Journal of Atmospheric and Solar-Terrestrial Physics 71 (2009) 635

Contents lists available at ScienceDirect

Journal of Atmospheric and Solar-Terrestrial Physics

journal homepage: www.elsevier.com/locate/jastp

Preface

Initial results from Poker Flat Incoherent Scatter Radar (PFISR)

The Advanced Modular Incoherent Scatter Radar (AMISR) is a phased array incoherent scatter radar (ISR) strategy with unique modular features that allow efficient and cost-effective dismantling, shipping, and re-assembly. The current AMISR comprises two identical radar antenna faces, each with approximately three times the sensitivity of the Sondrestrom incoherent scatter radar currently operating in Greenland. Each of the fixed antenna faces is approximately $30\,m^2$ with 4096 radiating elements located on 128 separate panels.

The first of these faces was completed in December 2006 at the University of Alaska's Poker Flat Research Range, located approximately 30 miles north of Fairbanks, Alaska. This AMISR face has been named PFISR—Poker Flat Incoherent Scatter Radar. PFISR provides the means for unique scientific observations via two significant features that have not been technically feasible in the past and that greatly enhance the way observations and experimental campaigns are conducted. First, the phased array concept allows pulse-to-pulse beam steering, thus enabling three-dimensional "imaging" of electron density features in high signal-to-noise environments. Second, an incoherent scatter radar with a solid-state transmitter and no moving parts permits both extended operating periods and true remote internet operation with virtual "control rooms" at locations worldwide. Indeed, during the 2007–2008 IPY, PFISR operated essentially 24/7 without on site personnel for 22 months. The great utility of these continuous operations, as evidenced in part by papers in this special issue, has prompted an effort to continue this beyond the end of the nominal IPY period.

PFISR uses advanced solid-state amplifiers and electronics that can be computer-controlled for maximum flexibility and ease of use. It provides outstanding opportunities for students and young scientists and engineers to be involved with the development of the project and the operation of the instrument.

Finally, the AMISR project is the first National Science Foundation (NSF) Upper Atmospheric Facility that was designed, constructed and operated with only NSF funding. The other UAF radars were designed with mostly Department of Defense funds and eventually taken over and modified for scientific use by the NSF.

Knowledge of the Earth's upper atmosphere, ionosphere and geospace environment has advanced significantly in the last 40 years because of the use of ISR. However, with AMISR this knowledge will undergo another dramatic advancement over the next years. At times, important temporal scales can range from seconds through days. Similarly, the relevant spatial scales range from sub-meters through thousands of kilometers. PFISR has significant scientific advantages over existing ISRs, largely due to the rapid steering provided by the phased array antenna. The nearly instantaneous steering capability promises to resolve many of the temporal/spatial ambiguities inherent in measurements from mechanically-steered dish-based systems.

The results of the first operations of PFISR in this issue demonstrate the features described above and show a remarkable diversity in topics. In addition to Polar Mesospheric Summer Echo studies, auroral effects, and support of sounding rockets, all resulting directly from PFISR's location, the reader will find papers concerning meteor studies, thermospheric winds, D-region structure, tides, and long-term IPY ionospheric modelling studies. Though PFISR has only been operational for a short time, this wide range of topics and impressive list of authors bodes well for the future of this new scientific instrument. The authors wish to thank the guest editors P. Erickson (MIT-LL), D. Janches (NWRA/CoRA Div.), C. Heinselman and M. Nicholls (SRI), and for the suberb job on compiling this issue.

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Available online 7 February 2009

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doi:10.1016/j.jastp.2009.01.009