DepthChron User Guide

Version 1.1.3 · Nov 24, 2026 · @Khan

DepthChron is uniquely designed for ease of use: it needs no coding, runs offline in a browser, takes mixed methods in one table and writes the methods paragraph.

1. About DepthChron

DepthChron turns dated levels in a sediment core into an age for every depth. It calibrates radiocarbon dates, applies the usual corrections, and builds a Bayesian (Bacon-style) or classical age-depth model. It runs entirely in your web browser, offline, and no data leaves your computer.

It handles mixed dating methods in one core:

- **Radiocarbon (14C)**, AMS or conventional, entered as 14C age, F14C or pMC, including post-1950 (bomb) samples
- **OSL / IRSL and other luminescence ages**, in ka or years before the measurement year
- **Calendar markers**: historical events, core-top collection year, the AD 1963 137Cs peak

Corrections include δ13C normalisation, marine reservoir (ΔR with its uncertainty), mixed marine–terrestrial carbon, hard-water offsets, and hemisphere-specific bomb curves.

Free and Pro editions

DepthChron Free is complete for age-depth modelling: everything that Bacon, OxCal, CALIB and clam offer for free is included, with no limits on cores or exports. DepthChron Pro adds interpretation of the model and event recurrence analysis. Both editions are version 1.1.3.

Feature	Free	Pro
14C, OSL / IRSL and calendar ages in one table, with all corrections	✓	✓
Calibration with IntCal20, SHCal20, Marine20, Bomb21 and older curves	✓	✓
Bayesian (Bacon-style) and classical models, with outliers and hiatuses	✓	✓
Unlimited cores; event layers and horizons; event ages compared across cores	✓	✓

Feature	Free	Pro
CSV tables, PNG and SVG figures, project files, methods paragraph, Download all	✓	✓
Demos: all features (three simulated cores) and Lake Ulu (short and long runs)	✓	✓
Runs keep going in a background tab	✓	✓
Model interpretation: accumulation zones, rate changes, hiatus gaps, checks of doubtful settings, results paragraph	–	✓
Event recurrence: intervals, mean recurrence, variability (CoV), chance of the next event (Poisson and BPT)	–	✓
Validation reports and data	–	✓

DepthChron Free and Pro are available from the TWM Global store.

What you need

- A recent desktop browser: Chrome, Edge or Firefox. A tablet works but a screen at least 1200 px wide is easier.
- No installation and no internet connection. Save the file `DepthChron.html` anywhere on your computer and double-click it.
- Your work is kept in the browser between sessions. Use **Save project** to keep a permanent copy as a `.depthchron.json` file; **Open project** reloads it on any computer.

2. Quick start

The first time you open DepthChron it loads the all-features demo: three simulated coastal cores (not real data) with radiocarbon, post-bomb, marine, mixed-carbon, OSL and 137Cs dates, event sand layers, a hiatus and an event horizon. All three cores are modelled one after another in under a minute, so every step, including event ages and recurrence, has results to explore. Lake Ulu: short run loads the published Lake Ulu core EN21103 from eastern Siberia (data: Jia et al., 2024, CC BY 4.0) with lighter settings (about 3 minutes; open the Model step and click Run model), and Lake Ulu: long run uses the full settings (about 20 minutes). Lake Ulu has no event layers, so its Events step is empty. A run keeps going if you switch to another tab.

To model your own core:

1. Click **New project** and give the project and core a name, the site latitude and the year the core was collected (**Project** step).
2. Enter or paste your dates on the **Dates** step. Each date needs a lab code, a depth, a type, a value and an error.
3. Check the corrections that apply to each date on the **Corrections** step: reservoir ΔR, mixed carbon, bomb zone, OSL datum.
4. Look at each calibrated date on the **Calibrate** step.
5. On the **Model** step choose **Bayesian**, pick the depositional environment (Steady or Dynamic), and click **Run model**.
6. Read the ages of event layers and horizons on the **Events** step. You mark these layers and horizons on the **Project** step.
7. Save tables, figures, the methods paragraph and the project file on the **Export** step.

The steps are along the top of the screen and can be visited in any order. A green tick marks a finished step and a red mark a step that needs attention; changing a date or a setting clears the old model so it can be run again.

3. The seven steps

Project

Project settings apply to every core:

- **Depth unit** (cm or m), **age scale** (cal BP, BC/AD, BCE/CE or b2k) and **age unit** (years or ka).
- **Calibration curves**: IntCal20 / SHCal20 / Marine20 for new work; IntCal13 set to reproduce older studies.
- **Mixed-curve uncertainty**: the CALIB 8.2 method (default) or the clam / rintcal method.
- **Date likelihood** for calibration: Normal (as CALIB and OxCal) or Student-t with wider tails.

Core settings: name, latitude (south negative), longitude, year collected, and the post-bomb zone. The zone is suggested from latitude; check the zone map in Hua et al. (2022) for monsoon regions.

Three tables on this step describe the core itself:

- **Instantaneous event layers**: tsunami sands, storm layers, turbidites, tephras or slumps. Give top and bottom depths; their thickness is removed from the model so the whole layer gets one age.

- **Hiatuses**: depths where time is missing, such as an erosional contact, with an expected gap length. Used by the Bayesian model.
- **Event horizons**: any depth whose age you want reported, such as the base of a sand sheet.

DepthChron checks this setup and warns on the Project and Model steps when event layers cover most or all of the core, when layers overlap, or when a hiatus falls inside an event layer. It also notes dated samples that lie inside an event layer: their age applies to the whole layer, and reworked material can be older than the event, so consider tagging them as maximum ages. Mark only single-event deposits as event layers; to get ages at chosen depths without removing anything, use event horizons.

Dates

One row per date: lab code, top and bottom depth (leave bottom blank for a thin sample), type, value, error, unit, material and tag.

To bring in many dates at once, drop an Excel (.xlsx) or CSV file on the dashed box, or click **Choose a file**. **Download template** gives a CSV with the right column order. A **live preview** above the table plots every calibrated date against depth as you type, and names any pair of dates whose ages clearly reverse with depth.

Type	Enter	Notes
14C	14C yr BP, F14C or pMC	Post-bomb values are calibrated with Bomb21 automatically
OSL / IRSL	ka or years	Set the measurement year under More so the age is shifted to the 1950 datum
Calendar	cal BP, AD, BC or b2k	Historical events and other known ages
Core top	Year AD	Defaults to the year collected
137Cs peak	Year AD	Defaults to 1963

The **tag** decides how a date is used: **Full age** (normal), **Maximum** or **Minimum age** (the level must be younger or older than this), or **Exclude** (kept in the table, left out of the model). Dates can be pasted from Excel or imported from an rbacon CSV file.

Corrections

Click **More** on a 14C date to set its corrections: the calibration curve (automatic from the material, or chosen), marine reservoir ΔR ± 1σ, marine fraction for mixed samples, hard-water offset, and δ13C if the value is not yet normalised. The Corrections step lists every

correction applied to every date, with warnings such as a marine sample with ΔR left at 0.

Calibrate

Each date is shown as its calibrated probability, with the 68.3% and 95.4% ranges and the median. Post-bomb dates are plotted in F14C so the bomb peak is readable.

Model

Choose **Bayesian (Bacon-style)** for most work, or a classical model (linear interpolation, linear regression, 2nd- or 3rd-order polynomial) for comparison. Section 4 explains the Bayesian settings. A Bayesian run takes from a few seconds to about a minute; the same seed and settings always give the same result.

The result shows the age-depth curve with its 95% range, sedimentation time down the core, the age table, and for Bayesian runs the chain traces and the prior and posterior of accumulation rate and memory.

Four summary cards sit above the figure: the age range, the mean sedimentation rate (also in mm per year), the model quality, and how many dates fit the model. A narrow **Log** column beside the depth axis shows event layers (sand pattern), hiatuses (red zigzag) and dated levels (coloured markers).

The age-depth figure is interactive: hover to read the depth, median age, 95% range and sedimentation rate; drag up or down to zoom into a depth range, and double-click or press **Reset zoom** to return; click any date to open its details (measured value, calibrated ranges, model age at that depth and whether it fits).

Events

Ages of the event layers and horizons in every modelled core, with 95% ranges, plotted on one time axis. Several cores share the axis so events can be compared across sites.

Export

Save the age table and the dates (CSV, opens in Excel), the event ages (CSV), the age-depth figure (PNG, or SVG vector for journals), the project file, and a methods paragraph written from your settings, ready to edit into a paper.

4. Choosing the model settings

Depositional environment

The environment buttons set the **memory prior**: how strongly the accumulation rate at one depth resembles the rate just above it.

Button	Memory mean / strength	Use for
Dynamic (default)	0.5 / 10	Coasts, estuaries, deltas, rivers, floodplains, landslide- or tsunami-affected sites, caves, and whenever unsure. Current rbacon default.
Steady	0.7 / 4	Deep or closed lakes with laminated or uniform sediment, open-ocean cores, raised bogs, with evidence of smooth deposition. Classic Bacon default.

In tests on simulated cores, Steady gave narrower 95% ranges that sometimes missed the true age, while Dynamic contained the true age at every depth on clean cores. Use Steady only when the lithology or dense dating supports smooth accumulation. On cores with abrupt changes in accumulation, both settings gave nearly the same ages: the spacing of the dates mattered far more.

Accumulation rate prior

- **Accumulation mean** (yr per cm) is the expected time to deposit one depth unit. DepthChron suggests a value from your dates; round it to a simple number such as 5, 10, 20 or 50.
- **Accumulation shape** (default 1.5) sets how strongly rates can vary. Higher values hold rates closer to the mean.

Section thickness

The core is cut into sections of this thickness (default 5 cm), each with its own accumulation rate. Aim for 10 to 200 sections over the modelled depth. Thinner sections give a more flexible curve and slower runs.

Outliers, hiatuses and event layers

- The default **Student-t** date likelihood lets the model down-weight a date that disagrees with its neighbours, as Bacon does. Dates outside the model's 95% band are listed after the run.
- A date known to be wrong (reworked shells, contamination) is best tagged **Exclude**, with the reason in its note.
- Add a **hiatus** at erosional contacts, and enter **event layers** so their thickness is removed before modelling.

Dating density

More dates improve a model more than any setting. Aim for a date every 20 to 50 cm, and add dates just above and below suspected changes in lithology or event layers.

5. Reading the results

A good Bayesian run shows a **Model OK: the chains agree** message, a largest split R-hat below 1.1, and every date overlapping the model's 95% band.

- **Age-depth figure**: the dark line is the median age, the grey band the 95% range, and the coloured shapes the calibrated dates (brown 14C, blue OSL, green calendar). Shaded bands mark removed event layers.
- **Sedimentation time**: years per depth unit down the core. Peaks mean slow deposition; troughs fast.
- **Chain traces**: the chains should overlap and wander around a level without trends.
- **Prior and posterior plots**: grey curves are your priors, bars the results. A posterior far from its prior means the dates moved the setting strongly. A memory posterior pressed against 0 or 1 means the data disagree with the chosen environment: try the other one and report both if the ages differ.
- **Age table**: median, mean and 95% range at each depth. Report the median with its 95% range; the full table is on the Export step.

Troubleshooting

Message or symptom	What it means	What to do
Check the model: the chains disagree (R-hat 1.1 or more)	The record allows two competing age solutions, often because of a doubtful date	Raise stored samples and burn-in, or decide on the doubtful dates (Exclude, or Maximum/Minimum tag)

Message or symptom	What it means	What to do
Dates listed outside the 95% band	The model treats them as outliers	Check the sample, material and corrections; exclude it if there is a reason
Only a few classical runs kept the ages in order	Dates reverse with depth	Use the Bayesian model, or tag the reversing date
Model bends sharply at a date	Too few sections, or an accumulation mean far from the data	Use thinner sections or the suggested accumulation mean
Marine date warning: ΔR is 0 ± 0	No local reservoir correction entered	Enter ΔR from the Marine Reservoir Correction database (calib.org/marine)
Post-bomb result looks wrong	Wrong bomb zone, or the value entered as 14C age instead of F14C or pMC	Check the zone and the unit on the Dates step
Results gone after reopening	Browser storage was cleared	Use Save project and Open project for permanent copies

6. Validation, citation and support

How DepthChron was checked

Test	Reference	Result
Calibration	CALIB 8.2 with IntCal20, SHCal20, Marine20 and mixed curves	Medians within 0–1 yr
Marine and post-bomb calibration	Heaton et al. (2023) Marine20 example; Hua et al. (2022) Bomb21 examples	Matching ranges
Bayesian model, standard example	MSB2K core in the rbacon package (Blaauw and Christen 2011)	Medians within 0.4–3.7 yr
Bayesian model, published records	23 Bacon chronologies from LegacyAge 1.0 (Li et al. 2022), same settings	Median difference about 16 yr per core, 4% of Bacon's 95% range; inside Bacon's 95% range on 22 of 23 cores

Test	Reference	Result
Coverage	36 simulated cores with known true ages	True age inside the 95% range at 100% of depths on clean cores

Citing DepthChron

Khan, A. (2026). DepthChron: age-depth modelling for mixed radiocarbon, luminescence and calendar ages, version 1.1.3 [Computer software]. Zenodo. https://doi.org/10.5281/zenodo.24493563 (all versions: https://doi.org/10.5281/zenodo.24424596)

Also cite the calibration curves and methods you used. The methods paragraph on the Export step lists them for your settings.

Key references

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Support

Questions and bug reports: twmglobals@gmail.com. Please attach your project file (Save project) so the problem can be reproduced.

DepthChron · TWM Global · Developed by an IIT alumnus and GATE UPSC qualifier.