Turnover and exchange of CO_2 in small lakes
Fresh waters – a window for CO_2 degassing

Lakes and waterways receive a lot of CO_2 via the inflow of groundwater and surface water. They also generate a CO_2 surplus since they break down more organic matter added from the landside than they generate themselves. Figuratively speaking, they have wide open windows for intensive CO_2 degassing to the atmosphere. The scope of the degassing depends on the size of the CO_2 surplus in the water. However, the rate of the CO_2 degassing depends on the roughness of the surface water (surface turbulence).

In large lakes, surface turbulence is exclusively driven by current and waves created by the wind. But small lakes are protected from the wind, and convective flow caused by sinking water bodies due to nighttime surface cooling may play an important and so far overlooked role in CO_2 degassing.

Professor Kaj Sand-Jensen and Research Assistant Kenneth Martinsen, with the Department of Biology, Copenhagen University, have revealed that small lakes typically see convective stirring every night in the summer half of the year. Therefore, present project focuses on both the physical driver behind and the scope of CO_2 degassing.

CO_2 degassing – how much and how

Small lakes (under 1 ha) are present in the hundreds of thousands in Denmark; differently put, they outnumber large lakes by a factor of 50. In Northern Europe alone, there are many millions of small lakes with a total area equal to that of large lakes. Therefore, the role of small lakes in regional and global CO_2 budgets is important, but inadequately treated.

Under this project, the research team will determine: 1) How much CO_2 is degassed by small lakes, and 2) how important are, respectively, wind and surface cooling to surface turbulence and thereby the rate of CO_2 degassing?

New monitoring methods and perspectives

For some years, it has been possible to monitor temperature, light level, oxygen and pH using small registered sensors installed by lowering them from the water surface to the lake bed. They provide data on the stirring and the CO_2 content of the water.

Now, however, it is possible to construct affordable floating chambers with a built-in CO_2 sensor that continuously registers and stores measurements of CO_2 content in the chamber air. This allows for calculation of the CO_2 degassing from the water surface and the water's CO_2 concentration.

The overall perspectives are to determine the physical forces (wind or cooling) that drive CO_2 degassing in small lakes, and to account for the role that the many small lakes play in the national CO_2 accounts.