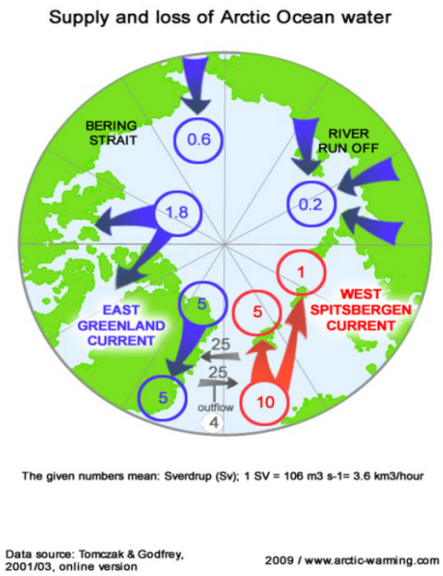
Chapter 2
The Arctic in Climatology

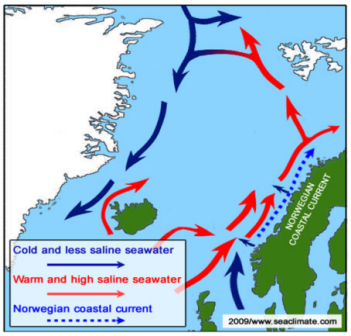
A. The general picture

a) Remote but influential



The Arctic Ocean is rarely in focus of civil society due to its harsh environment and remote location. Even from an oceanic perspective it has not a big weight. Although it covers an area of about 14,056,000 km^2 (5,427,000 sq mi), which is almost the size of Russia, and has four basins with depth of 3000m to 4500m, its total volume is only 1.3% of the World Ocean. However this does not reflect the impact of this ocean in the climatic system, which is substantially higher than its size and water volume. The influence derives from a number of unique physical features, which exist and are at work only here. As main aspect one has at least to name:

- The water body is very cold, generally slightly below 0 °C (32 °F), albeit the water layer at the range from the surface to max. 200m has temperatures close to the freezing point (-1.5° to -1.9° C) with variations over the depth.
- In this extreme cold environment is the degree of salinity of extreme importance, as even minor changes in temperature, salinity and density leads to internal water movements and change to a new equilibrium. At the sea surface and close to the continents the seasonal melting and freezing of sea ice, and river water ensure a high variability, to which the rule applies:
    - Warmer water is lighter than colder water;
    - More saline water is heavier than less saline water.
- During the winter season the ocean is always fully covered by sea ice, and as the sun does not rise above the horizon the direct influence of sunray is nil, while correspondingly during the summer season considerable.
- The Arctic Ocean is permanently supplied with new water from the Gulf Current, which enters the sea close at the surface near Spitsbergen. This current is called the West Spitsbergen current. The arriving water is relatively warm (6 to 8°C) and salty (35.1 to 35.3%) and has a mean speed of ca. 30 cm/sec-1. The warm Atlantic water represents almost 90%



of all water masses the sea receives. The other ca. 10% come via the Bering Strait or rivers. Due to the fact that the warm Atlantic water reaches usually the edge of the Arctic Ocean at Spitsbergen in open water, the cooling process starts well before entering the Polar Sea and is therefore a central aspect throughout this work.

- A further highly significant climate aspect of global dimension is the water masses the Arctic releases back to oceans. Actually, the outflow occurs only via the Fram Strait between Northeast Greenland and Spitsbergen, but together with very cold water from the Norwegian Sea basin the deep water spreads below the permanent thermocline into the three oceans, where it is slowly lost to the surface layer through weak but continuous upwelling, although it can be identified in the abyssal layers of the Pacific Ocean. However, this aspect has presumably not any traceable impact on the early arctic warming and can for the further work be neglected.

Although there is hardly a convincing reason to neglect the recent warming in the Arctic and the extent of ice melt during the summer season, it is not necessarily clear yet, whether the current discussion is based on a sound and comprehensive assessment. Climate research should not only deal with Arctic warming based on observations made during the last few decades, but at least be extremely interested in other climatic events that occurred in modern times, especially if somehow in connection with the situation in the Arctic. Why?

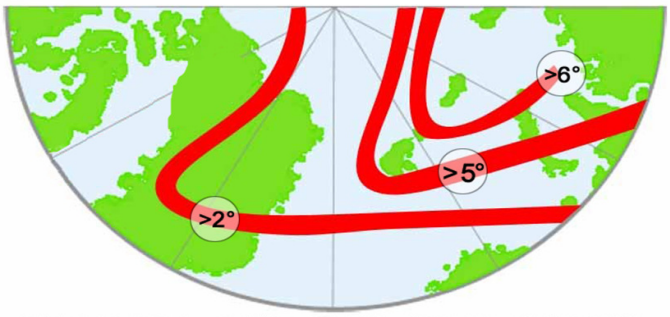
b) A climate revolution in the Arctic?

Beginning around 1850 the Little Ice Age ended and the climate began warming. For a long time, at least since 1650 which marked the first climatic minimum after a Medieval warm period, the Little Ice Age brought bitterly cold winters to many parts of the world, but is most thoroughly documented in the Northern Hemisphere as Europe and North America. The decreased solar activity and the increased volcanic activity are considered as causes. However, the temperature increase was remote and once again effected by the last major volcanic eruption of the Krakatoa in 1883. Up to the 1910s the warming of the world was modest.

Suddenly that changed. In the Arctic the temperatures literally exploded in winter 1918/19. The extraordinary event lasted from 1918 to 1939 is clearly demonstrated in the graph showing the ‘Arctic Annual Mean Temperature Anomalies 1880 – 2004’. But this extraordinary event has a number of facets, which will be raised and discussed in due course. Meanwhile almost a full century has passed, and what do we know about this event today? Very little! Scientific literature is quite superficial concerning all three questions: Where? When? Why? For example, one can find many graphs showing the huge temperature rise in the late 1910s, but the rise was actually located in the most northern part of the North Atlantic, during winter, a location remaining sea ice free throughout the winter season, in the west of Spitsbergen.

B. A Climatic revolution at Spitsbergen and the first assessments

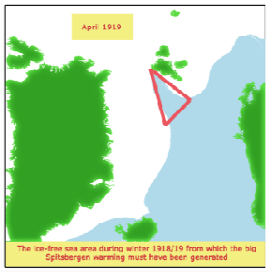
The enormous temperature rise at Spitsbergen in the late 1910s settled only slowly in the scientific community of those days. That may have partly be due to the fact that the Spitsbergen data recording only started in 1912 and the interest started when the actually observed warming needed to be addressed. As much as this investigation could observe, the Spitsbergen observations have been first published by Birkeland who has already been cited with his remark: “In conclusion I would like to stress that the mean deviation results in very high figures, probably the greatest yet known on earth” (Birkeland, 1930).



Winter temperature difference 1921-1930 minus 1911-1920
Data info source: H.H. Lamp; in: "The Arctic Ocean" (1982), Fig.7.10a.
- By approximation only - 2007AB

www.arctic-warming.com

1914



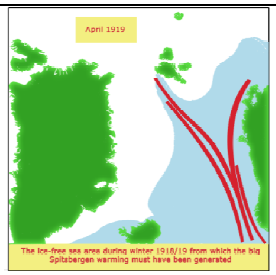
1915

1916

Sea Ice
In April 1914 /19
Did the big warming came from the open sea off Spitsbergen?

1917

1918

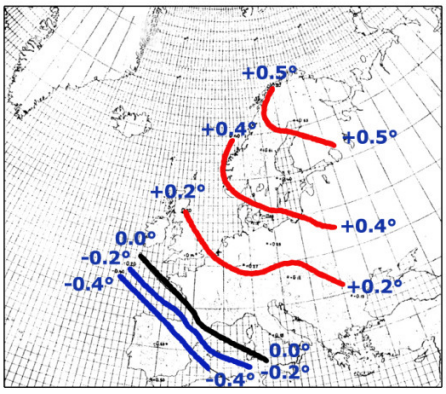


1919

The discussion which followed was interesting although it was not be able to come up with convincing findings. The scientific elaborations in the 1930s will be given all deserved attention in the following chapters. But now, as a sort of warm up, there are some observations and conclusion made by O.V. Johannsson (Johannsson, 1936). Although his investigation primarily focusing 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).
- As it 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).

Differences between annual mean temperature
For the period 1901-1930 versus average 1859-1900



Source: Andres Angström, 1939, Geogr. Ann. XXI 2009/www.seaclimate.com

- 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) as 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. Whether any of Johansson's findings and conclusion can withstand, a review is not so important, but the listed items show that the matter was seriously and competently discussed, and that the available material and knowledge allowed a fruitful investigation since a long time ago.

C. The early arctic warming and modern assessments

Many scientists confirm broadly the early two decade long warming period (WHEN) but fall short of identifying the exact time period and location, of which a few are here presented exemplatory:

- The warming in the 1920s and 1930s is considered to constitute the most significant regime shift experienced in the North Atlantic in the 20th century (Drinkwater, 2006).
- The huge warming of the Arctic that started in the early 1920s and lasted for almost two decades is one of the most spectacular climate events of the 20th century (Bengtsson, 2004).
- At least Polyakov (2002) get the timing right: The period from 1918 to 1922 displays exceptionally rapid winter warming not only in the circum-Arctic region northward of 62°N. (Polyakov, 2002).

- A meridional pattern was also seen in the late 1930s with anomalous winter (DJFM) SAT, at Spitsbergen (Overland, 2008).
- Average Arctic temperatures increased at almost twice the global average rate in the past 100 years. Arctic temperatures have high decadal variability, and a warm period was also observed from 1925 to 1945. (IPCC, 2007)

When it comes to explaining the causation of the warming (WHY), the matter seems rather sketchy than well founded. Here are a few examples:

- Natural variability is the most likely cause (Bengtsson, 2004);
- We theorize that the Arctic warming in the 1920s/1930s was due to natural fluctuations internal to the climate system (Johannessen, 2004).
- The low Arctic temperatures before 1920 had been caused by volcanic aerosol loading and solar radiation, but since 1920 increasing greenhouse gas concentration dominated the temperatures (Overpeck, 1997).
- The earlier warming shows large region-to-region, month-to-month, and year-to-year variability, which suggests that these composite temperature anomalies are due primarily to natural variability in weather systems (Overland, 2004).
- A combination of a global warming signal and fortuitous phasing of intrinsic climate patterns (Overland, 2008)

Further details will be provided later. At this stage it was intended to show that almost one century has passed since the first arctic warming started, and the discussion seems unable to get even the most basic facts clearly presented. A comprehensive picture of facts is paramount to consider convincing solutions. The following investigation tries to offer clues and explanations about what actually happened in the Arctic realm at the end of the 1910s and what may have caused the arctic warming at the beginning of the last century.

D. What is up for discussion?

While three issues are hotly debated worldwide: Climate Change, Global Warming, and Anthropogenic Forcing, the decisive role the oceans and seas have, has received little attention. Understanding the Arctic warming in the early last Century and the impact the oceans have played in to make the event happen, would significantly contribute to a more fruitful discussion of each of debated subjects.

The fact is that the winter temperatures made a jump of more than eight degrees Celsius at the gate of the Arctic Basin, after 1918. Nowadays, one century later, the event is still regarded as "*one of the most puzzling climate anomalies of the 20th century*" (Bengtsson, 2004). This shows that there hasn't been any convincing progress on understanding the climatic change issue! Since the Norwegian scientist B.J. Birkeland had published the temperature anomalies for Spitsbergen and concluded that these deviations could "*probably be the greatest yet known on earth*" the matter could be investigated. Although more than a ¾ century has passed the Intergovernmental Panel on Climate Change (IPCC) mentioned recently that the "*average Arctic temperatures increased at almost twice the global average rate in the past 100 years" (IPCC, 2007),* and that this represents a very significant part of the global warming issue. That is of little help if not a straight disservice to the climate debate.

1958

Th. Hesselberg & T. Werner Johannessen, Det Norske Meteorological Institute, Oslo

"The Recent Variations of the Climate and the Norwegian Arctic Sector"

in: R.C. Sutcliffe (ed): Polar Atmosphere Symposium, London 1958; p. 18f

EXTRACT from Summary:

The Norwegian Meteorologicial Service has erected five meteorological stations in the Atlantic sector of the Arctic regions, namely Spitsbergen (1912), Jan Mayen (1920), Bjørnøya (1921), Myggbukta (1922) and Hopen (1946).

- The present amelioration of the climate in the Arctic area therefore must begun before the year 1912. There are evidence that seem to indicate that it began in the 1870-years, approximately at the same time as the temperature rise began in more southerly regions.
- The rise of the temperatures in Spitstbergen is large compared with the rise in other parts of the world (about five times as great as in Norway). This fact can be explained by the position of Spitsbergen at the southern border of the inner Arctic area. This inner zone is retreating towards the north in connection with the general heating, and Spitsbergen that formerly was situated north of the parth of the cyclones surrounding the inner Arctic zones is now more frequenly visited by cyclones that bring mild air from south and south-west. Of special importance is the augmenting cyclonic winds sweep away the surface layers with very cold air that in calm weather is produced by the outgoing radiation.

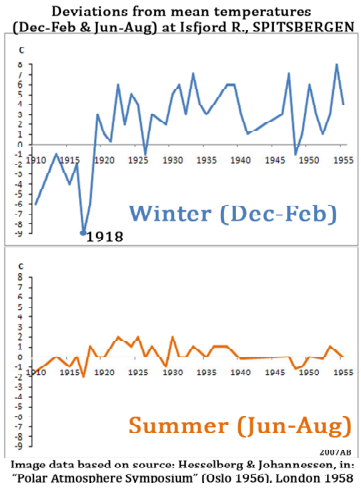
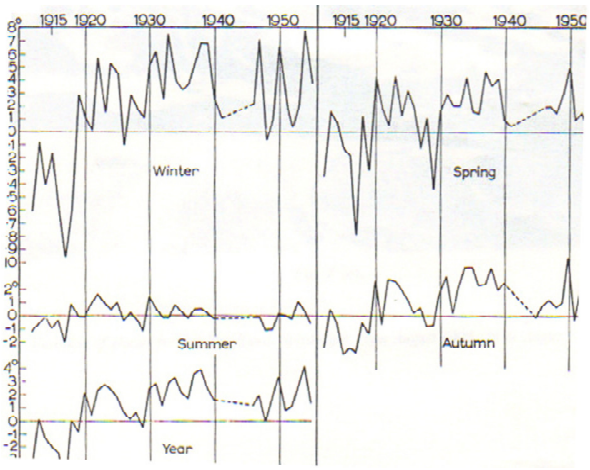


Image data based on source: Hesselberg & Johannessen, in: "Polar Atmosphere Symposium" (Oslo 1956), London 1958

EXTRACT from p. 22/23

- Of special interest are the data from Spitsbergen station, which was erected in 1912, some years before the great change in temperture conditions took place. This happened in the years 1917-1922.
- The remarkable rise in temperature is clearly seen in Fig.2 (shown to the left), that gives the departures of the mean temperatures from those of the reference period (1912-1930) at Isfjord R.. A smoothing by hand gives a rise of about 7 degrees for the winter and later on a slow increase of about 1 degree. For the other seasons the sudden rise around the year 1920 is approximately 3 degrees for the spring, 2 degrees for the summer, 3 degrees for the autumn and 4 degrees for the whole year.
- We see that the rise in the temperatures at Isfjord R. is confirmed by the data from Vardø. Also here the increase is especially rapid about the year 1920, but the rise is more modest.



Graphics: Lower figure is a cut from the Original (Fig. 2), the upper is a modified layout based on the original.

What need to be acknowledged is that the 'hot issue' was measured in the winter of 1918/19 on the remote Norwegian island of Spitsbergen, just 1,000 kilometers away from the North Pole. Spitsbergen experienced an increase of winter temperatures of more than 8º Celsius within only a few years. When the event started, the actual figure was particularly high (see: graph), and spread out far beyond the local region over a short period of time.

But if IPCC acknowledges the arctic warming, why do we still need to go back to the beginning of the 20th century to find out the reasons of the 'Big Warming' at Spitsbergen? Isn't it enough to accept modern scientific theories, which point to "internal variability of the climate system", including the naming of three possible mechanisms, namely: anthropogenic CO2 effects, increased solar irradiation, and reduced volcanic activity? (Bengtsson, 2004) Certainly not! The warming at Spitsbergen is one of the most outstanding climatic events since the volcanic eruption of Krakatoa, in 1883. The dramatic warming at Spitsbergen may hold key aspects for the understanding how climate ticks. The following elaboration intends to approach the matter from different angles, but on a straight line of thoughts, namely:

> WHERE: the warming was caused and sustained by the northern part of the Nordic Sea in the sea area of West Spitsbergen the pass way of the Spitsbergen Current.
>
> WHEN: The date of the commencement of warming can be established with high precision of few months, and which was definately in place by January 1919.
>
> WHY: the sudden and significant temperature deviation around the winter of 1918/19 was with considerable probability caused, at least partly, by a devastating naval war which took place around the Great Britain, between 1914 and 1918.

a) The objective of this investigation

The objective of investigating the Arctic Warming from 1918 to 1940 is to demonstrate that the oceans and seas control and determine the global climate. Insofar it is a part of a wider analysis[20] concerning the four major climatic diversions during the 20th Century, namely:

A. The Arctic Warming from 1918 to 1940;
B. The extreme cold war winters in Northern Europe, 1939-40, 1940-41, and 1941-1942;
C. The global cooling from ca. 1942 to ca 1970;
D. The resume of the pre WWII warming, or was this warming totally separated from previous trends?

What makes the early Arctic warming interesting and challenging is the necessity to establish at least two facts first, namely: Where and When, before considering any probable causation: WHY.

Imagine that a 'revolution' took place 90 years ago, but "many" only talk about future climate changes, and some even claim that they can predict the climate in 10, 20, or even 100 years ahead, having no idea or explanation what had happened not very long ago. That seems hardly acceptable, when there is a case at hand, which could show, at least to a considerable extent, how climate ticks. The basis of the case is quite

[20] See e.g.: www.seaclimate.com; www.warchangesclimate.com; and related book publications. Essays from 1992 to 1997: www.oceanclimate.de.

2008	Joe D'Aleo claims: **Warming in the arctic is likewise shown to be cyclical in nature.**

Discussed at: http://www.arctic-warming.com/; 17 May 2008

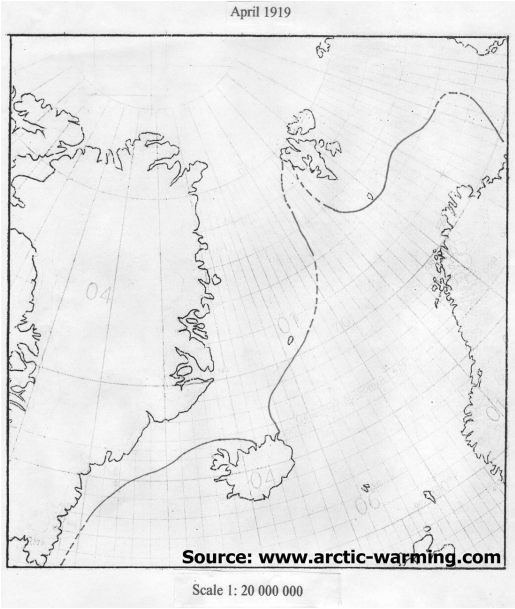
Joe D'Aleo claims:
Warming in the arctic is likewise shown to be cyclical in nature.
- An assertion that can be challenged –

In a recent article „Multidecadal Ocean Cycles and Greenland and the Arctic" by Joe D'Aleo (http://www.intellicast.com/Community/Content.aspx?a=128) on the 12th of May 2008, the author says:

"This week we will talk about temperatures and ice in Greenland and the Arctic, topics sure to dominate the news this summer. Already recent media stories have some scientists predicting another big melt this summer. We will show how that is not at all unprecedented (happens predictably every 60 years or so) and is in fact entirely natural", and

"We will show how that is not at all unprecedented (happens predictably every 60 years or so) and is in fact entirely natural."

The readable and interesting paper should not go unchallenged. Joe D'Aleo concludes i.a. that: *"The warm mode of the Atlantic Multidecadal Oscillation (AMO) also produces general warmth across much of the Northern Hemisphere including Greenland and the Arctic."*

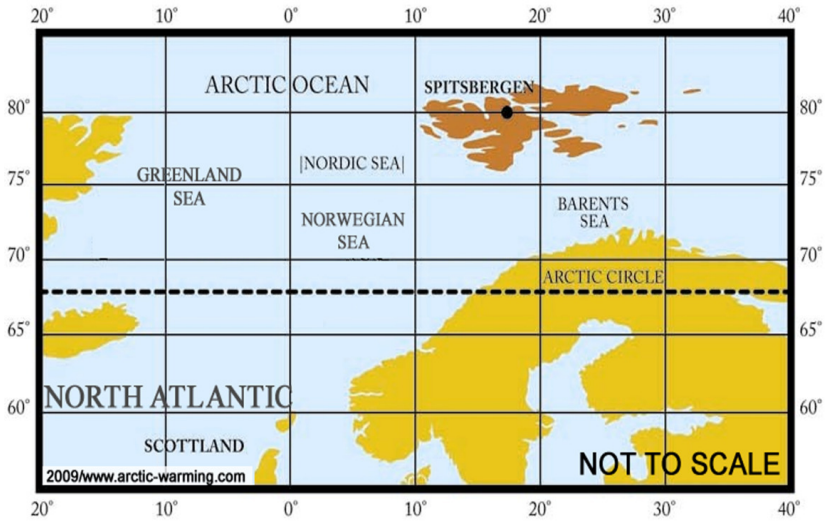


The fact is that the early arctic warming was anything else but not cyclical. It was an "explosion" and not gradual shift. The extreme rise of temperatures was initially confined to Spitsbergen, and only commenced in Greenland at least one year later. The sea ice cover off Greenland's coast had been reaching Iceland in April 1919 for the first time since 1911 (see b/w graphic). The research of this site and the PACON 2007 Conference Paper show that the early warming has nothing to do with Atlantic Oscillation, but had been entirely related to the impact of the arm of the Golf Current that passed Spitsbergen prior to entering the Arctic Ocean. Actually, the extensive sea ice cover in the North Atlantic until the month of April, prevented significantly to produce more warm air, which could have generated the extreme winter temperature rise at Spitsbergen, the remote archipelagos almost surrounded by ice up to April 1919, except a small open sea area formed like a tongue extending almost to the Arctic Ocean.

simple. The annual arctic average temperature swelled 2.5º Celsius between 1918 and 1939, the winter temperatures were much higher. But neither the general attribution of this event to the Arctic region, nor the reference to a time period over one or two decades are sufficient to get a clear picture of this extraordinary climatic event. In the next sections we will outline the principal parameters on which the subsequent discussion will take place.

b) WHERE?

The boundary of the Arctic is generally considered to be north of the Arctic Circle, which runs along the latitude of 66° 33' North, comprising an area of about 1.5 times the size of the United States. What happened in one corner of this huge area did not necessarily occur in another corner as well.



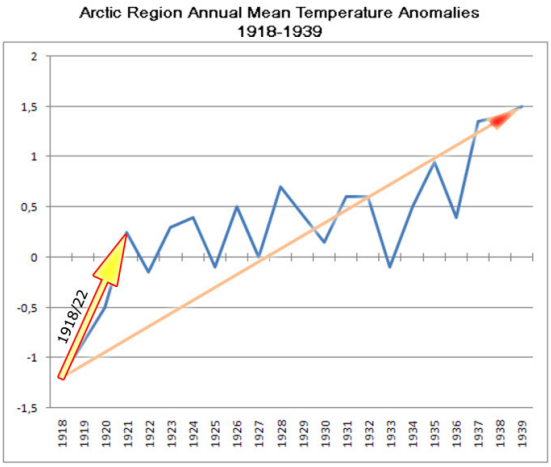
Speaking only generally about arctic warming may disguise important information. The 'climatic revolution' is precisely such case. The sudden warming at a very confined location, the remote archipelagos of Spitsbergen at the latitude of 77-80° North, or about 1000 km north of the Nord Cape of Norway is a key factor for analyzing the Arctic Warming in the late 1910s.

The overriding aspect of the location is the sea; the sea around Spitsbergen, the sea between particularly the Norwegian-, the Greenland-, and the Barents Sea (Nordic Sea). The Norwegian Sea is a huge, 3000 metres deep basin. This huge water masses stores a great amount of energy, which can transfer warmth into the atmosphere for a long time. In contrast the Barents Sea, in the southeast of Spitsbergen has an average depth of just around 230 metres. In- and outflow are so high that the whole water body is completely renewed in less than 5 years. However, both sea areas are strongly influenced by the water masses coming from the South. The most important element is a separate branch of the North Atlantic Gulf Current, which brings very warm and very salty water into the Norwegian Sea and into the Spitsbergen region. Water temperature and degree of saltiness play a decisive role in the internal dynamics of the sea body.

Source: www.arctic-heats-up.com; The Arctic Warming 1919 to 1939; by: Arnd Bernaerts

And what might be the role of the huge basin of the Arctic Ocean, 3000 metres depth and a size of about 15 million square kilometres? The difference towards the other seas mentioned is tremendous. The Arctic Ocean used to be widely ice covered in the first half of the 20th Century, the other seas only partly on a seasonal basis. Only between the open sea and the atmosphere an intensive heat transfer is permanently taking place. Compact sea ice reduces this transfer about 90% and more, broken or floating ice may change the proportion marginally. In this respect an ice covered Arctic Ocean has not an oceanic but 'continental' impact on the climate.

c) WHEN?



The outstanding warming-up phenomenon can be located with precision at Spitsbergen, and the exact timing is within a range of a few months.

www.arctic-warming.com

This investigation is fully aware that the sudden rise of arctic temperatures could be a mere coincidence of circumstances, but is unwilling to accept such an approach without challenging it. An explanation is necessary because this event didn't come from nowhere; it must have been caused by a physical force and dynamics, which resulted in sudden and unexpected temperature rises. Fortunately the collection of temperature data had already started in the early 20th Century. Already in the 1930s and 1940s the phenomenon was analyzed, albeit on a long-term statistical basis only.

Although it is long known that "*in 1919, the statistical means crosses zero value; or in other words, all previous years are colder, and all later years are warmer (*Johannsson 1936) one need to try to analyze the timing much more precisely. This will be done thoroughly, whereby the suddenness and the value of increase at the time of commencement of the event and during the following time period will be given particular attention. In so far it surprises that Polyakov (2003) states that *"the period between 1918 and 1922 displays exceptionally rapid winter warming",* but did not elaborate this aspect any further. We will demonstrate that warming started within a few months' period in 1918, latest in January/February 1919. The precise timing is, as the location, a decisive aspect to consider the causation of the event.

In this respect it is to note that the investigation rests on observed wintertime temperatures. This is a decisive tool. It excludes very clearly any direct influence of the sun and carbon dioxide (CO2), due to a long polar night. From October until February, sun radiation is virtually inexistent at Spitsbergen, and its direct influence on temperatures is practically zero. The winter season also diminishes any claim that CO2 could have played any significant role.

d) WHY?

Once the location and time of the commencement of the arctic warming have been determined with high precision, and that will be done, the next question inevitably arises: WHY? After all, the matter concerns a

'climatic revolution'. No earthquake shook the earth crust, no volcano of significance had erupted, no meteorite had hit the Earth, neither had any tsunami been observed. We will certainly not exclude the option that nature did it on "its own".

But this conclusion can and should only been drawn, if a serious contender for having caused the arctic warming since winter 1918-19 has evidently been excluded, namely the naval war around Great Britain and at other Northern European sea areas from 1914 to 1918. Not only was World War I presumably the biggest interference to the natural commons since Krakatoa, but most of the sea water which had been subject to naval war activities did not remain in their place but travelled with sea current system into the Spitsbergen region were suddenly the temperatures exploded in winter 1918-19. The thesis will be elaborated in depth in Chapter 7: "What caused the Arctic Warming?"

E. Expected results

Current conclusions, as outlined above, will be challenged at least on the ground that:

The "Big Warming" event from Spitsbergen proves that the climate change was not determined by the atmosphere; but first of all, if not alone by the sea.

If climate were defined as 'the continuation of the oceans by other means'[21], the arctic warming would – with high certainty – have been fully understood and explained since long, and thus could have provided a big service to the general climatic change debate.

[21] A number of papers by Arnd Bernaerts since 1992 suggest to use this term; see:www.oceanclimate.de , www.whatisclimate.com

1937 Scherhag, R., (1937) ‚Die Erwärmung der Arktis',

in: Cons. Intern. Expl. Mer. Rap. Proc.- Verb., Copenhagen, Vol. 12, p. 263-276.

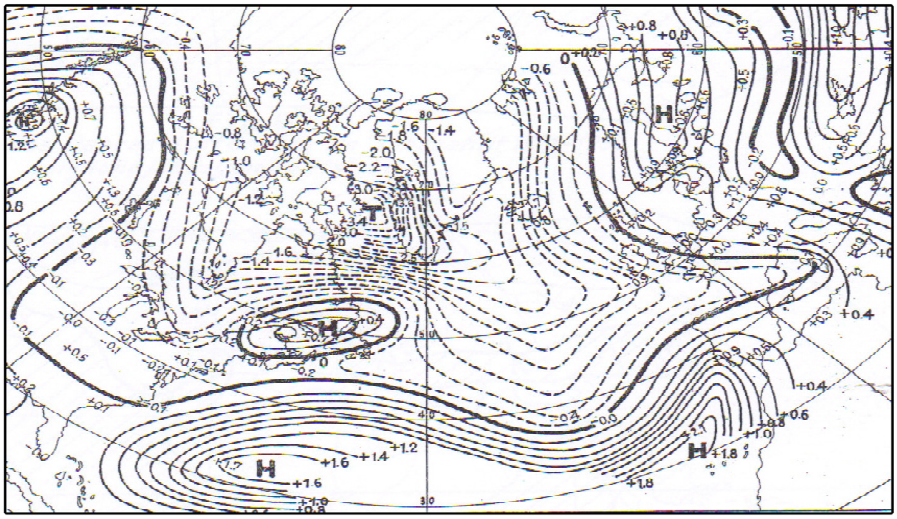
SUMMARY in ENLISH

The greater mildness of winters observable in the temperate zone during the last hundred years, accompanied by an increase in atmospheric circulation, has, during the last fifteen years, led to an extraordinary rise in temperature in the arctic regions, which in its turn has been accompanied by a corresponding retreat of the ice and a higher temperature in the sea. Just as, in the region from which the Gulf Stream springs, measurements of water temperature indicate a rise of about 0.5°C in the last ten years, there has also been found a like increase in surface temperature in the English Channel. Fifty-years series of temperatures from off-lying Norwegian coastal stations clearly manifest a similar warming, and it is therefore indubitable that the transport of the warm water of the Gulf Stream from Florida to its entry into the arctic has increased to a noteworthy extent. In this respect it appears to be a question of a secular period in the variation of atmospheric circulation of some 225 years duration, which seems at this juncture to have attained its maximum.

Tabelle 3.
Mittlere Abweichung der Eisgrenze (in km.) im Ostspitzbergenmeer (30° bis 50° Ostlänge) im Spätsommer.

Jahr	Abweichung	Jahr	Abweichung	Jahr	Abweichung
1898	-140	1911	0	1923	-210
1899	-100	1912	+110	1924	-100
1900	-50	1913	+160	1925	-170
1901	-60	1914	+120	1926	-50
1902	+40	1915	+30	1927	-10
1903	+80	1916	+320	1928	-70
1904	+10	1917	+140	1929	-10
1905	-110	1918	+100	1930	-290
1906	-150	1919	-30	1931	-270
1907	-240	1920	-140	1932	-100
1908	-230	1921	-120	1933	-280
1909	+70	1922	-270	1934	-180
1910	+80				

Late summer: plus = more ice-cover; minus = less ice-cover
EAST-SPITSBERG-SEA; 30° to 50° East



Deviation from long-term mean of winter air pressure during the decade 1921-1930.
Scherhag, R. (1936/Sept.); "Die Zunahme der atmosphärischen Zirkulation in den letzten 25 Jahren"; Annalen der Hydrographie und Maritimen Meteorologie, p. 397-407, Fig 7 (here reduced and streched)