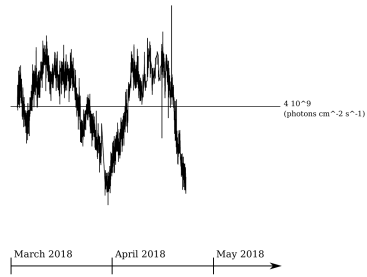


## Introduction

A



B

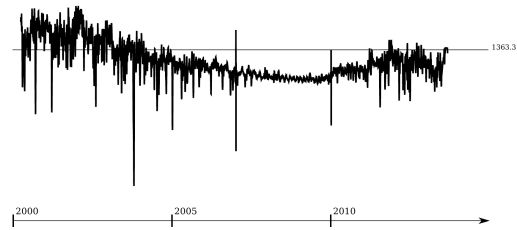


Figure 1 (A) Extracts form satellite data records of photon flux deposited in Univ. of South Carolina site, radiation of Sun in 2018; (B) Radiation of Sun from 2000 to 2013 recorded by "ACRIM3" satellite.

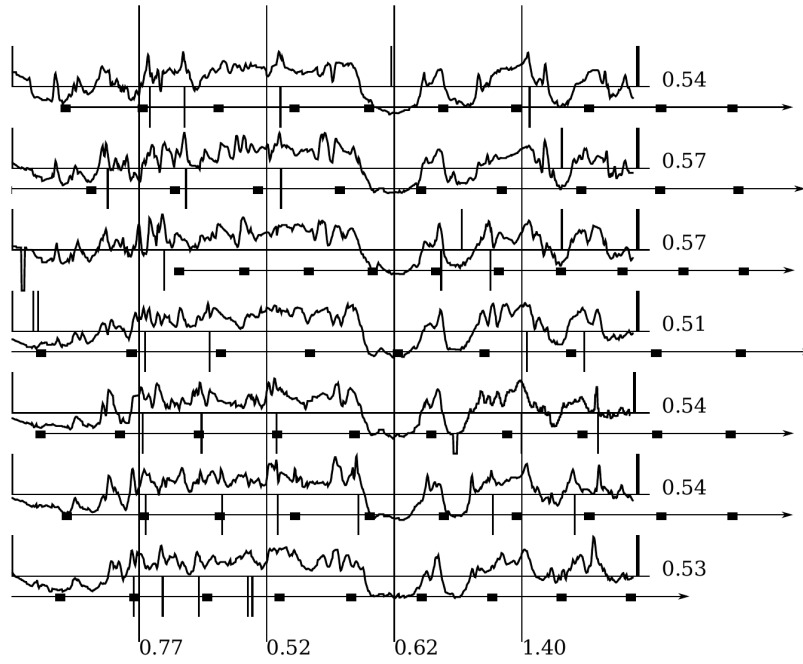
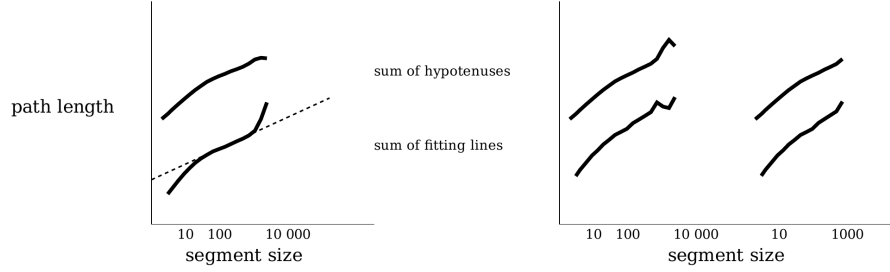


Figure 2 *Snapshot from video record of sun flaring 15.06.2002, deposited by Swedish physicists. Digits in column - Higuchi fractal dimension for spatial axis, digits in row - approximation of fractal dimension for time axis.*

## Methods

A



B

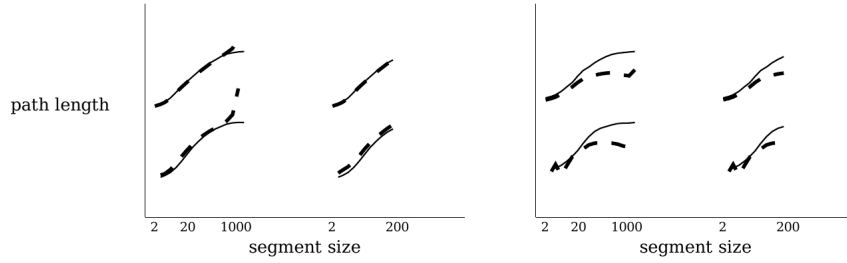


Figure 3 *Illustrations of attempts to guess a presence of the log-periodic dependency (A) Uniform distribution - chart in fig. 1A (B) Periodic bursts - chart in fig 1B, two tails in separate.*

Table 1 *Supplement to figure 3 - results of fitting of log-periodicity in log-log distributions*

|               | usc_18    |           | acrim3-1  |           | acrim3-2  |           |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|
|               | method 1  | method 2  |           |           |           |           |
| plain:        |           |           |           |           |           |           |
| dimension     | 0.577973  | 0.579382  | 0.691307  | 0.747027  | 0.598869  | 0.645797  |
| correlation   | -0.983925 | -0.969044 | -0.984111 | -0.97212  | -0.974277 | -0.959029 |
| fit in full:  |           |           |           |           |           |           |
| direction     | decc.     | decc.     | accel.    | accel.    | accel.    | accel.    |
| critical time | -711      | -141      | +318      | +474      | +6        | +8        |
| dimension     | 0.686096  | 0.880372  | 0.858975  | 1.07331   | 0.881265  | 0.788433  |
| correlation   | -0.992609 | -0.996231 | -0.998645 | -0.998409 | -0.998075 | -0.979409 |
| fit in part:  |           |           |           |           |           |           |
| direction     | accel.    | decc.     | decc.     | accel.    | accel.    | accel.    |
| critical time | +2        | -141      | -474      | +2        | +63       | +3        |
| dimension     | 0.677549  | 0.949008  | 0.822429  | 0.949565  | 0.599305  | 0.974975  |
| correlation   | -0.992127 | 0.996914  | -0.996929 | -0.99992  | -0.995057 | -0.999909 |

## Results

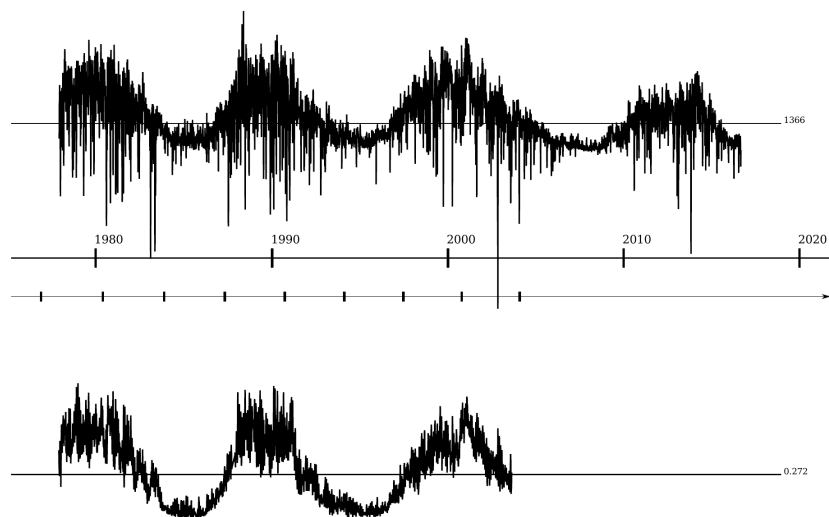


Figure 4 *Radiation of Sun in period from November 1978 to September 2017; in bottom - radiation at MgII frequency.*

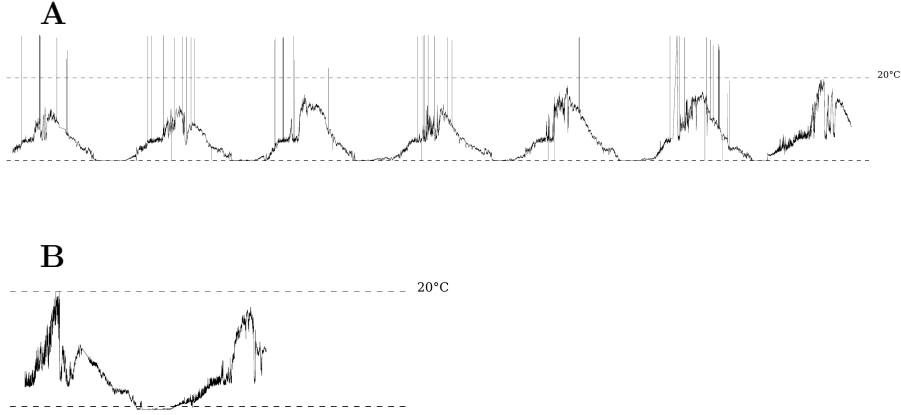


Figure 5 *Temperature of water in Baikal (A) series from May 2010 to October 2016; (B) series from May 2017 to September 2018.*

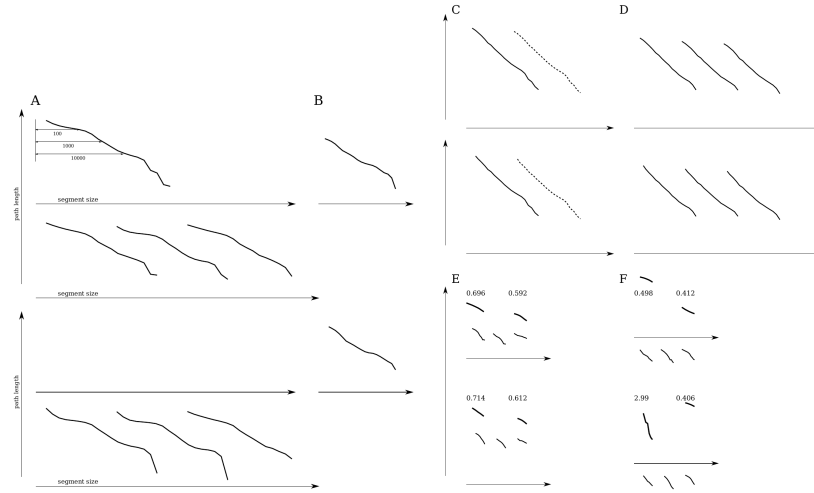


Figure 6 *Log-log dependencies, for the two types of method. A,B: temperature fn Baikal, A - 2010-2016, B - 2017-2018 period, C,D: solar activity, 1978-2017, E,F - fragments of auxiliary records on solar irradiation*

In A,D, three separate lines are the distributions for beginning, middle and ending parts of a period. Dashed lines in C, for a comparison - path lengths are estimated by the modified approach, suitable to fitting of log-perodicity. In E,F, - time series are of 15.06.2002 as in fig.2, and of 01.04.2018 as in fig1B, at average and in a few randomly choosed parts. Appropriate fragments from the long-time series, shown in fig 4 and here in C,D, are added for a comparison; numerical labels are estimated least-square slopes of regression lines.

|                                 | <i>method 1</i><br>dimension | correlation | <i>method 2</i><br>dimension | correlation |
|---------------------------------|------------------------------|-------------|------------------------------|-------------|
| Solar activity                  |                              |             |                              |             |
| 1-10 t.p.                       |                              |             |                              |             |
| period 1, at a whole            | 0.600865                     | -0.983845   | 0.597535                     | -0.993015   |
| period 1, split to 10 parts     | $0.603019 \pm 0.0681101$     |             | $0.610272 \pm 0.105999$      |             |
| period 2, at a whole            | 0.580363                     | -0.983685   | 0.597535                     | -0.991654   |
| period 2, split to 10 parts     | $0.568418 \pm 0.0552829$     |             | $0.573676 \pm 0.0685691$     |             |
| period 3, at a whole            | 0.562857                     | -0.983647   | 0.556838                     | -0.991774   |
| period 3, split to 10 parts     | $0.543297 \pm 0.0622227$     |             | $0.544673 \pm 0.0601166$     |             |
| Temperature in Baikal           |                              |             |                              |             |
| <i>long series</i> ; 1-10 t.p.  |                              |             |                              |             |
| period 1, at a whole            | 0.570939                     | -0.992162   | 0.812175                     | -0.995154   |
| period 1, split to 10 parts     | $0.613501 \pm 0.126926$      |             | $0.868055 \pm 0.177196$      |             |
| period 2, at a whole            | 0.532256                     | -0.991045   | 0.739015                     | -0.994156   |
| period 2, split to 10 parts     | $0.633994 \pm 0.217527$      |             | $0.876311 \pm 0.29755$       |             |
| period 3, at a whole            | 0.303322                     | -0.99865    | 0.385959                     | -0.995293   |
| period 3, split to 10 parts     | $0.364181 \pm 0.227035$      |             | $0.467551 \pm 0.320929$      |             |
| <i>short series</i>             |                              |             |                              |             |
| 1 - 80 t.p., at a whole         | 0.606348                     | -0.995202   | 0.662082                     | -0.988346   |
| 1 - 80 t.p., split to 10 parts  | $0.564113 \pm 0.164664$      |             | $0.628443 \pm 0.215225$      |             |
| 40 - 80 t.p., at a whole        | 0.508056                     | -0.981986   | 0.507846                     | -0.99867    |
| 40 - 80 t.p., split to 10 parts | $0.425593 \pm 0.28323$       |             | $0.444415 \pm 0.282211$      |             |

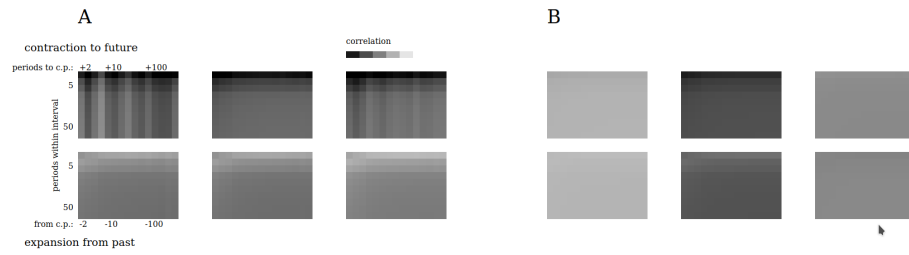


Figure 7 *Fitting of log-periodicity. A - solar activity data, three parts, B - Baikal water, long series, three parts.*

## References

1. Nottale, L., Scale relativity and fractal space-time: theory and applications, *arxiv.org*, 2008
2. Feranchuk, S., Belkova, N., et al. *Limnology and Freshwater Biology*, 2018,

## Appendix A

```
cat usc_18.txt | awk -v i=0 -v b1=2458119.5 -v b13=7 '{ if ( i == 100 && substr(
$13, 1, 1 ) != "0" ) { s = s "," 10 * ( $1 - b1 ) "," 500 * (substr($13,1,7)
- b13 ); i = 0; }; i = i+1; } END { print substr( s, 2 ) }' | ./fractal_dimension
-d_xy
```