

# SPACE WEATHER EFFECTS ON HF PROPAGATION ALONG DIFFERENT PATHS OF THE RUSSIAN CHIRP SOUNDERS NETWORK

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## **Abstract:**

This paper presents experimental data obtained on long paths (from 2200 km to 6500 km range) of Russian frequency modulated continuous wave (chirp) sounders network for the period from 2002 to 2004. Four transmitters: near Magadan (59.70N, 150.70E), Khabarovsk (47.50N, 134.50E), Irkutsk (52.30N, 104.30E), Norilsk (69.40N, 88.10E) and four receivers: near Irkutsk (51.830N, 104.0E), Yoshkar-Ola (56.50N, 47.90E), Nizhny Novgorod (56.10N, 44.10E), Rostov-on-Don (47.30N, 39.70E) were combined into single network to investigate a influence of geomagnetic storms and substorms on HF propagation in Asian region of Russia. In this region the geographic latitudes are in greatest excess of magnetic latitudes. As a consequence, elements of the large-scale structure, such as the main ionospheric trough, and the zone of auroral ionization, are produced in the ionosphere at the background of the low electron ionization. Coordinated experiments were carried out using 3-day Solar-Geophysical activity forecast presented by NOAA Space Environment Center in Internet. Sounding operations were conducted in the frequency band 4 - 30 MHz on a round-the-clock basis at 15-min or 5-min intervals. The frequency switching rate was 100 kHz/s or 500 kHz/s. Oblique-incidence sounding (OIS) ionograms were recorded during 5-7 days every season for three years. Moderate geomagnetic disturbances with Kp-index exceeded 5 and with the Dst-index less than -50 units occurred at the time of conducting five experiments. Analysis of the HF propagation in the above experiments received special attention. Additionally, data from a network of vertical-incidence sounding stations, and also data from the Irkutsk incoherent scatter radar were used. The comparison between experimental data and simulation of OIS ionograms using International Reference Ionospheric model (IRI-2000) allowed to estimate the forecast of HF propagation errors both under quiet condition and during geomagnetic disturbances. Strong deviations from median values of maximum observed frequencies on mid-latitude paths in daytime during geomagnetic disturbances present a real challenge to ionospheric forecast. Subauroral and mid-latitude chirp-sounding paths run, respectively, near the northward and southward walls of the main ionospheric trough. This make sit possible to study the dynamics of the trough\'s boundaries under different geophysical conditions and assess the influence of ionization gradients and small-scale turbulence on HF signal characteristics. For substorms of October 21-22 and 24-25, 2003, significant (up to ~50%) negative disturbances of electron density were recorded during the nighttime and daytime in the longitude sector from 90E to 150E from subauroral to

mid-latitudes (up to ~50N). During the nighttime the equatorial boundary of the auroral oval reached ~55N (invariant latitude). The off-great circle propagation signals were registered over a wide frequency range and for long time intervals during a moderate geomagnetic disturbances.