

# README, Applegate *et al* (2015), *Environmental Research Letters*

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17 July 2015

This document explains how to use the computer code and data files in this archive to reproduce the figures presented in Applegate *et al* (2015, *Environmental Research Letters*). The figures were produced using output from the three-dimensional ice sheet model [SICOPOLIS](#), development v3.0. We include the model output and some key inputs in this archive; however, we do *not* provide instructions for running SICOPOLIS here.

## Necessary software and preexisting data

The following pieces of software were used to create the figures:

- [R](#) v3.1.2 – statistical computing, figure generation
- [RStudio](#) v0.98.1103 – integrated development environment for R
- [Inkscape](#) v0.91 – figure polishing

We also used output from a run using the [CLIMBER-3 \$\alpha\$](#)  model, following the RCP 8.5 scenario. The results from this run were previously published by Schewe *et al* (2011, *Earth System Dynamics*), and were provided by Jacob Schewe.

## Necessary R packages

We used the following user-developed software libraries (packages) to generate our results. These packages must be installed using the `install.packages()` command in R before running any of our R code. Some of these packages depend on other packages; by default, R will install these prerequisite packages automatically.

- `RColorBrewer` v1.1-2
- `fields` v7.1
- `gridExtra` v2.0.0
- `DEoptim` v2.2-3

## Contents of this archive

The top-level directories in this archive are

```
list.dirs(full.names = FALSE, recursive = FALSE)
```

```
## [1] "code_figures" "data_tables" "output"      "searise"
## [5] "sem_test"     "temp_curves"
```

- `code_figures`: contains R scripts for

- reading the SICOPOLIS output in `output` and producing clean `.csv` files, which go into `data_tables`
- generating Figures 1-3 in the main text, plus Table S1 and Figures S1-S3 in the supplement
- `data_tables`: contains `.csv` files with processed results from SICOPOLIS
- `output`: contains unprocessed SICOPOLIS output
- `searise`: contains files for generating Figure 5 in the main text
- `sem_test`: contains files for generating Figure 4 in the main text
- `temp_curves`: contains the temperature curves used in the SICOPOLIS runs

The following R command lists all of the R script files (ending in `.R`) in this archive.

```
list.files(pattern = glob2rx('*.R'), recursive = TRUE)
```

```
## [1] "code_figures/data_file_writer_v4.R"
## [2] "code_figures/final_geoeng_plots.R"
## [3] "code_figures/read_ser.R"
## [4] "searise/sensitivity_fig.R"
## [5] "sem_test/sem_functions.R"
## [6] "sem_test/sem_test_v5.R"
## [7] "temp_curves/temp_curve_writer.R"
```

The key files are

- `code_figures/data_file_writer_v4.R`: takes the SICOPOLIS output files in `output/`, generates some clean `.csv` files from them, and places these files in `data_tables/`; uses `read_ser.R`
- `code_figures/final_geoeng_figs.R`: produces Figures 1-3 in the main text, plus Table S1 and Figures S1-S3 in the supplement; uses the clean data files in `data_tables/`
- `searise/sensitivity_fig.R`: produces Figure 5 in the main text; uses results from previous SICOPOLIS runs (`icevol(t)_RCP8p5.csv`) and from Bindshadler *et al* (2013, *Journal of Glaciology*, their Fig. 15a; `searise_data_v2.csv`)
- `sem_test/sem_test_v5.R`: produces Figure 4 in the main text; uses `sem_functions.R`
- `temp_curves/temp_curve_writer.R`: generates the temperature curves used in the SICOPOLIS runs

## Figure and table files

The following files contain figures and tables:

```
list.files(pattern = glob2rx('*.pdf'), recursive = TRUE)
```

```
## [1] "code_figures/extra_fig_pieces.pdf"
## [2] "code_figures/geoeng_fig1.pdf"
## [3] "code_figures/geoeng_fig2.pdf"
## [4] "code_figures/geoeng_fig3.pdf"
## [5] "code_figures/geoeng_figS1.pdf"
## [6] "code_figures/geoeng_figS2.pdf"
## [7] "code_figures/geoeng_figS3.pdf"
## [8] "code_figures/reviewer_figure.pdf"
## [9] "code_figures/table_S1.pdf"
## [10] "README.pdf"
## [11] "searise/geoeng_fig5.pdf"
## [12] "sem_test/geoeng_fig4.pdf"
```

README.pdf is this file. The files with names corresponding to `geoeng_fig*.pdf` correspond to the appropriate figure in the paper; similarly, `table_S1.pdf` contains the same information as in Table S1 in the supplement.

## Manual modifications to `table_S1.pdf`, `geoeng_fig2.pdf`, and `geoeng_fig3.pdf`

Table S1, plus Figures 2 and 3, were manually modified before being included in the manuscript. These modifications are *not* reflected by the .pdf files in this archive (see the published paper for the final figures).

- **Table S1:** The information in `table_S1.pdf` was put into [tablesgenerator.com](https://tablesgenerator.com), which allows coloring individual table rows according to the hex codes in the last column of `table_S1.pdf`. The column names were made clearer, and an extra row was added at the top to reflect the base, no-AM scenario.
- **Figure 2:** A side effect of the `image.plot()` function in the `fields` package causes the panels in multi-panel figures to be misplaced. To address this problem, panels **b** and **c** were swapped in Inkscape. We modified the *y*-axes, and added two new *y*-axes, to reflect the information in Table S1. We overlaid panels **a** and **c** over the appropriate panels from `extra_fig_pieces.pdf`. Finally, we deleted duplicate figure elements (*y*-axes and color bars), and moved some figure elements closer to one another.
- **Figure 3:** As Figure 2, except that no swapping of panels was needed.

## Running our R code

Run the R scripts in the following order:

1. `code_figures/data_file_writer_v4.R`
2. `code_figures/final_geoeng_plots.R`
3. `sem_test/sem_test_v5.R`
4. `searise/sensitivity_fig.R`

To run an R script, first open it in RStudio. Next, click **Session > Set Working Directory > To Source Location** in the menu at the top of the screen. Finally click the **Source** button in the upper right-hand corner of the Script window in RStudio. Remember to install the packages listed above before running these scripts.