Result of the IMO Video Meteor Network – Third Quarter 2019

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In the third quarter of 2019 we operated about 80 active meteor cameras in the IMO network, similar to previous months. The weather was most of the time ok, with just short periods of poor observing conditions around July 14 and 28, and between September 7 and 9, when the number of cameras dropped dramatically (Figure 1). Still, the output of the network remained well below previous years. 76 active cameras in July recorded about 32,000 meteors on well over 7,700 hours of effective observing time. In August we had 82 active cameras that captured over 73,000 meteors in over 12,000 observing hours. Both are the worst monthly results since 2014. In September we operated 80 cameras. Their output was about 50,000 meteors in nearly 12,000 hours of observing time. That is still below average, but at least not the worst result since 2014.

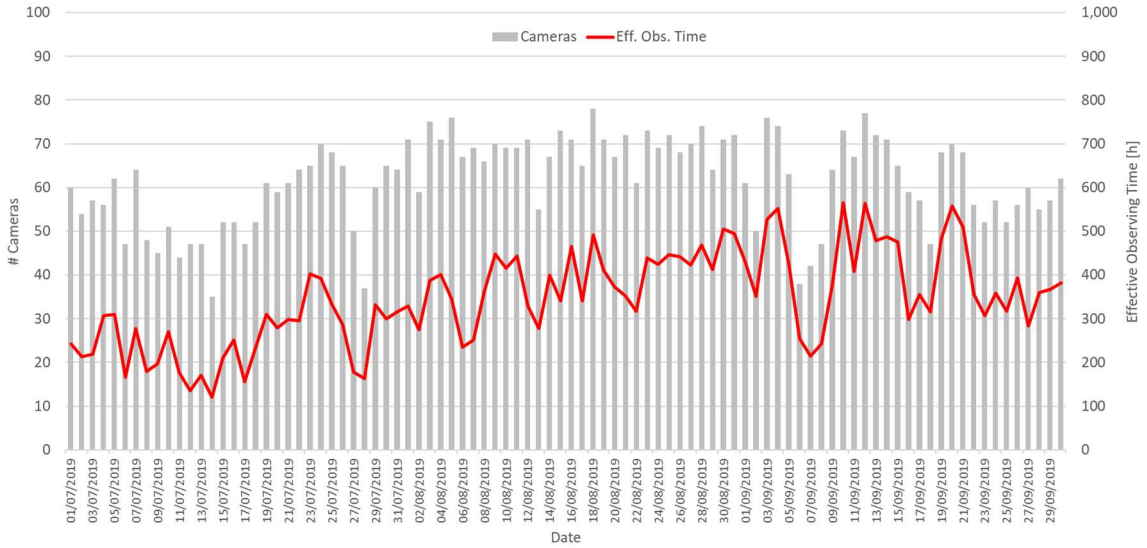

Figure 1: *Number of active cameras per night (grey bars) and effective observing time of these cameras (red line) in the third quarter of 2019.*

With regards to the meteor count we can clearly see the summer peak in figure 2. Even though the hourly average of four meteors per hour in early July is well above the annual minimum, we have short summer nights which limit the absolute number of meteors that can be recorded in the northern hemisphere. Towards the end of July, we have several active meteor showers (alpha Capricornids, southern delta Aquariids, Perseids) and the nights are getting longer, which raises the meteor counts significantly. In mid-August we reach the annual maximum. In the Perseid peak nights we record fifteen meteors per hour and more. In September the numbers reduce again, but the average hourly rate is still twice as high as in early July.

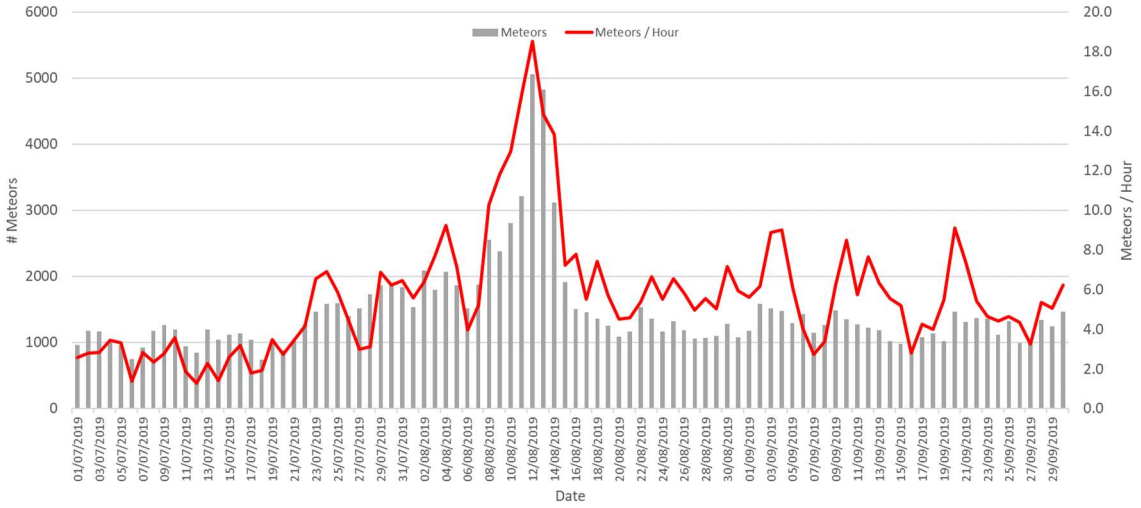

Figure 2: *Number of recorded meteors per night (grey bars) and average number of meteors per hours (red line) in the third quarter of 2019.*

After all observations had been uploaded to the flux database, we can now have a look at the activity profiles of meteor showers in the third quarter of 2019. In fact, thanks to new functions in meteorflux.org, we can derive population index profiles in parallel.

Let's start with the alpha Capricornids. Figure 3 shows their activity profile of 2019 compared to the long-term profile of the years 2011 to 2018. We see some remarkable deviations. The profile as such looks similar, but the whole activity seems to be shifted forward by 5° solar longitude. The peak occurs already at 122° solar longitude, in contrast to 127° solar longitude in the long-term average.

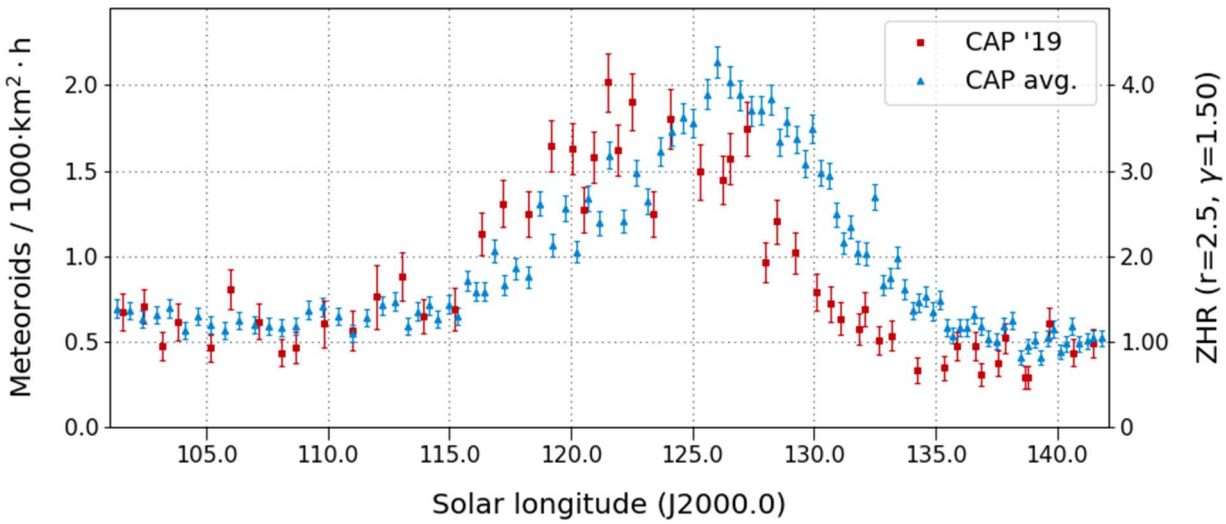

Figure 3: *Flux density of the alpha Capricornids in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

The population index of the alpha Capricornids starts at values above r= 2.5, but we assume that sporadic pollution is dominating at the edges of the activity profile. At the activity peak the population index is r=2.6, and at the descending activity branch in drops to r=2.3. This behaviour fits perfectly to the long-term profile with a minimum population index of r=2.0 at 129° solar longitude only shortly after the flux density peak (figure 4).

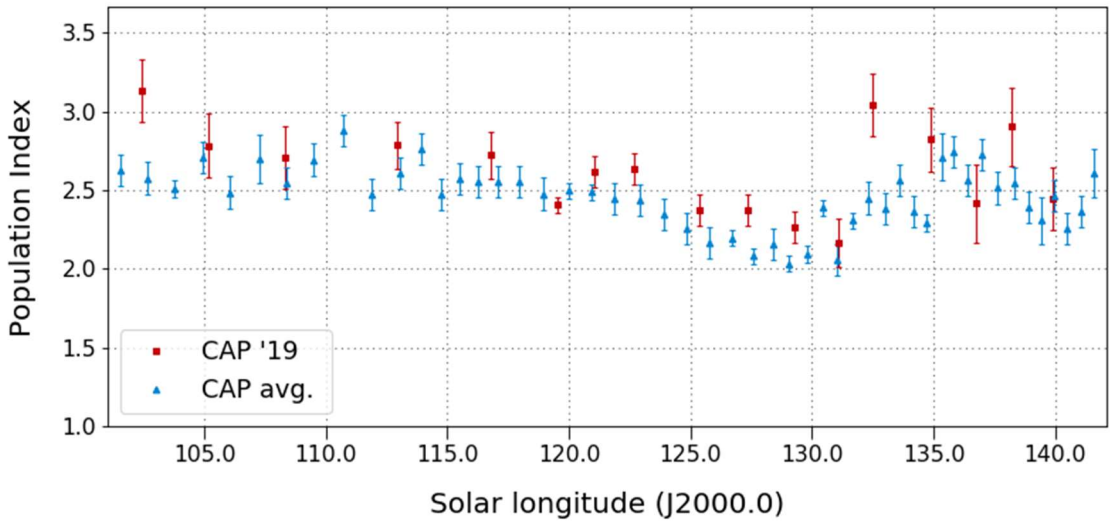

Figure 4: *Population index of the alpha Capricornids in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

The July gamma Draconids (figure 5) emerge hardly from the sporadic background in 2019, similar to previous years with the exception of 2016, when they experienced a brief outburst.

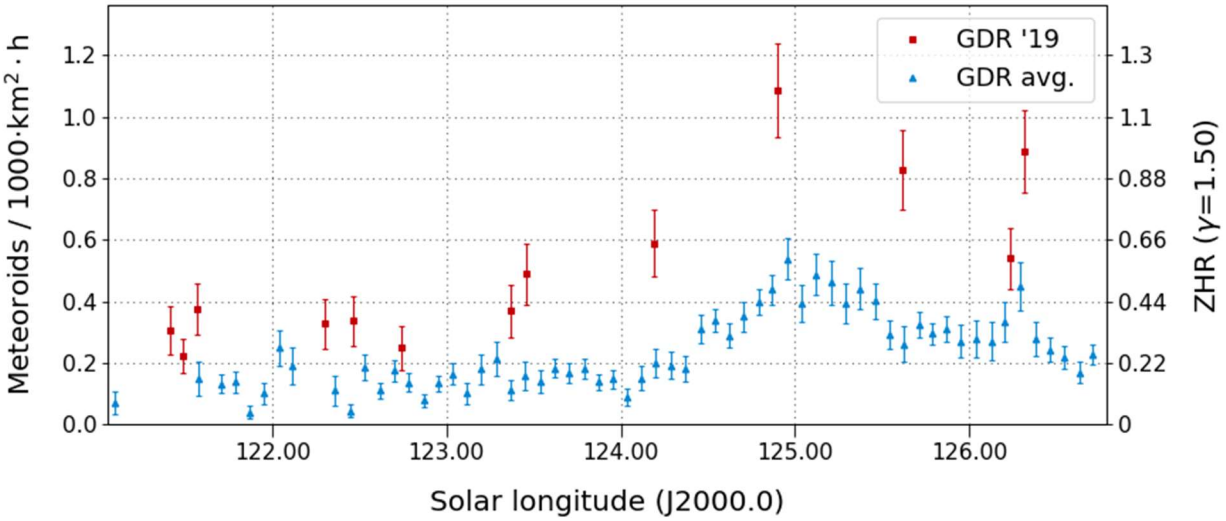

Figure 5: *Flux density of the July gamma Draconids in 2019 (red) as well as in the average of the years 2011-2018 (without 2016, blue), derived from observations of the IMO Network.*

In case of the southern delta Aquariids, the activity profile of 2019 fits nicely to the average of 2011 to 2018 (figure 6) – only the absolute flux density value remains well below the average. Whereas we typically observe values of up to 30 meteoroids per 1,000 km^2 and hour, it was only

20 meteoroids in 2019.

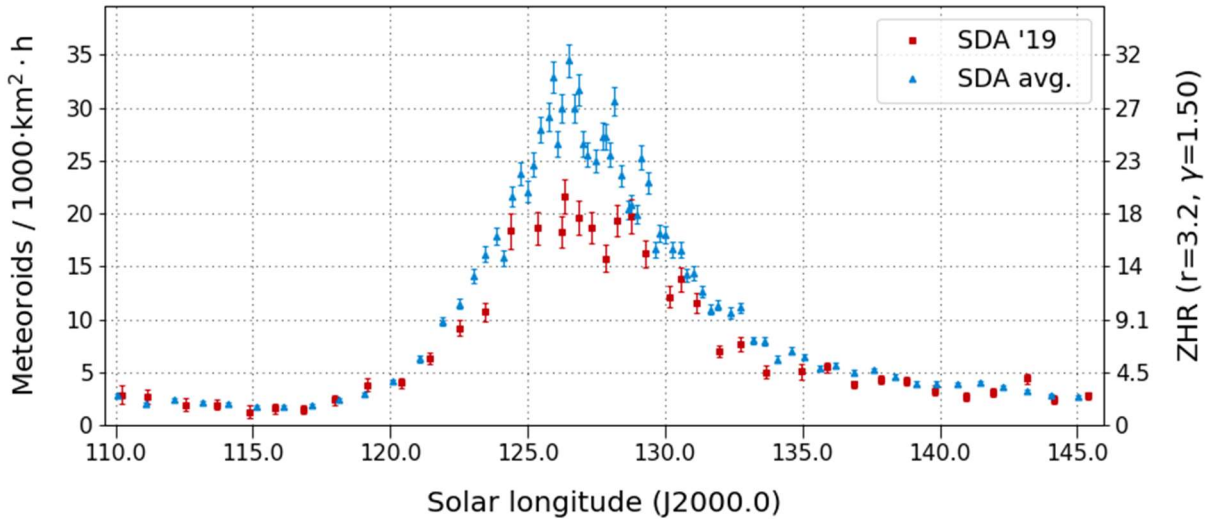

Figure 6: *Flux density of the southern delta Aquariids in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

According to the IMO Meteor Shower Calendar, the population index drops from values of r=3.0 away from the peak tor=2.5 at the activity maximum. In the 2019 profile (figure 7) we can see the drop clearly, but starting from r=2.5 to values of r=1.8. In the long-term profile the dip is less intense. Here we start with values of r=2.2 before the peak. The population index falls to r=2.0 during the peak, and rises to r=2.3 thereafter.

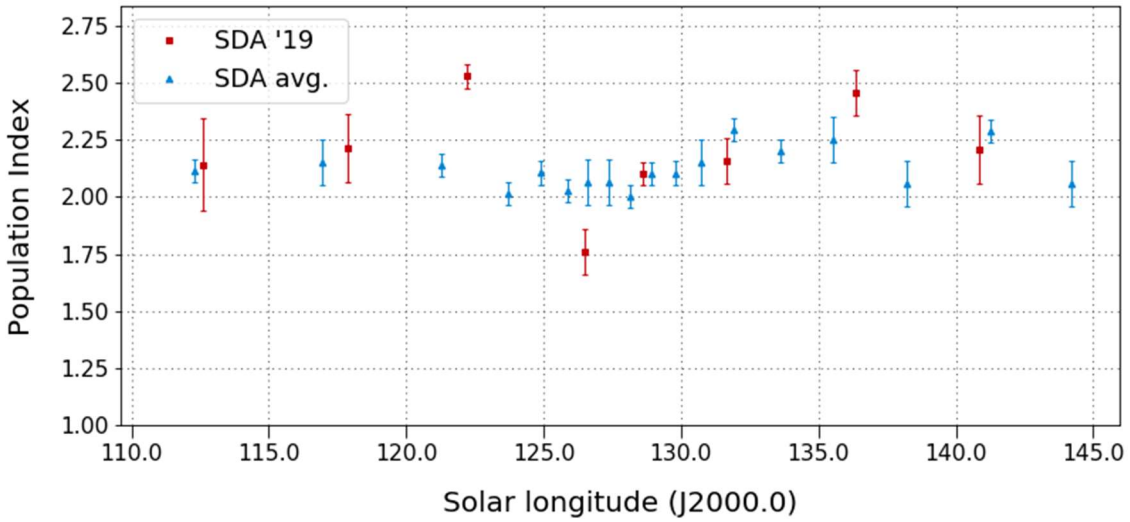

Figure 7: *Population index of the southern delta Aquariids in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

Let's now continue with the highlight of the year, the Perseids. Figure 8 compares at first the overall activity profile of 2019 with the average of the years 2011 to 2018. We notice the slow increase from mid-July to early August. At around 137° solar longitude the rate is raising dramatically, and it peaks at 139.5° solar longitude. Thereafter the rate is declining a little slower, but longer. Only at 142° solar longitude the decease is decelerating, and a week later the

Perseids are lost in the sporadic background. In this respect, 2019 data fit perfectly to the long-term profile.

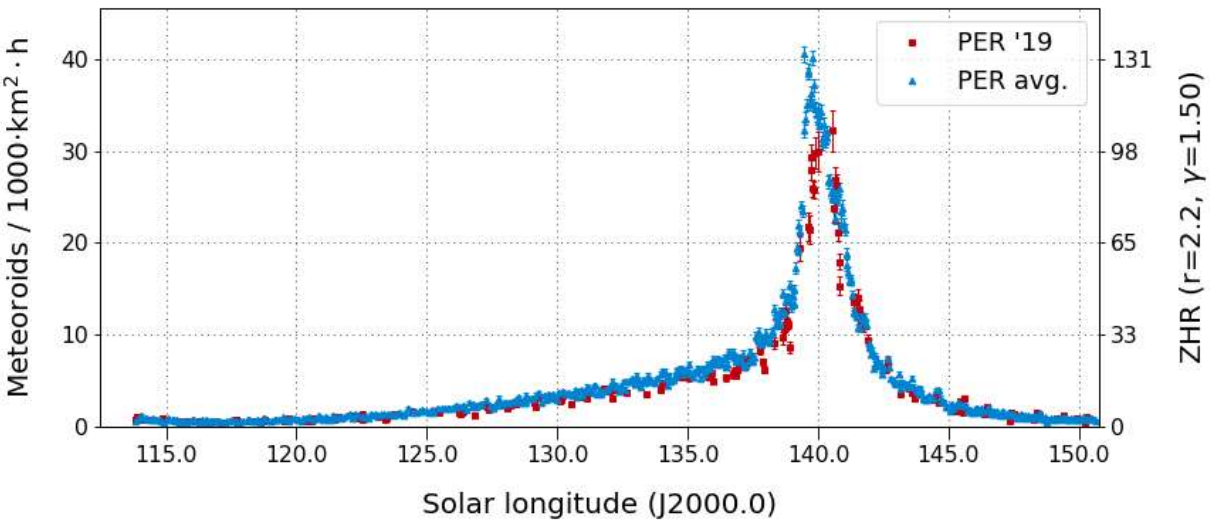

Figure 8: *Flux density of the Perseids in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

If we have a closer look at the peak time (figure 9) we still have a good match. Only peak flux density of about 30 meteoroids per 1,000 km^2 and hour in 2019 is below average.

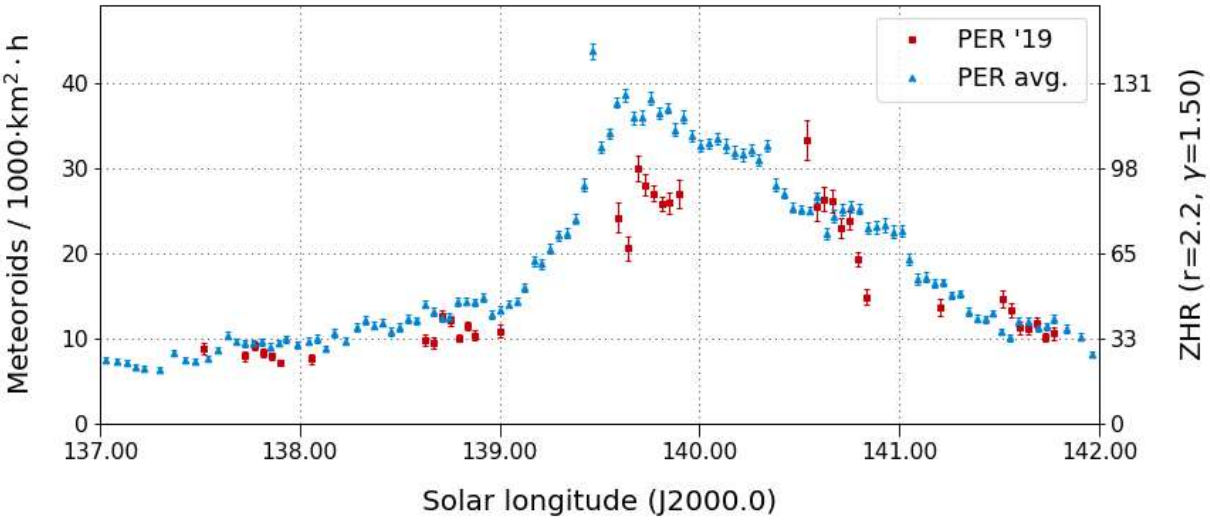

Figure 9: *Flux density of the Perseids near their peak in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

The population index profile of the Perseids differs from other showers. It is nearly constant and only oscillates between values of r=1.7 and r=2.0. The 2019 profile fits well into that trend, but we measured a slightly smaller value just at the shower peak. Overall, the brightness distribution is nearly constant and the fraction of bright meteors quite high (figure 10).

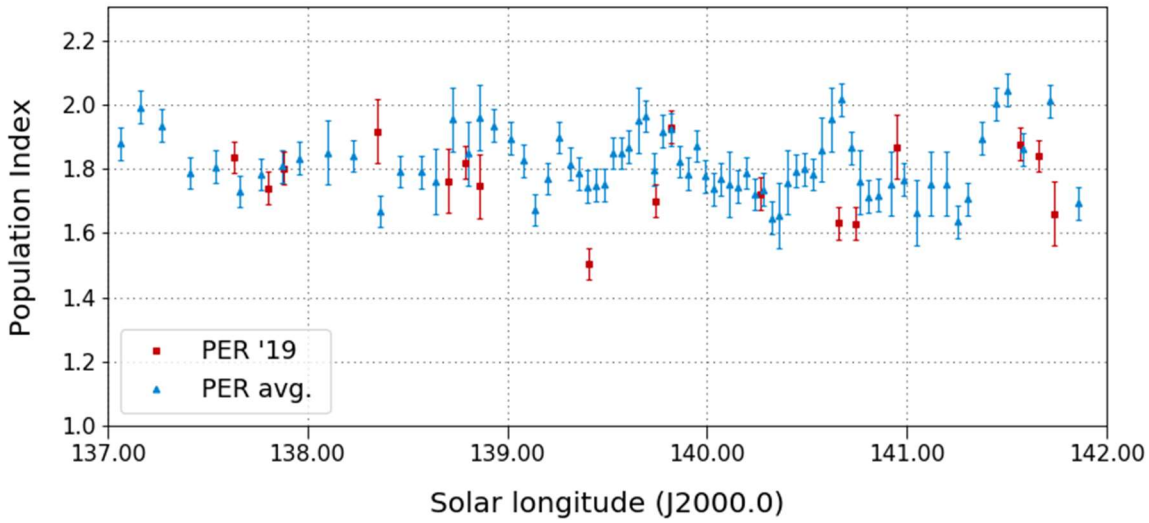

Figure 10: *Population index of the Perseids near their peak in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

This behaviour does not change when we extend the graph to the full activity interval of the Perseids. Not surprisingly, the population index shows strong scatter at the edges due to sporadic pollution, but the r-values remain rather low at all times (figure 11).

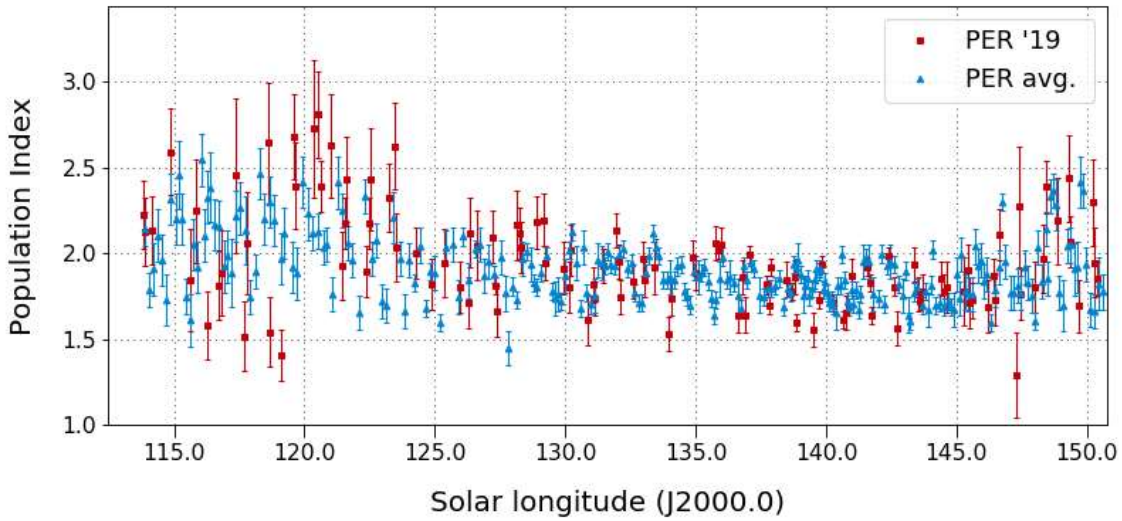

Figure 11: *Population index of the Perseids in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

The kappa Cygnids are active thoughout most of August. Their flux density is low, but they can still be distinguished clearly from the background. When comparing the activity profile of 2019 with the long-term average (figure 12) we left out 2014, when the shower experienced an outburst. Overall, the 2019 data fit well to the long-term profile.

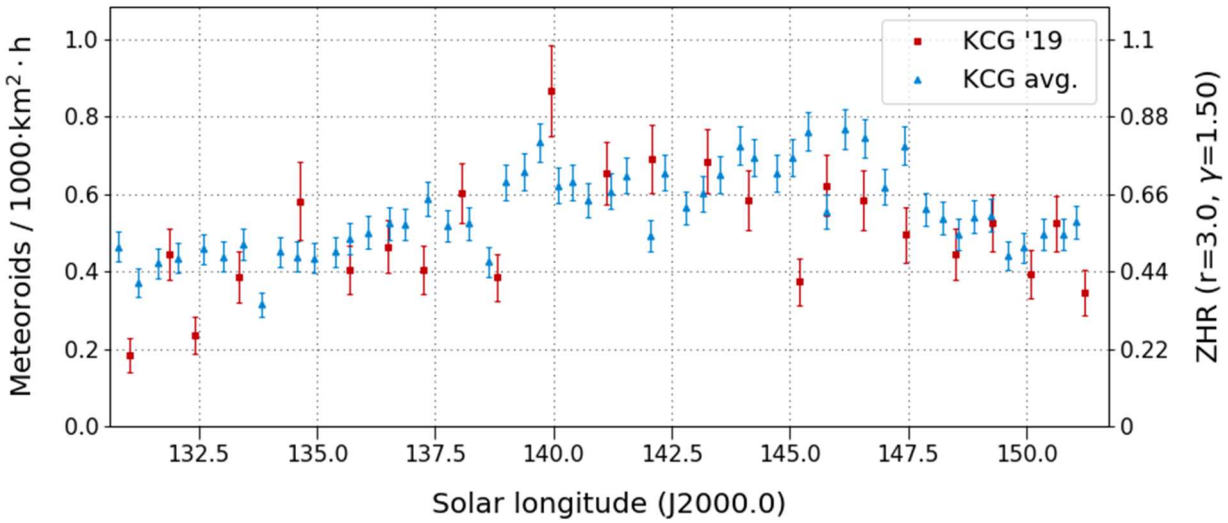

Figure 12: *Flux density of the kappa Cygnids in 2019 (red) as well as in the average of the years 2011-2018 (without 2014, blue), derived from observations of the IMO Network.*

The population index of the kapa Cygnids is r=2.6 at the edges, and it drops to values near r=2.2 at the activity peak. The 2019 profile fits also in this respect to the long-term trend (figure 13). Note that the activity profile shows a kind of double-peak at 140° and 146° solar longitude. At the same time, we see dips in the population index profile. Maybe we observe here two components of the shower.

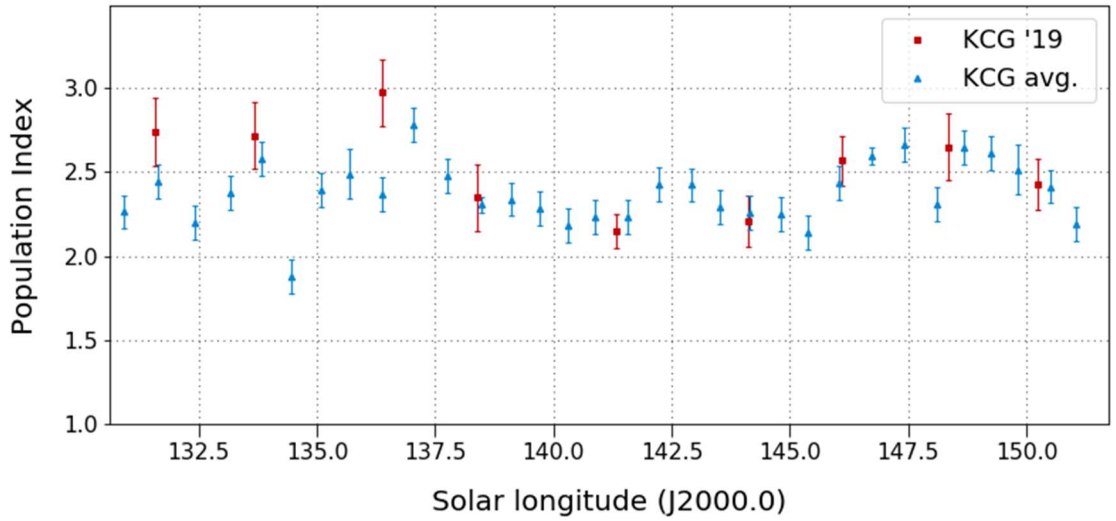

Figure 13: *Population index of the kappa Cygnids in 2019 (red) as well as in the average of the years 2011-2018 (without 2014, blue), derived from observations of the IMO Network.*

Finally, we want to analyse two showers of September. The alpha Aurigids (figure 14) can hardly be discerned from the sporadic background – neither in 2019 nor in the long-term activity profile.

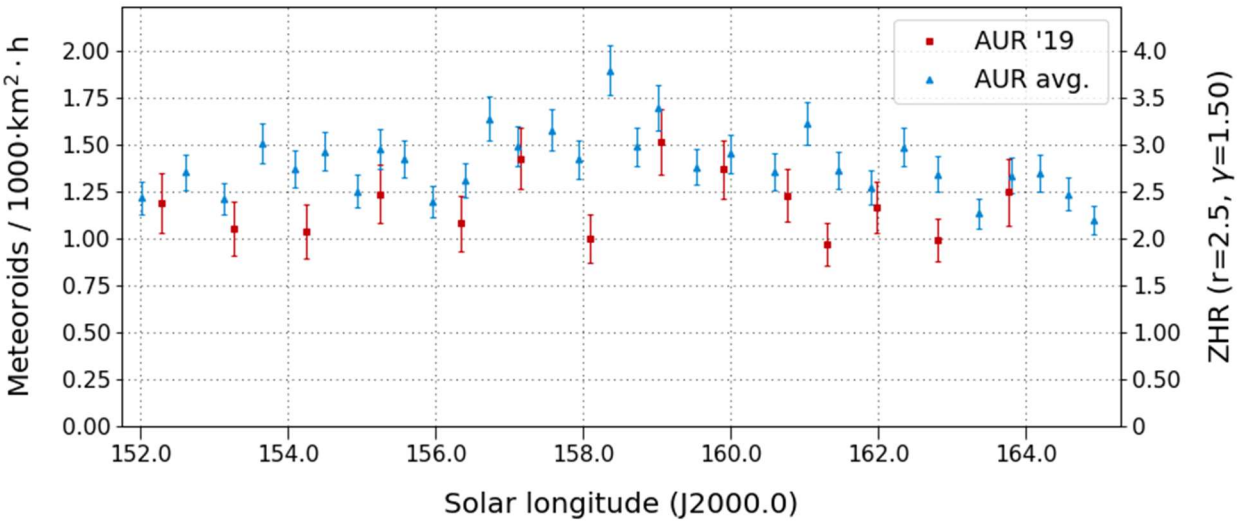

Figure 14: *Flux density of the alpha Aurigids in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

The September epsilon Perseids present often a surprise to the observers – last time in 2008 and 2013. According to the IMO Meteor Shower Calendar we did not expect enhanced activity in 2019. Only Mikiya Sato predicted possible outbursts at a solar longitude of 166.801° (2018) resp. 166.831° (2019). A quick look at the activity profile (figure 15) confirms this prognosis for 2019.

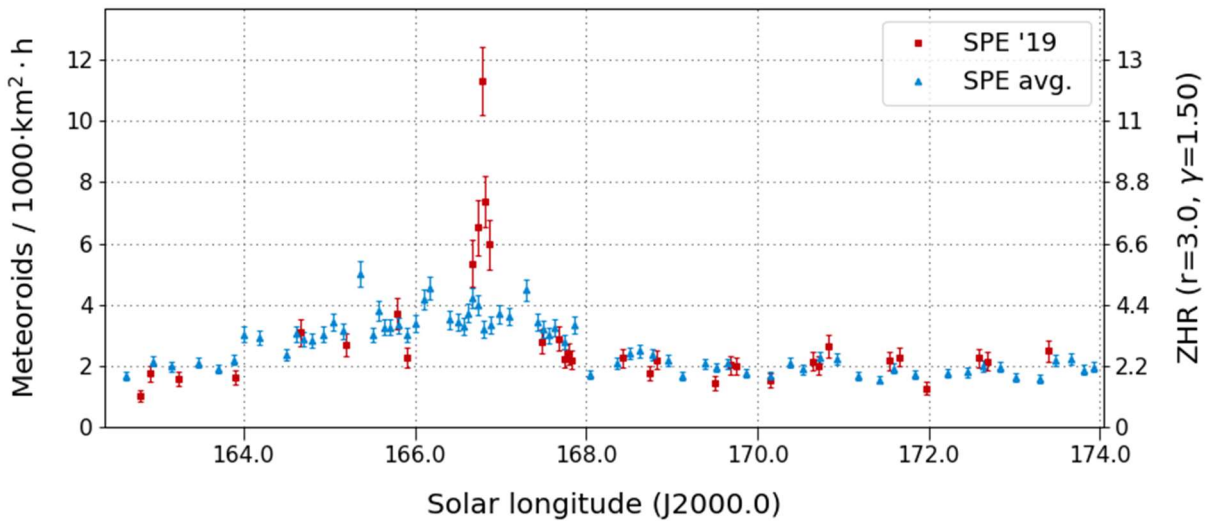

Figure 15: *Flux density of the September epsilon Perseids in 2019 (red) as well as in the average of the years 2011-2018 (without 2013, blue), derived from observations of the IMO Network.*

When we increase the temporal resolution (figure 16) we see a short outburst on September 10, 2019, near 01:10 UT (166.79° solar longitude). The peak solar longitude fits better to the prediction for 2018 than 2019. With about 17 meteoroids per 1,000 km^2 and hour, the activity was not as high as in previous outbursts, but it was still three times the average activity. The full width at half maximum (FWHM) was just half an hour.

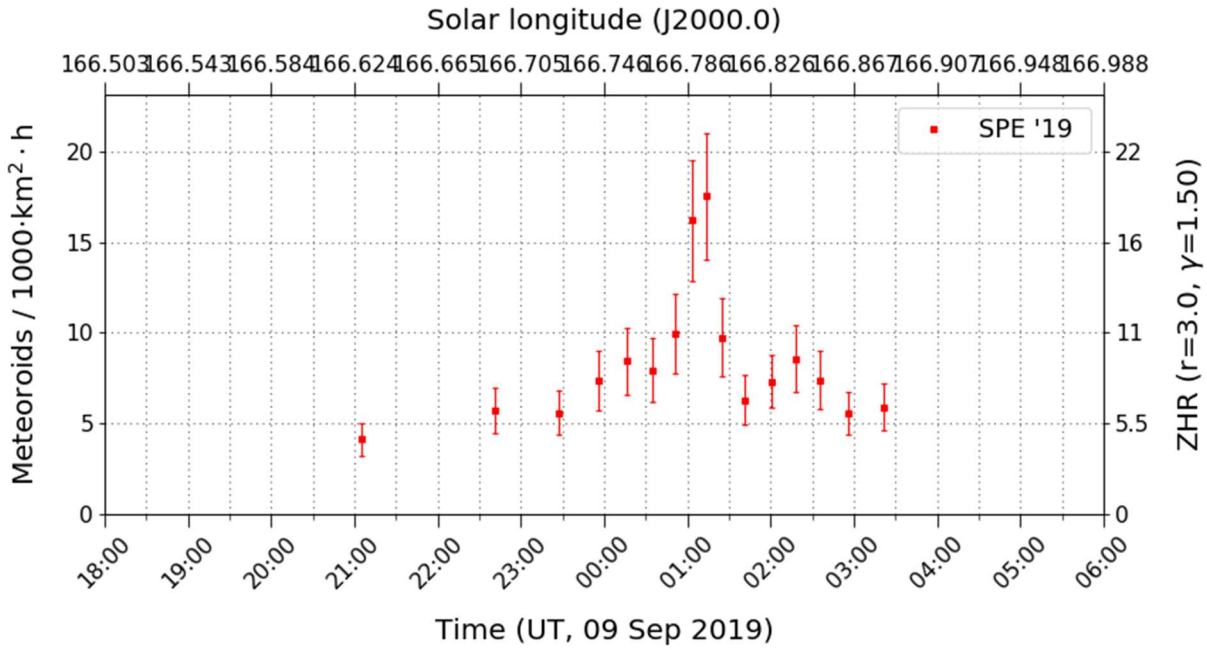

Figure 16: *Flux density of the September epsilon Perseids near their peak in 2019, derived from observations of the IMO Network.*

The population index was r=1.6 in the peak night. In the other nights, it scattered between r=1,75 and r=2,25 similar to the long-term profile (figure 17, without 2013).

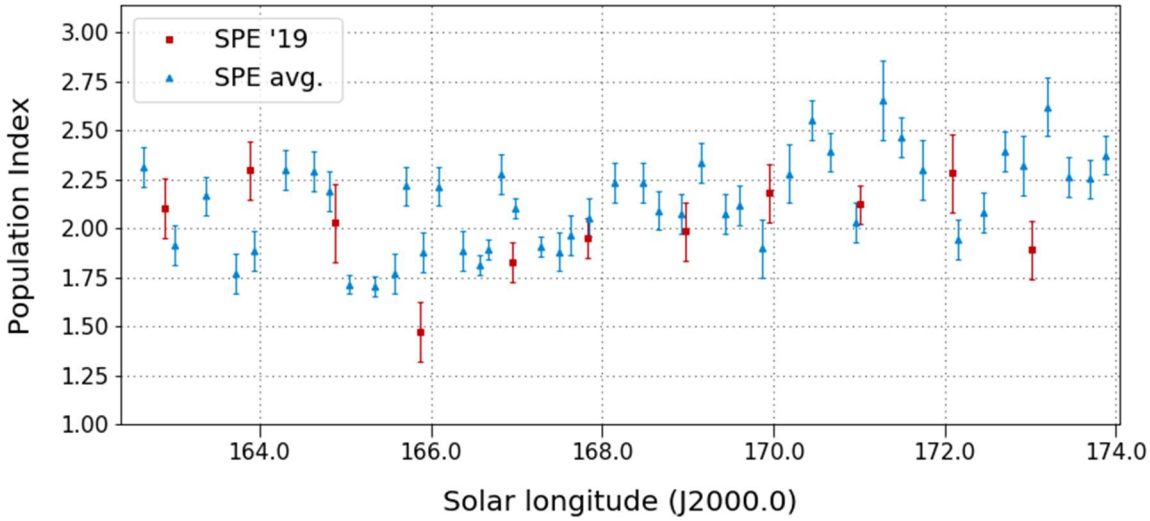

Figure 17: *Population index of the September epsilon Perseids in 2019 (red) as well as in the average of the years 2011-2018 (without 2013, blue), derived from observations of the IMO Network.*

Table 2: *Observational statistics for first quarter of 2019.*

Code	Name	Place	Camera	July			August			September		
				Nights	Time [h]	Meteors	Nights	Time [h]	Meteors	Nights	Time [h]	Meteors
ARLRA	Arlt	Ludwigsfelde/DE	LUDWIG2	27	89.5	598	26	124.9	932	23	136.2	897
BERER	Berkó	Ludanyhalaszi/HU	HULUD1	8	44.5	191	20	126.5	1008	11	101.8	437
BIATO	Bianchi	Mt. San Lorenzo/IT	OMSL1	24	115.1	427	29	180.0	1098	26	176.9	518
BOMMA	Bombardini	Faenza/IT	MARIO	26	141.0	714	31	206.1	1692	23	188.4	855
BRIBE	Klemt	Herne/DE	HERMINE	25	98.7	417	26	128.1	760	22	128.0	478
		Berg. Gladbach/DE	KLEMOI	26	100.9	426	27	138.1	875	20	134.7	534
CARMA	Carli	Monte Baldo/IT	BMH2	27	148.8	905	31	166.8	1337	27	201.1	1170
CASFL	Castellani	Monte Baldo/IT	BMH1	27	146.8	392	30	147.4	531	24	187.3	426
CINFR	Cineglosso	Faenza/IT	JENNI	25	141.8	612	31	211.5	1823	22	195.8	884
CRIST	Crivello	Valbrevenna/IT	ARCI	30	157.0	742	31	213.6	1453	27	196.4	647
			BILBO	30	154.0	827	30	205.8	1572	27	187.9	793
			C3P8	29	131.1	526	30	167.5	1103	26	170.3	566
			STG38	16	50.6	262	31	207.4	1819	28	215.3	1181
ELTMA	Eltri	Venezia/IT	MET38	29	101.7	395	28	127.2	979	26	104.7	632
FORKE	Förster	Carlsfeld/DE	AKM3	20	76.6	472	26	144.2	1017	20	117.5	532
GONRU	Goncalves	Tomar/PT	TEMPLAR1	28	162.2	708	30	198.2	1184	30	221.1	966
			TEMPLAR2	27	157.8	538	30	199.8	1050	30	226.9	753
			TEMPLAR3	23	130.9	210	28	172.7	469	28	215.4	328
			TEMPLAR4	29	140.0	550	29	189.9	1229	29	222.4	706
			TEMPLAR5	26	136.5	445	29	164.8	1105	29	208.4	751
GOVMI	Govedic	Sredisce ob Dr./SI	ORION2	26	88.7	275	17	86.6	456	23	71.3	450
			ORION3	12	54.8	87	26	152.2	439	21	116.2	202
			ORION4	11	45.2	82	26	139.7	395	22	113.3	169
HINWO	Hinz	Schwarzenberg/DE	HINWO1	25	99.4	417	29	163.0	968	23	151.9	625
IGAAN	Igaz	Budapest/HU	HUPOL	22	84.0	84	27	167.4	219	17	109.8	87
JONKA	Jonas	Budapest/HU	HUSOR	-	-	-	29	181.7	564	24	165.2	321
		Budapest/HU	HUSOR2	21	109.5	212	29	181.7	567	21	145.8	299
KACJA	Kac	Kamnik/SI	CVETKA	17	80.5	464	18	105.6	854	15	103.8	662
			METKA	6	14.6	60	27	156.2	368	22	145.9	312
		Kamnik/SI	REZIKA	17	83.4	480	18	106.7	823	15	122.9	1068
		Ljubljana/SI	SRAKA	23	74.2	303	23	93.0	494	19	130.2	449
		Kamnik/SI	STEFKA	17	81.5	292	18	109.7	580	15	109.4	433
KNOAN	Knöfel	Berlin/DE	ARMEFA	13	44.0	117	21	115.5	420	22	135.7	272
KOSDE	Koschny	La Palma / ES	ICC7	29	174.8	476	28	181.6	564	21	86.3	226
			ICC9	-	-	-	24	149.8	899	29	204.4	1040
			LIC1	27	153.5	720	28	161.8	961	21	90.5	358
			LIC2	-	-	-	23	188.3	2387	28	254.6	2768
KWIMA	Kwinta	Krakow/PL	PAV06	17	63.6	112	23	129.7	349	16	101.0	156
			PAV07	19	64.1	123	23	128.9	358	16	101.2	153
			PAV79	19	72.8	228	23	136.1	529	16	107.1	314
MACMA	Maciejewski	Chelm/PL	PAV35	9	30.9	126	27	122.5	803	18	107.7	321
			PAV36	9	39.4	212	27	142.4	1249	19	124.3	540
			PAV43	9	36.6	175	27	138.4	977	19	123.3	478
			PAV60	10	34.3	272	27	136.8	1128	16	116.4	621
MARRU	Marques	Lisbon/PT	CAB1	29	181.2	549	31	227.5	1480	30	233.2	714
			RAN1	24	102.5	274	29	182.8	1093	29	203.3	518
MISST	Missiaggia	Nove/IT	TOALDO	21	102.5	684	28	124.5	1136	18	117.9	623
MOLSI	Molau	Seysdorf/DE	AVIS2	27	104.9	841	29	119.1	1055	26	157.4	1119
			DIMCAM2	25	113.7	1338	25	113.6	1603	24	149.5	1610
			ESCIMO3	26	121.7	755	26	124.6	835	23	157.5	902
		Ketzür/DE	REMO1	28	99.8	923	28	138.2	1328	25	144.0	1197
			REMO2	27	98.3	638	28	128.4	859	26	152.9	811
			REMO3	26	110.3	673	29	159.9	1059	24	164.6	849
			REMO4	26	109.7	864	30	158.9	1365	26	172.2	1148
MORJO	Morvai	Fülöpszallas/HU	HUFUL	28	148.2	228	28	190.2	513	26	182.9	308
MOSFA	Moschini	Rovereto/IT	ROVER	24	115.1	197	30	131.5	439	24	156.1	246
NAGHE	Nagy	Budapest/HU	HUKON	29	46.9	365	23	108.5	856	15	85.8	306
		Piszkestetö/HU	HUPIS	31	132.0	531	30	197.8	1193	22	115.3	605
OTTMI	Otte	Pearl City/US	ORIE1	4	19.4	49	24	58.8	132	8	3.3	17
PERZS	Perkó	Becsehely/HU	HUBEC	26	111.2	439	27	160.6	862	20	127.4	537
SARAN	Saraiva	Carnaxide/PT	RO1	30	208.2	491	30	202.7	896	27	241.8	550
			RO2	30	202.1	627	29	208.5	1047	30	250.4	758
			RO3	31	232.5	856	31	244.1	1778	30	258.6	1024
SCALE	Scarpa	Alberoni/IT	LEO	26	113.3	154	22	116.9	364	-	-	-
SCHHA	Schremmer	Niederkrüchten/DE	DORAEMON	25	94.6	354	24	139.4	705	22	129.4	484
SLAST	Slavec	Ljubljana/SI	KAYAK1	15	57.9	183	21	110.6	439	19	115.3	336
			KAYAK2	19	89.8	126	21	115.6	231	22	138.2	158
STOEN	Stomeo	Scorze/IT	MIN38	29	112.8	716	30	143.8	1400	29	180.7	1198
			NOA38	29	135.0	579	30	155.2	1191	28	194.6	844
			SCO38	27	103.9	687	30	147.0	1628	29	182.6	1186
STRJO	Strunk	Herford/DE	BEMCE	-	-	-	11	77.6	853	20	120.3	1191
			MINCAM2	23	92.7	578	28	154.1	1205	25	131.6	676
			MINCAM3	23	76.4	255	27	100.8	688	20	110.0	478
			MINCAM4	20	88.0	157	28	146.1	381	20	118.6	212
			MINCAM5	23	84.9	201	28	139.8	631	19	78.6	241
			MINCAM6	23	83.2	299	16	67.0	600	-	-	-
TEPIS	Tepliczky	Agostyan/HU	HUAGO	18	63.6	178	26	136.2	353	18	137.4	187
			HUMOB	23	85.9	300	29	162.1	1124	23	170.6	823
WEGWA	Wegrzyk	Nieznaszyn/PL	PAV78	12	35.0	128	24	84.4	427	23	86.1	285
YRJIL	Yrjölä	Kuusankoski/FI	FINEXCAM	-	-	-	22	93.5	514	23	127.8	420
ZAKJU	Zakrajšek	Petkovec/SI	PETKA	12	50.0	252	17	98.6	484	25	170.1	919
			TACKA	10	39.5	74	16	82.9	202	22	154.2	350
Summe				**31**	**7722.0**	**32217**	**31**	**12047.6**	**73336**	**30**	**11994.9**	**50208**