Using O_2/Ar ratios as a proxy for biological productivity determinations in an Arctic River

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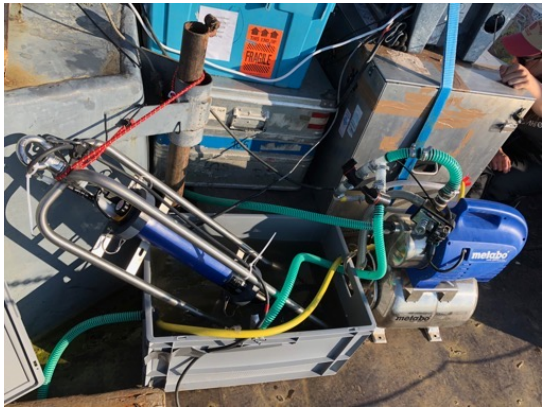
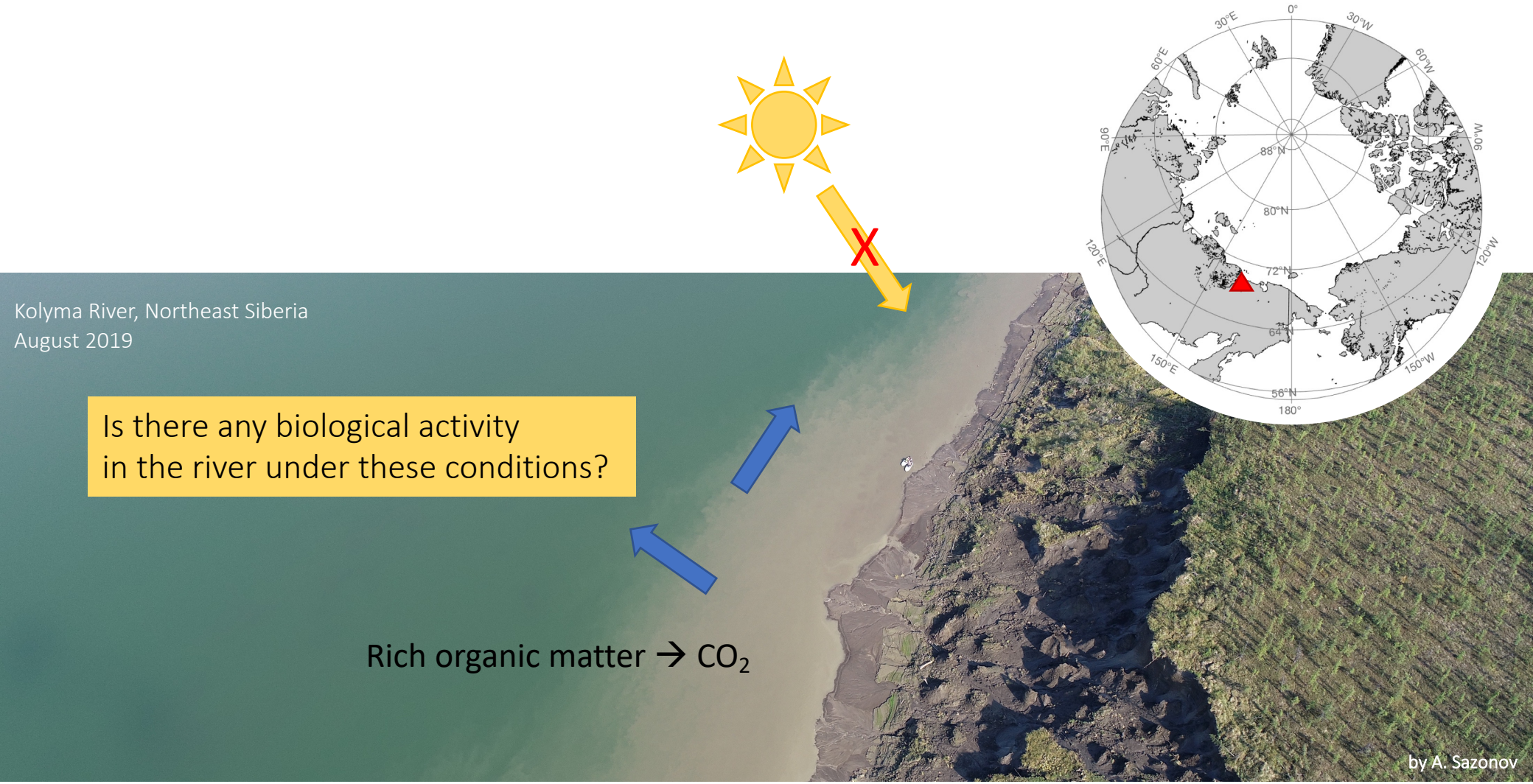
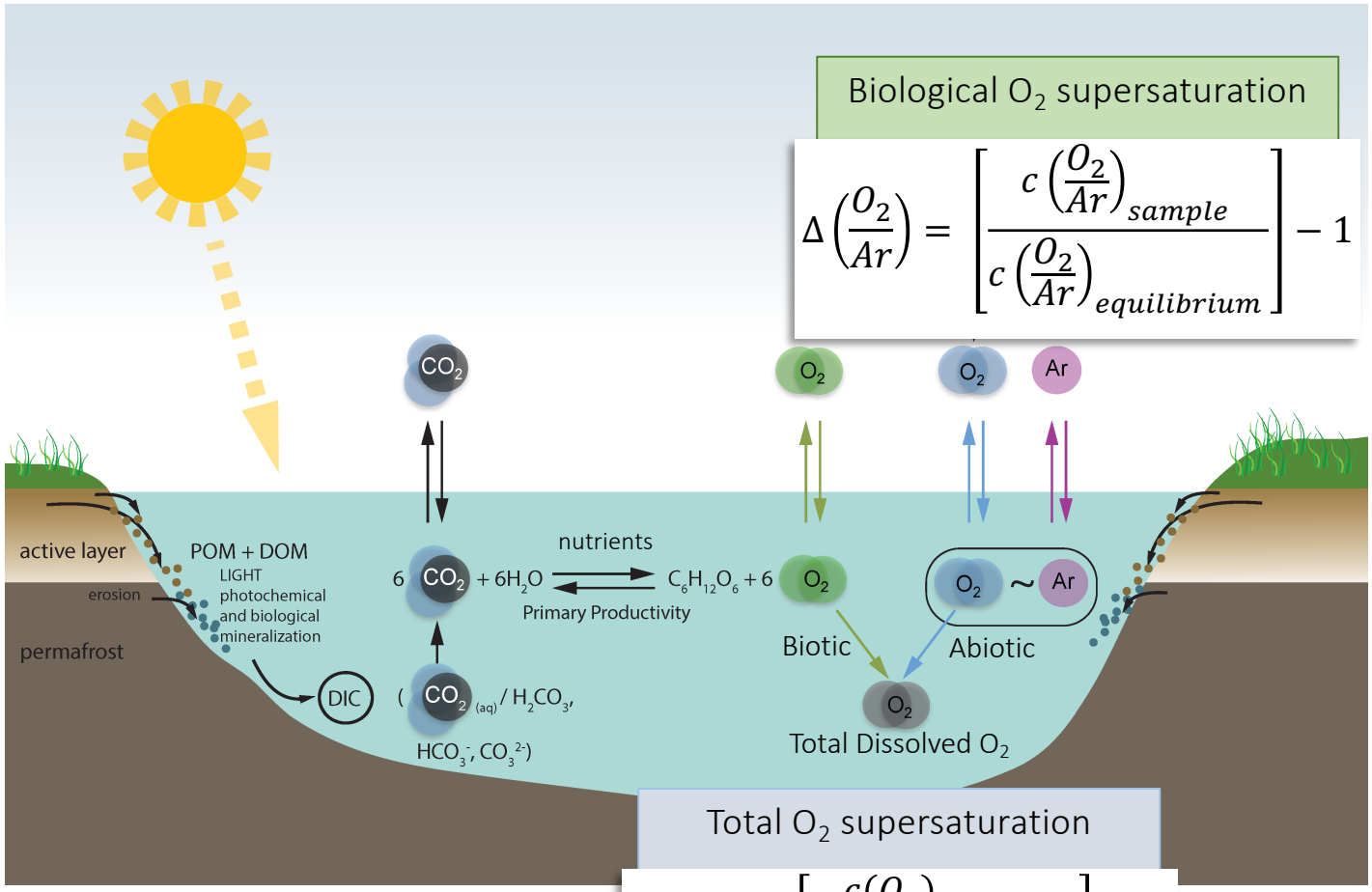



Kolyma River, Northeast Siberia
August 2019
Is there any biological activity
in the river under these conditions?
Rich organic matter → CO_2
by A. Sazonov

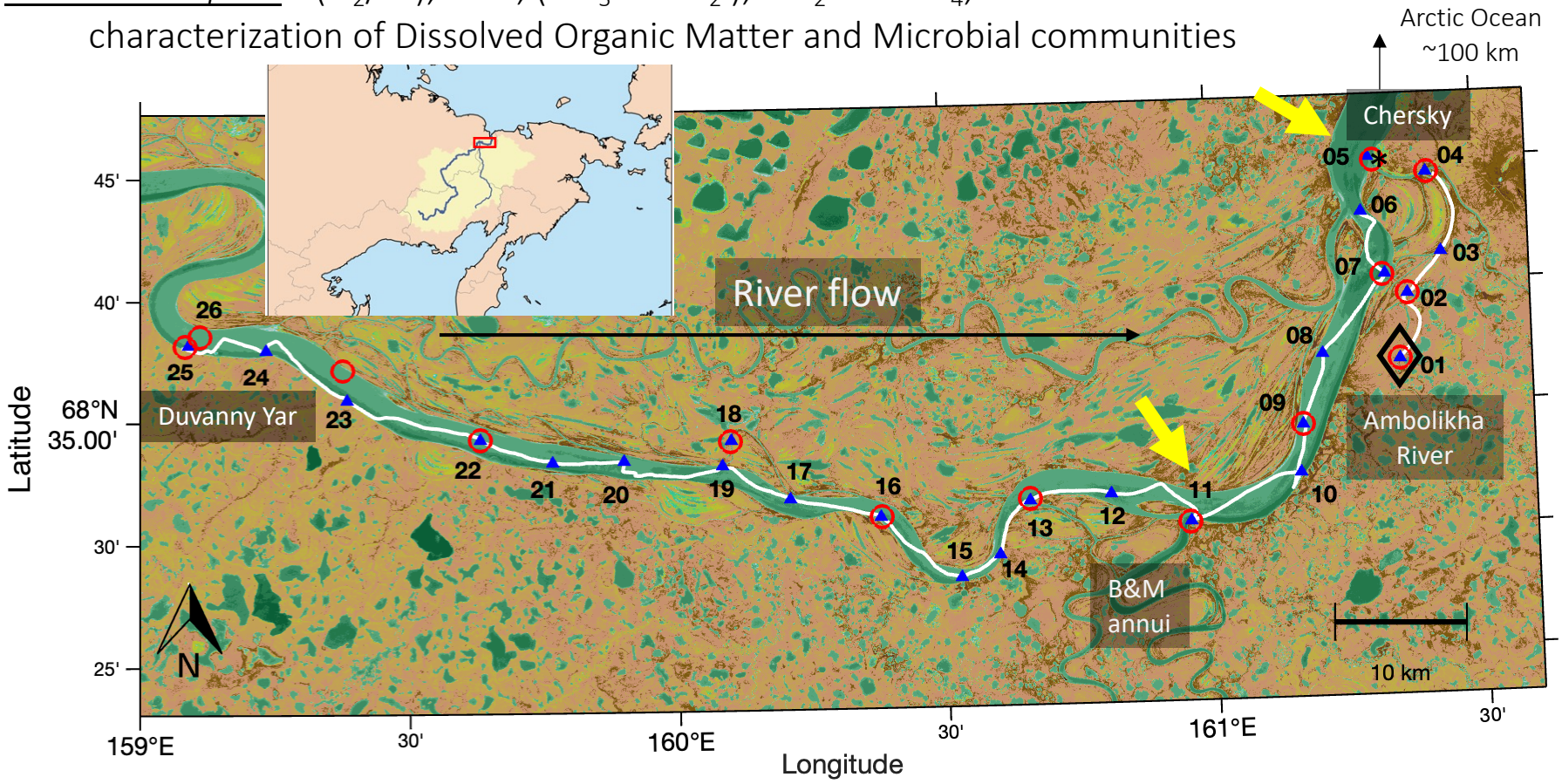
The O_2/Ar ratio is used to discriminate the physical component of dissolved O_2 from the biologically produced O_2



Navigated transect (120 Km) in Kolyma River, Northeast Siberia

On site measurements: T, $c(O_2)$, Turbidity, pH, pCO_2

Discrete samples: $\Delta(O_2/Ar)$, DOC, $(NO_3^- + NO_2^-)$, SiO_2 and PO_4,
characterization of Dissolved Organic Matter and Microbial communities



▲ 15-17 June 2019 (late freshet)

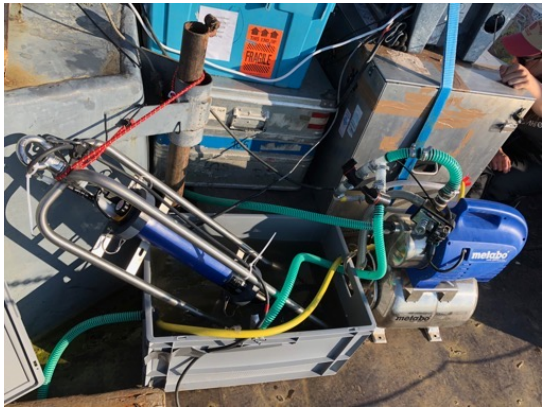
∗ 08 August 2019 (Bloom)

○ 05 August 2019 (summer low flow)

◇ 28 June and 03 July 2019 (transition)

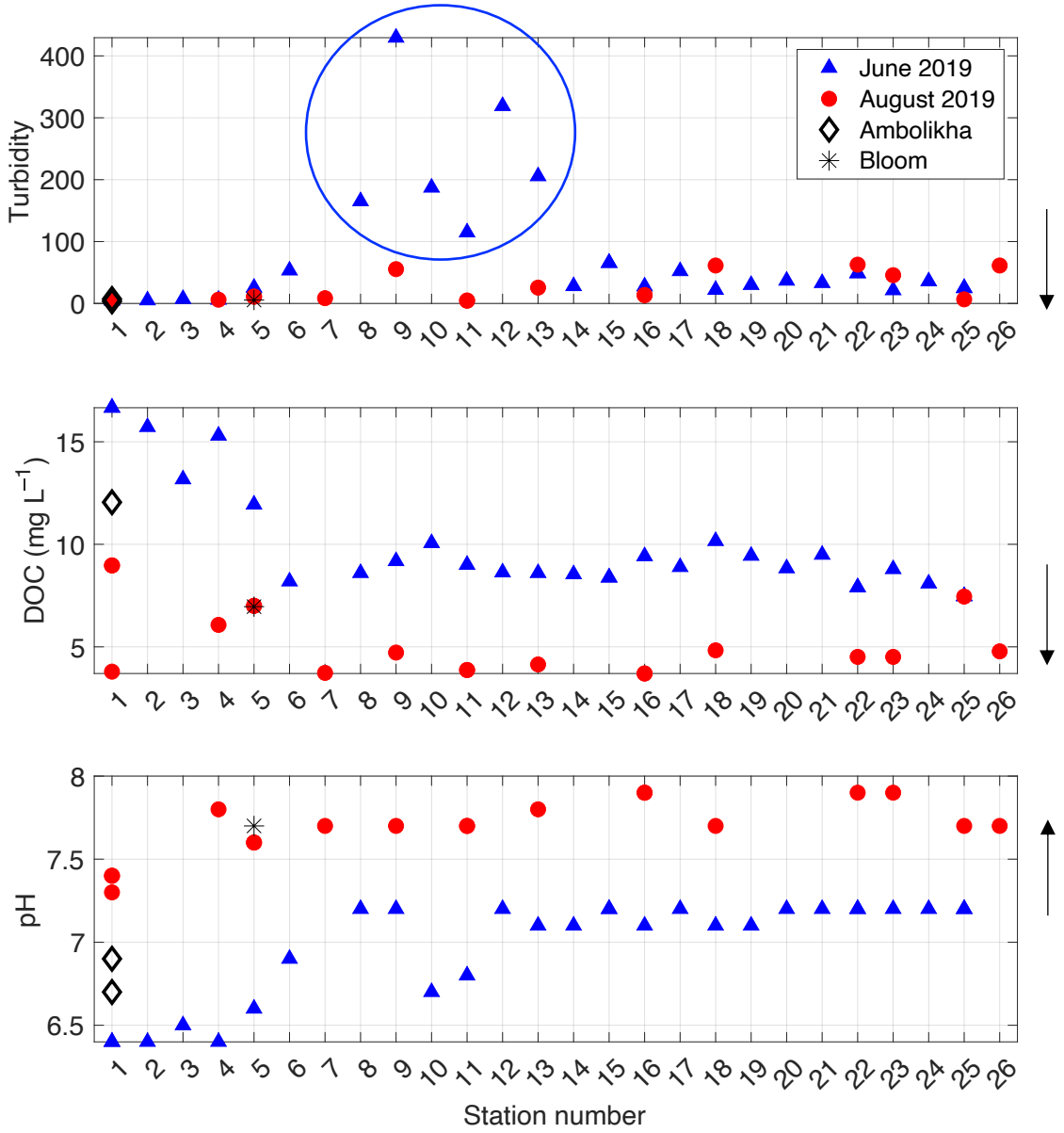
Methods summary

- Temperature, dissolved O_2 concentration, pH and turbidity: sensors mounted at EXO2 multiprobe*
- pCO_2 – Flow-through optical sensor, non-dispersive infrared absorption spectroscopy*
- Dissolved Organic Carbon (DOC) – combustion with high-temperature catalytic oxidation
- Dissolved Organic Matter (DOM) characterization: HR-electro spray ionization orbitrap MS (Kügler et al., 2019)
- Inorganic nutrients: (NO_3^- + NO_2^-), SiO_2 and PO_4
- O_2/Ar ratios, Isotope Ratio Mas spectrometry
- Microbial communities composition: DNA isolation, amplicon sequencing and 16S rRNA gene quantification

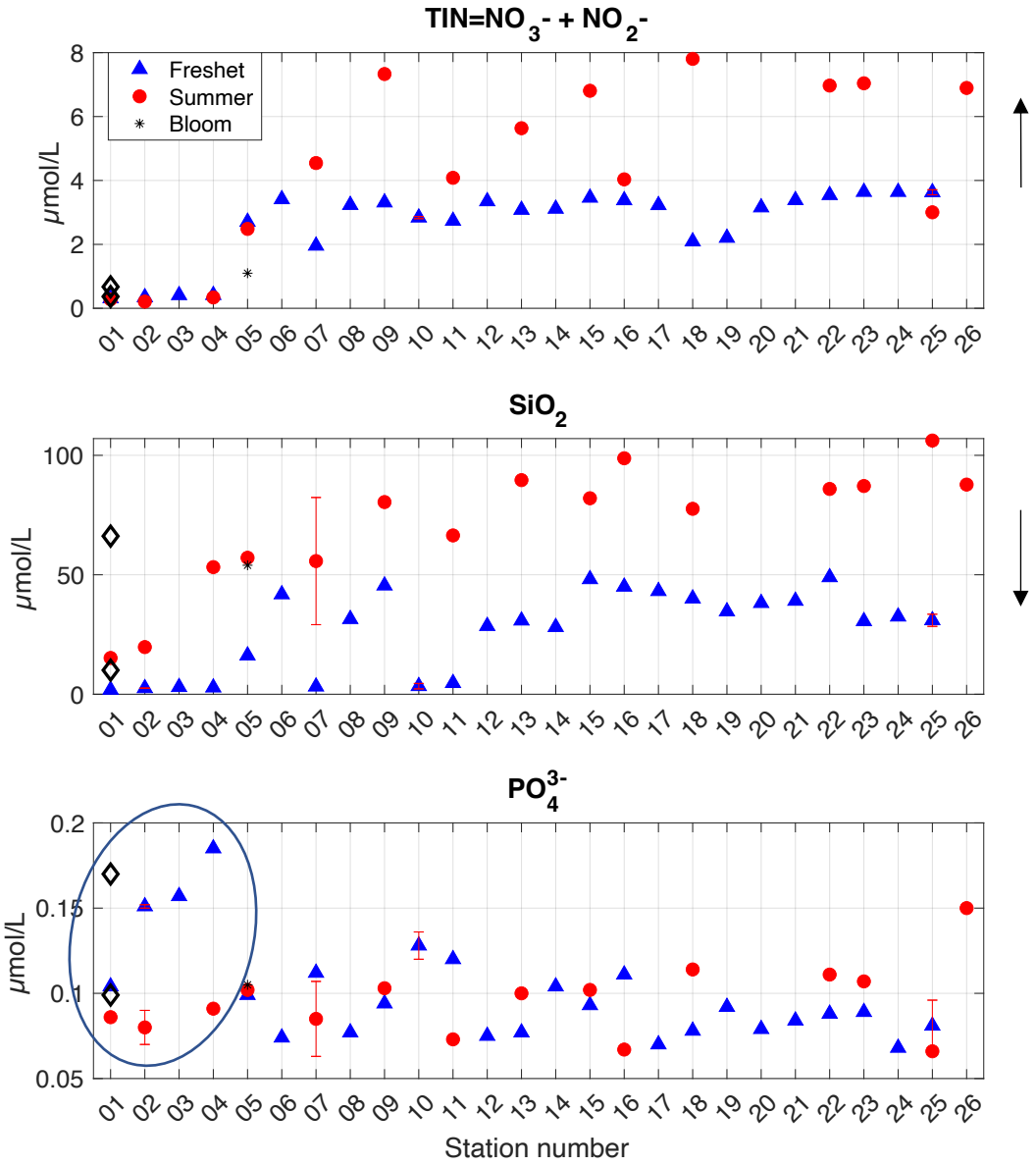


*on site measurements

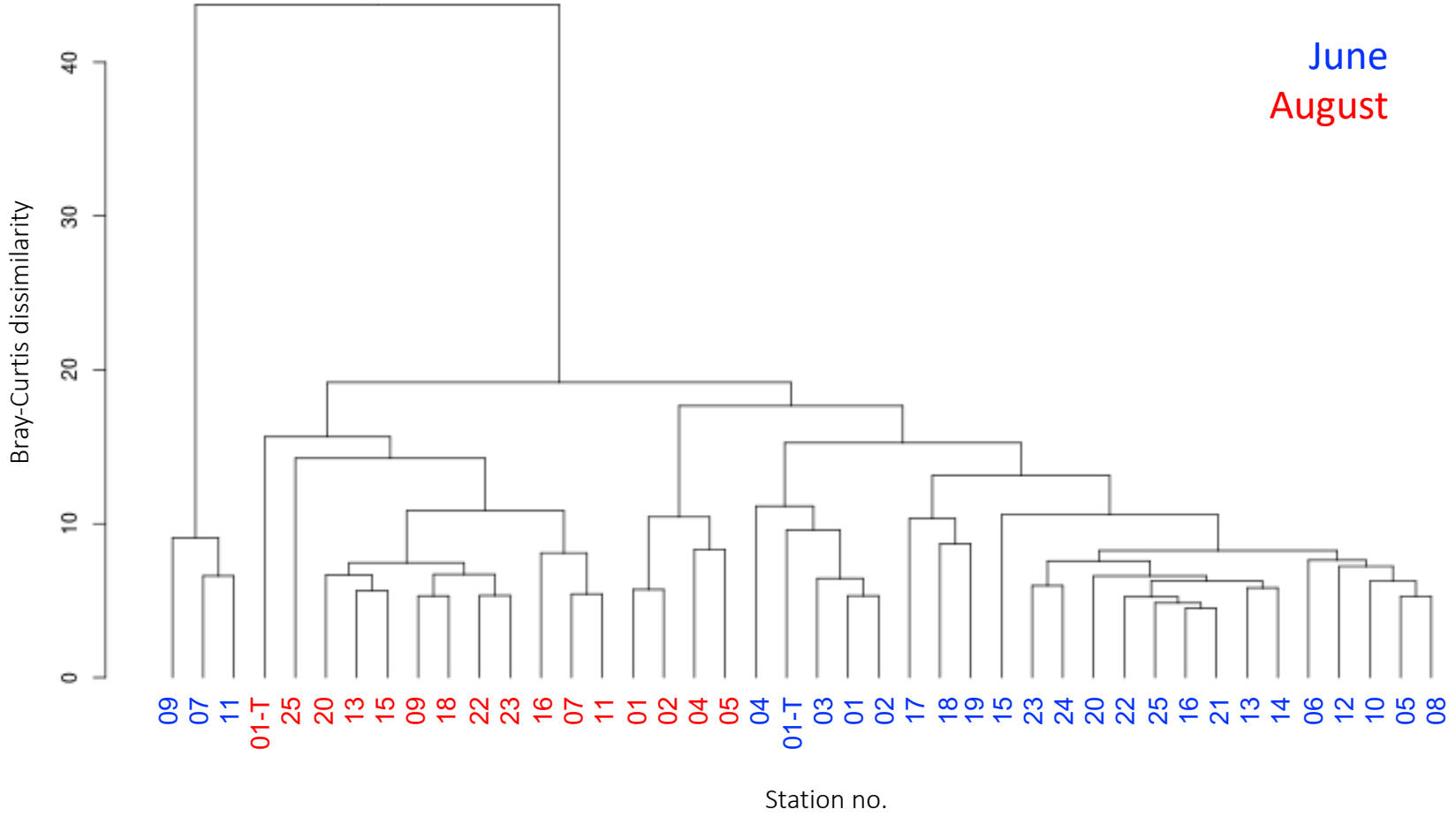
Late freshet (June) was characterized by highly turbid waters with higher dissolved organic carbon (DOC) content in more acidic waters than in summer (August)



Total inorganic nitrogen and silicate increased from June to August, but did not vary considerably and was not limiting for primary production.



Shift in the dissolved organic matter and microbial community composition from June to August possibly driven by changes from high to low water flow and drainage increase in summer.



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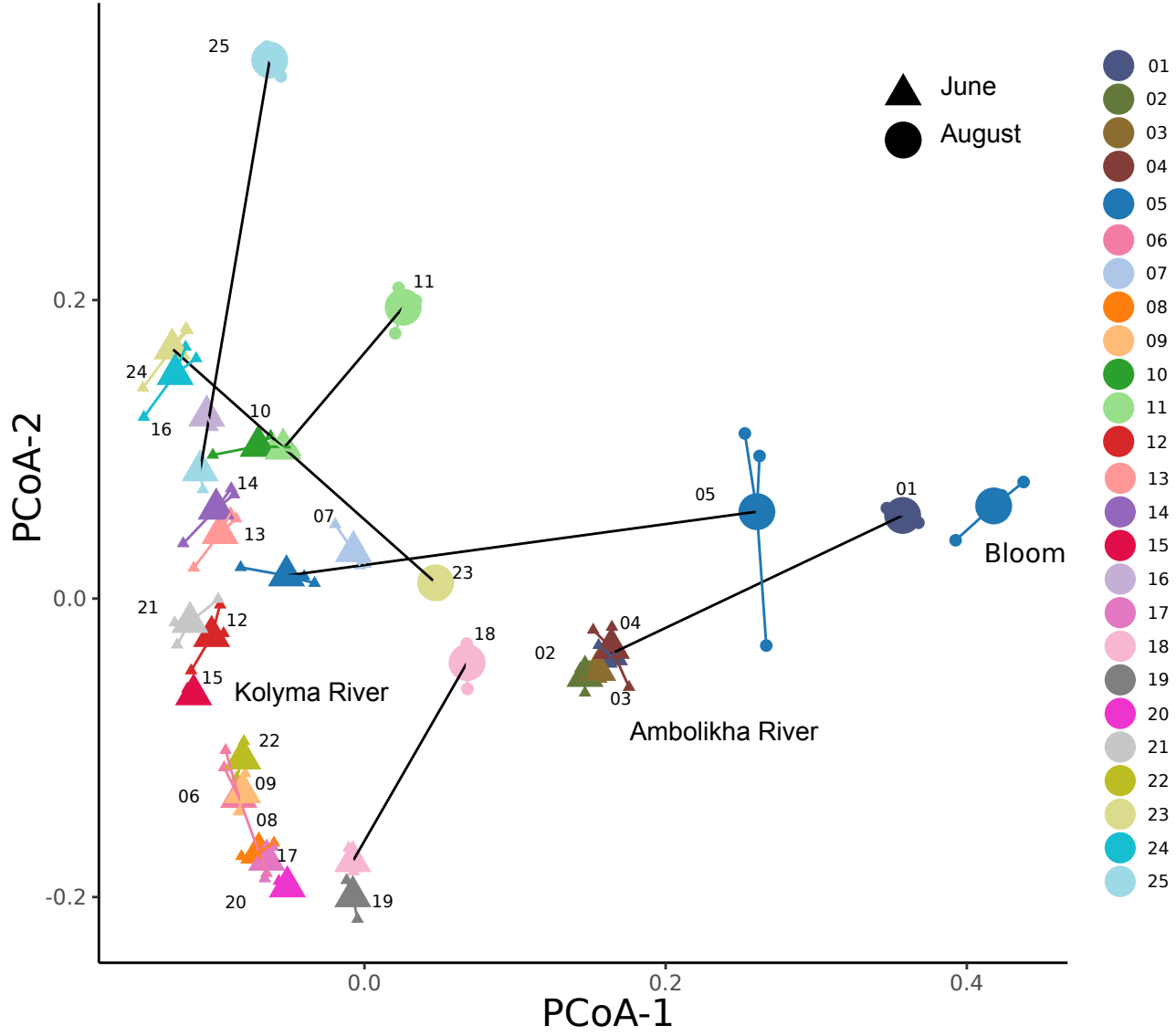
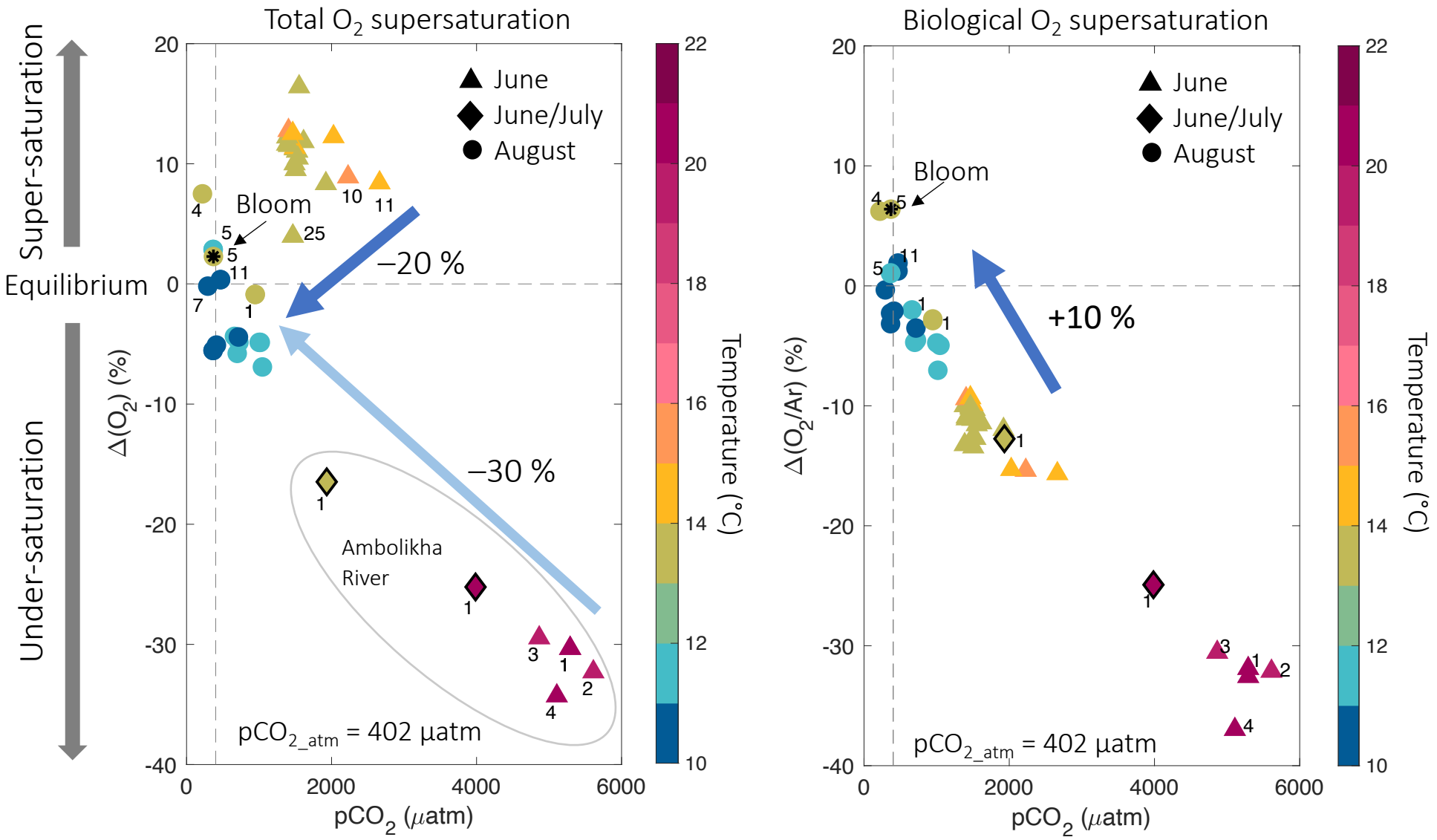
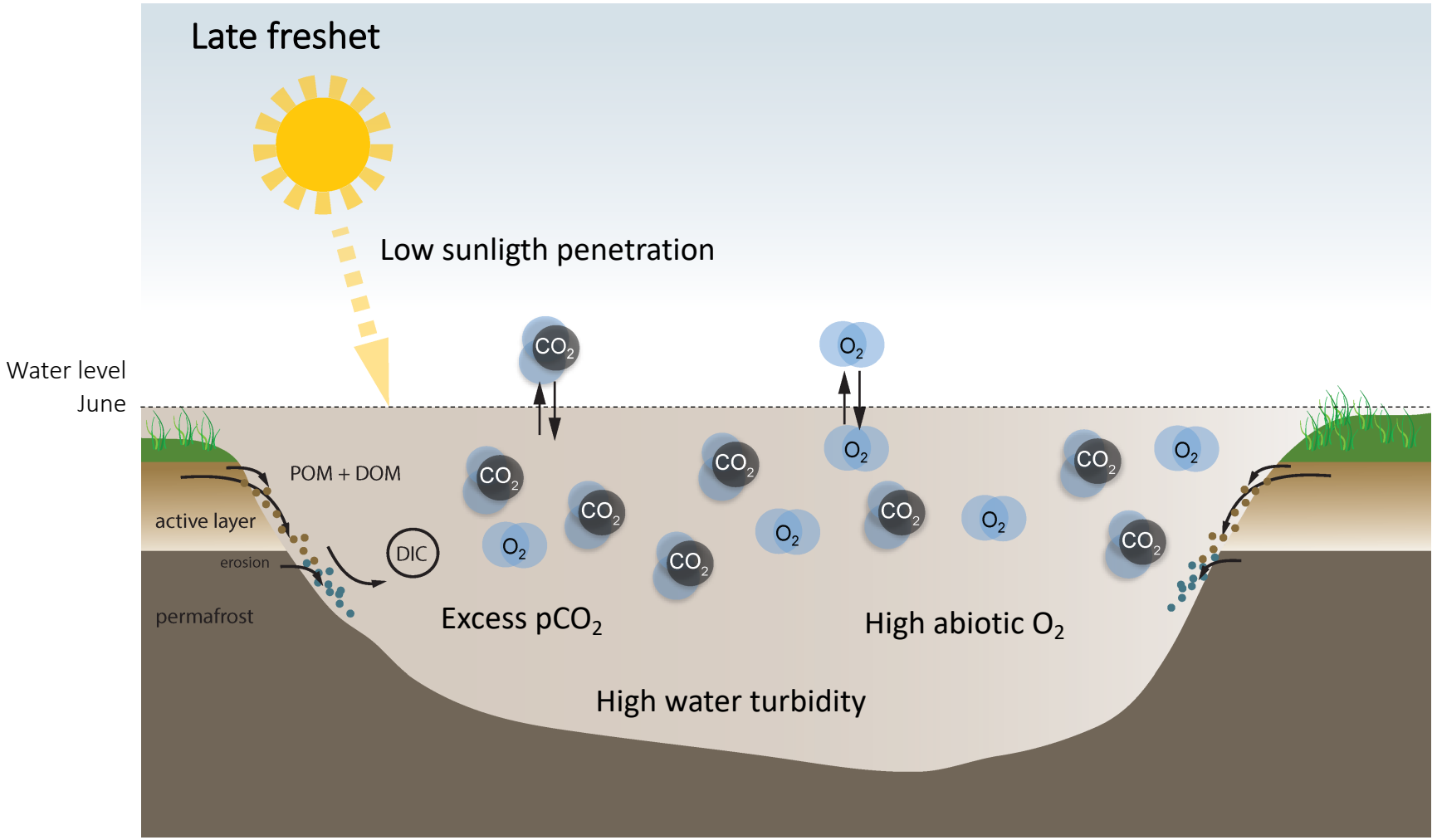


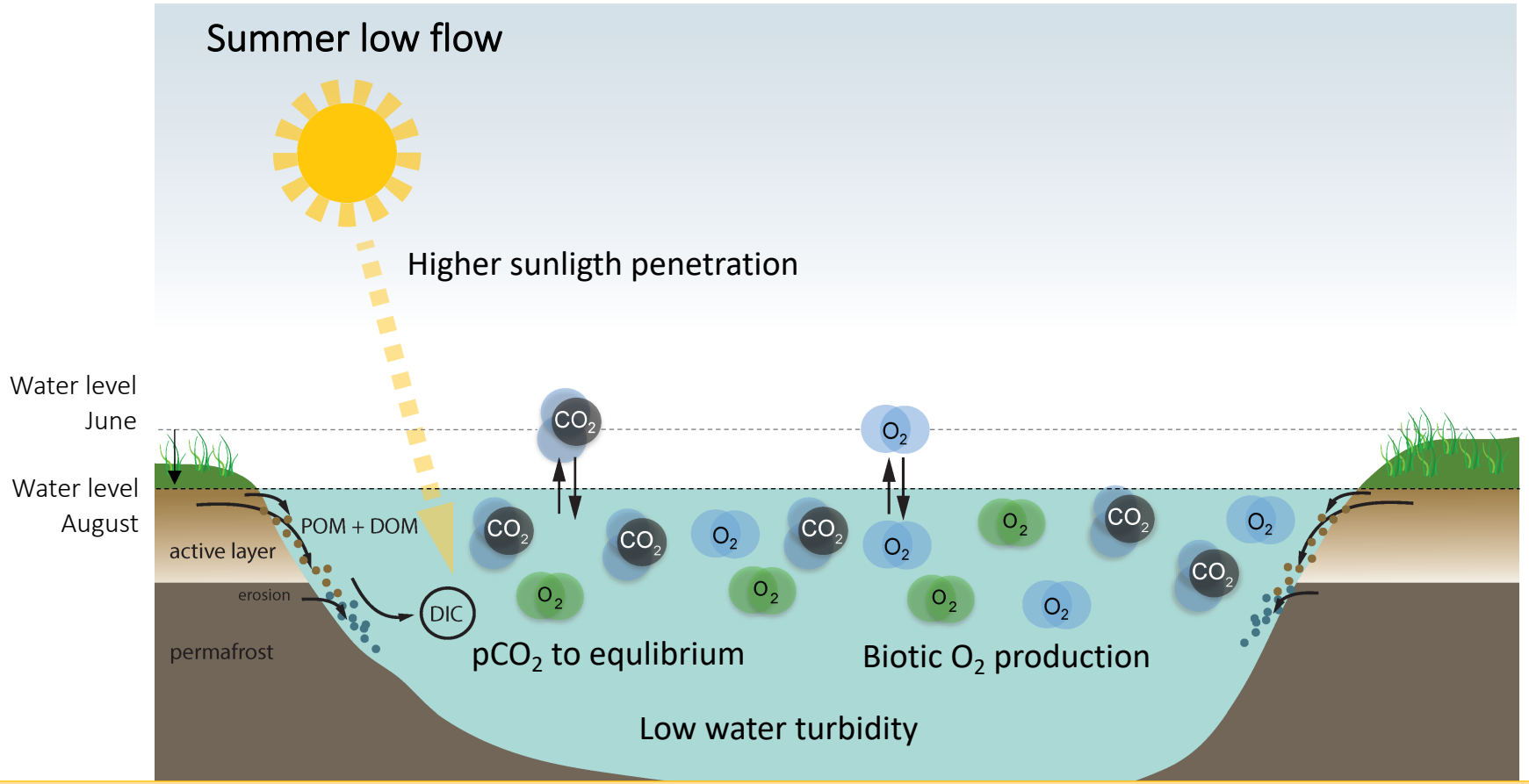
The biological O_2 supersaturation $\Delta(O_2/Ar)$ increased in August evidencing biological production of O_2 at confluence stations 4, 5 and 11.



In June, the biologial production of O_2 seemed to be limited by light transmission in turbid, well oxygenated and highly dynamic water flow



In August, the biologial production of O_2 takes place in outlets of tributaries under less dynamic conditions and higher light penetration



High turbidity limited the aquatic productivity, but if more rich organic carbon from thawing permafrost is available this may support carbon uptake in summer under hydrologic suitable conditions