Result of the IMO Video Meteor Network – First Quarter 2019

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Starting with this report, we switch to quarterly reporting of the IMO Video Meteor Network. At the same time, we will also update the format. The result section will contain as usual the statistics for the individual cameras, but we omit the technical details of them. That provides sufficient space for all three months in the table.

We also omit the tables with the details of the effective observing times and meteors per night, but we present these figures in a graphical format instead. This gives a quick overview of the statistics in this quarter. Unfortunately, we cannot present all numbers in a single graph, because that would be too confusing. Thus, we give in the first diagram (figure 1) the number of active video cameras (grey bars) and the effective observing of these cameras (red line), and in the second diagram (figure 2) the average number of meteors per hour (grey bars) and the absolute number of recorded meteors (red line).

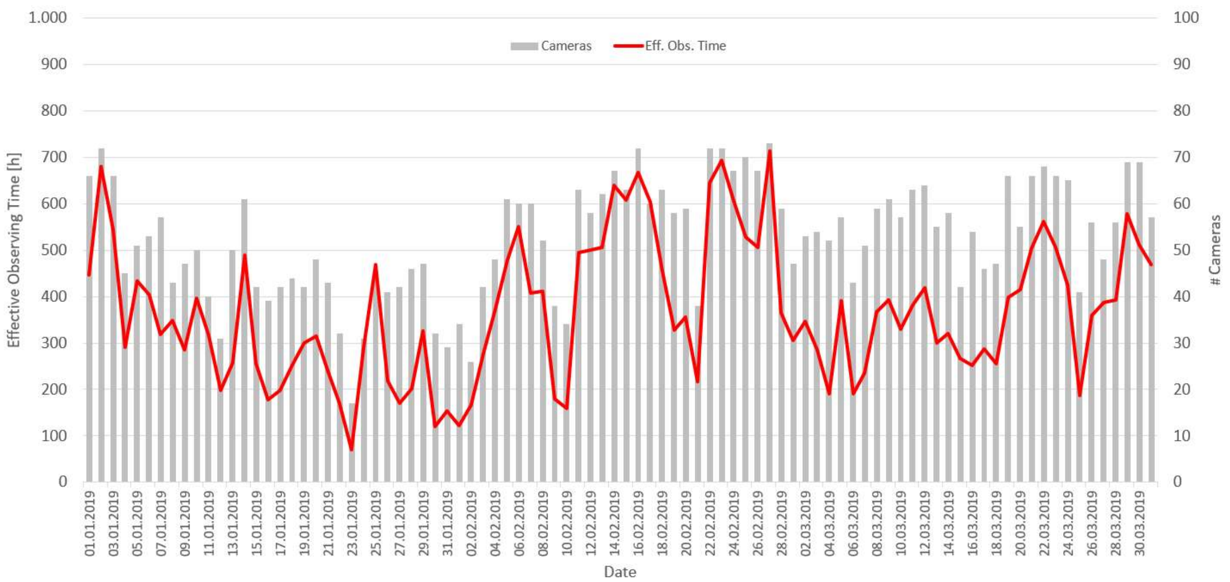

Figure 1: *Number of active cameras per night (grey bars) and effective observing time of these cameras (red line) in the first quarter of 2019.*

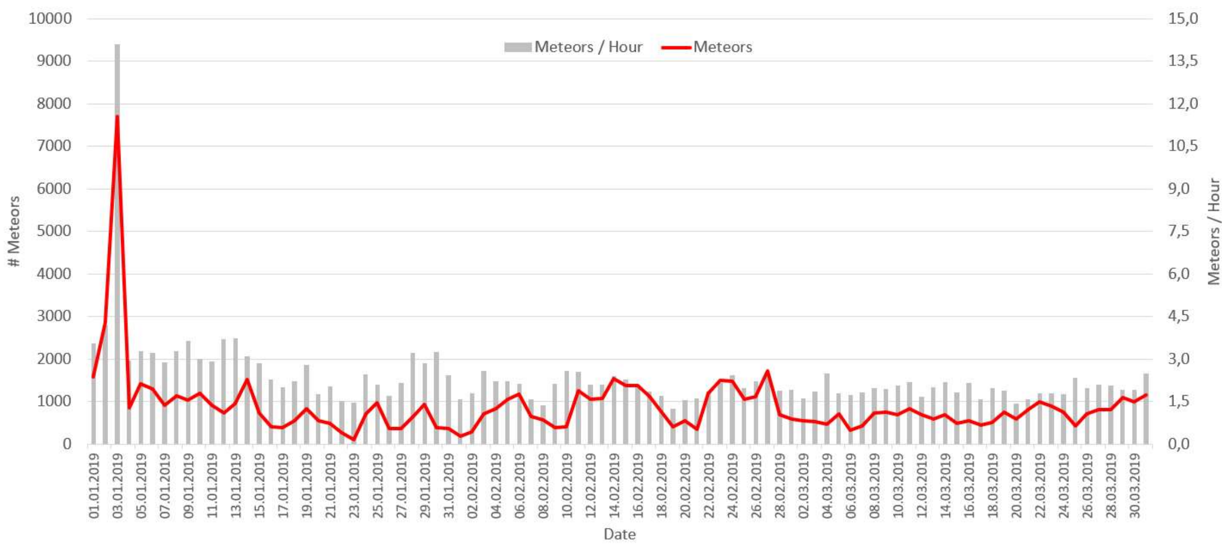

Figure 2: *Average number of meteors per hours (grey bars) and number of recorded meteors per night (red line) in the first quarter of 2019.*

The year 2019 started with nice weather, so that almost 70 cameras were in operation during the Quadrantid maximum. Combined with a high rate of 15 meteors per hour, this allowed us to recorded almost 8,000 meteors in that night alone. Thereafter weather deteriorated significantly and reached the low by the end of January. In February, the weather was pleasant again with only short interruptions, much better than on average. Looking at the effective observing time, we see that the nights are getting already shorter in March.
If we ignore the outlier during the Quadrantids, the hourly meteor rate started at above three per hour, but got down as every year to about two per hours in mid-January, which marks the annual low.

Comparing the outcome of January 2019 with previous years, we find that the number of observing hours was similar to the previous four years – only in 2017 we collected 25% more hours under exceptionally good conditions. The meteor count of January 2019, however, missed the record outcome of 2017 only by a small amount. The hourly average was higher than in any year since 2011.
February 2019 was a record-breaking month. With over 12,700 observing hours we topped the typical yield by 50%, and with respect to the meteor number the previous February record was topped by 20%. In the absence of relevant meteor showers, the hourly meteor rate varies typically between 2.0 and 2.2, and 2019 was no exception in this respect.
Over 11,500 observing hours in March was above average, and the second-best yield for this month after 2014. The meteor number was even slightly higher than five years earlier.
Hence, 2019 presented a very good start, and 85 cameras contributed to that result.

Let's have a closer look at the Quadrantids. Figure 3 compares the activity profile of 2019 with the average profile of the years 2011-2018. It is obvious, that we were not only lucky with respect to the weather, but that we also hit exactly the shower maximum in the night of January 3/4. Now when two out of three success factors are given, we can be sure that the bright full moon will light up the sky like daylight. But no, the peak happened just two days before New Moon, so it was one of these perfect Quadrantid peaks which you may enjoy only every twenty years or so.

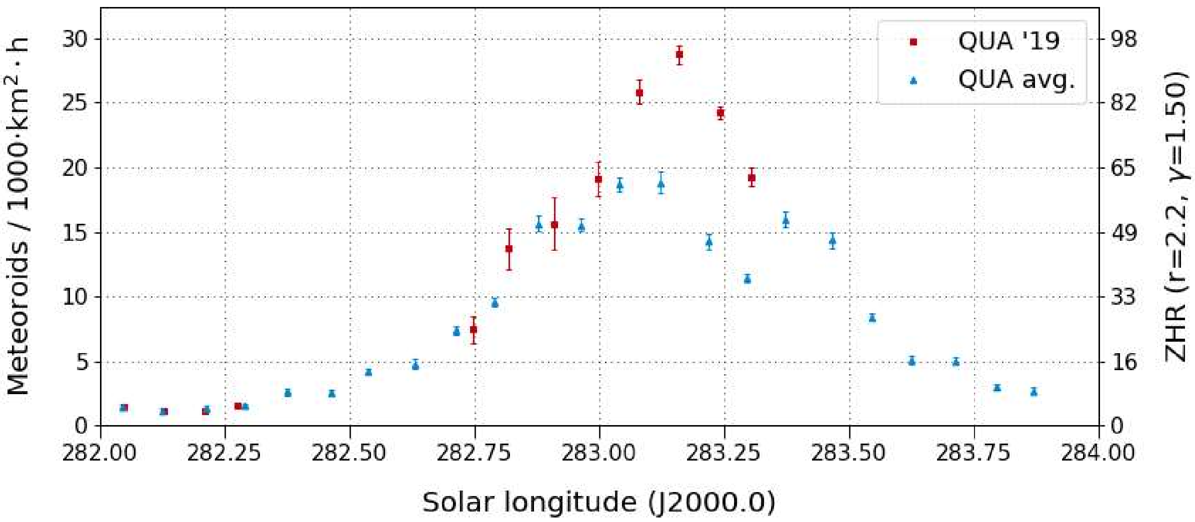

Figure 3: *Flux density of the Quadrantids in 2019 (red) as well as in the average of the years 2011-2018 (blue), derived from observations of the IMO Network.*

Thanks to the large yield of over 5,000 shower meteors on January 3/4, 2019, we could derive a high-resolution flux density profile of the peak night (figure 2) with a maximum resolution of down to 5 minutes per bin at best.

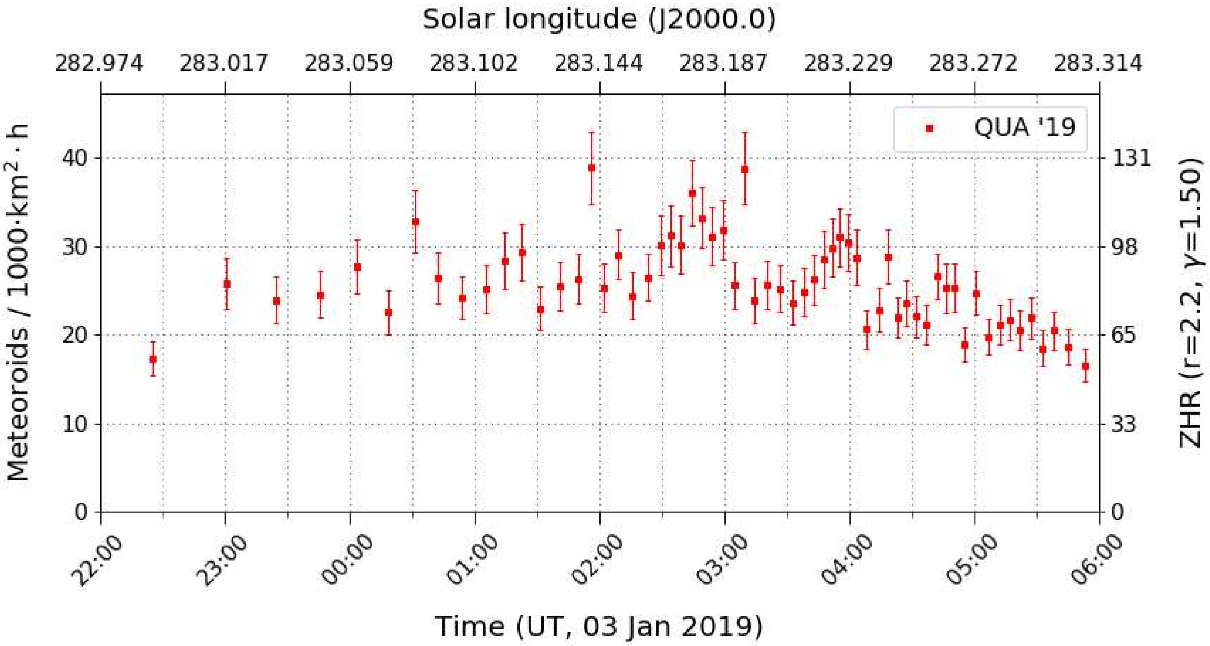

Figure 4: *High-resolution flux density profile of the Quadrantid peak 2019.*

At the begin of night, the density of data points is still low. That comes as no surprise, as the radiant is circumpolar in northern Europe, but it is located very low in the northern horizon in the evening hours. Only after midnight local time it is gaining altitude, which manifests itself in increasing meteor counts. If we ignore individual outliers at 01:56 UT (283.141° solar longitude) and 03:09 UT (283.193° solar longitude), the activity profile is remarkably smooth Peak activity is reached at 02:43 UT (283.175° solar longitude) with a flux density of more than 35 meteoroids per 1,000 km^2 and hour, which is somewhat less than the flux density of Perseids. The calculated peak ZHR of 120, however, is what we expect from very rich Perseid years.
Remarkable is the wave-like shape of the profile with a secondary peak after the primary at 03:55 UT (283.226° solar longitude). At this time, the radiant has further climbed and twilight is not yet an issue, which is why the meteor yield and the temporal resolution is highest then.

Figure 5 shows the r-value profile of the peak night in the same time interval as figure 4. The population index is nearly r=2.0, before it reaches a small peak with r=2.2 at 03:04 UT (283.190° solar longitude) and thereafter a more significant low of r=1.75 at 04:24 UT (283.246° solar longitude). There is no direct correlation with the peaks in the activity profile.

We compared our results with visual observations collected by IMO. The automated analysis of roughly 1,500 visual Quadrantids with a fixed population index of r=2.1 yielded a peak at 02:20 UT (283.16° solar longitude) with a ZHR of 115. Hence, the peak occurred half an hour earlier, but the ZHR is almost identical. Fine structures like the secondary peak are not visible due to the lower temporal resolution.

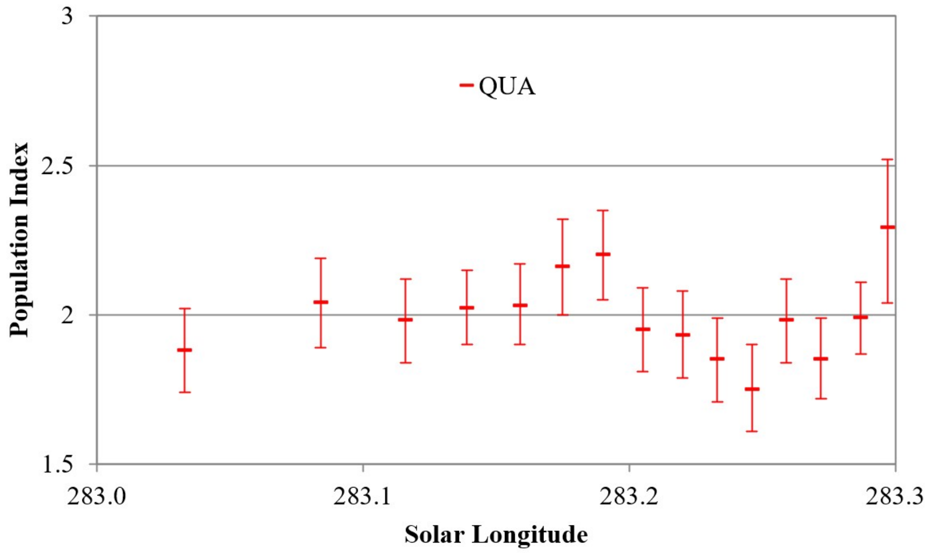

Figure 5: *Population index of the Quadrantids during the 2019 maximum.*

Finally, a word about the 20th anniversary of the IMO network, which we had celebrated in March 2019. On this occasion, we look back at the history in a separate article. However, one question is to be answered in this quarterly report: Did we really managed to collect over a million observing hours and over four million meteors in these twenty years?

Yes, we did! We could pass both values end of January resp. early February. Statistically speaking, our camera network observed as much as a single camera recording the clear sky for roughly 115 years in a row and detecting every 15 minutes a meteor.

Table 1: *Overall statistics from twenty years of IMO Video Meteor Network.*

Year	Obs. Nights	Eff. Obs. Time [h]	Meteors	Meteors / Hour
1999	117	1022.4	8351	8.2
2000	248	2514.1	12852	5.1
2001	293	4503.2	31646	7.0
2002	318	5862.5	23258	4.0
2003	357	9652.7	36381	3.8
2004	351	7403.5	25209	3.4
2005	356	9560.7	40770	4.3
2006	365	14995.1	69844	4.7
2007	364	16956.0	75053	4.4
2008	366	22937.5	92323	4.0
2009	365	32286.7	138766	4.3
2010	365	35489.3	192049	5.4
2011	365	69065.0	312110	4.5
2012	366	93558.7	353627	3.8
2013	365	86641.9	350003	4.0
2014	365	100391.3	368680	3.7
2015	365	122147.3	481218	3.9
2016	366	114713.8	477736	4.2
2017	365	118282.0	433047	3.7
2018	365	113760.4	444033	3.9
2019	90	33627.0	81510	2.4
Sum	**6877**	**1015371.1**	**4048466**	**4.0**

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

Code	Name	Place	Camera	January			February			March		
				Nights	Time [h]	Meteors	Nights	Time [h]	Meteors	Nights	Time [h]	Meteors
ARLRA	Arlt	Ludwigsfelde/DE	LUDWIG2	19	98.1	361	23	158.8	464	24	118.4	300
BERER	Berkó	Ludanyhalaszi/HU	HULUD1	4	28.3	123	-	-	-	-	-	-
BIATO	Bianchi	Mt. San Lorenzo/IT	OMSL1	13	22.1	162	17	181.1	295	26	213.0	320
BOMMA	Bombardini	Faenza/IT	MARIO	21	173.9	901	27	245.4	631	30	243.2	522
BREMA	Breukers	Hengelo/NL	MBB3	13	71.2	95	14	99.7	107	-	-	-
BRIBE	Klemt	Herne/DE	HERMINE	18	100.9	218	21	171.0	322	19	99.2	151
		Berg. Gladbach/DE	KLEMOI	5	14.7	41	-	-	-	-	-	-
CARMA	Carli	Monte Baldo/IT	BMH2	28	289.4	1627	25	267.1	1059	25	243.6	813
CASFL	Castellani	Monte Baldo/IT	BMH1	18	190.6	495	25	265.7	432	25	239.1	357
CINFR	Cineglosso	Faenza/IT	JENNI	20	178.8	807	26	250.3	654	30	258.4	520
CRIST	Crivello	Valbrevenna/IT	ARCI	26	212.3	949	25	216.2	497	27	207.5	426
			BILBO	26	234.1	1229	25	241.1	674	29	211.6	509
			C3P8	25	199.4	715	25	208.1	320	22	173.2	266
			STG38	25	161.3	1326	23	136.0	513	25	116.3	409
ELTMA	Eltri	Venezia/IT	MET38	18	141.3	656	19	168.8	342	23	174.5	246
FORKE	Förster	Carlsfeld/DE	AKM3	10	17.8	127	18	109.5	337	11	52.5	121
GONRU	Goncalves	Foz do Arelho/PT	FARELHO1	1	0.2	1	1	0.2	1	3	1.2	8
		Tomar/PT	TEMPLAR1	26	244.3	836	26	254.4	575	29	244.8	569
			TEMPLAR2	25	238.5	766	26	254.1	496	28	240.8	419
			TEMPLAR3	22	218.9	300	21	209.6	146	26	216.7	144
			TEMPLAR4	25	228.0	751	25	239.9	397	28	231.1	345
			TEMPLAR5	22	208.3	613	22	180.1	291	28	204.8	313
GOVMI	Govedic	Sredisce ob Dr./SI	ORION2	23	126.6	262	24	169.2	199	28	162.9	197
			ORION3	21	131.7	205	20	166.0	100	26	188.0	129
			ORION4	18	80.4	164	21	100.5	103	28	108.0	103
HINWO	Hinz	Schwarzenberg/DE	HINWO1	12	83.8	161	20	170.2	335	16	101.0	169
IGAAN	Igaz	Hodmezovasar./HU	HUHOD	14	54.8	116	19	163.3	134	25	160.8	145
		Budapest/HU	HUPOL	10	65.9	53	21	170.0	68	24	155.5	54
JONKA	Jonas	Budapest/HU	HUSOR2	12	77.9	158	19	162.9	130	23	150.9	124
KACJA	Kac	Kamnik/SI	CVETKA	8	27.6	94	17	137.9	417	22	163.1	393
		Kamnik/SI	REZIKA	10	36.6	187	17	135.6	485	22	155.7	437
		Ljubljana/SI	SRAKA	16	86.4	256	22	159.7	336	22	145.6	272
		Kamnik/SI	STEFKA	8	22.5	73	17	135.3	299	21	154.1	256
KOSDE	Koschny	La Palma / ES	ICC7	-	-	-	-	-	-	22	70.7	194
			ICC9	21	203.2	759	12	79.9	312	23	129.8	480
			LIC2	18	140.0	1808	10	61.7	624	27	124.6	1285
KWIMA	Kwinta	Krakow/PL	PAV06	3	22.1	8	14	76.7	38	8	47.4	18
			PAV07	3	17.6	13	12	112.1	60	13	70.1	47
			PAV79	3	16.1	16	16	140.6	139	13	91.8	84
MACMA	Maciejewski	Chelm/PL	PAV35	8	10.2	26	14	55.3	101	23	68.9	110
			PAV36	6	13.8	23	16	97.4	178	24	118.4	170
			PAV43	3	13.9	8	11	24.5	113	23	74.7	179
			PAV60	11	43.8	78	17	120.6	302	24	155.9	347
MARRU	Marques	Lisbon/PT	CAB1	21	153.4	489	27	243.1	420	27	227.4	412
			RAN1	24	232.7	622	23	186.8	319	26	218.8	251
MISST	Missiaggia	Nove/IT	TOALDO	20	171.5	492	18	160.3	225	18	142.0	275
MOLSI	Molau	Seysdorf/DE	AVIS2	18	81.1	331	22	158.5	612	24	150.7	492
			DIMCAM1	5	10.6	80	-	-	-	-	-	-
			DIMCAM2	11	57.1	401	23	161.1	1038	26	145.3	775
			ESCIMO2	14	82.2	119	20	148.7	245	21	117.4	171
		Ketzür/DE	REMO1	21	103.5	412	19	139.5	379	25	120.6	342
			REMO2	20	111.0	631	21	170.5	716	25	139.0	447
			REMO3	21	128.3	426	23	192.4	514	22	149.3	358
			REMO4	20	118.5	584	23	173.4	654	26	147.7	516
MORJO	Morvai	Fülöpszallas/HU	HUFUL	18	94.4	120	21	204.5	138	25	191.9	119
MOSFA	Moschini	Rovereto/IT	ROVER	24	128.8	485	23	127.7	256	27	97.4	192
NAGHE	Nagy	Budapest/HU	HUKON	10	59.5	177	23	143.7	334	27	108.5	232
		Piszkestetö/HU	HUPIS	20	83.6	320	23	172.3	339	28	170.1	315
		Zamardi/HU	HUZAM	16	104.9	255	21	186.3	195	25	158.9	157
OTTMI	Otte	Pearl City/US	ORIE1	15	18.7	84	1	0.5	2			
PERZS	Perkó	Becsehely/HU	HUBEC	19	106.3	488	25	175.6	363	29	184.1	305
ROTEC	Rothenberg	Berlin/DE	ARMEFA	10	66.9	90	17	130.5	147	19	111.3	106
SARAN	Saraiva	Carnaxide/PT	RO1	21	176.5	332	23	155.4	178	5	38.9	33
			RO2	18	148.3	324	18	133.2	172	10	69.2	85
			RO3	22	157.3	453	19	159.7	239	10	85.8	155
			RO4	19	153.2	141	19	117.8	81	9	78.1	43
			SOFIA	24	147.0	400	21	139.5	200	9	72.2	75
SCALE	Scarpa	Alberoni/IT	LEO	20	131.0	300	22	140.4	145	26	177.1	109
SCHHA	Schremmer	Niederkrüchten/DE	DORAEMON	21	116.7	242	20	158.2	228	20	107.6	144
SLAST	Slavec	Ljubljana/SI	KAYAK1	12	88.5	117	20	151.6	130	17	119.2	85
			KAYAK2	12	95.4	132	23	185.3	136	16	125.9	63
STOEN	Stomeo	Scorze/IT	MIN38	27	176.0	1100	23	183.9	630	29	207.1	540
			NOA38	26	183.5	1130	23	198.8	645	28	225.2	520
			SCO38	25	175.3	1211	23	199.7	655	29	213.4	618
STRJO	Strunk	Herford/DE	MINCAM2	20	114.5	427	25	150.6	501	24	109.5	250
			MINCAM3	18	122.2	188	20	157.2	222	21	113.1	108
			MINCAM4	15	64.6	105	20	145.4	151	18	71.1	62
			MINCAM5	17	104.6	164	22	154.8	183	23	102.4	104
			MINCAM6	20	116.7	216	20	147.3	186	22	98.9	114
TEPIS	Tepliczky	Agostyan/HU	HUAGO	20	123.8	407	19	172.3	261	25	161.8	206
			HUMOB	11	74.6	236	21	179.3	214	23	141.2	139
WEGWA	Wegrzyk	Nieznaszyn/PL	PAV78	12	55.5	95	17	58.9	148	20	39.7	79
YRJIL	Yrjölä	Kuusankoski/FI	FINEXCAM	10	79.3	186	14	81.3	138	18	98.7	166
ZAKJU	Zakrajšek	Petkovec/SI	PETKA	20	147.3	904	23	186.0	677	26	193.7	632
			TACKA	18	123.2	245	19	183.5	206	25	190.1	191
Sum				**31**	**9335.3**	**33228**	**28**	**12712.0**	**26248**	**31**	**11508.1**	**21937**