PERIODIC CHANGES IN THE ACTIVITY OF JUPITER’S HEMISPHERES. A. P. Vidmachenko, 1, Main Astronomical Observatory of National Academy of Sciences of Ukraine, Str. Ak. Zabolotnogo, 27, Kyiv, 03680, vida@mao.kiev.ua.

Fig. 1. Change of factor activity $A_J$ of Jupiter’s hemispheres with time $T$.

For planets with significant incline of equator to the orbital plane is characterized by a manifestation of seasonal changes in the optical characteristics of the atmosphere [6, 7, 10, 13, 15-23]. The inclination of Jupiter’s rotation axis to the orbital plane is only 3.13°. In [8, 14, 23] we proposed to take into account the geometric modulation of solar irradiance due to the planet motion along the orbit and variations of jovimagnetic latitude of the Earth $\varphi_m$, caused by the rotation of the planet’s powerful magnetosphere; $\varphi_m = \varphi_0 + \beta \cos(2\lambda - \lambda_0)$, where $\beta=10°$ is the angle between the magnetic axis and axis of Jupiter’s rotation, $\lambda$ – current longitude and $\lambda_0$ – longitude of the planet’s magnetic north pole. During the year on Jupiter $\varphi_m$ varies from $-13.13°$ to $+13.13°$. Therefore, a change in the reflectivity of Jovian atmosphere may occur extrema in a single planetary orbital period around the Sun. Because of the orbital eccentricity ($e=0.048$) northern hemisphere receives almost on 21% greater flow of solar energy to the atmosphere of Jupiter [1], because at the closest to the summer solstice time – planet is situated at perihelion.

In [8, 9, 12, 14, 23] we showed that the ratio of the brightness of the northern and southern temperate zones is a good factor for the photometric activity of the atmospheric processes on Jupiter. From the spectral mathematical analysis we obtained the existence of cyclicity of long-period variations of this factor activity with a period of 11.86 years. This allowed us to talk about the existence of the seasonal reconstruction of the physical parameters of the Jupiter’s atmosphere. Analysis of estimates magnitude of Jupiter’s disk $M_J$ in filter $V$, obtained from 1862 to 1991, and comparison these data with the Wolf numbers $W$, characterizing the variations of solar activity (SA), showed that a change in $M_J$ has extrema in the peaks of SA: minimum for the odd and maximums for the even cycles. That is, a change in the Jupiter’s brightness in visible light is much clearly manifested ~22-year magnetic cycle, and not the 11-year cycle. To combination of these data, we applied our described in detail in [11] and tested in [5], the program of spectral photometric analysis by the method of maximum entropy for observational data series. At the change of the visual Jupiter’s brightness, we found the presence of periodic components with periods of such values: with reliability greater 95% $T_1=23.9$ (+1.4, –1.0), $T_2=22.1$ (+1.3, –0.9), greater 90% $T_3=11.88$ (+0.8, –0.6), $T_4=11.1$ (+0.7, –0.5) and $T_5=3.4$ (+0.3, –0.2) year [13]. That is, we found a manifestation of the double value of an orbital period (~23.9 years), of an orbital period (~11.88 years), and periods of solar activity, characterized by a change in the Wolf numbers $W$ ($T_3=22.1$ and $T_4=11.1$ year). In addition, we have confirmed the existence of the periodic component $T_5=3.4$ years [2-4] in change of photometric characteristics of the atmosphere of Jupiter; it can be explained by the superposition of one of the following two pairs of frequencies: $\nu_5=\nu_1+\nu_4$ and...
with a sinusoid with period about 11.91 years. This value is almost identical with orbital period of Jupiter around the Sun; in 1998-2015 – the symmetry is somewhat disturbed. That is, there is alternately increase in the brightness or the northern, or the southern tropical and temperate zones for one period of Jupiter’s rotation around the Sun. This periodic variation of brightness and the increased activity of planetary different hemispheres, may indicate the periodic global restructuring of the circulation system, the structure of cloud layers and haze above the clouds. This allows us to talk about the correlation of the observed variations of reflective properties of the investigated parts of Jovian disk, tilting the axis of rotation of the planet and/or magnetic field to the orbital plane; that is, about the existence of seasonal reconstruction in the atmosphere of Jupiter. At the same time, the response of the atmosphere to change of the visible planetocentric declination of the Sun does not occur instantaneously, but with a significant (some years) delay.