INTRODUCTION

The Swarm mission allows us to investigate the effects of changing solar activity on ionospheric variability. We use the Swarm in situ measurements of the electron density and derived parameters that have been combined into a unique dataset called the Ionospheric Plasma Irregularities product (IPR) [1]. IPR provides characteristics of the plasma variability along the orbit and gives information on plasma density structures in the ionosphere in terms of their amplitudes, gradients and spatial scales.

Here we have continued the study of Kotova et al. [2] by including a larger data set and focusing on quiet geomagnetic conditions. We focused on distributions of electron density (Ne) and rate of change of density index (RODI) in 10 seconds in different regions in the Northern and Southern hemispheres for different solar activity levels.

Understanding the distribution of ionospheric parameters in the context of changing solar activity level can have implications for the development of new satellite instruments and for the accuracy of GNSS precise positioning.

Electron density and RODI in 10 seconds

NORTHERN HEMISPHERE

SOUTHERN HEMISPHERE

FIG. 3: Distributions (histogram) of the electron density and RODI in 10 s measured by Swarm A in Northern and Southern hemispheres during the days with high (top row), middle (central row) and low (bottom row) solar activity levels. The colours present the distribution in different regions: red in the low latitude region, green in the mid-latitude, blue in the high latitude, and purple in the polar cap regions. Y-axes presented in a logarithmic scale. Small plots (A) present some cases for one region with a more in-depth analysis of seasonal variability. The gray histogram represents the overall distribution, and the colors represent the contributions of the seasons. (B) Example of the best probability density functions (red line) determined to fit the histogram of the data (blue).

WORK WITH BIMODAL DISTRIBUTION of Ne

FIG. 5: An example of approximation of the bimodal Ne distribution using the model a sum of Gaussian curves.

CONCLUSIONS

❖ The main source of a two-peaked distribution of electron density is primarily solar illumination of the region.
❖ Comparing both hemispheres during different solar activity levels, we observed higher values of RODI in 10 s and electron density in the Southern hemisphere.
❖ Our results provide information on the shape of the distribution and probability density functions of Ne and derived ionospheric parameters (as RODI in 10 s) that can be used as a baseline important for other modeling studies.

REFERENCES

[1] Jin et al., 2022

[2] Kotova et al., 2022