ICEBERGS IN THE NORWEGIAN CONTINENTAL SHELF IN 1880-1881

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ABSTRACT

During the winter season of 1880-1881, Norway probably experienced one of the most severe sea ice condition in the last 150 years. The sea ice in East Finnmark came to a maximum position of approximatly 20 km from shore. Icebergs were observed at three different areas : at Storfjorden (62°N), Troms (70°N) and East Finnmark (70°N).

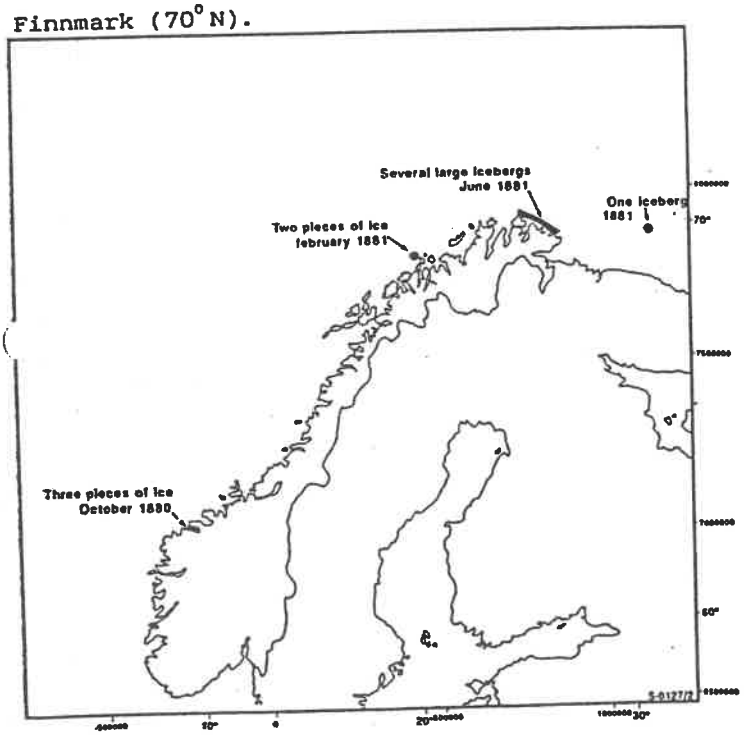

Figure 1 : Iceberg observations at the norwegian coast in 1880-81

KEYWORDS

Icebergs, sea ice, air temperature, sea temperature, air pressure, storms, currents, Barents Sea, Iceland, Norwegian Sea.

ICEBERGS

During the winter season of 1880-1881 icebergs were observed at several locations at the Norwegian coast and at ajacent waters. The following iceberg observations have been found through systematic review of Norwegian newspapers from 1880-1881.

A) In august-september 1880, the British explorer Leigh Smith with the ship "Eira", was on an expedition to Svalbard and Franz Josefs Land (Aalesunds blad, 1880 and Markham, 1881). South of Franz Josefs Land he found several enormous icebergs. The largest were 10 - 15 km long and 45-75 m high. Several were more than 60m high. The icebergs observed close to Hopen were "a quantity of small grounded icebergs".

B) In the middle of October 1880, 3 pieces of ice were observed in the Storfjorden (62° 25'N). The ice had a cubic form and the size above water level was 2-3 m. After a few days in the fjord they melted away. We are not completly sure if it was fragments of an

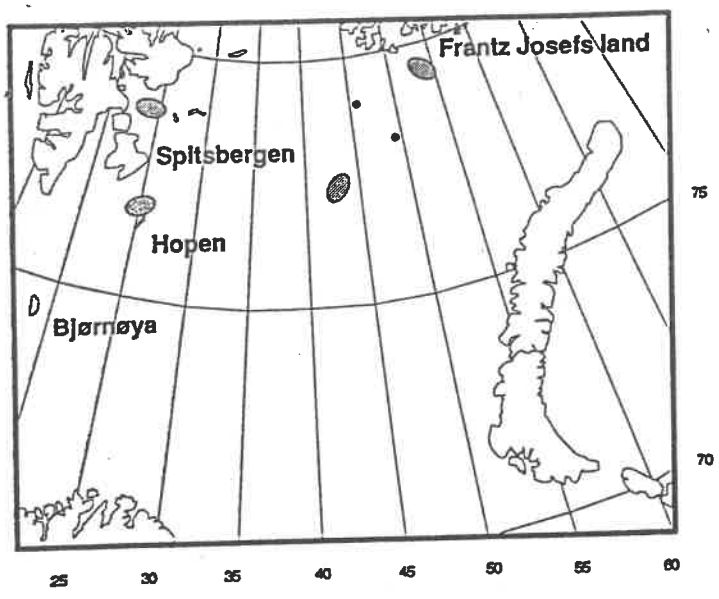

Figure 2 : Leigh Smiths iceberg observations from august 8th to september 17th 1880.

iceberg or man made ice from ice factories. Most probably it was fragments of an iceberg.

C) In January and February 1881, icebergs were observed at the south coast of Iceland. Most of them disappeard at the end of February when a storm from south moved them away. Some of the icebergs were left in a grounded position. No information was given about the size.

D) In the beginning of February 1881, two pieces of ice were found between Kvaløy and Vannøy (70°13'N 19°30'E) on the Norwegian Coast. The largest was 7-10 m above the water level and slightly less in length. The ice was blue without any pollution.

E) On the 19th of March the steamship "Thule" from Stavanger found sea ice and icebergs of variable sizes between Faroe Island and Seidisfjord in Iceland. The distance from Seidisfjord was 150 km. The ship went NNE close to the ice boarder and passed several other icebergs.

F) About June 5th 1881 the boat "Martine" found a gigantic iceberg outside Gamvik on the Norwegian coast 10 km from shore. The iceberg had a length of approximately 1 km, had 3 peaks and a height of 25-30 m. On June 12th 1881, the steamship "Finnmarken" probably found the same iceberg outside Berlevåg.

On June 14th, it was reported from Berlevåg that it had been possible from shore to observere icebergs passing Berlevåg every day. The largest was from shore estimated to be 30 m high. They were separated from the sea ice which was approximatly 20 km from shore. By the 14th of June they had dissapeared in a nort easterly direction.

June 16th it was reported that icebergs ha been seen at the coast from the post shi arriving Vardø that day.

In 1929 an old man at Berlevåg wrote to Adol Hoel at Norsk Polarinstitutt telling him abou an extreme year of sea ice which he believed to be in 1870 or 1871. From other sources we kn that in 1870-71 sea ice conditions were n extreme. His general description fits well wi the ice conditions as we know it from 1881. also told that a large piece of ice grounded Syltefjorden, and did not melt before late the summer (Rabot, 1929).

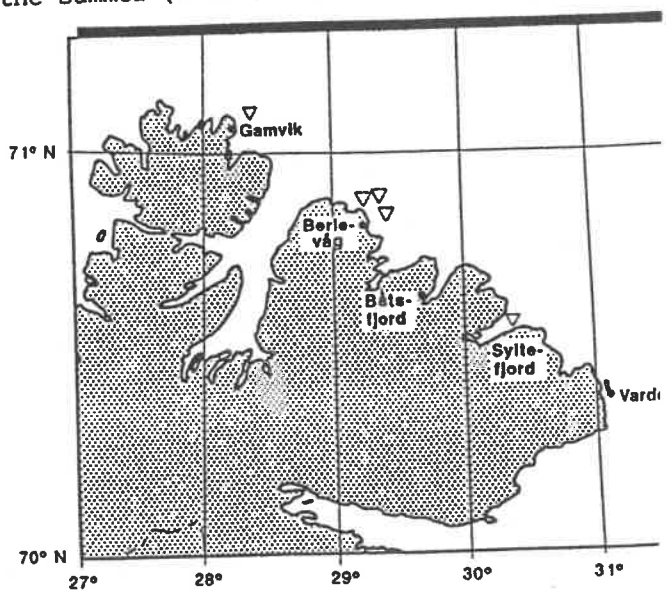

Figure 3 : Iceberg observations in E Finnmark.

G) Vieze (1928) and Vinje (1990) reports an iceberg was observed outside Kola Penin

in 1881 (70°N 37°E). No information is available of what time of the year the observation was made, nor on the size of the iceberg.

To get an idea of the origin of the icebergs, and the environmental conditions causing these icebergs to come to the norwegian coast, we have done a review of several other environmental parameters. A more thorough description of the environmental condition during the winter season is given by Hønsi and Kvitrud (1990).

The long time since the events took place makes it difficult to get accurate informations. The scientific mapping of meteorological conditions in Norway started in 1867, but a systematic mapping of oceanografical conditions had not started.

SEA ICE CONDITIONS

As we can follow the development from Pettersen (1881) and local newspapers an ice boarder of approximatly 72° N was representative of an average sea ice condition at May 24th-25th 1881. The sea ice had almost the same northerly position from Tromsøflaket to East Finnmark.

From May 25th to 27th a northely storm occured in the Barents Sea. It was followed by northerly winds as the most frequent for the next two weeks. The wind conditions must have brought the sea ice to an extreme position.

The maximum southerly position in East Finnmark came in June 1881. The distance from shore was about 10 km (Hoel, 1962) to 20 km (local newspapers, 1881). The ice cover had a length of 40-50 km in a westerly to easterly direction, seen from Berlevåg. From a mountain close to Båtsfjord, the sea ice was visible as long as it was possible to see (Hoel, 1962). After a few days it disappeared in an easterly direction.

People who went out to the ice explained that it was about 15 cm above water level (Hoel, 1962). Assuming a sea ice density of 900 kg/m^3 the total thickness should be about 1.5 m. This thickness is typical of Barents Sea first year ice.

May 26th 1881 local fishermen claimed that ice of 20-30 km in length had been observed at Kvænangen in Troms county (70°N 21°E). We don't know if this observation is reliable.

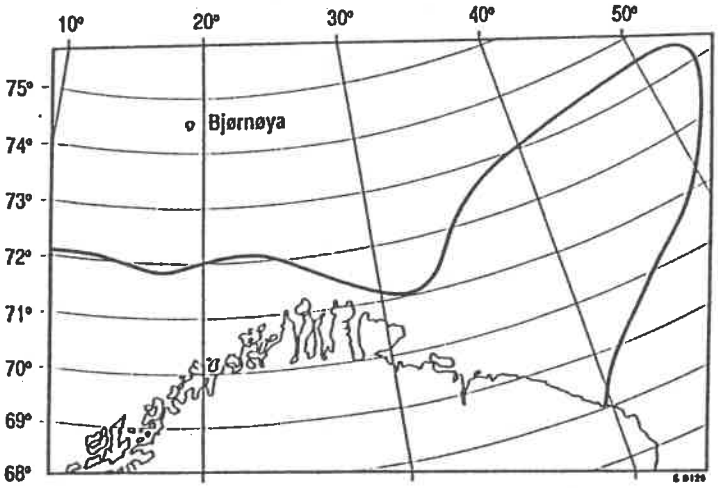

Figure 4 : The ice boarder about June 2th based on Kjærnli (1990).

OCEANOGRAPHICAL CONDITIONS

We have not been able to find any sea temperature measurements for offshore Norway in 1880-81. The sea surface temperature measurements in Norwegian coastal stations gave extremely low values this year (Frogner, 1949). The monthly means in Northern Norway were 2-3 standard deviations below normal from December 1880 to June 1881.

The sea surface temperature were heavily influenced by the air temperature. The coastal sea temperatures deviated more from the average than the air temperatures. This comparison is done on standard deviations below normal. This indicates that the offshore sea temperature also have been low.

At Gjesvær (71° N, 25° 30'E) the surface sea-temperatures in 1881 were:

	Jan	Feb	Mar	Apr	Mai	Jun
μ	-1.1	-1.0	-1.2	-0.4	0.8	4.0
α	-3	-3	-2	-3	-4	-3

μ = monthly mean (° C)

α = number of standard deviations below normal

The measurements between Iceland and Great Britain in 1876-81 indicate that the sea temperatures in the Atlantic water was close to be normal in the entire period. The only significant deviation was in 1880 when the temperature was considerably higher than normal (Dmed, 1978).

Two reports in local newspapers in 1881 claimed that the current velocity outside East-Finnmark had changed the last 10 years. The changes were specially noticable in the autumn 1880. In earlier years the tidal current had a noticable component from east. In the autumn of 1880 the western current had been so strong that the eastern tidal current was not possible to observe. The daily (M2+S2) tidal current velocities in this area is about 0.5 m/s (Gjevik et al, 1990).

METEOROLOGICAL CONDITIONS

The average air pressure in December 1880 - February 1881 was dominated by a high pressure above Iceland (Fitzharris and Bakkehøi, 1989). In January, the monthly average over Iceland was more than three standard deviations above normal. In western Spain it was more than three standard deviations below normal. In addition there were in average a low pressure north in Russia. This weather situation should give inflow of cold polar air to the Norwegian Sea. In a normal winter situation Iceland have a low pressure average.

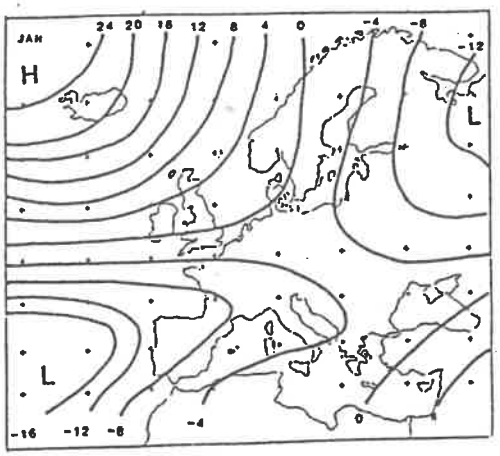

Figure 5 : Average monthly air pressure in january 1881.

On average, the air temperature was very low. Indeed, in 1881 Norway had its coldest yearly average for the last 130 years (Aune, 1989). Wilhelmsen (1980) found that the monthly averages were typically 1-2 standard deviations below normal every month from October 1880 to June 1881 in Vardø in East Finnmark. Similar conditions were also found in other norwegian meteorological stations (Wilhelmsen, 1980).

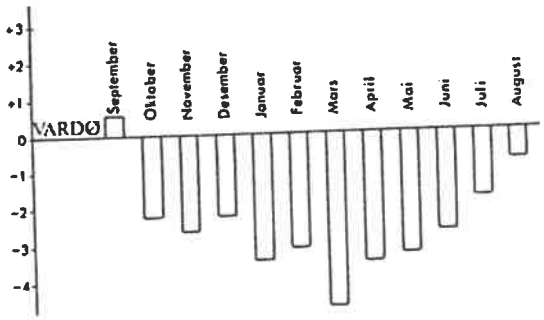

Figure 6 : Air temperature °C below norma at Vardø in 1880-81 (Wilhelmsen, 1980).

At the southern part of Norway, at Utsira, w have a continous record of wind observation going back to 1860 (Hønsi, 1989). These record indicate, as shown on figure 7, an extreme high number of days with wind velocitie exceeding 16 m/s in the 1880- 85. We have al reviewed wind observations at Tromsø giving general low wind velocities during the wint season of 1880-1881, and wind directions almo as today's average. Southwesterly win dominated during the winter season. Only a f days with stormy weather was reported. In Var

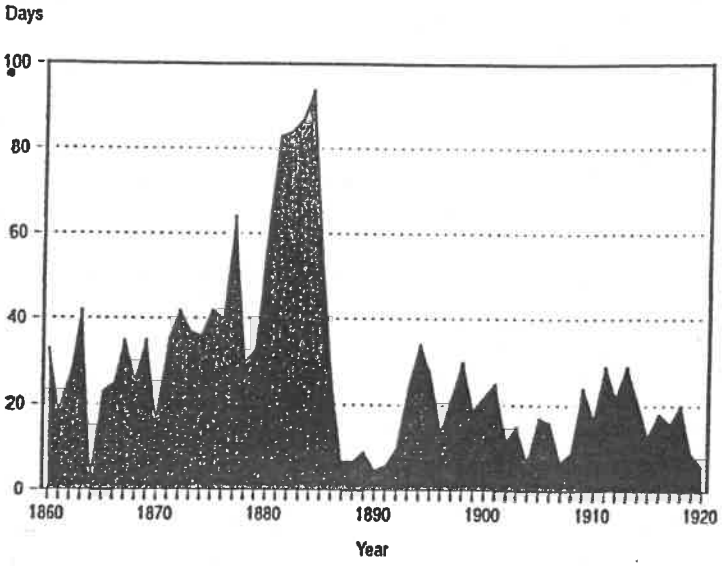

Figure 7: Number of days each year with wind velocities above 16 m/s at Utsira.

the number of days with high wind velocities were high during this winter season.

During that winter, the measured height of snow in Northern Norway was higher than ever experienced since (Wilhelmsen, 1980). The number of fatalities caused by avalanches in Norway was also higher than ever experienced since (Fitzharris and Bakkehøi, 1989).

According to Vinje (1989) it is the meteorological conditions which determine the seasonal extent of the ice border in the Barent Sea. It is also most probabably that the main reason for the extreme sheet ice and iceberg observations in 1881, was the extreme meteorological conditions this winter.

ICEBERG ORIGIN

Several special conditions makes it possible for icebergs to exist in areas where sea ice would have melted away. The major advantages are :

a) They are made in glaciers of fresh water and have a higher melting temperature than sea ice.

b) Their larger size helps them to have a longer melting time than sheet ice.

c) Their size gives a larger exposed area to wind, and therefore the icebergs tend to have higher moving velocities.

This must also be the reasons why icebergs were observed far away from the sea ice.

The first iceberg fragments observed at the coast in the winter of 1880-81 (case B) must have had their origin from Icelandic waters. It could have been one iceberg which had grounded and split into three pieces. During the years there have been several icebergs observations south of the Farae Island. An iceberg has also observed in the North Sea (e.g. in October 1927 at 60° N 0°30'W (Hønsi, 1988)). Russian drifting buoy experiments have been performed from the Kara Sea (Zubov, 1943). The buoys have been found on the northern coast of Iceland and in several possitions on the Norwegian coast. The metocean conditions should be in favour of such a flow direction.

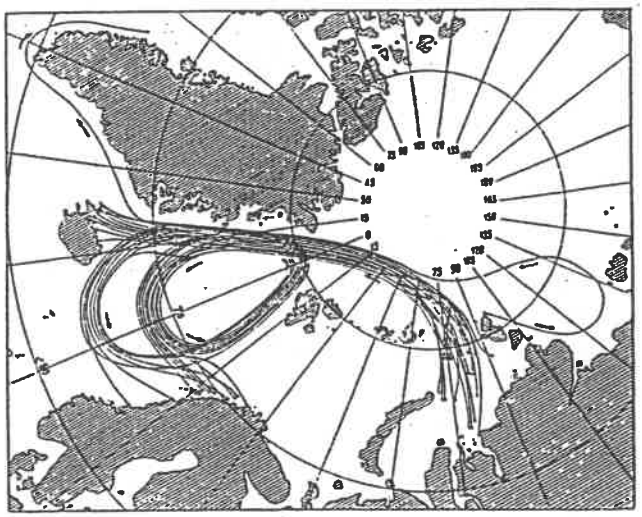

Figure 8 : Assumed routes of drifting buoys. The buoys were dropped in the Kara Sea and found at the indicated locations (Zubov, 1943).

The second iceberg (case D) could have come both from the Barents Sea and Iceland. This is probably also a deteriorated iceberg. The reports on increased eastwards current velocities on the coast and that the general current moves north eastwards in this area favours the Iceland theory. In addition the wind observations at Tromsø indicated southwesterly direction as the main wind velocity. The isobars will though be slightly changed near the coast, giving a change in the

wind directions from westerly or north westerly winds in open water, to south westerly at the coast (Per Strass, pers. com.). A review of daily standard weather maps for Europe (Hess and Brezowsky, 1969) also gives south westerly winds as the most frequent wind direction at Tromsø in the winter season 1880-81. The low wind velocities indicate that the iceberg drift must have been mainly current induced.

The third observation (case F) came in the same area as icebergs were observed in 1929 (Rabot 1929, Hoel 1962, Hønsi 1988 and Vinje 1990). In spring 1939 two icebergs were observed outside Gamvik. At the summer season the volume of the warm atlantic water decreases and the volume of cold polar water increases into the Barents Sea (McClimans and Nilsen, 1989). In addition northerly winds in the end of May 1881 and in the beginning of June brought them close to shore. The life in the sea ice must have given insignificant melting of the icebergs. The origin of the icebergs is probably the glaciers at Franz Josefs land.

SUMMARY

In the winter season of 1880-81 several icebergs reached the Norwegian coast. The icebergs at Storfjorden and Kvaløy probably came from Icelandic waters. The icebergs at East Finnmark came from the north and most probably have its origin from Frantz Josefs Land.

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