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A small wave of relief: Oxygen measured in the deep water of the Baltic Proper

Recent readings of the IOW reveal: Oxygen-rich saltwater from the North Sea has entered the Central Baltic Sea and there, for the first time since 2003, has displaced hydrogen sulfide in the deep water.

After a long period of oxygen depletion and hydrogen sulfide formation in the deep water of the Central Baltic Sea (since 2003), saltwater being rich in oxygen has reached these submarine areas once again, as the results of the most recent measuring campaign of the Leibniz Institute for Baltic Sea Research in Rostock-Warnemünde now reveal. This slightly improves the living conditions of higher organisms in these regions which were often referred to as “dead zones”.

The last time a similar event has been observed was in November / December 2011. Back then, the deep water of the Southern Baltic Sea was not ventilated further than the Gdansk Basin. The recently measured inflowing salt water succeeded in progressing farther to the Northeast up to the Central Gotland Basin. There,the bottom-near water layer in depths between 200 and 240 m was provided with oxygen while toxic hydrogen sulfide was removed. At the time of the measuring campaign, this inflow however did not yet reach the Northern part the Gotland Basin.

According to the Warnemünde scientists, two long-lasting phases of westerly winds in February and March 2014 have triggered these processes. The gauge data from February 3 – 20 and March 8 – 19 show minor wind-induced inflow events with estimated volumina of approximately 141 km³ and 203 km³, with the March event carrying the major volumes into the Baltic.

The scientific cruise from July 19 – 30, 2014 was one of five regular measurement campaigns per year which the IOW is conducting to monitor the state of the marine environment of the Baltic Sea. The campains follow a fixed station network reaching as far as to the Gotland Basin. Within the German EEZ, this is done on behalf of the Federal Maritime and Hydrographic Agency (BSH) which is responsible for the performance of the duties that the Federal Republic of Germany agreed upon in the Helsinki Convention. The gained data are used as a foundation for regular assessments of the state of the Baltic Sea, both on national and international level, as well as for numerous other scientific publications. Besides, they provide the scientific basis for further measures planned to protect or restore the ecosystem of the Baltic Sea.

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Background information: salt water inflows

The water body of the Baltic Sea is permanently stratified with brackish surface water fed by the constant freshwater discharge of numerous rivers. This surface layer is in constant exchange with the atmosphere. It is well provided with oxygen by wind mixing, temperature-induced convection processes and the biological production. From a depth of approximately 70 m on, in areas which are no longer influenced by wind mixing, the Baltic Sea shows its close connection to the North Sea: it is here that the salty North Sea water concentrates which periodically flows into the Baltic Sea via the Danish Belt Sea, Being saltier than the Baltic Sea water, it is also heavier, thus it is flowing along the bottom of the Baltic Sea into the deep basins. Both water bodies do not mix but to a minor degree which causes a permanent stratification. Solid particles like dead organic matter can easily pass this boundary whereas gases dissolved in the water are hold back efficiently. The oxygen content of the deep water therefore constantly decreases as the oxygen is consumed during the decomposition of the deposited organic particles. When the oxygen is entirely depleted, toxic hydrogen sulfide forms. An improvement of this state can only be reached by the lateral supply with large amounts of North Sea water which has been in contact with the atmosphere and therefore is rich in oxygen.

Submarine sills in the Western Baltic Sea hamper this horizontal water exchange. Only under specific meteorological conditions, the salt water can pass these natural impediments to supply the eastern/central parts of the Baltic Sea with oxygen. These sills are the so called Darß Sill, an extended sandy plain between the Danish Island of Moen and the peninsula of Fischland-Darß-Zingst with water depths of 18 – 19 m, and the Drogden Sill being positioned in the Oere Sound between the Danish island Zealand and the Swedish mainland with water depths of only 8 – 9 m.

Since 2003, no major salt water inflow has occured, which has led to the fact that in the deep areas of the central Baltic Sea (>90 m) all oxygen has been consumed and an increased formation of hydrogen sulfide went on. Thus, the biological living conditions for higher organisms have strongly been limited in these areas, which therefore were often referred to as “dead zones” in the media.

Images:

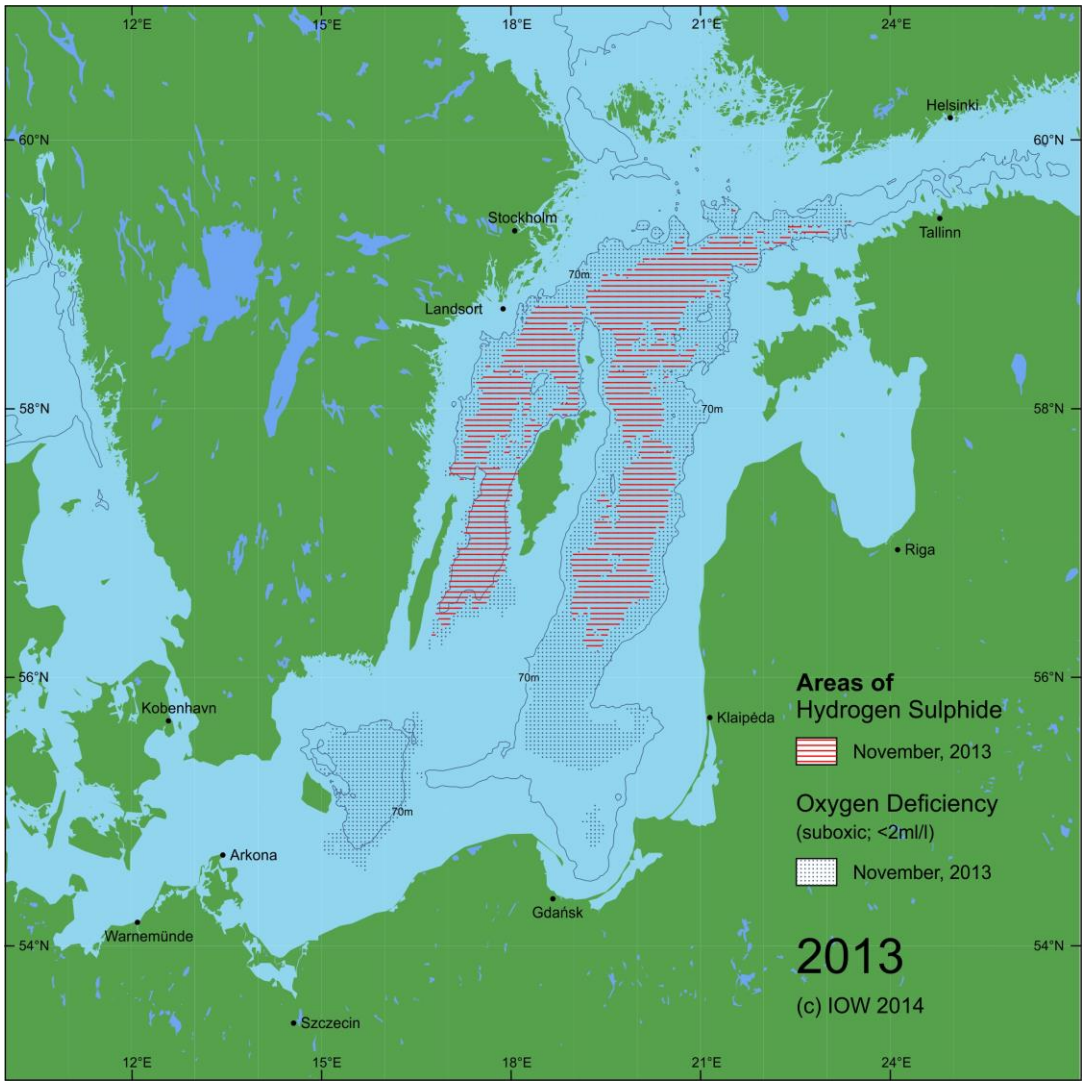

Figure 1: Central Baltic Sea November 2013 – Situation before salt water inflow

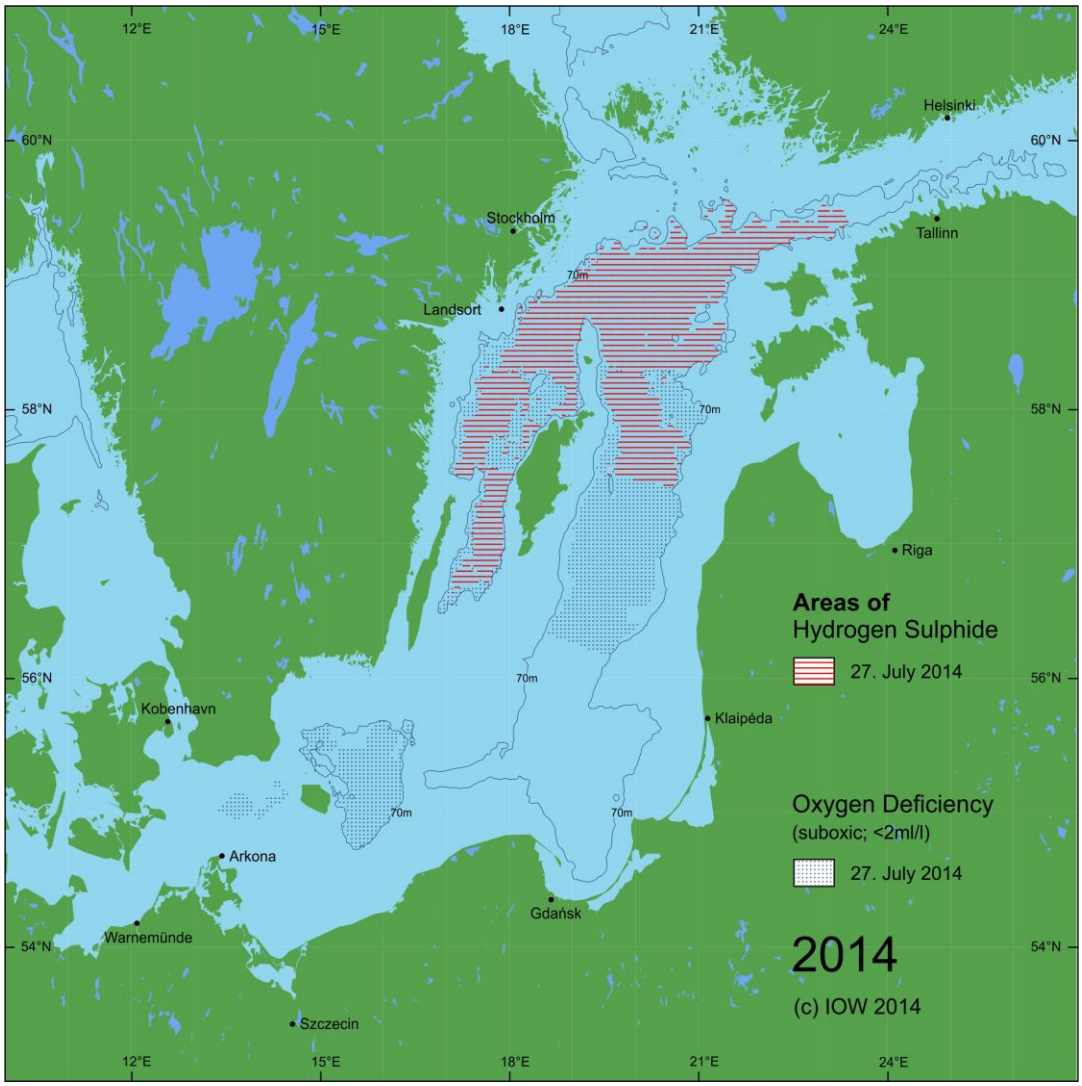

Figure 2: Central Baltic Sea in July 2014 – Situation after salt water inflow

Link to images in high resolution:

http://www.io-warnemuende.de/mitteilung/items/salzwassereinbruch-2014.html

Further material on demand

The IOW is a member of the Leibniz Association to which 89 research institutes and scientific infrastructure facilities for research currently belong. The focus of the Leibniz Institutes ranges from Natural, Engineering and Environmental Science to Economic, Social, and Space Sciences and to the humanities. The institutes are jointly financed at the state and national levels. The Leibniz Institutes employ a total of 17.200 people, of whom 8.200 are scientists, of which 3.300 are junior scientists. The total budget of the Institutes is more than 1.5 billion Euros. Third-party funds amount to approximately € 330 million per year. (www.leibniz-gemeinschaft.de)