Downscaling User Guide - macOS

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Oct 2023

1 Overview

This document is a guide to perform downscaling in a macOS having coarse projections and observational data pre-processed and saved in a certain format beforehand.

Code will first perform standard downscaling and save it in a .csv file and then perform BGL downscaling. If you are only interested in standard downscaling, you can turn off BGL downscaling by specifying it at the command line.

2 Basic set-up

You will need to have the coarse and observational data ready in .csv files in following formats.

- If N is the number of fine pixel locations in the region and T_o is the total time points in the current observational period, save observational data matrix in a .csv file named Obs_data.csv of the form of $N \times (T_o + 2)$ matrix. First two additional columns will provide lon/lat information. Name the fist two columns "lon", "lat" and the subsequent columns with respective years.
- If M is the number of coarse grid cells in the region, $T (> T_o)$ is the total number of time points in the current and the future downscaling periods, have the model data saved in a file named Model_data of the form of $M \times (T + 2)$ matrix. First two additional columns will provide lon/lat information. Name the fist two columns "lon", "lat" and the subsequent columns with respective years.

3 Running codes

- Download and install R (if you don't have R in your local server).

- Download and install MATLAB Runtime R2020b (9.9).
  MATLAB Runtime is a standalone set of shared libraries that enables the execution of a compiled MATLAB code. **NOTE:** MATLAB application was compiled with MATLAB R2020b. It is important to have the correct version of MATLAB Runtime as it would run into errors if you have a different version installed.

- Download and save all the files provided into your working directory.

- Open the terminal and navigate to your working directory.

- Type the command **chmod +x run_BGL.sh** and enter.

- To run the codes, type the command **Rscript Downscaling.R arg1 arg2 arg3 arg4**
  R script takes following arguments. Specify all the arguments within air quotes.

  - arg1: path to the mathlab runtime. Typically this is "/Applications/MATLAB/MATLAB_Runtime/v99/" on a mac. Please look for the correct path in your local server.
  - arg2: This is the path to your working directory.
  - arg3: Frequency of your data. For example if its is monthly data, frequency is 12. If it is daily data, frequency is 365.
  - arg4: Specify whether you want to turn off BGL downscaling. If you want to perform downscaling with BGL, type "on" otherwise type "off"

- To try the code with sample data provided, please use following line of commands. Provided sample observational data "Obs_data.csv" file includes monthly SSTs from 180 months at 309,700 fne-scale locations in the GBR region. Climate model data file "Model_data.csv" includes coarse projections for the current 180 months and 36 future months for validation."Obs_data.Validate.csv" includes observational data for the 36 validation months.
  Rscript Downscaling.R "/Applications/MATLAB/MATLAB_Runtime/v99/" "/Volumes/Disk2/Downscaling_local/" 12 "on"

- If you run into an error saying "BGL can not be run as it does not trust the application from an unknown developer", please check your privacy settings to allow applications from any developer and try again.

4 Output files

You will have below files as outputs.

- "Stand_Downscaled.csv": This files includes fine projections from standard downscaling. First two columns are lon/lat information and the subsequent columns are downscaled projections having respective year as column heading.
- "BGL_Downscaled.csv": This files includes downscaled projections from BGL downscaling. First two columns are lon/lat information and the subsequent columns are downscaled projections having respective year as column heading.
- "BGL_Downscaled.UQ.csv": This files includes standard erros for the projections from BGL downscaling. First two columns are lon/lat information and the subsequent columns are downscaled projections having respective year as column heading.