

EARS Geminids 2017 Radio Observation

G. T. Tomezzoli

EurAstro Association, Zeppelinstrasse 43, D-81669, Munich,
Germany

gt21949@gmx.de

1 Introduction

- The past EARS (EurAstro Radio Station) meteor radio observations provided matter for several publications.
- The Verbeeck's (1996) general recommendation to avoid presentations of raw meteor rates and other data directly derived from the radio observations but rather to present observations taking into account time-dependent parameters that dramatically influence the sensitivity of the radio stations motivated the EARS radio observation of the Geminids 2017 and offered the possibility to test the application of said parameters.

2 Geminids 2017 - raw meteor rates

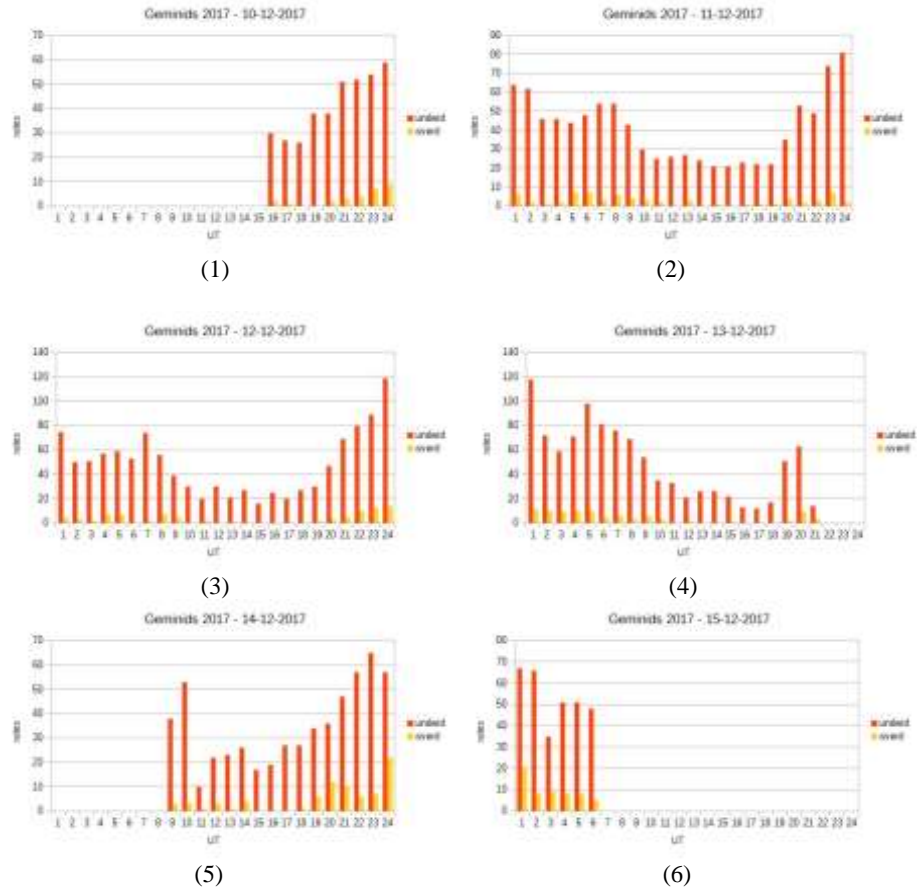


Fig. 1: Geminids 2017 – (1) – (6) EARS recorded raw meteor rates

- EARS, based on the forward-scattering principle, adopted the following configuration: emitter - radar GRAVES (Broyes-les-Pesmaes, $47^{\circ} 20' 51.72''$ N, $05^{\circ} 30' 58.68''$ E), distant about 500 km from EARS, 2m/70cm Diamond Duoband-Groundplane vertical antenna located about 45m high with respect to the ground, receiver ICOM 1500 (USB mode, 143.049 MHz), computer Pavillion dv6 (processor Intel Core Duo T2500) and SpecLab V26 b10 as recording software.
- Underd. and overd. raw meteor rates were derived by visually counting the radio echoes on the JPG images recorded every 5 minutes by SpecLab.

- The EARS radio observation took place in the recording period 10/12/2017 14:40 UT - 15/12/2017 06:10 UT. It run smoothly, except for an interruption on 13/12/2017 20:10 UT – 14/12/2017 08:25 UT and another interruption on 14/12/2017 10:30 UT – 11:00 UT both caused by storms over Munich which effected the connection between receiver and antenna.
- The Geminids raw meteor rates (Fig. 1(1)-(6)) showed:
 - 1) a raw underd. max. (Fig. 1(3)-(4)) within 12/12/2017 20:00 UT – 13/12/2017 05:00 UT with up to 119 underd./hour;
 - 3) a first raw overd. max (Fig. 1(5)) within 14/12/2017 18:00 UT – 14/12/2017 21:00 UT with up to 12 underd./hour;
 - 1) a second raw overd. max. (Fig. 1(5)-(6)) within 14/12/2017 23:00 UT – 15/12/2017 04:00 UT with up to 22 underd./hour.

- The observed underd. and overd. meteor rates on 11/12/2017, preceding said Geminids raw max. rates, were assumed as the sporadic underd. and overd. rates (Tabs. 1-2) to be subtracted from the observed raw underd. and overd. rates in the recording period for obtaining the Geminids net underd. and overd. rates (Tabs. 3-6).
- The net meteor rates (Tabs. 3-6) showed max rates corresponding to the above mentioned raw meteor max. rates:
 - 1) a net underd. max. (Tabs. 3-4, marked in red) within 12/12/2017 20:00 UT – 13/12/2017 05:00 UT with up to 64 underd./hour;
 - 2) a net first overd. max (Tab. 5, marked in yellow) within 14/12/2017 18:00 UT – 14/12/2017 21:00 UT with up to 8 underd./hour;
 - 3) a net second overd. max. (Tabs. 5-6, marked in yellow) within 14/12/2017 23:00 UT – 15/12/2017 04:00 UT with up to 20 underd./hour.

3 Geminids 2017 - error counts

The underd. and overd. rates error counts were estimated as $1/\sqrt{n}$ where $n = \text{rate}$ (Tabs. 7-11).

Tab. 7 : Geminids 2017 net underd. rates – estim. count errors – 12/12/2017

0	1	2	3	4	5	6	7	8	9	10	11	UT
11	0	5	11	15	5	20	2	0	0	0	4	rates
.3		.4	.3	.3	.4	.2	.7				.5	err.
12	13	14	15	16	17	18	19	20	21	22	23	UT
0	3	0	4	0	5	8	12	16	31	15	38	rates
	.6		.5		.4	.4	.3	.3	.2	.3	.2	err.

Tab. 8 : Geminids 2017 net underd. rates – estim. count errors – 13/12/2017

0	1	2	3	4	5	6	7	8	9	10	11	UT
64	10	13	25	44	33	22	15	11	5	8	0	rates
.1	.3	.3	.2	.2	.2	.2	.3	.3	.4	.4		err.
12	13	14	15	16	17	18	19	20	21	22	23	UT
0	2	1	0	0	0	29	28	0	0	0	0	rates
	.7	.1				.2	.2					err.

Tab. 9 : Geminids 2017 net overd. rates – estim. count errors – 14/12/2017

0	1	2	3	4	5	6	7	8	9	10	11	UT
0	0	0	0	0	0	0	0	0	0	0	3	rates
											.6	err.
12	13	14	15	16	17	18	19	20	21	22	23	UT
0	4	0	0	0	0	5	8	8	3	0	20	rates
	.5					.4	.4	.4	.6		.2	err.

Tab. 10 : Geminids 2017 net overd. rates – estim. count errors – 15/12/2017

0	1	2	3	4	5	6	7	8	9	10	11	UT
14	6	8	6	1	0	0	0	0	0	0	0	Err.
.3	.4	.4	.4	.1								err.
12	13	14	15	16	17	18	19	20	21	22	23	UT
0	0	0	0	0	0	0	0	0	0	0	0	rates
												err.

The error counts (Tabs. 7-10, marked in light blue) were negligible. Therefore, no correction was applied to the net Geminids net underd. and overd. rates.

4 Geminids 2017 - radiant elevations

Tab.11 : Geminids 2017 net. underd. rates – radiant elev. – 12/12/2017

0	1	2	3	4	5	6	7	8	9	10	11	UT
11	0	5	11	15	5	20	2	0	0	0	4	rates
68	73	72	64	55	45	35	26	17	8	1	-4	Alt.
131	167	211	239	257	270	280	290	300	310	320	331	Az.
12	13	14	15	16	17	18	19	20	21	22	23	UT
0	3	0	4	0	5	8	12	16	31	15	38	rates
-8	-10	-9	-6	-2	5	12	21	31	40	50	60	Alt.
344	357	10	22	34	45	55	65	75	84	96	110	Az.

Tab. 12 : Geminids 2017 net underd. rates – radiant elev. – 13/12/2017

0	1	2	3	4	5	6	7	8	9	10	11	UT
64	10	13	25	44	33	22	15	11	5	8	0	rates
69	73	72	64	55	45	35	25	16	8	1	-5	Alt.
132	169	213	241	258	251	281	291	300	310	321	333	Az.
12	13	14	15	16	17	18	19	20	21	22	23	UT
0	2	1	0	0	0	29	28	0	0	0	0	rates
-8	-9	-9	-6	-1	5	13	22	31	41	51	52	Alt.
344	358	10	23	35	46	56	66	75	85	97	97	Az.

Tab. 13 : Geminids 2017 net overd. rates – radiant elev. – 14/12/2017

0	1	2	3	4	5	6	7	8	9	10	11	UT
0	0	0	0	0	0	0	0	0	0	0	3	rates
69	74	71	63	54	44	34	24	15	7.5	0.5	-5	Alt.
134	172	214	242	259	271	281	291	300	310	321	333	Az.
12	13	14	15	16	17	18	19	20	21	22	23	UT
0	4	0	0	0	0	5	8	8	3	0	20	rates
-8	-9	-9	-6	-1	5	13	22	32	41	52	61	Alt.
345	358	11	24	35	46	57	66	76	85	97	112	Az.

Tab. 14 : Geminids 2017 net overd. rates – radiant elev. – 15/12/2017

0	1	2	3	4	5	6	7	8	9	10	11	UT
14	6	8	6	1	0	0	0	0	0	0	0	Err.
70	74	70	63	54	44	33	24	15	7	0	-5	Alt.
136	175	218	244	259	272	282	292	301	311	322	334	Az.
12	13	14	15	16	17	18	19	20	21	22	23	UT
0	0	0	0	0	0	0	0	0	0	0	0	rates
-9	-9	-9	-6	1	6	14	23	32	45	52	62	Alt.
346	359	12	24	36	47	57	66	76	87	98	114	Az.

- The Geminids radiant elevations during the days 14-15/12/2018 was estimated by means of the Java script calculator Convertalot (Schmitt 2004). The assumed radiant coordinates were: AR 07h 28m, decl. 32°.
- The radiant elevation (Tabs. 11-14, marked in green) was:
 - 1) at the max height of 69°-73° for net underd. max. (Tabs. 11-12, marked in red);
 - 2) at a height of 22°- 41° for the net first overd. max. (Tab. 13, marked in yellow);
 - 3) at the height of 61°-70° for the second net overd. max. . (Tabs. 13-14, marked in yellow).

5 Geminids 2017 - observability function

- All the examples in literature of observability functions considered are not applicable to the radar Graves – EARS system. In fact, radar Graves and EARS have different antennae, both the Graves and EARS antenna diagrams are not well known and the antennae separation (500 Km) is lower than those considered in said publications. The first FORWARD program (metel123.exe) runs on the EARS computer, however, it is not applicable because radar Graves – EARS system does not use Yagis antennae. Moreover, an anonymous publication (Anonymous) suggested not to use the observability function when the corrections suggested by FORWARD are too large and that the observability function given by FORWARD is based on many approximations, and thus not totally reliable. Consequently, unfortunately, it was not possible to calculate an observability function for radar Graves – EARS system for correcting the Geminids 2017 net underd. and overd. rates observed.

5 Geminids 2017 - Overd. Mass Index

- The Geminids overd. mass indexes were:
- 1) $1-s = 1.314$ in the period 14/12/2017 18:00 UT – 14/12/2017 21:00 UT corresponding to the net first overd. max.;
- 2) $1-s = 3.359$ in the period 14/12/2017 23:00 UT – 15/12/2017 04:00 UT corresponding to the net second overd. max.

- These values are not in agreement with the value of 1.68 ± 0.04 obtained for the Geminids 2015 by Blaauw (2017) using radar, optical and lunar impact data. This may be principally due to the different instrumentation and methods used.

Conclusion

- The EARS adopted configuration, revealed itself reliable in providing Geminids 2017 raw meteor rates in the recording period around the expected max. This, in line with the above mentioned general recommendation, allowed a substantial improvement in the quality of the data reduction, although, unfortunately, the observability function for radar Graves - EARS system, up to now, remains to be determined.

Thank you very much for your attention