Booklet on Naval War changes Climate

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A fascinating theory on the impact of naval warfare on climate

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CHAPTER A

How to change Climate

Do you want to have a freezing winter? Start a war at sea! Do you want to change global climate? Start a global naval war!

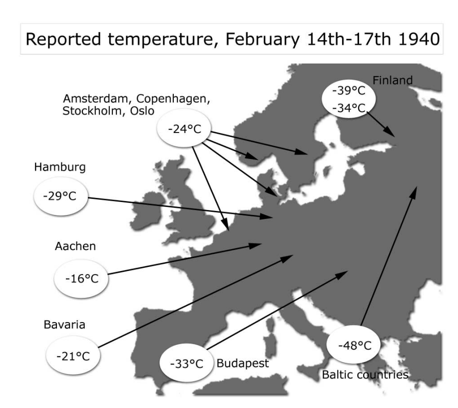
One cold wave after the other took hold of Northern Europe in what was called an arctic climate, since mid-December 1939. Nothing similar has happened in more than 100 years. Only three months earlier, more than 1000 naval vessels went out on sea and turned the waters of the North-and Baltic Sea upside-down. Day and night, week after week, many thousands of ships criss-crossed these seas, millions of "sea fountains" sprang up, being caused by shells, bombs, depth charges, sea mines, torpedoes. Ships and airplanes sank to the sea bottom with hundreds.

By mid-February 1940, The New York Times (NYT, the 14th of February 1940) reported another arctic cold wave:

"Europe suffered tonight in the paralysing grip of the bitterest cold in more than 100 years".

"At least 56 people died from Scandinavia to the Danube".

"The cold wave extended from the Arctic fringes of Norway and Finland to the Netherlands and Hungary".



"*The Netherlands Weather Bureau recorded the lowest temperature ever recorded in this country, 11.2 degrees below zero Fahrenheit*" (-11.2 F corresponds to-24°C).

"*Water transportation in the Netherlands is completely paralysed. The canals have been covered with thick ice for more than six weeks. Hundreds of persons abandoned their homes in the face of crushing ice packs boiling up from ice-blocked canals, rivers and seas*".

"*In Copenhagen the temperature has dropped to 13 degrees below zero Fahrenheit* (-25°C)".

"*The Baltic Sea was frozen over for the first time in many years. Islands along the coast of the Netherlands and the Baltic were isolated. All day they sent out SOS calls for coal and foodstuff*".

"*In Estonia, Latvia and Lithuania, more than 10,000 persons suffered severe cases of frost-bite. At least five persons froze to death in the three Baltic countries where temperatures reached-54 degrees below zero Fahrenheit* (-47°C) *for the first time in 150 years*".

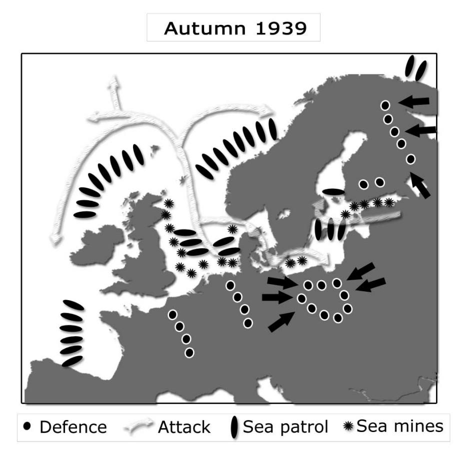
The unusually pronounced cold winter in Northern Europe went on for many weeks. In Sweden, all cold records were broken during the 19th/20th of February, with 32 degrees below zero F (-35.5°C), the coldest temperature since 1805 (NYT, the 23rd of February 1940).

The political factor

If war at sea changes the climate, such an event would have tremendous political implications. If there are significant political implications in 2006, there must have been in 1939 too, but unfortunately no one knew what was at stake at that time.

In the summer of 1939, a major world war was looming. British Prime Minister Neville Chamberlain tried desperately to persuade the German Chancellor Adolph Hitler not to push the world into another major war. The threat of the climate change was not among the argument list that Chamberlain used to convince his opponent. His efforts were in vain. Hitler wanted a war and he started it in September 1939. The war lasted six years and initiated the longest and biggest climate change of the last century.

This book is about oceans, wars at sea and climate changes. It focuses on two major climate changes, which happened because man abused oceans through naval warfare two times during the last century. The last and most



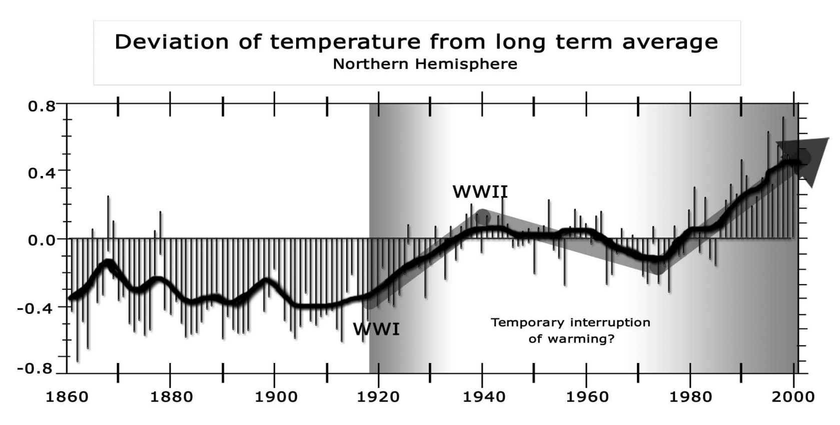
dramatic climate change occurred sixty-five years ago, generated three arctic winters in Northern Europe and cooled the world down for four decades.

Fifty million people were killed and the infrastructure and economy of many countries was ruined during World War II (WWII). But there are more tragic consequences that have not been seriously tackled yet. With the beginning of the war, in 1939, the warm climate switched to a cold phase, which lasted four decades. Now, more than half a century later, leading politicians and scientists warn us that climate changes are the greatest threat to the mankind. They claim that the threat is caused by the industrial release of carbon dioxide into the atmosphere. This works like a greenhouse effect that determines the earth's temperature to rise.

The British Prime Minister Tony Blair declared recently that there was "no bigger long-term question facing the global community" than the threat of a climate change[1]. Unfortunately, the focus is misplaced. It is not the atmosphere which determines the fate of the climate. It is the ocean who does it.

War at sea determined two major climate changes: one in 1918, at the end of World War I, and the other in 1939, at the beginning of World War II. If the oceans, as driving force of the climate, had influenced scientific research since the early days of meteorology, 150 years ago, then it would have been possible to stress that the advent of the two World Wars and the extensive fighting at sea were a real threat for the normal course of the climate.

How could the course of international conflicts have been managed if the world's leading statesmen of the 20th century had been concerned with the climatic changes due to the impact that a war at sea could have had on the ocean and on the climate? Could World War II have been prevented if global climate change had been as much a concern as it is today? Or would the leaders have tried to persuade the navies at war to leave oceans and seas out of the conflict? Would Hitler have reconsidered his war aims if the United States had warned him of their immediate implication in the war in case his decision had been to launch 1000 naval ships out on sea in an attack that risked generating a substantial climatic shift?



But, during the last 150 years, no one alerted the warring nations that going out on sea to fight a war would have an inevitable impact on the oceans status and, consequently, on the climate. No one sent effective diplomatic notes to Hitler, demanding him to cancel all military activities in the oceans, in August 1939.

The inevitable happened. Within four months after the beginning of WWII, Northern Europe was plunged into the coldest winter in more than 100 years. Since December 1939, Europe endured arctic conditions that had not been experienced since the Little Ice Age, in the $18^{th}/19^{th}$ century. And neither the scientific community nor the political leaders had any idea about the connection between the war and the arctic temperature conditions.

It is an irony that the deputy and chief of German Armed Forces, Herman Goering[2], in a speech designed to boost the morale of the German population striving to overcome the unbelievable difficulties of a cold and snowy winter, could get away with the statement he made on the 15^{th} of February 1940:

Nature is still more powerful than man.
I can fight man but I cannot fight nature
when I lack the means to carry out such a battle.
We did not ask for ice, snow and cold—
A higher power sent it to us.[3]

Herman Goering was wrong! Huge naval fleets out on fighting missions can easily turn nature's wheels. Adolf Hitler and the German Reich were responsible for the sudden transformation of both regional and global climate. While the war continued for five more years and the war at sea became global after Japan's attack on Pearl Harbour, in December 1941, Hitler's actions did not only generate three extremely cold winters in Europe but also initiated four decades of cold that lasted from 1940 until the early 1980's. All this happened after extensive and devastating naval activities in the Atlantic and Pacific regions.

But this simple fact had not been paid any serious attention. This book focuses on the two wars at sea, from 1914 until 1918 and from 1939 until 1945, when seas and oceans were turned into battlegrounds and huge water areas were turned upside-down by naval vessels and war activities such as shooting, aerial bombing, torpedoing, sea mining, and depth charging of submarines.

The scenario of autumn 1939

On the 1st of September 1939, Germany launched land, air and sea attacks on Poland. Soon, the Nazis deployed 5,000 planes upon Poland. On the 25th of September 1939, 240 German planes bombed Warsaw, dropping 560 tons of bombs (including the first bomb of 1,000 kg). 30 transport aircrafts dropped 70 tons of firebombs. Meanwhile, 1,000 batteries shelled the city day and night. Warsaw burnt for many days. The sky above Central Europe was filled with smoke and dust. Poland surrendered before the end of the month. Total casualties are estimated at 1 million, including 200,000 dead people and 700,000 war prisoners.

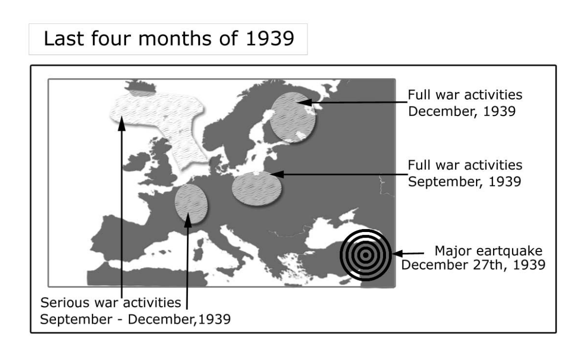
On the 3rd of September, Great Britain and France declared war to Germany. Several hundred-kilometre military defence zone between France and Germany (the Maginot Line and the Westwall) were put into full operation immediately. Two million soldiers faced each other in September 1939. Since October, the number increased to over three million. Attacks and encounters occurred frequently. One of the first attacks during the first war week saw 700 French tanks and planes moving seven miles over the Saarland border, while 300 air planes attacked German positions in an industrial region and ammunition area, some 125 miles further north. Similar encounters occurred frequently, week-by-week, month-by-month, until Germany attacked and occupied the Western Europe countries, in summer 1940.

On the 30th of November 1939, Russian troops invaded Finland with an army of 500,000 men (ca. 30 divisions), 2,000 tanks and 1,000 airplanes, while Finnish forces were weaker. Fighting took place along a 1,000 kilometre front-line, from the Barents Sea to the Gulf of Finland, with few access roads and very low temperatures (-46ºC around the Christmas of 1939), in the permanent darkness at north of the Polar Circle and with only a few hours of daylight in southern Finland.

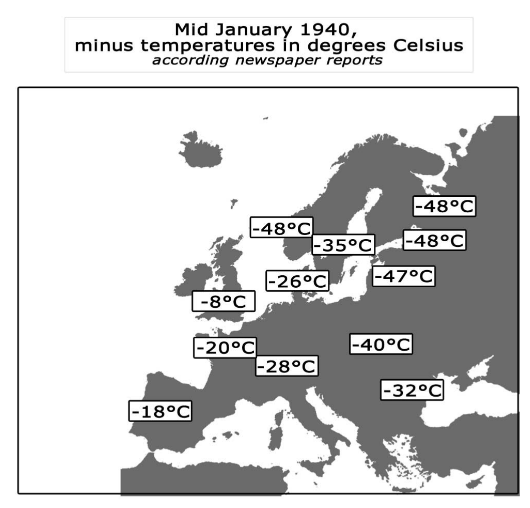
On the night of 26-27th of December, Anatolia was hit by a major earthquake which caused the death of 30,000 persons and generated a tsunami in the Eastern Black Sea.

In August 1939, many naval vessels had already been sent to distant positions. Baltic Sea, North Sea and Eastern North Atlantic were the preliminary areas for the war activities. After hour zero, many hundred naval vessels were permanently engaged in patrolling, escorting, mine laying, mine sweeping, depth charging of submarines, shelling of coastal batteries, enemy vessels or enemy air planes.

The importance of autumn 1939 for the climate research



The autumn of 1939 has a unique importance for climate research. On the 1st of September 1939, climate statistics was free from any "external" influence. The winter of 1938/39 had been the warmest in the past few hundred years. Since the end of the WWI, Europe had become warmer every year. In the 1930's, no abnormal phenomenon (which could have had an impact on the 'natural course' of climate) had been recorded either in Europe or in a wider region. In fact, the period between January and August 1939 had been slightly wetter than the average but, otherwise, thoroughly normal. Things changed only when WWII started. The impact of naval warfare on climate and nature occurred very suddenly. Oceanic and atmospheric matters run according to physical laws, but react to brutal forces. An excellent example is the autumn of 1939, when Northern European waters were suddenly confronted with the action of 1000 naval ships, which came up with a devastating force, powered by newly developed military means, like shells, torpedoes, sea mines, and aerial bombs.



Our focal point

This investigation is not concerned with naval history but with global warming, respectively climate changes. Describing military events in Europe since September 1939 would require any historical writer to make the distinction between activities on land, in the air and at sea. Military aspects interest us only as far as they affect the climate. As this investigation sustains that climate should be defined as the 'continuation of oceans by other means'[4], viz. atmospheric humidity instead of ocean water, a clear distinction can be made.

What happened above and under the sea surface is what interest us: activities like ship propulsion, shelling, mining, bombing, torpedoing, depth charges, ship scuttling and sinking, ship fire and explosion, loss of cargo (oil, chemicals, bulk), etc. Each and every activity that resulted in the 'churning and turning' of the seawater is very significant for the warming or cooling of air temperature. If the status of the ocean changes, a corresponding change of the atmospheric conditions is inevitable.

The interconnection is obvious. After only 100 days of war, Northern Europe tumbled straight into severe Little Ice Age conditions, comparable only to those from more than 100 years ago. First, let's see what it meant to Northern Europe to be thrown back in the Little Ice Age and focus on the causes of the arctic war winter of 1939/40.

CHAPTER B

Arctic winter 1939/40

General winter weather scenario

The severe winter period lasted from mid-December 1939 until March 1940. Even in Northern Spain, temperatures of minus 18 C were recorded, while in France people began to wonder whether they lived in Western Europe or in Siberia. However, the cold centre was situated in the Netherlands and in Northern Germany, and up to the Baltic countries. The low temperatures were generated by the arctic air coming from Siberia. Extreme weather conditions were felt in Finland, Sweden, Southern Norway, Denmark, South-western England, Northern France, Germany, Hungary, Yugoslavia, Romania, Poland, the Baltic countries, and Western Russia. In Southern Europe, south of the Alps, weather was extremely cold and unpredictable for some days, but average temperatures did not deviate significantly.

By mid-January 1940, newspapers reported extreme temperatures for Northern Europe: -48°C in Finland and the Baltic countries, -35°C in Southern Sweden, -26°C in Denmark, -40°C in Poland, -32°C in Budapest, -20°C in Paris. The weather remained extremely cold until April 1940.

By mid-February, a second cold wave took hold of Northern Europe with temperatures of -25°C in Sweden, Denmark and Holland, -33°C in Budapest, and -47°C in the Baltic countries. Sub-zero temperatures lasted in Potsdam/Berlin until the 15th of April, with only 20 days without freezing temperatures during the whole winter period.

Winter conditions in Northern European Countries

A brief overview of newspaper reports may give us some information about what it meant for Northern Europe to be thrown back in the Little Ice Age.

South-eastern England: At Kew Observatory, January 1940 was the coldest month since 1791, with the highest percentage of frost days. Greenwich figure was also the lowest recorded during the past one hundred years. In the close vicinity of London, the river Thames had frozen for the first time since 1814 (Neue Zürcher Zeitung, the 29th of January 1940).

The Netherlands: As early as the 6th of January 1940, drift ice in the East of Scheldt was so severe that Ameland was temporarily cut off from the mainland. Freezing conditions went on. By mid-February, hundreds of persons abandoned their homes because of the threat of crushing ice packs boiling up from ice-locked canals, rivers and seas. In mid-February, Amsterdam Weather Bureaus reported the lowest temperature ever recorded in the Netherlands: 11.2 degrees below zero Fahrenheit (-24°C). Water transportation in the Netherlands was completely paralysed. Canals were covered with thick ice for more than six weeks, while traffic on the Rhine and Waal had already stopped in early January.

Denmark: Even before the end of 1939, snowstorms swept Denmark. In mid-January 1940, Copenhagen registered-26°C (-15°F) and there was no sign that the cold wave would come to an end very soon. Heavy snowstorms blocked or slowed down the traffic in many parts of Denmark. "It is Denmark's worst winter since 1860", the New York Times reported in February 1940.

Sweden: On the 21st of February 1940, the New York Times reported: "In Sweden all cold records were broken in the last twenty-four hours, the coldest since 1805". Analysing the data base recordings for those four months i.e. December 1939–March 1940, the winter 1939/40 proved to be the coldest since 1880/81.

Finland: On the 24th of December 1939, James Aldridge's report (extract from NYT, the 25th of December 1939) was saying: "The cold numbs the brain in this Arctic hell, snow sweeps over the darkened wastes, the winds howl and the temperature is 30 degrees below zero Fahrenheit (minus 34.4°C). Here the Russians and Finns are battling in blinding snowstorms for possession of ice-covered forests…I reached the spot just after the battle ended. It was the most horrible sight I had ever seen. As if the men had been suddenly turned to wax, there were two or three thousand Russians and a few Finns, all frozen in fighting attitudes. Some were locked together, their bayonets within each other's bodies; some were frozen in half-standing positions; some were crouching with their arms crooked, holding the hand grenades they were throwing; some were lying with their rifles shouldered, their legs apart…Their fear was registered on the frozen faces. Their bodies were like statues of men throwing all their muscles and strength into some work, but their faces recorded something between bewilderment and horror."

The Baltic Countries: Already in December 1939, in the Eastern parts of the Baltic countries (at the Russian West border), the temperatures fell to-17°C (between the 24th and the 25th of December), and below-20°C one day later, extending to the Baltic coast and recording-14°C in Klaipeda and-17°C in Gdynia (Bight) on the 27th of December[5]. The harshest cold wave in years reached the Baltic countries by mid-January 1940, with temperatures of 40 degrees below zero Fahrenheit. In mid-February 1940, more than 10,000 persons were still suffering from severe frostbite in Estonia, Latvia and Lithuania. At least five persons froze to death in these three Baltic countries, where temperatures reached 54 degrees below zero Fahrenheit (-47.7°C) for the first time in 160 years and where the Baltic Sea froze over.

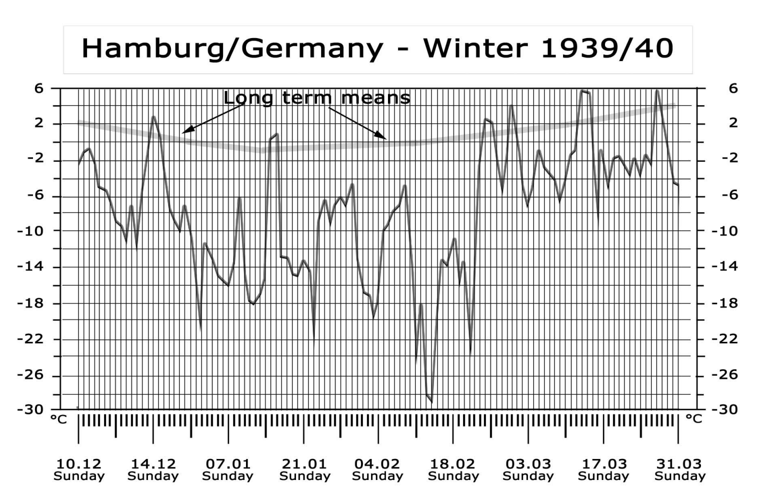
In Central Europe, in countries like **Hungary** or **Romania**, a very severe snowstorm paralysed shipping in the Black Sea and the lower Danube River even before Christmas 1939. On the coast, temperatures dropped to 15°C below zero. Snow also fell all over Bulgaria on the 21st-22nd of December, this way starting a new cold weather episode (down to-16°C). Temperatures of-20°C were recorded in Northern Bulgaria. During the remaining days of 1939, ice blocked the Danube and prevented German supplies from getting through. Railway traffic was expected to be hampered by snow, too. On the 30th of December 1939, The New York Times reported: "Cold winds have been recently blowing westward from Russia."

In January 1940, weather throughout Eastern Europe was unpredictable: very cold, very snowy and possibly the coldest in fifty or even more years.

In mid-January 1940, temperatures dropped at 40 degrees below zero Fahrenheit in Romania, while Bulgaria was reported to be suffering under the worst cold people could remember.

February 1940 was by no means better. It was reported that all records of cold weather in Europe were broken during that month and just when people were hoping that the worst was over, another cold wave hit the entire continent. Budapest endured the harshest cold weather in sixty years: 28 degrees below zero Fahrenheit (-33°C).

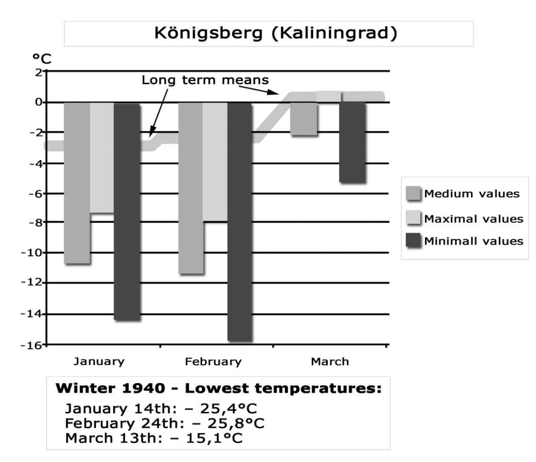
Extended areas of **Germany**, particularly those close to the North and Baltic Seas, experienced the coldest winter in more than 100 years. The centre of the cold wave expanded from Amsterdam, via Bremen, Hamburg, Berlin to Königsberg (Kaliningrad). In the Helgoland Bight and Southern Baltic Sea, naval activities were at their peak: starting with a 10 days battle from sea to shore, and from shore to sea, in Gdansk area in early September, and continuing with the laying of many dozens of mine fields along the German coast. A detailed description will be provided later.



Hamburg, a port city on the Elbe River, close to North and Baltic Seas, experienced record weather conditions despite its usually maritime climate, with winter temperature averages just above zero degrees Celsius. Instead of that, average temperature was below minus 12°C for almost two months (the 1st of January–the 20th of February). The Elbe was under ice. When unusual freezing started in December 1939, a big headline of a Hamburger newspaper was saying: "The Elbe will never be frozen over, since 1874/75 icebreaker would keep the shipping fairway open". After a while, nature proved that assertion wrong. The German navy encountered many difficulties. Many naval vessels were stuck in the middle of the floating ice.

For Berlin, Dresden and Halle this was the coldest winter in 110 years, and the summary of the daily data between November 1939 and March 1940 proves it beyond any doubt. After 1829/30, no other winters have been as cold as winter 1939/40 was. The coldest months of January in Berlin since recording started, in 1719, are: 1823, 1838, and 1940.

At the most eastern end of the southern region of the Baltic Sea, former Königsberg (later Kaliningrad), whose usually winter temperatures were of an average of –2°C, had to cope with the following average temperatures, as shown in the graph.



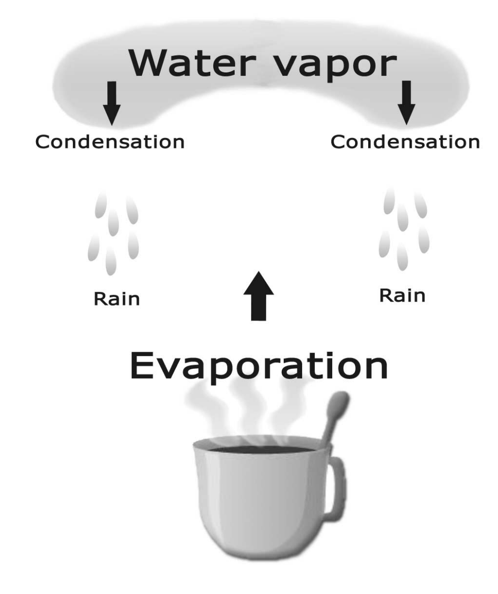
Summary: The evidence of the extraordinary winter conditions is overwhelming. It is further possible to clearly demonstrate that the entire Northern Europe, from Helsinki to Sofia and to London, fell prey to arctic conditions, while in a number of cities, like London, Amsterdam, Hamburg, Berlin, Dresden and Kaliningrad (Königsberg), there were registered record low temperatures, which were not experienced in more than a century before. As we have offered an overview of the impact and the characteristics of winter 1939/40, our next step is to explain and establish how this could happen. After all, global and regional weather is based on physics and nothing happens without a cause.

Seas churned by navies

Laws of physics governing Hot Soup in a Cup

Laws of physics also apply to hot soup in a cup. WWII unleashed tremendous military forces unheard-of in history before. Millions of soldiers marched up and down battlefronts. Thousands of naval ships ploughed oceans and seas day and night. In autumn 1939, the most affected seas were the Baltic-and the North Sea. Normally, both of them would have stored heat to their highest capacity by the end of August. Since the last Ice Age, they served in autumn as a substantial heat reservoir for the forthcoming winter season when days are short and sunrays contribution to regional weather conditions is unobservable. Together with the Gulf Current from the west of Great Britain and Norway, these seas ensure moderate winters to Northern Europe. These seas determine the weather of Western Europe (in the north of the Alps): maritime or continental winter climate. Winter 1939/40 in Northern Europe turned out to be an extremely continental one.

Allowing navies to participate in a war at sea, in Northern Europe natural heat reservoir, is like hastily stirring a hot soup to cool it down for quick consumption. Once the soup in a bowl is cooled down, it will never warm up naturally again. Likewise, once the heat storage of Northern-and Baltic Seas has been diminished, water will warm again only during the next year summer. And as navies were out on the sea in autumn 1939, the inevitable happened. Arctic cold wave was due to come in the winter 1939/40. Naval activities during the first four war months (from September until December 1939) represented an important force and the laws of physics didn't remain unnoticed.



"A spoon in a cup"

Dimension does matter if one considers the effect of stirring the soup in a bowl with a spoon. In oceanic terms, the enclosed seas of Northern Europe represent only 0.2% of global sea surface and a mere drop with respect to the total volume of the seas around the world (0.0026%). Nevertheless, they play a crucial role as their size represents roughly one-third of North-western Europe. As for the effect of the 'turning about' of the sea areas, their depths are of considerable importance. In the North and Baltic Seas, depth is not an impressive figure i.e. an average of mere 50 meters. In comparison, Mediterranean Sea has an average depth of 1,500 metres and sunrays warm the sea even in wintertime. Battleships in those days had an average size of about 35,000 tons, a draught of 10 metres and a speed of 32 knots (approx. 60 km/h). Battleships accompanied by a number of escort destroyers across the seas turned huge water areas around. Suddenly, there were thousands of naval ships out on sea, hunting enemies or being hunted from shore, air, surface ships or submarines.

Naval Fleets

By December 1939, the number of main naval ships belonging to Germany, Great Britain, France, Italy, the Soviet Union and Italy amounted to more than 1,000 vessels (including submarines, torpedo boats, etc.), with a total tonnage of 2.8 million plus at least another thousand smaller vessels and boats serving as mines sweepers, etc.

Great Britain: 250 big naval vessels (183 destroyers and bigger vessels) and approx. 57 submarines;
Germany: 30 big naval vessels (21 destroyers and bigger vessels) and 57 U-boats.

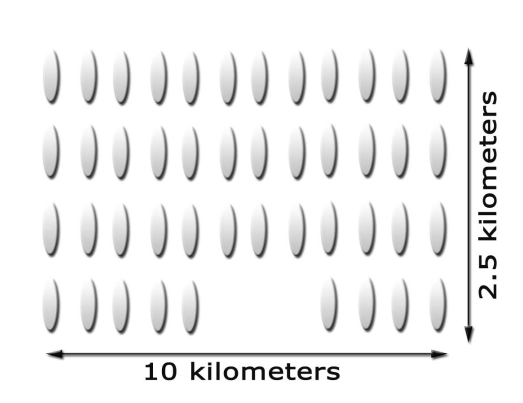
Remember that these figures indicate the navies' size on the 1st of September 1939, because thereafter new naval ships came into service almost every day.

The Merchant Fleet and the Convoy System

At the beginning of the war, world merchant fleet counted 30,000 ships with a total tonnage of about 70 million. British fleet was by far the largest with 20 Million tons, followed by Norway with 5 Million tons, Germany with 4.5

million tons, and France, the Netherlands and Italy with about 3 Million tons each.

As far as Britain was concerned, shipping activity was of utmost importance, so no effort was spared in order to maintain this. Atlantic supremacy should ensure sufficient supply to Great Britain at any time. Allies introduced the convoy system without delay, this strategic display having been very successful during WWI. The convoy system was supported by the First Lord of the Admiralty Winston Churchill who once said that it was "the dominating factor all throughout the war…Battles might be won or lost, enterprises might succeed or miscarry, territories might be gained or quitted, but dominating all our power to carry on the war, or even to keep ourselves alive lay our mastery of the ocean routes and the free approach and entry to our ports"[6].

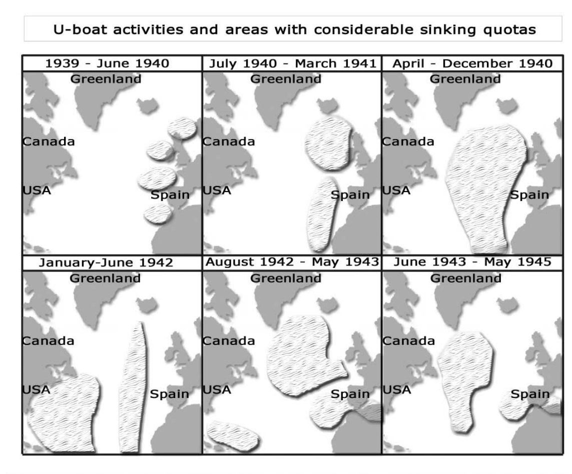


Convoying meant that up to 50 ships sailed in a display of four to five columns, frequently altering course by up to 90 degrees simultaneously (zigzagging), while naval escort vessels formed a shield around them. The threat of submarines and raiders was imminent everywhere. Britain announced that it would arm 2,000 merchant ships with guns. In 12 months 3,000 vessels were armed with a 4.7-inch gun each. By December 1939, 5,756 ships had sailed in convoys, which mean that more than 1000 convoys have been organized in a short period of time.

Submarine—U-boats

At the beginning of the war, German and British Navies had 57 submarines each. Britain eventually employed 270, the Germans about 1,000 during WWII.

British submarines had the difficult task of intercepting well protected German shipping around Northern Europe by direct torpedo attacks or by mine laying missions. Although Britain never managed to operate in the Baltic Sea during WWII, Royal Navy submarines took its heavy toll of German troop transporters, supply ships and escort vessels, quickly forcing the Germans to adopt the system of defensive convoys when operating in the North Sea or, since 1940, in the Norwegian waters. During the Second World War, British submarines were credited with the sinking of 475 merchant ships, 105 warships and 36 submarines, and with the damaging of many others.



What happened to submarines in North Sea and elsewhere for five years, day by day, since the 1st of September 1939 may be illustrated by a news report headlined: “British Submarines’ Crew, Bombed All Day At Bottom of Sea, Passes Time by Betting” (The New York Times, 6 October 1939): “the Admiralty today released a story about the crew of a trapped, crippled British submarine who ran a penny sweepstake pool at the bottom of the North Sea while the Germans groped for them with sweep wires and shattered bombs and depth charges for twenty-four hours. In the first hour six depth charges sounded faintly and in the second hour the explosions, louder and nearer, averaged one every two minutes”. Another report of the same date states: “British destroyer patrolling northeast of the English Channel had trapped two German submarines early this week and forced them into a mine field where they exploded and sank”.

However, submarine warfare during WWII actually meant success and failure to German U-boats in North Sea and North Atlantic, strategic areas for Great Britain’s vital supplies coming from Canada, USA, and the Southern Hemisphere countries. About a dozen German U-boats were already in the Atlantic when the war started in September 1939. Others operated in the European waters. In September 1939, groups of three to five naval vessels of the Royal Navy were formed to patrol large sea areas. These groups criss-crossed the seas day and night searching for U-boats and dropping depth charges when a U-boat was detected or assumed to be around.

On the 14th of September 1939, U-39 operating in the Hebrides area shot its torpedo at the 22,000-ton aircraft carrier '*Ark Royal*', but missed. Escorting destroyers *Faulkner*, *Foxhound* and *Firedrake* depth-charged U-39 in a series of attacks reported by an eye witness as it follows: "We gained ASDIC Contact with the Sub and each ship in turn, went in at full speed and fired a pattern of depth-charges. *Firedrake* attacked last, as we came out of it and heard our depth charges explode, we thought we had missed, until up it came, vertical like a huge cigar and then flopped down slowly". U-39 surfaced briefly, and then sank. A few days later, the attack of U-29 succeeded. In the early evening of the 17th of September 1939, 22,000-ton British aircraft carrier '*Courageous*' was on an enemy hunt together with four destroyers, in the Southwest areas (Southwest of Ireland), 150 nautical miles WSW of Mizen Head, Ireland. The carrier could travel at a speed of 30.5 knots (56 km/h). But the days of HMS '*Courageous*' were numbered. "A German submarine struck a telling blow at the British Navy last night by sinking the 22,000-ton aircraft carrier *Courageous*, with loss of an unknown number of its complement of 1,100 officers and men. It was the first real success scored by the German Navy in this war." From a salvo of three torpedoes, two hit the Courageous on portside. The destruction was devastating as described by Sub-Lieutenant Charles Lamb: 'There were two explosions, the like of which I had never imagined possible. As if the core of the earth exploded and the universe split from pole to pole, it could sound no worse…In the sudden deathly silence which followed, I knew the ship had died.' The *Courageous* turned over and sank in fifteen minutes, with a loss of 519 men who formed its crew. Lieutenant Wesmacott 'heard two violent explosions which seemed to lift the ship'.

Depth Charges

This section is about ASW, namely anti-submarine-warfare. A depth charge is a 'drum' containing explosives with a fuse which is detonated at a preset depth and which is based on hydrostatic pressure. Developed in 1916, during WWI, a depth charge could detonate up to 100m depth and carried 150 kg of explosives. There was little development for this weapon between the wars except for a 300kg variant. At the start of WWII, depth charges were essentially the same weapon as it existed at the end of WWI. This situation changed quickly.

In September 1939, The New York Times wrote about the procedures of U-boat hunting: "Once a submarine is located, British naval plans, so far as they were known before the war, call for attack by familiar methods of an enclosing diamond pattern of depth bombs, supplemented, of course, by shell fire and ramming if the submarine could be forced to the surface. In the diamond-pattern attack, the destroyer goes at full speed to the spot where the submarine, slow and clumsy under water, is thought to be. One depth bomb is charged just before the spot is reached. A few seconds' later two more are lobbed out by a Y-gun so that they land out on either side of the destroyer's wake. In the front part of the diamond pattern, another depth bomb is dropped over the stern, some distance ahead of where the Y-gun fired. This way a large area of the sea is covered by this diamond pattern. The effect is further increased by the fact that the bombs are timed to go off at different levels, so that the area is covered not only horizontally but vertically as well. The bursting area of a modern depth bomb is considerable".

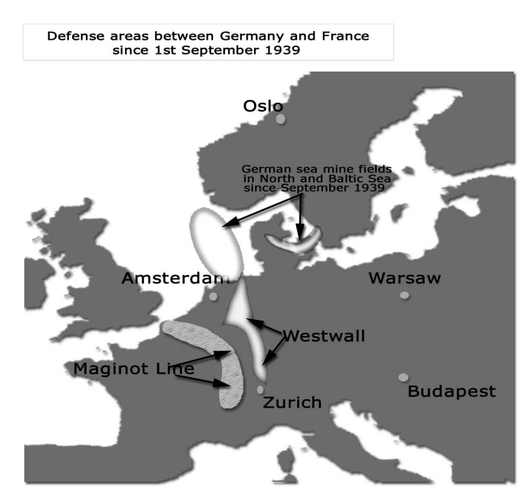
Evaluating the intensity of the destruction caused by the explosion of depth charges from sea surface to sea bottom is not easy. Many naval vessels were not out on sea for combat reasons, but for training, surveillance or testing, etc. For many commanders the situation was new and they took precautions against imminent or assumed threats, as the following report illustrates it: "Russian commanders of the transport ships and torpedo boats were so much afraid of being attacked by a Finnish submarine in the Gulf of Finland that they set off depth charges every 15 minutes or whenever an unconfirmed sighting of a periscope was reported, all that resulting in a total of 400 depth charges having been dropped by the end of the operation that day".

On the 29th of November 1939, at dawn, U-35 was cruising east of the Shetland Islands, in the North Sea. At the sight of the British Destroyer '*Icarus*', the U-boat crash-dived to 70 m depth and started steering evasive courses. As '*Icarus*' electronic devices for U-boat localisation were out of order, depth charges set for 80m were dropped in order to feign an attack. Two nearby destroyers were alerted. After contact had been established, two more depth-charge attacks followed, jamming U-35 diving plans and placing it at a sharp up angle. Crew was sent to the ship's bow to bring it back on even keel, but all their efforts were in vain. Explosions had also destroyed the fuel and ballast tanks aft. U-35 appeared suddenly at the surface and the crew was ordered to abandon the ship, but they were rescued by their attackers.

During the first sixteen months of war, an estimated number of 33 U-boats were destroyed in about 4,000 depth charge attacks. Each attack could mean the use of a few or, from the contrary, of many dozens of depth charges. The total number of depth charges dropped per month could easily reach several thousands. German naval vessels hunted Royal Navy submarines, too. Up to 10,000 or even more depth charge explosions could have occurred below the sea surface during the first four months of the war.

Since then, development of depth charges focused on increasing the depth at which a submarine might be successfully attacked, due to improvements to their sinking speed. Since 1943, the detonation of depth charges carrying a charge of 100 kg of TNT at a depth of 300 meters became possible.

Aerial bombing at sea



Neither the German navy nor the British one had a fully operational aerial arm at the beginning of WWII. The German Navy never got one. British Royal Air Force Coastal Command became operational in 1940. However, airplanes charged with bombing missions were operating frequently (British airplanes in the Helgoland Bight and German airplanes on England's East coast) or were attacking the enemy in the open sea. On the 3rd of September 1939, Britain was in possession of a fully operational unit of 2,600 aircrafts; the Germans had nothing less.

A few out of many hundred events are listed below in order to offer you an outline of what happened during the first few months of the WWII.

The 4th of September 1939: The First RAF raid of about 30 planes. Organised in separated groups, they targeted a fleet of Nazi naval vessels in the German Bight. About seven RAF planes were lost in mission.

The 27th of September 1939: In the middle of the North Sea, a squadron of British capital ships together with an aircraft carrier, a cruiser and destroyers were attacked by about twenty German aircrafts. Fourteen German land bombers made the attack.

The 29th of September 1939: British planes attacked a German naval squadron near Helgoland. Five out of 11 Hampdens (bomber planes) are shot down by German fighters.

The 9th of October 1939: British cruisers hunting submarines in the North Sea (southern coast of Norway) fought off German bombers, which attacked repeatedly. The Germans sent almost 150 planes to the scene of the battle.

The 17th of October 1939: Nazis bombed the naval base from the Firth of Forth near Rosyth, Scotland. Three ships were damaged; two bombers were shot down and crashed in flames into the sea.

The 21st of October 1939: Fighter planes shot down four German bombers out of nine which were deputed to attack a British convoy off the Humber estuary.

The 5th of November 1939: "Our outlook shouted, 'Planes right ahead, Sir; three planes; they are diving, Sir'. Our foremost guns opened fire with a roar that drowned everything. The muzzles were elevated almost level with the bridge and yellow flames sprang out, obliterating the shapes of the German machines swooping over the convoy. The sea leapt up in columns where their bombs were dropped."

The 14th of December 1939: Twelve RAF bombers attacked German warships in Helgoland Bight, but ended up by losing between six and ten bombers.

The 17th of December 1939: German bomber planes attacked trawlers near the English east coast and sank 10 boats of approx. 3,000 tons.

The 19th of December 1939: An air battle of significant proportions occurred the moment when British bombers encountered the German pursuit ships in the Helgoland Bight area. The loss was of 12 planes out of 24 RAF Wellington bombers deployed.

The 21st of December 1939: "German aircrafts attacked thirty-five vessels, including two neutral ships during the last three days. Of the ships attacked, one coasting steamer and six fishing trawlers sank."

Sea mines

Between 100,000 and 200,000 sea mines have been laid during the few autumn months of 1939. Most of the mines were placed in the North Sea and a substantial number in the Baltic Sea.

East Coast Barrier

The British successfully mined their East coast from Dover to Orkneys during the first few months of the war. In September 1939 alone, the British minelayers *Adventure* and *Plover* laid 3,000 mines across the Strait of Dover. In the second half of September, the barrage was completed with 3,636 U-boat mines, which soon paid results, Germany losing three U-boats in October. The British set up the East Coast Barrier, a mine barrage between twenty and fifty miles wide, from Scotland to the Thames, leaving a narrow space for navigation between the barrage and the coast. In early January 1940 The New York Times reported: "British naval vessels are sowing some of the last mines needed to complete Great Britain's 30,000,000-pounds protective shield for east-coast shipping, which is the most extensive mine field ever laid." If one assumes that the weight of those mines varied between 300 and 1,200 pounds, the number of mines laid in autumn along the east coast alone would be between 25,000 and 100,000 mines.

The report of a mining mission in mid-October 1939: The German destroyers *'Galster', 'Eckholdt', 'Lüdemann', 'Roeder', 'Künne'* and *'Heidkamp'* took on their cargo of 60 mines each (except *'Heidkamp'*) at Wilhelmshaven, and departed at noon, racing northwards first, at 30 knots, as a misleading measure, then, at dusk, turning westwards for the target area: the mouth of the Humber. In the early hours of the 18th of October, the five destroyers began their task, between the Humber Estuary and the Withernsea Light. On completion, the destroyers headed home at full speed. This minefield of 300 mines eventually sank seven ships.

Helgoland Bight (Deutsche Bucht)

At the beginning of the war, the German Navy laid a large mine field starting from the Nethelands' coastal waters (near Terschelling island) and going northwards across the Helgoland Bight up to the entrance of the Skagerrak, at a distance between 50 and 100 km off the coast of Schleswig-Holstein and Denmark. This barrage was known under the name of "Westwall". For about three weeks, a flotilla of at least 25 naval vessels was engaged in laying mines along this "Westwall".

The number of mines laid during the period in question could be somewhere between 20,000 and 200,000. But as the distance from Terschelling to 56° 30' North is of about 350 kilometres (170 sea miles) and the 25 naval vessels charged with this task were able to lay thousands of mines per day, it seems reasonable to assume that, by the end of the year, the Reichsmarine could have placed somewhere between 50,000 and 100,000 mines.

Home Fleet's surface vessels undertook a number of missions as well, with the purpose of laying mines in the German home waters. Such an illustrating example would be the mission undertaken by the British destroyers *Esk* and *Express*, which laid mines where "Westwall" 'exit channels' were assumed to be (in mid-September).

Mining the Baltic Sea—1939

War had just started when the 1,555-ton, Greek ship *Kosti* hit a German mine, two miles south of Falsterbo/Sweden, on the 4th of September, and sank after a terrible explosion in the minefield in the south of the Great Belt and the west of the Danish island of Zealand. Danish Government made public its plans of planting mines in its own waters. From the very first days of the war, the Germans had laid about 1,000 mines at the entrance in the Danish waters and they continued to lay mines during autumn as well. In the early November, gales had loosened several hundred mines from the German mine field, drifting them off the Copenhagen shore, where some of them exploded, breaking windows and frightening citizens with the terrific noise of their detonations.

During six long years, the situation got worse day-by-day. It is difficult to verify and tell the exact number of mines the Germans planted in the Southern Baltic Sea. Many thousands of mines were also placed in the Western Baltic Sea before the winter of 1939/40, and, as a result, the German Baltic waters suffered the impact of a compact ice cover starting with January 1940.

Other riparian countries planted mines as well. The Soviet Navy started laying mines in the Gulf of Finland in late September. An important number of mining activities of the Germans, Finns and Russians took place in this sea area during November and December 1939. The total number of mines laid in various parts of the Baltic Sea during the late 1939 could have been of several thousands.

Minesweeping

Minesweeping activities were another particularly effective means of churning and turning huge sea areas day-by-day, since the war started. A standard mine was the moored contact mine, a buoyant material filled with up to 1,000 kg of explosive. To avoid detonation, special ships used distant means to cut the mooring chain or wire attached to the mines to keep them afloat. Sometimes, the mines exploded before reaching the surface and if they surfaced they were blown up with rifle shots.

In November 1939, magnetic mines entered the scene. They could only be destroyed through forced explosion. From the climatic point of view, this was the worst case scenario. The mine was exploding in its location, at a depth of 20 or 50 metres, producing the biggest possible “stirring” effect in the water column reaching above. The countermeasure was to deactivate the ship’s ‘magnetism’ so that it could pass near the mine without activating it.

Minesweeping proved to be a tremendous, round-the-clock operation which implied covering millions and millions of sea miles in order to detect and destroy the ‘in waiting weaponry’. The efforts made during WWII were of huge proportions. German Defence machinery against Allied mining operations involved 46,000 personnel, 1,276 sweepers, 1,700 boats, and 400 planes, whereas the British Defence against Axis mining operations involved 53,000 men and 698 sweepers, plus many hundreds of fishing and auxiliary vessels.

"Stirred and shaken"

War destruction at sea is usually counted in sunken merchant tonnage or destroyed enemy naval ships. During autumn 1939 already the total loss of merchant ships was of about 380 with a tonnage of 1 million, out of which the British, Allied and Neutral forces counted 320 vessels and about 900,000 tons.

We are all aware of the attention paid today to the drama of only one ship that happens to sink in the sea. Well, imagine that during the autumn 1939 there were three sunken ships per day and that this terrible situation lasted for four months.

In addition, the Royal Navy lost: one battle ship, three destroyers, one aircraft carrier, one armed merchant cruiser, approx. 10 trawlers, two U-boats, and an important number of smaller units. The German Navy lost 9 U-boats and from its bigger units the pocket battleship *Graf Spee* at La Plata, in December 1939.

However, the sinking of about 500 ships of huge dimensions with several thousands of dead sailors and service men aboard may tell a lot about the human and material loss, but very little about the climatic repercussions which have violently shook the seas. Since the beginning of the war, many hundred vessels ploughed the seas day and night in a series of naval activities. A battleship at a cruising speed of 30 knots turns "upside down" a water column of about 12 meters over an area of 72 square km in only 24 hours. In only one month, 300 such ship manoeuvres can "stir" the complete North Sea surface layer.

Anthropogenic actions severely affected the seawater climatic structure. Seen from this perspective, the coming up of a cold winter was inevitable, as explained in the next section.

Seas reacted to naval churning

The theme

Although physical laws are the same for hot soup and for the "stirred" seas, things tend to become more complex when naval activities occur in the North and Baltic Seas. This happens because the location, seasons and acting forces are different and would not matter so much if science had organized a comprehensive and sufficient coverage of the temperature measurements throughout a seawater body, a long time ago. But such a system was not available before WWII and it is still not available today. Only a few coastal stations recorded sea surface temperatures for a longer period of time. This is by far too insignificant for the climate research. Only a complete picture of the interior of seas and oceans would help us detect and understand the climate course and changes.

But when the seas are the ones who determine the pace of weather and of climate, one can turn 'the table around' by using meteorological data and by citing deviations from usual atmospheric wintertime conditions, deviations which are due to the turning about of waters of the North and Baltic Seas.

This idea will be discussed under three aspects, namely:

- *West wind drift and the seas steaming;*
- *The origins of the abundant rain;*
- *Sea ice conditions during winter 1939/40.*

Europe's northern waters

The North Sea

The North Sea is one of the principal factors in European climatology. On one hand, the North Sea is part of the North Atlantic Ocean and has the aspect of a big bight. On the other hand, it draws a curve into the landmasses of the European continent. Climatic conditions are therefore transitory and its climate is neither maritime nor continental. Nevertheless, due to its geographical location, prevailing westerly winds travelling through the hemisphere within a zone of 2,000 kilometres width, usually ensure a temperate humid climate.

	North Sea diagonals (England—Continent)		
Water depth	Southern section West/East	Middle section West/East	Northern section West/East
Surface	*10/12.5 °C*	*8/15 °C*	*6/10 °C*
7.5 m	*11/13 °C*	*8/15 °C*	*5.5/10 °C*
20 m	*11/13 °C*	*7/13 °C*	*5.5/8.5 °C*
30 m	*11 °C*	*6.5/12 °C*	*5/7.5 °C*
40 m	-	*6/11 °C*	*4.5/6 °C*
60 m	-	*4,4 °C*	*4.5/3.5 °C*
80 m	-	*3,5*	*4.5/1.5*
100 m	-	-	*4/1.5*

Water depths of the North Sea can be roughly divided into two sections. The southern section consists of a plateau, south of a line running from mid-England (Hull) up to Northern Denmark and which is less than 40m deep. The northern section is a triangle among Northern Denmark-Hull-Shetland Islands, with a water depth ranging between 60 and 120m (the deepest place measures 263 m), and the submarine valley along the Norwegian coast with depths ranging between 240 and 350 metres, and of 500-700m in Skagerrak. The inflow of warm water from the Atlantic Gulf current enters the sea in the north and influences the current system from the surface to the bottom in the northern part only. The 40m deep southern plateau is hardly affected by the northern water, but receives some Atlantic water via the Strait of Dover and some freshwater from the rivers. This way, the North Sea is rich in water masses of different types and origins, which vary and fluctuate every season and every year. As all coastlines are subject to significant tidal forces, considerable water masses actually vary on a daily basis.

The annual data of approximate temperature variation in three West-East diagonals across the North Sea is as it follows:

The southern section of the North Sea

Due to the shallowness and tidal forces of the water body, its temperature structure can be described as a homogeneous one (from surface to the bottom), with small variations as the average temperatures indicate: December (8.5°C), January (6.5-7°C), February (5.5°C), March (5°C), April (6.5°C), suggesting that water very close to the coasts has lower temperatures during the winter season.

Between May and August, temperatures increase from 8.5°C to 14.5°/17°C and decrease as it follows:

Depth	August	Sept.	October	November
Surface, West-East	*14.5-17 °C*	*14-16 °C*	*12-13.5 °C*	*09°-10° (*)*
20 m, West-East	*14-16 °C*	*15-16.5 °C*	*13.5-14 °C*	*9.5-11 °C*

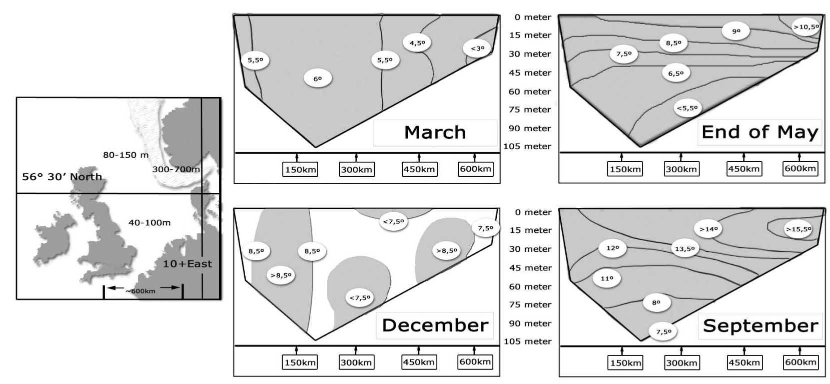
(*) in the mid-North Sea, the figure is considerably higher than in West & East (with 11.5°).

Fairly homogeneous figures of the water body temperature, with 15°/16°C at peak time and the lowest temperature in March (5°C), indicate that the water body experiences an average change of about 1.5°C per month.

The northern section of the North Sea

In March, the lowest annual average temperatures at the surface of the water ranged between 7°C in the northwest (Atlantic water) and 4.5°C in the southeast (Dutch coast). At the end of August, the highest average temperatures at the surface of the water ranged correspondingly (NW and SE) between 13°C and 17.5°C in the Helgoland Bight.

From May until August, a horizontal thermo-cline builds up, but declines during the autumn months. Temperature level increases at lower water levels (e.g. 20m, 40m) in autumn and decreases at the bottom (60m). It is therefore possible for the whole water body to be warmer in September than in August. Even if, after calculating the 'monthly averages', we get only an approximate figure, this gives us an indication about the monthly decrease in temperature (or energy release) which takes place in small quantities: from 11°C in August to 4.5°C in March, i.e. on an average it could be as little as only one degree per month.



The Baltic Sea

In terms of size, the Baltic Sea is a mere 'drop' of water in the world's oceans, but thanks to its strategic location and specific features it represents a 'significant' force and influences the weather in the countries surrounding it. It is an excellent location for the climatology study.

The total area of the Baltic Sea is of 400,000 square kilometres, with an average depth of 55m (including the Gulf of Bothnia, 55-294m and the Gulf of Finland, 30m). Except for the eastern part (Gdynia Bight with a maximum of 114m), the southern Baltic Sea is less than 50m deep. An important climatic feature of this sea is a 2,500m high mountain ridge going from the north to the south of Norway and drawing a sharp line between maritime and continental areas. Continental and polar air has much easier access behind this barrier than it has in areas where the Atlantic air travels east at a lower level. This mainly guarantees warm summers to Baltic countries by significantly delaying the arrival of continental winter conditions. There is hardly any other sea in the northern hemisphere which can convincingly illustrate the importance of the heat storage and release process throughout all seasons the way the Baltic Sea does.

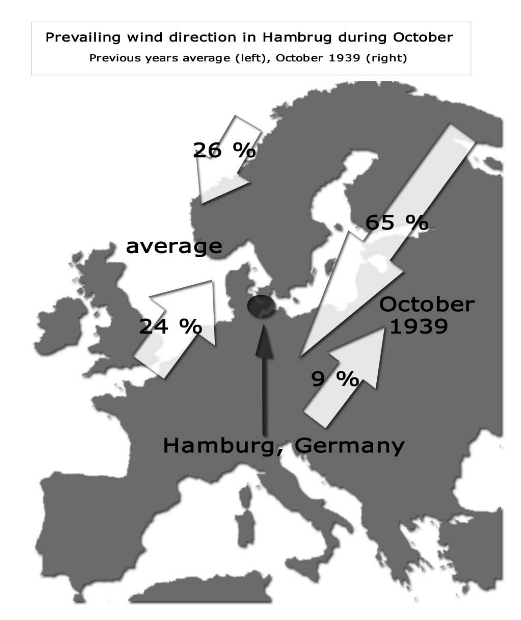
Actually, very cold conditions cannot last long on sea and nearby coastal areas as long as the sea is open and not iced. Icing is regarded as a critical point in the regional climatology. Every sea area covered with ice loses ten times less energy to the atmosphere than an open sea area. The importance of the heat flux can be clearly illustrated by the records of temperature data which show that winter average temperatures at the seaside are considerably higher than inland temperatures which sometimes decrease in great leaps, i.e. by 1°C per 50 km or even more (depending on their distance from the coast).

Between mid-September and the end of February, when the air is colder than the seawater, water temperature decreases between 13°C and 15°C, which is significantly more than that of the North Sea (9.5-11.5°C). This actually means that the surface temperatures, with an average ranging from 0°C (north) to 3°C (south) in January, quickly come close to zero. Deeper waters (80 metres and below) have just 4-5°C, while the water column above varies according to the seasons. These changes of temperature during various seasons are effective only from the surface to about 80m depths. While surface water reaches its peak temperature by the end of August, lower levels may reach their peak later on (e.g. 10°C at 40m, in late October). Therefore, all activities that took place at sea during the autumn 1939 could have had three principal effects:

- *The churning of the upper sea water layer and the increase of evaporation cause a soup cup effect.*
- *The turning about of the seawater masses will force warm water masses to greater depths. Later on, these warm masses will 'resurface' thus bringing about milder air (as usual) or delaying the icing processes by days or weeks.*
- *Any increased evaporation in autumn will cause the inevitable cool down of the sea water body. The less warm water is available, the colder the air above.*

Westerly winds

The western European weather is famous for the predominant flow of wind blowing from the North Atlantic above the Euro-Asian landmasses (from west to east). The wind brings warm air from the depression but soaked up with humidity from the ocean. In contrast, anticyclones influence the weather conditions through high air pressure combined with dry and cold air masses.

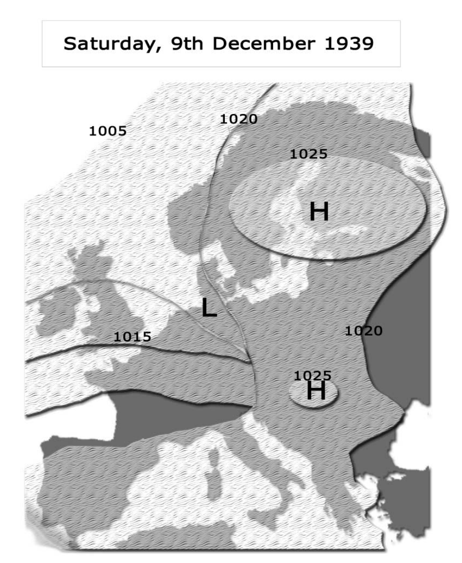


The war machinery changed the weather blueprint so quickly and decisively that after only a few weeks of war the westerly winds were already sealed off from passing through Central Europe.

The reaction of the North and Baltic Seas

North and Baltic Seas play their role according to the physical laws. By the end of August, they had reached the highest seasonal heat capacity. At this time, the upper water column (down to 30 meters depth) is about 10°C warmer than six months later, in March. If no unnatural phenomena come up to stir the seas, then only usual winter winds and storms make waves and only the internal currents exchange the cold water with warm water at the surface of the sea. In this case, seasonal cooling (from September to December and to March) occurs gradually, but close to long term statistical average. That is what climatology tells ever since: "climate is average weather over a long period of time".

However, statistics become useless if a spoon stirs forcefully a cup of hot soup or if naval forces interfere and turn seas up side down. Warm water starts to steam. The more water is turned and twisted, the more steam goes up. This is exactly what happened in autumn 1939. Seawater around Britain (particularly in the southern North Sea, Helgoland Bight, and Baltic Sea) was forced to evaporation at a rate above any other climate data average. Air above the seas became 'thin' and needed replacement with 'heavy' air, which was abundantly available in Northern Russia and in the Arctic region. Consequently, cold air travelled from North to Eastern and Western Europe. Prevailing north-east winds should be regarded as strong evidence that naval warfare acted in North and Baltic Seas the same way a spoon rapidly mixes the hot soup in a cup.



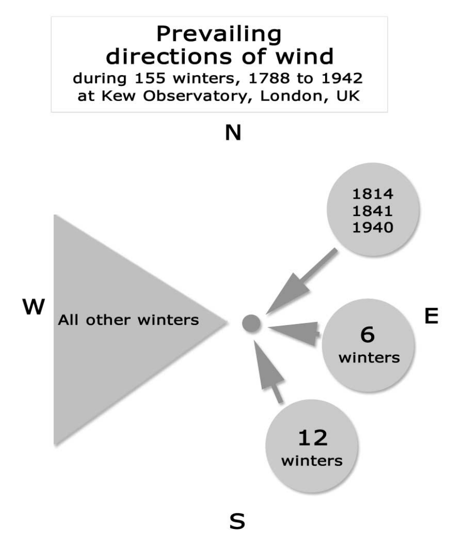
This phenomenon became evident the moment the German weather service reported that the wind direction has changed dramatically (the 2nd of November 1939). Based on immediate observations in Northern Germany, meteorologists noticed that the wind blowing from North-East had almost doubled its presence, while the most prevailing South-Western wind (usually 24%) accounted now for only 9%. This is a very strong and clear indication that huge air masses moved towards the North Sea and to the southern part of the Baltic Sea, phenomenon caused by unusually high evaporation in this area of the sea. While the North Sea water was 'stirred and turned', 'steam' rose upwards into the sky and determined air from the north-eastern area to flow in, thus preventing low-pressure cyclones to travel along the west-wind-drift channel via the North Sea to Central Europe and further on to Asia.

During the first days of December, we witnessed the last weak attempts of the cyclones to reclaim their common path of travelling east. By the 7th of December 1939, a high pressure coming from Belgium to Norway served as the last stitch for the installation of severe winter conditions. Humid Atlantic air seemed to have lost the game. The 'Neue Zürcher Zeitung' (the 14th of January 1940) analysed the situation as it follows (extract):

> *"The severe cold which invaded the whole Europe this week was by no means an accidental phenomenon that settled in by surprise. It rather represents the peak of a gradual process which had its beginnings during the first week of December. Towards the end of the phenomenon, high pressure began to stabilize in Northern and Middle Europe, keeping away the low Atlantic cyclones from the continent and diverting them mainly through Greenland and Iceland waters to the Sea…As soon as occasional Atlantic depressions moved East through the North*

and Baltic Seas, they were immediately replaced by cold air coming in from the Greenland area."

This is an impressive analysis. What the weather expert did not realise is the fact that the 'blocking' of the western winds had occurred since September 1939 and that war at sea was to be blamed ever since.



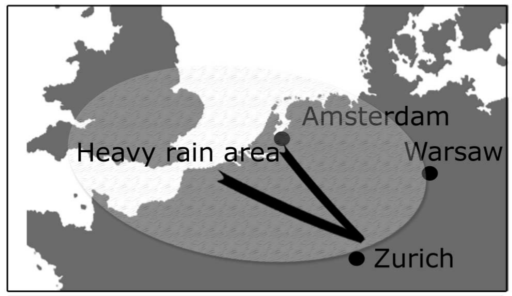
At this stage, it might be worth mentioning that a research conducted by Kew Observatory (London) in the early 1940s mentioned that prevailing wind directions in South-Western England during 155 winters (from 1788 until 1942) had only 21 easterly resultants, whereby the few winters 1814, 1841, and 1940 had resultants from NE to E-NE. Another few winters after 1841 (1845, 1870, 1879, 1891, 1895, 1904, 1929) were characterized by prevailing winds coming from S-SE to E-SE, but during all the other 130 winters the westerly wind prevailed. The exceptional situation of the first war winter (1940) is thus clearly underlined.

Why did it rain cats and dogs?

In the previous section, we offered an overview of the winds changing direction and blocking cyclone influence in Western Europe. We saw how excessive evaporation determined air to flow in from north-east. But what happened with the increased humidity of the air? What chain of physical phenomena was set in motion?

a. The general picture

First and most important picture: when there is less humidity in the air, it is easier for the cold air to take control. During the winter season, when the Northern Atmosphere is drier, general circulation decrease makes it easier for the polar air to travel to southern latitudes and to determine lower tempera-



200% to 300% rain above average during October & November 1939

tures in many other regions. Some may even wonder about the appearance of such arctic conditions. January 1940 reflected this exact situation. North America, China and Europe froze under extreme low temperatures and there was plenty of snow everywhere. We will first deal with the excessive rain in Western Europe and then, in a subsequent section of this chapter, with the situation of North America in autumn 1939 and January 1940. However, the record winter of 1939/40 in North Europe was 'homemade' due to naval warfare in its seas and to the forming of 'dry air', which may have been responsible for the extreme cold month of January 1940 throughout the Northern Hemisphere.

The next important picture is about the situation in which precipitations actually 'dilute' the atmospheric humidity. If it rains abundantly in one place, precipitations statistically diminish in other places until humidity restores average equilibrium again. This process may take more than a few weeks. If war can cause abundant precipitations during the winter season, nature needs much more time to 'fill' the gap during the summer season. So far this information represents only physical laws and not facts.

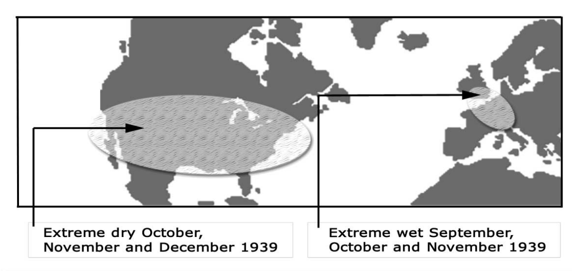
Hardly had WWII started when it began to rain excessively in Western Europe, from Berlin and Basel to Paris, Amsterdam and London, for three months: 200% above average in September, 300% in October, and more than 200% in November. Greenwich saw a higher rainfall only in 1888, and before that in 1840. In some places at the southern end of Maginot/Westwall Line there were recorded 30 days of rain during October 1939. A number of other locations had up to 24 days of rain.

The appearance of all the excessive rain in West Europe raises an essential question: where did all that water vapor come from?

b. Where did all the water come from?

One can discuss the matter under two aspects:

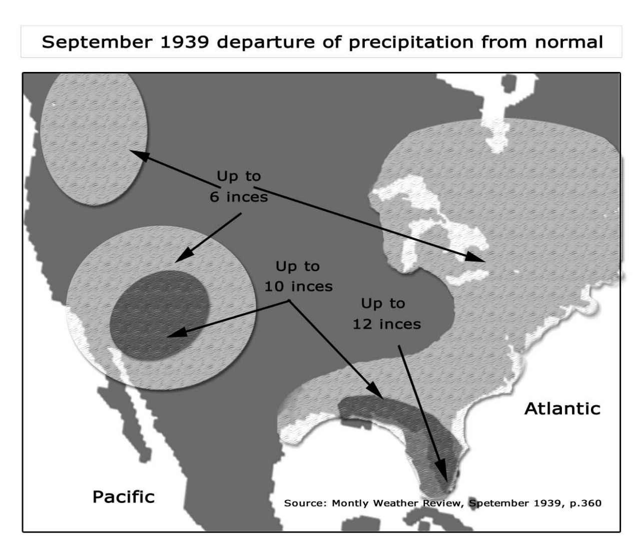
1. *where did so much water vapor come from?*
2. *how was it brought down?*



Since the 1st of September 1939, a huge defense area going from Basel to Dunkerque (Maginot Line) and from Basel to Emden (Westwall) was activated and guarded by one million soldiers on each side. From that moment on, encounters of different proportions, shelling, air fights, and aerial bombings occurred frequently. On the 7th of September 1939, 700 French tanks moved several miles into German territory, while 300 airplanes attacked German positions in an industrial region and munitions area, some 125 miles farther north.

Meanwhile, explosions of sea mines and of depth charges, shelling among enemy ships or ships versus coastal battery, and thousands of ship movements churned and turned around the waters of the North and Baltic Seas. Evaporation rate increased significantly. Water vapour attracted cold air flowing in from the north-east and pushing the excessive water vapour in the south-west, towards Westwall and Maginot Line, including South England. There started a record rain period for which we state three reasons:

1. Naval activities 'produced' a high and constant humidity all over the western war front, including the SE of England, North of France, North of Switzerland, Bavaria, and, further north, the Netherlands, the West, Middle and South of Germany (including Berlin and Silesia).



2. Water vapour condenses using the molecules as condensation nucleus. Condensation occurs on a wide variety of aerosol particles e.g. particles of dust, salt, desert sand or smoke. Ambushes and burning down of villages and cities in Poland (in September) and frequent military encounters on the front lines produced abundant condensation nuclei. Clouds formed and eventually 'burst' into rain.

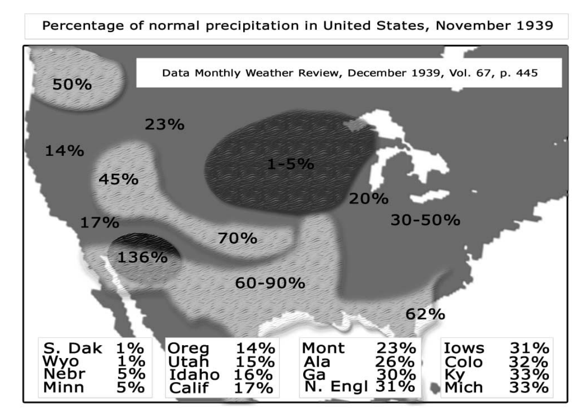
3. North-easterly air was cold. When high humid air laid over Western Europe and resisted being pushed farther south, arriving air would cool down the high humid air and it would inevitably rain.

A Reuters' report from the 5th of May 2006 can help us demonstrate that the Second World War activities played a major part in the phenomenon of rain-making: Chinese technicians have artificially generated heavy rainfall. 163 pieces of cigarette-like sticks containing silver iodide were burned and launched by seven rocket shells in six districts and counties for a cloud seeding operation, which resulted in the heaviest rainfall in Beijing in this spring.

The scenario seemed perfect: plenty of water vapour in the atmosphere, abundant condensation nuclei and a constant cold air incoming from the north-east. All these physical conditions lead to abundant rains in Western Europe.

USA dried out

The ‘rainmaking’ in Europe had a very interesting consequence on the other side of the globe. In the late autumn of 1939, the U.S.A. ‘fell dry’ after receiving only a small percentage of normal precipitation: in October 78%, in November 44% and in December 71%. On the 7th of January 1940, The New York Times reported that November was an unusual month because of its dry air. According to US Weather Bureau “the fall season was extremely dry over large areas. From the Rocky Mountains eastward it was the driest fall on record considering the area as a whole.”



After three months of poor rains, the soil and ground were too dry and thus unable to supply the atmosphere with humidity through evaporation. The door was open to polar air. On the 13th of December, Mountain View, Franklin County, New York had already reported a temperature of minus 20°F (=-29°C). Before the end of the year, winter brought “a biting northerly wind, driving gray, snow-laden clouds.” It was New York’s coldest winter day before the New Year’s Eve: down to 12°F.

Arctic air from the North was attracted by the dry American continent around Christmas and the U.S.A. remained under its influence until the end of January 1940.

The icing of the sea—Winter 1939/40

Icing along the Danish, German and Finnish coasts started early and sea ice conditions lasted longer than in dozens of previous years. This proves that the sea water along all coasts was too cold for that time of the year.

Denmark-Sweden: First signs of ice were reported around mid-December and they increased soon in the inner, closed waters. A maximum of 115 ice days was reported. While 34 stations reported more than 100 days, 99 stations reported 75-100 days. Last ice was reported in the Sounds on the 19th of April 1940. Because of the early start of the winter, it remained known as the severest ice conditions on sea for many decades.

North Sea—Helgoland Bight: Icing and ice floats emerged on river Elbe on the 16th of December 1939. In Hamburg, about 100 kilometres of river upstream from Helgoland Bight, at a mere 80 km distance from the Baltic Sea, there had been constant temperatures of sub-zero degrees Celsius since the 8th of December. Icing intensified massively since the 26th of December and extreme ice conditions maintained for 90 days, until mid-March 1940.

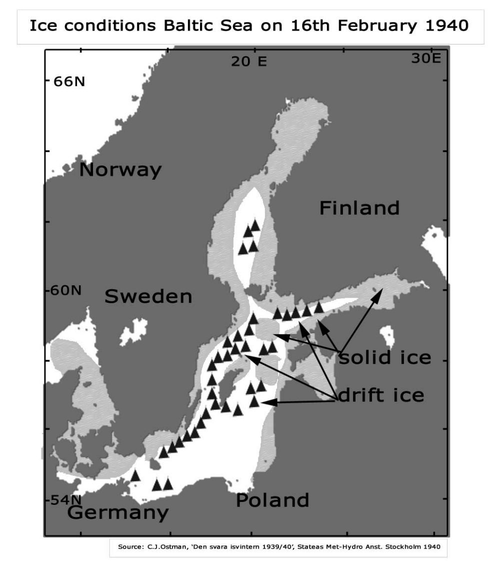
First ice arrived in Helgoland Bight, on the 17th of December 1939, and lasted until early March.

Southern Baltic Sea: Conditions for building up the ice differed in three ways from the average of previous years.

1. *Ice formation started first in the southern Baltic Sea in mid-December 1939, and*
2. *Full icing in the Gulf of Finland started only with the cold wave on the 14th-24th of January 1940.*

These events should not come as a surprise if one takes into consideration the German naval activities of the Kriegsmarine in the southern Baltic Sea: the ambush of Polish coastal defence, the laying of extensive sea minefields, the patrolling and the training of the crews.

In the South, at Greifswald Bodden (an open bight in the SE of the Rügen island), icing started on the 18th of December 1939. Solid ice remained intact in place until the 4th of April 1940. Last ice disappeared on the 11th of April 1940.



Northern Baltic Sea: The waters around Finland had never seen so much ice as during the war winter 1939/40 since 1883. And since the 30th of November, the region was especially affected by the most devastating war winter ever seen under the Arctic Circle where the sun never shines for many weeks. On land, the Russian Red Army attacked with more than 300,000 men on a front of one thousand kilometres length. At sea, the Russian Baltic Fleet attacked Finnish shore batteries on islands and coastal points with big shells. Submarines operated in the Gulf of Finland and in the Gulf of Bothnia, and laid many thousands of sea mines. Finish Navy was small but still operational. Because of the intense naval activities, the picture of the icing seems to be unclear at the first sight, which is not the case. It actually confirms that naval activities influenced substantially the sea-icing process.

Not to forget that the formation of sea ice started first in the southern Baltic Sea, along the coastline of Germany. In Hanko/Finland (at the west entrance in the Gulf of Finland), icing started on the 27th of December 1939; solid ice formed on the 4th of January 1940; the end of ice came on the 7th of May 1940, at almost the same time as in Helsinki. However, on the 15th of January 1940, the Gulf of Finland was still open as far as Pellinki. The Gulf of Bothnia was also open in most of its parts. Ice then formed rapidly. Although the Gulf of Bothnia is far in the North and its depths measure more than 200 metres—in the Baltic Sea area—it is the deepest water, holding considerable heat for considerable time even during cold winters. An 'ice-bridge' between Turku and the island of Åland (a depth of maximum 30 m) formed on the 6th-7th of January 1940, about 2½ weeks earlier than usual.

There is no other valid explanation for the temperature deviation and for the ice formation other than the war activities at sea. Most of the relevant factors for the Baltic Sea climatic conditions are the long open sea areas in the Gulf of Finland, a clear indication that, due to military activities, a high mixing of water took place, thus delaying ice formation.

Chapter summary

While the previous chapter described the severity of war winter 1939/40 on one hand, and the naval activities during four pre-war months on the other, this chapter attempted to link anthropogenic causes with corresponding reactions in regional environment. As navies churned huge sea areas about, the evaporation of the seas increased and eventually changed the prevailing winds, declined the movement of the Atlantic depression on common routes and caused record deviations of the sea water temperatures. At least in one case, the build-up of sea ice conditions in the North and Baltic Seas demonstrates several aspects of the naval war and of its implication in environmental issues.

The events presented above are not mere incidents. Why were North and Central Europe affected and why Hamburg became a 'cold air plug'? This city is closely placed between two seas that were most heavily churned during the pre-winter months. Why Southern Europe, Switzerland and the Mediterranean region were not dragged into cold sphere? Why excessive rain occurred along a busy war front between France and Germany while the regions with heavy naval activities only four hundred kilometres further north, from Helgoland to Königsberg, saw less rain than usual? Why sea-icing started more powerfully in the coastal waters of Germany than in an area 1,000 km farther north in Finish waters? All questions could be convincingly explained as being the result of sudden naval activities at sea.

CHAPTER C

The three years cold package & the war

The unexpected return of the Little Ice Age

One cold winter isn't enough to convince everyone that naval war can be as destructive to climate as a major natural event. Therefore, we will analyse here the first three war winters and will demonstrate that there is an important connection between the arctic war winter and the naval warfare.

Every of these three winters can clearly stand-alone for the anthropogenic influences on weather modifications, but it's their succession as a whole which offers an even more pronounced image of our thesis. Already in 1942, the Swedish meteorologist Gösta Liljequist[6] stressed that the phenomenon of three successive extreme winters happens very seldom in Northern Europe. The three war winters easily took the leading position among all temperature observation done in the last 250 years.

Liljequist's remark seems logical and easy to follow and to explain. North-Western Europe is half-continent, half-water. Due to winds, waters release more heat during the winter season. Once cooled down, wind ceases due to the replacement of the cyclone activities by dry, cold air coming with high pressure (anti-cyclones). The less sea surface is disturbed, the less heat is released until the sea ice appears that stops process almost completely. In other words, any cold but calm winter situation results in sustaining a heat reservoir, stored at deeper sea level during the winter season and available during the next winter.

Naval warfare interferes and breaks down the natural process. Whether sea surface water is warm or cold, navigation and warfare can still have harmful effects. Seawater is churned and turned with no regard that the North and Baltic Seas can sustain maritime winter only when they are able to release a heat quantity according to statistical average. That was tremendously overturned during the first three war winters. Since 1942, when naval war became global, Europe's sea areas lost their winter weather impetus. Naval war in the North Atlantic and the Pacific Oceans easily overruled any special impact of the North and Baltic Seas during the three-year series.

Actually, the statistics for the war winter temperatures between 1939 and 1942 is nothing less than a "Big Bang". In five out of six locations nothing comparable has ever happened since temperature observations have been made and, in only one case, the exception Wiesbaden, near Frankfurt am Main, happened 100 years ago. In the same locations, temperatures were with approximately 2 degrees lower per winter month than they were during the next three-year series. This applies for the main three winter months December, January and February as well. The distinction between the near-coast location and the inland location deserves our particular attention, too.

Near Seaside Location

Figures show monthly mean temperatures over a three years period
[Mean of six (Jan/Feb) respectively nine (Dec, Jan & Feb) months]

De Bilt/The Netherlands
Period 1706–1993

3 years	Jan& Feb	Dec-Feb.
Long term	*+ 4,5°C*	*+ 5,3°C*
1716-18	*- 0,7°C*	*- 0,12°C*
1829-31	*- 0,86°C*	*- 0,45°C*
1940-42	***-2,46°C***	***- 1,32°C***

Oslo/Norway
Period 1816–1988

3 years	Jan&Feb	Dec-Feb
Long term	*- 3,6°C*	*- 3,4°C*
1845-47	*- 6,8°*	*- 6,9°C*
1879-81	*- 6,5°C*	*- 6,5°C*
1940-42	***-9,55°C***	***- 7,86°C***

Stockholm/Sweden
Period 1756–1988

3 years	Jan. & Feb.	Dec.- Feb.
Long-term	*- 3°C*	*- 2,5°C*
1766-1768	*- 6,23°C*	*- 5,2°C*
1803-1805	*- 6,73°C*	*- 6,3°C*
1940-1942	***- 9,11°C***	***- 6,8°C***

It is astonishing that war winter 1940-1942 did not only break all the records but left the next coldest three-year winter package far behind. This happened particularly during the main winter months: January and February. Each of these six winter months was colder with 1,6°C (De Bilt), 2,7°C (Oslo), and 2,4°C (Stockholm) than any previous 'three cold winter' series, while the difference between the 2nd and the 3rd rank was insignificant (less than 0,5°C).

The temperature figure for 1940/42 is as unbelievable as a story about a 100-meter sprinter who would have broken the 10 seconds world record in only 8 seconds.

Furthermore, it is revealing that, from this group of three, Oslo (the most Atlantic location, at least from the distance point of view) is taking the lead, presumably due to the very cold sub-surface water that is 700-meter deep at Skagerrak. It is not a coincidence that the coldest January in Oslo is January 1941. Only half a year earlier, since April 1940, Germany had occupied Norway and had carried on naval activities of huge proportions along the Norwegian coasts. We cannot ignore the fact that the three coldest months of January in all the Oslo series in almost 200 years occurred during the war, more precisely in 1941 (-13°C), 1942 (-12,1°C) and January 1917, with-11,6°C (during World War I, winter which should be carefully analysed)[7].

The three described winters, which are a true record-breaking series, are a strong indication of the role the naval warfare has played. The impact of the naval war is obvious and it is proved by the fact that in the seaside locations the temperature record had been broken at a much higher degree than in inland locations, as the following table proves it:

Inland Location

Figures show monthly mean temperatures over a three-year period
[Mean of six (Jan/Feb) respectively nine (Dec, Jan & Feb) months]

Paris/ France
Period 1757–1993

3 years	Jan&Feb	Dec-Feb
longterm	*+3,8°C*	*+4°C*
1829-31	*+ 1.5°C*	*+1,4°C*
1879-81	*+ 1.8°C*	*+1,2°C*
194042	***+ 0,6°C***	***+1,1°C***

Wiesbaden/Germany
Period 1757–1961

3 years	Jan& Feb	Dec-Feb
longterm	*+1,5°C*	*+1,8°C*
1829-31	*- 3,6°C*	*- 2,7°C*
1840-42	*- 1,4°C*	*-0,7°C*
1940-42	***- 3,3°C***	***- 2,0°C***

Basel/Switzerland
Period 1755–1970

3 years	Jan& Feb	Dec-Feb
long-term mean	*+ 1,5°C*	*+ 1.7°C*
1766-1768	*- 2.2°C*	*- 2,1°C*
1829-1831	*- 2,8°C*	*- 2,2°C*
1940-1942	***- 2,9°C***	***- 2,2°C***

Even Paris, which is not so far away from the sea, blames the war at sea for the temperature modifications. With about one degree Celsius colder temperatures during main winter months, Paris is placed between seacoast and inland. In Wiesbaden (near Frankfurt) winters 1829-1831 kept the lead of the negative temperatures. Even two weather stations from Great Britain confirmed the January/February record war series 1940-1942, namely Oxford and Edinburgh. Edinburgh has the smallest negative deviation, with 0,17°C per month, presumably due to the fact that the warm Atlantic current flows into the North Sea in considerable quantities at any time of the year, and the Atlantic is not far away anyhow, while Oxford deviated with 0,7°C per month as compared to the next coldest series.

Oxford
Period 1828–1980

	Sum Jan&Feb
1940-42	*+ 7,6°C*
1879-81	*+ 11,8°C*
1829-31	*+ 12,2°C*

Edinburgh
Period 1764–1960

	Sum Jan& Feb
1940-42	*+ 7,6°C*
1836-39	*+ 8,6°C*
1774-76	*+ 10,4°C*

All the proofs demonstrate that negative temperature records are far away from being a mere coincidence. Sunrays played a minor role during the main winter months, while the North and Baltic Seas can contribute to the winter air temperature only through their available heat reservoir. If that has been reduced too early, then the regional temperature will drop below statistical averages, and records can fall. 1000 naval vessels crossing sensitive seas in combat missions day and night are as dangerous as a hurricane squeezing heat out of the sea. And if a hurricane goes by after a day or two, naval warfare was a constant presence, since the 1st of September 1939.

The following sections will focus, in detail, on each of the three initial war winters: 1939/40, 1940/41, and 1941/42.

The 1st War Winter (1939/40)—Cold Centre: Hamburg

The war winter 1939/40 has already received considerable attention in our previous chapter, in which we have established its dramatic development and possible causes. Over a very short period of just four months of naval war, heat was eliminated from the North European seas to such an extent that they could not prevent arctic air from taking control over the northern part of the continent during January and February 1940.

However, as already mentioned in the opening section of this chapter, there is more evidence which will help us prove the connection between naval activities and Europe's three cold war winters between 1939 and 1942. But if naval activities reached their full extent in a wider area (Northern Europe), the cold centre of this wide region during a war winter was exactly where pronounced naval activities had taken place during previous autumn months, and this would prove the connection between the two of them. First war winter (1939/40) is the first excellent example in this respect and the City of Hamburg proves it.

A record cold winter was reported in Northern Germany. Hamburg is a focal point between the North and Baltic Seas. Northern Germany has equally a central position between these two seas. For Hamburg and for Northern Germany as well, war winter 1939/40 was the coldest of the three initial war winters. Other riparian countries (e.g. the Netherlands, Norway, Sweden) experienced their ultimate arctic winter during one of the following war winters.

Since early December 1939, Hamburg's mean temperatures were below zero degrees Celsius, which were an extreme deviation from the long-term average, close to 0°C throughout the whole winter period because of the maritime weather characteristics between the two seas. Why did the situation change so much during the winter of 1939/40?

Massive naval activities started on the 1st of September 1939 and, only a few months later, cold air temperatures were close to breaking the record. We are talking about the Southern Baltic Sea, from Gdansk to Kiel and Helgoland Bight. Not only had several ten thousands of sea mines already been laid within a few weeks after the beginning of the war, but uncountable ship-coast and ship-ship encounters took place off the Polish coast, in September, while the German Navy trained several ten thousands of navy personnel off its coast and send hundreds of ships in surveillance operations, patrols, mine detecting, mine sweeping, battle missions and so on. Evidence of a connection between the weather change and the naval war emerged soon. Sea icing started on the German sea coast extremely early, in mid-December 1939, and became the most severe icing phenomenon ever recorded, lasting up to May 1940. Massive naval activities and record cold temperatures occurred concomitantly in the same area.

The 2nd War winter (1940/41)—Arctic Skagerrak

An overview of the winter 1940/41

General conditions of the war winter of 1940/41 in Northern Europe are easy to explain. Even if the winter was very cold, it did not equal the winter of 1939/40 (Germany, the Netherlands, Britain) or the third war winter of 1941/42, particularly in Sweden and the Netherlands. In Germany, the winter of 1940/41 ranked the 20th among about 150 other harsh winters; in the Netherlands, it ranked the 33rd among about 150 'ice winters' between 1706 and 1946; and in Sweden it ranked the 23rd among the cold winters since 1757, while the winter of 1939/40 was on the 9th or 10th place in the top of the coldest winters.

Cold centre: Kristiansand, Oslo, Gothenburg

Three known cities from Norway and Sweden mark roughly the sea area called Skagerrak, or the Strait of Skagerrak. In geographic terms, this refers to the waters among Denmark, Norway and Sweden, north of 57°North and 7°East. It was precisely here where the record-breaking events occurred during the 2nd war winter. It was extremely cold all over the Northern Europe, but Southern Norway, Western Sweden and Northern Denmark won the ultimate cold temperature trophy. In Oslo, January 1941 was by far the coldest month since 1816, with an average of-13°C[8]. A number of stations reported temperatures never recorded before. Vyborg station informed the Danish Meteorological Institute about the –30,2°C, which was the lowest temperature ever recorded. Previous record was of –29.6°C, in 1893.

The military occupation of Norway

In April 1940, seven months after the beginning of the WWII, Adolf Hitler sent the German Navy on attack missions to Norway. The well-prepared invasion plan known under the name of "Weserübung" was to take control in only one move. A minimum of six locations were targeted, Oslo and Kristiansand (Skagerrak), as well as Stavanger, Bergen, Trontheim, and Narvik, covering a distance of about 2,000 km, with numerous fjords, bights, islands and rocks.

During the campaign which lasted until June 1940, presumably 80 to 120 naval vessels and approx. 1,000 airplanes had been available in the service of the parties participating in the war. Although the Norwegian Navy was small, it was able to lay sea mines with their fleet made up of a dozen mine layers and to use the installed coastal batteries in an important number of locations. One of the first battles was fought in the vicinity of Narvik. On the 10th of April 1940, five Royal Navy destroyers entered the harbour of Narvik where five destroyers of the Kriegsmarine were seriously damaged, out of which two sank. Six other German ships were also sunk. British Navy lost two destroyers.

Material and ammunition needed by the German forces were to be transported to various locations with the help of about 50 vessels, with a total capacity of 250,000 tons. The loss of ships and tonnage during the campaign amounted to about 20% of the total ships/tonnage available, including two tank ships of 6,000 tons. The Campaign ended on the 10th of June. During the struggle that lasted four months, a total of 34 naval vessels of about 500,000 tons, including 9 submarines, 19 destroyers and bigger ships, were sunk or damaged. The loss of naval vessels was equal for both sides.

The struggle between the Allies and the German naval forces continued along the Norwegian coast throughout the remaining months of 1940. British, Dutch and Polish submarines permanently patrolled the area, searching and targeting German convoys and naval vessels.

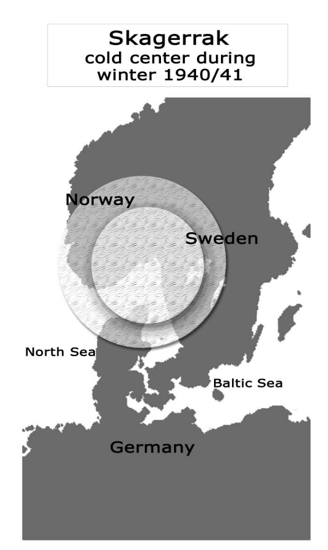
Stirring Skagerrak

When evaluating any war at sea, we must be aware of the fact that the impact of stirring and churning the seawater body down to a depth of 60-80 meters is nothing compared to the situations which affects lower water masses. Due to a complex current system with quite different water masses coming from different sources, Skagerrak makes it even worse. This may certainly be interesting for the ocean science but not so relevant for our investigation. Fine tuned observation may not be needed if we are rather interested in brute force experiments. Carrying out war operations in the deep water areas of Skagerrak and along the Norwegian south-western coast is nothing more than a grand climatic adventure. The already altered seawater structures will inevitably influence and finally change winter conditions.

Most of the Skagerrak sea area is below 200 meters deep, the deepest point measuring 700 meters. The average temperature for the whole water body will be of roughly 6°C in March and at peak time, in August, with hardly more than 1-2 degrees warmer. Even if the temperature of the surface layer can exceed 16°C in August, at more than 40 meters deep temperatures never exceed 10°C. As surface vessels had draught of up to 10 meters, submarines submerged to 100 meters deep and depths charges were made to explode at any place between 5 and 150 meters deep, water structure at Skagerrak was easily stirred. Indeed, temperatures of the surface seawater at Freder and Torungen were lower between August and November 1940 than the long-term averages or the temperatures of the pervious years.

Taking into account that a forceful current system can fairly exchange Skagerrak water[9], the occupation of Norway may be reflected in severe and early sea icing during the winter of 1940/41, which together with the pervious war winter of 1939/40 became the harshest ice winter in the north of Copenhagen in many decades.

Summing up Skagerrak Arctic Winter



In climatologic terms, Norway is a maritime country. Its weather is highly influenced by the warm Gulf Currents and by the Norwegian Current flowing northwards, along the coast. This weather extends its influence on the Strait of Skagerrak. In Oslo, average air temperatures for January ran amok in Oslo: 2°C lower than the next lowest averages during a January without war since 1816, viz. 1867 that accounted –11°C, while January 1941 recorded –13°C, in a city with a long-term January means of –3,5°C. January 1941 beats Little Ice Age conditions in the early 19th century and nobody has ever wondered why.

By all means, the answer is possibly the easiest in the world. During the previous nine months, all water areas and many fjords along the Norwegian coast became the battleground of the naval warfare. Naval vessels, bombs and depth charges did not only churn and turn seasonally warmed and cooled surface layer of the water (40-60 meter deep), but also operated along a 200-700 meter deep trench, along the coast of Norway, from Sweden (Gothenburg) to the Atlantic Ocean (north of the Shetland Islands). Deep water and surface water temperatures differ by 10 degrees, or even more at peak time, in August/September. Warfare at sea can easily 'restructure' the thermocline at any water level below.

A convincing proof for this causal relation between the war and the cold weather is the fact that all coastal areas around Skagerrak were dragged into exceptional cold conditions with record temperatures never experienced before. This leads us to only one conclusion: the German war machinery (used for Norway's occupation) and the naval warfare are responsible for the cold centre winter of 1940/41 which was established at Skagerrak and which influenced Oslo, Gothenburg and Vyborg with record low temperatures.

The 3rd War winter—The Baltic Sea experiment

Mainframe of the Experiment

How can one make an arctic winter and how can one prove it? The first condition for an interesting climate experiment is to exclude the sun. We did it by concentrating research on the winter period during the 1st and the 2nd war winters of WWII. The second condition for improving experimental conditions is to exclude the external influence of the water influx coming from different sources, e.g. the Atlantic Ocean. The Baltic Sea is almost completely disconnected from the oceanic system, salinity is low or inexistent (Gulf of Bothnia) and the current system affected by local forces (wind, temperature, salinity, and influx of river water). For the completion of an excellent climate change, the third condition is easy to imagine: the forceful stirring and shaking of the water basin. This all happened between June and December 1941 and the following winter proved the effectiveness of the experiment. Northern Europe fell pray to a record icy winter.

'Barbarossa'—Germany attacks Russia

Under the codename 'Barbarossa', Germany planned and ambushed Russia with an Army of 3,000,000 men, 3000 tanks, 7000 artillery pieces, 2500 aircrafts and other war relevant equipment. This happened on the 22nd of June 1941, along a battle line of 2000 km.

It is a well-known fact that, in June 1941, during a few months of invasion, the German Army encountered winter conditions in Western Russia, the severity of which cannot be imagined. It was totally out of tune with the climatic records over many years. So far, it is not so much of a surprise that the German armies had not been prepared to face the harsh winter conditions. They fell prey to a misjudgement similar to that of the Russian Army in Finland, in December 1939. While the war at sea 'pushed the weather' to very cold temperatures under the Arctic Circle during the winter of 1939/40, the Germans drove the weather conditions 'over the edge' by turning the Baltic Sea 'up-side-down'. This 6-month 'treatment' of the Baltic Sea, in 1941, was several times more intensive than in 1939. A little bit later, snow, freezing and ice conditions became extremely severe along the entire German—Russian front line, from the west of Murmansk, Leningrad, Kalini, Mazhaisk (west of Moscow) to Belowgrad, Rostov, and Sevastopol (Krim). Since mid-November 1941, temperature during daytime was of-3°C, and at night it went down to-7°C. By the end of November, temperature fell to minus 25 degrees Celsius on the Eastern Front. Along the frontlines close to Leningrad, heavy snowfall blocked almost all German mechanized operations. On the 7th of December, the German High Command stated in a communiqué that harsh winter conditions forced abandonment of big operations in the north until spring. In December, temperatures went down to-40°C.

Before the severe cold wave hit the Eastern Front, there was a heavy 'mud-period' which lasted from early October until freezing began. It all started with snow on about the 7th of October and went on with rain, bearing quite a number of similarities with the situation discussed in an earlier chapter concerning rain-making on the Western Front, along the river Rhine, in late 1939. Until the end of December 1941, the costs of invasion for the German Army were: 174,000 dead men, 600,000 wounded and 36,000 missing. Germany also lost 758 bomber planes, 568 fighter planes, and 767 other types of airplanes, not to mention the loss of tanks, flaks and vehicles, which was huge. The Russians' loss was considerably higher because of the death of 3,000,000 men, plus 1,3 million wounded and sick men.

War-Front sideline—The major battlefield of the climate

Immediately, the Baltic Sea became a battleground and was churned and turned all over its eastern part, from Gdansk to Leningrad. The operation 'Barbarossa' was a fringe war operation area. In climatic, terms it was a major theatre of regional weather modification.

The Germans mobilised about one hundred naval vessels: 10 large mine layers, 28 torpedo boats, and 2-3 dozen minesweepers. Air support was entrusted to the Luftwaffe. Russians had six big war ships, 21 destroyers, 65 submarines, six minelayers, 48 torpedo cutters and 700 airplanes. The considerable number of ships and airplanes were active in six months. The Kriegsmarine lost 35 ships. Russia alone lost 50 naval vessels when evacuating the Reval naval base. The total number of ships, which sank in the Baltic Sea during the second half of 1941, is of about 370, which may sum up 500,000 tons.

Sea mines were a considerable threat. Around 20,000 mines were laid, out of which many thousands were swept and destroyed. Although many of the Russian mines weighted less than 100 kg, the Soviet Baltic Sea Fleet alone laid at least 10,000 mines in the Finnish Gulf and outside the Soviet Ports, in the Baltic Sea (e.g. Riga and Reval). In early August, a dozen of Russian naval vessels laid mines as far away as the west of Bornholm. Probably the last Russian distant operation was a mining operation close to Gdansk, which lasted from the 20th of October until the 15th of November.

Many hundreds of daily naval activities caused a great Baltic 'turning and churning' experiment. One devastating experience determined the Russians Baltic Fleet to evacuate their fleet bases at Reval (Tallinn) by the end of August. More than 200 ships had been moved to Kronshtadt, not far away from Leningrad. More than 4,000 mines were laid on the way out, some of them placed so close together that the distance between two individual mines was sometimes of only 30 feet. Once the ships were out of the harbour, the convoys were bombed or torpedoed while crossing these minefields. This repositioning operation meant the loss of over 50 ships and some 36 transporters and auxiliaries for the Baltic Fleet, not to mention the total loss of lives (at least 6,000 men were lost).

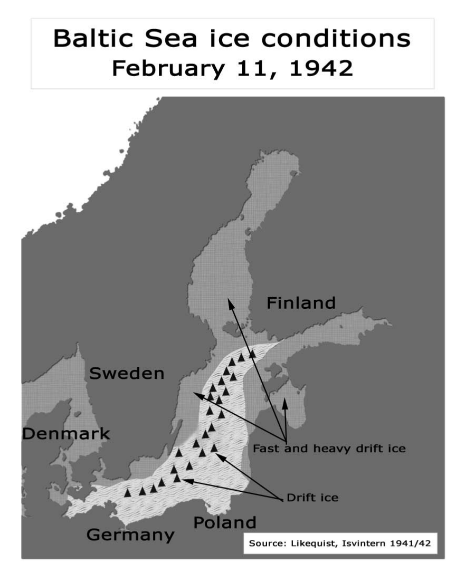
Another significant event occurred in early December 1941, when the Baltic Fleet desperately tried to evacuate the Finnish island of Hangoe, which they had occupied in December 1939. During its sailing, the 7,500-tons ship *Josif Stalin*, carrying ammunition and military personnel, was hit by four mines that initiated a tremendous detonation, killing four thousand of the troops aboard. 2,000 men survived. Since evacuation from Hangoe started on the 31st of October, the Baltic fleet lost, in half a dozen evacuation missions, three destroyers, three fast mine sweepers and other craft and transporters (*Josif Stalin*, *Andrey Zdanov*), the icebreaker *October* plus a host of smaller vessels.

The 'Barbarossa' operation has definitely played a major part in the remodelling of the Baltic seawater body during the autumn of 1941. The new water structure had been never experienced before, particularly the phenomenon of "squeezing" summer-stored heat at such an early date. For the occupation of the vast Russian territory, this may have been hardly more than a small contribution. But for regional weather modification, it was a substantial and highly effective phenomenon. This became evident at Malgoviks primary school in Norrland/Sweden (64° 37' North, 16° 25' East) where temperatures lower than minus 50°C were recorded on the 13th of December 1941 and registered in the Annual of the Swedish Meteorological Service. The sheer coincidence with the attack on Pearl Harbour only six days earlier shall be also taken into account.

Stockholm's coldness trophy

Location	**January 1942**			**February 1942**		
	Average Jan. 1942	Normal 1901-30	Lowest 1942	Average Feb. 1942	Normal 1901-30	Lowest 1942
Kiruna	*-16,6*	*-11,9*	*-35,5*	*-15,8*	*-11,8*	*-33,4*
Haparanda	*-17,0*	*-10,3*	*-31*	*-14,2*	*-11,2*	*-30*
Umea	*-17,2*	*-7,4*	*-30*	*-13*	*-7,4*	*-27,8*
?stersund	*-16,9*	*-7,9*	*-31,4*	*-11,2*	*-6,8*	*-26,4*
Karlstad	*-12,3*	*-3,2*	*-25,2*	*-10,8*	*-3,1*	*-24,6*
Stockholm	*-10,6*	*-2,5*	*-28,2*	*-10,5*	*-2,6*	*-18,8*
Karlshamm	*-8,4*	*-0,3*	*-22,5*	*-6,6*	*-0,6*	*-16*
Malm?	*-7,5*	*+0,3*	*-25*	*-6,2*	*-0,2*	*-20*
All figures in minus Celsius degree; Source: Statens						

Yet, the record conditions lasting a longer period of time and offering a wider perspective are more important than the small and short incident at Malgoviks primary school. Stockholm is a good place to demonstrate the situation. Sweden was not a war party. The Swedish meteorologist Goesta Liljequist expressed his amazement about the winter of 1941/42 as it follows: After the two hard winters of 1939/40 and 1940/41 and the difficulties they generated for shipping and fuel supply for the country, one has awaited and



expected that the winter of 1941/42 would bring a return of the mild winters, which had recently predominated. Instead, winter became one of the toughest, if not the severest of all winters during the last 200 years[10]. In 1943, Goesta Liljequist made a thorough assessment of "The severity of the winters at Stockholm, 1757–1942". The following data have been collected from his work.[11]

The winter of 1941/42 is highly ranked in the list of very severe winters. From the group of 15 most severe winters since 1757, the winter of 1939/40 occupies the 10th position and the winter of 1941/42 is in the top, as it follows:

Rank No	Mean temp. Dec.– March	Mean temperature Three coldest months	Sum of negative, monthly means temp.
1	*1788/89, - 8.0°C*	*1941/42, - 9.2° C*	*1788/89, - 31.9° C*
2	*1808/09, - 7.6° C*	*1788/89, - 9.1° C*	*1808/09, - 30.5° C*
3	*1941/42, - 7.5° C*	*1808/09, - 8.7° C*	*1941/42, - 30.5° C*

Liljequist points out the fact that, since temperature observations were made in 1760, the mean winter temperatures had increased with about 2°C and that this tendency was well marked especially after the middle of the 19th century. The deviation from 'normal' became even more evident. A 'true' comparison actually shows that the winter of 1941/42 was in any calculation from –0,5° (right column) to –2,5°C (middle column) colder than the winter of 1788/89. Even without any corrections in the group of the three coldest months (from December until February), the winter of 1941/42 is the coldest since 1757. At that time, when data registration began, average temperatures during the winter of 1756/57 was of –2,3°C. As no data are available before that year, Stockholm's winter, which immediately followed the 'Barbarossa' operation, could have been the coldest in many thousand years.

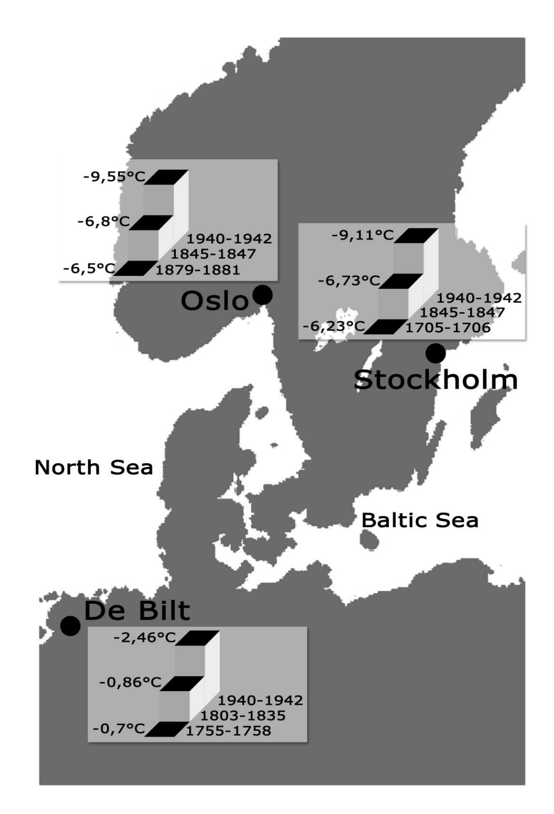
The closing assessment on Baltic Sea field experiment should be given to the Swedish meteorologist Gösta H. Lijequist[12] who wrote immediately after the extraordinary winter of 1941/42 (excerpt):

> *The winter 1941/42 was colder than the winters 1939/40 and 1940/41. At Stockholm it was one of the coldest winters since 1756, when regular temperature observations started. If we classify the severity of a winter according to the value of the mean temperature of the three coldest months of the winter half year, 1941/42 is the coldest winter since 1756.*

Concluding remark on 'Barbarossa'

Circumstances of the churning of the Baltic waters and devastating arctic conditions on the Russian territory prove without any doubt the interconnection between these two events. Insofar, it is easy to establish that Adolf Hitler shot himself in the feet. His "Blitzkrieg" failed, extreme deviations from statistical weather forecasts hindered his plans. Had German war machinery not touched the Baltic and the North Seas, the weather would not have experienced such major modifications. The harsh weather conditions prevented his army from reaching Moscow. Not having reached Moscow before the end of the year was the beginning of the end for Hitler's ruthless activities. And in so far, we were fortunate that meteorologists were not aware of such a connection back in the 1940's and thus could not advice Hitler and his army that they would endanger military goals against Russia by simultaneously conducting extensive naval warfare in the nearby seas. Arctic winter conditions quickly stopped his "Blitzkrieg" in the East in December 1941.

When Field Marshal Herman Göring had proclaimed in February 1940: "Nature is still more powerful than man. I can fight man but I cannot fight nature when I lack the means to carry out such battle. We did not ask for ice, snow and cold—A higher power sent it to us", the winter of 1941/42 proves him wrong. This winter was man-made, more precisely, caused by Hitler, his Government and his Army. Hitler, Göring and the ruling companions are responsible for the coldest winter in Northern Europe since data recording began, in the middle of the 18th century.



Three-year winter package

Successive cold winters, an exceptional case

Three extremely cold winters in a row are another striking evidence that naval war generated ice age conditions in Northern Europe. A demonstration could already be made on the basis of the statistics of the three winter temperatures in De Bilt, Oslo and Stockholm. Evidence is based not only on the sudden and extreme cold wave, which hit the Northern Europe and the maritime locations, but also on the fact that such a situation had never been observed before.

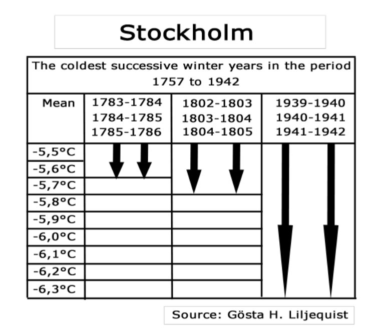
Fortunately, the 'three-year package' theory doesn't rely only on temperatures in order to prove that war at sea was the cause of the cooling phenomenon, but can rely on a number of additional aspects. For example, snow covered the British Isles, sea ice covered the Baltic Sea and the regions, which had the most significant naval activities, had to deal with record cold temperatures during the next winter.

Mentioned issues offer us a rich investigation field and will be discussed and explained with the help of materials published during WWII or shortly after. That includes early observation and references to the extremely low temperature conditions.

Low Temperatures

Sweden

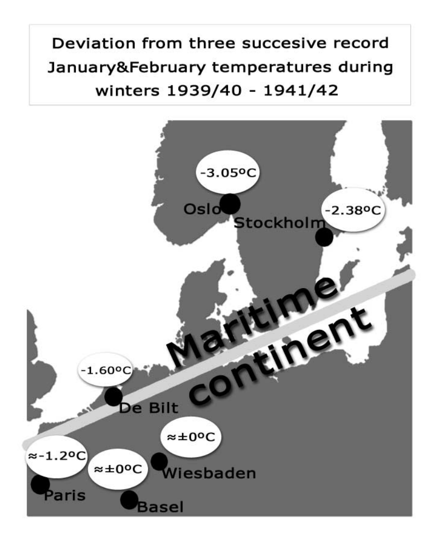
As already indicated above, G. Liljequist observed: Three successive ice winters are very rare[14]. After almost 200 years of weather observation in Stockholm, there are only two periods that come close to the most recent one in 1939-42. But none of the previous 'three-winter periods' (we take into account the average temperature of three coldest months) had been as cold as the winters of 1939-42, which were 0.6°C colder than the winter-group 1802-1805.



Kew Observatory/UK

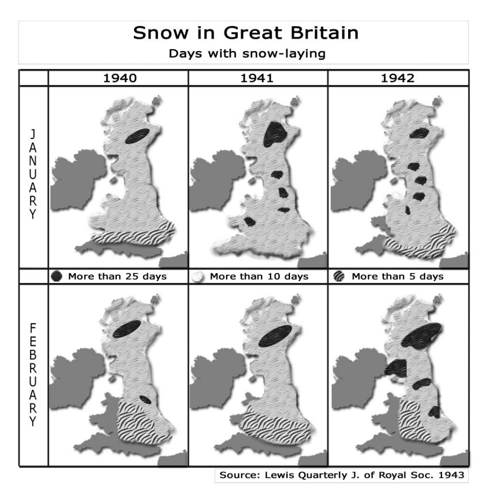
Even during the „Cold Epoch" (ca. 1810–1850), when 9 winters out of 42 were colder at Kew Observatory/UK than the 1939/40 "winter package", none of these winters was so closely followed by subsequent cold winters as during the winters of 1939/40, 1940/41 and 1941/42, which were furthermore commented upon: "The present century has been marked by such a widespread tendency towards mild winters that the 'old-fashioned winters', of which one had heard so much, seemed to have gone for ever. The sudden arrival, at the end of 1939, of what was to be the beginning of a series of cold winters was therefore all the more surprising. Since the winters of 1878/79, 1879/80 and

1880/81, there have never been three winters in a row as severe as those of 1939/40, 1940/41 and 1941/42."



Maritime and continental difference

Before moving to the next issue, temperature differences between maritime and inland locations, as mentioned in a previous chapter, should be included in a comprehensive 'three-year package' list. While record cold winter results were achieved throughout Northern Europe, the difference between sea and land is remarkable. Land values for January and December were only slightly below the previous record (Paris 1,2°C, Basel 0,1°C, and Wiesbaden managed only second place), while close-to-sea locations (De Bilt, Oslo and Stockholm) broke the previous cold records with extraordinary temperature differences from 1,6 to 2,7°C. This is strong evidence that the North and Baltic Seas played a major role in generating the three arctic winters. While warm Atlantic water arrives in Europe as usually, colder North Sea water is recorded by the British weather reports.



Snow in Great Britain

There are two necessary conditions in order to have a snowy winter: an abundant supply of aerial humidity combined with cold air. During the war, Britain's fleets were like a battleship in a bath tub, surrounded by warm water and bathing water steaming off. Cold continental air could quickly turn moist air into fog, rain, ice-rain or snow.

Extreme conditions came quickly. From the 27th of January until the 3rd of February 1940, England did not only face a tremendous snow problem but also experienced the most significant, long-lasting rain-ice event, presumably the severest ever known. The most affected regions were from Wales, via south-westerly parts of Midlands, to the south-western and central-southern regions. Meanwhile, violent stormy weather brought massive snow in the south-east of England, including snowdrifts reaching 15 feet height and even more[16]. Was it a surprise? Not really! Over the Atlantic, warm air clashed with cold air, which was actually colder than usually because of the naval warfare in the North and Baltic Seas.

Kew Observatory

Snow in Britain is a rare phenomenon. In the south-east of England, snow can be expected only every 10 days. Any deviation should raise questions and suspicion. During the winter of 1939-1942, the monthly snow rate was 400% higher. Here is Drummond's table showing the percentage of the days with snowfall:

Year	December	January	February	Dec.–Feb.
1939–40	*6%*	*32%*	*24%*	*21%*
1940–41	*6%*	*36%*	*29%*	*23%*
1941–42	*3%*	*42%*	*46%*	*30%*
Average(1871–1938)	*6%*	*10%*	*11%*	*9%*

A.J. Drummond.; „Cold winters at Kew Observatory, 1783-1942"; Quarterly Journal of Royal Met. Soc., 1943, pp 17ff and pp.147ff.

The Isles

Lewis[17] made the following two statements concerning the snow-cover of the British Isles during the months of January and February of the severe winters of 1940, 1941 and 1942. "The three consecutive winters of 1940, 1941 and 1942 were, however, unusually severe; the snow was considerable and the number of days of snow-laying comparatively large". "Three such severe winters in succession as 1940, 1941 and 1942 appear to be without precedent in the

British Isles for at least 60 years, a similar succession occurring from 1879 until 1881."

WWI and WWII

In 1942, at Kew Observatory, A.J. Drummond realised an exceptional situation: "Since comparable records began in 1871, the only other three successive winters as snowy as the recent ones were those during the last war, namely 1915/16, 1916/17 and 1917/18, when snow fell on 23%, 48% and respectively 23% of the days". The naval warfare caused more humidity in the air and facilitated the inflow of cold continental air over The Isles, thus generating rain, ice-rain and snow in quantities, which are above all statistical values. The intensive naval activities that took place in the English Channel and in the southern area of the North Sea lead inevitably to abundant snowfalls in the South-East of England.

Change of wind direction

Norway

Hesselberg & Birkeland point out significant climate deviations during the first three war years, as illustrated in the following table. Therefore, we should pay particular attention to the winter and spring seasons:

	Winter	Spring	Summer	Autumn
Atmospheric pressure	*+6 mb*	*+3 mbar*	*+0,5 mbar*	*+0,5 mbar*
Air temp.	*-4°C*	*-1°C*	*+0,3°C*	*+0,2°C*
precipitation	*- 12%*	*- 8%*	*+2%*	*+3%*
Wind from north	*+24%*	*+8%*	*+4%*	*+7%*
Wind from east	*-5%*	*0*	*0*	*-2%*
Wind from south	*-17%*	*-10%*	*-6%*	*-9%*
Wind from west	*-1%*	*+2%*	*+2%*	*+4%*
Hesselberg, TH., and Birkeland, B.J.; 'The continuation of the secular variations of the climate of Norway 1940-50', in: Geofysike publikasjoner Vol. XV. No.5, Bergen 1944-56; pp. 3-40.				

Means deviations during the period 1940-42 from the mean values of the period 1901-30

Three ice winters in the Baltic Sea

Sea icing on the German coast

An accurate indicator of the severity of a winter in the Baltic Sea and in its bordering countries is the annual icing phenomenon. Taking into account the extent of the icing phenomenon during the three war winters of 1939-42, it is possible to provide ample proof that this extraordinary situation could only have been generated by intensive military activities in these waters, over the time period in question. The main aspects can be summarised as it follows:

The first and the most significant argument: the suddenness and the severity of each of these ice winters for which we could find no other cause but the war at sea.

It is possible to establish a direct connection between the extent of the activities in the Baltic Sea and the degree of the icing phenomenon and of the arctic winter conditions:

1939/40: intensive military activities, the battle at Gdansk, the mining of the western Baltic Sea and of the Gulf of Finland, Finnish-Russian war at sea—all these resulted in very heavy ice.

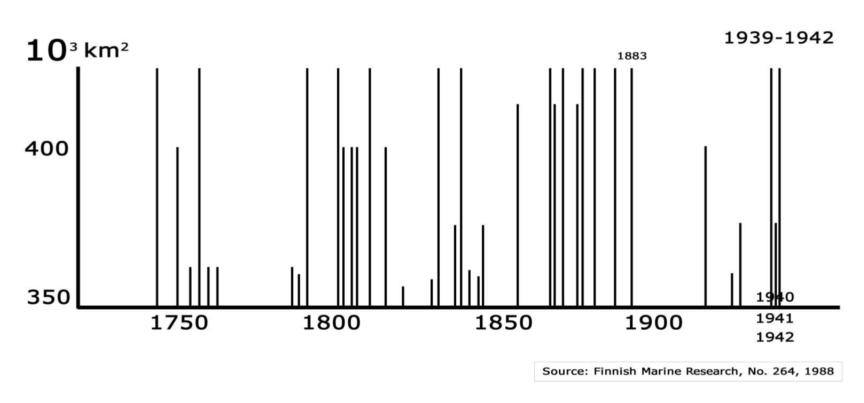
1940/41: there were only general naval activities, so the icing was less serious than that of the previous year. Yet, it was a severe ice winter.

1941/42: the Germans invaded Russia and fought with the Russian Baltic Fleet in the Central and the Northern Baltic Sea for five months (June-December 1941). This event had as consequence the most extended and heaviest icing ever.

Another significant proof is the fact that such a severe icing has never been seen before. It should be mentioned that, over the observation period, the general average temperatures in Sweden and in the Northern Hemisphere rose roughly with one degree, while the winter temperatures in Stockholm had risen with about 2°C since 1761. This comparison of the extreme winter conditions of the late 18th century-the early 19th century to the similar events from the mid-20th century will underline the extremely severe character of the latter.

The icing of the Northern Baltic Sea

Another important argument which supports our thesis that nothing but the war at sea had turned the Baltic Sea into an ice age sea is the extent of the ice cover during the three years in question. According to a graph made by the Finnish Institute[18] and showing the ice cover in the Baltic Sea, 57° North latitude (ca. Visby—Riga latitude), there has never been one group of three successive years with such an important extent of ice cover as the ice phenomenon of the war years of 1939-1942 since 1720 (when such observations were recorded).

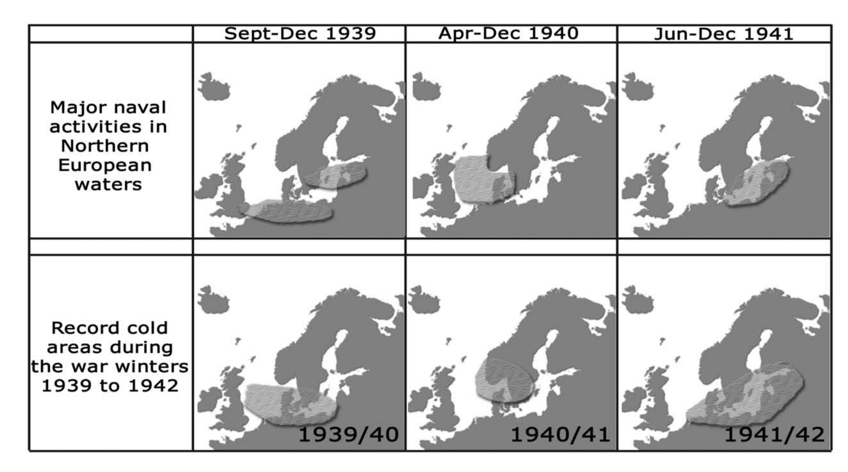


As the graph provided by the Finnish Institute actually shows figures only after 1720, the ice cover during the winters of 1939-42 could have been the most extensive in many hundred years. During the 200-year period, only 15 winters reached the highest ice volume possible, including those of 1939/40 and 1941/42. One of the reasons which would explain the rarity of this phenomenon is the fact that, from the moment the Baltic Sea reaches a high ice cover, the water body no longer transfers heat to the atmosphere, the deeper waters retaining more heat for the following winter season. But because of the intensive 'stirring and mixing' of the sea caused by military activities, a record ice coverage had been achieved in the Baltic Sea during the three war years of 1939-42. This was an inevitable phenomenon. There is virtually no other explanation available. Can any thesis offer a better explanation why not one year since 1883 experienced excessive ice condition, which only showed up again during war winters 1939/40 to 1941/42 after a pause of half a century?

Centers of record winters

It is interesting to observe that certain regions reported record climatic events, on one hand, and that there have been intensive military activities, on the other hand.

1939/40: Germany reported a record cold winter. In fact, heavy mining operations, battles (e.g. Gdansk), military surveillance, transport and exercises took place in the coastal waters of the Baltic Sea during the pre-winter months.



1940/41: Norway claimed to have recorded low temperatures never measured before in a number of stations in its southern regions, in the summer, immediately after the Germans had invaded Norway. Mine warfare and battles continued along its coast and heavy ship movements took place between Germany and Norway thereafter.

1941/42: Middle Sweden, Denmark and The Netherlands claimed the coldest winter in more than 130 years; after the German invasion of Russia, the so-called 'Barbarossa' meant heavy fighting in the Baltic countries from June until December. All mentioned locations claimed the winter of 1941/42 as the coldest, giving the first war winter of 1939/40 'only' a second place during a time period of 100 years or more.

The centre of the cold was 'in the middle of the Baltic and the North Seas', somewhere between Hamburg and Skagen/Denmark.

Summary

There is no change without a cause. The three arctic war winters of 1939-1942 are no exception to the rule. At a global level, people, air and sea are bound to law of physics. The mechanism is simple. Any stirred hot soup lets steam off and cools down. Any warm lake, sea or ocean that is churned and stirred during winter season lets off steam and cools down quickly.

The result is obvious. The three war winters of 1939-1942 were by far the coldest ever recorded during the last two centuries, and may be the coldest series even since the last ice age. One can only wonder why science pays no interest to this matter and remains silent on the issue of the WWII winter. Only four months after WWII commenced, North Europe's winter went back to icy conditions previously experienced more than 100 years ago, during the 'Cold Epoch'. Two extreme winters followed during the naval warfare that was fought in North European waters and in other waters adjacent to them. Nothing is completely explained yet. Conducting a war has devastating consequences, but not such chaotic ones. Three cold winters were the logical consequence of war at sea in sensitive waters. Ending a series of three arctic winters (1939-1942) was only "natural" after Japan had dragged the United States into the war, on the 7th of December 1941, and naval warfare went global on an unprecedented scale. A temporary regional cooling impact became a worldwide phenomenon for four decades.

Before turning attention to four decades global cooling from 1940 to 1980, we will discuss that already World War One (WWI) did already an intensive modification of Northern Hemisphere climate from 1918 to winter 1939/40.

CHAPTER D

20th Century Climate changed by the Naval War

A century of climatic perspective

We have seen how quickly and decisively a few months war at sea completely changed winter conditions in Northern Europe. Mild winters were suddenly replaced by the harsh conditions of the Little Ice Age, conditions the Europeans had not experienced for more than 100 years. This happened not only once, but three times in a row, namely during the first war winter (1939/40), the second war winter (1940/41) and the third war winter (1941/42).

During the winter months, average temperatures dropped severely in the entire Northern Europe. Meteorology commonly referred to that period in the following way: 'climate changes were the average weather for a long period of time'. This may raise the question whether, during the three war winters, there had been an important "climate change" or just some insignificant climatic changes. As there is significant evidence that temperatures turned down into what was called a cooling trend and that they remained at that level for four decades, we can dismiss from the beginning the latter assumption.

Actually, the 20th Century global temperature statistics indicate three significant trend alterations:

- *The first occurred during the winter 1918/19, at the end of the First World War. A fierce naval war, fought near the European shores for four years, resulted in a strong warming trend which lasted for two decades, until 1939.*
- *The second alternation occurred during the winter 1939/40. A four months war at sea in Northern Europe and a global naval warfare between 1941 and*

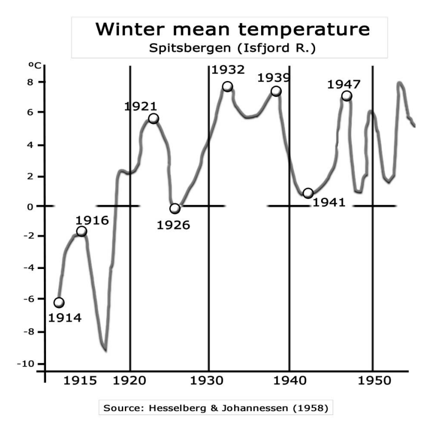
1945 resulted in a cooling trend which lasted for four decades, until about 1980.

- *The third change of temperature occurred around 1975, when the cooling trend which started during the winter 1939/40 came to an end, and the previous trend (1918-1939) replaced it. Temperature evolution after 1975 indicates that there is a strong, mutual relation between the climate and the naval warfare during WWI.*

In the following section we will focus on the warming trend (1918-1939) and on the cooling trend (1939-1980), and will provide strong arguments that the three initial arctic winters in WWII were war caused. At least at first sight, naval warfare had been the driving force for global temperatures changing direction twice, in 1918 and then in 1939. It will certainly not be possible to provide a 100% reliable proof, but, after carefully reading and evaluating the facts, you will be astonished by how deeply and convincingly 20th century naval warfare and global climate trends are interconnected.

WWI ended with the Big Warming

From a climatic point of view, World War I ended with a severe "bang" during late 1918. At Spitsbergen, the winter temperatures jumped up by 8°C in a few years. The Northern Hemisphere became suddenly and significantly warmer. The terms "Greening of Greenland" and "Warming of Europe" became common expressions.



The starting point of the "big warming" coincides with the end of WWI, in November 1918. There was no earthquake, no major volcanic eruption, no particularly intense sun spots, no meteorite fall at that specific time. Only one major event could explain the "big warming": the devastation caused by the naval war at about 2000 kilometres further in the south, around the British Isles, for four years. As the warming lasted two decades, until the end of 1939, the longevity of the warming process could be explained through the geographical positioning: the huge and deep Norwegian Sea, which permanently receives plenty of water masses that have passed the British Isles, either on its Atlantic side or coming from the North Sea.

During WWI, the naval war never extended at a global level, but was fought mainly around Britain. In fact, the naval war seriously started only in the autumn of 1916 when new naval weaponry became fully available and devastatingly effective: submarines (U-boats), depth charges, and sea mines. In 1917, German U-boats alone sunk 6,200,000 tons of enemy ships and vessels. That means that about 10 merchant ships were sunk every day. The total war damage was of 12 million tons: 5200 ships, plus about 650 naval vessels. Most merchant vessels were fully loaded with cargoes of all kinds, from grain, ore, coal, crude oil to whatever war parties needed. All that stuff polluted the sea and was taken along by the Gulf Current and by the Norwegian Current up to the North, going either into the Barents Sea or, as most of the water flowed, into the basin of the Arctic Sea, after passing Spitsbergen at 79^{o}N latitude.

After presenting a brief comparison of the weather during WWI and WWII, we will outline the impact of the naval forces unleashed during the last two war years, from the autumn of 1916 until 1918, then we will focus on the 'big warming' of Spitsbergen and on the arguments that support the theory that WWI is the main factor that determined this significant warming.

Weather during WWI and WWII: a short comparison

Several important factors need to be mentioned first. The land war started in 1914, while the naval war commenced at its fullest only in the autumn of 1916.

The German attack on Verdun started on February 21st 1916, the invading troops counting one million soldiers. This was the longest battle of WWI and ended on December 18th 1916. The French and German Armies lost several hundred thousands of men each. From the climatic point of view, close battle field regions were wetter than usual, e.g. Baden had 30% more precipitations, and in the Black Forest rain level was 50-80% higher than normal.

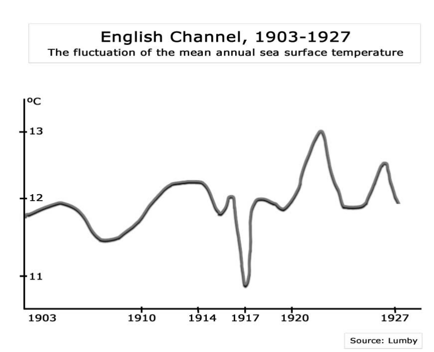
The battle of Verdun followed one of the top ranking cold winters of last century. The winter 1916/17 matched closely the record of the winter 1939/40. Not to forget that the devastating part of the naval war started only in the autumn of 1916. Submarine only went into action in 1915, sinking about

100,000 tons of ships per month and attaining about 300,000 tons per month during the second half of 1916. In addition, in 1916, a flotilla of more than 500 vessels was permanently navigating the seas around the British Isles covering a daily average of 1,000 square miles. All this, together with the increased use of sea mines, mine sweeping operations, and depth charges, had a particularly significant influence on the weather all over Great Britain. These changes are mentioned in the weather records. In Britain, June 1916 was a very cold and dull month. Rain persisted in the east and north, e.g. with about 150 hours of rain in Aberdeen and up to 200mm. The next extreme month was October 1916: it was wet and stormy, being recorded up to 200mm of rain daily. Up to this point, it was the highest daily rainfall ever recorded for the British Isles. An extremely cold December 1916 followed.

As sporadic events and monthly statistics are nevertheless not so relevant, we need more factual data to support our thesis. The position of the Great Britain, surrounded by the naval war, may represent our relevant evidence. For this purpose, we refer again to the time witness, A. J. Drummond from Kew Observatory, Richmond (London), who observed in 1943: "Since comparable records began in 1871, the only three successive winters as snowy as the recent ones (from 1939/40 until 1941/42) were those of the last war, namely 1915/16, 1916/17, 1917/18.[19]

As for the cooling down of the seas around Britain, it is also difficult to find veridical and solid evidence. In 1935, J. K. Lumby published a seawater temperature series of the English Channel between 1903 and 1927. Between 1901 and 1914, the temperature varied on a narrow band from 11.5ºC to 12.2ºC. During the war years (1914-1917), the temperature dropped to its lowest point of the series that is 10.9 º C.

"In September 1916, at Zeebrugge, the German U-boat flotilla alone sank nearly 50,000 tons of ships in the Channel, without any interference of the patrol vessels. Soon, it became clear that the common methods of fighting submarines were simply not working. For example, in September



> *1916, three U-boats operated in the Channel between Beachy Head and Eddystone Light, an area which was patrolled by forty-nine destroyers (49), forty-eight torpedo boats (48), seven Q-ships (7), and 468 armed auxiliaries—around 572 anti-submarine vessels in all, not taking into account the aircrafts. Shipping in the Channel was held up or diverted. The U-boats were hunted. They sank thirty ships, and escaped entirely unscathed themselves."* [20]

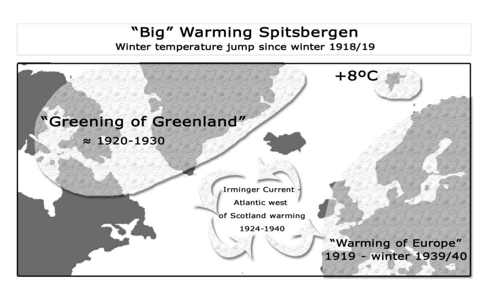
In 1949, another investigation of the Irish Sea situation (1900-1950), conducted by D.C. Giles, shows an important decline from 1914 until 1919[21]. Sea chilling becomes inevitable when naval warfare occurs during autumn and winter, when thousands of ship movements churn the sea day and night, when thousands of explosions under and above the sea surface turn sea levels upside-down. Consequences are obvious. In autumn, the sea cools out quicker, implicitly causing the cooling of the air, followed by a larger quantity of snow and by harsher winter conditions. The cooling down of Britain and the unusual temperature drop of the Isles from 1915 until 1918 are undoubtedly determined by the naval warfare.

In conclusion, weather anomalies in Britain during WWI are so similar to those occurring during WWII that no one can deny the obvious impact of the war at sea on weather and on climate changes.

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[22].

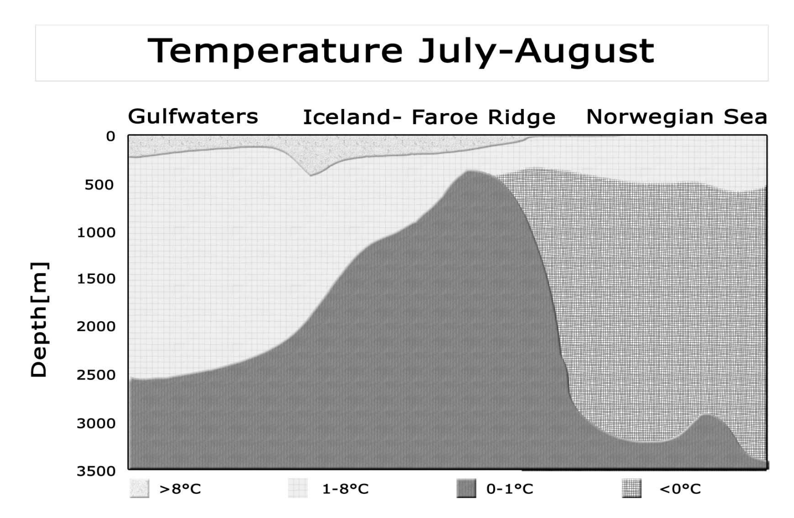


The temperature jump proved to be a lasting phenomenon, its longevity (until war winter 1939/40) remaining a mystery. Such a sudden temperature increase (plus 8°C) in such a short period of time is a peculiar event which could have had a significant contribution to the general understanding of climate 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.

Seas under naval stress

Naval warfare: 1914-1916

When WWI started, in August 1914, the German Navy had 28 U-boats. Their capacity was limited. From August 1914 until December 1916, the U-boats sank 2,200,000 tons of enemy ships. This means a total number of 1,500 Allies' vessels, or an average of about three vessels per day. On the other hand, the loss of U-boats increased mainly due to a newly developed depth charge with 300 pounds TNT or amatol, in 1915, which had become available and fully operable since 1916.

Naval Warfare: 1917-1918

The situation became dramatic for Britain in early 1917. U-boats sank more ships than shipyards could deliver. In April 1917 only, the annual rate of the previous years was reached in only one month (860,000 tons). In 1917, U-boats alone sank 6,200,000 tons, the equivalent of more than 3,000 ships.

The total loss of the Allies shipping was of about 12 million tons: about 5,500 merchant ships, 10 battle ships, 18 cruisers, 20 destroyers and 9 submarines. The total loss in naval units for the Allies and the Axis was of 650 ships (including 205 U-boats) with a tonnage of 1,200,000 tons.

Depth Charges—What it meant to attack a U-boat?

The onslaught of U-boats culminated with the sinking of almost one million tons per month (like, for instance, in April 1917). Although the British Navy was able to prevent hundreds of real or suspected attacks, the result was not at all encouraging. Only 11 U-boats could be sunk in a four-months period. New protection measures became a major necessity: convoying, patrols, a new promising weapon, depth charges, etc.

Sea Mines

The main minefields from the North Sea were on the Britain's East Coast including the Strait of Dover, Helgoland Bight and Northern Barrage. A rough figure for each of these areas is 50,000 mines. The total number of mines in the North Sea was of 190,000 and the total number during the whole WWI, of 235,000 sea mines.

Minesweeping is an activity that stirs and shakes the sea on an unprecedented scale. The 'stir impact' on the seas could possibly be many times higher than the mine laying and the impact of mines that 'hit a target' together. Britain alone had more than 700 fully operational minesweepers. Germans had a considerable number, too. Around 500 ships swept the North Sea every day, day and night.

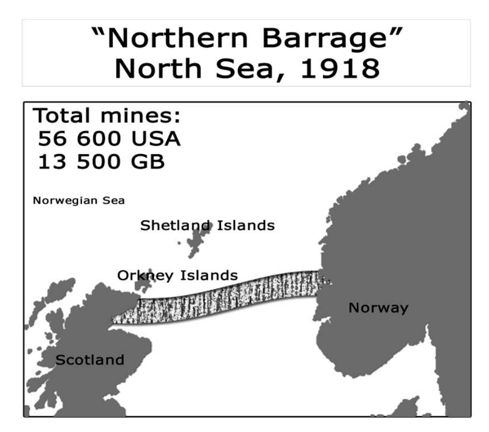
Barents Sea and Baltic Sea

Many intense encounters in the Barents Sea could have played a major role in the icing of the high North, in February 1915 and the harsh winter in the North-West of Europe (1916/17). Since early 1915, more than 450,000 tons of coal and 90,000 tons of weaponry had been shipped to the Russian port Archangel. Russian and German navies had laid thousands of sea mines. Dozen of minesweepers were permanently in service. U-boats sank 25 ships in late 1916 and 21 vessels between April and November 1917.

Dozens of mine fields with thousands of mines were placed in the Eastern Baltic Sea. Many naval activities took place every day, for four years. British and Russian submarines operated successfully. The increase of sea icing during the war years (1914-1918) can be attributed to the naval warfare from the Baltic waters.

Northern Mine Barrage

U-boats had been a serious threat to the Allies since 1916. Preventing U-boats from leaving the North Sea and sailing into the Atlantic Ocean seemed an essential thing to do. A long barrage between the Orkney Islands and



Norway would be required in order to 'close' the northern outlet of the North Sea, about 150 sea miles (approx. 275 km). Near the Norwegian coast, the water is 300 metres deep and near Orkney, about 100 metres. Sea currents can reach 3-4 nautical miles/hour. That was a challenge which required the development of a new mine, the MK6. The charge consisted of 300 pounds of grade B trinitrotoluol (TNT). The mine itself was supposed to have a destructive radius of 100 feet (approx. 30m) and to destroy submarines. Estimations showed that approximately 100,000 mines should effectively prevent U-boats from passing the line. Actually, only about 70,000 mines were laid until October 1918.

By March 1918, mines were already available. Shortly after the placement of the mines, they began to explode. According to a report for the USA Government, between 3 and 4 per cent of 3,385 placed mines blew up prematurely. In the middle section "A", mines were supposed to be placed as it follows: 10 rows of mines at a depth of 80 feet, 4 rows of mines at 160 feet, 4 rows of mines at 240 feet. 20,000 mines were disposed of while the work was in progress. The placement of mines ceased in November 1918 when first signs of the armistice appeared.

Mine sweeping started in spring and ended in autumn 1919. From more than 73,000 mines

- *about 5,000 exploded prematurely soon after having been laid;*
  - *from the remaining approx. 50,000 mines*
  - *more than 30,000 mines were already 'gone' in spring 1919, either drifted away or exploded during winter storms;*
- *20,000 mines were swept in 1919.*

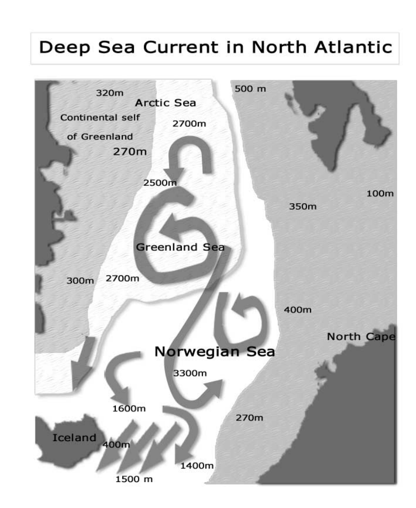
During six months of sweeping, operations consisted of seven sweeping missions involving more than 70 vessels and 10 supply vessels.

A possible cause for the sever warming: 1918-1939

Let's face the facts: WWI was the most destructive event the North-East of the North Atlantic had ever faced. Much of the North Atlantic water going North, and the whole North Sea was part of the naval battleground for four war years before moving northwards, towards Spitsbergen. Since 1918, the Arctic Ocean warmed twice: in 1938 and in 1980. Between slightly above the Arctic Circle and the pole, the warmest years on record in the Arctic Ocean were 1937 and 1938. War winter 1939/40 put an abrupt end to the Warming of Europe. The most convincing conclusion is that WWI has played a significant role in the warming of the climate since 1918, but how?

We started the chapter on Spitsbergen warming in 1918 by pointing out that two decades of sustained warming could only come from the Norwegian Sea, and/or from the northern arm of the Atlantic Gulf current.

The Norwegian Sea basis is a three thousand meter deep hole. The heat reservoir is enormous: enough to preserve the Northern Hemisphere from icing during the Nordic winters and to sustain regularly storms and winds. But water mass isn't the most important element. What matters even more is the very delicate balance of water temperatures and salinity at any depths.



We can't ignore the warm water inflow coming from the south. The inflow coming from the west of Scotland is the most significant and about 6-7° C warmer than water crossing the Iceland-Faroe Ridge. The inflow into the Norwegian Sea represents almost eight times the total outflow of all the world rivers (eight million tones per second), while the forwarded energy in terms of heat transport corresponds to an energy output of 100,000 major electricity power plants. In comparison to the 8x106 m3/sec warm water from the Gulf Current, the water transport in the Norwegian Coastal current on the southwest coast is of about 1 million cubic meter per second (1x106 m3/sec), increasing northwards with a speed between 30 and 100 cm/sec, or with 1 to 4 km per/h. It takes between 3 and 8 weeks for the water to reach Spitsbergen. It's a phenomenon of large proportions, so one can wonder if and how a nearby sea war can actually compete with such natural dimensions. But nature ways are intricate and physics offers thousands of variations and changes. The same way a very thin and still freshwater layer at the surface of vast sea areas would isolate almost completely the seawater body from the atmosphere during winter time, hundreds of other activities can change the structure of seawater layers. That must have happened in 1918 and it was indeed a phenomenon with important consequences. A two decade warming does not come from nowhere. Scientists who speak about climatic changes as a matter of expertise have to answer this question first.

Providing reasonable explanation for the warming of Spitsbergen in 1918 might not be such a difficult task. One explanation could be based on the fact that naval war around Britain and in the North Sea caused the cooling down of the water from September until March, this way having a strong effect on about up to 20% of all water that formed the Norwegian Currents. Therefore, the water coming from the North Sea had significant lower salinity as compared to the high salinity of the Atlantic water. This colder water would go down faster than usually, forcing saltier water (from the inner Norwegian Basin) to the surface. Significant parts of the system were forced into higher motion, and, at the north of Spitsbergen, colder and saltier water flowed quicker into the Artic Basin, which, at its turn, allowed more water to flow into the Norwegian Sea via the Scotland, Faroe, and Iceland ridges. The "experiment" ended with a larger amount of warm water at north of Scotland, after the end of WWI.

There might be other more convincing explanation and we are always interested in any good reasoning. But what we find difficult to accept is that the severe and lasting warming of Spitsbergen which took place almost one hundred years ago has not been explained yet. One century has passed since this sudden and severe warming first started, then materialized into a two decade phenomenon.

Global warfare—Global cooling

The Half Century Cooling

After having gone through three cold war winters (1939-1942 world), Europe was forced to go through an even much bigger climate change experiment. With Japan's ambush at Pearl Harbour with dozen of ships and hundreds of bomber air planes, on the 7th of December 1941, a new chapter of anthropogenic climate change began to be written. For the following four decades, climate switched to a colder status.

There is nothing pleasant about global cooling. Yet, for all those who are overwhelmed by the scientists affirmations that carbon dioxide is warming up our earth, the large area experiment initiated by the naval warfare can come as a blessing. Global statistics have never shown such a pronounced temperature downturn trend before war winter 1939/40, phenomenon which lasted until 1980th and which only went back to the level of 1939 in 1980. Carbon dioxide (CO2) can be excluded from the list of possible reasons for the global cooling. In the 70s, a serious debate on the danger of a new ice age broke out. The New York Times[23] reported that scientists observed many signs according to which Earth may be heading for another ice age. The Science magazine[24] published articles about the possible extended glaciations of the Northern Hemisphere, and regarded a return of the Ice Age as a very possible event. TIME magazine claimed[25] that, climatologically speaking; cassandras are becoming increasingly worried about their cooling trend findings, which may be considered as the signal of another ice age.

There was no doubt that global cooling was a serious phenomenon. Although the threat was eminent, neither the Intergovernmental Panel on Climate Change (IPCC) nor other groups concerned with the global warming issue have ever showed any interest in analysing the pronounced global cooling. The half century climate change occurred without any implication of the CO2.

Then what was the determinant factor? Nothing out of the ordinary happened. Throughout the early 20th century, nature resumed its course. No serious earthquake, tsunami, meteorite fall, sunspots occurred. Industrial plants and combustion machines abundantly released smoke, soot, sulphate, carbon dioxide and other greenhouse gases into the atmosphere, but, instead of a global warming, the world clime cooled down. The only serious event which took place for three years in European waters and for four years at a global level (since 1942) was the warfare.

The conduction of a naval war at a global level and the turning and churning of huge sea areas in the Atlantic, Pacific and Indian Oceans lead to the inevitable. Climate changed dramatically into a colder one, for four decades. Oceans and seas which had undergone a strong warming during World War I became now significantly colder. This change lasted half a century.

As the events and the destructive forces unlashed between 1939 and 1945 have played a determinant role in the global climate change, we will focus on the WWII naval war. The aim is to demonstrate that, as there were no significant natural phenomena during that time period, war at sea remains the only plausible explanation for the climatic modification. For a better comprehension of the interconnection between naval activities and ocean reactions to them, the following section will summarize some physical principles and geographical features of the war areas in the Atlantic and Pacific Oceans. After all, climate research should restrain from scaring anyone with global warming if unable to explain convincingly what made earth atmosphere cool down for four decades since WWII commenced in the first place.

World Oceans Churned and Turned

Water influences

The overview of the naval warfare in the wide oceanic spaces will always remain incomplete. The exterior aspect of the seas remains unchanged before and after a sea battle. All signs left on the water surface by ship movement, sea mine explosions, or shipwrecks disappear quickly. Only oil and cargoes may disturb the picture of unadulterated nature for a short while. Any scenery of action is back to normal very soon, as far as an external viewer is concerned.

After any anthropogenic action, physical structure of any ocean encounters smaller or bigger changes. The physical composition of the seas inevitably changes in terms of temperature scale and distribution of salinity. They never turn back to their previous state, but strive for a new equilibrium. Some call it a state of chaos, but it is plain physics. And physics, which stays behind all oceanic changes, has a major influence on the climate.

Naval War in the Atlantic Ocean (1939-41)

Naval war and supply across the seas became part of ocean physics for a long time. Allies sailed with 300.000 vessels across the North Atlantic. If every ship turned the sea about on a width of 20 meters, we can sum all up to 6 Million meters or 6,000 km. This means that the sea surface of the North Atlantic Ocean was ploughed through three times. Naval Escort Vessels and freely operating war ships certainly doubled the space of 'turnover'. Many thousands of torpedoes, many hundred thousand depth charges and bombs, and multi-millions of shells certainly doubled again the already 'doubled space' of turnover. Presumably not less than a dozen times the surface layer of the middle North Atlantic Ocean was completely 'churned and turned' in just over six years. Any 'turning' effect could reach down to a few meters, five to ten meters (vessel draught), 200-300 meters (depth charge), thousands of meters (sinking ships, cargo, ammunition, etc).

As mid-latitude, seasonal climatology heavily depends on the upper sea surface layer of about 30-60 meters, global naval war is a force to reckon.

Time influences

The climatic change during WWII has two distinct periods, namely the period before Pearl Harbour and the period thereafter. From September 1939 until early 1942, naval warfare was largely confined to European waters. Great climatic relevance of the war at sea in the North Europe became dramatically clear during the extremely cold winters of 1939/40, 1940/41, and 1941/42.

Outside European waters, naval activities during 1940 and 1941 were largely confined to Eastern North Atlantic. The most affected areas were the transportation routes from Britain to North America and from Britain to Gibraltar and Dakar.

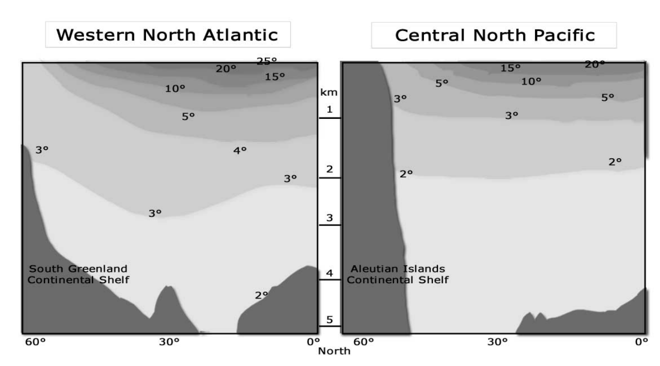
U-boats in the Atlantic Ocean

A number of German U-boats were already in the Atlantic when the war broke out, in September 1939. Britain came up rapidly with the convoy system. A convoy consisted of up to sixty, either slow or fast vessels, accompanied by up to ten naval escort ships. The first convoy set off in September. Also in September 1939, groups of three to five naval vessels were formed to control large areas in the North Atlantic Ocean. These groups criss-crossed the seas day and night searching for U-boats and dropping depth charges when a U-boat was detected, or assumed to be around. German surface naval vessels, such as the battleships *Deutschland, Scharnhorst* and *Gneisenau*, sailed in the Atlantic escorted by a number of escort vessels. Until the end of December 1939, the Allies and Neutrals had lost 55 vessels with a total tonnage of 300,000. Five U-boats were also sunk.

Fights increased in the North Atlantic during the war years 1940 and 1941. In August 1940, Germans lifted all restrictions on U-boat targets. The number of available U-boats was of 50 (in January 1940) and of 230 (in December 1941), of which about 8 were on permanent mission in the Atlantic during 1940, and 15 during 1941. The total loss inflicted on British, Allied and Neutral shipping by the Axis powers (U-boats, air forces, mines, and surface naval vessels) was of 3 million tons in 1940 and of 4 million tons in 1941. These figures relate to about 1,500 ships, with cargo, stores and fuel. The Germans lost about 40 U-boats in the Atlantic during these two years.

The Atlantic Convoy

Effective supply was essential in order to obtain a war victory. Thousands of accounts talk about dramatic events at sea. On September 21/22, 1940, the Convoy HX72 was caught in a twelve-hour battle, in which eleven ships were sunk and other two damaged, with a total loss of 100,000 tons of supplies and around 45,000 tons of fuel.



At the beginning of the war, the convoy escort was small in number and not always sailing with the group for the full distance of the voyage. In 1941, the average size of a convoy was of about forty ships, accompanied by six naval vessels as escort. Later on, certain escorts became quite massive. For example, in 1942, the Convoy ON202, made up of 38 merchant ships, had an escort of 3 destroyers and 3 corvettes; while the escort for the Convoy ONS18 comprised 6 destroyers, 8 corvettes, and one trawler.

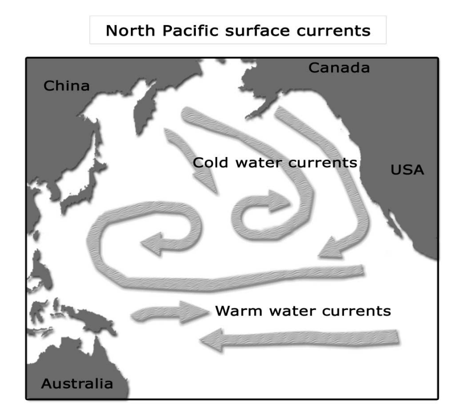
A special aspect concerns the loss of tankers between 1939 and 1941. The British fleet lost 1,469 tank-ships and the Norwegians 430 in just 28 months. If one assumes that the average loading capacity of each ship was of 2,000 cargo tons and that half of the sunken vessels were loaded, the total oil overflow could sum up to two million tons in 2 years, an amount corresponding to the total oil overflow of tank ships between 1967 and 2002.

However, U-boats were not acting alone in the North Atlantic. Since the Luftwaffe could operate out of France since summer 1940, long-range aircrafts were sent out in the Atlantic to attack supply routes. The total shipping tonnage sunk by the Axis airplanes in all sea areas during the first two war years is claimed to be of 1.5 million tons.

Naval War in the Pacific Ocean (1942-1945)

On December 8th 1941, The New York Times reported: Yesterday morning Japan attacked the United States at several points in the Pacific, with a major attack on Pearl Harbour. President Roosevelt ordered United States forces into action and a declaration of war was expected soon. Seven hostile actions from a naval ship off the coasts of San Francisco to Malaysia were reported (NYT, 08 December 1941). This was going to continue for four years. Allied forces, namely USA, Britain and the Netherlands, had a total strength of about 220 big naval vessels, including 70 submarines. Japanese had 230 naval vessels and 64 submarines in December 1941. Several aircraft carriers were available on both sides, able to deploy many thousands of airplanes.

Recording four years of naval warfare and putting them in connection with the modification of the ocean water at its surface level (1,000 metre depth) is an almost impossible task for a small study. It could only attempt to arouse the readers' imagination concerning the consequences of the war and the ocean temperature and salinity structure. Oceanic matters have been discussed in the corresponding chapter: 'Ocean system affected', with the mention that sea surface temperatures were low between 1945 and 1977[26]



The clash of the naval forces in the Pacific had no other precedent. The opponents made use of every means and military options. Heavy battles were fought. In May 1942, the combatants met in the Coral Sea, each with three-dozen ships and several hundreds of airplanes. In a first attack on May 05th, the US Navy destroyed one Japanese destroyer, three minesweepers, and 4 smaller vessels with 22 torpedoes and 76 bombs (each weighing 450 kg). Other attacks followed during next days. On May 8th, each side had lost about 35 aircrafts. A mighty explosion sank the aircraft carrier Lexington. Even more naval vessels and airplanes were destroyed in June 1942, during the Battle of Midway. The Japanese alone deployed more than 200 big naval vessels under five separate commands. The USA and Japan lost a significant number of naval vessels (more than 120,000 tons) and 400 airplanes.

Aircrafts played a significant role in the Pacific war. The strength of Japan's front line was in its air power which consisted in about 4,000 planes; the USA had 4,000 in January 1941 and 22,000 in July 1945. After taking over Okinawa, the US Third fleet had deployed 26 aircraft carriers, 64 escort carriers and 14,000 combat aircraft for a final attack on Japan. The Japan's loss was of 37,000 combat aircrafts (army and navy); the USA lost 8,700 aircrafts in the battle.

Material loss in the battle was of enormous proportions. Japan lost more than 500 warships (including 150 submarines) with a total tonnage of about 2,000,000, the figure in merchant tonnage was of about 8,000,000 of which 5 Mio (1,150 ships) have been sunk by US-submarines and 1.5 Mio by airplanes. During the war years, Japan had about 700,000 tank ship tonnages permanently afloat and lost, during the war period, 1,500,000 tanker tonnages. The US lost 52 submarines. Many of them fell pray to depth charges. Standard Japanese depth charge contained about 230lb of explosives. Anti-submarine bombs carried by aircrafts were 131lb and 550lb each, the latter being preferred when available. The Japanese had no means to determine the depth and position of an enemy submarine, so the pattern of their attacks usually consisted in dropping depth charges in a variety of settings according to the fuse time. The Japanese lost 150 submarines, many of them destroyed by depth charges. Only by studying special literatures, available in great number and detail, one is able to imagine what happened in the Pacific war theatre. One cannot escape the impression that WWII left its imprint on Pacific seawater.

War in the Atlantic Ocean (1942–1945)

Aerial warfare in the Atlantic Ocean

The use of planes during the Atlantic war progressed tremendously as the USA entered the war after the attack of Pearl Harbour, in December 1941. The US production was estimated at 127,000 planes in 1942, which exceeded the total number of German aircraft production during the whole war period. It meant that more aircrafts of a much better quality and power were available for surveillance, bombing and combat missions in the Atlantic Ocean. Even in August 1942, eighteen American B-24 aircraft, called 'Liberator', were ready to escort Atlantic convoys. These planes had a range of 2,400 miles, fuel tanks of 2,500 gallons and reached altitudes of 30,000 feet. After the winter 1942/43, anti-submarine missions were assigned to the long-range aircrafts in the Atlantic, which sank 33 submarines between April 1943 and September 1944. 209 long-range bomber aircrafts were available in the US navy in July 1942 and the number increased progressively to 2,200 aircrafts which searched and chased U-boats between June 1943 and May 1944.

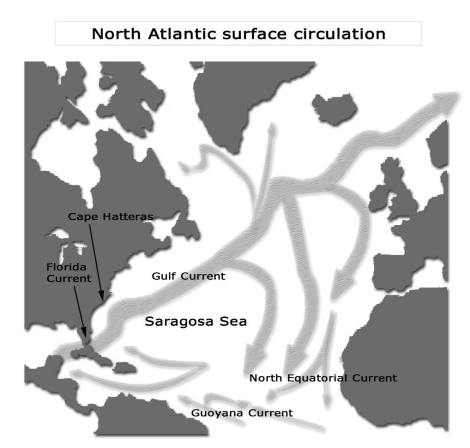
In 1942 and 1943, U-boats had very little support from the Luftwaffe and, even though, that little help diminished after the D-Day (1944). On the other hand, the Allies' air force presence in the Atlantic Ocean improved significantly. The British Coastal Command launched approximately 238,000 sorties, totalizing 1,300,000 flying hours. According to report of the Coastal Command, fourteen U-boats were destroyed and another twelve damaged.

As the German Luftwaffe wasn't well equipped, it couldn't manage a significant performance in the North Atlantic battle. However, they had a few hundred long-range, four-engine planes in service, which flew from their bases to France, in 1941. During the month of August 1941, they succeeded in sinking more than 300.000 tons of shipping, i.e. almost one-third more than the U-boats sank during the same month. Axis airplanes must have sunk a total of about 800 merchant ships in all war theatres. Even if less than half of that number was sunk in the hazardous waters of the Northern Atlantic and Northern Pacific, it actually meant the use of many thousands of bombs and the fall of hundreds of planes into the oceans.

U-boats near Florida and Cape Hatteras—1942

There was a short period, from January until June 1942, when U-boats operated successfully along the American East coast. Within half a year, they sank about 400 vessels. In only two weeks a few U-boats could sink 25 ships with a total tonnage of 200,000, out of which 70% were tankers. The summer of 1942 meant the end of the U-boat operation called 'Paukenschlag' (Drumbeat). The US Navy had become effective.

The Gulf Current flows from Florida to Cape Hatteras, before turning around at Cape Hatteras and flowing into the Atlantic and eastwards, to Europe. The warm current together with the colder Atlantic water off Cape Hatteras built a highly sensitive water body having a significant impact on the daily weather, seasons and climatic conditions in the Northern Hemisphere. The war in these sea waters is to be held responsible for considerable changes of the seawater sphere.



U-boats

In August 1942, the German U-boat fleet had reached the number of 340, with almost 300 boats more than three years earlier. During the whole war period, the U-boat force was of about 1,100 boats, out of which 850 participated in at least one combat mission and 630 were destroyed during enemy attacks.

German U-boats attacked and destroyed 2,822 vessels (14,220,000 tons). Italians sank 152 boats, 132 vessels (700,000 tons). The Axis U-boat fleet

(German, Italian, and Japan) is said to have sunk 25 big naval vessels, 41 destroyers and about 150 other naval vessels. The main operation field of the U-boats was the Atlantic Ocean. But the success of the U-boats attacks ended shortly as they were effective only between 1942 and March 1943.

Atlantic Convoys

As already mentioned above, the Allies completed over 300,000 Atlantic voyages during this war period. The heroic story of merchantmen has been written and rewritten in an uncountable number of books and essays. Here is only one case.

In March 1943, two convoys (SC122 and HX229) suffered forty-four hour attack of the U-boats on their route. During the three-day battle that ensued, twenty-three merchantmen of the two convoys were killed. At the same time, the convoy HX229A, which included thirteen tankers, eight refrigerator and four cargo liners (39 ships), was directed northeast, towards Greenland. There they came upon Arctic conditions. The three convoys, with a total of 131 ships, carried about 1,000,000 tons of cargo—petroleum fuel, frozen meat, food, tobacco, grain, timber, minerals, steel, gunpowder, detonators, bombs, shells, lorries, locomotives, invasion barges, aircraft and tanks.

Tanker and Ammunition ships

The destiny of many tankers proved to be extremely disastrous for their crew and for the ocean waters in the same time. The Allied and Neutral countries had about 1,000 tankers permanently in service since 1942. The total loss of tankers with a size of over 1,600 tons was of 4,221 ships between December 1941 and May 1944.

Depth Charges

One of the most effective means of penetrating deep below the sea surface is the depth charge. Depth charges, which could explode at a depth of 500 feet, were in use since 1942. The 'Hedgehog bomb', a highly powered explosive fired by a multi-barrelled mortar and filled with Torpex, was also in use. Its range was of 250 yards ahead of the escort vessel. When attacking ships, they could fire twenty-six depth charges in pairs, set to explode at 500 feet and 740 feet alternately, every ten seconds.

It seems difficult to obtain reliable figures with regard to the number of depth charges dropped in the Atlantic. The total figure could go somewhere around 500,000 or even more.

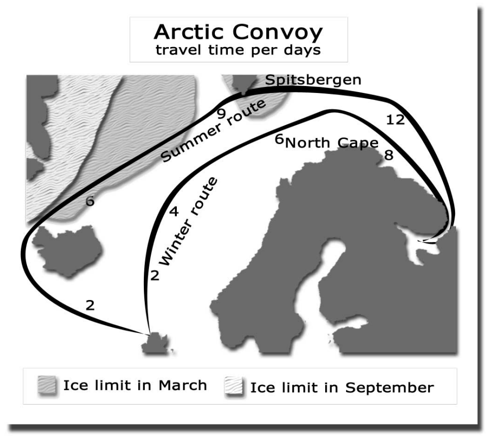
Gunners

After the WWI experience, transport ships were equipped with guns for protection against U-boats and surface raiders. During 12 months of war, 3,000 vessels were armed with a 4.7-inch gun manned usually by six trained gunners.

The Arctic Convoy

Russians received about 4,000,000 tons of cargo, including 7,000 aircrafts and 5,000 tanks via the most difficult and dangerous route going from Britain to Murmansk. Climatically, this was the most sensitive sea route and probably many times more effective in climate changes terms then the naval activities at one thousand miles further south. Out of the total shipped cargo, 7% was lost in the sea. Danger came not only from the arctic climate, but from the attacks of the German Navy and Luftwaffe from their North Norway bases. The Luftwaffe had 264 aircrafts in that area, while the British Fleet Air Arm and the Royal Air Force flew 17 combat missions to North Norway between January 1942 and November 1944, which involved around 600 airplanes.

Convoys started to sail in August 1941; the 35th convoy sailed in May 1945; convoys guarded a total of 715 ships. 100 merchant ships, with a total of 600,000 tons, were lost. The German side lost five surface naval ships including a battle ship and a battle cruiser and 32 submarines. British Navy lost 20 surface vessels and one submarine.



To avoid possible confrontations with German forces, the convoys sometimes travelled to the far North. For example, in July 1942, the ships which formed the convoy PC17 navigated close to Edge Island (Spitsbergen), at 77°N, and at the edge of the ice border, but were still suffered the attacks of Luftwaffe aircrafts and of U-boats.

The convoys were escorted by a considerable number of ships. Fighting at the East and West of the North Cape had some serious consequences as this was the theatre of the most destructive WWII battles. For the Norwegian and Barents Seas, military presence didn't pass unobserved: naval war had a huge impact on the sea.

Atlantic Sea Mines

Between 1940 and 1943, an 110,000 mines barrage was placed by Britain between Orkney and Iceland. The 'Mk XX' mines were supposed to prevent U-boats from reaching shipping routs in the Atlantic. Whether the barrage was a serious threat to U-boats or not is not a certain fact. It seems that it was not. But it would have been a tremendous threat to the sea if the mines had exploded prematurely.

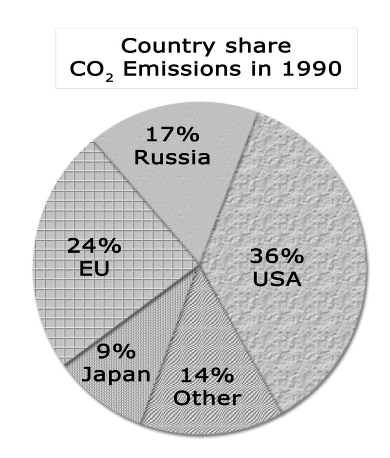
Summary

Even if information can't be very extensive in such a brief presentation of the naval warfare between 1942 and 1945, it is enough to give a general idea of the climatic phenomenon and to raise the awareness that oceans had been 'stirred and shaken' in a way that could have caused their unusual cooling which lasted four decades.

CHAPTER E

Climate changes today

The 'Effect of the Naval War' is a serious matter to discuss. The detailed investigation we went through in our pervious chapters proves that this phenomenon clearly dominated the climatic situation during the last century. The climate changed at least twice because of the war at sea. We still have to answer the question: by which proportion is man responsible for global warming?



This issue has been the subject of arduous debates for more than 20 years. And most of the claims say that modern civilization is responsible for the higher atmospheric temperatures, which were caused by man-made greenhouse gases. The Inter-Governmental Panel on Climate Change (IPCC), active since 1988, is the main supporter of this thesis.

The carbon dioxide (CO2) is the main argument of the IPCC. Proud to convey the "consensus" of hundreds of top scientists from around the world, this organisation has hardly ever hesitated to confirm its belief in the Assessments Reports[27] and their correctness.

The IPCC Report from 1990 states:

> *"Emission resulting from human activities is substantially increasing the atmospheric concentration of the greenhouse gases: carbon diox-*

ide, methane, chlorofluorocarbons (CFCs) and nitrous oxide. These increases will enhance the greenhouse effect, resulting on average in additional warming of the earth's surface. The main greenhouse gas, water vapour, will increase in response to global warming and further enhance it".[28]

Not everybody agrees with IPCC and its "consensus" thesis. While most of the scientists and climatologists support it, there are also voices which contradict the conclusions of IPCC. The most important document in this regard is the "Oregon Petition" of 1998, signed by 17,000 scientists who were protesting against the Kyoto Agreement. The petition requested the acknowledgement of the following statement:

There is no convincing scientific evidence that human release of carbon dioxide, methane, or other greenhouse gases is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate. Moreover, there is substantial scientific evidence that increases in atmospheric carbon dioxide produce many beneficial effects upon the natural plant and animal environments of the Earth".[29]

Neither the IPCC nor the Oregon Petition's claims are satisfactory enough. They don't reflect a correct assessment and analysis of the Earth's climate during the last 150 years.

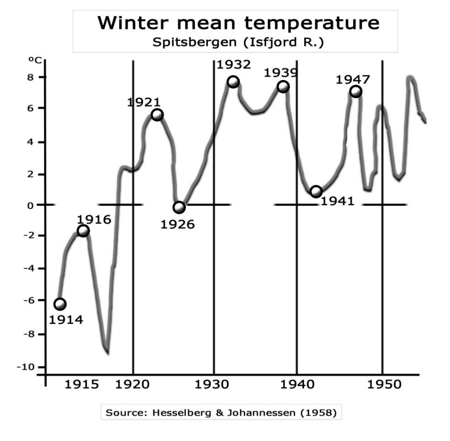
The 20th century climatic changes

After the end of the Little Ice Age (in the middle of 19th century, around 1850), global temperature started to rise, the main reason of this phenomenon being the decrease of the volcanic activities. But naval war interrupted a steady warming trend two times yet.

World War I ended with a severe "bang" in the late 1918.

There is nothing clearer than the beginning of a "big warming" that occurred concomitantly with the end of WWI, in November 1918.

During WWI, naval war was fought around Britain and in the North and Baltic Seas. It actually started seriously only in the autumn of 1916 when new naval weaponry became fully available and devastatingly effective (particularly



sub-marines (U-boats), depth charges, and sea mines). During the war year 1917, German U-boats alone sank ships with a total tonnage of 6,200,000. The war total loss was of 12 million tons: 5200 ships and about 650 naval vessels. Most merchant vessels had been fully loaded with cargoes of all kind, from grain, ore, coal, crude oil to whatever the war parties needed. All that stuff polluted the sea and was taken away by the Gulf Current or by the Norwegian Current up to the North. It was precisely there that the "big warming" occurred. At Spitsbergen, the winter temperatures jumped up by 8°C in only a few years. Suddenly, the Northern Hemisphere became significantly warmer. The terms like "Greening of Greenland" or "Warming of Europe" became common expressions.

World War II (1939–1941): In the autumn of 1939, the naval warfare ended within four war months which reversed the two decade warming trend and determined the cooling phenomenon which started with three extreme war winters in Northern Europe and which lasted four decades, until 1980.

If the war in Europe had ended with the winter of 1939/40, a few weeks after Herman Goering's speech (in mid-February 1940)[30], the description of the winter of 1939/40 as "weather modification" would have probably been correct. The extremely icy January and February 1940 would have 'submerged' in weather statistics.

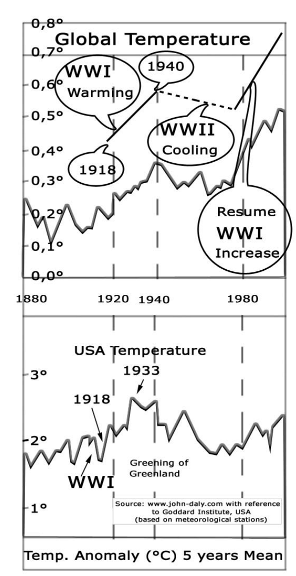
But this didn't happen. The war went on and the war winter of 1940/41 came up in Northern Europe with the same climatic conditions as the year before. The same phenomenon occurred again during the winter of 1941/42, when Germany was at war with Russia (since July 1941), the Baltic Sea became arctic and the temperature was colder than if they were at the North Pole.

World War II (1941–1945) saw naval war spreading at a global level and the global weather cooling down for four decades. After having gone through three chilling war winters in Europe (1939-1942), world community was ready to go through an even bigger climate experiment. With Japan's ambush at Pearl Harbor with dozens of ships and hundreds of bomber air planes, on the 7th of December 1941, a new chapter of anthropogenic climate change started and was going to last for about four to five years, until most of the sea mine fields had been eliminated (1946/47). Mission was soon accomplished. Climate changed very pronouncedly to a colder status which lasted until about 1980.

"Global Warming" continued after 1980? The fact is that there was a strong warming between 1918 and 1939, which was interrupted for four decades by the naval war and then re-emerged in the early 1980. At this point, one can guess whether we can talk about a new cause or it is just the follow-up of the interrupted WWI-warming trend of 1918-1939.

Causes of the climate change (the 19th century)

Since the middle of the 19th century, when industrialization started to grow rapidly, man became an active user of the surrounding nature in many respects. That brings up the big question: did temperatures rise because of the end of the Little Ice Age only or did human activities have a major contribution to this climatic phenomenon?



There are a number of man-made contributory factors that may have had specific impacts on the atmospheric heating, e.g. local warming in the cities *(due to housing, roads, and other resultant factors)*, smoke and dust over long distances or deforestation of huge forest areas. Each of the above examples may have had temporary or long lasting implications, but none of them is a major source for the strong warming or cooling trends during the last 150 years.

However, two major contributors (shipping and naval war) have been given little or no attention at all until now. Although the surface of the oceans is gigantic, their structure can be still influenced by certain factors. As we want to understand the impact of the oceans on climate better, we will briefly consider the main oceanic conditions.

Dimension

If the sun were "turned off," the temperature of the atmosphere would be with only 28°C above absolute zero, viz.-245°C. With the sun and the "greenhouse gases", but without enough water, the average temperature on earth would be of-11°C (resulting from a daytime mean temperature of approximately +135°C and a nighttime temperature of approximately-175°C). The moon provides such conditions at night. CO2 would delay the cooling towards the absolute minimum only for a short time. Its functioning on earth is not so much different.

The amount and the concentration of water in the atmosphere do matter. If the atmosphere is divided into two 'warming' or energy bearing mediums, more precisely water and greenhouse gases (CO_2, methane, etc.), then the atmospheric humidity will have a warming capacity equal to a two-meter deep layer of the ocean surface, while greenhouse gases, a power equal to a one-meter deep layer. Practically, this means that a rise of the atmospheric temperature with 1°C must cause a drop of an equivalent amount in the upper three meters of the ocean. But because water vapor is usually in a much higher concentration at lower altitudes, its impact on the weather is much more powerful than CO2. CO2 is always equally distributed throughout the atmosphere. Their weather and temperature functioning are extremely different from 'water in the air'. Water vapor is well above 95% responsible for the greenhouse effect; and on a foggy day, even 100%.

Since so much has been written about the greenhouse effect, whatever is written here will be insignificant. Basic understanding about carbon dioxide issue is relevant only as far as it is needed to provide a comparison between possible contributors to the warming trend (including human input). While atmospheric water is only a remote subject in IPCC reports on climate, the naval war and the shipping issue is practically inexistent.

Oceans and their functions

The oceans affected by naval and merchant ships operating and sailing the seas back and forth should have been the hottest topic in the debate on climate change since meteorology was established as a science in the late 19th century. Instead of that, oceans were ignored up to the late 20th century and not even today do they enjoy the significant position they deserve. Oceans are a decisive climatic force, the second after the sun.

a) The starting point is the fact that the oceans are huge and deep. If all continents were to be leveled, the globe would then be covered by one ocean all around the sphere, at a uniform depth of 3,000 meters. It is not only quite an impressive mass of water; water is also an excellent thermal reservoir. Heat capacity ratio between ocean and atmosphere is of 1:1000. The sea can store heat for hours, days, decades or even centuries. Atmospheric heat capacity is almost completely limited to the amount of water vapor available. If not sustained by sunrays or ocean heat, atmospheric heat is gone within 2 to 3 days. Humidity is particularly important for the winter seasons at higher latitudes where sunshine is rare, insufficient or even inexistent. Merchant and naval vessels, fishing and leisure boats plough and push warmer surface water to lower sea levels during summer time. During winter, the process is reversed. The more the ships turn the surface water layer around during the cold winter days, the more the warmer water from the lower levels will surface and contribute to rising the air temperature. However, heat capacity of shallow seas is grossly limited during winter season

b) A major climatic implication in the oceanic affairs started with the development and the use of screw-driven steam and motor vessels in the middle of the 19^{th} century. For more than one hundred years, 10,000 vessels sailed the seas every day, covering more than 40,000,000 kilometres. Each ship sailing the seas will force more heat inside the sea than out of the sea. The more heat the oceans hold, the warmer the atmosphere gets. Thus, an area as large as the Atlantic (from the ice barrier of the Arctic to the ice barrier of the Antarctic) can be ploughed up in one year.

c) But there are not only merchantmen out in the sea. If all ships are to be counted (including fishing vessels, coast guard ships, tugs and millions of leisure boats during the summer season), we can easily double or triple the churning effect in the coastal waters and seas. And sailing is not the only contributor: let's not forget the dragging, seabed drilling, off shore wind energy farms, etc. which may also contribute to the turning upside down of the seas. Actually, every contribution, as little as it may be, makes a difference in the statistics, possibly resulting in the change of the climate data.

d) There are virtually no continuous series of measurements, which would lead to acceptable conclusions about the isotherm structure and its development of the upper layer of the ocean to a depth of at least 50 meters, over a long period of time. But the temperature difference can be of several degrees within a few meters, during the summer as well as during the winter.

Who contributed and to which extent?

We are going to make a brief assessment of the percentage that each major contributor had in the process of the global warming.

The earth's temperature has been rising for several decades. That is a fact that we all agree on. Many people also agree that The Little Ice Age came to an end because the series of Middle Age volcanic activities had ceased in the first place. As its impact on global warming is a significant one, natural causes are given a contribution rate of 50%. The next high rating of 30% is given to the section "ocean uses". 20-25% is allocated to general ocean uses, as it happens day by day since the end of the Little Ice Age. Finally, only 5–10% is attributed to the naval war.

And where do we put the most important climate determinant? There is little one can do against the already established 'beliefs' of certain circles. This investigation gives CO2 a marginal rank, with only 10%. This low rating derives particularly from the fact that the atmosphere is not the driving force for the warming mechanism but a mere appendix of the oceans. Furthermore, since its first report in 1988, IPCC has never offered more explanation: through consensus, they just reached the conclusion that there was a connection between the rising of the CO2 level and the rising of the temperature level. This is hardly a convincing argument.

Other contributors and summary

One could possibly name many dozens of aspects and sources, alone or in combination with others that might contribute to warmer or colder regional and global air temperature. But none of them belongs to the "premiere league", as a major player. Not to be ignored, they are given a rating of 10 %.

Why focus on war at sea?

To begin with, there is nothing so impossible to observe and to record as the ocean water masses are. There have never been such large oceanic experiments before the two big naval wars, each with the duration of a half-decade during WWI and WWII.

Although industrialization and meteorological science emerged two centuries ago, reliable ocean statistics, comparable to atmospheric weather statistics, is extremely scarce, not to mention the anthropogenic ocean usage which hardly exists. The use of oceans has never been taken into account seriously when it came to its determinant role in the climate change. So far, serious data is not available. One would have to look for computer modelling, which, until now, has rarely given impressive results.

It is a shame that it seems necessary to regard historical naval wars as a kind of blessing. Their massive appearance and devastating forces serve as huge field for experiments. One needs only to sit down and compare time of activity and results on weather charts and weather statistics. If these "experiments" prove that naval war changed the regional weather and the course of the climate, it will serve as ample proof that any kind of ocean uses are serious forces to be taken into consideration when matters of climate changes are at stake.

The central point of this investigation was to demonstrate how, during two world wars (in the 20th century), naval warfare contributed to the global warming. An in-depth analysis has shown that the overall picture provides clear clues. World War I initiated a two-decade warming, from 1918 until 1939. World War II initiated a four-decade cooling period, from 1940 until about 1980. What made things even more interesting are the three consecutive arctic war winters of 1939/40, 1940/41 and 1941/42, caused by military activities in the North and Baltic Seas. The emergence of these three winters proved to be a powerful demonstration of how naval warfare drove temperatures to the Ice Age level, changed regional weather conditions and left an imprint on climatic statistics. This is commonly called "climate change".

Can WWII go by unnoticed?

The aim of the book was to drag the attention on the oceans, to explain the real cause of the global rising of temperatures, phenomenon that scientists started to study in the 1980's. The aim of the book was to ensure that the mainstream of climate research was not constantly missing the point. The investigation had the purpose to establish that anthropogenic climatic changes were real and caused by the two grand field experiments that men undertook during the last century.

This book wanted to show that the war activities on sea during WWI and WWII correlate perfectly with the only two significant climatic changes between 1900 and 2000. The first one started in 1918 and lasted until 1939, while the second started in the winter of 1939/40 and came to an end in the early 1980s. The temperature rise during the recent 25 years can have "new causes", but it might as well be a resume of the steep temperature rise between 1918 and 1939, interrupted by WWII.

CO2 gases are the most blamed for the so-called global warming. And this thesis continues to be the viable and general accepted explanation for most of the official world. The aim of the book was to leave no doubt that the ocean determined where the climate was heading to. In this scenario, CO2 played only a minor role. CO2 was definitely neither the source of the "Big Warming Bang" (in 1918, far in the North of the North Atlantic), nor of the global cooling (from 1939 until the 1980's).

Oceans and seas are very complex, which are not well-understood not even today. But war at sea during two major world wars was a tremendous force that has left its trace on the oceans. Two climate changes during the last century prove our thesis. Winter temperature had risen in Spitsbergen with 8°C (1918–1939). The whole Europe got warmer every year. The German Chancellor Adolph Hitler started the war in 1939 and immediately North Europe was dragged back into the Little Ice Age, which implied climatic conditions not experienced for over 100 years. Two arctic war winters followed in the region with extreme naval activities until the war at sea went global, in 1942. And what followed immediately after that?

There were four decades of global cooling, affecting particularly the Northern Hemisphere, because here naval war had the most devastating effects and left a definite fingerprint in the downturn of global temperatures.

Even though our book section on naval warfare between 1942 and 1945 is short, the connection between naval forces and global cooling is overwhelmingly convincing. Actually, it is the first reasonable explanation for this phenomenon at all.

Even more reliable proof is the several regional, large field experiments in Northern Europe's waters: 1916/17, 1939/40, 1940/41 and 1941/42. They were strongly felt throughout the region because of the extreme winter temperatures. Each time, the effect was like a "big shift", proving that a definition like "climate is the average weather over a longer period of time" is nonsense in the field of scientific research.

Winter temperatures of more than 5ºC below average are totally out of tune. Weather statistics cried for attention, but nothing happened in this respect over more than six decades.

Until now, only one of the most ruthless WWII warmongers, the German Vice-Chancellor Hermann Goering, commented the arctic winter of 1939/40 by saying that a higher power has "sent" the harsh winter conditions. It is time to prove him wrong and to blame him, Hitler and the Nazis for having caused the arctic war winters and the global cooling.

Imagine that there is a phenomenon like the global cooling and that no one cares about giving an explanation. Imagine that there is global warming and that, this time, the world is highly concerned. The first reflects circumstances that happened more than half a century ago; the latter is the actual situation. So far, the statements seem to contradict each other. But in a wider sense, they are pretty logical. Someone who claims to be able to explain current global warming must implicitly be able to explain a pronounced global cooling which affected the climate only half a century ago. Ignoring the event for more than six decades is even more bizarre than relating phenomena to a 'higher power'.

Do you remember the moment when the unusually powerful hurricane 'Katrina' hit New Orleans in the summer of 2005? People insisted on being informed and on understanding the phenomenon. Let's assume that winter temperatures turn suddenly to Ice Age conditions (not experienced for more than one hundred years), but no one talks about this because there is a war going on. That was the case during the winter of 1939/40, when, in several locations in Northern Europe, average temperatures were more degrees lower than during the previous century, and the WWII war machinery cooled down the earth for four decades.

If this investigation succeeds in proving that two major wars changed the course of the climate twice in the last century, it will also prove that shipping, fishing, off-shore drilling, and other ocean uses had constantly contributed to the global warming since the start of industrialization, more than 150 years ago. A new chapter on the climate change issue could be now opened, giving more attention to oceanic phenomena under the influence of the potential of the "*1982 United Nations Convention on the Law of the Sea*"[31]. All research would lead to a better understanding and protection of the stability of our short-term weather and long-term global climate.

Concluding Remark

Those readers who wish to read a comprehensive scientific assessment, with detailed references, can find complete information in the book "Climate Change and Naval War", published by Trafford/Canada, 2005, or visit

www.seaclimate.com, or, www.seaclimate.de
www.oceanclimate.de
www.warchangesclimate.com

ENDNOTES

1 www.bbc.co.uk/climate/policies/uk_policy.shtml Topic: Climate Change from the BBC Weather Centre/Policies/UK Policy; "PM Tony Blair described climate change as 'the most important environmental issue facing the world today'".

2 Hermann Goering was a celebrated pilot which fought on an air fighter in WWI. He joined the Nazi movement in 1923 and became head of Germany's armed forces in 1938. The following year, he officially became Hitler's deputy and legal heir. After WWII started, Goering was named in charge of the Luftwaffe. In 1946, he was found guilty of war crime during the War Crimes Trail at Nuremberg.

3 Herman Goering in a speech in Berlin on the 15th of February 1940; reported by The New York Times, the 16th of February 1940.

4 Arnd Bernaerts, Letter to Editor, NATURE, Vol.360, the 26th of November 1992, p. 292; SIR—The Earth Summit in Rio de Janeiro and the earlier struggle for a Convention on Climate Change may serve as a reminder that the 1982 Convention on the Law of the Sea has its tenth anniversary on 10 December. It is not only one of the most comprehensive and strongest international treaties ever negotiated but the best possible legal means to protect the global climate. But sadly, there has been little interest in using it for this purpose. For too long, climate has been defined as the average weather and Rio was not able to define it at all. Instead, the climate Change Convention uses the term 'climate system', defining it as "the totality of the atmosphere, hydrosphere, biosphere and geosphere and their interactions". All that this boils down to is 'the interactions of the natural system'. What is the point of a legal term if it explains nothing? For decades, the real question has been who is responsible for the climate. Climate should have been defined as 'the continuation of the oceans by other means'. Thus, the 1982 Convention could long since have been used to protect the climate. After all, it is the most powerful tool with which to force politicians and the community of states into actions.

5 German daily weather charts of 'Seewarte'.

6 Source:www.usafa.af.mil/dfh/harmon_series/docs/Harmon36.doc.

6 Liljequist, Gösta H.; ‚Isvintern 1941/42'; in: Staten Meteorologisk—Hydrograiska Anstalt, No.4, 1942, pp.2-15.

7 It should not be so much a surprise that the third coldest January occurred during WWI. There were also a lot of naval activities in all North Sea regions. Since late 1916 naval warfare stepped into a new age of destruction, due newly developed sea mines, submarines and depth charges (see chapter on WWI, below). In so far it might be not too far fetched to assume any link between the biggest naval encounter ever, the Battle of Jutland on 31st May 1916 and the record January 1941.

8 Second coldest was January 1942 (-12,1°C); Third coldest January 1917 (-11,6), seven months after Battle of Jutland according monthly means temperatures at Oslo/Gardermoen (www.wetterzentrale.com/klima/) during time period 1816-1988. 4th coldest January 1867 (-11°C), 5th coldest January 1820 (-10,7°C).

9 Water entering Skagerrak via the Jutland Current in the southwest, proceeding along Denmark's coast, turning anti clockwise at Sweden's coast to become off Oslo Fjord the Norwegian Coast Current flowing southwestward until leaving Skagerrak and turning northwards flowing along Norway's coast until reaching Norwegian Sea. In opposite direction a deep counter current injects high salinity Atlantic water into the Skagerrak deep.

10 Liljequist, Gösta H.; ‚Isvintern 1941/42'; in: Staten Meteorologisk-Hydrograiska Anstalt, No.4, 1942, pp.2-15.

11 Liljequist, Gösta H; 'The severity of the winters at Stockholm 1757–1942', Geografiska Annaler 1-2, 1943, p. 81-104; and as an extended paper in: Meddelanden, Serien Uppsatser, Stockholm 1943, pp.1-24.

12 Liljequist, Gösta H., ‚Isvintern 1941/42'; in: Staten Meteorologisk-Hydrograiska Anstalt, No.4, 1942, pp.2-15.

13 See above: Chapter I, Introduction

14 Gösta Liljequist, Liljequist, Gösta H. (1941/42); ‚Isvintern 1941/42'; in: Staten Meteorologisk-Hydrograiska Anstalt, No.4, 1942, pp.2-15.

15 A.J. Drummond.; ‚Cold winters at Kew Observatory, 1783-1942'; Quarterly Journal of Royal Met. Soc., No. 69, 1943, pp 17-32, and: Drummond,

A.J.; Discussion of the paper: ‚Cold winters at Kew Observatory, 1783-1942'; Quarterly Journal of Royal Met. Soc., 1943, p. 147ff.

16 Cave, C.J.P.; ‚The ice storm of January 27-29, 1940', and Discussion; Quarterly Journal of Royal Met. Soc., Vol. 66, No.285, 1940, pp.143-150. See also http://homepage.ntlworld.com/booty.weather/climate/wxevents

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