Great Historical Events That Were Significantly Affected by the Weather: Part 8, Germany’s War on the Soviet Union, 1941–45. I. Long-range Weather Forecasts for 1941–42 and Climatological Studies

Abstract

A brief account is given of Baur’s long-range weather forecast prepared in the autumn of 1941 for the 1941–42 winter in Eastern Europe. Baur’s forecast called for a ‘normal’ or mild winter but the winter turned out to be one of the most severe winters on record. The cold, the icy winds and blizzards greatly hit the German armies and coincided with the first major Soviet counteroffensive of the war. A Soviet weather forecast for January 1942, also called for a mild month.

A review of the climatological studies prepared for the war indicates that the occurrence of mud periods of considerable intensity in autumn was not considered. The autumn 1941 mud period immobilized most of the German armies for a month and caused the attempted final German assault on Moscow to take place in an early and severe winter.

Hitler would not tolerate the mention of winter and still less the mention of the retreat of Napoleon’s Grande Armée from Russia. The support given by Soviet meteorologists and hydrologists to the Red Army is sketched. For the 1941–42 winter the more-important short- to medium-range forecasts included a forecast for 7 November (anniversary of the October Revolution) at Moscow and a forecast for the start of Zhukov’s counteroffensive in the Battle of Moscow in December 1941.

1. Introduction

A study of the meteorological aspects of the war between Germany and the Soviet Union (USSR) for the autumn of 1941 and the winter of 1941–42 will be presented, using mostly unpublished information on long- and medium-range weather forecasts and German climatological studies that were prepared either for the attack on the USSR or in the course of the war proper. The information that the authors have on the German “side” is far more detailed than that we have for the Soviet side. And, although, as far as forecasts go, primary interest is in long- and medium-range predictions, mention will be made of a few short-range forecasts made by Soviet meteorologists for some particularly important events or operations. Special attention will be devoted to the severe 1941–42 winter and the “mud period” preceding it and will consider the effects of the 1941–42 autumn and winter on the fighting and on the troops.

2. Baur’s Forecast for the Winter 1941–42

During the 1930s the German meteorologist Franz Baur made a name for himself in the field of experiments on long-range weather forecasts. In addition to studies of the problem, he prepared forecasts for several days ahead, as well as monthly and seasonal forecasts; he coined the notion and term Grosswetterlage, often used by German meteorologists. At the time of outbreak of World War II (WW II), Baur and his institute were part of the Reichswetterdienst (The State Weather Service of the Third Reich). After the war’s outbreak, his institute was subordinated to the chief of the Weather Service of the German Air Force. In actual fact, Baur’s institute was not moved from its pre-war location at Bad Homburg, which was maintained throughout the War, in contrast to some other laboratories of the Reichswetterdienst.

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forecasting center of the German Air Force. Baur was requested by the headquarters (HQ) of the German Air Force to distribute his long-range forecasts to about 25 military offices. A forecast for winter 1941–42 was issued by him, probably at the end of October 1941, based on regional climatology and (supposed) sun-spot–climate relationships. The prediction called for a normal or a mild winter. Baur’s main justification for this rested with the assertion that never in climatic history did more than two severe winters occur in a row. Since both of the preceding two winters, 1939–40 and 1940–41, were severe in Europe, he did not expect that the forthcoming winter would also be severe.

Turning to the actual winter 1941–42, from 3 to 5 December, at a time when a Panzer division of the 4th Panzer Group of Colonel-General Hoepner was but 30 km north of Moscow, at a time when a Panzer division of the 4th Panzer Group of Colonel-General Hoepner was but 30 km north of Moscow, the advance elements of the division 25 km from the Soviet capital (see Hoepner’s letter in Bücheler, 1980, p. 159), a steep and large drop of temperature took place in western USSR (see Table 1 for the air temperatures at Moscow and Smolensk [morning temperatures only are available for Moscow in published form]). At Moscow, the morning, 07 LST, temperatures dropped about 28°C from 30 November to 7 December; 18°C from 3 to 5 December; at Smolensk the drop was nearly as large. The lowest value at the capital was reached on the 7th when it amounted to −29°C; the next day the temperature rose sharply to −15°C (Zhukov, 1984, p. 324).

For Smolensk, which at the time was the HQ of the German Army Group Center (the German Army Group most directly involved in the battle for the Soviet capital), the records of observations are held with the Deutscher Wetterdienst at Offenbach/M. As far as temperatures go, they include observations at three fixed hours of the day as well as maximum and minimum temperatures.

Looking through the charts of the Daily Series, Synoptic Weather Maps, Part I, Northern Hemisphere, Sea Level, prepared after the War by the United States Weather Bureau, for December 1941, it becomes clear that the temperatures reported for Moscow and Smolensk and listed in Table 1, were influenced by the well-known “heat-island” effects of cities. These effects are most prominent in the cold season and under statically stable conditions. We can therefore be sure that under inversion conditions and, generally, under stable conditions (inversions should be rather frequent over snow-covered land in northern USSR), air temperatures in the open fields, where most of the movements and fighting went on, must have been lower than indicated in Table 1.

### Table 1. Morning air temperatures (°C) at Moscow and Smolensk, 15 November–15 December 1941

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<th>1941 November</th>
<th>Moscow°</th>
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<td>15</td>
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Notes: a) The opening and closing dates of the table are dictated by what is available in published form for Moscow (Zhukov, 1984, p. 234). The published values are for 07 LST only. b) The data for Smolensk are for “Smolensk North” and they were recorded by the official German meteorological station. Copies of the original observation logs are kept by the Deutscher Wetterdienst, Offenbach/M. c) Temperatures in open areas near the two cities are likely to have been 3–5°C lower, especially in Moscow’s case.

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6 Marshal Zhukov, who, then a general of the army, was the commander-in-chief of what the Soviets called the “Western Front”. In fact, the Western Front was the Soviet Army Group directly involved in the Battle for Moscow.

Shkliarevich (1974, Fig. 1) has published the results of a comparison of air temperatures, measured along the Leningrad Television Tower inside the city, and at Voelkovo, at the rural or nearly rural site of the Main Geophysical Observatory of Leningrad. Unfortunately, the height of the lowest level of measurement is not clearly stated (10 m?), but the difference ΔTuv (urban minus rural) at this level between the two locations is 3°C in stable conditions (and about −1.5°C in neutral situations). A chart by Oke (1979, Fig. 13) shows the relationship between city-population size and the maximum urban–heat-island effect ΔTu−r (urban minus rural) at 8°C. Considering that the latter figure is a maximum and that Leningrad and Moscow almost certainly produced less heat in conditions of severe wartime scarcity of heating materials, we can assume that air temperatures in the open fields were perhaps 3°C–5°C lower than those shown in Table 1. Leningrad was under siege for about 800 days from late summer 1941 onward. In late autumn and winter 1941–42 the city suffered from starvation conditions. Not only were food and medicines short, but there was a great dearth of heating materials (see Pavlov, 1965). In the latter part of November Lake Ladoga froze over and then it was possible to send in supplies along what was called “winter road” or “ice road” or more affectionately, “road of life.” The total number of victims of the siege among the civilian population is given by some authors as up to one million. Pavlov (1965, p. 125) says that during the period of blockade, 632,000 people died of starvation alone.
Since the early 1950s, a very large body of literature has appeared in Western Germany on the war with the USSR. Some of these books are war diaries of army commands, as for instance, the war diaries of lipid army command (Kriegstagebuch des Oberkommandos der Wehrmacht, 1965), the war diary of Colonel-General Halder, chief-of-staff of the army until 1943 (Halder, 1964); others are diaries of army units; still others are histories of WW II, such as that of Lieutenant-General von Tippelskirch (1963); recollections of former high officers, as, for example, those of Guderian (1951), a famous Panzer general, and books that draw information from published and unpublished "histories" of army units, private diaries, and letters, such as books by Carell (1963) and others. Most of these quote temperatures measured by individuals (as distinct from official meteorological stations). Thus the Kriegstagebuch des Oberkommandos der Wehrmacht (1965), which almost daily gives a brief statement on the weather in the theaters of war in the East, reports for the area held by what was called Heeres-Gruppe Mitte (German Army Group Center [GAGC]), that is, the German Army Group most directly involved in the Battle for Moscow, a temperature down to −35°C on 5 December 1941; Halder (1964) cites a temperature report of −36°C on the same day for the Tula area (160-km south of Moscow), and a temperature of −38°C on the 6th, about the peak day of the cold outbreak, in the Tikhvin region (480-km NNW of Moscow, rather near Leningrad), see Halder (1964, pp. 327–328).

The cold outbreak of early December, coming after a cool-to-cold October and November (mean temperatures of Moscow: In October 2.1°C, in November −5.3°C; as against the 1931–60 CLINO values of, respectively, 4.5°C and −1.9°C) gravely hit the German armies that were not appropriately clothed (Hitler expected to break the resistance of the USSR before the coming of winter) and which were not equipped with armaments, tanks, and motorized vehicles that could properly function even in a "normal" winter in the northern parts of the USSR, let alone in a winter as rigorous as that of 1941–42.

On or about 8 December, K. Diesing, chief of the CWG and scientific adviser to the chief of the Weather Service of the Air Force (General Spang), asked Flohn to listen in on a second earphone to a telephone call to Baur. In the call, Diesing cited to Baur the reports of very low temperatures in the East and asked him if he maintains his seasonal forecast in face of the reports. Baur’s response was “the observations must be wrong.” This reply of Baur’s greatly impaired the esteem held for him by his colleagues.

Diesing passed away in June 1943, and in September Werner Schwerdtfeger was asked to take over Diesing’s position. Late in 1984, Schwerdtfeger prepared a paper of reminiscences of his service with the CWG in 1943–45. When he passed away unexpectedly in January 1985, his family and the University of Wisconsin Department of Meteorology asked H. Lettau to translate into English and edit the paper, which has been published in Weather (Schwerdtfeger, 1986). In his reminiscences the author writes that during the summer of 1942 the field HQ Hitler requested a forecast of temperatures in Eastern and Central Europe during the winter of 1942–43 and that, in turn, Diesing asked Baur to prepare the forecast. According to Schwerdtfeger, Baur’s long-range forecast was that the coming winter would not be cold, since the preceding three winters, and particularly two of the three were rather cold; a sequence of four cold winters in a row has never been seen in the 150-year-long series on hand. Schwerdtfeger adds that the winter of 1942–43 turned out much below normal and that the failure of the prediction and the suffering caused to the troops impaired the reputation of meteorologists in the eyes of many a military leader. Table 2 shows a comparison of the winter temperatures of 1942–43 derived by the authors.

3. German climatological reports on the Soviet Union, 1940 and 1941

At the time of Hitler’s Germany attack on the USSR (22 June 1941) very few current reports were available on the climate of the European territory of the USSR. They were issued by the Reichsamt für Wetterdienst (Air Force). One such study concerned itself with the soaking of the soil during the melting period. Although this was a careful study, it limited itself to the spring season whereas there also is such a 'mud period' in autumn. As a matter of fact, the first such mud period developed in autumn 1941. It was very intense and lamed military operations for about a month. Another investigation examined the beginning of snow cover, partly based on Russian publications that appeared prior to 1941. Both reports contain maps of the state of the soil and snow cover for 10-day periods; both studies suffer from the shortness of record.

Other official reports prepared in 1941 deal with cloudiness (especially low clouds), visibility and winds, average temperatures and precipitation, based on available sources. These reports were hastily collected and used recent synoptic data; the accompanying texts were short and apparently derived from textbooks. The sections on Russian winter emphasized the extreme stress due to strong winds even at moderately low temperatures and extreme stress due to bliz-

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7 In citing the temperature near Tikhvin, Halder notes: “Very great frost (minus 38), many frostbites.” Carell (1963, pp. 327–328) quotes from printed “histories” of some German Army units that were fighting in the battles for Moscow and Leningrad, temperatures of between −45°C and −50°C. Comments of these very low and questionable temperature reports will be set forth in chapter II of this study, which will deal with the weather of autumn 1941 and winter 1941–42. Particularly questionable is a report of −40°C in the Yakhroma area on 27 November. Stolfi (1980, p. 227) lists some of the low temperatures reported in the literature. See a graph of temperatures for December 1941 in the Battle for Moscow area. Prepared from histories of units, (Carell, 1985).

8 H. Flohn and O. Schuster remember (verbal communication from Schuster to Flohn) that in 1942 no long-range prediction was asked from Baur and that Schwerdtfeger, who was not with the CWG before September 1943, “projected” the forecast for winter 1941–42 to the following winter. Schuster was a member of the scientific staff of the CWG from its inception, Flohn from after late June 1941. The winter of 1942–43 was not very cold—as far as winters go in the USSR. It was certainly much milder than the winter 1941–42.

9 In highly rainy summers there can be a 'mud period' in summer too. The occurrence of such summer mud periods is much less frequent and when they occur, they are, generally, of a somewhat shorter duration.
4. Mud periods

In view of the lack of preparedness of the German High Command for mud periods (and the lack of adequate recognition of their incidence and frequent severity in autumn by German scientists), special attention is given to a report issued under the aegis of the Armed Forces Operations Department. Part of the report relates to the problem of ground trafficability. The report is mentioned not because of its scientific value and usefulness, but rather to illustrate the incorrectness of some of the studies made in preparation or connection of Germany's attack on the USSR. Whether correct or not, it is probably true that Hitler and his high command paid little attention to meteorological (and other) reports.

Few people are acquainted with the fact that even before the onset of the cold winter of 1941-42 in the areas of the Battle for Moscow (and Leningrad), a mud period immobilized the greater part of the Panzer, artillery, and mechanized units, in general, of the German Army for about four weeks; from about 10 October to 10 November 1941. The Red Army was less hampered by the mud for two reasons: The Soviet tanks had, in the main, wider tracks and larger bogie wheels than the German Panzers and their mechanized vehicles had a higher ground clearance; second, during the period of concern here, the Soviet forces were fighting a mostly defensive war where movement was not an overpowering factor.

At the time of WW II, there were very few paved roads in the USSR. Rains and low evaporation rates of the fall season played a minor role in the Crimean War in 1854. The effect of rasputizas played a more-or-less important role in earlier Russian history, such as in the campaign of Charles XII, a military king of Sweden at the beginning of the 18th century, the Pugachov rebellion later in the same century and in 1812, in Napoleon’s retreat from Russia; they also played a minor role in the Crimean War in 1854. The effect of the autumn 1941 mud period on the German Army fighting to reach Moscow will be discussed in chapter III of this study in some detail.

Because of the severe effects of the 1941 autumn rasputiza on the German Army, mention is made here of a report issued by an operations department of the German Army's
The 12-page report forms pages 115-126 of a document held under classmark RH2/v. 1326 at the (German) Federal Military Archive (Bundesarchiv-Militärarchiv) at Freiburg i. Br.
October. 'Typhoon' was the code name given to this operation. About a week after Typhoon's start, the operation got bogged down in the mud of an intense rasputiza for a month. The paralyzing effect of the mud period inevitably landed the continuation of the assault on Moscow into the winter.

Returning to the matter of approval of Operation Typhoon to begin on 2 October, it is worth pointing out the following: Hitler appears to have decided on the attack on the USSR in July 1940 (Greiner, 1951, pp. 116–117). Soon after taking the decision, he told his closest associates that he wanted the attack to start in autumn (1940). It was Field-Marshall Keitel, who was not yet completely subservient to Hitler at the time, and who succeeded then to convince him that the period of a few weeks remaining to the autumn is not sufficient for preparing such a vast campaign, and, further, that the Schlamm Periode of the autumn season and the upcoming winter would hamper operations in the USSR. There is no evidence that in summer 1941 when the operations against Moscow were approved to start early in October, Keitel would have pointed to the risk of a mud period and those of winters in the USSR. But in 1941, Keitel was totally obsequious to Hitler.

In referring to the autumn 1941 muddy season, Marshal Zhukov (1984, pp. 287–288) says the following: "Much has been said in postwar years about the complaints of Hitler's generals and bourgeois historians concerning the impassability of the Russian roads, the mud, Russia's frosts..." Then he goes on to describe how thousands upon thousands of Moscow women, who were completely unaccustomed to heavy digging, dug antitank ditches and trenches. However, he makes no mention on the effects of the quagmire on the Red Army. It is known from German Army observations that the Soviet forces also suffered from the muddy conditions, except that they suffered less, for, as was pointed out earlier, in October–November 1941 the Soviets were fighting a mainly defensive campaign and were less in need of a high degree of mobility; moreover, Soviet tanks and transports were better adapted to muddy terrain. Zhukov also says (p. 288) that "I may add for those who are inclined to use mud to camouflage the real reasons for their defeat at Moscow that in October 1941 the period of impassable roads was comparatively short. At the beginning of November the temperature fell; it snowed, and the terrain and roads became passable everywhere."

Not all will agree with Zhukov's statement that makes light of the autumn 1941 mud period. For instance, a US Army publication Effects of Climate on Combat in European Russia (1952, p. 31), authored by a committee of former German generals and general staff officers,10 has the following to say:

Large-scale operations are impossible during the muddy season. In the autumn of 1941, an entire German army was completely stopped by mud. The muddy season of that year began in mid-October and was more severe than any other muddy season experienced in World War I or World War II. During the first stages cart and dirt roads were impassable, and then the road from Roslavl' to Orel became mud-choked. Supply trucks broke through gravel-top roads and churned up traffic lanes until even courier service had to be carried out with tracked vehicles. Finally only horse-drawn vehicles could move; all other transport and the bulk of the tanks and artillery were stopped dead. The muddy season lasted a month.

5. A climatological study of the Central Weather Group (German)

After 25 June 1941 at the CWG, Flohn was requested to investigate the winter climate in the western USSR in a comparative manner. This study was based on the long series of temperature data for St. Petersburg–Leningrad since 1743, published by Wahlén (1881). In Wahlén's volume the mean daily temperatures of each month of the years 1743–1878 are printed on pages 15–17; the absolute minima of the individual months on pages 43–46; and the absolute extremes of each of the calendar days on pages 24–29. It was found that the sum of "degrees of frost" (Kältesumme in German, or sum of coldness) was a convenient tool for characterizing the severity of any given winter.

A diagram of the variation of coldness sums of severe and of mild winters was prepared, including the "famous" winter of 1812–13. The severity of the latter winter was surpassed by several other winters of the late 18th and 19th centuries, i.e. during one of the peaks of the "Little Ice Age," e.g. in 1808–09. Figure 1 has been drawn after a yellowish copy of one of the later versions of the diagram (during the relatively mild winter of 1942–43). A similar diagram—with cumulative graphs for other winters and the updated track of actual data measured at a mobile weather station 20-km southwest of Leningrad—had been demonstrated during the winter of 1941–42 to high-ranking officers and also to Hitler, see below. Flohn added the data for Potsdam, thus bringing out clearly the great differences in winter climate. Lacking better resources, such simple investigations formed the basis of CWG reports and forecasts.

Early in December 1941 the diagram was presented to Hitler. As was stated earlier, the diagram included the data for 1812–13. A witness whose name is not remembered, reported that Hitler, seeing the diagram, furiously exclaimed: "These damned meteorologists, also they are talking about Napoleon." Hitler would not tolerate the mention of winter 1812–13. Nevertheless, members of his staff frequently discussed it among themselves in the days of the December 1941 crisis. Major-General Warlimont (1962, p. 237), deputy chief of the Armed Forces Command Staff, who was with Hitler's HQ, writes that in the discussion among the staff, the book recording the conversations between Napoleon and General Caulaincourt (Napoleon's Ambassador to Tsar Alexander I until 1811), conducted during the 13-day long journey back

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10 The principal author is Colonel-General E. Raus who in the War of Germany against the USSR commanded successively a panzer division, a panzer army, and an army group of the German Army. The work is based on personal experience and memory and lacks the documentation required in a scientific paper. For instance, the statement that "the muddy season of autumn 1941 in the USSR was more severe than any other muddy season experienced in World War I and World War II" while it may be entirely correct, it is left undocumented.
The statement pointed out, additionally, that there is no comparison between Russian and German winters; even a "normal" Russian winter would be considered a very cold winter in Germany. (The temperature of winter, December through February, is around 0°C in Berlin, but −7°C to −10°C in Moscow.)

The text of the statement was approved by Diesing and it was presented to Göring, commander-in-chief of the German Air Force, in the presence of Colonel-General Jeschonnek, chief-of-staff of the Force, by O. Schuster, liaison officer of the CWG to the chief-of-staff. In Schuster's memory (verbal communication to Flohn), Göring's reaction was to bang his fist on the table and shout furiously: "In Russia it will never be colder than −15°C, the war goes on!".¹²

After the meeting Jeschonnek ordered Hitler's air force adjutant to report the statement to Hitler. It appears, however, that this was never done. As was pointed out in the previous section, the Russian winter was not to be mentioned in Hitler's presence. A kind of an exception is described in the next section.

7. Early December 1941 at the German High Command—Severe cold and a powerful Soviet counteroffensive

The first great and successful Soviet counteroffensive of the war in the Battle for Moscow, prepared and directed by Zhukov, opened on 5–6 December 1941. The counteroffensive, its ferocity and strength took the GAGC and the German High Command by surprise. The shock was all the greater that at the beginning of December some German Panzer units stood but 25–30 km from Moscow. The Soviets were effectively able to conceal the massing of their troops, tanks, equipment, and supplies for the offensive. Undoubtedly, the success of concealment was largely due to weather conditions that made it hard to carry out any aerial and other reconnaissance activities. Moreover, some three days before the start of the offensive the cold outbreak, to which reference was made in an earlier section of this paper, struck the German troops. They did not have appropriate winter clothing; many items of German weapons, tanks, and mechanized vehicles stopped functioning in the great cold. Even many of the German train engines malfunctioned below −15°C (see Appendix A).

The stunning success of the Red Army's offensive prompted Hitler and his staff to ascribe it to "a surprisingly early outbreak of a severe winter in the East" (Hitler's Instruction No. 39, dated 8 December 1941; reproduced in Hubatsch, 1962, p. 171). On 7 December, about a day after the launching of Zhukov's counteroffensive, O. Schuster, Diesing's deputy and liaison officer with the German High Command, was

¹² In a letter answering some questions raised by General Hossbach (1951 pp. 211–212), J. Kößler, chief meteorologist of the Army seems to refer to the above incident with Göring and says that presentation of the statement took place in September. The time point given by Kößler is not correct. It was the meridional circulations that were beginning to show as from late September, after they occurred frequently in summer 1941.
ordered to a conference with Hitler at his headquarters in East Prussia (Wolfschanze, near Rastenburg); also in attendance were Field-Marshal Keitel, chief-of-staff of the Armed Forces, Lieutenant-General Jodl, chief of the Armed Forces Command Staff (chief of Wehrmachtführungsstab), and other high-ranking officers. Subject of the meeting was the weather situation in the East. According to Schuster (personal communication to Flohn), during the coffee meeting following the conference, Hitler repeatedly said: “If I had known this before.”

Any repentance that Hitler may have had (or affected), it was short-lived. The next day he was elated (Domarus, 1965, p. 1792) at the news of the attack on Pearl Harbor, which resulted in the outbreak of open hostilities involving the United States. The same day he issued the above quoted Instruction No. 39; on the 11th he increased Germany’s fatal entanglement by declaring war on the United States. On the 16th the German High Command issued an order to the GAGC, which directs commanders and officers to see to it in person that the troops put up “fanatical resistance” and hold their present positions, without regard to the enemy’s possible breakthrough to their flank or rear (Kriegstagebuch des Oberkommandos der Wehrmacht, 1965, Document No. 110, p. 1084). Document No. 111, dated 21 December repeats the “stick-to-your-position” order; item 5 orders that prisoners and inhabitants (of the USSR) should be stripped of their clothing without any consideration (rückichtlos). Returning to the events of 8 December, German radio broadcasts of the day spoke of a natural catastrophe (viz. the “a surprisingly early outbreak of a severe winter”) striking the German forces. No word was said about the forceful Soviet counteroffensive.

8. A Soviet long-range weather forecast for January 1942

A review of some of the medium- and long-range weather forecasts made by Soviet meteorological (and hydrological) services in the war with Germany, as reported in Soviet literature, will be presented. A Soviet weather forecast for January 1942, a copy of which was accidentally found by German forces, will be discussed first.

The forecast predicted a “normal” January for the area of the Soviet Western Front, that is, for the Moscow Front, with a temperature departure of from 0°C to 1°C. We do not know what was the precise value of the normal adopted by the Soviet forecasters, but, if we take it that it was close to what was to become the 1931–60 CLINO for Moscow, viz. −10°C, and, if we compare this with the actual value of the mean of −20°C for January 1942 (see World Weather Records and the forthcoming chapter III of this study), then the forecast overestimated the actual mean by 10°C. That is, the Soviet forecasters erred in the same direction as Baur.14

Aside from the cold outbreaks in November and December (three major outbreaks in December) in the Western USSR, January 1942 turned out particularly cold, as indicated by the aforementioned mean value for Moscow. January was cold on the whole, but an extreme cold wave invaded during the last few days of the month. On 24 January an exceptionally cold pool of air (Kaltlufttropfen) was advected from the northeast to the general area of Kaliningrad (then Königsberg) and Riga. The diameter of the upper-tropospheric cold pool amounted to, roughly, 500 km, and, although the pool center was about 700 km to the west of the area of the Battle for Moscow, the latter was affected as well. This cold pool was so exceptional that it became a kind of a textbook example. Scherhag (1948, p. 233) refers to it as “one of the most memorable phenomena of this coldest winter of the last 200 years in northern and eastern Europe.” Indeed, the mean temperature of the 500/1000 hPa air layer of this area of Europe was 1°C–2°C colder than the mean for the winter of Yakutsk, the cold pole of Siberia (Flohn, 1944).

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13 The reference adopted by Hitler’s HQ for the cold wave of early December 1941 in the Western USSR was used to cover up its own failure in preparing for the contingency of winter warfare and to conceal the disastrous effects of the unexpectedly powerful Soviet counteroffensive; from 30 November to 7 December, morning temperatures at Moscow dropped 28°C: from −1°C to −29°C (Zhukov, 1984, p. 324).

14 The present authors wish to stress that the references to failures of the above mentioned long-range forecasts, both of Baur and that of the Soviet meteorologists involved, is not to be construed as an act of criticism. The truth is that not even in 1986, i.e. 45 years after the two long-range forecasts, are long-range forecasts very successful, especially not in cases of extreme anomalies as in 1941–42.

15 We shall point out in chapter III that in Northern Europe the winter of 1808–09 was even colder than winter of 1941–42. The stations whose data indicate this are Leningrad, Stockholm, and Uppsala and the comparison is based on the not totally unquestionable assumption that the methods of measurement of the early 19th century compare well with those of the current century. Returning to the data for January 1942, we do not have the daily values either for Moscow or Leningrad. German Army measurements indicate (Deutscher Wetterdienst, Offenbach/M) that at Riga, the minimum temperatures of the 24th and 25th were about −32°C, as against the mean monthly minimum of −18°C. In Kaliningrad the minimum temperature reached −34°C, at a nearby station even −39°C. Copies of the “official” meteorological logs of Riga are held with the Deutscher Wetterdienst at Offenbach/M.
9. Soviet reports on long- and medium-range forecasts in support of major military operations

Part of the May 1985 issue of the Soviet meteorological journal Meteorologiya i Gidrologiya is devoted to the 40th anniversary of termination of WW II in Europe. In an article titled “The USSR Center of Hydrometeorological Forecasting During the Period of the Great Patriotic War” (“Great Patriotic War” is the designation used by the Soviets for World War II as far as the USSR was involved in it). The author of the article, A. P. Zhidikov, states, on page 8 of his paper, that in addition to short-range forecasts, the Central Forecasting Institute regularly prepared forecasts for three days, for the “natural synoptic periods” (7–10 days), for monthly and for three-month periods. On page 9 of the same paper, the author writes that long-range forecasts were also made for the maximum flood elevation, monthly maxima and minima of water levels, dates of freezing, and breakup of ice cover of water bodies. Virtually no details are given and no mention is made of any cases where the forecasts failed though the state of the art of forecasting was, and still is, such that failures are likely to be incurred from time to time.

In the same issue, in a paper carrying the title “The Central Aerological Observatory During the Years of the Great Patriotic War,” S. S. Gaygerov, G. I. Golyshiev, and N. Z. Pinus describe a medium-range forecast prepared at a special demand for 7 November 1941, the 24th anniversary of the October Revolution. It was desired to hold a major military parade in Moscow, provided that a low-cloud cover develops that day over the capital. The low-cloud cover was needed to prevent the German Air Force from bombing the parade.

It might appear, perhaps, at first sight, that the forecast was not of military significance. It was militarily significant in so far, as the parade was to raise the morale of the people and the army. About mid-October, the German forces were but about 100 km from Moscow. This was a serious menace. At the order of the Central Committee of the Communist Party and the State Defense Committee (one of the highest organs of the wartime USSR), a partial evacuation of Moscow began on the night of 16 October (Zhukov, 1984, p. 286).

According to the authors, the predictions turned out correct. On pages 18–19 of their paper, Gaygerov, Golyshev, and Pinus state that soundings of the Central Aerological Observatory were of great importance in both the planning and implementation stages of the counteroffensive of the Soviets in the Battle for Moscow in December 1941. They point out that while the air was relatively warm at the beginning of the month (about —4°C) in the general area of Moscow, the aerological observations for 3–4 December showed a rapid cooling of the troposphere with the approach of a cold front. The forecast for 5–7 December, the start of the counteroffensive, called for a rapid drop in temperature and a decrease in cloudiness. Clearly, the forecast was of great operational importance because it suggested that the Soviet Air Force would be able to participate in the battle.

Appendix A. Lack of winter clothing and malfunctioning of equipment during the winter of 1941–42

Hitler was directly informed that winter clothing for the German troops in the Easy lay for weeks at the Warsaw Rail Station by Colonel-General Guderian at a meeting on 20 December 1941, (see Guderian, 1951, p. 242). Colonel-General Halder, chief-of-staff of the German Army at the time, states in his war diary (Halder, 1964, p. 286; [entry for 10 November 1941]).

18 Presumably, the temperature of —4°C cited by the authors is an early afternoon temperature, as confirmed by a reference to the Daily Series of Synoptic Weather Maps of the U.S. Weather Bureau, which are for about 1500 Moscow LST (12 UTC). Table 1 of the present paper indicates a temperature close to —8°C at a Moscow station at 07 LST. Temperatures are likely to have been lower in the open fields.

19 “Decrease in cloudiness”—this implies that the weather was cloudy beforehand. We have pointed out in section 7 that weather conditions of late November–early December made it difficult for the Germans to carry out reconnaissance flights. Thus, they remained unaware of the massing of troops, tanks, and other equipment by Zhukov for the counteroffensive.

20 Returning to the topic of rapid decreases and rapid increases of temperature, as, for example, at the beginning of December 1941, such marked changes occurred even before, though on smaller scale. In October and November 1941 some of these alterations involved increases in temperature above the freezing point, causing thaws and minor, short mud periods. These conditions led some German officers to write letters home (see, e.g., Paul, 1976) from the Battle for Moscow, likening the changes to a Wechselbad, that is, alternating cold and warm baths. Even in December 1941, on the 11th, temperatures of up to +8°C are shown west of Moscow behind a cold front, see the Daily Series of Synoptic Weather Maps, Part I of the U.S. Weather Bureau. The map for 5 December indicates temperatures between —19°C and —22°C. The maps are for the early afternoon hours of the Moscow time zone (about 15 LST).
ber 1941)) that the specific outfit will not be available to the troops before January in the case of the German Army Group South, and not before January’s end in the case of the GAGC. Actually, the troops of the latter were engaged in the Battle of Moscow, and they needed the winter clothing even more than those of the Army Group South, but the number of locomotives, lines, various train-station facilities as well as the number of engine drivers were not able to cope with the demand, especially in the case of the center. In November, even before the great cold outbreaks, the GAGC received 16 trains daily in the mean, as against the 31 required (Halder, 1964, p. 299, [entry for 19 November]). The situation worsened as November drew to its close, as in the cold many items of weapons, tanks, and mechanized vehicles stopped functioning in many instances. Even the German locomotives malfunctioned in the cold. A report of the GAGC to the Army High Command, dated 10 December, a week after the first major cold outbreak, states that at temperatures below −15°C the rail services could supply only 50 percent of the needs; on occasions of blizzards and snow flurries, the trains stopped altogether (quoted in Reinhardt, 1972, p. 216). The frost that was awaited by the German Army during the mud period, came in with a vengeance.

Hitler and his associates reckoned that Soviet resistance will be broken by the winter and that, therefore, there will be no need for winter clothing for the whole of the force engaged in the war during summer and autumn in the USSR. After the onset of the cold, the German population was urgently requested to collect furs, coats, warm underwear, and socks; the soldiers had to use newspaper under their uniforms for thermal insulation.

Zhukov (1985, p. 41) remarks that . . . it is true that Nazi soldiers wrapped themselves up in clothing seized from the population and walked about shod in unsightly home-made ‘galoshes’. Warm clothing and uniforms are also a weapon. [Authors’ italics.] But the Nazi Army was not prepared for the winter.

Despite the profound truth in Zhukov’s maxim that “warm clothing and uniforms are also a weapon,” the Soviet army was not adequately prepared for the winter either, especially in the early part of winter 1941–42. Marshal, Golikov (1984, p. 314), commander-in-chief of an army formation in the Battle of Moscow, writes the following:

In mid-November (1941), the commander of the 323 Division sent me the following message: ‘In connection with the onset of heavy frosts, I request your permission to postpone the Division’s drill for a few days, in view of the fact that the men are in summer uniforms, garrison caps and without gloves. During the November 12 drills the Division had incidents of first degree freezing of the extremities.’

Pages 315–316 refer to shortages of food, arms, and equipment. He returns to the subject of lack of winter clothing and writes as follows:

We were greatly worried by the lack of winter uniforms. The 323rd, 325th, and 328th divisions had no padded jackets and trousers, warm foot-cloths, caps with earmuffs, or gloves, until mid-November. The 322nd and 330th Rifle Divisions had only 30–50 percent of their quota of warm clothing. The lack of overcoats and underwear was especially bad in the 324th Rifle Division.

At the time the Soviet troops most properly dressed for the winter (and envied by the Germans) were those of the divisions brought over in October and November 1941 from Eastern Siberia, after Stalin was ready to give credence to messages of his outstanding spy in Tokyo, Japan, Richard Sorge, and other sources of intelligence that Japan prepares to go against the United States and not against the USSR.

In August 1942 the German High Command brought out a kind of a handbook Taschenbuch für den Winterkrieg in which a great number of suggestions were put forth on how to cope with winter conditions using the simplest local resources. This handbook was translated and published under the name German Winter Warfare (1943) by the Military Intelligence Division of the US War Department.

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