Effect of organic matter sSURface layer Enrichment on air-sea gas transfer velociTY (SURETY)

Abstract for general public

About one quarter of all anthropogenic emissions of CO_2 are absorbed by the ocean. This has the positive result of slowing down the global warming but also the negative one of ocean acidification. This means that studying how much CO_2 is deposited every year in the ocean is very important for understanding the climate change. The amount of the greenhouse gas moving from the atmosphere to the ocean, or the other hand, depends on its amount in air and water, expressed in terms of partial pressure, with the gas moving towards its lower value. This CO_2 flux is also dependent on how easy it is for gas to cross the sea surface. This depends mostly on turbulence, in other words how fast air and sea is mixed, determined mostly by wind speed above the sea surface. In recent years research results have shown that another factor influencing effectiveness of this process is the amount of surfactants, the organic matter present in the sea surface layer. The presence of surfactants significantly decreases gas transfer velocity. The measurements of how much if the substances are present in the surface microlayer is unfortunately very time consuming and sometimes dangerous as it involves sampling surface water of choppy sea for later laboratory analyses. The aim of our project is to find an optical method of estimating the surfactant activity which in future will get rid of the need to sample surface water. We propose to use optical measurements of surfactant fluorescence together with voltammetric (hanging mercury drop method) measurements of surfactant activity to find a new optical index of surfactant activity which when used in a formula together with wind speed will fit better the measured values of gas transfer velocity than existing formulas using wind speed only. In order to do that we will need to collect data during many research vessel cruises. We will perform measurements in at least three cruises each year, both in the Baltic and North Atlantic. The reason why we plan to study both basins is that the existing literature does not agree on whether gas transfer velocity is identical in seas with different salinity. Checking that is an additional aim of our project. The optical index we plan to develop will hopefully make it possible to replace in future water sampling and laboratory analyses with a continuous remote sensing from the board of the research ship or an aircraft using a lidar system (optical counterpart of a radar) using a laser light source and an optical receiver tuned to the optical bands for which we will find the optimal correlation with air-sea gas transfer velocity. This should allow mapping the surfactant activity of whole ocean basins significantly improving the estimations of air-sea CO_2 fluxes and thus improving our knowledge of global carbon budget.