Dariusz DRZEWIECKI, PhD
Department of National Security Geostrategii and Geography Department
National Defense University Warsaw, Poland

METEOROLOGICAL ELEMENTS OF SELECTED HISTORICAL EVENTS BASED ON THE WEATHER MAP'S DIGITAL RECONSTRUCTION

Abstract

The article is an attempt to analyse the synoptic situation during the major campaigns of the twentieth century, based on the reconstruction of digital weather maps. The analysis presented allows us to determine the weight of the impact of weather conditions on military operations during World War II in the key moments. Thanks to the development of the scientific discipline that is meteorology and skillful use of information from the measured data, we can assess its importance in the making of key decisions in the arena of military action and its impact on the fate of exemplary campaigns.

Key words: meteorology, weather forecasting, strategy, campaign, invasion, information, maps, history

Introduction

Weather for centuries was a riddle for humanity. The variability of the parameters and, thus, the climate often contribute to expressions of the evolutionary history of our planet and, also, the development of the civilisation of our species.

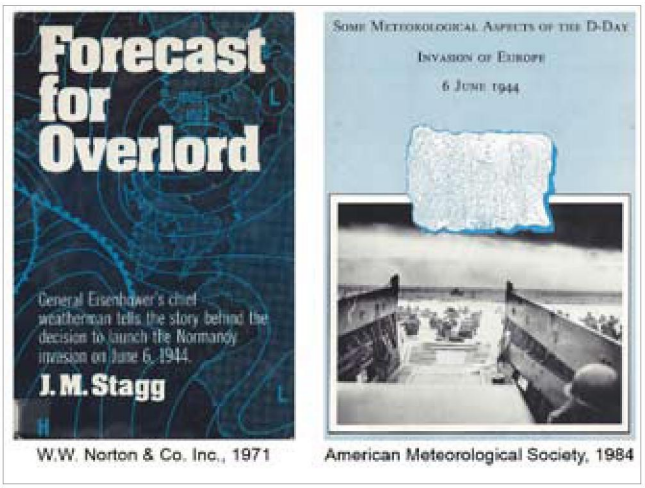
The ability to use its characteristic phenomena in local conditions is highlighted by great leaders because it often determined the outcome of the battle or the campaign. Technical capacity to communicate the results of its observation at a distance and insufficient knowledge of the characteristics of the mid-nineteenth century forced commanders to use intuition in this area, sometimes supported by experienced local observers. A strong army and a great tactical plan did not always guarantee success in battle, sometimes "luck decided her fate, most of which boiled down to the weather conditions existing in the area of operations. Of course, there were situations when this "happiness" helped, thus beating the theoretically stronger opponent.

The development of the same discipline as a self-study was used in the development of strategic plans for various types of activities of the armed forces in the second half of the nineteenth century, when technological advances (the use of the telegraph to send information) helped to create the new scientific discipline that is meteorology.

During the Second World War, the role of meteorological service was completely different. The campaign terms and major military operations were determined after a thorough analysis of synoptic maps. This was particularly important, especially for aviation, which during World War II played a first class role. Unfortunately, the work on the impact of meteorology on the outcome of the war was limited, and is an episode that has already constituted broader study.

Sources of data: an analysis methodology

We can find a number of publications by historians about the activities of the armed forces. Most often, they focus on statistical information relating to the parties to the conflict, the type of military equipment and tactical solutions used. Sometimes, for extra interest, there is information about weather conditions during the event. Unfortunately, there are no studies on the historical events based on analysis of synoptic maps. JM Development Stagg, 1971, and the one prepared by the US meteorological service in 1984 (fig. 1) for the invasion of Normandy in 1944,) are among the few exceptions.



W.W. Norton & Co. Inc., 1971 American Meteorological Society, 1984

Figure 1. Studies on Operation Overlord in the context of the synoptic situation

Fortunately, the development of computer technology and the ability to use the data grid and the results of measurements of meteorological parameters stored in archival data sets allow for the development of historical synoptic maps imposed on the map of Europe, but with the current political division.

Courtesy of the German meteorological service that provides the data files by placing them on a publicly available website, we can compare the reconstructed image synoptic maps from the early twentieth century, the calendar event. Of course, the analysis of this data is illustrative as to the overall synoptic situation, on the basis of which, with a certain probability, we can assess the presence of dangerous weather phenomena over the area of interest to us.

On land and sea

The rapid growth of interest in meteorology as a discipline was highlighted later by the development of maritime transport and aviation.

Intense storms on 14 November, 1854. a year which resulted in the sinking of many ships of the combined English – French fleet , acting against Russia during the Crimean War, initiated research on the process of the formation of dangerous weather phenomena. Research conducted by the French scientist, Urbain Leverrier (1811-1877), contributed to the establishment of the first weather information exchange network, through which were sent (using the telegraph) messages about possible dangerous weather phenomena. However, the technique transmitted information over a distance that the weather could surprise each of the parties to the conflict.

Going back to the proverbial "luck" contained in the introduction, we would cite episodes of the battles in which weather conditions greatly contributed to their outcome. Not dwelling on these too much, we will cite two of these which resulted in a period that amounted to a status quo in Europe. As for Poland, it is possible to cite an episode of the Battle of Grunwald (ger. Tannenberg - 1410), when procrastination by the Polish side contributed to the weakening of, the Teutonic army due to standing in the sun.

Polish troops remained in the shadow of the nearby forest and did not feel the heat of the day so acutely. The Grand Master sent emissaries with two swords who had to "mobilise" the Polish king to go out in the field. The battle took place on July 15 in the middle of summer, of course, and we can talk about happinesson this day because it was hot and had no rain, especially since July is the most abundant in rainfall month of the year. However, this Polish ruler used the weather successfully on that day, which was especially troublesome for the knights who were exposed to full sun for several hours and were baked in the heat.

From the point of view of today's Europe, the fate of the Spanish Armada should be borne in mind, in late August and early September 1588 when it set off to conquer England. Winning the campaign seemed to be a foregone conclusion, in particular because the British fleet was less numerous and consisted mainly of smaller and less well-armed "privateers", inferior in every respect to powerful Spanish galleons.

Destruction of the Spanish fleet and the largest naval operation in the history of the Kingdom of Spain was due to a sudden change of weather conditions, where the compact group of vessels under the command of the Duke of Medina-Sidonia was surprised by a strong storm lasting for 10 days. From 12 September 1588, as a result of rapid changes in weather, two thirds of the fleet crashed on the west coast of Scotland and Ireland and the remaining ships were pushed off course and barely reached the coast of Spain. The event is considered the beginning of the creation of one of the greatest empires in the history of our civilisation, namely the British Empire, and it happened during the reign of Elizabeth I.

In the air

During the First World War, with the development of aviation and its growing influence on the course of the war, the countries involved in the war, the development of science-related research processes in the atmosphere has been limited. One of the reasons was the disappearance of meteorological information exchange between the warring states and intentional introduction of erroneous data on weather phenomena of regional networks, to impede the enemy's actions in the air.

However, in the Nordic countries, not involved in the war, there was a dense network of meteorological stations during the same period. This enabled the creation of detailed maps of weather, on the basis of which the Norwegian scholar's chapters could be detected between the front air masses, and also involved the creation and development of cyclones with weather fronts. In the years 1918-1928, J. Bjerknes, H. Solberg, T. Bergeron (in Bergen - Norway), had developed a physical theory of fronts.

For the period between the rapid fall in the development of air transport, restrictions against Germany, restricting the development of military aviation, contributed to the rapid development of aviation traffic in the country.

Initially, the primary means of transport of passengers on longer routes were airships and seaplanes, means of communication especially sensitive to air storms and the phenomena accompanying them. During this period, German scientists (Kahler, Gockel, Arendt) dealt in a comprehensive manner with issues of

dangerous weather phenomena. They were the the first to develop spatial distribution of the number of days of storm and fog, as well as recognition of Tabular storms, fog and rain.

The emergence of the Third Reich and the new military action strategy (blitzkrieg), interaction with aviation mechanised forces, required a good knowledge of the weather conditions. Analysis of the occurrence of types of weather was undertaken for some months. A literal description of the forecast was provided in the "Directory der Grosswetterlagen "F.W. Gerstengarbe, P.C. Werner (1993).

From the point of view of a meteorologist, preparing forecasts for more than two days is associated with a rapid decrease in the probability of their verifiability and now use sophisticated mathematical models using the latest information technology, assisted by the radar system and satellites. Therefore, it seems unlikely that the Germans during the Second World War managed to draw testable predictions for longer periods. As for the weather over the bodies of water, it can still be explained by a cyclical occurrence of storms, depending on the season and knowledge on this subject passed through generations of sailors and fishermen. In contrast, over land, the course of meteorological phenomena are often influenced by local conditions, such as terrain, hydrological conditions and the type of plating area differentiating its albedo. Anyway, at the beginning of the twentieth century, changes in the weather did not have such a violent nature as they do now, which can be explained by the accuracy of the German forecasts, and from the point of view of the present state of knowledge of meteorology, we can talk about the great happiness of German forecasters. As it happens, luck ran with the campaign in the east, when the anticipated short and mild winter came very early, thus determining its course.

Mostly, the pressure system in a given residual area persisted much longer than it does now - analysis of synoptic maps drawn up on the basis of historical data tend to lead to such conclusions (analysis possible thanks to - what else – the courtesy of the German meteorological service). The biggest problem for aviation activities are fog, limited visibility or low cloud ceiling, which occurs during the cold, ice or restriction of visibility due to heavy snowfall. Often the occurrence of these phenomena are local factors and change, throughout the day, the physical parameters of the atmosphere and the land that determines the time of their formation and decay. An effective method has been developed for predicting these phenomena for more than one day and a regional meteorological office. Hence, the stringent requirements for airport meteorological communication and the continuous awareness of meteorology by aviation personnel.

Campaign in the west in 1940

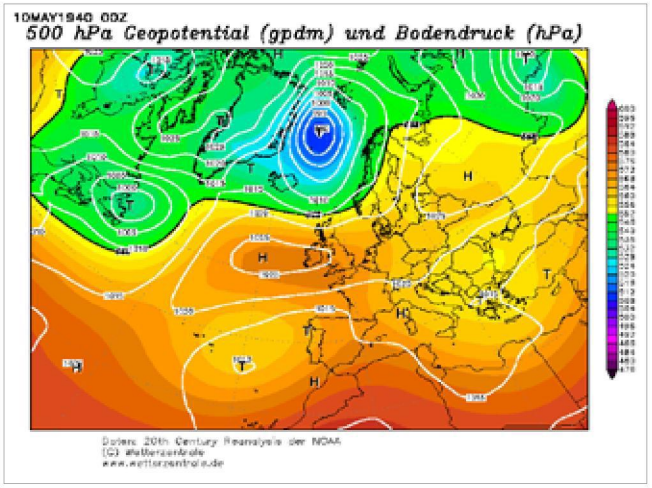
"On Sunday 12 November 1939 r., 15 minutes before sunrise, an attack on the West is about to begin" (Piekałkiewicz 2008). Hitler, after the campaign in Poland, wanted to use an element of surprise hitting on France through Belgium and the Netherlands, when the Allied forces in the British Expeditionary Force were not yet prepared to defend. The Allies had unique "luck" because in November 1939 there was intense and prolonged rainfall. Swollen rivers and vast flooded plains hindered rapid action against armoured troops. In these conditions, the effect of the air force was also limited due to persistent rain. After several subsequent dates planned for the attack, eventually the deadline was moved to the spring of 1940, when the weather conditions would be favourable. The allies gained a few months to develop a defensive strategy. Los (weather) seemed to favour France.

Five days of clear skies

Moving the date of the attack to the spring eliminated the element of surprise. Therefore, gen. Manstein, proposed a major hit to break the front section directed through the Ardennes (forested and a deserted hilly area, which, in the opinion of the French strategists,was insurmountable for military hardware). The simple and brilliant plan, despite the disapproval of the Land Force Command, gained immediate acceptance from Hitler.

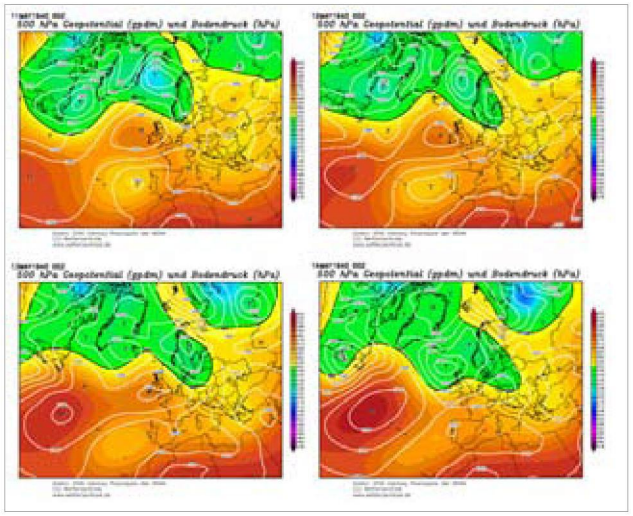
It's hard not to find similarities with the concept of John III Sobieski, King of Poland from the Vienna Victory (in 1683), where the main allied forces attack came from the wooded hills to the west of the city. A region from which the Turkish strategists had not

only ruled out the possibility of relief but itseemed impossible to achieve a starting position to attack this place with heavy cavalry and artillery. Who knows, maybe the idea of Manstein's was taken from the Vienna Victory, especially since his ancestors came from the Polish aristocratic family, Lewińskich. Maybe that's the case; however, the term for the campaign in the west this time was chosen very enthusiastically, for five days from 10 May , when the weather in the area of military operations stood dry and cloudless with a high pressure shaft extending through the the entire European continent with two centres of pressure - west of Ireland and over Russia (fig.2), allowing full use of the opportunities for close cooperation between armour and aviation.



Source: www.wetterzentrale.de.

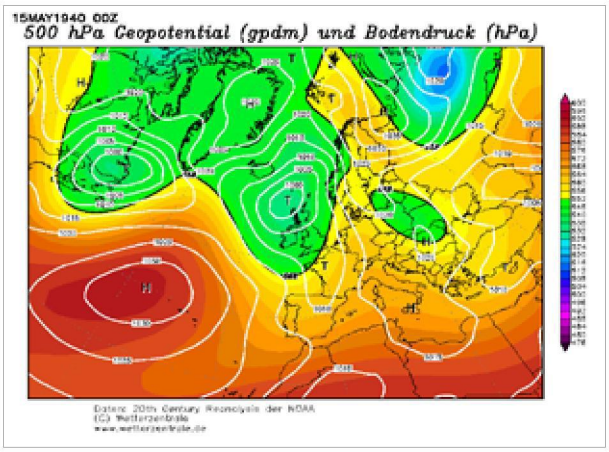
Figure 2. Mundane synoptic situation and the value of 500 hPa field on 10 May 1940



Source: www.wetterzentrale.de.

Figure 3. Mundane synoptic situation and the value of 500 hPa field from 11–14 May 1940y.

11 May 1940 marked the influence of the low-pressure over Scandinavia. However, its range only covered the central part of Europe. The area of Belgium and the Netherlands was still under the influence of a high pressure system (fig. 3).



Source: www.wetterzentrale.de.

Figure 4. Mundane synoptic situation and the value of the 500 hPa on 15th of May 1940

The synoptic situation in the area of Belgium and the Netherlands changed by May 15 (the fifth day of the campaign in the west), while over this area of the bay influences were the low-pressure centre north of Scotland (fig. 4).

On the fifth day of the campaign in the west

Memories of Churchill: „15 May, 1940 on., at half past eight in the morning, I was awakened by the news that Paul Reynaud (French politician, Prime Minister of the French Republic and the Minister of Foreign Affairs from March 21, 1940 the year) was on the phone: a camera was standing next to my bed . Reynaud spoke English and was clearly distressed : „We are defeated, we lost the battle" <. It was impossible for it to happen so quickly? But he said: „The Sedan front is broken; The German masses, the main armoured forces, are pouring through the breach."(Piekałkiewicz, 2008).

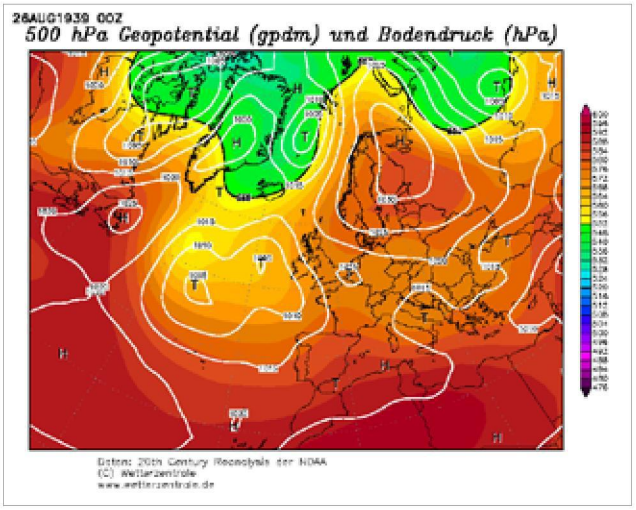
The next day, Churchill managed to prepare a plan for the evacuation of the British, and on the seventh day of the campaign in the west, May 17, Allied Supreme Commander of the Armed Forces, General Maurice Gamelin was dismissed. Before the crash, and the

biggest embarrassment in the history of the Allied forces, the British were saved by Hitler himself who ordered the speeding Armoured Group Kleist, which was aimed at the final break of the Allied forces, to rest. After several days of delay and confusion in the ranks of the Germans, which caused Hitler's decision, the demolition work was completed. Herman Goering and „his" Luftwaffe and well - again, incredible happiness for the Alliesas for three days German airplanes were grounded due to the presence of mist and the retention of low clouds.

The largest evacuation in history went ahead mainly due to favourable weather conditions and the decisions of Hitler. Nearly a quarter of a million British soldiers were transported back to the island. The September Campaign in Poland looked similar to the campaign in the west to commanders, but which to many western and Polish historians unfortunately did not leave a dry thread. Unfortunately, this also applies to the environment associated with Gen. Sikorski. On the fifth day of the September Campaign, the Army was still fighting but took a major hit from the German forces. And there remained four days to start the biggest battle in September on the Bzura river. Yet again, the weather, was extremely unfavourable for Poland and not only for five days, as in the West, but for the entire three weeks. It is highly probable that the campaign term was also selected in consultation with meteorological specialists, but each contains a pointer to forecast the probability of its verifiability. In this case, it amounted to 100%, which, given the rational analysis of the situation, is unlikely even today. Poland in September 1939 had unbelievable luck.

26 August, 1939 - the original date of the attack on Poland

The extensive system of high pressure extending over Europe, from Scandinavia to the western part of the Mediterranean, centred on the Kola Peninsula, the pressure at the value of 1034 hPa (fig. 5). The inflow of air masses from the north east (the morning in the summer season is not conducive to the formation of fog and cloud cover in the form of a low cloud sandwich).



Source: www.wetterzentrale.de.

Figure 5. Mundane synoptic situation and the value of 500 hPa field on 26 August 1939

1 September 1939 - the day of the attack on Poland by Nazi Germany

In still weather over Europe, a large high pressure system formed that in a few days had its centre of transformation over the area of the Second Republic. In the centre of pressure ok.1025 hPa., small pressure gradient windless weather is conducive to a clear sky (fig. 6).

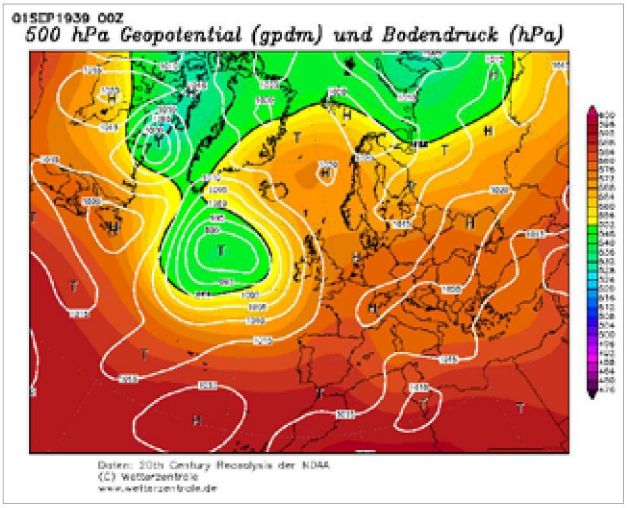


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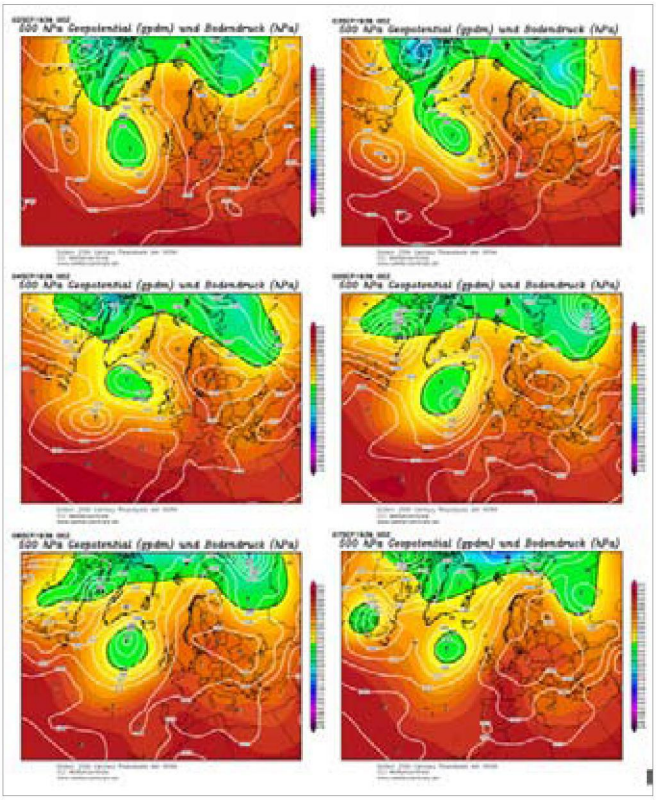
Figure 6. Mundane synoptic situation and the value of the 500 hPa on 1 September 1939y.



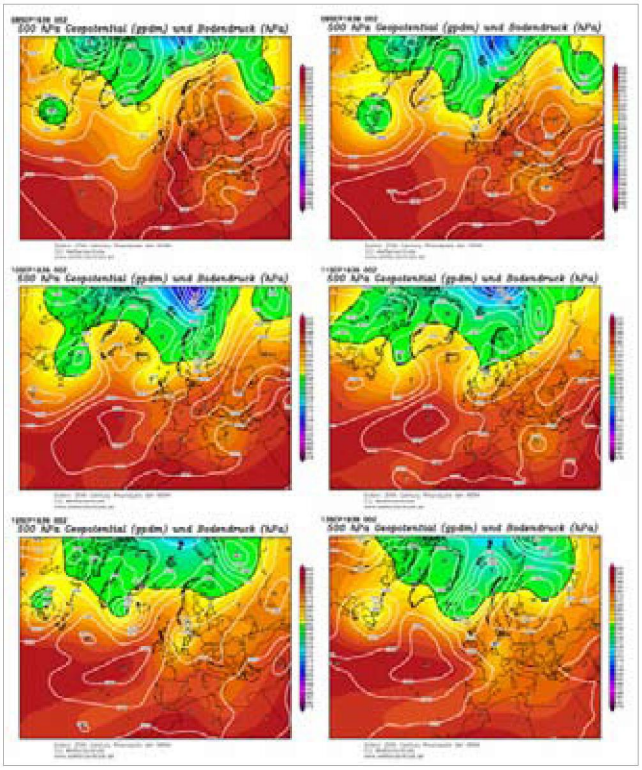
Source: www.wetterzentrale.de.

Figure 7. Mundane synoptic situation and the value of the 500 hPa held from 02–07 September 1939

The system of high pressure built back up by pressing a wedge from Scandinavia, from Poland up to southern Europe. Since September 05, in the centre of Poland, the pressure system favoured cloudless, almost windless sky (fig. 7).

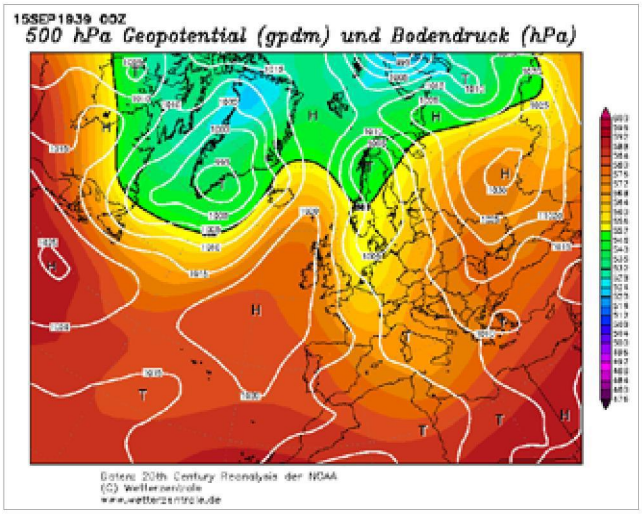
The large high pressure system had a slow transformation, but the first signs of change in meteorological conditions could be observed from 10 September. This was not related to the transformation of the total change in weight of the inflowing air. The Polish weather formed the same pattern, only on the 10th of September was there very likely to be convective cloud cover – and, rather, no precipitation (fig. 8).

From the west, the low-pressure system that separates the upland from over Russia and the Atlantic started tobuild on 15 September 1939.This was the first day of the three weeks that vast changes in weather conditions took place over Poland. Probably then, the system generated fronts and the north-west could expect clouds characteristic of the front zone and the first heavy rain (ryc.9). The exceptionally hot summer of 1939, low water level, and to mid-September an extensive high-pressure system, which generated a cloudless sky, allowed two weeks for the German army, aviation in particular, to use all of its capabilities. Germany may have been lucky and we had exceptional bad luck. Well, despite the obvious disparities in the distribution of forces due to the difference in the potential economic states of Germany and Poland, in favorable weather conditions, these disparities would not have been so clear. Advanced technology in bad weather often turns out to be unreliable. Unfortunately the weather did not favour us. The fight against two opponents (not including the Slovak army), the lack of promised aid from allies, offset against the initial term of general mobilisation of the Polish Army, which had been under pressure from western ambassadors, determined the fate of the September campaign. Despite everything, it should be considered that the resistance of the Polish army carried on for a very long time.



Source: www.wetterzentrale.de.

Figure 8. Mundane ynoptic situation and the value of the 500 hPa held from 08–13 September 1939



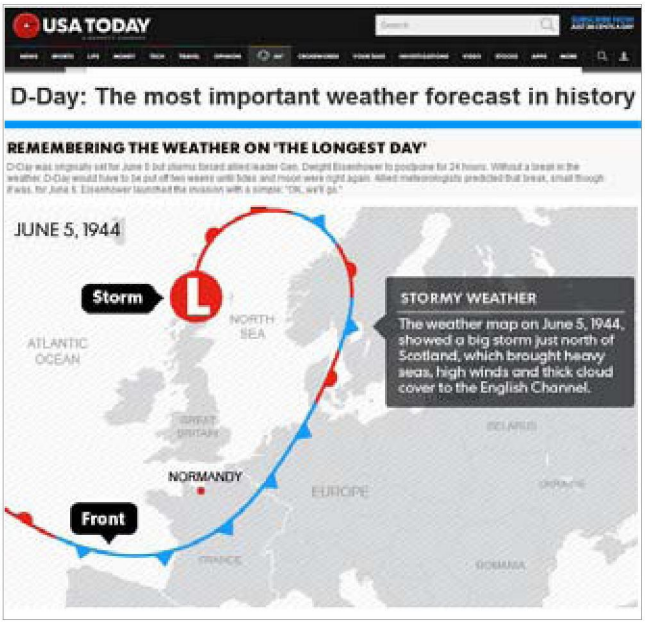
Source: www.wetterzentrale.de.

Figure 9. Mundane synoptic situation and the value of the 500 hPa geopotential on 15 September 1939

The creation of a second front in Normandy

(Forecast developed by the British meteorological service, under which General Eisenhower made a historic decision on the largest amphibious operation in history).

31 May 1944, equipment began to be loaded on ships. After half a year of preparation, murderous soldiers had to move into battle. The last moments weighed the fate of the entire operation. During the SHAEF (Supreme Headquarters Allied Expeditionary Force) meeting conducted on June 4, the weather forecast for the next day were very unsuitable. A heavy storm was anticipated. In such conditions, the barge transporting soldiers could have strayed from its course. A day later, the situation had changed and meteorologists argued with General Eisenhower that the ideal conditions for an attack would take place on the night of 5 to 6 June. The last meeting, at which the landing date was set for June 6, was the day before the invasion took place at 3.30. Part of the command was not convinced of the correctness of the decision. General Eisenhower decided to take a risk and decided not to postpone the date of the landing, and the day before the invasion was to say: „Here we go, and nothing can stop us."



Source: http://www.usatoday.com/story/weather.

Figure 10. Posted on the „USA Today" information site on the 70th anniversary of the Allied landing in Normandy as the most important in the history of weather forecasting

Source: http://www.ecmwf.int/en/research/projects.

Figure 11. A weather map with consecutive days of June 1944. Vector map on the left to the right of the wind speed in the overall synoptic situation

Today, it can be concluded that the Allies used a brief improvement in the weather (wind speed reduction) after passing a cold front zone, where on 6 June 1944, in the area of Normandy marked the edge of the baby boom residual impact on the central part of the Atlantic (ryc.11). The German forecasters had predicted

–that and this time luckily they left. An extensive network of measurement points located in the British Isles, Canada and the United States had contributed to the accuracy of weather forecasters compiled by the British, to which the German specialists had no access, especially since the meteorological data was secret information. In this case, the happiness advantage helped the professional use of information and knowledge of synoptic meteorology.

Conclusion

Decades have passed since these events and in the field of meteorology marked progress has been made that was unimaginable for earlier generations. Development of satellite meteorology, a dense network of radar, speed and continuity of the exchange of information twenty four hours a day on a global scale using the latest information technology can give the impression that at the beginning of the 21st century weather events should not be a surprise to us. Unfortunately, even the most perfect numerical models for diagnosis and prognosis of elements and weather phenomena will always be burdened with original errors resulting from the specific shape of the Earth's geoid itself. The roughness of the surface layer diversity of the planet, and dynamic processes occurring in the areas that affect the variability of physical and chemical parameters, force humanity to continuously improve research methods and deepen knowledge of earth sciences. It is difficult to imagine a sphere of our lives where weather information did not play a significant role. This is particularly true of military equipment, which must be reliable even in extreme conditions. Here, the weather can play a trick, as the „famous" American helicopters landing in a field of rape in a Polish village, when a thick fog made it impossible to continue the flight. Of course, one should quote the example of plane crashes, where weather conditions such as ice, a low ceiling of clouds and fog were the cause of the tragic events as they say or the recklessness of military pilots and the reluctance of many „soaring tricks" to deepen their knowledge in the field of meteorology, as some forecasters have. However, in Poland, even spectacular tragedies are dominated by politics, which unfortunately also dominates in the army. This section can be summarised by saying that we have great military meteorologists. At the beginning of the twenty-first century, we celebrated the 25th anniversary of the establishment of the Department of Meteorology at the Military University of Technology, the only one in Poland where educated masters of engineering are a rare specialty. Unfortunately, in the context of restructuring and seeking savings, this field of study has been liquidated. Bureaucrats undertake decisions for which meteorology and metrology is one specialty. You could find that out when officers from the Army directed postgraduate studies in the Department of Meteorology. The reality is that the professionals retire and the new is gone. Returning to the „happiness", the term flagship publication, even in a historical context, was supported by thorough knowledge and experience at the level of the era, and the misfortunes, that too often in recent years, Poland is haunted by, are obvious.

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