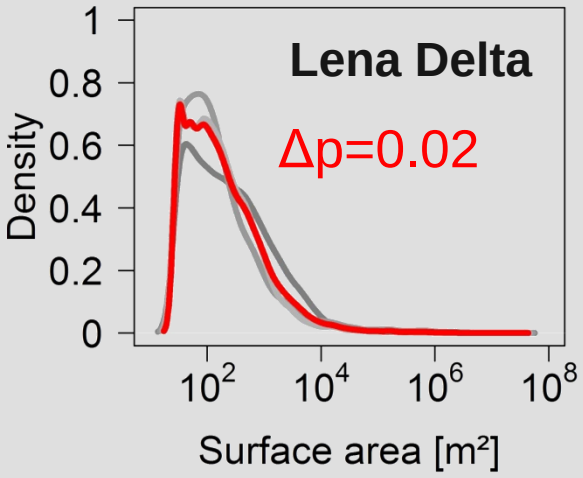
(1) Minimum sampling area

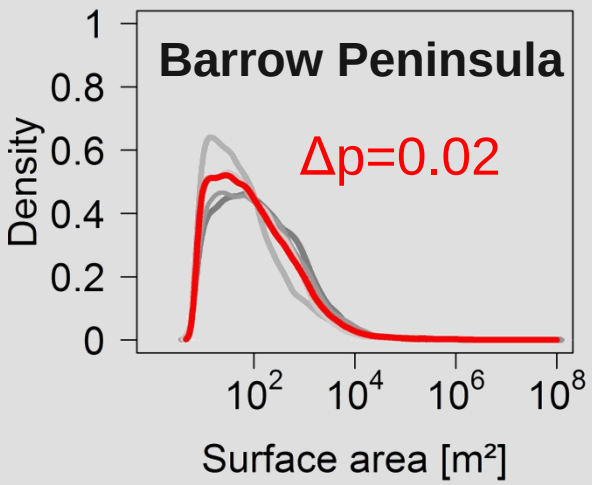
(2) Variability within the region



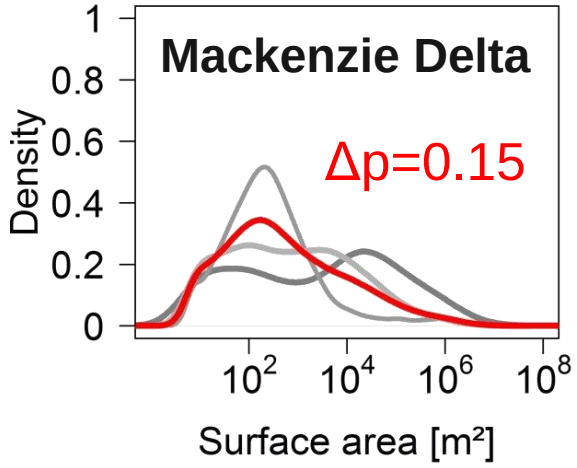


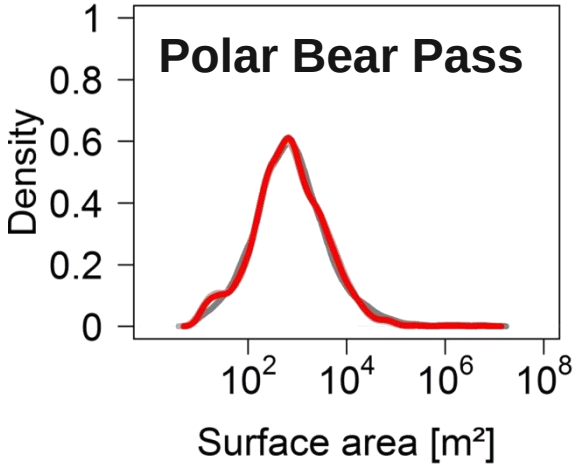
Regional probability density functions



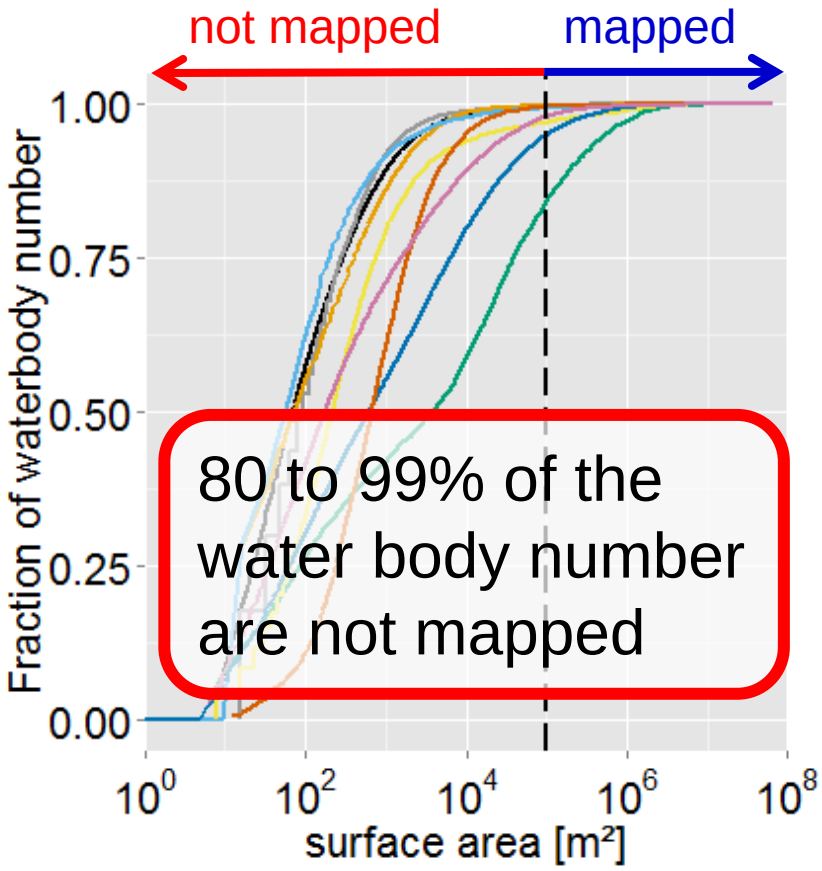


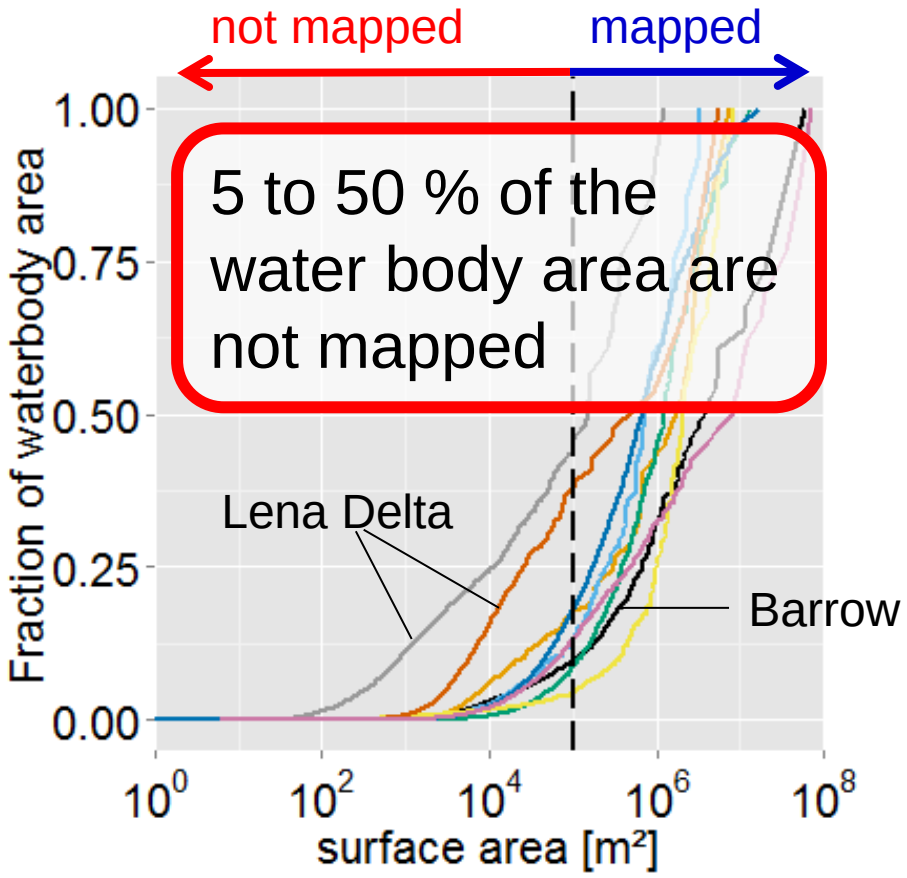
Similar conditions for lake ice formation and growth?



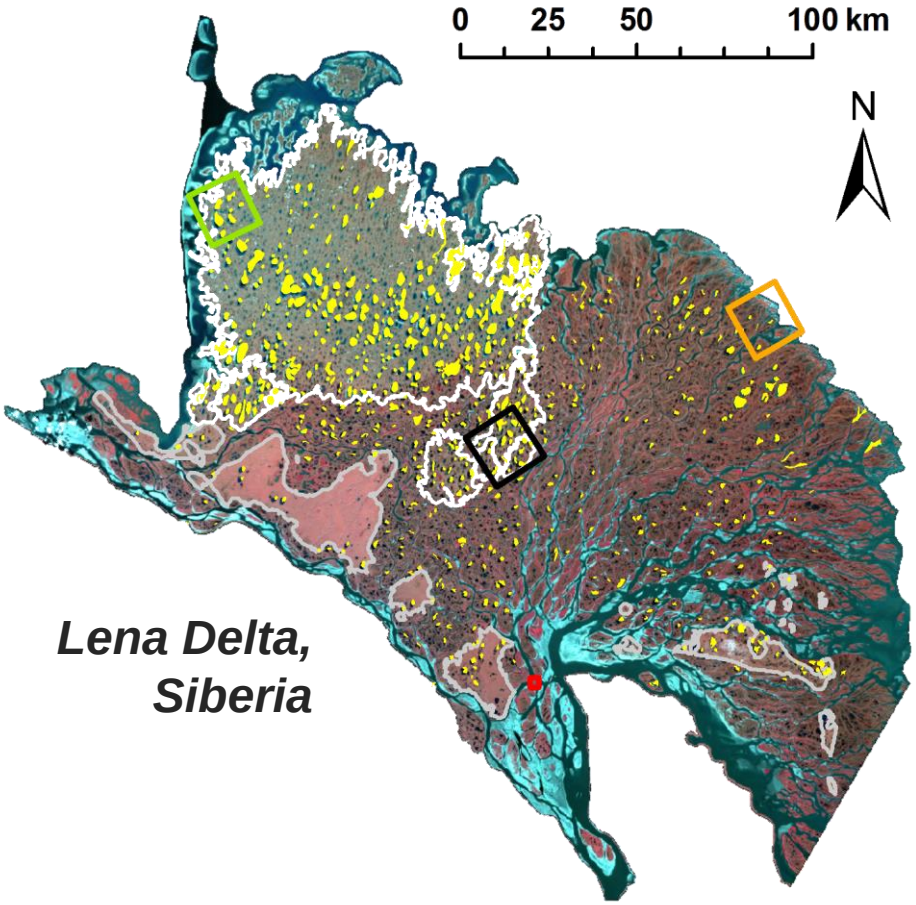


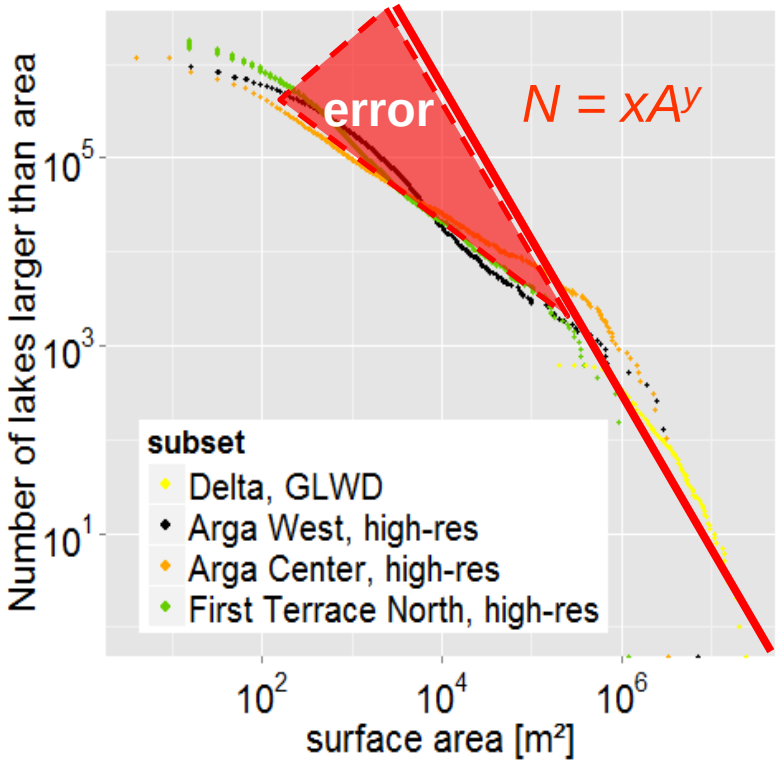
Inter-regional variability: number and area





Upscaling to Pan-Arctic Lake Distribution





Muster et al., RS, 2013

Conclusions

➔We need to zoom in before we can zoom out.

- Ensure that probability density functions are representative
- quantify regional variability to give a measure of uncertainty

➔Representative regional probability density functions can then be used to implement subgrid-scale information in coarse-scale grids.

Thank you!

Photos courtesy of:
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