IONOSONDE NETWORK ADVISORY GROUP (INAG)*

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CONTENTS

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People wishing to be placed on a mailing list to receive this Bulletin should notify the INAG Chair, Phil Wilkinson, or the INAG Secretary, Ray Conkright, WDC-A for STP, NOAA, Boulder, Colorado 80303, USA.

1. OBITUARY

SERGEJ CHAVADAROV

(24.02.1898-30.12.1992)

Contributed by: N. Danilkin

Professor Sergej Savelijevich Chavdarov, the former Head of the Ionospheric Radio and Propagation Department of Rostov-on-Don University (Russia), passed away on December 30, at the age of 94. The ionospheric world has lost one of its strong workers. He was a founder of the Rostov-on-Don Ionospheric School and one of the pioneers of ionospheric investigations in the world. He constructed the second ionosonde (1938) and the first absorption station (1939) in Russia. Sergej Chavdarov contributed very much to the development of Physics Education. His scientific papers cover a variety of subjects such as the physics, characteristics and global distribution of Es-layer, absorption in the D-region, construction of equipment for measuring ionospheric radio wave absorption, etc. In addition to his scientific contributions, he gave notable administrative and pedagogical service. His lectures and expositions amply demonstrated his great gifts of clear thinking and clear writing, and many of his lectures provided a first introduction to radio propagation and the ionosphere. Many of his pupils became famous scientists and good teachers.

Chavdarov was a physicist first and foremost. He was a person who was very faithful to science. His investigation of the 1941 Solar Eclipse serves as an example of this. It was war time, but it was also an extremely nice Solar Eclipse. Its ionospheric effect was great and long lived. 'The eclipse took place on September 21 and that day the German Troops attacked the city of Rostov-on-Don. Sergej Chavdarov was carrying out his measurement in the heat of battle. He finished his experiment accurately, destroyed the equipment and hid the results. After that he mounted his bicycle and left the city in the last line. After the war, this measurement was published.

Sergej Chavdarov retired in 1975, but for a long time he was a very good adviser for his numerous young colleagues and friends. Conversation with him never failed to be stimulating. His good and large scientific private library was presented by him to students. Not only his daughter Nadja, who supported him faithfully, and his grandson Sergej, but also his many friends and colleagues will cherish his memory and will miss the companionship and warmth of Sergej Chavdarov's personality.

2. Comments from the Chair

As always, my thanks to the people who have supplied articles and comments for the Bulletin. Special thanks are due to Dr John Caruana, of IPS, who proof read this copy of the Bulletin.

Several of the articles in this Bulletin discuss opening new stations and station networks, extensions to old networks and upgrading old networks, reminding us all that there is still an important future ahead for ionosondes. Each of these networks is different in operation, uses different ionosondes and different computer scaling software.

In the last Bulletin (INAG-58) there was a call for nominations for the positions of Chair and Secretary of INAG. If I receive more than one nomination for a person, I enter their names into a ballot for the positions mentioned. Since Ray and I were the only people in the ballot to record more than one nomination (several people did nominate both of us for our respective positions) I have recommended to the Commission G Chair, Prof. Wernik, that an election of officers is not required.

My thanks to the people who completed the questionnaire on the Bulletin. I would have liked more replies, but those that came in were welcome and helpful. An analysis of their opinions appears later in the Bulletin. Meanwhile, anybody who has not yet completed the questionnaire in INAG 58, please do so. The information will be useful to me.

I hope everybody has noticed that INAG now has an ISSN number. This is recorded on the front of the Bulletin. My thanks to Vivian To, of IPS, for arranging this for me.

One thing that would help me greatly in preparing the Bulletin would be for contributors of articles to send me the following items.

- a hard copy version of the text of their article, together with all the figures.
- an ascii file of the text on a 51/4" or a 31/2" floppy disk. Those who are able, could send the file by email to my INTERNET address **phil@ips.oz.au.**
- If you are able to produce a Word for Windows (IBM PC version) file, I can also handle it.

Finally, 40 papers were offered for the INAG sponsored session at the URSI General Assembly, *Ionosonde Networks and Stations.* A list of these papers appears later in the Bulletin. Ray and I will make up a UAG report from these papers. Please note the publication details in the article.

3. Comments from readers

3.1. Gerd Prölss, Bonn University
Gerd has written several papers on ionospheric storms and has made use of ionosonde data along with satellite data. He made the following comments about data from ionospheric stations.

"As a frequent user of ionosonde data, I want to thank all those people who collect these data, make these data available to us and contribute to the maintenance of the global network of ionosonde stations. Without their effort, much of my research work could not have been carried out. Thank you very much indeed.

To make better use of the information contained in ionograms, they should be reduced to real height profiles. In the past, WDC-A (R. Conkright, G. Talarski) offered a service at a reasonable price. I would like to add that they did an excellent job. I have now been informed that this service has been discontinued, and should it be resumed, it will be at a significantly higher price. One way out of this dilemma would be for users to reduce the ionograms themselves (using, for example, the POLAN program of Titheridge). There is, however, one lesson I have learned from the INAG Bulletins, namely that reducing ionograms can be quite a tricky business which requires a great deal of experience. I thus prefer to let experts do the job.

Therefore my suggestion is that the World Data Centers continue to offer an ionogram reduction service at a reasonable price. Considering that labor costs in the Eastern European countries are lower than in the West, I wonder whether WDC-A (Boulder) and WDC-B2 (Moscow) could jointly offer such a service."

Unfortunately, I have had this letter for some time now, so the respective labor costs may not be so favourable now. It is always good to hear from our "Users" and I welcome more comments of this type. A big effort goes into manually preparing scaled ionospheric data and this is often not given the recognition it deserves.

3.2. Alan Roger, BAS.
Alan wrote regarding the introduction of the scaling letter, the slash (/). Alan writes:

"I am very concerned over the philosophy underlying the proposed use of / for a variety of computer scaling tasks. My concerns are two fold.

i. The proposals that you are making are only applicable in the very short term. Most stations will make the transition rapidly and in practise, few will ever check their data by hand.

ii. I am most concerned that INAG is not insisting upon computer algorithms making an estimate of uncertainly for the parameters they determine. Many use curve fitting techniques and thus it would be relatively trivial to give an estimate of the 'goodness of fit' of the data to the curve, and thus determine accuracy."

Alan continues with some examples of his experience with one automatic scaling system that fails to handle HF interference bands.

I agree with Alan's concerns and I think they should be shared by all. However, I do not think it is all that easy to determine an error estimate. Those of us who have had experience with automatic scaling systems already realise they do not scale ionograms better than a person. Part of the reason for introducing the slash / was to increase the amount of computer scaled data available to people. However, I for one, feel that these data are not much use without ready access to the ionograms from which they were obtained. Hopefully, as CD-ROMs become more common, digital ionograms will be exchanged freely using this, or a similar medium. The problem is not small. I welcome all comments and discussion on computer scaling of ionograms. I feel it is one of the most important issues facing the INAG community.

3.3. Dr John Dudeney, BAS.

John has written to advise INAG that "the magnetometer and ionosonde station at Faraday station (65°S, 64°W), also known as the Argentine Islands, will be closed as a manned station from March 1996. The magnetometers and ionosonde currently sited there will cease operation then. The closure of this station is a consequence of a wide ranging reappraisal of the whole of the British Antarctic Survey (BAS) programme. For the solar terrestrial physics work this has resulted in focussing field activity at Halley Station and at unmanned sites poleward of Halley."

John goes on to acknowledge the importance of the Faraday data sets and points out that BAS will explore the possibility of placing automated equipment at Faraday. He hopes to report on this further at the IAGA and URSI Assemblies.

3.4. Errata - from INAG-57

In "Equatorial Electrojet and counter electrojet" some words have been misplaced at the bottom of column 2, page 14. This is a "fingers" problem I have with my word processor at times. I apologise to anybody who became confused by the article. The double underlined words are in the wrong position. They should be deleted from the position where they are underlined and placed where they now appear in **bold.**

> "The presence of Esq traces on the equatorial ionograms and VHF backscatter radar echoes from E region due to westward drift of electrons during daytime are considered evidence of an eastward electric field (Fig.3 and 4). The disappearance of Esq irregularities in the ionograms and absence of radar signals due to eastward drift of electrons during counter electrojet times are considered as the presence of a westward electric field, if a proper evidence for **a** westward electric field. However, **in the presence of a westward electric field, if a proper** electron density gradient (negative electron density gradient) is present at E region heights, VHF backscatter radar signals can be observed. The negative electron density gradient necessary for the gradient drift instability to become operative during counter electrojet conditions is provided, on certain occasions, by another type of sporadic E layer known as blanketing Esq layers. The generation mechanism of Esq layers is given below."

4. A New Ionosonde Station - France TELECOM Research Center opens a new station in Africa.

by R Hanbaba
CNET
FRANCE

November 1st 1992 was a great day for French CNET (Telecommunications National Research Center). It has opened a new sounding station in Korhogo (lat. 9.27N; long. 5.38W), Ivory Coast, Africa.

About 630 km (400 miles) north of Abidojan, the capital city, lost in deep savanna, there stands the station. It is part of the main international project for the study of the Equatorial Electrojet. But so far, it is the first and only proof that both France and Africa are involved in this IEEY project. But more is to come soon; 10 magnetometers from Timbuktu to Abidjan, HF radar and a Fabry-Perot interferometer in Korhogo.

The main investments were made by the CNET, with the help of the French Government and based on a student exchange programme with Ivory Coast National University. Moreover, we are now training the Ivorians to interpret ionograms and run the station and in two months' time, they should be able not only to obtain but also to treat quarter hourly digitised images.

As Korhogo will become a main center for our measurement campaign, we are arranging to have it run as reliably as requested by scientists.

Now the work is yet to come from a scientific point of view, as we are collecting a lot of data. Long live the Korhogo station!

Details of the other French stations are given in the following tables.

The French network

Station name	Station latitude	Station longitude	Dates of operations
Lannion	48.75N	356.55E	01/1971 to present
Poitiers	46.57N	0.35E	07/1948 to present
Dakar	14.76N	342.58E	05/1949 to present
Ouagadougou	12.37N	358.47E	05/1966 to present
Korhogo	9.27N	354.62E	11/1992 to present
La Réunion	21.20S	55.60E	10/1981 to present
Tahiti	17.73S	210.68E	12/1957 to present
Kerguélen	49.35S	70.24E	02/1953 to present
Terre-Adélie	66.66S	140.02E	02/1951 to present

Station name	Lannion - Poitiers - Dakar Ouagadougou - Korhogo La Réunion - Tahiti	Kerguélen Terre - Adélie
instrument	IPS 42 + DBD43	R4F
raw data	magnetic tape cartridges or optical disk	film 35 mm
data reduction	scaling according to international rules	
regular reduced data after	1 month	1 or 2 years
recordings	15 minute	15 minute (5 minute recordings for 3 days centered on RWD)
form of available data : - ionograms	floppy disk or magnetic tape (CNET format : a floppy disk containing exec files indispensable to display ionograms is available)	film 35 mn
- monthly tables of median and hourly values	microfiche	
- median and hourly values	floppy disk or magnetic tape (URSI / Commission G format)	

5. Ionosonde Network In Pakistan

Pakistan Space & Upper Atmosphere Research Commission (SUPARCO) presently operates three ionospheric sounders in Pakistan, located at Karachi (24.95 N, 67.14 E), Multan (30.18 N, 71.48 E) and Islamabad (33.75 N, 72.87 E). Two of these are Digital Sounders while the third is an Analog Sounder. The two Digital Sounders, Digisonde (DGS-256), were procured from the University of LOWELL, Centre for Atmospheric Research (ULCAR), USA and were commissioned, at Karachi and Islamabad in March 1987 and December 1992, respectively. Since then, the two Digital Sounders have been operating at Karachi and Islamabad acquiring the ionospheric data at these stations at 15-minute intervals. Prior to the commissioning of a Digisonde at Karachi, the PIR-9 Sounder was shifted to Multan in March 1987, where it has been in operation ever since. Also, prior to commissioning the second Digisonde at Islamabad in December 1992, an Analog Sounder PIR-9B operated there for about 1-1/2 decades. There is now a proposal to shift the PIR-913 Sounder to Quetta (30.22 N, 67.02 E) where a survey of the site for an ionospheric station has already been completed.

It is noteworthy that the two Digisondes, one each at Karachi and Islamabad, cover the southern and northern parts of the ionosphere over Pakistan, while the PIR-9 Sounder at Multan covers the central-east part. The ionosonde at Quetta will cover the central-west part of the ionosphere over Pakistan. Thus, the ionospheric station at Quetta, combined with the three existing stations, would provide a full coverage of the ionosphere over the country. The ionospheric station at Quetta will also enable one to carry out latitudinal studies of the ionosphere for Quetta and Karachi, and longitudinal studies for Quetta and Multan.

The salient features of Digital/Analog Sounders are given below :

DIGISONDE DGS-256 (MADE IN USA)

Peak Power Output:	10 kW
Pulse Width:	66 μsec at 200 Hz; 66 or 133 μsec at 50 & 100 Hz.
Pulse Repetition Rate:	50 Hz, 100 Hz and 200 Hz.
Frequency Sweep/Range:	Logarithmic and Linear 0.5-30 MHz.
Sweep Duration:	20 sec to several minutes depending on frequency sweep, step size and frequency repetition rate.
Transmitting Antenna:	Fixed high frequency broadband rhombic antenna of 600 ohms impedance.
Receiving Antennas:	2 x 7 Turnstile loops
Recording Method:	Magnetic tape recorder, dot matrix printer and an automatic real time ionogram scaler for true height analysis (ARTIST) for on-line Data Post-processing.

PIR-9 and PIR-9B (MADE IN JAPAN)

Peak Power Output:	10 kW (Nominal)
Pulse Width:	50 to 100 u-sec (Variable)
Pulse Repetition Frequency:	Line Frequency 50 Hz
Frequency Sweep/Range:	0.55 to 20 MHz
Sweep Time:	20 sec.
Transmit/Receive Antenna:	Crossed delta with 45 meter central mast.
Recording Method:	35 mm Camera.

6. Digital Ionospheric Sounding System (DISS)

Major Cecilia A. Askue,
United States Air Force
Learmonth Solar Observatory, Learmonth,
Western Australia
AUSTRALIA

In 1985, the United States Air Force (USAF) Air Weather Service installed the first Digital Ionospheric Sounding System (DISS) in Newfoundland, Canada, initiating a worldwide network of 19 such systems intended to provide real-time communication support for US defence customers. To date, 13 of the systems am operational in Canada, Greenland, the US, Puerto Rico, Bermuda and Australia. When the network is complete, DISS sites are planned to operate in Italy, the United Kingdom and Korea as well. The following paragraphs describe the configuration of the DISS, management of the DISS network, and use of DISS data in real-time and research modes.

At the heart of each DISS is a Digisonde 256 vertical incidence ionosonde developed in the US by the University of Lowell Center for Atmospheric Research. The ionosonde system consists of a variable-power pulse transmitter, a wideband high frequency (HF) transmit antenna, seven circularly polarised receiving antennas, and associated transformers, switches, cabling and peripheral recording devices. In addition, the ionosonde system employs a dedicated computer to automatically scale ionospheric data using the Automatic Real-Time Ionogram Scaling with True Height (ARTIST) algorithm. A dial-up capability, via modem, and global connectivity through the Air Weather Service's Automated Weather Network complete the DISS.

In terms of system specifications, the ionosonde pulses the ionosphere over a frequency range of 0.5 to 30 MHz at a power level of between 1 kW and 10 kW. Pulse length, frequency size step, and pulse repetition rate are selectable. The sweep duration and scheduling are also variable to meet changing needs. Typically, USAF DISS ionosondes sound the ionosphere for about 5 minutes every half hour.

The USAF Air Weather Service is fielding the DISS to help meet its requirement to provide global space environmental support to US defence customers. Day-to-day management of the DISS network is a function of the Air Force Space Forecast Centre (AFSFC), an agency of the Air Weather Service. Located near Colorado Springs, Colorado, the AFSFC is the hub of space environmental support for the US defence community. The AFSFC uses data from the DISS in both a real-time (warning) mode for its operational customers and in a research mode for development of better ionospheric specification and forecast models.

In real time, military planners and decision makers receive AFSFC products based on ionospheric observations to support a variety of missions. The DISS network, as employed by the AFSFC, provides data used in preparation of these mission tailored forecast and warning products. For example, users of HF communications depend on quality forecasts and warnings of ionospheric irregularities to schedule transmission times and choose optimum frequencies. Other users of ionospheric information include satellite system managers, radar operators and systems designers.

The ionospheric data requirements of operational, or real-time, customers undergo continuous scrutiny by AFSFC forecasters, as they seek better ways to specify and predict ionospheric composition and behaviour. The major portion of that effort involves production of improved ionospheric models and the development of a set of integrated space environmental models. Present ionospheric models at the AFSFC use climatological data based on effective sunspot number for initial characterisation of the northern hemisphere ionosphere. Then, due in part to sparsity of real-time southern hemisphere ionospheric data, the current models represent that half of the ionosphere, corrected for seasonal differences, as a mirror image of its northern hemisphere counterpart. Information from the DISS, including its Australian component, is vital for adjusting this representation to include observed anomalies before inserting it into a diagnostic or prognostic model. The ultimate goal is to link improved ionospheric simulations, using physically-based interfaces, to improved models of the neutral atmosphere, the magnetosphere and the interplanetary medium through integrated space environmental models.

In summary, the USAF Air Weather Service is installing 19 automated Digital Ionospheric Sounding Systems worldwide, each capable of providing scaled ionograms in real time. The AFSFC, an Air Weather Service agency, uses data from the ionosondes to provide mission-tailored ionospheric support to HF radio communication and frequency management, satellite systems, radar operations and systems design. In addition, the AFSFC is steering an aggressive effort to develop improved models of the space environment, including the ionosphere. The result of this on-going research will be more accurate operational support to US defence customers.

7. French Participation In The International Equatorial Electrojet Year (AIEE)

by R Hanbaba
CNET
FRANCE

A number of research groups have now joined the IEEY campaign according to their respective fields of interest, either by experimental surveys, or by more intensive modelling and analysis of the equatorial electrojet.