IONOSPHERIC NETWORK ADVISORY GROUP (INAG)*

IONOSPHERIC STATION INFORMATION BULLETIN No. 45**

*Under the auspices of Commission G, Working Group of the International Union of Radio Science (URSI)

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Issued on behalf of INAG by World Data Centre A for Solar Terrestrial Physics, National Oceanic and Atmospheric Administration, Boulder, Colorado 80303, U.S.A. This 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.

1. Introduction

by W.R. Piggott, Chairman

This Bulletin gives the report of the last meeting of INAG to be held under my Chairmanship. The network appears to be expanding rapidly and there are many new developments in the use and application of ionosondes. It is thus timely that INAG should be reorganised to meet the needs of the future, and I hope that you will give the new Chairman, Professor J. Gledhill, all the help that he will need in the future.

It will take some time to reorganise INAG, and it is desirable to identify all those who are willing to help either by making suggestions or as Members or Reporters of INAG. Please act now.

In addition to the difficulties in producing and circulating the Bulletin, which can now be minimised by using a fairly cheap word processor, I have found that my work as Chairman has sometimes been greatly hindered by lack of a few hundred dollars. Thus, for example, I was unable to attend the meeting in Hong Kong through loss of support for travel at the last minute.

To minimise these difficulties and to provide suitable equipment for the rapid production of the Bulletin and to help with difficulties due to the change in Officers, several groups represented at Florence volunteered sums of around $500 U.S. each to set up an International Fund for helping to finance the new INAG. I would like to draw this initiative to the attention of any other groups willing to help in a similar way. This also underlines the importance attributed to INAG's work internationally. I would also like to take this opportunity to thank URSI on your behalf for the increased support for the Bulletin which makes its future publication reasonably secure.

I would like to take this opportunity to thank you all for your support in the past, and to wish you every success in the future.

I hope it will be possible for me to be useful in the future in my capacity as an Honorary Member of INAG. I shall be happy to discuss your problems with you if I have the opportunity to visit your country in the future.

2. Report of URSI Working Group G1, Ionospheric Network Advisory Group, 1981-1984

by W.R. Piggott, Chairman

The re-equipping of existing ionospheric observatories and the setting up of new ones has continued rapidly during the last three years. Over half the present network of about 130 stations have installed new equipment recently.

Ten issues of the INAG Bulletin, averaging 18 pages per issue, have been produced. These have included reports of nine meetings led by INAG members, one of which, at IAGA, Edinburgh, was reported verbally at the URSI General Assembly in Washington. These were:

Edinburgh IAGA, UK	1981	reported in	INAG 34
Washington URSI, USA	1981		INAG 34
Irkutsk, USSR, Operators Conference	1981		INAG 35
Sydney, Australia, Operators Conference	1982		INAG 36
Fairbanks, Alaska, USQ	1982		INAG 37
Dourbes, Belgium	1982		INAG 37
Chilton, UK	1982		INAG 37
Hamburg IAGA, West Germany	1983		INAG 41/2
Hong Kong, ISEA	1984		INAG 43/4

The Atlas of High Latitude Ionograms, with notes in English, prepared by A.S. Bezprozvannaya and T.I. Shchuka, USSR, was reproduced in INAG 42. This is a very valuable aid to the interpretation of high latitude ionograms, complementing the High Latitude Supplement to the URSI Handbook.

INAG has started discussion on the problems of making more vertical incidence data available internationally through the World Data Centres in computer compatible form and on the special problems of digital ionosondes. Both of these present serious problems, which will take time to resolve. On the former, many stations at geophysically important sites do not have the local resources to collaborate fully and there are difficulties even at stations which use microcomputers or digital tables for their initial analysis. How ever, several important groups should have little difficulty in co-operating when a standard is agreed.

While the potential of digital ionosondes is well understood and many have been deployed, they have been used mainly for research purposes, or treated as if they were analogue machines, losing most of the special advantages of digital output. Thus, the problems which will arise in exploiting them synoptically have not been identified or investigated properly. INAG and the International Digital Ionosonde Group (IDIG, Working Group – G10) have attempted to promote such studies, but the result of this prompting will not be known before the General Assembly in Florence. All IDIG reports have been reproduced in the INAG Bulletin.

Use of the simplified analysis rules agreed at Washington appears to be confined to the groups originally asking for changes, and most of the network is continuing with the full analysis as in the past.

With the support of the Royal Society, UK, and of many local administrations, the Chairman has visited Australia, Belgium, People's Republic of China, Hong Kong, Indonesia, New Zealand and USA. In addition to discussing many local problems and helping to improve the standards of analysis, these visits have shown that there are many scientific problems which can be studied effectively using VI data. Many of these problems have not been discussed in the literature.
For example, most magnetically sub-tropical stations regularly record, but fail to recognise, typical auroral phenomena, apparently associated with the inner Van Allen belt. There appear to be many dramatic dynamic effects which are probably related to tidal phenomena near the same latitudes. Suggestions for research have been published in the INAG Bulletins and have provoked some re-examination of the data at a

few stations.

The present circulation of the INAG Bulletin is about 350 copies per issue, but this could be improved. Both producers and users of data, who do not currently receive it, are invited to apply through the Secretary of INAG.

Many of the new stations in developing countries have been set up to improve knowledge and control of MF and HF communications. These groups need more guidance on the practical application of ionospheric data and the organisation needed to attain this end, in addition to the normal INAG assistance in obtaining the data and in local research. The great expansion of the use of HF, particularly in the Southern Hemisphere, is mainly due to the numerous relatively small organisations, aircraft, ships, fishing fleets and, in developing countries, the need to exploit the cheapness and limited engineering back-up needed to maintain HF links. In contrast, it is now possible to give CCIR more complex data from at least a few digital stations, e.g. the doppler information that has been requested for many years. Guidance is needed on what is most useful and should be attempted first.

A new master list of VI stations was published in INAG 37 and a map of those operating during the International Magnetospheric Study was reproduced in INAG 39.

The workload on INAG officers is excessive and more active helpers are needed to maintain INAG services. New officers will be appointed at Florence.

3. INAG meetings at the XXI URSI General Assembly, Florence, Italy

There were two formal meetings of INAG during the XXI URSI General Assembly held in Florence, Italy from 28 August to 5 September 1984. The reports of these two meetings have been combined for convenience.

Those in attendance at least for part of one meeting were:-

W.R. Piggott*	Chairman
D.G. Cole*	Vice-Chairman
L.W. Barclay	U.K.
Sir Granville Beynon	U.K.
L. Bossy	Belgium
F. Borman	U.S.A.
J. Buchau	U.S.A.
L. Cander	Yugoslavia
R. Conkright*	Ass. Sec.
T. Dambaldt	Fed. Rep. Germany
H. Derblom	Sweden
J.R. Dudeney	U.K.
E. Galdrin	Spain
J.A. Gledhill*	South Africa
R. Hanbaba	France
R.D. Hunsucker*	U.S.A.
J.A. Jodogne	Belgium
T. Kelly	Australia
L.B. Kolawole	Nigeria
J. Oyinloye	Nigeria
A. Paul	U.S.A.
G.M. Pillet	France
S.A. Pulinets	U.S.S.R.
S. Radicella	Argentina
K. Rawer	Fed. Rep. Germany
B. Reinisch*	U.S.A.
A.S. Rodger*	Secretary
R.W. Vice	South Africa
P.J. Wilkinson*	Australia
J.W. Wright	U.S.A.

*INAG member

Chairman's Introduction

The Chairman drew attention to the MONSEE report about to be published in which the number of ionospheric observatories appears to have declined by about 7% over the last 8 years. The ensuing discussion confirmed that there were many new stations established in the last few years that the MONSEE directory has not included. For example, Digisondes 256 have recently been deployed at La Trobe, Australia and Peking, China. A map showing the locations of IPS-42 ionosondes installed up to the end of 1982 was reproduced in INAG 39, p.14; many of these are new observatories. In addition, several other new or reopened stations were mentioned, such as Hermanus, Hamburg, La Reunion and Tamanrasseat. The status of 10 or more other stations was not known. A review of INAG Bulletins since 1976 suggests that 39 stations had opened and only 14 closed. Thus the network is increasing in size quite rapidly, rather than contracting as suggested by MONSEE. The Chairman said that he would write to MONSEE to bring this discrepancy to their attention. It was recommended that a MONSEE standard form should be included in the next INAG Bulletin (see last page of this Bulletin). Those who have not returned one already are encouraged to do so.

Another area where there may be a reduction in the apparent size of the ionosonde network is through a small reduction in the number of stations submitting their data to the World Data Centre system. Costs may be a significant factor in this. It would be much better to send data only once a year than not at all. It was emphasised that it was of great benefit for many scientists and those involved in radio communications to have data from as many stations as possible. Therefore those responsible for the administration of ionosondes should make every effort to ensure that their data are made available to the WDCs. It was appreciated that some stations, especially those recently established, often have difficulties in analysing their data. Those experiencing such problems should make contact with INAG through the Chairman so that help may be provided.

The future of INAG

There was unanimous agreement that INAG fulfilled a very useful role and that it should continue. However, the Chairman indicated that both he and the Secretary would resign from these offices, and that a significant reorganisation of INAG would be necessary to ensure its future financially and to reduce the workload on the officers. Dr Piggott felt that the time had come for a thorough revision of INAG membership and method of operation. The members of the new INAG should decide which, if any, features of the old system should be continued. It was important that a new consensus of views should be established and that opinions be obtained from those interested who were not present at the meeting.

It was decided that there should be a Chairman, Executive Secretary, Publication Secretary and INAG members as has been the case since INAG was established in 1969. However, in addition there should be REPORTERS who would have very specific areas of responsibility and would be expected to produce short reports and notes in the INAG Bulletin at regular and frequent intervals. It was hoped that with this arrangement the Chairman would not have to produce much of the material of the Bulletin but would ensure that the Reporters met their obligations.

After some discussion, Professor Jack Gledhill was elected as Chairman of INAG and his colleague at Grahamstown, South Africa, Mr Raymond Haggard was appointed as Executive Secretary. Mr Raymond Conkright at World Data Centre A in Boulder agreed to continue as Publication Secretary and would still be responsible for the reproduction and the circulation of the Bulletin and the issuing of new station codes.

The new Chairman accepted that he should invite individuals to become INAG members to represent the stations in their country or in a small group of countries. He would welcome any suggestions of those who would be willing to be active members.

It was decided that there were 13 topics for which reporters would be beneficial and suitable people could be found to meet the requirements of these tasks. They were:-

Topic	Reporters
1. Ionogram. interpretation and scaling rules	R.Haggard and W.R. Piggott*
2. Handbooks and training aids	P.J. Wilkinson
3. New station co-ordinator	J.A. Gledhill
4 Co-ordinator for developing countries	R. Hanbaba
5. Interchange of ionograms and data, emphasising digital methods	R.O. Conkright
6. Automatic ionogram analysis methods	B. Reinisch
7. Technical developments for ionosondes	K. Bibl
8. N(h) profiling problems	A. Paul
9. International Reference Ionosphere input and co-ordination	L. Bossy
10. Low latitude problems	S. Radicella
11. High latitude problems	A.S. Rodger
12. Developments for the acquisition of ionosondes and their reduction to meaningful echo parameters	J.W. Wright
13. Algorithms for extracting aeronomic parameters from ionosonde data	J.R. Dudeney

* The Secretary of INAG would be responsible for collecting ionograms and sending them to INAG members who would carry out the initial analysis, and then send them to Dr Piggott who would collate and comment for Uncle Roy's Column.

Also it was decided that Dr W.R. Piggott should be an Honorary Member of INAG and would thus join A.H. Shapley in that capacity. Dr Piggott thanked the meeting for making him an Honorary Member and stated that he would be happy to continue to advise on ionogram interpretation and rules, to give other advice when requested and to lead meetings for INAG in any countries he might visit in the future.

The name of the Working Group

There are several topics above which are mainly of interest to those with modern ionosondes which provide phase, Doppler and amplitude information. The International Digital Ionosonde Group (IDIG) had decided to disband and felt that their interests could now be met within a restructured INAG. As a result of this change it was decided that the modified working group of URSI should be called the IONOSONDE NETWORK ADVISORY GROUP but would continue to have the acronym INAG.

The terms of reference of INAG

A small group of INAG and ex-IDIG members drafted revised terms of reference for INAG to take account of the wider interests of the new Working Group. These were agreed and are given below.

INAG is established by URSI to pursue the following objectives through the publication of a bulletin and by meetings in diverse locations.

1. To monitor, maintain and improve the standards of data produced by ionosondes and the ionosonde network.

2. To promote the interchange of data through the World Data Centres or by direct contact between stations and users, and the archiving of such data.

3. To revise the parameters and the associated rules to match the needs of the user.

4. To evaluate and make recommendations on the international importance of proposed and existing stations as required.

5. To encourage the development of improved ionosonde methods and to inform the community about them.

6. To encourage staff at ionosonde stations by informing them on the use of their data and allied matters.

7. To promote the use of ionosondes in research campaigns.

8. To encourage theoretical studies as an aid to the acquisition and interpretation of ionosonde data.

The future financing of INAG

(a) The bulletin

URSI had allocated $500 per annum for at least the last 9 years to partly offset the cost of the reproduction and circulation of the Bulletin incurred by World Data Centre-A in Boulder. URSI accepted an INAG request to have this sum increased to $750 per year. This will be sufficient for WDC-A to continue with their present invaluable efforts.

(b) The running costs of INAG

In the past, the considerable costs of running INAG have been borne by the organisation employing the Chairman and Secretary. For example, British Antarctic Survey have supported the majority of the typing required for the maintenance of INAG and in the last three years have also been responsible for the production of the INAG and IDIG Bulletins. In today stricter financial circumstances, no small organisation can afford to support this type of work. Therefore it was suggested that as many organisations and URSI national committees as possible be invited to provide financial support for INAG and INAG meetings. Several organisations represented at the meeting indicated that they would be prepared to give sums in the range of $500-$1000 to support the new INAG. URSI has accepted this plan and has established an international fund under the control of the Chairman of INAG for this purpose. All organisations and national URSI committees with interests in ionosondes and the use of their data are asked to make a generous contribution to the running costs of INAG. Further details will be given in the next Bulletin.

ICSU Guide to International Data Exchange - Ionosphere

Sir Granville Beynon, Chairman of the International Council for Scientific Unions (ICSU), gave a brief background to the revision of the Guide to International Data Exchange. A small committee has redrafted and simplified the text concerning the exchange of data for the ionosphere, and it is essential for those involved with these disciplines to review this draft text (included later in this Bulletin) and provide comments to the Chairman of INAG by 31 January 1985. The Chairman agreed to give Sir Granville the considered INAG response by 31 March. It is likely that the Guide for the interchange of ionospheric data will be published separately, prior to the completed Guide and probably during 1985.

Combined catalogue of ionosphere vertical soundings data

The World Data Centres for the Ionosphere in Boulder, USA, Moscow, USSR, Chilton, UK and Tokyo, Japan have recently produced a draft catalogue containing all the vertical incidence soundings data listed at the four locations. This will be circulated shortly to all known contributors. All stations known to the Data Centres are listed by geographic latitude and longitude, by geomagnetic latitude and in alphabetical order. There is a map illustrating the locations of all known stations, together with a catalogue of all the data held for these stations. In the past, INAG has found discrepancies in such lists due to difficulties in cataloguing all the available data or due to delays in incorporating the most recent data. Those who are or have been responsible for stations are requested to check the entries in this catalogue and to inform the appropriate WDC of any errors or omissions. A draft of the catalogue is available on request to WDC-A in Boulder.

The future of Huancayo Ionospheric observatory

Data from the ionospheric observatory at Huancayo have not been circulated for over a year. Considerable concern was expressed over this decision, as the station was one of the most important in the network. It has been established for over 45 years and the data from this station have played a very significant part in our current understanding of the equatorial ionosphere and its relationship to other solar-terrestrial phenomena. The data from Huancayo have also been extensively used in the production of the IF2 index - an important parameter for radio communication predictions. Therefore it was recommended that all possible efforts should be made to continue observations at this station. The Chairman of INAG would write to the responsible organisation pointing out the community's concern. Commission G adopted a resolution to this end. It was also noted that both CCIR and those at the recent Equatorial Aeronomy Conference in Hong Kong were in accord with the views of INAG on the continuing importance of this station.

Commercial interests and INAG Membership

There was a very heated and sometimes acrimonious discussion of the position of those involved in commercial activities which were directly related to INAG matters. For example, those who sell ionosondes may have conflicting loyalties or financial advantages if they were to be made INAG members or reporters. While this point was appreciated by all concerned, there was disagreement on how to define 'commercial', in that there were several people who spent some of their time and effort involved in either producing or selling products for the ionospheric community. It was felt by some that the experience, knowledge and local contacts of those who supply and maintain ionosondes but were involved in business rather than science, could outweigh the disadvantage of their diverse motivations. The matter was unresolved but the Chairman agreed to continue to seek opinions and provide a consensus view in due course.

Aid to developing countries

Dr Rudi Hanbaba has been appointed as Reporter with special responsibilities for the developing countries. Dr Hanbaba already has considerable experience in the application of VI data to practical problems in developing countries. He has provided support and advice to those carrying out ionospheric soundings at some African stations.

Future INAG Meetings

It is hoped to hold INAG meetings during the Conference on Ionospheric Physics and Radio Wave Propagation organised by the Ionospheric Prediction Service in Sydney, Australia between 11 and 15 February 1985. Also a further meeting may be arranged during the 5th IAGA Scientific Assembly in Prague, 5-17 August 1985.

Votes of thanks

Professor Rawer gave a brief tribute to the work of Dr W.R. Piggott who had resigned as Chairman of INAG in the course of the meeting. All those present gave Dr Piggott a standing ovation lasting several minutes. A resolution expressing the appreciation for all his efforts was submitted to URSI for approval. He also received another standing ovation during the Business meeting of Commission G. An acknowledgment of his work will be published in a later bulletin.

A vote of thanks was passed to all those who have contributed to the INAG Bulletin in the last three years and, in particular, the Secretary, A. Rodger, Assistant Secretary, R. Conkright, and Drs Besprozvannaya, Cole and Wilkinson.

Training manual

After the INAG meeting finished, a copy of an English translation of the first half of the Japanese Ionogram Training Manual was received. Dr Piggott announced this at a Commission G Business Meeting and thanked Dr N. Wakai and his helpers for the work involved.

The Japanese version has proved valuable to the Australian chain of stations. This will be passed to Dr P.J. Wilkinson as Reporter with responsibility for Handbooks and Training Aids.

4. Resolutions accepted by Commission G of URSI

The following resolutions were accepted by the Commission in business meeting during the Florence General Assembly.

1. URSI,

noting

(a) that Dr W.R. Piggott has been active, as chairman INAG and its predecessor, supporting the ionospheric network for over 25 years,

(b) that he is now retiring from this office,

expresses

its warmest thanks to Dr Piggott for his extraordinary service aiding and supporting stations and operators, and the international radio science community.

2. Commission G,

recognizing

(a) that there is a continuous interest in the maintenance of an ionosonde network;

(b) that a considerable number of ionosondes has recently been produced and deployed, some in developing countries;

(c) that INAG has made adequate arrangements for the future production of the INAG Bulletin;

appreciating

that significant financial support will continue to be provided by WDC-A and some national administrations;

recommends

that URSI continues to support the publication of the INAG Bulletin for the next three years.

3. Commission G,

recognizing

that it is difficult for INAG officers and members to obtain sufficient support to produce the INAG Bulletin and to attend INAG meetings;
recommends

that national committees and institutes provide all possible assistance to overcome these difficulties.

4. Commission G,

recognizing

that the costs of preparing the INAG Bulletin are too large to be met by the individual organization concerned, and that several organizations have expressed their willingness to contribute to these costs,

recommends

that URSI establishes an international fund to finance the operation of INAG under the control of the chairman of INAG, and invites the interested groups to contribute to this fund.

5. Commission G,

recognizing

that many new ionosondes have been set up which are not yet known to the WDCs;

recommends

that the responsible administrations arrange that the station details are sent to the preferred WDC and INAG is informed of its existence.

6. Commission G,

noting

that in spite of an increase in the number of ionosonde stations during the last decade, the response to the World Data Centres has considerably decreased

urges

ionosonde stations and administrations running such stations to ensure that the established interchange rules be respected and, in particular, monthly data reports be regularly delivered to the appropriate World Data Centre in the standardized format.

7. Commission G,

recognizing

that the ionosonde station at Huancayo has, for more than 47 years, played a highly significant role in the understanding of the ionized atmosphere at equatorial latitudes and its relationship to other geophysical phenomena,

noting

that this station has ceased regular operation

urges

that a routine programme of soundings be re-established and that the data be made available to the international community through the World Data Centres.

8. Commission G, noting

that the geophysical observatory of Tortosa has provided geomagnetic data continuously for the past 80 years, and ionosonde data for the past 30 years, thereby contributing significantly to the under standing of ionospheric processes,

urges

the responsible administration to maintain this observatory in operation.

9. Commission G,

appreciating

that the "Combined Catalogue of Ionosphere Vertical Soundings Data" is about to be published by the World Data Centres for Solar Terrestrial Physics

noting

that this catalogue will be of great value to the scientific community

encourages

all stations and administrations to examine the catalogue closely and bring any additions and corrections to the attention of the World Data Center-A in Boulder, USA.

10. Commission G,

noting

that a data base for incoherent scatter radar data has been established at the National Centre for Atmospheric Research (NCAR) in Boulder, Colorado,

urges

that in the interests of facilitating the interchange and exploitation of such data the responsible administrations adopt a common format and provide the data base with their data in a timely fashion.

11. Commission G,

noting that,

in order to interpret the new data being acquired at high latitude with a variety of radio and other techniques it is essential to know the interplanetary magnetic field

urges

that every effort be made by governments and governmental agencies involved in space measurements to ensure that these parameters be acquired and made available in a timely fashion.

12. Commission G, noting

that Working Group G10, the International Digital Ionosonde Group, has developed a draft standard nomenclature for parameters determined from digital ionosondes (INAG Bulletin 40/41 October 1983),

recommends,

the scientific community to adopt this nomenclature as standard in documents and scientific publications.

5. Greetings from the new Chairman

The retirement of Dr W.R. Piggott at the Florence General Assembly of URSI marks the end of an era in the affairs of INAG. Roy has been Chairman ever since INAG was originally set up. His expertise will not be completely lost, however, for he has agreed to give his opinion on ionograms we send him. I have asked Sir Granville Beynon to write an appreciation of Roy's services to INAG; I hope this will appear in the next issue of the Bulletin.

This is the last issue to be prepared by Alan Rodger, to whom we also owe a debt of gratitude for his devoted work over the past few years.

At the Florence Assembly I was elected as Chairman and Ray Haggard as Executive Secretary. Ray Conkright continues to be Publication Secretary and distribution of the Bulletin will be from WDC-A in Boulder as before. Your new executive will try to maintain the high standard of its predecessors. We shall always be happy to receive items and queries for the Bulletin.

PROF. J.A. GLEDHILL

6. Addresses of the officers and reporters of INAG

Chairman of INAG
Professor J.A. Gledhill
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Executive Secretary of INAG
Mr R. Haggard
(address as Prof. J.A. Gledhill)

Publication Secretary of INAG
Mr R.O. Conkright

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D-3411 Katlenburg - Lindau
Federal Republic of Germany

Dr J.R. Dudeney
(address as A.S. Rodger)

7. ICSU Guide to International Data Exchange Ionosphere

Preface

In the past year or so, the ICSU Panel for WDCs has given much attention to the problem of adapting and updating the WDC system to modern needs. As part of these discussions, attention has been given by the Panel to the preparation of a completely revised edition of the document known as the Guide for the Exchange of Data within the WDC System. This Guide was originally published in 1958 and was intended to ensure a steady flow of data in agreed format from the observing stations. There have been four editions of the Guide, the most recent being that published in 1979. The ICSU Panel has drawn up plans whereby different sections of the Guide will be revised by representatives of the appropriate international scientific bodies. The present document is a draft proposal for the revised form of the Ionosphere Section of the Guide and is based on detailed discussions at a meeting held at WDC-C1 , Chilton, UK, on 31 July-1 August 1984.

Present: Sir Granville Beynon (Chairman of ICSU Panel), H. Rishbeth (Panel Member for WDC-C); A.S. Rodger and P.J. Wilkinson (INAG); D.M. Willis, C.M. Doidge, M.A. Rapgood and R.W. Smith (WDC-C1 for STP).

The following text is the suggested replacement for pages 23-28 of the 1979 Edition of the Guide. We are well aware that much alteration and refinement may be needed before approval by the ICSU Panel. The aim has been to simplify the existing text and remove details that are not now being recorded extensively, and to add new information of a practical nature.

Comments and suggestions are solicited from WDC-A, WDC-B, WDC-C2, data producers, data users and the scientific community generally. They should be sent in the first instance to the new Chairman of INAG, Professor J.A. Gledhill.

1. World Data Centres

A. World Data Center A for STP

NOAA, D63
325 Broadway
BOULDER
Colorado 80303
USA

Telex: 45897 SOLTERWARN BDR

B. World Data Center B2

Molodezhnaya 3
MOSCOW 117296
USSR

Telex: 411478 SGC SU

C1. World Data Centre C1 for STP
Rutherford Appleton Laboratory
Chilton
DIDCOT
Oxfordshire OX11 OQX
United Kingdom

Telex: 83159 RUTHLAB G

C2. World Data Center C2 for Ionosphere
Radio Research Laboratories
2-1, Nukui-Kitamachi 4-chome
Koganei-shi
184 TOKYO
Japan

Telex:2832611 DEMPA J

2. Ionosphere vertical soundings

2.1 Programme of observations

The normal programme for vertical incidence sounding is to record an ionogram every 15 minutes, with more frequent soundings during periods of special interest. These are listed in the International Geophysical Calendar, copies of which can be obtained from WDCs in the September of the preceding year. See also section 9 of the URSI Handbook of Ionogram Interpretations and Reduction (UAG-23).

2.2 Data analysis

Data analysis should be carried out in accordance with uAG-23 and UAG23A. Further guidelines are provided in the Ionospheric Network Advisory Group (INAG) Bulletins which can be obtained through World Data Center A for STP.

Monthly tables of hourly values of the following parameters:

foF2, M(3000)F3 (or MUF(3000)F2), foEs, foE, fbEs, foF1, fxI, fmin, h'F, h'E, h'Es, h'F2, M(3000)F1 (or MUF(3000)F1), h'Es, types of Es.

should be sent to the World Data Centres. A subset of these parameters is acceptable. Monthly summaries (medians, quartiles, etc.) should be supplied with the monthly table for each parameter (except types of Es).

Frequency plots (f-plots) should be made for Regular World Days and nominated special periods in the International Geophysical Calendar.

Medians should be supplied with all monthly tables for each parameter.

2.3 Information to accompany the data

The following information should accompany the data submitted to the data centres:

- Station name
- Geographic co-ordinates
- Time zone applicable to the data
- Type of ionosonde used
- Normal sounding schedule
- Any deviations from URSI scaling conventions (see UAG-23 and UAG-23A)
- Media on which the ionograms are available
- Media on which scaled data are available
- Contact name and address, telephone and telex numbers.

2.4 Stations which do not record data on a regular basis

Stations which do not have a regular schedule should notify the WDCs of the nature of the programme and the availability of the ionograms and scaled data giving a contact name and address, telephone and telex number.

2.5 Methods for data exchange

a. The recommended method for exchanging hourly values, medians and quartiles is on 9 track, 0.5 inch magnetic tape. A recording density of 1600 bpi is preferred. The data should be written in ASCII or EBCDIC characters and the format given in appendix A should be adopted.

Further guidelines on these matters such as the documentation required to be sent with the magnetic tape are given in Appendix B of this guide or are available on request from the WDCs.

In the past, vertical incidence ionosonde data have been written on magnetic tape in the form of card images. This method is still acceptable and is described in UAG-23.

b. Tables of data and f-plots on microfiche or paper are acceptable. To ensure good reproduction, microfiche should be prepared with white characters on a dark background. Data submitted on paper should use white paper of good quality with characters printed in black. The paper submitted to the WDCs should not exceed A4 paper size (11 x 8 inches, 297 by 210 mm). Each page of tables should clearly indicate the station name, the month and year in which the data were recorded, and the name of the tabulated parameter.

c. Special arrangements should be made with the WDCs, if data are to be supplied by other methods, such as magnetic cassettes or floppy disks, or telecommunications links.

The use of microfilm for tabulations is discouraged.

e. A few selected ionograms to illustrate the height and frequency scale of the ionosonde, and to illustrate typical quiet and disturbed days for each season, should be sent to WDCs when practical.

2.6 Data from digital ionosondes

It is recommended that the nomenclature shown in Appendix C is used in conjunction with data from digital ionosondes which measure echo phase and amplitude.

3. other active ionospheric datasets held by WDCs

3.1 Ionospheric absorption

Ionospheric absorption is measured by three methods (Al, Pulse Echo; A2, Riometer; A3, CW Field Strength). These methods are described in UAG-57. Data from riometers in high latitudes are particularly in demand by scientists. WDCs should be notified annually of the availability of data from these three methods. In particular, experiments should indicate whether data are scaled and, if so, the type of scaling used (events, hourly values, etc.).

3.2 oblique incidence sounding
(... text to be supplied)

3.3 Total electron content
(... text to be supplied)

3.4 Scintillations
(... text to be supplied)

3.5 Meteor winds

3.6 General requirements

In all cases the following information is required from each station:

- Station name
- Geographic co-ordinates
- Media on which data are available
- Contact name and address, telex and telephone number for obtaining these data.

4. Ionospheric datasets held by experimenters

Many ionospheric datasets will normally be retained by the experimenters and will not be archived in WDCs. Experimenters holding datasets of general interest are encouraged to inform WDCs about these datasets so that WDCs may refer requests to the group holding the data. (Future WDC Catalogues will contain details of such datasets.) Examples of appropriate datasets include:

- Rocket measurements
- Satellite measurements
- Incoherent Scatter
- Coherent Scatter (e.g. STARE, SABRE)
- Whistlers, VLF and ELF Emissions
- Partial Reflections - electron densities and drifts
- HF Doppler measurements
- Meteor Winds
- MST Radars

The following information should be supplied to WDCs:

- Time periods, geographic regions and altitudes for which reduced data (e.g. electron density, temperatures, composition, ...) are available

- Time periods, geographic regions and altitudes for which raw data are available

- The availability of facilities for processing raw data

- Restrictions on the use of data

- Contact name and address, telephone and telex number for obtaining data.

Experimenters are encouraged to send reduced data of wide interest to WDCs but raw data should be retained by the experimental group. This referral process will become increasingly important with the development of distributed databases.

5. Other ionospheric data sets

There exist many other ionospheric data sets, of types listed in earlier editions of the Guide, comprising a valuable archive which will be held indefinitely in the WDCs. Many of these are virtually in a closed form, to which little or no new data are now added and it does not seem necessary to retain the guidelines previously issued. These categories are as follows:

- Topside Soundings
- Solar flare effects
- Ionospheric Drifts
- Ionospheric Back- and Forward-scatter
- Atmospheric Radio Noise.

6. Solar-terrestrial indices

Several solar-terrestrial indices, not necessarily ionospheric in origin, are frequently used in ionospheric research. Values of these indices should be sent to the WDCs, preferably in machine-readable form. Examples are:

a. Geomagnetic activity indices: Kp, Ap, Dst, the Auroral Electrojet indices

b. Solar activity indices: Sunspot Number, Solar 10.7 cm Radio Flux

c. Ionospheric indices: IF2, IG

d. Interplanetary Medium Data

7. Models

Empirical models are frequently used in ionospheric research. Examples of such models include:

- International Reference Ionosphere

- International Geomagnetic Reference Field

Groups which develop models for free use by the scientific community are encouraged to send details to the WDCs. Copies of computer programs may be sent, but only if the code is properly documented and all machine-dependent routines are clearly indicated.

8. Bibliography

UAG-23 (Upper Atmosphere Geophysics report 23), URSI Handbook of Ionogram Interpretation and Reduction, Second Edition, edited by W.R. Piggott and K. Rawer, November 1972.

UAG-23A, URSI Handbook of Ionogram Interpretation and Reduction, Second Edition, Revision of Chapters 1-4, edited by W.R. Piggott and K. Rawer, July 1978.

UAG-57, Manual on Ionospheric Absorption Measurements, edited by K. Rawer, June 1976.

Appendix A - Draft format for representing tabulation of vertical incidence ionosonde data in digital form on magnetic tape

Data for each parameter during one month form a physical block of fixed length 4800 bytes, which comprise 40 records each of length 120 bytes. The first record identifies the station, month of observation, and the parameter recorded. Subsequent records contain the actual data in the form of 24 groups of 5 characters representing values for the 24 hours of the day. Each 5 character group is coded using the rules laid down in UAG-23. Data for a year form a file of 12N blocks where N is the number of parameters scaled.

The format of each physical block is as follows:

Record	Columns	Description
1	1-20	Station name
1	21-25	Station code
1	26-29	Station time meridian of the station (e.g. 15°W, 9°E, etc)
1	30-33	Geographic co-latitude in tenths of a degree
1	34-37	Geographic east longitude in tenths of a degree
1	38-41	Year
1	42-43	Month
1	44-45	Parameter code (see UAG-23)
1	46-120	Spare
2		Hourly data for the first day of the month
.		..
.		..
.		..
32		Hourly data for the thirty-first day of the month (fill with blanks if there are less than 31 days in the month)
33		Medians
34		Count
35		Upper Quartile
36		Lower Quartile
37		Upper Decile
38		Range
39		Lower decile
40		Spare

If data are unavailable, the full block must be created but with blanks in the appropriate positions.
The arrangement of blocks in each file should ensure that the data for each month form a consecutive set of N blocks. For example, if the standard 14 parameters are scaled the blocks should be arranged:

Block	Month	Parameter
1	January	foF2
2	January	M(3000)F2
.	..	..
14	January	fxI
15	February	foF2
.	..	..
.	..	..
168	December	fxI

Appendix B - A general guide to the exchange of computer readable digital data

This is Appendix G to the Report of the Meeting of WDC Computer Experts held at WDC-C1 for STP, Chilton, UK, 8-12 August 1983, and was reproduced in INAG 43/44 pp 7-9.

Appendix C - Proposed nomenclature for digital ionosonde data

From IDIG Bulletin 4, by J.R. Dudeney, published in INAG Bulletin 40/41, page 9 (October 1983).

The symbols and their definitions given below are designed to be applied to any digital sounder data which contains echo phase and amplitude information.

1. Virtual slant range in km
   a. determined from time of flight — R'T
   b. determined from stationary phase — R'S

2. Virtual height in km
   a. from time of flight — h'T
   b. from stationary phase — h'S

3. 'Skymap' echo-location. This refers to the horizontal virtual range in km to the echo point in the cardinal directions.
   a. North-South — N'S
   b. East-West — W'S

4. Phase range in km — R*

5. Phase height in km — h*

6. 'Line of sight' Doppler velocity (m s^{-1}), defined as dR*/dt — V*

7. Virtual velocity (m s^{-1}), defined as dR'/dt — V'

8. Polarization index — PL
   This takes the character values: 0 for ordinary mode; X for extraordinary mode; N for unknown.

9. Signal Amplitude
   a. linear — Av
   b. logarithmic — Ad

10. Signal-to-noise ratio — SN

8. Views on international data exchange

INAG has received two long documents on international data exchange, one from Kel Aerospace Pty. Ltd. and the other from the Ionospheric Prediction Service in Australia. Both these papers are rather long to include in INAG at full length, therefore an effort has been made to summarise the important points from each so that that INAG community can have as many views as possible on this very important topic. If either group feels that I have been unfair to their paper, then I hope that the new Secretary of INAG, Ray Haggard, will give them a right of reply.

Kel Aerospace Pty. Ltd. Submission

In this document, the authors point out that the WDCs may be advocating the use of 9-track, 1/2" magnetic tape for historical reasons in that they are equipped to deal with and have become very familiar with handling this medium. However, they point out that many small organisations cannot and could not afford the outlay or running costs for the necessary equipment. The III magnetic tape drive is expensive, the airmail and tape costs could be significant especially considering that relatively small quantities of data are normally being transferred.

A further area where significant technical developments are occurring is in the collection of the original ionogram, data and their subsequent analysis by digital methods. For example, there is an increasing number of observatories with ionosondes which record their data on magnetic tape. INAG must develop rules for the exchange of these data as well for the more conventional interchange of ionospheric parameters.

Kel Aerospace argue forcefully that because their products for ionogram data collection and analysis are now used by a significant proportion of the ionosonde network and they anticipate that this share will probably increase, the standards which they have adopted for the recording of ionograms, the storage of analysed ionogram data and the transmission of these data sets through the telephone network, should be adopted as an international standard. The products which Kel Aerospace market include the IPS-42 Ionosonde, the DBD-43 Digital Ionosonde System, the Kel-46 Data Analyser and Kel-47 Central processing system. Each of these equipments uses a different recording medium and format. These have been described for INAG but it is suggested that those interested in these should contact Kel Aerospace directly for details.

The Kel Aerospace paper clearly lays out the advantages of using the international telephone system for the exchange of data and ionograms. These are that

- no magnetic medium needs to be bought for the transfer
- there is little chance of corruption of data in transfer
- there are no uncertainties or delays in arrival of the data
- there is no need to standardise the data medium for transfer
- there are no special magnetic medium reading requirements for the receiver of the data
- there is no need for customs formalities.

Kel Aerospace make several recommendations for the international exchange of ionospheric information.
Again these have been summarised. They propose that:

1. the WDCs should be encouraged to handle raw digital ionospheric data

2. 1/4", 4-track digital data tape formats used in the DBD-43 should be accepted as an international standard for the storage and exchange of data from Australian-type ionosondes.
3. those using non-Australian types of ionosondes should try to produce their data in a similar format to that of the DBD-43.
4. all stations should try to introduce modern digital communications as soon as possible for the transmission of raw and analysed data
5. because raw ionogram data are recorded in time order, there should be a lower level of agreed format for scaled ionospheric parameters in a 'per ionogram' method rather than the 'per parameter' method proposed by the WDCs. The basis for this argument is one of convenience and practicality, especially evident in conjunction with the Kel-47.

Ionospheric Prediction Service Submission

The Ionospheric Prediction Service has provided an updated and more detailed discussion of international data exchange than originally provided by Dr P.J. Wilkinson (INAG 43/44, p.3). This new report, written by Hamish Reid, differs substantially from the Kel Aerospace paper in that it assumes that the interface between the provider of data and the receiver of data (either the WDC system or a scientist) must be at the 1/2", 9-track tape level whereas Kel Aerospace suggest that several other media standards should be defined. Many more opinions on this matter are required so that INAG can form the consensus view of the community.

INAG should accept that digital data is likely to dominate the ionospheric data world within a few years; INAG should adopt standards dealing with this form of data as a primary source and exchange medium. It therefore should adopt standards already used for similar purposes, in particular the relevant ISO (International Standards Organisation), ANSI (American National Standards Institute), CCITT (Committee Consultatif Internationale de Telegraphie et Telephonie) and ASCII (American Standard Code for Information Interchange) standards.

It is suggested that the following standards should be adopted by INAG for ionospheric data exchange media and protocols:

a. Low priority and high volume data should be exchanged on I", 9-track magnetic tape, with a logical and physical format in conformance with ANSI X3.27-1978 magnetic tape standards; the reel size of such tapes should be allowed to be either 12", 8" or 7j", using 800 or 1600 bpi recording densities.

b. All exchanged data should be expressed using the ANSI X3.4-1977 (ASCII) character code, in textual rather than binary form.

c. All long-term data storage should be on magnetic tape complying with ANSI X3.27-1978.

d. INAG should not consider implementing its own data-exchange communications network.

INAG should also make arrangements for helping those members unable to comply with these standards.

An issue that seems to have become blurred in the general discussions on exchange media and protocols is that of internal and external standards. INAG should be concerned solely with data exchange between member organisations and not within member organisations. It should be irrelevant in the discussion of standards that, for its own private reasons, an organisation uses a particular media or set of protocols for internal data gathering.

In view of this it is very important that any standard adopted be realistic, compatible, proven and adaptable. Therefore they should not be unique, innovative, specific or complex.

Character standards

Digital computer data analysis, of course, requires that such data, whilst being processed, be in a digital format recognisable to the particular computer used. The advantages of also storing the data (and analysis results) in identical digital form is obvious - fewer conversion costs, a lack of intermediate codes, and a greater flexibility in final representation; but few computers agree on internal representations of such things as integers, let alone real and matrix data.

Standards exist, therefore, governing the external representation of digital data. Again, unfortunately, coverage of these standards is very restricted. The only universal data object recognised by all computers is the character.

There are two widespread character standards in use - the 7-bit-plus-parity ASCII code used by virtually all non-IBM computers, and the IBM 8-bit EBCDIC code. Use of either of these codes in digital data representation is also almost always further restricted to a subset of the full character set available - usually. In the case of ASCII, to the printable character set. The implications of these widespread restrictions is clear - all data to be exchanged between machines of different make or model must be expressed in terms of ASCII or EBCDIC printable characters.

The choice of whether to use ASCII or EBCDIC is a contentious issue, but most machines can convert from one to the other. INAG should recommend the use of ASCII character codes, but allow EBCDIC for a certain interim period. The use of binary data representations is likely to cause major problems for users and should therefore be disregarded.

Use of these low-level character representations must be made irrespective of the lower-level transport medium. Note that this is definitely not a recommendations for using ASCII coding for internal representation of data and is only concerned with external representations used for data exchange.

Media considerations

Historically, in the field of data exchange, magnetic tape (7- or 9-track) has been the preferred method of transporting data between computing sites. Lately, however, computer communications networks have also become an attractive option for data exchange - in many fields it is the major medium of communication and exchange. Also other exchange media have been proposed and in some cases used, principally floppy disks and tape cartridges.

1/2" magnetic tape

7-track magnetic tape is no longer widely used so that the remarks below are relevant to 9-track tape systems. The advantages of these systems are that they are in very widespread use, that they are a very high density medium at a relatively small cost and that agreed international standards for data exchange already exist. Also, storage and retrieval speeds are relatively rapid compared with floppy disk and telephone lines. The disadvantages of this system are that the necessary hardware costs, a tape drive, are large and that tapes are expensive to post and liable to damage in the international mail services.

Communications networks

Communication networks are largely still in their infancy and there are few agreed standards. Thus the advantages and disadvantages are rather specific to the network used. However, convenience and speed of transfer of data are the obvious gains from such a system but the present operating costs can be rather high.

1/4" magnetic tape, floppy disks and video tapes

For floppy disks, video tape and 1/4" magnetic tape cartridges, there is still considerable diversity in the standards and none are in particularly widespread use in professional organisations. Also, these media are no less likely to transportation damage than 1/2" tapes and do not significantly reduce postal costs. At present, most of the WDCs could not handle them.

Magnetic tape standards

If, as recommended in this proposal, INAG adopts magnetic tape as the primary exchange media, there are many details to be decided - mainly recording densities, reel sizes, recording formats, and associated documentation.

The most widely used tape recording densities on fig 9-track tape are currently 800, 1600, and 6250 bits per inch (bpi). There is the usual trade-off between storage efficiency and speed, and price and complexity. 1600 bpi is the suggested standard, though most modern systems will be able to handle all three recording densities.

Most magnetic tape drives accept 12", 8" and 7-1/2" reels. INAG should specify a preferred reel size to be exchanged. Storage should be done on the 12" reels.

INAG should adopt the ANSI X3.27-1978 standard 'Magnetic Tape Labels and File Structure for Information Interchange". This is a widely supported standard - most operating systems can handle at least level 1 of the standard. The ANSI standard specifies such things as maximum block sizes, record types, etc., and allows these characteristics to be parameterised and documented in the headers on the tape itself, thereby allowing an ANSI standard tape handler to determine the format and file structure of the tape simply by reading the headers (which are themselves of course in a defined format). The standard is also very reasonable and flexible, allowing a good variety of data types and formats.

Tapes conforming to the ANSI X3.27 standard are internally self-documenting: in theory once you can read the first header, all else follows in a well-defined way, documented in ASCII code in the various label files on the tape. This, however, is no substitute for providing human-readable documents explaining the format and contents of the tape. Unfortunately, there are no widely-used standards for this. Therefore IPS proposes adoption of section 7 of

A Guide to the Exchange of Computer-Readable Digital Data in INAG Bulletin 43/44 (p.8).

Computer networks are an attractive method of changing data but are very complex, and work is in progress to define workable technical standards.

Since technology will inevitably change the details of the implementation of the lowest levels quite substantially over the next few years, it is essential that interfaces to usable networks offer an interface that is at as high a level as possible. Currently, most networks are able to offer at least an X.25 level interface (the interfacing computer "sees" the network at the transport level); some still support only the lowest two levels. INAG must abide by the agreed international standards rather than try to develop its own.

INAG and WDC members are already on several international networks - for example the WDC (Boulder) is on the TELENET. it is not important which net a member is primarily attached to, as gateways exist between many nets. Data can be exchanged very rapidly and for a small fraction of the cost of a direct telephone link. Most networks say very little about what may be exchanged across networks; however there only one safe data type that can be exchanged across the world on networks - the printable character. Most networks will take care of the transmission format details, so it is left to INAG only to consider the format of the text to be transmitted. This is clearly an important and developing field, and thus one INAG should consider these problems raised.

Non-standard exchanges

Once INAG has adopted a set of standards for data exchange media, it should consider what it can do to help those organisations unable to implement the standards.

IPS recommends that a hierarchy of INAG members be set up, where those members capable of fully conforming with the standards should be encouraged to accept data in non-standard format; the data accepted under these conditions should be converted into the agreed format. It imposes some obligations on INAG members who do have the resources to conform. Unfortunately, there is probably no other way of encouraging and achieving the standards for data exchange media already developed in the data exchange community. IPS certainly has the resources to implement any reasonable standard INAG wishes to adopt, and will act to assist non standards-conforming members to exchange standards-conforming data.

Conclusions

1. INAG should adopt the standards that already exist for data exchange media in the world of data exchange; these standards have been discussed in this proposal.

2. INAG should leave the question of adopting a computer networking standard until such time as INAG members settle on a common network, or set of networks, that will be useful to all.

In all such standards development and adoption, INAG should recognise that it is a small part of a much larger exchange community, and that INAG will need the support of this wider community, and the computing world in general, if it is to be successful in using computers for ionospheric data exchange and analysis.

9. Some results from the European Es project 1983-84

by W.R. Piggott

The purpose of this note is to draw attention to the relatively regular behaviour of mid-latitude sporadic E when studied in an appropriate way. This is, of course, not a new point. It was originally made by Appleton in the early 1940s when the name sporadic E was adopted generally instead of the older term Abnormal E - he said "There is no evidence that it really is sporadic, only that its behaviour is complicated". The same point has been made recently by Derblom, 1981. I have, therefore, taken a few points from my recent study of European Es, with the hope that these may provoke others to study their Es data (see INAG 38 pp.7-8).

Provided that adequate precautions are taken to avoid gross errors due to weak partial reflections, the differences in gain sensitivity of foEs and fbEs are negligible compared with the variability of the phenomenon, so either can be used. However, counts of definite values of foEs usually greatly exceed those of fbEs so, as sampling errors often predominate, it is preferable to use foEs.

A central problem is that of obtaining an adequate sample of Es behaviour; most Es events last less than 30 minutes at a station, most intense events less than 10 minutes, so it is difficult to get adequate samples with tabulated hourly data. Missing data, due to C's or B's, are particularly troublesome as they are likely to be either extremely active or extremely inactive; only about a third of the days are near the average for a month.

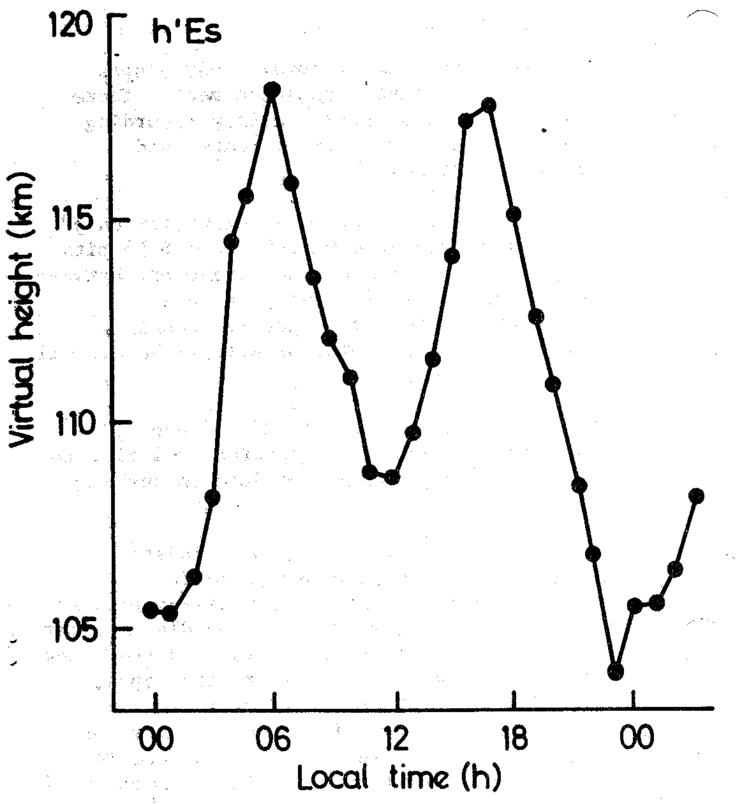
For this pilot analysis, the main effort has involved studies of (foEs-foE) and h'Es with some studies of the relations between (foEs-foE), designated Io, and (fbEs-foE), Ib. Using these parameters, it is possible to divide Es into three classes, weak Es, Io usually less than about 1.5 MHz, strong Es, Io above this level and intense Es, a form of very strong ts which is short lived at all stations that shows sudden jumps in Io of 2MHz or more above the general intensity level of Io and whose duration decreases rapidly as Io increases as seen at VI.

Each of these classes are correlated over much of Western Europe on time scales of one day or more, but not for shorter time scales. Thus the actual hour to hour changes at stations even 60 km apart are frequently dissimilar, though the daily or monthly statistics are highly correlated over ranges of order 500-1000 km. An important point is that the occurrence of weak Es is negatively correlated with that of the strong groups so that foEs or fbEs, which usually give mixtures of both, are confused and show conflicting results. This seems to be the main reason why past work has seldom produced usable results applicable to practical problems. Blanketing by strong Es only slightly increases the observed negative correlation because weak Es represents some 70% of all Es present at mid-latitudes. For a given station, the counts of weak Es, interpreted using the mean correlation, usually give a better indication of the strong Es activity than the counts of Io for the latter! However the correlation is weakened by a tendency for weak Es activity occasionally to decrease up to a day before strong Es activity starts. This is likely to be a useful precursor when forecasting Es activity.

The relations between the counts of intense Es and of strong Es are very non-linear, being small up to a threshold then rising steeply for any further increase in strong Es activity. This is in good accord with observations of Es in the VHF band at oblique incidence.

It is instructive to examine the diurnal variations of h'Es and the seasonal variation of the means of the diurnal variations. Additional accuracy has been obtained by averaging the upper and lower quartile values, rather than using the medians.. Both are similar in shape, but the upper quartile is often shifted earlier in time. In summer, in Western Europe, h'Es shows a double sawtooth shaped diurnal variation with peaks almost 12 hours apart (Fig. 1).

Most Es occurs on the downward parts of the pattern. In general, the most intense Es occurs one or two hours before the end of the downward trend. The evening occurrence of very dense Es is much greater than the morning. No Es (G conditions) usually occur most frequently during the upward sections and the diurnal variation of G is most evident on days with much strong Es, i.e. there is usually more G's in the upwards section when strong Es will be active in the following downward one. Thus the counts of strong Es and no Es are often positively correlated, particularly for these hours. The two peaks of Es activity move towards each other in winter months.



Mean of the upper and lower quartiles for h'Es for June, July and August.
Twenty-four months of Slough data have been used.

The seasonal variation of h'Es (Fig. 2) is also of sawtooth type with minimum height in November. While there are considerable year to year changes, each year shows a fairly regular sequence from September to March. It is notable that the downward section of the seasonal sawtooth occupies the height range at which most Es is seen when Es activity is greatest.

The Mediterranean zone provides special opportunity to study strong Es and intense Es as they are about 10 times more common in this zone than in Central Europe and actually blanket weak Es most of the time.

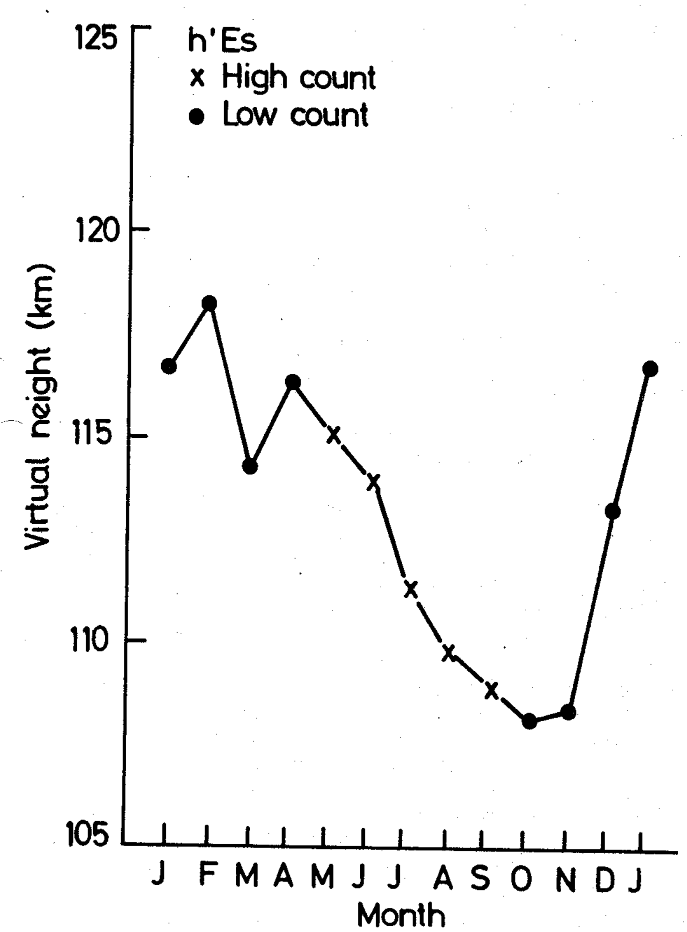
It appears probable that the distribution of the counts of Io above a given intensity level, x, is formed from two exponentials, strong Es dominating for Io 45 MHz and intense Es for Io >6 MHz. The count decreases by a factor of 2 for each 1 MHz rise in Io for strong Es, but much more slowly for intense Es, only a factor of 10 between 6 MHz and 14 MHz.

The diurnal, seasonal and solar cycle variations of strong and intense Es are much more closely related to the statistics of Es propagation in the VHF bands than are the corresponding statistics of foEs or fbEs, suggesting that this approach may have much practical application.

This work has been commissioned by the UK Radio Propagation Users Committee and this abstract is published with their permission in the hope that other V1 groups will also look at their local Es for both scientific and practical reasons.

Reference

Derblom, H., 1981, Reports of Uppsala Ionospheric observatory No. U10. SR 81 03, pp.1-76.



Seasonal variation of the mean value of h'Es for Slough.
Six year data have been averaged.

10. Results of INAG Questionnaire

Unfortunately, MONSEE issued a questionnaire shortly before the INAG questionnaire was prepared, and failed to inform INAG of its action. In consequence very few organisations (16) have replied to the INAG questionnaire and the sample is inadequate to draw worthwhile conclusions. It will, therefore, be more valuable to try to complete the MONSEE survey, and a copy of the MONSEE document is attached to this Bulletin.

About half the replies indicated that microprocessors were in use, about half purely manual. The majority of groups replying can convert to standard P tape but there were few replies from the smaller organisations whose views are, effectively, unknown. Out of the 16 organisations who have replied, 13 have or are intending to purchase a digital ionosonde – some simple, some complex.

11. Computation of MUF(3000)F2

by Adolf K. Paul, San Diego, USA

The following note has been received from Dr Adolf Paul, in response to the statements by Dr P.J. Wilkinson on the scaling of MUF(3000)F2 (INAG 43/44 p.12). Dr Paul suggests that the MUF(3000)F2 parameter can be well defined and be a very sensitive indicator of F-region variations such as gravity waves. Dr Paul's note describes an algebraic form for the computer scaling of this parameter from digital ionograms.

The MUF(3000) is derived from an ionogram by a transmission curve which is given in form of a table in the URSI handbook of ionogram interpretation and reduction (Piggott, W.R. and Rawer, K., 1972). It turns out that this-table can be fitted very accurately by an algebraic expression of the form

$$r = MUF/f = (a - b.h')\sqrt{h'}$$

If a least square fit is applied to all the data in the URSI table we obtain

$$a_1 = 66.858 \text{ and } b_1 = -0.0125$$

The accuracy of the fit can be improved, if it is only applied to the data in the virtual height range from 250 km to 600 km. Then we obtain

$$a_2 = 67.629 \text{ and } b_2 = -0.0148$$

In the following table the results from the two least squares fits are compared with the URSI data

h'	r(URSI)	r_1	r_1^{-r}	r_2	r_2^{-r}
200	4.55	4.551	0.001	4.572	0.022

250	4.05	4.031	-0.019	4.043	-0.007
300	3.65	3.643	-0.007	3.648	-0.002
350	3.33	3.340	0.010	3.337	0.007
400	3.08	3.092	0.012	3.085	0.005
500	2.69	2.710	0.020	2.693	0.003
600	2.40	2.423	0.023	2.397	-0.003
700	2.20	2.196	-0.004	2.163	-0.037
800	2.04	2.010	-0.030	1.971	-0.069

Since the virtual height where the transmission curve is tangent to the echo trace is rarely higher than 600 km, it is recommended to use the coefficients a_2 and b_2. In this case the error is less than 0.5% in the range between 200 km and 600 km. The MUF(3000) can now be obtained by evaluating the product r_2.f for a sequence of (h'.f) pairs in the vicinity of the expected tangent point. The maximum of r_2.f, obtainable by a parabolic fit, is then equal to the MUF(3000).

12. Co-ordinated Antarctic Data Study

At the SCAR meeting in Bremerhaven, it was agreed by the Upper Atmosphere Working Group to institute a coordinated study of Antarctic data for the two periods 10-13 June and 27-29 June 1982, UT. Ionosonde data are under the care of J.A. Gledhill. All interested investigators are asked to send at least a summary of the data available for the above periods, and preferably f-plots for each day on the scale of 1 cm per hour, to:

Prof. J.A. Gledhill
Hermann Ohlthaven Institute for Aeronomy
Rhodes University
Grahamstown 6140
South Africa.

All contributions will be acknowledged and all contributors will be kept in touch with developments as they occur. The final date for contributions is 1 December 1984.

13. Extracts of the IQSY Handbook

As sunspot minimum is approaching, a couple of extracts from the International Quiet Sun Year Ionospheric Manual are reproduced below as it was thought that they might be of some value.

a. Use of the symbols B and E when foF2 is small

Special care is necessary in the IQSY to distinguish between conditions when foF2 is less than the lowest frequency recorded (letter symbol E) and when abnormal absorption is present (letter symbol B). Even in the IGY, when foF2 was relatively large, many cases were found where B had been used incorrectly and E was really more appropriate.

The presence or absence of interference on the ionograms is often a good guide, as is the trend of foF2 near the difficult period. It should be remembered that abnormal absorption is uncommon during magnetically quiet periods. Re-analysis of old ionograms shows that many operators tend to use B despite clear evidence on the ionogram that E was the appropriate letter. Thus, for last solar minimum conditions, there are systematic abnormalities in certain tables and graphs of both foF2 and fmin which repeat for many months over several years, but are spurious.

b. Additional rules for frequencies below the gyrofrequency

The following conventions should be used in the frequency band below the gyrofrequency in place of the standard conventions:

- i f min, lowest frequency at which any echoes are observed (no rejection rules);
- -o- fminF, except when equal to the critical frequency of a lower layer, when should be used;
- o any ordinary-mode critical frequency or cusp frequency;
- z any z-mode critical frequency;
- x any cusp in a trace attributable to a maximum or a minimum in the ionization profile below the reflecting layer not already denoted by o;
- ● foEs.

The distinction between o and x depends on the presence or absence of retardation in the trace of the lower layer. Thus, if both lower and upper traces show retardation at the critical frequency and the upper layer is effectively blanketed by the lower near this frequency, use o. When it is clear from the sequence of events that the cusp is due to the formation of a ledge in the F layer, e.g., near sunrise and sunset, the symbol o is used and the critical frequency tabulated with the values for the appropriate layer. Care is needed to distinguish between foF1 and foE when the ledge first appears in the morning.

When the magneto-ionic modes are closely coupled, additional retardation occurs in the x mode when the working frequency is equal to the plasma frequency. Thus, a complex magneto-ionic wave often shows retardation at frequencies where the underlying ionization has a maximum or a minimum. The symbol x is introduced to denote maxima due to this phenomenon.

14. The determination of fxI and spread-F scaling

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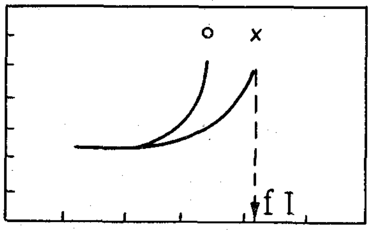
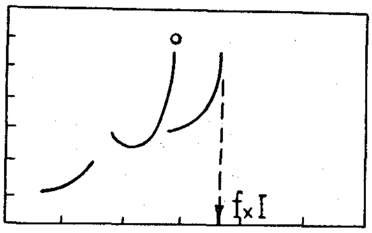
The scheme described below was prepared by the group responsible for scientific and methodical supervision of the vertical ionospheric sounding network. It was developed in accordance with the recommendations of the Irkutsk and Archangel Workshops on the scaling and interpretation of ionograms. The scheme describes the methods used for the determination of fxI, spread-F scaling and the f-plotting of oblique and diffuse traces. For the latter, it was decided not to differentiate between the various types of oblique traces, such as those seen in the vicinity of the trough, and to denote these by a dashed line on the f-plot. There are some differences here from the fxI and spread-F scaling system described by Alan Rodger in INAG 33. INAG would be interested to hear comments on both systems.

Determination of fxI in the absence of diffuse traces.



foF2	fxI	h'F	type F
044--	052-X	250--	X

Figure 1



foF2	fxI	h'F	type F
038EG	046-X	250--	X

Figure 2