2013 International Geophysical Calendar

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

Go to the ftp site for past calendars.

The International Geophysical Calendar contains information about:

- 2013 Solar Eclipses
- 2013 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
- Climate and Weather of the Sun-Earth System (CAWSES) II
- Space Research, Interplanetary Phenomena, Cosmic Rays, Aeronomy
- Meteor Showers

2013 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. For some programs, greater detail concerning recommendations appears from time to time published in IAGA News, IUGG Chronicle, URSI Information Bulletin and other scientific journals or newsletters.

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 the key people and 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. Quarterly World Days (QWD) are one day each quarter and are the PRWD which fall in the World Geophysical Intervals (WGI). The WGI are fourteen consecutive days in each season, beginning on Monday of the selected month, and normally shift from year to year. In 2013 the WGI are February, May, August, and November.

The 2013 FINAL Calendar is available in PDF format.

2013 Solar Eclipses:

The year 2013 has one annular and one hybrid eclipse.

a. **10 May 2013, annular solar eclipse**, magnitude 0.954, maximum duration 06m03s, in Australia (Western Australia, Northern Territory, northern Queensland), Papua New Guinea's eastern tip, Solomon Islands, Pacific Ocean, Kiribati (5m44s of annularity); partial phases visible throughout Australia, in the northern island of New Zealand and the western half of its South Island, in most of Indonesia, southern Philippines, Papua New Guinea, in Fiji, Tuvalu, American Samoa, Cook Islands, French Polynesia, U.S. (Hawaii; 44% in Honolulu)
    - Map of annular solar eclipse May 10, 2013.
    - Interactive Google map of annular solar eclipse May 10, 2013.
b. **3 November 2013, total solar eclipse with annularity at its beginning,** magnitude 1.016, maximum duration 01m40s, eclipse visible in the Atlantic Ocean, with partial phases visible at sunrise throughout eastern North America (U.S. east of Ohio to Georgia; Canada from Quebec to the east); Bermuda, South America (southern Columbia, eastern Venezuela, Guyana, Suriname, northeastern Brazil), Europe (Spain, Portugal, Greece), all of Africa except Cape Town region; and at sunset in the middle-East (western Turkey, Syria, Iraq, Saudi Arabia, Israel, Yemen, Gulf States). (Totality: Atlantic Ocean through Gabon, Congo, Democratic Republic o the Congo, Uganda, Kenya); annularity: Ethiopia, ending at sunset in western Somalia)
    - Map of hybrid solar eclipse November 03, 2012.
    - Interactive Google map of hybrid solar eclipse November 03, 2013.

Information from Jay M. Pasachoff, Williams College (Williamstown, Massachusetts), Chair, International Astronomical Union's Working Group on Eclipses, based on information and maps provided by Fred Espenak and Xavier Jubier.

- **Eclipse References:**
  - Fred Espenak, Fifty Year Canon of Solar Eclipses: 1986-2035, NASA Reference Publication 1178 Revised, July 1987.
  - Leon Golub and Jay M. Pasachoff, The Solar Corona, Cambridge University Press, 1998.
  - Jay M. Pasachoff and Alex Filippenko, The Cosmos: Astronomy in the New Millennium, Brooks/Cole Publishers, 2002, 2004 and 2006.
  - Leon Golub and Jay M. Pasachoff,Nearest Star: The Exciting Science of Our Sun, Harvard University Press, 2001.
  - Jay M. Pasachoff, The Complete Idiot's Guide to the Sun, Alpha Books, 2003.

2013 Meteor Showers

(Selected from data compiled by Alastair McBeath 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 2013.
   - June 11, 08:28 UT, γ-Delphinids

b. **Annual meteor showers liable to have geophysical effects:** Dates (based on UT in year 2013) are:

Dates	**Peak Time (UT)**	**Name**
Dec 28-Jan 12	Jan 03 13h25m	Quadrantids (QUA)
Apr 16-Apr 25	Apr 22 11h40m	Lyrids (LYR)
Apr 19-May 28	May 06 01h15m	η-Aquariids (ETA)
May 22-Jul 02	Jun 07 12h	Daytime Arietids (Ari)
May 20-Jul 05	Jun 09 11h	Daytime ζ-Perseids (Zeta Per)
Jun 05-Jul 17	Jun 28 10h	Daytime β-Taurids (Beta Tau)
Jul 12-Aug 23	Jul 30	Southern δ-Aquariids (SDA)
Jul 17-Aug 24	Aug 12 18h15m to 20h45m	Perseids (PER)
Sep 09-Oct 09	Sep 27 11h	Daytime Sextantids (Sex)
Oct 02-Nov 07	Oct 21	Orionids (ORI)
Nov 06-Nov 30	Nov 17 15h55m	Leonids (LEO)
Dec 07-Dec 17	Dec 13 13h15m - Dec 14 10h30m	Geminids (GEM)
Dec 17-Dec 26	Dec 22 14h15m	Ursids (URS)

c. **Annual meteor showers which may have geophysical effects:** Dates (based on UT in year 2013) are:

Dates	Peak Time (UT)	Name
Apr 15-Apr 28	April 23 16h45m	η-Puppids(PPU)
Jun 22-Jul 02	June 27 09h15m	June Bootids (JBO)
Aug 28-Sep 05	Sep 1 01h35m	α-Aurigids (AUR)
Sep 05-Sep 21	Sep 9 14h50m - 15h30m	September ε-Perseids(SPE)
Oct 06-Oct 10	Oct 8 17h25m	Draconids (DRA)
Nov 15-Nov 25	Nov 21 16h15m	α-Monocerotids (AMO)

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

References:

- 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. For many years Retrospective World Intervals were selected and announced by MONSEE (Monitoring of the Sun-Earth Environment) and elsewhere to provide additional analyzed data for particular events studied in the ICSU Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) programs.

RECOMMENDED SCIENTIFIC PROGRAMS

(FINAL EDITION)

(The following material was reviewed in 2012 by spokesmen of IAU, IAGA, WMO and URSI as suitable for coordinated geophysical programs in 2013.)

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 2 January 2013 at 0000 UT, 09 January at 0600 UT, 16 January at 1200 UT, 23 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 16 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. These will be identified by Retrospective World Intervals. 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 2013 **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:

- Sudden Stratospheric Warming (StratWarm): Dynamics, electrodynamics, temperature and electron density in the lower and upper thermosphere and ionosphere during a sudden stratospheric warming event.
    - Key objectives:
        - To extend studies of stratospheric warming effects to the lower and upper thermosphere and investigate coupling with the ionosphere

        - To document variations in multiple thermospheric and ionospheric parameters in response to different stratospheric sudden warming events
        - To capture and document ionospheric response to stratospheric sudden warmings during the rising solar activity
        - To measure electric field, neutral wind, electron and ion temperatures and electron density in the ionosphere and lower and upper thermosphere before and during sudden stratospheric warming
        - To compare variations in ionospheric and thermospheric parameters observed during SSW to average wintertime behavior of ionosphere and thermosphere
        - To compare variations in temperatures and winds to mesospheric response as given by MF and meteor radars and lidars
        - To examine mechanisms responsible for variations in lower and upper thermospheric dynamics, temperatures, electric field, and ionospheric electron density and investigate to what degree they can be related to sudden stratospheric warming
    - Background condition: The observations need to be made before and during the sudden stratospheric warming. A 10-day campaign is requested.
    - Primary parameters to measure: LTCS mode - electron and ion temperatures from lowest possible altitudes throughout the F region, zonal and meridional components of the neutral wind in the lower thermosphere (95-140km), ExB drift, F-region meridional wind. Temporal resolution can be sacrificed and data integration period increased in order to obtain data at lower altitudes.
    - Need for simultaneous data: The idea is to measure how variations in temperatures, electric field and winds associated with sudden stratospheric warming change with latitude and altitude and relate to variations in electron density.
    - Principle investigator: Larisa P. Goncharenko, lpg@haystack.mit.edu, MIT Haystack Observatory, Westford, MA 01886, USA. Larisa is responsible for issuing the alert. She anticipates a few days' notice.
    - Co-investigators: Jorge Chau (Jicamarca Radio Observatory, Peru), Hanli Liu (NCAR, USA), Peter Hoffmann (Institute for Atmospheric Physics, Germany).
- E-region **E** field: Latitudinal variation of the vertical electric field in the E region
    - Key objectives:
        - To measure the vertical and geomagnetic zonal ion drifts in the E and F regions
        - To study the height variation of the E-region electric field and its relationship to the F-region electric field
    - Background Conditions: Ideally two days each during geomagnetically quiet and active periods.
    - Primary Parameters to Measure: Vertical profiles of vertical ion drifts and geomagnetic zonal ion drift primarily during daytime. No beam swinging

unless necessary to obtain the two components in the geomagnetic zonal plane. For single feed, swing in the geomagnetic zonal plane if possible.
    - Secondary Parameters to Measure: Electron density, electron and ion temperatures.
    - Principle Investigator: Qihou Zhou, zhouq@muohio.edu, Tel: +1-513-529-0743 Electrical and Computer Engineering Dept., Miami University, Oxford, OH 45056, USA. Qihou will coordinate the observations and discuss with each ISR site to ensure that optimal modes will be used.
- Synoptic: Experiments are intended to emphasize wide coverage of the F region, with some augmented coverage of the topside or E region to fill in areas of the data bases that have relatively little data
    - Contacts: Jan Sojka, janjsojka@usu.edu; Mary McCready, mary.mccready@sri.com

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

Special programs: Mary McCready, Center for Geospace Studies, SRI International, 333 Ravenswood Avenue, Menlo Park, CA 94025, USA; tel:+1-650-859-5084; Fax:+1-650-322-2318; email: mary.mccready@sri.com, chair of URSI ISWG Commission G. See the 2013 Incoherent Scatter Coordinated Observation Days (URSI-ISWG) webpage for complete 2013 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.

Climate and Weather of the Sun-Earth System (CAWSES) II.

Program within the SCOSTEP (Scientific Committee on Solar-Terrestrial Physics): 2009-2013. Aim is to significantly enhance our understanding of the space environment and its impacts on life and society. The main functions of CAWSES are to help coordinate international activities in observations, modeling, and applications crucial to achieving this understanding, to involve scientists in both developed and developing countries, and to provide educational opportunities for students of all levels. Contact is Prof. Marianna Shepherd (mshepher@yorku.ca), SCOSTEP Scientific Secretary. Co-chairs are Joseph M. Davila (GSFC/NASA, USA) and Toshitaka Tsuda (RISH/Kyoto University, Japan).

Program theme groups and theme group leaders are:

- Task1: What is the solar influence on climate? -- Annika Seppälä (Finland), Katja Mathes (Germany)
- Task2: How will geospace respond to a changing climate? -- Dan Marsh (USA), Jan Lastovička (Czech Republic)
- Task3: How does short-term solar variability affect the geospace environment? -- Joseph Borovsky (USA), Kazunary Shibata (Japan)
- Task 4: What is the geospace response to variable inputs from the lower atmosphere -- Jens Oberheide (USA), Kazuo Shiokawa (Japan)
- Capacity building -- Nat Gopalswamy, Franz-Josef Lübken, Marianna Shepherd
- Informatics and eScience -- Peter Fox, Barbara Thompson, Kozyra
- See the CAWSES II website for more information.

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. ISWI is a follow-up activity to the successful IHY 2007, but focusing exclusively on space weather. 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, modeling, education, training, and public outreach. Contact J. Davila at Joseph.M.Davila@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 permanent scientific service of the International Union of Radio Science (URSI), with the participation of the International Astronomical Union and the International Union of Geodesy and Geophysics. ISES adheres to the Federation of Astronomical and Geophysical Data Analysis Services (FAGS), now a part of the new World Data System (WDS), of the International Council of Scientific Unions (ICSU). ISES coordinates the international aspects of the world days program and rapid data interchange.

This Calendar for 2013 has been drawn up by R. A. D. Fiori and H.E. Coffey, of the ISES Steering Committee, in association with spokesmen for the various scientific disciplines in SCOSTEP, IAGA and 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, FAX +1-613-824-9803, e-mail rfiori@NRCan.gc.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.