

IMBIE Phase II

– SW User Manual –

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1 Introduction

1.1 Scope

The scope of this document is to describe in detail the procedures to install and execute the IMBIE processor.

1.2 Applicable Documents

AD. 1 "Proposal for the ESA-NASA Ice sheet Mass Balance Inter-comparison Exercise (IMBIE) Phase II".

2 System requirements

2.1 Hardware requirements

The IMBIE processor is compatible with any computer with a 32- or 64-bit processor of 2.4Ghz clock speed or higher. It requires at least 2GB of RAM.

2.2 Software requirements

The IMBIE processor requires Python 3.5 (or more recent) to be installed, and is compatible with all modern operating systems.

A number of modules not included in the Python standard library are also required. The modules required are:

- numpy (<http://www.numpy.org/>)
- scipy (<http://www.scipy.org/>)
- matplotlib (<https://matplotlib.org/>)
- PrettyTable (<https://github.com/vishvananda/prettytable/>)

Further instructions on how to install these modules are provided in Section 3.1.2

3 Software Installation

3.1 Installing prerequisites

3.1.1 Installing Python

The IMBIE processor requires Python 3.5 (or more recent) to be installed. This is pre-installed on most recent linux distributions, or is available via the distribution's package manager. For Windows, installers are available from (<https://www.python.org/downloads/>).

Depending on the configuration of the system, this may require administrator privileges.

3.1.2 Installing modules

As listed in Section 2.2, the IMBIE processor requires a number of non-standard modules to be installed. These can be downloaded and installed using *pip*, the Python package manager, with the following command:

```
pip install numpy scipy matplotlib prettytable
```

Depending on the configuration of the system, this may require administrator privileges.

3.2 Installing the processor

The IMBIE processor will be delivered in a compressed-zip folder, with the following naming convention:

```
imbie_<version_number>.zip
```

Where <version_number> is in the form 'XX.YY', being 'XX' the major version number and 'YY' the minor version number.

To install the IMBIE processor, extract the compressed package and execute the `setup.py` script in the root directory of the extracted folder, with the argument 'install':

```
python3 setup.py install
```

This will install the processor to the system's python installation directory, allowing it to be executed from any directory via the command 'imbie'.

4 Application Execution

4.1 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.

4.2 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) 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.
 - `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.
 - `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) experiment 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

ANNEX A: 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:

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

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