

IOW press release, May 19, 2018

Into the heart of the blue-green algae bloom: IOW sailing expedition “BloomSail” is launched

On May 19, 2018, Jens Müller from the Leibniz Institute for Baltic Sea Research Warnemünde (IOW) starts his four-month sailing expedition BloomSail. The aim is a precise description of cyanobacteria mass development in the central Baltic Sea by means of CO₂ measurements and other parameters, which play a decisive role in the formation and further course of these so-called blue-green algae blooms. The use of an 8-metre yacht for the first time allows the observation of acute bloom events in high temporal and spatial resolution during an entire blue-green algae peak season. The blooms are to be investigated not only – as is usually the case – in surface water but also in deeper water layers.

Every year in calm summer weather, a phenomenon occurs in the central Baltic Sea that links two of the biggest environmental problems of this enclosed sea – over-fertilisation and the oxygen deficiency at the bottom of its deep basins: The so-called blue-green algae blooms emerge. These are mass developments of floating cyanobacteria – microorganisms, which like plants use sunlight for photosynthesis and do not depend on dissolved nitrogen compounds in the water, which are normally essential for algal growth. Instead, the blue-greens can convert the atmospheric nitrogen into the reactive compounds they need. Thus, at a time when other algae have used up all the available nitrogenic nutrients in the water column, they can produce massive algal carpets that are clearly visible even from space via satellite. The mass development is also facilitated by the plant nutrient phosphorus, which is excessively present in Baltic Sea due to over-fertilization. When the blue-green algae die off, they sink to the sea floor, where bacterial decomposition of the organic material depletes the available oxygen. In this way, the annual blue-green algae blooms contribute significantly to the development of the so-called death zones at the Baltic Sea bottom.

There are, however, surprisingly many knowledge gaps regarding blue-green algae blooms, despite their regular occurrence and their great importance for the Baltic Sea ecosystem: Which exact combination of factors – in terms of weather, nutrient conditions, salinity and water temperature – initiates the development of midsummer blooms? What are the dynamics of biomass production and biomass degradation within a blue-green algae bloom? How far do blue-green algae blooms extend into the deeper water layers? For some decades now, it has been possible to record their distribution at the sea surface via satellite data and automated measurements on board of ferries. Systematic attempts, though, to close the cited knowledge gaps with on-site measurements have failed so far because the exact onset of a bloom in time and space cannot be predicted. At the same time, it is organisationally and financially impossible to have research vessels cruising in the central Baltic Sea for an indefinite period in search of blue-green algae blooms.

This is where Jens Müller's “BloomSail” expedition comes in. From the beginning of June to the end of August the IOW marine chemist will carry out a measurement programme in different water depths aboard the sailing boat Tina V on daily cruises from his base port Herrvik on Gotland Island to the BY15 measuring station in Gotland Deep. These measurements will supplement the data that are recorded on the water surface by satellite and the automated ferry measurement programme. The aim is to describe the entire

dynamics of the blue green algae bloom, which can set in pulse-like within a few days and often evolves further very rapidly. “The advantages a sailing boat offers in this situation are great: I can be flexible on the spot exactly when the blue-green algae really get going. Large research vessels, whose expeditions are scheduled 1-2 years in advance, simply cannot do so,” explains Müller, who is supported in his work by two crew members who change every two weeks. “It will take patience and a little luck to successfully go ‘bloom hunting’ in such a relatively large window of time, but I can hardly imagine a better summer job,” adds the enthusiastic sailor with a wink.

The centrepiece of the BloomSail expedition program is the repeated measurement of the CO₂ partial pressure to assess the blue-green algae biomass. When blue-green algae grow, i.e. when they carry out photosynthesis and build up biomass, they absorb CO₂ from the water. Conversely, the degradation of biomass leads to the release of CO₂. Monitoring the CO₂ fluctuations in the seawater therefore allows precise conclusions about the respective biomass developments. In addition to the CO₂ monitoring, algae will be filtered from water samples to enable a direct determination of the organic material and its composition. Temperature, salinity and nutrient concentrations are also analysed to better understand, which conditions control the development of blue-green algae blooms. “In mid-September, when we return to our home port Warnemünde, the detailed sample and data evaluation can begin. We then will know much more about how blue-green algae blooms actually ‘tick’. A better understanding of their temporal and spatial dynamics also in deeper water layers can be an important puzzle piece for modelling and various other ecosystem analyses of the Baltic Sea,” Jens Müller concludes.

The BloomSail expedition is financed by the IOW and by the EU as part of the project BONUS Integral (short for “Integrated carbon and trace gas monitoring for the Baltic Sea”; further information at: www.io-warnemuende.de/integral-home.html). Jens Müller also receives an “Early Career Grant” from National Geographic for his BloomSail project.

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More information about the BloomSail project:

www.io-warnemuende.de/Tina-V-home-en.html

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