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REGIONAL PARTICULARITIES OF THE SAROS METEOROLOGICAL CYCLE ON EARTH

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Abstract. The aim of this paper is to prove that, anywhere on Earth's surface, it is possible to find cycles of air's temperature and of other meteorological elements with duration of 18 years and 11 days (the Saros cycle). Such cycles exist on all continents, mainly in areas with temperate climate (both in the Northern and Southern hemisphere) where the (planetary) Rossby waves exhibit more clearly. The role played by the atmospheric tides in the occurrence of the meteorological Saros cycle is fundamental, the same fact being valid for other meteorological cycles.

Introduction

In previous scientific papers ([2], [3], [4]), we proved the existence of some meteorological cycles, especially regarding the evolution of the daily maximum and minimum air temperatures. In all those papers, the proof is based on the influence of atmospheric tides generated by the combined attraction of the Moon and Sun.The existence of the Saros meteorological cycle can also be justified by the existence of a cycle of atmospheric tides having the same duration.This cycle is both lunar and solar, because it consists of an integer number of tropical, anomalistic and synodical revolutions (periods) of the Moon. Although the Sun has a special influence in the evolution of the meteorological elements, the Saros cycle does not consist of an integer number of solar years (365.24 days).

1. The Saros Cycle in Astronomy

The Saros astronomical cycle was discovered in the third century A.C. by the Greek Saros and is related to how the Solar and Lunar eclipses are produced.

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The Saros astronomical cycle is a lunisolar cycle with duration of 18 years and 11 days (i.e. 6585 days). After this time, the Solar and Lunar eclipses repeat themselves almost perfectly.

The 6585 days represent a multiple for the tropical, anomalistic and synodical periods (revolutions) of the Moon, as the following calculations show: 6585 days (the Saros cycle) divided to 27.32 days (the tropical period of the Moon) is 241.032≈241; 6585 days divided to 27.55 days (the anomalistic period of the Moon) is 239.019≈239; 6585 days divided to 29.53 days (the synodical period of the Moon) is 222.993≈223.

The Saros astronomical cycle determines a cycle of atmospheric tides with the same duration (6585 days). The cycle of atmospheric tides is also reflected in the evolution of several meteorological elements (air temperature, atmospheric pressure, rainfall, etc.) via the (planetary) Rossby waves, which have a more prominent action in the Earth's temperate zones (north and south).

Under these circumstances, the Saros astronomical cycle also represents a meteorological cycle which can be found on all continents and under very different climate conditions, especially in the air temperature evolution.

2. The Saros meteorological Cycle on different continents

2.1. The Saros meteorological cycle in Europe

In order to prove the existence of the Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures on the European continent, we selected three observation and measurement points situated in different climate conditions: Braila (in a continental temperate climate), Bordeaux (in an oceanic temperate climate) and Moscow (in a temperate climate with Arctic influence).

The graphs presented in Figure 1 show the presence of the Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures at the weather stations Braila, Bordeaux and Moscow.

By analyzing the graphs in Figure 1, the clear similarities in the evolution of the daily maximum and minimum air temperatures can be noticed at all three observation and measurement points, especially at Braila and Bordeaux.

The highest amplitude in the evolution of the daily maximum and minimum air temperatures occurred in Braila, in a continental temperate climate.

2.2. The Saros meteorological cycle in Asia

Due to the large size of Asia and to the great extent of this continent, both in latitude and longitude, choosing observation and measurement points to demonstrate the existence of the Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures proved to be a difficult task. In addition, there is a lack of meteorological data at some particular locations as well as discontinuities in the databases.

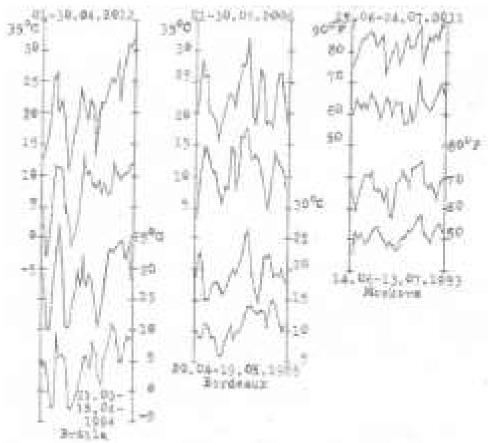

Fig. 1: The Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures at Braila, Bordeaux and Moscow

However, three observation and measurement points situated in different climate conditions were selected: Verkhoyansk (in a cold Siberian climate), Karamay (in a continental temperate climate) and Vladivostok (in a temperate climate, port on the Sea of Japan).

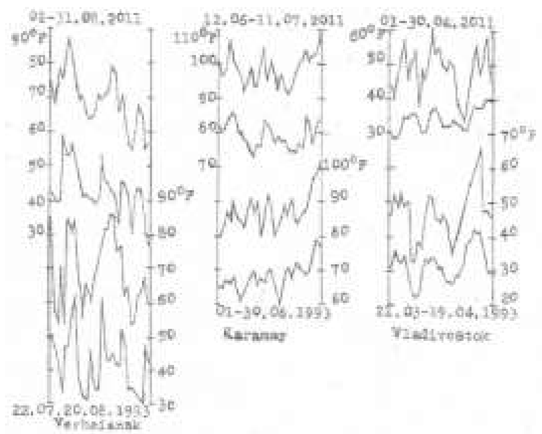

Fig. 2: The Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures at Verkhoyansk, Karamay and Vladivostok

The graphs presented in Figure 2 show the presence of the Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures at the weather stations Verkhoyansk, Karamay and Vladivostok.

An analysis of the graphs in Figure 2 reveals the clear similarities in the evolution of the daily maximum and minimum air temperatures at all three observation and measurement points, especially at Verkhoyansk and Vladivostok.

The highest amplitude in the evolution of the daily maximum and minimum air temperatures occurred in Verkhoyansk, in a Siberian climate with Arctic influence.

The lowest thermal amplitudes are recorded in Karamay, in a continental temperate climate from Central Asia, and at Vladivostok, in a temperate climate with oceanic influence.

2.3. The Saros meteorological cycle in North America

The lack of significant mountain ranges with longitudinal arrangement in North America determines an intense atmospheric circulation, both from the north and south, and this fact causes large oscillations in the evolution of air temperature.

In order to prove the existence of the Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures, three observation and measurement points in North America were selected, where the databases are complete. These points are the following: Minneapolis, Ottawa and Memphis, and are situated in different climate conditions.

In Figure 3, it is presented, with graphs, the Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures at the weather stations Minneapolis, Ottawa and Memphis.

An analysis of the graphs in Figure 3 points out the clear similarities in the evolution of the daily maximum and minimum air temperatures at all three observation and measurement points, especially at Ottawa and Minneapolis. Both observation and measurement points are located in the vicinity of the 45°N parallel, Minneapolis in the center of North America and Ottawa in the eastern part of the North American continent. Both points are located in the middle of the temperate zone where the (planetary) Rossby waves act fully.

The highest thermal amplitude in the evolution of the daily maximum and minimum air temperatures is recorded at Memphis, in a subtropical climate where both cold air masses (from the north) and warm air masses (from the south) penetrate.

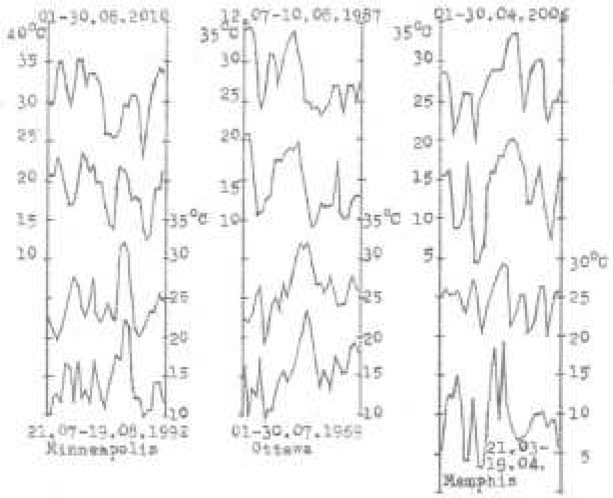

Fig. 3: The Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures at Minneapolis, Ottawa and Memphis

2.4. The Saros meteorological cycle in South America

As in the North American continent, in the South American continent there are not important mountain ranges with longitudinal arrangement. This fact facilitates the penetration of cold air masses (from the south), but also the penetration of warm air masses (from the north). However, the Saros meteorological cycle can be found in South America, in all types of climate.

To prove the existence of the Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures in South America, we selected three observation and measurement points, situated in different climate conditions: Iquitos (in an equatorial climate), Asuncion (in a tropical climate) and Comodoro Rivadavia (in a temperate climate).

The graphs presented in Figure 4 show the presence of the Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures at the weather stations Comodoro Rivadavia, Asuncion and Iquitos.

By analyzing the graphs in Figure 4, it can be noticed that the similarities in the evolution of the daily maximum and minimum air temperatures are obvious at all three observation and measurement points, especially at Iquitos (in an equatorial climate) and Asuncion (in a tropical climate).

The highest amplitude in the evolution of the daily maximum and minimum air temperatures can be noticed at Comodoro Rivadavia, in a climate with ocean influence.

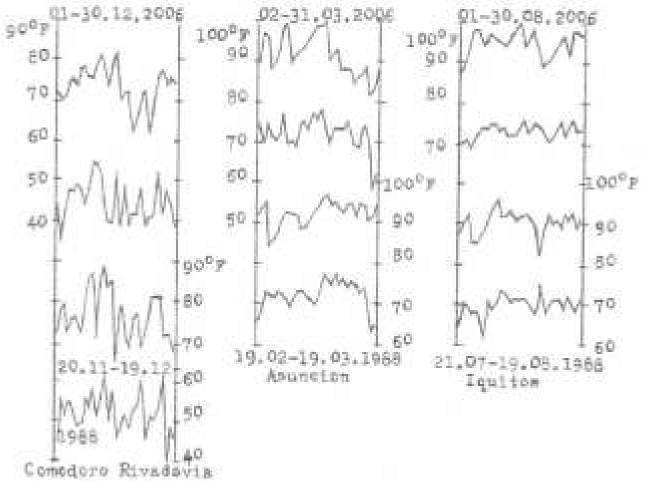

Fig. 4: The Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures at Comodoro Rivadavia, Asuncion and Iquitos

There is a clear difference between the climate of the points located on the west coast and those located on the east coast of South America, situated on the same latitude. This difference is due to the ocean currents that influence the two coasts, the cold currents on the west coast and the warm currents on the east coast.

2.5. The Saros meteorological cycle in New Zealand

Located in the southern hemisphere, between 34°S and 48°S, and in the eastern hemisphere, between 160°E and 180°E, New Zealand has an oceanic temperate climate where the thermal oscillations from summer to winter are very small. However, the Saros meteorological cycle can be found in all regions, both in the North Island and in the South Island.

In order to emphasize the Saros meteorological cycle, we selected Wellington as an observation and measurement point, which is the capital of the New Zealand and is located in the vicinity of the 42°S parallel.

In New Zealand, the Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures occurs at the beginning of the warm season and during this season as well.

The graphs in Figure 5 present the Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures for the months of August, September and October 2012 in comparison with the period July 21st –October 20th 1994 (the Saros cycle, i.e. 18 years and 11 days).

An analysis of the graphs in Figure 5 points out the clear similarities in the evolution of the daily maximum and minimum air temperatures in all three months, especially in the month of September 2012 in comparison with the period August 21st –September 19th 1994, which is the beginning of the warming period in the southern hemisphere.

2.6. The Saros meteorological cycle in Antarctica

The Antarctic continent is located around the South Pole and has the harshest climate on Earth. Even under these circumstances, there are countries in Europe, Asia, North America and South America that have territories here, in which meteorological observation posts can be found. In all situations, the climatic conditions are very difficult for carrying out activities.

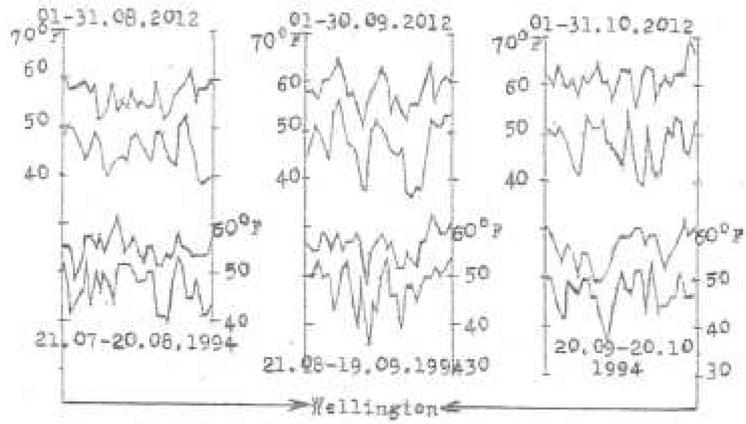

Fig. 5: The Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures for the months of August, September and October 2012 in comparison with the period July 21st –October 20th 1994 at Wellington

In order to demonstrate the existence of the Saros meteorological cycle in Antarctica, three observation and measurement points were selected: Esperanza Base and Marambio Base (both belonging to Argentina) and Neumayer (belonging to Germany).

In Figure 6, it is presented, with graphs, the Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures at the observation and measurement points Esperanza Base, Marambio Base and Neumayer.

By analyzing the graphs in Figure 6, the clear similarities in the evolution of the daily maximum and minimum air temperatures can be noticed at all three observation and measurement points, especially at Neumayer. The lowest temperatures are recorded at Neumayer (-30°F for the minimum temperatures and -

12°F for the maximum temperatures). At the observation and measurement points Esperanza Base and Marambio Base, the daily maximum temperatures climbed up to +50°F and the daily minimum temperatures dropped down to approximately 0°F.

These thermal differences between the two points Esperanza Base and Marambio Base, on one hand, and the point Neumayer, on the other hand, are due to the geographical positions of these three points. The observation and measurement points Esperanza Base and Marambio Base (of Argentina) are located in the vicinity of the 64°S parallel, while the point Neumayer (belonging to Germany) is located in the vicinity of the 70°S parallel and thus closer to the South Pole.

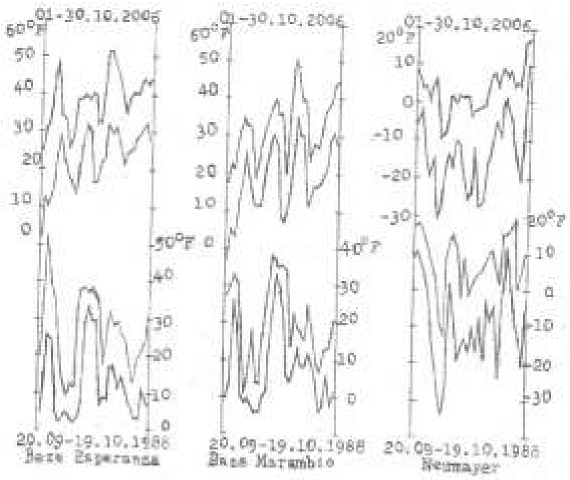

Fig. 6: The Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures at Esperanza Base, Marambio Base and Neumayer

2.7. The Saros meteorological in the evolution of the atmospheric pressure

A very important element in the synoptic meteorology is the atmospheric pressure. This meteorological element, used every hour in the synoptic meteorology, has a special importance. The daily, decadal and monthly mean values are used mostly in climatology.

Next, we will analyze the Saros meteorological cycle in the evolution of the atmospheric pressure.

The number of weather stations which communicate in the international network data regarding the atmospheric pressure is limited. Some weather stations communicate daily mean values of the atmospheric pressure at the sea level, while others at the level of the weather stations.

In order to demonstrate the existence of the Saros meteorological cycle in the evolution of the atmospheric pressure, we selected three observation and measurement points located in the northern hemisphere in the vicinity of the 45°N parallel. These points are: Braila (Romania), Minneapolis (USA) and Ottawa (Canada).

The graphs presented in Figure 7 prove the presence of the Saros meteorological cycle in the evolution of the atmospheric pressure (daily mean values) at the observation and measurement points Braila, Minneapolis and Ottawa.

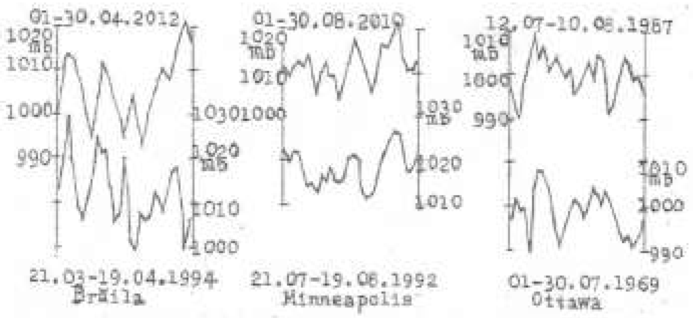

Fig. 7: The Saros meteorological cycle in the evolution of the atmospheric pressure (daily mean values) at Braila, Minneapolis and Ottawa

An analysis of the graphs in Figure 7 reveals the clear similarities in the evolution of the atmospheric pressure at all three observation and measurement points, especially at Minneapolis and Braila.

The fact that, for the atmospheric pressure, the daily maximum and minimum values are not used (as for the air temperature), reduced the amplitude of the daily atmospheric pressure oscillations. Both in meteorology and climatology, the daily maximum and minimum values of the atmospheric pressure are not usually used. These values are used only in special situations.

It should be mentioned that the graphs in Figure 7 represents the same dates as those in Figure 1 (for Braila) and in Figure 3 (for Minneapolis and Ottawa) where the existence of the Saros meteorological cycle in the evolution of the daily maximum and minimum air temperatures is proved. Consequently, the Saros meteorological cycle can be proved simultaneously for several meteorological elements.

Conclusions

By analyzing all the cycles presented in this paper, the following conclusions can be drawn:

-The Saros meteorological cycle in the evolution of some meteorological elements (air temperature and atmospheric pressure) is based on the Saros astronomical cycle with duration of 18 years and 11 days, i.e. 6585 days.

-The Saros meteorological cycle in the evolution of some meteorological elements can be observed especially in the periods when the declination of the Moon has maximum values (i.e. ±28°36′).

-An explanation for the emergence and succession of these cycles may be represented by the atmospheric tides that have the same periodicity and are generated by the combined attraction of the Moon and Sun.

-The atmospheric tides influence the characteristics of the (planetary) Rossby waves, which act on the entire surface of the Earth, especially in the temperate zones.

-By analyzing the Saros meteorological cycles in the two hemispheres of the Earth (Northern and Southern), it follows that these cycles have a higher frequency at the beginning of warming periods (the transition from the cold season to the warm season).

-The lack of complete meteorological data at some regions on Earth (Africa and Australia) makes it impossible the proof of the existence of the Saros meteorological cycle in these regions.

-Knowing the Saros meteorological cycle (that is based on the Saros astronomical cycle) and how it evolves can be very useful in making long-term forecasts (for more than 10 days).

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