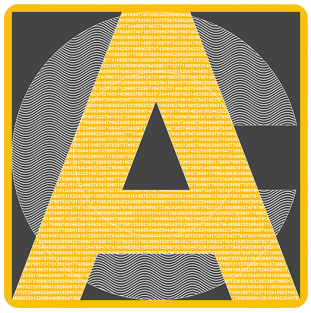

ACYCLE

version 2.3

Time-series analysis software for paleoclimate research and education

User's Guide

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Contents

ACYCLE ..... - 1 -

WHAT THEY SAY ..... - 4 -

COPYRIGHT ..... - 6 -

1. ACKNOWLEDGMENTS ..... - 7 -

2. REFERENCES ..... - 8 -

3. SOFTWARE SPECIFICATIONS ..... - 10 -

3.1 SYSTEM REQUIREMENTS ..... - 10 -

3.2 DOWNLOADING THE *ACYCLE* SOFTWARE ..... - 11 -

3.3 MATLAB VERSION ..... - 12 -

3.3.1 Toolboxes ..... - 12 -

3.3.2 Installation ..... - 12 -

3.3.3 Startup ..... - 12 -

3.3.4 Git Clone and Updating ..... - 13 -

3.4 MAC VERSION ..... - 15 -

3.4.1 Introduction ..... - 15 -

3.4.2 AcycleX.X-Mac-green ..... - 15 -

3.5 WINDOWS VERSION ..... - 18 -

3.5.1 Introduction ..... - 18 -

3.5.2 AcycleX.X-Win-Installer ..... - 18 -

3.5.3 AcycleX.X-Win-green ..... - 18 -

3.6 DATA REQUIREMENTS ..... - 19 -

4. *ACYCLE* GRAPHICAL USER INTERFACE (GUI) ..... - 20 -

4.1 FUNCTIONS AND GUI ..... - 20 -

4.2 FILE ..... - 21 -

4.3 EDIT ..... - 21 -

4.4 PLOT ..... - 22 -

4.5 BASIC SERIES ..... - 25 -

Insolation ..... - 25 -

Astronomical Solution ..... - 27 -

Length-of-day & Day-of-year ..... - 27 -

Signal/Noise Generator ..... - 28 -

LR04 Stack ..... - 30 -

Examples ..... - 30 -

4.6 MATH ..... - 35 -

Sort/Unique/Delete-empty ..... - 35 -

Interpolation ..... - 35 -

Interpolation Series ..... - 35 -

Select Parts ..... - 36 -

Merge Series ..... - 36 -

Multiply Series ..... - 36 -

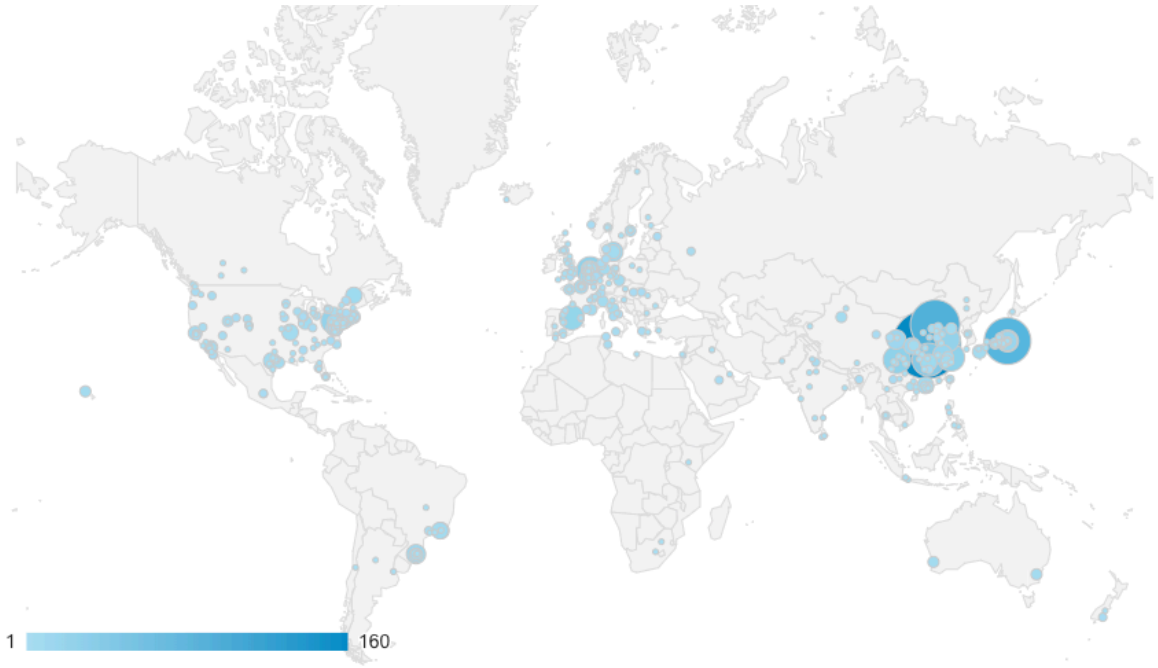
Add Gaps ..... - 37 -

Remove Parts ..... - 37 -
Remove Peaks ..... - 37 -
Clipping ..... - 37 -
Changepoint ..... - 37 -
Standardize ..... - 38 -
Principal Component ..... - 38 -
Log-transform ..... - 38 -
Derivative ..... - 39 -
Simple Function ..... - 39 -
Utilities ..... - 39 -
Find max/min ..... - 39 -
Image: ..... - 39 -
Show Image ..... - 39 -
RGB to Grayscale ..... - 39 -
Image Profile ..... - 39 -
Plot Digitizer ..... - 40 -
4.7 TIME SERIES ..... - 42 -
Detrending | Curve Fitting ..... - 42 -
Smoothing ..... - 43 -
Moving Average ..... - 43 -
Moving Median ..... - 43 -
Bootstrap ..... - 43 -
Prewhitening ..... - 44 -
Spectral Analysis ..... - 44 -
Evolutionary Spectral Analysis ..... - 47 -
Wavelet transform ..... - 48 -
Coherence & Phase ..... - 49 -
Lead/Lag Relationship ..... - 50 -
Filtering ..... - 51 -
Dynamic Filtering ..... - 53 -
Amplitude Modulation ..... - 55 -
Build Age Model ..... - 55 -
Age Scale | Tuning ..... - 55 -
Sedimentation Rate to Age Model ..... - 59 -
Power Decomposition Analysis ..... - 59 -
Sedimentary Noise Model ..... - 60 -
Correlation Coefficient (COCO/eCOCO) ..... - 61 -
TimeOpt ..... - 66 -
eTimeOpt ..... - 67 -
Spectral Moments ..... - 68 -
4.8 HELP ..... - 71 -
What's New ..... - 71 -
Manuals ..... - 71 -
Find Updates ..... - 71 -
Copyright ..... - 71 -
Contact ..... - 71 -
4.9 MINI-ROBOT ..... - 72 -

5. DYNOT MODEL DESCRIPTION ..... - 73 -
5.1 DATA FORMAT ..... - 73 -
5.2 STARTUP ..... - 73 -
5.3 SETTINGS ..... - 74 -
5.4. RUNNING THE DYNOT MODEL ..... - 77 -
5.5. OUTPUT FILES ..... - 78 -
6. CASE STUDIES ..... - 79 -
TYPICAL PROCEDURES IN CYCLOSTRATIGRAPHY ..... - 79 -
EXAMPLE #1: INSOLATION ..... - 81 -
Step 1: Load data ..... - 81 -
Step 2: Data pre-processing ..... - 82 -
Step 3: Detrending ..... - 82 -
Step 4: Power Spectral Analysis ..... - 83 -
Step 4: Evolutionary Spectral Analysis ..... - 84 -
EXAMPLE #2: LA2004 ASTRONOMICAL SOLUTION (ETP) ..... - 86 -
Step 1: Load data ..... - 86 -
Step 2: Data pre-processing ..... - 87 -
Step 3: Detrending ..... - 87 -
Step 4: Power Spectral Analysis ..... - 88 -
Step 5: Evolutionary Spectral Analysis ..... - 89 -
Step 6: Wavelet transform ..... - 90 -
EXAMPLE #3: CARNIAN CYCLOSTRATIGRAPHY ..... - 92 -
Step 1. Load Data ..... - 92 -
Step 2. Data Preparation ..... - 93 -
Step 3. Interpolation ..... - 93 -
Step 4. Detrending ..... - 95 -
Step 5. Power spectral analysis ..... - 96 -
Step 6. Evolutionary power spectral analysis ..... - 98 -
Step 7. Correlation coefficient ..... - 99 -
Step 8. Filtering ..... - 103 -
Step 9. Age model and tuning ..... - 104 -
Step 10. Repeat steps. ..... - 106 -
REFERENCES ..... - 107 -

Time series analysis plays a fundamental role in the natural sciences. In growing important geoscience application, recognition and interpretation of climate signals in proxy records can be time consuming and subjective. Three reasons motivated the development of the *Acycle* time series analysis program: (1) There is a need to broaden and encourage the experience of time series analysis in the geosciences, especially in paleoclimatology and cyclostratigraphy. (2) There is a need to speed the process for the time-series analysis steps, which can be very time-consuming. (3) There is a need to provide objective methods for the analysis of paleoclimate signals as reproducibility becomes a major challenge. We acknowledge our inspiring freeware predecessors: *Analyseries* (Paillard et al., 1996), *Anand*, and *Astrochron* (Meyers, 2014).

What they say



Total: 3,621 unique visitors (Sept 2018 – Feb 2020) (http://mingsongli.com/acycle)
Data source: https://analytics.google.com

- Dr. J. Fred Read (Virginia Tech, USA)

  It is truly an amazing contribution to the geosciences community. As someone who has spent much of the last 50 years trying to understand cyclic carbonates on shallow platforms, and having been involved with my students in some of the early work on stratigraphic modelling of the effects of Milankovitch forcing of carbonate platform stratigraphy, I was blown away by the power of the *Acycle* software. In the old days we used in house programs from our geophysicist Cahit Coruh, and recently I have used Analyseries, kSpectra and Timefrq43, moving from Dos to Windows to Mac, jumping from one to the other to get the job done. *Acycle* has done away with the need for this,

and I have been impressed with how very user friendly the program is – an indication of the tremendous effort and thought that has gone into putting this together.
You should all feel very proud of this contribution. It opens up much needed access to these powerful tools for a wide audience in the sedimentary geology and paleoclimate community. Thanks again for all your efforts. A really marvelous job.

- Dr. James G. Ogg (Purdue University, USA):

  "Mingsong Li's *Acycle* software enables us to quickly analyze the potential of new outcrops and boreholes, and then to determine the sedimentation rates and elapsed time. His *Acycle* software will become the standard tool for time-scale applications by all international workers."

- Dr. Paul E. Olsen (Columbia University, USA):

  "Not only is this software powerful and effective, it is also simple to use and therefore benefits researchers and at all levels within the paleoclimatology community, from novices to experts."

- Dr. Arsenio Muñoz Jiménez (University of Zaragoza, Spain):

  "Thank you very much and congratulations for the *acycle* software. I am using it and it is very very useful and interesting."

- Dr. Marco Franceschi (University of Padova, Italy):

  "Dr. Li's software is being immensely valuable to my work. Some of the stratigraphic series I am studying display a prominent cyclicity, but were deposited in contexts characterized by relevant changes in sedimentation rates and often lack accurate geochronological constraints. *Acycle* has been designed specifically for dealing with similar cases, by tackling them with a rigorous statistical approach, and therefore is providing an invaluable tool for their investigation."

- Dr. Xu Yao (Lanzhou University, China):

  "I am working on cyclostratigraphy and paleoclimate study of ancient strata and rocks (270 million years ago) with assistance from *Acycle* software. I also introduced this software to my colleagues whose research areas are paleoclimate implications of Quaternary loess (several thousand years ago). My colleagues have given me really good feedbacks about *Acycle* software."

- Dr. Christian Zeeden (IMCCE, Observatoire de Paris, France):

  "Dr. Li's software is novel and valuable in this context, especially because it facilitates the easy application of otherwise complex calculations."

- Dr. Nicolas R. Thibault (University of Copenhagen, Denmark):

  "I've been playing a lot with the excellent *Acycle* package for Matlab that Mingsong developed. Congratulations, this is a very nice interface that simplifies a lot our work and makes it truly faster to analyse a time-series."

- Dr. Frits Hilgen (Utrecht University, Netherlands):

> "I used it this academic year for the first time in my MSc course on Astronomical climate forcing and time scales as replacement of the outdated *Analyseries* program. The main advantages of *Acycle* is that it is very user friendly, has a lot of different options for the statistical analysis of paleoclimate records and in addition first-rate plotting options. For instance you can directly see the trend that you aim to remove and then decide whether you want to continue with it. It is further also very good to see the fast and almost continuous improvement of *Acycle*, including the processing of reported bugs. And, not unimportantly, also my students were very enthusiastic about Acycle and I now use it now for my own research as well!"

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This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

The *Acycle* authors reserve the right to license this program or modified versions of *Acycle* under other licenses at the discretion. Questions about *Acycle* may be directed to:

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Advice and suggestions are always greatly appreciated.

2. References

Please acknowledge *Acycle* on any publication of scientific results that is based on the use of *Acycle* and cite the following article in which *Acycle* is described:

Li, M., Hinnov, L.A., and Kump, L.R. 2019. *Acycle*: Time-series analysis software for paleoclimate projects and education, *Computers & Geosciences*, 127: 12-22. https://doi.org/10.1016/j.cageo.2019.02.011

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