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New book from IOW experts: “Carbon dioxide glasses” sharpen view on the state of the Baltic Sea

Bernd Schneider and Jens Müller from the Leibniz Institute for Baltic Sea Research Warnemünde (IOW) recently published a book on the biogeochemistry of the Baltic Sea. What is special is its novel perspective: The marine chemists use investigations into the marine CO2 cycle to obtain comprehensive and highly detailed analyses of marine biogeochemical processes. This new concept strikes new paths towards an efficient ecological monitoring of the sea. Amongst others, their research is based on a unique set of CO2 measurements, which span almost 15 years and were performed in high spatial and temporal resolution by an automated system aboard a cargo ship.

The exploration of the carbon dioxide cycle has been a focus of marine research for the past 30 years. Mostly, the investigations centre on the question of how the oceans participate in the global budget of the greenhouse gas CO2 and help buffer the increased emissions of CO2 released by humans into the atmosphere. Consequently, the resultant problem of ocean acidification is also moving into the spotlight, as more CO2 in seawater turns into carbonic acid.

However, when Bernd Schneider and Jens Müller from the IOW put on their “CO2 glasses”, as the subtitle of their book proclaims, they do not deal with this global CO2-driven transformation of marine ecosystems. Rather, they focus on crucial processes that characterise the ecological state of the Baltic Sea: primary production by phytoplankton in its seasonal and regional variability as affected for example by eutrophication (including blooms of blue-green algae) and causing oxygen depletion after breakdown of biomass in the deep waters of the central Baltic Sea basins. For their analyses the authors utilise the fact that all these processes are directly linked to the release or consumption of CO2: The formation of each organic molecule in the biomass of an organism requires the uptake of an equivalent amount of CO2. Inversely, the breakdown of biomass results in CO2 release. As both processes immediately result in measurable changes of seawater CO2 concentration, CO2 measurements can be used to accurately trace even highly dynamic biogeochemical transformations through time and space.

To demonstrate that the “CO2 glasses” are indeed an excellent tool to adequately capture these fundamentally important processes, and to identify and answer still unresolved questions, Schneider and Müller for the first time combined data and insights from nearly 25 years of IOW research. Especially noteworthy is a dataset of CO2 measurements in the Baltic Sea surface water, which was gathered almost non-stop over 15 years through automated measurement systems aboard a so-called voluntary observing ship. Equipped with IOW instruments the cargo ship from the shipping company “Finnlines” shuttles between Lübeck and Helsinki several times a week. A data density such as this can’t be achieved by a regular research vessel.

"Other methods commonly used to quantify processes of biomass growth and breakdown in the sea contain various types of uncertainties," Bernd Schneider explains. This applies for example to oxygen measurements or the consumption of dissolved nutrients as a proxy for biomass production, clarifies the experienced marine chemist, who has been researching biogeochemical processes for decades. "We were able to show, that the findings gathered from the analysis of our CO2 data are much more reliable and sensitive – both, when describing small-scale processes quantitatively and to recognise long-term trends early-on. CO2 concentrations are therefore a very good indicator for what is going on biologically in the Baltic Sea," Schneider continues.

"Moreover, technological advances in the automation of CO2 measurements created ideal conditions for establishing a closed-meshed monitoring network independent of research vessels," adds Jens Müller, who is about to finish his doctoral thesis and brought, among other things, his expertise for the analysis and visualisation of large dataset into the book.

"Our studies offer the basis for fundamental new strategies of the Baltic Sea eutrophication monitoring that is conducted by the Helsinki Commission for Baltic marine environment protection (HELCOM). We therefore recommend our book to all those who look for convincing proof that our approach is an efficient and scientifically sound monitoring tool," the authors conclude.

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