IONOSPHERIC NETWORK ADVISORY GROUP (INAG)*

IONOSPHERIC STATION INFORMATION BULLETIN NO. 47**



* Under the auspices of Commission G, Working Group G.1 of the International Union of Radio Science (URSI).


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## 1. From the Chairman

by J A Gledhill

With this second issue of the Bulletin under the new regime we are getting more familiar with the production processes. Unfortunately, one of the first impressions we have is that very few recipients of the Bulletin send us material for inclusion. To those who have done so, our grateful thanks. To the others, please let us know of any new developments at your station or institute and send any suggestions or queries to us. So far we have received no "difficult" ionograms for our help in interpretation. Does this all mean that everyone is satisfied? I hope not, for satisfaction is the beginning of decay!

We have received no reaction from anyone to the suggestion that INAG should give more attention to oblique incidence ionograms and their interpretation. An example of what can be done is given in the paper by Rash and Gledhill, J. Atmos. Terr. Phys., 46, 945-951, (1984). As will be seen elsewhere in this Bulletin, page 3, the matter had been put on the Agenda for the INAG meeting in Toulouse during the SCOSTEP/COSPAR meeting in July 1986.

With the receipt from Ray Conkright of the contributions collected from various institutions we are now adequately funded to bring out Bulletins hopefully 3 or 4 per year until 1987, when the matter will come up for reassessment at the URSI General Assembly in Israel. Jules Aarons is already calling for ideas for Commission G business at that meeting and all recipients of this Bulletin are encouraged to send in suggestions for matters to be dealt with at the INAG meeting then. In the meantime we express our grateful thanks to those who offered to contribute to the funding of INAG, without which the present Chairman and Secretary would have found it impossible to accept their respective jobs!

## 2. The use of Universal Time in reporting ionospheric data

Our Publication Secretary, Ray Conkright, has requested us to stress the importance of using Universal Time when reporting ionospheric data to World Data Centres. Your Chairman, who is also Coordinator for ionospheric data for the SCARUAP Working Group study of the events of 10-13 and 27-29 June 1982, endorses this request strongly. It is very frustrating to request data for a given date from a number of stations, only to find that many of the values are missing because the station concerned uses local standard time.

It is therefore proposed that INAG adopt the following resolution:

> In reporting ionospheric data to World Data Centres and other requesting institutions, all stations should use Universal Time, but should also give a clear statement of the relationship between local time and UT at the station.

This resolution will be discussed at the COSPAR/SCOSTEP meeting in July 1986.

## 3. Louvain-la-Neuve Workshop on IRI

Prof L Bossy has sent INAG a summary of the Louvain-la-Neuve Workshop on the International Reference Ionosphere (IRI) which was a follow up of the Graz meeting reported in INAG 46. Future meetings of the Task Group on IRI will be held at Potsdam - March 1986, Toulouse - July 1986, Novgorod - May 1987 and Tel Aviv - August 1987.

The Graz Workshop papers are now available and were published in Adv. Space Res., Vol. 5, no. 7. The Louvain-la-Neuve as well as the Toulouse contributions will also be published in the above journal.

Anyone interested in a summary of the Louvain-la-Neuve Workshop can obtain copies from: Prof L Bossy, Université Catholique de Louvain, 174 Avenue W Churchill, B-1180 Bruxelles, Belgium.

## 4. IRI Recommendation to INAG

During its Workshop in Louvain-la-Neuve, the URSI/COSPAR Task Group on the International Reference Ionosphere formulated the following recommendation directed at INAG through its Chairman Prof L Bossy:

> The group feels that it is important to improve the information about the electron density profile between the maxima of the E-layer and the F-region.
>
> It is therefore recommended to measure in addition to $h'_o$minF, also the frequency at which this minimum occurs with 0.1 MHz accuracy and the difference between the minimum height of the F-region extraordinary trace $h'_x$minF and $h'_o$minF to 1 km accuracy.
>
> Use of these three parameters would establish a starting point and slope for the F-region true height analysis, make a significant contribution to radio propagation studies and enlighten the geophysical properties of the important height range between 100 and 200 km on a worldwide basis.

We invite comments on the above recommendation from the recipients of INAG Bulletin as well as volunteers to provide the additional requested data.

## 5. Network News

### The French Ionosonde Network

Dr R Hanbaba has supplied information correcting and updating MONSEE Directory Edition 2. He further informs us that staff at Dakar, La Réunion and Tahiti are employed on a two yearly basis, whilst at Kerguelen and Terre Adélie staff are employed on an annual basis. There are no changes in the conditions of employment at the other stations. Detailed reduction of all data from the French Network is performed at Lannion from whence data are available for any of the stations listed in the following table.

| Station Name | Geographic Latitude | Longitude | Ionosonde |
|---|---|---|---|
| Lannion | 48.75 | 356.55 | C4 (1) |
| Garchy | 47.28 | 3.07 | Magnetic AB (2) |
| Poitiers | 46.57 | 0.35 | IPS 42 (3) |
| Dakar | 14.76 | 342.58 | IPS 42 |
| Ouagadougou | 12.37 | 358.47 | IPS 42 |
| Tahiti | -17.33 | 210.68 | IPS 42 (4) |
| La Rêunion | -21.07 | 55.32 | IPS 42 (5) |
| Kerguelen | -49.35 | 70.24 | R4F (6) |
| Terre Adêlie | -66.66 | 140.02 | Magnetic AB |

Notes:

(1) IPS 42 used for training and special purposes;

(2) Since March 1974 ionograms no longer reduced;

(3) IPS 42 replaces LRN ionosonde;

(4) IPS 42 replaces C4 ionosonde;

(5) IPS 42 replaces C4 ionosonde;

(6) In January 1985 the new French ionosonde, R4F, replaced the magnetic AB ionosonde.

Huancayo, Peru

INAG is indeed sad to hear that the Huancayo observatory is experiencing difficulties with equipment maintenance and that universal problem - funding!

Huancayo has been operating since 1934 and its monthly noon median foF2 data are used together with other observatories to compile and forecast the ionospheric indices of solar activity IF2 and IG for CCIR and the international radio communication community amongst others. Thus its continued operation is of vital importance to the community at large.

At present Huancayo is operating an outdated ionosonde model C4 and acquiring spares for it is proving to be a problem. If anybody in the ionospheric community can be of assistance - spares or perhaps a more modern ionosonde - please do not hesitate to contact either the Chairman of INAG or Jacinto H Pantoja, Ionospheric Department, Observatorio de Huancayo, Instituto Geofisico del Peru, Apartado 46, Huancayo, Peru.

Possible removal of ionosonde at Sanae, Antarctica to Gough Island

There is a possibility that the Advanced Chirpsounder at Sanae, Antarctica (72°S, 2°W) may be moved to Gough Island (40°s, 10°W) at the end of 1987, for a period of perhaps two years. This is by no means a definite proposal at present. The move is being discussed in the light of the results of the shipborne ionograms obtained in the South Atlantic Anomaly during project ISAAC in June/July 1983, when auroral and other particle types of sporadic E ionization were very frequently observed. It is possible that a two-year stay on Gough Island would provide data of considerable scientific interest, though it may involve the interruption of the 24-year series of observations at Sanae.

Members of the ionospheric community are invited to comment on any aspect of this possibility, including:

a) the use they make or have made of data from Sanae;

b) their reaction to the possible break in ionospheric observations;

c) the relative merits of continuing at Sanae or observing from Gough Island.

Comments should be sent to the Chairman or Executive Secretary of INAG (address on page 1).

## 6. Notice of INAG Meeting

A meeting of INAG will be held during the SCOSTEP/COSPAR Assembly in Toulouse, France, on the afternoon of Tuesday, 8 July 1986.

An overhead projector and a 35-mm slide projector will be available.

Agenda

1. Welcome by the Chairman.
2. Minutes of the meeting held in Prague. (INAG 46 p.11)
3. Matters arising from the minutes.
4. Report by the Chairman on activities since the last meeting.
5. Discussion of proposal that all stations should use Universal Time in reporting ionospheric data, with an indication of local standard time in terms of UT. (See page 2 of this Bulletin for proposed wording.)
6. Discussion of IRI Recommendation to INAG. (See page 2 of this Bulletin.)
7. Discussion of the possible use of oblique incidence ionograms in ionospheric forecasting.
8. Station news.
9. Workshop on ionograms presented for analysis and comment by those present.
10. Real time acquisition and international exchange of ionospheric data.
11. Any other business.

## 7. Rhodes University Chirp sounding research

by A W V Poole, Rhodes University, RSA

### Introduction

In the mid 1970's the Rhodes University Antarctic Research Group (now incorporated into the Hermann Ohlthaver Institute for Aeronomy) acquired two Barry Research "chirp" ionosphere sounders for operation at the home base, Grahamstown, and at Sanae base, Antarctica.

The intention then was to provide reliable vertical incidence recordings at the two stations, and to allow for the synoptic observation of the oblique Sanae-Grahamstown path which passes through the eastern edge of the South Atlantic Anomaly. These objectives have been largely successful, and good quality records have been acquired for one complete sunspot cycle, despite some initial misgivings that were expressed at our choice of the "chirp" rather than the more conventional "pulse" technique.

This period has also seen the advancement of computer technology and with it the emergence of various "advanced " ionosondes whose superiority over the traditional sounder lies essentially in their retention of the phase information of the returning echo, and more flexibility in the programming of the sounding format. However, all commercially available advanced sounders have been based on the pulse radar technique, inviting a similar research effort for chirp-based sounders. Accordingly, we have, over the last ten years, pursued such research at a theoretical and engineering level and accepting limitations set by staff members and funding, have been successful in converting a chirpsounder to advanced capability.

### Review of chirp technique

Instead of a pulse of radio energy at the sounding frequency, the chirp transmitter waveform consists of a continuous signal of constant amplitude, but with the frequency increasing at a linear rate, typically 50 kHz $s^{-1}$, for a typical duration of 0.5s. Because the frequency increases with time, the instantaneous received frequency (after ionospheric reflection) will lag behind the instantaneous transmitted frequency by an amount proportional to the group delay, which is in turn proportional to the virtual height. The chirp receiver performs a subtraction, and an echo will appear at the receiver output as a continuous tone representing the difference frequency (typically 100 Hz) proportional to the virtual height. The receiver output of duration 0.5s can then be spectrum analysed to determine the frequency, and in fact the output of such a spectrum analyser, being a scan of amplitude as a function of frequency, will not be dissimilar in appearance to the familiar "A" scan of the conventional pulse ionosonde. Figure 1 shows an atypical daytime ionogram recorded on film at Grahamstown, in which complicated E-region layer structure and oblique echoes demonstrate the clarity with which individual traces can be identified.

### Advanced sounding

Although the term "digital" was originally used to describe the new generation of ionosondes, it has become necessary to distinguish between ionosondes

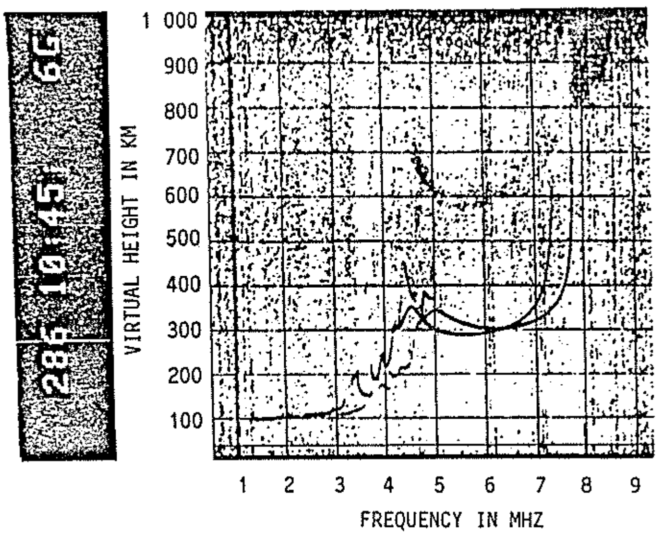


Fig. 1 A conventional chirp ionogram recorded on film at Grahamstown (33.3°S, 26.5°E), showing E-region structure and oblique reflections.

which are capable of making measurements based on phase comparisons from those that merely convert standard ionosonde outputs to numbers by means of analog-to-digital conversion. The former class of sounder is thus described as "advanced", rather than "digital", and it is into this category that our research has fallen.

In chirp sounding, the phase of the echo corresponds to the phase of the difference signal or tone that appears at the receiver output. This phase is easily, and elegantly, measured by spectrum analysis through the discrete Fourier transform. It is thus possible to make phase comparisons in a way analogous to that employed in advanced pulse sounders, to evaluate group height, Doppler velocity, angle of arrival and polarisation mode. The Fourier transform also provides a quantitative measure of the amplitude of the echo.

### The Rhodes Ionosonde

An advanced chirp sounder was developed by modification of one of our two standard Barry Research (now BR Communications) Chirpsounders. Briefly, this process involved (i) replacement of the controller by a microprocessor, (ii) replacement of the receiver by two phase matched receivers (bought from BR), (iii) replacement of the analog spectrum analyser with a home built Fast Fourier Transform analyser, (iv) addition of a digital data capture system with magnetic tape drive. It was also necessary to evolve a receive antenna array with appropriate antenna switching capabilities.

### Typical data

The data from such a device is of course digital in nature and can be displayed in any manner that software ingenuity will allow. Figure 2 shows the data set from a swept frequency ionogram recorded at Grahamstown.

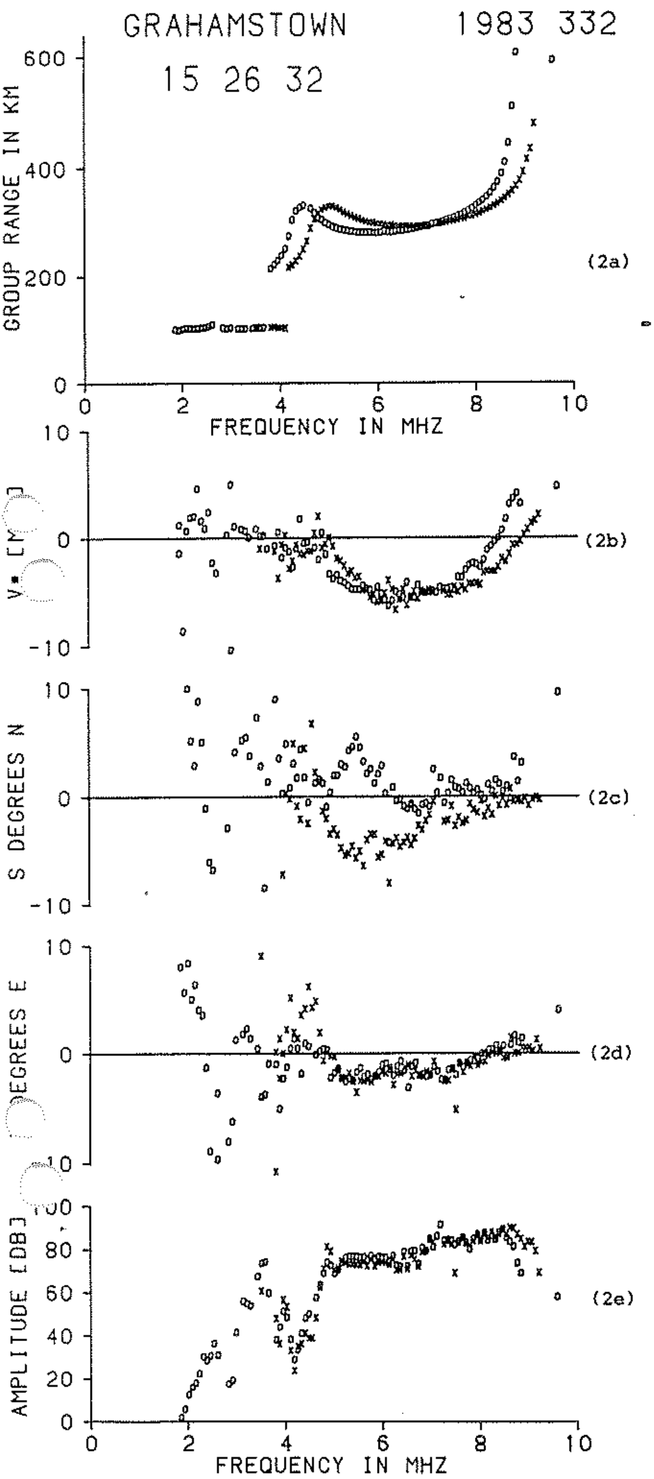


Fig. 2 A computer generated digital ionogram showing (a) group range, (b) Doppler velocity, (c) north-south arrival angle, (d) east-west arrival angle and (e) echo amplitude, against frequency.

Above (2a) is the group range (virtual height) plotted as a function of frequency in the familiar ionogram format of conventional film records. The polarisation modes of the echoes are identified by the appropriate symbol. Next below (2b) is the Doppler velocity of each reflection point, plotted on the same frequency scale. Below this again are, in order, (2c) the north-south and (2d) east-west arrival angles, measured from the perpendicular. The apparent large deviations of the E-region reflections near 2.0 MHz are due partially to error in the phase measurements due to poor signal-to-noise ratios near fmin, and partially to unresolved systematic phase deviations below 2.0 MHz due possibly to mutual antenna coupling. The lowest graph (2e) plots the relative amplitude of the echo signal strength, which shows the fall off in intensity at the low frequency end.

Conclusion

This prototype ionosonde is now at Sanae base, Antarctica, and is being used to monitor ionospheric micropulsations and movements of the plasmapause. In addition, we are planning to measure ionospheric absorption in 1986. The transition from Grahamstown to Antarctica has not, however, been without some teething problems.

The personnel most involved with this work have been Geoff Evans, John Fisher and myself. We would welcome any queries, which could, in the first instance, be addressed to me.

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## 8. IPS Tables for Validating Scaling Letter Usage

by P J Wilkinson, IPS, Australia

### 1. Introduction

Using the rules set out in UAG-23A, various computer tests are made at IPS to check for internal consistency of the scaled data. These tests fall broadly into two sections. First, the various allowed combinations of descriptive and qualifying letter pairs are tested and non-standard, or unusual, pairs are noted. Second, the various scaled parameters are intercompared for internal consistency.

In this note only the first tests are considered.

Validity tables of the various combinations of descriptive and qualifying letters for the twelve URSI characteristics scaled at IPS automatic data monitoring programme for some years and similar methods have been applied in other countries (eg New Zealand).

An earlier system at IPS checked scaling usages as either correct or not, the rejected scalings being either modified, or accepted and published unchanged. To improve the checking procedures, a graded range of acceptances for scaling usages is now used. The gradings are currently experimental and are discussed in the next section.

Manual scaling is often qualitative and because of this it is undesirable for on-line error testing to appear quantitative, requiring absolute scaling letter usages. When a pair of scaling letters is simply rejected or accepted the scaler could gain this impression. To preserve a natural scaling environment, while capitalising on the computer on-line checking facilities for rapid adjustments of clearly incorrect usages, a graded range of acceptances was invoked. The various grades proposed were discussed at some length at the 1984 Australian Operator's Conference and reflect, as accurately as possible, Australian thinking on what is an acceptable and likely scaling letter usage, what is unlikely or even contravenes URSI scaling conventions and what is not possible.

## 2. Gradings used for qualifying/descriptive letter pairs

Six levels of grading were considered sufficient.

### 2.1 Reject. Grade = 0

Pairs of letters that seem impossible are given a zero grade. Should such a pair of letters be scaled, the scaler would be asked to rescale the parameter. However, if the scaler insists, the rejected pair could be entered.

These scalings would be checked again in the IPS Head Office and would either be changed, in which case the scaler would be notifed why, or accepted, in which case the look up tables may be revised. In either case, the example would be noted as a possible example of an unusual ionogram for discussion by INAG or for use in local training.

### 2.2 Rare. Grade = 1

Pairs of letters that seem most unlikely, but are conceivable, are considered rare and are given a grade of 1. Such pairs are processed in the same way as a reject only there is less onus on scalers to reconsider their scaling.

### 2.3 Unusual. Grade = 2.

These pairs are considered to occur quite infrequently at IPS mainland stations and are graded 2. The system will automatically accept the scaling, but the scaler will be reminded that the scaling is unusual. Reinspection of the ionogram may result in a changed scaling, but such cases would be accepted and would not normally be reconsidered at IPS head office.

### 2.4 Local Convention. Grade = 3.

Scalings that are accepted, or advocated, by IPS but appear in conflict with normal URSI conventions are graded 3. It is intended that these scalings will be studied carefully at IPS and will be brought to INAG's attention for wider international discussion. Scalers are also reminded that the particular usage is a local convention, so they can assess the ionogram involved to see if it is worth using as an example of a useful NON-URSI scaling.

### 2.5 Accept provisionally. Grade = 4.

These scalings seem strange or unnecessary. Again, scalers will be able to think carefully about such scalings and may wish to keep a copy of the ionogram sequence in question for future discussion.

### 2.6 Normal URSI standard usage. Grade = 5.

The bulk of scaling usages falls into this category.

### 2.7 Flag. Grade = 6.

Where a descriptor is being used as a flag, all letter pairs associated with the descriptor are given grade 6. This will remind scalers that a flag is being used. This category includes URSI flags and any local flags.

There is a discussion of flags in the 1984 Australian Operator's Conference (INAG 43/44).

## 3. The Validity Tables

Tables 1 to 12 give the twelve validity tables currently used at IPS. The validity tables are shown on pages 7 to 10. Each table is coded in the same way and includes a lower case "b" which denotes a blank, or no scaling letter used.

Also, a brief comment on the flags scaled with a characteristic accompanies each table.

The tables are all for the same day - March 8, 1984.

## 4. Discussion

As grades 0,5 and 6 account for 98% of scaling letter pairs it is apparent that the Australian Operators Conference felt there was a reasonable degree of certainty about what constituted an acceptable scaling.

Alternative gradings might be used to tailor the scaling system to a particular location, in which case the letter pairs associated with different weights could vary. The grades proposed in this report are probably more representative of mid-latitudes. However, I am doubtful whether significant changes would be possible if tailoring for high or low latitudes were adopted. Changes are much more likely if different scaling philosophies are adopted (eg that fmin is used primarily as an absorption parameter).

Grades might also be used to train scalers by forcing them to look closely at ionograms. As yet, this has not been considered fully.

At IPS we believe these tables are a good representation of the URSI scaling conventions and that scaling usages that have zero grades are unlikely to arise if correct scaling procedures are followed.

Data validation using tables such as those presented here are now common and INAG should move to achieve a level of standardisation in this area. I would hope that this issue could be raised at a future INAG meeting and discussed further.

Table 1

| | b | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | 5 | | 3 | 3 | | | | | | | | | | | | | | | 3 | 3 | | | | | | | 6 |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Z | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | | | | 5 | | 5 | | | | | | | | | | | | | | 5 | | | | | | | 6 |
| D | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| U | | | | | | | | | | | | | | | | | | | | 5 | | | | | | | 6 |
| I | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Replacement | | | 5 | 5 | | | | | | | | | | | | | | | | 5 | | | | | | | |

Parameter: fmin

Flags: fmin scaled from z-mode

Table 2

| | b | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | 5 | 5 | 5 | 5 | | | 5 | | 5 | | | 5 | | | | | | 6 | | 5 | | | | | | | 6 |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Z | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | | 5 | 5 | 5 | | 5 | 2 | | | | | 5 | | | | | | 6 | | 5 | | | | | | | 6 |
| D | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| U | | 5 | 5 | 5 | | 5 | 2 | | 2 | | | 5 | | | | | | 6 | | 5 | | | | | | | 6 |
| I | | 5 | 5 | 5 | | | | | | | | | | | | | | 6 | | 5 | | | | | | | 6 |
| Replacement | | 5 | 5 | 5 | | 5 | | | | | | | | | | | | 6 | | 5 | | | | | | | 6 |

Parameter: h'E

Flags: Q Range spread greater than 30 km
Z z-mode from E-region
Q supercedes Z

Table 3

| | b | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | 5 | 5 | 5 | 5 | | | 5 | | 5 | | | 5 | | | | | | | 5 | 5 | | | | | | 6 | 6 |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Z | | 5 | | 5 | | | 5 | | 5 | | | | | | | | | | 5 | 5 | | | | | | 6 | 6 |
| O | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | 1 | 1 | 5 | | | 5 | | 5 | | | 5 | | | | | | | 2 | 5 | | | | | | 6 | 6 |
| E | | 5 | 5 | 5 | | 5 | 1 | | 2 | | | 5 | | | | | | | 5 | 5 | | | | | | 6 | 6 |
| D | | 5 | | 5 | | | 1 | | 2 | | | 5 | | | | | | | 5 | 5 | | | | | | 6 | 6 |
| U | | 5 | 5 | 5 | | 2 | 5 | | 5 | | | 5 | | | | | | | 5 | 5 | | | | | | 6 | 6 |
| I | | 5 | 5 | 5 | | | | | 2 | | | | | | | | | | 5 | 5 | | | | | | 6 | 6 |
| Replacement | | 5 | 5 | 5 | | | 1 | | 2 | | | | | | | | | | 5 | 5 | | | | | | 6 | 6 |

Parameter: foE

Flags: Y lacuna
Z z-mode from E-region (alternate)
Y supercedes Z

Table 4

| | b | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | 5 | | 5 | 5 | | | | | 5 | | | 5 | | | | | | | | 5 | | | | | | | 6 |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Z | | | | | | | | | | | | 5 | | | | | | | | | | | | | | | 6 |
| O | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | 5 | | 5 | | 1 | | | | | | 5 | | | | | | | | 5 | | | | | | | 6 |
| E | | | 5 | 5 | | 5 | | 5 | | | | 5 | | | | | | | | 5 | | | | | | | 6 |
| D | | | | 5 | 5 | | | | | | | 5 | | | | | | | | 5 | | | | | | | 6 |
| U | | | | | | | | | 2 | | | 5 | | | | | | | | 5 | | | | | | | 6 |
| I | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Replacement | | | 5 | 5 | | | | 5 | | | | | | | | | | | | 5 | | | | | | | 6 |

Parameter: foEs

Flags: Z z-mode from Es layer

Table 5

| | b | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | 5 | 5 | 5 | 5 | | | 5 | 5 | 5 | | | 5 | | | | | | | 5 | 5 | | | | | | 5 | |
| A | | 5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Z | | | | | | | | | | | | 5 | | | | | | | | | | | | | | | |
| O | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | | | 1 | | | | | | | | 5 | | | | | | | | 1 | | | | | | | |
| E | | 5 | 5 | 5 | | 5 | 5 | 5 | 2 | | | 5 | | | | | | | 3 | 5 | | | | | | 5 | |
| D | | 5 | | 5 | | | | 5 | | | | 5 | | | | | | | | 5 | | | | | | | |
| U | | 5 | 2 | 5 | | | 5 | 5 | 5 | | | 5 | | | | | | | 3 | 5 | | | | | | 5 | |
| I | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Replacement | | 2 | 5 | 5 | | | | | | | | | | | | | | | | 5 | | | | | | 5 | |

Parameter: fbEs

Flags: no flags

Table 6

| | b | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | 5 | 5 | 2 | 5 | | | 3 | 2 | 1 | | | 5 | | | | | | 6 | | 5 | | | | | | | |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Z | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | | | | 5 | | | 3 | 5 | | | | 5 | | | | | | 6 | | 5 | | | | | | | |
| D | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| U | | | | 5 | | | 3 | 2 | | | | 5 | | | | | | 6 | | 5 | | | | | | | |
| I | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Replacement | | | 5 | 5 | | 5 | 3 | 5 | | | | | | | | | | 6 | | 5 | | | | | | | |

Parameter: h'Es

Flags: Q range spread greater than 30 km

| | b | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | 5 | 5 | 5 | 5 | | | 5 | | 5 | | | | | | | | | | 5 | 5 | | | 2 | 2 | | 6 | 6 |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Z | | | | 5 | | | 5 | | 5 | | | | 1 | | | | | | 5 | 5 | | | | | | 6 | 6 |
| O | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | 2 | 5 | 5 | | | 5 | | 5 | | | | 1 | | | | | | 5 | 5 | | | | | | 6 | 6 |
| E | | 5 | 5 | 5 | | | 5 | | 5 | | | | 4 | | | | | | 5 | 5 | | | | | | 6 | 6 |
| D | | | | | | | 5 | | 5 | | | | | | | | | | 5 | 5 | | | | 2 | | 6 | 6 |
| U | | 5 | 5 | 5 | | | 5 | | 5 | | | | 5 | | | | | | 5 | 5 | | | | 5 | | 6 | 6 |
| I | | 5 | 5 | 5 | | | | | 5 | | | | | | | | | | 2 | 5 | | | | | | | |
| Replacement | | 5 | 5 | 5 | | | 5 | | 5 | | | | 5 | | | | | | 2 | 5 | | | | 1 | | 6 | 6 |

Table 7

Parameter: foF1

Flags: Y lacuna
Z z-mode from F1 region (alternate)
Y supercedes Z

| | b | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | 5 | 5 | 5 | 5 | | | 5 | | 5 | | | | 5 | | | | | 3 | 2 | 5 | | | | 5 | | | |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Z | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | | 5 | 5 | 5 | | | 2 | | 5 | | | | | | | | | 3 | | 5 | | | | | | | |
| D | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| U | | 5 | 5 | 5 | | | 2 | | 5 | | | | 4 | | | | | 3 | 2 | 5 | | | | | | | |
| I | | 5 | 5 | 5 | | | | | 5 | | | | | | | | | 3 | | 5 | | | | | | | |
| Replacement | | 5 | 5 | 5 | | | | 5 | 5 | | | | 5 | | | | | 3 | | 5 | | | | 5 | | | |

Table 8

Parameter: h'F2

Flags: no flags

| | b | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | 5 | 5 | 5 | 5 | | | 5 | | 5 | | | | | | | | | 6 | 2 | 5 | | | | | | 5 | 6 |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Z | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | | 5 | 5 | 5 | | 5 | 5 | | 5 | | | | | | | | | 6 | | 5 | | | | | | 5 | 6 |
| D | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | |
| U | | 5 | 5 | 5 | | 5 | 5 | | 5 | | | | | | | | | 6 | 2 | 5 | | | | | | 5 | 6 |
| I | | 5 | 5 | 5 | | | | | 2 | | | | | | | | | | | 5 | | | | | | 5 | 6 |
| Replacement | | 5 | 5 | 5 | | 5 | | | 2 | | | | | | | | | 6 | | 5 | | | | 1 | | 5 | 6 |

Table 9

Parameter: h'F

Flags: Q range spread greater than 30 km
Z z-mode from F1 region (alternate)
Q supercedes Z

Table 10

| | b | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | 5 | 5 | 5 | 5 | | | 5 | 5 | 5 | | | | 4 | | | | | | 5 | 5 | | | 5 | 5 | | 6 | 6 |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Z | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | | | | 5 | 2 | | 5 | | 2 | | | | | | | | | | 5 | 5 | | | | 5 | | 6 | 6 |
| D | | 5 | 5 | 5 | | 2 | 5 | | 2 | | | | | | | | | | | 5 | | | | | | 6 | 6 |
| U | | 5 | 5 | 5 | 2 | 2 | 5 | | 5 | | | | 4 | | | | | | 5 | 5 | | | 5 | 5 | | 6 | 6 |
| I | | 5 | 5 | 5 | | | | | 1 | | | | | | | | | | 5 | 5 | | | | | | 6 | 6 |
| Replacement | | 5 | 5 | 5 | 2 | 5 | 5 | 5 | 5 | | | | 4 | | | | | 5 | 5 | 5 | | | | 5 | | 6 | 6 |

Parameter: M(3000)F2

Flags: Z z-mode from F2 region
Y lacuna
Y supercedes Z

Table 11

| | b | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | 5 | 2 | 2 | 5 | | | 6 | | 5 | | | | | | | | | | 5 | 5 | | | 5 | 5 | | | |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Z | | | | 5 | 1 | | 6 | | 5 | | | | | | | | | | 2 | 5 | | | | | | | |
| O | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | 2 | | 5 | | | 6 | | 5 | | | | | | | | | | 5 | 5 | | | | | | | |
| E | | | | 5 | | 5 | 6 | 5 | 5 | | | | | | | | | | | 5 | | | | | | 5 | |
| D | | | 2 | 5 | 5 | | 6 | | 5 | | | | | | | | | | 5 | 5 | | | | 5 | | | |
| U | | 2 | 2 | 5 | | | 6 | | 5 | | | | | | | | | | 5 | 5 | | | 5 | 5 | | | |
| I | | 5 | 5 | 5 | | | 6 | | 5 | | | | | | | | | | 2 | 5 | | | | | | 5 | |
| Replacement | | 5 | 5 | 5 | | | 6 | | 5 | | | | | | | | | 5 | 2 | 5 | | | | 5 | | 5 | |

Parameter: foF2

Flags: F spread greater than or equal to 0.3 MHz

Table 12

| | b | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | 5 | 2 | 5 | 5 | | | 5 | | 2 | | | | | | | | 6 | 5 | | 5 | | | | 5 | 6 | | |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Z | | | | 5 | | | | | | | | | | | | | | | | 5 | | | | | 6 | | |
| O | | | 5 | 5 | | | 3 | | 2 | | | | | | | | 6 | | | 5 | | | | 5 | 6 | | |
| J | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | | | | 2 | | 5 | | | | | | | | | | | | | | 2 | | | | | 6 | | |
| D | | | 5 | 5 | 5 | | | | | | | | | | | | 6 | | | 5 | | | | 5 | 6 | | |
| U | | | 5 | 5 | 1 | | | | | | | | | | | | 6 | | | 5 | | | | 5 | 6 | | |
| I | | | | 4 | | | | | | | | | | | | | 6 | | | 4 | | | | | 6 | | |
| Replacement | | 5 | 5 | 5 | | | | | | | | | | | | | 6 | | | 5 | | | | 5 | 6 | 5 | |

Parameter: fxI

Flags: X, no spread present
P, spur controls fxI
P supercedes X

## 9. Preliminary format for representing N(h)-profiles of lower ionosphere in digital form on magnetic tape

by A Feldstein, WDC B2, Moscow, USSR

Data for every density profile constitute one or several physical blocks of fixed length of 600 bytes. The length of a logical record is 120 bytes. The first logical record gives information concerning the profile, the following 4 logical records contain the electron density values or the experimental raw data.

### 1. Format of a physical block

| Position | Format | Description |
|---|---|---|
| 1- 20 | A20 | Station name. |
| 21- 25 | A5 | Station code. |
| 26- 29 | I4 | Geographical colatitude x 10 (with tenths precision). It varies from 0° over the north pole to 180° over the south pole. |
| 30- 33 | I4 | Geographical east longitude x 10 (with tenths degrees precision). It varies from 0° to 360°. |
| 34- 37 | I4 | Year. |
| 38- 39 | I2 | Month. |
| 40- 41 | I2 | Day. |
| 42- 45 | I4 | Universal Time x $10^2$ (with hundredths pieces of hour precision). |
| 46- 49 | I4 | Local time x $10^2$ (with hundredths pieces of hour precision). |
| 50- 53 | I4 | Solar zenith angle x 10 (with tenths degrees precision). |
| 54- 58 | I5 | Gyrofrequency $f_H$ at 90 km, kHz. |
| 59- 63 | I5 | Magnetic dip angle, degrees x $10^2$. |
| 64- 66 | I3 | Monthly average sunspot number (Zurich). |
| 67- 69 | I3 | Daily sunspot number (Zurich). |
| 70- 72 | I3 | Daily Ap-index. |
| 73- 74 | I2 | Method of observation. |
| 75- 76 | I2 | Method of N(h) - profile evaluation. |
| 77- 78 | I2 | Special case parameter. |
| 79- 80 | I2 | Type of data. |
| 81- 82 | I2 | Total number of physical blocks. |
| 83- 84 | I2 | Sequence number of the physical block. |
| 85- 87 | I3 | Sampling time (minutes). |
| 88- 92 | I5 | Height resolution (metres). |
| 93-120 | X28 | Blank (reserve). |
| 121-125 | I5 | |
| 126-130 | I5 | 96 values assignment of data depending on type of data |
| . . . | . | |
| . . . | . | |
| 596-600 | I5 | |

### 2. Description of the parameters

This version of the format was compiled on the basis of format for representing N(h)-profiles of F-layer (Draft of the "Guide to International Data Exchange - Ionosphere". Edited by M A Hapgood and H Rishbeth, United Kingdom, 6 August 1985) and format used in L F McNamara data base of D and E ionosphere layers N(h)-profiles (UAG-67). First 49 positions correspond to format of N(h)-profiles of F-layer.

Method of observation (similar to UAG-67) -

1. partial reflection,
2. rocket,
3. wave interaction,
4. VLF-LF reflection,
5. other.

Method of N(h)-profile evaluation.

First figure corresponds to method of observation, e.g., for partial reflection:

10. QL-approximation of the Sen-Wyller refractive index,
11. Sen-Wyller refractive index.

Special case parameter (similar to UAG-67) -

1. solar eclipse,
2. solar flare,
3. solar X-ray event,
4. sudden ionospheric disturbance,
5. winter anomaly day,
6. midlatitude particle precipitation,
7. solar proton event/solar cosmic ray event,
8. polar cap absorption,
9. auroral absorption,
10. daytime absorption event,

11. polar substorm,

12. polar radio blackout,

13. auroral arc condition.

Type of data

0-electron density ($cm^{-3}$). In this case logical records 2-5 (positions 121 to 600) will contain not more than 48 sets of two words - height (km) x $10^2$ and electron density ($cm^{-3}$). All points of the N(h)-profile are arranged with increasing height. If the profile contains less than 48 points the last word is delimiter: 9999. If the profile has more than 48 points, it is continued in the following physical block.

Raw experimental data. For partial reflection, e.g.,

11. amplitude values of ordinary and extraordinary waves in orbitrary units (Ao, Ax),

12. phase values of ordinary and extraordinary waves in degrees (Po, Px).

In this case logical records 2-5 (positions 121-600) will contain not more than 32 sets of three words - height (km) x $10^2$, amplitude Ao (or phase Po) and amplitude Ax (or phase Px). All points of the amplitude (or phase) profile are arranged with increasing height. If the profile contains less than 32 points the last word is delimiter: 9999. If the profile has more than 32 points it is continued in the following physical block.

Sequence number of the physical block.

If total amount of physical blocks occupied by one N(h)-profile (electron density and raw data jointly) is equal to N, then sequence number of physical block varies from 1 to N.

## 3. Comments

Reserve positions (93-120) may be used in dependence on method of observation. For instance, it is useful to include working frequency in MHz and reference to collisional frequency model between charged and neutral particles for partial reflection. The first and the last heights for the N(h)-profile probably ought to be present in the first logical record. It would be very convenient to propose such a format that every N(h)-profile corresponds to one physical block. This condition is fulfilled for F-layer N(h)-profiles calculated from ionograms. But it is hardly possible if we want to unify the data representation for completely different methods such as partial reflections and rocket experiments.

The draft of the format was compiled at WDC B2, Moscow, on the basis of suggestions received from DDR Scientists at the Kuhlungsborn Ionosphere Observatorium.

# 10. NOAA Data Announcements

## Detailed Ionospheric Vertical Soundings Data on Magnetic Tape

The National Geophysical Data Center (NGDC) has created a computer compatible master file of hourly ionospheric vertical sounding characteristics. In addition to the data prepared by NGDC, ionospheric data from Australia, Canada, France, Japan, Sweden and the United Kingdom are placed in the master archive system.

The master archive system consists of all the scaled hourly value data together with the monthly statistical data (medians, median counts and quartiles) for each hour for each parameter. The master system presently contains over 3752 station months of data from 58 different stations. The station months are archived on tape by year and include data from 1957 through 1985 (there is no data for 1959 and 1961). These data are placed on the master tapes in the following order: year, station, month, characteristic, followed by the hourly values for all days of the month and then the monthly statistical data for that characteristic.

Magnetic tape data can be provided as direct tape copies of yearly archive tapes. As a special tape request, a combination of individual station months or selected characteristics of one or more station months can also be provided. Possible tape formats are: 9-track, ASCII or EBCDIC coded, with 2000-byte (character) blocks containing 80-byte records. Available densities are 800, 1600 and 6250 bits-per-inch (bpi).

Cost (in US dollars) for direct tape copies of yearly archive tapes are:

| | |
|---|---|
| 800-bpi magnetic tape | 190.00 per tape |
| 1600-bpi magnetic tape | 190.00 per tape |
| 6250-bpi magnetic tape | 220.00 per tape. |

Costs for providing selected station months or characteristics on magnetic tape are available upon request.

Also, as a special request, microfiche or computer printout can be generated from these data. Prices available upon request.

## Total Electron Content Digital Data Base

NGDC has also created a computer compatible data base for the digital ionospheric total electron content (TEC) holdings. These data consist of hourly, median and median count values. The TEC values are expressed in units of $10^{15}$ electrons per square metre.

An electromagnetic wave propagating through a plasma in the direction parallel to the magnetic field will undergo differential rotation. The left-hand polarization component responds differently from the right-hand component due to the integral number density of electrons within that column. This differential rotation, called Faraday rotation, can be used to determine the TEC between a satellite beacon and a ground-based antenna. This data base results from a beacon frequency of approximately 136 MHz.

The TEC data are available on one magnetic tape. One files contains one network month; one network month contains from one to twelve stations. Magnetic tape copies are available as 9-track, ASCII or EBCDEC coded, with 2000-byte (character) blocks containing 80-byte records. Available densities are 800, 1600 and 6250 bits-per-inch (BPI).

The cost (in US dollars) for a TEC magnetic tape is as follows:

| | |
|---|---|
| 800-bpi magnetic tape | 105.00 per tape |
| 1600-bpi magnetic tape | 105.00 per tape |
| 6250-bpi magnetic tape | 120.00 per tape |
| Data on computer printout | 7.50 per network month. |

For more information of the above please contact:

National Geophysical Data Center
NOAA, Code E/GCX2
325 Broadway
Boulder Colorado 80303
U S A.

## 11. Solar Eclipses in 1986

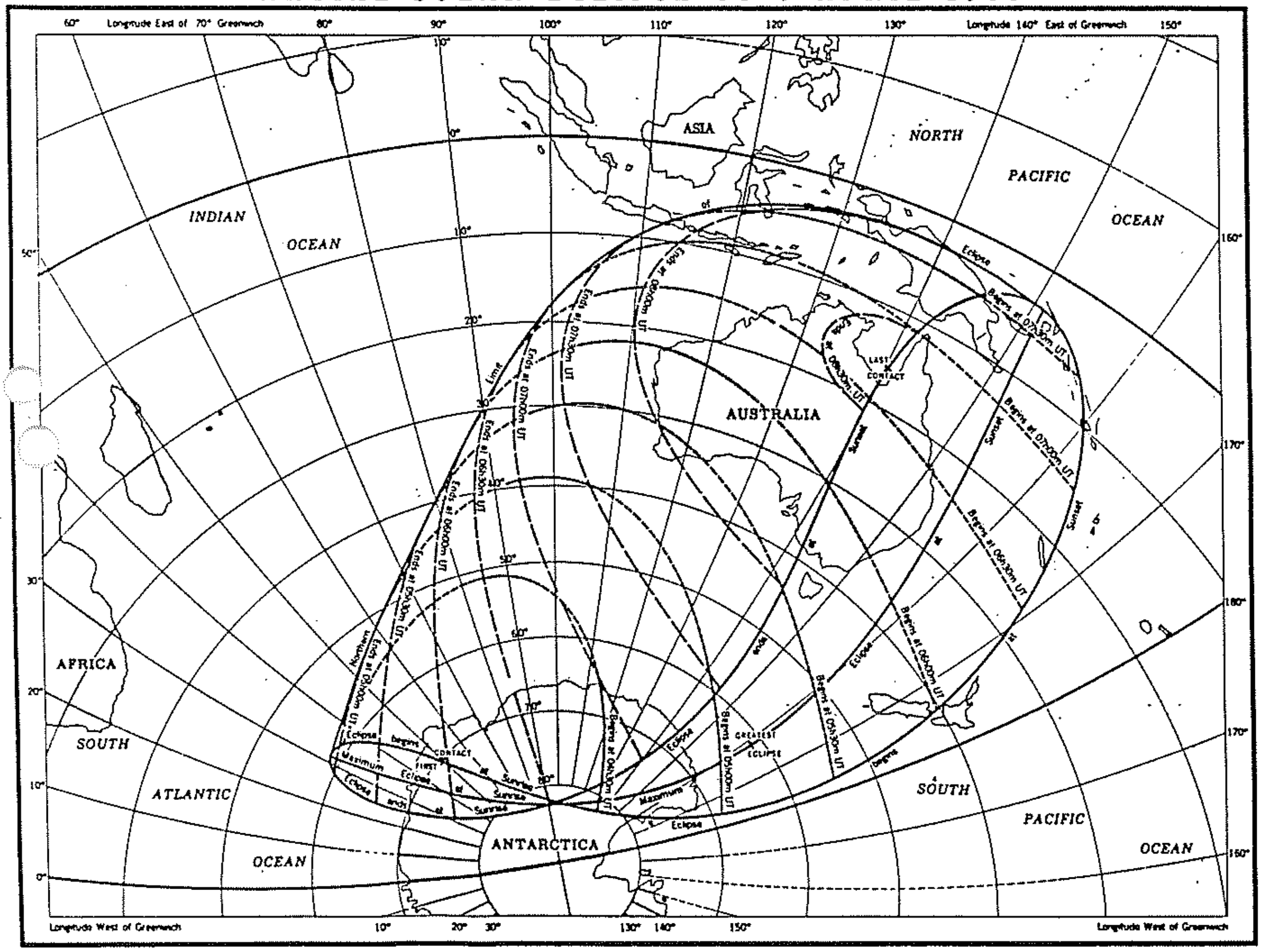
There will be a partial solar eclipse between about 0410 and 0832 UT on April 9, 1986 visible from parts of Antarctica, the Southern Indian Ocean and Australasia.

There will be an annular-total solar eclipse between about 1657 and 2114 UT on October 3, 1986 visible from Greenland, North America, Central America, North Atlantic Ocean and the northern portion of South America.

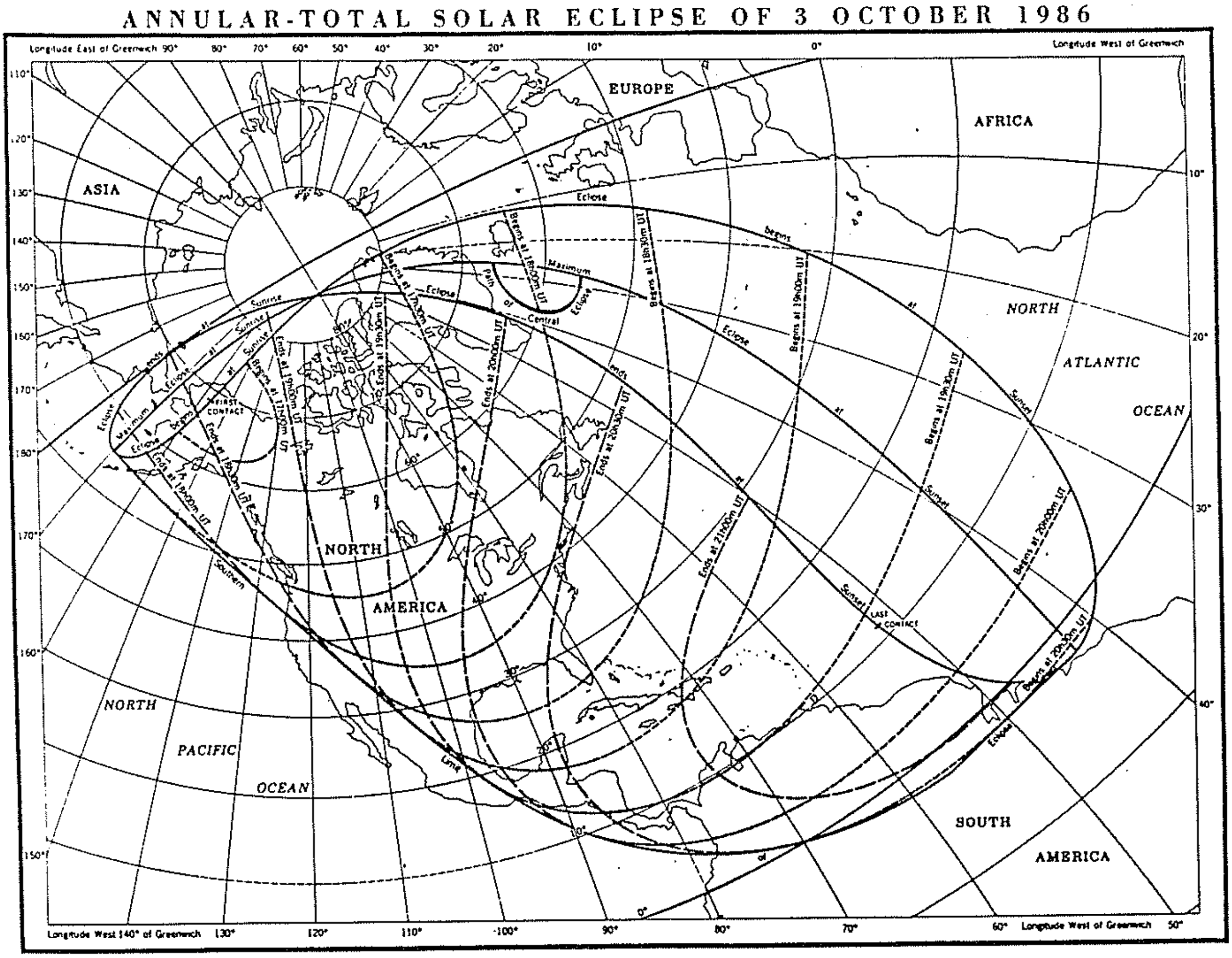
Details of both eclipses are available in the Astronomical Almanac.

Geophysical stations in the eclipse zones and their conjugate areas are asked to treat these days as Priority World Days.

PARTIAL SOLAR ECLIPSE OF 9 APRIL 1986



ANNULAR-TOTAL SOLAR ECLIPSE OF 3 OCTOBER 1986




The eclipse diagrams reproduced from the Astronomical Almanac with kind permission from the US Government Printing Office

## 12. INAG Bulletin

To maintain the regular publication of the INAG Bulletin there is a continuing need for articles, notes, forthcoming events, station news, equipment problems and solutions, scaling aids and general comments and ionograms for interpretation and discussion.

INAG Bulletin cannot exist without input of material from the recipients of the bulletin. So please spare a few minutes to jot down something of interest and forward to Ray Haggard (address on page 1), all contributions will be published.

Further, constructive criticism concerning INAG Bulletin and its contents would be most welcome. Please let us know what you, the readers, would like to see in INAG Bulletin and whether there are any special features you would like us to concentrate on. Either drop me a line or bring the matter up for discussion at the next INAG meeting.

The INAG mailing list needs to be updated and corrected. Thus, as a first step, we have included a mailing list questionnaire on page 17. Please will all recipients and those wishing to receive INAG Bulletin, fill in the questionnaire and return to address shown thereon as soon as possible. Thank you one and all for your cooperation.

13. Late News Items

## 1. KEL Ionosonde

We are informed by Terry Kelly of KEL Aerospace that he has encountered severe misconceptions about the price of the IPS-42 KEL AEROSPACE Ionosondes. They were rumored to have escalated to more than $80,000 U.S. dollars. Mr. Kelly assures us that this is not so. The price of the basic IPS-42 is currently less than $40,000 U.S. dollars, in a configuration ready for connection to an existing antenna and mains power supply for routine ionospheric monitoring. The confusion may have arisen from quotations for "Fully Digital Turnkey" systems that include the new DBD-43 (digital add-on) plus antenna, installation, spare parts, etc. Potential purchasers of KEL Ionosondes should contact Mr. Kelly for valid quotations. His address is:

KEL AEROSPACE PTY LTD
1/12 Brennan Close
Asquith
N S W 2078
Australia
Telex: AA 152300

## 2. Electron Density Profile Analysis

World Data Center-A for Solar-Terrestrial Physics has produced UAG-93 (IONOGRAM ANALYSIS WITH THE GENERALIZED PROGRAM POLAN) which is the documentation of John E. Titheridge's POLynomial ANalysis program to convert vertical soundings of the ionosphere to real-height profiles. This method was established by URSI Subgroup G/6/2 on N(h) Analysis as the best method of those programs tested.

ABSTRACT. "Different methods for the real-height analysis of ionograms and their fields of application are surveyed. A flexible, new procedure is developed to give maximum accuracy and reliability in an automatic, one-pass analysis. The program POLAN uses polynomial real-height sections of any required degree, fitting any number of data points. By choice of a single parameter (MODE) it can reproduce all current methods from linear-laminations to single or overlapping polynomials. In addition, a wide range of least-squares modes are available; these are preferable for most purposes, particularly with oversampled data (as from digital ionosondes). The mode of analysis changes automatically within the program to give an optimised least-squares calculation in the start, peak and valley regions. Physically unacceptable solutions are adjusted by imposing limits on the profile parameters. The new profile coefficients (and the new fitting error) are obtained directly and rapidly from the previous solution. This permits repeated application of the adjustments, as required, and cancellation of any change if it produces an unacceptably large increase in the virtual-height fitting error.

The information available using combined ordinary and extraordinary ray data is studied under different conditions. Procedures are developed which can solve the underlying and valley ambiguities with high accuracy, given suitable data, and which can detect and reject bad data. Physically reasonable models are incorporated into the least-squares start and valley calculations. This ensures an acceptable, standardised form for the profiles in these regions when only ordinary ray data are available. With good ordinary and extraordinary ray data POLAN produces the maximum amount of information which can be obtained about the unobserved regions, and results are almost independent of the physical models. With poor or inconsistent data, giving a less well-defined solution, results become increasingly biased toward the physical model so that acceptable results are obtained under most conditions.

Many of the techniques used in POLAN are new. Procedures and models developed for the start, peak and valley regions are described in reasonable detail along with the precautions found to be necessary for maximum accuracy with extraordinary ray data. Mathematical procedures for ensuring full accuracy at all dip angles are described in the appendices. Optimum rules for scaling data are also developed and the practical use of POLAN is detailed. All programs are listed in the appendices, along with standard test data and the corresponding outputs. Copies of the programs are available on magnetic media from World Data Center-A."

The WDC-A is now offering UAG-93, POLAN and Electron Density Profiles (created with POLAN) to interested individuals. For details please contact Ray Conkright at WDC-A/NGDC, Code E/GC2, 325 Broadway, Boulder, Colorado 80303, U.S.A., phone 303-497-6414.

# 14. International Geophysical Calendar 1986

(See other side for information on use of this Calendar)

| | S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 |
| | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| JANUARY | 12 | 13 | 14$^{M+}$ | 15$^{M+}$ | 16$^{+}$ | 17$^{+}$ | 18 |
| | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| | 26 | 27 | 28 | 29 | 30 | 31 | 1 |
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| FEBRUARY | 9 | 10 | 11$^{M}$ | 12$^{M}$ | 13 | 14 | 15 |
| | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| | 23 | 24 | 25 | 26 | 27 | 28 | 1 |
| | 2 | 3 | 4 | 5$^{+}$ | 6$^{+}$ | 7 | 8 |
| MARCH | 9 | 10 | 11$^{M}$ | 12$^{M}$ | 13 | 14 | 15 |
| | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| | 30 | 31 | 1$^{+}$ | 2$^{+}$ | 3$^{+}$ | 4$^{+}$ | 5 |
| | 6 | 7 | 8$^{M}$ | 9$^{M}$ | 10 | 11 | 12 |
| APRIL | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| | 27 | 28 | 29 | 30 | 1 | 2 | 3 |
| | 4 | 5 | 6$^{M+}$ | 7$^{M+}$ | 8 | 9 | 10 |
| MAY | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| | 1 | 2 | 3 | 4$^{M+}$ | 5$^{M+}$ | 6 | 7 |
| JUNE | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| | 29 | 30 | | | | | |
| | S | M | T | W | T | F | S |

| S | M | T | W | T | F | S | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | |
| 6 | 7 | 8 | 9$^{M+}$ | 10$^{M+}$ | 11 | 12 | |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | JULY |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 | |
| 27 | 28 | 29 | 30 | 31 | 1 | 2 | |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 | AUGUST |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | |
| 24 | 25 | 26 | 27$^{M+}$ | 28$^{M+}$ | 29 | 30 | |
| 31 | 1 | 2 | 3 | 4 | 5 | 6 | |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 | SEPTEMBER |
| 21 | 22 | 23$^{+}$ | 24$^{M+}$ | 25$^{M+}$ | 26$^{+}$ | 27 | |
| 28 | 29 | 30 | 1 | 2 | 3 | 4 | |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 | OCTOBER |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 | |
| 26 | 27 | 28 | 29$^{M+}$ | 30$^{M+}$ | 31 | 1 | |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 | NOVEMBER |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 | |
| 23 | 24 | 25 | 26$^{M}$ | 27$^{M}$ | 28 | 29 | |
| 30 | 1 | 2 | 3 | 4 | 5 | 6 | |
| 7 | 8 | 9 | 10$^{+}$ | 11$^{+}$ | 12 | 13 | |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 | DECEMBER |
| 21 | 22 | 23 | 24$^{M}$ | 25$^{M}$ | 26 | 27 | |
| 28 | 29 | 30 | 31 | 1 | 2 | 3 | |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 1987 JANUARY |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 | |
| 25 | 26 | 27 | 28$^{M+}$ | 29$^{M+}$ | 30 | 31 | |
| S | M | T | W | T | F | S | |

(14) Regular World Day (RWD)

(15) Priority Regular World Day (PRWD)

◇12 Quarterly World Day (QWD) also a PRWD and RWD

8 Regular Geophysical Day (RGD)

3 4 World Geophysical Interval (WGI)

14$^{+}$ Incoherent Scatter Coordinated Observation Day and Coordinated Tidal Observation Day

9 Day of Solar Eclipse

9 10 Airglow and Aurora Period

11$^{M}$ Dark Moon Geophysical Day (DMGD)

**NOTES:**

1. Days with unusual meteor shower activity are: Northern Hemisphere Jan 3,4; Apr 21-23; May 3-5; Jun 8-12; Jul 27-29; Aug 10-14; Oct 19-23; Nov 2-4, 17-18; Dec 12-16, 21-23, 1986; Jan 3,4, 1987. Southern Hemisphere May 3-5; Jun 8-12; Jul 26-30; Oct 19-23; Nov 2-4, 17-18; Dec 5-7, 12-16, 1986.
2. Study of Traveling Interplanetary Phenomena (STIP) Interval XIX: March 1986 International Halley Watch
Revised STIP dates: STIP XV 12-21 Feb 1984; STIP XVI 20 April - 4 May 1984; STIP XVII 15 May - 30 June 1985; and STIP XVIII September 1985.
3. Middle Atmosphere Cooperation (MAC) begins 1 Jan 1986 and runs through 1988.
4. Day intervals that IMP 8 satellite is in the solar wind (begin and end days are generally partial days): 1985 Dec 29-1986 Jan 6; Jan 11-19, 24-31; Feb 6-13, 18-26; Mar 3-10, 15-23 and 28-Apr 4; Apr 9-17, 22-30; May 5-13, 18-25, 30-Jun 7; Jun 11-19, 23-Jul 2; Jul 6-15, 18-27, 31-Aug 8; Aug 13-21, 26-Sep 3; Sep 7-15, 20-28; Oct 3-10, 15-22, 28-Nov 3; Nov 10-16, 22-29; Dec 5-12, 18-25, 31-1987 Jan 6.
There will not be total IMP 8 data monitoring coverage during these intervals.
(Information kindly provided by the WDC-A for Rockets and Satellites, Greenbelt, MD U.S.A.).
5. + Incoherent Scatter programs start at 1600 UT on the first day of the intervals indicated, and end at 1600 UT on the last day of the intervals.

OPERATIONAL EDITION, September 1985

## EXPLANATIONS

This Calendar continues the series begun for the IGY years 1957-58, and is issued annually to recommend dates for solar and geophysical observations which cannot be carried out continuously. Thus, the amount of observational data in existence tends to be larger on Calendar days. The recommendations on data reduction and especially the flow of data to **World Data Centers (WDCs)** in many instances emphasize Calendar days. The Calendar is prepared by the **International Ursigram and World Days Service (IUWDS)** with the advice of spokesmen for the various scientific disciplines. For greater detail concerning explanations or recommendations your attention is called to information published periodically in **IAGA News, IUGG Chronicle, URSI Information Bulletin** or other scientific journals.

The **Solar Eclipses** are: April 9 (partial — maximum magnitude 0.82) covering about half of the Antarctic, moving across the south part of New Zealand, across Australia, the eastern part of Indonesia and most of New Guinea (maximum eclipse path includes the South Magnetic Pole area in Antarctica, Macquarie Island, the south part of New Zealand, the eastern part of Australia and the eastern part of New Guinea); October 3 (annular-total) beginning in the extreme eastern USSR, moving across the arctic regions, Greenland, Iceland, and across N. America except the extreme SW, across Central America and the Caribbean Sea, and ending in Colombia, Venezuela, Guyana, Surinam, French Guiana and northern Brazil (maximum eclipse (about 0.3 seconds) path in eastern USSR, Alaska, eastern Greenland and Iceland with the Sun only 5 degrees in altitude).

**Meteor Showers** (selected by P.M. Millman, Ottawa) include important visual showers and also unusual showers observable mainly by radio and radar techniques. The dates for Northern Hemisphere meteor showers are: Jan 3, 4; Apr 21-23; May 3-5; Jun 8-12; Jul 27-29; Aug 10-14; Oct 19-23; Nov 2-4, 17-18; Dec 12-16, 21-23, 1986; and Jan 3, 4, 1987. The dates for Southern Hemisphere meteor showers are: May 3-5; Jun 8-12; Jul 26-30; Oct 19-23; Nov 2-4, 17-18; and Dec 5-7, 12-16, 1986. Note that the meteor showers that come in the first week of May and the third week in October are of particular interest (fragments of Halley's comet) because of the approach of Halley's comet in 1986. Especially note Halley's comet approach (Perihelion February 9 at 0.59 AU) and STIP Interval XIX March 1986 — International Halley Watch.

**Definitions:**

| | |
|---|---|
| Time | = Universal Time (UT); |
| Regular Geophysical Days **(RGD)** | = each Wednesday; |
| Regular World Days **(RWD)** | = Tuesday, Wednesday and Thursday near the middle of the month (see calendar); |
| Priority Regular World Days **(PRWD)** | = the Wednesday **RWD**; |
| Quarterly World Days **(QWD)** | = **PRWD** in the **WGI**; |
| World Geophysical Intervals **(WGI)** | = 14 consecutive days each season (see calendar); |
| **ALERTS** | = occurrence of unusual solar or geophysical conditions, broadcast once daily soon after 0400 UT; |
| **STRATWARM** | = stratospheric warmings |
| Retrospective World Intervals **(RWI)** | = intervals selected by MONSEE for study. |

For more detailed explanations of the definitions, please see one of the following or contact H. Coffey (address below): *Solar-Geophysical Data*, November issue; *URSI Information Bulletin; COSPAR Information Bulletin; IAGA News; IUGG Chronicle; WMO Bulletin; IAU Information Bulletin; Solar-Terrestrial Environmental Research in Japan; Journal of the Radio Research Laboratories* (Japan); *Geomagnetism and Aeronomy* (USSR); *Journal of Atmospheric and Terrestrial Physics* (UK); *EOS Magazine* (AGU/USA).

**Priority recommended programs for measurements not made continuously** — (in addition to unusual **ALERT** periods):

**Aurora and Airglow** — Observation periods are New Moon periods, especially the 7 day intervals on the calendar;

**Atmospheric Electricity** — Observation periods are the **RGD** each Wednesday, beginning on 1 January 1986 at 1800 UT, 8 January at 0000 UT, 15 January at 0600 UT, 22 January at 1200 UT, etc. Minimum program are **PRWDs**.

**Geomagnetic Phenomena** — Observation periods on **RWDs**.

**Ionospheric Phenomena** — Quarter-hourly ionograms; more frequently on **RWDs**, particularly at high latitude sites; f-plots on **RWDs**; hourly ionograms to WDCs on **QWDs**; continuous observations for solar eclipse in the eclipse zone. See Airglow and Aurora.

**Incoherent Scatter** — Observations on Incoherent Scatter Coordinated Days; also intensive series on **WGIs** or Airglow and Aurora periods. **Special programs:** Dr V. Wickwar, SRI International, 333 Ravenswood Ave., Menlo Park, CA 94025 U.S.A., URSI Working Group G.5.

**Ionospheric Drifts** — During weeks with **RWDs**.

**Traveling Ionosphere Disturbances** — special periods, probably **PRWD** or **RWDs**.

**Ionospheric Absorption** — Half-hourly on **RWDs**; continuous on solar eclipse days for stations in eclipse zone and conjugate area. Daily measurements during Absorption Winter Anomaly at temperate latitude stations (Oct-Mar Northern Hemisphere; Apr-Sep Southern Hemisphere).

**Backscatter and Forward Scatter** — **RWDs** at least.

**Mesospheric D region electron densities** — **RGD** around noon.

**ELF Noise Measurements of earth-ionosphere cavity resonances** — **WGIs**.

**All Programs** — Intensive observations during unusual meteor activity.

**Meteorology** — Especially on **RGDs**. On **WGIs** and **STRATWARM** Alert Intervals, please monitor on Mondays and Fridays as well as Wednesdays.

**Middle Atmosphere Cooperation (MAC)** — **RGDs**, **PRWDs** and **QWDs**. For planetary waves and tides monitor at least 10 days centered on **PRWDs** and **QWDs**. See Middle Atmosphere Dynamics Calendar for 1986. (Dr. T. VanZandt, NOAA R/E/AL3, 325 Broadway, Boulder, CO 80303 U.S.A.)

**Solar Phenomena** — Solar eclipse days, **RWDs**, and during **PROTON/FLARE ALERTS**.

**Study of Traveling Interplanetary Phenomena (STIP)** — XV = 12-21 Feb 1984 solar GLE; XVI = 20 Apr-4 May 1984 Forbush decrease; XVII = 15 May-30 Jun 1985 alignment of Venus magnetotail with satellites VEGA 1, VEGA 2, MS-T5, PVO, and ICE; XVIII = Sep 1985 Giacobini-Zinner Comet fly-by by ICE; XIX = March 1986 International Halley Watch.

**Space Research, Interplanetary Phenomena, Cosmic Rays, Aeronomy** — **QWDs**, **RWD**, and Airglow and Aurora periods.

**URSI/IAGA Coordinated Tidal Observations Program (CTOP)** — Dr. R. G. Roper, School of Geophysical Sci., Geophysical Sci., Georgia Inst. of Tech., Atlanta, GA 30332 U.S.A. has the 1986 CTOP calendar.

**The International Ursigram and World Days Service (IUWDS)** is a permanent scientific service of the International Union of Radio Science **(URSI)**, with the participation of the International Astronomical Union and the International Union Geodesy and Geophysics. IUWDS adheres to the Federation of Astronomical and Geophysical Services (FAGS) of the International Council of Scientific Unions (ICSU). The IUWDS coordinates the international aspects of the world days program and rapid data interchange.

This Calendar for 1986 has been drawn up by H.E. Coffey, of the IUWDS Steering Committee, in association with spokesmen for the various scientific disciplines in SCOSTEP, IAGA and URSI. Similar Calendars have been issued annually beginning with the IGY, 1957-58, and have been published in various widely available scientific publications.

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**Additional copies are available upon request to IUWDS Chairman, Dr. P. Simon, Ursigrammes Observatoire, 92190 Meudon, France, or IUWDS Secretary for World Days, Miss H.E. Coffey, WDC-A for Solar-Terrestrial Physics, NOAA E/GC2, 325 Broadway, Boulder, Colorado 80303, USA.**

## 15. INAG Mailing List Questionnaire

Please complete the following and return to the address given below as soon as possible.

Name: ______________________________

Title: ______________________________

Institution: ______________________________

Street and/or box number: ______________________________

City: ______________________________

State: ______________________________

Mail (ZIP) code: ______________________________

Country: ______________________________

Number of Bulletins required: ______________________________

Comments: ______________________________

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