THE LONG TURN BEHAVIOR OF THE ELECTROMAGNETIC IMPEDANCE TENSOR AT NAGYCENK GEOPHYSICAL OBSERVATORY – IAGA DIVISION 5. OBSERVATORY, INSTRUMENTS, SURVEYS AND ANALYSES

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1 Introduction

Transient electromagnetic variations, observed at the surface of the Earth are direct signatures of MHD waves and electric currents in the ionized environment of the planet. At the same time, the temporal variation of the surface geomagnetic field induces currents in the conductive subsurface. The secondary magnetic field related to the induced currents is superimposed on the external origin field variations. The analysis of the temporal and spatial character of the natural electromagnetic field variations at the surface of the Earth therefore provide a unique tool for investigating and understanding physical phenomena arise in the ionosphere and magnetosphere, Pilipenko and Fedorov (1993), as well as for probing the structure of the Earth interior, Vellante (1997).

In the Széchenyi István Geophysical Observatory at Nagycenk, a parallel monitoring and registration of geomagnetic and telluric variations has been carried out for more than fifty years. The unique long continuous time series allows to study the long term behaviour of the source field and the subsurface anisotropy by means of the observation based surface electromagnetic impedance tensor.

2 Data processing, analysis and results

Conventional electromagnetic investigation techniques, like the magnetotellurics are based on the simplifying assumption that the characteristics of the external field can be eliminated from the estimated transfer function, namely the ratio of the geoelectric and the geomagnetic spectral components by a least-square method. This assumption has been examined in details by Beamish (1979). Based on the analysis of three station geomagnetic time series he confirmed that source field characteristics do affect the estimated response function at mid-latitude. It also has been evidenced that significance of the effects increase with both latitude and period. To identify and investigate the characteristics of the ionospheric origin source current filed a comprehensive study of the theoretical and observation based surface electromagnetic impedance function has been carried out in the GGI.

Four year of continuous recording has been subjected for the analysis covering a solar maximum phase (2000-2004). Individual response funcions has been computed for each overlapping 128 minute long time windows of telluric and geomagnetic recordings. To get rid of the low power local source electromagnetic noise which often results outliers in the transfer function statistics power thresholds has been set for both fields. The thresholds has been determined based on a detailed analysis of the statistical distribution functions of the individual transfer function values in each frequency class. The distance of the mean and the median of the whole set and the iqr (inter-quartile range) has been computed in each iteration step. By increasing the threshold power, the less individual data is accepted, the statistical distribution function of the impedance modulus as stochastic variable becomes sharper and more localized.

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The rejected individual impedance modulus values have been replaced by 2D interpolation (above the frequency-time space). The recovered impedance function series' (one function series for each tensor element) has been subjected for Fourier analysis. Long term variation of the response functions at each frequency class of the studied range has been investigated. Spectral components related to the Earth rotation and orbiting around the Sun has been demonstrated, so as the harmonics. The distribution of the modulation amplitude at each characteristic spectral peak has also been analysed.

The effects of the subsurface anisotropy and the source field characteristics has been identified in the estimation process of the response function.

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