# A COMPARISON BETWEEN THE ARIEL 4 EMBIENT ELECTRON DENSITIES AND IONOSPHERIC CRITICAL FREQUENCIES OVER THE COST 251: IITS AREA

Y.Tulunay[1], H.Rothkaehl[2], G.Juchhikowski[2], I.Stanisławska[2]

[1] İTÜ Faculty of Aeronautics and Astronautics, Maslak 80626 İstanbul, Turkey
[2]Space Research Centre PAS, 00-716 Warsaw, Poland

ABSTRACT

The electron density trough is the ionospheric projection of the magnetospheric plasmapause. The trough marks the region where electron density variation is abrupt over a narrow range of geomagnetic latitudes. The ionospheric electron densities or ionospheric critical frequencies foF2, are variable both temporally and spatially. Therefore, it is essential to understand the role of the trough in ionospheric variability.

A comparison between the ambient electron density data returned by the polar orbiting Ariel 4 satellite from December 1971 till August 1972 and ionospheric critical frequency values for the same period over the COST 251 area were used to study the changes of the position and shape of the ionospheric trough. The data have been chosen for the well distinct trough features in particular.

## 1. INTRODUCTION

The trough studies initiated by Tulunay and Sayers (Ref.1) using the Ariel 3 data were extended in the past to encompass the Ariel 4 and other independent data. Some improved criteria for the computer selection of troughs have been adopted to enhance the statistics of the analysis and to improve the quality of the trough data. The results of the data analysis based on more than 1000 Ariel 3 and Ariel 4 trough cases have appeared in literature since 1971. Naturally, there has been some considerable work published in the literature since the Ariel 4 days. However, there has been no concrete, adaptable trough model agreed upon up to now to our knowledge. Since the satellites Ariel 3 and Ariel 4 offered a continuous coverage, with reliable data which were obtained by the same technique and the statistics based on more than 1000 trough cases encouraged the authors to present some typical examples of these extensive and detailed results which can shed considerable light on the morphological, feature and dynamical identity of the trough.

## 2. DISCUSSION AND RESULTS

The Ariel trough was usually observed both day and night in the magnetic winter hemisphere where the relative positions of the sub-solar point to the magnetic equator varies considerably such as for the December Solstice (NH winter) over ($0^oE$-$180^oE$) geographic longitude zone (LONG 1); and for the June Solstice (SH winter), in the ($100^oW$-$40^oW$) zone (LONG2). Otherwise, the trough was observed at night between ($22^{50}$-$07^{40}$)LT in summer hemisphere, and again at night, but longer periods, in the winter hemisphere (Figures 1 and 2).

The trough was not observed at all either day or night, in the magnetic summer and equinox hemisphere where the relative position of the sub solar point to the magnetic equator does not vary very much such as in the June Solstice (NH summer), ($0^oE$-$180^oE$) zone, and in the December Solstice (SH summer), ($100^oW$-$40^oW$) zone (Figures 1 and 2). Since Ariel 4 days there have been many attempts to diagnose, to model, to classify the "trough" and the physics behind it. There have been several semi –empirical formulae in the literature to make the trough a friendly-user tool for forecasters (Ref.2). In particular, it is important to consider the topside satellite data with the ground based ionospheric measurements interpreting the role of the trough both scientifically and in practical applications. Figure 3 (a) and (b) illustrate the results of some recent work in which the Ariel 4 ambient electron densities are compared with the electron densities computed from the ionospheric critical frequencies during magnetically quiet periods. Both results reflect the prevailing conditions of the ionosphere over the COST 251 area. In Figure 3 (a) the mid-latitude trough is very prominent which is structured towards the higher latitudes. The high latitude trough or the high latitude "hole" (Ref.3) is very clear at geomagnetic latitudes greater than $60^oN$ approximately. At the ionospheric heights, as seen in Figure 3 (b) the mid-latitude trough is clear. The statistics is poor over higher latitudes due to the scarcity of ionospheric data. Therefore, in Figure 3 (b) the hole is not clearly marked.

Figures 4 (a) and (b) show the ionosphere of the Figures 3 (a) and (b) during high magnetic activity. The satellite results indicate that the trough moved to lower latitudes and the polar ionosphere is depleted (Ref.4). The bottom side, computed electron densities, however, do not show much difference. That is, the trough moved to lower latitudes slightly and there is not much difference in the electron densities magnitude wise. However, the tendency is to observe a deeper trough at lower latitudes.

## 3. CONCLUSION

It has been obvious that the foF2 peak can extend above 500 km. in the topside ionosphere. As a consequence of this the signature of the trough can easily be felt in the foF2 data all over the world. From this point of view it must be essential to include the influence of the trough in foF2 predictions or forecasts.

In order to establish a better description and prediction of the mid-latitude trough features it is essential to combine the in-situ satellite observations with those of the ground based measurements such a task will yield a more reliable empirical trough model.

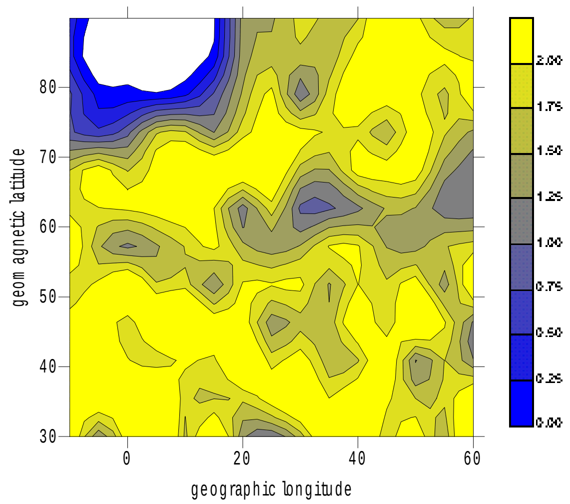


*Figure 3.a.*
*The global distribution of ambient electron density(MHz) gathered on the board of Ariel 4 satellite, from December 1971 till August 1972, over COST 251 area for Kp<1-.*

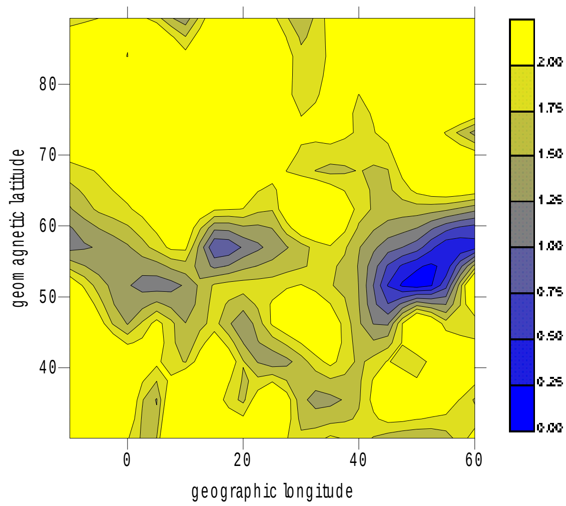


*Figure 4.a.*
*The global distribution of ambient electron density(MHz) gathered on the board of Ariel 4 satellite from December 1971 till August 1972 over COST 251 area for Kp>4+.*

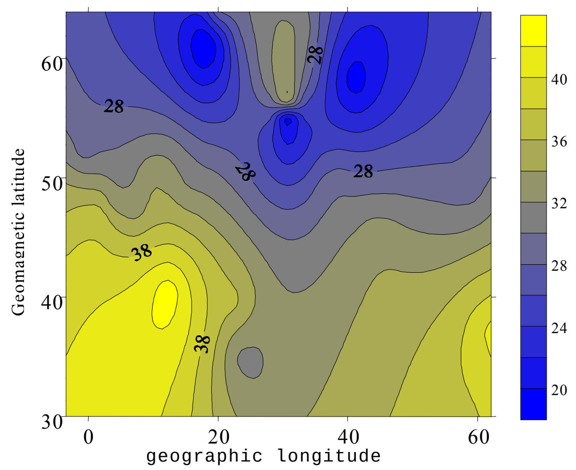


*Figure 3.b*
*The distribution of mean critical electron density(MHz*10) for four very quit days with Kp<1, over COST 251 area, covered the ARIEL 4 time domain, constructed by use the ionosonde ground based measurements.*

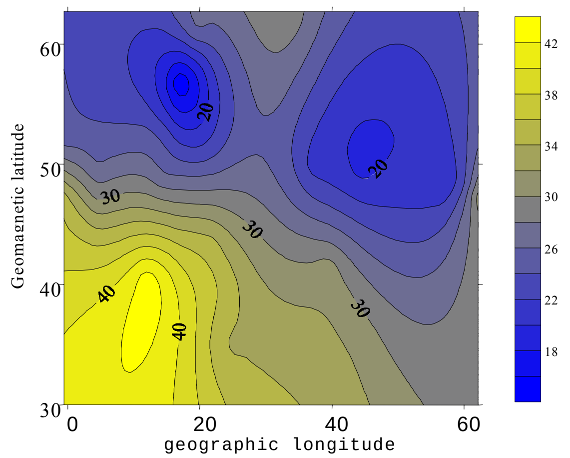


*Figure 4.b*
*The distribution of mean critical electron density(MHz*10) for four very disturb days with Kp>4+, over COST 251 area, covered the ARIEL 4 time domain, constructed by use the ionosonde ground based measurements.*

## 4. REFERENCES


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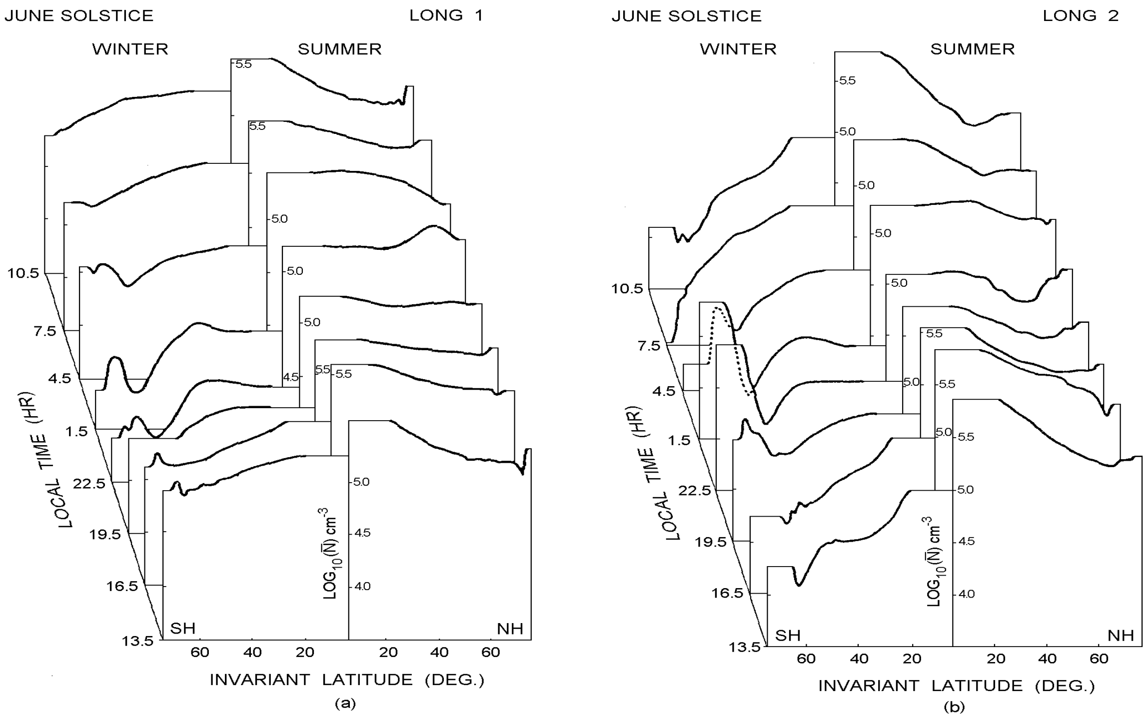


***Figure 1(a,b).*** *The latitudinal behavior of the averaged electron densities at different local times and for two longitudinal zones for two hemispheres in the June solstice.*

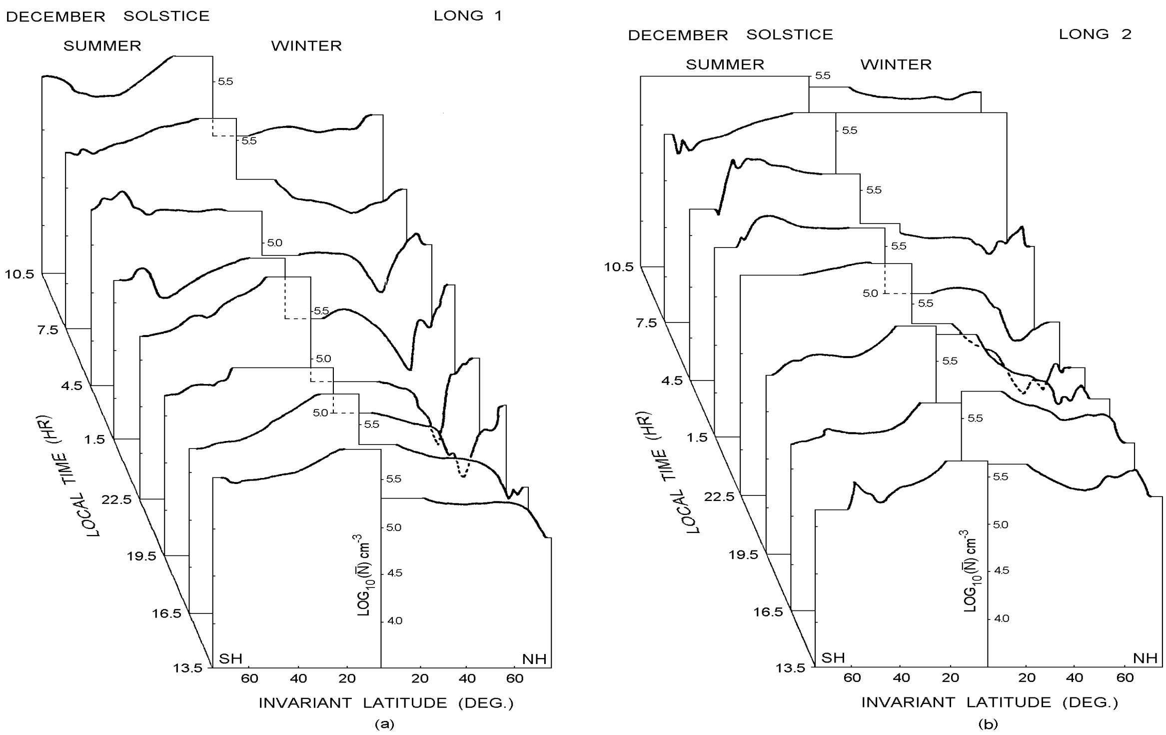


***Figure 2(a,b).*** *The latitudinal behavior of the averaged electron densities at different local times and for two longitudinal zones for two hemispheres in the December solstice.*

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