

Ice winter 2019/2020

The BSH provided information on the ice situation and expected ice development in the entire Baltic Sea and in German coastal waters during the ice winter 2019/20 with the following reports and maps:

123 Ice reports (Amtsblatt, normally issued Mon - Fri),
30 weekly reports,
29 ice overview charts (once a week as a reference map for the whole Baltic Sea),

Due to the lack of ice on German coasts, no "German Ice Reports", no NAVTEX messages and no ice reports "Deutsche Ostseeküste" and "Deutsche Nordseeküste" were issued.

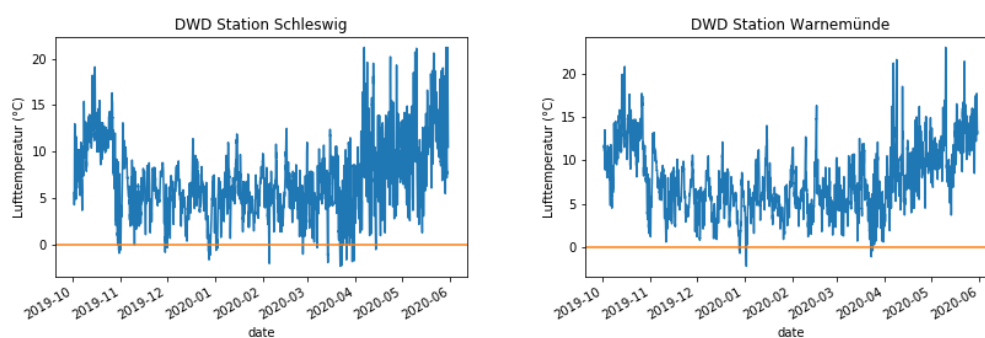
The current BSH ice reports and ice maps are available free of charge on the Internet at <https://www.bsh.de/Ice>. The archive with all ice charts produced so far is available at <ftp://ftp.bsh.de/outgoing/Eisbericht/>.

Ice winter 2019/20 in Germany

No sea ice occurred on German coasts in the 2019/20 season. The ice-free winter of 2020 continues the temporal trend towards weaker ice winters found in the Ice Atlas and in earlier seasonal reports. Ice-free winters on the German coast like 2020 (or as good as ice-free winters with a cumulative ice volume sum of less than 0.01) occurred ten times in the past on the Baltic Sea coast (in the period from 1879) (in 1882, 1884, 1898, 1944, 1988, 1989, 1990, 1992, 2000 and 2007) and on the North Sea coast (in the period from 1897) a total of 17 times (1898, 1911, 1925, 1927, 1944, 1975, 1989, 1990, 1992, 1993, 2000, 2002, 2004, 2007, 2008, 2015, 2019).

Air temperatures Germany

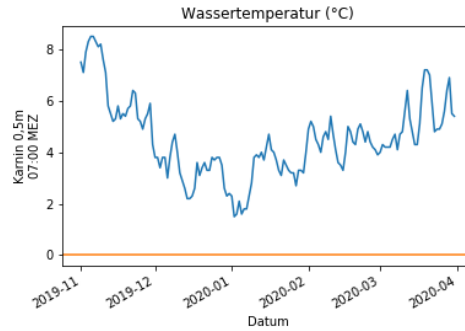
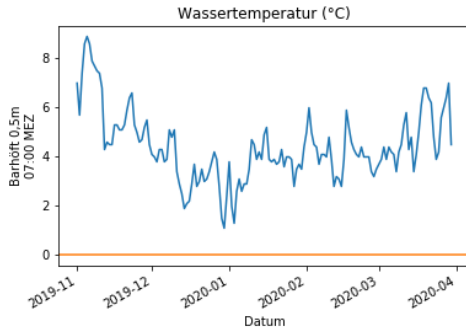
Weather data from Germany come from the German Weather Service. Since air temperatures at 2m altitude in northern Germany were almost continuously significantly above 0°C (mostly around 5°C) and only sporadically fell below 0°C, the seawater did not cool down enough to form ice even at sheltered locations. Therefore, no ice was reported by all German ice observation stations.



2m Air temperatures (source DWD) of the stations Schleswig and Warnemünde.

Water temperatures Germany

Daily water temperatures are recorded continuously by several sources (most from WSV gauging stations, but also from other government agencies and the Navy) during the winter. At Barhöft and Karnin, both measuring at 0.5m water depth and located in shallow, sheltered areas, temperatures below 2°C occurred at times, but neither came close to 0°C at any time. At the other stations on the German coast, water temperatures were generally above 2°C throughout.

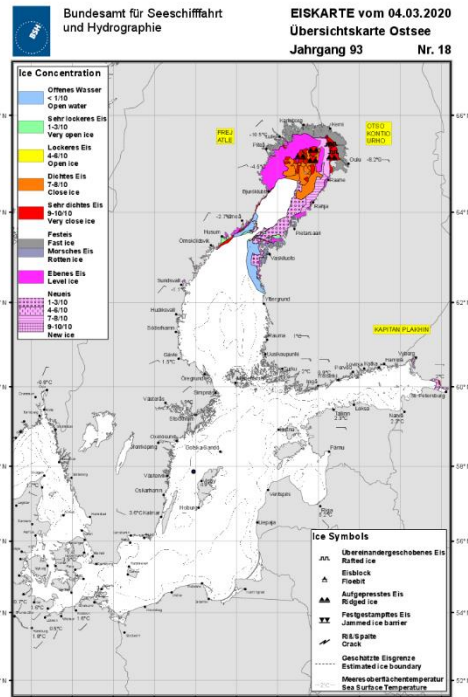
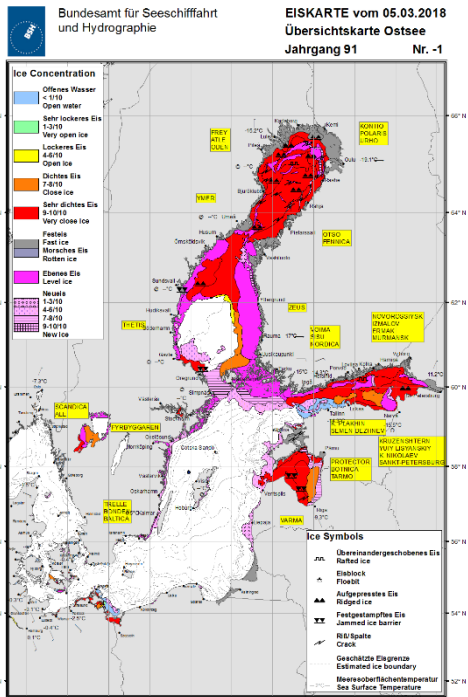


Ice winter 2019/20 of the entire Baltic Sea

At the beginning of November, the Bay of Bothnia experienced heavy frost at night and also the daytime maximum temperatures were partly below 0°C and the first ice formed. Therefore, the first weekly report was issued on November 4 and the first Amtsblatt and ice chart on November 7. However, this cold phase, during which ice thicknesses up to 10cm were reached on the coasts of the northern Bay of Bothnia, ended in the 46th calendar week (11.-17.11). After this relatively early start, further ice formation was slow and it was not until December 7, with maximum ice thicknesses of about 20cm, that the first shipping restrictions were imposed. After another relatively mild phase, a somewhat colder phase occurred in late January/early February and ice cover in the northern Bay of Bothnia increased; however, this increase did not last long. A further increase then occurred at the end of February/beginning of March, which then also led to the maximum ice extent. The maximum with 36000km² was reached on 4.3.2020 according to the weekly BSH ice charts. According to the daily Finnish/Swedish ice charts the maximum was on 5.3.2020 with 37.000km². The northern Bay of Bothnia was ice covered and along the coast the ice extended down into the northern Sea of Bothnia. As the season progressed, the ice cover decreased, but it took until the end of May for the last ice to disappear and for the season to end with the 129th Amtsblatt on May 25; a relatively normal end in terms of timing.

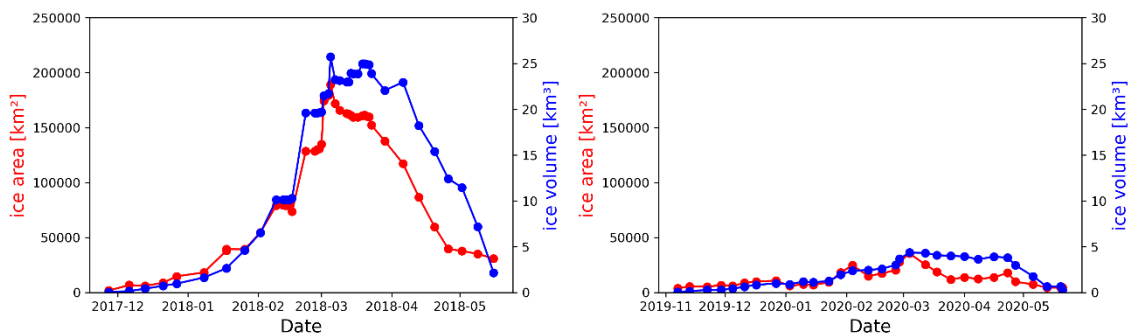
The maximum ice-covered area of about 36-37000km² is the smallest since estimates are available (from 1720). Prior to the 2019/20 season, the 2007/08 season had the smallest ice-covered area to date at 49000km², followed by 2014/15 at 51000km². The 2019/20 season volume of about 4.4km³ is also the smallest after 2015 (5.5km³) and 2008 (9.0km³). However, the volume time series only goes back to the 1970s.

The length of the ice season, measured as the period from the first gazette on 7/11/2019 to the last one on 25/5/2020, was more on the longer side, but this is also related to the early start of the gazette before the first shipping restrictions on Dezember 7. Therefore, since the length of the season covered by ice charts is also longer, in comparison, the figures of the accumulated ice volume total of the entire Baltic Sea of the 2020 ice winter are stronger than those in 2008 and 2015.



Comparison of the maximum ice extent in a moderate ice winter (left, 2017/28) and the extent of the 2019/20 ice winter (right) with the lowest ice cover ever determined.

How weak the 2019/20 ice winter was can also be seen well in the comparison of the course and maximum values of coverage and volume with the 2017/18 ice season. This ice winter fell into the moderate winter category (171000 to 294000km²) with an ice coverage of about 180000km². The above increases in ice cover at the end of January and end of February are only weakly discernible with the same scaling, and in 2017/18 the increase in ice-covered area within a week was sometimes larger than the maximum ice cover in 2019/20.



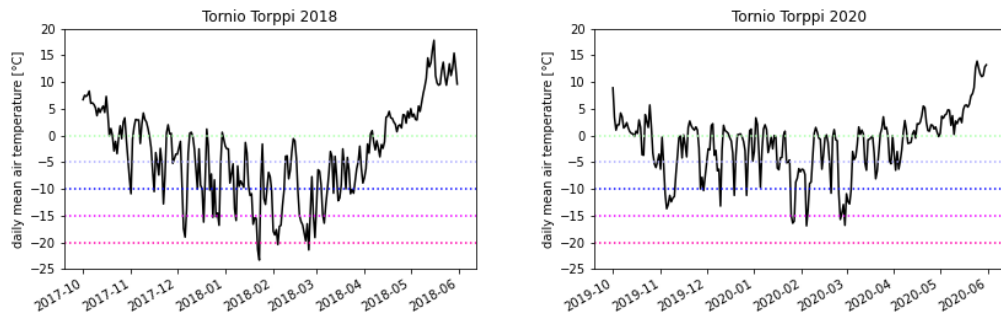
Comparison of the time course of ice extent and ice ice volume in a moderate ice winter (left, 2017/18) and the 2019/20 ice winter (right).

Shipping restrictions

Due to the low ice cover, no or only light shipping restrictions were in force in many places. Comparatively severely affected were the Finnish ports in the Bottenwiek, where the highest restrictions were ice class IA and 2000dwt. Due to the low coverage, the ice was relatively mobile and the predominantly westerly winds drove the ice eastward, where press ice barriers and ramped ice formed. On the west side of the Bay of Bothnia, conditions were generally easier for navigation. Thus, on the Swedish side, restrictions were lifted as early as May 11, while on the Finnish side they were not lifted until May 20.

Air temperatures Finland

The Finnish Meteorological Institute (FMI) provides weather data from many Finnish stations on its website, some of which are used here. Interesting here is also a comparison with previous ice winters. Since in the ice winter 2019/20 ice occurred almost only in the Bay of Bothnia, we take as a characteristic station Tornio far north, on the Finnish-Swedish border.



In November 2019, temperatures dropped below -10°C for several days, which led to initial ice formation and why the first gazette was issued on November 7. However, due to temperatures around and above 0°C , further ice formation stalled thereafter and it was not until December 7, that the ice situation was such that the first shipping restrictions were issued. In the further course, the daily mean temperatures dropped to -10°C on individual days, but were mostly at only 0°C and sometimes just above. There were only two longer cold spells at the end of January and at the end of February, when daily mean temperatures of about -15°C were reached.

Comparing this to the 2017/18 ice winter, the slightly longer, cold, early phase is missing. However, the beginning of the shipping restrictions on 6/12/2017 (at the same time also the first issue of the *Amtsblatt*) was almost simultaneous. In 2017/18, however, daily means above 0°C were never observed in January, February, and March, and temperatures below -20°C were sometimes observed. Monthly means from December to April (-7.3 , -9.6 , -12.6 , -8.3 , $+0.4$) are more in line with the climatological mean (-6.2 , -9.9 , -9.3 , -5.1 , $+1.1$) than winter 2019/20 (-2.5 , -4.2 , -5.9 , -3.0 , $+0.2$), which therefore tended to be warmer than average. The difference between the two ice seasons is also found in the cold sum (sum of all negative temperatures), which is equal to -1285 for 2017/18, while it is only -725 for 2019/20.

Annex 1: All BSH ice cover charts for the 2019/2020 season.

