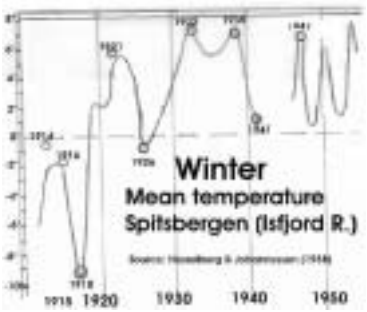
Spitsbergen heats up – Big Warming 1918 (5_12)

Warming process started around 1880

A severe rise in temperature occurred out of the blue north of the European continent in 1918. With the end of the Little Ice Age (~ 1850), and after Krakatoa's volcanic dust had disappeared from the global skies (~ mid-1880), global temperatures had started to rise significantly and steadily. The turn to warming can be largely attributed to less and almost insignificant volcano activity since the second half of the 19th century. Had the earth been free of any industrialized civilisation, the temperatures would have risen constantly. This process would have been reversed one day, when a mighty volcano, meteorite or an oceanic current change would have altered the course of the climate towards a colder world. But the earth has a civilisation that may have interfered. And it did. A number of states waged a war at sea in Northern European waters from 1914-1918. Suddenly the temperatures at Spitsbergen received a big boost. The Norwegian Arctic island Spitsbergen had the same air temperatures as Berlin in January 1919. Had that been caused by a war at sea taking place further in the south? The answer will be 'yes'. The question is only how did it happen and how to prove it?

Rise in temperatures



The armistice had just been signed in November 1918 when Spitsbergen experienced an extremely warm winter. First World War activities at sea seem to have initiated a significant shift in the climatic patterns in the northern North Atlantic. Suddenly the temperatures made a jump. The change was so pronounced that the scientific community spoke of the 'Greening of Greenland' during the 1920s and the 'Warming of Europe' for two decades thereafter. All that stopped with the commencement of WWII. In 1940 the global mean temperatures stopped rising and in some areas even dropped considerably. This also seems to have drained away the interest in identifying the reasons for the 'Warming of Europe' in the 1920s and 1930s.

Searching for reasons for this warming in the Northern North Atlantic is the aim of this paper. To achieve this objective it is proposed to focus attention on the location where the warming started. Once the location is reasonably identified, it makes sense to look for causes, either precisely identify a cause or proof or rule out any cause and conclude that everything happened by sheer coincidence.

Secondly this paper proposes to focus the attention on identifying the region that served as a cradle for the climatic change from 1918 until the start of WWII, with the aim of linking the war at sea in the North Sea and Britain's Home waters to the climatic change. Spitsbergen, the region particularly in focus, is halfway between the North Pole and the North Cape, and about 2,000 km north of Scotland. North of Spitsbergen the North Atlantic ends.

WWI had hardly ended in November 1918 when high in the northern hemisphere a change of great significance occurred. An accelerated warming of the air temperatures occurred high up in the northern North Atlantic. In the 1930s a number of scientists mentioned this fact in more or less general terms. They will be mentioned first. In subsequent sections a brief presentation of the general temperature developments during the pre-WWI decade and in a further section a detailed description of the data records at Spitsbergen and the wider region from about 1914-1922 are given.

Focus on Spitsbergen

One of the first to point to the extraordinary temperature developments at the 'Green Harbour' Spitsbergen station was the Norwegian scientist B.J.Birkeland[1] in 1930. He was very surprised at what he discovered. He finishes his brief essay: "In conclusion I would like to stress that the mean deviation results in very high figures, probably the greatest yet known on earth". A couple of years later, in 1936, Johannsson (Helsingfors) and Scherhag (Hamburg) put Birkeland's findings into a wider context.

Johannsson [2] considers the recent temperature conditions at Spitsbergen with reference to Birkeland's research from 1930. Although Johannsson focuses his investigation on the relevance of sun-spots, some general findings are nevertheless interesting, for example:

- In 1919 the statistical means crosses zero-value; or in other words, all previous years are colder, all later years are warmer (p. 86).
- The climate had become more maritime (p. 86).
- Between 1917 and 1928 the increase during the summer season is +0.9°C per 10 years, and in winter +8.3°C, in February +11.0°C (p. 87).
- There was a colder period from 1912 to 1917 (p. 90), which, had this not occurred, would have resulted in a 1.1°C increase at the Green Harbour Station (p. 91).

[1] Birkeland [2] Johannsson

- As is known, the winters in Europe over recent decades (after 1880, even more since 1900) have become milder, the climate more maritime, the annual temperature means higher (p. 91).
- It seems that the changes are coming from the North, but this is not necessarily confirmed by temperature observations at some stations (e.g. Stockholm, Edinburgh), showing a warming from 1876-1920, but not later (p. 91).
- Temperatures in North Norway show no change between 1891-1905, but a +0.4°C change between 1921-30 (in Svalbard, 2.5°C), indicating that the increase in N-Norway is only delayed, and presumably also in Svalbard (p. 91f).

Johannsson's main conclusion is that the increased air circulation (15 % higher) between 1896 and 1915 had gradually changed the current and ice conditions, thereby altering the borders between the Arctic gulf current climate and the true Arctic climate further north.

Scherhag[3] discussed in his paper of 1936 the extraordinary increase in the winter temperatures in Greenland, concluding that this was caused by a considerable retreat of the ice border and the prominent increase of the atmospheric circulation[4]. Concerning the situation at Spitsbergen in 1919, he only refers to Birkeland's work from 1930, as stated above. In 1938 Brooks[5] pointed to the anomaly in Scherhag's assertion on increased circulation: Attributing the recent period of warm winters to an increase the in strength of atmospheric circulation only pushes the problem one stage further back, for one should still have to account for the change in circulation.

Scherhag[6] states that a thorough research on changes in temperatures over the whole northern half of the globe over the years 1921 to 1930 confirmed that the largest part of the region investigated had indeed been considerably too warm during the decade 1921-1930. Scherhag stressed that "such kind of climate change as could now be observed in Spitsbergen and along the western coast of Greenland were certainly not restricted to a small region but must be global"[7]. In his subsequent research paper Scherhag also pays little attention to the situation at Spitsbergen in the late 1910s, merely acknowledging that the extent of the temperature increase would doubtlessly be greatest in the Arctic[8].

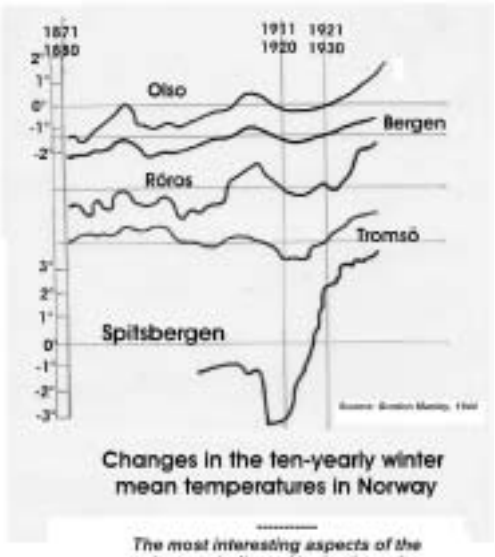
[3] Scherhag, Nordeuropa [4] Scherhag, Nordeuropa [5] Brooks
[6] Scherhag, Arctic [7] Scherhag, Arctic [8] Scherhag, Milderung
[9] Kelly, et.al.

Kelly et.al.[9] concludes: Concerning the average temperatures in the Arctic (65°-85°N) a warming of 1.6°C occurred between 1917 and 1921, with the maximum reached in the 1930s. Rapid warming affected the Arctic during the late 1910s and 1920s, with the average temperature peaking during the late 1930s.

There are a number of other research papers dealing with the warming of the Northern Atlantic since the end of the 1910s, which will be discussed in another chapter: Warming of Europe. All pre-WWII papers acknowledge the suddenness of the rise in temperatures in the North Atlantic region since the early 1920s but make little use of the hint given by Birkeland in 1930[10] (see: above) that something extraordinary happened in Spitsbergen at the end of WWI.

Spitsbergen Temperatures 1912 – 1926

To find out at what time exactly the climatic changes of the 1920s started, the following discussion considers the core winter months of December to February, if not stated otherwise. As explained elsewhere, tracing the sources of 'climate making' is much easier if the sun is not involved. Without the sun heat from the oceans is the sole sustainer of the weather mechanism in wintertime at high latitude.
Concerning the summer 1918 at Spitsbergen Weickmann[11] reports that the water in the Fjords of Spitsbergen west coast had been very warm, 7-8°C. WWI had still a couple of months to go.



Changes in the ten-yearly winter mean temperatures in Norway

The most interesting aspects of the changes indicated is the time of commencement of the rise, showing that the turning point was later in the South as in the North: Spitsbergen before 1920; Tromsö in 1920, Roso, ca. 1921-25; Bergen and Oslo, 1924-25.

[10] Birkeland [11] Weickmann [12]Manley
[13] Birkeland

A very clear demonstration of the rise in temperature during winters in the North is given by a graph of temperature developments in Norway from 1871 –1938, prepared by H.W. Ahlmann and reproduced by Manley[12], showing the changes in the ten-yearly winter mean temperature in Norway (Tromso, Röros, Bergen, Oslo) and Spitsbergen. The most interesting aspects of the changes indicated is the time of commencement of the rise, showing that the turning point was later in the South as in the North: Spitsbergen before 1920; Tromso in 1920, Röros, ca, 1921-25; Bergen and Oslo, 1924-25.

As mentioned earlier, the information given for Spitsbergen (Svalbard) by Birkeland in 1930[13] was already a quite sufficient indication of the suddenness of the temperature shift. Some figures are reproduced:
Deviation from monthly means based on average means for January: 16,09°C; February 19.09°C (1912-1926);

Year	**Annual deviation**	**January Deviation**	**February deviation**	**Sum of Jan-Feb**	
1912	-3.1	-8.4	-7.3	-15.7	
1913	+0,2	+0.3	-1.7	-1.4	
1914	-1,3	-5,7	-4.9	-10.6	
1915	-2.0	+1.8	-0.5	+1.3	
1916	-2,5	-8.6	+2.1	-5.5	
1917	-5.0	-7.4	-10.3	-17.7	
1918	+0.1	-10.1	-0.4	-10.5	
Mean deviation per winter months Jan., Feb.: - 4,3					
1919	-0.8	+8.6	-4.7	+3.9	
1920	+2.3	+3.8	+1.4	+5.2	
1921	+0.6	-0.8	+0.1	-0.7	
1922	+2.5	+10.5	+6.9	+17.4	
1923	+2.9	+3.3	+4.8	+8.1	
1924	+2.5	+5.7	+8.1	+13.8	
1925	+1.9	+4.3	+6.3	+10.6	
1926	+0.8	+2.2	+0.5	+2.7	
Mean deviation per winter months Jan., Feb: +3,8					

As already mentioned[14], the change came suddenly. On the basis of half a dozen years the jump before and after winter 1918/19 is about 8°C. Comparing only January/February of 1917 and 1918, with January/February of 1919 and 1920 the temperature jump is almost plus 10°C.

[14] Johannsson

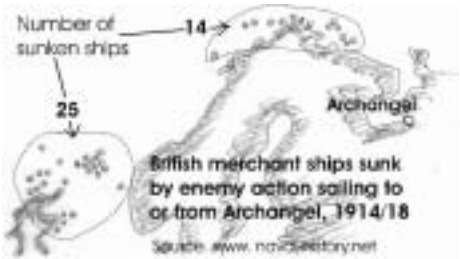
During the winter of 1918/19 the temperatures varied much. There were long periods in November and December 1918 with close to zero degrees (approx. 26 days less than 5°C), with 4 days above zero in November and 7 days in December. In January 1919, on 14 days the temperatures did not reach –5°C, five days were frost-free. With average monthly temperatures of –7.47°C and +8°C, respectively, above 15-year means the sea must have transferred a lot of heat to the air. However, during February – April 1919, the temperatures were well below the average with a large ice cover far out into the sea. But that did not affect the significant warming that started a few months earlier.

One further point needs to be observed. Actually, the 'warming-up' process must have started some months before winter 1918/19. The annual deviation for 1918, i.e. "+0.1", indicates the end of a cooling trend since 1915, during the previous winter 1917/18, sometime in spring or early summer 1918. The warming at Spitsbergen started in 1918. The 'warming processes' must have started within a short period of time, definitely not before 1916, and the 'Severe Warming' at Spitsbergen not later than winter 1918/19. During that time the war at sea in English waters had been going on and the first mines of the Northern sea-mines barrage had just been laid when temperature data records started indicating a sharp rise (A).

Further details: (A) Sea mines warfare 1914-18 (5_14).

As the 'rise' sustained for two decades only, the seas, by a substantial shift of the seawater bodies around Spitsbergen and the Northern Seas could have generated such long-term climatic changes. This section could establish with high reliability, that a colossal temperature rise occurred in the Spitsbergen region from summer 1918 to winter 1918/19.

Cause for the rise in temperature

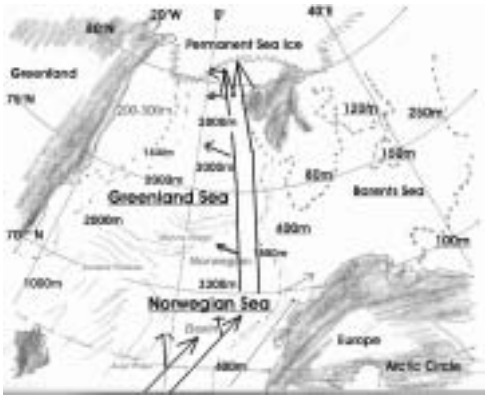


The questions on the causes for the temperature increase at Spitsbergen in 1918 can partially be answered very decidedly. The heat must have been generated in the eastern part of the Norwegian/Greenland Sea, either due to internal processes within the water bodies, or by 'more' warm water from the Atlantic Gulf current. The latter came with the West Spitsbergen Current after it had travelled as the Norwegian current from the Hebrides Islands northwards and continuing as the North Cape Current to the Barents Sea.

Once the warm Atlantic water is north of the Hebrides and Iceland matters get very complex. The availability of large and deep-water bodies is the ultimate 'blueprint' for the Northern Hemisphere climate.

But the most remarkable aspect of the ocean system with all its idiosyncrasies is the miraculous stability, which the system has. Everything fits together, and nothing changes without a cause. And the fact that nothing changes in the ocean system without a cause also applies fully to the sudden rise in temperature at Spitsbergen 1918/19.

How the 'Severe Warming' happened in detail is completely out of the purview of this investigation. This paper only aims at reiterating the responsibility of the war at sea for the dramatic warming event in the Spitsbergen area and the ensuing climatic change during 1919-1939. After all, the war at sea 'moderated' the common temperature and salinity structure of huge sea areas and sea bodies over many seasons. Billions of tonnes of water from Britain's coastal areas and the North Sea flow northwards to the Arctic region. This water could 'in one way or the other' have changed the hydro-physical feature, e.g. sinking quicker, freezing later, etc. For this purpose some thoughts on making and sustaining a Severe Warming are outlined in the following four scenarios.



Scenario 1: A considerable part of the Atlantic water moves via currents to the basin of the Arctic Ocean (max. depth 4,000 m). Actually, due to the high salinity of the Atlantic water and the cooling process, the water becomes very dense and 'falls' over a ridge (with a depth of 600 m below sea level) in the Arctic Basin. Before the Spitsbergen current reaches the ridge, at about 80° North, the water at a depth of 20 metres has a salinity of about > 35 per mille and a temperature of up to 7°C[15].

Schokalsky[16] states: The warming of the polar region started in 1921. This is presumably due to the fact that the arm of the North Atlantic current that enters the Arctic Ocean at the edge of the Spitsbergen continental shelf had increased its strength. The cover layer of cold water, which had been 200 metres in the 1890s, was reduced to less than 100 metres in the 1920s.

[15] Knies [16] Schokalsky

More, quicker and closer to the sea surface the warm Spitsbergen Current carries water along the island Spitsbergen to the Arctic Basin, the warmer it will become there and in the Arctic region, and winter icing will be less. Such a situation might have contributed significantly to the severe warming in 1918, but could hardly be the sole source for the sustained warming over two decades.

Scenario 2: The North Cape Current, which supplies the Barents Sea with Atlantic water, may have contributed to the warming in the long run. But generally speaking, the Atlantic water 'disappears' in the East of the North Cape and Spitsbergen. Instead a polar water current flows in from NE and partly joins the Spitsbergen Current in the south of Spitsbergen. According to Wagner[17] the mean water temperatures in the Barents Sea increased by +1.8°C from 1912/18 to 1919/28. From 1916 to 1925 the annual mean water temperature was as follows[18]:

1914 = -0.3°C	1915 = + 0.7°C	1916 = -1.1°C	1917 = -1.5°C	1918 = -1.6°C
1919 = + 0.6°C	1920 = +1.0°C (?)	1921 = +1.0°C	1922 = +1.9°C	1923 = +1.0°C

Wagner's additional observations confirm a 'rise of 2-3°C at water depths of 100 and 200 m over the last 30 years (1895 and 1927). However, a general observation of 'over 30 years' is of little help in this case.

It is not easy to assess how much the only up to 500 m deep Barents Sea might have contributed to the 'Severe Warming'. Presumably not very much during 1918, although the Barents Sea ice border retreated significantly since 1919[19]. On a 10-year mean basis (1911/20 and 1921/30) a significant increase of 6°C at Franz-Joseph Land was observed[20]. After all, a complete renewal of water body of the Barents Sea is completed in every four years[21]. Thus, the Barents Sea would require a permanent water inflow, which could only come from the South when it is supposed to sustain warming. According to Lamb[22], the highest water temperatures in the top 200 m of the Barents Sea at 70-72°N; 33°E, north of the Kola peninsula, already appeared to have been reached during the period 1935-39.

After all, the Barents Sea may have contributed to the warming of Europe from 1918-1939 on the basis that the sea received warm water and changed something of its internal processing, different from previous years.

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[17] Wagner, p.50 [18] Wagner, Tabl.10 [19] Wagner, p.47
[20] Kirch [21] Schokalsky, p.71 [22] Lamb, p.528

Scenario 3: West of Spitsbergen the seawater has temperatures of 5°C and a salinity of 34.90 –35.00 mg. A big part of the warm Atlantic Gulf water that has reached Spitsbergen, 'turns left' in southwest direction at position 75-77° North and flows either as Greenland current down to Newfoundland and back in the Atlantic or goes down the huge Greenland Sea Basin with depths of 2,000 metres and more (max. ca. 3,500 m), or circles for some time with the surface water layer or the thermocline waters. This water may have contributed to the warming at a later period of time on a long-term basis.

Scenario 4: At fourth place is the Norwegian Sea Basin with depths of 3,000 metres. The whole eastern part of the European North Atlantic – Norwegian Sea - is a reservoir for Atlantic Gulf water going to depths of 800 metres. This water body has a huge heat retaining capacity. Any increase in temperature, or enlargement of the 'warm water part', or 'its functioning', would quickly be reflected in temperatures at Spitsbergen, in Europe, or elsewhere in the Northern Hemisphere. In addition, while the deep water of this basin is formed north of Jan Mayen, it can, in exceptional circumstances, by any means, warm Atlantic water that is 'pushed down' to lower depths after passing the Shetland Islands, Faroe Island and Iceland ridge (approx. 500 m). This water then remains in the Norwegian Sea for some time, until 'the time has come' for increased heat, which reaches the sea surface again to be released into the atmosphere. The war at sea could have caused the Norwegian Sea to increase its heat storage during the war years 1914-18.

This 'restructuring' of the sea body by the war at sea could also have led to an increase in the inflow of warm water[23]; whereby in a section crossing the Norwegian Atlantic Current, a very marked change occurred in 1928, when temperatures and salinities had relatively much higher values than previously observed. From May 1927 until May 1929 a dynamic calculation showed an increase in the masses of 'Gulf Current' streaming northwards to the Norwegian Sea of about 20%.

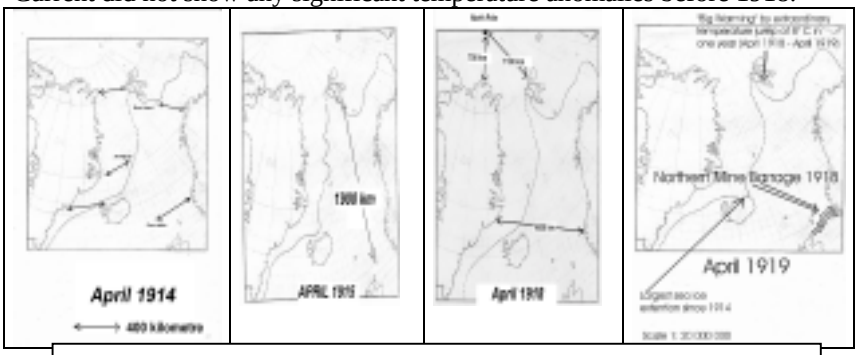
As an interim summary it can be said that the temperature rise in 1918 may have been generated by three of four possible causes as mentioned above. For the subsequent climatic change from 1919 to 1939 the Norwegian Sea presumably had been the core contributor.

Sub polar North Atlantic

The North Atlantic from Canada and the United States to the shores of Great Britain and France can be definitely excluded from those causes which have contributed to the severe warming at Spitsbergen. In this connection, reference is made to the information relating to the impact over the time after

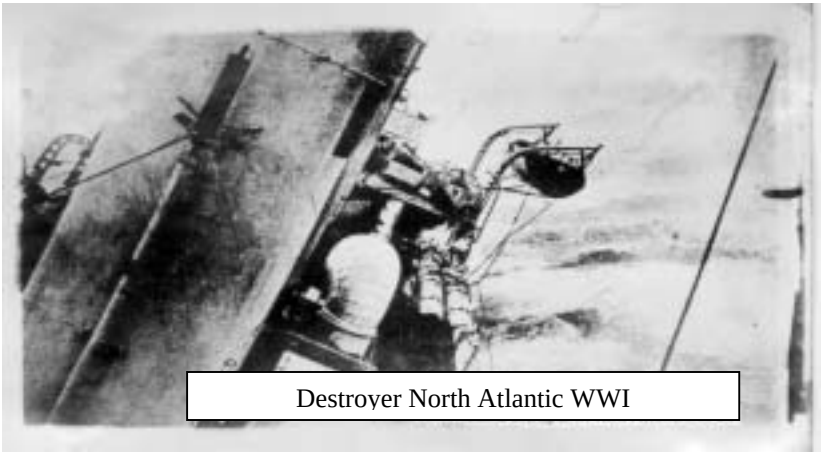
[23] Helland-Hansen

1918, (see below; chapter Warming of Europe 5_15), indicating that the Gulf Current did not show any significant temperature anomalies before 1918.



Sea ice extension in Northern North Atlantic during World War I

A 'manipulation' of the Gulf Currents during WWI while passing the Faeroe Ridge can certainly not be excluded from the causes, at least for the Severe Warming in 1918. However, to sustain the warming for two decades, further 'modifications' must have occurred in the various water bodies north of the Faeroe Islands as well.



Destroyer North Atlantic WWI

Previous research and analysis

Weickmann[24]; At +7-8 °C, the water temperatures in the Spitsbergen Fjords on the west coast were very warm in summer 1918!

[24] Weickmann [25] Manley [26] Henning

Manley[25]: The effect was indeed remarkable; the salty Atlantic water penetrated further into the Arctic to such a degree that, for example, the average length of the coal shipping season at Spitsbergen almost doubled in length, from 95 days during1909-12 to 175 days during 1930-38.

Henning[26]; Before 1917 the duration of shipping to Spitsbergen had averaged 94 days but since 1918 –1939 it had become 157 days. The warming moved the vegetation in Scandinavia some 100 km further north.

Schokalsky[27]. The discovery concerning the warming of the Polar Sea, which dates from 1921, was also observed by the 1928 *Marion* Expedition in the Baffin Bay as well as in the Barents Sea.

Kunz, G.[28] dates the temperature shift at Spitsbergen to 1918, based on the winter ice conditions around Spitsbergen, noting that after the very ice-rich years of 1915-17 the subsequent years since 1918 had most been ice-poor.

WWI depth charge secured & in action

Brooks[29]: At Spitsbergen at least, the rise occurred in two stages, the winters of 1922-23 to 1924-25 being warm, those of 1925-26 to 1929-30 somewhat cooler, and those of 1930-31 onwards warmer than the first group.

Summary

Every aspect elaborated above with regard to the warming at Spitsbergen indicates that it was not a common meteorological event, but a 'Severe Warming' in terms of climatic change. The change was not only severe but also lasted for two decades. That is

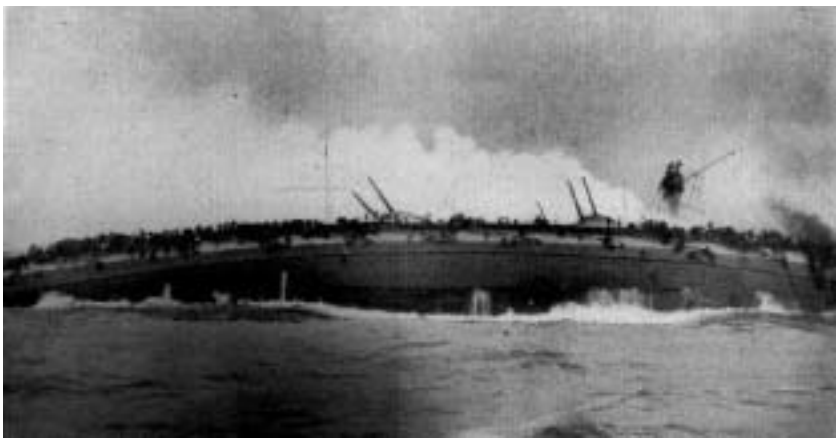
[27] Schokalsky [28] Kunz [29] Brooks,

possibly even not less remarkable. The shift could evidently be dated to have happened from about summer 1918 to spring 1919, whereby January 1919 with mean temperatures +9°C above average definitely marked the turning point. January 1919 is presumably the only major climatic change event in recent times that can be dated with such precision.

The big shift remains extraordinary even considering that the period 1915-18 had been relatively cold. The rise remains remarkable even if the cold war period of 1915-18 is reduced to the general warming trend since the 1880s. The shift in 1918/19 would still be "probably the greatest yet known on earth" as Birkeland saw it in 1930 (see above).

The 'Severe Warming' occurred in very close correlation with the war at sea waged only 2,000 km further south from where the ocean and North Sea waters need only 2-3 months to be carried by the Norwegian and Spitsbergen Currents to the Arctic region. The war at sea in Europe had shifted to high gear since winter 1916/17. This could have changed the structure of water bodies and currents over huge areas. The Northern Sea Mines Barrage laid in 1918 could have provided the 'last straw' for the warming, which showed its appearance in summer 1918 with extraordinary warm water temperatures in the Spitsbergen Fjords[30].

After all, the 'Severe Warming' at Spitsbergen in 1918 did not come from "nowhere", nor did the subsequent 'climatic change'. The war at sea from 1914-18 unleashed forces, that were presumably mighty enough to cause a severe warming at Spitsbergen.



Sinking battleship

[30] Weickmann, FN 11