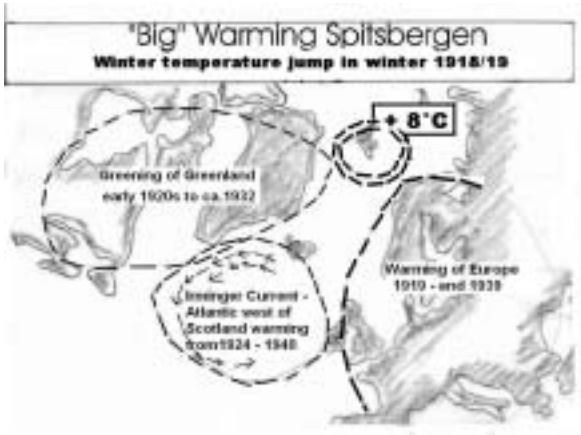
Warming of Europe, Greening of Greenland (5_15)

Climate Change - War at Sea impact 1918 to 1939

The Theme – chain of proof

This paper aims at establishing that the war at sea from 1914-18 was responsible for the major climatic change events during the 1920s and 1930s, such as the Greening of Greenland, Warming of Europe and the Dust Bowl in the 1930s, etc. which attracted wider interest. Towards this purpose climate observations during the period in question will be analysed relating to significant changes, their timing, location, etc. If a closer link between the war at sea and any of these events can be established, it will lead to reliable evidential circumstances in support of the cause.



In a detailed analysis a close timely interrelation between the military activities and the Severe Warming at Spitsbergen has been established, (A). The following elaboration will further establish that the major climatic events in the subsequent two decades had their origin in the 1918 event (B). This discussion will be based on data compiled in the next section under: General Statements, Facts and Remarks, subdivided into relevant sea areas in the far north of the Atlantic.

It is widely acknowledged that the regions between Greenland and Iceland in the west, and the Barents and Kara Seas in the east, and lands surrounding them are the regions most sensitive (perhaps in the whole world) to climate changes, and that they respond very strongly to either warming or cooling[1]. The Norwegian Sea, due to its size, depth, and warm current may occupy the prime place among climate sensitive areas in the polar North Atlantic (C).

> Further details: (A) War at sea, 5_13, and Sea mines, 5_14; (B) Spitsbergen heats up, 5_12; (C) Sea system effected, 4_12.

[1] Lamb, Arctic Ocean, pp. 135-161.

However, each of these regions has an individual climatic history during the period from 1918 to 1939. Certain events and aspects of a sea area can provide facts to the 'chain of proof' that the origin of climate change was in time and location close to WWI. This shall be done by brief statements concerning the -

1. North Atlantic region relevant to the Severe wWrming, and for the
2. three climatic events between 1918 and 1939,

based on material compiled below under section: General Statements, Facts and Remarks, to which the reader is kindly referred to.

Impact on different sea areas

Spitsbergen had been the centre of the 'severe warming' in 1918, and remained the central area for the accelerated warming trend through the 1920s and 1930s.

Even though the Barents Sea played a major role in the warming-up process, it was clearly not the principal cause It reacted more like a follow-up to what was happening further west, with clear indications that its influence increased after 1930 until 1939.

Greenland experienced a brief warming period from the early 1920s to early 1930s presumably initiated by warmer water that was diverted from the Spitsbergen Current to 'the left', towards Greenland in 1918/19.

Greenland Sea: Although the data available from Jan Mayen since 1922 indicate a relatively stable situation of the temperature values from 1922 to 1928, a modest rise occurred since the end of the 1920s. During the 1930s mean winter temperatures had been temporarily significantly higher. This is analysed as follows:

a) The first period can be regarded as proof that the warming in 1918 and the following decade occurred primarily in the Eastern part of the North Atlantic, and that the brief warming of Greenland during the 1920s was a short-term 'over-flow' from the Spitsbergen Current or the Norwegian Sea in 1918 and during the following few years.
b) Varying levels of warming during the second period may have a correlation with an increased influence of the Gulf Current since the end of the 1920s.

The sub polar North Atlantic had no impact on the severe warming at Spitsbergen in 1918. Available data seem to indicate that the air and sea water temperature remained on an 'average' until the second half of the 1920s, after which a continuous warming trend set in, lasting until 1939. Whether the modest temperature rise alone would have had any significant impact and whether it would have significantly influenced the continuous

warming of the European North Atlantic is difficult to confirm. However, by 1928 the Gulf Current seems to have flowed more forcefully towards the North; see the following paragraph.

Norwegian Sea. Very little information during the period 1918-1939 is available to assess the actual impact during the post WWI period. Nevertheless, the continuing temperature rise over the Northern European continent (e.g. Norway), and the Barents Sea and its continued stability at Spitsbergen, should be related to the warming potential of the Norwegian Sea. By the end of the 1920s the Gulf Current seems to have gained even more influence.

This assumption is based on the following facts:

a) A stronger inflow to the Norwegian Sea in 1928 is recorded (see: section Norwegian Sea, Helland-Hansen; below).
b) Sea areas' temperatures seem to have got some 'backing' around 1930.
c) The warming of Europe continued forcefully through the 1930s, with the warmest winters in 1937/38 and 1938/39.
d) The 'Dust Bowl' in the United States started in 1931 (see: below).
e) The winter of 1928/29 had been extremely cold in Europe, which might have been caused by too warm water in the Norwegian Sea.

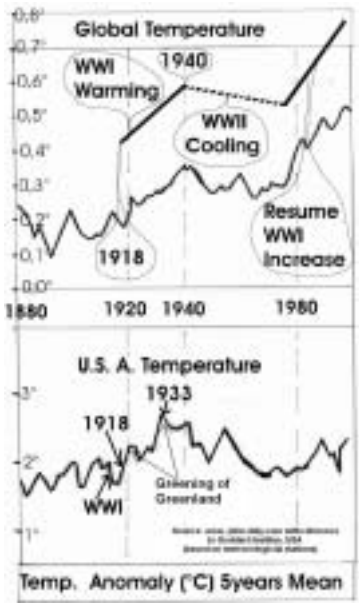
It seems that the Norwegian Sea presumably experienced two sea water warming events, the first in 1918, and the second about ten years later. One can only guess that the warming of air temperatures at Spitsbergen and Northern Europe during the 1930s could have been more moderate without the second event.

Remark: The winter of 1928/29 had a very special meteorological feature, so did the even more extreme winter of 1946/47. The latter is by date closely related to WWII. A time period of ten years had passed before the winter of 1928/29 occurred. After WWII it is less than two years. A correlation between WWI and WWII and the two extreme winters should not be prima facie ruled out. The huge and deep Norwegian Sea still holds many secrets. If one deep-sea 'bubble' had taken shape during WWI or WWII, it might take a different time period to burst.

Three major climatic events after WWI

The 'Greening of Greenland': The 'Greening of Greenland' was remarkable because it was quite sudden and significant enough for recognition. More important is the fact that the warming was on a short-term basis only. It lasted only about ten years. This is regarded as a supporting factor to the war at sea thesis. The war at sea 'initiated' a severe warming in Spitsbergen in

the waters of the North Atlantic 1918. Its impact on the water body was so massive, that a considerable part of the 'transformed' water at Spitsbergen took a westward direction to Greenland. After a short period of time a warming along the Greenland coast was observed and called the 'Greening of Greenland'. The effect of the warm water lasted only for a short while. After one decade the warming had died away. That indicates a sudden and mighty interference, like the eruption of a volcano or an earthquake. Nature reacts, but returns to its normal equilibrium after a period of time. If the Severe Warming in 1918 was 'war made at sea', then the Greening of Greenland was also of anthropogenic making.



The Great Plains 'Dust Bowl': Recently scientists from NASA's Goddard Space Flight Centre in Greenbelt/USA*), found by computerized climate simulations that warm water in the tropical Atlantic initiated a wind circulation that cut off the flow of moisture from subtropical waters to the Great Plains. The point stressed by the scientists is that the sea water temperatures played an important role in this matter, even if the warming or cooling occurred only for a fraction of a degree. In the early 1930s the jet stream over the Gulf of Mexico weakened and operated further south, thereby excluding the Great Plains from the common supply of precipitation.
*) NASA; -www.nasa.gov/vision; keyword: Dust Bowl; Krishna Ramanujan.

At the mid-latitude circulation the temperature gradient between the equator and the poles determines the location of the subtropical jet stream. When the polar areas are warm, as in summer usually, the gradient lessens and the strength of the westerly airflow diminishes.

A warming of the northern North Atlantic at Spitsbergen, with a serious climatic shift in 1918, and possibly, a much smaller one again in 1928, would inevitably affect the flow of the Westerly. Although the rain bringing jet stream to the Great Plains consists of low flowing air, the accelerated warming in the northern Atlantic may have played an important part in the long-term drought during the 1930s.

'Warming of Europe': The warming of Europe from the end of the 1910s to 1939 has been widely acknowledged since the early 1930s. The source of the warming in 1918 were the European Atlantic waters: Norwegian Sea, the Spitsbergen Current and the Barents Sea, presumably established and sustained by an internal process in the Norwegian Sea, and/or supplied by a temporarily or long-term increased inflow of Gulf Current water at the end of the 1910s and 1920s.

The warming of Europe actually started most markedly in Britain with a cooling during the WWI years from 1914-1918. The responsibility of the war at sea for this cooling and Britain's three successive snow winters between 1915 and 1918 has been explained in a previous chapter. More important is the considerable circumstantial evidence that the Severe Warming at Spitsbergen in 1918 was presumably the immediate result of the war at sea around Britain, and in the North, Baltic and Barents Sea. Whether the total European warming period from 1918 to 1939 was solely or partly caused by WWI is of secondary importance only, if a further even more convincing cause can be named. The Severe Warming of 1918 was too serious and demands more than just a cursory interest.

General Statements, Facts and Remarks

Spitsbergen

Substantial information on the severe warming in 1918 has been compiled in chapter: Spitsbergen heats up (5_12).

Spitsbergen. (data since 1912): Spitsbergen is of special interest as the climatic warming can be particularly well observed there. The increase during winter is very pronounced[2].

Brooks[3]. At Spitsbergen the rise occurred in two stages, the winters of 1922 till 1923 had been warm, those of 1925/26 to 1929/30 somewhat cooler, and those of 1930/31 onwards warmer than the first group.

Scherhag[4]. At Spitsbergen the warming up continued until WWII, according to the following table:

Spitsbergen: Deviation of mean monthly temperatures - winter months December to March

1918 – 19 = + 1.1	1925 – 26 = + 0.6	1932 – 33 = + 5.8
1919 – 20 = + 2.2	1926 – 27 = + 2.0	1933 – 34 = + 6.5
1920 – 21 = + 1.9	1927 – 28 = + 2.6	1934 – 35 = + 6.5
1921 – 22 = + 4.3	1928 – 29 = - 0.2	1935 – 36 = + 6.0

[2] Kirch, p. 22. [3] Brooks, 1938 [4] Scherhag, Polargebiet

1922 – 23 = + 3.7	1929 – 30 = + 2.9	1936 – 37 = + 7.5
1923 – 24 = + 4.1	1930 – 31 = + 5.5	1937 – 38 = + 8.0
1924 – 25 = + 5.3	1931 – 32 = +5.6	1938 –39 = (+ 7.1)

Lamb[5] provides a graphic account of the temperature difference between 1911-20 and 1921-30 with the centre east of Spitsbergen (+6°C). Lamb indicates that this region, together with the Norwegian Sea, seems to be the most sensitive to climatic variations.

Greenland Sea / Greenland

Jan Mayen (data since 1920): The warming is not so significant, amounting to only 0.25°C during the period 1922/31 and 1930/39[6].
If means for the four winter months December-March are analysed, only the winters of 1928/29, 1929/30, 1932/33, and 1938/39 saw an increase in temperature of 1 to 1 ½°C. Particularly the winter seasons of 1921 to 1928 seem to have been quite 'stable', varying at the most by 0.35°C. During the 1930s a modest rise occurred. Note: The monthly mean temperature data can be found in the work of Kirch[7].

Myggbukta/East Greenland (data since 1922; 73°29'N, 21°34'W): According to Kirch, the station's summer mean had shown a typical warming trend, lasting until 1930/39 with a maximum of 3.29°C. A cooling started in 1931/40[8].

Analysing climate developments on the winter temperature data, one can see a warming trend since winter 1923 until 1933. Between 1933 and 1936 the previous gains (+7°C) were lost. Winter temperatures got +5°C warmer again since 1936 until winter 1938/39. Note: The monthly mean temperature data can be found in the work of Kirch [9].

Manley[10]: The last 'bad ice year' in the Greenland Sea was 1923.

Bjerknes[11]: The sea surface temperatures near Greenland culminated in the early 1930s.

Carruthers[12] mentions that due to warmer water, the cod fishing by Greenlanders, increased dramatically, from 500 to 1,000 tons in 1922-1925, to 8,000 in 1925-1929 p.a., whereas the catch decreased to 6,000 tons in the year 1937. An excessively low temperature off East Greenland's coast affects the survival of cod is confirmed by Nellen[13], showing in a graph that the

[5] Lamb, Arctic
[6] Kirch
[7] Kirch
[8] Kirch
[9] Kirch
[10] Manley
[11] Bjerknes, Atlantic
[12] Carruthers
[13] Nellen

production continued on the level of about 5-6,000 tons until 1948, then accelerated ten-fold, but dropped almost to zero in the late 1980s.

Bjerknes[14] analyses the warming in the 1920s as follows:
North of about 57° North the trend in sea temperature has been slightly upwards. Actually this change resulted from a brief but strong upward trend in the 1920s, which overcompensated the accumulated effect of a preceding long and slow downward trend. A somewhat similar brisk upward trend, starting as late as 1920, is found in the Labrador Current. ….The warming of the waters in the far northern Atlantic (to which the Pacific has no parallel) was much more sudden and short in range than farther south. Essentially, it lasted only from 1920 to 1930 in Greenland waters and from 1920 to the early 1940s in Iceland and northern British waters.

Barents Sea

Boar Island (data since 1920): The recorded winters of 1920 and 1921 (January/February) were significantly colder than the following, except 1928/29, until the winters of 1939/40 and 1940/41. In so far the warming started with the winter of 1921/22. The annual means are fairly equal (1 to 3.2°C, between 1920 and 1932), only getting warmer after 1932.
The winter means show a general rising trend until 1939 since data are available. What is noticeable is a considerable 'unrest' on a short-term basis, e.g. the December/February means in the winter of 1921/22 were -10°C, one year later it was - 3°C. The cold winter of 1928/29 in Europe is fully reflected in the data record and quite obviously not related to the sea water conditions in the Norwegian/Barents Seas. Note: The monthly mean temperature data can be found in the work of Kirch[15].

Vardo/Norway (North Cape) (data since 1867): After a pronounced cooling during 1909/1918, a strong increase with 0.8°C by 1913/22 occurred, which remained constant until 1919/28. This was followed by a cooling by 0.5°C until 1923/32, culminating in a rapid warming in 1930/39[16].
Taking the winter temperatures as the main indicator of the start of a warming trend, at Vardo the warming only started in winter 1919/20 (December-March), being one degree warmer than the previous years, but also showing a clear warming trend in annual means. Note: The monthly mean temperature data can be found in the work of Kirch[17].

Kelly, et al[18]: The 1920s was a decade with strong warming in the Arctic regions. The Barents Sea and Kara Sea had warmed annually by 2°C by the

[14] Bjerknes, Atlantic [15] Kirch [16] Kirch
[17] Kirch [18] Kelly

mid-1920s, and the Greenland sector had warmed by a similar amount by the end of the 1920s. The warming continued during the 1930s, but more pronounced in winter.

Schokalsky[19] reported of a dramatic thinning of the upper layer (up to 100 m), that was less salty and colder than the lower 600-800 m layer of Atlantic water (high salinity and about two degrees warmer) between Franz Josef Land and Novaya Zemlya, as observed in 1928 and later on, with warming tendency.

Blacker[20] indicates that south of Spitsbergen the warm West Spitsbergen Current had been kept at bay by two cold currents, the Bear Island Current and the East Spitsbergen Current before 1930, and that the West Spitsbergen Current had had no influence beyond 75°N. Blacker continues: The West Spitsbergen Current greatly increased in volume so that it now covers most of the bank as far north as Isfjord, and has a marked influence even further north. A similar chain of events must have caused the disappearance of most Arctic species from the Bear Island region. Blacker concludes (p.37): Changes in the distribution of benthos in the area since about 1930 indicate that there has been a great increase in the area of the bottom over which Atlantic conditions are predominant, and a corresponding decline in the area influenced by Arctic conditions.

Hesselberg, et.al[21]: The rise in the temperatures at Isfjord is confirmed by the data from Vardo (North Cape). Also here the increase is especially rapid about the year 1920, but the rise is more modest.

Blacker[22] reports: Russian scientists have recorded changes in the bottom fauna of the Murman coast and Kola Fjord with an increase of boreal species. When compared with the years 1900-06, these changes have been related with an increase of about 1°C in the mean bottom temperature of the Murman Current for the period 1921-26.

Norwegian Sea

Helland-Hansen[23] reports observations in a section crossing the Norwegian Atlantic Current, where a very marked change occurred in 1928, when temperatures and salinity had relatively higher values than previously observed. From May 1927 to May 1929 the dynamic calculation showed an increase in the masses of the 'Gulf Current' streaming northwards to the

[19] Schokalsky
[20] Blacker, pp. 1, 35, 37
[21] Hesselberg, et.al, Polar, Fig.2
[22] Blacker
[23] Helland-Hansen

Norwegian Sea of about 20%. The effect was observed in high latitudes after a couple of years.

Kushnir[24]: From 1920 onward a basin wide warming ensued, leading to warm anomalies after 1930 or so, depending on latitude and whether sea surface temperatures are examined. The increase is highest in the section 60-70°N (according to Fig.2, p.144).

Manley[25]: A rise in winter temperature means in Norway started after winter 1918/19 with 1-2°C during the next two decades.

Atlantic – South of Iceland – West of England

Bjerknes[26]: Maximum sea surface temperatures occurred from Iceland to England in the early 1940s.

Bjerknes[27]: While investigating the sea surface temperature (SST) conditions between Iceland and the Azores (time series of annual sea temperatures from 1850-1960), he states: 'the sea temperature at the centre goes through the maximum a little after 1890, the minimum a little after 1920, and again the maximum after 1940 (for 61.5°N). Actually, the 'time series' mentioned by Bjerknes (ditto, Fig.5) indicates a modest rise in the SST since about 1926 until the second half of the 1930s.

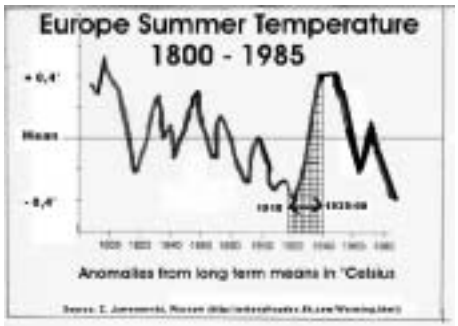
Deser et.al.[28]:
A dominant mode of variation in the winter time surface climate over the North Atlantic during this century is associated with the global surface warming trend during the 1920s and 1930s. It tempts to speculate that the observed climate trends over the North Atlantic during the 1920s and 1930s were due to an intensification of the thermohaline circulation (ditto, p.1752).

The pattern of change in sea surface

[24] Kushnir, Yochanan [25] Manley, Fig.4 [26] Bjerknes, Atlantic
[27] Bjerknes, Fluctuation [28] Deser

temperatures and air temperature between 1900-29 and 1939-68 (or equivalent, the trend during 1917-39) indicate that the warming was concentrated along the Gulf Stream east of Cape Hatteras. The warming also occurred over the Greenland Sea and the eastern subtropical Atlantic.

Eythorsson[29]: Iceland air and sea temperatures had been rising for over two decades since the 1920s, the rise was most pronounced during the winter months (Fig.1 and 5).



Rodewald[30] published in 1948 the deviation of water temperatures at South Iceland from 1895-1939. These figures provide the strong indication that the warming of the ocean at Iceland started only in 1926, which can be regarded as proof that the warm sea water that initiated the warming at Spitsbergen needed about six years to reach Iceland. Due to the significance of these data the record from 1895 to 1939 is reproduced as follows:

Slevogsbank (South Iceland) 63°N, 21°W, sea water temperature differences 1895 –1939

1895, +0.84	1906, -0.27	1917, -0.16	1926, +0.22	1935, +0,47
1896, +0.24	1907, -0.56	1918, -0.05	1927, +0.14	1936, +0,54
1897, +0.19	1908, +0.21	1919, -0.42	1928, +0.93	1937, +0,47
1898, -0.16	1909, +0.37	1920, -0.39	1929, +0.43	1938, +0,73
1899, -0.03	1910, +0.35	1921, -1.07	1930, +0.12	1939, +1,10
1900, -0.02	1911, -0.19	1922, -0.65	1931, +0.14	
1901, +0.28	1912, +0.08	1923, -0.62	1932, +0.39	
1902, +0.20	1913, -0.28	1924, -0.08	1933, +0.66	
1903, -0.10	1914, -0.63	1925, -0.14	1934, +0.54	
1904, +0.43	1915, -0.45			
1905, -0.23	1916, -0.05			

During the time before and after 1926 there was roughly a jump in sea water temperatures of more than one-half degree. This was a very significant change that might have been getting some support from the warming of the north of the North Atlantic, commencing at Spitsbergen in 1918, that reached Greenland in the early 1920s and arrived in Iceland in 1926. However, the Gulf Current would in principle, have caused a warming of the Irminger Current.

[29] Eythorsson [30] Rodewald, Bemerkungen [31] Rodewald, Golfstrom

Rodewald[31] provides sea water temperatures, all showing an increasing tendency since 1919 in respect of three sea areas in the East Atlantic, as follows:

Sea Area	Ca. Position	1906 - 1913	1919 -1939	Shift in °C
Irminger Current	63N,10-20W		Strong increase	+ 2.5 °C
West of Scotland	57N, 15W	Strong varying	increase	+ 1.0 °C
SW of Ireland	50N, 19W	Strong varying	increase	+ 1.0°C

Lumby[32]: In the south-west of Ireland (ca. 100 km), it is evident that until about 1927 temperature conditions at 200 m remained more or less static, but after that an increase took place, which, so far as may be judged from the somewhat scanty observations, has in recent years reached an amount of ¾°C.

Brown[33]: The mean annual air temperature for the area around 51°N 12°W (ca. 200 km west of south-west Ireland) during the period 1880-1960, shows little average trend over the whole period, although it does show a marked warming trend from 1922-1939. The mean annual sea temperatures also show this rising tendency from 1922 to 1939, and also there was a small average rising tendency for the sea temperature over the whole period.

[32] Lumby [33] Brown