International Geophysical Calendar 2016 (FINAL)

(See information to follow on the use of this Calendar)

	S	M	T	W	T	F	S
January						1	2
	3	4	5 +	6 +	7 +	8 +	9 +
	10 N +	11 * +	(12) * +	**13** *	(14)	15	16
	17	18	19	20	21	22	23
	24 F	25	26	27	28	29	30
February	31	1	2	3	4	5 +	6 +
	7 +	8 * N +	(9) * +	**10** * +	(11)	12	13
	14	15	16	17	18	19	20
	21	22 F	23	24	25	26	27
March	28	29	1	2	3	4	5 +
	6 +	7 +	8 * +	9 * N +	(10) * +	11 +	12 +
	13 +	14 +	15 +	16 +	17 +	18 +	19 +
	20	21	22	23 F	24	25	26
April	27	28	29	30	31	1	2
	3	4	(5)	**6** *	7 * N	8 *	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22 F	23
	24	25	26	27	28	29	30
May	1	2	(3)	**4** *	(5) *	6 * N	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21 F
	22	23	24	25	26	27	28
June	29	30	31	1	2	3	4
	5 N	6 *	(7) *	**8** *	(9)	10	11
	12	13	14	15	16	17	18
	19	20 F	21	22	23	24	25
	26	27	28	29	30		
	S	M	T	W	T	F	S

	S	M	T	W	T	F	S
						1	2
	3	4 * N	(5) *	**6** *	(7)	8	9
	10	11	12	13	14	15	16
	17	18	19 F	20	21	22	23
	24	25	26	27	28	29	30
	31	1 *	(2) * N	**3** *	(4)	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18 F	19	20
	21	22	23	24	25	26	27
	28	29	(30)	**31** *	(1) * N	2 *	3
	4	5	6	7	8	9	10
	11	12	13	14	15	16 F	17
	18	19	20	21	22	23	24
	25	26	27	28 *	29 *	30 *	1 N
	2	3	(4)	**5**	(6)	7	8
	9	10	11	12	13	14	15
	16 F	17	18	19	20	21	22
	23	24	25	26	27	28	29
	30 N	31 *	1 *	2 *	3	4	5
	6	7	(8)	**9**	(10)	11	12
	13	14 F	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28 * +	29 * N +	30 * +	1 +	2 +	3 +
	4	5	(6)	**7**	(8)	9	10
	11	12	13	14 F	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28 *	29 * N	30 *	31
	1	2	(3)	**4**	(5)	6	7
	8	9	10	11	12 F	13	14
	15	16	17	18	19	20	21
	22	23	24	25 *	26 *	27 *	28 N
	29	30	31				
	S	M	T	W	T	F	S

January
July
February
August
March
September
April
October
May
November
June
December
2017
January

N NEW MOON F FULL MOON

(12) Regular World Day (RWD)

13 Priority Regular World Day (PRWD)

10 Quarterly World Day (QWD)
also a PRWD and RWD

6 Regular Geophysical Day (RGD)
World Geophysical Interval (WGI)
1 2

\+ Incoherent Scatter Coordinated Observation Day
(The period March 5-19 is a Meridian Circle Alert interval. During this time all radars will operate for the same five days continuously. The precise timing of the 5 day interval will be based on predictions of magnetic disturbances.)

9 Days of Solar Eclipse: March 9, total; Sept 1, annular

6 7 Airglow and Aurora Period

11* Dark Moon Geophysical Day (DMGD)

NOTES on other dates and programs of interest:

1. Days with significant meteor shower activity (based on UT in year 2016) — regular meteor showers: Dec 28-Jan 12; Jan 28-Feb 21; Apr 16-25; Apr 19-May 28; May 14-Jun 24; May 20-Jul 05; Jun 05-Jul 17; Jul 12-Aug 23; Jul 17-Aug 24; Sep 09-Oct 09; Oct 02-Nov 07; Nov 06-Nov 30; Dec 04-Dec 17; Dec 17-26. These can be studied for their own geophysical effects or may be "geophysical noise" to other experiments.
   (http://www.imo.net/calendar)

2. **GAW (Global Atmosphere Watch)** - early warning system for changes in greenhouse gases, ozone layer, and long range transport of pollutants.
   http://www.wmo.int/pages/prog/arep/gaw/gaw_home_en.html

3. **VarSITI (Variability of the Sun and Its Terrestrial Impact)** – SCOSTEP Program 2014-2018. Four scientific elements: 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: Prof. Marianna Shepherd (mshepher@yorku.ca)
   http://www.yorku.ca/scostep/?page_id=1426

4. **ILWS (International Living With a Star) Program** – International effort to stimulate, strengthen, and coordinate space research to understand the governing processes of the connected Sun-Earth System as an integrated entity.
   http://ilwsonline.org/

5. **ISWI (International Space Weather Initiative)** – 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 (nat.gopalswamy@nasa.gov)
   http://www.iswi-secretariat.org/

6. + **Incoherent Scatter Coordinated Observations Days** - starting no later than 1300 UT on the first day of the interval and ending no earlier than 2000 UT on the last day of the interval (minimum 31 hours of observations): January 5-12 Flow Channels; February 5-10 Gravity Waves; March 5-19 alert for Meridian circle; November 28-December 3 Irregularities.
   http://www.isr.sri.com

   Flow channels Day-night connection by localised flow channels: Coordination with Heliophyscis System (Toshi Nishimura, toshi@atmos.ucla.edu).

   Gravity Wave Gravity wave propagation in the mesosphere and thermosphere (Andrew Kavanagh, andkav@bas.ac.uk).

   Meridian Circle Meridional Circle (MERINO): Collect synthesized upper atmosphere data along a complete meridian circle for investigation of geospace processes associated with space weather. Determine latitudinal variations and their east-west hemispheric differences during solar storms (Shunrong Zhang, shunrong@haystak.mit.edu).

   Irregularities Development of decameter-scale field-aligned irregularities following sudden changes in the drift direction of polar cap patches (Hanna Dahlgren, hannad@kth.se; Gareth Perry, perry@phys.ucalgary.ca).

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 **ICSU World Data System (WDS)** 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 **Solar Eclipses** are:
a.) 9 Mar 2016, total solar eclipse. The total eclipse path crosses the Indonesian Islands of Sumatra, Borneo, Sulawesi, Ternate, and then onward into the Pacific, where mid-eclipse occurs with maximum totality of 4 m 9 s. 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.

b.) 1 Sep 2016, annular solar eclipse. 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

Information assembled by Jay M. Pasachoff, Williams College (Williamstown, MA), Chair, International Astronomical Union's working group on Eclipses (http://www.eclipses.info) with thanks to Fred Espenak (Arizona) (*Thousand Year Canon of Solar Ecllipses 1501 to 2500; http://www.astropixels.com/pubs; http://www.EclipseWise.com*) and Xavier Jubier (Paris) 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.

Meteor Showers Dates selected from the International Meteor Organization Shower Calendar 2016. Peak times provided by Jürgen Rendtel. Includes meteor showers observable mainly by radio and radar techniques. The dates are given in Note 1 on the previous page.

Definitions:

Time	=	Universal Time **(UT)**
Geophysical Day **(RGD)**	=	each Wednesday
Regular World Day **(RWD)**	=	Tuesday, Wednesday and Thursday near middle of month
Priority Regular World Day **(PRWD)**	=	the Wednesday **RWD**
World Geophysical Interval **(WGI)**	=	14 consecutive days each season
Quarterly World Day **(QWD)**	=	**PRWD** in the **WGI**
ALERT	=	occurrence of unusual solar or geophysical conditions, broadcast once daily soon after 0400 UT

For more detailed explanations of the definitions, please visit ftp://ftp.ngdc.noaa.gov/STP/publications/igc_calendars/ or http://www.spaceweather.org/.

Priority recommended programs for measurements <u>not made continuously</u> (in addition to unusual **ALERT** periods):

Airglow and Aurora — Observation periods are New Moon periods, especially the 7 day intervals on the calendar;

Atmospheric Electricity — Observation periods are the **RGD** each Wednesday, beginning on 6 Jan 2016 at 0000 UT, 13 Jan at 0600 UT, 20 Jan at 1200 UT, 27 Jan at 1800 UT, etc. Minimum program is **PRWDs**.

Geomagnetic Phenomena — At the minimum, need observation periods and data reduction on **RWDs** and during **MAGSTORM Alerts.**

Ionospheric Phenomena — Quarter-hourly ionograms; more frequently on **RWDs,** particularly at high latitude sites; f-plots on **RWDs;** hourly ionogram scaled parameters to **WDCs** on **QWDs**; continuous observations for solar eclipse in eclipse zone. See **Airglow and Aurora.**

Incoherent Scatter — Observations on Incoherent Scatter Coordinated Days; also intensive series on **WGIs** or **Airglow and Aurora** periods.

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 http://www.isr.sri.com

Ionospheric Drifts — During weeks with **RWDs.**

Travelling Ionospheric Disturbances (TIDs) — special periods, probably **PRWDs** or **RWDs**.

Ionospheric Absorption — Half-hourly on **RWDs**; continuous on solar eclipse days in eclipse zone and conjugate area. Daily measurements during Absorption Winter Anomaly at temperate latitude stations (Oct-Mar Northern Hemisphere; Apr-Sep Southern Hemisphere).

Backscatter and Forward Scatter — **RWDs** at least.

Mesospheric D region electron densities — **RGDs** around noon.

ELF Noise Measurements of earth-ionosphere cavity resonances — WGIs.

All Programs — Appropriate intensive observations during unusual meteor activity.

Meteorology — Especially on **RGDs**. On **WGIs** and **STRATWARM** Alert Intervals, please monitor on Mondays, Wednesdays, and Fridays.

GAW (Global Atmosphere Watch) -- WMO program to integrate monitoring of atmospheric composition. Early warning system of changes in atmospheric concentrations of greenhouse gases, ozone, and pollutants (acid rain and dust particles). WMO, 7 bis avenue de la Paix, P.O. Box 2300, CH-1211 Geneva 2, Switzerland. http://www.wmo.int/pages/prog/arep/gaw/gaw_home_en.html

Solar Phenomena — Solar eclipse days, **RWDs,** and during **PROTON/FLARE ALERTS.**

VarSITI (Variability of the Sun and Its Terrestrial Impact)–SCOSTEP Program 2014-2018. VarSITI strives for international collaboration in data analysis, modeling, and theory to understand how the solar variability affects Earth. VarSITI 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). http://www.yorku.ca/scostep/?page_id=1426

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. See http://ilwsonline.org/.

ISWI (International Space Weather Initiative) – Program of international cooperation to advance space weather science. 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. Contact: Dr. N. Gopalswamy - nat.gopalswamy@nasa.gov. See http://www.iswi-secretariat.org/.

Space Research, Interplanetary Phenomena, Cosmic Rays, Aeronomy — QWDs, RWDs, Airglow and Aurora periods.

The International Space Environment Services (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. PDF versions of the past calendars are available online.

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Copies of earlier years' calendars are available upon request to either 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 contact ISES Secretary for World Days, Dr. Robyn Fiori, telephone +1-613-837-5137, e-mail robyn.fiori@canada.ca. Beginning with the 2008 Calendar, all calendars are available only in digital format.

The website for the International Geophysical Calendar, including recent versions, can be found at http://www.spaceweather.org/. Archived calendars from 1957 to present are available at ftp://ftp.ngdc.noaa.gov/STP/publications/igc_calendars/.