

Secular variations of the Earth's magnetic field and their long-term modulation

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A b s t r a c t (extended): It is widely accepted that the greater part of the Earth's magnetic field secular variations has their source in the Earth's interior. However, in addition the external sources show their influence, too. To consider the secular variations of the horizontal component SV(H) at mid-latitude and subauroral observatories of the Northern hemisphere for the 1890–1990 interval with regard to the Wolf number. The data from the following observatories were used: Witteveen, Niemegk, Leningrad, Kazan, Sverdlovsk, Irkutsk, Valentia, Meanook, Frederiksborg. For those observatories the registration exist over the last 100 years.

The attempt was made to follow the contribution of external sources into SV(H) changes. The secular variations of the horizontal component SV(H), expressed by differences between consecutive annual values of the horizontal component (ΔH) for individual observatories, were considered for the time interval 1890–1990. The profiles (not shown) of SV(H) appear to be in accord with the quasi-sinusoidal law with high frequency irregularities, similarly to aa index changes reported by *Střešitík* (1991).

The feature mentioned is more apparent in smoothed profiles as shown in Fig. 1. The upper curve presents the mean annual Wolf number values (W) for eight cycles of the solar activity starting from the 13th (1890–1901) to the 20th one (1965–1976). The thick bold horizontal lines show the secular variations and W values averaged over the cycle. The averaged values of SV and W over the cycle, if compared cycle by cycle, show the consistent changes.

This feature is persistent. There was selected the time interval of eleven-thirteen solar cycles when the more complex changes of mean W were observed. Fig. 2 shows mean annual variations of W and SV(H) at the Kew magnetic observatory registered during solar cycles activity XI–XIII. As seen the changes of SV(H) and W, if the averaged values over individual cycles being compared, are in accord.

If the assumption is made that long-term modulation of SV(H) with period ~80 years exists, then the contribution of this external source can be accepted to be of the zero level for the 14th cycle since W is the lowest for this solar cycle. In this case SV(H) appears to be formed by only internal sources. It is interesting to evaluate the spatial distribution of secular variation due to internal sources only when the part of SV(H) due to external sources (its dependence on W and ΣKp changes) is subtracted. More detailed analysis is needed to verify the distribution of isolines mentioned.

Key words: secular variations, solar cycle

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