SOLAR ACTIVITY INFLUENCE ON SEASONAL CHANGES IN SATURN'S ATMOSPHERE. A. P. Vidmachenko, Main Astronomical Observatory of National Academy of Sciences of Ukraine, Str. Ak. Zabolotnogo, 27, Kyiv, 03680, vida@mao.kiev.ua.

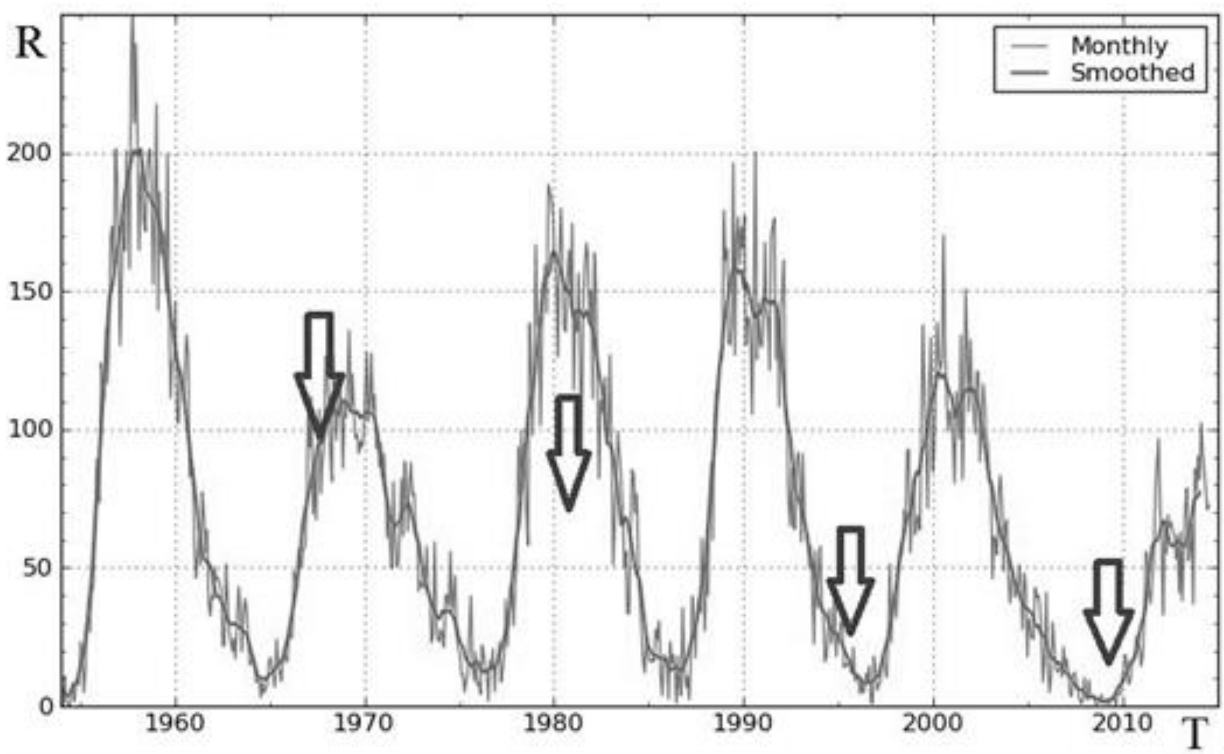

Fig. Change in the index (R) of Solar activity over time (T). The arrows mark the equinoxes for Saturn (http://sidc.oma.be/html/sidc_graphics.html).

Introduction: In [10] we pointed out that in the 2009 equinox in Saturn's atmosphere was not expected progress changes of methane absorption in the winter, before the closed by rings, hemisphere. Although all previous moments of the 1966, 1980 and 1995 equinoxes, showed good agreement with the model [1, 2, 6] of seasonal changes in Saturn's atmosphere.

Changes in Saturn's atmosphere: Due to the large distance from the Sun, Saturn has a low temperature in the photochemically active regions of the atmosphere. This fact, in combination with a predominant content of hydrogen leads to the photochemical processes [9], which are the main products of various hydrocarbons and ammonia NH_3. A significant change in the Sun's irradiation of atmosphere leads to variations in the molecules number of CH_4, NH_3 and products of their dissociation. In this connection, the effects of orbital motion, the presence of rings, as well as solar activity - induced change in the quantitative and qualitative composition of the upper atmosphere of Saturn. The resulting variations in the optical thickness of the photochemical haze, largely modify access incoming solar energy to those layers in the atmosphere where weather on the planets is formed. Different model estimates are well explained by the seasonal variation of methane absorption in the atmosphere of Saturn that took place around the 1966, 1980 and 1995 equinoxes. But the results of the relevant observations in the northern hemisphere at the 2009 equinox significantly differ [10].

Seasonal effects observed in the deeper layers of the troposphere can be associated even with condensation and convection. In fact, the change of insolation controls latent heat flow, when the heat capacity of the atmosphere is sufficiently large and the temperature remains virtually unchanged. Additional solar radiation absorbed by the particles is stronger, than that required for equilibrium, and thus provides the necessary latent heat for sublimation. Conversely, decreased absorption of insolation is compensated by latent heat, which comes with ammonia gas when it is freezing. Therefore, the thermal regime of the upper layers of planetary atmospheres is largely determined by solar activity also because of the impact on the atmosphere of solar radiation at different wavelengths, especially - in the short-wavelength part of the spectrum.

For the Earth's atmosphere known that the amplitude of the daily pressure changes more with a maximum of solar activity, than during its minimum. In solar minimum convection is significantly reduced, and mixing in the atmosphere practically no. It is we observed in Saturn's northern hemisphere [2] during the period from 2007 to 2010.

As can be seen from Fig., 2-3 years before the equinoxes in 1966, 1980 and 1995, the number of R, characterizing the solar activity, varied from 40 to 180 in 1980. But before the equinox 2009 was a minimum of solar activity, and the value of R was virtually zero. This suggests that at the time of the equinox 2009 convection in Saturn's atmosphere was as low, as possible [2] and, therefore, after leaving the ring shadows in the winter northern hemisphere deep cloud layers stayed in a “frozen” state with virtually no active processes on the Sun. Such processes are especially noticeable in the ultraviolet spectral region. Under these conditions, an indoor rings previously inactive cloud layer, remained the same deep level. This allowed us to continue to observe a strong methane absorption of methane and ammonia gas above the cloud layer [5]. Thus, the absorption of methane in an inactive winter hemisphere remained almost the same, and equal of absorption in the former summer hemisphere, which is illuminated by direct sunlight.

Thus, the results of observations of methane absorption distribution over the disk of Saturn for 1965-2011 and their analysis showed pronounced seasonal changes taking place on levels above the clouds. Changes in the methane absorption along the meridian in equinox 1966 and 1995, are in opposition to the same observational data obtained at the equinox 1980 [3, 4, 7, 8]. According to the observations of Saturn's equinox 2009 is expected that (similar to 1980) the differences in the methane absorption between the southern and northern hemisphere at mid-latitudes of Saturn has occurred [5].

Despite the fact that all physical and orbital characteristics of the Saturn equinoxes in 1966 and 1980, and in 1995 and 2009, virtually the same, but the response on them get different. In equinox 2009, after the release of the atmosphere from under the rings of Saturn, the expected formation of high ammonians clouds did not happen.

We assume that this is due to the fact, that in 2008-2009 the solar activity was minimal, and therefore it can not have a noticeable effect on the change of the methane absorption.

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