## Events featuring the natural satellites of Jupiter, March 2025

The satellites (also known as Galilean satellites in honor of the first person to observe them) of Jupiter provide some of the most striking phenomena observable with basic instrumentation. With a good pair of binoculars mounted on a tripod or a small telescope, we may be able to observe eclipses, occultations and transits of the Galilean satellites or their shadows over Jupiter. Similarly, telescopic observation of Jupiter's Great Red Spot (GRS) allows us to enjoy one of the largest storms in the entire Solar System. The following table summarizes all the events featuring Jupiter's satellites and observable from Granada.

- Column 1: Day of the month
- Column 2: Time in Coordinated Universal Time (to transform to local time add one hour in winter time and two in summer time)
- Column 3: Jupiter's altitude above the horizon
- Column 4: Main object: GMR, Great Red Spot; Gan, Ganymede; Cal, Callisto; Io, Io; Eur: Europa.
- Column 5: Event

For those unfamiliar with astronomical language, here we indicate what each of the phenomena tabulated below consists of:

- Transit: This occurs when one of Jupiter's satellites is between us and the planet, i.e. it is (in projection) over Jupiter's disk.
- Transit of the shadow: Based on the previous definition, you can get an idea of what I'm referring to here. Both Jupiter and its satellites are illuminated by the Sun and they all project a shadow in turn. This shadow, if projected by a satellite, can be lost in space or can fall on Jupiter's surface. If this is the case, we will be able to see a dark spot moving across the surface of the planet. For an observer located on Jupiter's surface, it would be a solar eclipse.
- Occultation: If the shadow, instead of being projected by the satellite onto Jupiter's surface, is projected by Jupiter onto the satellite, an eclipse will occur. What we can observe is that a given satellite goes from being visible to not being visible, because it is in the shadow projected by Jupiter and therefore does not receive any light to reflect and be visible. It would be the equivalent phenomenon to a lunar eclipse on Earth.
- Regarding the Great Red Spot (GRS), what we tabulate in this table is the moment when it passes through the central meridian, i.e. when the spot is in front of us.

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12         00:56         7.1         Io         Occultation begins           12         20:34         57.7         GRS         Crosses central meridian           12         22:10         38.7         Io         Transit begins           12         23:29         23.1         Io         Shadow transit begins           13         00:23         12.6         Io         Transit ends           13         19:26         69.5         Io         Occultation begins           13         20:49         54.0         Eur         Occultation ends           13         20:52         53.6         Eur         Eclipse begins           13         22:57         28.6         Io         Eclipse ends           14         18:53         73.5         Io         Transit ends           14         20:11         60.6         Io         Shadow transit ends           14         20:11         60.6         Io         Shadow transit ends           14         22:14         36.4         GRS         Crosses central meridian           15         19:01         72.0         Gan         Eclipse ends           16         23:53         15.3         GRS	11	23:51	19.5	Gan	_
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12         20:34         57.7         GRS         Crosses central meridian           12         22:10         38.7         Io         Transit begins           12         23:29         23.1         Io         Shadow transit begins           13         00:23         12.6         Io         Transit ends           13         19:26         69.5         Io         Occultation begins           13         20:49         54.0         Eur         Occultation ends           13         20:52         53.6         Eur         Eclipse begins           13         22:57         28.6         Io         Eclipse ends           13         23:31         21.9         Eur         Eclipse ends           14         18:53         73.5         Io         Transit ends           14         20:11         60.6         Io         Shadow transit ends           14         22:14         36.4         GRS         Crosses central meridian           15         19:01         72.0         Gan         Eclipse ends           16         23:53         15.3         GRS         Crosses central meridian           17         19:44         63.5         GRS	12	00:56	7.1	Io	Occultation begins
12       23:29       23.1       Io       Shadow transit begins         13       00:23       12.6       Io       Transit ends         13       19:26       69.5       Io       Occultation begins         13       20:49       54.0       Eur       Occultation ends         13       20:52       53.6       Eur       Eclipse begins         13       22:57       28.6       Io       Eclipse ends         13       23:31       21.9       Eur       Eclipse ends         14       18:53       73.5       Io       Transit ends         14       20:11       60.6       Io       Shadow transit ends         14       22:14       36.4       GRS       Crosses central meridian         15       19:01       72.0       Gan       Eclipse ends         16       23:53       15.3       GRS       Crosses central meridian         17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       20:55       47.6       Eur       Occultation begins	12	20:34	57.7	GRS	_
12       23:29       23.1       Io       Shadow transit begins         13       00:23       12.6       Io       Transit ends         13       19:26       69.5       Io       Occultation begins         13       20:49       54.0       Eur       Occultation ends         13       20:52       53.6       Eur       Eclipse begins         13       22:57       28.6       Io       Eclipse ends         13       23:31       21.9       Eur       Eclipse ends         14       18:53       73.5       Io       Transit ends         14       20:11       60.6       Io       Shadow transit ends         14       22:14       36.4       GRS       Crosses central meridian         15       19:01       72.0       Gan       Eclipse ends         16       23:53       15.3       GRS       Crosses central meridian         17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       20:55       47.6       Eur       Occultation begins	12	22:10	38.7	Io	Transit begins
13       19:26       69.5       Io       Occultation begins         13       20:49       54.0       Eur       Occultation ends         13       20:52       53.6       Eur       Eclipse begins         13       22:57       28.6       Io       Eclipse ends         13       23:31       21.9       Eur       Eclipse ends         14       18:53       73.5       Io       Transit ends         14       20:11       60.6       Io       Shadow transit ends         14       22:14       36.4       GRS       Crosses central meridian         15       19:01       72.0       Gan       Eclipse ends         16       23:53       15.3       GRS       Crosses central meridian         17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	12	23:29	23.1	Io	Shadow transit begins
13       20:49       54.0       Eur       Occultation ends         13       20:52       53.6       Eur       Eclipse begins         13       22:57       28.6       Io       Eclipse ends         13       23:31       21.9       Eur       Eclipse ends         14       18:53       73.5       Io       Transit ends         14       20:11       60.6       Io       Shadow transit ends         14       22:14       36.4       GRS       Crosses central meridian         15       19:01       72.0       Gan       Eclipse ends         16       23:53       15.3       GRS       Crosses central meridian         17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	13	00:23	12.6	Io	Transit ends
13       20:52       53.6       Eur       Eclipse begins         13       22:57       28.6       Io       Eclipse ends         13       23:31       21.9       Eur       Eclipse ends         14       18:53       73.5       Io       Transit ends         14       20:11       60.6       Io       Shadow transit ends         14       22:14       36.4       GRS       Crosses central meridian         15       19:01       72.0       Gan       Eclipse ends         16       23:53       15.3       GRS       Crosses central meridian         17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	13	19:26	69.5	Io	Occultation begins
13       22:57       28.6       Io       Eclipse ends         13       23:31       21.9       Eur       Eclipse ends         14       18:53       73.5       Io       Transit ends         14       20:11       60.6       Io       Shadow transit ends         14       22:14       36.4       GRS       Crosses central meridian         15       19:01       72.0       Gan       Eclipse ends         16       23:53       15.3       GRS       Crosses central meridian         17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	13	20:49	54.0	Eur	Occultation ends
13       23:31       21.9       Eur       Eclipse ends         14       18:53       73.5       Io       Transit ends         14       20:11       60.6       Io       Shadow transit ends         14       22:14       36.4       GRS       Crosses central meridian         15       19:01       72.0       Gan       Eclipse ends         16       23:53       15.3       GRS       Crosses central meridian         17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	13	20:52	53.6	Eur	Eclipse begins
14       18:53       73.5       Io       Transit ends         14       20:11       60.6       Io       Shadow transit ends         14       22:14       36.4       GRS       Crosses central meridian         15       19:01       72.0       Gan       Eclipse ends         16       23:53       15.3       GRS       Crosses central meridian         17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	13	22:57	28.6	Io	Eclipse ends
14       20:11       60.6       Io       Shadow transit ends         14       22:14       36.4       GRS       Crosses central meridian         15       19:01       72.0       Gan       Eclipse ends         16       23:53       15.3       GRS       Crosses central meridian         17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	13	23:31	21.9	$\operatorname{Eur}$	Eclipse ends
14       22:14       36.4       GRS       Crosses central meridian         15       19:01       72.0       Gan       Eclipse ends         16       23:53       15.3       GRS       Crosses central meridian         17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	14	18:53	73.5	Io	Transit ends
15       19:01       72.0       Gan       Eclipse ends         16       23:53       15.3       GRS       Crosses central meridian         17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	14	20:11	60.6	Io	Shadow transit ends
16       23:53       15.3       GRS       Crosses central meridian         17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	14	22:14	36.4	GRS	Crosses central meridian
17       19:44       63.5       GRS       Crosses central meridian         19       21:23       42.6       GRS       Crosses central meridian         20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	15	19:01	72.0	Gan	Eclipse ends
19       21:23       42.6       GRS       Crosses central meridian         20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	16	23:53	15.3	GRS	Crosses central meridian
20       00:07       10.4       Io       Transit begins         20       20:55       47.6       Eur       Occultation begins	17	19:44	63.5	GRS	Crosses central meridian
20 20:55 47.6 Eur Occultation begins	19	21:23	42.6	GRS	Crosses central meridian
<u> </u>	20	00:07	10.4	Io	Transit begins
20 21:23 41.9 Io Occultation begins	20	20.55	47.6	Eur	Occultation begins
	20	21:23	41.9	Io	Occultation begins

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Day	Time	Altitude	Objet	Event
	(TU)	$(^{o})$		
(1)	(2)	(3)	(4)	(5)
21	19:53	58.9	Io	Shadow transit begins
21	20:51	47.5	Io	Transit ends
21	22:08	32.1	Io	Shadow transit ends
21	23:02	21.3	GRS	Crosses central meridian
22	18:54	68.8	GRS	Crosses central meridian
22	19:19	64.5	Io	Eclipse ends
22	20:32	50.6	Gan	Eclipse begins
22	20:44	48.1	$\operatorname{Eur}$	Shadow transit ends
22	23:02	20.5	Gan	Eclipse ends
24	20:33	48.7	GRS	Crosses central meridian
26	22:12	27.2	GRS	Crosses central meridian
27	23:21	13.2	Io	Occultation begins
27	23:38	9.9	$\operatorname{Eur}$	Occultation begins
28	20:35	45.2	Io	Transit begins
28	21:49	30.4	Io	Shadow transit begins
28	22:49	18.4	Io	Transit ends
28	23:51	6.7	GRS	Crosses central meridian
29	00:04	4.5	Io	Shadow transit ends
29	19:38	55.7	Gan	Occultation begins
29	19:43	54.7	GRS	Crosses central meridian
29	20:42	43.1	$\operatorname{Eur}$	Shadow transit begins
29	20:55	40.4	Eur	Transit ends
29	21:15	36.3	Io	Eclipse ends
29	22:06	26.1	Gan	Occultation ends
29	23:20	11.9	Eur	Shadow transit ends
31	21:22	33.3	GRS	Crosses central meridian

Table 1: Phenomena Featuring Jupiter's Satellites and the Great Red Spot (GRS)