

Special features in the Sea Surface Temperature of the Baltic Sea in 2016 and the impact on the cyanobacteria development

Satellite data of sea surface temperature (SST) and water color are used to illustrate the thermal and cyanobacteria development in the annual state assessment of the Baltic Sea. The sea surface temperature is derived from data from the American NOAA and European MetOp weather satellites, which are made available daily to the IOW by BSH Hamburg. The development of cyanobacteria in summer is daily observed with the spatially highly resolved MODIS true color images (RGB, 250 m) of the satellites Aqua and Terra from the Lance Rapid Response System of NASA. New possibilities arise with the Sentinel satellite series of the European Space Agency (ESA). For example, Sentinel 2, a land observation satellite with a spatial resolution of 10 m, allows the detailed investigation of structures that appear in the water color, e.g. River discharge or cyanobacteria filaments.

The year 2016 was the third warmest year since 1990, after 2014 and 2015. In particular, the months February to July and September contributed by their positive anomalies. With up to +5 K over the long-term average, May was the warmest since 1990 (Fig. 1). In August, deep pressure systems with unusually frequent west wind conditions in the northern and central Baltic Sea led to a long-lasting strong upwelling of cold water along the Swedish coast. This resulted in negative deviations from the long-term average value of up to -4 K. September was warmer than the long-term average in the southern and western parts and was one of the warmest since 1990 in these regions. October and especially November were characterized by unusually frequent east winds in the central Baltic Sea, which initiated

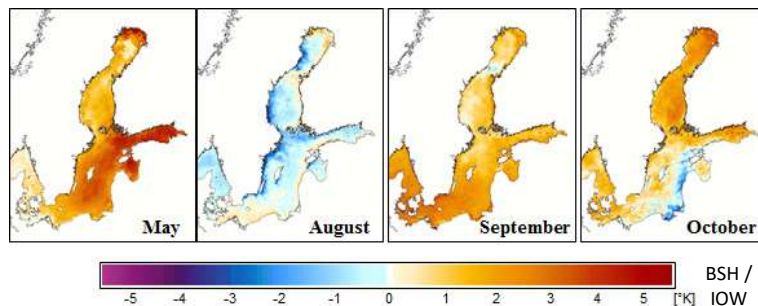


Fig. 1: Anomalies of monthly mean Sea Surface Temperature of the Baltic Sea referenced to the long term average (1990-2016) for the months May, August, September and October 2016. Daten: BSH

upwelling of cold water along the coast of the Baltic countries and anomalies of -2 K to -3 K. June and September were among the warmest months in the southern Baltic Sea and October in the Gulf of Bothnia.



Fig. 2: MODIS Aqua quasi true colour image on 22 Jan 2016 shows the eastern part of the German Baltic Sea coast at the time of maximum ice coverage in the entire Baltic. (Scene: NASA- MODIS Rapid Response System)

A strong cooling at the beginning of the year 2016 led to ice in the German inner coastal water already on 6 January, continued until 23 January and thus ensured early maximum ice cover in the entire Baltic Sea in 2016. MODIS Aqua from 22 January 2016 shows the ice conditions in the inner German coastal waters from the Darss-Zingst Bodden Chain to the Szczecin Lagoon. The week from 9 to 15 March was the coldest week in the entire open Baltic Sea.

The strong warming in the late spring led not only to the positive anomalies in May and June, but also to an early development of cyanobacteria. Measurements during the monitor cruise around 20 May have confirmed the satellite

observations. A strong warming in the second half of July made 26 July to the warmest day

of the year. After a first drop in temperature at the beginning of August, which took place especially in the northern Baltic Sea, stable conditions prevailed, which lasted until the middle of September with temperatures of 18-20 ° C in the southern and western Baltic Sea. As a result, an extension of the cyanobacteria bloom could be observed until September.



Fig. 3: The Sentinel 2 scene from 24 August 2016 shows filigree Cyanobacteria-filaments south-west of Gotland with a spatial resolution of 10 m. Scene: Copernicus Sentinel data

The scene depicted in Fig. 3 of the Sentinel 2 land observation satellite from 24 August 2016 with a spatial resolution of 10 m shows the possibilities for the detailed investigation of structures, as in this case of the filigree cyanobacteria filaments south-west of the island of Gotland.

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