

# Projekt 1: SLR Einstelldaten

VU Echtzeitanwendungen geodätischer Weltraumverfahren  
SS 2019

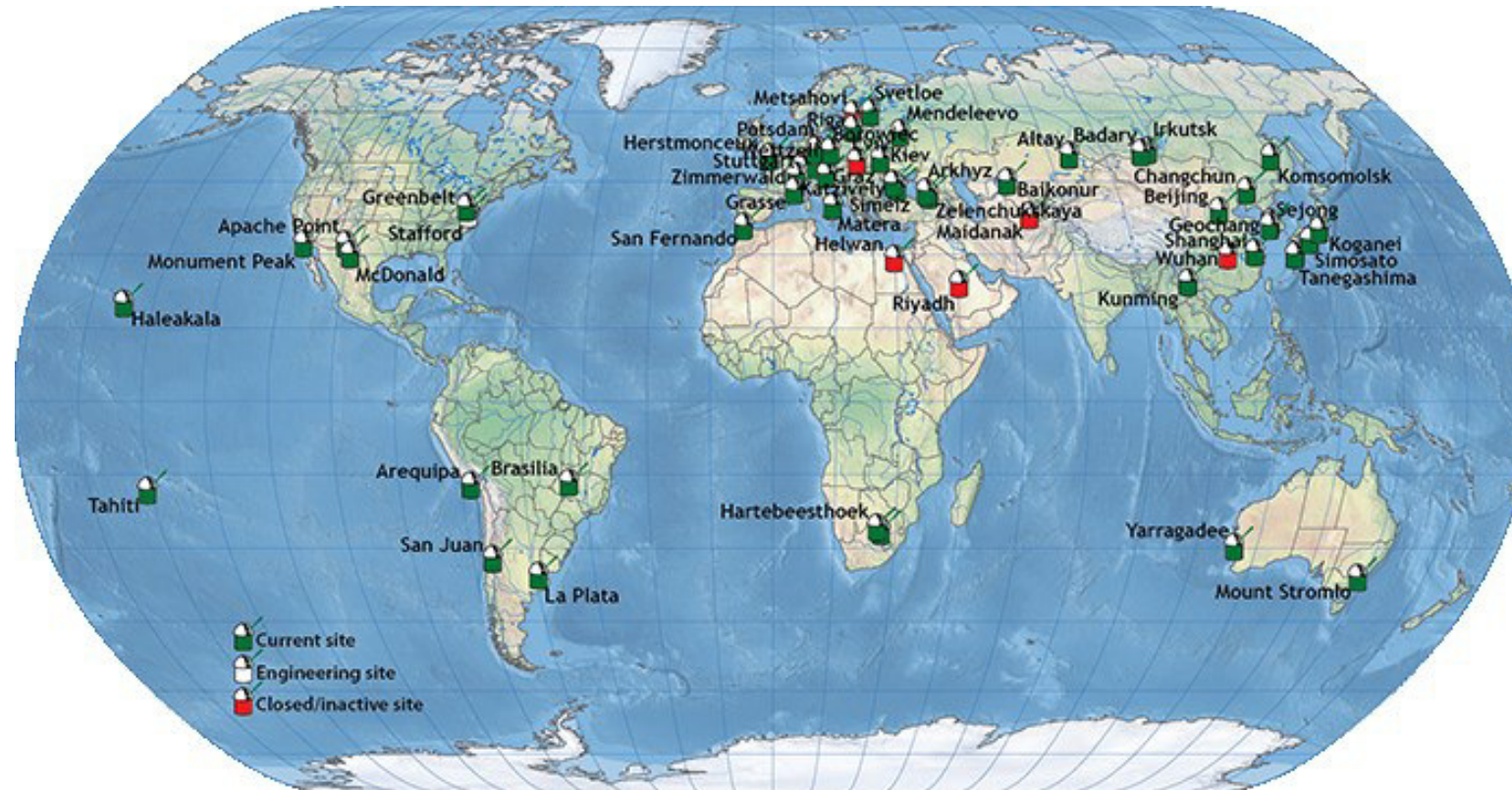
Gruppe 2

# Aufgabenstellung

- Berechnung eines 24h Beobachtungsplan für Laserteleskop
  - ILRS Satellitenprioritätenliste
  - ILRS Station
- Vorgaben:
  - Elevation  $> 10$  Grad
  - Bahnhöhe  $\leftrightarrow$  Beobachtungsdauer
  - Maximale Drehrate = 50 Grad/Minute
  - Beobachtungsstart & -ende immer zur vollen Minute
  - Maximal 10 verschiedene Satelliten

# ILRS Stationen

- International Laser Ranging Service



# Greenbelt

- Ostküste Nordamerikas
- Position (WGS84):
  - X: 1130745.549 m
  - Y: -4831368.033 m
  - Z: 3994077.168 m
- Latitude: 39.0202694 N deg
- Longitude: 283.1723048 E deg
- Elevation: 18.496 m

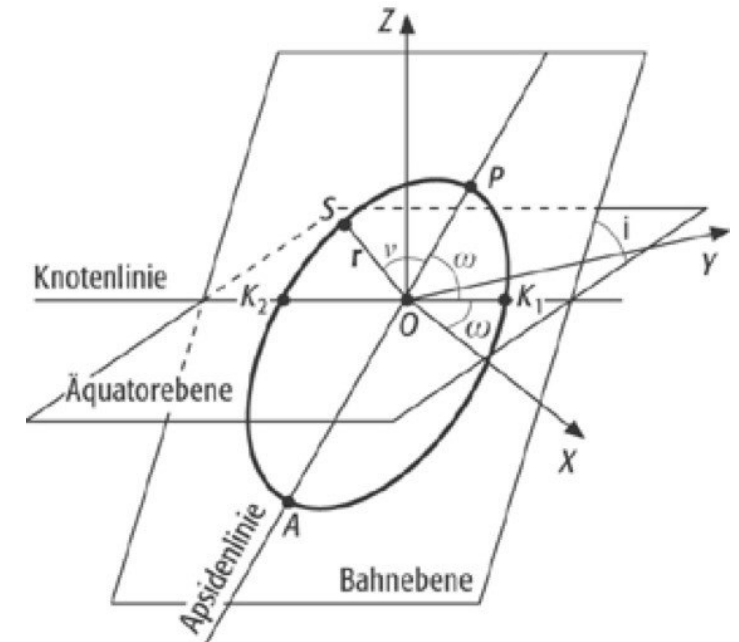


# Durchführung

- Download der Ephemeriden am 26.03.19
- Berechnung der erdfesten Satellitenkoordinaten
- Berechnung der Einstelldaten
- Sichtbarkeitsplot
- Beobachtungsplan
- Skyplot

# Ephemeriden

- „Two-Line Orbital Element“ Format
  - Name, Nummer des Satelliten
  - Datum & Uhrzeit
  - Keplerelemente
    - Exzentrizität []
    - Inklination [deg]
    - Rektaszension des aufsteigenden Knotens (raumfest) [deg]
    - Argument des Perigäums [deg]
    - Mittlere Anomalie [deg]



GRACE-FO 1

1 43476U 18047A 19084.88958892 .00000329 00000-0 12313-4 0 9991  
2 43476 89.0045 197.9822 0017557 175.2507 184.8910 15.23833181 46750

# Positionsberechnung (1)

- Große Halbachse  $a$  [m]

$$a = \sqrt[3]{\frac{GM}{n^2}}$$

$GM$  ... geozentrische Gravitationskonstante [ $m^3/s^2$ ]

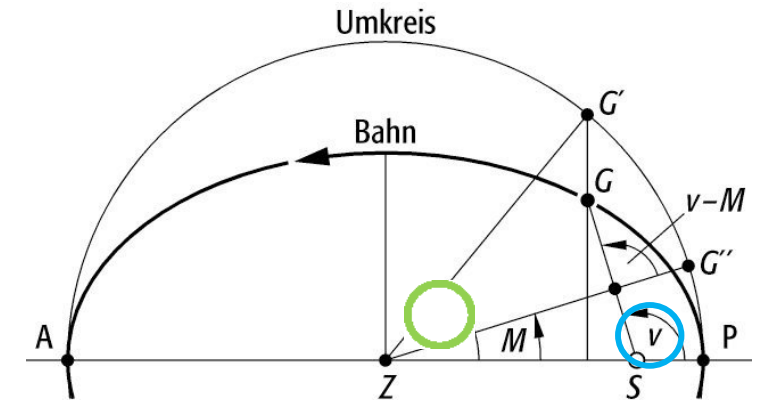
$n$  ... Umdrehungen [ $^\circ/s$ ]

# Positionsberechnung (2)

- Wahre Anomalie  $v$  [deg]

$$E_l = M$$

$$E_{l+1} = M + e * \sin E_l$$



$$v = 2 * \arctan \left( \sqrt{\frac{1+e}{1-e}} * \tan \left( \frac{E_{l+1}}{2} \right) \right)$$

$M$  ... Mittlere Anomalie [deg]

$e$  ... Exzentrizität []



# Positionsberechnung (3)

- Satellitenposition in der Bahnebene

$$\begin{aligned}X' &= r * \cos(\omega) \\Y' &= r * \sin(\omega) \\Z' &= 0\end{aligned}$$

- Korrektur der Rektaszension

$$\Omega_{erdfest} = \Omega_{raumfest} - \dot{\Omega}_e * t_{0e}$$

$\dot{\Omega}_e$  ... Erdrotationsgeschwindigkeit [ $deg/s$ ]

$t_{0e}$  ... vergangene Zeit ab GPS-Wochenbeginn [s]

# Positionsberechnung (4)

- Erdfeste Koordinaten

$$\begin{aligned}X &= X' * \cos(\Omega) - Y' * \sin(\Omega) * \cos(i) \\Y &= X' * \sin(\Omega) + Y' * \cos(\Omega) * \cos(i) \\Z &= Y' * \sin(i)\end{aligned}$$

$\Omega$  ... Rektaszension (erdfest) [*deg*]

$i$  ... Inklination [*deg*]

# Einstelldaten

$$\alpha = \arctan\left(\frac{-\sin\Lambda * \Delta x + \cos\Lambda * \Delta y}{-\sin\Phi * \cos\Lambda * \Delta x - \sin\Phi * \sin\Lambda * \Delta y + \cos\Phi * \Delta z}\right)$$

$$\zeta = \arccos\left(\frac{1}{s}(\cos\Phi * \cos\Lambda * \Delta x + \cos\Phi * \sin\Lambda * \Delta y + \sin\Phi * \Delta z)\right)$$

$$s = \sqrt{\Delta x^2 + \Delta y^2 + \Delta z^2}$$

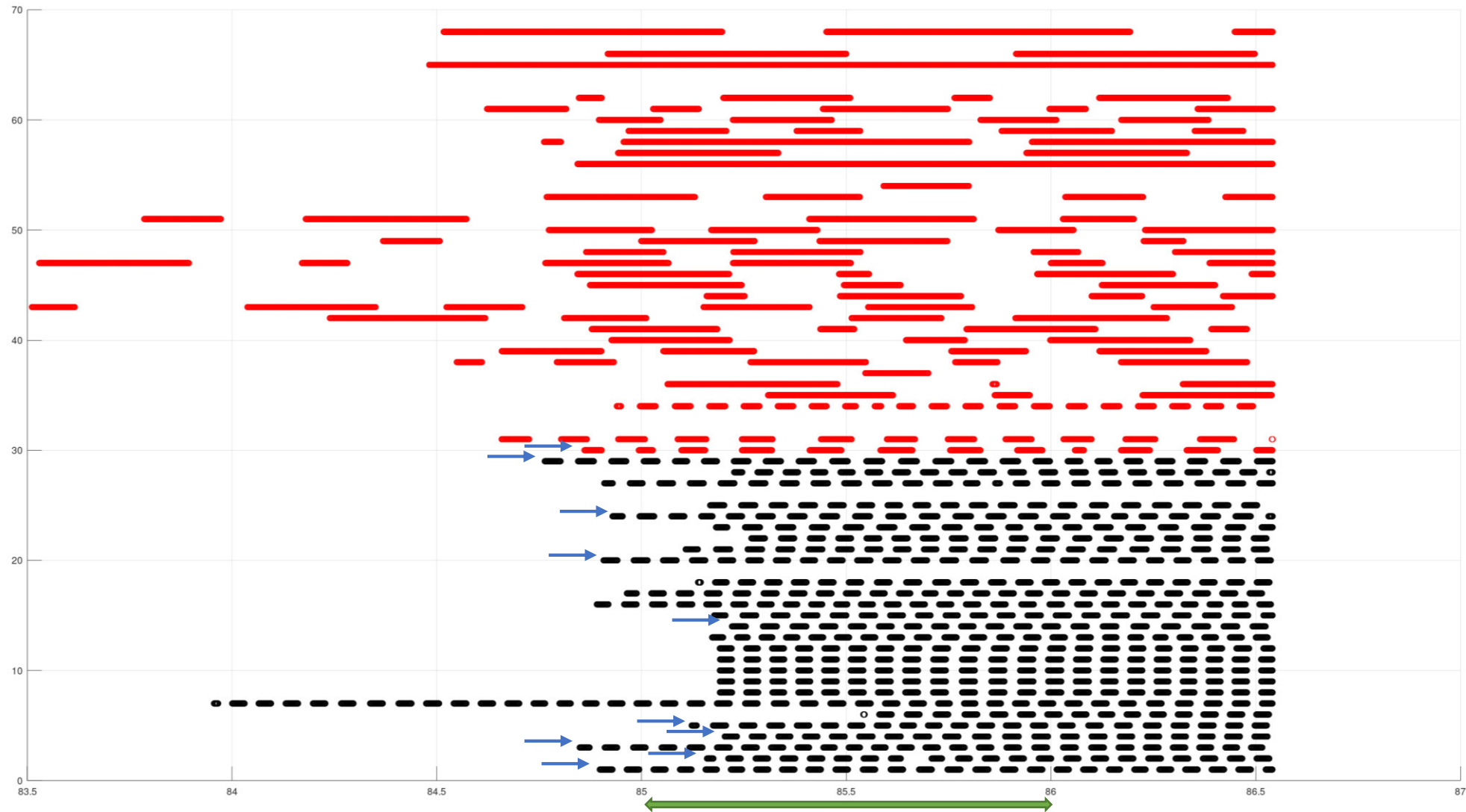
$\Lambda, \Phi$ ... Länge, Breite der Station [*deg*]

$\Delta x, \Delta y, \Delta z$  ... Koordinatendifferenzen [*m*]

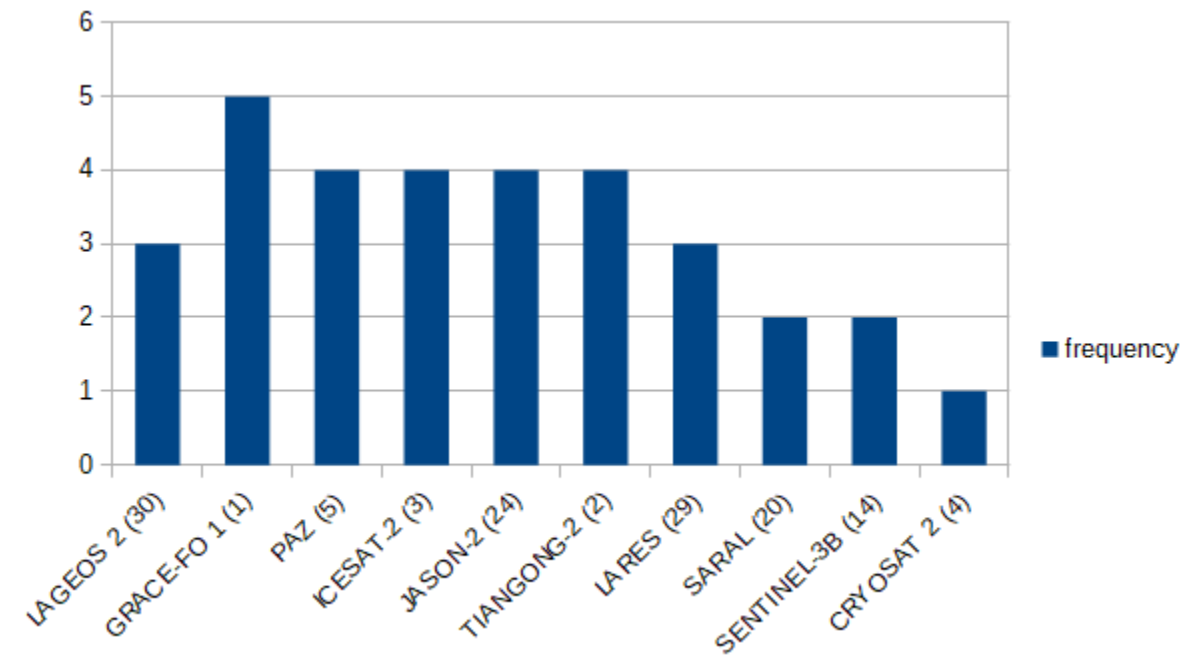
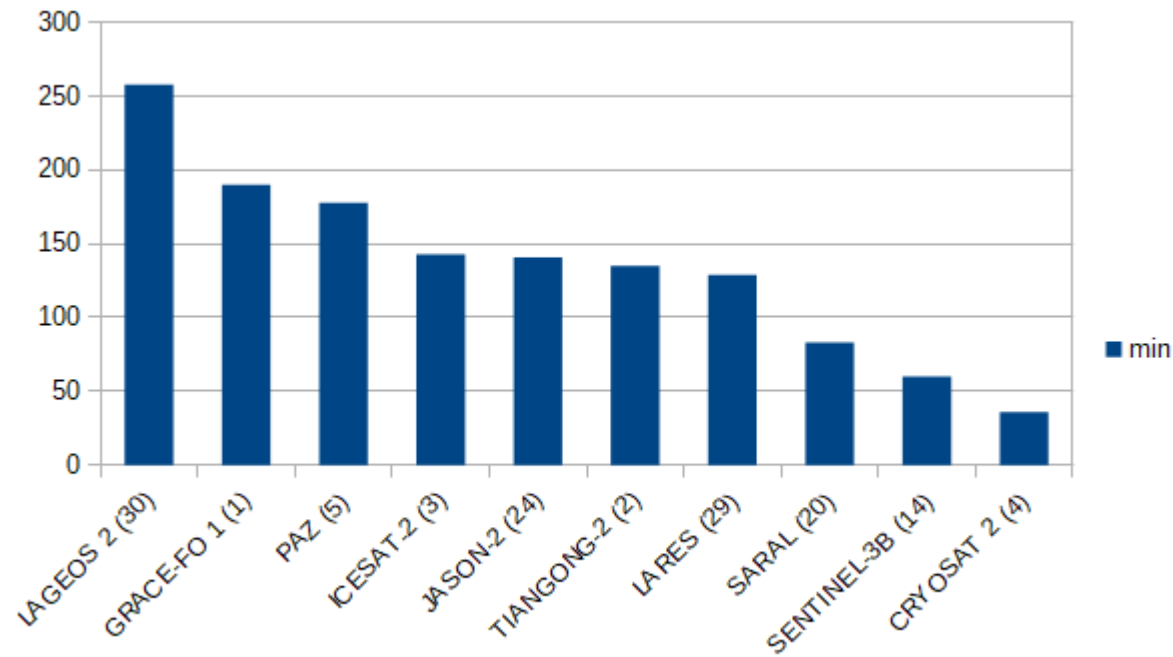
# Satelliten

- 10 Satelliten:
  - GRACE-FO 1 (1)
  - TIANGONG-2 (2)
  - ICESAT-2 (3)
  - CRYOSAT 2 (4)
  - PAZ (5)
  - SENTINEL-3B (14)
  - SARAL (20)
  - JASON-2 (24)
  - LARES (29)
  - LAGEOS 2 (30)

# Sichtbarkeit

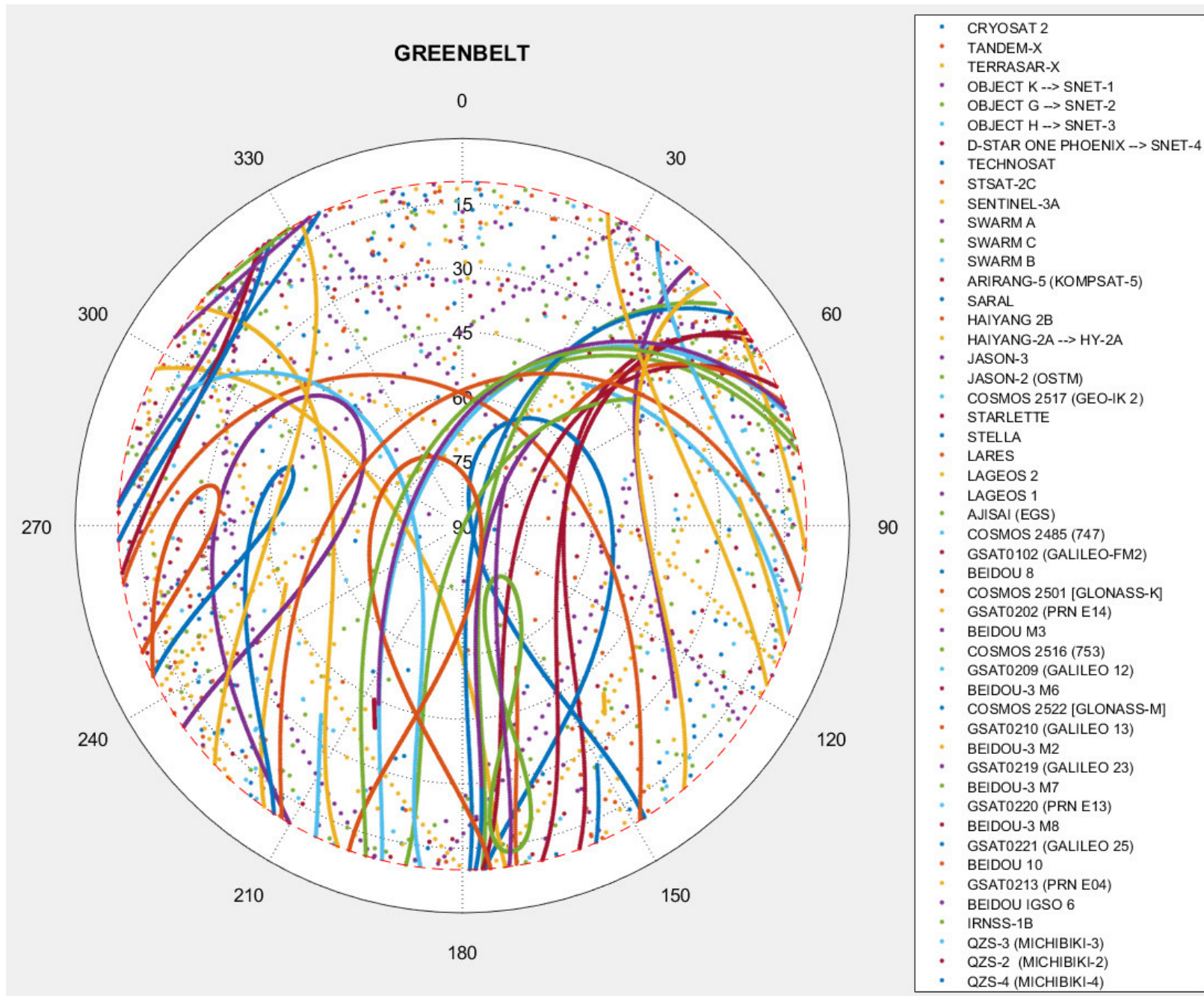


# Beobachtungsdauer & Häufigkeit



# Skyplot

26.03.2019



# Zusammenfassung

- Satellitenpositionen aus den Keplerelementen berechnet
- 10 verschiedene Satelliten beobachtet
- Bevorzugt Satelliten mit hoher Priorität beobachtet
- Satellit mit Priorität 30 am längsten beobachtet (ca. 250 min)
- Satellit mit Priorität 1 am häufigsten beobachtet (5 mal)



# Probleme

Bei der Berechnung wurden die West- und Ostkomponenten vertauscht, dadurch ergab sich ein Fehler in unseren Berechnungen. Aufgrund dessen sind Skyplot und Beobachtungsplan fehlerhaft. Auch die Berechnung für den Skyplot mit den „falschen“ Koordinaten führte zu keinem sinnvollen Ergebnis. Auch durch mehrmalige Kontrolle des Formelapparates konnte der Berechnungsfehler nicht gefunden werden, da wir uns streng an die Formeln aus UE Satellitengeodäsie und VU Geokoordinatensysteme gehalten haben, ist uns dies nach wie vor unklar. Der Skyplot wurde korrigiert, der Beobachtungsplan allerdings bezieht sich auf die fehlerhaften Berechnungen.

# Beobachtungsplan26032019

Time	Satellite	Elevation	Azimuth
0	JASON-2 (24)	61.9955382005866	23.0292898324984
1		67.7062629881952	15.4711052654725
2		72.5857237103149	5.33960529414586
3		76.4687668107209	351.080382317801
4		79.0538305190709	331.119014939959
5		79.9915082156583	306.742877728345
6		79.3240582355409	283.898724993944
7		77.6069038591743	266.768331441007
8		75.3944005916363	254.847865114357
9		73.0007753839387	246.391220253259
10		70.5724340005235	240.101389398483
11		68.1736020672046	235.194077969363
12		65.830872030034	231.205010942752
13		63.5534983768863	227.851700387573
14		61.3426672926041	224.955416555562
15		59.1958692008065	222.398535450595
16		57.109025967944	220.100782329796
17		55.0775448686337	218.005556621561
18		53.0968399455873	216.071775072497
19		51.162581382894	214.268837016986
20		49.2708035468695	212.573416997609
21		47.4179393310521	210.967362005819
22		45.6008166784643	209.436276694936
23		43.8166366095515	207.968548922421
24		42.0629432333151	206.554664202516
25		40.3375913855641	205.186714045915
26		38.6387148608408	203.858037117657
27		36.9646967107772	202.562953102186
28		35.3141422492263	201.296562399459
29		33.6858549464856	200.054593311847
30		32.0788151504881	198.833283994481
31		30.4921614504408	197.629290199206
32		28.9251744453104	196.439612399743
33		27.3772626651854	195.261537653129
34		25.8479504000408	194.09259279173
35		24.3368672073901	192.930506420443
36		22.8437388918487	191.773177827151
37		21.368379772201	190.618651375463
38		19.9106860735192	189.465095288183
39		18.4706303021342	188.310783982332
40		17.048256479484	187.154083306309
41		15.6436761269217	185.993438173667
42		14.2570649075325	184.82736219825
43		12.8886598430038	183.654429020687
44		11.5387570338134	182.473265082651
45		10.2077098196195	181.282543657598
46	Teleskop-Umstellen		
47	Teleskop-Umstellen		
48	Teleskop-Umstellen		
49	GRACE-FO 1 (1)	42.8002753697059	83.4654999669382
50		47.9266938759687	84.8032396328178
51		52.80754406917	86.8330340406429

# Beobachtungsplan26032019

52	57.3792759104629	89.7481639626327
53	61.5708684545329	93.8094657243864
54	65.2949897512966	99.3490090460028
55	68.4382026072388	106.730534395987
56	70.8577764004185	116.201300256666
57	72.402603345404	127.585748041941
58	72.9742368184266	139.994203086196
59	72.5990431672565	152.022984620149
60	71.4343841335898	162.492916111491
61	69.6947541212226	170.938439670813
62	67.5752357713092	177.469832339012
63	65.2209693776751	182.429360393632
64	62.7298399689901	186.174216390277
65	60.1650924056018	188.999539865787
66	57.5669533893909	191.12918268556
67	54.96089265284	192.727742348858
68	52.3629999575623	193.915400088266
69	49.7833866870575	194.78025692072
70	47.2283306927352	195.387470938608
71	44.7016390779756	195.785747194058
72	42.2055245195805	196.0118879714
73	39.7411762358924	196.093984285981
74	37.3091367900023	196.053669636805
75	34.9095536979641	195.907727367682
76	32.5423492231556	195.669249972082
77	30.2073360589672	195.348485013685
78	27.9042968593582	194.953459518749
79	25.6330394303499	194.490446008421
80	23.3934354581712	193.964314053873
81	21.1854480900557	193.378798182165
82	19.0091519958678	192.736704045147
83	16.8647484108587	192.040068616357
84	14.7525768962336	191.290285901373
85	12.6731250303961	190.488206640536
86	10.6270368792332	189.634218353631
87	Teleskop-Umstellen	
88	Teleskop-Umstellen	
89	Teleskop-Umstellen	
90	SARAL (20)	57.7484150488501 98.6792234593979
91		57.4431256479391 102.924950924281
92		56.9905837982711 106.992174350123
93		56.4052929290242 110.870573347172
94		55.7005316406701 114.554550981131
95		54.8884402464551 118.042773012644
96		53.9800708676603 121.337495722351
97		52.9854294201707 124.443812122885
98		51.9135227521612 127.368911856531
99		50.7724151013277 130.12141459976
100		49.5692931745846 132.710806903048
101		48.3105370384506 135.146990638529
102		47.0017935137256 137.439937431291
103		45.6480491059264 139.59943607711
104		44.2537001758369 141.634917106508

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105	42.8226187808293	143.555338642301
106	41.3582132597097	145.369119219998
107	39.8634831411309	147.084105419894
108	38.3410683243979	148.707564461123
109	36.7932927297263	150.246194041968
110	35.222202767763	151.706143548341
111	33.6296010601416	153.093042259619
112	32.0170758751824	154.412031375112
113	30.3860267422245	155.667797605436
114	28.7376866869296	156.864606768124
115	27.0731414970809	158.006336341356
116	25.3933463900036	159.09650630375
117	23.6991404127146	160.138307854954
118	21.9912588668	161.134629797896
119	20.2703440132427	162.088082489795
120	18.5369542787559	163.001019351196
121	16.7915721549066	163.875555972258
122	15.034610954502	164.713586882096
123	13.2664205660786	165.516800056437
124	11.4872923269023	166.286689235758
125 Teleskop-Umstellen		
126 Teleskop-Umstellen		
127 Teleskop-Umstellen		
128 JASON-2 (24)	50.3717246455736	244.078222414022
129	47.57713225062	241.251701398202
130	44.9385631657719	238.686208447669
131	42.4440910768749	236.319771163259
132	40.0816607637308	234.108161538006
133	37.8397689798315	232.018970555647
134	35.7077869984982	230.027886265471
135	33.6760844765026	228.11628472438
136	31.7360444759342	226.269628120946
137	29.880020974596	224.476373590458
138	28.1012683484309	222.727213637695
139	26.3938596708212	221.014537010582
140	24.7526032720226	219.332039291221
141	23.1729626439431	217.674437160079
142	21.6509822137943	216.03725573284
143	20.1832200195198	214.416668243632
144	18.7666874713473	212.80937378982
145	17.3987959202727	211.212503134013
146	16.0773095204361	209.62354545217
147	14.8003037738443	208.040290903119
148	13.5661291252799	206.46078527848
149	12.3733789976994	204.883293968763
150	11.2208617029287	203.306273179399
151	10.1075757165535	201.72834683499
152 Teleskop-Umstellen		
153 Teleskop-Umstellen		
154 GRACE-FO 1 (1)	75.8128940808732	170.746882568463
155	73.773393042367	184.884416236276
156	70.9508217247776	194.752026227829
157	67.7170736290027	201.367508676478

# Beobachtungsplan26032019

158	64.2935058368928	205.783950211878
159	60.8039550151481	208.737916226906
160	57.3179611165211	210.70021366303
161	53.8752285377196	211.969541292532
162	50.4985913012727	212.739016411037
163	47.2009914376899	213.136810394739
164	43.9893876538756	213.2502853484
165	40.8670440880485	213.140465462585
166	37.8349268271482	212.850906929915
167	34.8925861409916	212.413276909604
168	32.038729261878	211.850955380837
169	29.2715997226505	211.181419377717
170	26.5892318142626	210.417858598774
171	23.9896222892743	209.570294308765
172	21.4708460949166	208.646370210695
173	19.0311336612214	207.651922364575
174	16.668921479618	206.591397623999
175	14.3828839684241	205.468166596367
176	12.1719521386742	204.284762183374
177	10.035322884867	203.043065045101
178	Teleskop-Umstellen	
179	Teleskop-Umstellen	
180	Teleskop-Umstellen	
181	Teleskop-Umstellen	
182	ICESAT-2 (3)	69.463256729256
183		95.3190200506483
184	66.8010814978435	98.711081969966
185	64.3484191828499	101.719089697886
186	62.0623350701383	104.462445448101
187	59.9089879247775	107.009425374858
188	57.8617504129532	109.402249039315
189	55.8996091848845	111.668745808793
190	54.0059012429747	113.828278497275
191	52.1673411284024	115.894964154002
192	50.3732777368519	117.879524584947
193	48.6151265401726	119.790399073226
194	46.8859342239503	121.634439609882
195	45.1800430555119	123.417359853782
196	43.4928305379451	125.144033605099
197	41.8205061619328	126.818698496299
198	40.1599517142261	128.445098394722
199	38.508595025048	130.02658524764
200	36.8643095553089	131.566193529497
201	35.2253340816653	133.066695833222
202	33.590208112889	134.530645260963
203	31.9577196952894	135.960408425851
204	30.326863032384	137.358191675769
205	28.6968039227289	138.726062354858
206	27.0668514590137	140.06596638356
207	25.43643476701	141.379743073324
208	23.8050838207961	142.669137840375
209	22.172413570111	143.935813307325
210	20.538110770711	145.181359157781
	18.9019230300578	146.40730102123

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211	17.2636496759302	147.615108602894
212	15.6231341311583	148.806203228203
213	13.9802575375119	149.981964939396
214	12.334933419704	151.143739258802
215	10.6871032188538	152.292843717231
216 Teleskop-Umstellen		
217 Teleskop-Umstellen		
218 JASON-2 (24)	22.2202113535195	84.7781357532345
219	24.0854866424624	82.6022641444752
220	26.075177527754	80.3327840551131
221	28.204327056366	77.9483999985523
222	30.4900719684138	75.4215074134831
223	32.951602081777	72.715678012006
224	35.6097951542326	69.7818836586391
225	38.4862264813577	66.5526970884723
226	41.601012447982	62.933181973735
227	44.9685187377771	58.7862860639319
228	48.5891986650846	53.9091085967006
229	52.4344759491	47.9946005045054
230	56.4193472764794	40.5735272741332
231	60.3546828892234	30.9469807457898
232	63.8740930614587	18.2006338055823
233	66.3686249281951	1.63421268465102
234	67.091114470477	342.022804423489
235	65.6167090584291	322.398757734392
236	62.2304333770904	305.800750432531
237	57.6397563115981	293.012537431178
238	52.5056019034955	283.336699360638
239	47.2808540175914	275.858610706051
240	42.2342344664657	269.878574051358
241	37.5067230442074	264.926820679115
242	33.158099349746	260.696071125474
243	29.1997858435139	256.983421286599
244	25.6166219287838	253.651974356421
245	22.3805493656947	250.607063619916
246	19.4587398656016	247.781618444442
247	16.8181162517413	245.12703793153
248	14.4276537628335	242.607381474418
249	12.2593811168329	240.195586051418
250	10.2886585987651	237.870946996078
251 Teleskop-Umstellen		
252 PAZ (5)	10.5369664813299	224.423127843933
253	13.0313897525311	226.349040281712
254	15.7756457788748	228.24916265335
255	18.7997595519133	230.120164696408
256	22.13648842046	231.957669087664
257	25.820325403812	233.755763608611
258	29.8855687394149	235.506223635873
259	34.3630648784785	237.197221862452
260	39.2752667081356	238.811081663107
261	44.6295044894018	240.320130664859
262	50.4099778855232	241.678474915074
263	56.5699392493887	242.804103929631

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264	63.0264027373173	243.534892718702
265	69.659095178012	243.500180083346
266	76.308893117984	241.633958421088
267	82.7236418285448	233.256580462728
268	87.3360576919843	173.539576418425
269	83.6246177042752	102.609655627237
270	78.1413473518818	92.7713927773993
271	72.8864308472865	90.5494850651591
272	68.0012597609288	90.3340301404588
273	63.5000596759415	90.922763705765
274	59.365851985706	91.9099823876809
275	55.5698738413704	93.1214506601877
276	52.0792428926452	94.470182753805
277	48.8608156894451	95.9080353473688
278	45.8831910129532	97.4062952701268
279	43.1176617204263	98.9468486524253
280	40.5385560714091	100.517765376813
281	38.1232353343945	102.110922271233
282	35.8519109609879	103.720645630847
283	33.7073792367699	105.342897229539
284	31.6747300425474	106.974765926928
285	29.7410608051549	108.614138963805
286	27.89521130002	110.259483024752
287	26.1275259489604	111.909694604688
288	24.4296451860073	113.563995411871
289	22.7943247750847	115.221857790855
290	21.2152806763126	116.88295061282
291	19.6870565713311	118.547099405079
292	18.2049111110014	120.214256568234
293	16.7647221170526	121.884478857838
294	15.3629052734068	123.557910175477
295	13.9963450952891	125.234768292461
296	12.6623363353053	126.91533452139
297	11.3585342084934	128.599945620959
298	10.0829120931161	130.288987408032
299	Teleskop-Umstellen	
300	Teleskop-Umstellen	
301	CRYOSAT 2 (4)	49.2298676088281
302		88.0293395775792
303		53.5574381498632
304		89.7195078165426
305		57.7293655053711
306		92.1505636071081
307		61.6857582924288
308		95.5639075188024
309		65.3482989532145
310		100.293481550048
311		68.6092094389041
312		106.772401691195
313		71.3189401092152
314		115.467223050695
315		73.285317858686
316		126.62369611642
		74.314271887357
		139.775386816002
		74.3088346151318
		153.461452804047
		73.3509525644712
		165.896294178206
		71.6590940587508
		176.042650317692
		69.4726024406883
		183.815771680298
		66.9806235058872
		189.608342516341
		64.3119742089382
		193.88987971406
		61.5492857381481
		197.052465556295

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317	58.7446454957019	199.387865626615
318	55.9308801524422	201.105034182181
319	53.1287632336685	202.352562295649
320	50.3514644392753	203.236784320843
321	47.6072951662785	203.834696941855
322	44.9014254472343	204.202812647578
323	42.236977535176	204.38317059784
324	39.6157360185604	204.407434734868
325	37.0386174745652	204.299716976412
326	34.5059862927692	204.078547757933
327	32.0178701886031	203.758270934268
328	29.5741091557181	203.350045290993
329	27.1744595709973	202.862573630189
330	24.8186676886426	202.302640662371
331	22.5065220196055	201.675514971392
332	20.2378910284888	200.985253169731
333	18.0127505621065	200.234932899899
334	15.8312040710888	199.426833583512
335	13.6934977632206	198.562578510446
336	11.6000321868909	197.643248183474
337	Teleskop-Umstellen	
338	Teleskop-Umstellen	
339	Teleskop-Umstellen	
340	Teleskop-Umstellen	
341	SENTINEL-3B (14)	73.8695536676819
342		79.0567687002189
343		68.8953194557849
344		80.7419816759729
345		64.2434134196269
346		82.4277908175477
347		59.9144241343967
348		84.1125025549736
349		55.8979730421898
350		85.7955601266058
351		52.1765367838245
352		87.4768271185885
353		48.7285816539101
354		89.156353109235
355		45.5308969767257
356		90.8342811930822
357		42.560195528568
358		92.5108064352661
359		39.7941246472886
360		94.1861553518169
361		37.2118424776725
362		95.8605750288285
363		34.7942937378816
364		97.5343270373581
365		32.5242896014218
366		99.2076838970893
367		30.3864674743266
368		100.880926970165
369		28.3671827611708
370		102.554345194716
371		26.4543668988176
372		104.228234330442
373		24.637373283546
374		105.902896526384
375		22.9068240942147
376		107.578640096509
377		21.2544653308976
378		109.255779431675
379		19.6730337559764
380		110.934635001842
381		18.1561371774508
382		112.615533417671
383		16.6981481789662
384		114.298807530116
385		15.294110652572
386		115.984796552619
387		13.9396581105853
388		117.673846194326
389		12.6309425989615
390		119.366308795223
391		11.3645730138054
392		121.062543455664
393		10.1375616763981
394		122.762916153797
395	Teleskop-Umstellen	
396	Teleskop-Umstellen	



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370 ICESAT-2 (3)	61.3071410110967	89.7057018103927
371	63.0269263329262	95.4761119321
372	64.2411967600575	101.653737394935
373	64.9820370916987	108.058556833861
374	65.2857849960916	114.484429595529
375	65.1952047068557	120.73102343882
376	64.7583711881222	126.634025029119
377	64.0254610759937	132.082658054437
378	63.0451158065298	137.021365232701
379	61.8616282172595	141.4400658299
380	60.5134160899496	145.359962531511
381	59.0326379300543	148.820188511631
382	57.4455601734646	151.86769505363
383	55.773298196158	154.550661877149
384	54.0326673908183	156.914741116103
385	52.2369961576329	159.001245448629
386	50.3968349683261	160.846530832416
387	48.5205438683532	162.482045023514
388	46.6147647450423	163.934705963928
389	44.684794260073	165.227412467672
390	42.7348754221113	166.379578999448
391	40.768424458114	167.407640254778
392	38.7882071096721	168.325502067978
393	36.796475780935	169.144931870548
394	34.7950765357785	169.875890367958
395	32.7855329211187	170.526809911266
396	30.7691119815781	171.104826348214
397	28.7468765760084	171.615971171024
398	26.7197271440531	172.065330216667
399	24.6884353384958	172.45717438684
400	22.6536713849813	172.795067027874
401	20.6160266122664	173.081951834844
402	18.576032281172	173.320224455819
403	16.5341756038701	173.511790380037
404	14.4909136684378	173.658111193217
405	12.4466858528292	173.760240863737
406	10.4019252173485	173.818853372881
407 Teleskop-Umstellen		
408 Teleskop-Umstellen		
409 TIANGONG-2 (2)	44.832128976649	221.984573734355
410	47.1765742595441	218.869775850834
411	49.1740783080085	215.44878594724
412	50.8289928324246	211.756353171889
413	52.1473546270446	207.840251829776
414	53.1376845161005	203.760256526946
415	53.8116851535612	199.585081941718
416	54.1846157024237	195.387564880429
417	54.2752066500029	191.238929365206
418	54.1051042972925	187.203297642936
419	53.69795792559	183.333518087319
420	53.0783379397326	179.668925442656
421	52.2706802212135	176.235065635907
422	51.2984033013022	173.044961089411

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423	50.1832726295542	170.10129144184
424	48.9450202758216	167.398896565184
425	47.6011849443403	164.92717069298
426	46.1671179786013	162.672105379325
427	44.656099774901	160.617892959797
428	43.07951956097	158.748101397744
429	41.4470833878472	157.046481688871
430	39.767026591978	155.497485419272
431	38.046316227162	154.08656725188
432	36.290835693179	152.80033564628
433	34.5055482965425	151.626601367991
434	32.6946392784221	150.554360535713
435	30.861637437494	149.573738351955
436	29.0095182706048	148.675911478025
437	27.1407908526223	147.853020988067
438	25.2575706853553	147.098083552075
439	23.361640598607	146.404905536705
440	21.4545015679725	145.768002718135
441	19.5374150734324	145.182526992597
442	17.6114383876809	144.644200637576
443	15.6774539673702	144.1492581685
444	13.7361939298885	143.694395545167
445	11.788260434094	143.276726335401
446 Teleskop-Umstellen		
447 LARES (29)	25.0484236030893	160.714009512722
448	26.4947138986819	159.687644113812
449	27.9296563863456	158.623183432021
450	29.3519085486651	157.516896088284
451	30.7599637853035	156.364777432253
452	32.1521295910943	155.162532433044
453	33.5265028496952	153.905561020907
454	34.8809419633643	152.588947406169
455	36.2130355630435	151.207455415356
456	37.5200675956224	149.755532523063
457	38.7989786795053	148.227326033245
458	40.0463237710679	146.616715775113
459	41.2582264127539	144.917368703671
460	42.4303301599642	143.122821873241
461	43.5577482310134	141.226601264314
462	44.6350130105325	139.222384685297
463	45.6560277686046	137.104217122116
464	46.6140238187887	134.866786016031
465	47.501527270959	132.505761424413
466	48.3103404219544	130.018201188563
467	49.0315434708857	127.403013477804
468	49.6555223597104	124.661458087964
469	50.1720277628565	121.797654018357
470	50.5702682065942	118.819045636278
471	50.8390367151516	115.736766125044
472	50.9668652506155	112.565829263824
473	50.9421949791231	109.325083881832
474	50.7535440492344	106.036883508518
475	50.3896495760528	102.726457526648

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476	49.8395585024086	99.4210152389592
477	49.0926441998201	96.1486612593198
478	48.1385324306381	92.9372373235194
479	46.9669308521179	89.8132213023956
480	45.5673689723109	86.8008041187477
481	43.9288685747739	83.9212326430458
482	42.0395770189761	81.1924612866133
483	39.8864077271331	78.6291092523995
484	37.4547452780368	76.2426845599798
485	34.7282895706343	74.0420155030952
486	31.6891372854729	72.033825405654
487	28.3182305873245	70.2233940643215
488	24.5963396531898	68.6152643298174
489	20.5057756255518	67.213970509519
490	16.0330281663165	66.0247836702616
491	11.1724423216026	65.0544860562255
492	Teleskop-Umstellen	
493	Teleskop-Umstellen	
494	Teleskop-Umstellen	
495	Teleskop-Umstellen	
496	TIANGONG-2 (2)	10.4937148128874 244.023932133457
497		17.326023860603 243.448273099059
498		23.3397225011474 242.435710155205
499		28.5720187389954 241.020077199626
500		33.0894617071782 239.229326077698
501		36.9663212973224 237.088477610361
502		40.2730279010081 234.622260560927
503		43.0713758133758 231.857406689398
504		45.4135653948683 228.82449701241
505		47.3431334694036 225.559192989173
506		48.896634496244 222.102667868805
507		50.1054541887033 218.501104229515
508		50.9974330554981 214.804251159169
509		51.5981433348026 211.063213235611
510		51.9317644774896 207.327815822781
511		52.021572952252 203.643989395802
512		51.8901120008174 200.051596686598
513		51.5591355563899 196.582997080408
514		51.0494266485688 193.262455062232
515		50.3805775447074 190.106321410779
516		49.5707942648189 187.123797187916
517		48.6367607442515 184.318047026773
518		47.5935745308383 181.687446079149
519		46.4547497423904 179.226797236878
520		45.2322742641388 176.928416385105
521		43.9367052452204 174.783036910096
522		42.5772877440568 172.780523455757
523		41.1620840158792 170.910408679597
524		39.6981041317198 169.162278490847
525		38.1914316177515 167.526034796493
526		36.647340270776 165.992063510235
527		35.0704001605239 164.551331960195
528		33.4645721260585 163.195435437629

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529	31.8332909182311	161.916608345128
530	30.179537646347	160.707711648195
531	28.505902454833	159.562205248067
532	26.8146384638497	158.474111464995
533	25.1077080151477	157.4379739696
534	23.3868222123466	156.448815122837
535	21.6534746610949	155.50209368189
536	19.9089702173167	154.593664111951
537	18.1544494520768	153.719738240064
538	16.3909094459683	152.876849640413
539	14.619221437715	152.061820907074
540	12.8401457723072	151.271733818071
541	11.0543445236836	150.50390229959
542 Teleskop-Umstellen		
543 Teleskop-Umstellen		
544 Teleskop-Umstellen		
545 Teleskop-Umstellen		
546 Teleskop-Umstellen		
547 PAZ (5)	19.4739878028259	63.0039322948429
548	27.9275360844788	64.4744153389771
549	34.7127193688019	66.4554686120773
550	40.1853720570952	68.9038459668761
551	44.6322880309188	71.7901202592064
552	48.2649550696631	75.0905613277998
553	51.2338229737168	78.7805773164454
554	53.6447183230667	82.8292208366709
555	55.5724749202223	87.1948684683816
556	57.0712855824308	91.8226061097638
557	58.1823316289088	96.6440040044691
558	58.9392666162113	101.579721045021
559	59.3719521120574	106.544734867491
560	59.5087261325506	111.45518696636
561	59.377472968653	116.235273468511
562	59.0058085381286	120.822633003959
563	58.4207269062503	125.171278673003
564	57.6480272084168	129.251957492973
565	56.7117583845154	133.050494399514
566	55.6338152521353	136.564973977411
567	54.433728583466	139.802561561671
568	53.1286323947197	142.776527275605
569	51.7333641337275	145.503769154866
570	50.260648689684	148.002923421526
571	48.7213244425272	150.293024118835
572	47.1245809134364	152.392617039962
573	45.4781884696503	154.319219871881
574	43.7887091421505	156.089030437689
575	42.0616836386763	157.71680363649
576	40.3017934640288	159.21583731083
577	38.5129992670657	160.598024313078
578	36.6986576476889	161.873941453244
579	34.861619086578	163.052955937859
580	33.0043096921477	164.143336949453
581	31.1287992804681	165.152364846119

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582	29.2368580305859	166.086433681314
583	27.3300036569745	166.951144833101
584	25.4095407494019	167.751390845502
585	23.4765936664326	168.491429377835
586	21.5321341385105	169.17494760875
587	19.5770045414773	169.805117671147
588	17.611937639055	170.384643783549
589	15.6375734599605	170.915801746046
590	13.6544738681934	171.400471419116
591	11.6631353001364	171.840162723118
592 Teleskop-Umstellen		
593 GRACE-FO 1 (1)	20.5961945934646	164.939655596802
594	22.5655971093956	164.626454777925
595	24.5342111992095	164.292192097114
596	26.5018373562041	163.933486423103
597	28.4682126947494	163.546485415637
598	30.4329959052818	163.126776911451
599	32.3957480819226	162.669281756971
600	34.3559082022791	162.16812369036
601	36.3127616361102	161.616470796585
602	38.2653995133419	161.006341743783
603	40.2126660386408	160.328368444651
604	42.1530898256402	159.571505004063
605	44.0847939390841	158.722670940903
606	46.0053774453498	157.766315033382
607	47.911758712818	156.683885445739
608	49.7999672758817	155.453193500966
609	51.6648665862726	154.047665385097
610	53.4997843288052	152.435493469398
611	55.2960204139316	150.578736296672
612	57.0421963577236	148.432489841933
613	58.7234064731217	145.944388202318
614	60.3201378146147	143.054924769143
615	61.8069554114703	139.699448391656
616	63.1510245782903	135.813168576887
617	64.3106925201703	131.340920644933
618	65.2345925751497	126.253247455768
619	65.8620075754157	120.568489059952
620	66.1253062591405	114.375988487764
621	65.9547437246394	107.849227588098
622	65.2845578485358	101.235254935398
623	64.0577189244841	94.8155728437829
624	62.2264177178872	88.8518874651939
625	59.7472579196729	83.5417483297613
626	56.5728905349016	79.0014294002134
627	52.6434857606487	75.2749547972233
628	47.8817310454502	72.3564677003597
629	42.1954488147576	70.2135462015019
630	35.4935670473144	68.8051360469655
631	27.7227839213099	68.0929403458238
632	18.9282308283576	68.0474820875888
633 Teleskop-Umstellen		
634 Teleskop-Umstellen		

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635 Teleskop-Umstellen		
636 Teleskop-Umstellen		
637 LAGEOS 2 (30)	62.680774790003	193.374880227555
638	63.6411753340816	191.495359972839
639	64.5628337144079	189.445244992352
640	65.4404580774906	187.213113225639
641	66.2682144989541	184.788694425866
642	67.0397463278869	182.163739573883
643	67.7482323650258	179.333097271465
644	68.3864961603112	176.295962878661
645	68.9471773874187	173.057211140452
646	69.4229715161318	169.628654146931
647	69.806934910473	166.029998446656
648	70.0928391735645	162.289234704122
649	70.2755431064952	158.442213686167
650	70.3513373298949	154.531268120813
651	70.3182109654152	150.60292622156
652	70.1759961862312	146.704982418191
653	69.9263653825125	142.883365983057
654	69.5726823925825	139.17930625833
655	69.1197353759917	135.627208513501
656	68.5733964105353	132.253464162424
657	67.940257731994	129.076200295898
658	67.227287819984	126.105800525567
659	66.4415369334714	123.345940764631
660	65.5899066140881	120.794877461675
661	64.6789850512037	118.44677414047
662	63.7149417918523	116.292922031395
663	62.7034710421111	114.322777566754
664	61.6497717519117	112.524791075432
665	60.5585535841013	110.887034351954
666	59.434059712508	109.397652515568
667	58.2800994735311	108.045172223439
668	57.1000858182537	106.818698175718
669	55.8970741060647	105.708026240941
670	54.6738000103248	104.703696600651
671	53.4327152048228	103.797005308874
672	52.176020126606	102.979988199028
673	50.9056935296895	102.245387374078
674	49.6235188112551	101.586607599477
675	48.3311072524001	100.997667696928
676	47.0299184035014	100.473150389747
677	45.7212778847051	100.008152856033
678	44.4063928824114	99.5982393964636
679	43.0863656148648	99.2393970312
680	41.7622050220921	98.9279944355669
681	40.4348369125519	98.6607443541935
682	39.1051127743206	98.4346694586949
683	37.7738174343345	98.2470715059896
684	36.4416757262662	98.0955035921386
685	35.1093583066204	97.9777452653277
686	33.7774867397922	97.8917802507903
687	32.4466379561564	97.8357765427665

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688	31.1173481726608	97.8080686289591
689	29.7901163527005	97.8071416279149
690	28.4654072710674	97.83161713703
691	27.143654240312	97.8802406069242
692	25.825261546719	97.9518700757776
693	24.5106066371325	98.0454661142938
694	23.200042091886	98.1600828478936
695	21.8938974139949	98.2948599374087
696	20.5924806603911	98.4490154128642
697	19.2960799372595	98.6218392669438
698	18.0049647783388	98.8126877254754
699	16.71938742234	99.0209781218501
700	15.4395840033155	99.2461843107864
701	14.1657756658289	99.4878325643731
702	12.8981696151065	99.7454978999737
703	11.6369601109099	100.01880079544
704	10.3823294126638	100.307404252251
705 Teleskop-Umstellen		
706 Teleskop-Umstellen		
707 Teleskop-Umstellen		
708 TIANGONG-2 (2)	35.5494876927649	203.446208228097
709	34.6657350450942	201.289094009735
710	33.7477432419199	199.186016297942
711	32.7984135686324	197.134311558015
712	31.8204454803884	195.131299619869
713	30.8163558795987	193.174299001074
714	29.7884957699231	191.260641304587
715	28.739064926837	189.387684092941
716	27.670125024762	187.552821939967
717	26.5836115259841	185.753495564211
718	25.4813445459216	183.987199081157
719	24.3650388484416	182.251485493912
720	23.236313084177	180.543970588725
721	22.09669835754	178.862335423683
722	20.9476461899039	177.204327604133
723	19.7905359341759	175.567761532742
724	18.6266816876787	173.950517809949
725	17.4573387444953	172.3505419447
726	16.2837096243287	170.765842518031
727	15.1069497118571	169.194488924503
728	13.92817253816	167.634608799644
729	12.7484547337914	166.084385225888
730	11.5688406813464	164.542053795315
731	10.390346893815	163.005899594862
732 Teleskop-Umstellen		
733 Teleskop-Umstellen		
734 Teleskop-Umstellen		
735 PAZ (5)	10.5754262265498	88.7021015819795
736	15.2372602887366	88.1221128562284
737	19.9540267317323	87.7868189119271
738	24.6869237441848	87.71550205636
739	29.3962295253983	87.9343100094483
740	34.0420558355071	88.4781054891489

# Beobachtungsplan26032019

741	38.5847743436006	89.3927804196446
742	42.9849386497698	90.7380772852013
743	47.2025573809213	92.5908085586236
744	51.1956239853734	95.0479768908197
745	54.9178967294399	98.2284213249231
746	58.3161178914041	102.26985329587
747	61.3273149049864	107.315187830418
748	63.8777444335995	113.478794662959
749	65.88639834801	120.784581532127
750	67.276683869185	129.084842996563
751	67.9969904387408	138.007360528368
752	68.0425006161192	147.002875200899
753	67.4636111929933	155.505775462952
754	66.3531087152987	163.106598782822
755	64.8208849636291	169.621442573042
756	62.9716185642576	175.05157264417
757	60.8930548030546	179.502522382127
758	58.6534143075258	183.117371971279
759	56.3035493938689	186.038511449834
760	53.8805553469116	188.391245911321
761	51.4112409950838	190.27952684319
762	48.9149385024342	191.787103685714
763	46.4056140797828	192.980531525513
764	43.8933996221391	193.912427988124
765	41.385688107607	194.624370664404
766	38.8879141141753	195.149275981225
767	36.4041112992644	195.513279472611
768	33.9373129361239	195.737195034936
769	31.4898420173523	195.837638574333
770	29.0635233849186	195.827891517205
771	26.6598405276585	195.718565358659
772	24.2800528991048	195.518114851197
773	21.9252849262628	195.233236139208
774	19.5965946419549	194.869177282412
775	17.2950276215454	194.429981864162
776	15.0216603274134	193.918681324752
777	12.7776358493945	193.337447903525
778	10.5641942326971	192.687717296256
779	Teleskop-Umstellen	
780	GRACE-FO 1 (1)	13.520854278087
781		188.315354292037
782		15.5222612894507
783		189.163850927223
784		17.5469192910035
785		189.982246272173
786		19.5958748119001
787		190.769129688941
788		21.6703221561992
789		191.522555632548
790		23.7716039450737
791		192.239949035546
792		25.9012099288162
793		192.917983600294
		28.0607727606615
		193.552424649297
		30.2520588535059
		194.137925081483
		32.4769515996699
		194.667758559634
		34.7374229862575
		195.133467676447
		37.0354877701645
		195.52439554131
		39.3731315461973
		195.827055494241
		41.7521996961989
		196.02427315234



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794	44.1742274352502	196.094004095751
795	46.6401804449671	196.007683602963
796	49.1500583006052	195.727893537654
797	51.7022845707196	195.20502397886
798	54.2927603283603	194.372449842376
799	56.9133785920583	193.139530255751
800	59.5496644043414	191.381513821125
801	62.1769893247868	188.925422718358
802	64.7544926672761	185.532020152787
803	67.2155259235037	180.878602226327
804	69.4537424634182	174.562155005161
805	71.3071095847276	166.177645932482
806	72.5529019172426	155.567468461112
807	72.9443030268213	143.244896214063
808	72.3074504416534	130.57123172603
809	70.6333510140231	119.132971483629
810	68.0626098984836	109.851804697709
811	64.7914728058593	102.823171280017
812	61.0009448532094	97.7108488411716
813	56.836369061033	94.0934884323664
814	52.4123033183668	91.6087777794062
815	47.8220531227949	89.9811637792852
816	43.1447283886036	89.0099761358983
817	38.4490337583612	88.5506231801186
818	33.7947354720181	88.4985046657273
819	29.2328983926173	88.7771484688635
820	24.8057331568335	89.3298928947326
821	20.5465752038919	90.114138538673
822	16.4802333507593	91.0973695739834
823	12.6237347158766	92.2543738880278
824	Teleskop-Umstellen	
825	ICESAT-2 (3)	23.776190926946 125.027334838303
826		25.7283970749987 123.927195014172
827		27.7113159090602 122.839172259352
828		29.7263652173711 121.762408602947
829		31.7753254029383 120.696263801364
830		33.8603898970959 119.640372984572
831		35.9842263911383 118.594725547688
832		38.1500511143709 117.559774324862
833		40.3617188478718 116.536588634405
834		42.6238318747029 115.527072099095
835		44.941871583396 114.534278215724
836		47.3223568486949 113.562877167065
837		49.7730333538608 112.619863449538
838		52.3030971235084 111.715659821252
839		54.923452447225 110.865899005505
840		57.6469962359009 110.09441780061
841		60.4889008671199 109.438539135844
842		63.4668184128907 108.958959497346
843		66.6008023083965 108.759672155721
844		69.9123847005977 109.032059364827
845		73.4210908106126 110.165245308427
846		77.1321196445847 113.072516526681

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847	80.985203650647	120.408492733433
848	84.5557178395043	142.379359342609
849	85.3895517123655	199.860359002609
850	81.6208755897252	235.963329011742
851	76.0486247480906	247.057865229467
852	69.591105757371	250.97390524927
853	62.4329291913456	252.239509958252
854	54.6864424001726	252.241158898714
855	46.5078656347713	251.524787233212
856	38.1184932369108	250.345382060273
857	29.7838328046728	248.837147649951
858	21.7676256180008	247.077394128733
859	14.2843062676387	245.114164191483
860 Teleskop-Umstellen		
861 LAGEOS 2 (30)	44.8877155249374	256.14802298268
862	46.5923780804191	255.961933004294
863	48.2840776144862	255.71853955437
864	49.9613579330905	255.412309361603
865	51.6226972336637	255.036890431024
866	53.2664892725814	254.584973312951
867	54.891019642902	254.048126460428
868	56.4944360645756	253.416601238703
869	58.0747113179283	252.679101948362
870	59.6295971221175	251.822516526478
871	61.1565668758834	250.83160488423
872	62.6527447576285	249.688644960141
873	64.1148182792821	248.37304291159
874	65.53893112336	246.86092570134
875	66.9205532056679	245.124755202094
876	68.2543258480803	243.133038057714
877	69.5338825112464	240.85026184949
878	70.7516510313176	238.237273076387
879	71.8986536693819	235.252429508845
880	72.9643389367096	231.853996506538
881	73.9365059942165	228.004363139165
882	74.8014169692532	223.676605779054
883	75.5442243990036	218.863505310662
884	76.1498440343828	213.588077659689
885	76.6043355101984	207.912986499087
886	76.8966807306663	201.944548853789
887	77.0206007732683	195.826984582753
888	76.9758628633029	189.725567700288
889	76.7685839736381	183.802686646948
890	76.4103880811487	178.194912431763
891	75.9167242724245	172.998565665108
892	75.304910760464	168.266503012475
893	74.5924172581415	164.013798998242
894	73.7956552497105	160.227749690929
895	72.9293031809844	156.878218100297
896	72.0060546674412	153.926118020329
897	71.0366415707253	151.32940193049
898	70.0300053673901	149.046803807343
899	68.9935294059828	147.039899370722

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900	67.9332801825396	145.274042766408
901	66.8542310835715	143.718617591165
902	65.7604576865388	142.346905146356
903	64.6553023421472	141.13576293647
904	63.5415099872529	140.06522866092
905	62.4213388401922	139.118114217768
906	61.2966500117868	138.279622974937
907	60.1689798221078	137.537005182156
908	59.0395981241915	136.879256092629
909	57.9095553928551	136.296855928224
910	56.7797208276162	135.781548222706
911	55.6508132772359	135.326152071148
912	54.5234264264671	134.924403661307
913	53.3980493881156	134.570822736332
914	52.2750836059028	134.260600096461
915	51.154856785482	133.989502759372
916	50.0376344226951	133.753793897317
917	48.9236293815841	133.550165122762
918	47.8130098830191	133.375679091614
919	46.705906192687	133.227720733028
920	45.6024162403281	133.103955701406
921	44.502610357153	133.002294885368
922	43.4065352827389	132.920864007064
923	42.3142175643489	132.857977509283
924	41.2256664489784	132.812116063262
925	40.1408763502892	132.781907141711
926	39.0598289580021	132.766108193666
927	37.9824950455241	132.763592033686
928	36.9088360220323	132.773334120708
929	35.8388052674659	132.79440145377
930	34.7723492825122	132.825942854872
931	33.7094086804765	132.867180445017
932	32.6499190436227	132.917402149243
933	31.5938116630432	132.975955091308
934	30.5410141781713	133.042239759491
935	29.491451129609	133.115704842395
936	28.4450444369041	133.195842648306
937	27.4017138112054	133.282185034008
938	26.3613771112849	133.374299779379
939	25.3239506502148	133.471787352966
940	24.2893494589385	133.574278021188
941	23.2574875121875	133.681429260252
942	22.2282779213186	133.792923435289
943	21.2016330981657	133.908465715866
944	20.1774648933706	134.027782201046
945	19.1556847122264	134.150618230588
946	18.1362036106721	134.276736861825
947	17.1189323737253	134.405917494306
948	16.103781578359	134.537954626513
949	15.0906616425589	134.672656730854
950	14.0794828620876	134.809845234787
951	13.0701554362847	134.949353597411
952	12.0625894840459	135.091026472075

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953	11.0566950510416	135.234718946708
954	10.0523821089897	135.380295854494
955 Teleskop-Umstellen		
956 Teleskop-Umstellen		
957 Teleskop-Umstellen		
958 SARAL (20)	11.6482795669847	173.339953268045
959	13.5314940341763	173.892549665086
960	15.4190863680648	174.439967834944
961	17.3114897975689	174.982249902374
962	19.2091823741248	175.51930667854
963	21.1126913171432	176.050903156762
964	23.022597960127	176.576639484523
965	24.9395433406357	177.095926408675
966	26.864234475667	177.60795386602
967	28.7974513565931	178.111650958035
968	30.740054681309	178.605634962986
969	32.6929943104251	179.08814623767
970	34.6573183811225	179.556964751907
971	36.6341829237563	180.009302443968
972	38.6248616822664	180.441663376558
973	40.6307556073305	180.849660493346
974	42.6534011186345	181.227773131597
975	44.6944756334085	181.569022557969
976	46.7557978894316	181.864532409456
977	48.839319009218	182.102924990799
978	50.9470976389995	182.269479488171
979	53.0812481113577	182.344938505429
980	55.2438430853559	182.303784876998
981	57.4367390288443	182.111703805209
982	59.6612694827446	181.721764576347
983	61.9177079757965	181.068545369918
984	64.2043209452464	180.058886224118
985	66.5156722810123	178.557032759323
986	68.8395246229554	176.360449538504
987	71.1510472716969	173.160716601025
988	73.4018187689232	168.484236068603
989	75.4992178348614	161.62369122049
990	77.2716424501189	151.655989362201
991	78.4310334106604	137.894084463849
992	78.606373142212	121.186304832799
993	77.5434493422054	104.650170808889
994	75.282622079782	91.3043473426529
995	72.0387865588354	81.8631708644144
996	68.0072895916787	75.5979060573346
997	63.3093717860336	71.5936801784064
998	58.0156753736322	69.1596665151911
999	52.1796699305377	67.835468908856
1000	45.8642893101641	67.3218055838335
1001	39.1603170226239	67.4223240507211
1002	32.1949943898566	68.0054307755116
1003	25.1284172511945	68.9806384330093
1004	18.1376634725896	70.2839451460568
1005	11.393539585709	71.8686330218568

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1006 Teleskop-Umstellen

1007 Teleskop-Umstellen

1008 PAZ (5)	11.1982103241834	127.435789114049
1009	13.140487898982	126.328092132988
1010	15.1193570271079	125.255476673869
1011	17.1348230960229	124.217227410156
1012	19.1871418470286	123.212895390577
1013	21.2768307637438	122.242347699918
1014	23.4046831394265	121.305829823259
1015	25.5717849893344	120.404045337873
1016	27.7795348996206	119.53825926863
1017	30.02966676833	118.710433954096
1018	32.3242751551137	117.923410005961
1019	34.6658425454522	117.181150590475
1020	37.0572671371151	116.489075949995
1021	39.5018885744867	115.854528729548
1022	42.0035070472538	115.287432592504
1023	44.5663877204221	114.801242701724
1024	47.1952364430574	114.414347728438
1025	49.8951219398372	114.152189625676
1026	52.6712999505778	114.050559673473
1027	55.5288571837092	114.160889168096
1028	58.4720181342028	114.559054071915
1029	61.5028010643552	115.360636763691
1030	64.618360930048	116.748600860234
1031	67.8055297981055	119.025906271514
1032	71.028970184047	122.719769058028
1033	74.203823964682	128.789655731996
1034	77.1301273082086	138.984023795078
1035	79.3523200518848	155.90372941667
1036	80.0533450721807	179.985882001885
1037	78.6137443521419	203.811527178939
1038	75.3750711281195	220.269328232887
1039	71.0046285518426	230.032618164219
1040	65.9206077278572	235.687944314665
1041	60.3438573724533	238.940897467113
1042	54.4131898716182	240.725002798838
1043	48.2421458457109	241.553553085885
1044	41.9407029851555	241.721733681522
1045	35.619965650513	241.407839156774
1046	29.3884322189897	240.724469779069
1047	23.344941832883	239.745565205776
1048	17.5719537749778	238.521398450489
1049	12.1314380017705	237.087301557671

1050 Teleskop-Umstellen

1051 Teleskop-Umstellen

1052 Teleskop-Umstellen

1053 LARES (29)	78.1785348116286	168.350202633552
1054	76.5456072101977	159.82309318038
1055	74.693159367392	153.75335972996
1056	72.7274654805703	149.435335531117
1057	70.7095673202128	146.339233125337
1058	68.6740298177054	144.101640931895

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1059	66.6403594688503	142.477901000053
1060	64.6194476070643	141.302016004368
1061	62.6171765961517	140.459369827626
1062	60.6364695717356	139.869194893115
1063	58.6784820718396	139.473405344687
1064	56.7433108117495	139.229418675182
1065	54.8304238695355	139.105464502028
1066	52.9389260534603	139.077459840858
1067	51.0677244771494	139.126886964753
1068	49.2156324712836	139.239324767855
1069	47.3814347311361	139.403414138677
1070	45.5639277546381	139.610116885869
1071	43.761944365064	139.85217670617
1072	41.9743679137039	140.12372151347
1073	40.2001397738263	140.419966204169
1074	38.4382624842704	140.73698781194
1075	36.68780009713	141.071553538138
1076	34.9478767609538	141.420987887658
1077	33.2176742264782	141.783069063635
1078	31.4964287328327	142.155947492478
1079	29.7834275783563	142.538081258766
1080	28.0780055765165	142.928184585546
1081	26.3795415268962	143.325186470767
1082	24.6874547834021	143.728197299547
1083	23.0012019692913	144.136481772939
1084	21.320273866523	144.549436880427
1085	19.6441924921009	144.966573933027
1086	17.9725083641567	145.387503892902
1087	16.30479795411	145.811925402504
1088	14.6406613170759	146.239615044979
1089	12.9797198903774	146.670419467597
1090	11.3216144485822	147.104249078501
1091	Teleskop-Umstellen	
1092	Teleskop-Umstellen	
1093	Teleskop-Umstellen	
1094	Teleskop-Umstellen	
1095	LAGEOS 2 (30)	33.7058855327319 299.513360631433
1096		35.8288901098348 298.573783851467
1097		37.8849438536704 297.571020163707
1098		39.8736695354293 296.501082569639
1099		41.7947717950782 295.359708902701
1100		43.6479891195847 294.14236724083
1101		45.4330490546208 292.844269937062
1102		47.1496270618244 291.460399151053
1103		48.7973094076027 289.98554737434
1104		50.3755605161327 288.414377074308
1105		51.8836953364355 286.741504170042
1106		53.3208574554505 284.961610489215
1107		54.686003924485 283.069590474519
1108		55.9778980349909 281.060736981441
1109		57.1951115482363 278.930969739496
1110		58.3360381016081 276.67710759215
1111		59.3989196110453 274.297181645437

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1112	60.3818873730789	271.790780704974
1113	61.2830191368652	269.159412886658
1114	62.1004125670691	266.406858525515
1115	62.8322741897262	263.539480605186
1116	63.477021121684	260.566451751113
1117	64.0333907707834	257.499853831612
1118	64.5005515517888	254.354609949346
1119	64.8782059245055	251.148220878936
1120	65.1666762210472	247.900298832776
1121	65.3669642112463	244.63191830194
1122	65.4807773454026	241.364831606867
1123	65.5105179406147	238.120619307877
1124	65.4592356978953	234.919856984497
1125	65.330548063158	231.781377005809
1126	65.1285362697306	228.721687576577
1127	64.8576268398155	225.754585924718
1128	64.5224686685962	222.890974287067
1129	64.1278147439759	220.138862403374
1130	63.6784155142753	217.503522639517
1131	63.1789284503479	214.987755091165
1132	62.6338459433516	212.592219228559
1133	62.0474416684	210.315793613394
1134	61.4237340863618	208.155933347935
1135	60.7664648644918	206.109003944085
1136	60.0790895911359	204.170578653949
1137	59.3647781181071	202.335693133722
1138	58.626422060443	200.599056347598
1139	57.8666473094422	198.955219960869
1140	57.0878297906245	197.398710414812
1141	56.2921130700674	195.924128771927
1142	55.481426749383	194.526223597775
1143	54.6575048769397	193.19994187643
1144	53.8219038371966	191.940462442992
1145	52.9760193640971	190.743215799437
1146	52.1211024645295	189.603893549438
1147	51.2582741412123	188.51845009611
1148	50.3885388782484	187.483098720731
1149	49.5127969035673	186.494303710068
1150	48.6318552760519	185.548769824614
1151	47.7464378658741	184.643430093955
1152	46.8571943079887	183.775432680027
1153	45.9647080136037	182.94212735509
1154	45.0695033248532	182.14105198994
1155	44.1720518953363	181.369919331123
1156	43.2727783748112	180.626604256943
1157	42.3720654709039	179.90913163493
1158	41.4702584547777	179.215664853464
1159	40.5676691716774	178.544495063529
1160	39.6645796113772	177.89403114012
1161	38.7612450879412	177.262790354056
1162	37.8578970729846	176.64938973216
1163	36.9547457217889	176.052538075268
1164	36.0519821273081	175.471028598457

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1165	35.149780333043	174.903732154943
1166	34.2482991323254	174.349591004186
1167	33.3476836783266	173.807613084807
1168	32.4480669263044	173.276866753974
1169	31.5495709271129	172.756475956435
1170	30.652307988788	172.245615788346
1171	29.7563817210734	171.743508423091
1172	28.8618879760292	171.249419368564
1173	27.9689156963568	170.762654027523
1174	27.0775476817143	170.282554534844
1175	26.1878612821947	169.808496847594
1176	25.2999290269679	169.339888065737
1177	24.413819195332	168.876163963275
1178	23.5295963365106	168.416786711265
1179	22.6473217438703	167.961242775811
1180	21.7670538885966	167.509040975593
1181	20.8888488173295	167.059710684892
1182	20.0127605177606	166.612800169282
1183	19.1388412558066	166.167875042357
1184	18.2671418875136	165.72451683284
1185	17.3977121486347	165.28232165245
1186	16.5306009244239	164.840898955706
1187	15.6658565019886	164.399870383668
1188	14.8035268072988	163.958868684339
1189	13.9436596287474	163.517536703064
1190	13.0863028289838	163.075526436922
1191	12.2315045465768	162.632498147563
1192	11.3793133889334	162.188119527515
1193	10.5297786177733	161.742064915374
1194	Teleskop-Umstellen	
1195	ICESAT-2 (3)	26.7149002736326 183.734871699992
1196		28.8013765179661 184.187320237306
1197		30.9042842126503 184.603928051162
1198		33.0247502623909 184.979551070072
1199		35.1639635882429 185.307793002418
1200		37.3231551423478 185.580691649906
1201		39.5035652896546 185.788305357594
1202		41.7063921603141 185.918162667543
1203		43.9327113054631 185.954522471586
1204		46.1833518908822 185.877368754875
1205		48.4587066129469 185.661029770908
1206		50.7584396412346 185.272261091321
1207		53.0810360239483 184.667558957223
1208		55.423101833277 183.789368825288
1209		57.7782681392382 182.560726728593
1210		60.1354600858942 180.877756428712
1211		62.4761470121549 178.599498424796
1212		64.7699801153571 175.535266171344
1213		66.9680019368999 171.432515771359
1214		68.9926818878957 165.976438124447
1215		70.7254609280014 158.8315305144
1216		71.9977490938513 149.782158530353
1217		72.6020129856952 139.008354854081



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1218	72.3435450911362	127.337061342018
1219	71.1186267803138	116.06239675647
1220	68.951153982549	106.295756144007
1221	65.952705315885	98.5121882878147
1222	62.2582984056813	92.6453820681315
1223	57.9904653574602	88.3917446570488
1224	53.2535853579263	85.4176823965796
1225	48.1412200815151	83.4402502227591
1226	42.7447456439958	82.2413235354971
1227	37.1586465577249	81.6587663783244
1228	31.4813614352459	81.5732729540684
1229	25.8121989717875	81.8968139696381
1230	20.2458065491092	82.5638130570671
1231	14.8661457663223	83.5247352561368
1232	Teleskop-Umstellen	
1233	Teleskop-Umstellen	
1234	SENTINEL-3B (14)	36.9727162314028 135.208836195463
1235		38.9363462811737 134.548117520922
1236		40.9132673893946 133.882040855914
1237		42.9044514135871 133.208729853838
1238		44.9110581506385 132.52619789665
1239		46.9344667719285 131.832326301955
1240		48.9763146974659 131.124838752298
1241		51.038545852834 130.401270771257
1242		53.1234708570406 129.65893255591
1243		55.2338425063169 128.894862644584
1244		57.3729510331057 128.105768506708
1245		59.5447451528969 127.287947708168
1246		61.7539870414955 126.437178850265
1247		64.0064523715009 125.548562888893
1248		66.3091907620059 124.616277865492
1249		68.6708680252331 123.633171569469
1250		71.1022202580752 122.590025031344
1251		73.6166623089762 121.474078538857
1252		76.2311109652014 120.265688950788
1253		78.9671073363904 118.929407713643
1254		81.8523469234916 117.383920212087
1255		84.922666195874 115.352570743848
1256		88.2223614853052 110.442600115017
1257		88.1604106186156 299.47288250122
1258		84.1806449544511 294.277770297363
1259		79.6969766071975 291.783762017765
1260		74.5539021865039 289.541770048968
1261		68.5374152981352 287.2627072164
1262		61.3690406574188 284.851828827332
1263		52.7201853737547 282.257725203134
1264		42.2929861326433 279.442474752055
1265		30.0286545920331 276.373488337588
1266		16.4140366728953 273.021497325073
1267	Teleskop-Umstellen	
1268	Teleskop-Umstellen	
1269	Teleskop-Umstellen	
1270	Teleskop-Umstellen	

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1271 Teleskop-Umstellen		
1272 Teleskop-Umstellen		
1273 GRACE-FO 1 (1)	46.396952045522	43.2865054147008
1274	53.1857898127928	47.7952879885859
1275	57.9082440561514	52.8112060308222
1276	61.3322662698027	58.3469224646455
1277	63.8524503252955	64.3846952808939
1278	65.6840019632142	70.8640004830489
1279	66.9526557672339	77.6746737585151
1280	67.7397461480456	84.6612457451897
1281	68.1060332281393	91.6410865719963
1282	68.1038941875004	98.4322718128211
1283	67.7824235074868	104.881245415338
1284	67.188384765663	110.880502319469
1285	66.365291431303	116.37251516245
1286	65.3521813617147	121.342774913451
1287	64.1828575595988	125.807750309179
1288	62.8857575384685	129.802708386263
1289	61.484304684794	133.371990037329
1290	59.9975217668156	136.562360164483
1291	58.4407280814672	139.419010569842
1292	56.8262103660042	141.983478728816
1293	55.163814480922	144.292799123634
1294	53.4614412763536	146.379376138921
1295	51.7254495174588	148.27123886598
1296	49.9609772423778	149.992469547989
1297	48.1721953207485	151.56368635939
1298	46.3625064116034	153.002517034429
1299	44.5347007645445	154.324032990492
1300	42.6910782736354	155.541132302496
1301	40.8335442888174	156.664869876179
1302	38.9636850647561	157.704738089365
1303	37.0828274072119	158.668903250419
1304	35.1920860348677	159.564403779159
1305	33.2924013651197	160.39731580428
1306	31.3845698097085	161.172891315261
1307	29.4692681895904	161.895673333426
1308	27.5470735145699	162.569591892958
1309	25.6184790954863	163.198044002501
1310	23.6839077445338	163.783960212489
1311	21.7437226569531	164.329859945723
1312	19.798236442896	164.837897353852
1313	17.8477186828871	165.309899131547
1314	15.8924023071088	165.747395443653
1315	13.9324890428365	166.151644888921
1316	11.9681541319139	166.523654228593
1317 Teleskop-Umstellen		
1318 TIANGONG-2 (2)	35.1886317759959	163.416055295341
1319	36.1844838781741	161.127472135963
1320	37.0840414709819	158.742289928444
1321	37.8799904413232	156.263578716874
1322	38.564856445523	153.696297248144
1323	39.1311252360769	151.047479047917

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1324	39.5713822677199	148.326347986042
1325	39.8784662123741	145.544337898709
1326	40.0456283453917	142.714995418722
1327	40.0666875046323	139.853754329288
1328	39.9361689902442	136.977582969838
1329	39.6494158246387	134.104521761192
1330	39.2026624787846	131.253143052031
1331	38.5930644197953	128.441977097771
1332	37.8186812211486	125.688953443727
1333	36.878415806988	123.010905013025
1334	35.7719168888404	120.423173286583
1335	34.4994551242216	117.939339205564
1336	33.0617855871635	115.571088839703
1337	31.4600097386086	113.328208463317
1338	29.6954494677311	111.218692709094
1339	27.769544373361	109.248943012639
1340	25.6837817388787	107.424031577024
1341	23.4396670181779	105.748007737266
1342	21.0387413400415	104.224227682471
1343	18.4826516253195	102.855693794149
1344	15.7732783028695	101.6453954146
1345	12.9129250756527	100.59664802373
1346 Teleskop-Umstellen		
1347 Teleskop-Umstellen		
1348 Teleskop-Umstellen		
1349 Teleskop-Umstellen		
1350 JASON-2 (24)	74.7643275565907	222.090338390392
1351	72.9781624090682	216.531022989809
1352	71.1478897094635	212.081261616323
1353	69.298851178951	208.436131353445
1354	67.4454465891896	205.385897254586
1355	65.5958306845248	202.784744613767
1356	63.7545436024759	200.529433257248
1357	61.9240052877191	198.545352007706
1358	60.1053810541131	196.777462411073
1359	58.2990926792956	195.184362959093
1360	56.5051253765021	193.734337612772
1361	54.7232146993229	192.402677799967
1362	52.9529614308012	191.169833835789
1363	51.1939025345973	190.020115768556
1364	49.4455549144254	188.940764583768
1365	47.7074421566504	187.921277384361
1366	45.9791105409858	186.952909634185
1367	44.2601382572002	186.028302788365
1368	42.5501403252213	185.141202031143
1369	40.8487708181725	184.286239665678
1370	39.1557234206203	183.458766956482
1371	37.4707309916971	182.654722162121
1372	35.7935645687125	181.870525902525
1373	34.1240320944937	181.102997387587
1374	32.4619770520497	180.349286720937
1375	30.8072771246252	179.606819702001
1376	29.1598429562148	178.873252425927

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1377	27.5196170593943	178.146433622992
1378	25.8865728990616	177.42437315429
1379	24.2607141689602	176.70521543534
1380	22.6420742706625	175.987216826899
1381	21.0307160004363	175.268726235642
1382	19.4267314472679	174.548168323393
1383	17.83024210449	173.824028844148
1384	16.2413991976549	173.09484172207
1385	14.6603842320942	172.359177557447
1386	13.0874097648959	171.615633306037
1387	11.52272040768	170.862822924056
1388 Teleskop-Umstellen		
1389 Teleskop-Umstellen		
1390 Teleskop-Umstellen		
1391 Teleskop-Umstellen		
1392 LARES (29)	50.1528097764662	42.4718120886549
1393	56.2652490857438	38.7326719263593
1394	62.0707233299	34.3102723591173
1395	67.4868369509039	28.7782625834128
1396	72.4274292884774	21.3430431018649
1397	76.7605567087648	10.441454508762
1398	80.2066308212221	353.09737641005
1399	82.1748140563483	326.081004336346
1400	82.0568946809012	294.900608890407
1401	80.2699331041427	271.645105030951
1402	77.7354288739756	257.275126445076
1403	74.9710987666478	248.120261060511
1404	72.182203285005	241.791267088829
1405	69.4466846991968	237.07679864744
1406	66.7931162926466	233.351491858008
1407	64.2298011768179	230.271156275819
1408	61.7563215234517	227.633638376832
1409	59.3685032961705	225.313226955876
1410	57.0606905906864	223.227846197559
1411	54.8268292468619	221.321642001188
1412	52.6609883227628	219.555229067053
1413	50.5576032420302	217.89996548017
1414	48.5115768636767	216.334451219193
1415	46.5183071378977	214.842309006121
1416	44.5736772376542	213.41073325249
1417	42.6740273980963	212.029514773539
1418	40.8161189034202	210.690369079832
1419	38.9970958822837	209.386463561724
1420	37.2144479206739	208.1120780992
1421	35.4659750101257	206.862357104407
1422	33.7497555078969	205.633125439593
1423	32.0641173145997	204.420749748825
1424	30.4076122174036	203.222032601401
1425	28.7789932132688	202.034130696276
1426	27.1771945649835	200.854490955769
1427	25.60131432213	199.680800093105
1428	24.0505990413999	198.510944453306
1429	22.5244304551375	197.342977779737

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1430	21.0223138571551	196.175095165289
1431	19.543867997099	195.005611884298
1432	18.0888162967482	193.832946119909
1433	16.6569792224454	192.655604836472
1434	15.2482676669821	191.472172221531
1435	13.8626772111598	190.281300253518
1436	12.500283150238	189.081701051136
1437	11.1612361834055	187.872140736828
1438 Teleskop-Umstellen		
1439 Teleskop-Umstellen		
1440 Teleskop-Umstellen		