INAG-13 January 1973

IONOSPHERIC NETWORK ADVISORY GROUP (INAG)

Ionosphere Station Information Bulletin No. 13

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I. Introduction

by

W. R. Piggott, Chairman

Your Chairman and I.N.A.G. wish to thank you for your collaboration in the past and to wish you a successful and prosperous New Year.

I am sure that you will all be pleased to hear that the Second Edition of the URSI Handbook of Ionogram Interpretation and Reduction was published by World Data Center A for Solar-Terrestrial Physics as Report UAG-23 in November 1972. I should like to take this opportunity to thank all those who made this publication possible and in particular, those mentioned in section 0.4 of the Introduction to the Handbook.

A free copy of the Handbook has been sent to all known stations. Additional copies can be purchased at the price of $1.75 each, payable to Department of Commerce, NOAA, from the National Climatic Center, Federal Building, Asheville, North Carolina U.S.A. 28801, Attn: Publications. I feel that the Ionospheric Community owes a debt of gratitude to WDC-A and NOAA for having produced this book at such a low selling price - the first edition which was much smaller cost over £5 (£13 approximately) and thank them on your behalf.

Work is proceeding on producing translations of the Handbook in French, Russian and Spanish and we shall let you know in the INAG Bulletin when these are available. The French version is well advanced and is likely to be available soon.

The magnitude of the job of rewriting this Handbook was so great that it was only possible, in practice, to send copies of the draft to a few experts for comment. It is thus possible that you will still find some points which are not clear to you. *Your Chairman would welcome comments, criticisms and proposals for improving the Handbook.* You will notice that each Chapter is paginated separately at top of the pages as well as the pages being numbered consecutively at the bottom so that pages can be added without too much confusion. It is possible to remove the staples and punch the sheets so that the book can be loose leaf form if you so desire. This was done so as to help introduce any corrections or changes made in the future. It is also possible to rewrite and reissue individual chapters. While this is written primarily for use at stations, it is useful if users of the data also refer to it so as to recognize the conventions and limitations of the data. INAG therefore suggests that you show your copy to any scientists interested in V.I. data whom you may meet. Thanks to the efficiency of those responsible for publishing the Handbook at WDC-A and NOAA, it has been possible to include all changes in words agreed at Warsaw in the Handbook which is therefore completely up-to-date.

This Bulletin contains comments by your Chairman on the proposals of the Seminar of Kaliningrad (INAG-12 p20-21). *Some of these are controversial and your comments would be helpful.* An alternative, equivalent set of accuracy rules expressed in total range of uncertainty, as requested by Kaliningrad, is included in this Bulletin and may be used instead of the standard rules if preferred. They represent a rewording and not a change in rules. Figure 2.1 p 30 in the Handbook will need to be redrawn for this wording and an alternative is being prepared. *The Editors would like to know which alternative statement of the rules you prefer.*

It is important that accurate information is available on all the networks which will be collaborating in the period 1973-1978 for inclusion in the new edition of the Guide for International Interchange of Data. Please make certain that your National Representatives to the meeting in London, April 1973, (p. 7 of this Bulletin) are provided with up-to-date information or, if more convenient, send these data to your INAG Chairman or Secretary. *The Chairman would like to hear whether those attending this meeting wish him to organize an INAG meeting during it.*

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* Under auspices of Commission III Working Group III.1 of the International Union of Radio Science (INAG).

** Issued on behalf of INAG by World Data Center A for Solar-Terrestrial Physics, National Oceanic and Atmospheric Administration, Boulder, Colorado 80302, U.S.A. The bulletin is distributed to stations by the same channels (but in the reverse direction) as their data ultimately flow to WDC-A. Others wishing to be on the distribution list should notify WDC-A.

The need to improve data on worldwide changes in the height and shape of the F2 layer has been discussed in a number of INAG bulletins. These data are needed to enable ray tracing techniques to be used in predicting the operation of long distance circuits. In this Bulletin we include a short summary of some work by P. A. Bradley and J. Dudeney which shows one way in which existing parameters can be used to give a reasonable estimate of hmF2 and the shape of the F2 layer. The principle used is that the functions describing the electron density profile should not have more free parameters than the number of classical parameters available and should be well defined by these parameters. This work shows that even a very simple model can give data of adequate accuracy for studying hmF2 and the shape of the F2 layer.

The note is intended to draw attention to the possibilities of this type of approach and to provoke other groups to try similar investigations. It appears probable not to be necessary to define the F1 layer, thus greatly simplifying the work of producing world maps. *Your comments and local tests would be useful. INAG hopes that other groups having techniques which might interest the network will also provide short notes for these Bulletins.*

The Recommendations of U.R.S.I. passed at Warsaw have now been published in U.R.S.I. Information Bulletin No. 184, September 1972. This also contains a report on the 14th I.C.S.U. General Assembly at Helsinki and the decision to reorganize IUCSTP.

A full list of the new Working Groups of Commission III of URSI is given in this Bulletin together with the names of Chairmen and Vice-Chairmen and the scope of each Group. The latter have not yet been confirmed by the Chairmen and so may be slightly amended. The proposed scope for W.G. 1 INAG was amended with approval of Commission III Chairman. INAG will not change the nature of its work though there will be more emphasis on communication between scientists and networks, a job INAG has not stressed in the past (see INAG-12, p. 2). There will be close collaboration between Working Groups where they overlap and we may therefore expect comments and requests for data from the Working Group Chairmen.

Now that the Handbook is generally available, it is likely that further comments of the type raised in Kaliningrad on fbEs f-plot symbols will be appropriate. INAG would like to air as many of these as possible at an early date so that the Handbook text can be regarded as generally acceptable to all users. *Please make your comments or ask for clarifications as soon as possible so that they can be collected and published in the next Bulletin.*

INAG urgently requests volunteers to act as consultants for high latitude problems.

II. Kaliningrad Symposium - Discussion

The Report to INAG of the Seminar on vertical incidence soundings held at Kaliningrad U.S.S.R. August 18-25, 1971 was published in INAG-12, pp. 20-21.

The seminar made four major recommendations reproduced, with comments, below.

Recommendations:

The participants of the seminar decided for improvement of the work at the stations it was necessary (1) that the stations should send monthly station reports of the ionosonde operation including information on power, sensitivity, frequency markers, height markers, etc. (a standard form is supplied to the stations for these report); (2) that a two-weeks course on interpretation and reduction of ionograms and on equipment operation be held every two years; (3) that the exchange of personnel between stations including operators, scientists and engineers be arranged for periods of 3-8 months; and (4) that the participants of the seminar believed it was very undesirable that some Administrations wished to reduce the amount of data scaled and sent to the World Data Center (i.e., tabulations, N(h) profiles, etc.) since this practice would reduce the usefulness of the data available at the World Data Center for scientific studies needing long sequences of data.

Comments on Recommendations:

Rec. 1.

This is highly desirable where networks are able to do it as it enables the network administration to monitor all its stations. Many individual stations overlook the need to let the WDCs know when frequency or height markers are changed, or even when new equipment is installed, with the result that ionograms at the WDCs cannot be analyzed and incorrect advice is given to scientists about the availability and probable quality of data. WDC-A has prepared a file on all known stations, giving equipment details, dates of changes, programs, etc., and would welcome both current and past details from your station. This file is mostly compiled from reports of visitors to the stations or to WDC-A and is still very incomplete. In most cases, the latest data is that given in the Atlas of Ionograms. *Please check the Atlas and bring us up-to-date.*

Rec. 2.

INAG hopes that this initiative will be followed in other parts of the world and draws attention to the need to advertise existing or planned local training courses so that other groups can cooperate in them. For example, courses given in the U.K. are often used by operators from other countries who speak English and wish to improve their training. *INAG invites such groups to notify the community of future training operations by using the Bulletin* and draws attention to URSI Commission III, Rec. III.17, on training.

Rec. 3.

Rec. 3 was discussed at Warsaw where it received general support. INAG suggests that those wishing to arrange such interchange write to other Administrations or, if preferred, put forward a proposal in the INAG Bulletin.

Rec. 4.

Rec. 4 has also been raised by scientists outside the U.S.S.R. Most complaints involve stations which are isolated and also in regions where the magnetic dip and geographic latitudes are widely different. Such stations are often geophysically extreme and thus their data have particular import for research. The next most important case is where a close family of stations are exploited for regional studies. Need for these data is usually rather intermittent - the justification put forward by the Administrations concerned, so that the complaints tend to occur several years after the decision to restrict data analysis has been made. The changing needs of the users of the data should also be considered, e.g., when the decisions to cease circulating foF1, M3000F1, foE were made these parameters were less important practically than at present - they are now often needed to define profiles for ray tracing experiments.

Eight questions for discussion at Warsaw and, more generally, through the INAG Bulletin were put forward. The questions as posed and comments are given below, and *you are invited to join in the discussion by writing to INAG.*

(1) In order to have more numerical values of foF2, where there is spread F that does not give the possibility of determining foF2 or fxF2 even with uncertainty, but nevertheless the trace has a rather clear high frequency edge, one should use the value of the high frequency edge of spread trace with symbols EF. (But when we have complex ionograms with oblique traces such reductions are not recommended.)

Comment

This is a request, in effect, to omit the accuracy rule limitation when the trace has an upper clear edge. The problem of increasing the number of numerical foF2 values has been greatly discussed and INAG altered the accuracy rules to allow D and E to be used over wider limits (Handbook pp. 29-31). With these limits the percentage of numerical foF2 values at difficult times of day has increased by a large factor and the significance of the remaining values is rather doubtful. INAG feels that the new rules, confirmed at Warsaw, will greatly reduce the problem and should be more fully tested before making any further changes.

A more important point is that data obtained in the early days, before accuracy rules were established, proved to be highly misleading. For this reason accuracy limits were imposed so that the maximum of reliable data could be obtained. The difficulty has been confirmed in recent years by users of topside data. These do not use accuracy rules index 4 (D) meaning greater than, 5 (E) less than, with no limits. In practice all D, E values have to be ignored as the errors are quite unknown and sometimes very great. In view of these experiences INAG feels that the principle of allowing controlled extrapolation but not allowing uncontrolled extrapolation is a very good one which should not be broken.

(2a) to classify Es night as one of the types Es - k and to write the numerical values of night E not in table of regular E layer but in table of Es layer, i.e, to include the numerical values of night E simultaneously in fbEs, and the values h'E in the table of h'Es. To follow the numerical values of night E write descriptive letter E. On f plots in these cases it is necessary to plot the values of fbEs with o (open circle).

In the cases when the values of fbEs in the presence Es - r are determined with the help of retardation on the low edge of the trace of F2-layer, the value of fbEs in table must have descriptive E also, and on the f plot use o (open circle). (Such cases may be when the night E is blanketed by Es layer of type r.)

Comment

This problem was discussed at Leningrad, Brussels and Warsaw. The agreed procedure is to write the values of night E parameters in both E and Es tables in the form (foE)-K. The Kaliningrad proposal could be satisfactory at stations where normal E is never seen at the hours when night E is present but raises difficulties at stations where normal E can be present. At all stations it implies that both E and Es tables have to be considered when considering profile problems as Es causes little or no retardation, night E more retardation than normal E. For these reasons INAG at Warsaw formally adopted the Leningrad-Brussels proposals rather than that of Kaliningrad. The remaining points are common and have been formally adopted. (Handbook p. 69, pp. 90-92, p. 152, Fig. 6.17 p. 155.)

(2b) In connection with the above, the participants did not agree that it is necessary to divide the types of Es into two groups - certain and uncertain. They recommended to keep the previous rules and show the types of Es by • (closed circle) on f plots.

Comment

In the past only fbEs has been plotted on the f plot with a single sign -•- for both certain and doubtful values. Warsaw introduces -c- for blanketing by night E, and this is generally agreed.

During the discussions of the evaluation of fbEs when the F2 layer is totally blanketed, some groups wished to use (foEs)EA or a figure based on the second order trace EA, others the expected value of (foF2), (foF2)DA. These differing opinions would have resulted in different values of fbEs being placed on the f plot by different groups for the same ionogram pattern. For this reason it was decided to denote (foEs)EA by a less than symbol and the usual fbEs line -V- and to denote (foF2)DA by the greater than symbol with the fbEs line -Λ-. (Handbook pp. 152, 154.) At Warsaw the consensus of opinion was in favor of using (foEs)EA in all cases. If this is generally accepted, there is no objection to keeping the standard fbEs symbol for this case and ceasing to use the alternatives, since the absence of any F-layer symbols shows that the value is a doubtful value. Logically, of course, the correct usage would be to employ a limit symbol but it would be more convenient for the operators to keep to the usual fbEs symbol in this case. However if some groups wish to use (foF2)DA, the Handbook symbols are probably essential to avoid misinterpretation of the f plots.

INAG asks for comments, as soon as possible, on whether you all agree to drop (foF2)DA and whether you wish to adopt the standard fbEs symbol for limit cases or whether you prefer to keep to the current text. It is clear that the Kaliningrad group are in favor of the former, a view which has had some support elsewhere. We cannot insist that groups who prefer to use (foF2)DA do not use it and need to know if the confusion is likely to be significant. *Please make your views known.*

There was a *discussion on the use of ftEs on f plots* (INAG 12, p. 6) and *INAG awaits comment from other workers on this point.* The provisional rules discussed at Warsaw are reproduced in the Handbook, p. 155. fxEs is given preference, Δ, as it is a principle of the f plot that the f plot shows what is actually seen, interpreted by the sequence and most common interpretation. *INAG would like to have opinions on whether these rules should be adopted internationally, changed, or allowed as local rules.*

(3) For the stations which cannot give the accuracy of determining foE with an accuracy of 0.05 MHz (for example, for some high latitude stations or stations which have ionosondes of low quality, it is permitted to scale foE with an accuracy of 0.1 MHz). In either case the accuracy should be noted on the tabulations.

Comment

This is a special case of a general rule which was adopted in the beginning of international cooperation. Where it is adopted, it is important that the tabulation shows the final 0 so as to be consistent with other data. Thus 3.1 MHz would be written 310, and the rule that the last figure must be 0 or 5 becomes that the last figure is always 0.

(4) Operators would prefer to consider the total range of uncertainty rather than the deviations from the most probable value, and have asked INAG to consider this possibility.

There is no objection to this proposal.

Accuracy rules in total range of uncertainty form.

The rules in section 2.22, pp. 29-31, of the Handbook should be replaced as follows:

(a) If the total range of uncertainty does not exceed 4% or 2Δ whichever is the greater, then the numerical value is unqualified.

(b) If the total range of uncertainty exceeds 4% or 2Δ whichever is the greater but does not exceed 10% or 4Δ whichever is the greater, the value is considered doubtful and the qualifying letter U is used with the most probable value together with the descriptive letter which most nearly represents the reason for the uncertainty.

(c) If one boundary is certain and the other possible boundary lies within 10% or 3Δ whichever is greater, from it, the most probable value is taken as being midway between the observed limits, and the qualifying letter U is used with this value and the appropriate descriptive letter.

(d) When the total range of uncertainty exceeds that in paragraph (b) but is less than 20% or 5Δ whichever is greater, of an observed boundary of possible positions of the principal echo trace, then this observed limit is tabulated with the qualifying letter D or E, whichever is applicable, and the appropriate descriptive letter.

(e) When the total range of uncertainty exceeds 20% or 5Δ whichever is greater, a descriptive letter only is tabulated without a numerical value. Note that it is not possible to use Fig. 2.1. A replacement for Fig. 2.1 can be provided if required, as on p. 6 of this Bulletin.

(5) The participants feel strongly that the parameters M(3000)F2 and M(3000)F1 must always be determined using the standard transmission curve methods and should not be deduced from hp values.

Comment

Agreed. The M(3000) factors are determined by tangent point of the transmission curve which is at a larger ratio relative to the critical frequency than is hp and is therefore less influenced by underlying ionization.

(6) The participants think it is not necessary to submit form 7G containing notes on the measurements to the World Data Center.

Comment

Current practice is that form 7G is not circulated to WDCs. It is important that form 7G is stored at the station or administrative center so that queries on ionosonde operation can be answered. It is sometimes necessary to be able to check that equipment was compatible when long term changes in ionospheric parameters are being studied.

(7) It is necessary to scale hp and to send these tables to the World Data Center with their medians and quartiles.

Comment

At present very few stations scale hp systematically since it is widely recognized that hp is more liable to errors due to underlying ionization than is M(3000). It is necessary to persuade scientists and Administrations that the parameter gives worthwhile additional information before it can be accepted. INAG is willing to circulate short articles by interested groups but must stress that it appears difficult to support this recommendation on present knowledge.

(8) They ask INAG to give additional rules on techniques of interpretation and scaling of characteristics measured from E2 or F0.5 traces in order to standardize the scaling of these characteristics at different stations. They wished to encourage the scaling of these parameters on a voluntary basis.

Comment

Additional rules have been included in the Handbook pp. 17, 18, 20. It is important that groups wishing to encourage the use of particular parameters notify INAG of any references. Such references, with short notes if provided, will be published in the INAG Bulletin so as to draw attention to the problems.

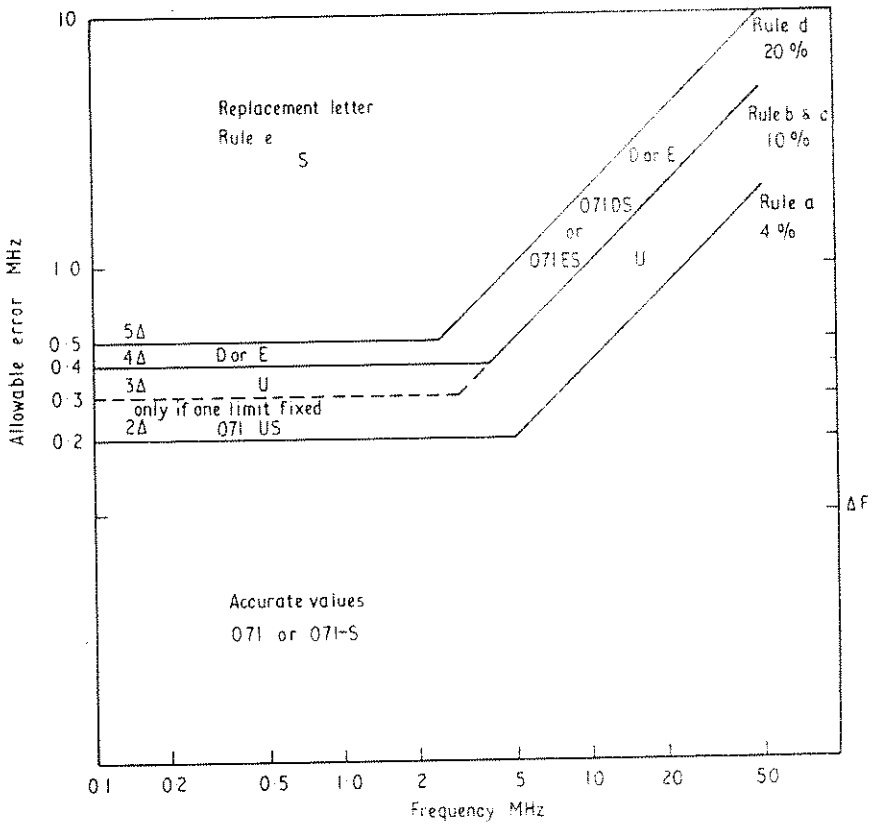


Fig. 2.1a Alternative for Fig. 2.1 of Handbook.
Accuracy rules for F region frequencies [illegible] total range of error.

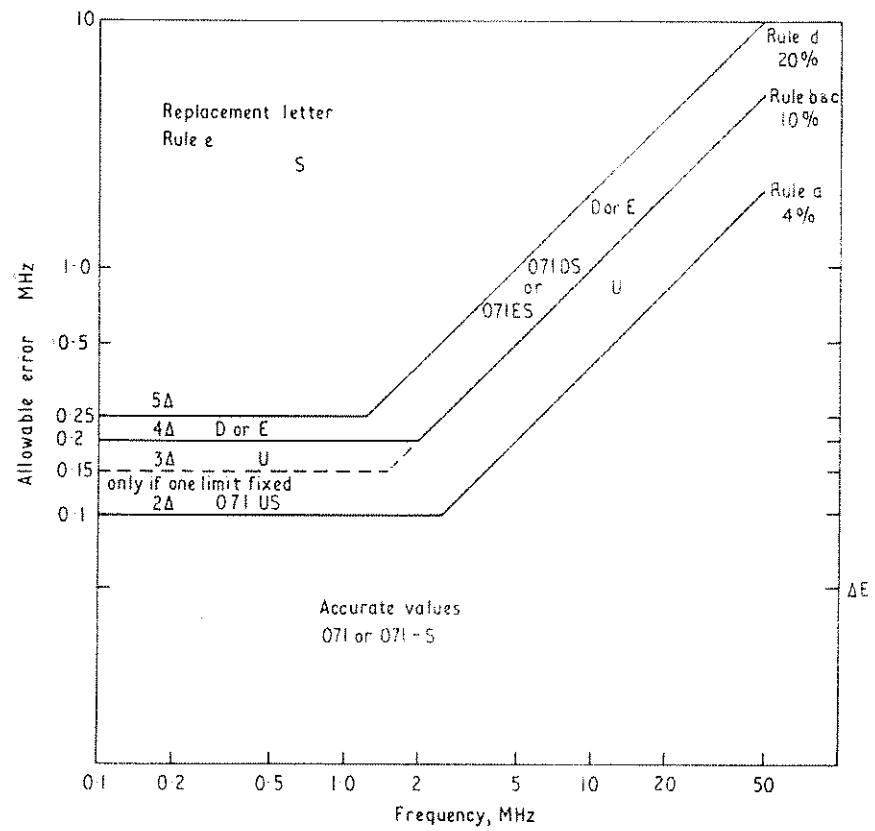


Fig. 2.1b Alternative for Fig. 2.1 of Handbook.
Accuracy rules for F region frequencies [illegible] of total range of error.

III. IUCSTP General Meeting on Future STP Projects and Programs London 2-6 April 1973

1. The Inter Union Commission on Solar-Terrestrial Physics (IUCSTP or STP for short) is being reorganized into a Special Committee on Solar-Terrestrial Physics (probable acronym SCOSTEP). Special Committees of ICSU are established to do a special job, e.g., CSAGI was the Special Committee for the IGY. At present it is proposed that SCOSTEP should be responsible for planning of international collaboration for the period 1973-1978 and any need for continuation after that date will be reviewed in 1976.

2. SCOSTEP is calling a General Meeting in London 2-6 April 1973 to discuss goals and programs for the period 1973-1978 which will involve its Working Groups, the National Representatives from all interested nations and representatives of the Scientific Unions. Discussion will involve which programs and projects should be organized by the Unions and which ones by SCOSTEP, to review the planning already completed, and to discover the extent of potential participation in the collaborating countries, the probable availability of research effort and of observatories which could provide monitoring data. The agenda will cover four main fields:

    1. The International Magnetospheric Study 1976-78.
    2. Solar and Interplanetary Programs.
    3. Atmospheric Physics Programs.
    4. Monitoring of the Sun-Earth Environment (MONSEE).

3. The results of planning already completed will be published during January 1973 in STP Notes No. 11 obtainable from the National Academy of Sciences, 2101 Constitution Avenue, Washington, DC 20418, U.S.A.

4. A new guide for International Data Exchange and lists of collaborating stations will be discussed at the London meeting by MONSEE. Over 3000 copies of the existing Guide [STP Notes No. 6, October 1969] have been circulated. It is very important that you check that your station is correctly described in this Guide and that any suggestions you have for changes (INAG-12, p. 21) be sent to the Chairman of MONSEE, or the Chairman or Secretary of INAG, as soon as possible. Alternatively you should inform your National Representative of your suggestions so that they can be discussed at the MONSEE meeting in London which will form part of the SCOSTEP meeting.

5. It is important that the lists of existing and proposed stations in all ionospheric techniques should be as complete as possible. Your Chairman has been requested to revise these lists on behalf of MONSEE and therefore asks you to let him know of any proposed changes in station operation for ionospheric phenomena, section B of the Guide, i.e.:

    - B1 Ionospheric vertical soundings
    - B2 Topside V.I. soundings and satellite probe data
    - B3 Incoherent scatter sounding
    - B4 Oblique incidence sounding
    - B5 Ionospheric or aeronomical rockets
    - B6 Total electron content by satellite beacons
    - B7 Absorption method A1 (pulse echo)
    - B8 Absorption method A2 (riometer)
    - B9 Absorption method A3 (CW method)
    - B10 Ionospheric drifts (all methods)
    - B11 Ionospheric scintillations from satellite beacons
    - B12 Ionospheric back and forward scatter
    - B13 Whistlers and VLF emission
    - B14 Atmospheric radio noise

    If your station is marked with an * in the Guide (pp. 56-58), meaning 'proposed station', please confirm whether it is now operational, or is likely to be installed in the period 1973-1978, or has been abandoned.

6. The URSI V.I. consultant took advantage of the first meeting of IUCSTP in London to hold a meeting of V.I. station administrators to discuss V.I. network problems. This eventually led to the formation of INAG. On this occasion the Chairman of INAG will be heavily occupied by MONSEE problems. It is possible, however, to hold a meeting of INAG in London in association with the SCOSTEP meeting if you so desire. *Please let the Chairman know if you want to discuss INAG matters or raise problems.* This gives the first opportunity to hear whether the Handbook is satisfactory or to explain any points which are not clear in it and the Editors of the Handbook would welcome comments, either in a meeting or informally. At the time of this meeting we need your recommendations on modification of the Scientific Program for Vertical Incidence Soundings to be published on the 1974 International Geophysical Calendar (See INAG-12, p. 21). *Please send your suggestions to the INAG Chairman by April 1.*

IV. A New Technique for Determining the Height of Maximum Ionisation and Semithickness of the F2-Layer from the Standard Ionogram Parameters

by

P. A. Bradley and J. R. Dudeney
Radio & Space Research Station
Ditton Park, Slough, Bucks., England

Routine ionogram scaling gives critical frequencies but not true heights. True height analyses are time consuming for morphological studies involving large numbers of ionograms. Here we present a simple set of equations giving hmF2 and ymF2 in terms of the standard ionogram parameters foF2, foE, M(3000)F2, h'F2 or h'F. Comparisons with true height analyses show that for many applications the new equations have adequate accuracy and their use is advocated as an alternative to either placing further scaling burdens on the ionospheric observatories or the large scale copying and distribution of ionograms to individual research workers.

The new equations have been derived from studies involving the development of an idealised model of the E and F layers selected to give a good fit to true height profiles. This model consists of:

(i) a parabolic E layer below its height of maximum electron concentration hmE, with semithickness ymE. hmE is taken as constant at 110 km and ymE as 20 km, to be consistent with the usual form of the E Layer;

(ii) a parabolic F2 layer with height of maximum electron concentration hmF2 and semithickness ymF2. hmF2 and ymF2 are determined from the empirical equations given below;

(iii) a linear increase of electron concentration with height between hmE and the point on the parabolic F2 layer where the plasma frequency is 1.7 foE. This figure was derived empirically to minimize errors at hmF2. Thus the model is specified in terms of four variable parameters foF2, foE, hmF2 and ymF2. No allowance is incorporated for a discrete F1 layer; ionization in the F1 height region is taken as being given entirely in terms of the E and F2-layer ionization parameters.

An example of a comparison with an F-region true height analysis kindly provided by Dr. W. Becker of the Max-Planck-Institute for Aeronomy for a Lindau ionogram is given in Figure 1. Comparisons with other ionization profiles for a range of locations and solar epochs, including extreme cases, will be given in a full description of this work by the present authors. In particular, the model is good to within 20 km under nearly all conditions including magnetically disturbed periods; but excluding the special case of low latitudes for hmF2 greater than 500 km, at which time the F layer is not strictly parabolic and M(3000)F2 does not have its usual meaning.

Ionograms have been synthesized from the model ionisation distributions and thereby empirical relationships established between the model and ionogram parameters. These give:

(i) $$hmF2 = a[M(3000)F2]^{b} \text{ km}$$

where $$a = 1890 - \frac{355}{x - 1.4}$$

and $$b = (2.5x - 3)^{-2.35} - 1.6$$

where $$x = foF2/foE \ ;$$

(ii) $$ymF2 = hmF2 - h'F2 + \Delta h' \quad (h'F2 \text{ numerical})$$

or $$ymF2 = hmF2 - h'F + \Delta h' \quad (h'F2 \text{ not numerical})$$

where $$\Delta h' = \left(\frac{0.613}{x - 1.33}\right)^{0.86} . (hmF2 - 104) \ .$$

A simpler but less accurate equation for hmF2 is:

$$hmF2 = \frac{1490}{M(3000)F2 + \Delta M} - 176$$

where $$\Delta M = \frac{0.18}{x - 1.4}$$

This is a modification of Shimazaki's (1955) equation for hpF2 which takes account of underlying ionisation. Note ΔM tends to zero as x becomes large.

These equations apply for x greater than 1.7. In practice at a few locations, notably high latitudes in summer, x may fall below 1.7; in these cases, this limit value must be used.

To show the accuracy of the equations, Figure 2 presents sample comparisons between the calculated values of hmF2 and ymF2 and the corresponding parameters, here called haF2 and yaF2, derived using the hc,qc true height analysis. The data relate to 75 high quality ionograms recorded during 1967-1969 at Argentine Islands (65°S, 64°W) where the regular variations of hmF2 are very large. Approximately half these ionograms are for summer months and show well defined F1 layer phenomena; whereas for the remainder, taken from winter and equinox, such phenomena were entirely absent. The agreement between model and true height data is good and there are no obvious seasonal trends, showing that the presence or absence of the F1 ledge of ionisation has negligible influence. Similar comparisons at other locations indicate that the computed value of hmF2 is rarely incorrect by more than 30 km.

Numerical coefficients defining the ionospheric parameters foF2, foE and M(3000)F2 are available, giving the predicted values for all geographic positions, months, times of day, and levels of solar activity. To show a practical application, a world map of hmF2 has been constructed. Figure 3, for 1200 hours UT in June for a smoothed sunspot number of 100. Regions with high and low values are denoted by H and L, respectively.

REFERENCE

SHIMAZAKI, T. 1955 J. Radio Res. Labs., Japan, 2, 85.

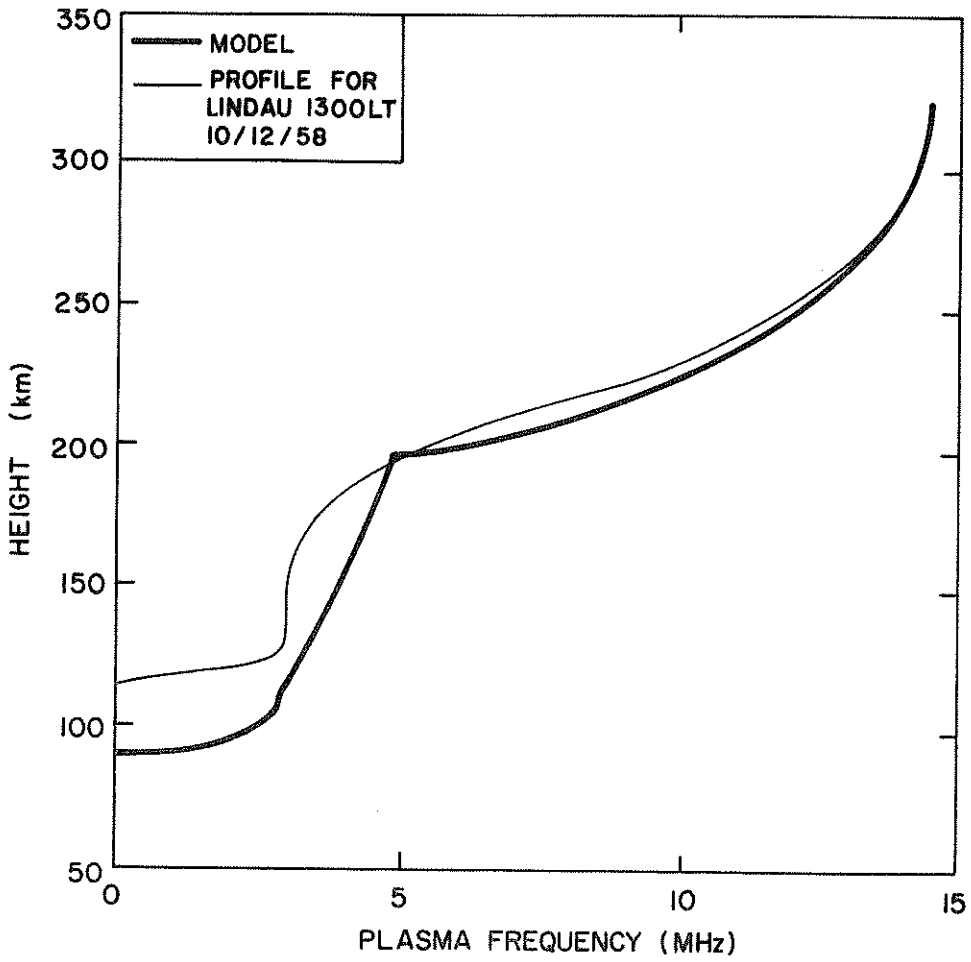


Fig. 1. Comparison between model profile and an N(h) profile from the same winter ionogram.

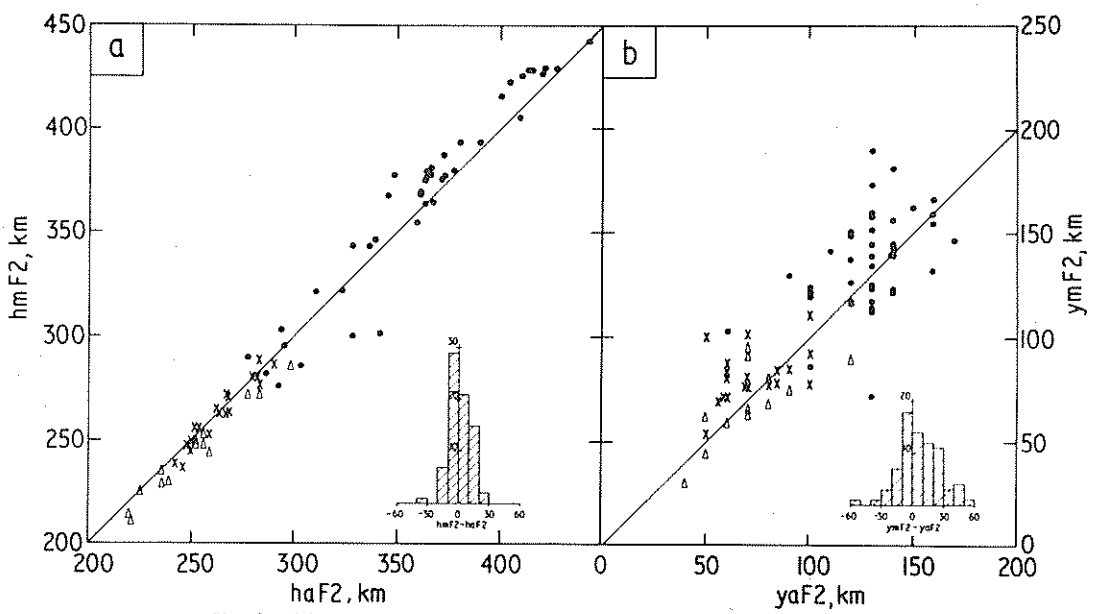


Fig. 2. (•) Summer data; (Δ) Winter data; (X) Equinox data.
Comparison of deduced values of hmF2, ymF2 and measured values haF2, yaF2.

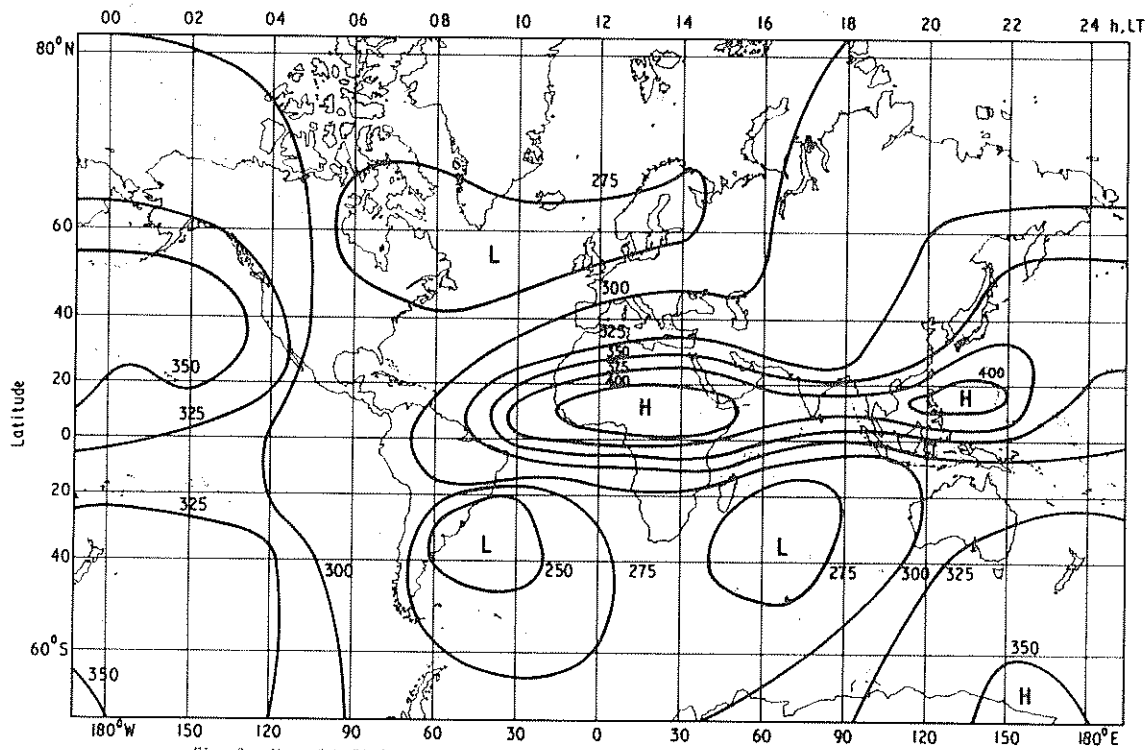


Fig. 3. Map of hmF2 for 1200 UT in June sunspot number 100 using ionogram parameters given by C.C.I.R. programs for foF2, M(3000)F2, h'(F,F2) and foE.

C.6. — Teaching of Radio Science

The URSI Council,

considering

(*a*) that, during the XVII General Assembly of URSI, it established a temporary Working Group on the Teaching of Radio Science with the following membership :

Chairman : G. Barzilai (Italy);
H. G. Booker (USA);
J. Brown (UK);
R. Coutrez (Belgium);
J. A. Gledhill (South Africa);
A. P. Mitra (India);
V. Padula-Pintos (Argentina);
G. I. Makarov (USSR);
H. L. Knudsen (Denmark);
J. Voge (France);

(*b*) that this Group had insufficient time to collect, from delegates, information relating to the teaching of radio science in their countries;

resolves

1. that the Working Group shall remain in existence until the next General Assembly and work by correspondence;

2. that its terms of reference shall be

2.1. to establish contacts with radio scientists in the Member Committees of URSI who are interested in teaching;

2.2. to present a report to the XVIII General Assembly on methods of promoting the teaching of radio science.

C.10. — IUWDS

The URSI Council,

noting

(*a*) that the IUWDS is one of the Permanent Services adhering to FAGS;

(*b*) that the IUWDS Steering Committee is concerned with the practical operation of the Service in accordance with the requirements of IAU, IUGG and URSI;

(*c*) that there is a need for a body which can be made responsible for the formulation and, when necessary, modification of the scientific objectives of IUWDS and for the provision of independent advice on the Service when required by the Unions or by FAGS;

recommends

1. that, as required by the Statutes of FAGS, IUWDS be placed under the authority of a Board, the composition of which shall be decided by the interested Unions and shall include the Director of the Service;

2. that the URSI Board of Officers be authorised to establish the Board after consultation with IAU and IUGG.

C.11. — Status of IUCSTP

The URSI Council,

recognising

(*a*) that the ICSU Unions alone should be responsible for making decisions on long-term programmes of research;

(*b*) that a Special Committee of ICSU is the appropriate type of body for the organisation of a closely coordinated short-term programme requiring the cooperation of several Unions and the direct participation of specially formed national groups;

considering

(*c*) that the organisation of the International Magnetospheric Study (IMS), and other short-term projects proposed by IUCSTP in March 1972, is an appropriate task for a Special Committee of ICSU;

(*d*) that IUCSTP already operates under Provisional Statutes that are based on those of such a Committee;

recommends

1. that ICSU recognise IUCSTP as the Special Committee for the IMS and other short-term projects;

2. that the terms of reference of the Committee be limited to the planning and coordination of the IMS and a number of other short-term projects;

3. that the Provisional Statutes be modified accordingly and that 31 December 1978 be specified as the date of termination of the Committee;

considering further

(*e*) that, for reasons which can not be foreseen at present, it may later be considered desirable to defer the above-mentioned terminating date;

recommends

4. that, in 1976, IAU, IUGG, IUPAP and URSI, after consultation with COSPAR, should review the scientific programmes for which the Special Committee has been made responsible;

5. that, if it appears to be essential, they should jointly recommend, to the General Assembly of ICSU in 1976, an extension of the life of the Committee.

C.15. — UNESCO Subventions

The URSI Council,

considering

(*a*) that an important part of the activities of URSI consists in the organisation of international scientific symposia and other meetings of scientists, and in the issue of publications;

(*b*) that the annual subventions received from UNESCO, via ICSU, are used to cover part of the cost of these activities;

resolves to convey to UNESCO the warm thanks and appreciation of the Union for the valuable support thus provided.

V. Resolutions and Recommendations passed at the XVII General Assembly of URSI, Warsaw, August 1972

The formal resolutions and recommendations passed at the XVII General Assembly at Warsaw are published in the URSI Bulletin, No. 184, dated September, 1972. Those of general interest to the networks are reproduced below. The French translation is also available in Bulletin No. 184.

The draft Commission III recommendations published in our last Bulletin have been slightly reworded, but, in most cases, without changing their substance significantly. To save space these have been omitted but can be provided to anyone needing the exact text.

C.1. — Status of URSI

The URSI Council,

considering

(*a*) that fundamental research in radio science has present and future applications in many other branches of science;

(*b*) that the relative importance of the contributions made by radio scientists to these other branches will vary from time to time depending on the needs of the moment;

(*c*) that, in consequence, an international organisation concerned with radio science must be completely free to decide how to distribute the effort devoted to the different aspects of radio science and its applications;

(*d*) that it would be difficult or impossible for this organisation to enjoy the necessary full freedom of action within a Union primarily concerned with another branch of science, for example, astronomy, biology, geophysics, etc.;

(*e*) that the concern of URSI with certain aspects of other disciplines may imply that the responsibilities of URSI overlap those of other Unions leading to a duplication of effort and to other problems;

resolves

1. that URSI shall retain its status as an independent Union of ICSU;

2. that, in order to stimulate the scientific activities of the Union, the URSI Board of Officers, in consultation with the Chairmen and Vice-Chairmen of Commissions, be authorised to examine the internal structure of the Union and to recommend modifications appropriate to this objective;

3. that, where consultation or collaboration between URSI and another Union seems to be desirable, the Board of Officers and the Chairmen of Commissions be encouraged to establish the appropriate direct contacts.

C.5. — Publications

The URSI Council,

noting the Reports of the Publications Committee and of the Finance Committee *(Proc. URSI Gen. Ass. 16, 1972)*;

resolves to draw the attention of the Board of Officers :

1. to the recommendations of the Publications Committee concerning the following publications :

1.1. *URSI Information Bulletin* and *INAG Bulletin*,

1.2. Proceedings of the XVIII General Assembly (1975),

1.3. URSI Handbooks on Ionograms and on Ionospheric Absorption,

1.4. *Review of Radio Science* (1975),

1.5. Abstracts of Papers to be presented at the XVIII General Assembly;

2. to the recommendations contained in para. 4.2 of the Report of the Finance Committee concerning the need for reductions in the expenditure on URSI publications.

III.6. — Sporadic-E

Commission III,

considering

(*a*) that many questions relating to the structure and the cause of sporadic-E ionization (Es) have not yet been solved;

(*b*) that successful cooperative experimental and statistical investigations of Es have been made in Europe;

recommends

1. that these investigations be continued and extended to cover the temperate-latitude regions of both Europe and Asia;

2. that greater use be made of rockets and incoherent scatter sounders in experiments on Es;

3. that these investigations be actively encouraged by Working Group III.2 on E- and F-region dynamics.

III.9. — Ionospheric Drift Observations

Commission III,

considering

(*a*) that there is a need for further experimental observations of the effects caused by stratospheric warmings, seasonal reversals and planetary waves;

(*b*) that valuable coordinated measurements of movements in the lower ionosphere have been made in Europe;

recommends

1. that such coordinated measurements be continued in Europe and extended to include other geographical regions;

2. that intensive programmes of measurement be arranged during four periods per year, each period having a duration of two or three weeks;

3. that programmes for the measurement of F-region drifts be arranged to coincide with these periods;

4. that the coordination of all these programmes be organised by Working Group III.2.1 on drift observations.

III.10. — Large Arrays for Fine Structure

Commission III,

considering

(*a*) that our knowledge of the fine structure and the dynamics of the ionosphere is still incomplete;

(*b*) that significant advances could be made by the study of data acquired using the spaced antenna technique with large antenna arrays;

recommends that national organisations be encouraged to construct and use such arrays :

1. for the determination of the fine structure of the ionosphere;

2. for clarification of the meaning of routine ionospheric drift measurements of Type D1.

III.13. — SHISG

Commission III,

considering

(*a*) that the Southern Hemisphere Ionospheric Studies Group (SHISG) has recently been created;

(*b*) that ionospheric observations made near the South Atlantic anomaly are of great interest, particularly in connection with the International Magnetospheric Study;

recommends that SHISG be invited to take all the steps necessary

1. to maintain the network of vertical incidence ionosondes in its region;

2. to contribute to the IMS by stimulating studies of the ionospheric effects caused by the precipitation of particles.

III.14. — Measurements of Absorption

Commission III,

considering

(*a*) that cooperative programmes for the measurement of ionospheric absorption have been undertaken during two winter seasons (Rec. III.14, Ottawa 1969);

(*b*) that the results obtained have been useful for monitoring conditions in the atmosphere near the mesopause;

(*c*) that, in this context, it is particularly important to isolate the diurnal component of variations in absorption;

recommends

1. that the scientific results obtained during these programmes be presented and discussed at the Symposium on the Lower Ionosphere, to be held in Constance (F.R. of Germany) in 1973, with the joint sponsorship of URSI, IAGA and COSPAR;

2. that the network of stations in Europe continue to make absorption measurements, as part of a synoptic programme, until the next minimum in the solar activity cycle;

3. that efforts be made to establish a Northern Hemisphere network by adding new stations at other longitudes (Notes 1, 2);

4. that the data obtained during programmes for the measurement of absorption be examined in conjunction with other significant parameters of the atmosphere in the range of heights 50-100 km;

5. that no immediate decision be made regarding detailed retrospective studies of the data obtained;

6. that Working Group III.3 on ionosphere-mesosphere studies be made responsible for coordinating the measurements and for deciding on a standard format for the presentation and interchange of data.

Note 1. — For hemispheric monitoring of ionospheric absorption, Type A1 measurements are particularly recommended. At least two frequencies (near 2.2 and 1.7 MHz) should be used.

Note 2. — Measurements made on ships in the Atlantic and Pacific Oceans would be of particular value in helping to cover the wide longitude

III.15. — Regional Cooperation

Commission III,

considering

(*a*) that cooperative programmes of observation can be most beneficial in helping to resolve particular scientific problems;

(*b*) that the Official Members of Commission III in Europe have successfully organised several such programmes;

(*c*) that the "European Regional Group on Ionospheric Physics" is at present organising a cooperative programme of ground-based measurements in its region in connection with the International Magnetospheric Study;

recommends

1. the continuation of such activities in Europe;

2. the initiation of similar activities in other regions of the world.

III.16. — Observations during a Magnetic Storm

Commission III,

considering

(*a*) that a major coordinated programme of observations during a predicted magnetic storm was undertaken in 1970 (Rec.III.22, Ottawa 1969);

(*b*) that the experience gained showed the need for improvements in the network of communications used for disseminating the warnings;

(*c*) that the problems of the dynamics of the F region have not yet been solved;

(*d*) that COSPAR has proposed the organisation of a new project having wider scope;

resolves

1. to thank the organisers of the project referred to under *a*);

2. to make Working Group III.2 on E- and F-region dynamics responsible for the preparation and organisation of a new project incorporating improvements based on past experience.

III.19. — Digital Recording

Commission III,

considering

(*a*) that the number of ionosondes using digital recording techniques and also the volume of digital data produced are rapidly increasing;

(*b*) that buffered formating tape recorders and other solid-state memories are continuously becoming less expensive;

(*c*) that the available time and the capabilities for incrementally reading, for storing and for reformating digital data that are at the disposal of many potential users is quite limited;

(*d*) that digital reading and display systems, with limited storage and continuous tape recorders reading full blocks (records), are much more easily available;

recommends

1. to record digital data on digital tape if this is feasible;

2. to format the data into blocks (records) of limited length (that is, not more than $5 \cdot 2^{10}$ characters (bytes) each of which includes identifiers presenting information on all the physical and technical parameters necessary to process the data);

3. to maintain, even for systems incorporating very sophisticated on-line data-processing features, the capability of digitally recording a limited number of data samples directly after pre-processing for consistency checks, comparisons with other methods and other exchange purposes.

III.20. — Support for Ionospheric Stations

Commission III,

considering

(*a*) that several ionospheric stations situated in locations of considerable importance have been closed down because of a lack of technical and financial support from national sources;

(*b*) that other stations are likely to be closed down in the near future for the same reasons;

(*c*) that these stations represent an important element in the world network of stations;

(*d*) that the data provided by this network are used by organisations responsible for international telecommunication systems;

recommends

1. that URSI explore the possibility of obtaining technical and financial support for such stations from international governmental organisations;

2. that decisions on the utilisation of the support thus provided be made in consultation with the International Telecommunication Union.

VI. Titles and Scopes of Working Groups for URSI Commission III as of December 29, 1972

3.1 Ionosphere Network Advisory Group (INAG)

Chairman: W. R. Piggott (UK)
Vice Chairman: J. V. Lincoln (USA)

To assist the ionosphere network stations, and to serve as a means of communication between them and the scientific community.

3.2 E and F-Region Dynamics-Observations and Theories

Chairman: H. Kohl (FRG)
Vice Chairman: H. Rishbeth (UK)

To coordinate theoretical and experimental work in the dynamics of the upper ionosphere.

3.2.1 Drift Observations

Chairman: K. Sprenger (GDR)

To coordinate measurements of horizontal movements in the ionosphere.

3.2.2 Traveling Ionosphere Disturbances

Chairman: P. Bauer (France)

To coordinate measurements of gravity-wave disturbances produced by ionospheric storms.

3.3 Ionosphere-Mesosphere Studies Involving Absorption and Other Radio Techniques.

Chairman: E. A. Lauter (GDR)
Vice Chairman: C. F. Sechrist, Jr. (USA)

To coordinate theoretical and experimental studies of the winter anomaly in absorption and other related phenomena.

3.3.1 Absorption Measurements

Chairman: H. Schwentek (FRG)

To coordinate measurements on ionospheric absorption in Europe and Japan.

3.4 Data Processing in Ionospheric Research

Chairman: S. A. Bowhill (USA)
Vice Chairman: A. Haug (Norway)

To promote exchange of information and international agreement for the optimum processing and exchange of ionospheric data.

3.5 Production and Loss of Ionization (including Flare Effects).

Chairman: L. Thomas (UK)
Vice Chairman: A. D. Danilov (USSR)

To coordinate theoretical and experimental studies of the neutral and ion chemistry of the ionosphere.

3.6 Morphological Models of the Ionosphere.

Chairman: K. Rawer (FRG)

To coordinate the development of numerical and analytical models of electron density and related parameters of the ionosphere.

3.6.1 International Reference Ionosphere.

Chairman: K. Rawer (FRG)

To develop, jointly with COSPAR, reference models of vertical structure of the ionosphere.

3.6.2 Complete Electron Density Profiles

Chairman: C. G. McCue (Australia)

3.6.3 Ionospheric Mapping

Chairman: R. Gallet (USA)

3.7 Radio Experiments Concerning Ionosphere-Magnetosphere Interactions (joint with Commission IV).

Chairman: J. W. King (UK)
Vice Chairman: K. I. Gringauz (USSR)

To develop programs for radio experiments for the IMS, and coordinate these with URSI scientists.

3.8 Incoherent Scatter

Chairman: P. Bauer (France)
Vice Chairman: J. V. Evans (USA)

To exchange experimental and theoretical information, and plan programs using the technique of incoherent scatter.

3.9 Radio Wave Propagation in the Ionosphere.

Chairman: H. G. Booker (USA)
Vice Chairman: C. Altman (Israel)

To coordinate the exchange of information on new scientific aspects of radio propagation in the ionosphere.

3.10 High-latitude Phenomena Involving the Ionosphere (joint with Commission IV).

Chairman: A. G. McNamara (Canada)
Vice Chairman: W. H. Campbell (USA)

To promote the exchange of information on experimental and theoretical aspects relating to ionosphere behavior outside the plasmapause (L>4), and to act as a communication link between URSI and the Upper-Atmosphere Working Group of SCAR.

VII. INAG Meeting, Boulder, Colorado, November 9, 1972

Attendees

Members

W. R. Piggott, Chairman
J. V. Lincoln, Vice Chairman and Secretary
L. E. Petrie, Canada

Invited participants

L. S. Hayden
R. Conkright
E. R. Schiffmacher

Membership, Representatives and Consultants

The formal membership, consultants and representatives of INAG were discussed. It was proposed, subject to the agreement of absent INAG members and URSI Commission III, to invite Mr. L. E. Petrie to become a member of INAG. Representatives could be contructive in having scientific groups in their

countries show how routine ionospheric vertical incidence data could be used. By representing special projects and public opinion there should be possible:

1. Best possible advice to stations;
2. Evaluation of work and how results of station fit into general long term science.

Unofficial consensus exists that:

1. INAG is a good judgment group, and that networks as a whole will accept INAG advice.
2. Unwise to try to lead until real need is proven, then can sell the new idea to network.
3. INAG can advertise new ideas but should be pushed by demand since every change means 2-3 years of incompatible data.

Mr. Petrie said INAG is unique and was respected by network since not radical. INAG is the interface for scientist to network. Mr. Piggott stated the Bulletin could present liberal views but should give no instructions until firm decisions reached.

The following consultants to INAG have been proposed for high latitude problems:

Richard Smith, Radio and Space Research Station, Slough, United Kingdom
E. L. Hagg, Communications Research Centre, Ottawa, Canada
L. S. Hayden, National Oceanic and Atmospheric Administration, Boulder, Colorado, U.S.A.
J. K. Olesen, Technical University of Denmark, Lyngby, Denmark

Profiles of Electron Density

INAG has been requested to assist in the program of Recommendation III.1 Profiles of Electron Density of Commission III on the Ionosphere. (See INAG-12, p. 8.) Persons wishing to participate in this work are invited to make contact with Prof. J. N. Nisbet, Pennsylvania State University, University Park, Pa. 16802, USA. Miss Lincoln said NOAA was supplying many ionograms to Prof. Nisbet and also was doing some of the analysis. Mr. Piggott stated uniformity would be lost without consideration of essential detailed points. The second edition of the Handbook does not cover advanced systems.

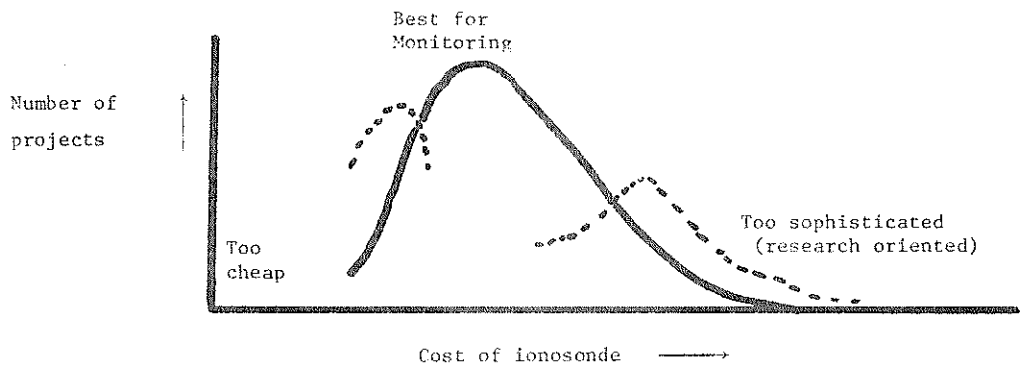
Regional Meetings

This meeting in Boulder was such a one in North America. It has been stated that the Argentinians have expressed willingness to bring local technicians together for training. Mr. Piggott said by this means 'what to scale' and 'how to scale' can be taught.

A GEOS meeting in Netherlands, November 1972, is to plan the European ground based network for IMS. Mr. Piggott is to attend. If many new stations are proposed a cheap reliable ionosonde will be needed.

Ionosondes

Following a presentation by E. R. Schiffmacher of status of work on ionosondes in the National Geophysical and Solar-Terrestrial Data Center, NOAA, Boulder, Colorado, U.S.A., there was considerable discussion. Mr. Petrie has promised to write a review on the problem. The graph below highlights some of the difficulties.



Correspondence with INAG members indicates the desire for inexpensive sounders, but compromises as to performance are then necessary.

There was discussion of the key station concept. Mr. Piggott reminded INAG that no such stations have been proposed by INAG to date. The V.I. network is one of institutions and stations freely cooperating. Stations are operated for different reasons. Expansion of the network has been for primarily non-ionospheric reasons. Sounders are used as sensitive indicators of changes in upper atmosphere. Stations have cooperated because in addition to own use realize their data are valuable to others.

Revision of Handbook

W. R. Piggott, one of the Editors, of the U.R.S.I. Handbook of Ionogram Interpretation and Reduction -- second edition, was able to resolve the remaining questions of L. Hayden so that the manuscript copy could be forwarded to the printer. L. E. Petrie read several sections to assure clarity of expression.

The meeting adjourned with encouragement to tackle high latitude problems as the next major objective.

J. Virginia Lincoln, Secretary

VIII. WMO-IUCSTP Joint Exploratory Committee on Solar-Terrestrial Monitoring

The second report of the Joint Exploratory Committee (JEC) has been published in *STP Notes No. 10*, pp. 43-44. The JEC is investigating possible cooperation between WMO and the networks involved in MONSEE, of which vertical soundings is one.

The report is mainly concerned with possible WMO assistance in listing stations and programs of work in the MONSEE program and the use of WMO telecommunications at present and in the future. The WMO Executive Committee has agreed to cooperate on the publication and updating of station lists provided that this does not incur any costs to the WMO. It has recommended that the Secretary General of WMO study the possible wider use of data relating to solar activity and the state of the upper atmosphere and the corresponding participation of WMO in the collection, processing and distribution of the data and to report.

IX. A Critical Examination of the Performance of the "Composite Virtual Height" Method of Summarizing N(h) Profiles of the Ionosphere

by

A. R. Laird, J. W. Wright and T. N. Gautier
Environmental Research Laboratories
National Oceanic and Atmospheric Administration
Boulder, Colorado 80302

The paper is to be submitted to *Radio Science*. Its abstract and conclusions are quoted below:

Abstract

A procedure intended for obtaining representative electron density profiles of the ionosphere, from groups of ionograms, without incurring the expense and uncertainties of first obtaining the constituent profiles, is examined with the evidence accumulated through more than 200 station-years of experience with the method. Some objective comparisons of this "composite virtual height" process with ionospheric parameters obtained by accepted statistical methods, and some subjective evaluations of the composite process, are presented. It is concluded that the method performs satisfactorily in practice and that it offers the economy, accuracy, representativeness, and internal self-control to justify continuing its use in global ionospheric monitoring.

Conclusions

We believe that the results presented here lend confidence to the use of the composite h'(f) process. The cases where its performance can be seriously criticized are those where it is clearly

difficult to average or summarize by any method. There is a definite need to single out such cases for further study, and the composite tracing process at least facilitates such future work. On the other hand, (and at the latitudes and epochs studied here), the majority of individual h'(f) curves within a month at a given hour are sufficiently similar in shape to permit averaging in perhaps many ways. The composite method offers speed, economy, and sufficient internal self-control to recommend continuing its use in global ionospheric monitoring programs. Furthermore, with continuing progress in the development of digital data acquisition systems, it is not difficult to imagine automated "composite" processes which can quickly yield representative profiles for any chosen grouping of observed ionospheric conditions.

X. hp and M3000 Factors

There is considerable activity in several groups on the problem of deducing reliable heights from the M(3000) factors and several papers are in progress of publication.

INAG has received English and Russian versions of a paper by Z. Rapoport entitled "On the determination of M3000", published in Ionosfernye Issledovaniya (Ionospheric Researches), No. 3, pp. 83-89, Acad. Sciences, Moscow, 1960. This paper reviews the relations between hp and M3000 and advocates the use of hp for real time evaluation of M3000 directly from the image on a cathode ray tube, whence the delays involved in making a photograph and using the standard slider are not acceptable.

This paper is brought to your attention as a partial answer to a question which is frequently asked, namely: Why do any groups still measure hp despite its severe limitations? Note that values of M(3000) deduced in this way are not strictly equivalent to direct measurements and the Kaliningrad seminar therefore discouraged this procedure when M(3000) can be measured directly.

XI. Ground-based and Satellite Observations

Coordination between ground-based and satellite observations with particular application to the ESRO geostationary Satellite was discussed at a meeting of GEOS experimenters called by the Committee for Coordination of Observations associated with GEOS held at Noordwijk, Netherlands, Nov. 15-16, 1972.

These discussions brought out rather clearly that the satellite experimenters had little experience in planning a geophysical investigation in which it is necessary to monitor the geophysical conditions applicable to the data being studied. In geophysics the forces acting are liable to vary with time and place and thus it is necessary to know whether experiments really refer to the same geophysical conditions or not. Otherwise one has the situation where two groups, studying the same type of phenomenon on different occasions or at different times, can come to views on the causes of the phenomena which are incompatible and cause unnecessary and, in general, rather destructive controversity. By a coincidence, a case which may well be of this type occurred in a meeting of the Royal Astronomical Society in London during the next week!

The particular purpose of this note is to draw attention to the need for more studies of relations between ionospheric phenomena, magnetospheric phenomena, and particle precipitation using ground-based data so that adequate guidance can be given to satellite experimenters. This point is particularly brought to the attention of groups with stations at high latitudes, particularly groups operating auroral, magnetic, and ionospheric stations, or who have access to rocket and satellite data, and an interest in morphological problems. At Noordwijk the experimenters specifically asked for guidance from the ground-based investigators.

XII. Coordinated Measurements of Drifts

Prof. K. Sprenger, chairman of subgroup 2 of URSI Working Group III.3, responding to URSI Commission III Recommendation III.9, proposes that the following periods in 1973 and winter 1973-74 be used for the coordinated European simultaneous drift or wind measurements by radio techniques. While this project is mainly of interest for the European sector, it is advantageous if other groups making drift measurements also make measurements in these periods. Those intending to participate in the Asian-European regional collaboration are requested to notify Prof. K. Sprenger, Zentral Institut für solar-terrestrische Physik, Observatorium für Ionosphärenforschung DDR 2565, Kuhlungsborn, German Democratic Republic, unless they have already received this circular.

Main periods:	Jan.	15-27, 1973
	March	12-24, 1973
	June	4-23, 1973
	Oct.	15-31, 1973
	Jan.	14-26, 1974

For those wishing to operate monthly the following additional periods are recommended:

Feb.	12-17, 1973	Aug.	13-18, 1973
April	16-21, 1973	Sept.	17-22, 1973
May	14-19, 1973	Nov.	12-17, 1973
July	16-21, 1973	Dec.	17-22, 1973

Full particulars can be obtained from Prof. Sprenger.

XIII. Reports from Stations

1. J. Turner - Report on the Second Conference of Australian Ionospheric Station Operators.

It has been two years since the last conference for operators was held in Sydney and the number of changes in both staff and operating instructions in this period suggested that another meeting should be held. Like the previous conference, this was an intensive refresher course held over two days, 9th - 10th November, 1972. This was short enough to allow normal routine soundings without interuption and long enough for useful discussion. The reason for the conference was to maintain the good relationship existing between the staff at the Sydney office and the station operators, for each to understand more fully the aims, and constraints on those aims, of the others.

The conference this time was less general in content and was mostly taken up with scaling and interpretation of ionograms. In order to make the discussions on scaling more stimulating a number of scaling exercises were devised. These covered the following points, the normal ionosphere, common complications such as spread F, sporadic E, equipment faults, and interference. The exercises were scattered throughout the two days of the meeting. They were placed among short talks given by the operators where relevant to their topic. Each group of exercises and talks were followed by a discussion period where all the different scaling interpretations were mulled over and differences ironed out.

As the scaling exercises were the hub of this conference it may be interesting to describe their operation here. For each exercise the members of the conference split into groups of four. A group was made up of a senior member of the Sydney staff, a novice-in-training or an operator recently trained, and two other operators one of whom would have considerable experience. While each ionogram was scaled by the group as a whole, the initial interpretation was left for the least experienced of the group with the others throwing in advice when necessary, and the Sydney staff acting as observers. Three or four ionograms were scaled in each exercise, each group having the same exercise. The composition of the groups were changed for each new exercise. The results were displayed against the official version and any differences debated in a full conference discussion after the exercise. In this way a considerable commentary on scaling was generated and the novices learnt much from the more experienced operators (and sometimes the other way round).

Each operator had prepared a ten minute talk which included these topics, "the occurrence of spread F", "the effects of antenna size on foF2, fxF2 and noise", "the training of indigenous operators", and "sporadic E". Members of the electronics lab gave talks on equipment, other staff members gave talks on the aims and needs of the research being carried out at IPSD, the need for scaled data and the reasons for stringent scaling rules.

Working lunches were held to enable the operators to informally meet the Sydney IPSD staff. An exhibition of research and routine work recently completed or normally being carried out by IPSD was put on display one evening and this obviously was a great success in developing an understanding for the use of the data.

Following the conference all the discussions have been crystallized to a short list of explanations of the URSI Handbook where it has been shown necessary. The final interpretation of the scaling exercises has also become part of the Australian Station Operator's kit.

Only when all the operators are brought together can the problems of scaling and interpretation be sorted out uniformly. While the short duration of this conference did not allow all debatable points of scaling to be discussed fully it did allow many of the problems to be realized.

2. Abstracts from a letter from J. Weiss, Manager, Ionosonde Station, Juliusruh/Rugen.

The present thematical contents of the INAG bulletin I consider sufficient. Our station had hitherto a good help by the bulletin, and we should be sorry for a drastic abridgement or shutdown.

Comments on other techniques and methods of ionospheric research in the bulletin are of special interest for collaborators of smaller stations, which have no possibility to keep in view the newest

state of ionospheric research. Nevertheless this part of the bulletin could be omitted, if a restriction is indispensable, without impairment of the main use.

The literature citations also are of great use for small stations with one or two scientists, which cannot afford a full subscription to all subject periodicals. If a restriction of the INAG bulletin is necessary, I feel that here the abstracts should be omitted or limited to 5 lines.

The comments on new ionosondes, new attachments to ionosondes and new ways of handling data are important so far as they can help modernize the ionosonde stations. Moreover, I feel that a publishing of special parameters of ionosondes could be useful under the following conditions: in due course all presently working ionosondes should be described with an uniform point of view in order to compare the different types. Particularly that data should be published, which are not available in the WDC but important for judgement of ionosonde data of the different stations: accuracy and stability of the height and frequency scale of ionograms; sense and frequency of transmitter output control and receiver gain shifting. Moreover it would be interesting to know, by which personal and technical fitting-out the ionosonde stations do all the work connected with the handling of data.

The question of Mr. Piggott "Is the Bulletin too conservative in outlook?" I answer in the negative. I agree with Mr. Piggott, that long sequences of observations without a break in continuity of rules of reduction are eminently important. This necessity justifies a more conservative point of view in handling the questions connected with production and reduction of data. This outlook should be expressed in the INAG bulletin.

Ionosonde station - Juliusruh/Rugen

Ionosonde: modified SP-3 (constructed in GDR, 1961).
- Frequency range: original 0.5 to 20 MHz, since Jan. 1, 1972 0.2 to 20 MHz.
- Frequency and height scale: crystal-stabilized, maximum reading accuracy ±0.05 MHz and ±2 km.
- Pulse frequency: 30 Hz; pulse length: 100µs.
- Maximum pulse power: 35 kW.
- Duration of sweep: 27 sec. up to 5 MHz; 43 sec. up to 15 MHz.
- Recording equipment: 35-mm-film, examples see Report UAG-12, Vol. II, p. 224.
- Gain-shifting (receiver): automatically in steps of 5 decibels.
  - Maximum difference (day-night): 25 decibels. The shifting time depends on solar zenith angle.
- Antenna systems: for transmitting 3 different rhombic antennas, max. extent vertical 70 m, horizontal 200 m. For receiving a delta antenna, height 70 m, base 250 m.
- Sounding program: each quarter hour: two ionograms by day (the first 0.2 to 5 MHz, the second 0.2 to 15 MHz; height range 250 or 750 km, respectively), one ionogram in the night (0.2 to 15 MHz, height range 750 km).

Handling Ionograms:
- Development of films daily, automatically.
- Reduction of ionograms: daily, usually manual by projection. Usually only tabulation and f plots of hourly values.
- Copies of ionograms: with an automatic equipment, only on demand.
- Electron density: height profiles: only on special demand. Remedy: semi-automatic digitalizer for ionograms (Pencil Follower) and computer program.
- Direct control of ionograms: from 0600 to 2200 hours, nearly hourly for short-term warnings of disturbed radio propagation.

Publishing of Data:
- Daily report UFOFD and UMUFD in URSIGRAM PRAHA.
- Monthly publishing in the GEOPHYSICAL DATA of the Zentralinstitut für solar-terrestrische Physik (Heinrich-Hertz-Institut) of Akademy of Sciences of the GDR: foE; Es-type; foEs; h'Es; fbEs; h'F; foF1; M(3000)F1; foF2; M(3000)F2.
- Plots of special days: collected for each year in a special issue of GEOPHYSICAL DATA.

Staff for V.I. measurements: controlled by a physicist. The specified routine work is done by one engineer-in-charge, three observers and one woman for reduction.

Note by Chairman:
- This statement gives the information which is needed to construct a useful summary of V.I. station facilities. It would be useful to add the list of any other ionospheric techniques in use at the station where appropriate.

3. Maui

The F2 layer criticals continued to be very high again during this month and a high of 18.0 MHz at 2000 HST, October 31st, was recorded. Needless to state, this value is about as high as I have seen for this hour even during sunspot maximum during my 25 years at this location! For some reason, criticals were unusually high all day long on the last day of October. (Goblins?) Es activity was also quite dominant and several hours of records throughout the month showed complete blanketing of the upper layers of Es.

4. Slough Ionospheric Observatory

As from 1 November 1972, the routine observatory ionosonde has been changed to an equipment known as the RSRS Mk III. This instrument was originally designed and built about 10 years ago but has since been extensively modified and now has the following characteristics:

Frequency range	1 - 20 MHz in one logarithmic band
Sweep time	53 seconds
Transmitter output power	15 kw average over the band
Pulse repetition frequency	50
Pulse width	90 μseconds
Frequency marks	At 1 MHz intervals with additional 200 kHz markers between 1 and 10 MHz
Height ranges	200, 500 and 1000 km
Height marks	Every 20 km with 100 km marks accentuated
Video differentiation time constant	150 μseconds.

The increased power and narrower pulse width, compared with the previous Mk II instrument, produces ionograms which show considerably more detail than previously. One such feature has been the appearance of an Es type layer between 85 and 90 km which is not associated with high D-region absorption (definitely not 'd' type). It was recorded on at least nine days during the first half of December 1972 usually as a weak non-blanketing layer with a top frequency of about 3 MHz and lasting for up to seven hours. However, on December 14th, a weak layer, first seen at 1500 hrs intensified and by 1700 hrs produced strong echoes with a good second order and an unusually low fmin below the minimum frequency of the ionosonde (1 MHz). This layer was still visible, although much weaker, at 1800 hrs but had disappeared an hour later. As December 14th was the last of three successive days of unusual meteor activity, it seems probable that this layer is of meteoric origin as reported by Naismith [JATP, 5, 73, 1954].

5. Installation of new C-4 in Thule (Qanaq)

The new C-4 was put into operation at Thule/Qanaq the 28th of October at approx. 1800 local time after the last units arrived on the 25th.

The first units including the frame arrived on the 11th of October and the old C-4 was stopped and removed from the building to make room for the new one as soon as possible since there was no possibility to store the new sounder in a safe way until all parts had arrived. Due to helicopter break down the last units did not arrive until the 25th as mentioned.

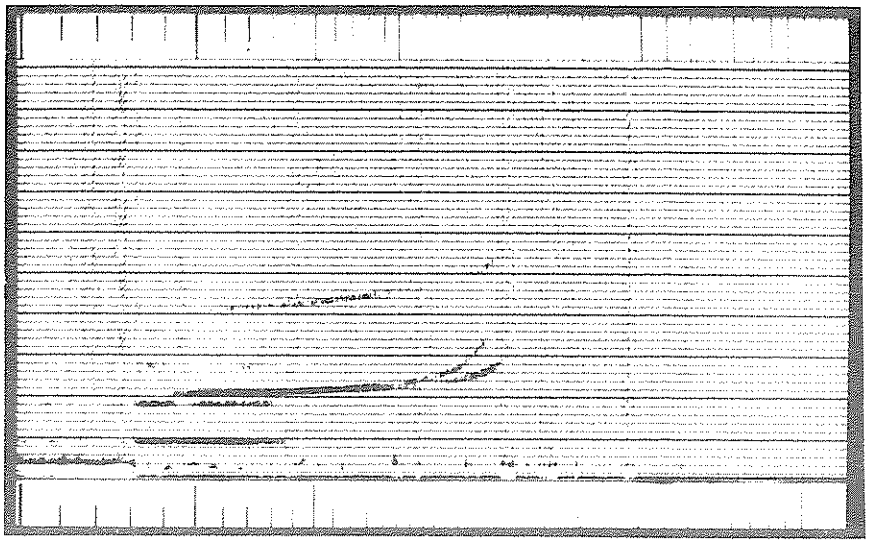
The report says that the excellent marking of cables and units made it easy to reassemble the sounder, and there was only minor damage from the travel.

We feel our two men up there did a nice job assisted by local people and by Mr. J. M. Roesen who had just terminated his employment by AFCRL at Geopole, and therefore was willing to assist "on his way back to Copenhagen". It turned out this way that it was not necessary to send up another engineer from our laboratory, which was very convenient at that time since we were tied up in a rocket campaign at Sonder-Strom, Greenland.

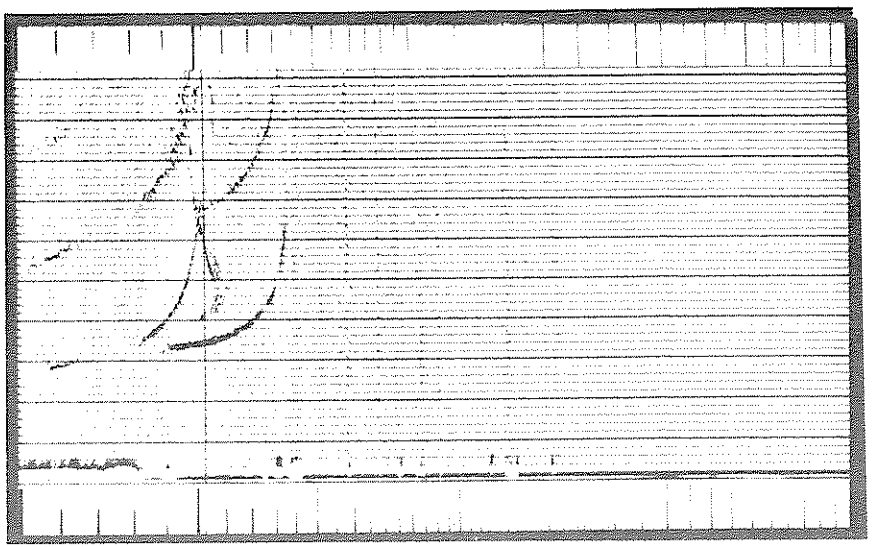
XIV. Reports from World Data Centers

World Data Center A for Solar-Terrestrial Physics, Boulder, Colorado, U.S.A.

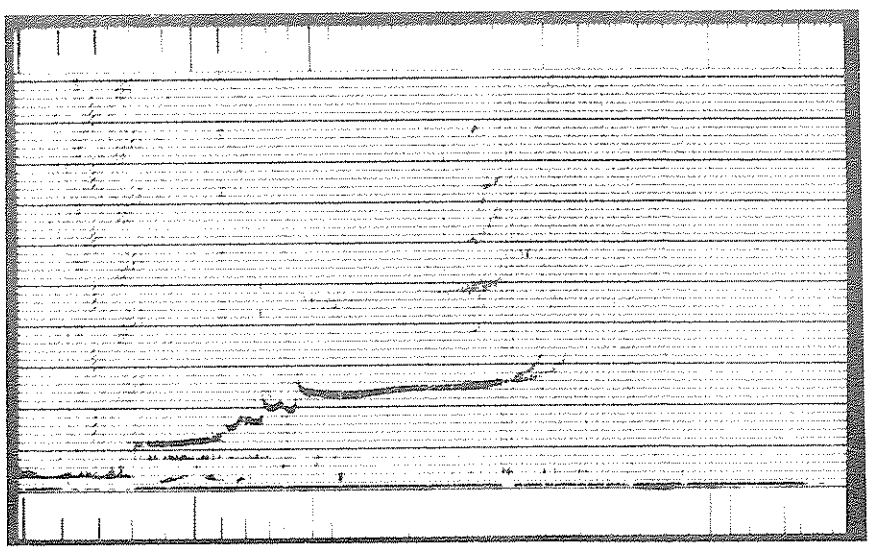
Following the Symposium on the Future Application of Satellite Beacon Measurements, Graz, Austria, 29 May to 2 June 1972 [reported in COSPAR Information Bulletin, No. 63, pp. 17-33, September 1972] discussions have been held with Mr. R. Fritz of NOAA, Dr. A. V. da Rosa of Stanford University and Mr. J. Klobuchar of AFCRL on formats for reporting vertical electron content information obtained from the observation of geostationary satellites. The new Handbook, Report UAG-23, includes the recommended codes and punched card format. WDC-A has received the first of these data from observations of ATS-1 and ATS-3 recorded at Boulder. Sample tapes have also been received from Dr. da Rosa.



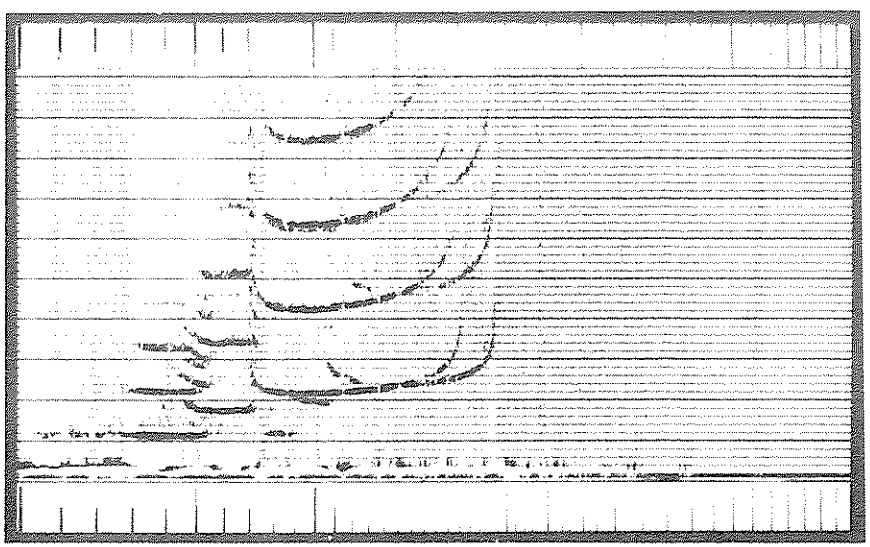
(1) 1700 DEC. 14 LOW Es



(3) 0500 DEC. 24 GOOD OBLIQUE ON O-TRACE



(2) 1100 DEC. 15 MORE USUAL FORM OF LOW Es



(4) 0900 DEC. 26 DETAILED E STRUCTURE AND CLEAR foF2

World Data Centre C1 for Ionosphere, Slough, U.K.

The center has been increased in size by about 100 sq. meters or roughly 50%. More efficient filing systems are also being introduced and as a result much of the topside satellite data, previously held by the upper ionosphere group at Slough, are being transferred to the WDC. This means that future inquiries for World Maps, Ionograms and Nh' profiles of topside satellites should be addressed to WDC-C1 rather than to Dr. J. W. King.

The ionospheric catalogue will be re-issued in January. The results of a questionnaire circulated with our previous issue suggested that most users prefer the alphabetic listing of stations rather than by latitude. However, to satisfy both interests the new catalogue has the yearly summary listed by geographic latitude and the detailed monthly data in alphabetic order as before.

World Data Center C2 for Ionosphere, Radio Research Laboratories, Tokyo, Japan.

Dr. I. Kasuya reports: "The Radio Research Laboratories, Ministry of Posts and Telecommunications of Japan established the Okinawa Radio Wave Observatory on May 15, 1972 in accordance with the reversion of Okinawa to Japan, and took over the duties of the ionospheric observation at Okinawa.

"We wish to publish hourly scaling data with monthly median values from at least June 1, 1972 in the same format as those of other Japanese ionospheric observatories.

"I would like to report you as an information to INAG, by the way, that we have gradually sent off our staffs to the Okinawa Radio Wave Observatory which used to be the Propagation Station, and continue to make observations. We are now catching up the scaling of the ionograms and will publish the hourly data of each month in the very near future."

XV. Translations of INAG Bulletins

Translations of INAG Bulletins are now available in Spanish and translations of parts of Bulletins in French and Russian.

Those wishing to receive the translated versions are requested to notify the appropriate INAG member:

Spanish	-	Miss J. V. Lincoln
French	-	Mlle. G. Pillet
Russian	-	Dr. N. V. Medinkova

The addresses will be found on the English version of the Bulletins.

A note by Mlle. Pillet in the French version of INAG-11 is reproduced below.

"Vous n'avez recu la version française des Bulletins INAG que pour les deux premiers numéros car je n'ai pu trouver le temps de préparer la traduction in-extenso des Bulletins suivants.

"Je me propose de ne diffuser en francais que des extraits de synthèse du Bulletin INAG en renvoyant le lecteur à la version anglaise, en particulier pour les articles comportant des figures ou des figures ou des reproductions d'ionogrammes.

"Je vous serais obligée de me faire savoir si vous recevez la version anglaise du Bulletin INAG et si vous désirez la traduction de certains articles parus dans les Bulletins INAG n°3 à 10."

XVI. Literature Citations

The summary below will give the journal, volume number, page number and list of stations used in the publications as evidence of the use of the V.I. network.

Doklady Akademie Nauk Tadzhikskoy SSR XV, No. 8, 1972, pp. 15-17 (Dushanbe).

Geomagnetism i Aeronomiya, XII, No. 5, 1972, pp. 836-842 (Sofia, Michurin); pp. 928-931 (northern hemisphere); pp. 936-937 (ship Akademak Kurchatov); pp. 939-941 (Leningrad, Gorky, Moscow).

Geofizicheskiye Issledovaniya n Zone Polyarn, Siyaniy, 1972, p. 92 (Murmansk).

Izvestiya AN TSSR, Ser. FTKh i GN, No. 4, 1971, 84 (70 northern hemisphere stations).

JATP, 1972, 34, 1163 (Canberra, Petropavlovsk, Capetown, Poitiers, Hobart, Magadan, Kerguelen, Sogra, Marion Is., Lindau, Townsville, Kokubunji); 1201 (Alouette II); 1233 (Wallops Is.); 1470 (Canberra); 1495 (de Bilt, Slough, Freiburg); 1537 (Huancayo).

JGR, 1972, 77, 6121 (ISIS 1); 6202 (Erie); 6804 (Erie); 6911 (AFCRL aircraft).

J. Radio Res. Lab., Japan, 19, 1 (Resolute Bay, Godhavn, Kiruna, Sodankyla, College, Lycksele, Narssarssuaq, Uppsala, Churchill, Inverness, Moscow, Macquarie Is., Campbell Is., Falkland Is., Lindau, Slough, Poitiers, Ottawa, Wakkanai, Christchurch, Alma Ata, Hobart, Akita, San Francisco, Tokyo, Canberra, Buenos Aires, White Sands, Mundaring, Yamagawa, Brisbane, Tucuman, Grand Bahama, Okinawa, Sao Paulo, Ahmedabad, Raratonga, Maui, Townsville, Dakar, Huancayo, Kodaikanal, Port Moresby, Ibadan, Singapore).

Radio Science, 1972, 7, 897 (Boulder, White Sands); 1033 (Boulder digital).