



# CASCADe

## The Circum-Arctic Sediment Carbon Database: Open for Studies of Biogeochemistry-Climate Couplings



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### Rationale and Introduction

One of the grand challenges in climate change science is the large-scale dynamics and near-future trajectory of carbon and methane remobilization and fate from the massive pools held in land and subsea permafrost, hydrates and other compartments in the Arctic.

Studies of e.g. terrestrial organic carbon (terrOC) release across the Arctic are challenged by the scale enormity, landscape heterogeneity and territorial inaccessibility.

To facilitate climate-relevant large-scale biogeochemistry research in the Arctic, CASCADe (<https://cascade.aces.su.se/>) was established as a publicly-accessible database through an extensive community collaboration (Martens et al., 2021).

### Database structure, mgmt and use

The CASCADe is a multidimensional database for the Arctic Ocean with a primary/original focus on organic matter descriptors (e.g., OC, C/N,  $\delta^{13}\text{C}$ ,  $\Delta^{14}\text{C}$ , molecular markers/biomarkers), fortified with other sediment physical and geochemical properties, all held within a fully georeferenced context. To facilitate quality assurance for users, the database also records metadata (e.g., sampling techniques, sample storage and analytical methods) and lists the applied QA/censoring criteria for data inclusion in the CASCADe.

- **surface sediments** representing annual to decadal time scale;
- **shallow sediment** cores of centennial time scale (e.g., multicores);
- **deeper soft sediments of millennial scale** (piston and heavy gravity cores); and
- **orbital time scale** (drillcores in subsea permafrost).

For surface sediments, it now holds data from **nearly 6000 stations** for OC, about **2000  $\delta^{13}\text{C}$**  and **400  $\Delta^{14}\text{C}$**  from **across all seven shelf seas** and the interior basins (see Fig.).

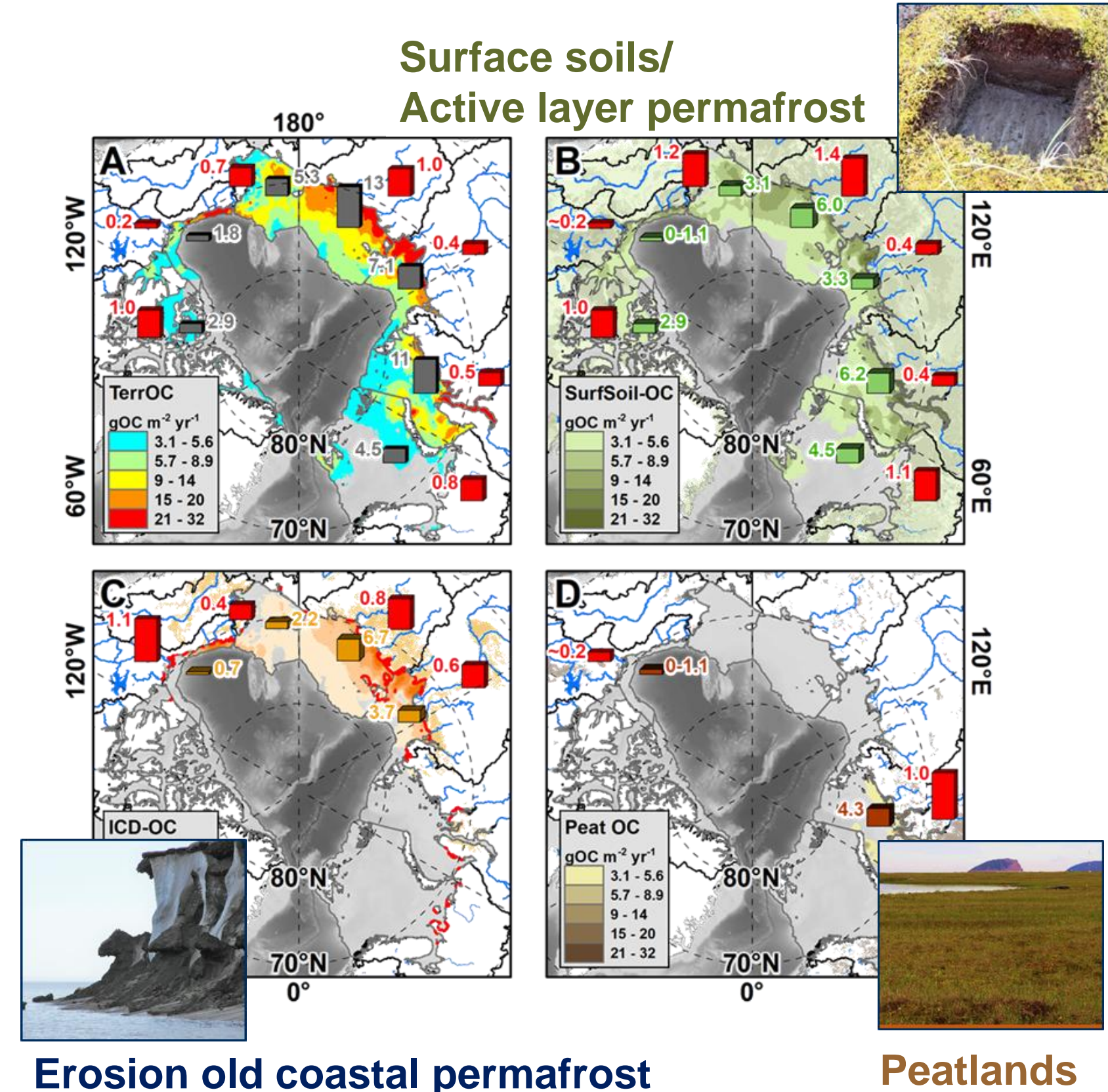
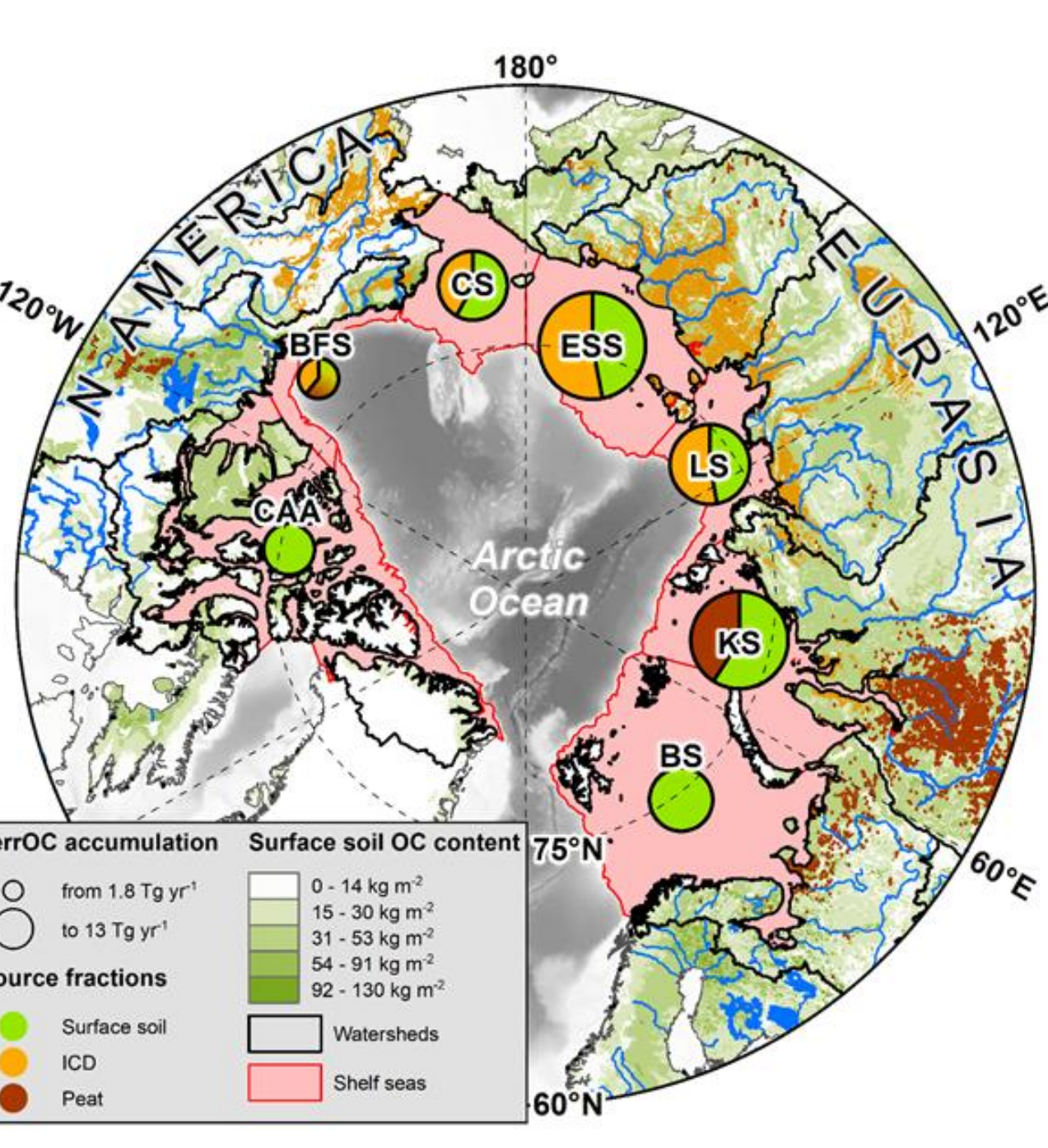
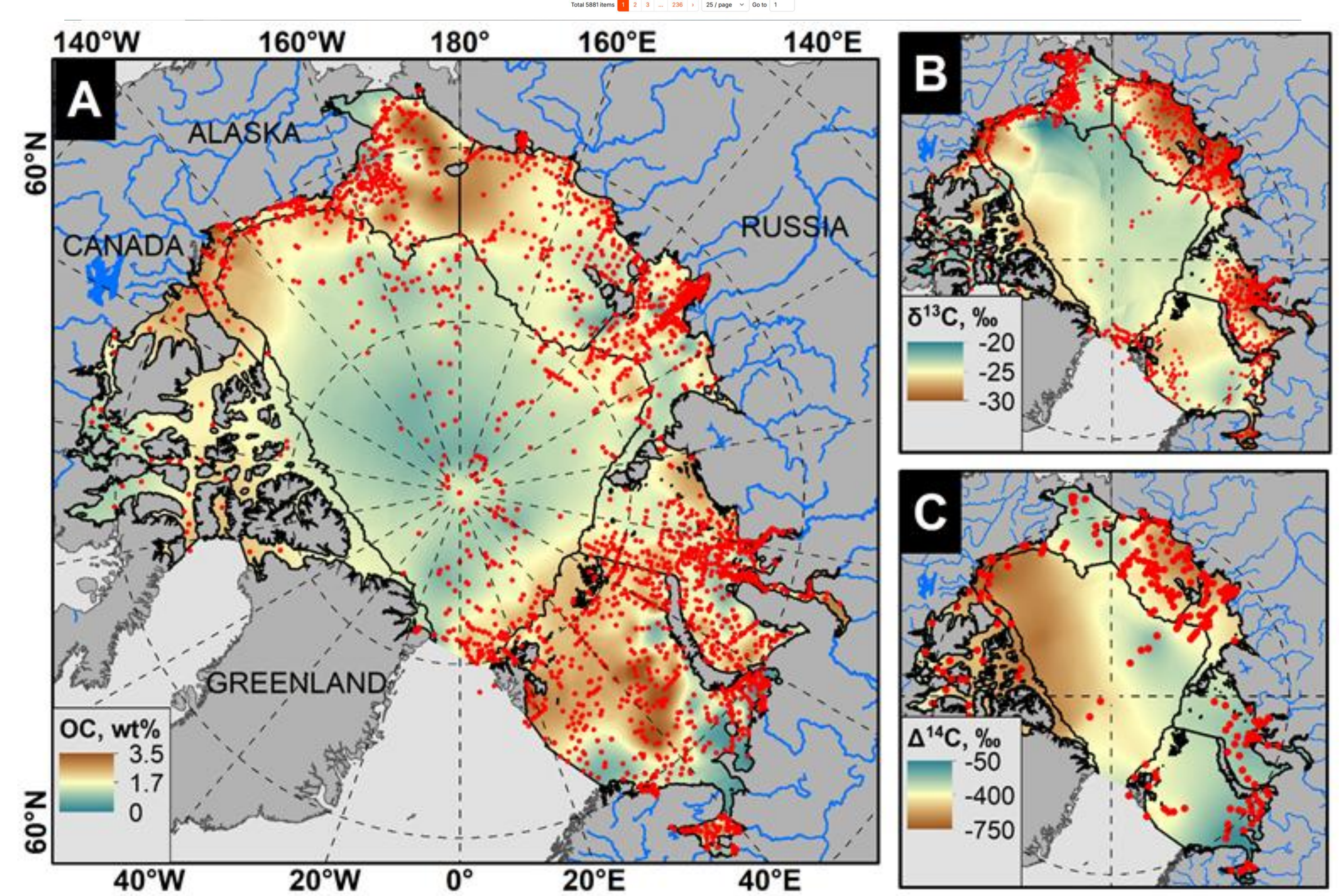
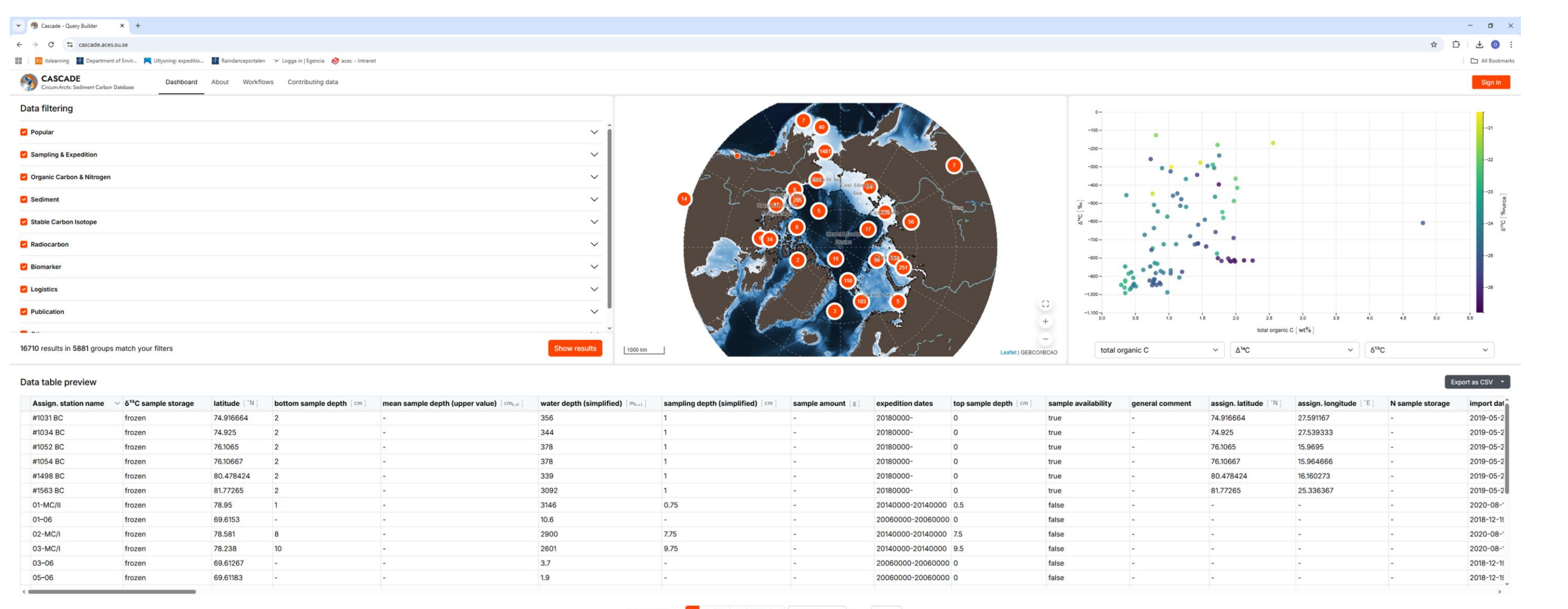
The CASCADe is now in a PostgreSQL database system to facilitate both management/development and for open interactive access and data download (see top Figure/QR and test on laptop or phone <https://cascade.aces.su.se>). The CASCADe database is curated by a part-time database manager at Stockholm Univ.

Our SU sediment archives are extensive for especially the Sib-Arctic shelf seas. If you are interested to obtain some subsamples and explore collaboration – contact us!

### Initial findings from CASCADe

- **Strong geospatial gradients of OC- $\delta^{13}\text{C}$ - $\Delta^{14}\text{C}$  around the Circum-Arctic** (Martens et al., 2021)
- **Circum-Arctic release of terrestrial carbon** (Martens et al., 2022):
  - varies between regions: **80% from the Eurasian Arctic!**
  - varies in C-source: **Old vs “younger” permafrost vs peat**
  - varies in Integrated C Remobilization Index: **I-CRI**
- **CASCADe-Methane**: Circum-Arctic patterns of  $\text{CH}_4$  hotspots

### Web view of CASCADe (explore via QR!)



### Ongoing and new directions (ideas welcome!)

#### CASCADe opens doors for a Circum-Arctic Perspective on many research Q:

- CASCADe – Biomarkers/terrestrial: biomarkers of sources and degradation status adds to initial CASCADe-“isotoposcapes” (of  $^{13}\text{C}$ + $^{14}\text{C}$ ), shown above (+ figures to the right)
- CASCADe-Methane: Where are the methane hotspots (and sources - add isotopes)?
- CASCADe – Biomarkers/methanotrophy: “molecular fossils” of methane activity, geospatially and temporally (e.g., how long have high seawater- $\text{CH}_4$  existed?) (*Albin Eriksson et al*)
- CASCADe-Mercury: Transport vectors, exposure maps (*ms in review*)
- CASCADe-Contaminants: Legacy and emerging organic contaminants, Arctic exposures
- CASCADe-Paleo: Historical remobilization of carbon/GHG at times of rapid warming (*in prep*)
- CASCADe-BC: Patterns of Arctic fires and release of albedo/climate-relevant Black Carbon
- **CASCADe-X: \_\_\_\_\_ ?? your suggestion for application/dimension of CASCADe ??**



### Be a Cascader – get a hat!

Contribute to build CASCADe with your Arctic data on TOC,  $\delta^{13}\text{C}$ -OC,  $\Delta^{14}\text{C}$ -OC and/or biomarkers!

<https://cascade.aces.su.se>  
[cascade@aces.su.se](mailto:cascade@aces.su.se)

### Funding

Some references:

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Vonk et al., 2012. Activation of old carbon by erosion of coastal and subsea permafrost in Arctic Siberia. *Nature* 489, 137–140. doi:10.1038/nature11392

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