Second Meeting Report

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

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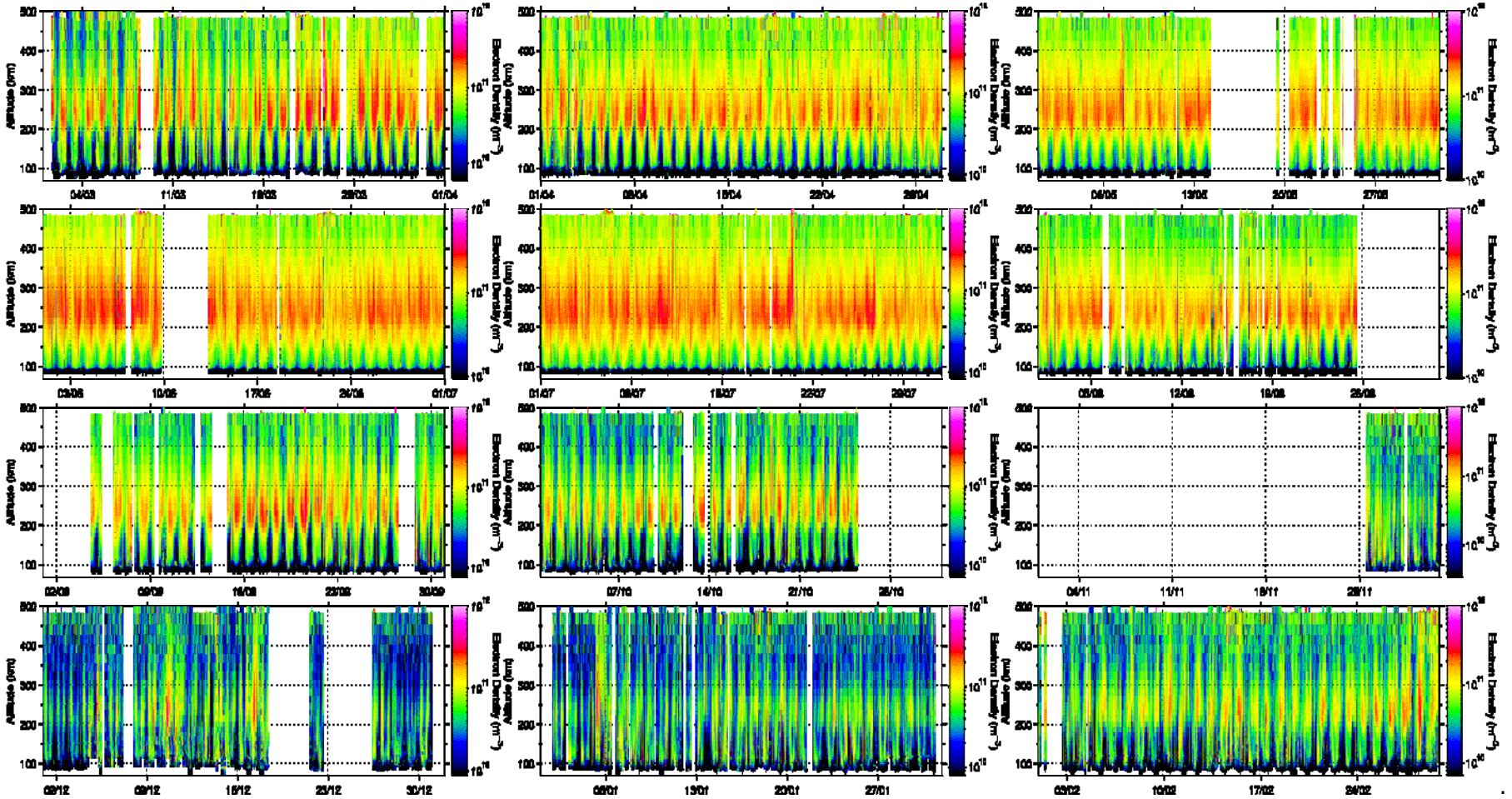
The second meeting of the ISSI Working group 'Towards more effective physics-based and statistical models of the polar ionosphere' was held at the International Space Science Institute in Bern 13-17 May 2008.

Nine working group members assembled in Bern: Beichen Zhang, Herb Carlson, Jan Sojka, John Holt, Pierre-Louis Blelly, Unni Pia Løvhaug, Yvonne Rinne, and Tony van Eyken of the main team attended together with Thomas Ulich, who had also attended the first meeting, and Tim Spain (UCL), who replaced Alan Aylward. Mihail Codrescu was this time unable to obtain permission to travel (but was available to participate remotely), as was Geoff Crowley. Ruiyuan Liu was prevented from attending at the last moment for family reasons.

The first phase of the observational program had been completed on 29 February 2008 when the high-duty-cycle program at the EISCAT Svalbard Radar had been terminated after a full year of operation. All the goals of the program had been met, except during an interval in late 2007 when issues at the local power station had prevented adequate power being available. However, the Poker Flat Radar (PFISR) was still operating its low-duty-cycle mode, now several months into the second year of the IPY interval.

The Poker Flat Radar (PFISR) operated throughout the first year of the IPY and has continued into the second producing the longest quasi-continuous incoherent scatter radar data set ever recorded.



Spring, Summer, Fall, and Winter as revealed by the ionospheric density measurements between 100 and 500km made by the EISCAT Svalbard Radar from March 2007 through February 2009.

The meeting agenda concentrated initially on reviewing and developing the work completed since the first workshop (30 October – 3 November 2007) before considering the development of planned publications and possibilities for new papers arising from the completed work.

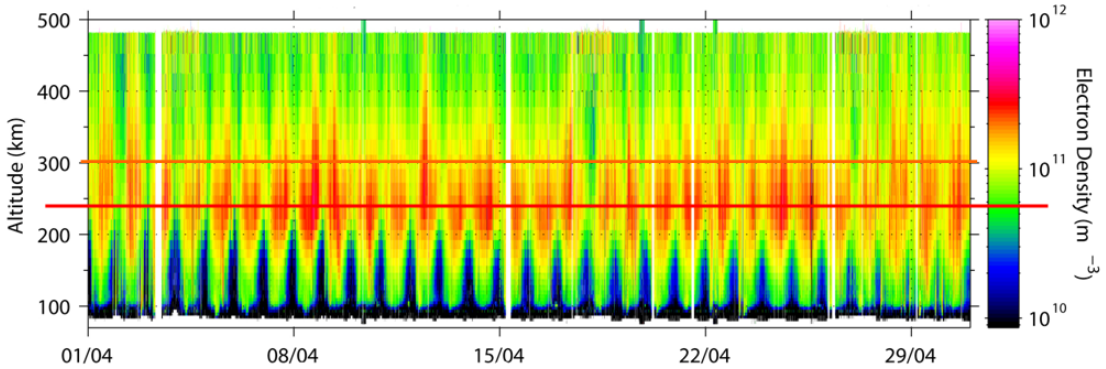
Based on the availability of the unique incoherent scatter data sets, a new ISSI working group 'Bridging the gap between the middle and upper atmosphere: coupling processes due to winds and waves over an extended altitude range' had been proposed and accepted. It would hold its first meeting in the autumn and exploit the, so far little investigated, low altitude (<100km) datasets available from the ESR and PFISR as well as related data from the other radars and elsewhere.

While none of the planned papers had yet reached the stage of publication, a great deal of work had been completed and working group members were able to devote further time at the meeting to progressing the core papers.

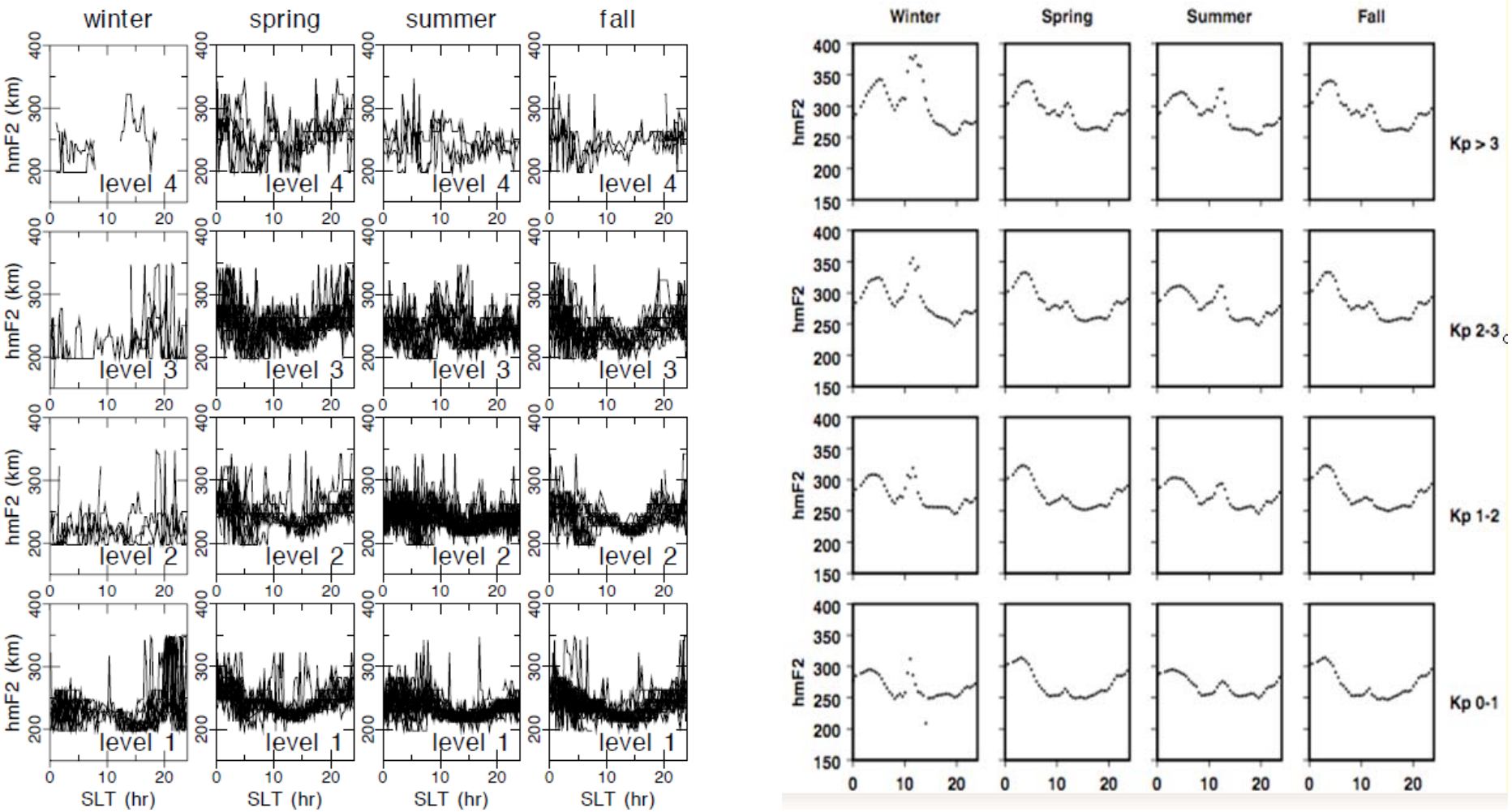
In addition to the six paper projects already underway, two new projects were adopted; the first related to the observation and modelling of intense ion-up flows which, while occurring irregularly and for only short periods, are believed to represent a major source of the ion population of the magnetosphere, and the second related to the study of conjugate effects revealed particularly through comparisons of magnetometer data from northern Scandinavia, in the Northern hemisphere, and from the Chinese Antarctic Station at Zhonshan, in the Southern hemisphere.

A major component of the work since the first workshop had related to the development of the Madrigal database products and a common view of the data presentations for both the model and observational data.

Much modeling effort, and many extensive computer modeling runs had also been completed. In many cases, very simple comparisons of gross ionospheric features, such as the height of the peak of the F-region (h_mF2), had proved the most useful.



April 2007 ESR data showing the variation of the ionospheric density with altitude and time. The red line is the approximate mean height of the observed ionization peak (~240km) while the orange line is the best modellers' belief of where it should be (~300km). Climate modellers have suggested that doubling the amount of green-house gasses in the atmosphere would lower the temperature of the upper atmosphere (while increasing it near the ground) causing contraction and a reduction in the F2 peak altitude of about 40km. Changing the temperature to take account of the reductions seen in the long term values in many years of incoherent scatter observations at Millstone Hill accounts for about two thirds of the differences in altitude and peak density, the rest is currently unexplained. This could be a very clear indicator of the real impact of climate change in these sensitive regions.



Left: EISCAT Svalbard Radar derived h_mF2 sorted by season and magnetic activity. Right: corresponding model output from the TDIM (Utah State University (USU) Time Dependent Ionospheric Model).

The scale and magnitude of the potential work involved in the project had expanded substantially as participants worked their way into the various problems and sub-projects and the working group decided to limit its efforts to a subset of the available projects in order to be able to complete a significant fraction of the work before the third, and final meeting.

The revised plan, in order of priority, includes:

1. Further development and implementation of common data views and inclusion of the data (models and observations) into Madrigal
2. The 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.
3. The investigation of the role of Joule heating and the relative importance of the high latitude drivers.
4. A new investigation of the conjugate effects in the data and models
5. The 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.

New tasks and goals were established to guide the work in preparation for the next meeting.

In summary, the working group had made substantial progress since the first workshop with some model results now reproducing gross features of the observed datasets. However, the expanding range of detailed comparisons, and the extension of the work to include other models, and other model types, showed that the project could potentially expand well beyond the scope of an individual ISSI working group necessitating some selection of the elements to be considered before the final workshop planned for early November 2008.

The working group participants again 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 Schutte, for making this wonderful opportunity possible.

Tony van Eyken
Coordinator