Extended Text for use in Journals:

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. For on-line information, see

http://www.ises-spaceweather.org.

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 2009 the WGI are February, May, August, and November.

2009 Solar Eclipses:

a.) January 26, 2009, annular eclipse, up to 7 m 54 s, visible in Indonesia (southern Sumatra, western tip of Java, and most of Borneo). Partial phases will be visible from southern Africa, southern India, southeast Asia, and western Australia.

b.) July 22, 2009, total solar eclipse, the longest in the 18 year 11 1/3-day Saros series, with maximum of 6 m 39 s in mid-Pacific. The eclipse begins in the rainy season in India, crosses the eastern tip of Nepal, Bangladesh, Sikkim, Bhutan, northernmost Myanmar, China from west to east (including Wuhan, Hangzhou and Shanghai, with over 5 min of totality and close to 6 min on the central line between them), and some southern Japanese islands. The partial phases will be visible from all of China, from western Russia, most of southeast Asia, and the northern tip of Australia's Cape York.

By Jay M. Pasachoff, Chair, International Astronomical Union Working Group on Eclipses
Based on calculations from Fred Espenak, NASA's Goddard Space Flight Center, and information from Jay M. Pasachoff, Peterson Field Guide to the Stars and Planets; see http://www.eclipses.info.

Eclipse References:

o Fred Espenak, Fifty Year Canon of Solar Eclipses: 1986-2035, NASA Reference Publication 1178 Revised, July 1987.
o Leon Golub and Jay M. Pasachoff, The Solar Corona, Cambridge University Press, 1998. http://www.williams.edu/Astronomy/corona
o Jay M. Pasachoff and Alex Filippenko, The Cosmos: Astronomy in the New Millennium, Brooks/Cole Publishers, 2004. http://info.brookscole.com/pasachoff
Brooks/Cole Publishing, 2002. http://www.williams.edu/Astronomy/jay
o Leon Golub and Jay M. Pasachoff, Nearest Star: The Exciting Science of Our Sun, Harvard University Press, 2001. http://www.williams.edu/astronomy/neareststar
o Jay M. Pasachoff, The Complete Idiot's Guide to the Sun, Alpha Books, 2003, http://www.williams.edu/astronomy/sun.

2009 Meteor Showers (selected by P. Jenniskens, SETI Institute, Mountain View, CA, pjenniskens@mail.arc.nasa.gov):

a.) **Meteor outbursts** are unusual showers (often of short duration) from the crossing of relatively recent comet ejecta. Dates are for the year 2009.

- Aug 12, 07:16 UT, Perseids: encounter with the 1610-dust trail of 109P/Swift-Tuttle, weak enhancement on top of strong annual shower
- Oct 18-24, Orionids: possible enhanced rate from several day wide Filament component of bright meteors from comet 1P/Halley
- Nov 17, about 21:43 UT (may be 0.5-1hr later), Leonids: encounter with the 1466 (16-revolution old) and 1533 (15-revolution old) dust trails of comet 55P/Tempel-Tuttle. Predicted peak rate some ZHR = 500/hr; enhanced rate of bright meteors possible from Filament encounter 1-day wide, peaking on Nov. 17 at 17:35 UT; new Moon in Scorpius

b.) **Regular meteor showers:** The dates (based on UT in year 2009) for regular meteor showers are:

- Jan 01-Jan 06, peak Jan 03 14:10 UT (Quadrantids);
- Apr 16-Apr 25, peak Apr 22 13h UT (Lyrids);
- Apr 19-May 28, main peak May 04 21h UT, plus broad component centered on May 07 11h UT (Eta Aquariids);
- May 22-Jul 02, peak Jun 07 11h UT (Daytime Arietids);
- May 20-Jul 05, peak Jun 09 10h UT (Daytime Zeta Perseids);
- Jun 05-Jul 17, peak Jun 28 10h (Daytime Beta Taurids);
- Jul 08-Aug 19, peak Jul 28 17h UT (Southern Delta Aquariids);
- Jul 17-Aug 24, peak Aug 12 22:18 UT (Perseids);
- Sep 26-Oct 03, peak Oct 01 13h UT (Daytime Sextantids);

- Oct 02-Nov 07, peak Oct 22 00h UT (Orionids);
- Oct 31-Nov 23, peak Nov 17 11h UT (Leonids);
- Nov 27-Dec 18, peak Dec 14 02:20 UT (Geminids);
- Dec 17-Dec 26, peak at Dec 22 21h UT 2008 (Ursids).

Meteor Shower Websites:

- Meteor shower activity forecast from your own location -- Peter Jenniskens
  http://leonid.arc.nasa.gov/
- Shower names and data -- IAU Meteor Data Center
  http://www.astro.amu.edu.pl/~jopek/MDC2007/index.php
- Shower activity near-real time reports -- International Meteor Organization
  http://www.imo.net/
- Announcements and reports of meteor outbursts -- Minor Planet Center
  http://www.cfa.harvard.edu/iau/cbet/RecentCBETs.html
- Shower outburst activity forecast -- Institut de Mecanique celeste et de calcul des ephemerides
  http://www.imcce.fr/page.php?nav=en/ephemerides/phenomenes/meteor/index.php

References:

- Peter Jenniskens, Meteor showers and their parent comets. Cambridge University Press, 2006, 790 pp.

The occurrence of **unusual solar or geophysical conditions** is announced or forecast by the ISES through various types of geophysical **"Alerts"** (which are widely distributed by telegram and radio broadcast on a current schedule). Stratospheric warmings (STRATWARM) are also designated. The meteorological telecommunications network coordinated by WMO carries these worldwide Alerts once daily soon after 0400 UT. For definitions of Alerts see ISES "Synoptic Codes for Solar and Geophysical Data", March 1990 and its amendments (http://ises-spaceweather.org). Retrospective World Intervals are selected and announced by MONSEE 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 2008 by spokesmen of IAGA, WMO and URSI as suitable for coordinated geophysical programs in 2009.)

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 7 January 2009 at 0000 UT, 14 January at 0600 UT, 21 January at 1200 UT, 28 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 21 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 the 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 possible to analyze the detailed data only 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:
CAWSES – Climate and Weather of the Sun-Earth System, (S. Avery – susan.avery@colorado.edu.
CEDAR -- Coupling, Energetics & Dynamics of Atmospheric Regions (http://cedarweb.hao.ucar.edu/);
GEM – Geospace Environment Modeling (http://www-ssc.igpp.ucla.edu/gem/);
MST – Studies of the Mesosphere, Stratosphere, and Troposphere -- Coordinated D- and E-region campaigns focusing on lower altitudes, with JRO in high resolution MST mode – gravity wave momentum fluxes (G. Lehmacher – glehmac@clemson.edu);
C/NOFS: Communications/Navigation Outage Forecasting System (Odilie de LaBeaujardiere – Odilie.delaBeaujardiere@hanscom.af.mil)
Stratospheric Warmings = Dynamics and temperature of the lower thermosphere during sudden stratospheric warming – ten days of observation in February (L. Goncharenko -- lpg@haystack.mit.edu);
Synoptic – Wide coverage of the F-region, augmented with topside or E-region measurements – broad latitudinal coverage (W. Swartz – wes@ece.cornell.edu).
TEC Mapping I-- SR/GPS Coordinated Observation of Electron Density Variations (Shun-Rong Zhang -- shunrong@haystack.mit.edu);
TIDs Quasi-Periodic Medium-Scale = Latitude dependence of the F-Region plasma variations during the passage of medium-scale Traveling Ionospheric Disturbances (MSTIDs) – continuous vertical power profiles through E/F regions (100-800 km) with best time resolution possible (5 minutes or better) (J.D.Mathews -- JDMathews@psu.edu)

International Polar Year continuation of year-long observations with Jicamarca, Poker Flat, EISCAT Svalbard ISRs (Tony van Eyken -- Tony.van.Eyken@eiscat.se)
AO --Arecibo Obs (**http://www.naic.edu/aisr/olmon2/omframedoc.html**);
JRO – Jicamarca Radio Observatory (**http://jro.igp.gob.pe/english/radar/operation/real-time_en.php**).
PMSE -- Polar phenomena, run at EISCAT, PFISR and RISR. *Contact:* Ian McCrea.

Special programs: Dr. Ingemar Haggstrom, EISCAT, Box 812, SE-98128 Kiruna, Sweden; tel: +46 98079155;Fax: +46 98079159; e-mail ingemar@eiscat.se. URSI Working Group G.5. See http://e7.eiscat.se/Members/ingemar/skedule/2009WDschedule.htm for complete 2009 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 traveling ionosphere disturbances, propose special periods for coordinated measurements of gravity waves induced by magnetospheric activity, probably on selected PRWD and RWD.

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 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 involving the earth-ionosphere cavity resonances any special effort should be concentrated during the 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 Organizations (WMO) GAW integrates many monitoring and research activities involving measurement of atmospheric composition. 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, 1211 Geneva, Switzerland.

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.

CAWSES (Climate and Weather of the Sun-Earth System). Program within the SCOSTEP (Scientific Committee on Solar-Terrestrial Physics): 2004-2008. Its focus is to mobilize the community to fully utilize past, present, and future data; and to produce improvements in space weather forecasting, the design of space- and Earth-based technological systems, and understanding the role of solar-terrestrial influences on Global Change. Contact is Susan Avery (susan.avery@colorado.edu), Chair of CAWSES Science Steering Group. Program "theme" areas are: Solar Influence on Climate – M. Lockwood and L. Gray (UK); Space Weather: Science and Applications – J. Kozyra (USA) and K. Shibata (Japan); Atmospheric Coupling Processes – F. Luebken (Germany) and J. Alexander (USA); Space Climatology – C. Frolich (Switzerland) and J. Sojka (USA); and Capacity Building and Education, M.A. Geller (USA). See http://www.bu.edu/cawses/.

IHY (International Heliophysical Year) 2007-2009 – International effort to advance our understanding of the fundamental heliophysical processes that govern the Sun, Earth, and Heliosphere -- http://ihy2007.org/. See also the IPY (International Polar Year) -- http://www.ipy.org/; IYPE (International Year of the Planet Earth) -- http://www.yearofplanetearth.org/, and eGY (Electronic Geophysical Year 2007-2008) -- http://www.egy.org/ -- all celebrating the 50th Anniversary of the IGY (International Geophysical Year 1957-58) -- http://www.nas.edu/history/igy/.

Space Research, Interplanetary Phenomena, Cosmic Rays, Aeronomy. Experimenters should take into account that observational effort in other disciplines tends 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 (QWD) 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 QWD 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 (dgreen@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 (http://www.imo.net). Meteoroid orbits are collected by the IAU Meteor Data Center (http://www.astro.sk/~ne/IAUMDC/Ph2003/).

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 Geodesy and Geophysics. ISES adheres to the Federation of Astronomical and Geophysical Data Analysis Services (FAGS) of the International Council of Scientific Unions (ICSU). The ISES coordinates the international aspects of the world days program and rapid data interchange.

This Calendar for 2009 has been drawn up by 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 at ftp://ftp.ngdc.noaa.gov/STP/SOLAR_DATA/IGC_CALENDAR.

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Additional copies are available upon request to ISES Chairman, Dr. David Boteler, Geomagnetic Laboratory, Natural Resources Canada, 7 Observatory Crescent, Ottawa, Ontario, Canada, K1A 0Y3, FAX (613)824-9803, e-mail dboteler@NRCan.gc.ca, or ISES Secretary for World Days, Ms. H.E. Coffey, WDC for Solar-Terrestrial Physics, Boulder, NOAA E/GC2, 325 Broadway, Boulder, Colorado 80305, USA FAX number (303)497-6513; e-mail Helen.E.Coffey@noaa.gov.

The calendar is available on-line at http://www.ises-spaceweather.org.