An interpolation model of spatio-temporal oscillations of sporadic E-layer parameters in the Northern hemisphere

E.Yu. Ryabchenko and O.N. Sherstyukov

Department of Radiophysics, Kazan State University, Russia (reug@ksu.ru)

A new original method for investigating global spatio-temporal wave properties of meteorological, e.g. ionospheric parameters is offered. Its most important application is study of planetary wave influence on ionospheric parameter variations. Wave amplitude distributions, wave phase, propagation velocity and motion directions can be obtained on the basis of interpolation and further analysis of experimental data from world ionospheric database. A special software package was developed to perform high-speed data processing and visualization. The offered method implies the following steps. 1. An original time series of experimental measurements $s_k(t)$ (k — station index, t — discrete time) are analysed in time and frequency domains using a continuous wavelet transform to find out a dominant oscillation, which is interested for the further analysis. Hereafter, two ways are offered to select this oscillation: 1) use of absolute values of wavelet transform at corresponding scale or 2) digital band-pass filter. 2. Derived time series $f_k(t)$, containing selected oscillation or its amplitude, are used to build a spatio-temporal oscillation model, which is the scalar field $F(x, y, t)$, obtained by interpolating values of $f_k(t)$ on the discrete coordinate grid (x, y) at the discrete time t. 3. An original technique based on pattern recognition algorithm is offered to compute a field motion direction at any point of grid (x, y) at each moment t_i. Displacement of surrounding $F(x, y, t_i)$ values in the certain radius from the given point (x_o, y_o) is detected to obtain motion directions of wave of the given period. Considered method was used for investigating atmospheric planetary wave influence on variations of sporadic E layer highest frequency. A 39-year measurement data for 1960–1998 of more than 100 ionosondes were used to build a dynamic model of quasi 5- and 16-day wave propagation in the Northern hemisphere. Predominance of zonal direction is obtained during the analysis of 16-day wave motion in the Eastern sector.