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THE DIURNAL VARIATION OF Es LAYER PARAMETERS AT SODANKYLÄ IN SUMMER 1973 BASED ON IONOSPHERIC SOUNDINGS UTILIZING LOW FIXED GAIN

by

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Abstract

Ionospheric soundings were taken at Sodankylä in summer 1973 at a low fixed gain and an expanded height scale in order to reveal the behaviour of blanketing Es layers without contamination from weak scattered echoes. The diurnal variation of virtual height of Es reveals that two distinct waves of descending Es layers dominate the Es statistics. The first wave commences at 8 LT from the altitude of 115 km and the second at 17 LT from the altitude of 122 km. The time of descent to an altitude of roughly 100 km is several hours. The Es layers belonging to the evening wave are much stronger than those in the morning wave.

1. *Introduction*

The Es data measured in Sodankylä from 1958 – 1972 have been studied in several papers (TURUNEN, [1], [2], [3], [4], [5]). As described by Turunen (TURUNEN, [2]) these parameters suffer from too high gain used in the ionospheric sounding in the years mentioned. In summer 1973 a special experiment was carried out by using parallel receiving and recording system for obtaining reliable and accurate data about Es layers having high reflection coefficient. Only the Es parameters were scaled from the ionograms with the greatest possible accuracy, for example the virtual height was scaled by an accuracy of one kilometer, which in practice is impossible if the height scale of the ionogram is the standard one allowing the interpretation of F layer parameters under all ionospheric conditions.

Only the data from June, July and August were used because in these months the normal E layer is seen most of the time at Sodankylä thus allowing a homogeneous Es type scaling and the noise conditions are very favourable allowing the wanted accuracy. Because of the low fixed gain the fmin is immediately very high or total absorption occurs in case of auroral activity, and the data describe mainly the Es behaviour under quiet magnetospheric conditions. Because of the fixed gain the normal diurnal variation in absorption, of course, causes some modulation in foEs, which must be borne in mind. The results obtained give an important extra information about the Es phenomena seen at Sodankylä and studied in the papers listed above.

2. *Results of analysis*

The median virtual height variation is presented in Fig. 1. All the data from the three months studied are used. Two descending waves are clearly seen, the first one starting at 8 LT and the second at 17 LT. The waves seem to overlap in the afternoon and the individual events also verify this in some cases. The scatter of points, which the median curve is based on, is surprisingly small. The morning wave starts from

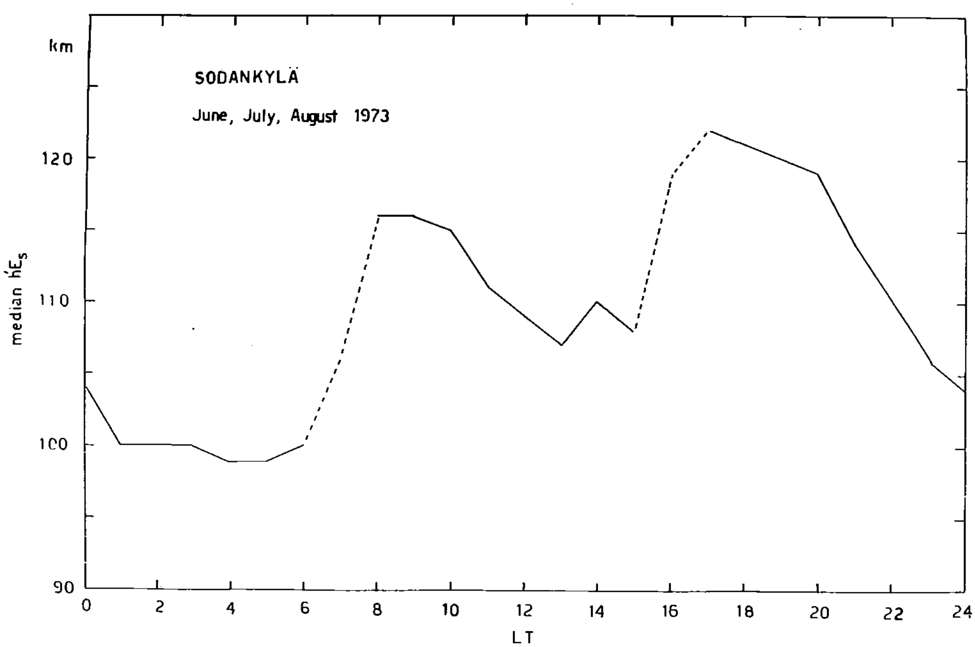

Fig.1. Median virtual height variation of Es layers at Sodankylä in June, July, and August, 1973.

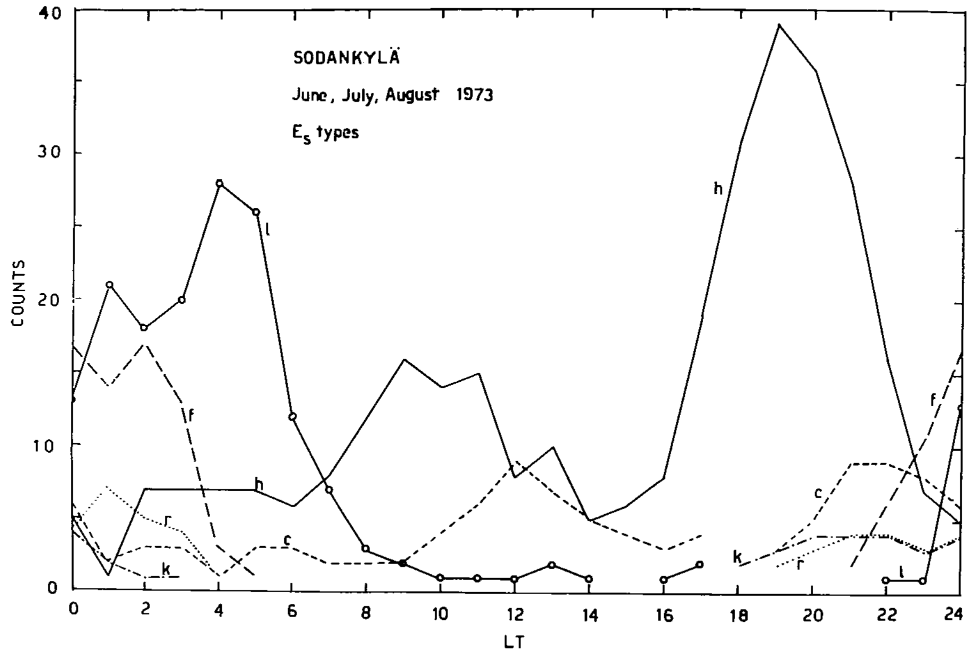

Fig. 2. The hourly counts of different Es types seen at Sodankylä in June, July, and August, 1973. Also presented is the particle E layer (letter k).

the altitude of 115 km and the afternoon wave from the altitude of 122 km. The reason why the upward going parts of the variation are drawn by dotted lines is that no individual Es layers having that kind of increase in virtual height were seen in the data.

In Fig. 2 the occurrence of different Es types in the studied period is shown. As it is already clear from the virtual height variation, there exist two maxima in the »h» type Es and a similar behaviour is also seen in the »c» type Es but about two hours later. In the »f» and »l» type Es only one maximum is seen relating to the evening wave. This indicates that the morning wave does very seldom, if ever, have the »l» type Es as a final stage but the evening wave has it almost always. It is easy to understand that the count of the »c» type Es is low because it happens only at very narrow height interval if compared with the »h» and »l» type Es. The broad maximum in the »f» and »l» types of Es shows that these layers belonging to the evening wave are very persistent.

This fits well with the earlier results showing (Turunen and Rao, [4]) that the sequential Es is at Sodankylä an evening time phenomenon. In that study

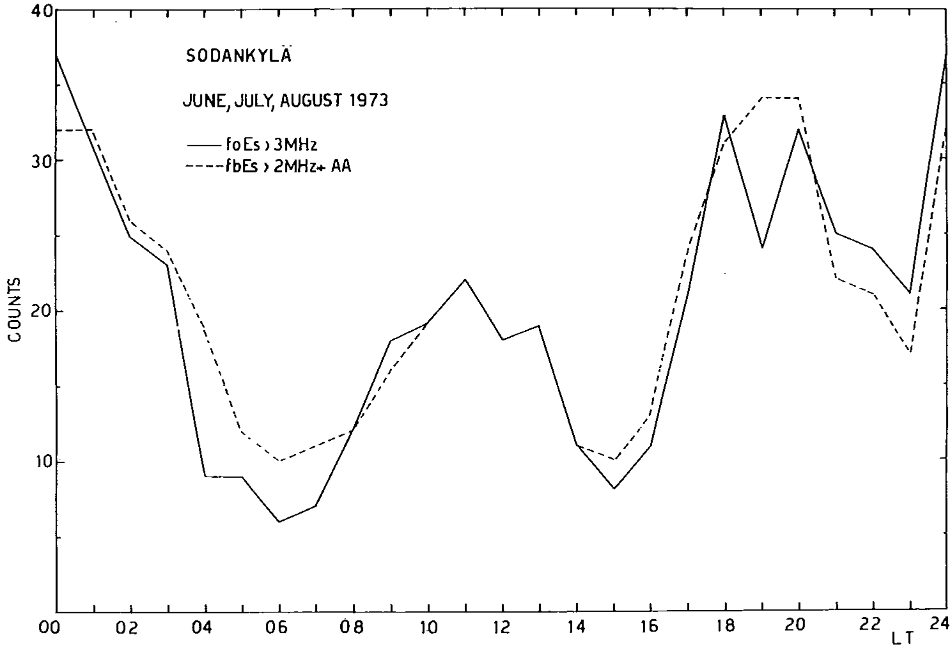

Fig. 3. Hourly counts of cases when foEs exceeded 3 MHz, solid line, and when fbEs exceeded 2 MHz, dotted line.

no sequential Es layers were found in the morning but this study shows that a very similar process occurs also in the morning hours but the events do not have an »l» type Es as a final stage. Thus it seems that perhaps all midlatitude type Es layers seen at Sodankylä in summertime belong to the sequential Es but the sequence is seldom complete.

In Fig. 3 foEs > 3 MHz and fbEs > 2 MHz are presented. Their behaviour is very similar. There are three maxima, a shallow maximum around the noon hours relating to the morning wave, an evening maximum relating to the »h» type Es layers, and a night time maximum relating to the »l» and »f» types of Es layers together with a small amount of Es layers belonging to the auroral zone types. The figure shows that the Es layers belonging to the morning wave are usually weaker than those belonging to the evening wave. This explains why nice sequential Es layers are only an evening time phenomenon.

The only auroral zone type of Es was the retardation Es in the data. Because of its close relationship to the particle E layer, the diurnal variation of the particle E is also indicated. As seen in the Figure 2 those two have almost but not exactly identical diurnal variations.

The lack of auroral type Es is caused by two reasons, namely, the low gain used prevented the weak scatter to be recorded and, if possible, some other type than auroral type was systematically given for an Es layer if it was physically justified.

3. *Summary and discussion*

By using special recordings especially suitable for the study of Es layers it was found that in summer time at Sodankylä the main part of Es activity occurs in two distinct waves the first commencing in the morning at 8 LT and the second in the evening at 17 LT. The two waves are caused by sequential Es although the phenomenon is seldom complete at Sodankylä. The evening wave is much stronger, the occurrence frequency of Es layers belonging to this wave is higher, and also the foEs and fbEs values are higher. The morning wave seldom shows the »l» type Es as a final stage, in contrast with the evening wave where there usually occurs the »l» or »f» type of Es layer, which is often very persistent. The semidiurnal component of the tidal wave may be the main source of midlatitude types of Es layers at Sodankylä. If the gain used in the soundings is low, the number of the »a» type Es layers is very small in summertime. In this study none was found.

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