Study of mouse behavior in different gravity environments

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Supplementary Figure 1. AIS activity based on times of day in hypergravity, microgravity, artificial gravity and ground control experiments. Activity continuous corresponding to time course data per day obtained using EthoVision in hypergravity (Centrifuge Gondola A-D), artificial gravity (FL AG A1 and A4 cage), microgravity (FL MG M1 and M4 cage), ground control at daytime (D001, D002, D004, D005) and ground control at night-time (N001, N002, N004, N005). The gray blocks indicate the period when the cages were refreshed and dotted blocks indicate missing data.
Centrifuge Gondola A

Times of day (h)
Ground control Cage N002

Ground control Cage N005
Supplementary Figure 2. Time course and histogram of active continuous

a) Time course of activity continuous

b) Log converted activity continuous (using data before low-pass filter)

c) Histogram of log converted activity continuous (using data before low-pass filter)
Supplementary Activity amount when sampled from time course data.

Time course data obtained log-converting the activity continuous data after low-pass filter is shown in Fig. S1_1 and a histogram of the data is shown in Fig. S1_2.

Figure S1_1 Time course obtained log-converting the activity continuous data after low-pass filter (horizontal scale is 1/30 s).

Figure S1_2 Histogram of the data after lo-pass filter
Here, the region is divided into five areas (A< -12, -12 ≦ B< -6, -6 ≦ C<0.5, 0.5 ≦ D<7, 7 ≦ E) as shown in figure S1_2. A summary of the state of movement of mouse is shown in Table S1.

Table S1 Summary of the state of movement

| Figure No. | Time region (s)   | Behavioral type | Region class | Remarks            |
|------------|-------------------|-----------------|--------------|--------------------|
| S1_3A1     | 2669.8-2736.2     | Resting         | A< -12       |                    |
| S1_3A2     | 3423.4-3424.5     | Resting         | A< -12       |                    |
| S1_3A3     | 7708.0-7724.2     | Resting         | A< -12       |                    |
| S1_3BC     | 9127.6-9128.6     | Drinking        | -12 ≦ BC<0.5 |                    |
| S1_3CD     | 5107.5-5109.5     | Drinking        | -6 ≦ CD<7    | Area D: frequent   |
| S1_3C      | 1279.5-1281.2     | Grooming        | -6 ≦ C<0.5   |                    |
| S1_3DE1    | 6153.2-6200.2     | Grooming        | 0.5 ≦ DE     | Area D: frequent   |
| S1_3DE2    | 10442.0-10449.0   | Rearing         | 0.5 ≦ DE     | Area E: frequent   |
The areas in pink part indicate movement.
**Supplementary Table 1. Video recording of centrifugation on the ground (HG).**
The bold text indicates the date and time of recording the video.

| Elapsed days | Video Basic recording duration | No recording duration | Remarks |
|--------------|---------------------------------|-----------------------|---------|
| 1            | 9:30-10:30                      |                       | start centrifugation |
| 2            | 9:30-10:30                      |                       |                     |
| 3            | 14:30-15:30                     |                       |                     |
| 4            | 13:30-14:30                     |                       |                     |
| 5            | 9:30-10:30                      |                       |                     |
| 6            | 13:30-14:30                     |                       |                     |
| 7            | 9:30-10:30                      |                       |                     |
| 8            | 9:30-10:30                      |                       |                     |
| 9            | 9:30-10:30                      |                       |                     |
| 10           | 9:30-10:30                      |                       |                     |
| 11           | 9:30-10:30                      |                       |                     |
| 12           | 14:00-15:00                     | 7:00-18:59            |                     |
| 13           | 8:30-9:30                       |                       |                     |
| 14           | 9:00-10:00                      |                       |                     |
| 15           | 9:00-10:00                      |                       |                     |
| 20           | 9:00-10:00                      |                       |                     |
| 21           | 9:30-10:30                      |                       |                     |
| 25           | 9:30-10:30                      |                       |                     |
| 28           | 9:30-10:30                      |                       |                     |
| 29           | 9:00-10:00                      |                       |                     |
| 30           | end centrifugation              |                       |                     |
**Supplementary Table 2. Video recording and cage refreshment operation for crew in flight (FL).** a: add water into feed-water container, b: replace feed container, c: clean-up a cage, d: water leaking, e: change the cage. The bold text indicates the date and time (total time) of recording the video.

| Elapsed days | Cage number | Remarks       |
|--------------|-------------|---------------|
|              | A1  | A4  | M1  | M4  |              |
| 1            |     | ✔   | ✔   | ✔   | ✔   | TCU to MHU   |
| 3            | ✔   | ✔   | ✔   | ✔   | ✔   | video recording 9:54-15:55 (6) |
| 5            | ✔   | ✔   | a   | ✔   | ✔   | cage refreshment |
| 7            | ✔ a,b | ✔ a,b | ✔ b | ✔ b | ✔ b |              |
| 9            | ✔ a  | ✔ a  | ✔ a | ✔ a | ✔ a |              |
| 12           | ✔ ✔   | ✔   | ✔   | ✔   | ✔   | video recording 7:12-16:01 (9) |
| 13           | ✔ a   | ✔ a   | ✔ a | ✔ a | ✔ a |              |
| 14           | ✔ a,b | ✔ a,b | ✔ b | ✔ b | ✔ b |              |
| 17           | ✔ a  | ✔ a  | ✔ a | ✔ a | ✔ a |              |
| 19           | ✔ a   | ✔ a   | ✔ a | ✔ a | ✔ a |              |
| 20           | ✔ b,c | ✔ b,c | ✔ b,c | ✔ b,c | ✔ b,c | cage refreshment |
| 21           | ✔ b   | ✔ b   | ✔ b | ✔ b | ✔ b |              |
| 22           | ✔ ✔   | ✔   | ✔   | ✔   | ✔   |              |
| 23           | ✔ d   | ✔ d   | ✔ d | ✔ d | ✔ d |              |
| 25           | ✔ ✔   | ✔   | ✔   | ✔   | ✔   | video recording 7:59-16:00 (8) |
| 26           | ✔ a,b,c | ✔ a,b,c | ✔ a | ✔ a | ✔ a |              |
| 27           | ✔ a,b | ✔ a,b | ✔ a,c | ✔ a,c | ✔ a,c | cage refreshment |
| 31           | ✔ a,b | ✔ a,b | ✔ a | ✔ a | ✔ a |              |
| 33           | ✔ ✔   | ✔   | ✔   | ✔   | ✔   | video recording 7:15-15:17 (8) |
| 34           | ✔ a,c | ✔ a,c | ✔ c | ✔ c | ✔ c | cage refreshment |
| 36           | ✔     | ✔     | ✔     | ✔     | ✔     | MHU to TCU |
Supplementary Table 3. Video recording and cage refreshment operation on the ground (GC). a: add water into feed-water container, b: feed pellet, c: change deed-water nozzle. The bold text indicates the date and time (total time) of recording the video.

| Elapsed days | Cage number | Remarks                          |
|--------------|-------------|----------------------------------|
|              | 001 002 004 005 |                                  |
| 1            |             | start rearing video recording    |
| 2            | ✔ ✔         | 10:00-18:59 (9), 20:00-06:59 (11) |
| 4            | ✔ ✔         | 12:00-18:59 (7), 20:00-06:59 (11) |
| 7            | ✔ ✔         | 11:00-18:59 (8), 20:00-06:59 (11) |
| 8            | ✔ ✔         | video recording                  |
|              |             | 11:00-18:59 (8), 20:00-06:59 (11) |
| 10           | ✔ ✔         | video recording                  |
|              |             | 08:00-13:59 (6)                  |
| 11           | ✔ ✔         | cage refreshment                 |
|              |             |                                   |
| 14           | ✔ ✔         | video recording                  |
|              |             | 11:00-18:59 (8), 20:00-06:59 (11) |
| 15           | ✔ ✔         | cage refreshment                 |
|              |             | 11:00-18:59 (8), 20:00-06:59 (11) |
| 16           | ✔ ✔         | video recording                  |
|              |             | 08:00-13:59 (6)                  |
| 20           | ✔ ✔         | cage refreshment                 |
|              |             | video recording                  |
| 21           | ✔ ✔         | cage refreshment                 |
|              |             | 11:00-18:59 (8), 20:00-06:59 (11) |
| 22           | ✔ ✔         | cage refreshment                 |
|              |             | 12:00-18:59 (7), 20:00-06:59 (11) |
| 28           | ✔ ✔         | video recording                  |
|              |             | 11:00-18:59 (8), 20:00-06:59 (11) |
| 29           | ✔ ✔         | video recording                  |
|              |             | 12:00-18:59 (7), 20:00-06:59 (11) |
| 36           |             | stop rearing                     |

Videos with a short continuous recording time were not used.
Supplementary AG and MG videos.

The following 4 movies are the recorded A1 of AG cage and M1 of MG cage on the 3rd and 33rd days and converted to 180x speed using ffmpeg (FFmpeg Developers. (2016). ffmpeg tool (Version be1d324) [Software]. Available from http://ffmpeg.org/).

03A.mov: day-3 AG cage
33A.mov: day-33 AG cage
03M.mov: day-3 MG cage
33M.mov: day-33 MG cage
## Supplementary Table 4 Statistic of GC activity ratio per hour.

### Daytime

| Times of day (h) | t-value | p-value | FDR |
|------------------|---------|---------|-----|
| 12 13            | -0.103  | 0.459684 | 0.05 |
| 12 14            | 0.171   | 0.433224 | 0.025|
| 12 15            | -0.774  | 0.225582 | 0.00625|
| 12 16            | 0.5176  | 0.306452 | 0.01 |
| 12 17            | -2.661  | 0.00915 | 0.002632|
| 12 18            | -1.419  | 0.087598 | 0.0083846|
| 13 14            | 0.2881  | 0.388519 | 0.016667|
| 13 15            | -0.687  | 0.251267 | 0.007143|
| 13 16            | 0.6632  | 0.258872 | 0.008333|
| 13 17            | -2.651  | 0.009151 | 0.002778|
| 13 18            | -1.359  | 0.096571 | 0.004167|
| 14 15            | -1.049  | 0.154945 | 0.005 |
| 14 16            | 0.3656  | 0.359905 | 0.0125 |
| 14 17            | -3.142  | 0.003269 | 0.0025 |
| 14 18            | -1.714  | 0.052933 | 0.003333|
| 15 16            | 1.5976  | 0.065005 | 0.003571|
| 15 17            | -2.363  | 0.019999 | 0.002941|
| 15 18            | -0.814  | 0.213998 | 0.005556|
| 16 17            | -4.03   | 0.000489 | 0.002381|
| 16 18            | -2.256  | 0.020009 | 0.003125|
| 17 18            | 1.146   | 0.134881 | 0.004545|

Yellow is below the p-value upper limit.

### Night-time

| Times of day (h) | t-value | p-value | FDR |
|------------------|---------|---------|-----|
| 20 1             | 4.895   | 0.000117 | 0.00102|
| 20 2             | 8.6033  | 5.83E-07 | 0.00091|
| 20 3             | 8.0835  | 1.25E-06 | 0.00094|
| 20 4             | 8.2327  | 9.12E-07 | 0.00093|
| 20 5             | 5.8018  | 2.45E-05 | 0.00096|
| 20 6             | 5.0008  | 0.000159 | 0.00106|
| 20 21            | 4.54    | 0.000237 | 0.00111|
| 20 22            | 3.9538  | 0.001062 | 0.00132|
| 20 23            | 4.348   | 0.000307 | 0.00116|
| 20 24            | 4.3533  | 0.000247 | 0.00114|
| 21 1             | 0.2358  | 0.408278 | 0.0125 |
| 21 2             | 3.9239  | 0.000626 | 0.00125|
| 21 3             | 3.542   | 0.001404 | 0.00139|
| 21 4             | 3.5746  | 0.001297 | 0.00135|
| 21 5             | 1.0952  | 0.144824 | 0.00313|
| 21 6             | 1.1177  | 0.14061 | 0.00278|
| 21 22            | 0.4048  | 0.345759 | 0.00625|
| 21 23            | -0.397  | 0.348377 | 0.00714|
| 21 24            | -1.105  | 0.14396 | 0.00294|
| 22 1             | -0.215  | 0.416254 | 0.00167|
| 22 2             | 2.911   | 0.005259 | 0.00152|
| 22 3             | 2.6042  | 0.00976 | 0.00167|
| 22 4             | 2.6123  | 0.009662 | 0.00161|
| 22 5             | 0.4959  | 0.3137 | 0.00556|
| 22 6             | 0.5917  | 0.281184 | 0.005 |
| 22 23            | -0.737  | 0.236665 | 0.00385|
| 22 24            | -1.305  | 0.109047 | 0.00263|
| 23 1             | 0.6484  | 0.262975 | 0.00455|
| 23 2             | 4.4358  | 0.000233 | 0.00109|
| 23 3             | 4.0314  | 0.000539 | 0.00122|
| 23 4             | 4.0765  | 0.00048 | 0.00119|
| 23 5             | 1.5376  | 0.071931 | 0.00227|
| 23 6             | 1.493   | 0.078524 | 0.00238|
| 23 24            | -0.7    | 0.247554 | 0.00417|
| 24 1             | 1.4004  | 0.091416 | 0.0025 |
| 24 2             | 5.4811  | 5.42E-05 | 0.00098|
| 24 3             | 5.0141  | 0.000126 | 0.00104|
| 24 4             | 5.0936  | 0.000104 | 0.001 |
| 24 5             | 2.3796  | 0.016073 | 0.00192|
| 24 6             | 2.1651  | 0.025584 | 0.002 |
| 1 2              | 3.7455  | 0.000919 | 0.00128|
| 1 3              | 3.3615  | 0.002065 | 0.00147|
| 1 4              | 3.3919  | 0.001916 | 0.00143|
| 1 5              | 0.8733  | 0.19772 | 0.00357|
| 1 6              | 0.9243  | 0.185036 | 0.00333|

Yellow is below the p-value upper limit.
Supplementary Table 5 Statistic of HG activity ratio per hour.

| Times of day (h) | t-value   | p-value     | FDR  |
|------------------|-----------|-------------|------|
| 7 8              | 2.325351  | 0.01497019  | 0.002083 |
| 7 11             | 4.220844  | 0.00018584  | 0.001613 |
| 7 12             | 4.016291  | 0.00029217  | 0.001667 |
| 7 13             | 5.079951  | 3.14E-05    | 0.001351 |
| 7 14             | 4.828128  | 5.34E-05    | 0.001389 |
| 7 15             | 3.8669    | 0.00078334  | 0.001724 |
| 7 16             | 2.163235  | 0.02095995  | 0.0025  |
| 7 17             | 0.4388635 | 0.3328634   | 0.01   |
| 7 18             | -2.320626 | 0.01520651  | 0.002174 |
| 8 11             | 1.322892  | 0.1004507   | 0.004167 |
| 8 12             | 1.260957  | 0.1106147   | 0.004545 |
| 8 13             | 1.872685  | 0.03891629  | 0.003125 |
| 8 14             | 1.674394  | 0.05573186  | 0.003333 |
| 8 15             | 0.4775526 | 0.02022142  | 0.008333 |
| 8 16             | -0.509547 | 0.3079575   | 0.007143 |
| 8 17             | -2.278565 | 0.0178752   | 0.002273 |
| 8 18             | -4.601924 | 0.0001515   |        |
| 11 12            | -0.01523  | 0.4939937   | 0.05   |
| 11 13            | 0.5880036 | 0.2813857   | 0.005556 |
| 11 14            | 0.3486004 | 0.3654056   | 0.0125 |
| 11 15            | -1.404755 | 0.0895126   | 0.003571 |
| 11 16            | -2.213667 | 0.01876584  | 0.002381 |
| 11 17            | -4.69011  | 0.0001429   |        |
| 11 18            | -7.28881  | 3.35E-07    | 0.001163 |
| 12 13            | 0.5668996 | 0.2885253   | 0.00625 |
| 12 14            | 0.3431025 | 0.3675165   | 0.016667 |
| 12 15            | -1.270239 | 0.1115103   | 0.005  |
| 12 16            | -2.081834 | 0.02463998  | 0.002778 |
| 12 17            | -4.36439  | 0.00015469  | 0.001563 |
| 12 18            | -6.867467 | 3.75E-07    | 0.00122 |
| 13 14            | -0.261027 | 0.3982506   | 0.025  |
| 13 15            | -2.444025 | 0.01243563  | 0.002  |
| 13 16            | -3.005152 | 0.00338307  | 0.001852 |
| 13 17            | -5.960849 | 2.69E-06    | 0.00125 |
| 13 18            | -8.363838 | 1.03E-08    | 0.001111 |
| 14 15            | -2.084507 | 0.02581622  | 0.002941 |
| 14 16            | -2.744204 | 0.00605777  | 0.001923 |
| 14 17            | -5.611871 | 6.17E-06    | 0.001282 |
| 14 18            | -8.302496 | 1.87E-08    | 0.001136 |
| 15 16            | -1.403263 | 0.08985664  | 0.003846 |
| 15 17            | -4.729461 | 7.56E-05    | 0.001471 |
| 15 18            | -7.877739 | 2.77E-07    | 0.00119 |
| 16 17            | -2.157346 | 0.02149542  | 0.002632 |
| 16 18            | -4.946505 | 3.03E-05    | 0.001316 |
| 17 18            | -3.375001 | 0.00142646  | 0.001786 |

Yellow is below the p-value upper limit.
### Supplementary Table 6 Statistic of GC activity ratio.

| Elapsed day | Daytime |          |          | Night-time |          |          |
|-------------|---------|----------|----------|------------|----------|----------|
|             | t-value | p-value  | FDR      | t-value    | p-value  | FDR      |
| 2           | -0.6517 | 0.2960   | 0.005    | 2          | -1.7875 | 0.1433   | 0.00185  |
| 2           | 3.2663  | 0.0903   | 0.00135  | 2          | 2.1704  | 0.1122   | 0.00167  |
| 2           | 3.0602  | 0.0823   | 0.00122  | 2          | -5.6859 | 0.0416   | 0.00135  |
| 2           | 3.6441  | 0.0350   | 0.00111  | 2          | 1.3949  | 0.1948   | 0.00227  |
| 2           | 3.1651  | 0.0823   | 0.00125  | 2          | 0.2834  | 0.4111   | 0.00455  |
| 2           | 1.7048  | 0.1407   | 0.00192  | 2          | 0.6234  | 0.3110   | 0.00385  |
| 2           | 3.3439  | 0.0596   | 0.00116  | 2          | 0.9796  | 0.2208   | 0.00263  |
| 4           | 1.0884  | 0.1991   | 0.00278  | 7          | 0.2834  | 0.4111   | 0.00455  |
| 4           | 1.7196  | 0.1571   | 0.00227  | 4          | -11.9968| 0.0189   | 0.00122  |
| 4           | 1.4348  | 0.1599   | 0.00238  | 4          | -5.8923 | 0.0510   | 0.00139  |
| 4           | 2.4485  | 0.0745   | 0.00119  | 4          | -1.0908 | 0.2311   | 0.00294  |
| 4           | 1.5859  | 0.1483   | 0.00208  | 4          | -2.4807 | 0.0894   | 0.00156  |
| 4           | 0.8289  | 0.2723   | 0.00385  | 4          | -3.4745 | 0.0401   | 0.00132  |
| 4           | 1.9173  | 0.0999   | 0.00139  | 4          | 0.8296  | 0.2546   | 0.00313  |
| 7           | 2.1423  | 0.1152   | 0.00172  | 7          | 0.9405  | 0.2261   | 0.00278  |
| 7           | 2.8393  | 0.1060   | 0.00161  | 7          | -2.4134 | 0.1233   | 0.00172  |
| 7           | 2.7424  | 0.1032   | 0.00156  | 7          | -0.1683 | 0.4469   | 0.00556  |
| 7           | 3.3434  | 0.0557   | 0.00114  | 7          | -0.0430 | 0.4855   | 0.00125  |
| 7           | 2.8021  | 0.1026   | 0.00152  | 7          | -0.0872 | 0.4695   | 0.00625  |
| 7           | 1.9692  | 0.1004   | 0.00147  | 7          | -0.0643 | 0.4784   | 0.00833  |
| 7           | 2.9799  | 0.0863   | 0.00132  | 7          | 2.1809  | 0.1286   | 0.00179  |
| 8           | 1.3840  | 0.1901   | 0.00278  | 8          | -4.6970 | 0.0640   | 0.00147  |
| 8           | 1.1404  | 0.2010   | 0.00294  | 8          | -1.7700 | 0.1631   | 0.002    |
| 8           | 2.2518  | 0.0831   | 0.00128  | 8          | -0.6555 | 0.3028   | 0.00357  |
| 8           | 1.2805  | 0.1847   | 0.00263  | 8          | -1.2246 | 0.1728   | 0.00208  |
| 8           | 0.7474  | 0.2887   | 0.00455  | 8          | -1.4192 | 0.1592   | 0.00192  |
| 8           | 1.6519  | 0.1231   | 0.00185  | 8          | 1.3237  | 0.1947   | 0.00217  |
| 14          | -0.2251 | 0.4252   | 0.01     | 14         | 21.6413| 0.0049   | 0.00111  |
| 14          | 1.7240  | 0.1620   | 0.0025   | 14         | 1.3096  | 0.2071   | 0.00238  |
| 14          | -0.0101 | 0.4966   | 0.05     | 14         | 3.1565  | 0.0943   | 0.00161  |
| 14          | 0.3784  | 0.3846   | 0.00714  | 14         | 5.1667  | 0.0534   | 0.00143  |
| 14          | 0.8271  | 0.2710   | 0.00357  | 14         | 20.0455 | 0.0056   | 0.00114  |
| 15          | 1.7231  | 0.1455   | 0.002    | 15         | 0.0453  | 0.4856   | 0.01667  |
| 15          | 0.1767  | 0.4381   | 0.01667  | 15         | 0.0831  | 0.4736   | 0.00714  |
| 15          | 0.4114  | 0.3746   | 0.00556  | 15         | 0.2192  | 0.4311   | 0.005    |
| 15          | 0.8565  | 0.2466   | 0.00333  | 15         | 11.0921 | 0.0239   | 0.00125  |
| 21          | -1.6596 | 0.1546   | 0.00217  | 21         | -0.0104 | 0.4965   | 0.025    |
| 21          | -0.2812 | 0.4084   | 0.00833  | 21         | 0.0095  | 0.4969   | 0.05     |
| 21          | -1.0884 | 0.2069   | 0.00313  | 21         | 1.2915  | 0.2075   | 0.0025   |
| 22          | 0.3774  | 0.3843   | 0.00625  | 22         | 0.0440  | 0.4848   | 0.01     |
| 22          | 0.7383  | 0.2736   | 0.00417  | 22         | 3.0383  | 0.0850   | 0.00152  |
| 28          | -0.1820 | 0.4416   | 0.0025   | 28         | 4.6610  | 0.0392   | 0.00128  |
**Supplementary Table 7 Statistic of HG activity ratio.**

| Elapsed day | t-value | p-value | FDR    |
|-------------|---------|---------|--------|
| 2           | -1.8195 | 0.0597  | 0.00051546 |
| 4           | -3.9766 | 0.0037  | 0.00039063 |
| 5           | -4.5474 | 0.0020  | 0.00037879 |
| 7           | -4.6792 | 0.0028  | 0.00038462 |
| 8           | -5.1405 | 0.0013  | 0.00037037 |
| 10          | -7.7199 | 0.0004  | 0.00037313 |
| 11          | -7.7473 | 0.0001  | 0.00032895 |
| 12          | -7.6434 | 0.0002  | 0.00033784 |
| 13          | -5.8083 | 0.0006  | 0.0003714 |
| 14          | -9.0506 | 0.0003  | 0.00034014 |
| 15          | -6.3253 | 0.0003  | 0.00034247 |
| 20          | -8.8659 | 0.0002  | 0.00033113 |
| 21          | -7.0481 | 0.0002  | 0.00033557 |
| 25          | -5.7800 | 0.0001  | 0.00032968 |
| 26          | -5.1912 | 0.0003  | 0.00036765 |
| 28          | -5.4392 | 0.0008  | 0.00037594 |
| 29          | -6.8982 | 0.0002  | 0.00033333 |
| 3           | -2.3761 | 0.0278  | 0.00046729 |
| 5           | -3.0221 | 0.0121  | 0.00043103 |
| 7           | -3.5103 | 0.0097  | 0.00042017 |
| 8           | -3.8104 | 0.0057  | 0.0003876 |
| 10          | -5.9450 | 0.0029  | 0.00038376 |
| 11          | -6.0746 | 0.0026  | 0.00035211 |
| 12          | -4.4135 | 0.0026  | 0.00038168 |
| 13          | -7.4876 | 0.0005  | 0.00034965 |
| 14          | -5.1256 | 0.0012  | 0.00036496 |
| 16          | -7.0356 | 0.0004  | 0.00034483 |
| 20          | -5.5108 | 0.0008  | 0.00035971 |
| 29          | -6.1699 | 0.0004  | 0.00034722 |
| 31          | -3.8647 | 0.0054  | 0.00039683 |
| 33          | -4.3666 | 0.0009  | 0.00039397 |
| 34          | -5.8066 | 0.0008  | 0.00036232 |
| 35          | -0.6881 | 0.2586  | 0.0017086 |
| 37          | -1.7565 | 0.0699  | 0.00053191 |
| 38          | -1.7395 | 0.0681  | 0.00052632 |
| 39          | -2.2662 | 0.0485  | 0.00050173 |
| 41          | -3.4392 | 0.0069  | 0.00050984 |
| 42          | -2.9485 | 0.0151  | 0.00043478 |
| 43          | -2.1431 | 0.0384  | 0.00034807 |
| 44          | -3.9703 | 0.0070  | 0.00041322 |
| 45          | -2.7266 | 0.0173  | 0.00044248 |
| 46          | -3.8847 | 0.0068  | 0.00040605 |
| 47          | -2.7192 | 0.0179  | 0.00044643 |
| 48          | -3.5828 | 0.0058  | 0.00040323 |

Yellow is below the p-value upper limit.
### Supplementary Table 8 Statistic of FL activity ratio.

|     | AG     |     | MG     |     |
|-----|--------|-----|--------|-----|
|     | Elapsed day | t-value | p-value | FDR | Elapsed day | t-value | p-value | FDR |
|     | 3 12  | -5.3001 | 0.0273 | 0.01 | 3 25 | -0.1422 | 0.4529 | 0.05 |
|     | 3 25  | -5.9182 | 0.0506 | 0.0125 | 3 33 | 0.6329 | 0.3015 | 0.025 |
|     | 3 33  | -7.0219 | 0.0106 | 0.0083 | 25 33 | 0.8116 | 0.2773 | 0.013 |
|     | 12 25 | 2.7115  | 0.1114 | 0.025 |     |     |     |     |
|     | 12 33 | -0.0387 | 0.4865 | 0.05 |     |     |     |     |
|     | 25 33 | -4.1249 | 0.0735 | 0.0167 |     |     |     |     |
Red letters are percentage values converted from rest, Immobility, and inactive.

### Supplementary Table 9

| No. | Strain              | Sex          | Age (weeks) | Bin (hours) | Awake/Active (%) | Rest/Immobility/Inactive (%) | Method | Faces | Calculation method | Publication year | Reference & Remarkstotal light dark (min or sec) (%) |
|-----|---------------------|--------------|-------------|-------------|------------------|-------------------------------|--------|-------|-------------------|-----------------|--------------------------------------------------------|
| 1   | C57BL/6 male        | week6        |             |             |                  |                               | Video  |       |                   | 2007            | [15]                                                   |
| 2   | C57BL/6 male        | week11-14    | 34          |             |                  |                               | Video  |       |                   | 2008            | fig1A [16]                                              |
| 3   | CAST/EiJ male       | week10-12    | 56.7        |             |                  |                               | Video  |       |                   | 2010            | Figure6.a [12]                                         |
| 4   | C57BL/6 male        | month3-9     |             |             |                  |                               | Video  |       |                   | 2012            | [17]                                                   |
| 5   | C57BL/6 × CBA/CaJ   | week9        |             |             |                  |                               | EEG/EMG|       |                   | 2013            | Table 1 [18]                                           |
| 6   | C57BL/6N male       | week20.1     |             |             |                  |                               | EEG/EMG|       |                   | 2014            | [19]                                                   |
| 7   | C57BL/6 male        | week10-20    | 53.1        |             |                  |                               | EEG/EMG|       |                   | 2016            | fig2B,Standard-diet [20]                                |
| 8   | C57BL/6 male        | week8        | 47.6        |             | 32.3 ± 3.5       | 63.3 ± 4.3                    | Video  |       |                   | 2018            | Table 1 [21]                                           |

The activity was analyzed using the HomeScan60® (HS) software and manual annotation. The software does not identify movements of less than 6 frames out of a 30-frame movie. The identification accuracy of the software is over 80% on average. The estimated amount of activity from WT Rest of Fig. 2A control. The vertical axis (Time) in Fig. 2A is shown in second/hour. Therefore, hour was converted into seconds and calculated as a ratio. Awake / Active (%) was calculated by subtracting averaged Rest/Immobility/Inactive (%) from 100%.
### Supplementary Table 10 Statistic of GC active interval.

| Daytime | Night-time |
|---------|------------|
| **Elapsed** | **t-value** | **p-value** | **FDR** | **Elapsed** | **t-value** | **p-value** | **FDR** |
| 2 | 4 | -1.6634 | 0.1531 | 0.0017 | 2 | 4 | -1.522 | 0.185 | 0.0017 |
| 2 | 7 | 1.0219 | 0.2419 | 0.0028 | 2 | 7 | 0.193 | 0.439 | 0.01 |
| 2 | 8 | -1.2782 | 0.2089 | 0.0025 | 2 | 8 | -0.937 | 0.225 | 0.0021 |
| 2 | 14 | 1.5363 | 0.1663 | 0.0019 | 2 | 14 | 0.857 | 0.264 | 0.0029 |
| 2 | 15 | -1.0507 | 0.2399 | 0.0026 | 2 | 15 | 0.812 | 0.256 | 0.0028 |
| 2 | 21 | -1.0279 | 0.2433 | 0.0029 | 2 | 21 | 0.942 | 0.224 | 0.0019 |
| 2 | 22 | -6.7904 | 0.0108 | 0.0011 | 2 | 22 | -0.640 | 0.294 | 0.0036 |
| 2 | 28 | 2.2701 | 0.0919 | 0.0013 | 2 | 28 | 1.054 | 0.241 | 0.0025 |
| 4 | 7 | 1.7521 | 0.1291 | 0.0014 | 4 | 7 | 170.773 | 0.000 | 0.0011 |
| 4 | 8 | -0.6288 | 0.3125 | 0.0033 | 4 | 8 | 0.357 | 0.391 | 0.0056 |
| 4 | 14 | 2.3938 | 0.0696 | 0.0013 | 4 | 14 | 7.638 | 0.041 | 0.0012 |
| 4 | 15 | -0.4008 | 0.3731 | 0.0038 | 4 | 15 | 3.722 | 0.084 | 0.0012 |
| 4 | 21 | -0.3480 | 0.3882 | 0.0045 | 4 | 21 | 3.186 | 0.097 | 0.0013 |
| 4 | 28 | -1.4096 | 0.1815 | 0.0024 | 4 | 28 | 0.475 | 0.359 | 0.0042 |
| 7 | 8 | -1.6476 | 0.1302 | 0.0014 | 7 | 8 | -1.688 | 0.170 | 0.0017 |
| 7 | 14 | -0.1158 | 0.4605 | 0.0100 | 7 | 14 | 2.227 | 0.134 | 0.0014 |
| 7 | 15 | -1.4585 | 0.1495 | 0.0016 | 7 | 15 | 1.169 | 0.225 | 0.0022 |
| 7 | 21 | -1.4464 | 0.1492 | 0.0016 | 7 | 21 | 1.214 | 0.219 | 0.0019 |
| 7 | 22 | -2.7446 | 0.1055 | 0.0014 | 7 | 22 | -1.016 | 0.247 | 0.0026 |
| 7 | 28 | -0.1528 | 0.4499 | 0.0071 | 7 | 28 | 29.006 | 0.006 | 0.0012 |
| 7 | 29 | -1.6908 | 0.1337 | 0.0015 | 7 | 29 | -0.833 | 0.279 | 0.0031 |
| 8 | 14 | 1.7678 | 0.1432 | 0.0015 | 8 | 14 | 2.367 | 0.104 | 0.0014 |
| 8 | 15 | 0.1776 | 0.4377 | 0.0056 | 8 | 15 | 2.049 | 0.092 | 0.0013 |
| 8 | 21 | 0.2333 | 0.4187 | 0.0050 | 8 | 21 | 2.046 | 0.089 | 0.0013 |
| 8 | 22 | 0.1446 | 0.4541 | 0.0083 | 8 | 22 | 0.174 | 0.440 | 0.0125 |
| 8 | 28 | 1.8201 | 0.1514 | 0.0017 | 8 | 28 | 2.715 | 0.112 | 0.0013 |
| 8 | 29 | 0.6650 | 0.3036 | 0.0031 | 8 | 29 | -0.264 | 0.415 | 0.0063 |
| 14 | 15 | -1.5600 | 0.1611 | 0.0019 | 14 | 15 | 0.107 | 0.464 | 0.05 |
| 14 | 21 | -1.5580 | 0.1597 | 0.0018 | 14 | 21 | 0.378 | 0.380 | 0.0045 |
| 14 | 22 | -4.5338 | 0.0542 | 0.0012 | 14 | 22 | -1.571 | 0.168 | 0.0016 |
| 14 | 28 | -0.0439 | 0.4849 | 0.0500 | 14 | 28 | 0.490 | 0.354 | 0.0038 |
| 14 | 29 | -2.2928 | 0.0745 | 0.0013 | 14 | 29 | -1.101 | 0.233 | 0.0024 |
| 15 | 21 | 0.0520 | 0.4816 | 0.0250 | 15 | 21 | 0.246 | 0.415 | 0.0071 |
| 15 | 22 | -0.1046 | 0.4667 | 0.0125 | 15 | 22 | -1.467 | 0.154 | 0.0015 |
| 15 | 28 | 1.6058 | 0.1688 | 0.0022 | 15 | 28 | 0.114 | 0.464 | 0.025 |
| 15 | 29 | 0.4381 | 0.3622 | 0.0036 | 15 | 29 | -1.103 | 0.225 | 0.0023 |
| 21 | 22 | -0.1846 | 0.4416 | 0.0063 | 21 | 22 | -1.543 | 0.136 | 0.0015 |
| 21 | 28 | 1.6090 | 0.1677 | 0.0021 | 21 | 28 | -0.222 | 0.430 | 0.0083 |
| 21 | 29 | 0.3870 | 0.3765 | 0.0042 | 21 | 29 | -1.180 | 0.209 | 0.0018 |
| 22 | 28 | 6.9354 | 0.0207 | 0.0011 | 22 | 28 | 1.765 | 0.164 | 0.0016 |
| 22 | 29 | 1.4905 | 0.1732 | 0.0023 | 22 | 29 | -0.342 | 0.389 | 0.005 |
| 28 | 29 | -2.7455 | 0.0676 | 0.0012 | 28 | 29 | -1.171 | 0.225 | 0.002 |
Supplementary Table 11 Statistic of HG active interval.

| Elapsed day | t-value | p-value | FDR |
|-------------|---------|---------|-----|
| 2           | 3       | 1.7156  | 0.0693 | 0.0039397 |
| 4           | 2.7701  | 0.0217  | 0.0003623 |
| 5           | 3.5771  | 0.0109  | 0.0003571 |
| 7           | 4.1737  | 0.0097  | 0.0003448 |
| 8           | 4.5952  | 0.0089  | 0.0003356 |
| 10          | 4.2971  | 0.0076  | 0.0003289 |
| 11          | 4.8722  | 0.0068  | 0.0003268 |
| 12          | 4.3968  | 0.0104  | 0.0003521 |
| 13          | 4.3898  | 0.0090  | 0.0003378 |
| 14          | 4.3891  | 0.0079  | 0.0003311 |
| 15          | 4.2808  | 0.0079  | 0.0003333 |
| 20          | 3.9444  | 0.0111  | 0.0003597 |
| 21          | 4.3907  | 0.0094  | 0.0003401 |
| 25          | 3.8387  | 0.0104  | 0.0003497 |
| 26          | 4.1768  | 0.0064  | 0.0003472 |
| 28          | 3.6400  | 0.0106  | 0.0003546 |
| 29          | 4.0344  | 0.0096  | 0.0003425 |
| 3           | 0.3573  | 0.3629  | 0.0016667 |
| 5           | 0.9760  | 0.1934  | 0.0017143 |
| 7           | 1.3444  | 0.1320  | 0.0004717 |
| 8           | 1.6357  | 0.0990  | 0.0004132 |
| 10          | 1.5029  | 0.1087  | 0.0004348 |
| 11          | 1.6559  | 0.0921  | 0.0004065 |
| 12          | 1.4576  | 0.1199  | 0.0004683 |
| 13          | 1.5030  | 0.1120  | 0.0004464 |
| 14          | 1.5445  | 0.1053  | 0.0004274 |
| 15          | 1.4774  | 0.1123  | 0.0004505 |
| 20          | 1.1545  | 0.1621  | 0.0005495 |
| 21          | 1.4865  | 0.1148  | 0.0004545 |
| 25          | 1.1256  | 0.1659  | 0.0005682 |
| 26          | 1.3430  | 0.1323  | 0.0004762 |
| 28          | 1.0199  | 0.1843  | 0.0006579 |
| 29          | 1.2638  | 0.1427  | 0.0004909 |
| 5           | 1.1717  | 0.1540  | 0.0005155 |
| 7           | 1.9770  | 0.0565  | 0.0003876 |
| 8           | 2.7196  | 0.0316  | 0.0003676 |
| 10          | 2.2109  | 0.0385  | 0.0003731 |
| 11          | 2.5269  | 0.0264  | 0.0003650 |
| 12          | 2.3557  | 0.0469  | 0.0003846 |
| 13          | 2.3479  | 0.0391  | 0.0003759 |
| 14          | 2.3550  | 0.0346  | 0.0003704 |
| 15          | 2.1790  | 0.0408  | 0.0003788 |
| 20          | 1.5718  | 0.0911  | 0.0004032 |
| 21          | 2.3471  | 0.0415  | 0.0003817 |
| 25          | 1.4579  | 0.1011  | 0.0004202 |
**Supplementary Table 12 Statistic of FL active interval.**

| AG | Elapsed day | t-value | p-value | FDR |
|----|-------------|---------|---------|-----|
| 3  | 12          | 2.8506  | 0.0743  | 0.0083 |
| 3  | 25          | -0.6439 | 0.2963  | 0.025 |
| 3  | 33          | 3.1851  | 0.0894  | 0.0125 |
| 12 | 25          | -2.8208 | 0.0894  | 0.01 |
| 12 | 33          | 0.1505  | 0.4500  | 0.05 |
| 25 | 33          | 3.0019  | 0.0987  | 0.0167 |

| MG | Elapsed day | t-value | p-value | FDR |
|----|-------------|---------|---------|-----|
| 3  | 25          | -0.0749 | 0.4753  | 0.05 |
| 3  | 33          | -1.1212 | 0.2311  | 0.013 |
| 25 | 33          | -1.0819 | 0.2313  | 0.025 |
Supplementary Information on EthoVision execution.

1. Setup
Start EthoVision and click "New Default Experiment".
Enter the required data on the Experiment Setting screen.
Click "Arena Settings" and determine the analysis area of video.
Click "Trial Control Setting" and use the default.
Click "Detection Settings".
Enter the following items and click "save Changes" at the end.
- Method: gray scaling
- Activity Settings:
  Activity Threshold 3 or 17
  Background noise 1
  Compression artifact filter on

2. Acquisition
Select “Open Acquisition” from “Acquisition” on the menu bar.
Set "Arena Settings", "Trial Control Settings", and Detection Settings" and press the green button on Acquisition Control screen to start data collection.

3. Analysis
Click "Data Profiles" and use the default.
Click "Analysis output" and press "Calculation" button.
Export "Raw data".
Supplementary Information on AIS Activity analysis R script flow.

1. Read Data passed low-pass filter
2. Convert Data by $-\log_{0.9}$
3. Estimate probabilistic density using Kernel Density, instead of histogram.
4. Classified peak of probabilistic density by number of peak
   - 4 peaks or more (198 combinations of peak positions and numbers)
   - 3 peaks (24 combinations of peak positions and numbers)
   - 2 peaks (1 combination of peak positions and numbers)
5. Basically, the minimum point between peaks is calculated as X-coordinate of separation point (the threshold).
   (It depends on the case. See R script in Supplementary R script.)
6. Count first read data above antilog converted threshold as the Active, below as the Inactive.
7. Output file name, threshold, inactive bins, active bins to a file.
### find local maxima subroutine

obtained from https://stackoverflow.com/questions/34205515/finding-local-maxima-and-minima-in-r

```r
code
localMaxima <- function(x) {
  y <- diff(c(-.Machine$integer.max, x)) > 0L
  rle(y)$lengths
  y <- cumsum(rle(y)$lengths)
  y <- y[seq.int(1L, length(y), 2L)]
  y <- y[-1]
  y
}
```

### find local minima

```r
code
localMinima <- function(x) {
  y <- diff(c(.Machine$integer.max, x)) > 0L
  rle(y)$lengths
  y <- cumsum(rle(y)$lengths)
  y <- y[seq.int(1L, length(y), 2L)]
  y <- y[-1]
  y
}
```

### main

```r
code
# edited by Michihiko Shimomura
# copyright JAXA, 2020
# "list.name" is a list that contains the file names for batch processing.
# For example, assuming that the file names of the files in which activity continuous is described are "a1.txt" and "a2.txt",
# "list.name" file is described as follows:
# a1
# a2
#
# The data is described in the file "a1.txt" in the following format.
# 0.713274
# 0.170416
# 0.002047
# 0.009628
# 0.001609
# 0.379159
# 0.436011
# 0.346797
# <unip>
#
#
listlist <- read.table("list.name", header=F)
pdf("evidence.pdf")
for(mm in 1:length(listlist$V1)){
  minmaxt<-c()
  minmaxy<-c()
  minmaxy1<-c()
  thr<-c()
  thr1<-c()
  f1<-c()
  f2<-c()
  f3<-c()
  f4<-c()
  f5<-c()
  f6<-c()
  ca<-c()
  dis <- 12
  bai <- 1.2
  sl <- c()
  fil <- paste(listlist$V1[mm],"_r2.txt", sep="")
  x <- scan(fil)
  l <- length(x)
  t <- seq(1:l)[30]
```
xlog <- -log(abs(x), 0.9)
y <- data.frame(time=t, va0=x, va1=xlog)

# w$x time, w$y log, w$z real
d <- density(xlog, kernel="gaussian", window= kernel, n=512)
plot(d)
mtext(text=fil)

### find maxima points
loc.maxxd <- d$x[localMaxima(d$y)]
loc.maxxd <- c(loc.maxxd, c(loc.maxxd[1]))

temax <- cbind(c(loc.maxxd), c(1))

### find minima points
loc.minxd <- d$x[localMinima(d$y)]
loc.minxd <- c(loc.minxd, c(loc.minxd[1]))
temin <- cbind(c(loc.minxd), c(0))

### merge max and min points
minmax <- rbind(temax, temin)
minmaxt <- minmax[order(minmax[,1], decreasing=F), ,drop=F]

### numbering
ban <- c(1:nrow(minmaxt))
minmaxt <- cbind(c(ban), minmaxt)

### arrange in descending order of amplitude (minmaxt[,3])
minmaxty <- minmaxt[order(minmaxt[,3], decreasing=T), ,drop=F]

### pick up six in descending order of amplitude
minmaxty1 <- minmaxty[1, ,drop=F]
if(nrow(minmaxty) >= 2){
  f1 <- minmaxty[1, ,drop=F]
  f1 <- minmaxty[2, ,drop=F]
} else if(nrow(minmaxty) >= 3){
  f1 <- minmaxty[1, ,drop=F]
  f2 <- minmaxty[2, ,drop=F]
  f3 <- minmaxty[3, ,drop=F]
} else if(nrow(minmaxty) >= 4){
  f1 <- minmaxty[1, ,drop=F]
  f2 <- minmaxty[2, ,drop=F]
  f3 <- minmaxty[3, ,drop=F]
  f4 <- minmaxty[4, ,drop=F]
} else if(nrow(minmaxty) >= 5){
  f1 <- minmaxty[1, ,drop=F]
  f2 <- minmaxty[2, ,drop=F]
  f3 <- minmaxty[3, ,drop=F]
  f4 <- minmaxty[4, ,drop=F]
  f5 <- minmaxty[5, ,drop=F]
} else if(nrow(minmaxty) >= 6){
  f1 <- minmaxty[1, ,drop=F]
  f2 <- minmaxty[2, ,drop=F]
  f3 <- minmaxty[3, ,drop=F]
  f4 <- minmaxty[4, ,drop=F]
  f5 <- minmaxty[5, ,drop=F]
  f6 <- minmaxty[6, ,drop=F]
}

### categorize peak position
if(temax[1,1] > temax[2,1] && temax[2,1] > temax[3,1] && temax[3,1] > temax[4,1])
  ca <- "AA1234"
if(ft1[1,1] < ft2[1,1] && ft2[1,1] < ft4[1,1] && ft4[1,1] < ft3[1,1]) {
  if(ft1[1,3]/ft2[1,3] < bai && abs(ft1[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis && ft4[1,3]/ft3[1,3] < bai && abs(ft4[1,2]-ft3[1,2]) < dis) {
    ca <- "AB1243"
  } else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis) {
    ca <- "AB342"
  } else if(ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft3[1,3] < bai && abs(ft2[1,2]-ft3[1,2]) < dis) {
    ca <- "AB243"
  } else if(ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis) {
    ca <- "AB24"
  } else if(ft4[1,3]/ft3[1,3] < bai && abs(ft4[1,2]-ft3[1,2]) < dis) {
    ca <- "AB43"
  } else {
    ca <- "AB"
  }
}

if(ft1[1,1] < ft3[1,1] && ft3[1,1] < ft2[1,1] && ft2[1,1] < ft4[1,1]) {
  if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis) {
    ca <- "AC1324"
  } else if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis) {
    ca <- "AC324"
  } else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis) {
    ca <- "AC132"
  } else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis) {
    ca <- "AC13_24"
  } else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis) {
    ca <- "AC13"
  } else if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis) {
    ca <- "AC32"
  } else if(ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis) {
    ca <- "AC24"
  } else {
    ca <- "AC"
  }
}

if(ft1[1,1] < ft3[1,1] && ft3[1,1] < ft4[1,1] && ft4[1,1] < ft2[1,1]) {
  if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft4[1,3] < bai && abs(ft3[1,2]-ft4[1,2]) < dis && ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis) {
    ca <- "AD1342"
  } else if(ft3[1,3]/ft4[1,3] < bai && abs(ft3[1,2]-ft4[1,2]) < dis && ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis) {
    ca <- "AD342"
  } else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft4[1,3] < bai && abs(ft3[1,2]-ft4[1,2]) < dis) {
    ca <- "AD134"
  } else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis) {
    ca <- "AD13_42"
  } else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis) {
    ca <- "AD13"
  } else if(ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis) {
    ca <- "AD42"
  } else if(ft3[1,3]/ft4[1,3] < bai && abs(ft3[1,2]-ft4[1,2]) < dis) {
    ca <- "AD43"
  } else {
    ca <- "AD"}
}

if(ft1[1,1] < ft3[1,1] && ft3[1,1] < ft4[1,1] && ft4[1,1] < ft2[1,1]) {
  if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft4[1,3] < bai && abs(ft3[1,2]-ft4[1,2]) < dis && ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis) {
    ca <- "AE1342"
  } else if(ft3[1,3]/ft4[1,3] < bai && abs(ft3[1,2]-ft4[1,2]) < dis && ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis) {
    ca <- "AE423"
  } else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft4[1,3] < bai && abs(ft3[1,2]-ft4[1,2]) < dis) {
    ca <- "AE14_23"
  } else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis) {
    ca <- "AE14"
  } else if(ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis) {
    ca <- "AE42"}
```r
if((ft1[1,1] < ft4[1,1] && ft4[1,1] < ft3[1,1] && ft3[1,1] < ft2[1,1]) ||
   (ft2[1,1] < ft1[1,1] && ft1[1,1] < ft3[1,1] && ft3[1,1] < ft4[1,1]) ||
   (ft3[1,1] < ft2[1,1] && ft2[1,1] < ft1[1,1] && ft1[1,1] < ft4[1,1]) ||
   (ft4[1,1] < ft3[1,1] && ft3[1,1] < ft2[1,1] && ft2[1,1] < ft1[1,1])) {
  ca <- "B"
} else if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis) {
  ca <- "A"  
} else {
  ca <- "AE"
}

else if(ft2[1,3]/ft3[1,3] < bai && abs(ft2[1,2]-ft3[1,2]) < dis) {
  ca <- "AE23"  
} else {
  ca <- "AE"  
}
```

```r
if((ft1[1,1] < ft4[1,1] && ft4[1,1] < ft3[1,1] && ft3[1,1] < ft2[1,1]) ||
   (ft2[1,1] < ft1[1,1] && ft1[1,1] < ft3[1,1] && ft3[1,1] < ft4[1,1]) ||
   (ft3[1,1] < ft2[1,1] && ft2[1,1] < ft1[1,1] && ft1[1,1] < ft4[1,1]) ||
   (ft4[1,1] < ft3[1,1] && ft3[1,1] < ft2[1,1] && ft2[1,1] < ft1[1,1])) {
  ca <- "B"
} else if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis) {
  ca <- "A"  
} else {
  ca <- "AE"
}
```
```r
if(ft2[1,1] < ft1[1,1] && ft1[1,1] < ft4[1,1] && ft4[1,1] < ft3[1,1]){
    if(ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis && ft4[1,3]/ft1[1,3] < bai && abs(ft4[1,2]-ft1[1,2]) < dis)
        ca <- "BF431"
    else if(ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis)
        ca <- "BF43"
    else if(ft1[1,3]/ft4[1,3] < bai && abs(ft1[1,2]-ft4[1,2]) < dis)
        ca <- "BF31"
    else if(ft4[1,3]/ft3[1,3] < bai && abs(ft4[1,2]-ft3[1,2]) < dis)
        ca <- "BF3"
    else {
        ca <- "BF"
    }
}
```

```r
if(ft2[1,1] < ft1[1,1] && ft1[1,1] < ft3[1,1] && ft3[1,1] < ft4[1,1]){
    if(ft2[1,3]/ft3[1,3] < bai && abs(ft2[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis)
        ca <- "BF31"
    else if(ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis)
        ca <- "BF3"
    else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis)
        ca <- "BF"
    else {
        ca <- "BF"
    }
}
```
ca <- "CA3214"
} else if(ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft4[1,3] < bai && abs(ft1[1,2]-ft4[1,2]) < dis){
  ca <- "CA214"
} else if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis && ft1[1,3]/ft4[1,3] < bai && abs(ft1[1,2]-ft4[1,2]) < dis){
  ca <- "CA321"
} else if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis){
  ca <- "CA32"
} else if(ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis){
  ca <- "CA21"
} else if(ft1[1,3]/ft4[1,3] < bai && abs(ft1[1,2]-ft4[1,2]) < dis){
  ca <- "CA14"
} else {
  ca <- "CA"
}

## ft3, ft1, ft2, ft4
if(ft3[1,1] < ft1[1,1] && ft1[1,1] < ft2[1,1] && ft2[1,1] < ft4[1,1]){  
  if(ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft2[1,3] < bai && abs(ft1[1,2]-ft2[1,2]) < dis && 
  ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis){
    ca <- "CB3124"
  } else if(ft1[1,3]/ft2[1,3] < bai && abs(ft1[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis){
    ca <- "CB124"
  } else if(ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft2[1,3] < bai && abs(ft1[1,2]-ft2[1,2]) < dis){
    ca <- "CB312"
  } else if(ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis && ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis){
    ca <- "CB31_24"
  } else if(ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis){
    ca <- "CB31"
  } else if(ft1[1,3]/ft2[1,3] < bai && abs(ft1[1,2]-ft2[1,2]) < dis){
    ca <- "CB12"
  } else if(ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis){
    ca <- "CB24"
  } else {
    ca <- "CB"
  }
}

## ft3, ft1, ft4, ft2
if(ft3[1,1] < ft1[1,1] && ft1[1,1] < ft4[1,1] && ft4[1,1] < ft2[1,1]){  
  if(ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft4[1,3] < bai && abs(ft1[1,2]-ft4[1,2]) < dis && 
  ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis){
    ca <- "CC3142"
  } else if(ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis && ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis){
    ca <- "CC142"
  } else if(ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft4[1,3] < bai && abs(ft1[1,2]-ft4[1,2]) < dis){
    ca <- "CC314"
  } else if(ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis && ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis){
    ca <- "CC31_42"
  } else if(ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis){
    ca <- "CC31"
  } else if(ft1[1,3]/ft4[1,3] < bai && abs(ft1[1,2]-ft4[1,2]) < dis){
    ca <- "CC14"
  } else if(ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis){
    ca <- "CC42"
  } else {
    ca <- "CC"
  }
}

## ft3, ft2, ft4, ft1
if(ft3[1,1] < ft2[1,1] && ft2[1,1] < ft4[1,1] && ft4[1,1] < ft1[1,1]){  
  if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis && 
  ft4[1,3]/ft1[1,3] < bai && abs(ft4[1,2]-ft1[1,2]) < dis){
    ca <- "CD3142"
  } else if(ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft4[1,3] < bai && abs(ft1[1,2]-ft4[1,2]) < dis){
    ca <- "CD214"
  } else if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis){
    ca <- "CD324"
  } else if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis && ft4[1,3]/ft1[1,3] < bai && abs(ft4[1,2]-ft1[1,2]) < dis){
    ca <- "CD32_41"
  } else if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis){
    ca <- "CD32"
  } else if(ft2[1,3]/ft4[1,3] < bai && abs(ft2[1,2]-ft4[1,2]) < dis){
    ca <- "CD41"
  } else {
    ca <- "CD"
  }
}
if(ft3[1,1] < ft4[1,1] && ft4[1,1] < ft2[1,1] && ft2[1,1] < ft1[1,1]){
  if(ft3[1,3]/ft4[1,3] < bai && abs(ft3[1,2]-ft4[1,2]) < dis && ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis) {
    ca <- "CE3421"
    }
  else if(ft4[1,3]/ft3[1,3] < bai && abs(ft4[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis) {
    ca <- "CE421"
    }
  else if(ft3[1,3]/ft4[1,3] < bai && abs(ft3[1,2]-ft4[1,2]) < dis && ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis) {
    ca <- "CE342"
    }
  else if(ft3[1,3]/ft4[1,3] < bai && abs(ft3[1,2]-ft4[1,2]) < dis) {
    ca <- "CE34"
    }
  }
}

if(ft3[1,1] < ft4[1,1] && ft4[1,1] < ft1[1,1] && ft1[1,1] < ft2[1,1]){
  if(ft3[1,3]/ft4[1,3] < bai && abs(ft3[1,2]-ft4[1,2]) < dis && ft4[1,3]/ft2[1,3] < bai && abs(ft4[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis) {
    ca <- "CF3412"
    }
  else if(ft4[1,3]/ft1[1,3] < bai && abs(ft4[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft2[1,3] < bai && abs(ft1[1,2]-ft2[1,2]) < dis) {
    ca <- "CF412"
    }
  else if(ft3[1,3]/ft4[1,3] < bai && abs(ft3[1,2]-ft4[1,2]) < dis && ft4[1,3]/ft1[1,3] < bai && abs(ft4[1,2]-ft1[1,2]) < dis) {
    ca <- "CF341"
    }
  else if(ft4[1,3]/ft1[1,3] < bai && abs(ft4[1,2]-ft1[1,2]) < dis) {
    ca <- "CF41"
    }
  }
}

if(ft4[1,1] < ft1[1,1] && ft1[1,1] < ft2[1,1] && ft2[1,1] < ft3[1,1]){
  if(ft4[1,3]/ft1[1,3] < bai && abs(ft4[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis) {
    ca <- "DA4132"
    }
  else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis) {
    ca <- "DA132"
    }
  else if(ft4[1,3]/ft1[1,3] < bai && abs(ft4[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis) {
    ca <- "DA413"
    }
  else if(ft4[1,3]/ft1[1,3] < bai && abs(ft4[1,2]-ft1[1,2]) < dis) {
    ca <- "DA41"
    }
  }
}

if(ft4[1,1] < ft1[1,1] && ft1[1,1] < ft3[1,1] && ft3[1,1] < ft2[1,1]){
  if(ft4[1,3]/ft1[1,3] < bai && abs(ft4[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis) {
    ca <- "DB4132"
    }
  else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis) {
    ca <- "DB132"
    }
  else if(ft4[1,3]/ft1[1,3] < bai && abs(ft4[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis) {
    ca <- "DB413"
    }
  else if(ft4[1,3]/ft1[1,3] < bai && abs(ft4[1,2]-ft1[1,2]) < dis) {
    ca <- "DB41"
    }
  }
}
```r
if(ft4[1,1] < ft2[1,1] && ft2[1,1] < ft1[1,1] && ft1[1,1] < ft3[1,1]) {
    ca <- "DB"
} else {
    ca <- "DC"
}
```
ca <- "DF43"
} else if(ft3[1,3]/ft2[1,3] < bai & abs(ft3[1,2]-ft2[1,2]) < dis){
  ca <- "DF32"
} else if(ft2[1,3]/ft1[1,3] < bai & abs(ft2[1,2]-ft1[1,2]) < dis){
  ca <- "DF21"
} else {
  ca <- "DF"
}

### extract a separation point

if(ca == "AA"){
  tminmaxt <- minmaxt[(ft1[1,1]+1):(ft4[1,1]-1), ,drop=F]
  tminmaxt <- tminmaxt[order(tminmaxt[,1], decreasing=T),drop=F]
  lth <- nrow(tminmaxt)
  if(lth == 1){
    tht <- tminmaxt[1, ,drop=F]
  } else if(lth == 2){
    if(tminmaxt[2,3]/tminmaxt[1,3] < 1.5 & tminmaxt[2,1] > tminmaxt[1,1]){ 
      tht <- tminmaxt[2, ,drop=F]
    } else {
      tht <- tminmaxt[1, ,drop=F]
    }
  } else if(lth >= 3){
    sl <- cbind(1:lt)
    wa <- c()
    for s in 1:lt{
      if(s == 1){
        sp <- 0
      } else {
        sp <- (tminmaxt[s - 1,3] - tminmaxt[s,3])/(tminmaxt[s - 1,2] - tminmaxt[s,2])
      }
      wa <- rbind(wa,sp)
    }
    sl <- cbind(sl,wa)
    sl <- sl[order(sl[,2], decreasing=T), ,drop=F]
    if(sl[1,2] == 0){
      if(tminmaxt[sl[2,1],2] > 10){
        tht <- tminmaxt[sl[3,1] , ,drop=F]
      } else {
        tht <- tminmaxt[sl[2,1] , ,drop=F]
      }
    } else {
      tht <- tminmaxt[sl[1,1] , ,drop=F]
    }
  }

  if(ca == "AA12") {
    if (ft3[1,3]/ft4[1,3] < 1.6){
      tminmaxt <- minmaxt[(ft2[1,1]+1):(ft3[1,1]-1), ,drop=F]
      tminmaxt <- tminmaxt[order(tminmaxt[,1], decreasing=T),drop=F]
      lth <- nrow(tminmaxt)
      if(lth == 1){
        tht <- tminmaxt[1, ,drop=F]
      } else if(lth == 2){
        if(tminmaxt[2,3]/tminmaxt[1,3] < 1.5 & tminmaxt[2,1] > tminmaxt[1,1]){ 
          tht <- tminmaxt[2, ,drop=F]
        } else {
          tht <- tminmaxt[1, ,drop=F]
        }
      } else if(lth >= 3){
        sl <- cbind(1:lt)
        wa <- c()
        for s in 1:lt{
          if(s == 1){
            sp <- 0
          } else {
            sp <- (tminmaxt[s - 1,3] - tminmaxt[s,3])/(tminmaxt[s - 1,2] - tminmaxt[s,2])
          }
          wa <- rbind(wa,sp)
        }
        sl <- cbind(sl,wa)
        sl <- sl[order(sl[,2], decreasing=T), ,drop=F]
        if(sl[1,2] == 0){
          if(tminmaxt[sl[2,1],2] > 10){
            tht <- tminmaxt[sl[3,1] , ,drop=F]
          } else {
            tht <- tminmaxt[sl[2,1] , ,drop=F]
          }
        } else {
          tht <- tminmaxt[sl[1,1] , ,drop=F]
        }
      }
    }

  if(ca == "AA12_34") {
    if(ft3[1,3]/ft4[1,3] < 1.6){
      tminmaxt <- minmaxt[(ft2[1,1]+1):(ft3[1,1]-1), ,drop=F]
      tminmaxt <- tminmaxt[order(tminmaxt[,1], decreasing=T),drop=F]
      lth <- nrow(tminmaxt)
      if(lth == 1){
        tht <- tminmaxt[1, ,drop=F]
      } else if(lth == 2){
        if(tminmaxt[2,3]/tminmaxt[1,3] < 1.5 & tminmaxt[2,1] > tminmaxt[1,1]){ 
          tht <- tminmaxt[2, ,drop=F]
        } else {
          tht <- tminmaxt[1, ,drop=F]
        }
      } else if(lth >= 3){
        sl <- cbind(1:lt)
        wa <- c()
        for s in 1:lt{
          if(s == 1){
            sp <- 0
          } else {
            sp <- (tminmaxt[s - 1,3] - tminmaxt[s,3])/(tminmaxt[s - 1,2] - tminmaxt[s,2])
          }
          wa <- rbind(wa,sp)
        }
        sl <- cbind(sl,wa)
        sl <- sl[order(sl[,2], decreasing=T), ,drop=F]
        if(sl[1,2] == 0){
          if(tminmaxt[sl[2,1],2] > 10){
            tht <- tminmaxt[sl[3,1] , ,drop=F]
          } else {
            tht <- tminmaxt[sl[2,1] , ,drop=F]
          }
        } else {
          tht <- tminmaxt[sl[1,1] , ,drop=F]
        }
      }
    }
  }
wa <- rhind(wa, sp)
}
sl <- chind(sl, wa)
sl <- sl[order(sl[2], decreasing=T), drop=F]
if(sl[1,2] == 0) {
  if(tminmaxt[sl[2,1],2] > 10) {
    tht <- tminmaxt[sl[3,1], drop=F]
  } else {
    tht <- tminmaxt[sl[2,1], drop=F]
  }
} else {
  tht <- tminmaxt[sl[1,1], drop=F]
}
if((minmaxt[sl[1,1],1]+2,1,2) - minmax(tminmaxt, sl[1,1,1]+2,2) > 0.00001) {
  tht <- rhind(sl[2,1], drop=F)
}

if(ca == "AA23") {
  if(ft4[1,2] > 5) {
    tminmaxt <- minmaxt[ft4[1,1]+1:(ft3[1,1]-1), drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F), drop=F]
    tht <- tminmaxt[1, drop=F]
  } else {
    tminmaxt <- minmaxt[ft4[1,1]+1:(ft4[1,1]-1), drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F), drop=F]
    tht <- tminmaxt[1, drop=F]
  }
}
if(ca == "AA34") {
  if((ft2[1,3]/ft3[1,3] < 1.1) {
    tminmaxt <- minmaxt[ft1[1,1]+1:ft2[1,1]-1, drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F), drop=F]
    tht <- tminmaxt[1, drop=F]
  } else {
    tminmaxt <- minmaxt[ft1[1,1]+1:ft4[1,1]-1, drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F), drop=F]
    tht <- tminmaxt[1, drop=F]
  }
}
if(ca == "AA234") {
  tminmaxt <- minmaxt[ft1[1,1]:ft4[1,1], drop=F]
  tminmaxt <- tminmaxt[order(tminmaxt[,4] == 0, drop=F]
  tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=T), drop=F]
  lt <- nrow(tminmaxt)
  if(lt == 1) {
    tht <- tminmaxt[1, drop=F]
  } else if(lt == 2) {
    if((minmax(tmax, 1, 3] < 1.5 & tminmax[2,1] > tminmax[1,1]) {;
      tht <- tminmaxt[2, drop=F]
    } else {
      tht <- tminmaxt[1, drop=F]
    }
  } else if(lt >= 3) {
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=T), drop=F]
    sl <- chind(sl)
    wa <- c()
    for (s in 1:lt) {
      if(s == 1) {
        sp <- 0
      } else {
        sp <- (tminmax[sl[1,3]] - tminmax[sl[3,3]]) / (tminmax[sl[2,3]] - tminmax[sl[2,3]])
      }
    wa <- rhind(wa, sp)
  }
  sl <- chind(sl, wa)
  sl <- sl[order(sl[2], decreasing=T), drop=F]
  if(sl[1,2] == 0) {
    tht <- tminmaxt[sl[2,1], drop=F]
  } else {
    tht <- tminmaxt[sl[1,1], drop=F]
  }
  tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F), drop=F]
  if((ft1[1,2] < tminmax[1,2] & tminmax[1,2] < ft2[1,2] & (tminmax[2,3] - tminmax[1,3])/(tminmax[2,2] - tminmax[1,2]) < 0.00001) {
    tht <- tminmaxt[1, drop=F]
  }
}
if(ca == "AB12"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(ft3[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "AB24"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(ft3[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "AB243"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(ft2[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "AB43"){
    tminmaxt <- minmaxt[(ft1[1,1]):(ft4[1,1]), ,drop=F]
    tminmaxt <- tminmaxt[tminmaxt[,4] == 0, ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,1], decreasing=T),drop=F]
    lt <- nrow(tminmaxt)
    if(lt == 1){
        tht <- tminmaxt[1, ,drop=F]
    } else if(lt == 2){
        if((ft2[1,3] - minmaxt[ft2[1,1]-2, 3])/(ft2[1,2] - minmaxt[ft2[1,1]-2, 2]) < 0.0007 || (ft2[1,3] - minmaxt[ft2[1,1]-2, 3])/(ft2[1,2] - minmaxt[ft2[1,1]-2, 2]) > 0.0009){
            tht <- tminmaxt[2, ,drop=F]
        } else {
            tht <- tminmaxt[1, ,drop=F]
        }
    } else if(lt >= 3){
        sl <- cbind(1:lt)
        wa <- c()
        for(s in 1:lt){
            if(s == 1){
                sp <- 0
                } else {
                    sp <- (tminmaxt[s - 1,3] - tminmaxt[s,3])/(tminmaxt[s - 1,2] - tminmaxt[s,2])
                wa <- rbind(wa,sp)
            }
            sl <- cbind(sl,wa)
            sl <- sl[order(sl[,2], decreasing=T), ,drop=F]
            if(sl[1,2] == 0){
                tht <- tminmaxt[sl[2,1], ,drop=F]
            } else {
                tht <- tminmaxt[sl[1,1], ,drop=F]
            }
            if(sl[1,2] == 0 & sl[2,2] == 0){
                tht <- tminmaxt[sl[1,1], ,drop=F]
            }
        }
    }
}
if(ca == "AB12_43"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(ft3[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "AB"){
    tminmaxt <- minmaxt[(ft1[1,1]):(ft3[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "AB43"){
    tminmaxt <- minmaxt[(ft1[1,1]):(ft4[1,1]), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),drop=F]
    tht <- tminmaxt[1, ,drop=F]
    lt <- nrow(tminmaxt)
    if(lt == 1){
        tht <- tminmaxt[1, ,drop=F]
    } else if(lt == 2){
        if((ft2[1,3] - minmaxt[ft2[1,1]-2, 3])/(ft2[1,2] - minmaxt[ft2[1,1]-2, 2]) < 0.0007 || (ft2[1,3] - minmaxt[ft2[1,1]-2, 3])/(ft2[1,2] - minmaxt[ft2[1,1]-2, 2]) > 0.0009){
            tht <- tminmaxt[2, ,drop=F]
        } else {
            tht <- tminmaxt[1, ,drop=F]
        }
    } else if(lt >= 3){
        sl <- cbind(1:lt)
        wa <- c()
        for(s in 1:lt){
            if(s == 1){
                sp <- 0
                } else {
                    sp <- (tminmaxt[s - 1,3] - tminmaxt[s,3])/(tminmaxt[s - 1,2] - tminmaxt[s,2])
                wa <- rbind(wa,sp)
            }
            sl <- cbind(sl,wa)
            sl <- sl[order(sl[,2], decreasing=T), ,drop=F]
            if(sl[1,2] == 0){
                tht <- tminmaxt[sl[2,1], ,drop=F]
            } else {
                tht <- tminmaxt[sl[1,1], ,drop=F]
            }
            if(sl[1,2] == 0 & sl[2,2] == 0){
                tht <- tminmaxt[sl[1,1], ,drop=F]
            }
        }
    }
}
tht <- tminmaxt[1, ,drop=F]
}
else if(lt >= 3){
  sl <- cbind(1:lt)
  wa <- c()
  for(s in 1:lt){
    if(s == 1){
      sp <- 0
    } else {
      sp <- (tminmaxt[s - 1,3] - tminmaxt[s,3])/(tminmaxt[s - 1,2] - tminmaxt[s,2])
    }
    wa <- rbind(wa,sp)
  }
  sl <- cbind(sl,wa)
  sl <- sl[order(sl[,1], decreasing=T), ,drop=F]
  if(sl[,1] == 0){
    tht <- tminmaxt[sl[,2], ,drop=F]
  } else {
    tht <- tminmaxt[sl[,1], ,drop=F]
  }
}
}
if(ca == "AC324"){
  tminmaxt <- minmaxt[(ft1[1,1]+1):(ft2[1,1]-1), ,drop=F]
  tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F), ,drop=F]
  tht <- tminmaxt[1, ,drop=F]
}
if(ca == "AD"){
  tminmaxt <- minmaxt[(ft1[1,1]+1):(ft2[1,1]-1), ,drop=F]
  tminmaxt <- tminmaxt[order(tminmaxt[,1], decreasing=T), ,drop=F]
  tht <- tminmaxt[1, ,drop=F]
  lt <- nrow(tminmaxt)
  if(lt == 1){
    tht <- tminmaxt[1, ,drop=F]
  } else if(lt == 2){
    if((ft2[1,3] - minmaxt[ft2[1,1]-2, 3])/(ft2[1,2] - minmaxt[ft2[1,1]-2, 2]) < 0.0007 || (ft2[1,3] - minmaxt[ft2[1,1]-2, 3])/(ft2[1,2] - minmaxt[ft2[1,1]-2, 2]) > 0.00099999){
      tht <- tminmaxt[2, ,drop=F]
    } else {
      tht <- tminmaxt[1, ,drop=F]
    }
  } else if(lt >= 3){
    sl <- cbind(1:lt)
    wa <- c()
    for(s in 1:lt){
      if(s == 1){
        sp <- 0
      } else {
        sp <- (tminmaxt[s - 1,3] - tminmaxt[s,3])/(tminmaxt[s - 1,2] - tminmaxt[s,2])
      }
      wa <- rbind(wa,sp)
    }
    sl <- cbind(sl,wa)
    sl <- sl[order(sl[,1], decreasing=T), ,drop=F]
    if(sl[,1] == 0){
      tht <- tminmaxt[sl[,2], ,drop=F]
    } else {
      tht <- tminmaxt[sl[,1], ,drop=F]
    }
    if(minmaxt[ft2[1,1]-2,3]/minmaxt[ft2[1,1]-1,3] < 1.01){
      tht <- minmaxt[ft2[1,1]-1, ,drop=F]
    } else {
      tht <- minmaxt[ft2[1,1]-2, ,drop=F]
    }
  }
}
if(ca == "AD324"){
  if( ft3[1,3]/ft4[1,3] < 1.1){
    tminmaxt <- minmaxt[(ft4[1,1]+1):(ft4[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F), ,drop=F]
    tht <- tminmaxt[1, ,drop=F]
  } else {
    tminmaxt <- minmaxt[(ft4[1,1]+1):(ft4[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F), ,drop=F]
    tht <- tminmaxt[1, ,drop=F]
  }
}
if(ca == "AD34"){
  tminmaxt <- minmaxt[(ft1[1,1]+1):(ft2[1,1]-1), ,drop=F]
  tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F), ,drop=F]
  tht <- tminmaxt[1, ,drop=F]
}
if (ca == "AE423"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(ft2[1,1]-1), drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,4], decreasing=T), drop=F]
    lt <- nrow(tminmaxt)
    if(lt == 1){
        tht <- tminmaxt[1, drop=F]
    } else if(lt == 2){
        if((ft2[1,3] - minmaxt[ft2[1,1]-2, 3])/(ft2[1,2] - minmaxt[ft2[1,1]-2, 2]) < 0.0007 || (ft2[1,3] - minmaxt[ft2[1,1]-2, 3])/(ft2[1,2] - minmaxt[ft2[1,1]-2, 2]) > 0.0009){
            if (abs(tminmaxt[1,3]-minmaxt[tminmaxt[2,1]+1,3])/(tminmaxt[1,2]-minmaxt[tminmaxt[2,1]+1,2]) < 2e-5){
                tht <- tminmaxt[1, drop=F]
            } else {
                tht <- tminmaxt[2, drop=F]
            }
        } else {
            tht <- tminmaxt[1, drop=F]
        }
    } else if(lt >= 3){
        sl <- cbind(1:lt)
        wa <- c()
        for( s in 1:lt){
            if(s == 1){
                sp <- 0
            } else {
                sp <- (tminmaxt[s-1,3] - tminmaxt[s,3])/(tminmaxt[s-1,2] - tminmaxt[s,2])
            }
            wa <- rbind(wa,sp)
        }
        sl <- cbind(sl,wa)
        sl <- sl[order(sl[,2], decreasing=T), drop=F]
        if(sl[1,2] == 0){
            tht <- tminmaxt[sl[1,1], drop=F]
        } else {
            tht <- tminmaxt[sl[2,1], drop=F]
        }
        if((minmaxt[tminmaxt[sl[1,1],1]+2,3] - minmaxt[tminmaxt[sl[1,1],1]+1,3])/(minmaxt[tminmaxt[sl[1,1],1]+2,2] - minmaxt[tminmaxt[sl[1,1],1]+1,2]) < -0.0001){
            tht <- tminmaxt[order(tminmaxt[,3], decreasing=F), drop=F]
        } else {
            tht <- tminmaxt[1, drop=F]
        }
    }
}
if (ca == "AE424"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(ft3[1,1]-1), drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,4], decreasing=T), drop=F]
    lt <- nrow(tminmaxt)
    if(lt == 1){
        tht <- tminmaxt[1, drop=F]
    } else if(lt == 2){
        tht <- tminmaxt[2, drop=F]
    } else if(lt >= 3){
        sl <- cbind(1:lt)
        wa <- c()
        for( s in 1:lt){
            if(s == 1){
                sp <- 0
            } else {
                sp <- (tminmaxt[s-1,3] - tminmaxt[s,3])/(tminmaxt[s-1,2] - tminmaxt[s,2])
            }
            wa <- rbind(wa,sp)
        }
        sl <- cbind(sl,wa)
        sl <- sl[order(sl[,2], decreasing=T), drop=F]
        if(sl[1,2] == 0){
            tht <- tminmaxt[sl[1,1], drop=F]
        } else {
            tht <- tminmaxt[sl[2,1], drop=F]
        }
        if((minmaxt[tminmaxt[sl[1,1],1]+2,3] - minmaxt[tminmaxt[sl[1,1],1]+1,3])/(minmaxt[tminmaxt[sl[1,1],1]+2,2] - minmaxt[tminmaxt[sl[1,1],1]+1,2]) < -0.0001){
            tht <- tminmaxt[order(tminmaxt[,3], decreasing=F), drop=F]
        } else {
            tht <- tminmaxt[1, drop=F]
        }
    }
}
if(ca == "AE23"){
    tminmaxt <- minmax(t1[(f1[1,1]+1):(f3[1,1]-1),], drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,4] == 0), drop=F]
    lt <- nrow(tminmaxt)
    if(lt == 1){
        tht <- tminmaxt[1, ,drop=F]
    } else if(lt == 2){
        if((f2[1,3] - tminmaxt[f2[1,1]-2, 3])/(f2[1,2] - tminmaxt[f2[1,1]-2, 2]) < 0.0007 || (f2[1,3] - tminmaxt[f2[1,1]-2, 3])/(f2[1,2] - tminmaxt[f2[1,1]-2, 2]) > 0.0009)
            tht <- tminmaxt[2, ,drop=F]
        } else {
            tht <- tminmaxt[1, ,drop=F]
        }
    } else if(lt >= 3){
        sl <- cbind(1:lt)
        wa <-c()
        for( s in 1:lt){
            if(s == 1){
                sp <- 0
            } else {
                sp <- (tminmaxt[s - 1,3] - tminmaxt[s,3])/(tminmaxt[s - 1,2] - tminmaxt[s,2])
            }
            wa <- rbind(wa,sp)
        }
        sl <- cbind(sl,wa)
        sl <- sl[order(sl[,2], decreasing=T), ,drop=F]
        if(sl[1,2] == 0){
            tht <- tminmaxt[sl[2,1] , ,drop=F]
        } else {
            tht <- tminmaxt[sl[1,1] , ,drop=F]
        }
    }
}
if(ca == "AE"){
    tminmaxt <- minmax((f1[1,1]+1):(f3[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F), ,drop=F]
    if(tminmaxt[2,3]/tminmaxt[1,3] < 1.25 && tminmaxt[1,1] < tminmaxt[2,1]){
        tht <- tminmaxt[2, ,drop=F]
    } else {
        tht <- tminmaxt[1, ,drop=F]
    }
}
if(ca == "AF32"){
    tminmaxt <- minmax((f1[1,1]+1):(f2[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F), ,drop=F]
    if(tminmaxt[2,3]/tminmaxt[1,3] < 1.25 && tminmaxt[1,1] < tminmaxt[2,1]){
        tht <- tminmaxt[2, ,drop=F]
    } else {
        tht <- tminmaxt[1, ,drop=F]
    }
}
if(ca == "AF43"){
    tminmaxt <- minmax((f1[1,1]+1):(f2[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,4] == 0), ,drop=F]
    lt <- nrow(tminmaxt)
    if(lt == 1){
        tht <- tminmaxt[1, ,drop=F]
    } else if(lt == 2){
        if((f2[1,3] - tminmaxt[f2[1,1]-2, 3])/(f2[1,2] - tminmaxt[f2[1,1]-2, 2]) < 0.0007 || (f2[1,3] - tminmaxt[f2[1,1]-2, 3])/(f2[1,2] - tminmaxt[f2[1,1]-2, 2]) > 0.0009)
            tht <- tminmaxt[2, ,drop=F]
        } else {
            tht <- tminmaxt[1, ,drop=F]
        }
    } else if(lt >= 3){
        sl <- cbind(1:lt)
        wa <-c()
        for( s in 1:lt){
            if(s == 1){
                sp <- 0
            } else {
                sp <- (tminmaxt[s - 1,3] - tminmaxt[s,3])/(tminmaxt[s - 1,2] - tminmaxt[s,2])
            }
            wa <- rbind(wa,sp)
        }
        sl <- cbind(sl,wa)
        sl <- sl[order(sl[,2], decreasing=F), ,drop=F]
        if(sl[1,2] == 0){
            tht <- tminmaxt[sl[2,1] , ,drop=F]
        } else {
            tht <- tminmaxt[sl[1,1] , ,drop=F]
        }
    }
}
wa <- rbind(wa,sp)
} 
sl <- cbind(sl,wa)
sl <- sl[order(sl[,2], decreasing=T), drop=F]
if(sl[,2] == 0) {
  tht <- tminmax[t[sl[,1]], drop=F]
} else {
  tht <- tminmax[t[1,1], drop=F]
}

if(ca == "AF432"){
  tminmaxt <- minmaxt[(ft1[1,1]+1):(ft4[1,1]-1), drop=F]
  tminmaxt <- tminmaxt[order(minmaxt[,1], decreasing=T), drop=F]
  lt <- nrow(minmaxt)
  if(lt == 1) {
    tht <- tminmax[1, drop=F]
  } else if(lt == 2) {
    if((tminmaxt[1,1] - minmaxt[1,2])/(tminmaxt[1,2] - minmaxt[1,1]) < 0.0007) {
      tht <- tminmax[2, drop=F]
    } else {
      tht <- tminmax[1, drop=F]
    }
  } else if(lt >= 3) {
    sl <- cbind(1:lt)
    wa <- c()
    for(s in 1:lt) {
      if(s == 1) {
        sp <- 0
      } else {
        sp <- (tminmaxt[s-1,3] - tminmaxt[s,3])/(tminmaxt[s-1,2] - tminmaxt[s,2])
      }
      wa <- rbind(wa,sp)
    }
    sl <- cbind(sl,wa)
    sl <- sl[order(sl[,2], decreasing=T), drop=F]
    if(sl[,2] == 0) {
      tht <- tminmax[t[sl[,1]], drop=F]
    } else {
      tht <- tminmax[t[1,1], drop=F]
    }
  }
}

if(ca == "AF"){
  tminmaxt <- minmaxt[(ft1[1,1]+1):(ft2[1,1]-1), drop=F]
  tminmaxt <- tminmaxt[order(minmaxt[,1], decreasing=T), drop=F]
  lt <- nrow(minmaxt)
  if(lt == 1) {
    tht <- tminmax[1, drop=F]
  } else if(lt == 2) {
    if((tminmaxt[1,1] - minmaxt[1,2])/(tminmaxt[1,2] - minmaxt[1,1]) < 0.0007) {
      if((tminmaxt[1,3] - tminmaxt[2,3])/(tminmaxt[1,2] - tminmaxt[2,2]) > 0) {
        tht <- tminmax[2, drop=F]
      } else {
        tht <- tminmax[1, drop=F]
      }
    } else if((tminmaxt[1,1] - minmaxt[1,2])/(tminmaxt[1,2] - minmaxt[1,1]) > 0.0009) {
      tht <- tminmax[1, drop=F]
    } else if(lt >= 3) {
      sl <- cbind(1:lt)
      wa <- c()
      for(s in 1:lt) {
        if(s == 1) {
          sp <- 0
        } else {
          sp <- (tminmaxt[s-1,3] - tminmaxt[s,3])/(tminmaxt[s-1,2] - tminmaxt[s,2])
        }
        wa <- rbind(wa,sp)
      }
      sl <- cbind(sl,wa)
      sl <- sl[order(sl[,2], decreasing=T), drop=F]
      if(sl[,2] == 0) {
        tht <- tminmax[t[sl[,1]], drop=F]
      } else {
        tht <- tminmax[t[1,1], drop=F]
      }
    }
  }
}
if(ca == "BA21"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(ft4[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,2], decreasing=F),drop=F]
    if(1 > 3)
        tht <- tminmaxt[2, ,drop=F]
    else if(tminmaxt[1,3]/tminmaxt[2,3] > 3 ){
        tht <- tminmaxt[2, ,drop=F]
    } else {
        tht <- tminmaxt[1, ,drop=F]
    }
}
if(ca == "BA21_34"){
    tminmaxt <- minmaxt[(ft2[1,1]+1):(ft4[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,1], decreasing=T),drop=F]
    lt <- nrow(tminmaxt)
    if(lt == 1){
        tht <- tminmaxt[1, ,drop=F]
    } else if(lt == 2){
        if((ft2[1,3] - minmaxt[ft2[1,1]-2, 3])/(ft2[1,2] - minmaxt[ft2[1,1]-2, 2]) < 0.0007 || (ft2[1,3] - minmaxt[ft2[1,1]-2, 3])/(ft2[1,2] - minmaxt[ft2[1,1]-2, 2]) > 0.0009){
            if(tminmaxt[1,3] - tminmaxt[2,3] < 0.0007){
                tht <- tminmaxt[2, ,drop=F]
            } else {
                tht <- tminmaxt[1, ,drop=F]
            }
        } else {
            tht <- tminmaxt[1, ,drop=F]
        }
    } else if(lt >= 3){
        sl <- cbind(1:lt)
        wa <- c()
        for(s in 1:lt){
            sp <- 0
            if(s == 1){
                sp <- 0
            } else {
                sp <- (tminmaxt[s,3] - tminmaxt[s-1,3])/(tminmaxt[s,2] - tminmaxt[s-1,2])
            }
        }
        wa <- rbind(wa,sp)
        sl <- cbind(sl,wa)
        sl <- sl[order(sl[,2], decreasing=T),drop=F]
        if(sl[1,2] == 0){
            tht <- tminmaxt[1, ,drop=F]
        } else {
            tht <- tminmaxt[sl[1,1], ,drop=F]
        }
    }
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),drop=F]
    if(tht[1,3] > tminmaxt[1,3] && tht[1,2] > tminmaxt[1,2]){
        tht <- tminmaxt[1, ,drop=F]
    }
}
if(ca == "BA34"){
    tminmaxt <- minmaxt[(ft2[1,1]+1):(ft3[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "BA213"){
    tminmaxt <- minmaxt[(ft3[1,1]+1):(ft4[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "BA"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(ft3[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "BB231"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(ft4[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "BD21"){
    if(ft3[1,2] > 0){
        tminmaxt <- minmaxt[(ft2[1,1]+1):(ft4[1,1]-1), ,drop=F]
        tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
        tht <- tminmaxt[1, ,drop=F]
    } else if(ft3[1,2] < 0){
        tminmaxt <- minmaxt[(ft2[1,1]+1):(ft3[1,1]-1), ,drop=F]
        tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
        tht <- tminmaxt[1, ,drop=F]
    }
}
if(ca == "BD21_43"){
    tminmaxt <- minmaxt[(ft2[1,1]+1):(ft3[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "BA34"){
    tminmaxt <- minmaxt[(ft2[1,1]+1):(ft3[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "BC"){
    tminmaxt <- minmaxt[(ft2[1,1]+1):(ft3[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    if(tminmaxt[nrow(tminmaxt),1] - tminmaxt[1,1] == 0){
        tht <- tminmaxt[1, ,drop=F]
    } else {
        tht <- tminmaxt[1, ,drop=F]
    }
}
if(ca == "BC23"){
    tminmaxt <- minmaxt[(ft3[1,1]+1):(ft1[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "CA321"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(ft4[1,1]-1), ,drop=F]
    if(nrow(tminmaxt) >= 3){
        tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
        tminmaxt[2, 3]/tminmaxt[1,3] < 1.5 && tminmaxt[2,3] > tminmaxt[1,3] {
            tht <- tminmaxt[1, ,drop=F]
        } else {
            tht <- tminmaxt[1, ,drop=F]
        }
    } else {
        tht <- tminmaxt[1, ,drop=F]
    }
}
if(ca == "CD"){
    tminmaxt <- minmaxt[(ft2[1,1]+1):(ft3[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "CF"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(ft4[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "CF34" && ft4[1,2] < -100){
    tminmaxt[1, ,drop=F]
    tminmaxt[1, ,drop=F]
    tht <- tminmaxt[1, ,drop=F]
}
if(ca == "DA"){
if(ft2[1,3]/ft3[1,3] > 4) {
  tminmaxt <- minmaxt[(ft1[1,1]+1):(ft2[1,1]-1), ,drop=F]
  tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
  thr <- tminmaxt[1, ,drop=F]
} else {
  tminmaxt <- minmaxt[(ft1[1,1]+1):(ft3[1,1]-1), ,drop=F]
  tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
  thr <- tminmaxt[1, ,drop=F]
}

if (ca == "DA12") {
  tminmaxt <- minmaxt[(ft1[1,1]+1):(ft3[1,1]-1), ,drop=F]
  tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
  thr <- tminmaxt[1, ,drop=F]
}

if (ca == "DA23") {
  tminmaxt <- minmaxt[(ft1[1,1]+1):(ft2[1,1]-1), ,drop=F]
  tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
  thr <- tminmaxt[1, ,drop=F]
}

if (ca == "DB") {
  tminmaxt <- minmaxt[(ft1[1,1]+1):(ft2[1,1]-1), ,drop=F]
  tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
  lt <- nrow(tminmaxt)
  if(lt == 1) {
    tht <- tminmaxt[1, ,drop=F]
  } else if(lt == 2) {
    if( (tminmaxt[1,3] - tminmaxt[2,3]) / (tminmaxt[1,2] - tminmaxt[2,2]) < 0 ){
      if(tminmaxt[1,3] < tminmaxt[2,3]) {
        tht <- tminmaxt[1, ,drop=F]
      } else {
        tht <- tminmaxt[2, ,drop=F]
      }
    } else if (minmaxt[tminmaxt[2,1] + 1, 3] / tminmaxt[2,3] > 1.6) {
      if(tminmaxt[1,3] < tminmaxt[2,3]) {
        tht <- tminmaxt[1, ,drop=F]
      } else {
        tht <- tminmaxt[2, ,drop=F]
      }
    } else if (minmaxt[tminmaxt[2,1] + 1, 3] - tminmaxt[2,3] < 0.00004 & & (tminmaxt[1,3] - minmaxt[tminmaxt[2,1] + 1, 3]) / (tminmaxt[1,2] - minmaxt[tminmaxt[2,1] + 1, 2]) < -0.00001) {
      if(tminmaxt[1,3] < tminmaxt[2,3]) {
        tht <- tminmaxt[1, ,drop=F]
      } else {
        tht <- tminmaxt[2, ,drop=F]
      }
    } else if (minmaxt[tminmaxt[2,1] + 1, 3] - tminmaxt[2,3] < 1.3) {
      if(tminmaxt[1,3] < tminmaxt[2,3]) {
        tht <- tminmaxt[1, ,drop=F]
      } else {
        tht <- tminmaxt[2, ,drop=F]
      }
    } else if (minmaxt[tminmaxt[2,1] + 1, 3] - tminmaxt[2,3] > 1.2 & & minmaxt[tminmaxt[2,1] + 1, 3] / tminmaxt[2,3] > 1.0) {
      if(tminmaxt[1,3] < tminmaxt[2,3]) {
        tht <- tminmaxt[1, ,drop=F]
      } else {
        tht <- tminmaxt[2, ,drop=F]
      }
    } else {
      if(tminmaxt[1,3] < tminmaxt[2,3]) {
        tht <- tminmaxt[1, ,drop=F]
      } else {
        tht <- tminmaxt[2, ,drop=F]
      }
    }
  }
  else if (lt >= 3) {
    sl <- cbind(1:lt)
    wa <- c()
    for( s in 1:lt){
      if(s == 1){
        sp <- 0
      }
```r
if(ca == "DB32") {
  tminmaxt <- minmaxt[(ft1[1,1]+1):(ft2[1,1]-1), ,drop=F]
  tminmaxt <- tminmaxt[order(tminmaxt[,1], decreasing=T),drop=F]
  h <- trow(tminmaxt)
  if(h[1,1] == 1) { 
    tht <- tminmaxt[, ,drop=F]
  } else if(h[1,1] == 2) {
    if((ft2[1,3] - minmaxt[ft2[1,1]-1, 3])/(ft2[1,2] - minmaxt[ft2[1,1]-1, 2]) < 0.0006 || (ft2[1,3] - minmaxt[ft2[1,1]-1, 3])/(ft2[1,2] - minmaxt[ft2[1,1]-1, 2]) > 0.0009) {
      tht <- tminmaxt[, ,drop=F]
    } else {
      tht <- tminmaxt[, ,drop=F]
    }
  } else if(h[1,1] >= 3) {
    sl <- cbind(sl,wa)
    wa <- c()
    for(s in 1:h){
      if(s == 1) {
        sp <- 0
      } else {
        sp <- (tminmaxt[s - 1,3] - tminmaxt[s,3])/(tminmaxt[s - 1,2] - tminmaxt[s,2])
        wa <- rbind(wa,sp)
      }
      sl <- cbind(sl,wa)
    }
  }
}
```

tminmaxt <- minmax(tminmaxt[,1:3])
for(s in 1:lt)
  if(s == 1)
    sp <- 0
  else
    sp <- (tminmaxt[s-1,3] - tminmaxt[s,3])/(tminmaxt[s-1,2] - tminmaxt[s,2])
wa <- cbind(wa,sp)
sl <- cbind(sl,wa)
sl <- sl[order(sl[,2], decreasing=T), ,drop=F]
if(sl[1,2] == 0)
  tht <- tminmaxt[sl[2,1] , ,drop=F]
else
  tht <- tminmaxt[sl[1,1] , ,drop=F]

if(ca == "DE"){
  tminmaxt <- minmax(tminmaxt[,1:3])
  tht <- tminmaxt[,1] , ,drop=F
}
if(ca == "DE31"){
  tminmaxt <- minmax(tminmaxt[,1:3])
  tht <- tminmaxt[,1] , ,drop=F
}
if(ca == "DE43"){
  tminmaxt <- minmax(tminmaxt[,1:3])
  tht <- tminmaxt[,1] , ,drop=F
}
if(ca == "DE431"){
  tminmaxt <- minmax(tminmaxt[,1:3])
  tht <- tminmaxt[,1] , ,drop=F
}
if(ca == "DF432" ){
  tminmaxt <- minmax(tminmaxt[,1:3])
  tht <- tminmaxt[,1] , ,drop=F
}
if(ca == "DF32" ){
  tminmaxt <- minmax(tminmaxt[,1:3])
  tht <- tminmaxt[,1] , ,drop=F
}
if(ca == "DF43" ){
  tminmaxt <- minmax(tminmaxt[,1:3])
  tht <- tminmaxt[,1] , ,drop=F
}

if(ca == "DF21"){
    tminmaxt <- minmaxt[(ft3[1,1]+1):(ft1[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "DF"){
    tminmaxt <- minmaxt[(ft2[1,1]+1):(ft1[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "AA123" | ca == "AA1234"){
    tminmaxt <- minmaxt[(ft0[1,1]+1):(ft4[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "AB124" | ca == "AB1243"){
    tminmaxt <- minmaxt[(ft0[1,1]+1):(ft3[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "AC13" | ca == "AC13_24" | ca == "AC132" | ca == "AC1324"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(0(ft2[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "AD13" | ca == "AD13_42" | ca == "AD134" | ca == "AD1342"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(0(ft2[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "AE142" | ca == "AE14" | ca == "AE14_23" | ca == "AE1423"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(0(ft2[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "AF14" | ca == "AF14_32" | ca == "AF143" | ca == "AF1432"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(0(ft2[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "BA13" | ca == "BA134" | ca == "BA234"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(0(ft4[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "BB" | ca == "BB14" | ca == "BB23" | ca == "BB23_14" | ca == "BB2314"){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(0(ft4[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "BC23_41" | ca == "BC2341" | ca == "BC341" | ca == "BC41"){
    tminmaxt <- minmaxt[(ft0[1,1]+1):(ft1[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "BD14" | ca == "BD14_31" | ca == "BD1431"){
    tminmaxt <- minmaxt[(ft0[1,1]+1):(0(ft3[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "BE13" | ca == "BE413"){
    tminmaxt <- minmaxt[(ft0[1,1]+1):(ft1[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "BF24" | ca == "BF24_31" | ca == "BF2431"){
    tminmaxt <- minmaxt[(ft0[1,1]+1):(0(ft3[1,1]-1), ,drop=F)
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1,,drop=F]
}
if(ca == "CA" | ca == "CA14" | ca == "CA21" | ca == "CA214" | ca == "CA32" | ca == "CA32_14" | ca == "CA3214"){
tminmaxt <- minmaxt[(ft2[1,1]+1):(ft4[1,1]-1), ,drop=F]
tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,,drop=F]

tht <- tminmaxt[1, ,drop=F]

} else if(nrow(temax) == 3){
## ft1, ft2, ft3
if(ft1[1,1] < ft2[1,1] && ft2[1,1] < ft3[1,1]){  
  if(ft1[1,3]/ft2[1,3] < bai && abs(ft1[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft3[1,3] < bai && abs(ft2[1,2]-ft3[1,2]) < dis){  
    ca <- "a123"  
  } else if(ft2[1,3]/ft3[1,3] < bai && abs(ft2[1,2]-ft3[1,2]) < dis){  
    ca <- "a23"  
  } else if(ft1[1,3]/ft2[1,3] < bai && abs(ft1[1,2]-ft2[1,2]) < dis){  
    ca <- "a12"  
  } else {  
    ca <- "a"  
  }
} else if(temax(temax) == 3){
  # ft1, ft2, ft3
  if(ft1[1,1] < ft2[1,1] && ft2[1,1] < ft3[1,1]){  
    if(ft1[1,3]/ft2[1,3] < bai && abs(ft1[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft3[1,3] < bai && abs(ft2[1,2]-ft3[1,2]) < dis){  
      ca <- "a123"  
    } else if(ft2[1,3]/ft3[1,3] < bai && abs(ft2[1,2]-ft3[1,2]) < dis){  
      ca <- "a23"  
    } else if(ft1[1,3]/ft2[1,3] < bai && abs(ft1[1,2]-ft2[1,2]) < dis){  
      ca <- "a12"  
    } else {  
      ca <- "a"  
    }
  }
}
if(ft1[1,1] < ft3[1,1] && ft3[1,1] < ft2[1,1]){
    if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis) {
        ca <- "b13"
    } else if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis) {
        ca <- "b32"
    } else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis) {
        ca <- "b13"
    } else {
        ca <- "b"
    }
}

## ft2, ft1, ft3
if(ft2[1,1] < ft1[1,1] && ft1[1,1] < ft3[1,1]){
    if(ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis) {
        ca <- "c213"
    } else if(ft1[1,3]/ft3[1,3] < bai && abs(ft1[1,2]-ft3[1,2]) < dis) {
        ca <- "c13"
    } else if(ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis) {
        ca <- "c21"
    } else {
        ca <- "c"
    }
}

## ft2, ft3, ft1
if(ft2[1,1] < ft3[1,1] && ft3[1,1] < ft1[1,1]){
    if(ft2[1,3]/ft3[1,3] < bai && abs(ft2[1,2]-ft3[1,2]) < dis && ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis) {
        ca <- "d231"
    } else if(ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis) {
        ca <- "d31"
    } else if(ft2[1,3]/ft3[1,3] < bai && abs(ft2[1,2]-ft3[1,2]) < dis) {
        ca <- "d23"
    } else {
        ca <- "d"
    }
}

## ft3, ft2, ft1
if(ft3[1,1] < ft2[1,1] && ft2[1,1] < ft1[1,1]){
    if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis && ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis) {
        ca <- "e321"
    } else if(ft2[1,3]/ft1[1,3] < bai && abs(ft2[1,2]-ft1[1,2]) < dis) {
        ca <- "e21"
    } else if(ft3[1,3]/ft2[1,3] < bai && abs(ft3[1,2]-ft2[1,2]) < dis) {
        ca <- "e32"
    } else {
        ca <- "e"
    }
}

## ft3, ft1, ft2
if(ft3[1,1] < ft1[1,1] && ft1[1,1] < ft2[1,1]){
    if(ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis && ft1[1,3]/ft2[1,3] < bai && abs(ft1[1,2]-ft2[1,2]) < dis) {
        ca <- "f312"
    } else if(ft1[1,3]/ft2[1,3] < bai && abs(ft1[1,2]-ft2[1,2]) < dis) {
        ca <- "f12"
    } else if(ft3[1,3]/ft1[1,3] < bai && abs(ft3[1,2]-ft1[1,2]) < dis) {
        ca <- "f31"
    } else {
        ca <- "f"
    }
}

#### extract a separation point by patterns
if(ca == "b"){
    if(ft3[1,2] - ft1[1,2] > 35) {
        tminmaxt <- minmaxt[(ft1[1,1]+1):(ft3[1,1]-1), ,drop=F]
        tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
        tht <- tminmaxt[,1, ,drop=F]
    } else {
        if(minmaxt[ft2[1,1] - 1,3] < minmaxt[ft3[1,1] - 1,3]) {
            tht <- minmaxt[ft2[1,1] - 1, ,drop=F]
        } else {
            tht <- minmaxt[ft3[1,1] - 1, ,drop=F]
        }
    }
}

```
if(ca == "d23"){
  if(ft2[1,2] > -60){
    tht <- minmaxt[ft3[1,1] + 1, ,drop=F]
  } else {
    if(ft1[1,1] != 1 && ft1[1,1] != nrow(minmaxt)){
      tht <- minmaxt[ft1[1,1] + 1, ,drop=F]
    } else {
      tht <- c()
    }
  }
}

if(ca == "f"){
  tht <- minmaxt[ft1[1,1] + 1, ,drop=F]
}

if(ca == "e32"){
  if(ft3[1,2] > -40){
    tht <- minmaxt[ft2[1,1] + 1, ,drop=F]
  } else {
    if(ft1[1,1] != 1 && ft1[1,1] != nrow(minmaxt)){
      tht <- minmaxt[ft1[1,1] + 1, ,drop=F]
    } else {
      tht <- c()
    }
  }
}

if(ca == "f12"){
  if(ft3[1,2] > -45){
    tht <- minmaxt[ft3[1,1] + 1, ,drop=F]
  } else {
    if(ft2[1,1] != 1 && ft2[1,1] != nrow(minmaxt)){
      tht <- minmaxt[ft2[1,1] + 1, ,drop=F]
    } else {
      tht <- c()
    }
  }
}

if(ca == "e"){
  if(ft1[1,2] > -60){
    tht <- minmaxt[ft2[1,1] + 1, ,drop=F]
  } else {
    tht <- minmaxt[ft3[1,1] + 1, ,drop=F]
  }
}

if(ca == "a"){
  if(ft2[1,2] - ft1[1,2] > 50){
    tminmaxt <- minmaxt[(ft1[1,1]+1):(ft2[1,1]-1), ,drop=F]
    tminmaxt <- tminmaxt[order(tminmaxt[,3], decreasing=F),,drop=F]
    tht <- tminmaxt[1, ,drop=F]
  } else {
    if(ft1[1,2] < -10){
      if(minmaxt[ft1[1,1] + 1, 3] <= minmaxt[ft2[1,1] - 1,3] && minmaxt[ft2[1,1] - 1,3] <= minmaxt[ft2[1,1] + 1, 3]) {
        tht <- minmaxt[ft1[1,1] + 1, ,drop=F]
      } else if(minmaxt[ft2[1,1] - 1,3] <= minmaxt[ft2[1,1] + 1, 3] || ft2[1,2] > -10){
        tht <- minmaxt[ft2[1,1] - 1, ,drop=F]
      } else {
        tht <- minmaxt[ft2[1,1] + 1, ,drop=F]
      }
    } else {
      tht <- minmaxt[ft1[1,1] + 1, ,drop=F]
    }
  }
}

if(ca == "c"){
  if(ft3[1,2] < 10){
    tht <- minmaxt[ft1[1,1] + 1, ,drop=F]
  } else {
    tht <- minmaxt[ft1[1,1] - 1, ,drop=F]
  }
}

if(ca == "d31"){
  if(ft3[1,2] > -40){
    tht <- minmaxt[ft3[1,1] + 1, ,drop=F]
  } else {
    if(ft1[1,1] != 1 && ft1[1,1] != nrow(minmaxt)){
      tht <- minmaxt[ft1[1,1] + 1, ,drop=F]
    } else {
      tht <- c()
    }
  }
}
if(ca == "d"){
    if(02[1,2] > -40){
        tht <- minmaxt[02[1,1] + 1, ,drop=F]
    } else if(03[1,2] > -40) {
        tht <- minmaxt[03[1,1] + 1, ,drop=F]
    } else if(01[1,2] > -10) {
        tht <- minmaxt[01[1,1] - 1, ,drop=F]
    } else {
        tht <- minmaxt[01[1,1] + 1, ,drop=F]
    }
}
if(ca == "f31"){
    tht <- minmaxt[01[1,1] + 1, ,drop=F]
}
if(ca == "a23"){
    if(02[1,2] < -45) {
        tht <- minmaxt[03[1,1] + 1, ,drop=F]
    } else {
        tht <- minmaxt[01[1,1] + 1, ,drop=F]
    }
}
if(ca == "a12"){
    tht <- minmaxt[02[1,1] + 1, ,drop=F]
}
if(ca == "e21"){
    tht <- minmaxt[03[1,1] + 1, ,drop=F]
}
if(ca == "c21"){
    tht <- minmaxt[03[1,1] - 1, ,drop=F]
}
if(ca == "f312"){
    tht <- minmaxt[02[1,1] + 1, ,drop=F]
}
if(ca == "b32"){
    if(minmaxt[02[1,1] + 1, 3] <= minmaxt[03[1,1] - 1,3]) {
        tht <- minmaxt[01[1,1] + 1, ,drop=F]
    } else if(03[1,2] < -10) {
        tht <- minmaxt[03[1,1] - 1, ,drop=F]
    } else {
        tht <- minmaxt[01[1,1] + 1, ,drop=F]
    }
}
if(ca == "a32"){
    tht <- minmaxt[01[1,1] - 1, ,drop=F]
}
if(ca == "a21"){
    tht <- minmaxt[01[1,1] + 1, ,drop=F]
}
if(ca == "a123"){
    if(01[1,2] < -60 && 04[1,2] > -60) {
        tht <- minmaxt[04[1,1] + 1, ,drop=F]
    } else {
        tht <- minmaxt[03[1,1] + 1, ,drop=F]
    }
}
if(ca == "a213"){
    tht <- minmaxt[03[1,1] + 1, ,drop=F]
}
if(ca == "e321"){
    if(01[1,2] > 0) {
        tht <- minmaxt[01[1,1] - 1, ,drop=F]
    } else {
        tht <- minmaxt[01[1,1] + 1, ,drop=F]
    }
}
if(ca == "d321"){
    if(01[1,2] > -10) {
        tht <- minmaxt[01[1,1] - 1, ,drop=F]
    } else {
        tht <- minmaxt[01[1,1] + 1, ,drop=F]
    }
}
} else if(nrow(temax) == 2) {
    th <- minmaxt[3, ,drop=F]
    if(minmaxt[2,3] < 1.0e-4) {
        tht <- c()
    }
} else {
    tht <- c()
}

th <- th[1,2]
an <- 1/0.9^th

### The value below the threshold is replaced with 0.
### In the example, file names a1_a.txt and a2_a.txt are added with "_a" after the input file name.
### The data is described in the file "a1_a.txt" in the following format.
### 0.713274
### 0.170416
### 0
### 0
### 0.379159
### 0.436011
### 0.346797
### <snip>

xyz <- y$va0
xyz[xyz<an] <- 0

smo <- paste(listlist$V1[mm],"_a.txt", sep=""

write(xyz, file=smo, ncolumns=1)

### Output file name "2018cent.txt"
### Active bins and inactive bins separated by the threshold,
### the active bins, the inactive bins, the threshold, and the input file name are described in the output file "2018cent.txt".
### For example
### filename threshold active bins inactive bins
### a1.txt 0.119149149720695 24853 306018
### a2.txt 0.095528323822769 62935 206791

kotae <- c(fil,ca, an, cxyz)
write(kotae, file="2018cent.txt", append=T, ncolumns =5)