ENCONTREITOR

a new approach to meteor shower research software

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BRAMON
BRAZILIAN METEOR OBSERVATION NETWORK

IMC 2018
SLOVAKIA
Pezinok - Modra

How do brazilian guys who don’t like football have fun?

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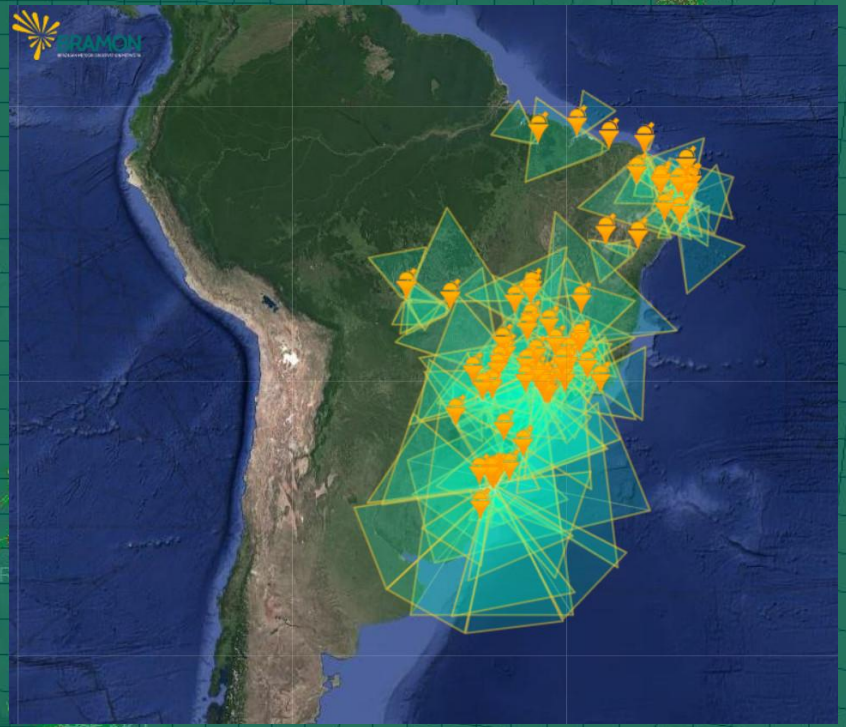
BRAMON
Brazilian Meteor Observation Network

- Started operating in January 2014
- A collaborative network of amateur astronomers performing a volunteer work: citizen science
- Today BRAMON have 130 cameras and 94 operators covering 20 brazilian states
- Around of 150.000 orbits collected since 2014
- In 2017, we started searching for new radiants in or database
- So Leonardo Amaral has started development a software to aid this work
- The resulting software was Encontreitor, and it does much more than that...



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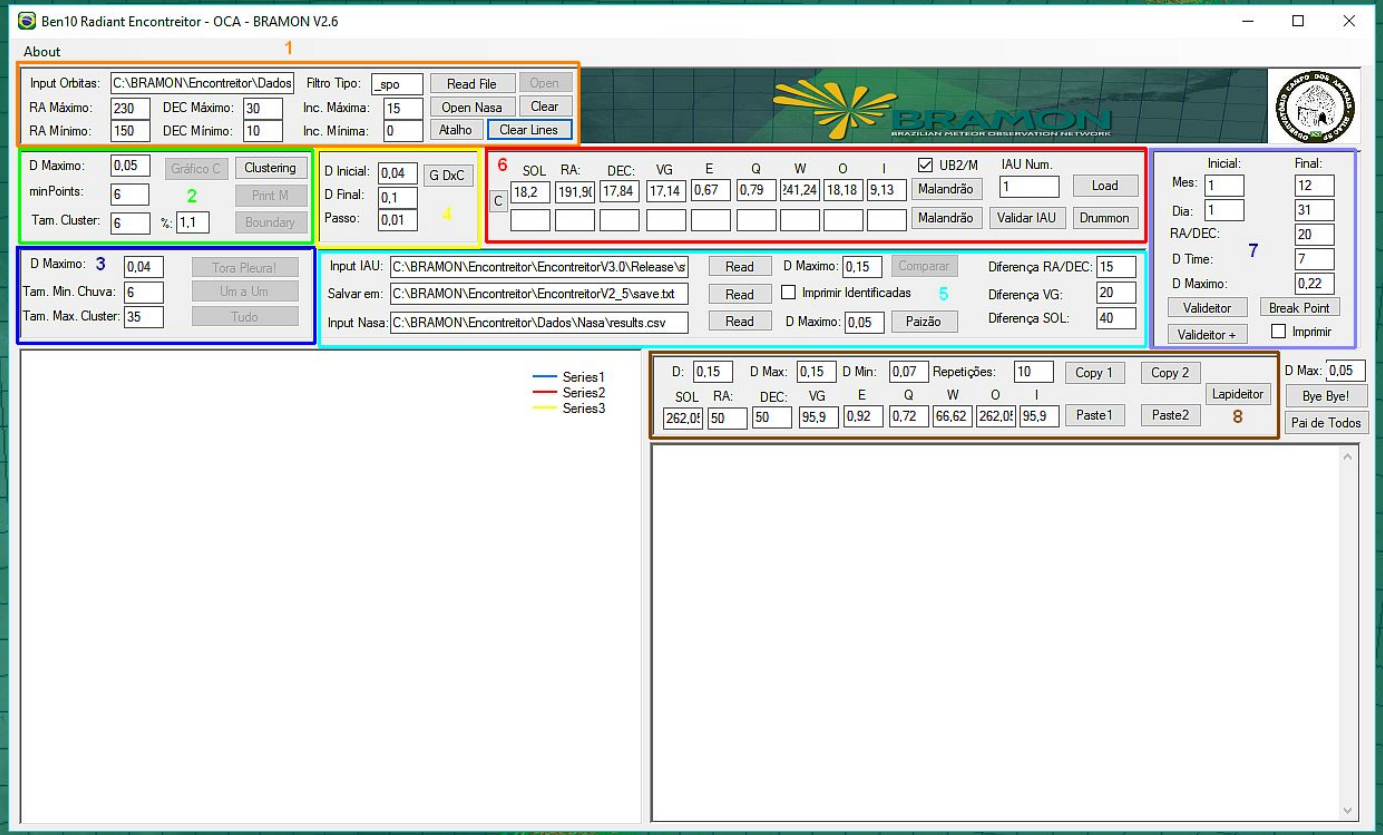
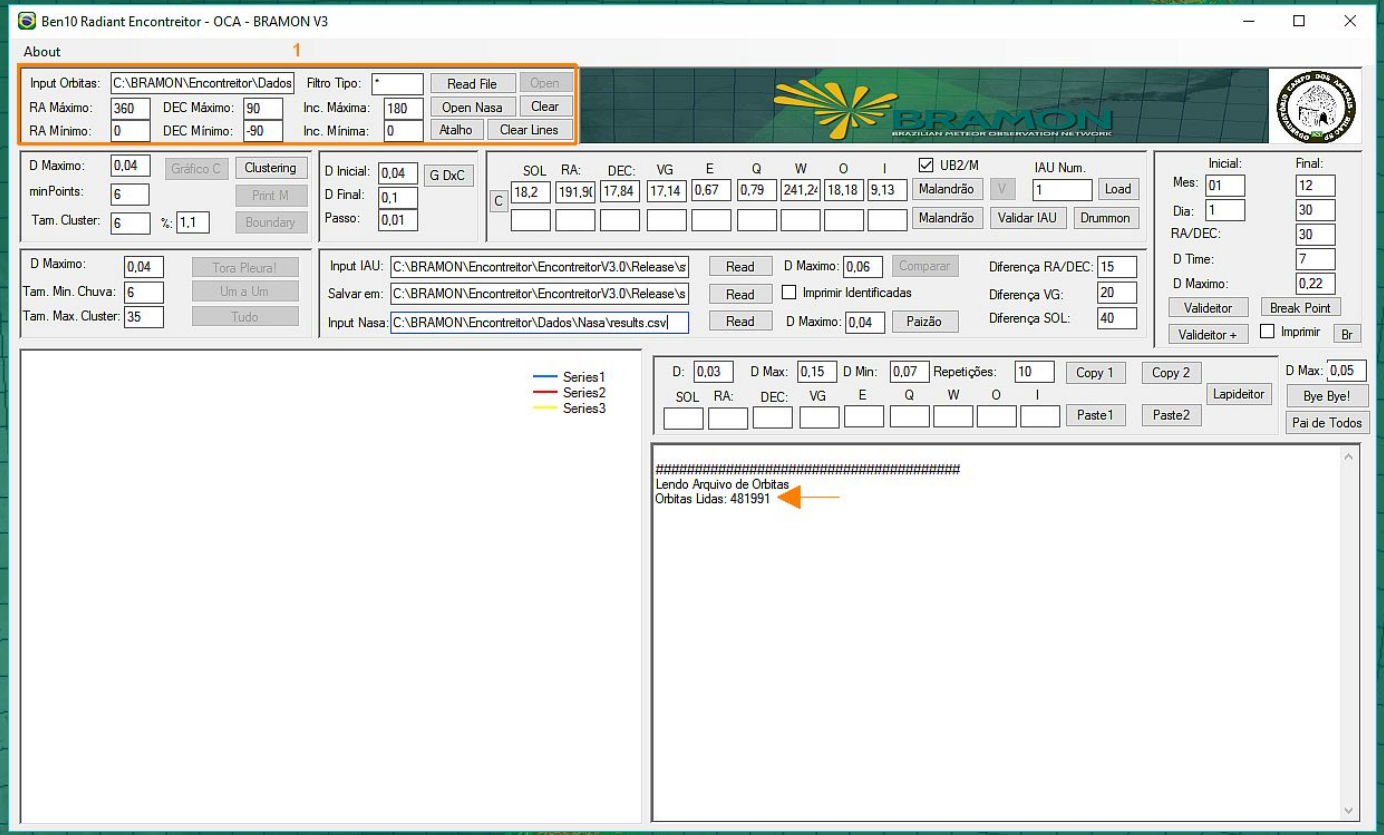
Encontreitor Main Screen

1. Input data and filters
2. Clustering parameters
3. Tora Pleura parameters
4. DxC Graph parameters
5. Input, output and filters to validations and Paizão
6. IAU list check and Malandrão function
7. Breakpoint and Validator functions
8. Lapideitor (refinement of shower data)



Step 1: Meteor Clustering

- Enter the meteor database (u.csv) to search for clustering
- Define filter for meteor class (generally _spo)
- Define filter for sky area (right ascention and declination limits)
- Define filter for orbit inclination
- And “Read File” to start fun!



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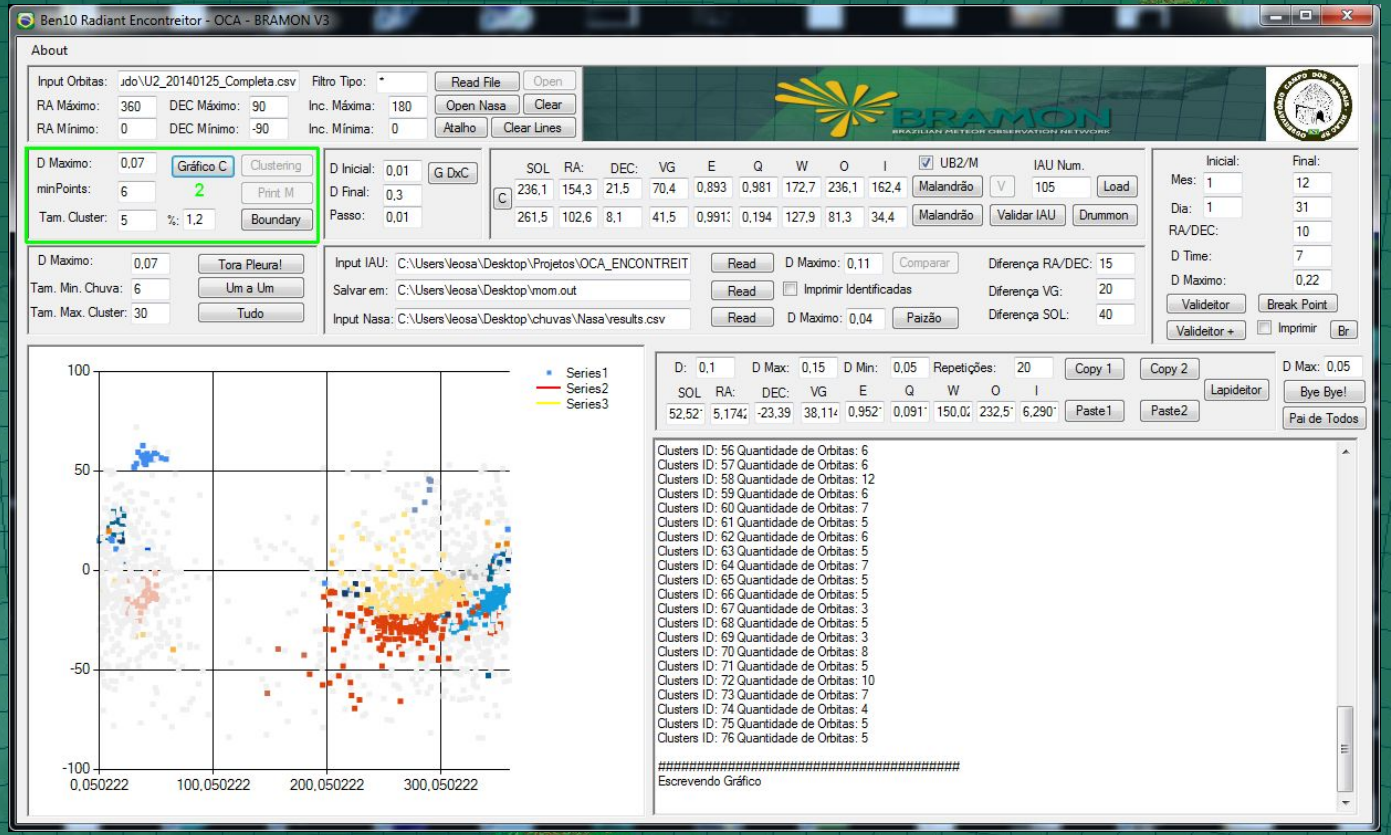
DBSCAN Meteor Clustering

- Encontraitor Uses DBSCAN (Ester et al.) to search for clusters in a meteor database
- DBSCAN search is based in the distance between two points
- In clustering function, the points is the meteors and its distances is the D-criteria between them



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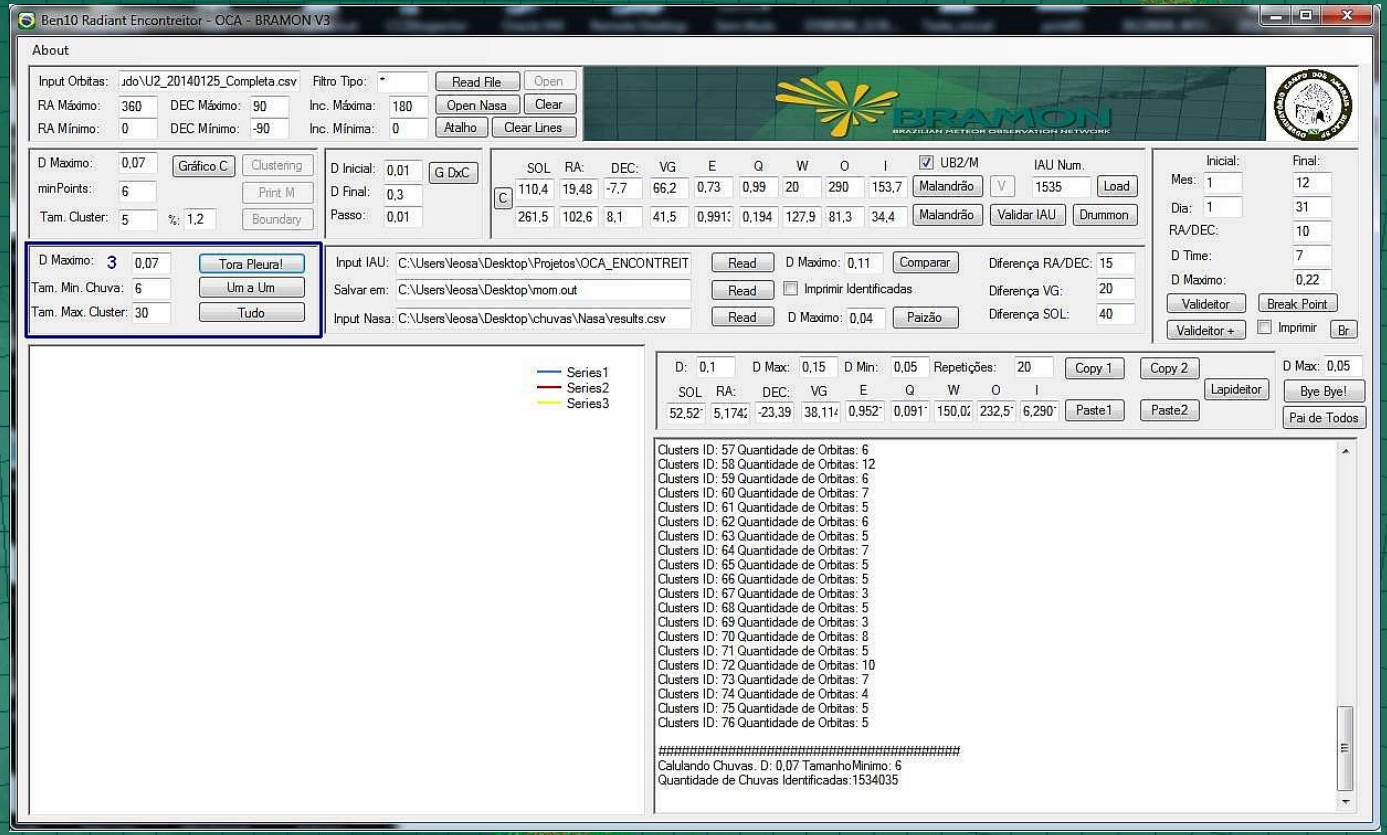
Step 2: Tora Pleura - Combinating meteors in clusters

- Algorithm performs a simple combination in each cluster
- Clusters are filtered by size, group min size: 6 meteors
- Every grouping have a mean orbit determinated, and every member of the group have their orbital elements confronted against the mean orbit
- If the result of each of the tests are lower than a D min value, this grouping is considered a possible new radiant.



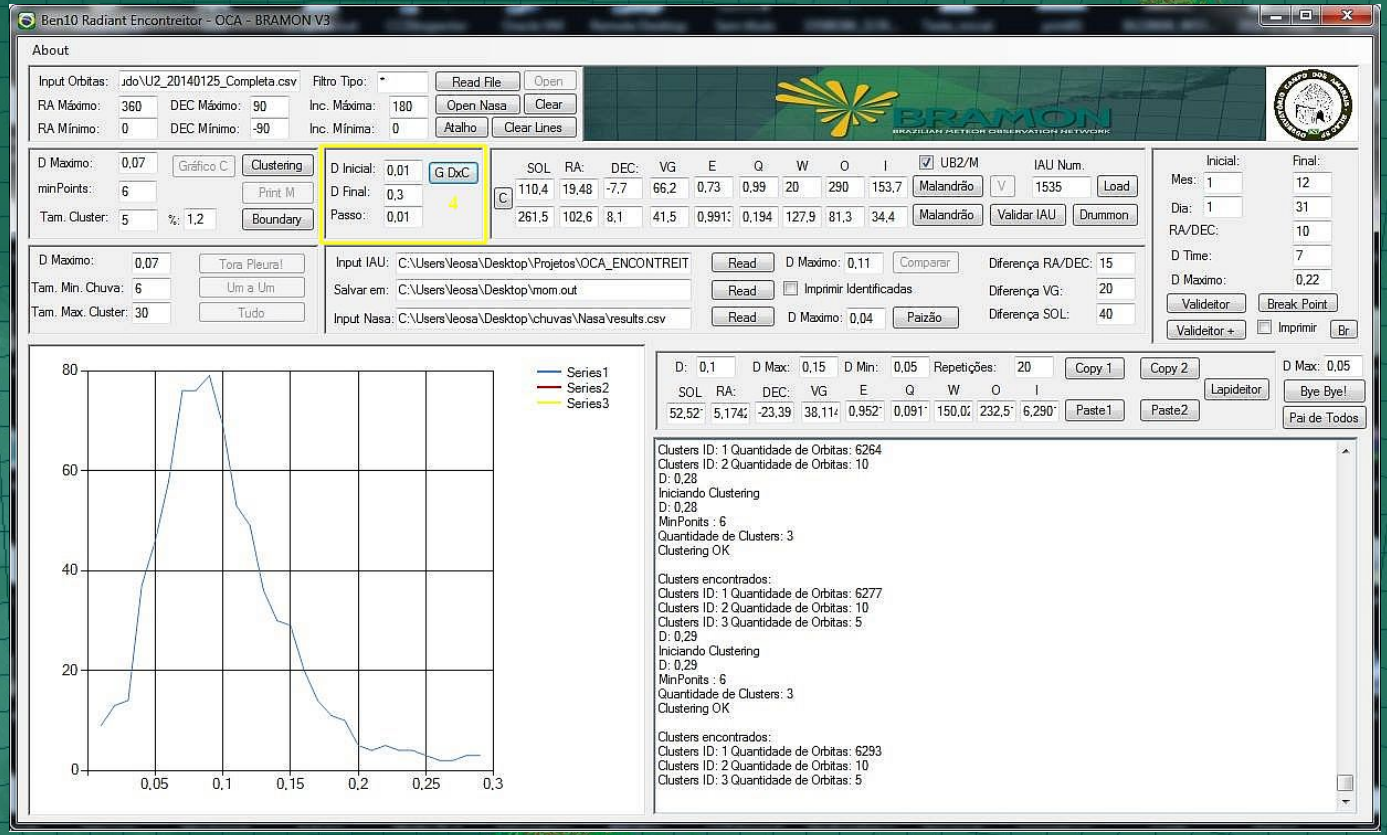
Tora Pleura Output

- Groupings output of Tora Pleura combinatory analysis
- The not repeated meteors of each group should be selected which will ultimately constitute a single possible new radiant
- The groups consisting entirely of non-repeated meteors in other groups are discarded

```
Chuva: 1 Quantidade de Orbitas: 6
_013101HUM0008  311,504272  149,222733  13,413737   28,527868   0,807864    0,299786    123,84449   131,518341  0,135483    38072
_20110131_215942    311,523193  145,473557  10,372658   29,509405   0,835203    0,32847 117,696304  131,52356   5,447201    38077
_20110202_195833    313,468323  148,024231  10,398056   30,423262   0,848644    0,299051    121,15596   133,469452  4,537366    38166
_20110204_003209    314,675934  151,770004  10,349031   30,173508   0,842868    0,296514    121,920296  134,677963  3,336128    38248
_20110204_223933    315,611084  150,379211  10,12289    28,087879   0,803158    0,336391    118,622681  135,613144  3,680166    38306
_20110204_223933    315,611084  150,034683  11,080391   29,863907   0,845365    0,326989    117,316368  135,613861  2,727558    38307
Chuva: 2 Quantidade de Orbitas: 6
_013101HUM0008  311,504272  149,222733  13,413737   28,527868   0,807864    0,299786    123,84449   131,518341  0,135483    38072
_20110131_215942    311,523193  145,473557  10,372658   29,509405   0,835203    0,32847 117,696304  131,52356   5,447201    38077
_20110202_195833    313,468323  148,024231  10,398056   30,423262   0,848644    0,299051    121,15596   133,469452  4,537366    38166
_20110204_003209    314,675934  151,770004  10,349031   30,173508   0,842868    0,296514    121,920296  134,677963  3,336128    38248
_20110204_223933    315,611084  150,034683  11,080391   29,863907   0,845365    0,326989    117,316368  135,613861  2,727558    38307
_020607PET0006  317,537689  151,123749  11,059768   31,449945   0,879408    0,312155    117,429604  137,541382  2,210033    38442
Chuva: 3 Quantidade de Orbitas: 6
_013101HUM0008  311,504272  149,222733  13,413737   28,527868   0,807864    0,299786    123,84449   131,518341  0,135483    38072
_20110131_215942    311,523193  145,473557  10,372658   29,509405   0,835203    0,32847 117,696304  131,52356   5,447201    38077
_20110202_195833    313,468323  148,024231  10,398056   30,423262   0,848644    0,299051    121,15596   133,469452  4,537366    38166
_20110204_223933    315,611084  150,379211  10,12289    28,087879   0,803158    0,336391    118,622681  135,613144  3,680166    38306
_20110204_223933    315,611084  150,034683  11,080391   29,863907   0,845365    0,326989    117,316368  135,613861  2,727558    38307
_020607PET0006  317,537689  151,123749  11,059768   31,449945   0,879408    0,312155    117,429604  137,541382  2,210033    38442
Chuva: 4 Quantidade de Orbitas: 6
_013101HUM0008  311,504272  149,222733  13,413737   28,527868   0,807864    0,299786    123,84449   131,518341  0,135483    38072
_20110131_215942    311,523193  145,473557  10,372658   29,509405   0,835203    0,32847 117,696304  131,52356   5,447201    38077
_20110204_003209    314,675934  151,770004  10,349031   30,173508   0,842868    0,296514    121,920296  134,677963  3,336128    38248
_20110204_223933    315,611084  150,379211  10,12289    28,087879   0,803158    0,336391    118,622681  135,613144  3,680166    38306
_20110204_223933    315,611084  150,034683  11,080391   29,863907   0,845365    0,326989    117,316368  135,613861  2,727558    38307
_020607PET0006  317,537689  151,123749  11,059768   31,449945   0,879408    0,312155    117,429604  137,541382  2,210033    38442
Chuva: 5 Quantidade de Orbitas: 6
_013101HUM0008  311,504272  149,222733  13,413737   28,527868   0,807864    0,299786    123,84449   131,518341  0,135483    38072
_20110202_195833    313,468323  148,024231  10,398056   30,423262   0,848644    0,299051    121,15596   133,469452  4,537366    38166
_20110204_003209    314,675934  151,770004  10,349031   30,173508   0,842868    0,296514    121,920296  134,677963  3,336128    38248
_20110204_214120    315,570099  151,519073  9,425589    31,875687   0,875069    0,277842    122,607643  135,571808  4,397001    38302
_020607PET0006  317,537689  151,123749  11,059768   31,449945   0,879408    0,312155    117,429604  137,541382  2,210033    38442
_20110206_231321    317,662811  153,967361  11,19232    31,340393   0,870701    0,29698 120,099518  137,670349  1,081675    38463
Chuva: 6 Quantidade de Orbitas: 6
_013101HUM0008  311,504272  149,222733  13,413737   28,527868   0,807864    0,299786    123,84449   131,518341  0,135483    38072
_20110202_195833    313,468323  148,024231  10,398056   30,423262   0,848644    0,299051    121,15596   133,469452  4,537366    38166
_20110204_003209    314,675934  151,770004  10,349031   30,173508   0,842868    0,296514    121,920296  134,677963  3,336128    38248
_20110204_223933    315,611084  150,034683  11,080391   29,863907   0,845365    0,326989    117,316368  135,613861  2,727558    38307
_020607PET0006  317,537689  151,123749  11,059768   31,449945   0,879408    0,312155    117,429604  137,541382  2,210033    38442
_20110206_231321    317,662811  153,967361  11,19232    31,340393   0,870701    0,29698 120,099518  137,670349  1,081675    38463
```

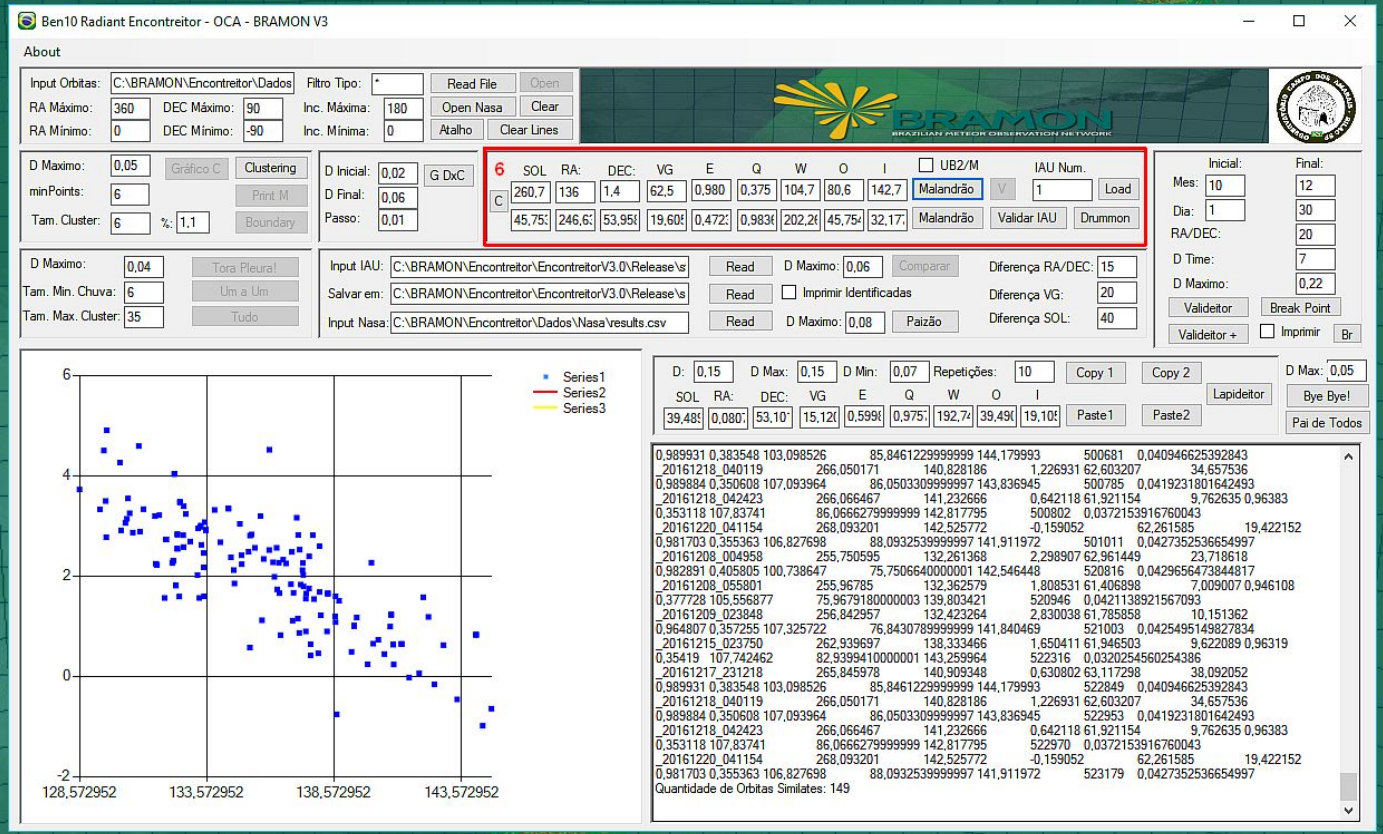
Gráfico DxC, valor ótimo para Critério Drummond

- Specification of the step values to be applied in the Breakpoint and Valideitor tests
- Graph D x C: determination of the optimal cut value of the Drummond Criterion to be applied in the Tora Pleura procedure



Malandrão

- Manual input of mean orbital elements to search for similar meteors in the database.
- The meteors of the output will be those that are below of a maximum D value stipulated in relation to the inserted mean orbital elements
- Validar IAU (Validate against IAU): With this function we can compare the average orbit of a possible new shower against the orbital elements of showers already cataloged in the IAU. In this way we check if it the new shower is not a shower already cataloged



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Universe Sandbox Integration

Orbiteitor

DATA	SOL	RA	DEC	VG	A	E	Q	W	O	I	LINHA
_20080405_024857	15,218296	196,013	17,0600	17,220	2,05118	0,629736	0,759479	247,870316	15,218712	9,236534	275126
_20090409_032705	18,924726	193,535	12,7188	16,785	2,408183	0,672546	0,788568	241,876129	18,928066	5,703797	296525
_20100405_225146	15,528642	191,255	18,4303	16,968	2,127976	0,633077	0,780803	244,299271	15,529799	10,121608	322382
_20100408_013803	17,979357	195,787	19,4845	17,732	2,440867	0,679705	0,781798	242,70903	17,980017	10,340018	18135
_20110331_220224	10,68555	184,800	17,7038	17,795	2,47618	0,689043	0,769986	244,026108	10,685518	8,240647	40323
_20110405_222246	15,261774	189,229	19,0667	16,828	2,267243	0,649865	0,793841	241,586655	15,261972	9,62307	348106
_20110407_233708	17,650526	189,664	18,24992	15,958	2,279859	0,643744	0,812214	238,782974	17,651327	7,569154	40621
_20110411_235822	21,22654	200,185	22,59124	17,574	2,281965	0,650058	0,798556	241,024185	21,227509	13,654943	348317
_20110413_015604	22,655405	195,397	12,10215	16,414	2,27326	0,652474	0,790018	242,405334	22,658245	5,555848	40829
_20120401_183328	12,262426	185,34433	17,03944	18,490	2,387294	0,688803	0,742919	248,246536	12,264165	8,680168	78425
_20130331_004524	10,285555	185,54837	12,79651	17,367	2,141926	0,649625	0,750477	248,384293	10,286057	6,389234	110943
_20130403_230925	13,795387	191,272	15,6923	17,546	2,073471	0,638426	0,749713	249,041534	13,795063	8,999256	398571
_20130407_224354	17,716127	192,325	18,7963	16,775	2,234929	0,644087	0,795439	241,60817	17,715815	9,936028	398668
_20130410_224828	21,035686	192,693	16,4730	16,681	2,456317	0,672323	0,80488	239,308365	21,035946	8,121412	111197
_20130410_224829	21,035698	191,936	16,8365	16,123	2,372186	0,656345	0,815214	238,040817	21,035969	7,772994	111198
_20130411_232842	21,676569	191,924	17,7289	15,709	2,393852	0,652275	0,832401	235,207977	21,676977	8,3326	398809
_20130415_202615	25,840332	191,124	18,1736	15,773	2,408891	0,653602	0,834435	234,985733	25,84164	8,838623	111418
_20130418_002356	27,591524	204,08786	19,2142	17,287	2,387787	0,662736	0,805315	239,764908	27,592649	12,174107	399008
_20140403_015350	12,673228	186,46524	14,4431	17,099	2,519759	0,688091	0,785935	241,608368	12,675307	6,039321	424906
_20140408_022734	17,620962	192,670	17,2500	17,161	2,614389	0,694287	0,799254	239,467407	17,623238	8,261148	425098
_20140409_025434	18,990875	196,670	18,6559	17,912	2,541961	0,692142	0,782562	242,249542	18,992657	10,445728	154686
_20140417_003709	26,737997	198,163	12,15219	16,949	2,471073	0,679411	0,792199	241,368439	26,738859	6,742683	155081
_20150328_185945	7,56951	177,722	17,5459	17,620	2,375786	0,678967	0,762705	245,370956	7,571946	7,022351	197152
_20150331_194843	10,567418	181,667	15,165	18,216	2,529651	0,702073	0,753652	246,132584	10,569446	6,816148	197254
_20150406_225246	16,605461	190,284	12,6227	18,129	2,461354	0,693772	0,753737	246,583771	16,605698	6,990292	197561
_20150415_232940	25,463247	195,920	19,0796	16,721	2,670074	0,691144	0,824667	235,651505	25,463566	9,616448	198315
_20150419_225850	29,355217	197,959	12,9871	16,545	2,528929	0,678391	0,813325	238,049179	29,356644	7,883296	244019
_20150421_011558	30,425083	200,622	15,8643	16,101	2,57901	0,677965	0,830532	235,193741	30,426708	7,966329	198730
_20160405_215031	15,944347	190,300	19,00931	17,560	2,338468	0,6662	0,78058	243,2565	15,945259	10,465377	484677
_20160405_215031	15,944347	190,300	19,00931	17,560	2,338468	0,6662	0,78058	243,2565	15,945259	10,465377	506834

Copiar Template

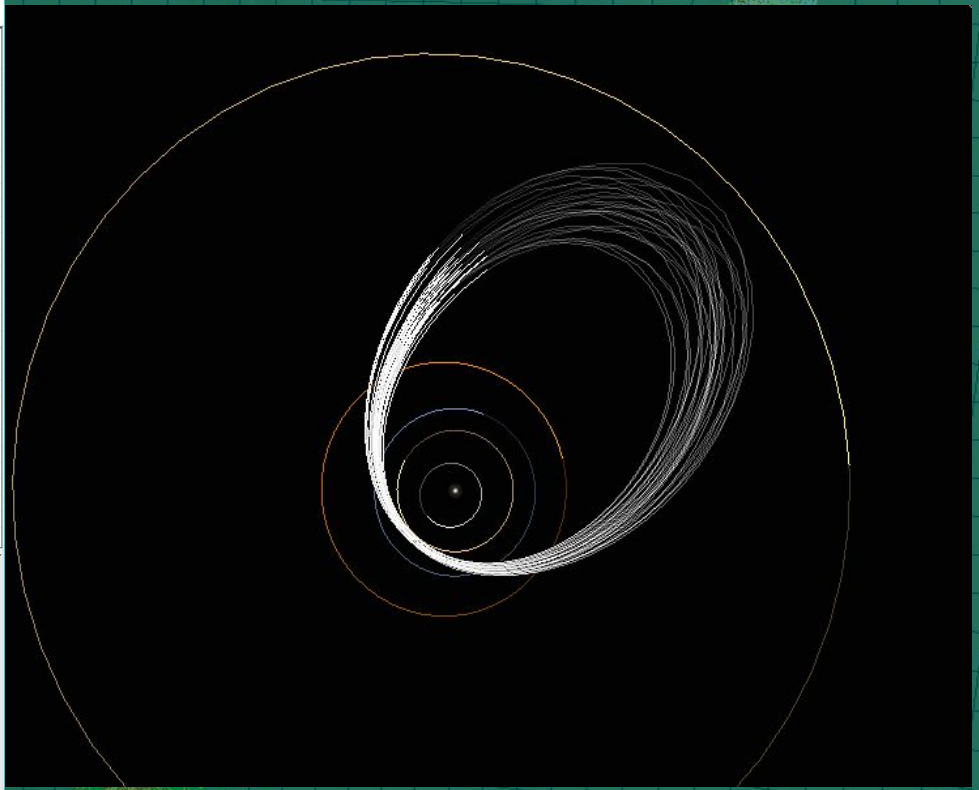
Massa (kg): 1,0
Densidade: 1,0
Salvar US
Open US

Cor:
- Azul
- Amarelo
- Verde
- Vermelho
- Branco

US - Salvar em: input: Read
US - Template: input: Read
US - Path: C:\Program Files (x86)\Universe Sandbox\ Read

Data: 2457343.05
Salvar Mercury
Mercury
Element
Close

M - Template: input: Read
M - Path: C:\Mercury Read



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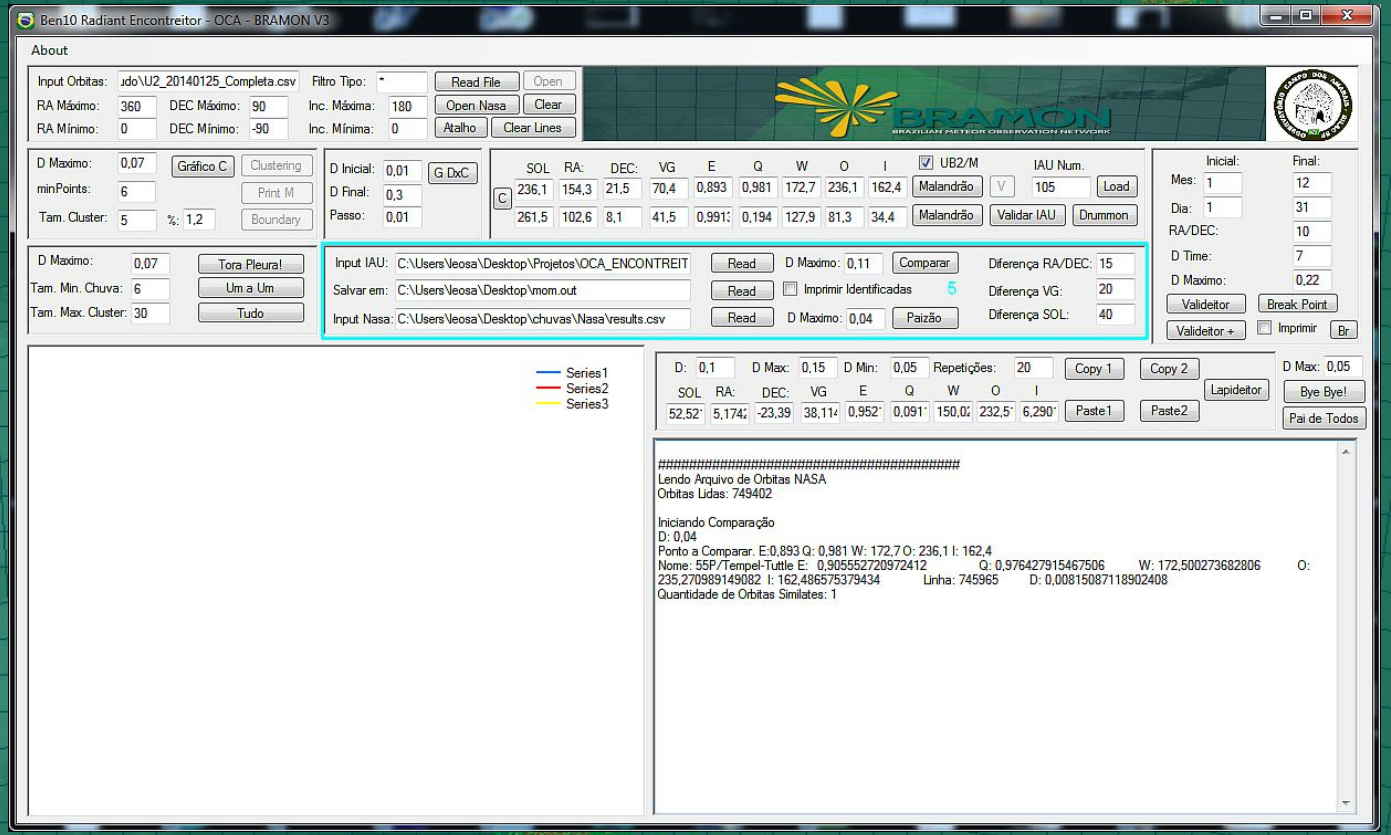
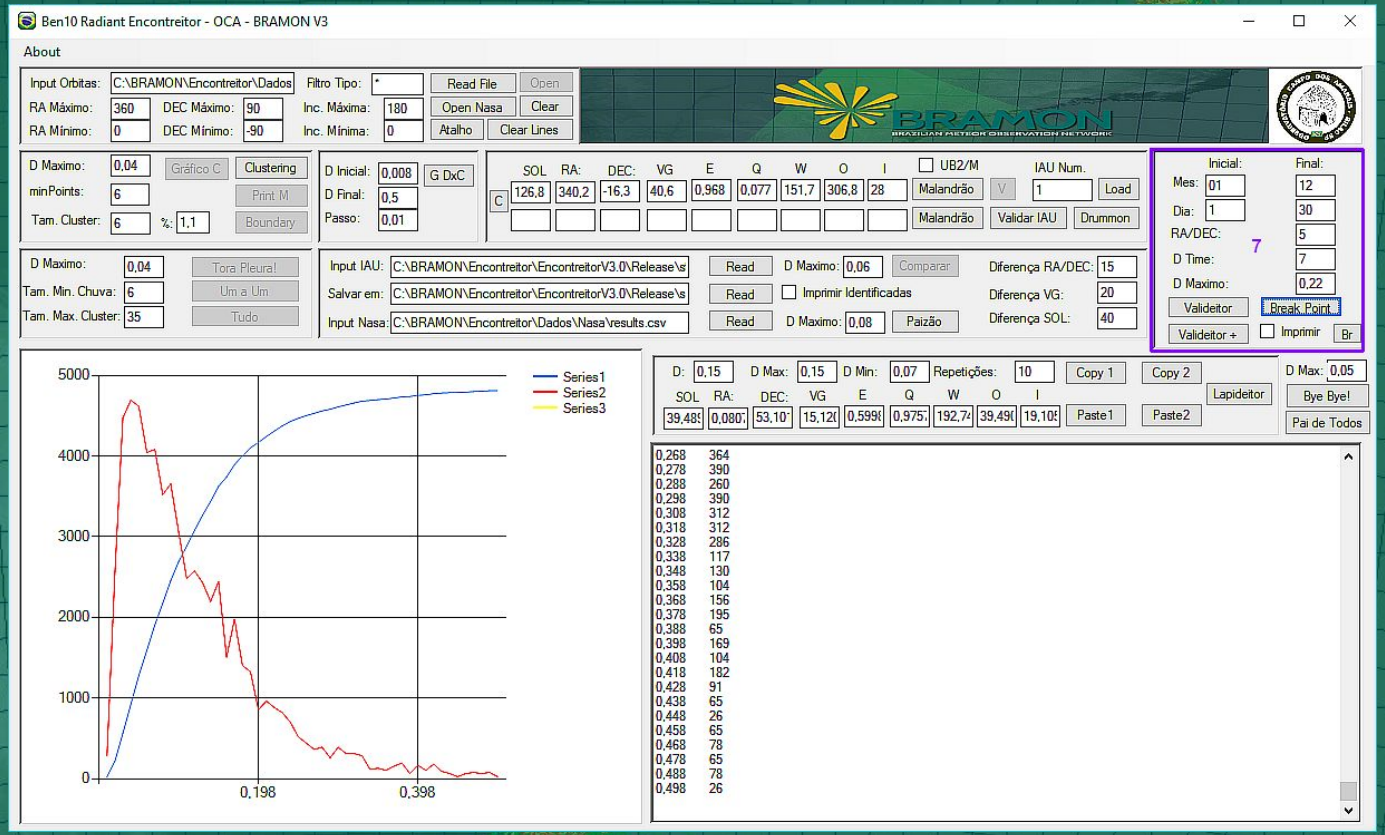
Paizão Function: Search for Parental body

- Paizão (Parental Bodies): with this function we test the mean orbital elements of a new shower against the JPL Small-Body Database to search for parental bodies of the showers



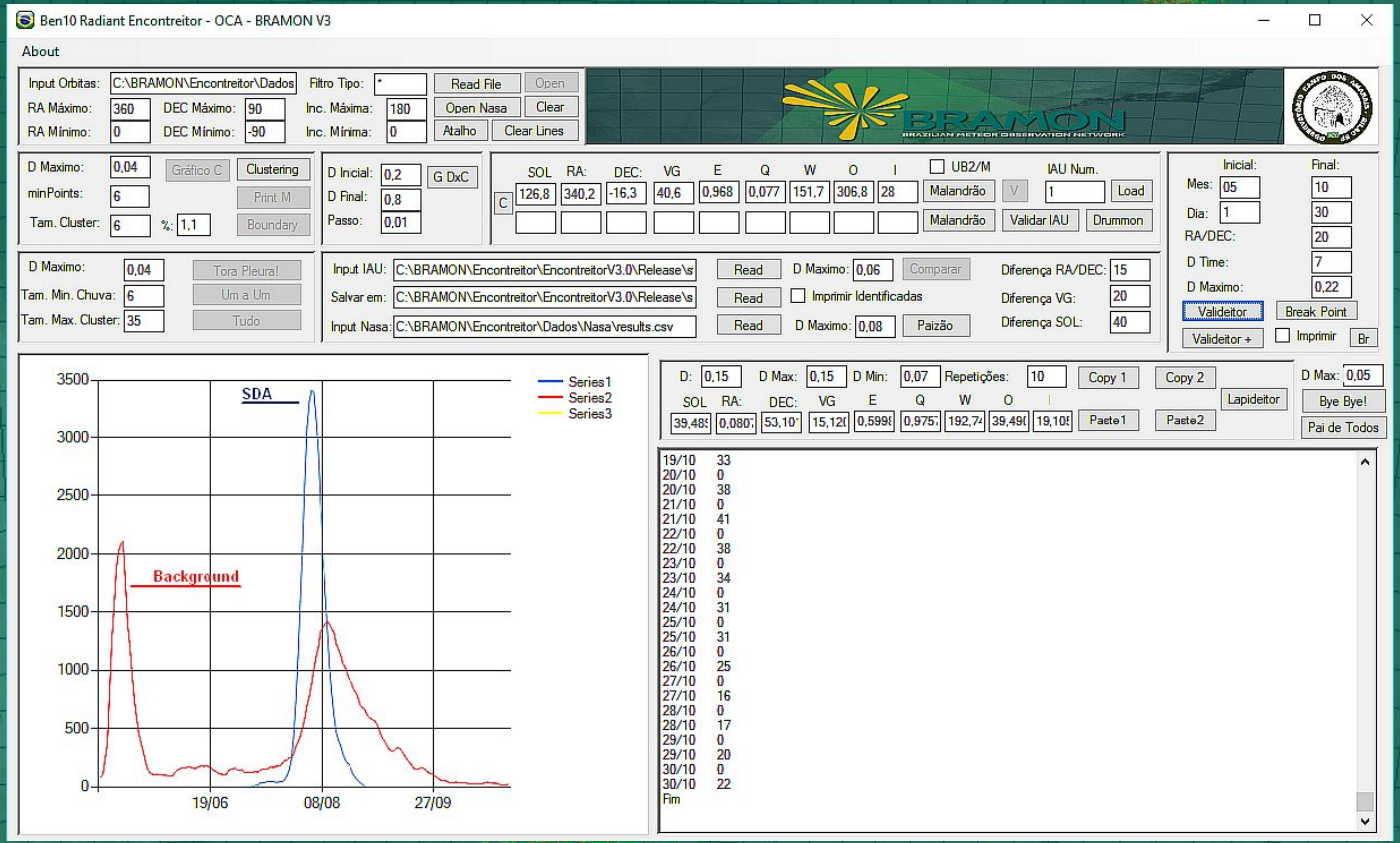
Breakpoint Validation

- Breakpoint Method (Welch, 2001), test of the mean orbital elements of a candidate new shower against a continuum meteor background



Valideitor: Search for incrase of shower activity

- The Valideitor analyzes over time (day by day) the amount of orbits that belong to a given radiant. To determine if an orbit belongs to a radiant, the Drummond test is applied between an individual meteor orbit in database and the shower orbital parameters. If the result is less than a given maximum D (we usually use the value of 0.21), the orbits are considered to belong to the radiant.
- Over time, the number of orbits that fit in the radiant tends to increase, so you can see the formation of a peak in the graph.



Ben 10 isn't dead!

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WILSON BONFIM ABREU FILHO
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Very thanks to...

Jakub Algol Koukal

- Supports BRAMON since it was created
- He taught us a lot about meteors
- He gave us some lashes
- And was our babysiter too

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THE END

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