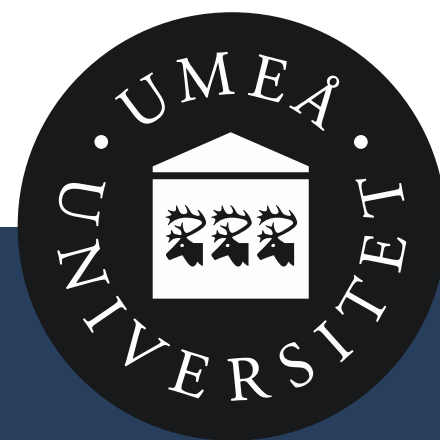




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SOURCES OF AIR-WATER CO₂ -FLUXES FROM SUB-ARCTIC LAKES WITH DIFFERENT DOC CONCENTRATIONS

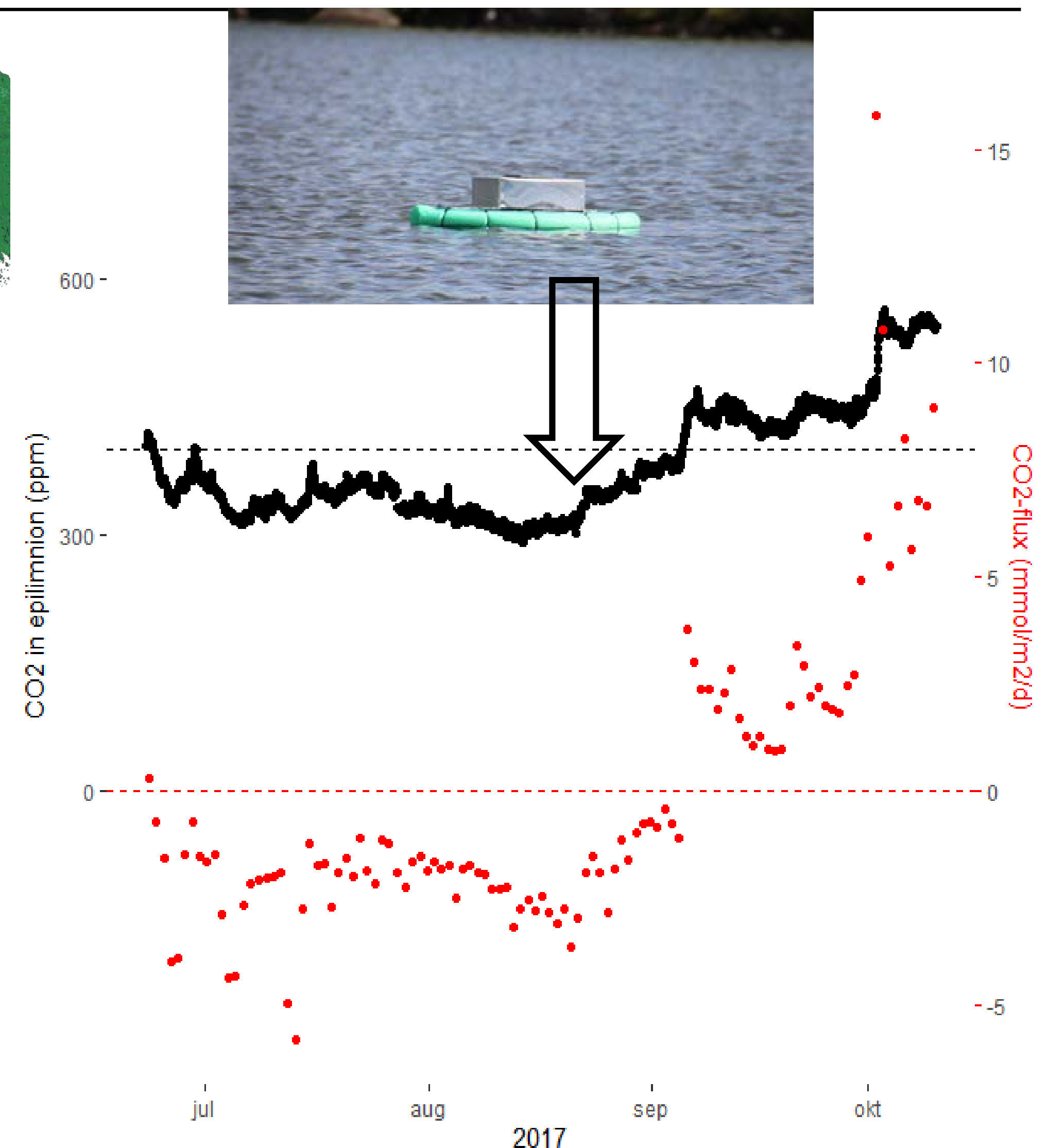
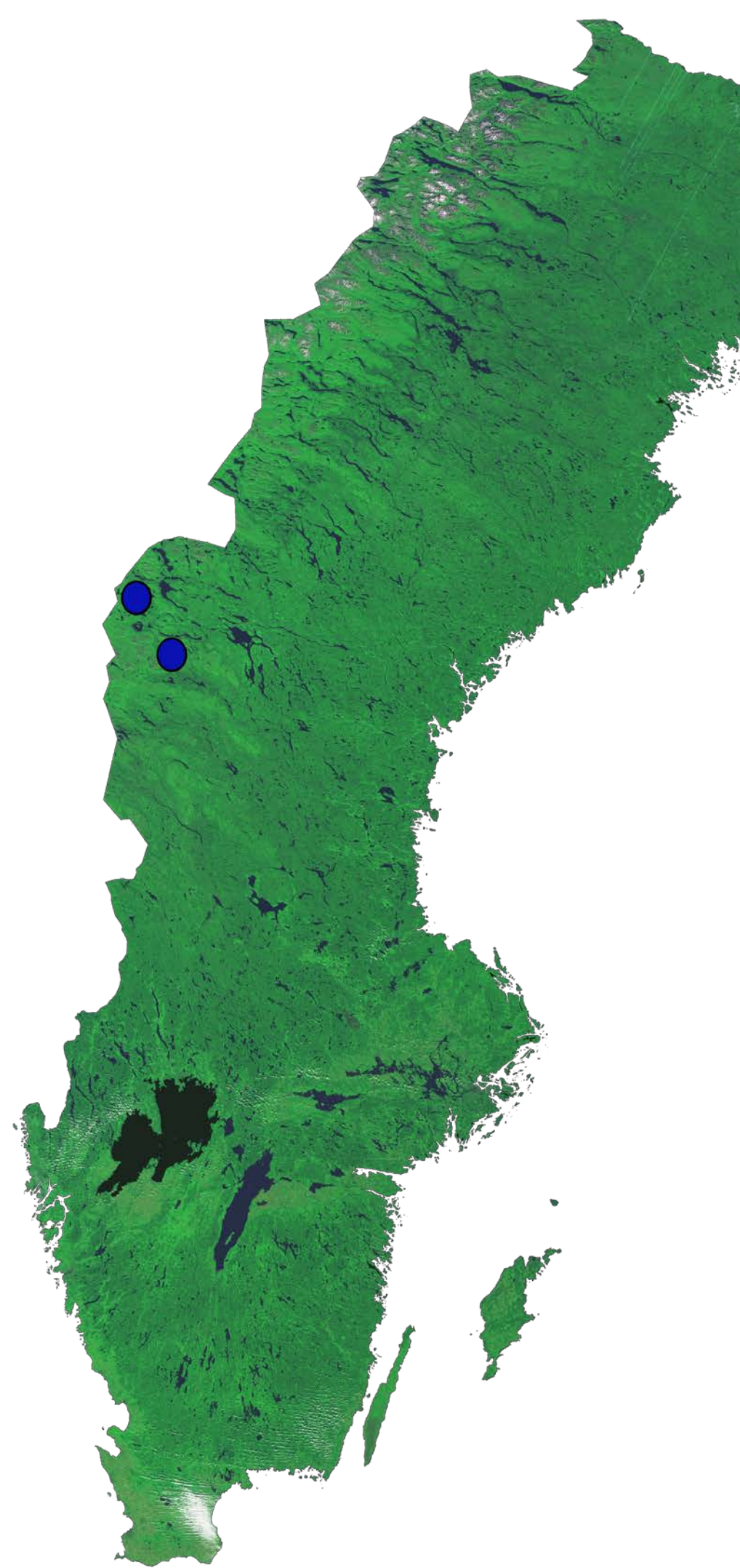
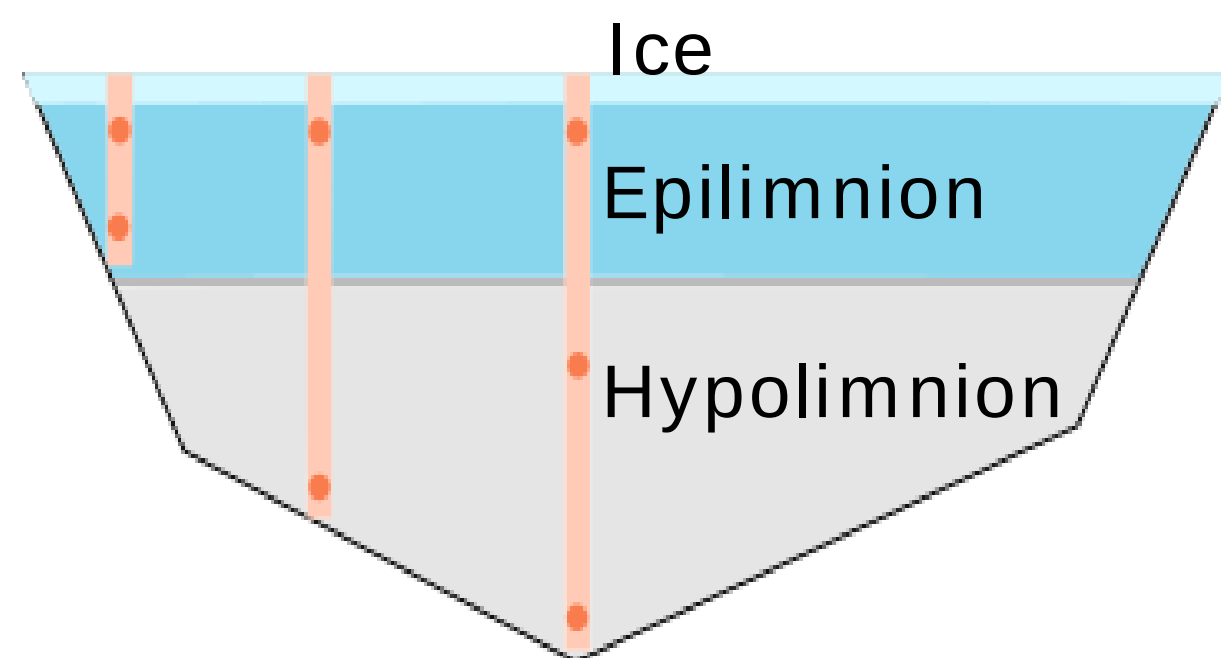
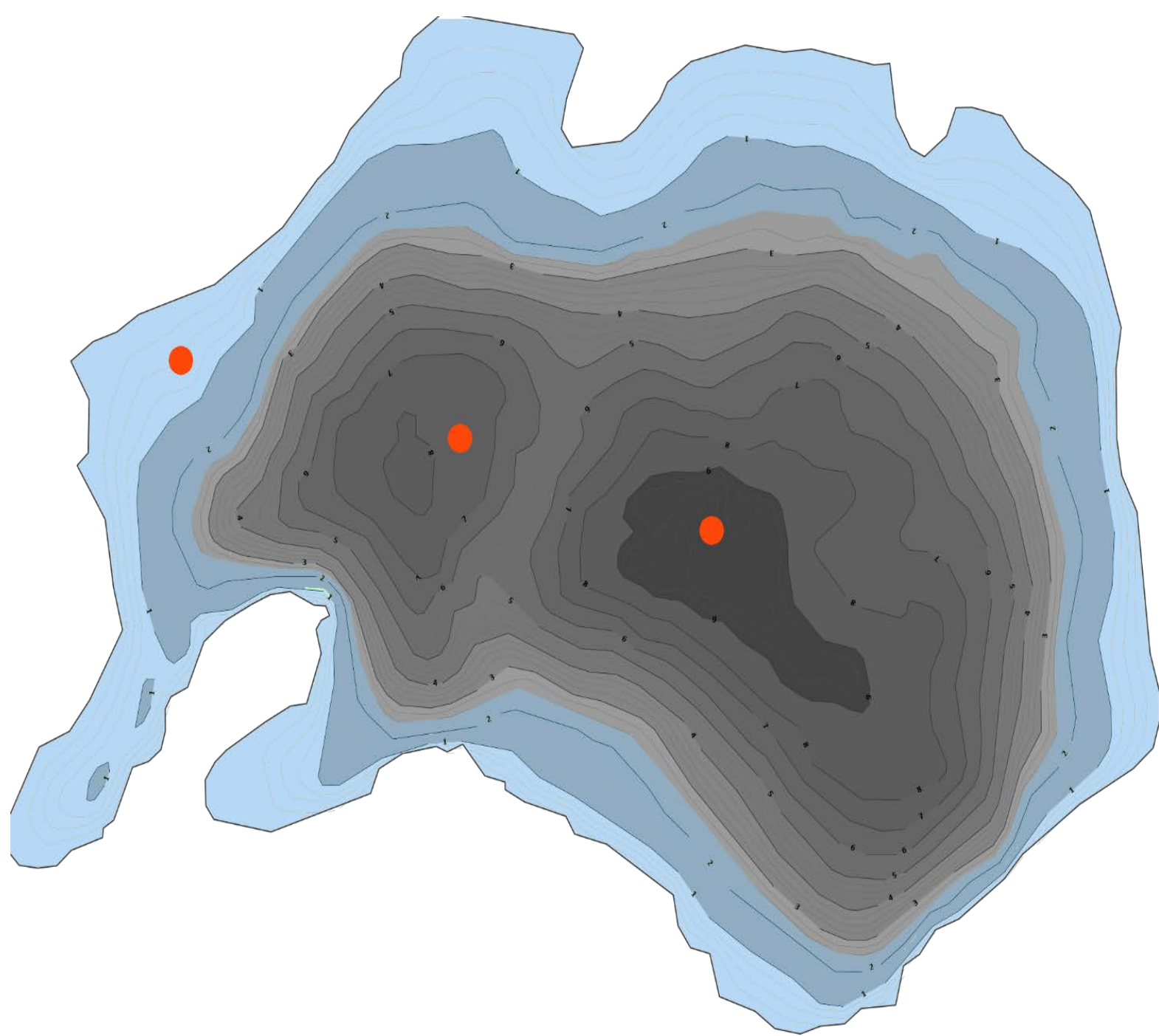
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Most lakes are supersaturated with CO₂, and are thus net sources of CO₂ to the atmosphere. We used data on total yearly fluxes and yearly internal net CO₂ production to quantify the contribution of internal vs external CO₂ sources to annual CO₂-flux. Insight in source contribution to lake CO₂-flux improves our understanding on lake functioning under a changing climate.

Methods

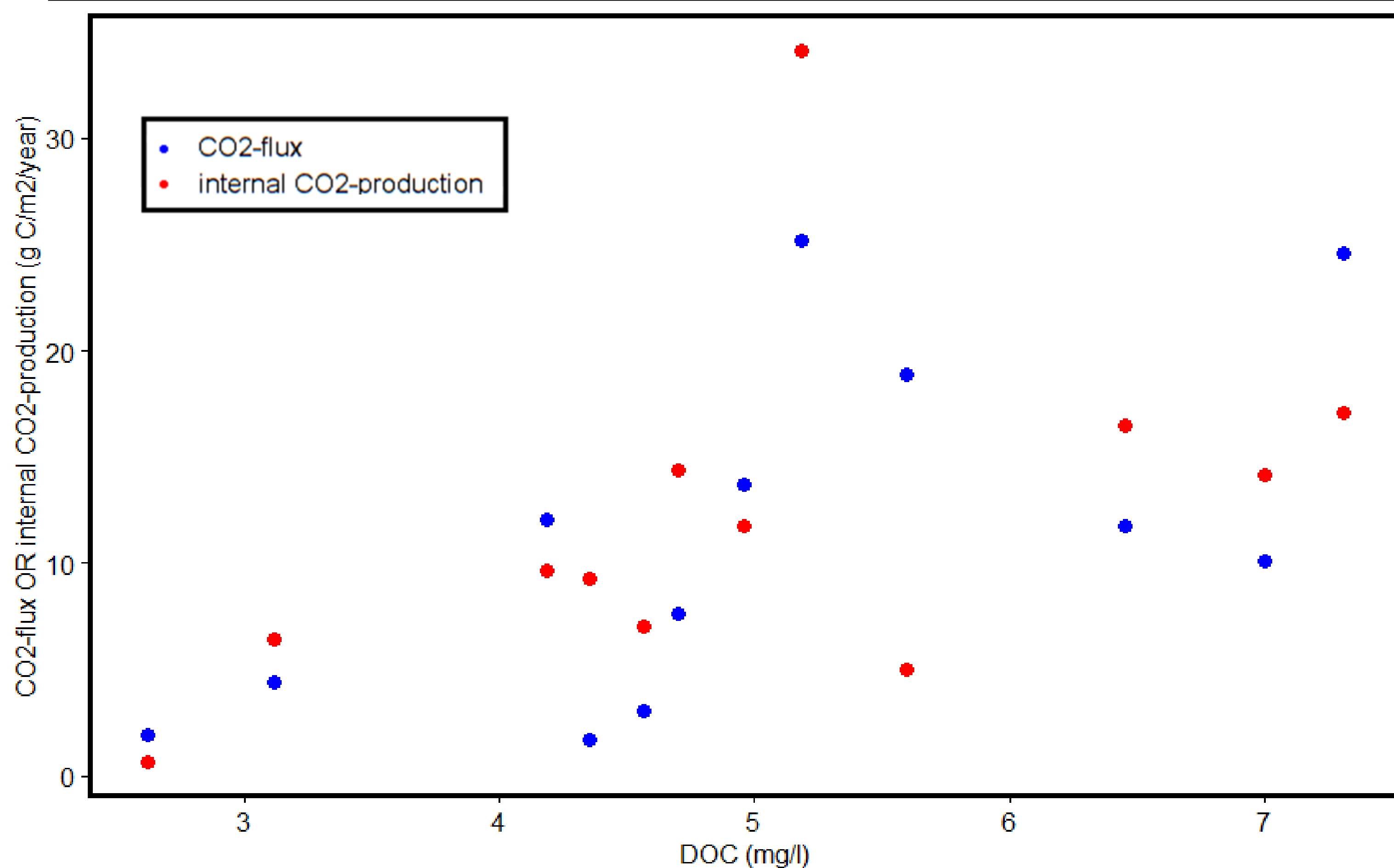
We studied 14 lakes in the Swedish Scandes during the open-water season. We used high-frequency sensors to estimate CO₂-fluxes and net internal CO₂-production (community respiration – gross primary production) of CO₂ during the open water season, and DIC mass balance to determine winter CO₂-buildup and fluxes at spring ice-off.



- The lakes were sampled for DIC at three points at each lake.
- At each 1 sample was taken 1m below the ice and 1m over the bottom. An extra sample was taken at the deepest site.
- Samples were averaged as epilimnion mass, and hypolimnion mass.
- The ice-off flux was calculated as by subtracting DIC mass after ice-off from before ice-off.

- CO₂-Fluxes were determined with an equilibrium chamber giving hourly data on surface layer pCO₂ over the full open-water season.
- Wind speed data was used to model the rate of CO₂ -flux.
- NEP, GPP and R were modelled using oxygen loggers in the epi- and hypolimnion during the open-water season. From these data we estimated net CO₂ production for the ice-free season.

Results and Conclusion



Total Flux and Net internal production of CO₂ plotted over lake DOC concentration. Two lakes have been removed as outliers (having >40x higher net internal production than total flux).

- Yearly CO₂ -Flux increases with increasing lake DOC concentrations, net internal CO₂ -production (R minus GPP) shows the same pattern.
- In 36 % of the studied lakes, Net internal CO₂ – production was less than total CO₂ Flux. There must thus be an external CO₂ -source making up the difference, for instance CO₂-enriched soil water.
- In 64 % of the studied lakes, internal CO₂ –production > total Flux, meaning that not everything produced is outgassed, and the lakes retain some of the CO₂ on annual basis.
- External CO₂-sources are found at both high and low DOC concentrations. Thus source contribution is irrespective of lake DOC concentration.

We found that annual CO₂-flux was partly sourced through external CO₂-input, e.g. CO₂-enriched water in 36 % of the studied lakes. However in most lakes, irrespective of DOC concentrations, internally produced CO₂ can make up the full annual CO₂-flux.



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