First OIS experiments in Mexico.

M.A. Sergeeva[1,2*], J.A. Gonzalez-Esparza[1], D.V. Blagoveshchensky[3], O.A. Maltseva[4], V.V. Shumaev[5], P. Corona-Romero[1,2], V. De la Luz[7], J.C. Mejia-Ambriz[1,2], L.X. Gonzalez[1,2], E. Romero-Hernandez[6], M. Rodriguez-Martinez[7], E. Aguilar-Rodriguez[1], A. Espinosa-Jimenez[1], E. Andrade[1], P. Villanueva[1], V.J. Gatica-Acevedo[8], A.G. Chernov[5].

[1] LANCE, Instituto de Geofisica, Unidad Michoacan,
[2] CONACyT, Instituto de Geofisica, Unidad Michoacan, Universidad Nacional Autonoma de Mexico, Mexico
[3] Saint-Petersburg State University of Aerospace Instrumentation, Saint-Petersburg, Russia
[4] Institute for Physics, Southern Federal University, Rostov-on-Don, Russia.
[5] Sitkom LLC, Yoshkar-Ola, Russia
[6] LANCE, Universidad Autonoma de Nuevo Leon, Monterrey, Mexico
[7] ENES, Unidad Morelia, Universidad Nacional Autonoma Universidad Nacional Autonoma de Mexico, Mexico de Mexico, Morelia, Mexico
[8] Instituto Politecnico Nacional, Mexico City, Mexico

ABSTRACT.

Since 2015, the monitoring of the ionosphere state in Mexico is performed by the Mexican Space Weather Service (SCiESMEX) which forms the part of the National Space Weather Laboratory of Mexico (LANCE). Up to the moment, the vertical Total Electron Content (TEC) calculated with local GNSS receiver data was the main parameter to estimate the changes in the ionosphere of the region. It is known that the ionospheric sounding is an important source of information about the ionosphere and radio propagation conditions along the radio path. In 2018, LANCE began the series of the oblique sounding experiments (OIS) in the country. No OIS experiments in the low-latitude North-American region were made before. These measurements are the first step to solve the task of the continuous real-time ionospheric sounding in the country. Chirp signal reception in the frequency range of 2-30 MHz with the frequency sweep rate of 100 kHz/s was organized in the center of Mexico in the premises of LANCE (lat ~19N, lon ~101W). The Maximum and the Lowest Observed Frequencies (MOF and LOF) were obtained from the ionograms. The results for the short radio paths (~3000km) are reported. The measurements were performed during the periods of quiet Space Weather conditions which means the solar minimum conditions and the absence of significant variations of the geomagnetic field and the intense solar flares. The geomagnetic field conditions were estimated by local magnetometer data: local K index (Kmex) is calculated continuously by SCiESMEX in real-time. The first results showed the following. The diurnal ionospheric variation of local TEC data was confirmed by MOF data with some shift in the hour of the diurnal electron density maximum. The nighttime enhancements detected with TEC were also confirmed by MOF data. It is known that the appearance of the sporadic Es-layers is typical for low-latitudes. Indeed, Es traces were frequently detected at the ionograms. They occurred both at day and nighttime. The presence of Travelling Ionospheric Disturbances (TIDs) is also characteristic for the region. In general, characteristics of the received OIS signals varied significantly at day and night. In regard to the HF propagation conditions, the widest frequency range of the received signals was detected in the morning and daytime hours. The characteristic feature of the region is the multi-hop propagation. Another characteristic feature is the presence of the interlayer propagation modes which were detected during daytime and nighttime conditions. The obtained results of observations were compared to the modeling results because we

use the modeled value of the Maximal Useful Frequency of the ionospheric F2 layer (MUF(D)F2) directly. In our case, the distance D was about 3000 km. Therefore, MUF(D)F2 was obtained with the International Reference Ionosphere model, using its M3000F2 parameter. The discrepancies between the modeling and observations results were detected. LANCE acknowledges partial support from CONACyT LN 293598, CONACyT PN 2015-173 and CONACyT-AEM Grant 2017-01-292684. D.V. Blagoveshchensky acknowledges grant № 18-05-00343 from Russian Foundation for Basic Research. O.A. Maltseva acknowledges grant under the state task N3.9696.2017/8.