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Causes of anomalous hot summers and the possibility of their forecasts

Nikolay Sidorenkov

Hydro-Meteorologycal Center of Russia, Global Atmospheric Circulation Lab., Moscow, Russian Federation (sidorenkov@mecom.ru, (7 499) 255 1582)

In the summer of 2010, an unprecedented heat wave of record duration and intensity was observed over European Russia. The heat wave took hundred thousands of lives, led to fires that destroyed hundreds of villages and about one million hectares of forest, and cost the Russian economy hundred millions of dollars.

It is believed that daily temperature anomalies vary randomly with time. However, the spectral analysis of a long-time series of daily air temperature anomalies revealed pronounced components with a lunar year period of 355 days, a lunar evection half-period of 206 days, a lunar quarter year period of 87 days, and a lunar sidereal month period of 27 days (See Figure 12.3 [1]).

The tides influence the atmospheric pressure and cloud amount. The amplitude and phase of lunar tides affect the cloud cover at an observation site. In clear skies, the atmosphere is heated by solar radiation during the long daytime in summer but is cooled due to escaping infrared radiation during the long nighttime in winter. As a result, in clear skies the daily mean air temperature (T) in summer exhibits positive anomalies, while its negative anomalies are observed in winter. In cloudy skies, the air temperature anomalies have opposite signs. In the spring and autumn T does not depend on the cloud amount because the day is approximately equal in length to the night. In this way, the interaction of the lunar gravitational effects with the atmospheric radiation conditions creates oscillations of T with lunar periods and amplitudes depending on the physical and geographical conditions of the site.

In Moscow the amplitude of the "solar" 365-day oscillations of temperature T is about 15°, and the basic 355-day "lunar" oscillation of T is about 5°. The "solar" temperatures oscillations interfere with the "lunar" temperature oscillations to form beats of T. A beat is characterized by a periodic variation in the amplitude of the resulting oscillation. When the phases of the interfering oscillations coincide, their partial amplitudes add together so that the resulting amplitude of T becomes maximal (15°+5°=20°). As a result, hot summers and cold winters are observed during these periods. Then the phases of the oscillations gradually diverge, and the amplitude of the resulting oscillation of T decreases to become minimal at a phase difference of 180°, when the amplitudes of the interfering oscillations are subtracted (15°–5°=10°). As a result, cool summers and warm winters are observed in these cases.

The beat frequency is equal to the half-difference between the frequencies of the interfering oscillations. The interference of 365-day and 355-day oscillations gives rise to a period beat of 35.2 years, which is known in climatology as the Brückner cycle.

The addition of the "solar" semiannual period of oscillations of air temperature and its 206-day "lunar" period generates beats of T with a period of 4.4 years. As a result, the 35-year cycle of the annual oscillation amplitude of T becomes hidden so that the extrema of T seem to vary randomly (there appear "clones" like the extrema in 1936 and 1938 and in 2002 and 2010).

The sequence of hot summer seasons over European Russia in 1901, 1936/1938, 1972, and 2002/2010 is associated primarily with the 35-year beats of air temperature. In 2010 their influence was supplemented with the effects of some eclipse cycles: a 19-year doubled Metonic cycle (analogous to that in 1972), an 8-year octaeteris subcycle (peat and forest fires also occurred over European Russia in August and September, 2002), a 29-year inex cycle (the 1981 summer was hot and dry), and other less significant lunar cycles.

Clearly, the 2010 heat wave over European Russia resulted from beats of not only temperature but also all the other hydrometeorological characteristics, i.e. pressure, wind, humidity, etc. These conditions correspond to nearly stationary blocking highs persisting for a long time. What are the forces that cause them to persist? There are strong reasons to believe that these are the anomalous gravitational forces produced by slow variations in the relative positions of the Moon, Earth, and Sun, by the rotation of their major axes (apses), by the motion of the nodes of their orbits, and by variations in their orbital parameters [1,2]. The variations in the mutual configurations in the Earth–Moon–Sun system generate gravitational perturbations that slowly propagate in near-Earth space and induce atmospheric baric waves (blocking anticyclones and depressions), which move over the Earth's surface together with the gravitational perturbations. Blocking highs cause anomalous frosts in winter and anomalous heat waves in summer.

Heat waves over European Russia were observed during the summers of 1972, 2002, and 2010. One year earlier (in 1971, 2001, and 2009, respectively) a summer heat wave occurred in Western Siberia, and a similar phenomenon was observed in Western Europe during the summers of 1973 and 2003. These facts suggest that the summer locations of the centers of nearly stationary blocking highs move from east to west at a velocity of about 40° per year. Therefore, a heat wave can be expected in Western Europe during the summer of 2011. The anomalously cold December of 2010 in Western Europe agrees with this prediction, since a cold winter in the air temperature beats is followed by a hot summer. Over European Russia, there will be a depression with cool and wet weather in the summer of 2011.

1. Sidorenkov N.S., The interaction between Earth's rotation and geophysical processes. WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2009. 317 pp. (2009).
2. Wilson I., Sidorenkov N. Catastrophic heat-waves in Southern Australia and extremes in the Solar/Lunar tides - are they linked? Geophysical Research Abstracts. 12, EGU2010-10157-1, (2010).