# 2016 International Geophysical Calendar (FINAL)

**Cooperative programs pertaining to solar activity and the Earth's environment**

Go to the ftp site for past calendars.

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**The International Geophysical Calendar contains information about:**

- 2016 Solar Eclipses
- 2016 Meteor Showers

and recommended scientific programs for

- Airglow and Aurora Phenomena
- Atmospheric Electricity
- Geomagnetic Phenomena
- Ionospheric Phenomena
- Vertical Incidence sounding program
- Incoherent Scatter observation program
- Meteorology
- Global Atmosphere Watch (GAW)
- Solar Phenomena
- Variability of the Sun and Its Terrestrial Impact (VarSITI)
- Space Research, Interplanetary Phenomena, Cosmic Rays, Aeronomy
- Meteor Showers
-

## 2016 FINAL Calendar -- PDF version

### EXPLANATIONS

This Calendar continues the series begun for the IGY years 1957-58, and is issued annually to recommend dates for solar and geophysical observations, which cannot be carried out continuously. Thus, the amount of observational data in existence tends to be larger on Calendar days. The recommendations on data reduction and especially the flow of data to World Data Centers (WDCs) in many instances emphasize Calendar days. The Calendar is prepared by the International Space Environment Service (ISES) with the advice of spokesmen for the various scientific disciplines.

The Calendar provides links to many international programs, giving an opportunity for scientists to become involved with data monitoring and research efforts. International scientists are encouraged to contact key people and to join the worldwide community effort to understand the Sun-Earth environment.

The definitions of the designated days remain as described on previous Calendars. Universal Time (UT) is the standard time for all world days. Regular Geophysical Days (RGD) are each Wednesday. Regular World Days (RWD) are three consecutive days each month (always Tuesday, Wednesday and Thursday near the middle of the month). Priority Regular World Days (PRWD) are the RWD which fall on Wednesdays. World Geophysical Intervals (WGI) are 14 consecutive days in each season, beginning on Monday of the selected month, and normally shift from year to year. In 2016 the WGI are February, May, August, and November. Quarterly World Days (QWD) are one day each quarter and are the PRWD which fall in the WGI.

The 2016 FINAL Calendar is available in PDF format.

## 2016 Solar Eclipses:

A total solar eclipse will sweep across western and northern Indonesia and into the Pacific on 9 March 2016, and an annular solar eclipse will cross Africa from Gabon to Tanzania to Madagascar, and on to the island of Réunion on 1 September 2016. Maps are accessible through http://www.eclipses.info, the site for the International Astronomical Union's Working Group on Eclipses.

a. **09 March 2016**. The total eclipse path crosses the Indonesian Islands of Sumatra, Borneo, Sulawesi, Ternate, and then onward into the Pacific, where mid-eclipse occurs with a maximum totality of 4 m 9 s. Cloudiness statistics based on past satellite data are available at http://eclipser.ca. On Ternate, at an altitude of about 47°, there is a maximum totality of 2 m 45 s, with the centerline farther south of about 3 m 15 s. Partial phases will be visible at sunrise in eastern India and southeastern Asia northward through most of China. Northern Australia will have about 60% coverage, with the northwestern two-third of Australia in the partial-eclipse zone. Hawaii will have over 60% of the Sun's diameter covered, with 70% partial eclipse in Honolulu in the late afternoon, about an hour before sunset.

   - Map of total solar eclipse 09 March 2016 (by Fred Espenak)
   - Interactive Google map of total solar eclipse 09 March 2016 (by Xavier Jubier)

b. **01 September 2016**. The 97% (of the solar diameter) annular path (94% of the area) crosses Africa from Gabon through Congo and DR Congo through southern Tanzania to northern Mozambique and northern Madagascar, and on to the French island of Réunion. All of Africa except for the Mediterranean coast and inland regions will have a partial eclipse, with 26% of the solar diameter covered in Cape Town, South Africa. The peak duration of annularity, in southern Tanzania, will be 3 m 6 s, with a possible subtraction of about 15 s for Baily's beads. Calculations show about 2 m 51 s in southern Réunion, with a possible subtraction of about 15 s for Baily's beads.

   - Map of partial solar eclipse 01 September 2016 (by Fred Espenak)
   - Interactive Google map of partial solar eclipse 01 September 2016 (by Xavier Jubier)

We thank Fred Espenak (Arizona) (http://EclipseWise.com) and Xavier Jubier (Paris) (http://xjubier.free.fr/en/) for their data and maps; see also Michael Zeiler's http://eclipse-maps.com for maps and Jay Anderson's http://eclipser.ca for weather discussions. Espenak's Thousand Year Canon of Solar Eclipses: 1501 to 2500 is available from www.astropixels.com/pubs, and is the successor to earlier Canons and the NASA website that he ran. It and other work of Espenak, much of it formerly on the NASA website, is now available at http://EclipseWise.com.

Information assembled by Jay M. Pasachoff, Williams College (Williamstown, Massachusetts), Chair, International Astronomical Union's Working Group on Eclipses.

- **Eclipse References:**

  - Pasachoff website linking much eclipse reference material: http://eclipses.info
  - Fred Espenak, Thousand Year Canon of Solar Eclipses 1501 to 2500, 2014 (ISBN-10: 194 1983006); www.astropixels.com/pubs
  - Fred Espenak, Five Millennium Canon of Solar Eclipses: -1999 to +3000, 2006 (NASA/TP-2006-214141);
  - http://eclipse.gsfc.nasa.gov; http://eclipse.gsfc.nasa.gov/OH/OH2014.html
  - Leon Golub and Jay M. Pasachoff, The Solar Corona, 2nd ed., Cambridge University Press, 2010 (ISBN-10: 052188201X).
  - Jay M. Pasachoff and Alex Filippenko, The Cosmos: Astronomy in the New Millennium, 4th ed., Cambridge University Press, 2014 (ISBN-10: 049501303X).
  - Leon Golub and Jay M. Pasachoff, Nearest Star: The Surprising Science of Our Sun, 2nd edition, Cambridge University Press, 2014 (ISBN-10: 1107672643).
  - Jay M. Pasachoff, The Complete Idiot's Guide to the Sun, Alpha Books, 2003 (ISBN-10: 1592570747).

## 2016 Meteor Showers

(Selected from data compiled by Jürgen Rendtel for the International Meteor Organization Shower Calendar):

a. **Meteor outbursts** are unusual showers (often of short duration) from the crossing of relatively recent comet ejecta. Dates are for the year 2016.

   - 21 April (comet P/2009 $WX_{51}$): Possibility of activity at 02:02 UT.
   - 12 September (ε-Eridanids): Possible outburst around 17:30 UT.
   - 05 October: Possibility of outbursts for the October 5/6 meteors, sometimes called the October Camelopardalids, around 05 October 2016 14:45 UT.

b. **Annual meteor showers liable to have geophysical effects:** Dates (based on UT in year 2016) are:

| Dates | Peak Time (UT) | Name |
|---|---|---|
| December 28-January 12 | January 04, 08:00 | Quadrantids (QUA)[1] |
| January 28-February 21 | February 08, 18:30 | α-Centaurids (ACE)[2] |
| April 16-April 25 | April 22, 06:00 | Lyrids (LYR) |
| April 19-May 28 | May 05, 20:00 | η-Aquariids (ETA) |
| May 14-June 24 | June 07 | Daytime Arietids (ARI)[3] |
| May 20-July 05 | June 09 | Daytime ζ-Perseids (ZPE)[3] |
| June 05-July 17 | June 28 | Daytime β-Taurids (BTA) |
| July 12-August 23 | July 30 (possibly July 28-30) | Southern δ-Aquariids (SDA) |
| July 17-August 24 | August 12 13:00 to 15:30 | Perseids (PER) |
| September 09-October 09 | September 27 | Daytime Sextantids (DSX) |
| October 02-November 07 | October 21 | Orionids (ORI) |
| November 06-November 30 | November 17 | Leonids (LEO) |
| December 04-December 17 | December 14 | Geminids (GEM) |
| December 17-December 26 | December 22, 09:00 | Ursids (URS)[4] |

[1]Quadrantids (QUA): Model calculations of Jérémie Vaubaillon indicate the peak may occur earlier with a maximum between January 3, 22 UT and January 4, 02 UT.

[2]α-Centaurids (ACE): IMO observations found the timing of the mean of 'traditional' broad maximum varied between August 12 08 UT to 22 UT. Mikhail Maslov and Esko Lyytinen indicate we will cross a part of the stream which was shifted closer to the Earth's orbit by Jupiter in 2016, which could result in background ZHR levels of 150-160. Earth should encounter small meteoroids already on August 11 22:34 UT with brighter meteors expected at 23:23 UT. Jérémie Vaubaillon anticipates the densest part of the stream will be crossed August 12 between 00 UT and 04 UT, well before the broad nodal maximum.

[3]Daytime Arietids (ARI) and Daytime ζ-Perseids (ZPE): Shower maxima dates are not well established and may occur up to a day later than indicated.

[4]Ursids (URS): No unusually strong activity has been forecast, although modelling by Jérémie Vaubaillon suggests a possibility of weak activity December 22/23 (more likely) and 23/24, close to 00 UT each night.

c. **Annual meteor showers which may have geophysical effects:** Dates (based on UT in year 2016) are:

| **Dates** | **Peak Time (UT)** | **Name** |
|---|---|---|
| April 15-April 28 | April 23 | π-Puppids(PPU) |
| June 22-July 02 | June 27 03:00 | June Boötids (JBO)[1] |
| August 28-September 05 | August 31, 19:00 | α-Aurigids (AUR) |
| September 05-September 21 | September 09 04:00 | September ε-Perseids(SPE) |
| October 06-October 10 | October 08 | Draconids (DRA) |
| November 15-November 25 | November 21 | α-Monocerotids (AMO) |

[1]June Boötids (JBO): Some June Boötids may be visible in most years around June 20-25, but with activity largely negligible except near June 23, 2016. Particles which may encounter the Earth are expected to be small and will not produce visual activity, although radar may detect signs of the trail.

**Meteor Shower Websites:**

- Shower activity near-real time reports -- International Meteor Organization
- Meteor shower activity forecast from your own location -- Meteor Shower Flux Estimator
- Shower names and data -- IAU Meteor Data Center
- Announcements and reports of meteor outbursts -- IAU Minor Planet Center
- Shower outburst activity forecast -- Institut de Mecanique celeste et de calcul des ephemerides (IMCCE)

**Meteor Shower References:**

- Handbook for Meteor Observers, edited by Jürgen Rendtel and Rainer Arlt, IMO, 2014.
- Meteor Shower Workbook, edited by Jürgen Rendtel, IMO, 2014.
- A Comprehensive List of Meteor Showers Obtained from 10 Years of Observations with the IMO Video Meteor Network, by Sirko Molau and Jürgen Rendtel (WGN, the Journal of the IMO 37:4, 2009, pp. 98-121).
- Peter Jenniskens, Meteor showers and their parent comets. Cambridge University Press, 2006, 790 pp.

## Real Time Space Weather and Earth Effects

The occurrence of **unusual solar or geophysical conditions** is announced or forecast by ISES through various types of geophysical **"Alerts"** (which are widely distributed via the internet on a current schedule). Stratospheric warmings (STRATWARM) were also designated for many years. The meteorological telecommunications network coordinated by the World

Meteorological Organization (WMO) carries these worldwide Alerts once daily soon after 0400 UT. For definitions of Alerts see ISES URSIgram Codes.

# RECOMMENDED SCIENTIFIC PROGRAMS (FINAL EDITION)

(The following material was reviewed in 2015 by the ISES committee with the advice of representatives from the various scientific disciplines and programs represented as suitable for coordinated geophysical programs in 2016.)

## Airglow and Aurora Phenomena.

Airglow and auroral observatories operate with their full capacity around the New Moon periods. However, for progress in understanding the mechanism of many phenomena, such as low latitude aurora, the coordinated use of all available techniques, optical and radio, from the ground and in space is required. Thus, for the airglow and aurora 7-day periods on the Calendar, ionosonde, incoherent scatter, special satellite or balloon observations, etc., are especially encouraged. Periods of approximately one weeks' duration centered on the New Moon are proposed for high resolution of ionospheric, auroral and magnetospheric observations at high latitudes during northern winter.

## Atmospheric Electricity.

Non-continuous measurements and data reduction for continuous measurements of atmospheric electric current density, field, conductivities, space charges, ion number densities, ionosphere potentials, condensation nuclei, etc.; both at ground as well as with radiosondes, aircraft, rockets; should be done with first priority on the RGD each Wednesday, beginning on 06 January 2016 at 0000 UT, 13 January at 0600 UT, 20 January at 1200 UT, 27 January at 1800 UT, etc. (beginning hour shifts six hours each week, but is always on Wednesday). Minimum program is at the same time on PRWD beginning with 13 January at 1200 UT. Data reduction for continuous measurements should be extended, if possible, to cover at least the full RGD including, in addition, at least 6 hours prior to indicated beginning time. Measurements prohibited by bad weather should be done 24 hours later. Results on sferics and ELF are wanted with first priority for the same hours, short-period measurements centered around minutes 35-50 of the hours indicated. Priority Weeks are the weeks that contain a PRWD; minimum priority weeks are the ones with a QWD. The World Data Centre for Atmospheric Electricity, 7 Karbysheva, St. Petersburg 194018, USSR, is the collection point for data and information on measurements.

## Geomagnetic Phenomena.

It has always been a leading principle for geomagnetic observatories that operations should be as continuous as possible and the great majority of stations undertake the same program without regard to the Calendar.

Stations equipped for making magnetic observations, but which cannot carry out such observations and reductions on a continuous schedule are encouraged to carry out such work at least on RWD (and during times of MAGSTORM Alert).

## Ionospheric Phenomena.

Special attention is continuing on particular events that cannot be forecast in advance with reasonable certainty. The importance of obtaining full observational coverage is therefore stressed even if it is only possible to analyze the detailed data for the chosen events. In the case of vertical incidence sounding, the need to obtain quarter-hourly ionograms at as many stations as possible is particularly stressed and takes priority over recommendation (a) below when both are not practical.

For the **vertical incidence (VI) sounding** program, the summary recommendations are:

a. All stations should make soundings on the hour and every quarter hour;
b. On RWDs, ionogram soundings should be made at least every quarter hour and preferably every five minutes or more frequently, particularly at high latitudes;
c. All stations are encouraged to make f-plots on RWDs; f-plots should be made for high latitude stations, and for so-called "representative" stations at lower latitudes for all days (i.e., including RWDs and WGIs) (Continuous records of ionospheric parameters are acceptable in place of f-plots at temperate and low latitude stations);
d. Copies of all ionogram scaled parameters, in digital form if possible, be sent to WDCs;
e. Stations in the eclipse zone and its conjugate area should take continuous observations on solar eclipse days and special observations on adjacent days. See also recommendations under Airglow and Aurora Phenomena.

For the **incoherent scatter observation program**, every effort should be made to obtain measurements at least on the Incoherent Scatter Coordinated Observation Days, and intensive series should be attempted whenever possible in WGIs, on Dark Moon Geophysical Days (DMGD) or the Airglow and Aurora Periods. The need for collateral VI observations with not more than quarter-hourly spacing at least during all observation periods is stressed.

Special programs include:

- **Day-night connection by localised flow channels: Coordination with Heliophyscis System Observatory campaign: 20160105-20160111**
    - **Key objectives**:
        - To determine structure of fast flow channels forming on the dayside cusp region and their propagation across the polar cap toward the nightside auroral oval
        - To determine impact of fast flow channels on global plasma circulation processes, including magnetic reconnection, flux transfer events, plasma sheet flow bursts, and subauroral polarization streams

- **Background condition**: To take advantage of THEMIS-MMS conjunctions during dark-sky conditions, the proposed runs should be performed during January 5-15, 2016.

- **Primary parameters to measure**: F-region (150-800 km altitude) key parameters including $N_e$, $T_e$, $T_i$ and $V_i$ at highest time resolution. For AMISRs, the THEMIS-mode beam pattern is requested for obtaining wide FOV and dense coverage. For Sondrestrom and ESR a combination of fast azimuth scans and elevation scans are preferred, and EISCAT VHF and UHF are suggested to run a combination of vertical and low elevation north modes but these are negotiable. For Millstone Hill, azimuth scans at low elevation for SAPS measurements are requested. Jicamarca and Arecibo will measure penetration electric fields.

- **Need for simultaneous data**: In early 2016, MMS and THEMIS will be on the dayside and nightside, respectively, for measuring disturbances related to reconnections for the first time. Ground-based observations are essential for connecting day and night processes as well as providing 2-D perspective of flow structures, because such processes are expected to have flow channels around the cusp propagating deep into the polar cap associated with PMAFs and polar cap patches, and occasionally leading to nightside auroral intensifications. In addition, flows in the nightside plasma sheet penetrate to lower L-shells and can be measured as enhanced electric fields by mid-equatorial radars. We therefore need all radars to be operating at the same time.

- **Principal investigator**: Toshi Nishimura, University of Californa, Los Angeles (toshi@atmos.ucla.edu)

- **Co-investigators**: Vassilis Angelopoulos, Larry Lyons, Mike Nicolls, J. Mike Ruohoniemi, Eric Donovan, Emma Spanswick, Joran Moen, Lasse Clausen, Kjellmer Oksavik, Joshua Semeter, Marilia Samara, Robert Michell, Donald Hampton, David Knudsen, Kazuo Shiokawa

- **Gravity wave propagation in the mesosphere and thermosphere: 20160205-20160209**

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

  - **Background condition**: 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.

- **Primary parameters to measure**: Local near vertical profiles of $N_e$, $T_e$ and $V_i$ from the mesosphere to the F-region with high time resolution.

- **Need for simultaneous data**: An opportunity to examine the large scale gravity wave field at various longitudes.

- **Principal investigator**: Andrew Kavanagh, British Antarctic Survey, Cambridge, UK (andkav@bas.ac.uk)

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

- **Meridian Circle (MERINO): 20160305-20160319 (five day run in 15 day alert period)**

  - **Key objectives**:
    - Collect synthesized upper atmosphere data aloing a complete meridian circle, for investigation of geospace processes associated with space weather
    - To determine latitudinal variations and their east-west hemispheric differences during solar storms

  - **Background condition**: The aim is to run during a magnetic storm, with a five-day continuous observation providing both storm conditions and a quiet-time reference. The exact dates will be selected about three days before the start of the campaign, based on predictions of magnetic activity. If no major disturbances are anticipated, the campaign period will be selected on the basis of recurrent magnetic activity.

  - **Primary parameters to measure**: Synoptic modes for mid and low latitude radars; Low elevation AZ scans + regional mode for Millstone Hill. Convection measurements for high-latitude radars.

  - **Need for simultaneous data**: The coordinated observing project involves ISR World Day participants as well as the Chinese Meridian Circle project facilities. This major Chinese project provides comprehensive ground-based space weather observing in the Eastern Hemisphere, in particular along the 120E longitude, where 15 observatories, including an ISR, distributed from northern China to the South Pole, are established. They are equipped with, among other instruments, ionospheric radio sensors (digisondes, GPS receivers, MF radars, coherent radars, etc) and optical sensors (Lidars, FPIs, all-sky imagers). For this campaign, intensive observational modes will be adopted for most of the instruments.

  - **Principal investigator**: Shunrong Zhang, MIT Haystack Observatory, USA (shunrong@haystak.mit.edu)

- **Co-investigators**: Guotao Yang and Zhaohui Huang (National Space Science Center, China); John Foster (MIT Haystack Observatory, USA)
- **Time**: Five days in the alert period from 5-19 March. Shunrong will be responsible for issuing the alert notice, which will be around three days in advance of the experiment start.

- **Development of decameter-scale field-aligned irregularities following sudden changes in the drift direction of polar cap patches: 20161128-20161202**

  - **Key objectives**:
    - To measure the growth rate of decameter-scale field-aligned irregularities associated with polar cap patches
    - To evaluate the theory of gradient drift instability in the polar cap, and to assess its role as a source of HF coherent backscatter
    - To study the effect of sudden convection flow change on the development of decameter-scale field-aligned irregularities associated with polar cap patches
    - To investigate the effect of sudden flow change on the rotation and density distribution of a polar cap patch
    - To study the time history of the irregularities by tracking a patch through multiple ISR and HF radar fields of view (FOVs)

  - **Background condition**: We wish to run during and near new moon periods in the winter season for optimal optical conditions, during any geomagnetic conditions. Since we hope to observe patches as they evolve during their transport across the polar cap, the most favorable time of observations would be between 04 UT and 18 UT, since during this time frame, assuming a southward IMF configuration, the likelihood of patches drifting over several ISRs is highest.

  - **Primary parameters to measure**: Horizontal profiles of the F-region electron density, ion-drifts and electric fields, ion and electron temperatures. For specific radar modes we suggest running horizontal scans towards north for EISCAT UHF and ESR, the composite scan mode for Sondrestrom, a 6 x 7 beam grid mode for RISR-N (as used during the ‘optics’ mode in Feb 2012) and RISR-C and the 11 x 11 Semeter Nov 2007 beam mode for PFISR.

  - **Need for simultaneous data**: Our objectives require us to monitor the time history of the patches as they traverse multiple local time sectors in the high latitude region, which is only possible using several ISRs.

  - **Principal investigator**: Hanna Dahlgren, KTH Royal Institute of Technology, Stockholm, Sweden (hannad@kth.se); Gareth Perry, University of Calgary, Canada (perry@phys.ucalgary.ca)

  - **Co-investigators**: Joshua Semeter, Boston University, USA (jls@bu.edu)

- AO -- Arecibo Observatory
- JRO -- Jicamarca Radio Observatory.

Special programs: Ian McCrea, Rutherford Appleton Laboratory, UK; tel:+44(0)1235 44 6513; Fax:+44(0)1235 44 5848; email: ian.mccrea@stfc.ac.uk, chair of URSI ISWG (Commission G). See the Incoherent Scatter Coordinated Observation Days (URSI-ISWG) webpage for complete 2015 definitions.

For the **ionospheric drift** or wind measurement by the various radio techniques, observations are recommended to be concentrated on the weeks including RWDs.

For **travelling ionosphere disturbances**, propose special periods for coordinated measurements of gravity waves induced by magnetospheric activity, probably on selected PRWDs and RWDs.

For the **ionospheric absorption** program half-hourly observations are made at least on all RWDs and half-hourly tabulations sent to WDCs. Observations should be continuous on solar eclipse days for stations in the eclipse zone and in its conjugate area. Special efforts should be made to obtain daily absorption measurements at temperate latitude stations during the period of Absorption Winter Anomaly, particularly on days of abnormally high or abnormally low absorption (approximately October-March, Northern Hemisphere; April-September, Southern Hemisphere).

For **back-scatter and forward scatter** programs, observations should be made and analyzed at least on all RWDs.

For synoptic observations of **mesospheric (D region) electron densities**, several groups have agreed on using the RGD for the hours around noon.

For **ELF noise measurements of earth-ionosphere cavity resonances** any special effort should be concentrated during WGIs.
It is recommended that more intensive observations in all programs be considered on days of unusual meteor activity.

## Meteorology.

Particular efforts should be made to carry out an intensified program on the RGD -- each Wednesday, UT. A desirable goal would be the scheduling of meteorological rocketsondes, ozone sondes and radiometer sondes on these days, together with maximum-altitude rawinsonde ascents at both 0000 and 1200 UT.

During **WGI and STRATWARM Alert Intervals,** intensified programs are also desirable, preferably by the implementation of RGD-type programs (see above) on Mondays and Fridays, as well as on Wednesdays.

## Global Atmosphere Watch (GAW).

The World Meteorological Organization (WMO) Global Atmosphere Watch (GAW) integrates many monitoring and research activities involving measurement of atmospheric composition, and serves as an early warning system to detect further changes in atmospheric concentrations of greenhouse gases, changes in the ozone layer and in the long range transport of pollutants, including acidity and toxicity of rain as well as of atmospheric burden of aerosols (dirt and dust particles). Contact WMO, 7 bis avenue de la Paix, P.O. Box 2300, CH-1211 Geneva 2, Switzerland or wmo@wmo.int.

## Solar Phenomena.

Observatories making specialized studies of solar phenomena, particularly using new or complex techniques, such that continuous observation or reporting is impractical, are requested to make special efforts to provide to WDCs data for solar eclipse days, RWDs and during PROTON/FLARE ALERTS. The attention of those recording solar noise spectra, solar magnetic fields and doing specialized optical studies is particularly drawn to this recommendation.

## Variability of the Sun and Its Terrestrial Impact (VarSITI).

Program within the SCOSTEP (Scientific Committee on Solar-Terrestrial Physics): 2014-2018. The VarSITI program will strive for international collaboration in data analysis, modeling, and theory to understand how the solar variability affects Earth. The VarSITI program will have four scientific elements that address solar terrestrial problems keeping the current low solar activity as the common thread: SEE (Solar evolution and Extrema), MiniMax24/ISEST (International Study of Earth-affecting Solar Transients), SPeCIMEN (Specification and Prediction of the Coupled Inner-Magnetospheric Environment), and ROSMIC (Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate). Contact is Prof. Marianna Shepherd (mshepher@yorku.ca), President of SCOSTEP. Co-chairs are Katya Georgieva (SRTI, Bulgaria) and Kazuo Shiokawa (STEL, Japan).

**ILWS (International Living With a Star)** International effort to stimulate, strengthen, and coordinate space research to understand the governing processes of the connected Sun-Earth System as an integrated entity. Contact info@ilwsonline.org.

**ISWI (International Space Weather Initiative)** -- a program of international cooperation to advance space weather science by a combination of instrument deployment, analysis and interpretation of space weather data from the deployed instruments in conjunction with space data, and communicate the results to the public and students. The goal of the ISWI is to develop the scientific insight necessary to understand the science, and to reconstruct and forecast near-Earth space weather. This includes instrumentation, data analysis, modelling, education, training, and public outreach. Contact Dr. N. Gopalswamy at nat.gopalswamy@nasa.gov.

## Space Research, Interplanetary Phenomena, Cosmic Rays, Aeronomy.

Experimenters should take into account that observational efforts in other disciplines tend to be intensified on the days marked on the Calendar, and schedule balloon and rocket experiments accordingly if there are no other geophysical reasons for choice. In particular it is desirable to make rocket measurements of ionospheric characteristics on the same day at as many locations as possible; where feasible, experimenters should endeavor to launch rockets to monitor at least normal conditions on the Quarterly World Days (QWDs) or on RWDs, since these are also days when there will be maximum support from ground observations. Also, special efforts should be made to assure recording of telemetry on QWDs and Airglow and Aurora Periods of experiments on satellites and of experiments on spacecraft in orbit around the Sun.

## Meteor showers.

Of particular interest are both predicted and unexpected showers from the encounter with recent dust ejecta of comets (meteor outbursts). The period of activity, level of activity, and magnitude distributions need to be determined in order to provide ground truth for comet dust ejection and meteoroid stream dynamics models. Individual orbits of meteoroids can also provide insight into the ejection circumstances. If a new (1-2 hour duration) shower is observed due to the crossing of the 1-revolution dust trail of a (yet unknown) Earth threatening long-period comet, observers should pay particular attention to a correct determination of the radiant and time of peak activity in order to facilitate predictions of future encounters. Observations of meteor outbursts should be reported to the I.A.U. Minor Planet Center (mpc@cfa.harvard.edu) and International Meteor Organization (visual@imo.net). The activity curve, mean orbit, and particle size distribution of minor annual showers need to be characterised in order to understand their relationship to the dormant comets among near-Earth objects. Annual shower observations should be reported to national meteor organizations, or directly to the International Meteor Organization. Meteoroid orbits are collected by the IAU Meteor Data Center.

The International Space Environment Service (ISES) is a space weather service organization currently comprised of 17 Regional Warning Centers around the globe, 4 Associate Warning Centers, and one Collaborative Expert Center (European Space Agency). ISES is a Network Member of the International Council for Science World Data System (ICSU-WDS) and collaborates with the World Meteorological Organization (WMO) and other international organizations, including the Committee on Space Research (COSPAR), the International Union of Radio Science (URSI), and the International Union of Geodesy and Geophysics (IUGG). The mission of ISES is to improve, to coordinate, and to deliver operational space weather services. ISES is organized and operated for the benefit of the international space weather user community.

ISES members share data and forecasts among the Regional Warning Centers (RWCs) and provide space weather services to users in their regions. The RWCs provide a broad range of services, including: forecasts, warnings, and alerts of solar, magnetospheric, and ionospheric conditions; extensive space environment data; customer-focused event analyses; and long-range predictions of the solar cycle. While each RWC concentrates on its own region, ISES serves as a forum to share data, to exchange and compare forecasts, to discuss user needs, and to identify the highest priorities for improving services.

ISES works in close cooperation with the World Meteorological Organization, recognizing the mutual interest in global data acquisition and information exchange, in common application sectors, and in understanding and predicting the coupled Earth-Sun environment.

This Calendar for 2016 has been drawn up by Dr. R. A. D. Fiori of the ISES Steering Committee, in association with spokesmen for the various scientific disciplines in the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP), the International Association of Geomagnetism and Aeronomy (IAGA), URSI and other ICSU organizations. Similar Calendars are issued annually beginning with the IGY, 1957-58, and are published in various widely available scientific publications. PDF versions of the past calendars are available online.

Published for the International Council of Scientific Unions and with financial assistance of UNESCO for many years.

Copies are available upon request to ISES Director, Dr. Terry Onsager, NOAA Space Weather Prediction Center, 325 Broadway, Boulder, CO, 80305, USA, telephone +1-303-497-5713, FAX +1-303-497-3645, e-mail Terry.Onsager@noaa.gov, or ISES Secretary for World Days, Dr. Robyn Fiori, Geomagnetic Laboratory, Natural Resources Canada, 2617 Anderson Road, Ottawa, Ontario, Canada, K1A 0E7, telephone +1-613-837-5137, e-mail robyn.fiori@canada.ca. Beginning with the 2008 Calendar, all calendars are available only in digital form.

The website for the International Geophysical Calendar, including recent versions, can be found here.