

THE INTERNATIONAL SPACE ENVIRONMENT SERVICE

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ABSTRACT

The world's real-time space weather services are provided by the 10 Regional Warning Centres of the International Space Environment Service (ISES). These international centres monitor and predict solar terrestrial activity and provide space weather forecasts for users who plan or conduct activities sensitive to space weather conditions. The International Space Environment Service (formerly known as the International Ursigram and World Days Service) is a joint service of URSI, IAU and IUGG and is a permanent service of the Federation of Astronomical and Geophysical Data Services (FAGS).

1. MEMBERSHIP OF ISES

ISES has an important role in co-ordinating the exchange of information between member centres around the world. These centres are known as Regional Warning Centres (RWCs) and there are ten scattered around the globe (see Table 1).

Table 1. The ISES Regional Warning Centres

Beijing (China)
Boulder (USA)
Moscow (Russia)
Paris (France)
New Delhi (India)
Ottawa (Canada)
Prague (Czech Republic)
Tokyo (Japan)
Sydney (Australia)
Warsaw (Poland)

Regional Warning Centres provide services to the scientific and user communities within their own regions. These services consist of forecasts of disturbances to the solar terrestrial environment. Increasingly, services also include real-time information about the space environment available to users through the Internet. An important feature of the ISES system is that RWCs are able to construct and direct their services to the specific needs of their own customers.

Users of the RWC services are very diverse and in fact vary quite substantially from centre-to-centre according to the needs of the nation in which the RWC resides. Typical users include: high frequency (HF) radio communicators; mineral surveyors using geophysical techniques; power line and pipeline authorities; operators of satellites and a host of commercial and scientific users. The increasing sophistication and sensitivity of modern technology has resulted in a steadily expanding range of applications where a knowledge of the solar terrestrial environment is important.

2. THE MAIN ACTIVITIES OF ISES

As well as providing services to their own users, RWCs exchange information and forecasts with other centres in the group. Each centre makes forecasts of solar, geomagnetic and ionospheric conditions for the coming day and these are forwarded to Space Environment Center (SEC) in Boulder (USA), which has a special role as World Warning Agency. SEC then issues a forecast which is based on the individual forecasts and their own assessment of likely conditions.

The agencies which operate ISES centres are often themselves important sources of solar terrestrial data. These are relayed through the network by the centres, sometimes in coded format. SEC also plays a key role in this data exchange as it collects data and makes it available to other centres.

National Geophysical Data Center in Boulder also produces the International Geophysical Calendar on behalf of ISES. This calendar gives a list of "World Days" which scientists are encouraged to use for carrying out their experiments. The calendar is distributed widely in the scientific community and is published in a number of scientific journals.

In addition, on behalf of ISES, the World Data Center for Rockets and Satellites in Greenbelt, USA, summarises the status of satellite orbits in the Spacewarn Bulletin available through the Web.

Table 2. The main activities of ISES

- International Exchange of Solar Terrestrial Data and Space Weather Forecasts
- Publication of the International Geophysical Calendar
- Monitoring Status of Satellite and Spacecraft Launches
- The Solar Terrestrial Predictions Workshops

3. THE ISES PREDICTIONS WORKSHOPS

The involvement of ISES in space weather forecasting and solar terrestrial data exchange leads naturally to an involvement in the analysis and interpretation of these data. To improve the accuracy and usefulness of space weather services, it is vital to better understand the sun-earth environment. As a result of this need, ISES has organised a series of "Solar Terrestrial Predictions Workshops" bringing together scientists, forecasters, and the users of forecasts. There have been five meetings: USA (1979); France (1984); Australia (1989); Canada (1992); and Japan (1996). An important outcome has been the collection of papers into the "Workshop Proceedings" which serve as invaluable reference material.

Table 3. The ISES Predictions Workshops

Boulder (1979)
Meudon (1984)
Sydney (1989)
Ottawa (1992)
Hitachi (1996)

4. THE EVOLUTION OF ISES DATA EXCHANGE

Data exchange and services in ISES have evolved greatly since its formation. Initially, exchange of information was limited by transmission speed and by cost. Therefore, information was sent mostly by telex in the form of compact codes which were relayed on from centre-to-centre. The same factors limited RWC services to simple "warnings" of anticipated disturbances.

The growth of facsimile in the 1980's gave a great boost to services in allowing a diversity of products, including products in a graphical form. But facsimile was still quite expensive, especially for international transmission.

It was the advent of Internet and the Web which has provided a real revolution in data exchange and in the services provided by RWCs. With Internet, data exchange is no longer

limited by communication speed and cost. This has resulted in a huge array of data becoming available and RWCs no longer need to collect regional data and relay it to other centres..

Along with these changes there has been a dramatic increase of interest in space weather and in space weather forecasts. This has resulted in many more centres becoming involved in space weather forecasting. Space weather forecasting has in fact become globalised and the users of forecasts can go to any centre to get the information that they require.

5. SPACE WEATHER FORECASTING - THE FUTURE

The operation of a forecast centre can be divided into three components, not all of which are unique functions of forecast centres. These are:

Space Environment Monitoring:

Important data are now obtained from space probes, but forecasting still requires a diverse range of information much of which comes from ground-based observatories. The agencies which operate forecast centres are in general heavily involved in the monitoring of the environment. We need to continue to monitor the sun, the geomagnetic field, and the ionosphere. So there is an ongoing role for RWCs and others in this task.

Space Environment Modelling:

Forecasting is becoming far more sophisticated and there are now huge volumes of information which must be processed. Whereas in the past, every centre was able to make a simple forecast of many aspects of the space environment, the task is becoming complex and it seems inevitable that centres must specialise. Perhaps, to provide such forecasts, we need global "centres of excellence" for others to use.

Supporting the User:

Once a basic forecast is available, it needs to be turned into a product meaningful to the users. This transition remains something that is best handled by local centres. Such centres understand the needs of the user and can provide appropriate space weather products for them. Likewise, local centres can respond rapidly and flexibly to users. Given, basic forecasts and data, centres can "value add" to give products that are of great benefit to users.

6. CONCLUSION

ISES and its centres have much to take pride in during the years of its operation. The future, with expanded communications, more data, and a better understanding of the science, also looks full of excitement and challenge. ISES welcomes membership inquiries from any centre involved in space weather forecasting.