
IMBIE

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CONTENTS:

1	Installation Guide	3
1.1	Creating a conda environment (optional)	3
1.2	Installing dependencies	3
1.3	Installing the processor	3
2	Configuration Options	5
3	Executing the processor	9
4	Error Codes	11
5	Example Configuration	13
6	Downloads	15
7	API	17
8	Indices and tables	19

Welcome to the software documentation for the IMBIE processor. The software is from the [project repository](#).

Information on how to install the processor can be found in the *[Installation Guide](#)*.

Details of the configuration file format and how to create an IMBIE configuration file can be found under *[Configuration Options](#)*

INSTALLATION GUIDE

1.1 Creating a conda environment (optional)

If you are using conda, you may wish to create a new environment for the imbie processor, e.g:

```
$ conda create --name imbie
```

you can then activate this environment using the command:

```
$ conda activate imbie
```

If you are using conda, you should ensure that your environment is active before continuing with the other steps on this page

1.2 Installing dependencies

To install the IMBIE processor using pip, first install the dependencies listed in *requirements.txt* using the command:

```
$ pip install -r requirements.txt
```

1.3 Installing the processor

then, the processor itself can be installed using the command:

```
$ python setup.py install
```

You can verify that the installation has succeeded by running:

```
$ imbie --help
```


CONFIGURATION OPTIONS

The IMBIE processor has a number of configuration options, which are specified using a configuration file. This file should be a plain-text document. The configuration parameters, their purpose, and their valid values are described below.

All values should be written as Python variables of the appropriate type – for example, text strings should be contained by quote-marks, and numbers should be written without them. Each parameter should be written in its own line of the file, and the name of the parameter should be the first entry in the line, written without quote-marks.

Empty lines are ignored, and the parameters may be specified in any order. Some parameters are optional, which means that it is not compulsory to provide an entry for them in the configuration. In the case that an optional parameter is not provided, the default value/behaviour is described here. The list of options are:

- *input_path* – The directory to search for input data. Absolute or relative paths can be used. The processor will search all subdirectories of the input path for '.answers.json' files which contain details of data submissions. The processor will then read any CSV-format data files specified in the relevant fields of the JSON document
- *output_path* – The directory in which to save plots and tables. Absolute or relative paths can be used.
- *export_data* – Optional field. A Boolean value (True or False). If True, the processor will export the computed data as CSV files. By default, the value is considered to be False.
- *plot_format* – Optional field. Specifies the format in which to save plots – should be one of “png”, “jpg”, “svg”, or “pdf”. If this parameter is omitted, the plots will not be saved and will instead be rendered in a window.
- *start_date* – Optional field. Specifies the date (in decimal years) from which to begin the analysis. All time-series starting before the specified date will be cropped to begin at this date (or omitted, if ending before the date provided).
- *stop_date* – Optional field. Specifies the date (in decimal years) at which to end the analysis. All time-series ending after the specified date will be cropped to end at this date (or omitted, if starting before the date provided).
- *align_date* – Optional field. Specifies the date (in decimal years) at which to align the integrated time-series. If this parameter is absent, then the time-series are instead offset such that their start-points are aligned with the average time-series.
- *combine_method* – Optional field. Specifies the method used to combine multiple time-series. This must be one of:
 - “eqg” – Equally-weighted groups: Each experiment group has an equal contribution to the overall average. By default, this method is used.
 - “eqs” – Equally-weighted series: Each individual contribution has an equal contribution to the overall average
 - “inv” – Inverse error-weighted: Each individual contribution is weighted according to the inverse of its error margin.

- *“imbiel”* – A special method designed to replicate the behaviour of the processor used in the IMBIE 2012 analysis: averages are calculated with the same method used when averaging time series in the IMBIE 2012 analysis. Groups are equally weighted, and error margins are RMS over square root of the number of elements.
- *group_avg_error_method* – Optional field. Specifies the method that should be used to compute the error margin when multiple dM/dt time-series from the same experiment group are averaged together to produce a single estimate for the group. If omitted, the default behaviour depends on the method selected in *combine_method*. The value must be one of:
 - *“sum”* – The sum of the errors.
 - *“rms”* – Root Mean Squared.
 - *“rss”* – Root Sum Squared.
 - *“avg”* – The mean.
 - *“imbiel”* – method used by the IMBIE 2012 analysis: errors are calculated with the same method used when averaging time series in the IMBIE 2012 analysis, they are RMS over square root of the number of elements.
- *sheet_avg_error_method* – Optional field. Specifies the method that should be used to compute the error margin when multiple dM/dt time-series from different experiment groups are averaged together to produce a single estimate for an ice sheet. If omitted, the default behaviour depends on the method selected in *combine_method*. The value must be one of:
 - *“sum”* – The sum of the errors.
 - *“rms”* – Root Mean Squared.
 - *“rss”* – Root Sum Squared.
 - *“avg”* – The mean.
 - *“imbiel”* – method used by the IMBIE 2012 analysis: errors are calculated with the same method used when averaging time series in the IMBIE 2012 analysis, they are RMS over square root of the number of elements.
- *sum_errors_method* – Optional field. Specifies the method that should be used to compute the error margin when multiple time-series are summed together. This must be one of:
 - *“sum”* – The sum of the errors. By default, this method is used.
 - *“rms”* – Root Mean Squared.
 - *“rss”* – Root Sum Squared.
 - *“avg”* – The mean.
 - *“imbiel”* – method used by the IMBIE 2012 analysis: errors are calculated with the same method used when averaging time series in the IMBIE 2012 analysis, they are RMS over square root of the number of elements.
- *average_nsigma* – Optional field. Specifies the maximum margin when computing the average of multiple time-series. Values beyond this multiple of the standard deviation from the mean are considered to be outliers, and omitted from the average. By default, there is no maximum margin and all values will contribute to the average.
- *users_skip* – Optional field. A list of contributions (specified by the contributor’s username, with all capital letters, accents or diacritic marks removed, eg ‘Sørensen’ should be written ‘sorensen’) to exclude from the analysis. Multiple usernames can be specified, separated by whitespace.
- *users_mark* – Optional field. A list of contributions (specified by the contributor’s surname) to mark in dM/dt and dM time-series plots. Multiple usernames can be specified, separated by whitespace. This parameter can be used to indicate the identity of outlying contributions.

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- *plot_smooth_window* – Optional field. Specifies the time-window (in decimal years) which should be used when applying a moving average to dM/dt time-series plots. By default, no moving average is applied.
 - *plot_smooth_iters* – Optional field. Specifies the number of iteration of smoothing to apply to plotted series. Default is 1 if omitted.
 - *bar_plot_min_time* – Optional field. Specifies the minimum date from which the mean and standard deviation dM/dt are calculated for the error-bar plot. By default, there is no minimum date.
 - *bar_plot_max_time* – Optional field. Specifies the maximum date from which the mean and standard deviation dM/dt are calculated for the error-bar plot. By default, there is no maximum date.
 - *include_la* – Optional field. A Boolean value (True or False). If True, an additional “LA” (Laser Altimetry) expirement group will be considered by the processor. If the parameter is omitted, the value is considered to be False.
 - *methods_skip* – Optional field. A list of experiment groups to exclude from the analysis. Multiple groups can be specified, separated by whitespace. Valid values are:
 - “RA”: The Altimetry group
 - “GMB”: The Gravimetry group
 - “IOM”: The Mass-Budget group
 - *use_dm* – Optional field. Enables reading dM contributions in order to convert these to dM/dt data. False by default if omitted.
 - *dmdt_window* – Optional field. Sets the length (in decimal years) of the curve-fitting window used for dM-to-dM/dt conversion. If the parameter is omitted, the value is considered be 1 year.
 - *dmdt_method* – Optional field. Specifies the method to be used for the curve-fitting in the dM- to-dM/dt conversion. Valid settings are:
 - “ordinary_least_squares” – basic fitting (default if parameter is omitted)
 - “weighted_least_squares” – inverse-error weighted least squares fitting
 - *truncate_dmdt* – Optional field. Sets whether or not dM/dt series produced by the dM-to- dM/dt conversion process should be cropped to the length within which a complete window can be constructed from the input dM data. True by default if omitted.
 - *truncate_avg* – Optional field. Toggles whether group average series should be truncated to the length of contributions when truncate_dmdt is applied. False by default.
 - *apply_dmdt_smoothing* – Optional field. Specifies if the dM/dt contributions should be smoothed after reading. The window used for this smoothing is the same as the value of dmdt_window
 - *reduce_window* – sets the width (in decimal years) of the window over which to apply a moving average on the contributions, reducing the number of data points in each series. If omitted, the averaging is not applied.
 - *data_smoothing_window* – Optional field. Specifies the width (in decimal years) of windowed smoothing to apply to internal data. If omitted, no smoothing is applied.
 - *data_smoothing_iters* – Optional field. Specifies the number of iteration of smoothing to apply to internal data series. Default is 1 if omitted.
 - *export_smoothing_window* – Optional field. Specifies the width (in decimal years) of windowed smoothing to apply to exported data. If omitted, no smoothing is applied.
 - *export_smoothing_iters* – Optional field. Specifies the number of iteration of smoothing to apply to exported data series. Default is 1 if omitted.
 - *imbie1_compare* – Optional field. Toggles whether to provide a plotted comparison with IMBIE-1 data. True by default.
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- *output_timestep* – Optional field. Sets the interval between data points in output files (in decimal years). If no value is provided, the data will not be adjusted.
- *output_offset* – Optional field. Sets the fraction of the year at which the first data point in the output files should be provided. All subsequent points will be spaced according the value of *output_timestep*. If omitted, no adjustment is performed.
- *smb_data* – Specifies the path of Surface Mass Balance CSV data to use for calculating ice sheet dynamics for Greenland
- *data_min_time* – Optional field. In conjunction with *data_max_time*, sets a time window to be applied to the input data when read.
- *data_max_time* – Optional field. See *data_min_time*
- *dmdt_tapering* – Optional field. Boolean value, when True, applies window tapering method to dm-to-dmdt conversion. Default False.
- *dmdt_monthly* – Optional field. Forces monthly interpolation of data points when performing dm-to-dmdt conversion when set to True. Default False.

The default axis limits can be changed for certain plots only, using the following six options. This affects only plots whose names start with *group_rate_boxes*, *groups_mass_intercomparison*, *groups_rate_intercomparison*, *regions_mass_intercomparison* and *regions_rate_intercomparison*.

- *plotter_min_time* – Optional field. Sets earliest date in plot time range. Default if omitted is 1990.
- *plotter_max_time* – Optional field. Sets latest date in plot time range. Default if omitted is 2022.
- *plotter_min_dmdt* – Optional field. Sets lowest value in plot dm/dt range. Default if omitted is ``-``500 (Gt/yr).
- *plotter_max_dmdt* – Optional field. Sets highest value in plot dm/dt range. Default if omitted is 200 (Gt/yr)
- *plotter_min_dm* – Optional field. Sets lowest value in plot dm range. Default if omitted is ``-``9000 (Gt)
- *plotter_max_dm* – Optional field. Sets highest value in plot dm range. Default if omitted is 3000 (Gt)

EXECUTING THE PROCESSOR

Once the IMBIE processor has been installed as per the instructions in Section 3, it can be invoked using the command ‘imbie’. This will execute the processor in the current directory. The general interface to the processor is in the form:

```
$ imbie [configuration file]
```

The argument provided should be the path to a valid IMBIE configuration file. The format of this file should follow the description in Section 4.2. If the execution is successful, the output files will be found in the output directory that has been indicated in the configuration file. Two additional processing utilities are also installed by the setup.py installation script. These are the dM-only processor, and the data pre-processor, which can be invoked by the commands imbie-processdm and imbie-preproc respectively. Each of these commands require an IMBIE configuration file as their only argument. The dM-only processor will perform the IMBIE processing chain on change-of-mass files which have been created by the pre-processing tool.

ERROR CODES

When the IMBIE Processor encounters an error, details of the problem will be printed to the terminal window. Additionally, the processor will return a numeric error code. The definitions of these codes are provided here:

Table 1: Error Codes

Value	Name	Details
1	logging	Cannot open logging file
2	input_path	Input directory does not exist
3	no_data	No data found in input directory
4	config_missing	Config file does not exist
5	config_invalid	Error reading config file
6	output_path	Cannot write to output path

EXAMPLE CONFIGURATION

Below is an example copy of a configuration file that can be used by the IMBIE processor.:

```
input_path "~/imbie/submissions-data/imbie_v2.02_data_20171011_GM"
output_path "output/20200227/"
plot_format "eps"
export_data True
use_dm True
dmdt_window 3
dmdt_method "weighted_least_squares"
truncate_dmdt True
truncate_avg False
apply_dmdt_smoothing False
reduce_window 1
users_skip "mtalpe" "xpwuajpl" "roelof" "IMBIE1" "jmouginot" "rignot2" "ahlstrom"
combine_method "inv"
group_avg_error_method "rms"
sheet_avg_error_method "max"
sum_errors_method "rss"
table_format "html"
bar_plot_min_time 2005
bar_plot_max_time 2015
plot_smooth_window 1.083333
plot_smooth_iters 2
imbiel_compare False
```


DOWNLOADS

isardSAT_imbie3_SUM_v1b_20220411.pdf

isardSAT_imbie3_SwDoc_v1b_20220331.pdf

INDICES AND TABLES

- `genindex`
- `modindex`
- `search`