Environmental controls on coloured dissolved organic matter (CDOM) in lakes of Yamal peninsula

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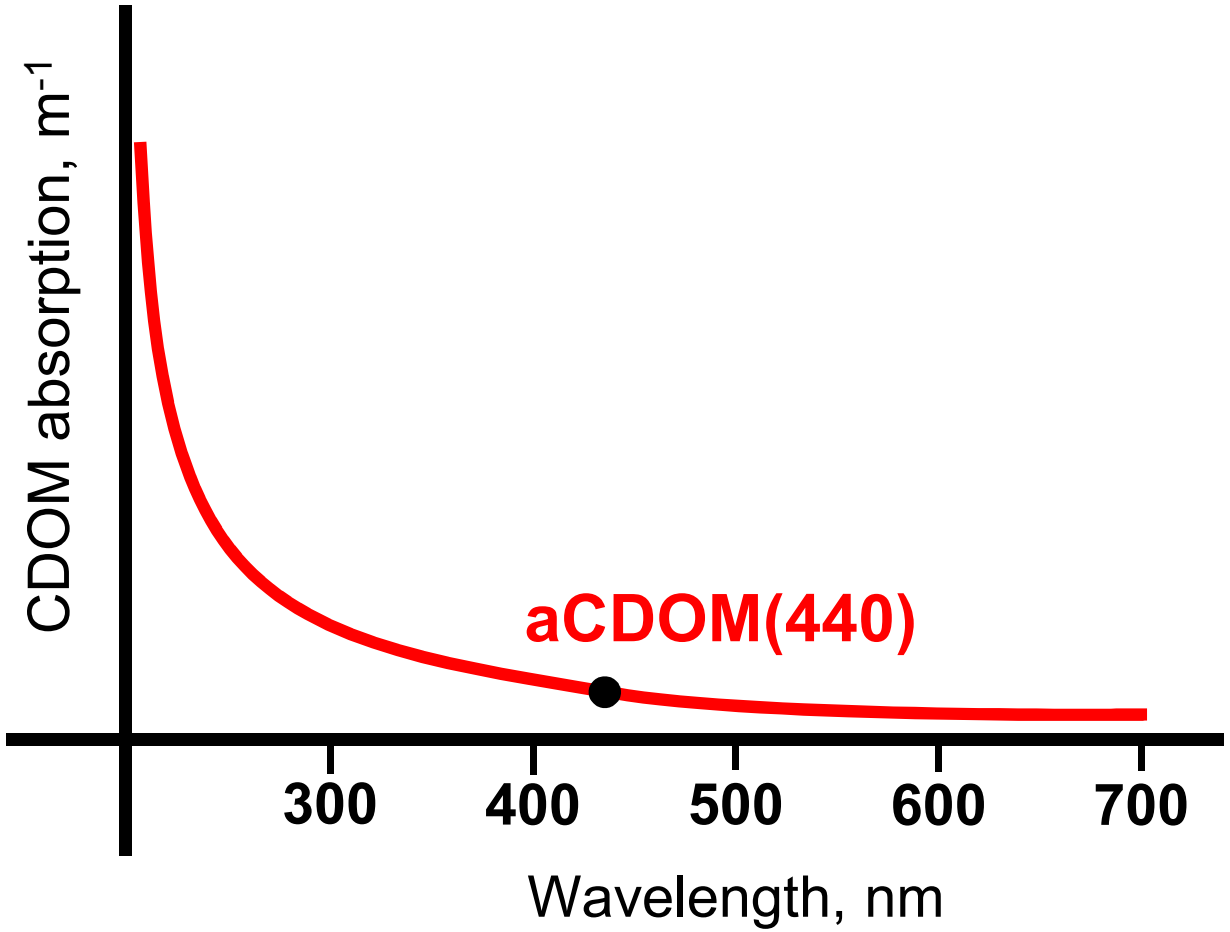
Motivation

- *CDOM is a optically measurable proxy of commonly used DOC (dissolved organic carbon)*
- *possibility to apply remote sensing based algorithms to assess CDOM in water objects*
- *understand the regional processes linked to i.e. permafrost thaw in polar regions*
- *Arctic lakes are important methane emitters, which should be considered in Earth System Models*

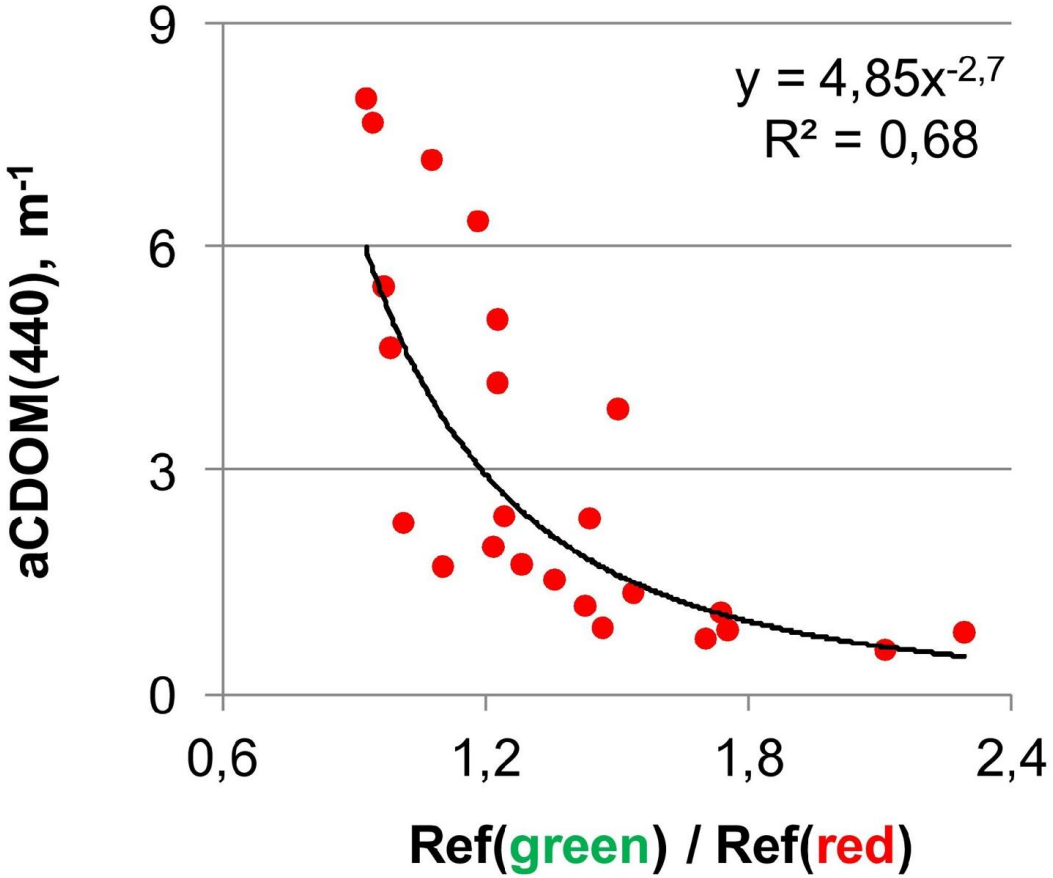
Key research questions

- *What is the CDOM range in Yamal lakes?*
- *Which environmental parameters do explain the difference in CDOM among lakes?*
- *How the cryogenic processes may influence the CDOM concentration of lakes?*

Coloured Dissolved Organic matter (CDOM)



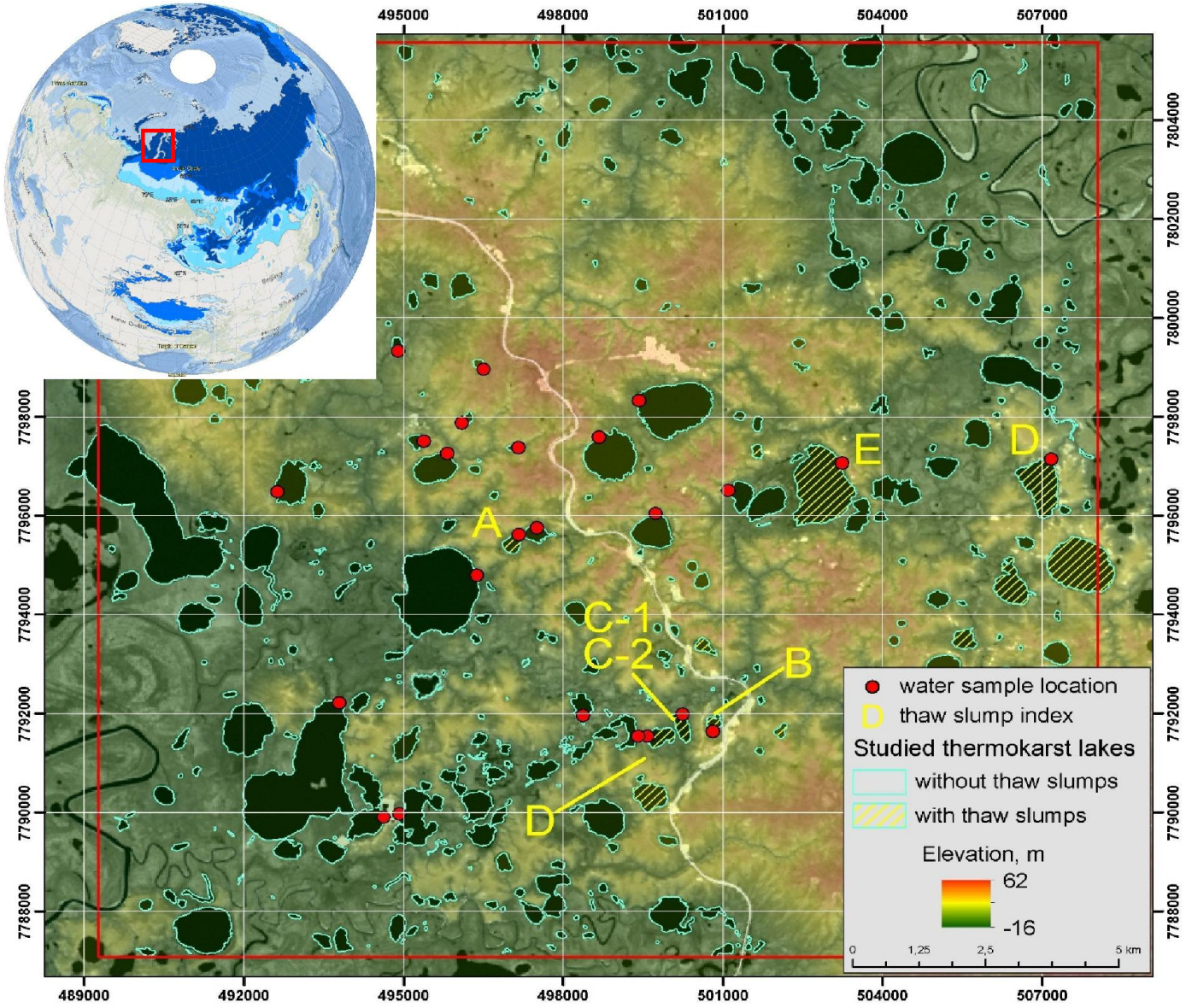
In-situ and remote sensing based CDOM

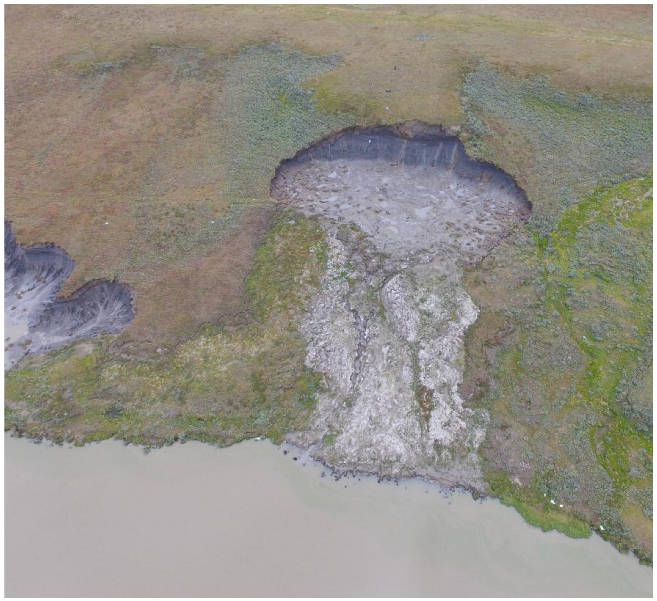


Ref(green) и Ref(red) – reflectance values of green and red bands of GeoEye-1 2013-07-05 (DGF©) satellite image

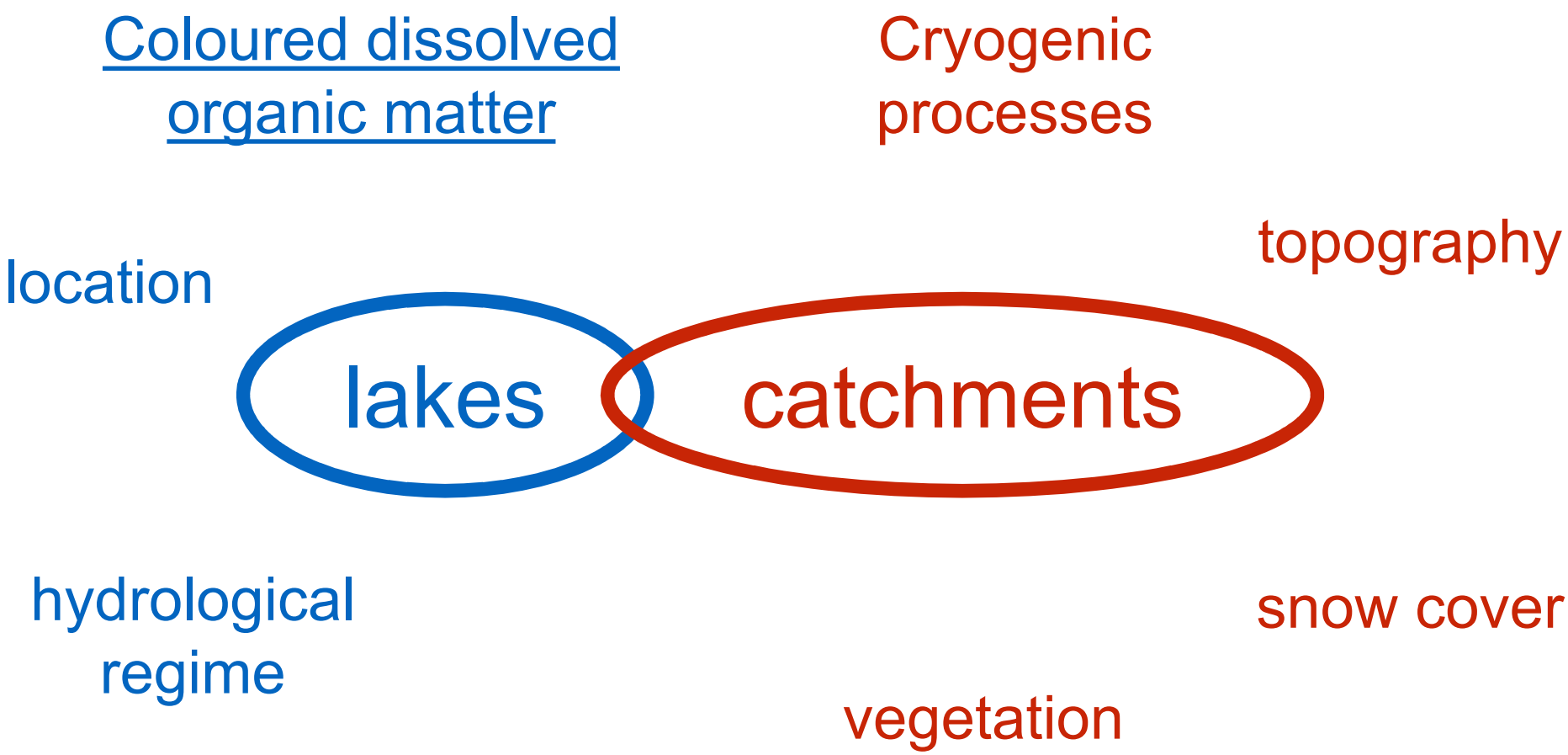
after Kutser et al., 2005

Key site: Central Yamal





Methods:


Coloured dissolved organic matter
Cryogenic processes
topography
location
lakes
catchments
hydrological regime
snow cover
vegetation

- Extraction of parameters

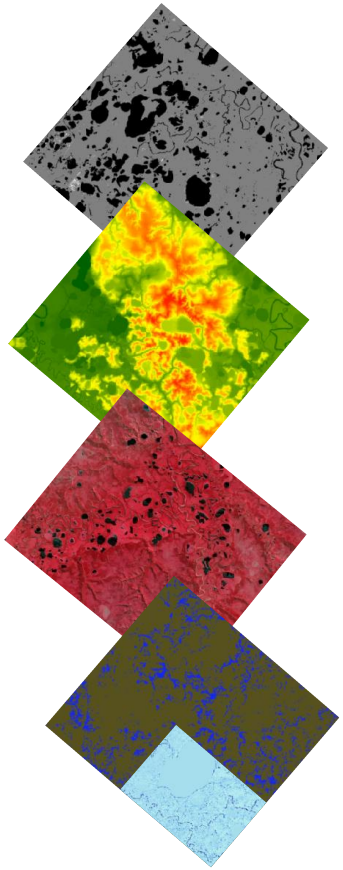
TerraSAR-X

TanDEM-X
IDEM

SPOT-5

ALOS Palsar

Snow map



Extraction of lake polygons

Catchment delineation,
topography analysis

Calculation of vegetation
indicies (NDVI, CHLa)

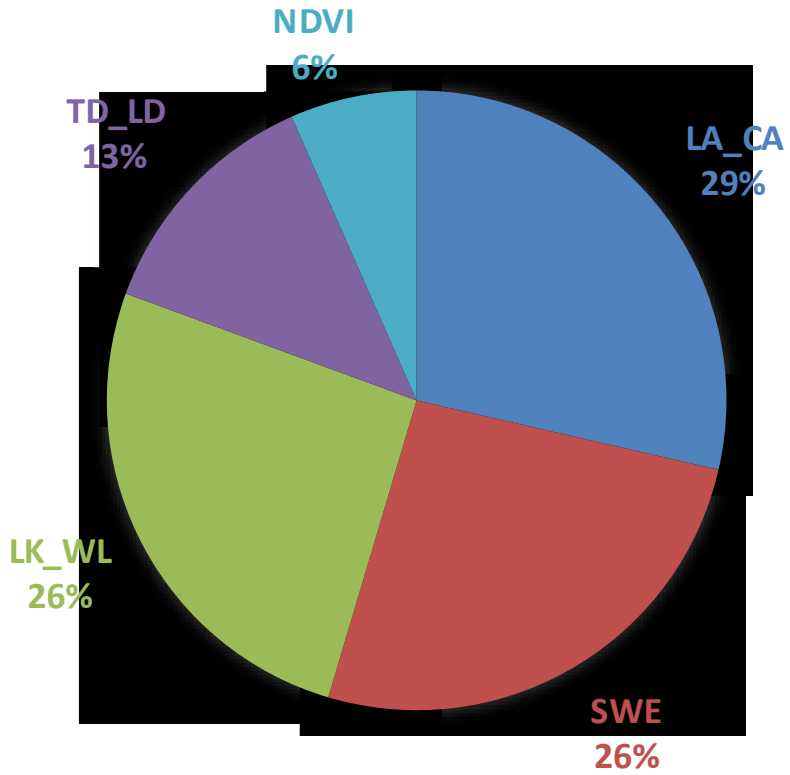
Shrub map

Snow storage for catchments

Statistical analysis of CDOM and lake & catchments parameters

Method – Boosted Regression Tree (BRT) (Elith et al. 2008)

N = 363 lakes and catchments



DA –catchment are / lake area ratio

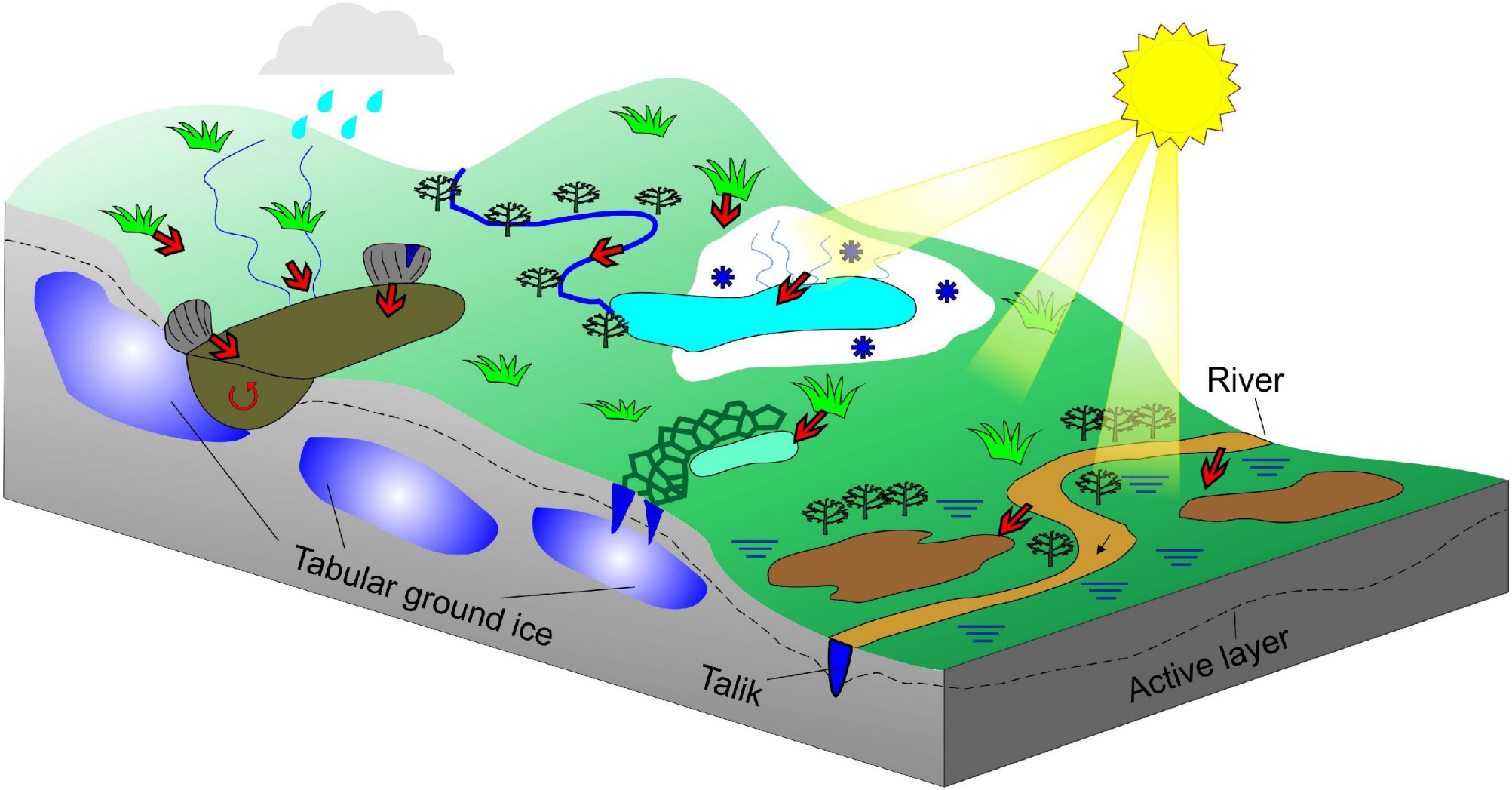
SWE – the assessed volume of snow water equivalent in catchments (Dvornikov et al. 2015)

LK_WL – absolute height of water level (m. a.s.l)

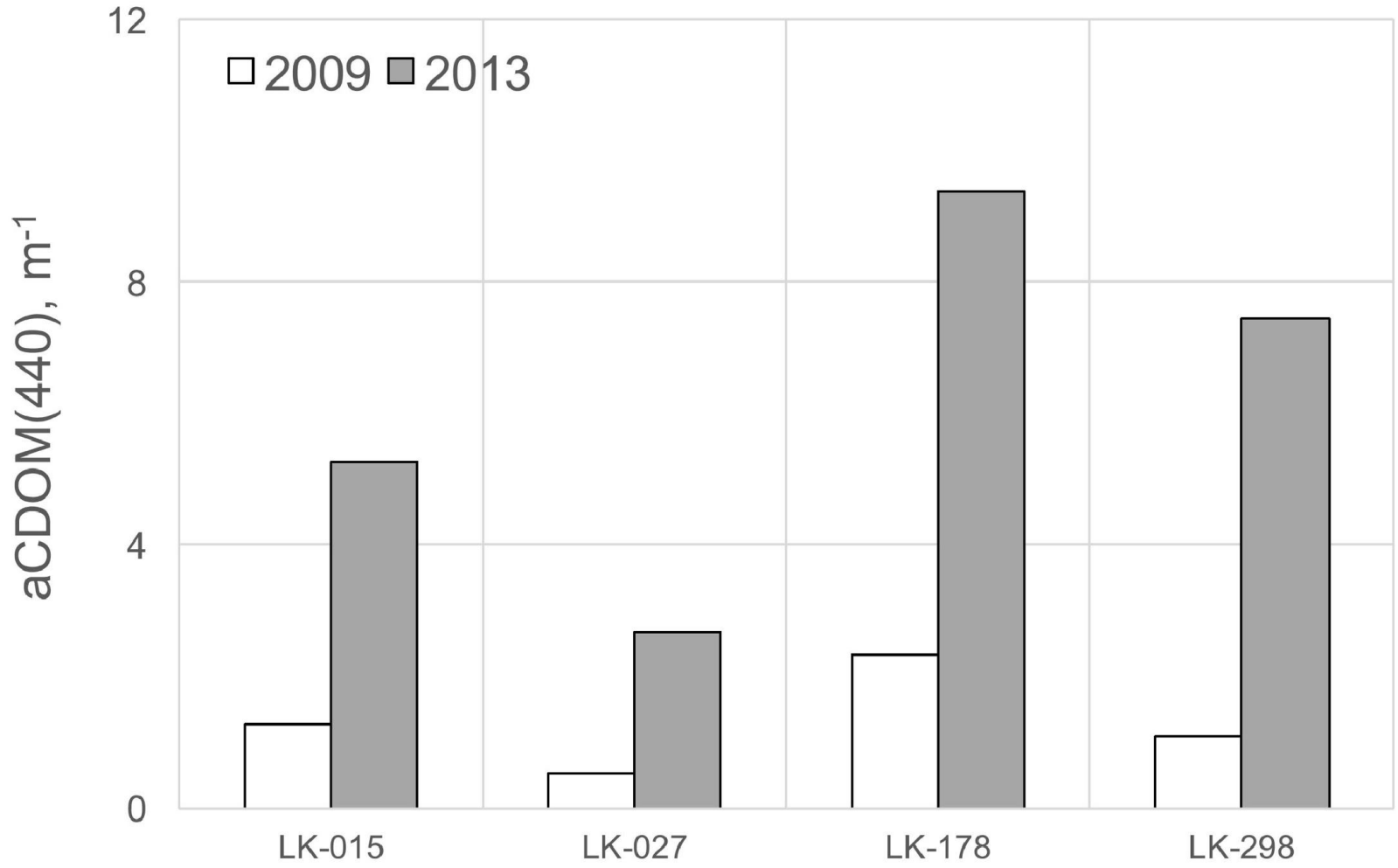
TC – the presence / absence of thermocirque in the coastal zone of the lake

NDVI – median of the Normalized Difference Vegetation Index in the catchment

- Environmental drivers of CDOM



- CDOM concentration change “before” and “after” formation of thrmocirque



- Where does the organic matter come from?

Measured DOC concentration – 243 mg/L !

Conclusions

- CDOM concentration might be 3-4 times higher in lakes affected by fresh thermocirques (release of old organic matter previously stored in permafrost)
- Lakes located on a floodplain of rivers receive an additional input of organic matter once the area is inundated
- Based on the remote observation of CDOM and the extraction of environment parameters, the number of environmental drivers of CDOM was found
- It is possible to monitor CDOM (and DOC) in a regional scale using e.g. 10-15 m spatial resolution Sentinel-2 and Landsat-8 data

Acknowledgements: