Secular variations of the geomagnetic field during the 19–21 solar cycles

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A b s t r a c t (extended): The geomagnetic field (GMF) time variability implies superposition of fluctuations with different amplitudes and periods. Of key importance is the identification of characteristic periodicities at the low-frequency part of the spectrum, that is the analysis of secular variations which may be induced by internal as well as external changes. Here we present some results on the spectral analysis of secular changes using monthly mean data recorded at the geomagnetic observatories Wingst (WNG) – Germany, Grocka (GCK) – Yugoslavia, Panagjurishte (PAN) – Bulgaria, Tihany (TIH) – Hungary, L'Aquila (AQU) – Italy, Hurbanovo (HRB) – Slovakia during the 19th, 20th and 21st solar cycles (from 1953 to 1987).

Table 1. The periods of secular changes obtained using FFT for the considered time series.

Observatory (code)	PERIOD T (Months)						
19th S.C.							
WNG		6.1	8	12.2	17.1	28.4	42.7
GCK	4	6.5	8.5		15	27	
20th S.C.							
WNG	6	7	12.2	16	23.3	51.2	
GCK	6	8.5	12.2		23.3	42.7	64
AQU	6	8.8	12.2	16	23.3	42.7	
PAG	6	8.8	12.2	16	23.3	42.7	
21st S.C.							
WNG	6	8.3	12.2	16	19.7-21.3	28.4	42.7
GCK	6	8.5	12.2	19.7	23.3	28	42.7
AQU	6	8.3	12.2	16	21.3	28.4	42.7
PAG	6	8.3	12.2	16	21.3	28.4	42.7
HRB	6	8.3	12.2	18.3	23.3		42.7
THY	6	8.3	11.6	16	21.3	32.0	

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The secular variations can be considered within individual solar cycles and can also be investigated on the basis of magnetic surveys comparing successive epochs charts (*Schulz, 1997*; *Schulz* and *Gentz*, 1998; *Kovács et al.*, 1998; *Cholakov, 1998*). For the selected observatories the monthly mean values of the geomagnetic field horizontal component were considered during the 19th (1953-1966), 20th (1967-1976) and 21st (1977-1987) solar cycles, i.e. for time interval from 1953 to 1987. In order to remove the long term trend components polynomial least-square fits were used, similarly as in *Korte* and *Beblo* (1998). After that the fast Fourier transformation (FFT) was applied for the time series from different European observatories. The results are given in Table 1.

The results show that in addition to strong semiannual and annual components longer periodicities are also present and their dominant properties are somewhat different for the considered solar cycles. The obtained results agree well with the previous results of secular change studies (*Rivin, 1989; Bieleková, 1989; Mihajlovich, 1998*). The identification of sources of these variations, however, remains an important task for future geomagnetic research.