Results of the IMO Video Meteor Network – Fourth Quarter 2019

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As reported at the 2022 IMC, the observational database of the IMO video meteor observers was migrated to the AWS cloud recently. In addition, a new web service was programmed, that can generate monthly and yearly statistics as well as a number of further reports. All figures and data for observing statistics in this report were generated for the first time with the new web service at the push of a button.

The number of active video cameras remained also in the fourth quarter of 2019 at the level of 80 and therefor unchanged to the previous months. The weather was unusually good in October, but from the end of October till December it remained poor. Only at the end of year, the number of clear nights was rising again (figure 1).

With nearly 13,000 hours of effective observing time and 65,000 meteors, the output of October was slightly lower than in the previous two years, but better than in the years before. In November we had the lowest yield since 2010. No more than 25,000 meteors were recorded in more than 6,500 hours of effective observing time. December, on the other hand, slightly outperformed the previous two years and matched to the average since 2013 with 56,000 meteors from almost 11,000 observing hours.

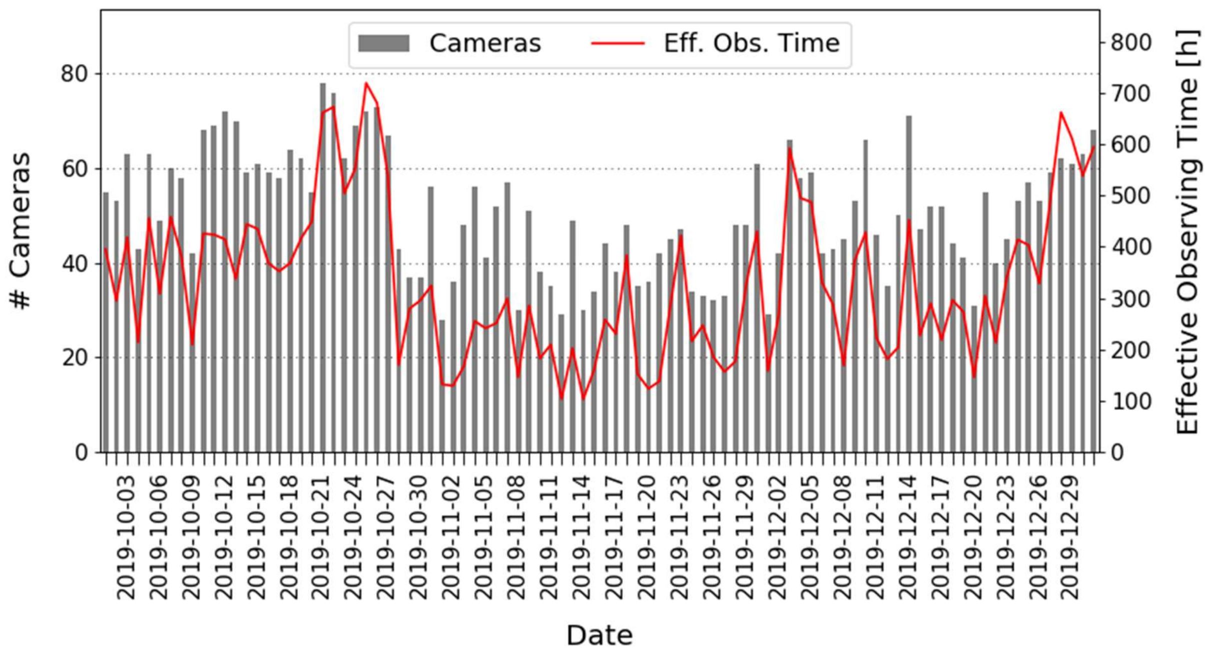

Figure 1: *Number of active cameras per night (grey bars) and effective observing time of these cameras (red line) in the fourth quarter of 2019.*

The average meteor rate (figure 2) fluctuated in the last quarter of 2019 around the value of five meteors per hour. Clear outliers are visible in the third decade of October during the Orionids, and during the Geminids in December. At these times, also the absolute number of recorded meteors increased significantly.

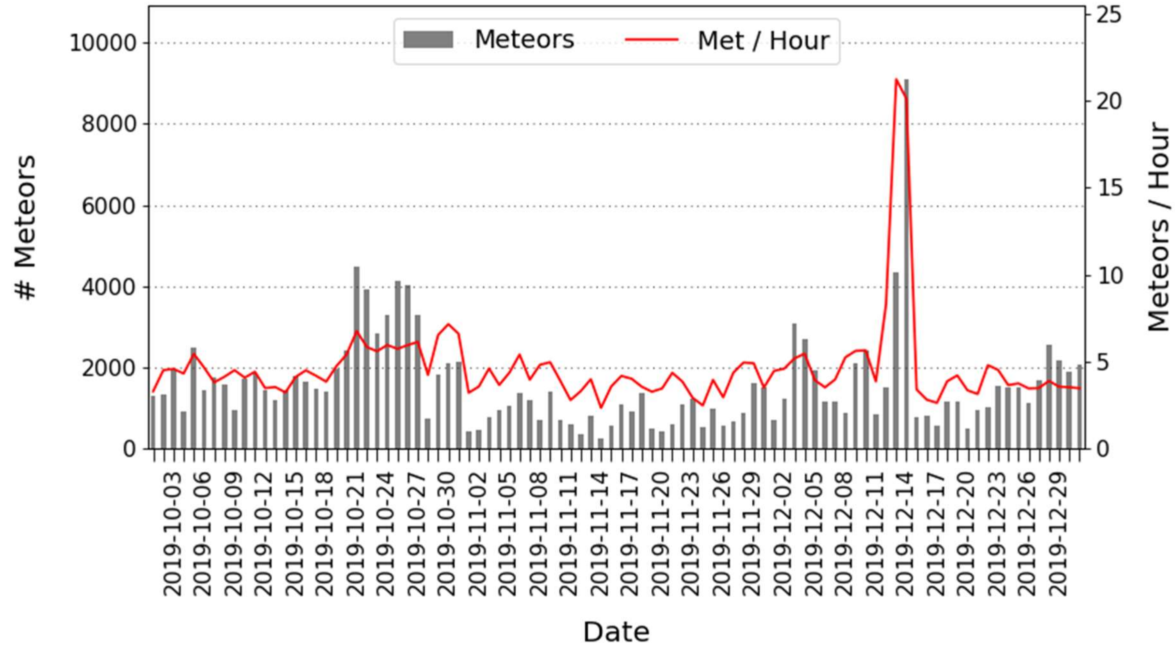

Figure 2: *Number of recorded meteors per night (grey bars) and average number of meteors per hours (red line) in the fourth quarter of 2019.*

We start the analysis of meteor showers with the Taurids, which are active over a long period of time. Figure 3 compares the activity of both Taurid branches in 2019. As usual, the southern Taurids dominate at the first half till end of October. Thereafter, the northern branch becomes stronger.

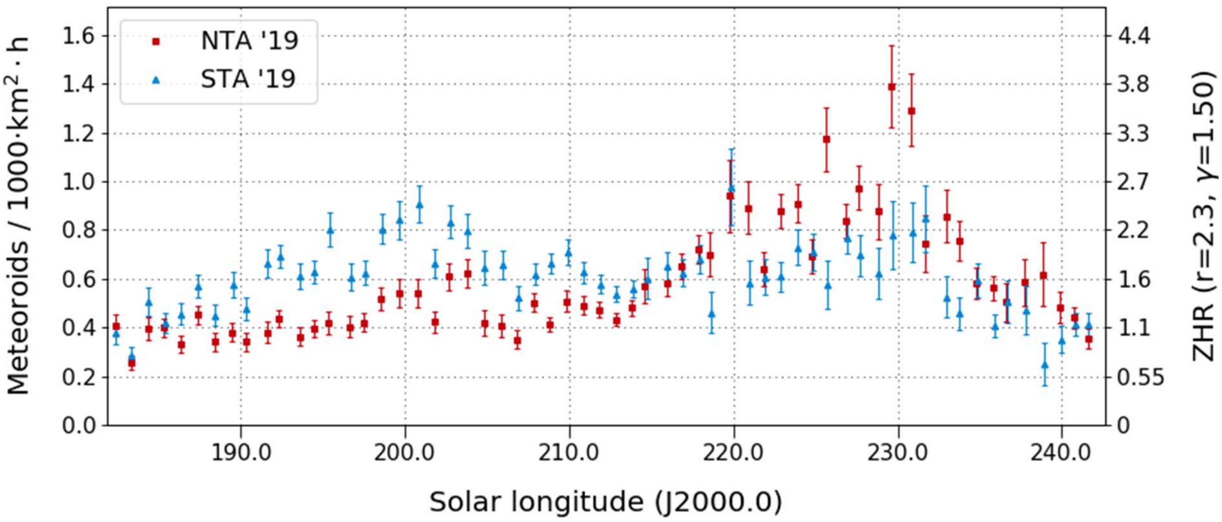

Figure 3: *Flux density of the Northern (red) and Southern (blue) Taurids in 2019, derived from observations of the IMO Network.*

The population index is showing unusually high values at the begin of the activity interval (figure 4). In fact, I even had to extend the range of possible values in the software, which was only reaching till 3.5 so far. We measured consistently values beyond that, not just single outliers. Only by the Orionid peak the population index had fallen to a normal level of 2.5. Until the end of the activity interval, it remained in the range of 2.5 to 3.0 Only around November 12 it was reaching smaller values near 2.0. That matches exactly to full moon. At the same time, the flux density shows outliers in the opposite direction. Hence, we assume that we observe the "usual" artefact, that at full moon the rates are getting higher and the population indices smaller due to a hitherto misunderstood systematic effect in limiting magnitude calculation.

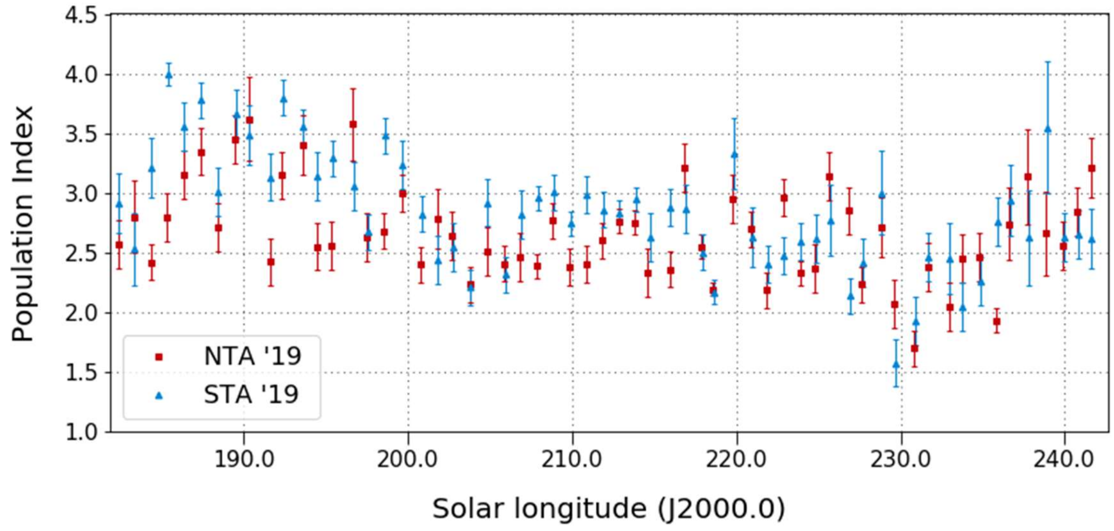

Figure 4: *Population index of the Northern (red) and Southern (blue) Taurids in 2019.*

To verify if these variations in flux density and population index are a long-term trend, we calculated additionally the average long-term profiles from 2011 to 2019 (figure 5). Indeed, we see two maxima for the Southern Taurids (mid-October and near November 5), whereas the Northern Taurids have just a single maximum mid-November.

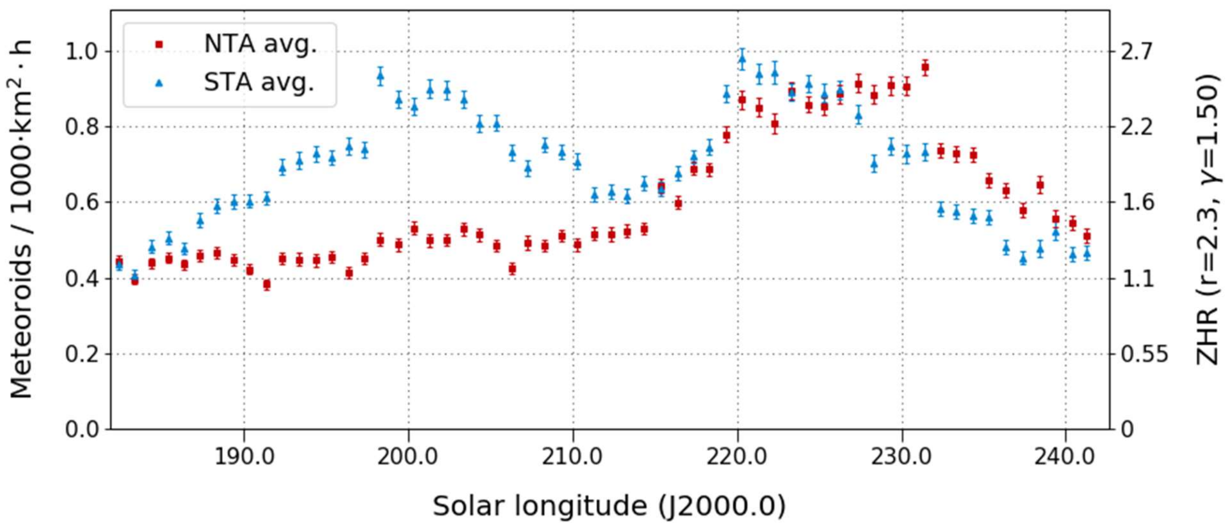

Figure 5: *Flux density of the Northern (red) and Southern (blue) Taurids in the years 2011-2019, derived from observations of the IMO Network.*

We can also confirm the trend, that the population index of the Southern Taurids is large (above 3.0) at the beginning, then it remains for most of the time near 2.5, and only at the end of the activity interval it is reaching values below 2.5 (without influence of moon phase). The Northern Taurids show less variations, but also their population index is higher at the beginning than in the end (Figure 6).

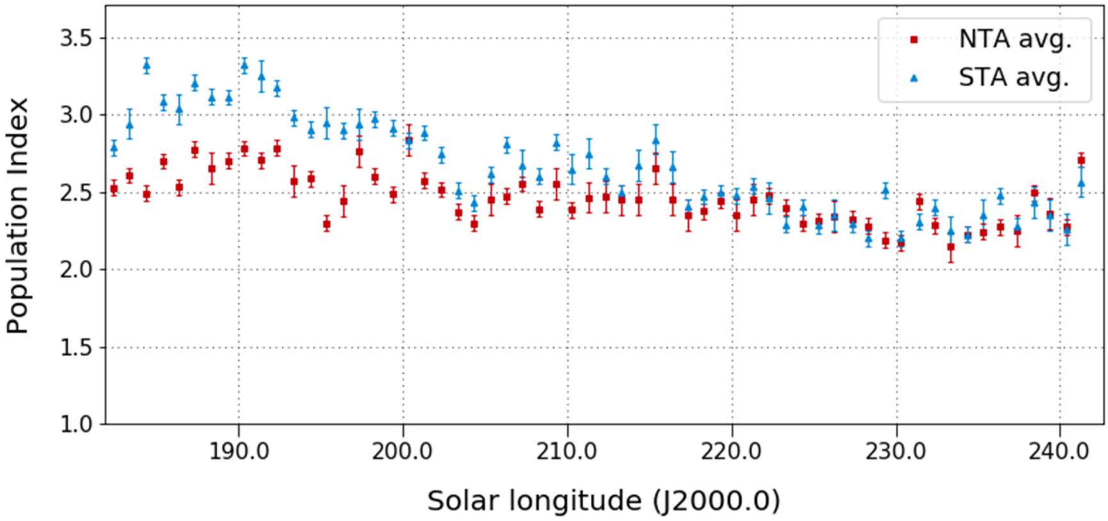

Figure 6: *Population index of the Northern (red) and Southern (blue) Taurids in the years 2011-2019.*

The October Camelopardalids remained almost invisible in 2019. If we compare the profile of 2019 with their long-term profile (figure 7), we also see why: The narrow peak just fell into the European daytime hours in 2019.

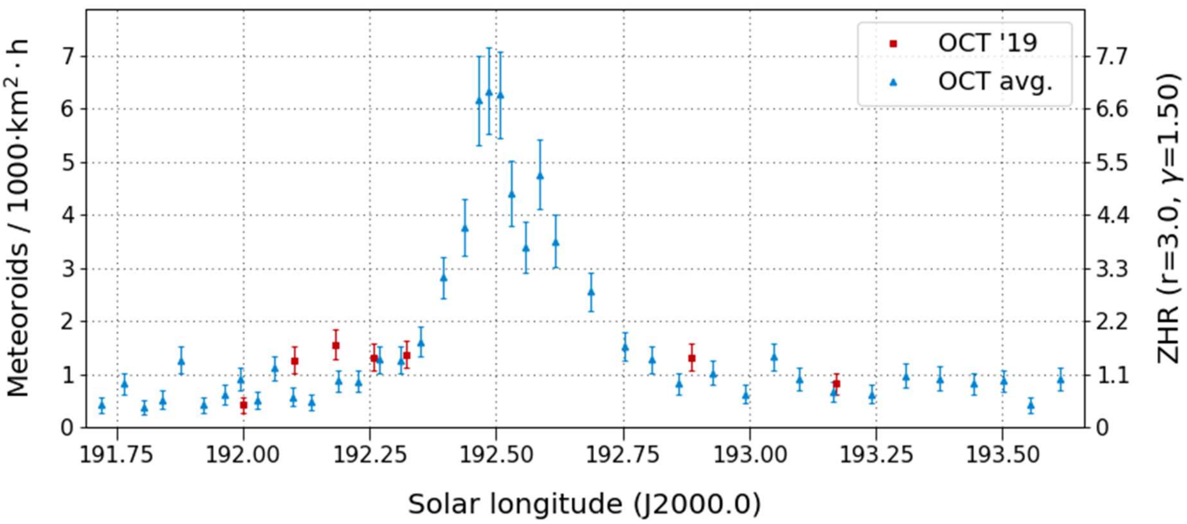

Figure 7: *Flux density of the October Camelopardalids in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

The activity profile of the October Ursae Majorids (figure 8) is matching well to the long-term profile of 2011 to 2018, including the peak at 202.15° solar longitude. So this shower right before the Orionids did not present a surprise.

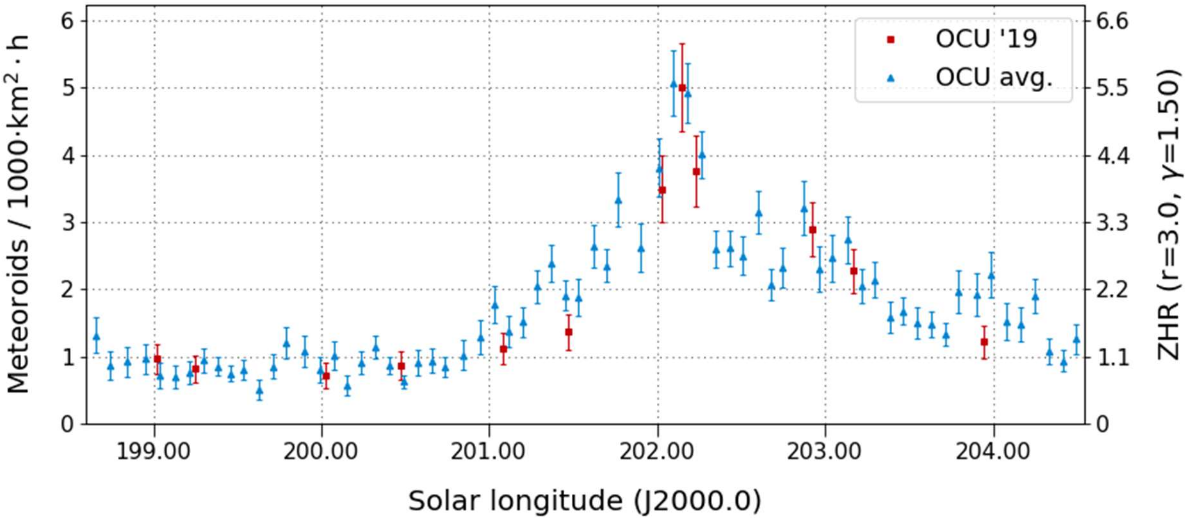

Figure 8: *Flux density of the October Ursae Majorids in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

Only a few days later, the Orionids presented their slight asymmetric activity profile with nearly constantly high rates between October 20 and 25 (figure 9). Starting from October 16 they emerge from the sporadic background, and by the end of the month, they disappear there again.

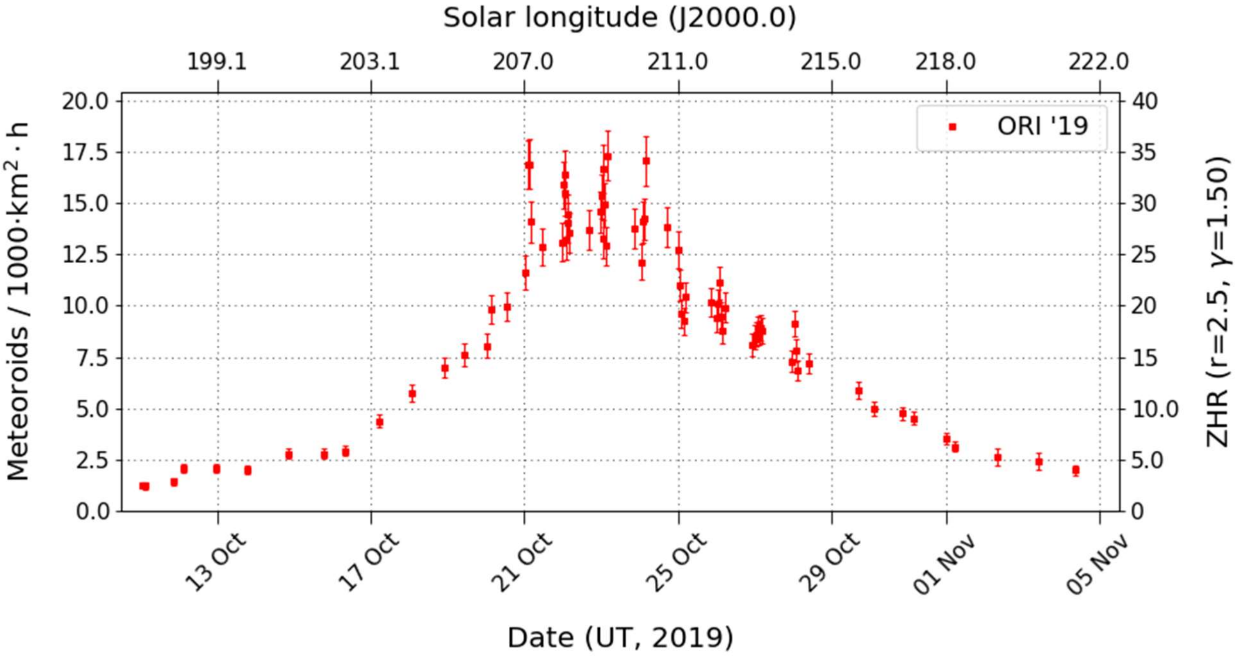

Figure 9: *Flux density of the Orionids in 2019, derived from observations of the IMO Network.*

With values near 2.0, the population index of the Orionids is at first relatively small (figure 10). At the activity peak the r-values rises to 2.5 and remains there until the end of the activity period.

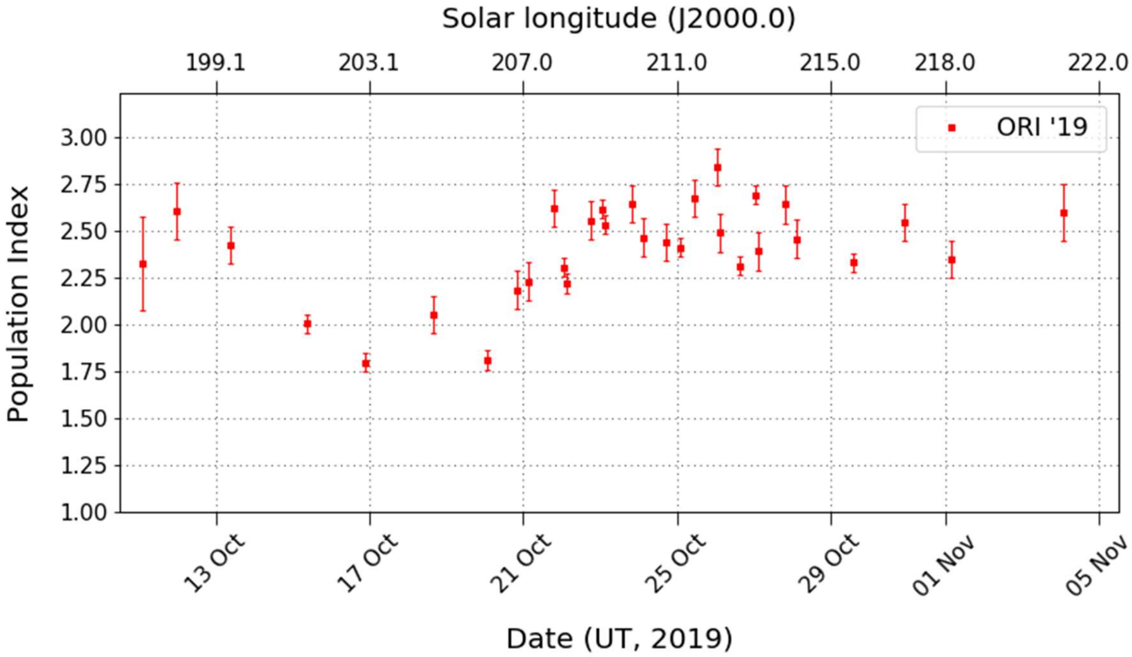

Figure 10: *Population index of the Orionids in 2019.*

The Leonids have been more active in mid-November 2019 than in the average of previous years (figure 11). With a flux density of 10 meteoroids per 1,000 km^2 and hour they are still far away from the outbursts at the last turn of millennium, but a ZHR of 20 is respectable, in particular since the population index was as usual well below 2.0, so that proportionally brighter Leonids could be seen (figure 12).

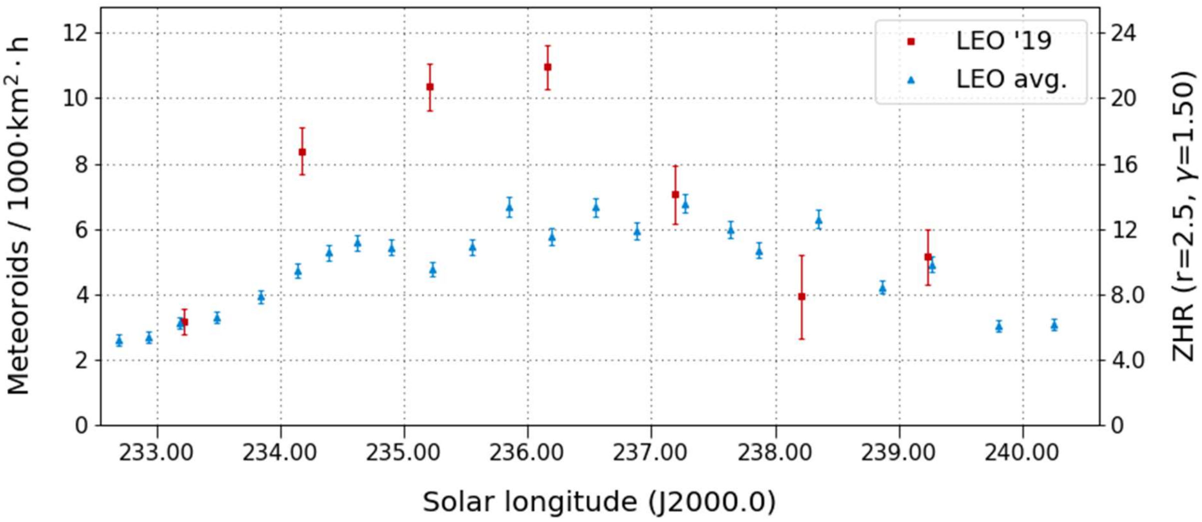

Figure 11: *Flux density of the Leonids in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

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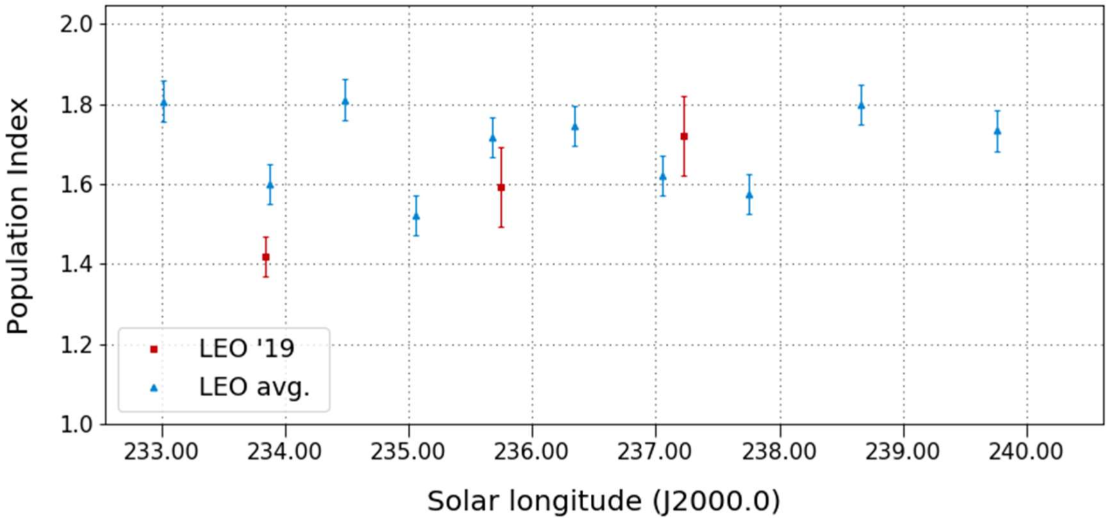

Figure 12: *Population index of the Leonids in 2019 (red) as well as in the average of the years 2011-2018 (blue).*

It is worthwhile to zoom into the activity of the shower near November 17/18, 2019 (figure 13). More than a decade ago, M. Maslov predicted in the IMO journal WGN, that the ZHR should raise to values of the order of 20 near 23 UT. The first flux density measures of that night directly after the radiant rose are indeed clearly enhanced.

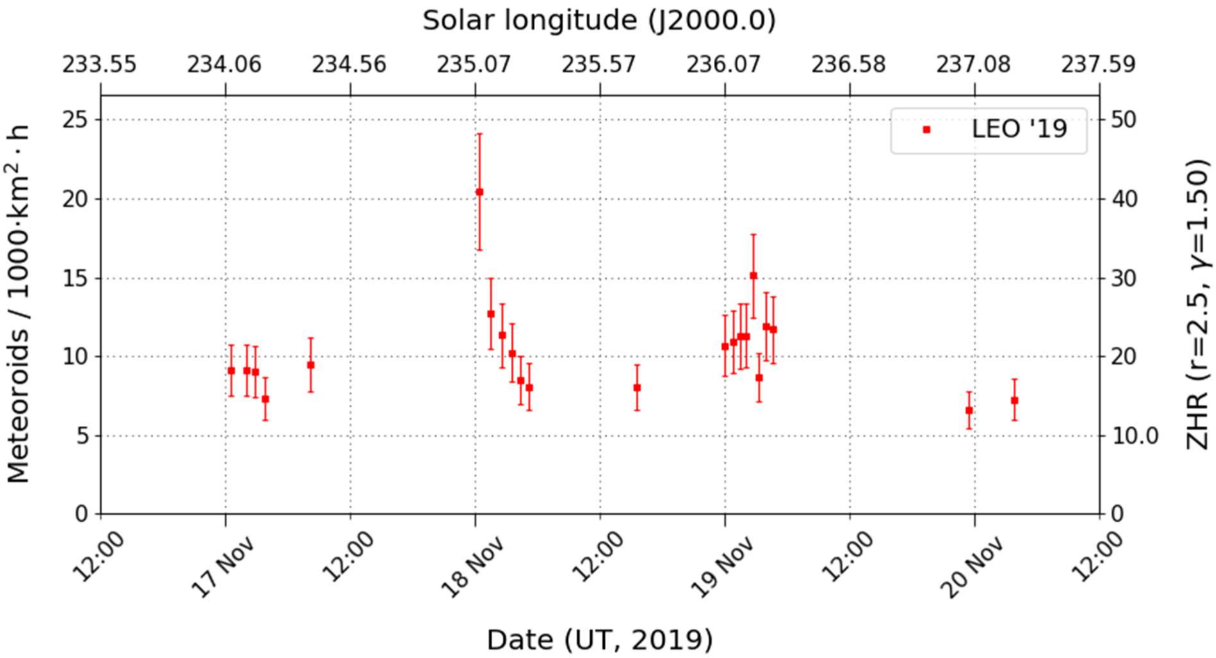

Figure 13: *High resolution flux density profile of the Leonids at the 2019 peak.*

Also, for the alpha Monocerotids right thereafter there were predictions of enhanced rates at November 22, 4:56 UT. Even though that point in time was rather close to dawn for most European cameras, combined with the November-typical poor weather, the active cameras could indeed report a sudden rise in rates at about 4:40 UT, which declined similarly abrupt at 5:20 UT. In the activity profile of the shower, this short outburst becomes clearly visible (figure 14). However, due to the short duration of the peak, the flux density is not particularly spectacular.

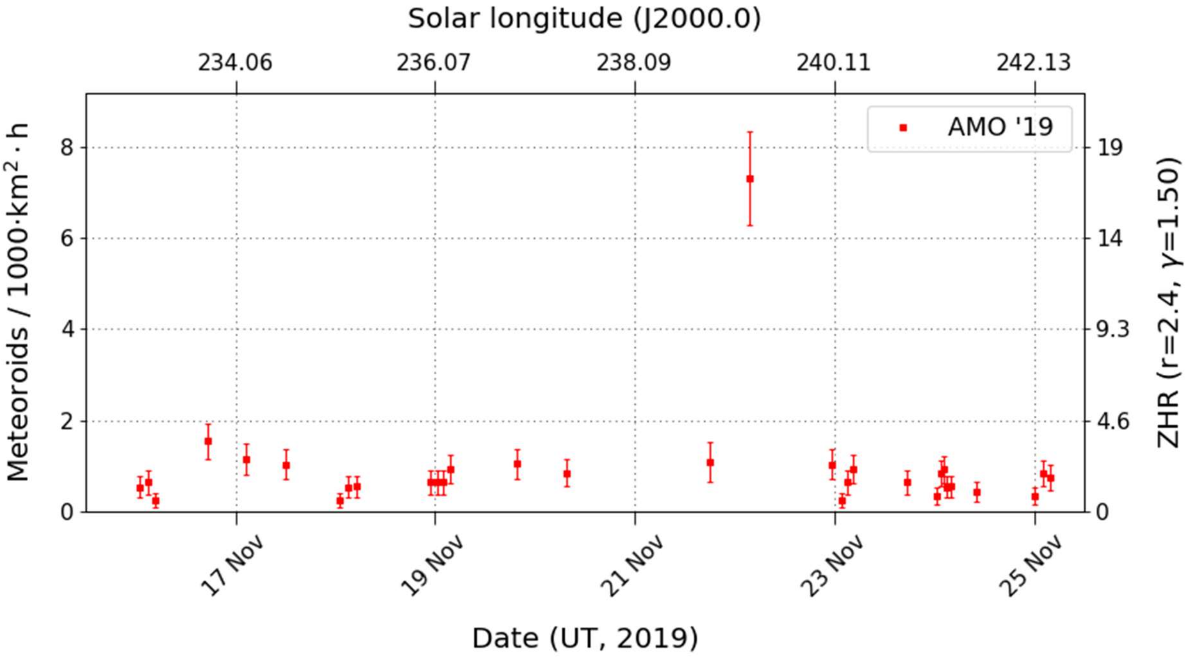

Figure 14: *Flux density of the alpha Monocerotids in 2019, derived from observations of the IMO Network.*

You have to select a very high resolution at the minute level to unveil the true nature of the outburst (figure 15). Highest rates were indeed reached at 4:55 UT and the whole outburst lasted not much longer than 20 minutes. In this short interval, the flux density reached values of up to 100 meteoroids per 1,000 km^2 and hour, which translated to an effective ZHR of more than 200. This is in agreement with visual observations, which also yielded a ZHR beyond 100 at 4:55 UT. You can imagine that almost instantaneously you are in the middle of the Perseid maximum, but less than half an hour later the show stops suddenly.

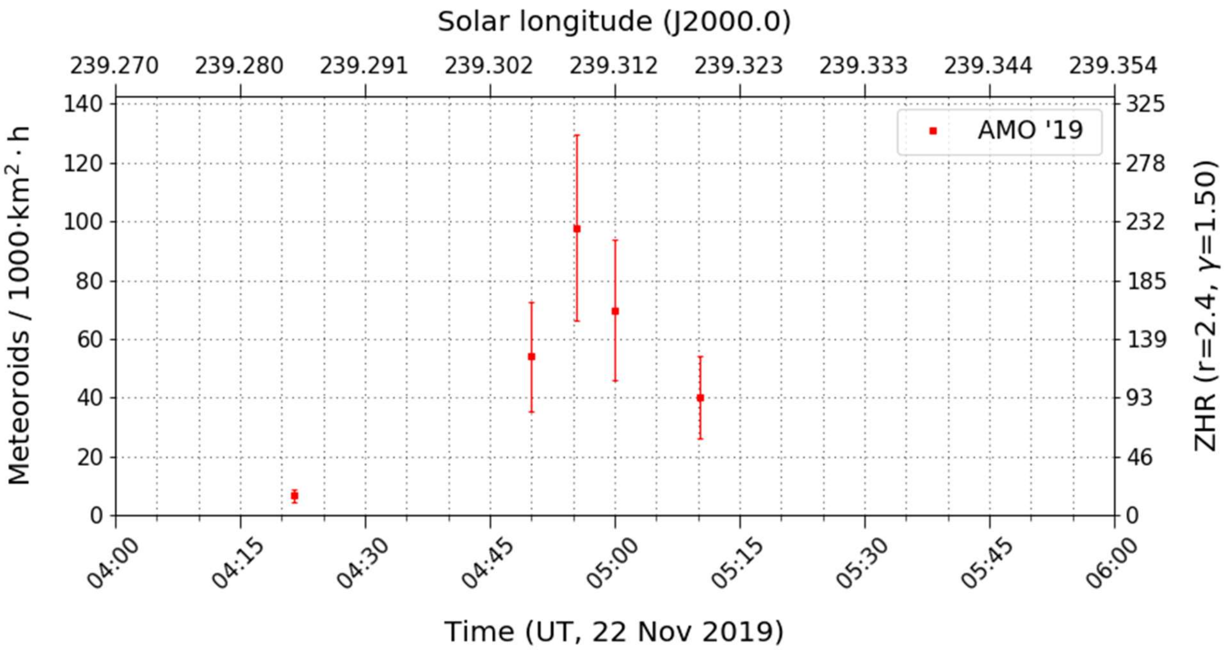

Figure 15: *High resolution flux density profile of the alpha Monocerotids at the 2019 peak.*

The maximum of the Geminids in December happened just at full moon, which explains the higher-than-average flux density compared to the long-term profile (figure 16). The peak itself fell just in-between the European nights of December 13/14 and 14/15. Note that it seems as if we observed an early peak in the first night at a solar longitude of 261.4°. However, that can be easily explained by the fact, that the full moon culminated near midnight and impacted the flux density strongest by that time, whereas it was less disturbing at the begin and end of night.

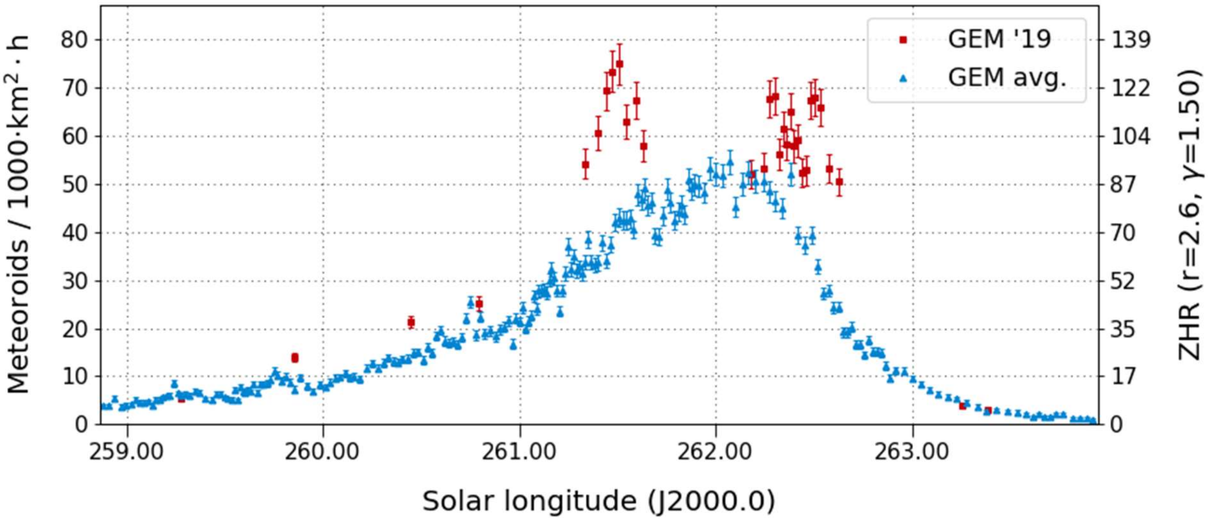

Figure 16: *Flux density of the Geminids in 2019 (red) as well as in the average of the years 2012-2018 (blue), derived from observations of the IMO Network.*

As in previous years, the population index of the Geminids reached valued between 1.7 and 2.0 (figure 17). Once more, we can explain slightly smaller than average values with the moon phase.

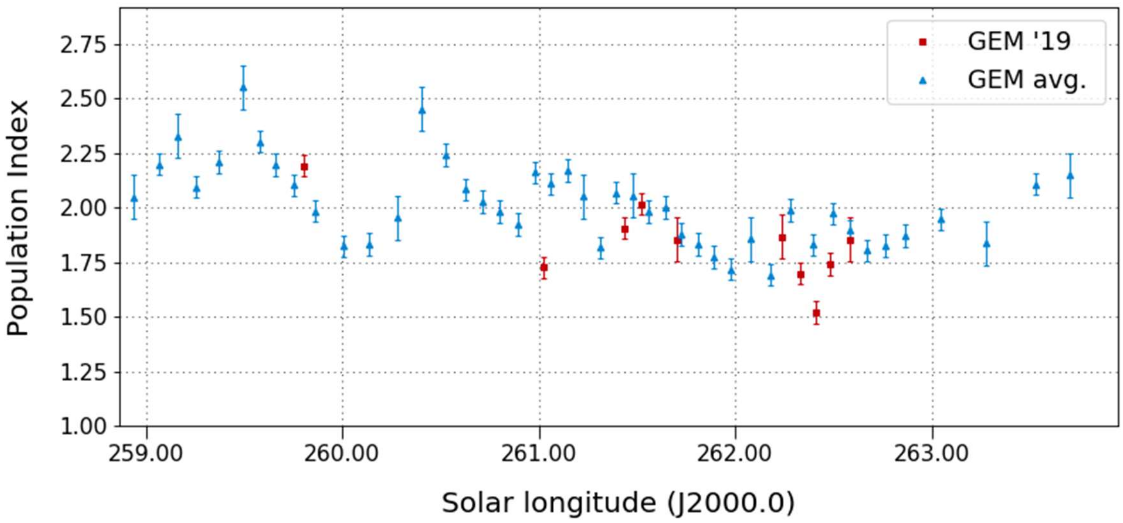

Figure 17: *Population index of the Geminids in 2019 (red) as well as in the average of the years 2011-2018 (blue).*

The activity of the last shower of year varies from one year to the next. In 2019, the Urid peak fell into the night of December 22/23. With 10 meteoroids per 1,000 km^2 and hour, the flux density was 2019 slightly above the long-term average of 2011 to 2018 (figure 18), but it fell short of years with enhanced activity like 2011, 2014 and 2018 (figure 19).

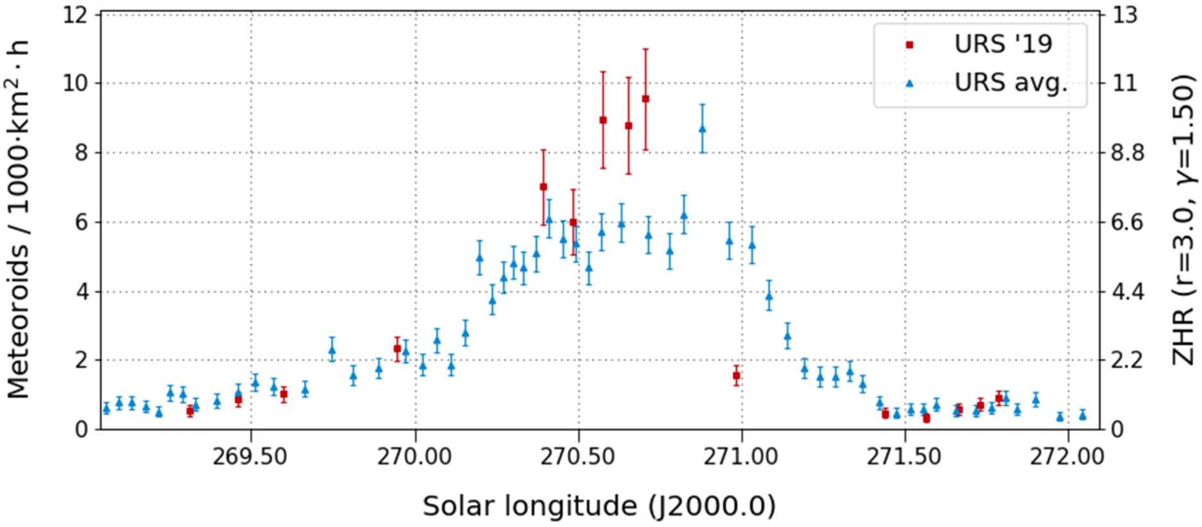

Figure 18: *Flux density of the Ursids in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

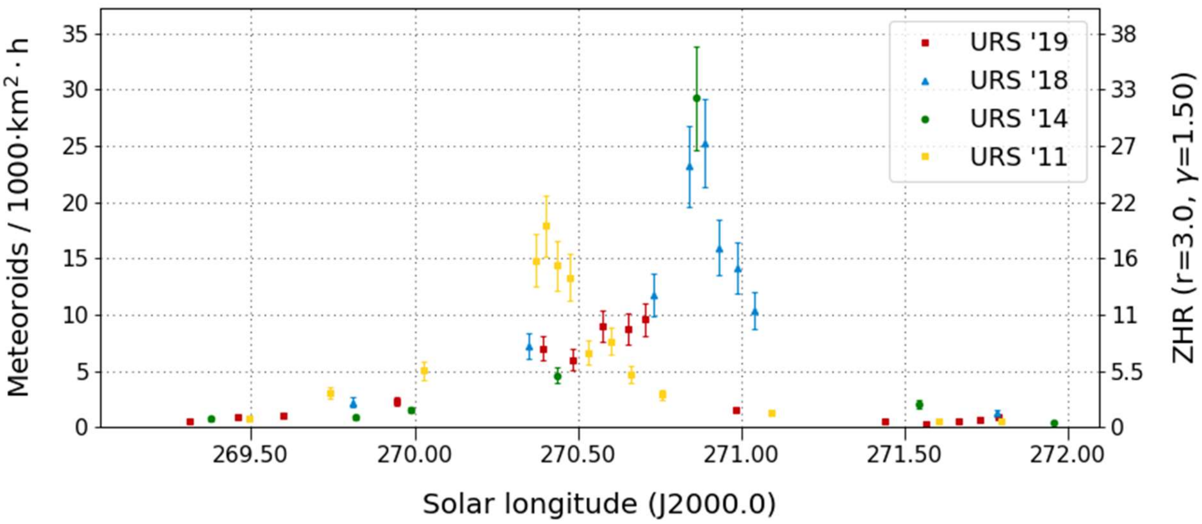

Figure 19: *Comparison of the flux density of the Ursids in the years 2011, 2014, 2018, and 2019.*

Table 1: *Observational statistics for fourth quarter of 2019.*

Code	Name	Place	Camera	October			November			December		
				Nights	**Time [h]**	**Meteors**	**Nights**	**Time [h]**	**Meteors**	**Nights**	**Time [h]**	**Meteors**
ARLRA	Arlt	Ludwigsfelde/DE	LUDWIG2	29	183.2	1397	23	109.9	527	24	138.8	864
BERER	Berkó	Ludanyhalaszi/HU	HULUD1	15	146.3	599	7	59.7	280	12	107.9	574
BIATO	Bianchi	Mt. San Lorenzo/IT	OMSL1	27	186.9	816	21	53.5	225	21	140.4	930
BOMMA	Bombardini	Faenza/IT	MARIO	27	184.9	1117	16	52.9	302	21	162.1	1602
BRIBE	Klemt	Herne/DE	HERMINE	24	106.5	491	23	149.9	476	24	167.2	516
		Berg. Gladbach/DE	KLEMOI	23	122.6	598	24	128.1	464	22	159.1	562
CARMA	Carli	Monte Baldo/IT	BMH2	25	182.4	1558	6	46.1	355	-	-	-
CASFL	Castellani	Monte Baldo/IT	BMH1	20	167.6	581	-	-	-	-	-	-
CINFR	Cineglosso	Faenza/IT	JENNI	27	196.6	1249	21	92.1	476	24	164.3	1684
CRIST	Crivello	Valbrevenna/IT	ARCI	22	147.4	760	15	77.1	361	20	202.8	839
			BILBO	22	134.7	879	13	58.4	274	22	203.5	1317
			C3P8	18	116.9	556	14	83.5	319	19	172.0	836
			STG38	21	148.2	1161	13	64.3	325	22	212.7	1556
ELTMA	Eltri	Venezia/IT	MET38	21	94.7	685	11	63.3	270	22	193.4	1449
FORKE	Förster	Carlsfeld/DE	AKM3	25	149.3	810	16	82.8	293	13	113.3	578
GONRU	Goncalves	Tomar/PT	TEMPLAR1	28	230.2	1330	23	142.3	474	24	190.5	807
			TEMPLAR2	27	229.8	1063	23	140.2	381	23	190.5	723
			TEMPLAR3	25	213.6	452	21	102.9	125	24	174.2	225
			TEMPLAR4	28	224.9	895	25	132.8	335	23	178.6	683
			TEMPLAR5	26	201.6	943	21	90.0	256	25	176.0	610
GOVMI	Govedic	Sredisce ob Dr./SI	ORION2	27	194.6	868	16	65.8	173	21	132.6	504
			ORION3	24	176.7	370	16	43.0	89	23	81.2	171
			ORION4	24	179.5	357	14	26.6	78	23	73.3	182
HINWO	Hinz	Schwarzenberg/DE	HINWO1	28	191.6	991	24	155.6	593	20	147.8	687
IGAAN	Igaz	Budapest/HU	HUPOL	9	74.7	49	-	-	-	-	-	-
JONKA	Jonas	Budapest/HU	HUSOR	27	227.9	539	17	97.9	223	17	116.8	314
			HUSOR2	25	223.6	600	15	94.6	228	14	97.0	327
KACJA	Kac	Kamnik/SI	CVETKA	8	85.3	545	2	5.3	20	16	100.3	543
			METKA	25	147.6	488	16	39.8	97	22	83.2	277
			REZIKA	8	84.8	1500	1	3.8	25	18	113.0	1315
		Ljubljana/SI	STEFKA	-	-	-	-	-	-	17	113.6	435
		Kamnik/SI	SRAKA	22	134.1	426	6	21.9	53	-	-	-
KNOAN	Knöfel	Berlin/DE	ARMEFA	27	196.7	457	18	79.9	159	20	129.3	281
KOSDE	Koschny	La Palma / ES	ICC7	18	115.8	298	23	103.6	308	22	89.1	290
			ICC9	29	224.2	1330	28	223.7	1284	27	221.5	1642
			LIC1	20	98.0	372	21	83.1	279	23	109.5	308
			LIC2	28	256.7	3413	26	241.8	2564	25	233.4	2195
KWIMA	Kwinta	Krakow/PL	PAV06	23	206.2	423	12	83.1	98	12	82.6	173
			PAV07	23	202.9	476	12	76.1	101	12	92.8	199
			PAV79	23	202.5	729	13	79.6	163	12	98.6	356
LOJTO	Łojek	Grabniak/PL	PAV103	18	146.3	192	3	13.3	8	6	42.7	39
			PAV57	19	145.3	602	2	15.3	22	5	45.4	131
MACMA	Maciejewski	Chelm/PL	PAV35	26	160.5	608	13	63.4	132	21	82.5	281
			PAV36	27	203.7	1166	13	79.2	285	16	114.5	550
			PAV43	27	197.6	991	11	77.6	244	18	117.6	534
			PAV60	26	204.4	1345	14	95.7	368	21	131.1	599
MARRU	Marques	Lisbon/PT	CAB1	26	228.0	1058	3	4.3	14	6	33.1	54
			RAN1	22	150.3	554	20	53.7	201	25	163.1	686
MISST	Missiaggia	Nove/IT	TOALDO	17	119.0	956	7	37.4	91	20	191.0	851
MOLSI	Molau	Seysdorf/DE	AVIS2	21	134.1	870	18	107.3	464	25	181.8	966
			DIMCAM2	22	125.4	1421	19	99.8	824	25	162.8	1676
			ESCIMO3	15	96.4	588	14	83.4	346	25	193.2	990
		Ketzür/DE	REMO1	18	86.7	272	1	2.9	9	9	46.2	233
			REMO2	28	172.8	1204	20	100.7	472	25	163.0	1034
			REMO3	28	207.3	1171	22	116.3	463	26	198.4	956
			REMO4	28	208.7	1458	21	111.8	518	28	186.5	1020
MORJO	Morvai	Fülöpszallas/HU	HUFUL	29	230.4	494	22	143.4	230	18	113.9	376
MOSFA	Moschini	Rovereto/IT	ROVER	21	140.8	292	11	67.1	86	26	240.5	867
NAGHE	Nagy	Budapest/HU	HUKON	4	15.9	65	-	-	-	-	-	-
		Piszkestetö/HU	HUPIS	28	197.6	1455	14	86.8	285	8	64.0	379
OTTMI	Otte	Pearl City/US	ORIE1	19	12.3	73	13	9.3	52	22	20.3	117
PERZS	Perkó	Becsehely/HU	HUBEC	20	152.3	931	9	44.7	239	12	87.9	635
SARAN	Saraiva	Carnaxide/PT	RO1	26	224.6	697	25	173.8	322	25	226.8	573
			RO2	27	211.2	726	23	142.8	315	24	192.3	597
			RO3	21	173.4	934	25	160.2	492	21	196.4	762
			RO4	-	-	-	11	64.4	107	24	180.7	416
SCALE	Scarpa	Alberoni/IT	LEO	-	-	-	2	0.5	3	25	73.1	608
SCHHA	Schremmer	Niederkrüchten/DE	DORAEMON	19	93.1	355	24	114.9	313	24	109.8	376
SLAPE	Slanksy	Munich/DE	SONYA7S	-	-	-	1	0.8	53	-	-	-
SLAST	Slavec	Ljubljana/SI	KAYAK1	23	146.1	628	4	15.8	25	19	151.6	478
			KAYAK2	23	176.1	205	3	10.6	11	15	154.7	146
STOEN	Stomeo	Scorze/IT	MIN38	28	147.0	1216	21	83.5	549	28	218.5	2076
			NOA38	25	127.7	762	21	96.8	466	28	230.5	2157
			SCO38	28	151.9	1198	21	88.1	592	30	221.5	2185
STRJO	Strunk	Herford/DE	BEMCE	23	148.5	1509	19	126.9	893	24	138.0	1264
			MINCAM2	25	145.8	1125	19	103.6	664	15	90.3	552
			MINCAM3	25	117.7	660	19	107.5	442	23	125.4	573
			MINCAM4	23	124.5	252	19	84.5	168	16	79.0	171
			MINCAM5	23	113.5	497	21	120.8	453	25	126.5	597
TEPIS	Tepliczky	Agostyan/HU	HUAGO	15	158.0	380	13	93.6	133	13	74.1	227
			HUMOB	26	237.0	1399	13	102.6	420	19	139.7	624
WEGWA	Wegrzyk	Nieznaszyn/PL	PAV78	23	150.3	531	20	86.3	235	22	102.0	358
YRJIL	Yrjölä	Kuusankoski/FI	FINEXCAM	19	76.3	315	8	61.2	187	9	67.5	171
ZAKJU	Zakrajšek	Petkovec/SI	PETKA	19	140.7	962	11	41.6	108	21	161.6	1168
			TACKA	25	172.6	451	9	39.8	61	22	187.4	440
Sum				**31**	**12963.5**	**64739**	**31**	**6589.0**	**25418**	**30**	**10989.8**	**56047**