



*COUNTMYVARVES*

*(CMV)*

*USER MANUAL*

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## WHO IS THIS DOCUMENT FOR?

Do you want to count the varves in a sediment core or high resolution outcrop photo? Do you need a sediment chronology or sedimentation rate record? If yes, this document is for you.

countMYvarves is intended to be easy to use, fully open source and free of any licensing burdens. It can be run through MATLAB, but can also be run without a MATLAB license as a standalone app (available for all standard operating systems). Running countMYvarves requires no coding, and this document provides a step by step guide for getting started - and how to do more complex work.

See the associated Van Wyk de Vries, Ito, Shapley and Brignone, 2020 paper in Quaternary Science Reviews for more examples, details and discussions.

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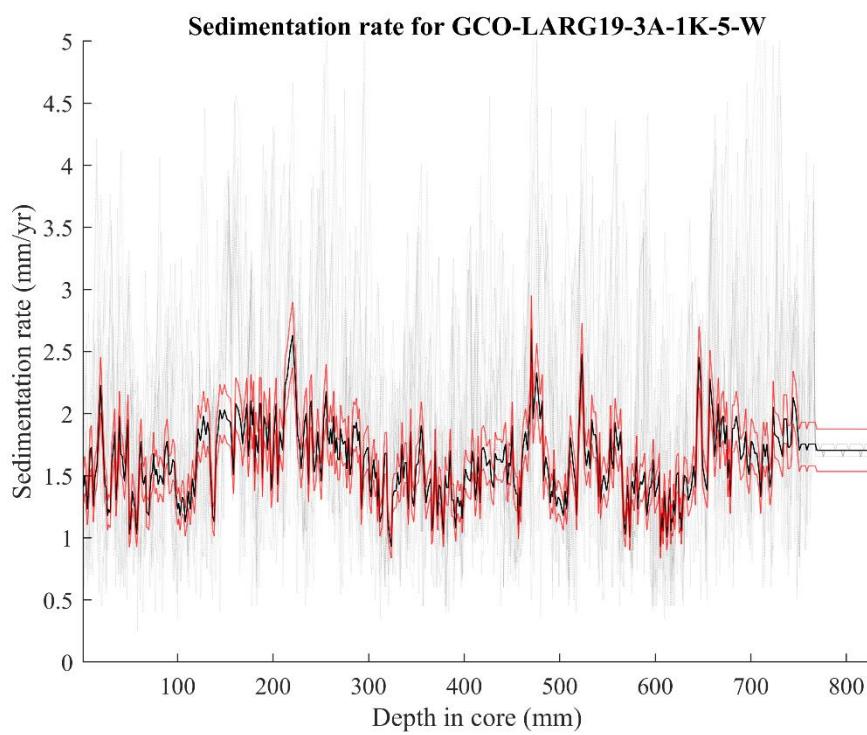
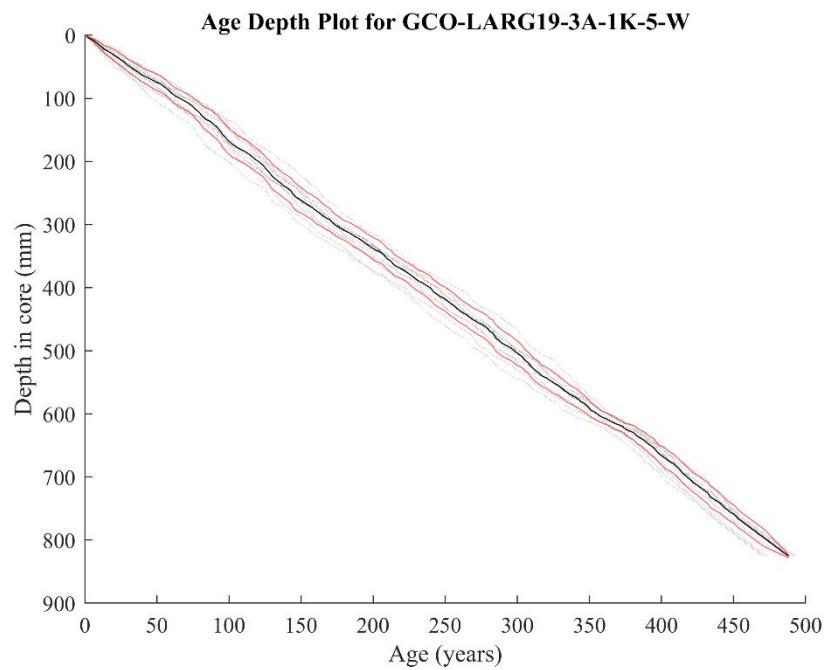
# 1 WHAT IS COUNTMYVARVES?

countMYvarves is a toolbox that enables the number of annual sediment layers or ‘varves’ to be counted. Varve counts may be desirable for a number of different purposes, including building age-depth models, dating events in the sediment record and reconstructing sedimentation rates. Manually counting varves is possible (and is recommended to complement model results where possible), however is time consuming and difficult to reproduce. countMYvarves aims to speed up this process, and automate the uncertainty quantification and not-taking portion of the process.

countMYvarves also includes a number of functions that help speed up analyses, including:

- Automatic pre-processing and noise reduction in images
  - Automatic detection of outlier varves
- Extrapolation over disrupted (‘un-countable’) portions of sediment, exclusion of instantaneously deposit sediment (e.g. tephras, landslides)
- Automatic generation of high quality plots, and easy to inspect data files (e.g. spreadsheet, pdf)

The two images on the following page show a sedimentation rate plot and age-depth model output from a countMYvarves run of a Patagonian lake core. The following sections describe the basic theory behind this toolbox, detailed instructions for getting started and a ready to run example.



# 2 BACKGROUND

If you are just reading this user manual to generate some quick varve counts, feel free to skip this section and move on to the step by step guide in section 3.

Image autocorrelation is an old signal processing technique which involves comparing one portion of an image to other portions of it. It is particularly useful for detecting periodicity in noisy signals, e.g. a sine wave obscured by random noise. Many varve sequences are of this type, with a quasi-periodic signal covered by other noise, imperfect preservation, etc. The autocorrelation process is able to detect periodicity and overcome noise where more traditional transect peak-counting techniques may fail.

The autocorrelation calculations in countMYvarves are performed using MATLAB's 2d correlation function corr2 and a custom sliding window script. Details about this function can be found here (<https://www.mathworks.com/help/images/ref/corr2.html>). A detailed description of the countMYvarves script is given in the associated Van Wyk de Vries, Ito, Shapley and Brignone, 2020 paper in Quaternary Science Reviews.

For some background on varves and varve counting itself, the following papers are good reads:

- “Zolitschka, B., Francus, P., Ojala, A. E., & Schimmelmann, A. (2015). Varves in lake sediments—a review. *Quaternary Science Reviews*, 117, 1-41.”

Very nice review describing the formation mechanism, appearance and diversity of varves.

- “Ojala, A. E. K., et al. "Characteristics of sedimentary varve chronologies—a review." *Quaternary Science Reviews* 43 (2012): 45-60.”  
Review paper describing the range of varve counting techniques applied, and their pros and cons.
- “Weber, M. E., et al. "BMPix and PEAK tools: New methods for automated laminae recognition and counting—Application to glacial varves from Antarctic marine sediment." *Geochemistry, Geophysics, Geosystems* 11.3 (2010).”  
Description of a ‘instensity transect analysis’ varve counting technique, and its application to counting varves in Antarctic sediment.
- “Ebert, Thomas, and Martin H. Trauth. "Semi-automated detection of annual laminae (varves) in lake sediments using a fuzzy logic algorithm." *Palaeogeography, Palaeoclimatology, Palaeoecology* 435 (2015): 272-282.”  
Description of ‘fuzzy logic’ based machine learning varve detection algorithm, and its use on maar lake sediments from Germany.
- “Fabijańska, Anna, Andrew Feder, and John Ridge. "DeepVarveNet: Automatic detection of glacial varves with deep neural networks." *Computers & Geosciences* (2020): 104584.”  
This paper describes convolutional neural network based varve counting code DeepVarveNet, and provides a good amount of detail about the advantages and limitations of such techniques.

# 3 GETTING STARTED: STEP BY STEP GUIDE (WITH IMAGES)

This portion of the guide aims to guide a new user through the process of running their first varve counting calculations and assumes no prior computing knowledge. We will run through the process of obtaining scans, then running countMYvarves and examining the main outputs.

In order to run countMYvarves you will need to have run the installer (different ones available for the different operating systems) and have matlab runtime installed. I recommend installing matlab runtime v2019a, this should work on older operating systems and still be recent enough to access all countMYvarves functionality. Download RUNTIME here:

<https://www.mathworks.com/products/compiler/matlab-runtime.html>.

## 3.1 Obtaining suitable imagery

There are many different methods for obtaining good core scans, and any of these may be used. Images should be in .jpg format and ideally should have a resolution such that varves are composed of at least 5-10 pixels. Imagery that is too high resolution (i.e. large scale varves, and unnecessarily computationally intensive) may be resampled within the countMYvarves interface.

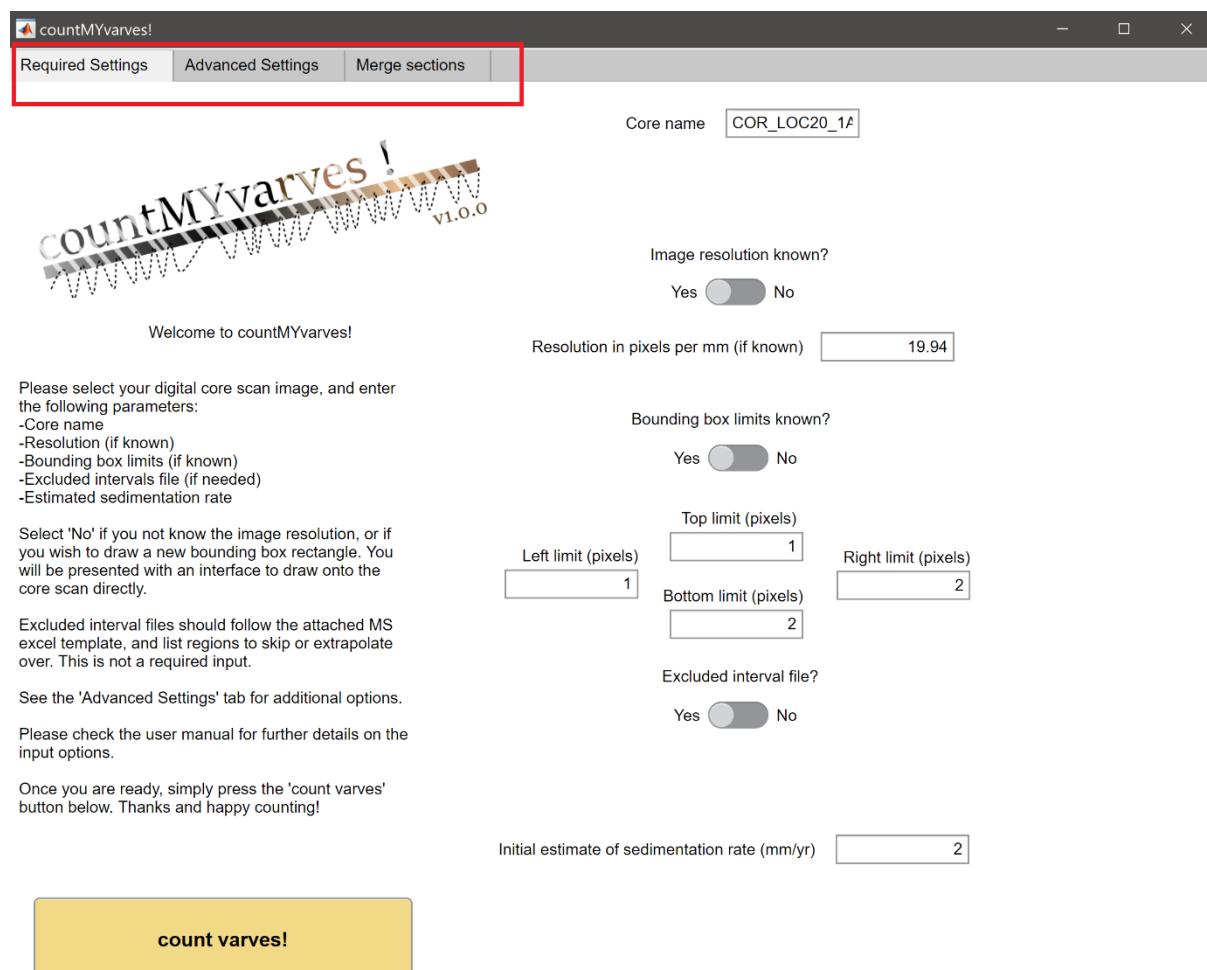


Due to the nature of the autocorrelation algorithm, results will be best when the image is evenly lit (as differences in lighting may reduce the ‘similarity’ between varves). If the images represent core scans, then this will not be an issue as scans are performed in a well constrained environment. If you are using field photos however, ensure that they are taken at a time of day with even illumination (e.g. midday or on a clouded day) and from the same angle to the sediment face to minimize lighting differences.

## 3.2 Running countMYvarves

(Note that a full description of all input parameters is given in section 4.)

Once you have run the countMYvarves installer, you can click on the app icon, which should open up the following user interface.





Some basic instruction are given for the input boxes, note the three tabs in the top left of the interface. For a basic run you will likely only need the first ('Required Settings') tab, although it is worth having a glance through the advanced settings. The 'Merge sections' tab is for combining the chronologies from multiple images, and is described in section 3.3.

Begin your countMYvarves run by entering a name for this model run. The results will be saved in the same folder as the image itself, in a 'Results' folder. This results folder will contain the results of all runs on images in the original folder, including multiple runs on the same image. Make sure you change the name while performing multiple runs, as countMYvarves will overwrite files with the same name.

**countMYvarves!**

Required Settings   Advanced Settings   Merge sections

Core name   

Image resolution known?  
 Yes  No

Welcome to countMYvarves!

Please select your digital core scan image, and enter the following parameters:

- Core name
- Resolution (if known)
- Bounding box limits (if known)
- Excluded intervals file (if needed)
- Estimated sedimentation rate

Select 'No' if you not know the image resolution, or if you wish to draw a new bounding box rectangle. You will be presented with an interface to draw onto the core scan directly.

Excluded interval files should follow the attached MS excel template, and list regions to skip or extrapolate over. This is not a required input.

See the 'Advanced Settings' tab for additional options.

Please check the user manual for further details on the input options.

Once you are ready, simply press the 'count varves' button below. Thanks and happy counting!

Resolution in pixels per mm (if known)

Bounding box limits known?  
 Yes  No

Left limit (pixels) <input type="text" value="1"/>	Top limit (pixels) <input type="text" value="1"/>	Right limit (pixels) <input type="text" value="2"/>
Bottom limit (pixels) <input type="text" value="2"/>		

Excluded interval file?  
 Yes  No

Initial estimate of sedimentation rate (mm/yr)

**count varves!**



Next check whether you know the resolution of your images (in pixels per mm) or not. Most scanners will have a standard resolution of e.g. 10 or 20 pixels per mm or something close to that.

If you know your resolution, leave the slider on ‘Yes’ and write in your resolution value in the box below. If you do not know it, move the slider to ‘No’ and ignore the value in the box below. You will be prompted to draw a box on the core image to determine the resolution after starting the model run.

**countMYvarves!**

Required Settings   Advanced Settings   Merge sections

Core name

Welcome to countMYvarves!

Please select your digital core scan image, and enter the following parameters:

- Core name
- Resolution (if known)
- Bounding box limits (if known)
- Excluded intervals file (if needed)
- Estimated sedimentation rate

Select 'No' if you not know the image resolution, or if you wish to draw a new bounding box rectangle. You will be presented with an interface to draw onto the core scan directly.

Excluded interval files should follow the attached MS excel template, and list regions to skip or extrapolate over. This is not a required input.

See the 'Advanced Settings' tab for additional options.

Please check the user manual for further details on the input options.

Once you are ready, simply press the 'count varves' button below. Thanks and happy counting!

Image resolution known?  
 Yes  No

Resolution in pixels per mm (if known)

Bounding box limits known?  
 Yes  No

Left limit (pixels)	<input type="text" value="1"/>	Top limit (pixels)	<input type="text" value="1"/>
Bottom limit (pixels)	<input type="text" value="2"/>	Right limit (pixels)	<input type="text" value="2"/>

Excluded interval file?  
 Yes  No

Initial estimate of sedimentation rate (mm/yr)

**count varves!**



Similar to the image resolution, check whether you know the four pixel limits of the area on the core scan for which you wish to count varves. These may be found in most basic image editing programs, e.g. MS Paint.

If you know these values, please enter them in the boxes provided. If not, move the slider over to 'No' and ignore the values. You will get the opportunity to manually draw a box onto the core image.

**countMYvarves!**

Required Settings   Advanced Settings   Merge sections

Core name

Image resolution known?  
 Yes  No

Welcome to countMYvarves!

Resolution in pixels per mm (if known)

Please select your digital core scan image, and enter the following parameters:

- Core name
- Resolution (if known)
- Bounding box limits (if known)
- Excluded intervals file (if needed)
- Estimated sedimentation rate

Select 'No' if you not know the image resolution, or if you wish to draw a new bounding box rectangle. You will be presented with an interface to draw onto the core scan directly.

Excluded interval files should follow the attached MS excel template, and list regions to skip or extrapolate over. This is not a required input.

See the 'Advanced Settings' tab for additional options.

Please check the user manual for further details on the input options.

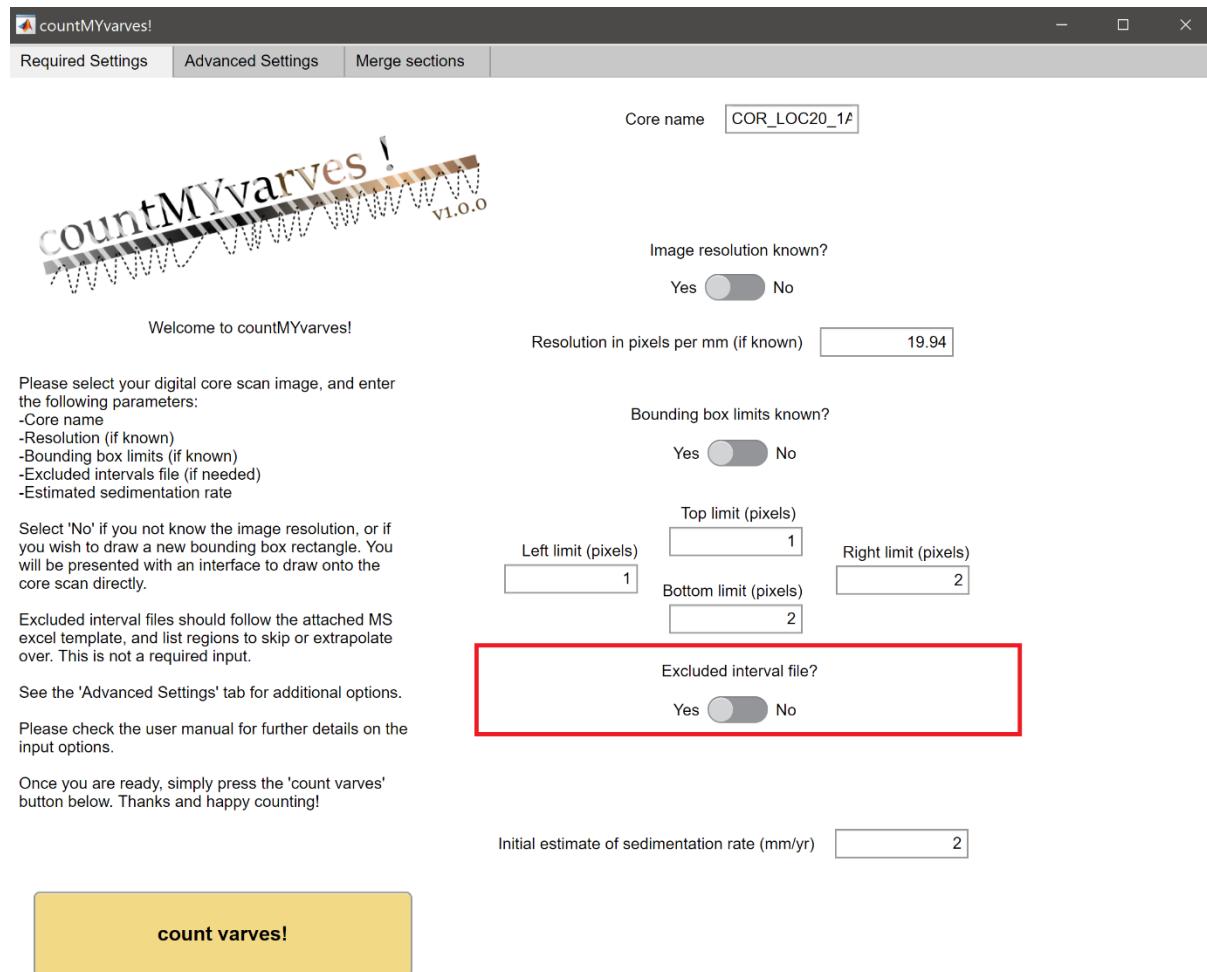
Once you are ready, simply press the 'count varves' button below. Thanks and happy counting!

Initial estimate of sedimentation rate (mm/yr)

**count varves!**



Next select whether you need an excluded interval file for this run or not. In this file you will be able to enter zones to skip (e.g. core top, tephra layer) or extrapolate over (disrupted sediment). A template file is provided, you may edit and rename this for your own runs.



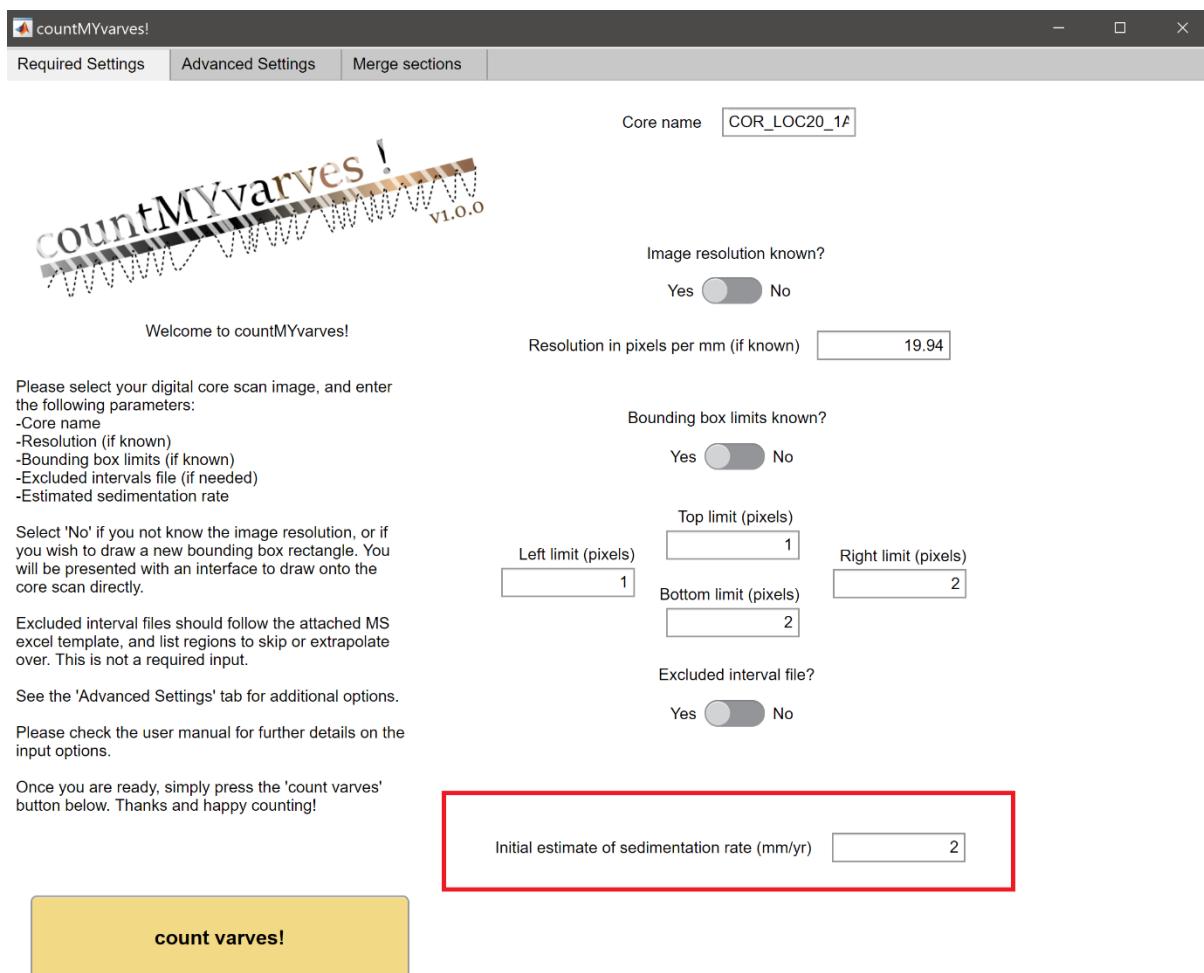
Here is an example excluded interval Excel spreadsheet.

A	B	C	D
Enter portions of the core that will not be included in the varve counting into this spreadsheet. The code will automatically overwrite this portion according to one of two conditions:			
1 will extrapolate varves across interval with the same mean thickness as the surrounding area (e.g. disrupted sediment, etc)			
2 will exclude the area in question from varve counting (e.g. tephras, avalanche deposits, other immediately deposited units that represent no time passage)			
Lower bound of interval (mm). -1 for first pixel in image.	Upper bound of interval (mm) -2 for last pixel in image	Overwrite condition (e.g 1 or 2)	Notes
-1	71.1	71.1	2 Zorbitrol
71.1	91.3	91.3	1 Disturbed portion at top of core
397	408	408	1 Disrupted base
408	-2	-2	2 Zorbitrol

There are 4 main columns: the first two define the start and end of the interval in question (enter -1 to default to first pixel of the core and -2 to default to last pixel), the third column defines the overwrite condition (1 for extrapolate, 2 for exclude/skip) and a fourth column for

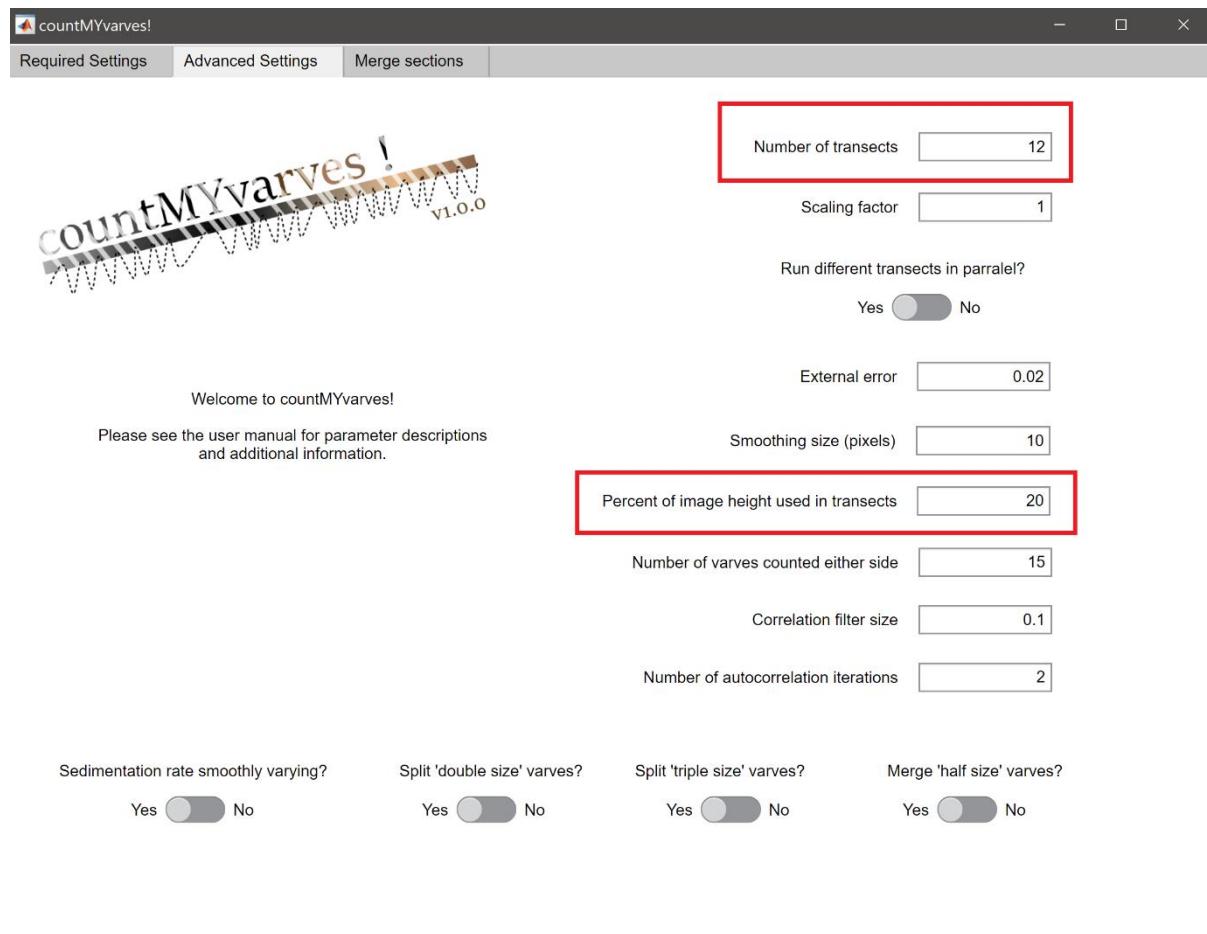
some notes justifying the exclusion or extrapolation. The full spreadsheet (including notes) is written to the automatically generated lab report for future scrutiny and easy reproducibility.

Next, enter an initial estimate of sedimentation rate. This value is used to filter the raw image in preprocessing, smooth out noise and ‘seed’ the autocorrelation before the first varve has been detected. The results are slightly dependent on this value, so I would recommend counting ~5-10 varves and measuring them to get a decent value. Variations within ~50% of the real value should not bias the results very much, large variations will be flagged in the outputs (and you may want to repeat the run with a better value).



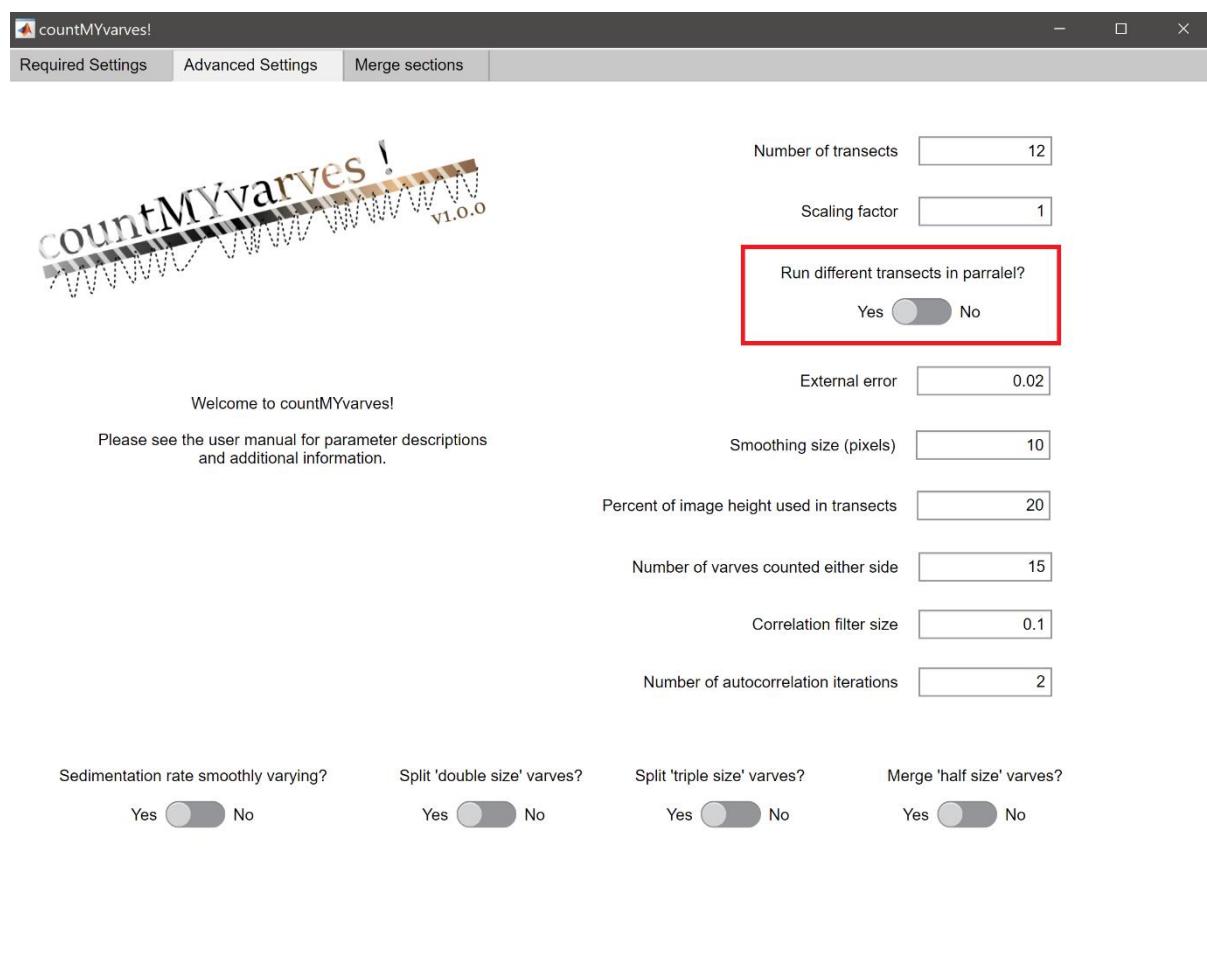
You are now nearly ready to set you run going! We will just quickly check through some relevant ‘Advanced options’ that you may in some situations wish to tweak. Note that section 4 runs through these inputs in more detail.

First, you may tweak the number of transects and the percentage of image height used in each transect. Multiple transects are independently ‘varve counted’, with the results of these used to determine both a median and uncertainty in age and sedimentation rate. By increasing the number of transects and decreasing the percentage of image height used in transects (e.g. to 24 and 10% respectively) you will get more independent estimates and possibly fuller account of uncertainty. For quicker runs you may also reduce them (e.g. to 6 and 33% respectively) to save time. The default will be suitable in most cases.





You may also toggle parallel computing on or off here. In most cases you will want to leave this on as runs will be completed 2 to 3 times faster (depending on the number of cores in your machine), however it will also be computationally intensive. If you wish countMYvarves to run in the background more slowly, but using less computational resources then you may toggle this to ‘No’. I would recommend this if you wish to 1) be running other codes at the same time as running countMYvarves or 2) are likely to be in video calls while countMYvarves is running. Otherwise leave this on ‘Yes’, it will save you some time!





Finally, you may decide which assumptions about the sedimentation style are valid in this core. If you leave all of these on ‘Yes’, countMYvarves will detect (apparent) erroneous values and correct them based on surrounding varves. For instance a varve that is an outlier and close to double the local median would be considered a mis-count and split into two. This will not be valid for all sediment styles, so may be toggled off. Note that more ‘noise’ will persist if these are turned off, as not all varves can always be detected perfectly.

**countMYvarves!**

Required Settings   Advanced Settings   Merge sections

Welcome to countMYvarves!  
Please see the user manual for parameter descriptions and additional information.

Number of transects	<input type="text" value="12"/>		
Scaling factor	<input type="text" value="1"/>		
Run different transects in parallel?			
Yes	<input checked="" type="radio"/>	No	
External error	<input type="text" value="0.02"/>		
Smoothing size (pixels)	<input type="text" value="10"/>		
Percent of image height used in transects	<input type="text" value="20"/>		
Number of varves counted either side	<input type="text" value="15"/>		
Correlation filter size	<input type="text" value="0.1"/>		
Number of autocorrelation iterations	<input type="text" value="2"/>		
Sedimentation rate smoothly varying?	Split 'double size' varves?	Split 'triple size' varves?	Merge 'half size' varves?
Yes <input checked="" type="radio"/> No	Yes <input checked="" type="radio"/> No	Yes <input checked="" type="radio"/> No	Yes <input checked="" type="radio"/> No



We are now ready to start the varve count for this core! Click on the large yellow button in the bottom left of the ‘Required setting’ tab to start the process.

**countMYvarves!**

Required Settings   Advanced Settings   Merge sections

Core name: COR\_LOC20\_1A

Welcome to countMYvarves!

Please select your digital core scan image, and enter the following parameters:

- Core name
- Resolution (if known)
- Bounding box limits (if known)
- Excluded intervals file (if needed)
- Estimated sedimentation rate

Select 'No' if you not know the image resolution, or if you wish to draw a new bounding box rectangle. You will be presented with an interface to draw onto the core scan directly.

Excluded interval files should follow the attached MS excel template, and list regions to skip or extrapolate over. This is not a required input.

See the 'Advanced Settings' tab for additional options.

Please check the user manual for further details on the input options.

Once you are ready, simply press the 'count varves' button below. Thanks and happy counting!

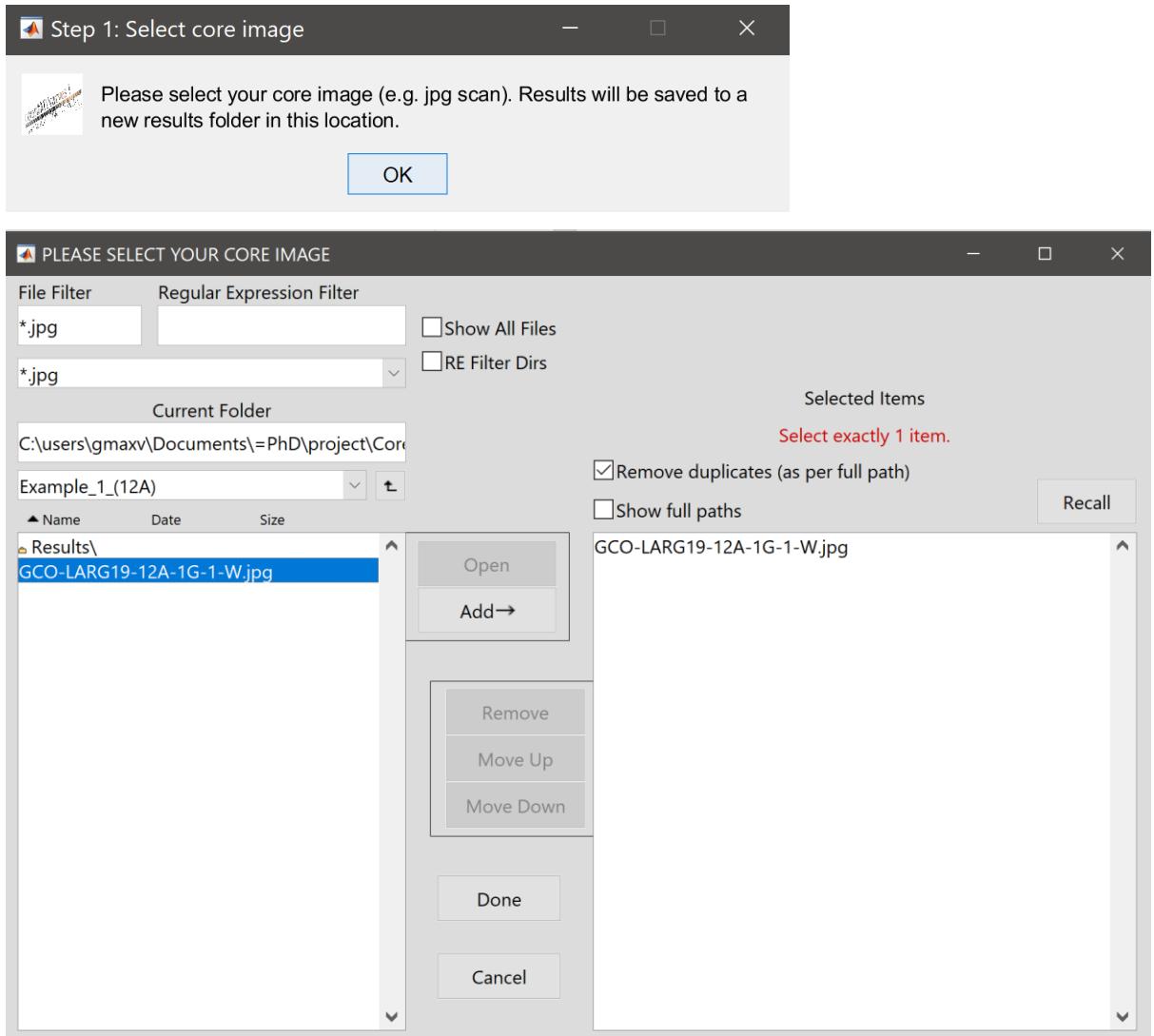
Initial estimate of sedimentation rate (mm/yr): 2

count varves!

Depending on your choices you will now have a series of different diaolox boxes open. They have some brief instructions associated with them:

- 1) Select core image file

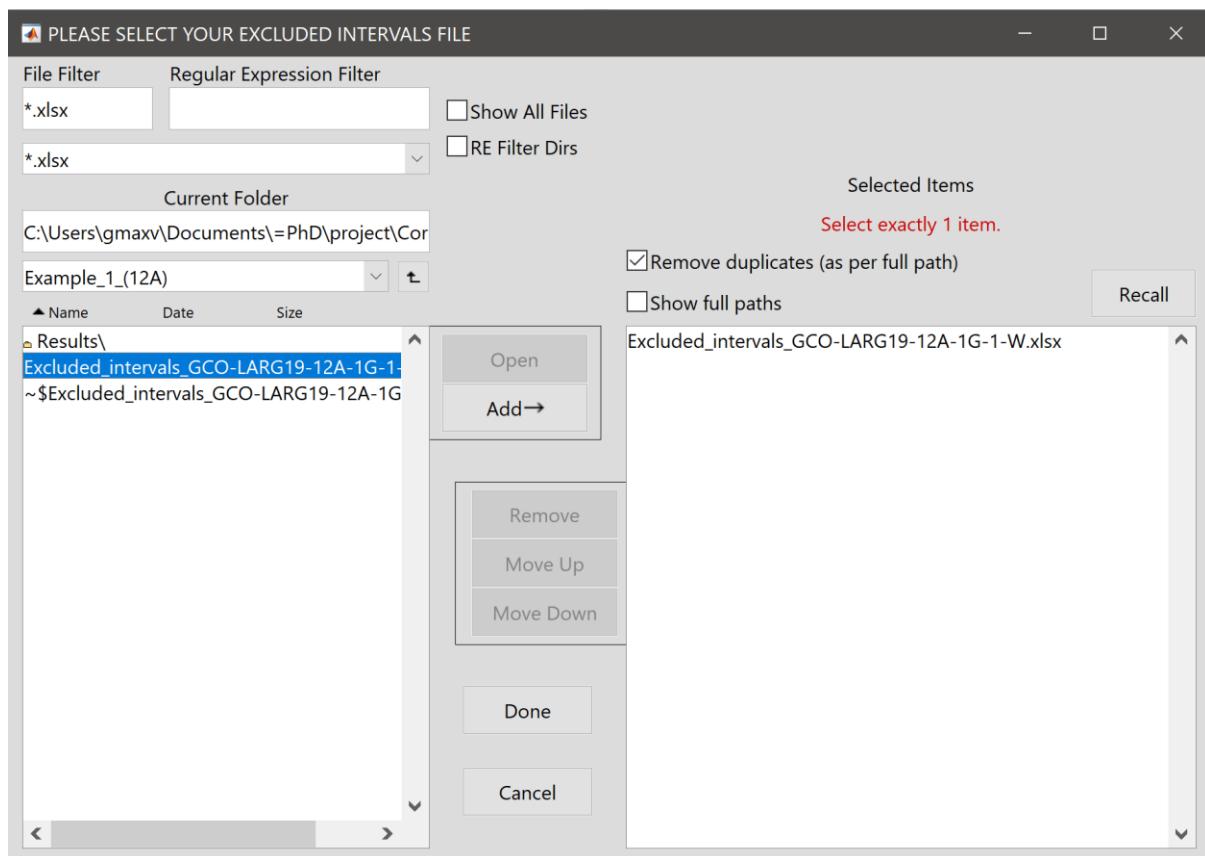
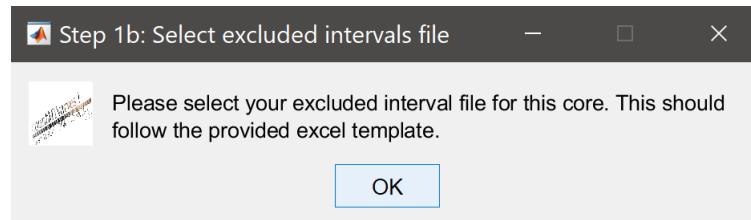
This should be a .jpg file of the varves which you wish to count. Note that the results folder will be created in the same location as this file.



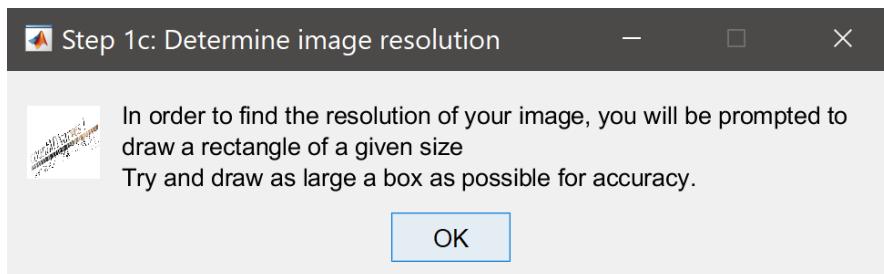
Select the file. Note that the core selection dialog may begin at your root directory (e.g. C: or \$root) and you will need to navigate to your user files.

## 2) (Optional) Select excluded interval file

This dialogue will only appear if you selected ‘Yes’ on the excluded interval slider.



### 3) (Optional) Determine image resolution



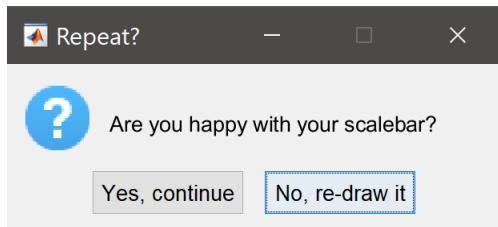
Now enter the size of the box you are going to draw in the next step (e.g. enter 200 for a 20 cm box).



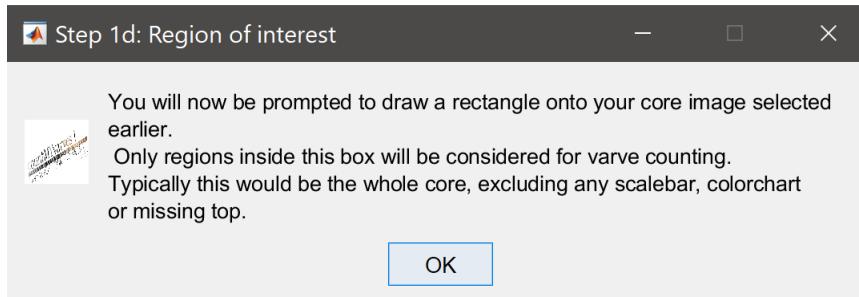
Now draw the box. The height of the box does not matter, only the width is counted. This is easiest if you have a scale-bar built into your image, but if you know the total length of your core in cm you may use that as well.



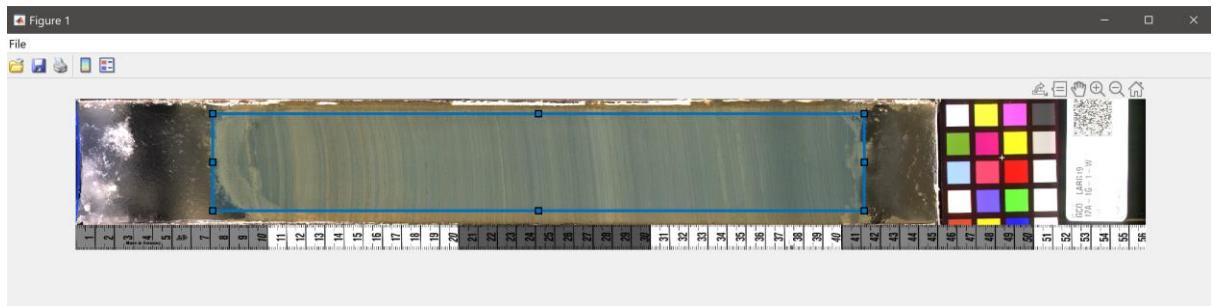
Finally, you will get a chance to re-draw the box if it did not quite fit where you wanted. Select 'Yes, continue' if the box looked OK.



#### 4) (Optional) Draw bounding box limits

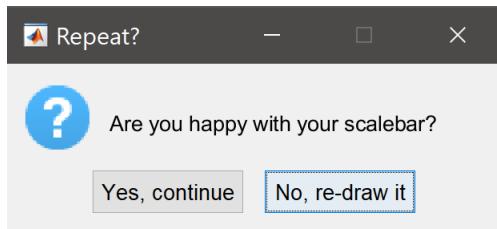


Now you will get to draw a similar rectangle to the ‘image resolution’ step. However you will want to watch both the height and width of the rectangle here. Make sure you draw it in a way that takes into account all of the sediment you wish to count varves in:

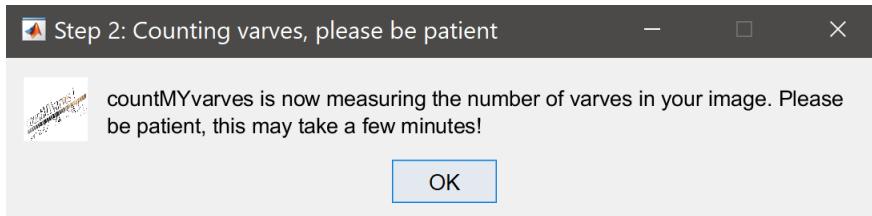


In this case I am excluding the non-sediment portions of this core image, as well as the upper and lower ~10% of the image as the layers are disrupted in this zone during coring and core processing. You may draw the box in any part of the image, and the end zones may be excluded through the ‘excluded interval’ file as well as via this method.

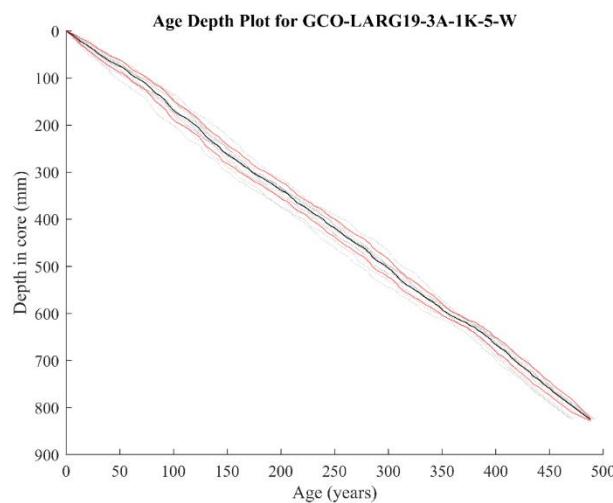
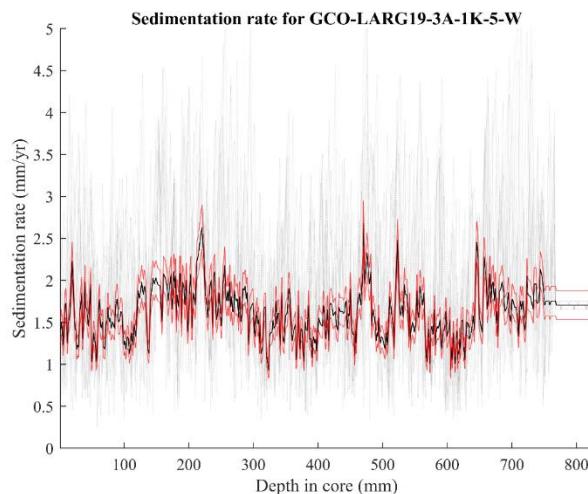
Again, you will get the chance to re-draw the box if you are not sure about it. Click ‘Yes, continue’ and the varve counting will begin.



You will now get this dialog box informing you that the main model is running:



You will get a final pop-up dialog showing when the model is finished. You can find the results of this run in <Image folder>/Results/<Name you entered>/. Among others, you should have sedimentation rate and age-depth model plots, a .csv spreadsheet with the raw data and an automatically generated lab report.

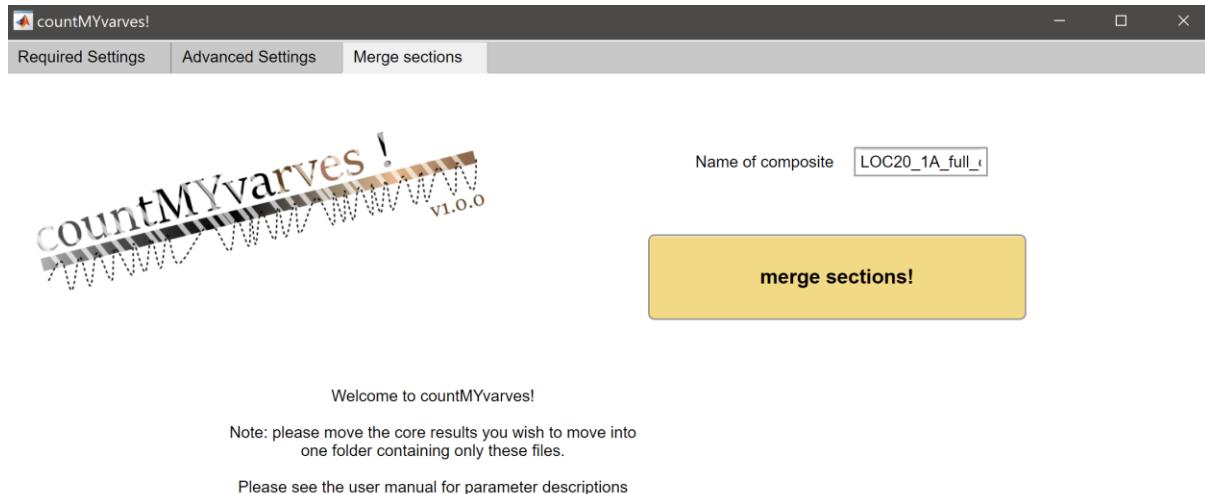




### 3.3 Merging multiple sections/images into one

In some cases you will wish to merge multiple varve counting results into one, where a core has been scanned in multiple sections or an outcrop photographed in multiple parts. This can be done with countMYvarves using the third, ‘Merge sections’ tab.

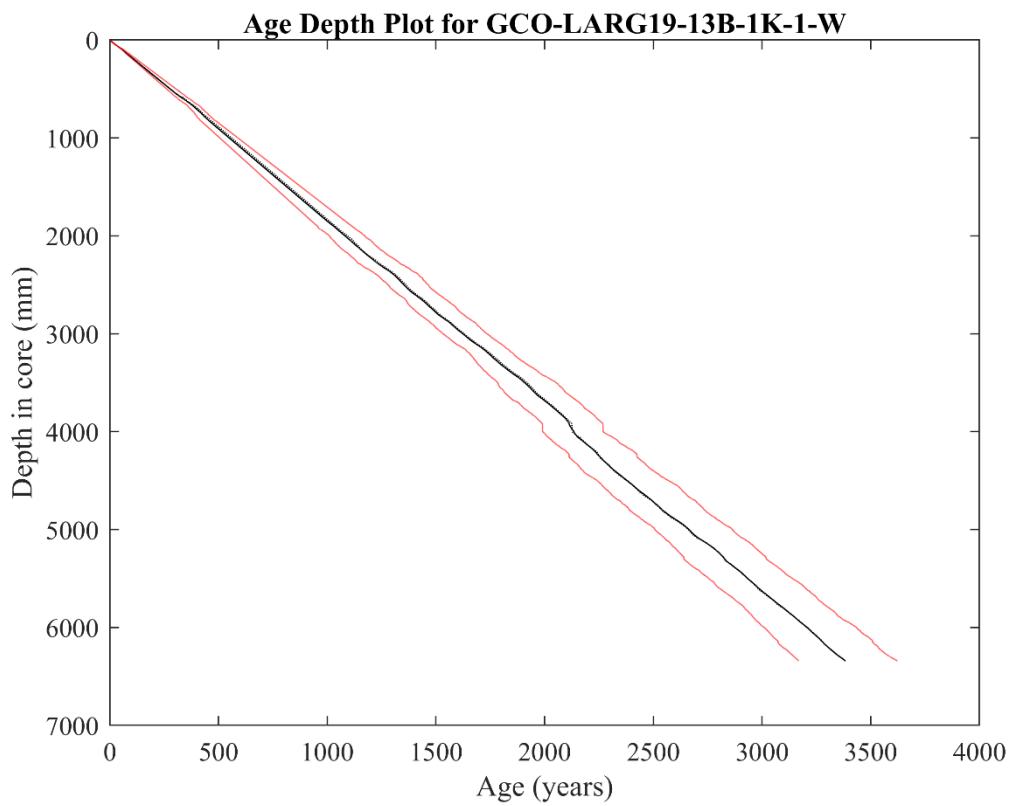
First, begin by following the steps in 3.2 to run each individual section. Then move these sections to a new folder containing only the results folders for each section. countMYvarves will read the folder names, thus having any additional folders or files in this location may cause it to fail.



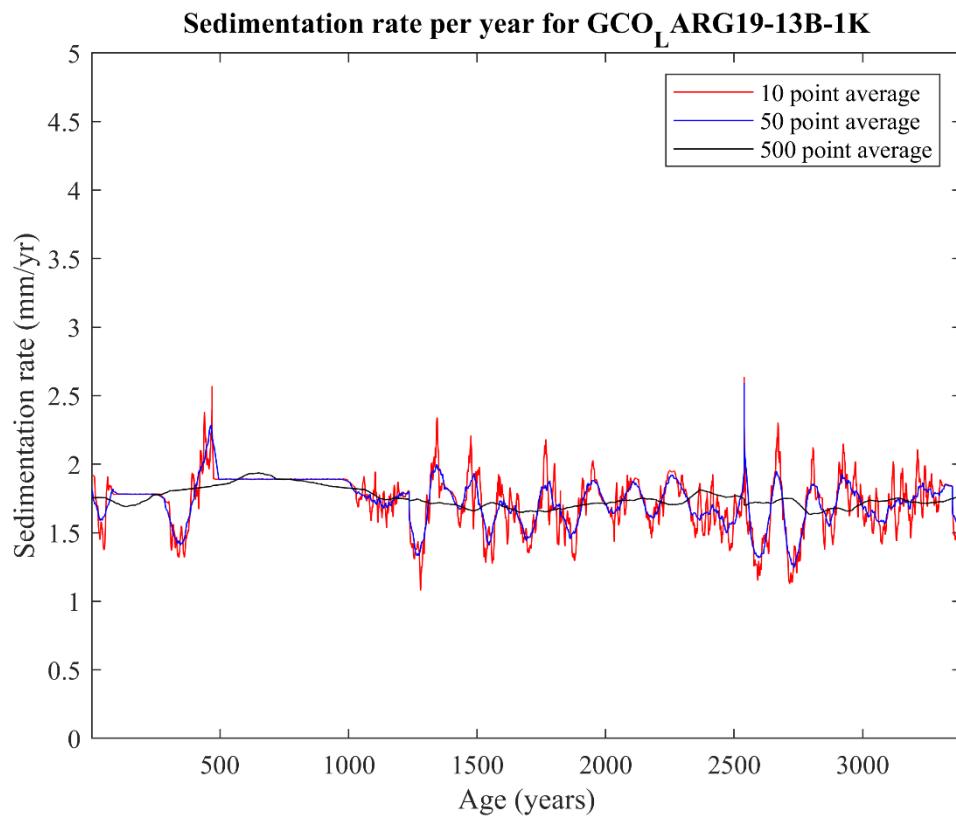
Simply enter a name for the composite, and press the ‘merge sections!’ button. You will be prompted to select the folder containing your results to merge, and they should be merged (with some new plots) in a few seconds.

You should find a merged age-depth model, a number of smoothed and unsmoothed sedimentation rate plots and a .csv with your raw merged data for further processing and analysis.

Example merged age-depth model:

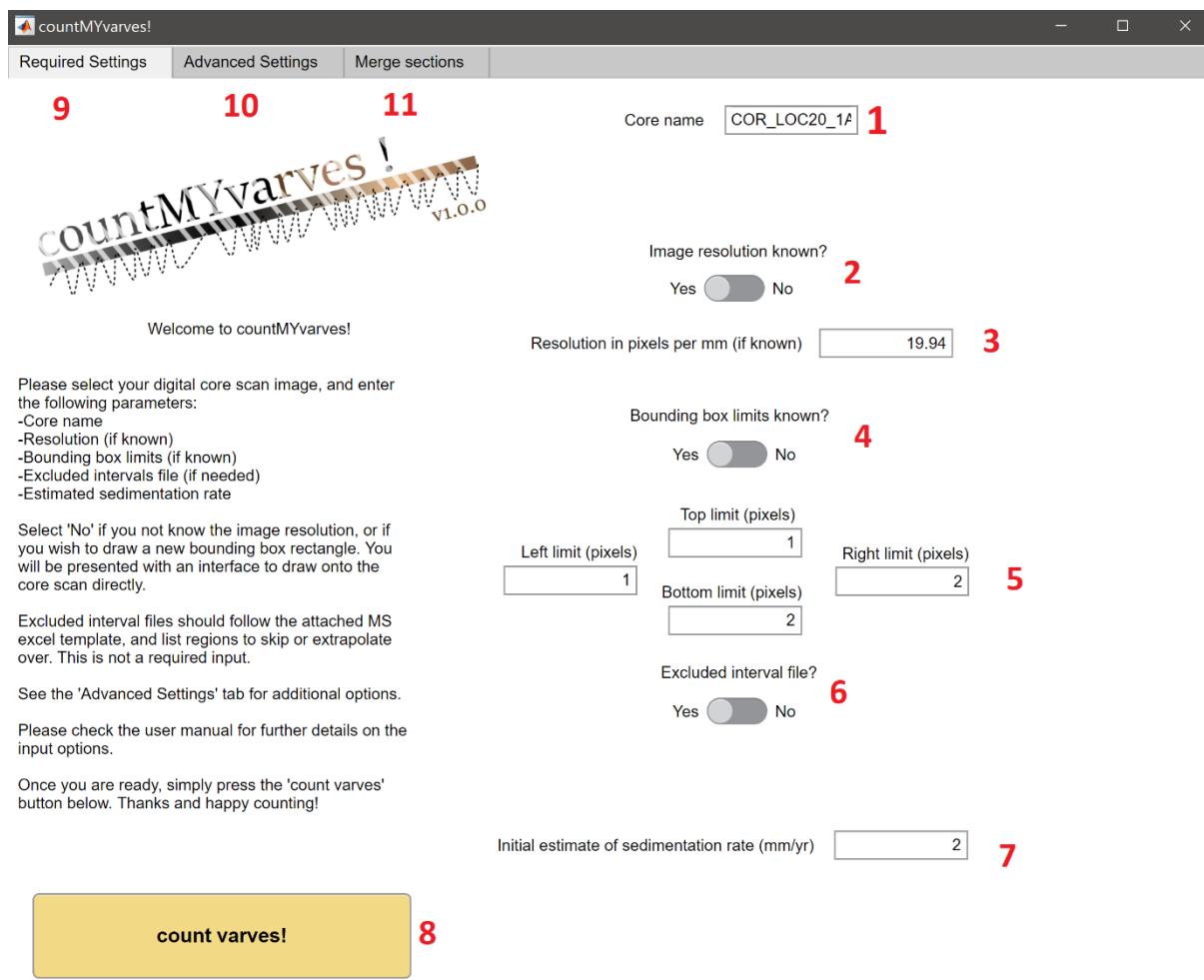


Example merged sedimentation rate vs time plot, including 10, 50 and 500 year moving mean revealing different patterns.



# 4 INPUT PARAMETERS

This section will run through the details of each input parameter in the GUI:



## 1 Core Name

This is the name of the run for one particular core scan or sediment image. If doing repeated runs on the same image make sure to change the name or the old run will be overwritten.

## 2 Image resolution known or not

Select ‘Yes’ if you know the resolution in pixels per mm of the .jpg image that you are using, and ‘No’ if you do not. If you select ‘No’ then the following box (3) can be ignored, and you will be prompted to draw a box of a certain size on the image prior to starting the run.

## 3 Resolution

If you do know the resolution, please enter it here (in pixels per millimetre).

## 4 Bounding box limits known or not

Select ‘Yes’ if you know the bounding box limits for your run (in pixels) of the .jpg image that you are using, and ‘No’ if you do not. If you select ‘No’ then the following boxes (5) can be ignored, and you will be prompted to draw a new bounding box on the image prior to starting the run.

## 5 Bounding limits

If you do know the bounding limits of your run (in pixels), they can be entered here. Pixel values can be found in many basic text editors, such as MS Paint and macOS equivalents.

## 6 Excluded interval file

Select ‘Yes’ if you are using an excluded interval file for this run, and ‘No’ if you are not. If you select ‘Yes’ then you will be prompted to select an excluded interval file prior to starting the run. A template excluded interval file is available and can be edited to work for any image.

## **7** Initial estimate of sedimentation rate

This value is used to filter the raw image in preprocessing, smooth out noise and ‘seed’ the autocorrelation before the first varve has been detected. The results are slightly dependent on this value, so I would recommend counting ~5-10 varves and measuring them to get a decent value. Variations within ~50% of the real value should not bias the results very much, large variations will be flagged in the outputs (and you may want to repeat the run with a better value).

## **8** count varves! button

This button will initiate your varve counting run. Press when you have adjusted all of your settings!

## **9** Required settings tab

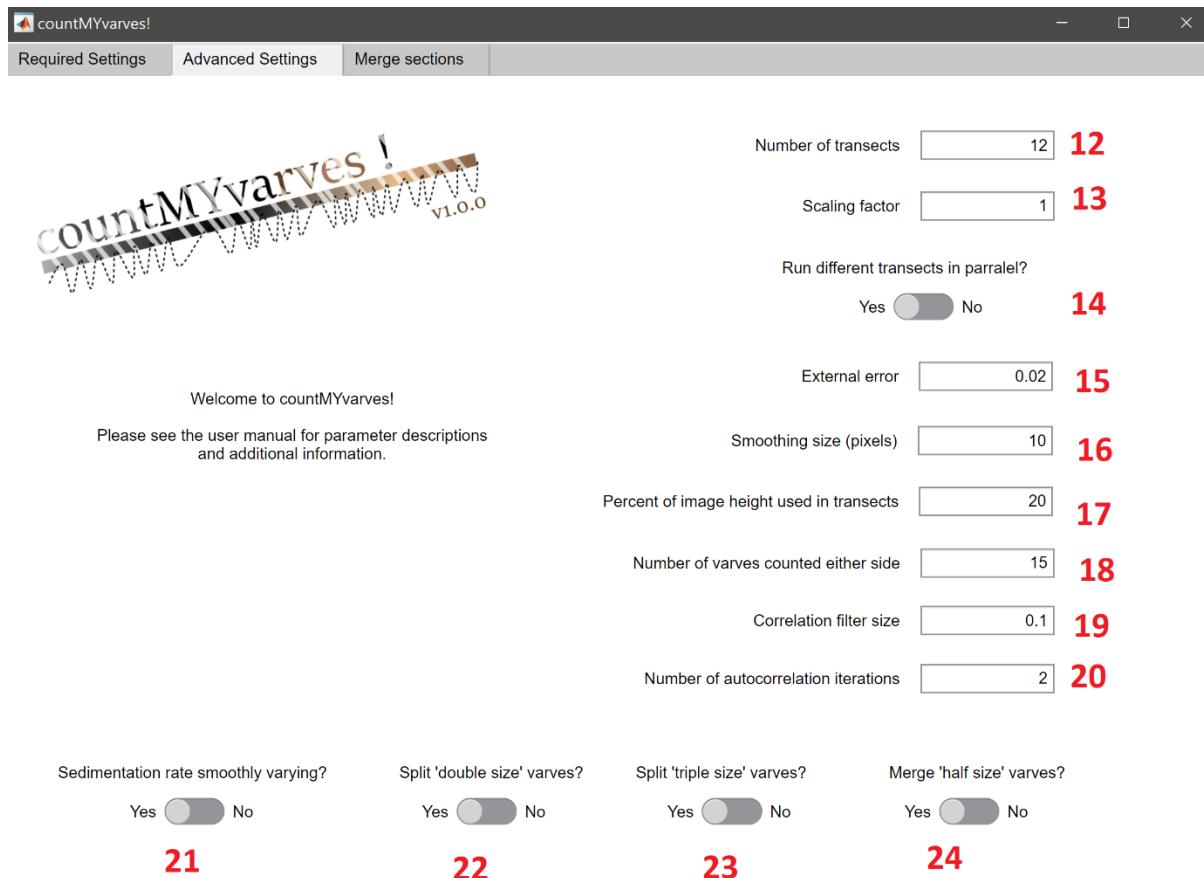
This tab defines the inputs that must be entered in order for countMYvarves to successfully run.

## **10** Advanced settings tab

Advanced model options. These may be left at the defaults in most cases, but adjusting them may result in better results.

## **11** Merge sections tab

This tab allows you to merge the results of several sections into a composite. Run all of the individual sections first.



## 12 Number of transects

This option allows you to adjust the number of horizontal transects along which varves are counted. The variation in results between transects allows the uncertainty to be quantified within a run. Minimum recommended: 4. Separate transects are run in parallel (see option 14), so setting this to a multiple of the number of cores on your machine will typically be the most efficient (e.g. 12 or 24 will be suitable for most machines).

## 13 Scaling factor

This option allows images to be resampled to reduced computational time for very large (thick) varves. If you have more than ~50-100 pixels per varve, consider resampling the image to a lower resolution. This will not reduce performance, and will considerably reduce

computational expense. Setting this value to 2 will reduce the resolution of the image by 50% (2 pixels resampled to one), setting this to 3 will resample the image to 33% and so on. This number need not be an integer, you may for example set it to 1.3 if 2 results in too low resolution. This option is generally a good idea in any high-resolution scan with multi-cm scale varves.

## **14** Run transects in parallel

You may choose to turn parallel computing on or off here. MATLAB's parallel computing toolbox is compiled into countMYvarves, so you will not need to deal with any additional licenses to be able to benefit from parallel computing.

You may turn this off if you are likely to be conducting other computationally intensive tasks while countMYvarves is running. Runs will typically be around 2-3 (for machines with 2-4 cores) to 3-5 (with 6-12 cores) times faster when run in parallel than in serial.

## **15** External error

Enter what level of external error you think is reasonable for your core. The default is 2%. This error will be propagated into the uncertainty bounds of any age-depth models calculated. This uncertainty is in addition to the variation between the multi-transect counts.

## **16** Smoothing size

Initial smoothing size of the image to reduce ‘speckles’ and outlier pixels. 10 pixels is typically suitable.

## **17** Percent of image height used in transect

Scale of each transect as a percentage of the core image within the bounding box or user defined pixel limits. The larger this is, the thicker the 2D stip varves are counted along. This should typically be at least a few tens of pixels wide to ensure best results from 2D autocorrelation. If you increase the number of transects run in parallel you may consider reducing this (e.g. to 10%) so that overlap is not excessive.

## **18** Number of varves counted on either side

The number of ‘varves’ on either side of the reference chip that are taken to form the search chip. 15 is usually a good value, ensuring sufficient correlation coefficients at each value to remove outliers yet not introducing too much noise through comparing distant varves.

## **19** Correlation filter size

The 1-D correlation coefficient is filtered with a moving mean filter in order to reduce any high frequency noise. The size of the moving mean filter is (Correlation filter size) x (Estimated varve thickness), so a value of 0.1 is a filter 10% of the size of mean sedimentation rate. This value should not be raised too high, or over-smoothing may occur.

## **20** Autocorrelation iteration

An iterative comparison between the estimated and calculated sedimentation rate (‘varve thickness’) is run in order to reduce the possibility of over smoothing. Typically two iterations are sufficient.

## **21** Smoothly varying sedimentation rate

This option defines whether outlier detection filters are used. If sedimentation rate is not smoothly varying, outlier varves cannot be detected and replaced.

## **22** Split double size varves

If on yes, varves that are within 25% of double the local (10 year) mean varve thickness will be split into two (i.e. a varve boundary will be introduced at the mid-point between the two ends).

## **23** Split triple size varves

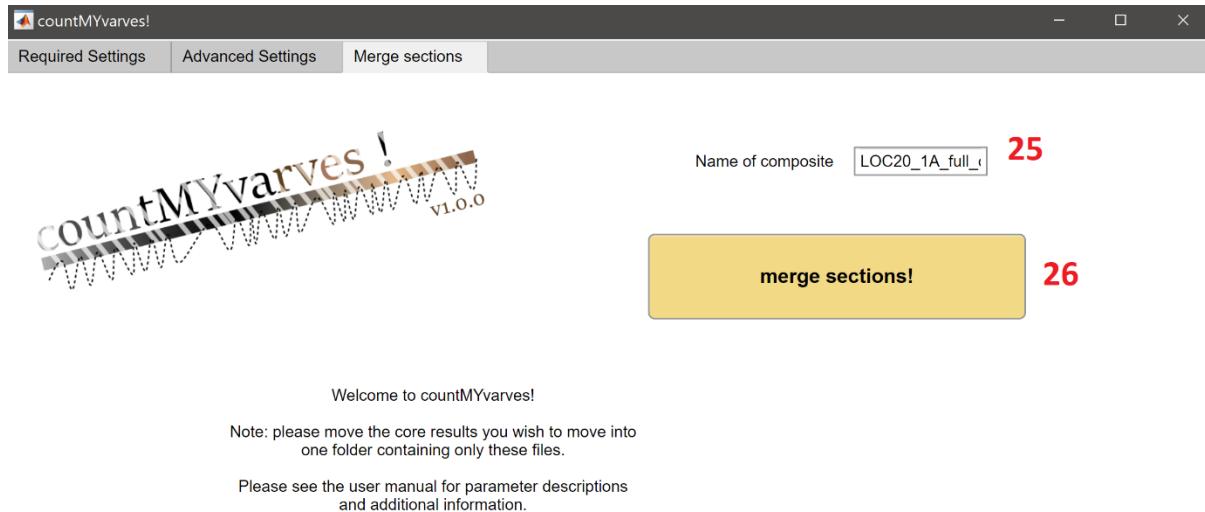
If on yes, varves that are within 25% of triple the local (10 year) mean varve thickness will be split into three (i.e. two varve boundary will be introduced at the third and two-thirds points between the two ends).

## **24** Merge half size varves

If on yes, subsequent varves whose thicknesses are both less than 25% of the local (10 year) mean varve thickness but whose summed thickness is within this range will be merged into a single varve (i.e. the boundary between the two will be deleted).

## **24** Date options: Maximum day

Last day searched for in the image timeseries. If correctly labelled in YYYYMMDD format this will be automatically extracted from the file name. Default is 31 (i.e. all images counted).



## 25 Merge sections : name

Enter a name for your merged sections to be named as.

## 26 Merge sections : run merging

Click on this button to initiate the merging procedure. This will initially open a file selection dialog for you to locate the folders to merge.

# 5 EXAMPLE: LAGO ARGENTINO

## CORE 12A

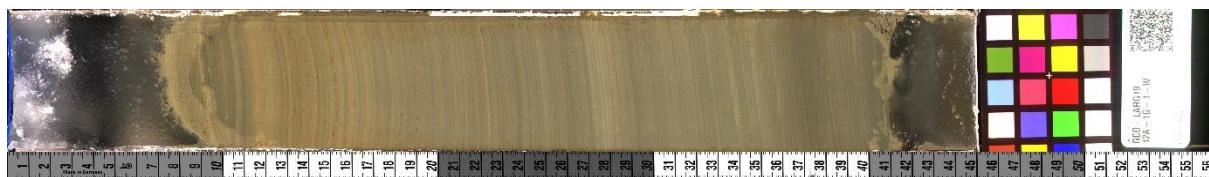
Lago Argentino is a large proglacial lake in Southern Patagonia. This lake was cored in S Winter 2019 as part of NSF project GUANACO, with the aim of reconstructing the history of glacier and solid-Earth changes in the region.

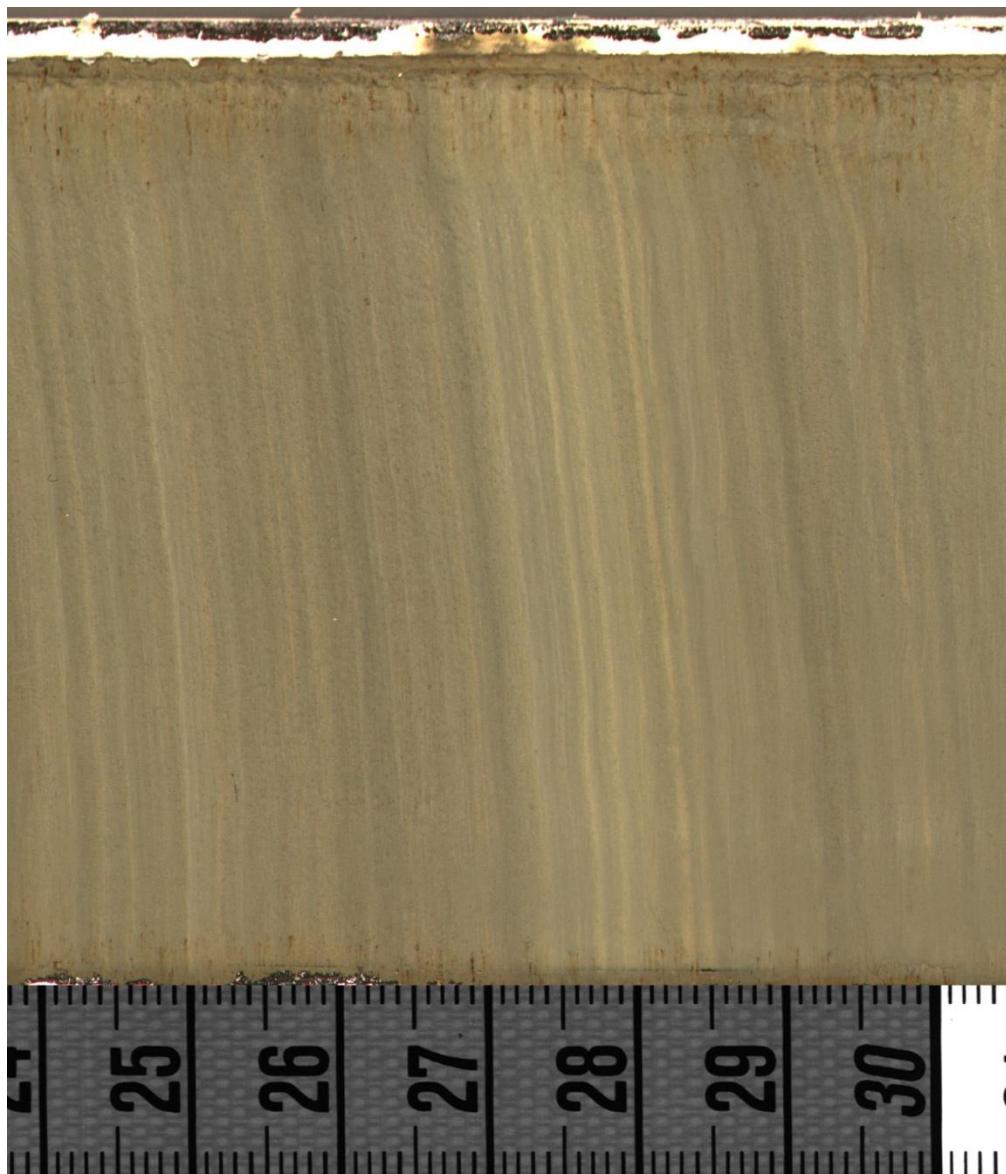


The sediment within this lake is mostly composed of alternating dark-light laminations which we interpret as annual (varves). Core 12A is a gravity core collected from the main basin of the lake (see red star), and is composed entirely of laminated deposits.



The high resolution core scan image (see below) and a pre-filled excluded interval file are provided in the supplementary material. Follow the step by step instructions in section 3 to count the varves on this core, and feel free to tweak the input parameters to see their effect.





You should get results similar to these figures:

