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The Pacific War and the Climatic Shift, 1942-1945.

- CORRELATION OR CAUSATION? -

By Arnd Bernaerts, Hamburg

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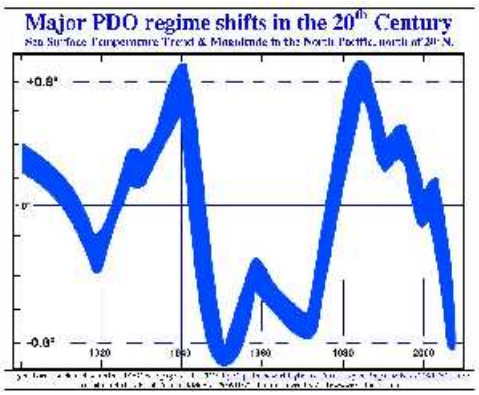
PACON 2010 CONFRENCE ABSTRACT

Although it is an established fact that during WWII a global cooling commenced that lasted for three decades, rarely any question have been asked, whether the significant correlation to naval activities in the Western North Pacific left a fingerprint in the temperature data at that time. As the US Navy and her Allies assembled a huge strike force since 1943 until the surrender of Japan in August 1945, their enormous range of activities at and under the sea surface could have changed the structure of sea layers at some depths considerably, either warming, or cooling the sea surface layer. The paper will discuss the circumstances during the relevant years, and analyze data sets, with the aim to demonstrate that the impact of WWII activities in the Pacific rectify to investigate the strong correlation thoroughly, as even a small contribution of naval war activities to the global cooling since 1945 should be known, understood, and a subject in the climate change debate had the Pacific War on climate? It seems time to pay attention to the matter.

Introduction

Fortunately all weather statistics show a global temperature declined from the first half of the 1940s to approximately the mid 1970s. For the Northern Pacific Ocean the shift occurred in 1943. Something must have happened very suddenly; something must have turned the physics and dynamics of the earth's atmosphere toward a cooling mood. Had it been due to a long-term variations in ocean circulations, which produce pronounced patterns of sea surface temperature (SST) anomalies that directly impact weather and climate?[1]. Was the driving impulse been set by the Pacific War from 1942 to 1945? Every well founded explanation is welcome, as this is the very essence meteorological science is all about[2].



[1] Ross, Jeremy (2009), The Pacific Ocean's Influence on Climate Change: How Low will the PDO Go? At : http://icecap.us/index.php/go/new-and-cool/the_pacific_oceans_influence_on_climate_change_how_low_will_the_pdo_go/ ; visited 17 April 2010

[2] American Meteorological Society, Glossary, 2nd ed; defines: "'meteorology' as the study of the physics, chemistry, and dynamics of the earth's atmosphere, including the related effects at the air–earth boundary over both land and the oceans". http://amsglossary.allenpress.com/glossary/preface2 , visited: 02 April 2010

This paper is putting its aim at two aspects. One is to highlight the observed and documented aspects of the cooling period, and whether more needs to be done, as in the case of the often mentioned "prolonged El Nino from 1939 to 1942". The other aspect concerns the causation of the climatic shift, by discussing only one of presumably a number of conceivable aspects, namely the impact of naval war, of the scale and magnitude as occurred since Pearl Harbour in December 1941. This should be regarded as an offer to overcome the unacceptable situation that the event is still not sufficiently explained. Any explanation of the cooling since the early 1940s needs to be based on "physical-dynamical" terms, and why a warming period had ended in the early 1940s, which had started several decades earlier.

While it is evident that the global cooling period commenced concurrently with World War II (WWII), claiming that a link could exist between the climatic shift and the naval war is completely unheard of. The immediate problem for communicating this matter is not so much the enormous naval war activities at that time, in the North Atlantic as well in the Western Pacific Ocean between 1942 and 1945, but presumably the very different focus placed regarding the functioning of the earthly weather system over time and space. The paper regards the ocean as the source, which dominates and regulates the atmosphere. That is certainly not illustrated by the old fashion explanation that: Climate is average weather over a period of time"[3]. The same can be said if text from the Glossary of AMS[4] is consulted: That weather consists of the short-term (minutes to days) variations in the atmosphere, while climate is: The slowly varying aspects of the atmosphere–hydrosphere–land surface system. That is all very superficial, vague, and of little help to understood the global system better. To get the matter straight the paper is based on the understanding that "climate is the continuation of the ocean by other means", whereby 'means' mean: water-vapor and heat.

Unfortunately, there is no list of possible links and supporting records, which indicate changes in the marine environment and climate change during WWII. That is mainly due to the fact that ocean research was more a fragmented than a systematic science in the mid of the 21st Century, and a possible relation between naval war and any ocean impact on the atmosphere not even remotely considered, and therefore also not recorded. There is little one can analytically use. Actually there is hardly much more than a few land stations with a sufficient long record on air temperatures. Although there exist 'sea air' (SAT) and 'sea surface temperatures' (SST), but those taken during the war years by merchant and war ships should be met with great suspicion. This was the conclusion of a paper presented at the PACON Conference in Hong Kong 1997, with the notion: "The average run of 'freak' data gives an average run of 'freak' results. Any use of SST series covering 1939 to 1945 requires due consideration of WWII conditions"[5]. An exception could be those data collected or compiled for fishery research, but for this paper only very few could be obtained. Because this is not much to discuss the naval war thesis it seems necessary to overcome these enormous shortcoming by mobilising all sources possible, and which is the main reasons for this paper. Even if the naval war contributed with a small margin, it would be time to understand the mechanism, and to include it in the climate change debate.

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[3] The definition is still used by the World Meteorology Organisation (WMO): www.wmo.int, Visited: the 19 October 2009; Go: Home/Themes/Weather or Climate; or: Home/Topics/Weather or Climate

4 American Meteorological Society, ibd., Glossary. For the full glossary text see: weather and climate. E.g. weather - is the state of the atmosphere, mainly with respect to its effects upon life and human activities.

[5] Bernaerts, Arnd (1997), „Reliability of Sea-Surface Temperature Data taken during War Time in the Pacific", PACON Proceedings, October 1997, pp. 240-250.

The matter could and should have discussed since merchant, fishing and naval vessels, changed from sailing to screw propulsion. As water is an excellent isolator, it is easier to bring heat into the system than to release it from the system. But as nothing has ever been done to assess the climatic impact over the full period of screw driven vessels since about 1850, a short war period may can do the trick. Quite suddenly there had been a huge armadas out at sea, and they penetrate the sea on a much wider scale and deeper than at any other comparable time period, during which the temperature and salinity structure is rapidly changed, and what are the consequences for the atmosphere in space and time. Although the physical superiority of the oceans are well known, few aspects shall be briefly recalled:

___the average temperatures of the oceans is below 4°C,
___only a very thin ocean surface layer at lower latitude regions have more than 10°C,
___the oceans hold 1000 times more water than the atmosphere,
___The atmospheric vapour is completely exchanged every ten days.
___ The upper 3m of the ocean surface layer has the same heat capacity as the entire troposphere (the lower 10'000 m of the atmosphere). Hence the heat required to raise the temperature of the troposphere by 1ºC can be obtained from cooling the upper 3m of water by the same amount.
___The dynamics or the oceans are to a very high degree purely internal, except three external sources: the sun, sea ice, and wind. With screw driven boats and ships the wind has got an companion, which is mixing the sea surface layer over huge sea areas that alters the temperature structure and salinity over several meters depths. During war times the mixing can reach sea levels several dozen meters below the surface, and thus be temporarily more effective than strong and stormy wind.

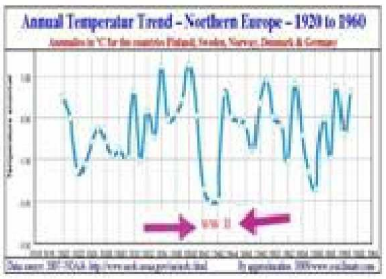
The Cooling and the War in Overview

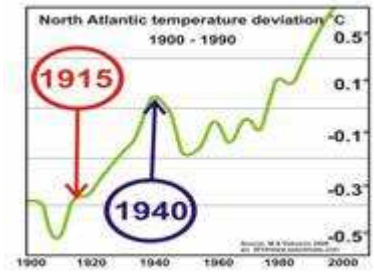
For the general picture there is a precise timing. "In fact, the temperature decrease in the Northern Hemisphere by about 0,5°C between 1940 and 1970". This finding published James Hansen et al in 1981[6], and had been recently again confirmed by Thompson et al. as follows: "Data sets used to monitor the Earth's climate indicate that the surface of the Earth warmed from ~1910 to 1940, cooled slightly from ~1940 to 1970, and then warmed markedly from ~1970 onward"[7] suggesting that: "The weak cooling apparent in the middle part of the century has been interpreted in the context of a variety of physical factors, such as atmosphere–ocean interactions and anthropogenic emissions of sulphate aerosols".
This investigation will concentrate entirely on a specific physical factor which may result from naval war activities on the sea surface layer, which commenced on the 1st of September 1939 and lasted until autumn 1945. Naval war activities during WWII can be roughly divided in three phases:

- Phase 1: 09/1939 to 12/1941, European waters and seas, increasing in the North Atlantic;
- Phase 2: 1942 and 1943, high all over the North Atlantic, increasing in the West Pacific.
- Phase 3: 1944 to 08/1945, decreasing in the North Atlantic, high in the West Pacific.

The temperature shift in Europe commenced with the first war winter 1939/40, which was the coldest for 100 years, while the North Atlantic followed suit (Fig. 2-4).

[6] Hansen, J., D. Johnson, A. Lacis, S. Lebedeff, P. Lee, D. Rind, and G. Russell, 1981: Climate impact of increasing atmospheric carbon dioxide. *Science*, **213**, 957-966; and at: http://pubs.giss.nasa.gov/cgi-bin/abstract.cgi?id=ha04600x (visited: 08 April 2010) .
[7] Thompson, David W. J.; John J. Kennedy, John M. Wallace & Phil D. Jones (2008), A large discontinuity in the mid-twentieth century in observed global-mean surface temperature, *Nature* 453, 646-649 (29 May 2008)





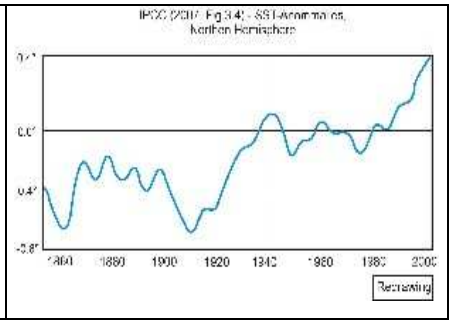


Fig. 2, 3 & 4

The Pacific Ocean showed a downturn as well that will receive more attention later. Taking a first view at the Pacific Decadal Oscillation Index (PDO) – Fig. 5 -, indicates that a driving mood started soon after 1940, which would fit perfectly with the commencement of naval war in the Pacific

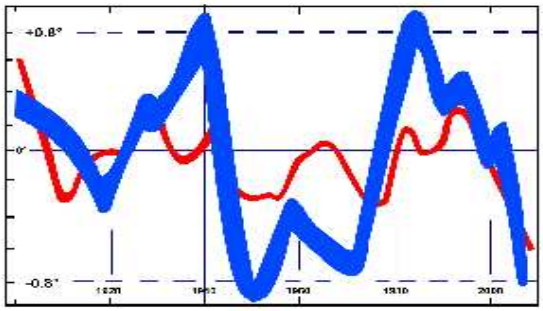


Fig.5; PDO and El Nino (red) Trend 1900 to 2005

Fig.6 , Defence and Advance of naval forces Fig.6

after the Japanese ambush on Pearl Harbour on 7th December 1941. From this day the United States started to organised a naval and aerial force to operate in the Western Pacific with breathtaking dimensions, by bomber forces, naval surface vessels, and submarines which alone sunk about 1.400 merchant and naval vessels representing a total tonnage of 5.0 million tons. All numbers given are only rough figures. The number of submarines increased from a few dozen in 1942 to well above 200 in 1944, during which more 40 boats where on war patrol at any time. The US Navy lost 48 submarines in the war zone of the Pacific. Together with the increasing US surface fleet and the bomber capacity since 1942 the total Japan losses amounted to 10.0 million tons, or about 3000 vessels including about 110 submarines. The Allies material losses were considerable less, but accounts also in approximately 1000 ships, and many thousand air crafts. Due to naval activities alone presumably many millions of shells have been fired, many ten thousand bombs dropped into the sea, many thousand sea mines laid, depth charges released, and torpedoes fired. The number of Japanese sea mine in the Japan Sea seems to have been so effective that US submarine avoided this operation area. The US and Allies forces advanced from the South and South-East via the Singapore, Indonesia and the Philippines before reaching Okinawa in summer 1945, but had been also active further north, e.g. at midway (06/1942) and the Aleutian (06/1942 to 08/1943).

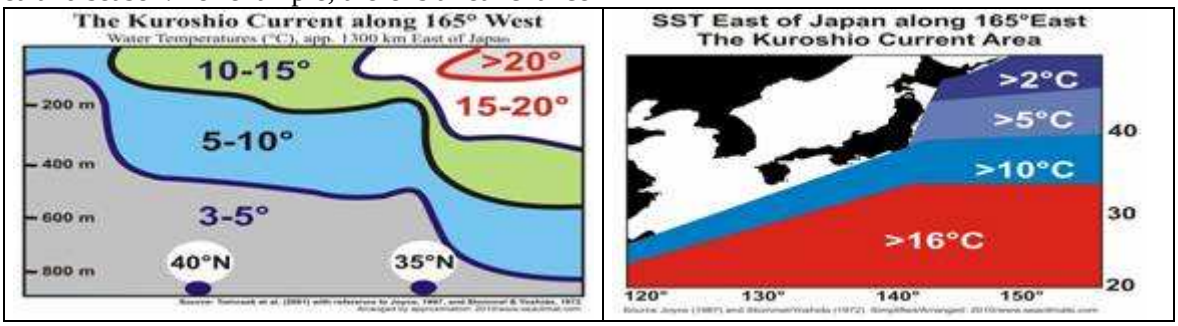
The war in the Western Pacific was a physical factor in the marine environment never experienced before, and an immediate correlation to the downward turn of air temperatures is obvious. In the next section I will try to underline this aspect more substantially.

The area to focus on.

Any efforts to cover the full range of the Western Pacific from Australia to the Aleutian is doomed to fail due to lack of sufficient data, in particular of reliable sea surface data. In this respect I investigated ship taken SST in the Pacific during WWII more than 10 years ago raising doubts of their usefulness. This should be particularly observed when this data have been used to consider the existence of an El Nino event. In my previous paper I worked with some SST figures as shown in Fig.6 from Folland et al (1990) and Wright (1986), and could not find anything useful for the naval war thesis. My doubt than has not ceased but increased, particularly with regard to the widely supported claim that there had been a prolonged El Nino event from 1939 to 1942. For example, Diaz and Kiladis (1992) recognise

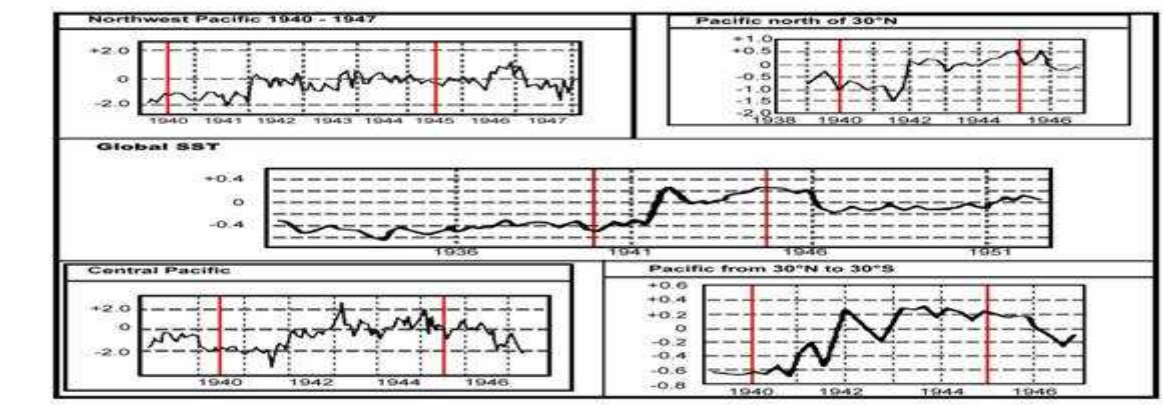
an El Nino only for 1939, followed by a La Nina event in 1942[8]. I do not question that El Nino events show traces in data records elsewhere, but the situation during WWII was to special for not being highly suspicious in this respect. Already for this reason no further attention will be paid to the Equatorial Pacific.

A further import reason not to pay attention to data from a region of lower latitude is the physical property of the upper ocean water layers, which have very high temperature (heat content), with a continued warming potential by the sun, and with little seasonal changes. The physical dimension are so huge and constantly influenced by the sun that it would be absurd to look whether naval activities may have left traces. But for not being misunderstood, the question has to be handled on the basis of area and season. For example, there is a real chance



to link evidently the three extreme war winters 1939/40, 1940/41, and 1941/42 in Europe to the naval war, by concentration fully on the winter season alone. Only during this time period the influence of the sun in the North- and Baltic Sea is not high. If external forces churn and turn the sea surface the heat stored during the summer is lost earlier and the winter gets colder.

Unfortunately, the Pacific Ocean can in no way be compared with the small, and shallow waters in Northern Europe, which are at a higher latitude than the Aleutian. The Northern Pacific is very deep, in permanent motion, which means that the season are of not of much



help either. The water masses move on, so that any traces are quickly "submerged", possibly showing up only in the long run. Actually the US forces moved with the warm Kuroshio Current towards Japan. The warm water layer is thin (Fig.). The average water temperatures of the whole basin is about 4° C, with a wide range of salinity. As naval activities could have changed the structure over a considerable depth manifold, it seems of little help, and for this paper impossible, to raise and discuss such physic-dynamical matters. Vice versa, certain observation will be presented, which requires an explanation, and which should be further investigated in the context of the climatic shift in the Pacific during WWII.

[8] Diaz, Henry F. and G. N. Kiladis (1992), in: Diaz and Markgraf (ed); "El Niño", Atmospheric teleconnetions associated with the extreme phase of Southern Oscillation, p 8-28.

IV. Temperatures anomalies in Japan - 1944/45

(1) A cold winter in Japan 1944/45 due to natural variation only?

a. The military situation towards the end of 1944.

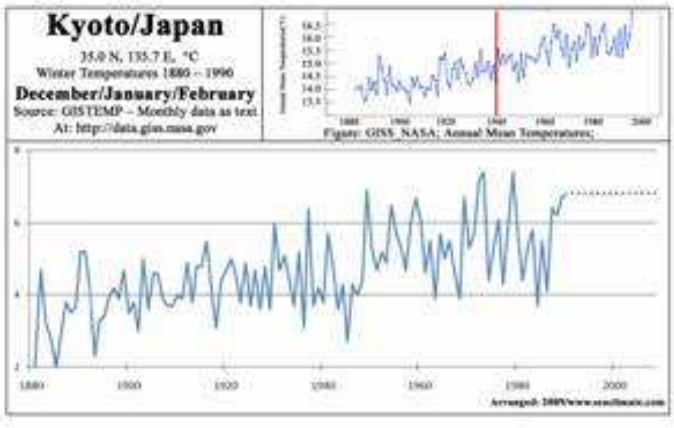
Only nine months before the Japan surrendered in August 1945 the island went through an unusual and very cold winter 1944/45. Since autumn 1944 the US Navy retook the Philippines. The larges engagement took place in the Leyte Gulf, and covered a number of clashes and fighting that are know as Battle of the Leyte Gulf. The enemies employed at least 40 carries, 20 battle ships, and about 200 cruiser and destroyer, as well as many hundred air planes. Fighting continued in the Philippines and the Indonesian Archipelago until the early 1945, but the distant to Okinawa was not more than 1'000 km and to the South of Japan 2'000 km. Japan's North-South supply lines could be more effectively penetrated by submarines and bombers. Water masses from the military operation or attack areas were carried with the Northern Equatorial Current and Kuroshio Current towards Japan within a short period of time, and suddenly Japan had an exceptional cold winter based on the months December 1944, and January and February 1945.

1st Dec.1944; US-Army Map

1st March 1945; US Army Map

b. The coldest winter on record

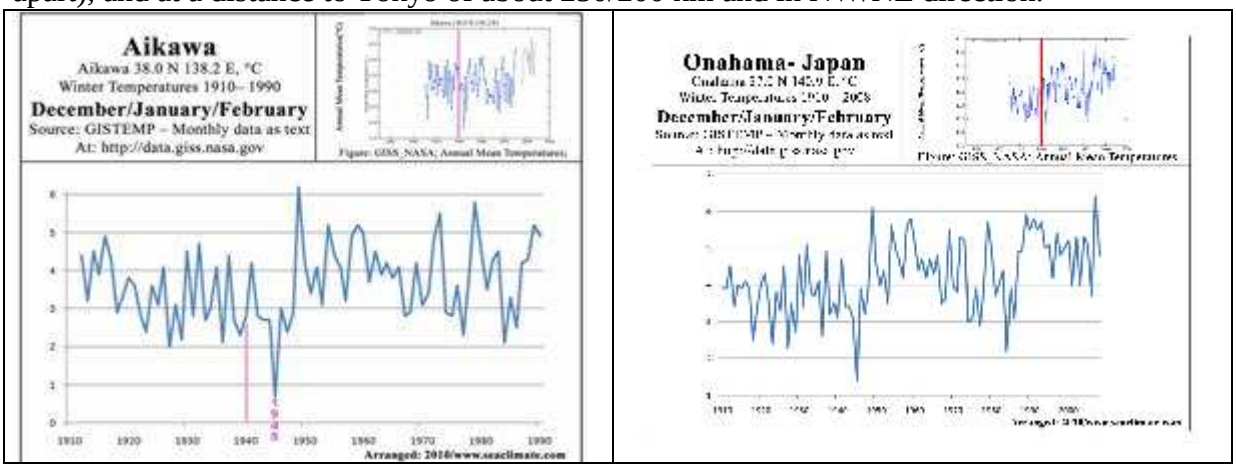
Records are to happen, and if regarded in terms of weather data, records are those which are shown in available data sets. This investigation is based on NASA/Giss data, and prior WWII the data are not older than 60 years, which cover a maximum period from 1880 to 2009, but sometimes less. First it is to show what happened, where it happened, and which forcing mechanism should be considered.



To begin with the significance of what happened shall be demonstrated by the data record of Kyoto, not only because it has a data record since 1880, but also while a 'Kyoto Protocol' represents international efforts on climate change matters.

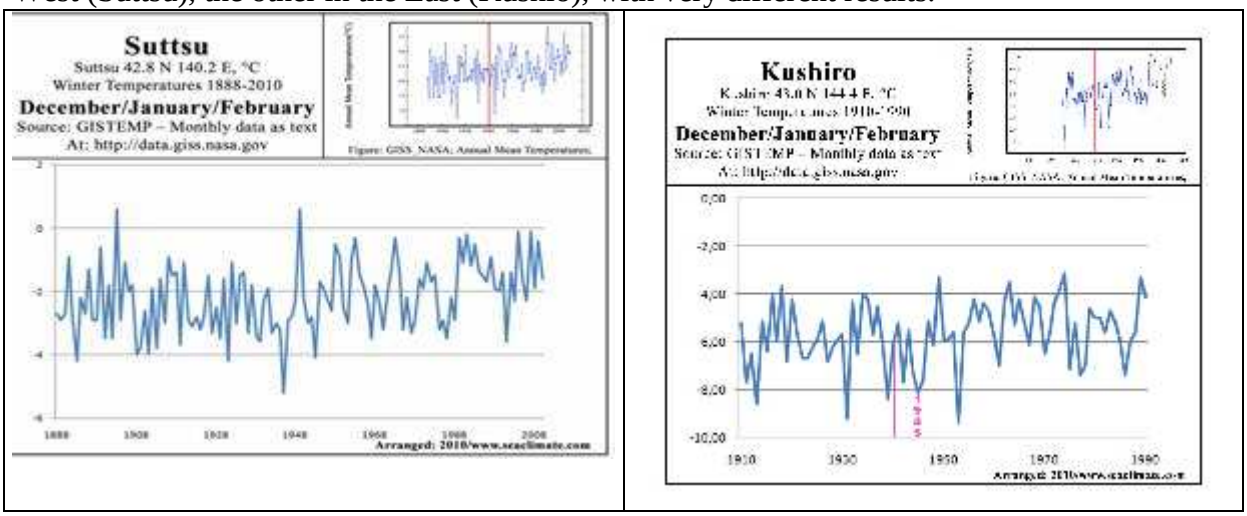
The presentation concerns air temperatures, and with regard to Kyoto at a location that is in a mountain region. This interior positioning results in hot summers and cold winters, although the Japan Sea in the West and the Pacific Ocean in the East are within a few dozen kilometres. The interior condition prevented Kyoto from experiencing an all time cold record in winter 1944/45. According the Fig. The D/J/F temperature had been merely the coldest since 53 years, while 1892, 1884, and 1882 were significantly colder.

In contrast to an inland station, the next two are coastal stations, one in the Sea of Japan (Aikawa), the other at the Pacific Ocean (Onahama), at almost the same latitude (ca. 300 km apart), and at a distance to Tokyo of about 250/200 km and in NW/NE direction.



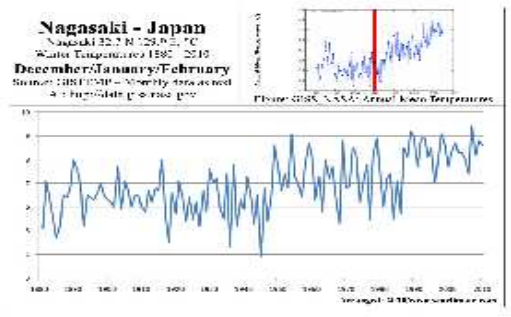
The excessive low winter temperatures 1944/45 at both stations is remarkable and presumably can not be explained with natural 'variability', but must have been strongly influenced by the temperature conditions of the sea water.

An immediate support for the sea water impact can be drawn from the next two images, representing also coastal stations. They are located about 700 km north of the Aikawa/Onahama station, on the Island Hokkaido, and also about 300 km apart, one in the West (Suttsu), the other in the East (Kushio), with very different results.



While the temperature deviation in Suttsu during winter1944/45 is extreme over the shown period from 1888 to 2009, the station at the shore of the Pacific, Kushiro, did not experienced an unusual drop in temperatures. Any considerations of this divergence has to include the very different sea current conditions. At three of the four coastal stations mentioned are highly influenced by warm water currents from the south (Fig.), where as the Kushiro station is in the reach of the cold Okhotsk Current from the north. While the Okhotsk Current was

presumably the least effected by naval war activities, the warm currents coming from the South had been effected.

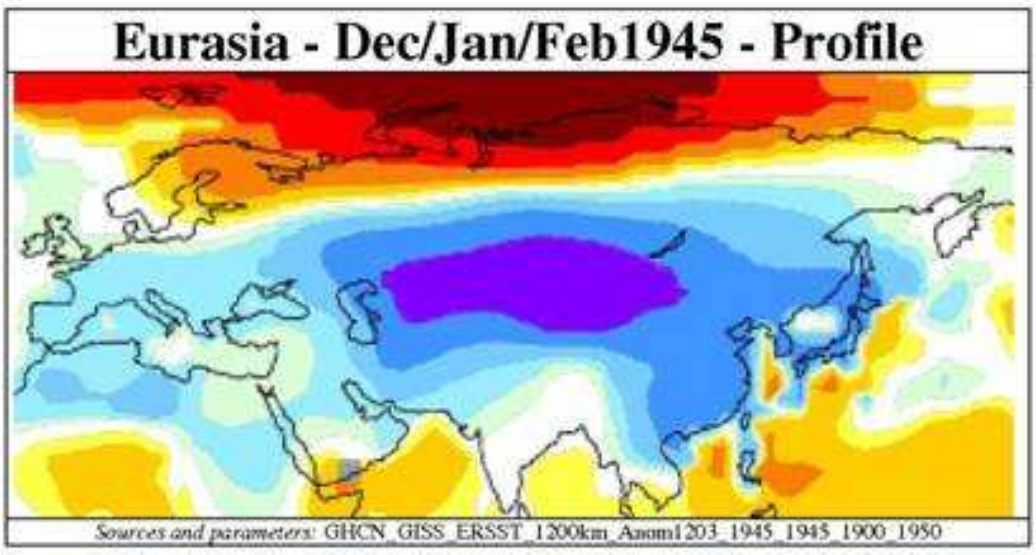


The corresponding situation as in at the mid-axis of main island Japan, can be found at Nagasaki at the southern edge, and about 600 km WSW of Kyoto. Here the warm water current enters as Tsushima Current the Sea of Japan, or passes a Kuroshio Current the East coast of Japan until it turns east at the height of Tokyo at about 36°North. The Nagasaki image covers the same period as Kyoto, but registered an all record winter, which was slightly less distinct as at the other coastal stations, except Kushiro, which allows to draw the first conclusion:

- Those coastal station at Japans west or east coast that are influenced by warm water currents from the south showed record cold winter temperatures.
- Only the most north-eastern station Kushiro, influenced by the Okhotsk Current transporting cold water from the north the winter remained close to the average.
- The inland station at Kyoto clearly shows the significance to the last war winter, but much less striking as Nagasaki in the south and Suttsu in the north.

c. The regional extent of the cold winter

Based on the NASA/ GISS Surface Temperature Analysis for the winter 1944/45 (DJF), the Fig.XX show the region from the North Atlantic all over Eurasia up the East coast of Japan, with a core cold area east of the Caspian Sea up to China. Whether this remarkable situation is in part the product of extreme military activities all over the North Atlantic, or in western Europe over the year 1944 and during the winter months is not to be debated here. I will also abstain to make any comments with regard to the war activities in China, but only make few remarks with regard to the possible impact of the naval activities in the western Pacific. South of Korea it might be worth to note that the cold stretches along the entire coast of China and includes the Philippines and the Island Taiwan, as well a considerable sea area in the south of Nagasaki. If this data can be trusted, it seems only logically to link them, at least partly, to the huge naval activities which took place during that period of time. Such approach is even more inevitable with regard to all coastal seas around Japan, which are fully included in the area of cold air temperatures, together with western Sea

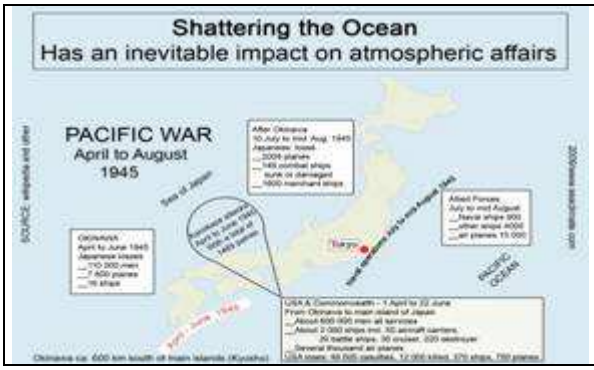


of Japan up to Vladivostok. Interesting is further the fairly marked contrast along the eastern coast of Japan, with low temperatures very restricted to the coast, while further out at sea higher temperatures occurred. Any influence by ENSO is unlikely as the years 1944 & 1945 are regarded as neutral. Despite the overview and some interesting information, it is to little to formulate any reasonable assumptions, which at best can be only drawn –with constrain- from the fact that the winter 1944/45 is a record winter.

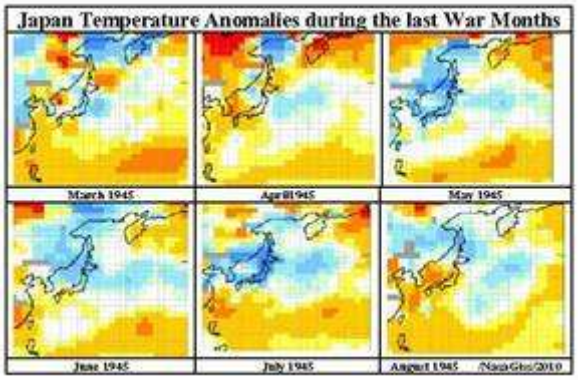
2. Coldest months on record - May & July data 1945

Since January 1945 a huge military machinery closed down on Japan rolling northwards from Burma, and the Philippines, or closing in from the East after the strategic Iwo Jima Island had been conquered in a battle lasting from 19 February until 16 March for which the US Marine Corp employed 450 ships, including 6 battleships, 4 cruisers and 16 destroyers, and a manpower of 50'000. To prepare for landing the island was bombed for 72 days by B-24s from the Marianas[9], while naval ships bombard the island for three days. Since summer 1945 the USA was able to commence from Iwo Jima 1,000 bomber raids against Japan.

There were many other naval activities, from bombing, kamikaze, mining, submarines, and shelling underway, of which major last big battle concerning the occupation of Okinawa began on April 1, 1945 and ended June 21, 1945. The material employed and lost was gigantic.



USA & Commonwealth Strength (approximate)
__ 600'000 men all services;
__2'000 ships incl. 50 aircraft carriers; 20 battle ships, 30 cruiser, 220 destroyer;
__ Several 1'000 air planes;
USA loses:
48'000 casualties, 12'000 killed, 400 ships (10% sunk, 90% damaged); 700 planes.
Japanese losses (approximate)
__110'000 men; __7'800 planes; _16 ships;
Kamikaze attacks on ships: By about 1'465 planes



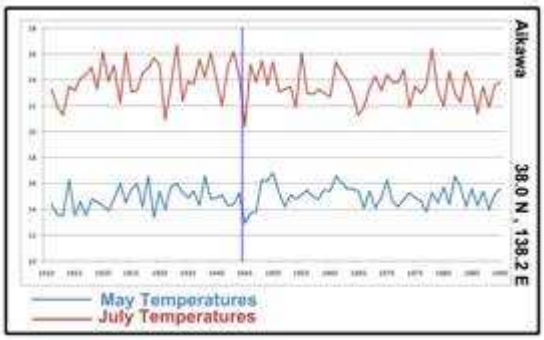
After the Battle of Okinawa had ended the Japanese lost further 2000 planes, 140 combat ships and 1'600 merchant vessels until surrender on 14th August 1945, while the Allies forces could operate with a strengths of 900 naval ships, 4'000 other ships, and 15'000 air planes.
That is certainly only a small part of the story of what has happened in the western Pacific

[9] The Marianas are the northernmost islands of a larger island group called Micronesia, situated between 13° to 21° North, and 144° to 146° East. The distance to Tokyo is about 2'400 km. They had been recaptured by August 1944 and after rebuilding an air strip in Tinian over the next several months, a total of 19'000 combat missions were launched from here alone against Japan. By August 1945, Tinian was by space and operation the largest airbase in the world, and accommodated nearly 1000 B-29s, the so-called: Superfortress with an armament of: 12 .50-caliber machine guns, 1 20 mm cannon, 20,000-pound bomb load, , and, for example, in March 1945 B-29s laid mines in Japan's Shimonoseki Strait to interrupt shipping.

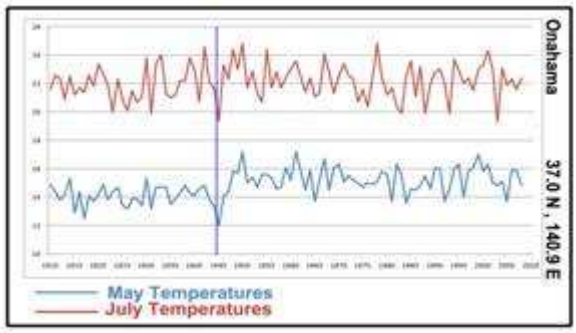
during 1945 months, and it should come as a surprised if that shall have left no traces in the marine environment, and on the climate.

This issue is addressed as an example in the hope that it may be taken up one day to assess the matter in great detail, because a brief review of a number of Gisstemp station in Japan showed very cold temperatures just at the time the Allies forces approached the shores of Japan in summer 1945. The Fig. (915_6Month_) shows the months March to August 1945, and with a bit leniency one can argue that the negative anomalies are close to the Sea of Japan, the east coast of Japan und the adjacent ocean space eastwards, with the exception of August 1945. Was the sudden increase of temperature due to the fact that the war had ended on 14 August 1945?

The analysis becomes more concrete if a look at the individual monthly temperature data, as at all stations from Southern Japan to Vladivostok the May and July data are particularly cold, and for a number of stations on main island of Japan the coldest on record. Here only two examples from those station in central Japan are presented, which are already shown in Fig: .



AKAWAI – West Central Japan



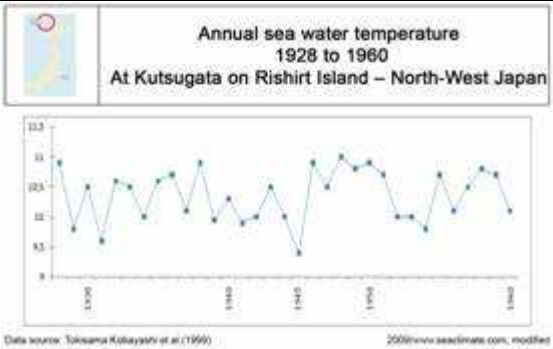
ONAHAMA – East Central Japan

The deviation at the stations Aikawa and Onohama during the months May and July 1945 is so significant and extraordinary that it requires a clear answer, what has caused this statistical anomaly, respectively can naval war as a contributing facto evidently be excluded?

3. A clue from SST?

It is not much what is at offer on sea surface temperature. On one hand to few have been taken in those days, and for me and this research they have not been accessible, respectively barred by language barrier. It is hoped that this paper stirs the interest to collect and publish such material in an accessible manner. Thanks.

The relevance of the Figures shown is indicated in the explaining boxes. They support the



Source*): Tokimasa Kobayashi et al. (1999):
"Long-term fluctuation of the catch of Pacific herring in Northern Japan".
PICES-GLOBEC, 8th Meeting in Vladivostok, October 1999

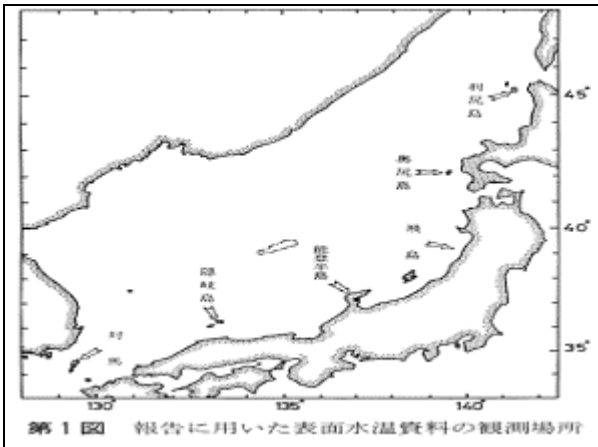
__(Extract): The annual mean seawater temperatures recorded at Takashima showed that an apparent rise in five year running mean after 1910.

__(Extract): There was a remarkable decline in sea surface temperature from 1939-1945 and the temperature rose again after 1946.

NOTE: The very low SST in 1945.

*) http://www.pices.int/publications/scientific_reports/Report15/REX_Longterm.pdf

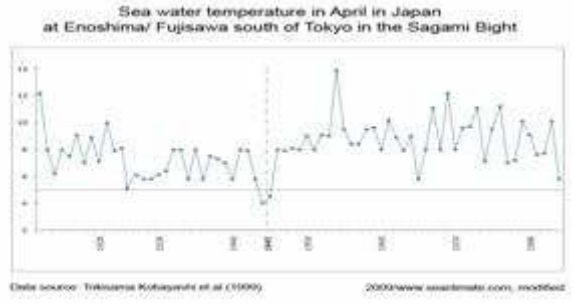
findings with regard to the air temperatures in 1945, and that the cold winter all over Japan was closely related to the low sea water temperatures, with close linkage to military activities along Japan's coast and port approaches.



第 1 図　報告に用いた表面水温資料の観測場所

Figure and Extract from: Kösuke Naganuma (1978), "On the Water Temperature Fluctuation at the Representative Points in the Japan Sea along the Honshu Coast";
Bull. Jap. Sea Reg. Fish (29), p. 269-282.
(Except abstract on in Japanese)

___(Extract): The surface water temperature analyses were carried out on those data observed during the period from 1918 through 1975 at several points along the Honshu coast of the Japan Sea, Tsushima, Oki Islands, Noto Peninsula, Tobishima, Okujiri-tõ, and Rishiri-tõ (see: previous Figure).
___(Extract): 3) The annual average temperature at each point varies as low as 0,8°C for every latitudinal degree from the south to the north.
___(Extract): 10) It is pointed out that the period before 1945 was low temperature period, and thereafter high temperature period.



Source*): Tokimasa Kobayashi et al. (1999):
"Long-term fluctuation of the catch of Pacific herring in Northern Japan".
PICES-GLOBEC, 8th Meeting in Vladivostok, October 1999

COMMENT: The record low SST during the month of April 1944 and 1945 in succession are a clear indication that high naval activities in the Sagami Bight south of Tokyo kept the water temperatures at unusual low level.

4. Discussion

Correlation is one thing, causation another. While temperature anomalies and naval activities in winter 1944/45 and the remaining war months correlate in many respect perfectly, it is a quite different matter to make a similar claim on causation. Actually that is not intended. Instead this investigation shall demonstrate that it touches a matter of high scientific relevance, and is a unique opportunist to understand the functioning of climate and the relevance of human activities better.

On one side it could be shown that it seems highly unlikely that there has been no mechanism between the naval activities in the western Pacific and the observed record low temperatures, but I am only in the position to guess on how it might have worked, and even less certain about the question, whether it had had any initial or long term cooling in the North Pacific from the mid 1940s to the mid-1970s.

But what would be the consequences if on assumes that the low temperatures in Japan had been caused by regional naval activities in the Western Pacific? Did any impact just had an short term effect on the most upper sea surface layer, or had the activities penetrated much deeper over several dozen meters, with substantial changes of the sea structure concerning temperatures and salinity? What processes had been initiated in this way, and how long would it last until the sea would return back to a pervious stage?

None of this questions can be answered here. The exceptionality of the winter 1944/45, and other months in 1945, indicate that the penetration was severe, so severe that in perfect simultaneity the Northern Pacific turned form a warm phase into a cold phase.

V. The Shift in the Pacific – mid 1940s –?

Scope of assessment
There was a 35-year global cooling, which had started between 1940 and 1945. Reasoning the causation are rare, and non is sufficient. The cooling was evident in the Pacific as well. Could the naval war in the Pacific over just three years have contributed to trigger a climatic shift in the North Pacific? If it was not naval war, which mechanism caused the large discontinuity in the mid-twentieth century in observed global-mean surface temperature? Was it a "natural event", or by what kick off was the process set in motion?

For none of the question there is a sufficient answer. There is the global issue, which turned sea and air temperatures toward cooling in the early 1940s, particularly all over the Northern Hemisphere. If naval war did play any role in this respect, the North Atlantic and its war torn adjacent seas in Northern Europe definitely contributed highly, due to its much higher extension pole-wards, and the sensible structure of the warm Gulf Current system that flows through colder water up to the Fram Strait at high northern latitude. One has to assume that any substantial climatic shift generated in the North Atlantic will inevitably show its impact in the North Pacific. This makes the identification of any contribution by the Pacific Ocean to an observed climate shift not easier, but worth a try.

The criteria to evaluate the climatology of the North Pacific are numerous, with regard to the basin itself, in relation to immediate connected systems, or distant system. There is for example the question whether variations in the tropical Pacific and the North Pacific are interrelated? Some say no[10], others assume a remote link[11]. Therefore this investigation will not try to answer, but assume that some sort of interaction exist, whereby little knowledge exist about degree and time scale? The question here is whether human activities can be traced with regard to the climatic shift in the 1940s, because it is all about physic, and the dynamics in the ocean sphere, and naval force in the marine environment during the Second World War generated forcing potential. The forcing mechanism could have been an external force, or internal forces, but in the end it must have been a force that can be named and quantified in physical, or physic-dynamical terms. Efforts have been made, but not convincing[12]. While naval activities, like wind, have an impact the upper sea surface layer concerning the temperature and salinity structure, the vastness of the North Pacific in extension and volume, makes it hard to assume any relevance between WWII and the observed climate shift in the mid 1940s. But as long as the reason for the shift has not been evidently established, naval war activities need to be regarded as option, that should not be

[10] Latif, M. (2001) On the North Pacific Climate Variability, saying: the North Pacific decadal and multi-decadal variability on time scales from 10-50 years evolves independently of the variations in the tropical Pacific, so that this kind of variability must be regarded as internal to the North Pacific; at: http://www.mpimet.mpg.de/fileadmin/publikationen/Reports/max_scirep_318.pdf (visited 25 April 2010).
[11] Newman, M.; G.P. Compo, and M.A. Alexander (2003); "ENSO-Forced Variability of the Pacific Decadal Oscillation"; Journal of Climate, Vol. 16, No 23, p.3853-58 .
[12] See for example: Sarachik, E.S. and D.J. Vimont, (year??), "Decadal variability in the Pacific"; http://www.atmos.washington.edu/~dvimont/Papers/pdv/pdv.pdf

overseen. The question is about the impact human activities may have on climate, and that should be known as complete as possible pretty soon. For this reason this investigation restricts the scope on the so-called Pacific Decadal Oscillation (PDO).

PDO – Pacific Decadal Oscillation

With a paper on fishing in the North East Pacific in 1997 by Mantua et al.[13], the PDO concept emerged. The paper abstract reads:

> *Evidence gleaned from the instrumental record of climate data identifies a robust, recurring pattern of ocean-atmosphere climate variability centered over the mid-latitude Pacific basin. Over the past century, the amplitude of this climate pattern has varied irregularly at interannual-to-interdecadal time scales. There is evidence of reversals in the prevailing polarity of the oscillation occurring around 1925, 1947, and 1977; the last two reversals correspond with dramatic shifts in salmon production regimes in the North Pacific Ocean. This climate pattern also affects coastal sea and continental surface air temperatures, as well as stream flow in major west coast river systems, from Alaska to California.*

The PDO issue shows a change of sea surface temperatures (SST), by representing a pattern of SST anomalies in the North Pacific.
The matter is about warm or cool surface waters in the Northern Pacific, actually north of 20° N, respectively north of Hong Kong, Taiwan, and Hawaii, which does not match fully with the war activities in the West Pacific that includes the Philippines, the South China Sea, and other regions south of latitude 5° North.
During a "warm", or "positive", PDO phase, the west Pacific becomes cool and part of the eastern ocean warms; during a "cool" or "negative" phase, the opposite pattern occurs. With regard to the WWII situation, until 1939 the water off Japan's shores was colder, which was reversed by the end of the war, when the sea surface temperature in the Asia part became warmer, while on the American side the water cool significantly.
Until now no mechanism has been identified to explain the shifts. They are rare, and occurred over the last 300 years six times: 1750, 1905, 1946, 1977, 1998, and 2008[14]. Concerning the last century N. Mantua identifies two full PDO cycles: a cool PDO regimes from 1890-1924 and again from 1947-1976, while warm PDO regimes dominated from 1925-1946 and from 1977 through (at least) the mid-1990's[15], whereby the timing may vary with the researcher, e.g. saying that a warm phase lasted from 1925–42 that turned into a cold PDO cycle from 1943–76[16].

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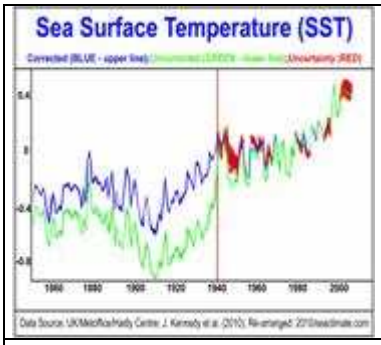
[13] Mantua, Nathan J.; Steven R. Hare, Yuan Zhang, John M. Wallace, and Robert C. Francis (1997); A Pacific interdecadal climate oscillation with impacts on salmon production , Bulletin of the American Meteorological Society"; Vol 78, pp. 1069-1079.

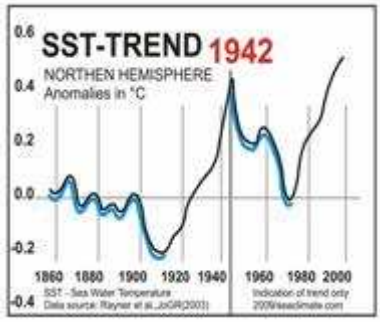
[14] Biondi, Franco; Alexander Gershunov, Daniel R. Cayan (2001); **"**North Pacific Decadal Climate Variability since 1661", Journal of Climate, vol. 14, issue 1, p. 5 .

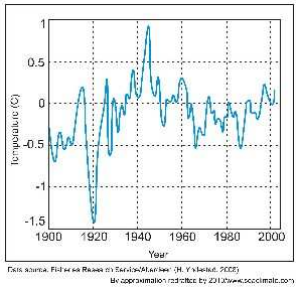
[15] Mantua, Nathan; 2000; "How Does The Pacific Decadal Oscillation Impact Our Climate?" at: http://www.guaranteedweather.com/content_page.aspx?content_id=56 (visited 24 April 2010)

[16] Zhang, Yuan; Wallace, J.M.; Battisti, D.S. (1996) "ENSO-like Interdecadal Variability: 1900-93", Journal of Climate, vol. 10, Issue 5, pp.1004-1020

The Timing of the Shift

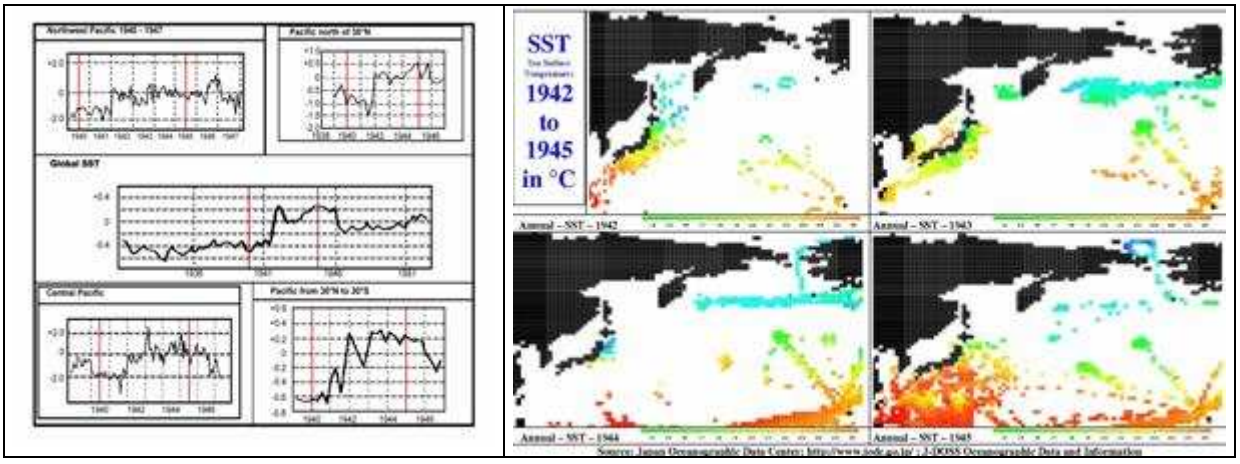




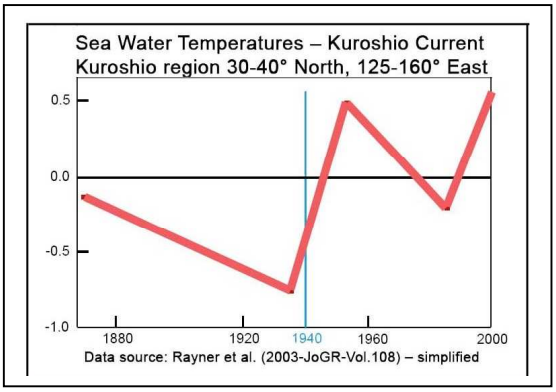


Although the sea surface temperature (SST) data taken during WWII can not be very much trusted, they need nevertheless to be assessed with regard to timing. Actually, if naval war would definitely have a proven impact in that way that it shows up in SST and SAT (surface air temperature), WWII should show up at slightly different time, first in the Europe/Atlantic (between 1940 and 1942), and in the North Pacific between 1942 and 1945. The set of three SST graphics indicate that the pre WWII warming continued until 1942, globally (left), Northern Hemisphere (mid), and NW of Scotland (right). Offering a corresponding image for the Pacific, for example as used for my paper in 1997 (Folder 926), is of little help, although they correspond partly with the other SST images. Meanwhile the Japan Oceanographic Data Center[17] runs an interesting portal that shows the area and number of samples taken (Folder 912), together with the indication of real data taken, that are here shown for the years 1942 – 1945 (from left to right). This image indicates that the available samples are rather few, but it should be also noted that the Aleutian range shows unusual dense sampling during 1942 and 1943, which can be immediately brought in connection with the intense naval activities since the Japanese invaded the Aleutian islands Attu and Kiska (1,900/1'200 km west of continental Alaska) in June 1942, lasting until August 1943. Could the shift from a warm to a cold phase have been set in motion here? In this respect this paper can only recommend to undertake more investigation in this respect.

Before ending this section I would like to present a graphic showing the SST developments of the Kuroshio Current. According this information a decline stopped before 1940 to turn into a



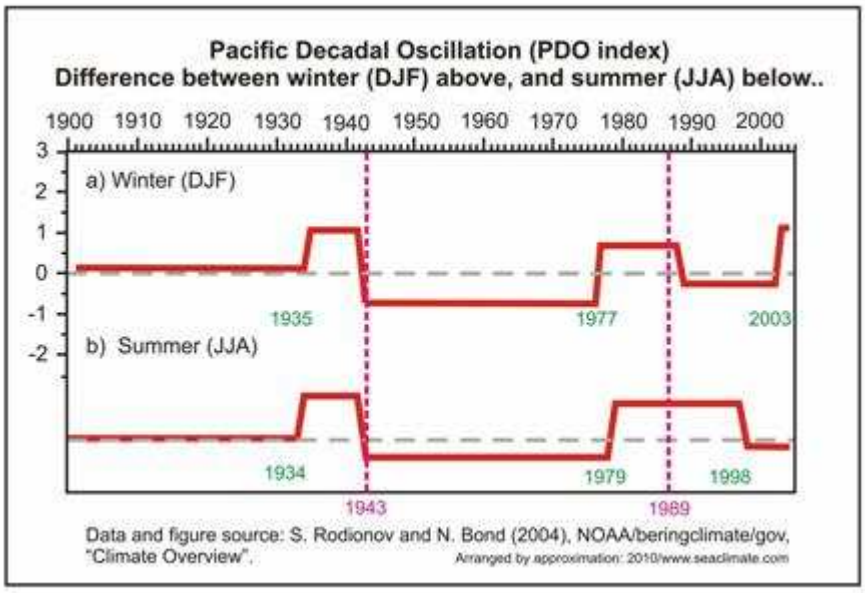
[17] http://www.jodc.go.jp/ ; J-DOSS Oceanographic Data and Information



warming trend until about the mid 1950s, which would be highly speculative for being interpreted here, but hopefully will be used to look for more material that could help to evaluate whether naval war has had an impact in the marine environment.

In collusion it must be admitted that the available material does not allow to say more about the timing of the shift that it occurred between 1940 and 1942.

Interpreting the PDO record.



The interpretation of the PDO record shall be based on material published by Rodionov and Bond (2004)[18]. The image shows two short positive periods (1934 to 1943) and (1977/79 to 1989/98), and three negative phases, according the core winter (DJF) and summer (JJA) months. It is easy to note that there are differences in the amplitude, and duration as follows:

__the first positive phase appeared in summer 1934 and briefly later in winter 1935.

__the second positive phase even indicate a longer delay (1977 to 1979) and a reversed timing, the winter earlier than the summer.

The most important information one can get from the graphic is the timing of decline in the year 1943, which not only shows that the level of decline is lower than to the other two time periods available, before 1934/35, and after 1989/98, but it is the only trend change that occurred in winter and summer alike and without any delay .

While both aspects could be important to determine any naval war impact, the simultaneous trend change is a clear indication that something 'extraordinary' must have happened, something that was not just a gradual change from one mode into another. A simultaneous change requires an 'unusual' force, e.g. a volcanic eruption, a sun-spot, or a tsunami, to show

[18] S. Rodionov, J. Overland, and N. Bond (2004), "Climate Overview – 2004"; http://www.beringclimate.noaa.gov/reports/np_04.htm

the same timely effect in timing without any delay. Is there no 'special situation' the marine environment is too dull to react unison in subsequent seasons. In so far one has to assume that usually there is some delay in time, if not, one has to look for an explanation, why the change in 1943 was different from the other shifts observed.

VI Discussion and Summary

The role of the Pacific Ocean in the only global cooling period since the last Little Ice Age from the early 1940s to the 1970s is little understood, although the occurrence of the decrease of the global air temperatures simultaneously with the spreading and intensification of naval war from Europe into the Atlantic, and in the Western Pacific until the defeat of Japan in August 1945 makes it difficult to understand why. The prevention of anthropogenic induced climatic changes is very much in demand, and even the smallest contribution by naval war activates during WWII should not be ignored.

In this respect it was neither the aim nor necessary to say much about beginning of the global cooling, but to demonstrate that over the short period of build up of naval strengths by the Allies and the closer naval war activities concentrated Western Pacific, closer and closer to Japan, a significant change in low air temperatures became evident. Only a half year before the war ended, Japan faced the coldest winter on record. The months remained colder than the average until the fighting ceased in August 1945. The prevailing circumstances indicate toward human activities in the regional sea space. The few available sea water temperature data support such assumption, which fully reflects to notion by Tokimasa Kobayashi et al. (1999) that: "There was a remarkable decline in sea surface temperature from 1939-1945 and the temperature rose again after 1946."

By showing that naval war activities presumably had had a very decisive impact on the temperature conditions in the Western Pacific over several months, it is no longer possible to deny outright that this did no have had any impact on the wider Northern Pacific Ocean and the trend as indicated in the Pacific Decadal Oscillation. The decline of the PDO at about 1943 has certainly not been caused alone by the naval war in the Pacific, Atlantic, or Europe, but it can neither be excluded that it contributed. Any ignorance in this respect is an unacceptable situation.