Earth Observation and Geoinformation Science Lab
Institute of Geography and Geology

UNIVERSITÄT GREIFSWALD
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Remote sensing of peatland degradation – a review on gaps and hotspots of research across the northern hemisphere
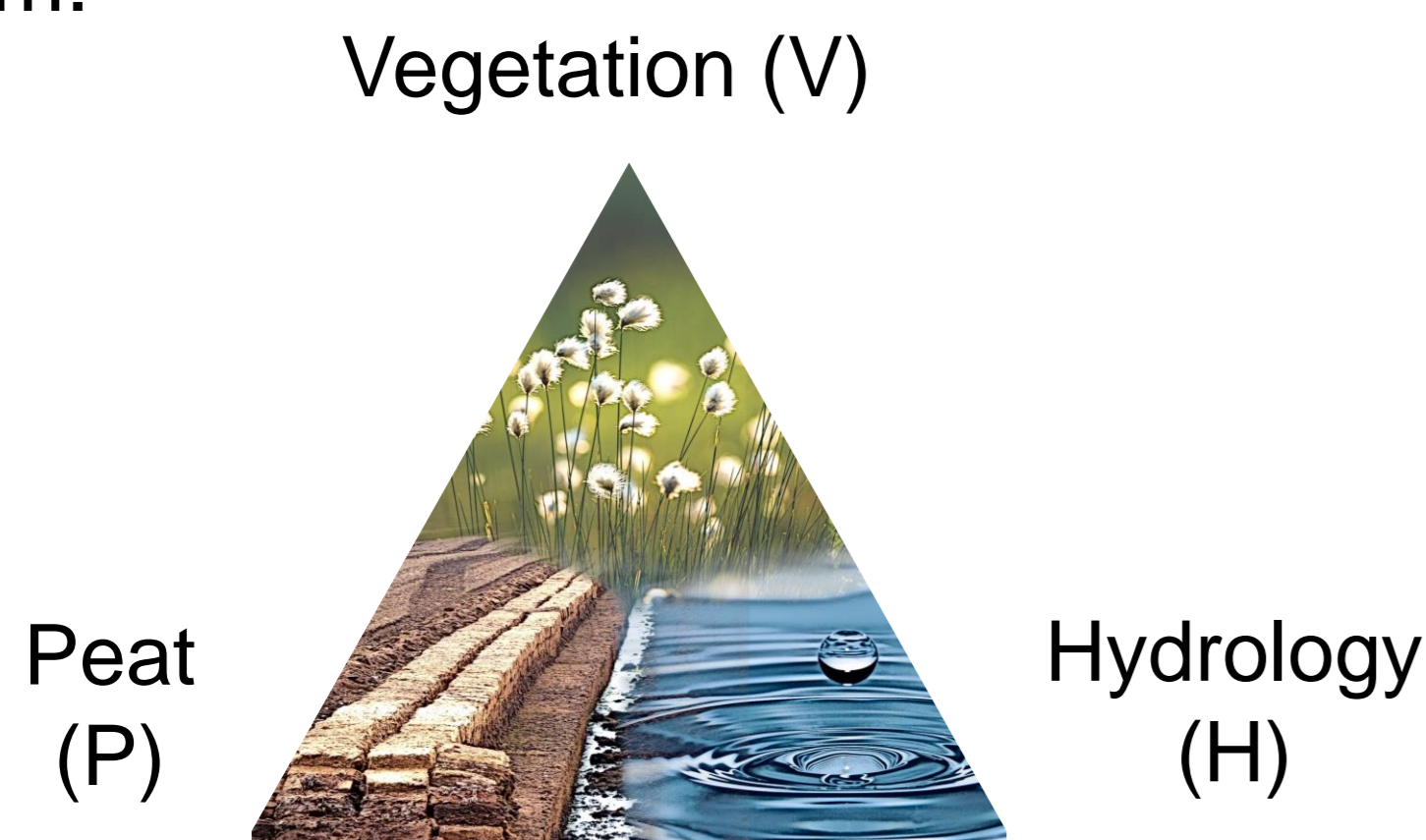
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OSPP Contest

Sharing is encouraged

Introduction

Peatlands are globally important ecosystems, storing carbon. They consist of a tripartite system:

Vegetation (V)

Peat (P)   Hydrology (H)

- Peatland use is mostly unsustainable,
- Disrupts the balance between peat, water, and vegetation,
- 500,000 km² of degraded peatland currently cause 5% of GHG emissions.

Approach

We reviewed 115 papers (1981 – 2022) from the Web of Science to assess Remote Sensing application for peatland degradation research.

Hydrology
Vegetation
Peat body
= PHV codes
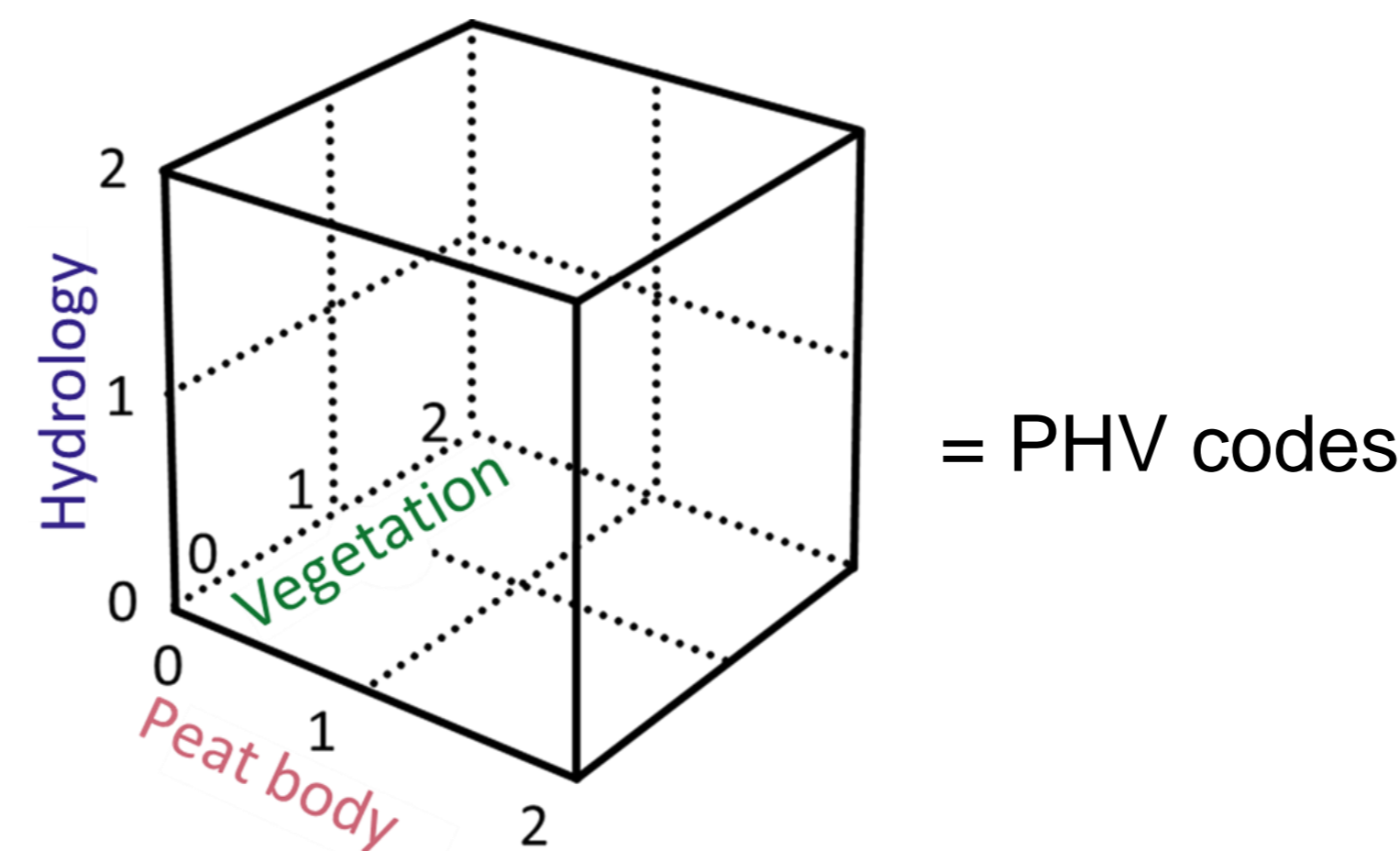
Ranking of each paper's degradation analysis on 3 axes (adapted after Connolly & Holden 2013) with values:
- '0' (dimension not assessed),
- '1' (dimension partly assessed),
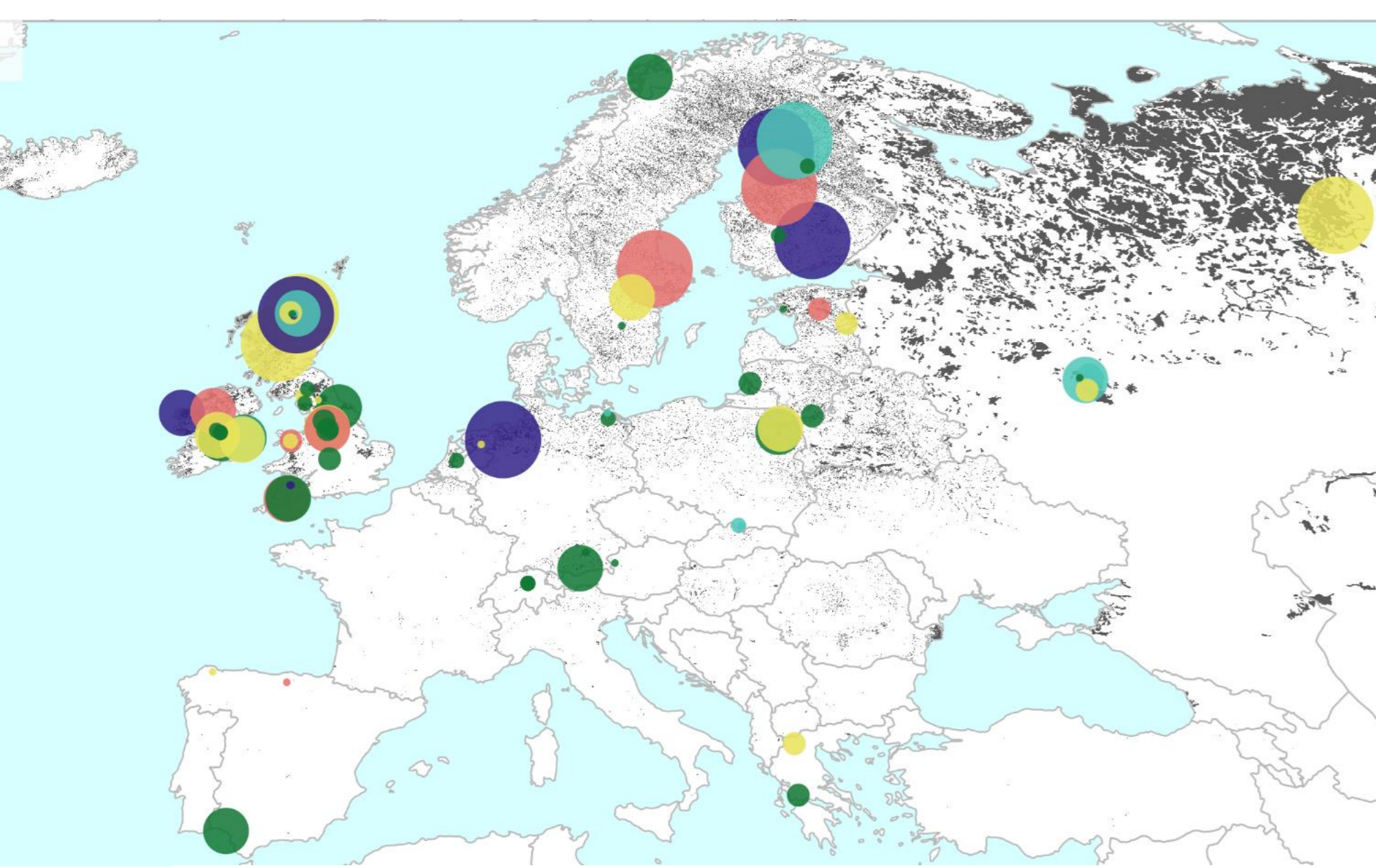- '2' (dimension profoundly assessed).

PHV analysis resulted in 26 codes within five research groups around the 3 dimensions:

2-dimensional focus — 21
3-dimensional focus — 12
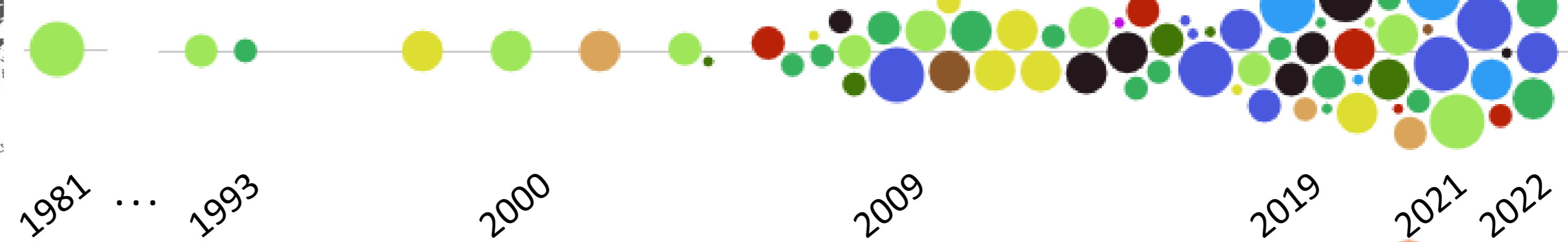P-focus — 10
H-focus — 10
V-focus — 62
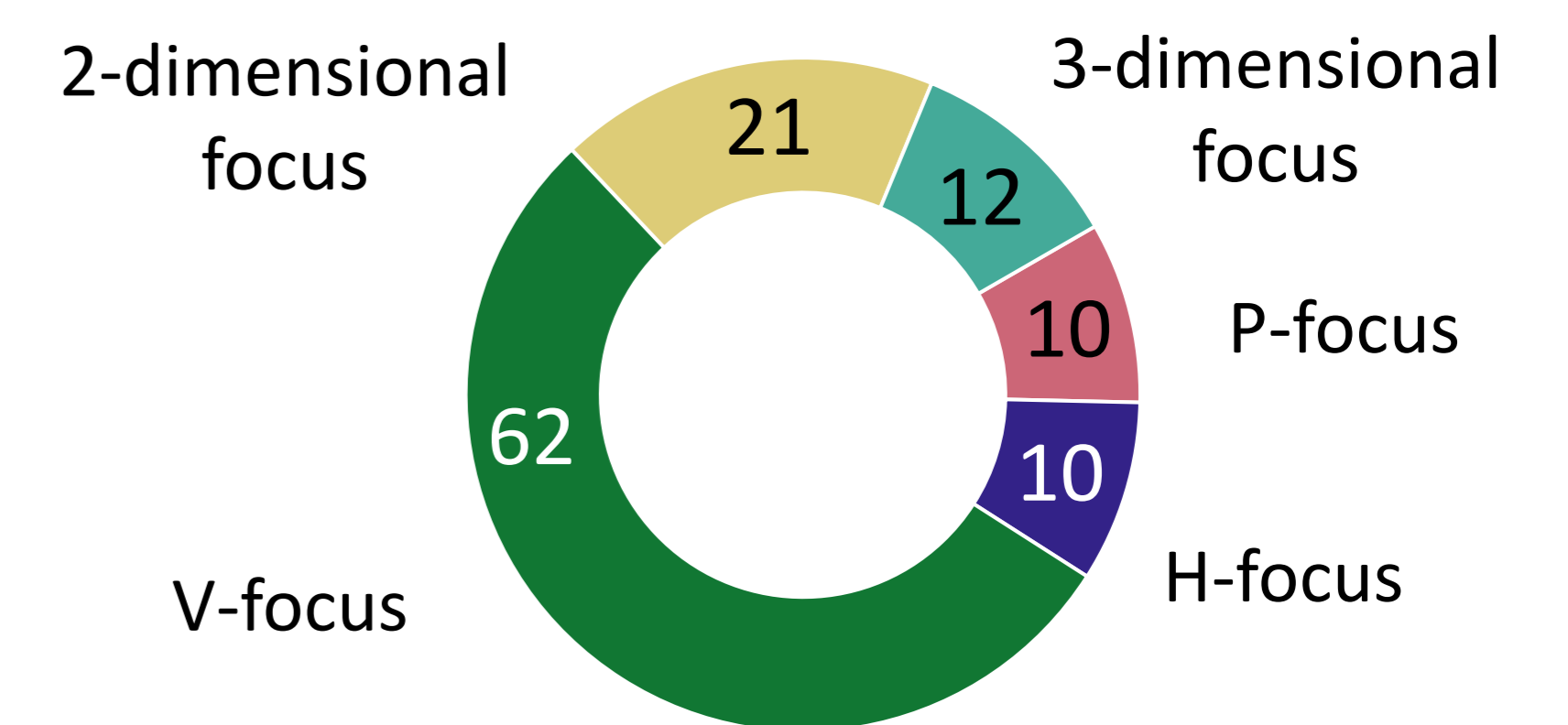
Meta-analysis per paper on:
- location and details of their study area,
- general research topic (RT),
- used remote sensing (RS) imagery and methods,
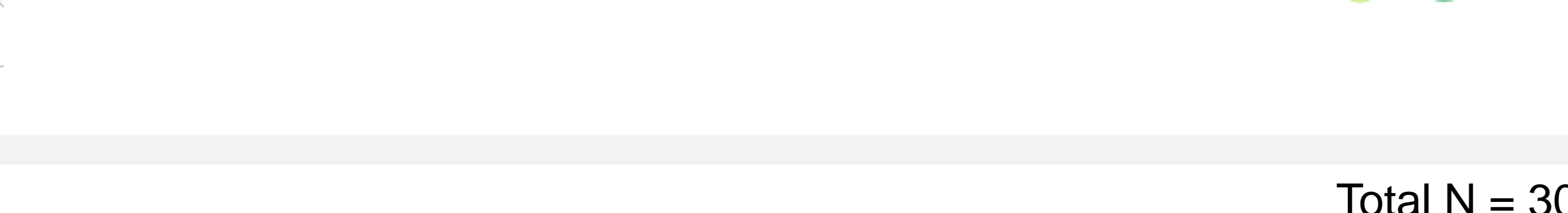- In temperate or boreal zone.
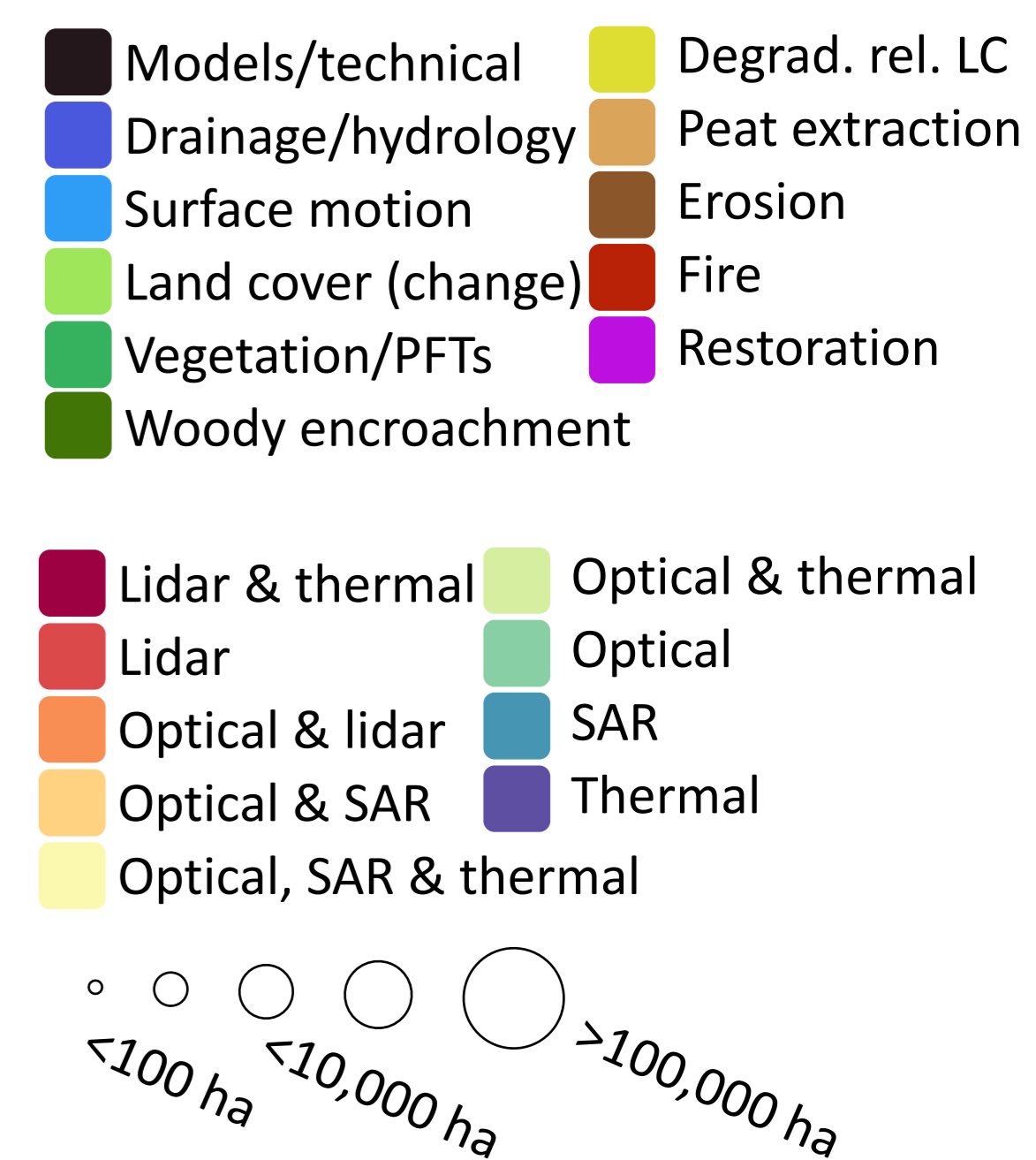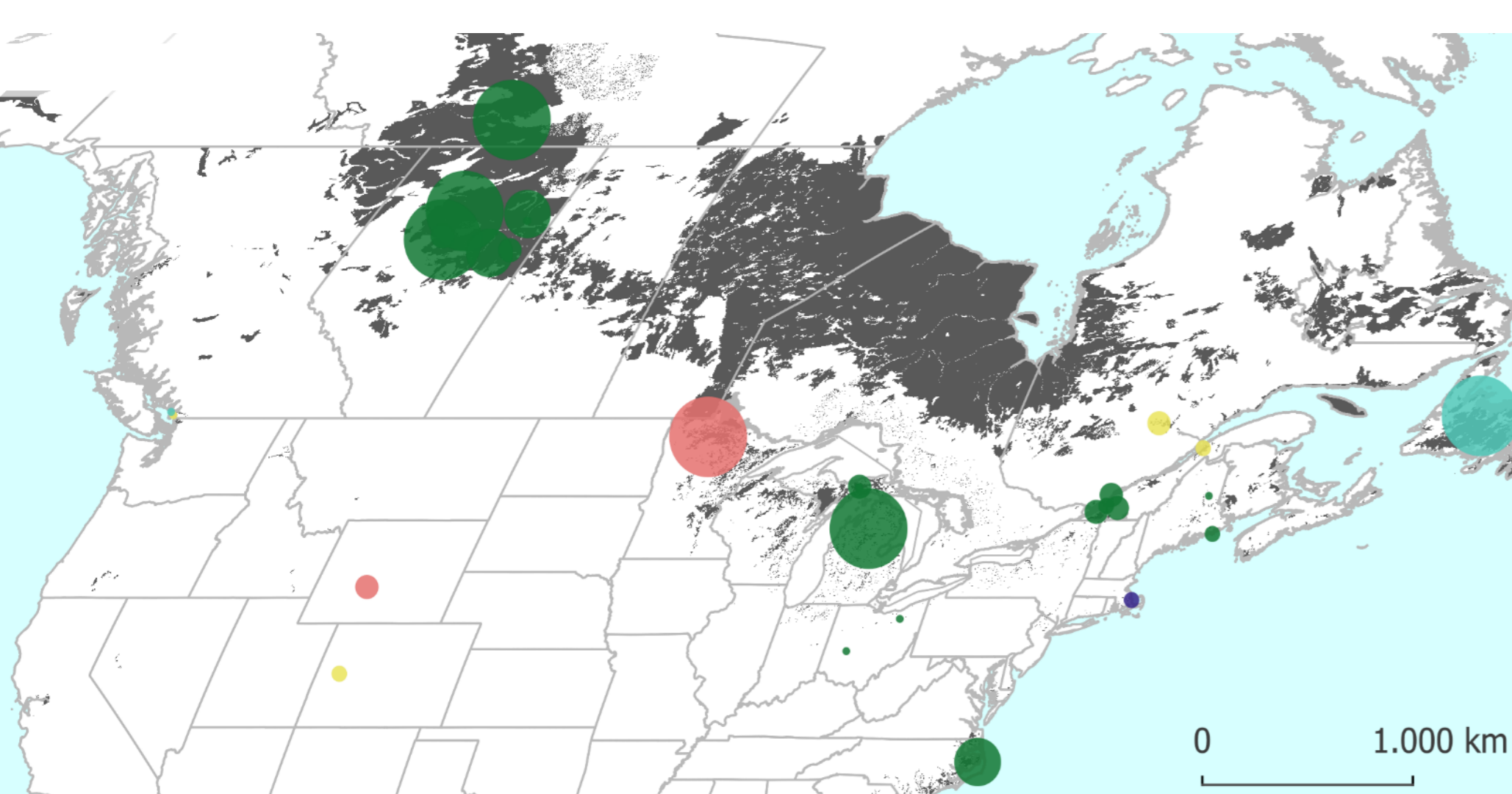
Results for Europe

Total N = 76

Research Topics

1981 … 1993   2000   2009   2019 2021 2022

Remote Sensing

Legend

- Models/technical
- Drainage/hydrology
- Surface motion
- Land cover (change)
- Vegetation/PFTs
- Woody encroachment
- Degrad. rel. LC
- Peat extraction
- Erosion
- Fire
- Restoration

- Lidar & thermal
- Lidar
- Optical & lidar
- Optical & SAR
- Optical, SAR & thermal
- Optical & thermal
- Optical
- SAR
- Thermal

<100 ha   <10,000 ha   >100,000 ha

Results for Northern America

Total N = 30

Research Topics

1991   2003   2008   2016   2021 2022

Remote Sensing

Results for Asia

Total N = 9

PHV cluster
- P – peat focus
- H – hydrology focus
- V – vegetation focus
- 2-dimensional focus
- 3-dimensional focus

Size class
- <100 ha
- <1,000 ha
- <10,000 ha
- <100,000 ha
- >100,000 ha

- Global Peatland Map
- Countries/States
- Water

Research Topics

2002   2009   2013   2017   2022

Remote Sensing

0   1.000 km
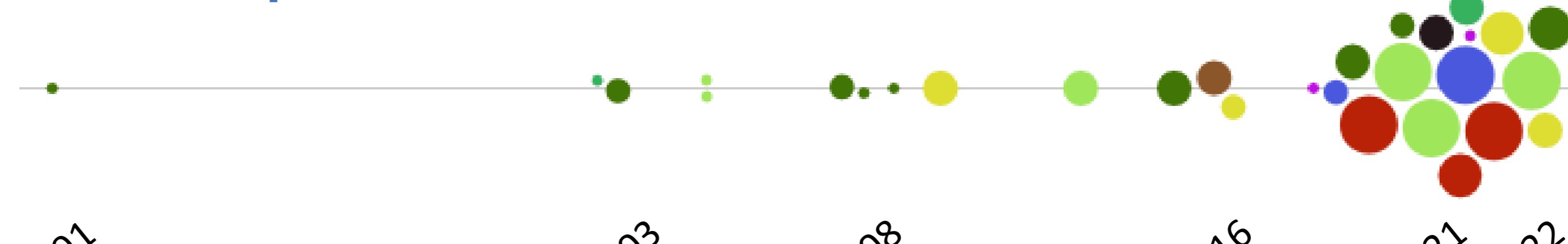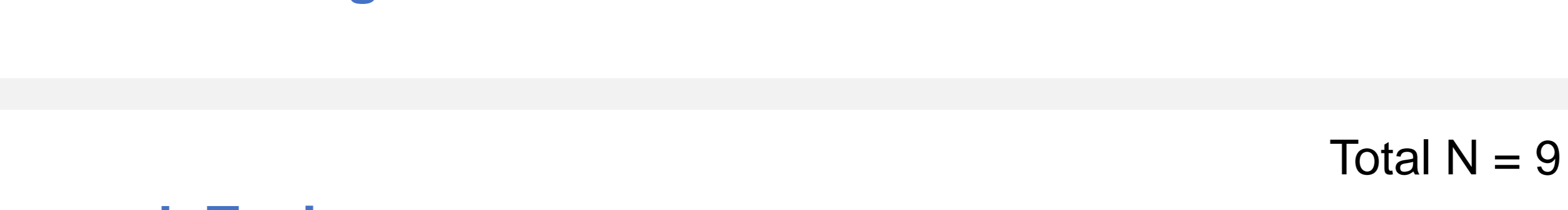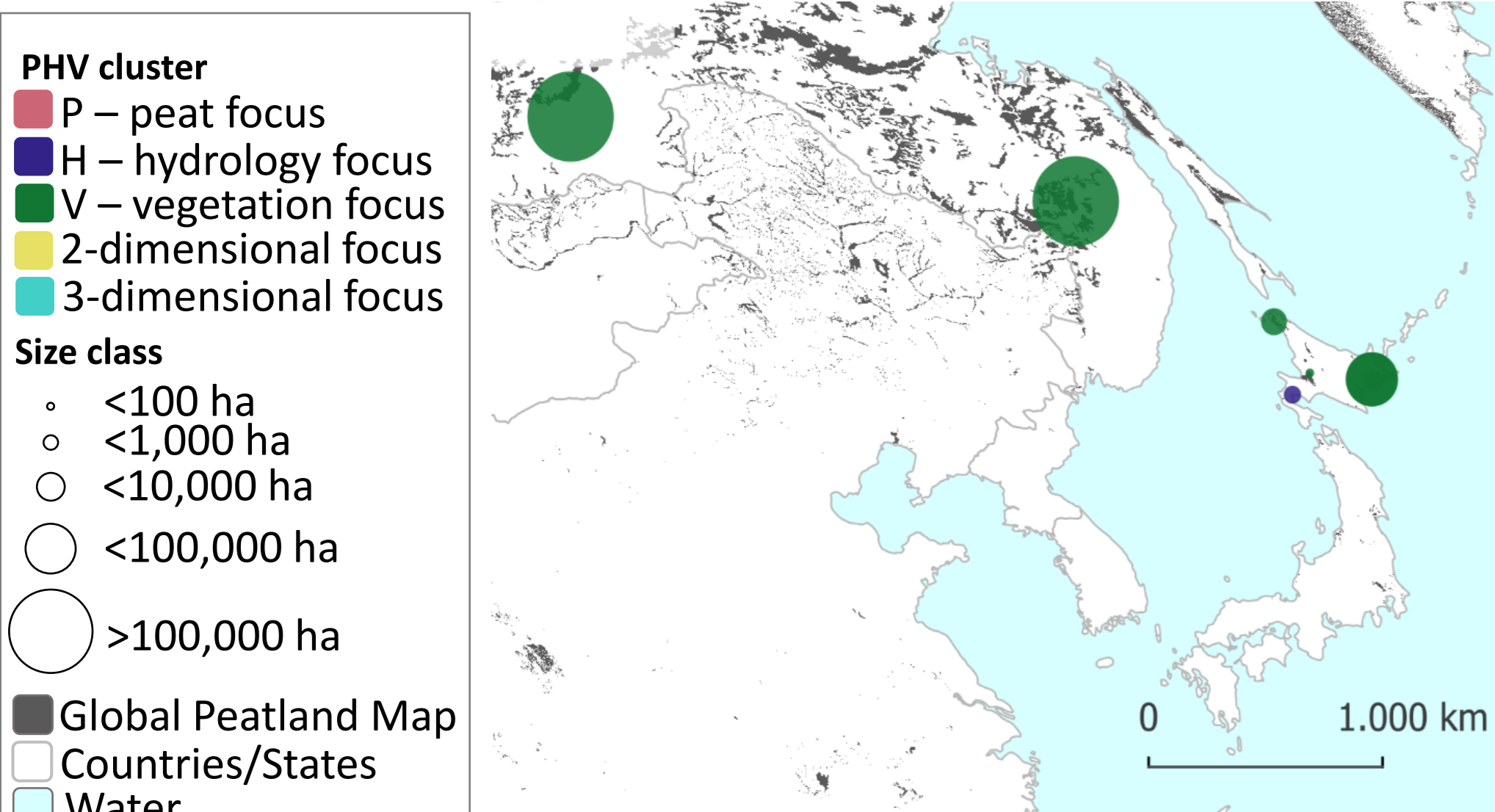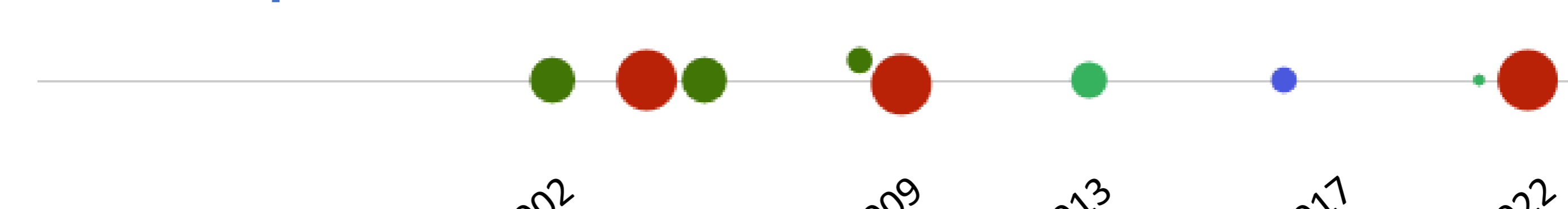
- ➢ Optical aerial imagery and satellite data exclusively used until 2004 across the Northern Hemisphere
- ➢ Research topics are diverse in Europe. Optical RS data dominates, followed by Optical + Lidar combinations and singular SAR approaches.
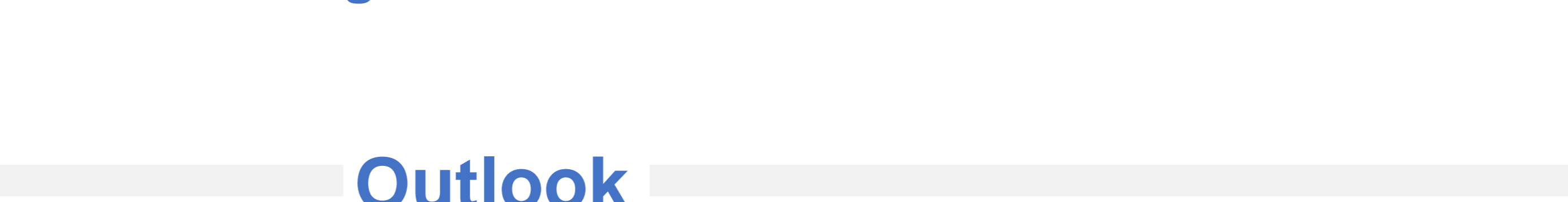- ➢ Peatland degradation research in Canada and the US only recently received increased attention and focused on vegetation using optical or lidar data.
- ➢ Research in Asia solely stems from Japan and eastern Russia and is mostly focused on woody encroachment and fire.

Outlook

- ➢ Locations of study areas don't always represent peatland distribution or degradation hotspots.
- ➢ PHV groups geographically unevenly distributed.
- ➢ Temperate and boreal Asia strongly underrepresented

- ➢ 3-dimensional research that analyzes P, H, and V simultaneously is very rare, but could enhance the value of analyses for degradation assessments and restoration strategies.

- ➢ 3D assessments of small areas are always performed using optical data combined with a second RS imagery type.
- ➢ Peatland degradation research using RS needs more attention and focus on underrepresented dimensions.