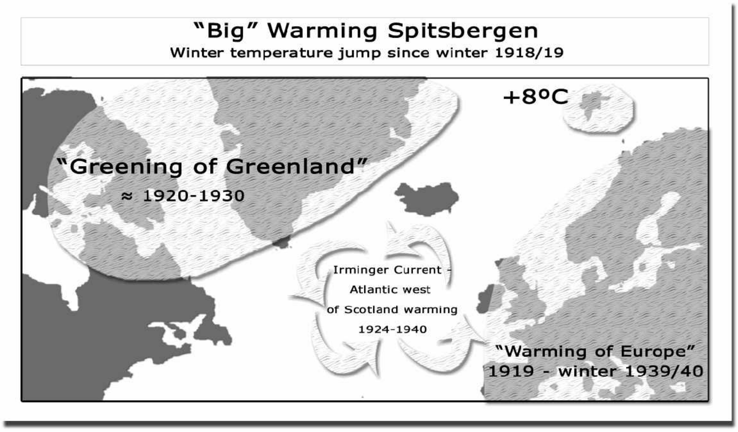
Spitsbergen 1918 – The big warming

The Jump

The most significant climatic change which took place during the World War One occurred at Spitsbergen, a remote archipelagos situated between the North Cape of Norway and the North Pole. During the winter 1918/19, temperatures suddenly exploded, phenomenon described by the eminent Norwegian scientist B.J. Birkeland as probably the greatest temperature deviation on earth[i].



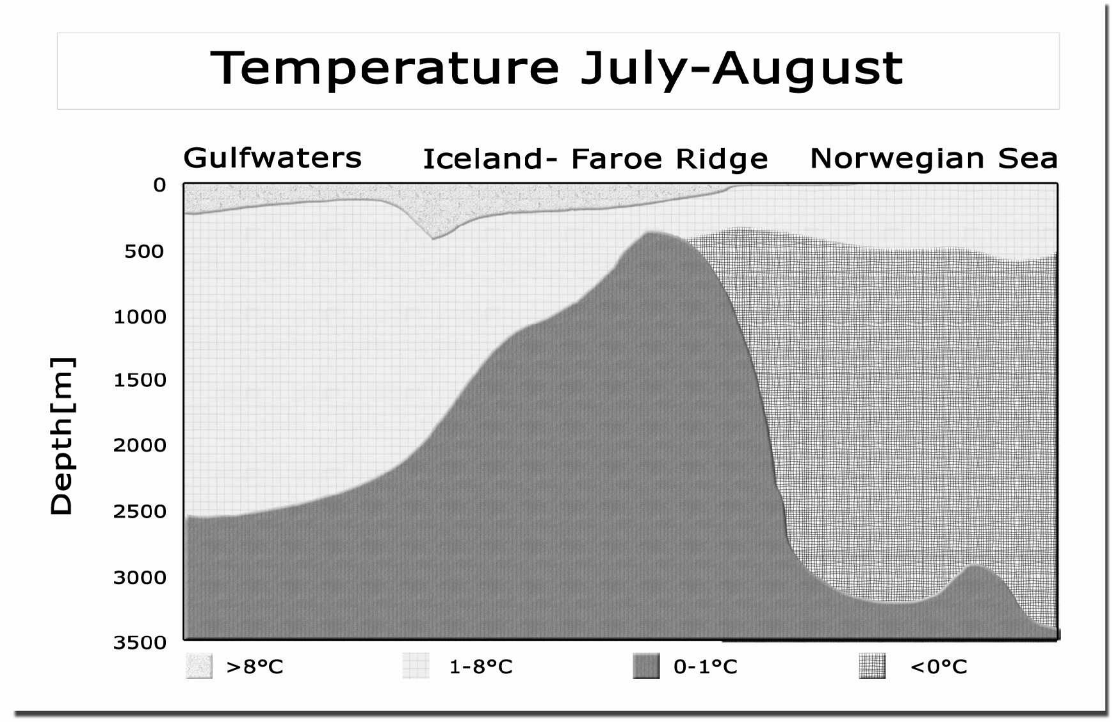
The temperature jump proved to be a lasting phenomenon, its longevity (until war winter 1939/40) remaining a mystery. Such a sudden temperature increase (plus 8°C) in such a short period of time is a peculiar event which could have had a significant contribution to the general understanding of climate almost one century ago. Surprisingly, it might not be so difficult to find clues regarding its causes. The timing, duration and location may help to include or exclude possible options and causes.

Speaking of timing, there was no other force before the winter 1918/19 than the devastating land and naval war in Europe which could influence so radically the climate, while nature followed its course without any significant disturbance: no earthquakes, volcano eruptions, meteorite fall or unusual sunspots.

Concerning duration, it is important to mention that we are talking about a sustained event which lasted for two decades in Europe and for one decade in Greenland (from 1920 until about 1930). These events were so striking that people began to use new terms like "Greening of Greenland" and "Warming of Europe". The sustainability argument proves that the warming phenomenon has its roots in the Northern North Atlantic, north of the Faeroe Island and south of the Arctic Sea.

As for the location, the sustained warming gives us an idea about the origins and the trajectory of the warm wave. One can quickly exclude all sea areas around Spitsbergen, except for the Norwegian Sea. The Barents Sea (situated at the east of

Spitsbergen) has an average depth of 300 metres, which means that its water masses cannot sustain a constant warming throughout many years if not constantly supplied with warm water coming from the Norwegian Sea. The Arctic Sea (at the north of Spitsbergen) is too cold and widely covered with ice to have played any role. The Greenland Sea can be definitely excluded as a source of the Spitsbergen warming as well because it is the Greenland Sea that receives a huge mass of inflowing water from the Norwegian Sea, via the Gulf Current, the Norwegian Atlantic Current and the Spitsbergen Current, and not vice versa.



Actually, the warming can only have its origins in the Norwegian Sea, which means that during WWI the southern border of the warming source is directly connected to the northern border of the naval war area. Even more, on its way from the North Atlantic Gulf Current to the Norvegian Sea, the most important warm water inflow passes near Great Britain, the place of the devastating naval war. The period of the seawater flowing from the naval war region to Spitsbergen is of only a few weeks. From this perspective, the warming in the north and the war at sea in Europe can be regarded as interconnected phenomena. One can speak about a deeper connection between these two events if one takes into consideration certain typical seawater behaviour as well. We will offer a brief overview of this aspect in the following section.

The physics of the Norwegian Sea waters

The Norwegian Sea water has the same physical properties as the seawaters around the globe. Nevertheless, the warm water of the Gulf Current, the cold winters caused by the high latitudes, the influence of many forceful, low pressure cyclones, and the presence of the massive Norwegian mountain ridge, as well the size and depth of the Norwegian Sea result in a unique and various mixture of physical characteristics.

Fortunately, the basic rules are simple: salty and cold water is heavy and "sinks", sweet water and warm water are light and "flow" over heavier water. Therefore, cold freshwater forms a layer above the warm water current. Cold freshwater may flow below the warm, saline rich water. We also know that water is an excellent isolator. For example, 'light' rainwater (which flows at the surface) can be as good as a refrigerator when it comes to preserving stored food from outside temperatures. Without mixing rain and melt water "swimming" at sea surface with salty Atlantic water off Norwegian coast, the Norwegian Sea would now be frozen, no matter how much warm Gulf water passes through the Norwegian Sea.

Consequently, there is a long way from registering all principal physical rules to assessing the thousands of possible variations that occur. Usually, the Norwegian Sea surface water which determines the weather and climate for the whole Northern Hemisphere is particularly influenced by three natural events: the warm Gulf current, the freshwater from land and rains, and, last but not least, the wind. In addition, after the replacement of sailing ships with machine driven vessels, a lot of surface water mixing took place every day. Large sea areas and water masses have been turned upside down particularly during the two World Wars.

The most significant features of the Gulf Current water that enters the Norwegian Sea are its high temperature and high salinity. As soon as water-cools down it sinks like fruit syrup in a glass of water. Due to its high salinity, it is warmer than the water it replaces at the lower level. The more water goes below, the more water will flow from the Atlantic, this involving a greater "warming potential" in the area than before. The more salty water is cooled down, the more forcefully this water masses will start sinking.

In comparison with salty water, freshwater is very light. Rain, river and melt freshwater has the strong tendency to float above brackish and salty water until it becomes much colder than the saline water below, or otherwise an external force must occur and determine the water mixing.

Wind in any form is the most powerful agent which determines the surface sea water mixing. It is, in fact, the only external source nature has at hand to enforce the mixing. On the other hand, the mixing range the wind reaches is extremely limited and hardly goes further the 50 meters sea surface layer. All the other seawater mixing is due to the internal processes, based on temperature, salinity, and density.

But what is the contribution of the naval war? Naval war certainly is a source of water mixing. Particularly in wintertime and in all sea areas at the north of Biscay, not only does it determine a rapid mixing between freshwater and more saline water, but it also pushes cooled surface sea water to greater depth in exchange for warmer water, until the summer warmed water is exhausted and arctic air can easily take control. This phenomenon has already been explained in great detail in Chapter B. In the next section, we will focus on the sea situation between Britain and Spitsbergen during WWI. We will discuss about the impact on the Norwegian Sea and about the important warming of Spitsbergen due to naval warfare.

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i Birkeland, B.J.; 'Temperaturvariationen auf Spitzbergen', Meteorologische Zeitschrift, Juni 1930, p.234-236