

## Geomagnetic disturbance forecasting at the Ionospheric Prediction Service

**R. J. Thompson**

*Ionospheric Prediction Service, Department of Science, PO Box 702, Darlinghurst, NSW 2010, Australia.*

The Ionospheric Prediction Service (IPS), a branch of the Department of Science, provides routine frequency predictions for users of HF communications within Australia and the Asian-Pacific region. To supplement this service, IPS operates the Sydney Regional Warning Centre which has the responsibility to provide forecasts of geomagnetic disturbances and associated ionospheric disturbances. Examples of this latter group of users are people involved in geophysical surveying for minerals; pipeline authorities interested in minimizing corrosion in long pipelines; and electrical authorities interested in preventing damage to power transmission grids. Satellites can also be damaged, or even lost completely, through solar-induced disturbances to the sun-earth environment and so the coming launch of Australia's domestic satellites is expected to increase the demand for IPS Radio and Space services in this direction.

Most, if not all, geomagnetic and space disturbances originate in the sun. The particular sources generally thought to be associated with disturbances are solar flares, disappearing filaments and solar coronal holes.

Solar flares are sudden outbursts of radiation over a wide band-width of wavelength ranging from X-rays right through to the radio end of the spectrum. Major flares can also accelerate charged particles which, if they reach the earth, produce a geomagnetic disturbance.

Solar filaments are thin, relatively cool, dense structures suspended above the solar chromosphere by magnetic fields. Large filaments may remain relatively unchanged for several months but, at times, become active and disappear abruptly and completely. The disappearance of a large, suitably oriented filament is found to be correlated with a terrestrial disturbance some time later.

Coronal holes are extended regions of less than average density and temperature in the solar corona and are the sources of high speed solar wind which can produce disturbances to the terrestrial magnetic field. Coronal holes are often long-lived and produce sequences of disturbances spaced at intervals of 27 days, the apparent rotation period of the sun.

Forecasts of terrestrial disturbance require timely and continuous observations of the sun both at optical and at radio wavelengths. To provide these observations, IPS maintains close data exchange links with similar overseas organizations and operates several solar observatories within Australia. In addition, IPS has collaborative arrangements with Australian universities and the CSIRO to obtain solar data from their observatories.

At Culgoora in northern NSW, IPS has an optical observatory which maintains a routine patrol for solar flares. The staff at the Culgoora observatory also operate the Culgoora radiospectrograph which was built by the CSIRO Division of Radiophysics. The instrument provides vital information on the movement of clouds of charged particles moving out through the solar corona.

At Learmonth in the north-west of Western Australia, IPS jointly operates a solar optical and radio observatory with the United States Air Force (USAF). Data from optical and radio patrols at Learmonth are sent routinely to the USAF forecast centres and to the IPS Sydney Regional Warning Centre.

In addition to requiring timely observations of the sun, forecasts of terrestrial disturbances require an understanding of those solar events which are likely to produce disturbances. To this end IPS has a continuing interest in undertaking research in solar-terrestrial relationships. Current topics being studied include: the association of solar filament disappearances and geomagnetic disturbances; the prediction of disturbances from observation of solar coronal holes; and seasonal effects in geomagnetic disturbances.

The services produced by IPS for geophysical users are as follows: warnings, usually issued by telex, of impending disturbances; a monthly summary of solar and geophysical data; a recorded telephone message updated daily or more frequently when required; specialist advice upon request.

Details of these services are given in the IPS Handbook — H8 or can be obtained by writing to: Assistant Secretary, Ionospheric Prediction Service, PO Box 702, Darlinghurst, 2010, Australia; or by phoning (02) 269 8613.