First Meeting Report

'Towards more effective physics-based and statistical models of the polar ionosphere'

A. P. van Eyken (Coordinator), A. D. Aylward, P-L. Blelly, H. Carlson, G. Crowley, J. Holt, R. Liu, U. P. Løvhaug, J. Moen, Y. Rinne, J. Sojka , and B. Zhang

The first meeting of the ISSI Working group 'Towards more effective physics-based and statistical models of the polar ionosphere' was held at the International Space Science Institute in Bern between 31 October and 3 November 2007.

After some travel difficulties, ten working group members assembled in Bern: Herb Carlson, Geoff Crowley, John Holt, Yvonne Rinne, Jan Sojka, and Tony van Eyken of the main team attended together with Mihail Codrescu (NOAA), Rico Behlke (University of Tromsø), Thomas Ulich (Sodankylä Geophysical Institute) and Odd Erik Garcia (University of Tromsø). Neither of the Chinese team members was able to attend due to visa difficulties. Mihail Codrescu introduced a further modelling community to the group while Thomas Ulich brought extensive relevant experience from the long term ionosonde, and related, observations at Sodankylä. Rico Behlke and Odd Erik Garcia replaced Joran Moen and Unni Pia Løvhaug for this meeting.

First ISSI Workshop: (L to R, standing): Odd Erik Garcia, John Holt, Jan Sojka, Herb Carlson, and Geoff Crowley; (seated): Yvonne Rinne, Mihail Codrescu.

The Working Group proposed to exploit the huge effort to operate several of the World's incoherent scatter throughout the International Polar Year (IPY) which started on 1 March 2007 and, in particular, to use the expected unique dataset to both challenge and develop the best available models of the high latitude ionsosphere.

Members of the group reported on the progress of the operations at the incoherent scatter radars. Such radars normally operate for 1-2000 hours per year and the IPY operations were intending to extend this to round the clock operation at the EISCAT Svalbard Radar and the Poker Flat Radar in Alaska (more than 8000 hours) with extensive additional operations by the radars at Irkutsk, Siberia, Sondrestrom, Greenland, and Millstone Hill, Massachusetts.

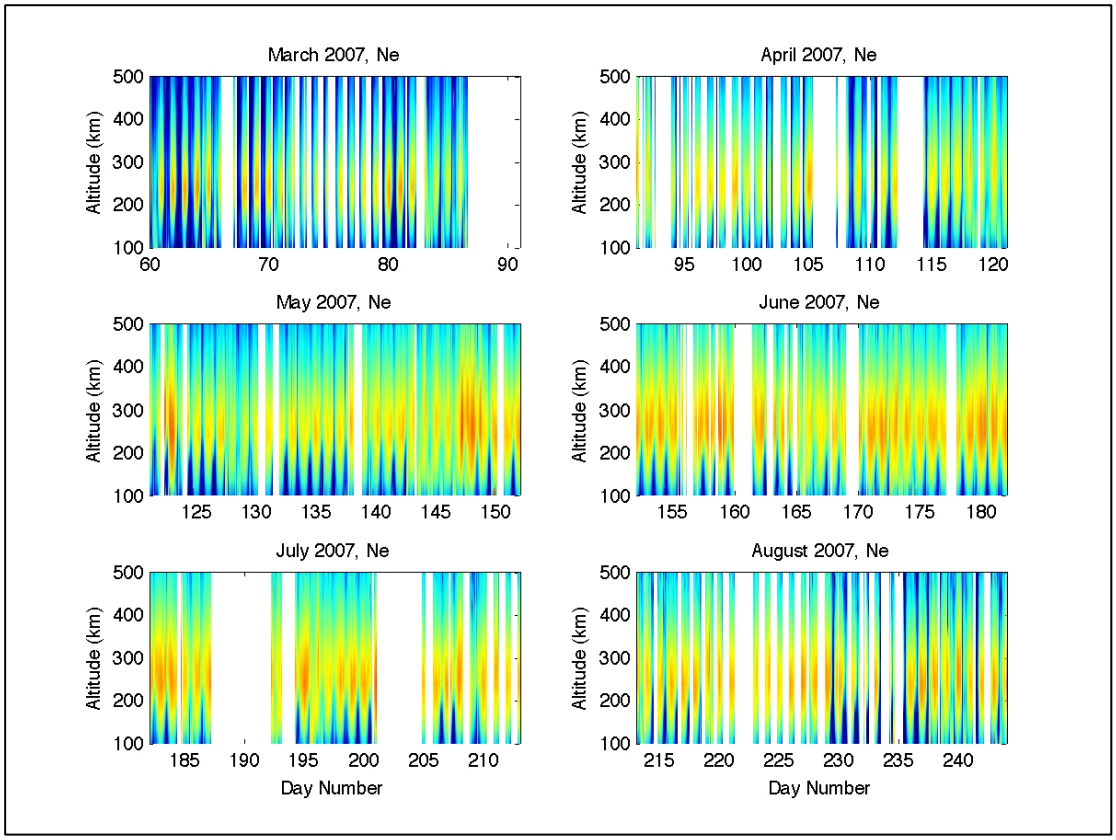
To date, operations had proceeded well at all the radars. Various difficulties had been encountered, and overcome, and the data sets were every bit as valuable as had been hoped.

The EISCAT Svalbard Radar, located at 78°N, close to the northernmost regular community in the World.

The agenda of the meeting covered:

- Introduction of the participants
- Reviews of the available observational and model data products and the IPY objectives.
- Working sessions introducing modellers to data taking and data providers to modelling issues
- Working sessions to develop effective ways to compare model and observational data and address ways to improve the models
- Working sessions on the development of data handling and data products to support the continued efforts of the working group
- Development of the outlines of the first set of papers planned by the working group

In practice, the working group spent its time roughly equally discussing observational and model data products, discussing the required infrastructure to allow effective comparison between model runs and observational data, and discussing the structure and contents of the planned papers.



Electron Density data for the first six months of the IPY as recorded by the Poker Flat Radar in Alaska

Both the observational and modelling participant groups were found to have considerable problems in fully understanding the problems and difficulties faced by the other and found the open discussions and workshop style presentations extremely valuable.

Perhaps the major outcome was that the scale of the problem in relating long model run data outputs to real-world observational data was revealed to be rather greater than the group had presupposed. Even the best model runs were unable to reproduce major features of the observational data even under the very quiet ionospheric conditions encountered in this period of minimum solar activity within the Sun's eleven-year cycle. However, the data represent an unprecedented view of the quiet ionosphere and a unique opportunity to try to properly characterise the 'undisturbed' polar atmosphere.

The working group discussed the development of new, and higher level, data products to be included in the distributed web-based database system used by the radars. This system, called Madrigal, is effectively a Virtual Observatory (VO) which makes the radar data easily accessible within the community (other IPY-related initiatives are extending the programming interfaces to support interaction with other, higher-level, VOs and data portals)

and the working group also considered ways to directly include model data runs in the database allowing the existing database tools to be used to compare the two data sets efficiently.

Many, many detailed investigations and comparisons were identified for further study and the working group finally selected no less than six projects for further study and with potential to produce refereed publications within the lifetime of the working group. These were:

1. A general paper describing the radar and modelling effort related to the IPY, a general overview of the data collected, and a discussion of the model-observation comparisons envisaged.
2. An investigation of the ionospheric variability revealed by the long data set, in particular comparing the variance of the model and observational data at solar minimum and attempting to separate climate and weather components.
3. An investigation of the role of Joule heating and the relative importance of the high latitude drivers.
4. Detailed studies of the quietest and least-disturbed intervals during the year in an attempt to identify the behaviour of the undisturbed ionosphere.
5. A correlative study between the observed data and a variety of global indices related to other instruments and observations, particularly geographically widespread measurements of the magnetic field and its variations.
6. A particular study of the E-region response to solar input, atmospheric tides and atmospheric gravity waves.

A number of other projects were also identified but delayed to a later time. Leads were assigned to each project and work plans constructed for investigations and developments to be completed before the second workshop.

During the workshop, a smaller sub-group of the team also created and populated an initial outline project web page within the main ISSI web pages and began to add content describing the various models, the observation instruments, and the planned and running studies.

During the workshop, the working group members interacted with a second group, studying Sun-Earth interactions from a system viewpoint, which was also at ISSI at that time, and ad hoc presentations were arranged by each group for the benefit of the other. This unexpected interaction was felt to have been very valuable, and a further illustration of the effectiveness of the approach supported by ISSI, and led directly to a major new initiative in high-latitude instrumentation which seems likely to significantly enhance the field in several years time.

The working group participants found the ISSI experience and working environment hugely conducive to the progress of their work and thank the organisers at ISSI, particularly Dr Vittorio Manno and Ms Brigitte Fasler, for making this wonderful opportunity possible.

Tony van Eyken
Coordinator