Requesting Incoherent Scatter World Day Runs

Introduction

The global network of incoherent scatter radars (ISR) makes observations of fundamental properties of the upper atmosphere, ionosphere, and magnetosphere. Use of these radars is open to all qualified scientists, and the data are freely disseminated to a broad community of users for research and in the development and validation of models and instrumentation.

Radar observing time is allocated by one of two routes:

- Formal or informal applications from individuals or groups to the institutions responsible for operating each of the various facilities, and
- World Day observations, coordinated through a plan developed annually by the URSI Incoherent Scatter Working Group (ISWG).

This document addresses the second of these allocation routes.

World Day runs are typically carried out four or five times per year. Normally, they are conducted as coordinated, continuous and simultaneous experiments, involving all the incoherent scatter radars in the global network. Occasionally, however, a run will address only a subset of the facilities (e.g. high-latitude radars only, or low-latitude radars only). World Day runs are multi-day experiments, typically two to five days in length, though longer intervals are possible. In a typical year, World Day experiments will comprise between 20 and 25 days of observations in total.

If a particular set of geophysical conditions is required, it can be possible to embed the World Day run within a longer "alert window", meaning that the multi-day continuous experiment only starts once the correct conditions are achieved. Once the observations start, however, they should run continuously for their full allocated time.

The Application Process

The high demand for ISR observations, in particular for extended multi-radar operations, requires certain procedures to ensure that the highest priority scientific research is addressed by the coordinated World Day schedule, within the limits imposed by the cost and technical restrictions of ISR operations. In order to be successful, a World Day proposal has to demonstrate that it genuinely addresses a topic of interest to a wide science community and that it has a real need for distributed data from multiple facilities.

The process begins with the development of a baseline schedule of general-purpose experiments that fall within the operating constraints of the radars. See, for example, the baseline World Day schedule for 2018, shown in Appendix 1 below.

An experimenter having a need for extended duration and/or multiple facility ISR experiments should first review the schedules and archives of the various facilities carefully, to determine whether their observational requirements can be met by observations which have already been made or scheduled. If not, and if the experiment cannot be easily accommodated through requests to individual radar facilities, a proposal for World Day operations should be submitted to the Chairperson or Deputy Chairperson of the ISWG. Calls for such proposals are made annually, in May of each year, with applications due in the second half of June.

If you are unsure whether or not your experiment requires the submission of a World Day proposal, please contact the ISWG Chairperson, Deputy Chairperson, or any staff member of an ISR facility. The ISWG Chair will initiate an interactive review process, enabling experimenters to provide additional input or arguments as needed. Every effort will be made to accommodate all requests.

The ISWG typically meets each year at, or during, the annual CEDAR meeting, to review all the proposals, with the aid of external reviewers solicited by the Chair as appropriate. This group will determine how the global network of ISRs can best satisfy the approved observational requests and ensure that the experimental configurations, numbers of radars involved, time distribution and total time allocated are appropriate for the specified science goals. The proposer's presence during this discussion is not required, though proposers who happen to be at the CEDAR meeting are encouraged to take part in the discussion.

Example Application

Appendix 2 shows an example of a successful World Day proposal from 2015 (by kind permission of the proposer). This run was awarded five days of continuous observations in February 2016, during the much longer multi-instrument LWCYCLE campaign mentioned in the proposal.

The application satisfies all of the core requirements for a World Day case, which should include at least the following:

- An experiment title;
- Names and contact details of the proposer and any co-investigators;
- Details of a contact person to co-ordinate with the ISRs (if different from the proposer);
- A summary of the key science objectives;
- Required conditions (solar/geomagnetic activity, season of the year, phase of the moon, specific dates, if applicable);
- List of facilities (stating which are required and which are optional);
- The required experiment mode (plasma parameters to be measured, pointing directions or scan parameters, time resolutions, specific modes if known) for each radar;
- A justification of why simultaneous multi-point data are needed;
- A justification of why the science aims cannot be achieved by other data (existing or planned);
- A description of the existing experiment which comes closest to achieving the aims of the proposed study;
- A list of participating scientists and their duties;
- A list of personnel with whom the idea has already been discussed;
- A more detailed description and justification, with appropriate references.

After the ISWG meeting

Regardless of whether your application is successful, you will be notified of the outcome within a week or two after the CEDAR meeting. The feedback will tell you how much time has been awarded on which facilities and will provide you with the details of the individual facility operators, whom you should contact to discuss the details of your run.

If your proposal has been scheduled for a World Day run, we ask that you begin contacting the facilities **no later than three months** prior to your experiment. The operators will normally be very helpful in liaising with you to find the best radar experiment to satisfy your science goals.

If your proposal is embedded within a longer alert period, you will need to decide **three days beforehand** on a nominal date for the start of the run and inform the facilities involved. Shorter lead times may be possible for some facilities, but operations requested less than three days from the projected start date cannot be guaranteed.

Once your experiment has run, and the results have been analysed and interpreted, it would be very useful for the ISWG to have some feedback on how the process has gone. We ask all proposers who have been awarded time to write a short one-page summary of their World Day experiment, including any “lessons learned” for discussion at the following ISWG meeting. Any such proposers attending the CEDAR meeting are encouraged to attend the ISWG session to report on their results.

Anybody with questions about this process should feel free to consult with the ISWG Chairperson, Deputy Chairperson, or any either facility staff member, for clarification of any issues which may be unclear.

Appendix One: List of ISR World Days Awarded for 2018

2018 ISR World Day Schedule

Month	Starting Date	Length	New Moon	Experiment	Proposer
January	15-16	2	16	QB50 Field-Aligned/Vertical	Aruliah
	10-31	10		StratWarm (see Note 1)	Sato
February	14-16	3	15	Patches	Gillies & Perry
March			17		
April			15		
May			15		
June	12-13	2	13	QB50 Field-Aligned/Vertical	Aruliah
	6-20 alert	5		CONGSS Storms (see Note 2)	Zhang
July			12		
August			11		
September			9		
October			8		
November			7		
December			7		
Special Case	see Note 3	3		CME sudden commencement	Zou

Note 1: The decision to start this 10-day run will be based on predictions of Sudden Stratospheric Warming. In the case of no SSW event, the World Day will revert to a 5-day run at the end of the alert period, Jan 29 to Feb 3. There should be five days notice for the alert.

Note 2: The decision to start this aler-based run will be based on predictions of magnetic disturbances. The alert should be announced five days before the start of the run.

Note 3: The decision to start this alert-based run will be based on the prediction of an ICME. The alert window will last the entire year, with a best effort made by operators to respond. The alert should be announced five days before the start of the run. Intention is to catch the sudden commencement in as many radars as possible to look at the global response.

Appendix 2: Example ISR application from 2015

Title: Gravity wave propagation in the mesosphere and thermosphere

Principle Investigator: Andrew J. Kavanagh, British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB30ET, Email: andkav@bas.ac.uk

Co-Investigators: Tracy Moffat-Griffin (BAS); Adrian Grocott (Lancaster University); Lisa Baddeley (UNIS); Dag Lorentzen (UNIS), Noora Partamies (UNIS);

Point Person: Andrew J. Kavanagh

Key Objectives:

- To measure the electron density and temperature profiles in the mesosphere and thermosphere during the German GW-LCYCLE.
- To extract gravity wave parameters in the mesosphere and thermosphere for comparison with lower atmosphere and SuperDARN observations.

Background Conditions: Preferably quiet geomagnetic conditions are preferred to improve the ability to extract gravity wave parameters from waves forced from the lower atmosphere either by direct propagation or secondary generation. Clear skies are preferred to allow optical support

UAFs Needed: All high latitude systems, several days of operations required to overlap the GW-LCYCLE campaign.

Primary parameters to Measure: Local near vertical profiles of Ne, Te, and Vi from the mesosphere to the F-region with high time resolution.

Secondary parameters: Off vertical, multi direction measurements in the RISRs to extract horizontal gravity wave parameters (e.g. Nicolls and Heinselman, 2007)

Need for simultaneous data: an opportunity to examine the large scale gravity wave field at various longitudes

Existing Data Meeting Objectives: None completely. Although past data sets exist from which gravity wave data can be extracted no long time series were taken at the same time as the GW-LCYCLE campaign.

Existing Data Closest to Objectives: The closest was the world-day run from February 2015 but lacked the simultaneous lower altitude data. It would be very interesting if a stratospheric warming were to occur in 2016 such that we could compare the observations between the two years.

Participant Duties: Kavanagh will coordinate the experiments to ensure proper modes are used at each facility and will liaise with the GW-LCYCLE campaign. Grocott will coordinate analysis of simultaneous supper atmosphere measurements from SuperDARN (e.g. Grocott et al. 2013). Other Co-Is will work on data analysis from the radars and other support instruments.

Facility Personnel Contacted: None.

Further Details and Background:

The GW-LCYCLE programme is a German campaign to study gravity wave excitation, propagation and dissipation as a coupling mechanism between the troposphere and middle atmosphere (~10 – 120 km). From December 2015 to March 2016 they will be run a major observational campaign deploying three instrumented aircraft, employing observations from distributed ground-based LIDARs and radars and increased launches of radiosondes (3-hourly) from 3 sites (Andoya, ESRANGE, and Sodankylä). This region is a hot-spot of gravity wave activity in the stratosphere and examination of gravity waves at different altitude will shed light on momentum and energy coupling.

The inclusion of the ISR in Europe, Greenland and North America will provide a means of simultaneously examining the propagation of gravity waves from the middle atmosphere into the thermosphere. It is a difficult proposition to identify individual wave paths from the lower atmosphere all the way to the mesosphere and beyond due to the effects of filtering and ducting of waves. Recent observations made with the DLR mobile LIDAR show that there are some possible cases but mostly the mesosphere becomes a complex 'soup' of structures, not least because of the wave breaking that occurs. With the ISR network (and other diagnostics) we can concentrate on what happens to those waves that propagate (e.g. Livneh et al., 2007), or generate secondary waves (e.g. Vadas & Liu, 2009) into the thermosphere. We aim to:

- Identify secondary generation of waves
- Compare GW activity in the ISR with observations of TID in SuperDARN radars
- Link wave breaking or propagation to lower atmosphere measurements where possible

The spread of ISR also presents opportunities for comparisons of waves within and without the polar vortex. For those sites (such as the ESR) with optical measurements of gravity waves (e.g OH imaging) we will be able to compare the horizontal structure with the vertical wave structure.

Good techniques have been developed to extract gravity wave parameters from ISR data (e.g. Nicolls & Heinselman, 2007; Nicolls et al, 2010; Vlasov et al., 2011). These observations will provide a means of testing the theoretical predictions of the wave propagations made by Vadas & Fritts (2004, 2005), Vadas (2007) and Sun et al. (2007) amongst others. We will be able to examine the thermospheric role played by gravity waves generated via forcing from below compared with those generated in-situ.

References:

Grocott, A., Hosokawa, K., Ishida, et al. (2013). Characteristics of medium-scale traveling ionospheric disturbances observed near the Antarctic Peninsula by HF radar. Geophys. Res. Lett. , 5830-5841.

Livneh, D. J., Seker, I., Djuth, F. T., & Matthews, J. D. (2007). Continuous quasiperiodic thermospheric waves over aricebo. J. Geophys. Res. , 112, A07313.

Nicolls, M. J., and C. J. Heinselman (2007), Three-dimensional measurements of traveling ionospheric disturbances with the Poker Flat Incoherent Scatter Radar, Geophys. Res. Lett., 34, L21104, doi:10.1029/2007GL031506.

Nicolls, M. J., R. H. Varney, S. L. Vadas, P. A. Stamus, C. J. Heinselman, R. B. Cosgrove, and M. C. Kelley (2010), Influence of an inertia-gravity wave on mesospheric dynamics: A case study with the Poker Flat Incoherent Scatter Radar, J. Geophys. Res., 115, D00N02, doi:10.1029/2010JD014042.

Sun, L., W. Wan, F. Ding, and T. Ma, Gravity wave propagation in the realistic atmosphere based on a three-dimensional transfer function model, Ann. Geophys., 25, 1979–1986, 2007.

Vadas, S. L., Horizontal and vertical propagation and dissipation of gravity waves in the thermosphere from lower atmospheric and thermospheric sources, J. Geophys. Res.,112, A06305, doi:10.1029/2006JA011845, 2007.

Vadas, S. L. and D. C. Fritts, Thermospheric responses to gravity waves arising from mesoscale convective complexes, J. Atmos. Sol.-Terr. Phys.,66, 781–804, 2004.

Vadas, S. L. and D. C. Fritts, Thermospheric responses to gravity waves: Influences of increasing viscosity and thermal diffusivity, J. Geophys. Res., 110, D15103, doi:10.1029/2004JD005574, 2005

Vadas, S. L., & Liu, H. -L. (2009). Generation of large-scale gravity waves and neutral winds in the thermosphere from the dissipation of convectively generated gravity waves. J. Geophys. res , 114, A10310.

Vlasov, A., Kauristie, K., van de Kamp, M., Luntama, J.-P., and Pogoreltsev, A.: A study of Traveling Ionospheric Disturbances and Atmospheric Gravity Waves using EISCAT Svalbard Radar IPY-data, Ann. Geophys., 29, 2101-2116, doi:10.5194/angeo-29-2101-2011, 2011.