Annual and UT variation for different levels of geomagnetic activity

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Geomagnetic activity is well-known to be described by season variation with maxima in vicinity of the equinoxes and minima near the solstices. The fact that geomagnetic storms are more intense and numerous at the equinoxes than at the solstices was known for 150 years. Cause of this annual variation is still not found that simulates studies and discussions in this field. Annual modulation of geomagnetic activity is generally attributed to one or more of three mechanisms known as axial, equinoctial and Russell-Mcpherron based on different physics of the solar wind and geomagnetic field interaction. Besides, Clua de Gonzales et al (2001) using monthly averages of geomagnetic indices (aa, Dst and AE) found peak in July for ranges of high levels of geomagnetic activity that is outside of the known seasonal profile of annual variation. The main problem which we tried to solve is that the variation of the mean statistical activity is not caused by strong geomagnetic disturbances within certain Universal Time intervals of days during year. The purpose of our study was to obtain annual and UT variation of geomagnetic activity for different levels according to intensity. The other aim of our study was to detect a day (in July or not) inside a month of the highest geomagnetic activity (we used 14-day means of indices instead monthly ones). At last we attract for explanation of our results our model of geomagnetic activity based on variation of mutual orientation of electric field of the solar wind relative to geomagnetic moment during orbital and daily motions of the Earth. For our study we used 3-hour geomagnetic indices Kp (1932-2004) and aa (1868-2004), 1-hour indices Dst (1957-2004). We obtained for the all geomagnetic indices that as the level of intensity increases, the classical season variation becomes less clear. For strong disturbances in range of Kp=8-9 we obtained clear non-classical season variation with absolute maximum on 4 April (plus minus 7 days) and two comparable peak 16 July, 28 September (the same error bar for both days). We see the same positions of peaks and their intensity for level aa$>$200: absolute maximum on 4 April and less intensive maxima in 16 July and 28 September. Behavior of reaching the peaks in equinoxes differ from the summer solstice peak: gradual increasing of geomagnetic activity before maximum at the equinoxes and sharp rise of geomagnetic activity in July from low activity to its highest level that lasts for approximately 2 weeks. Annual variation of Dst$<$ - 200 nT shows two clear comparable peak on 4 April and 25 November and less intensive peaks in July and September. Our analysis showed that UT variation of all discussed indices for the high level of geomagnetic activity (Kp$>$8, aa$>$200, Dst$<$

- 200 nT) have clear minimum in range of 0430-0930 UT, phase of the maxima of the UT variation depends from analysed index. We suggest explanation for appearance of large geomagnetic activity in March, July, November based on variation of geoeffective parameter Em (component of electric field along the geomagnetic moment) that has according to our study increased values in these months.