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OSCILLATIONS AND CYCLES OF AIR TEMPERATURE IN THE UNITED STATES

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Abstract. The work is trying to demonstrate that in the United States there are the same cycles of air temperature (almost perfect) discovered and presented in Romania and in New Zeeland (Chatham Islands). The great extension in latitude and longitude of the United States records to these oscillations and cycles of air temperature their own characteristics. The lack of some important ranges of mountains situated in a longitudinal way permits the fast and intensive advection of polar, arctic and tropical air masses.Also the lack of some important mountain ranges arranged longitudinally allows the rapid and intense advection of the polar and arctic air masses and also of those with tropical origin. As a result, higher amplitudes of air temperature appear.

Introduction

The cycles of daily maximum and minimum temperature discovered in Romania and New Zeeland and described in previous works, have been explained by the atmospheric tidal cycles caused by the Moon and Sun attraction. The same causes underlie the explications and the demonstrations for the cycles of air temperature in the United States. Also the explications are more consistent in the USA area through the Rossby wave propagation, taking into consideration its longitudinal expansion. In some situations can be noticed a phase shift between the characteristics of the thermal oscillations from the west side of the USA and those from the central and eastern areas located on the same latitude. In addition, the characteristics of the thermal oscillations can be found on the European territory, but with a larger phase shift. On the USA territory there are cycles of daily maximum and minimum temperature lasting less than one year, but also cycles lasting more than one year. For the description of these different cycles were chosen points with subarctic climate (Nome), temperate climate (Minneapolis) and subtropical climate (Memphis).

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Cycles of air temperature lasting less then a year

All cycles of daily maximum and minimum temperature lasting less than a year which were discovered in Romania and New Zeeland also appear on the territory of the USA. The most important are:

The 14-day cycle. This cycle appears to a large extend due to the almost 14-day period (13.66 days, half of the tropical period of the Moon, which is 27.32 days) in the evolution of the Moon, the celestial body which causes the tides of the atmosphere for the same period of time. This cycle appears anywhere on the territory of the USA. Fig. 1 shows graphics of the cycles of daily maximum and minimum temperature, which were recorded at the meteorological stations in Nome (Alaska), Minneapolis (Minnesota) and Memphis (Tennessee) lasting 14 days.

From the analysis of these graphics, one can observe that the warm and cold advections reappear after approximately 14 days, no matter which meteorological station is referred to.

The six- month cycle (approximately 183 days). In fact, this cycle is due to the six-month period (half of the tropical year, which lasts 365.24 days), in the evolution of the Sun, the celestial body that causes the atmospheric tides for the same period of time.

Fig.2 presents graphics which show the evolution of the daily maximum and minimum temperatures at the three meteorological stations. It can be noticed that the main warm and cold advections can be recorded after a 6-month interval.

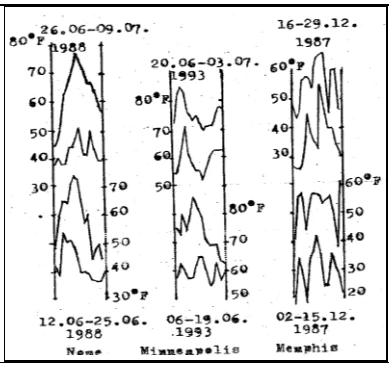

Fig.1 – The 14-day cycles of air temperature in the United States

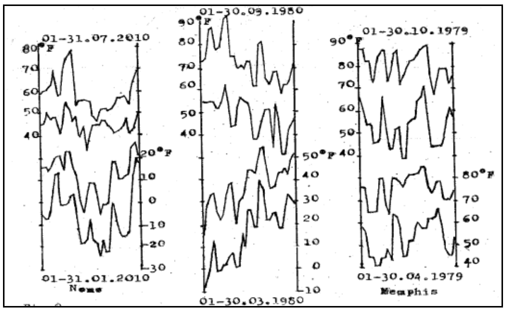

Fig. 2 - The six-month cycles of air temperature in the United States

In the graphic which shows the evolution of the daily maximum and minimum temperatures from Minneapolis it can be noticed that the warm and cold advections reappear after approximately 6 months (March 1980 - September 1980), even if the general tendency of the air temperature is to grow (March 1980) or to diminish (September 1980).

All these are explained by the fact that, no matter how is the sign of declination of the Moon and the Sun (+in the North; - in the South hemisphere), at the same absolute values of the declination, the atmospheric tides occur identically. Thus the tropical period of the Moon (27. 32 days) and the tropical year of the Sun (365. 24 days) can be halved.

1.3. The 246-day cycle (approximately eight months)

The appearance of this cycle can be explained through the fact that in 246 days (approximately eight months) can occur nine tropical periods of the Moon (27.32 days), according to the calculations: 246:37.32=9.00. This cycle is produced everywhere on the surface of Terra. Figure 3 presents the 246-day cycles of daily maximum and minimum temperatures at the three representative meteorological stations in the United States.

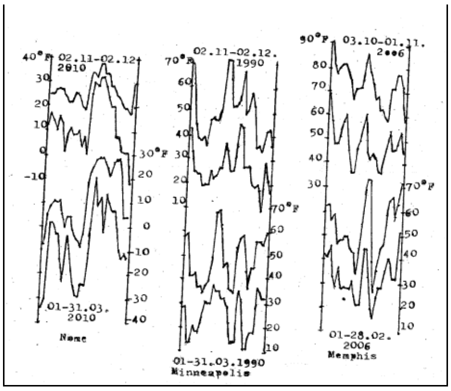

Fig. 3 – The 246-day cycles of daily maximum and minimum temperatures in the United States.

In the United Stated there are also other cycles of daily maximum and minimum temperatures lasting less than a year discovered in Romania and in New Zealand. These have the period of 28; 55; 82; 110; 137; 164; 192; 220; 274; 301; 328 and 355 days. All these cycles represent multiples of the Moon's tropical period (27.32 days).

2. The cycles of air temperatures lasting more than a year

These cycles of daily maximum and minimum temperatures lasting more than a year are clearer, because they represent not only multiples of the Moon's tropical period (27.32 days), but they are also cycles for the other Moon's periods (the anomalistic period = 27.55 days and the synodic period = 29.53 days). These cycles are at the same time cycles of the atmospheric tides. Of these, the cycles of 11 years, 18 years and 11 days (Saros's Cycle) and the cycle of 19 years (Meton's Cycle) are more important.

2.1 The 11-year cycle

As it is known, there are many cycles in the Sun's activity, of which the most important is the 11-year cycle (4017.64 days). This cycle is, at the same time, a tidal and month-solar one, because this period is also a multiple for the Moon's tropical and synodic periods, according to the calculations: 4017.64: 27.32 = 147.0 and 4017.64: 29.53 = 136.0. This tidal and month - solar cycle is one cycle of the daily maximum and minimum temperatures too. Figure 4 presents graphics with cycles of the daily maximum and minimum temperatures recorded in the United States with the 11-year period.

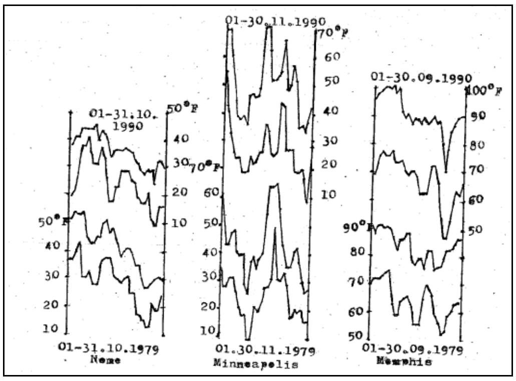

Fig.4 – The11-year cycles of daily maximum and minimum temperatures in the United States.

From the analysis of these graphs it can be concluded that the main hot and cold advections are repeated after an 11 -year period regardless of the region to which we refer.

2.2. The cycle of 18 years and 11 days (about 6585 days)

This cycle is known in astronomy as the cycle of Saros. After a period of 6585 days, eclipses of the Sun and Moon are again almost identical. It is a monthly cycle, since it does not have a whole number of years. At the same time, this cycle is a tidal one, whereas during this period of time 241 tropical revolutions, 239 anomalistic revolutions and 233 (periodical) synodic revolutions of the Moon occur, according to the calculations: 6585:27.32 = 241, 0; 6585:27.55 = 239.0 and 6585: 29.53 = 223.0.

Through Rossby waves, this cycle is also reflected in the evolution of daily maximum and minimum temperatures, causing a cycle with the same duration.

Figure 5 presents Saros Cycle in the evolution of daily maximum and minimum temperatures in the United States.

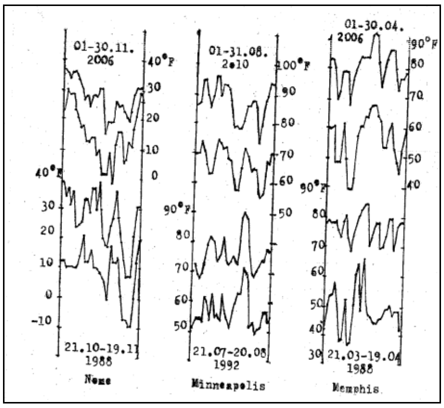

Fig.5 – The Saros Cycle in the evolution of daily maximum and minimum temperatures in the United States

We find this cycle everywhere on Earth, but especially in temperate areas, where Rossby waves (planetary) fully occur.

2.3 The 19-year cycles (about 6940 days)

This cycle is known in Astronomy as cycle of Meton, which was found in the Ancient Period. After completion of this period of time, phases of the Moon are repeated identically. This cycle is a month-solar one, because it includes a whole number of years, but also a whole number of tropic and synodic revolutions of the Moon, according to calculations 6940: 27.32 =254.0; 6940: 29.53 = 235. 0. Being a tidal cycle too, this is reflected in the evolution of daily maximum and minimum temperatures.

For the first time, this meteorological cycle was discovered in Romania, after that it was also demonstrated in New Zeeland. In the United States it has the highest frequency, especially in the temperate climate regions.

Fig.6 presents Meton cycle in the evolution of daily maximum and minimum temperatures at the three representative meteorological stations in the USA.

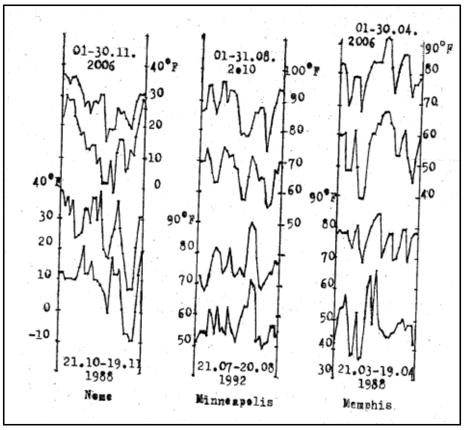

Fig.6 – Meton Cycle in the evolution of daily maximum and minimum temperatures in the United States

From the analysis of the graphics in figure 6, similar to the other cycles described earlier, it can be noticed that the main warm and cold advections reappear after a period of 19 years. Also can be noticed some similarities (less clear) between meteorological stations from Minneapolis and Memphis, although there is a large distance between them. These similarities might occur because the graphics from the two meteorological stations describe the same months (July 1988 and 2007).

From the above mentioned results that the problem of the temperature cycles is a complex one, especially for those with a period of more than one year, because more of these have connections between each other. So the difference between the 19- year cycle and the 11- year one is of 8 years, which is, actually, a cycle too. So, 6940 (the 19-year cycle) – 4018 (the 11-year cycle) = 2922 days (the eight-year cycle). This cycle is a month-solar one, because it has a whole number of years and a whole number of tropical and synodic revolutions of the Moon, according to the following calculations: 2922: 27.32 days = 107; 2922: 29.53 days = 99.

With this, the eighth -year cycle (2922 days) is, at the same time, a tidal cycle. With the help of the Rossby waves, this also influences the evolution of daily maximum and minimum temperatures.

In the United States, this cycle appears in all regions, regardless of their climate conditions.

The graphs in figure 7 shows the evolution of daily maximal and minimal temperatures in the air in an eight -year cycle, in the United States.

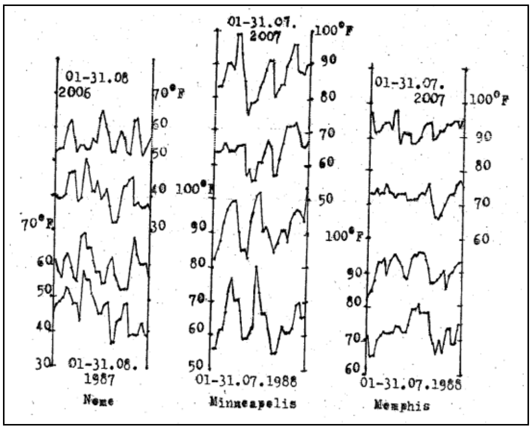

Fig.7 – The eight-year cycle in the evolution of daily maximum and minimum temperatures in the air in the United States

This cycle was discovered and demonstrated for the first time on Romanian territory, but it can also be found in other European regions, regardless of their climate conditions. In all situations, the main hot and cold advections are repeated after an eight-year time, as it can be observed in the graphs in figure 7.

If, we take difference between the Meton cycle (19 years) and the Saros cycle (18 years + 11 days), we get a cycle of 355 days, which is part of the one-year length category.

Calculations show that 6940 days (Meton cycle) -6585 (Saros cycle) = 355. This cycle is a lunar one, because, during this time, approximately 13 tropical and 12 synodical revolutions of the Moon are produced, based on these calculations: 355: 27.32 = 12.994 and 355: 29.53 = 12.021

In this instance, this cycle is also a tidal one. Just like in the case of other cycles, through the (planetary) Rossby waves, this cycle is also reflected in the evolution of daily maximal and minimal temperatures in air.

The existence of this cycle was proved for the first time in Romania, but it appears on the surface of the Earth, regardless of the type of the climate.

On the territory of the USA, this cycle appears in all regions, beginning with Alaska and ending with Florida. The graphics from figure 8 outline definitely the existence of this cycle in the evolution of daily maximum and minimum temperatures in air, on the territory of the USA.

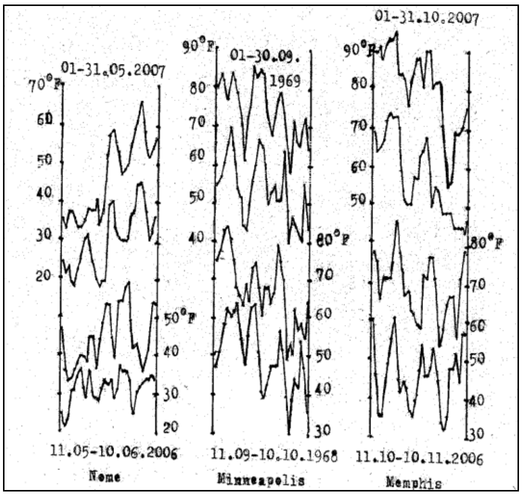

Fig.8 – The 355-day cycle in the evolution of daily maximum and minimum temperatures in the air in the United States

In the following, we will analyze the problem of the similarities between the evolution of the maximum and minimum temperatures from the territory of the USA and from the territory of Europe. We will describe only the similarities that appear around the latitude of 45° North, so in full temperate zone.

For understanding the phenomenon more correctly, were taken for comparison the evolution of the daily maximum and minimum temperatures in the air from the meteorological station from Minneapolis (USA) and the meteorological stations from Europe, situated approximately at the same latitude (45 degrees North).

These similarities in the evolution of daily maximum and minimum temperatures between Minneapolis and other meteorological stations from Europe are noticed during all seasons. All similarities are produced at a time difference between 10 and 14 days, if we take into consideration localities from the territory/ of Romania. The time difference decreases at the same time moving through West from the territory of Romania.

The graphics from figure 9A describe the evolution of the daily maximum and minimum temperatures from Minneapolis (USA) on the 1^{st} to 30^{th} of April 2006, in comparison with the 9^{th} of April - 8^{th} of May 2006 from Milano (Italy) and the 11^{th} of April and the 10^{th} of May 2006 from Braila (Romania). The time difference between Minneapolis and Milano is of eight days. This difference reaches ten days if we count between Minneapolis and Braila. All the three localities are situated around the 45th parallel.

The graphics from figure 9B show the evolution of daily maximum and minimum temperatures from Minneapolis from the period 21.09 - 20.11.1993 in comparison with the period 01.10-30.11 (October-November) 1993 from Galati (Romania). In both situations from figure 9 (A and B) it can be noticed that the main warm and cold advections are produced at a difference in time of ten days for the localities from Romania and only eight days for Milano (Italia) comparative with Minneapolis (the SUA).

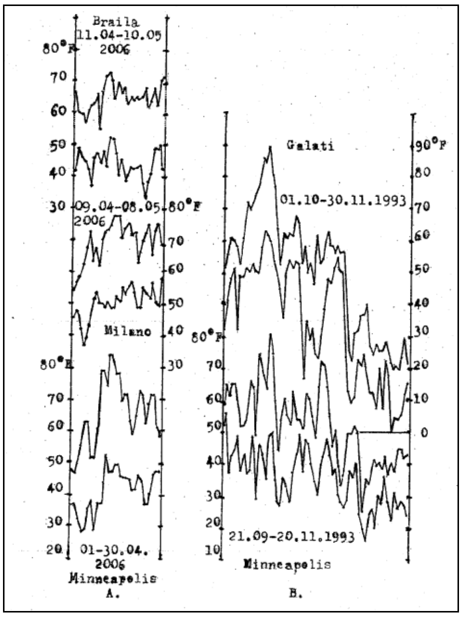

Fig.9 – t The similarities in the evolution of daily maximum and minimum temperatures between Minneapolis, Milano and Braila (A); between Minneapolis and Galati (B)

In other situations, similarities in the evolution of daily maxim and minimum temperatures between Minneapolis and the localities from Romania are produced at a difference in the time of 13 and 14 days.

The graphs in figure 10 (A and B) show this time difference between Minneapolis (the SUA) and the localities from Romania (Viziru, Bucharest, Iasi and Braila).

From the analysis of the graphs in figure 10 it is found that the similarities in the evolution of temperatures are clearer for the localities from Romania situated around the 45° North latitude. For example, the similarities with Minneapolis are more obvious at Viziru and Galati, situated near the 45 degrees North parallel (as Minneapolis). For Bucharest Baneasa and Iasi, situated at other latitudes, the similarities have a lower clarity.

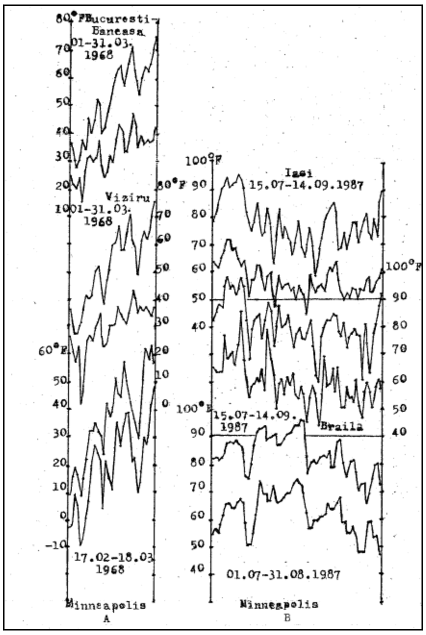

Fig.10 – The similarities in the evolution of daily maximum and minimum temperatures between Minneapolis (the USA) and localities in Romania

These similarities with Minneapolis can be also observed for the localities situated more to the east from the Romanian territory, but at the same latitude. The graphs in figure 11 present the obvious similarities between Minneapolis, Galati and Krasnodar (Russia).

The graphs in figures 9, 10 and 11 show the similarities of the evolution of daily maximum and minimum temperatures from the air between Minneapolis and more localities from Europe situated around the 45° North latitude. The same graphs show the time differences of these similarities, which are between 8 and 14 days, depending on the longitudinal distance between Minneapolis and these localities.

For explaining these time similarities and differences we have to take into consideration some characteristics of Rossby (or planetary) wave propagation.

As we know Rossby waves have wavelength (λ) of 2000 and 6000 km and characterize the atmosphere dynamic from temperate areas of the Earth , especially from Northern hemisphere.

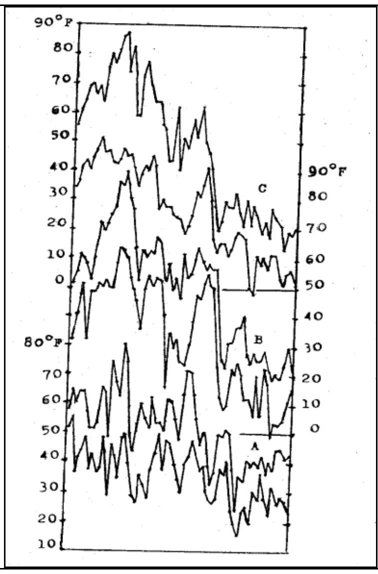

Fig.11

The similarities in the evolution of daily maximum and minimum temperatures from the air between Minneapolis (USA) = A; Galati (Romania) = B and Krasnodar (Russia) = C. Periods: Minneapolis = 21.09- 20.11.1993; Galati = 01.10-30.11.1993; Krasnodar = 03. 10- 02.12. 1993.

Relative to the environment (atmosphere in this case) these waves always propagate in a negative direction of the axis “x”, such as from east to west.Their propagation speed is reduced, but it grows as the wavelength (λ) grows. As the atmosphere in the temperate areas of the Earth has much faster speeds from west to east, Rossby waves will also propagate from west to east, depending on the surface of the continents and oceans. When the wavelength of Rossby waves is 5,400 km, these are static regarding the terrestrial surface. This means that the propagation speed from east to west of Rossby waves with λ = 5400 km is equal to the moving speed of the atmosphere from west to east (vice-versa).

For the northern hemisphere, a Rossby wave has a maximum barometric situated on the North and a minimum barometric located on the South. The evolution of daily maximum and minimum temperatures from the air and the meteorological phenomena is determined by how the atmospheric circulation occurs in the anticyclone and the cyclone of Rossby wave. The weather patterns generated by the baric and thermal features of Rossby wave propagate once with this, especially from west to east.

For the same locality from Romania, for example, Braila, located at 45°12’ North latitude, differences can appear during the time between 10 days (figure 9A) and 14 days (figure 10B). This phenomenon is explained clearly by the propagation speed of Rossby waves which depend on their wavelength (λ). It is understood that at a time difference of 10 days, the length of Rossby waves is smaller than the situation in which the time difference is 14 days.

From this it results that in situations when we don't have similarities between Minneapolis and Braila (even Galati), the wavelength of Rossby waves reached or overcame 5400 km. In this situation other pieces from Rossby wave chain will determine the weather features from Braila.

Conclusion

From the analysis of the daily maximum and minimum air temperatures in the United States the next conclusions can be drawn:

- The daily maximum and minimum air temperature cycles found in Romania and New Zeeland can be found in the United States, too.
- These cycles aren't perfect, because neither the astronomical cycles (solar, lunar, lunar-solar), nor the generated tidal ones aren't perfect.
- The lack of important mountain ranges with longitudinal orientation in the United States determines very fast and strong advections both to the arctic and polar air masses, and to the tropical ones; the air amplitudes being very high.
- The most frequent cycles with duration longer than a year are the Cycle of Meton (19 years), the Cycle of Saros (18 years and 11 days) and the cycle of 11 years.
- The most frequent cycles with duration smaller than a year are ones of 14 days, 6 months, 8 months and 355 days.
- The time similarities and differences between the evolution of daily maximum and minimum air temperatures in Minneapolis from several localities in Europe situated, approximately, at the same latitude (45°N) are due to the propagation of the Rossby waves.

Knowing these time differences of the similarities, we can develop meteorological forecasts on a long time (over 10 days) for several regions of Romania, with a greater probability.

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