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Cyclical evolution of solar corona by observation in line FeXIV 5303Å

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Abstract. We investigate the series of the green corona (GC) intensity by the combined catalogues of Rybansky, Tlatov and the original series of Kislovodsk station.

We study series of GC intensity from the combined catalogues of Rybansky (1994), Tlatov and the series of Kislovodsk station (Tlatov et al. 2001) (they cover the period 1939–2000), using both direct GC intensity (see, e.g., Ivanov & Ikhsanov 1998, Vasiljeva & Tlatov 1997, Badalyan et al. 1999) and densities of local maxima of coronal brightness (LBM) (Rybansky et al. 1994, Altrock et al. 1997, Ikhsanov & Ivanov 2000). There is a good agreement between the Tlatov and Kislovodsk series of GC. Comparing middle and high intensities of Tlatov's and Rybansky's series, we see that in the latter two different systems of intensity were used (Ikhsanov & Ivanov 2002). Behaviour of GC intensities in high (>45°) and low latitudes are similar (correlation coefficients 0.8–0.9). LBM of low intensity (0–10) are localized near solar minima in high latitudes. Around solar minimum the LBM density in high latitudes increases. For large intensities (>50) behaviour of LBM approximately agrees with development of the "Maunder butterflies" for sunspots. Three branches of GC LBM are clearly visible in the series of Rybansky and Tlatov (Fig. 1). GC LBM in all branches have tendency to concentrate in areas of higher density. It is especially pronounced in the low-latitude branch, where the areas have typical sizes 20°–25° and time of repetition 1–2 years.

In the beginning of the cycle, with the advent of the low-latitude GC branch, densities of the first high-latitude branch of LBM begin to grow (Fig. 2). This branch moves fast to the pole and reaches its highest latitude in maximum of the cycle. The second high-latitude branch of GC is observed in high latitudes after the polar reversal. Afterwards the branch persists in the form of discrete surges from middle to high latitudes. After maximum of the cycle this branch usually starts fast descending to middle latitudes. In Kislovodsk data the third GC branch is clearly visible, that appears after the polar reversal and disappears in high latitudes before maximum of the next cycle.

The first high-latitude branch seems to originate simultaneously with first sunspots of the new cycle, but becomes visible later. The second branch emerges immediately after the polar reversal. In cycle 21 after the solar maximum the high-latitude GC branches quickly descended to middle latitudes and in the solar minimum in each hemisphere fluently changed to the low-latitude branch of the next cycle. Such a picture was interpreted by Altrock et al. (1997) as existing of an extended solar cycle with duration 16–17 years. But in other pairs of cycles there were no such a pronounced transition of branches. In some cases (e.g., in cycles 19-20) the second GC branch disappeared in latitudes that are noticeably higher than the place of emerging of the next low-latitude branch. LBM of higher density, as a rule, are connected with low-latitude belts of the surges, which often follow to the surges with polarity of the low-latitude branch of m.f. These fact argue for relation of the second branch with the low-latitude branch of the same cycle.

Evolution of low-latitude and polar faculae in cycle 21 (Khusainov 1988) is similar to

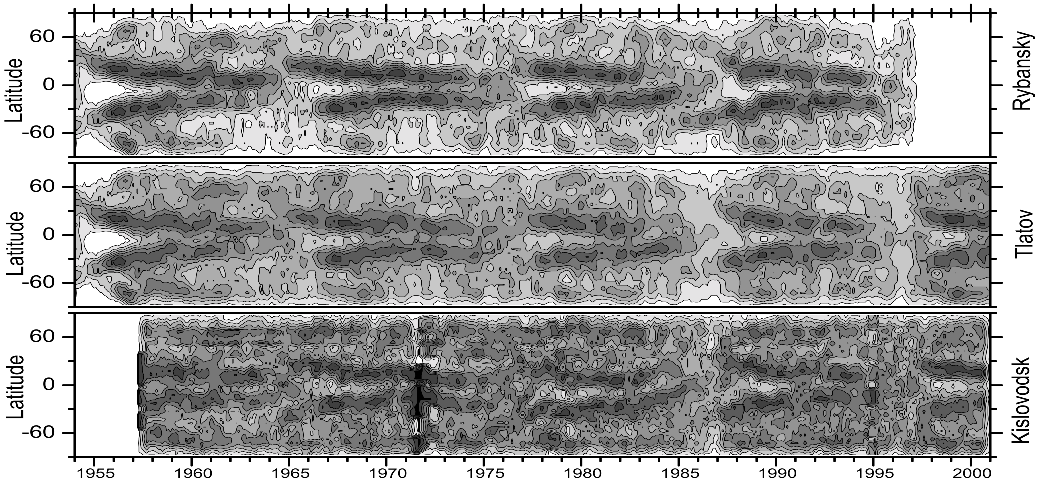

Figure 1. Latitude-time evolution of the LBM in three systems of observations

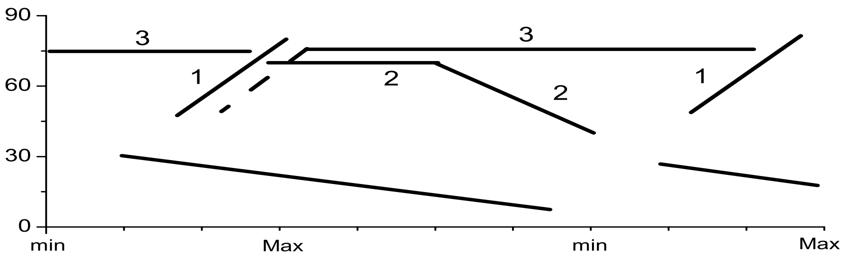

Figure 2. Scheme of evolution of GC branches in the northern hemisphere

development of the low-latitude and third high-latitude LBM branches (by Kislovodsk data) correspondingly. To time of separation of the second and third GC branches individual surges of polar faculae from the low-latitude branch stop emerging. Simultaneously the transition of the large-scale solar m.f. from phase I to phase II takes place (Ikhsanov & Ivanov 2001).

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