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NUMERICAL MAPPING AND MODELLING AND THEIR APPLICATIONS TO PRIME

COST 238/PRIME Workshop

Eindhoven, The Netherlands
1994

OVERVIEW

The volume contains a selection of papers presented at the May 1994 COST 238 Workshop on 'Numerical mapping and modelling and their applications to PRIME'. It is a pleasure once again to be associated with a full PRIME Workshop - this time the sixth in a series extending over as many years. PRIME (Prediction and retrospective ionospheric modelling over Europe) was formally initiated as Project COST 238 in March 1991 as a four-year project aimed at developing improved models of the European ionosphere for telecommunications applications, but the work has its origins earlier arising from existing collaborations in the areas of vertical and oblique-incidence sounding. We now have active participation from groups within 18 Western and Eastern European countries and again all were represented at this latest Workshop.

COST (Cooperation in Scientific and Technological Research) was initially established for European Union Member States, with each country joining those projects in which it has interest on a case-by-case basis. However, over recent years the numbers of COST countries have grown and there is now provision for participation of individual institutes from non-COST countries. In our case we have three such institutes involved.

The Workshop gave prominence to progress in developing NEW empirical mapping techniques along lines first proposed at a limited Workshop held in Abingdon, UK in December 1993. Following tests by specially appointed computer experts who had been assessing the relative accuracies of various candidate approaches the previous week in Eindhoven, latest developments were considered. Discussions centred on what further improvements could be incorporated. Subsequent to a successful specialist Workshop on instantaneous mapping which took place in Warsaw in March 1994, this topic was also addressed at length and a number of optional approaches considered.

The work of PRIME as a whole covers the topics of vertical and oblique-incidence sounding, short-term and long-term ionosphere mapping and modelling and short-term forecasting of ionospheric characteristics. Some 30 presented papers addressed different aspects of these subjects. In addition there were 9 poster papers. As always, time constraints limited full review of every facet, but by restricting the numbers of presented papers to invited topics it became possible to identify the key points and to take important decisions on the way ahead. I am grateful to Dr Leon Kamp and to the Working Group Leaders for their help in formulating the Workshop programme.

Each Session Chairman and Working Group Leader has provided a summary covering the ensuing discussion. Thanks should be extended to all who contributed to the Workshop both in preparing presentations and in participating in the discussions. I believe that in a very full programme optimum use was made of the available time and that good and timely overall progress is being made towards our agreed goals.

We are all particularly grateful to Dr Kamp on behalf of the Eindhoven University of Technology for hosting us and for the painstaking way in which he made the local arrangements. We extend our sincere thanks to him and his colleagues for all they did to ensure the event was a success. We especially thank Professor F W Sluijter and the University for hosting an accompanying social excursion and dinner.

Thanks are accorded to the University, The Netherlands Foundation for Fundamental Research on Matter, Océ van der Grinten, Stichting Universiteitsfonds Eindhoven, PTT Research and to the European Commission for financial support in making the meeting possible. Finally too our thanks go to Dr Kamp for arranging this present publication.

Peter A Bradley
Chairman COST 238

VARIABILITY OF ELECTRON DENSITY AT FIXED HEIGHTS USING DIGISONDE DATA

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ABSTRACT

Series of electron density at fixed heights obtained from digisonde ionograms from Dourbes, Belgium, taken at intervals of 5 and 15 minutes in different months were analysed to investigate ionospheric time variability. The increase of variability with height found in a previous work is confirmed and an additional dependence of the variability with season and solar zenith angle is discovered. The possibility of a quantitative estimate of the variability with height and time in the F region is mentioned.

INTRODUCTION

This work attempts a confirmation of the main findings of a previous study on the time variability of the electron density at fixed heights (Mosert de Gonzalez and Radicella, 1993) done with hourly data obtained from conventional ionogram inversion.

Series of electron density values at fixed heights acquired from inversion of Lowell digisonde ionograms taken at 5 minutes (June 1990) and 15 minutes (October 1991) intervals from Dourbes (50.1 º N, 4.6 º E) are analysed in the present paper. ARTIST results were validated with ADEP software which output a data file including the electron density profiles. From this file densities at fixed heights from 160 to 260 km every 20 km were extracted. Figures 1 and 2 show examples of data from the two periods analysed.

In order to investigate the time dependence of the variability 5 min interval data covering one hour period and all the days available for June 1990 and 15 min interval data covering two hours period and all the days available for October 1991 have been considered. For the statistical analysis only data sets with more than 80 values were used.

The variability parameters applied are the standard deviation SIGMA and the coefficient of variability V given by the percentage ratio between the standard deviation and the mean of the set of values considered. The standard deviation can be considered an absolute estimate of variability and the coefficient V a relative one.

DATA ANALYSIS

Figures 3 and 4 show the variation with height of the standard deviation SIGMA and the coefficient of variability V % respectively for representative hours of the two periods analysed. Black symbols correspond to October data.

The figures indicate that both the absolute and the relative variability increases with height in the altitude range investigated (160-260 km) confirming the results by Mosert de Gonzalez and Radicella (1993). The variation with height of SIGMA and V around midday in June indicates the presence of a minimum of variability around 180-200 km as found by the authors just mentioned. In addition it can be seen that in day-time in October the increase of SIGMA with height is more pronounced than in June .

Figures 5 to 8 show the time variation of variability, the latter being larger at night-time confirming again the results by Mosert de Gonzalez and Radicella (1993). Figures 5 and 6 present also the mean values of the electron density N as a function of height and time of the day for the two periods analysed. The increase of SIGMA with height in October appears to be related to the increase of N that is very large in comparison with the corresponding values observed in June, suggesting a seasonal behaviour of the variability.

Figures 7 and 8, where the time variation of V is seen, indicates an enhancement of variability with the increase of solar zenith angle. Such a relation is confirmed in Figures 9 and 10 where the values of V at 200 km and 260 km for both months (J for June and O for October) are shown as a function of the cosine of the solar zenith angle X. The corresponding r^2 given in the figures show a good correlation between the two variables and also confirm a seasonal influence that should be further investigated.

CONCLUSIONS

The main conclusions are:

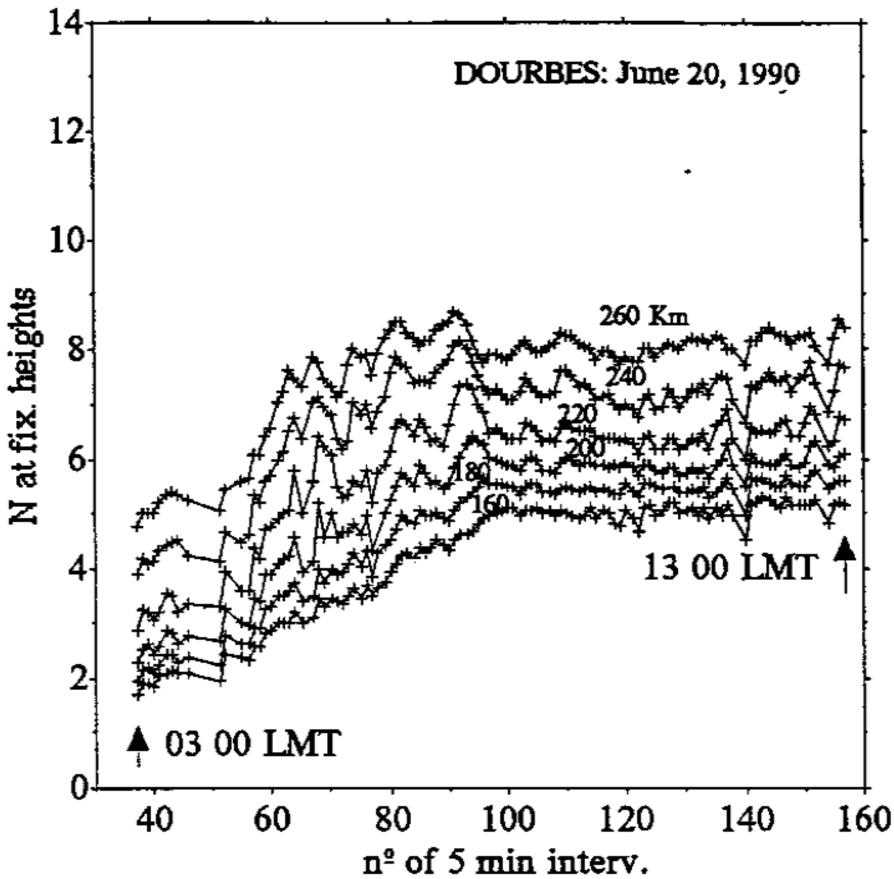
1.- As already found by Mosert de Gonzalez and Radicella (1993), the electron density variability at fixed heights increases with altitude in the F region in the range of 160-260 km.

2.- The relative variability is clearly dependent on solar zenith angle but depends also on the season.

3.- An extended analysis on the lines indicated in the present paper should make possible to give a quantitative estimate of the variability as a function of height and time.

REFERENCE

Mosert de Gonzalez, M. and Radicella, S.M.,(1993), " Study of ionospheric variability at fixed heights using data from South America ", presented at the 1993 IRI Workshop. Sent for publication in *Adv. Space Res.*



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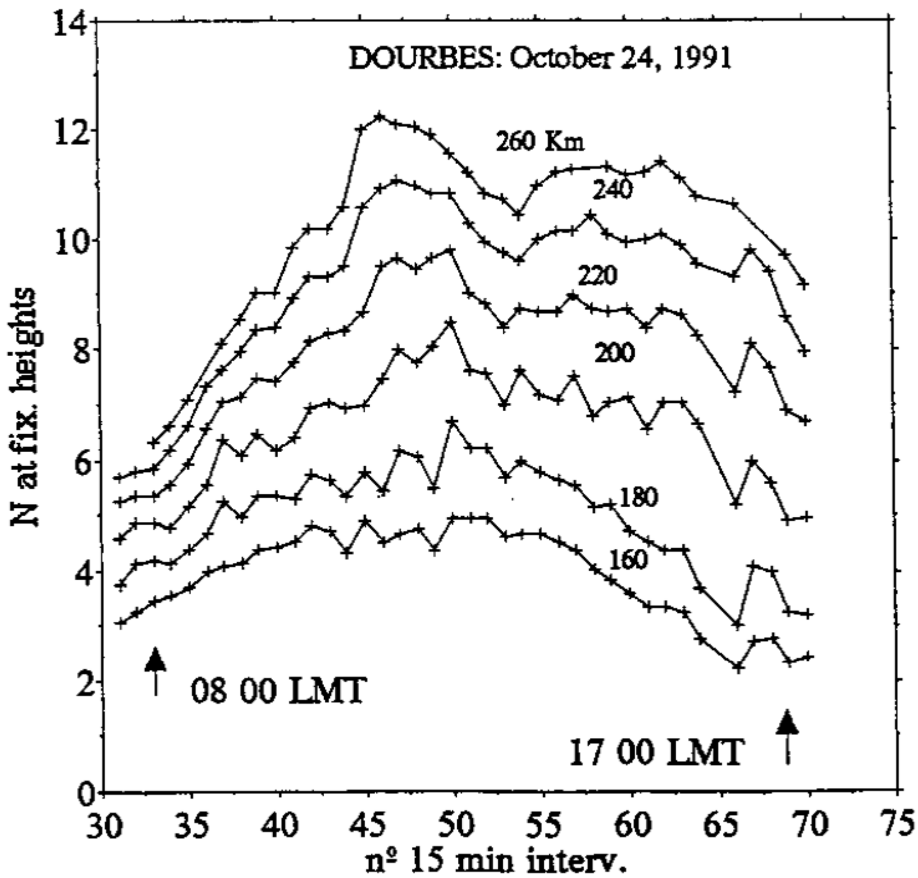

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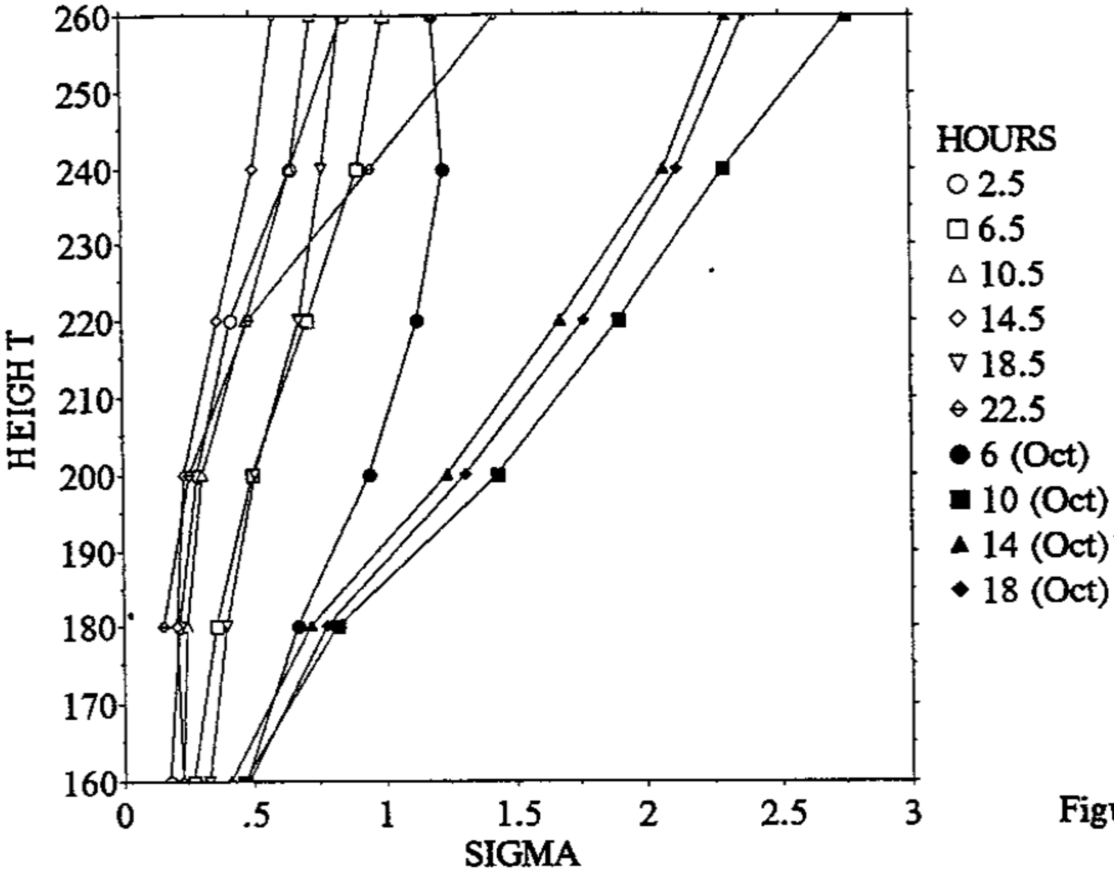

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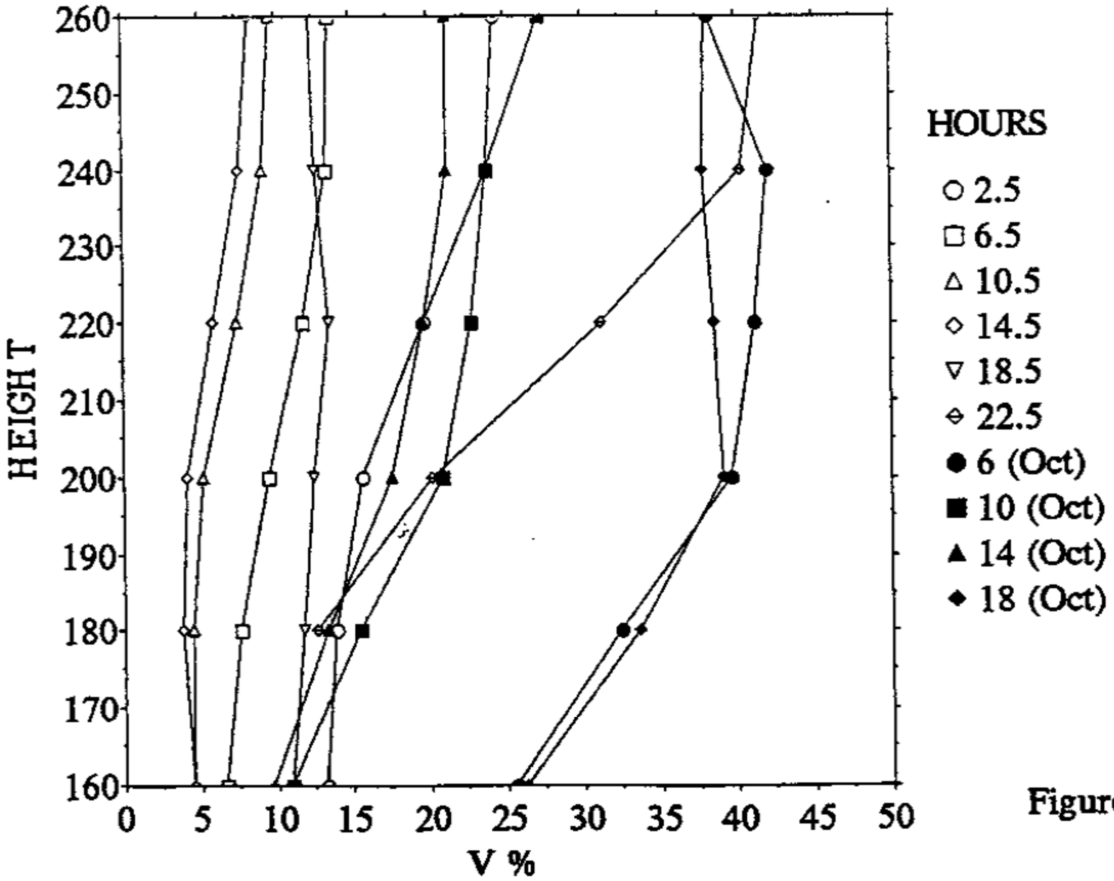

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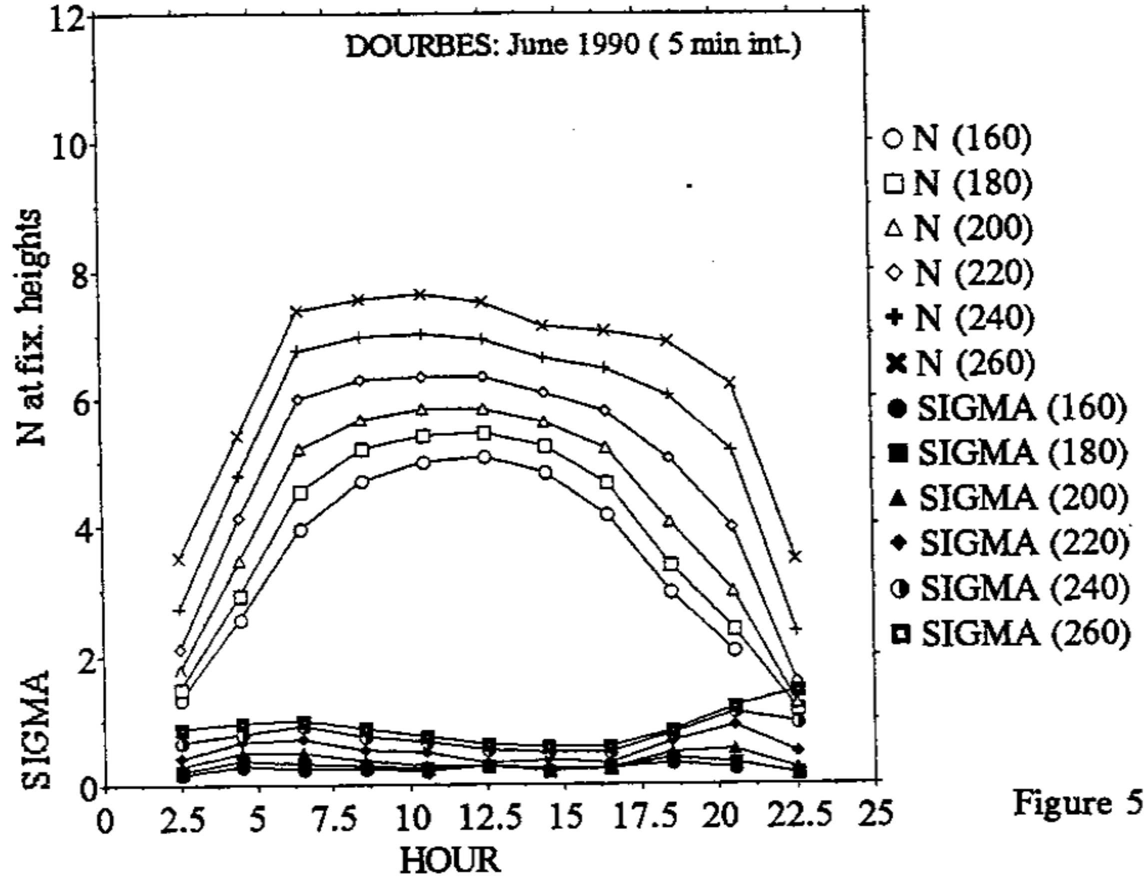

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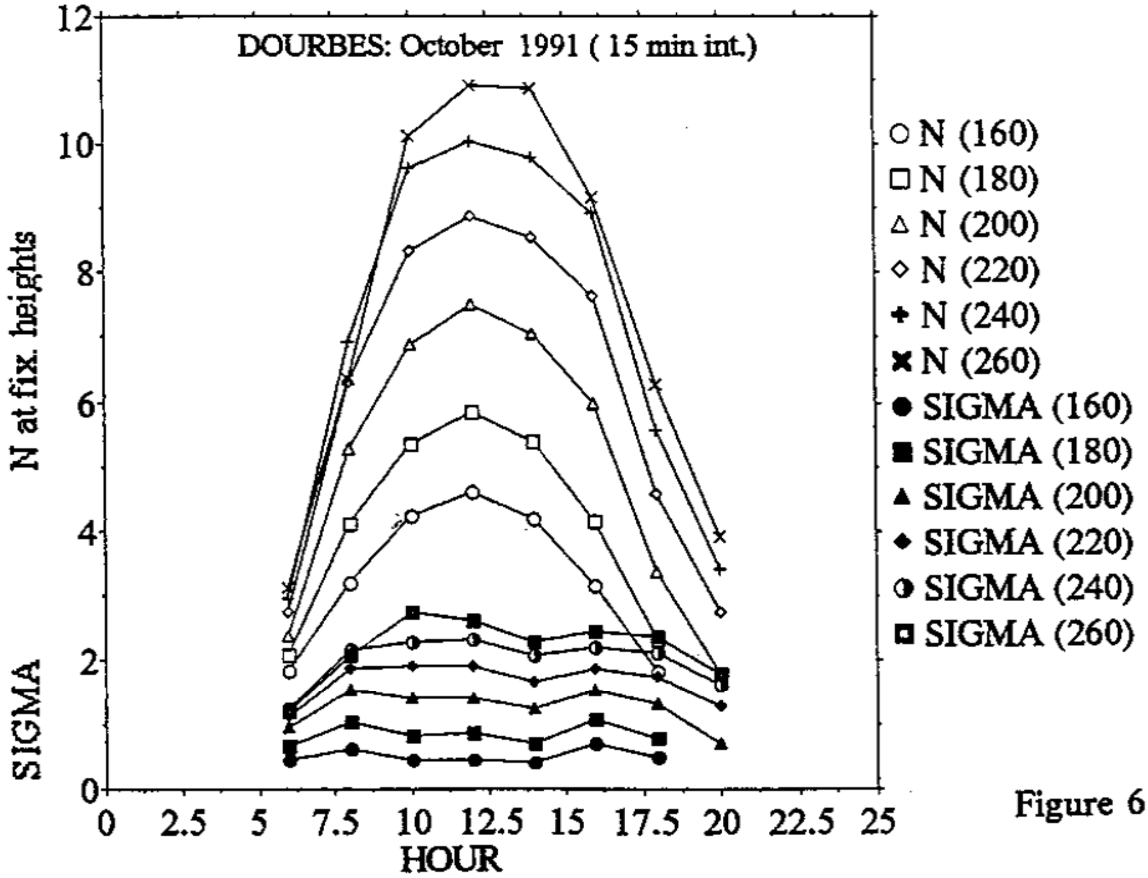

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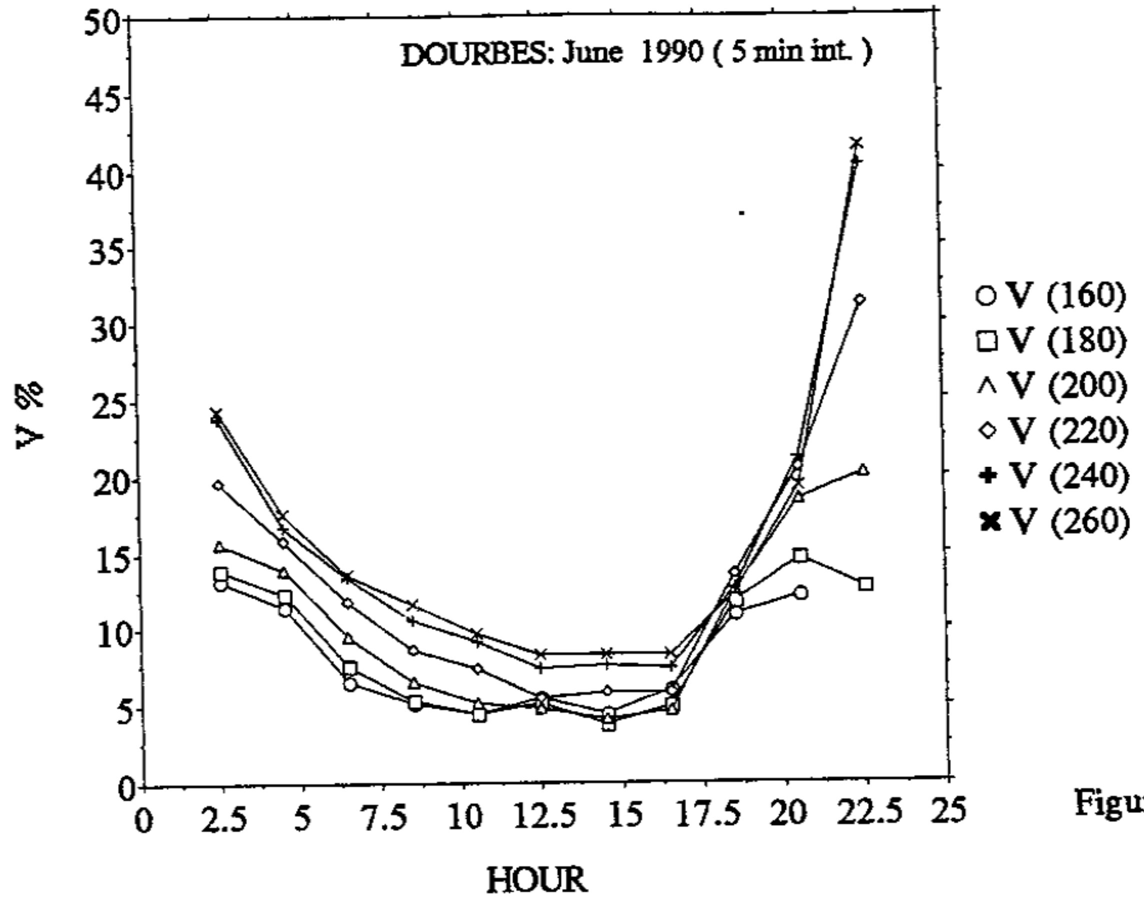

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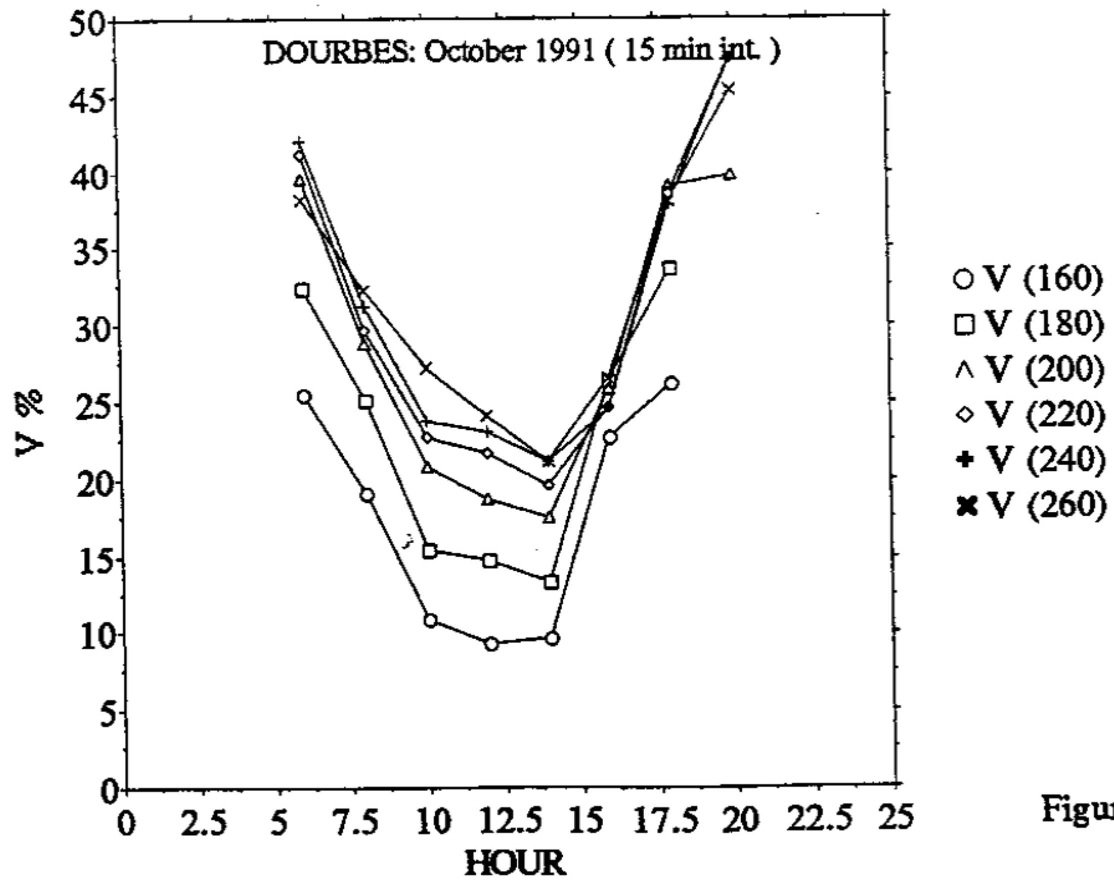

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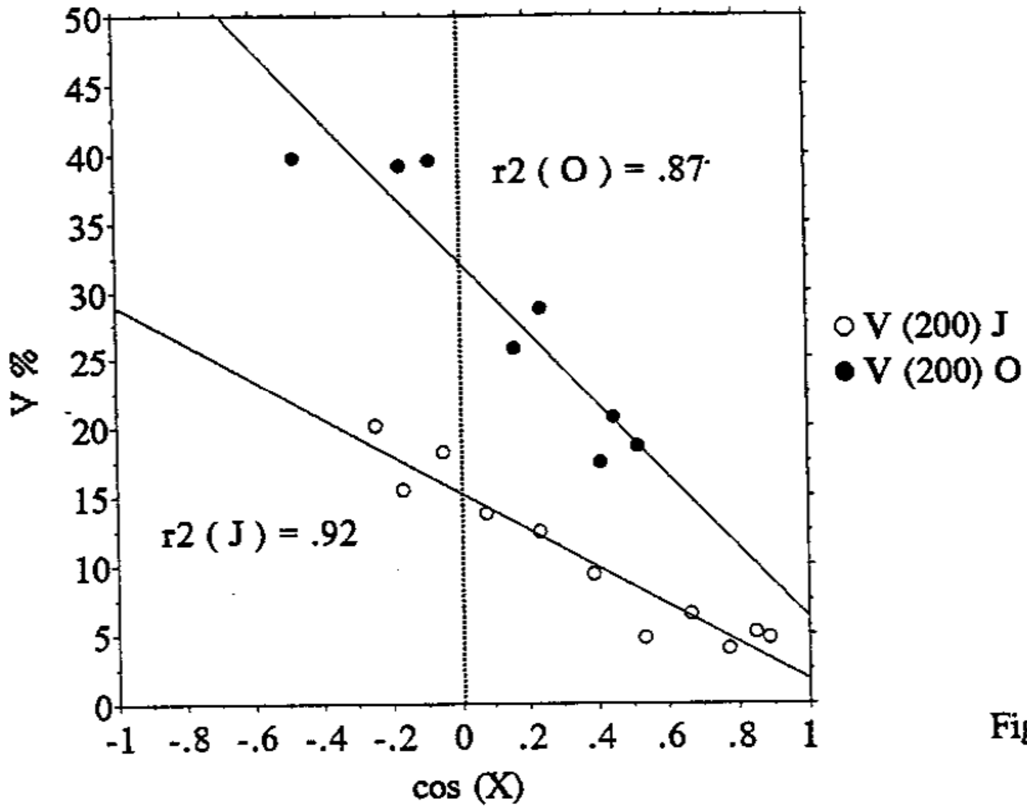

Figure 9

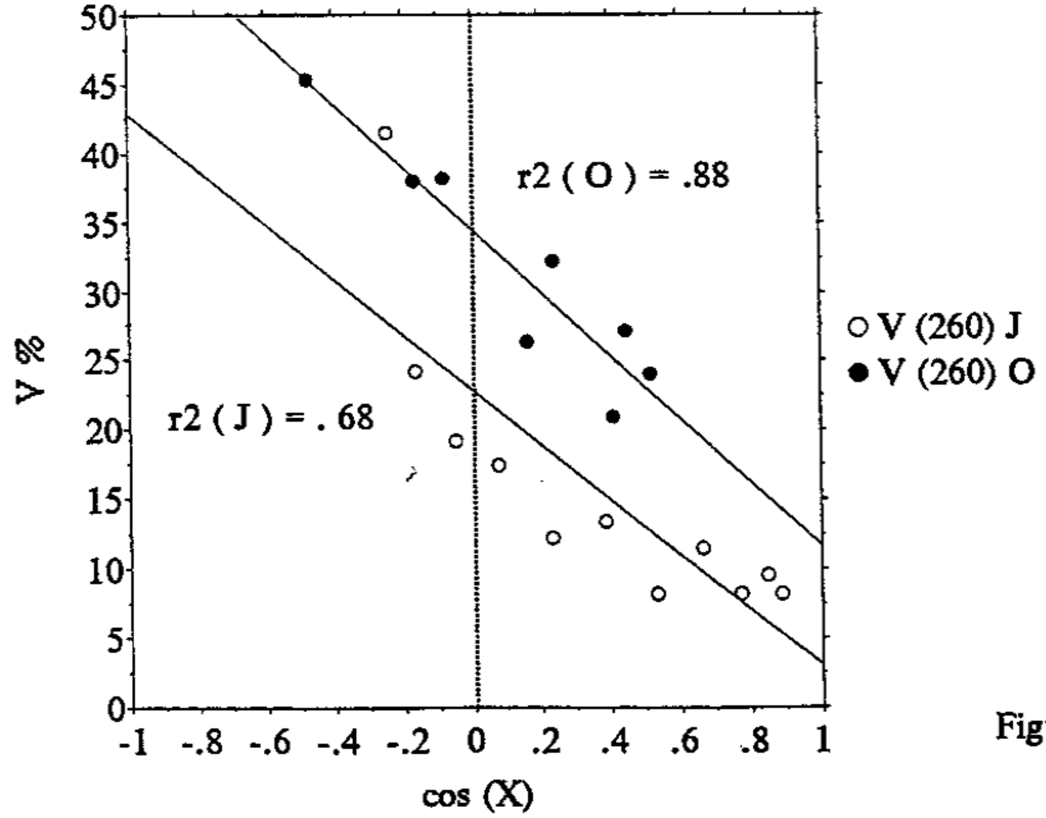

Figure 10