Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Appendix 2

This page intentionally left blank

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

AgMIP The Agricultural Model Intercomparison and Improvement Project

Guide for Running AgMIP Climate Scenario Generation Tools with R

in Windows

Version 2.3

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Version 2.3
Updated Oct. 25th, 2013

Guide for Running AgMIP Climate Scenario Generation Tools with R in Windows

This Guide explains how to create climate series and climate change scenarios by using the AgMIP Climate team's methodology as outlined in the AgMIP Guide for Regional Integrated Assessment: Handbook of Methods and Procedures (available for download at www.agmip.org)

Details how to:

- install R and the required packages to run the AgMIP Climate Scenario Generation scripts
- create climate scenarios from CMIP5 GCMs using a 30-year baseline daily weather dataset

The Guide also outlines a workflow that can be modified for application to your own climate data.

This Guide and workflow are under continuous development and we expect to add new capabilities and sections in future versions. The methods and scenarios here are intended for AgMIP research and may not be suitable for other applications. Please contact Nicholas Hudson (nih2106@columbia.edu) if you have any questions or comments.

By Nicholas Hudson (nih2106@columbia.edu), CCSR | Columbia University
and Alex Ruane (alexander.c.ruane@nasa.gov), NASA Goddard Institute for Space Studies
With special thanks to Yunchul Jung (University of Florida) and Sonali McDermid (NASA GISS)

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Background - 2

Contents

★Background 3
Installation 4
Download and Install R 5
Download and Install Packages 6
★Downloading AgMIP Climate Scenario Generation Scripts and Data 10
Creating folders for R scripts and input data 10
★Downloading R scripts and data from WebDrive 11
★Creating baseline .AgMIP files with "AgMIP Excel File Template_v2.0.xls" 14
★Opening "AgMIP Excel File Template.xls" 14
Creating baseline .AgMIP files with the enabled macro 15
Creating baseline .AgMIP files without the enabled macro 17
★Running AgMIP Climate Scenario Generation scripts 19
★Explanation of input variables to be changed in the run scripts 19
Modifying variables in the run scripts 28
Sourcing the run scripts 32
Explanation of output files 33
Suggested workflows for the run scripts 37
run_agmip_farmclimate.R 38
run_agmip_simple_delta.R 39
run_agmip_simple_mandv.R 41
run_agmip_simple2full.R 43
Creating "full" files from "run_agmip_simple_delta.R" outputs 43
Creating "full" files from "run_agmip_simple_mandv.R" outputs 44
Next Steps… 46
Appendix 1: Creating .AgMIP files in Excel 47
Appendix 2: Example file for "agmip_farmclimate.R" 49
Appendix 3: Example file for "agmip_simple_delta.R" and "agmip_simple2full.R" 50

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

★Background

Version 2.3 of the Guide for Running AgMIP Climate Scenario Generation Tools with R provides updated links for downloading the input data and AgMIP Climate Scenario Generation scripts for R. Version 2.3 also corresponds with the updated version of the script "agmip_farmclimate.R" that was available with version 2.1.

The updated version of "agmip_farmclimate.R" includes a correction to handle negative vapor pressure (Vprs) values and NaN dew point temperature (Dewp) values as well as to correct NaNs created when calculating the change factor for precipitation (Rain). If you have encountered any of these errors when running "**run_agmip_farmclimate.R**", we recommend that you rerun "**run_agmip_farmclimate.R**" with the updated version of "agmip_farmclimate.R".

If you have not encountered these errors you do not need to rerun "**run_agmip_farmclimate.R**", but we highly recommend that you use the updated version of "agmip_farmclimate.R" for future analysis.

The updated version of "agmip_farmclimate.R" can be downloaded from the links provided in the section **Downloading R scripts and data from WebDrive**.

New sections or sections that have been substantially updated are marked with green stars (★). These stars have not been updated and reflect changes that were made for version 2.1.

The only difference of version 2.3 from versions 2.1 and 2.2 is that version 2.3 contains updated WebDrive links for downloading the necessary scripts and minor adjustments to "agmip_simple_delta.R" and "agmip_simple_mandv.R" to ensure that Tmax > Tmin in the generated climate change scenarios.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Installation

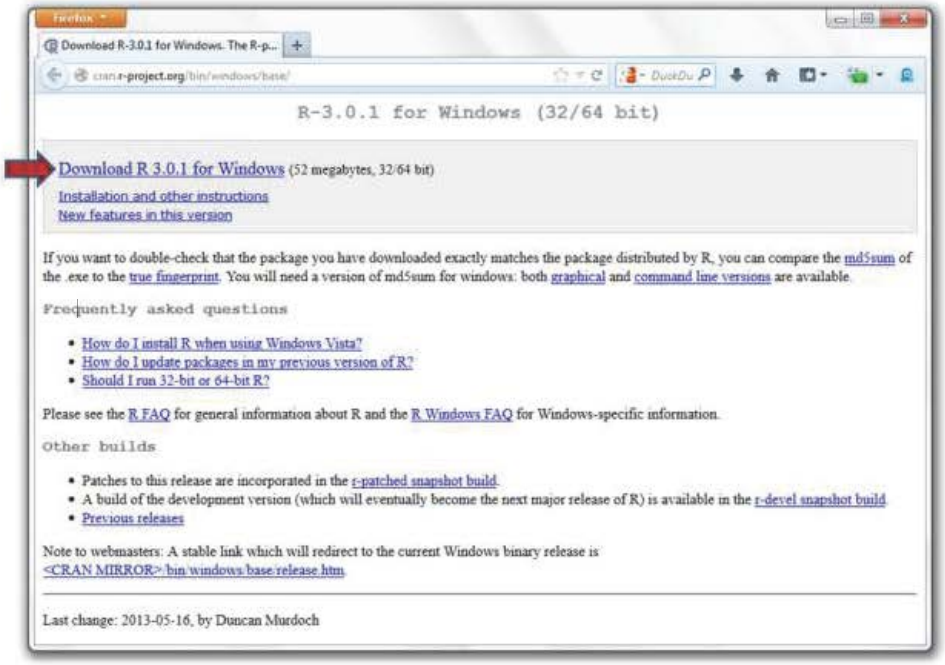
This section explains how to install R and the packages necessary to run the climate scripts.

R is a free environment that can be used for statistical analysis and graphic development. To run the scripts properly, packages are required to add functionality to R. These packages are free, easy to download, and importantly ***must be loaded, but not reinstalled, every time you begin a new R session***. The AgMIP Climate Scenario Generation scripts that are described in this Guide have been designed to load the required packages automatically as long as the packages have been properly installed.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Download and Install R

Download the most recent version of R from <http://cran.r-project.org/bin/windows/base/>. The image below shows a screenshot from the provided link to the R website. As you can see in the below image, the most recent version of R is 3.0.1 (as of the publication of this Guide). If there is a more recent version of R, you should download that version. To download the installation file in your web browser, click on the link indicated by the red arrow. Run the downloaded .exe file and follow the steps of the installation wizard. After the installation is complete, open R.



Note: The R website provides a lot of helpful information if you are experiencing any difficulties downloading or installing R onto your computer. Also, there are versions of R available for Mac OS <http://cran.r-project.org/bin/macosx/> and Linux <http://cran.r-project.org/bin/linux/>. Again, the R website is very useful so if you are installing R on either of these platforms and are experiencing any difficulties, your questions may be answered by information provided by this website.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Installation - 6

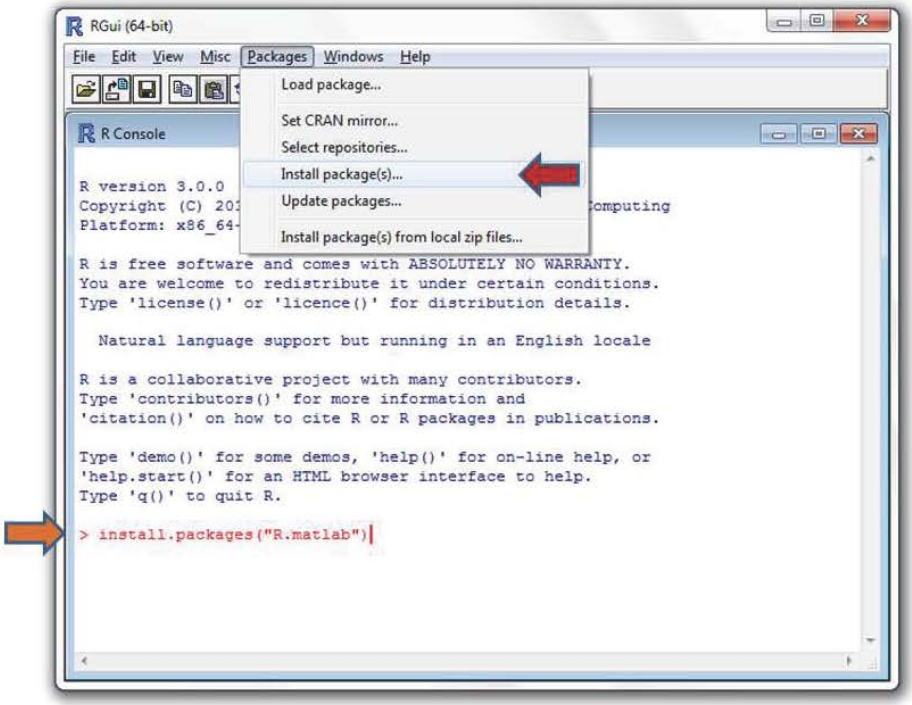
Download and Install Packages

1. After installing R onto your computer, you will need to install the "R.matlab", "R.utils", and "MASS" packages. Let's start with the "R.matlab" package. You can perform this action by either

- Selecting R: Packages-> Install package(s)… from the menu bar (shown by the red arrow below) or by
- Typing the command

```
install.packages("R.matlab")
```

into R Console (the orange arrow below).



Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Installation - 7

After selecting the nearest CRAN mirror, R will install the selected package "R.matlab" as well as the dependent packages "R.oo" and "R.methodsS3" to your package library. Occasionally the closest mirror does not work. If this is the case, simply try a different location. A successful install will display the following message in R Console:

```
package 'R.oo' successfully unpacked and MD5 sums checked
package 'R.methodsS3' successfully unpacked and MD5 sums checked
package 'R.matlab' successfully unpacked and MD5 sums checked
```

IMPORTANT: The next step, Step 2, is crucial for the installed packages to run correctly. ***The packages must be loaded, but not reinstalled, every time you begin a new R session to perform the operations required by the provided climate scenario scripts.*** However, the provided scripts described in this Guide automatically load the necessary packages with the 3 line code shown below:

```
library <- c("R.matlab","R.utils")
lapply(library, require, character.only = T)
rm(library)
```

Thus, if you will only be running the provided climate scenario scripts, you can skip Step 2 and proceed to Step 3. If you are designing your own scripts and would like to retain the functionality of the provided scripts you will either need to incorporate the three line code above or follow Step 2 to load the packages.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

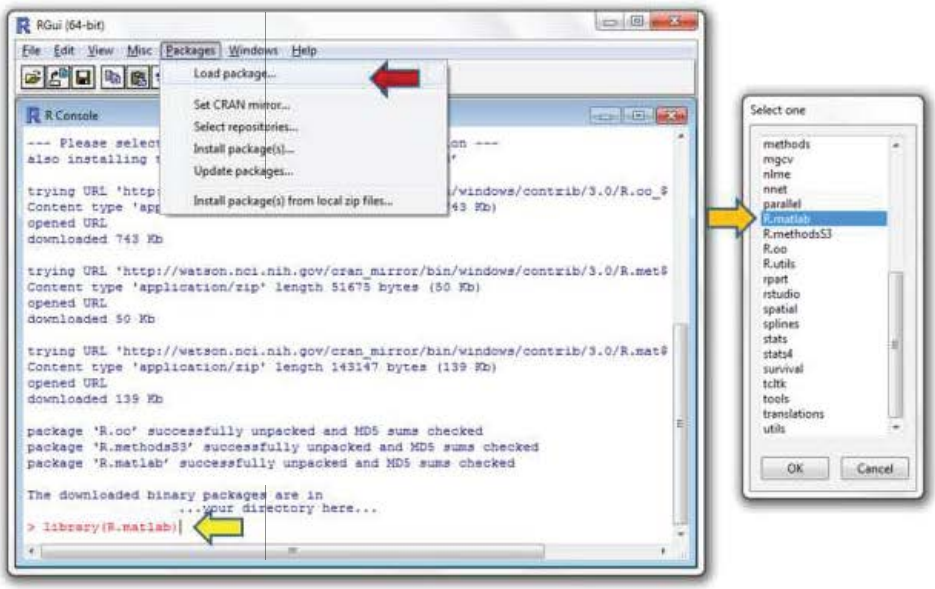
Installation - 8

2. Load "R.matlab" package. You can perform this action in one of two ways.

- **You can select R: Packages-> Load package… from the menu bar (shown by the red arrow below), which brings up a pop-up box titled "Select one." Choose "R.matlab" as indicated by the orange arrow.**
- **Alternatively, you can type the command**

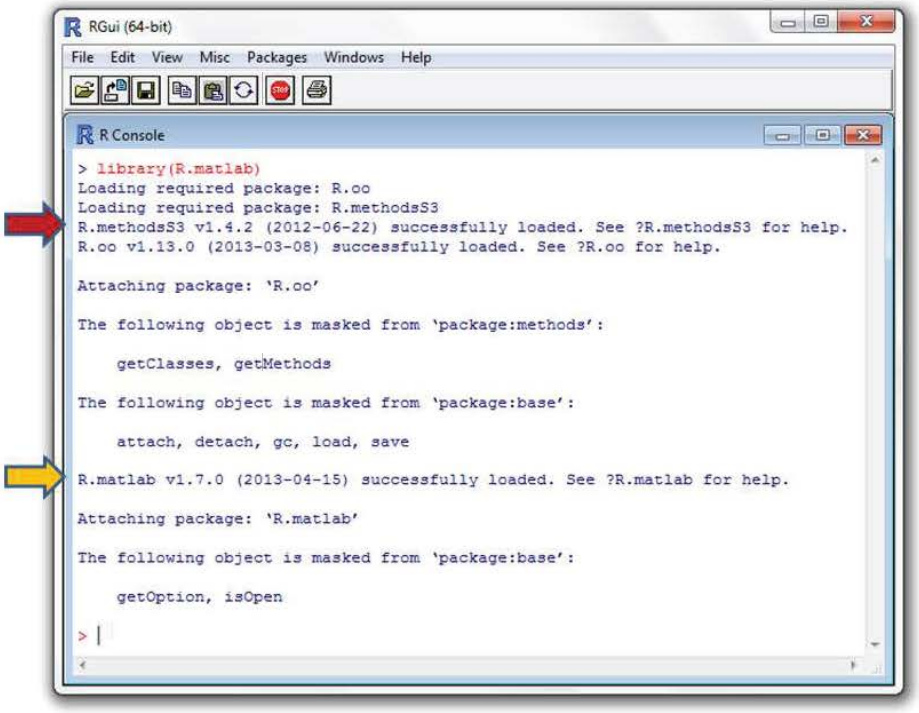
```
library(R.matlab)
```

into R Console as is indicated by the yellow arrow below.



Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

When loading R.matlab, R will automatically load the dependencies, R.oo and R.methodsS3. R Console's output will inform you if all three packages were successfully loaded. The red arrow below points to the lines indicating "R.oo" and "R.methodsS3" were successfully loaded, while the orange arrow points to the "R.matlab" line.



3. Repeat steps 1 and 2 (pages 6-8) to install and load the packages "R.utils" and "MASS".

IMPORTANT: The "MASS" package will be used by "agmip_simple_mandv.R" and has been added to the list of required packages for Version 2.0 of the Guide. If you are intending to run the script "run_agmip_simple_mandv.R", you will have to install the "MASS" package. Otherwise it is not necessary to install this package.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

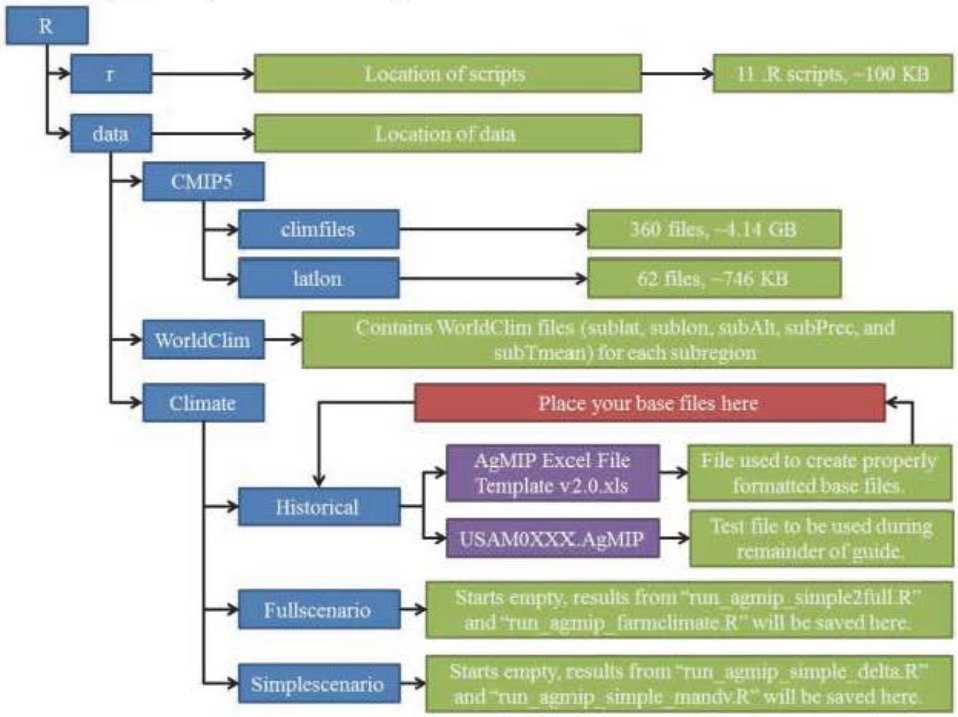
★Downloading AgMIP Climate Scenario Generation Scripts and Data

The following section explains:

1. **The folder hierarchy necessary for climate scripts and data to function properly**
2. **How to download the climate scripts and data**
3. **Where to place these files within your newly created folder structure**

Creating folders for R scripts and input data

AgMIP climate scripts require the below directory structure. We recommend that you use this folder hierarchy as this is the easiest approach for running the AgMIP Climate Scenario scripts. The hierarchy of the folders should look as follows (where blue = folders, purple = files, green = description, red = important information):



Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

We now provide you with the folder structure already created. The first link of the next section, **Downloading R scripts and data from WebDrive**, is the zipped folder structure that already contains the R scripts, test files, AgMIP Excel file template, WorldClim datasets and latitude and longitude datasets for GCMs in the correct folder locations. Additionally, you will have to download the GCM climate data and place these files into "~/R/data/CMIP5/climfiles".

IMPORTANT: R is case sensitive so it is important to preserve the downloaded folder hierarchy for the AgMIP Climate scripts to function correctly.

★Downloading R scripts and data from WebDrive

The next step will be to download the climate data and R scripts from WebDrive (links provided on the next couple pages). This is NASA Goddard's Online File Depot and has been set up by Alex Ruane. To gain access to these files, use the username and password provided below.

WebDrive Log In Information	
Username	aruane
Password	AgMIPRRTs
Expiration Date	November 23, 2013

The provided links have a 30 day expiration date and the files were posted on October 24, 2013, and thus will not be available after November 23, 2013. If you are attempting to download these files after this date, contact either Alex Ruane at **alexander.c.ruane@nasa.gov** or Nicholas Hudson at **nih2106@columbia.edu**.

You will be downloading GCM files that use RCP 4.5 and RCP 8.5 as well as the latitude and longitude files needed to properly read the GCM files.

Not all of the files that you will be downloading will be described in this Guide, but they will be discussed in future versions.

Below are the links for the required input data and R scripts along with a brief description of the files and the folder destination where the files should be placed within your newly created folder structure:

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Downloading AgMIP Climate Scenario Generation Scripts and Data - 12

R scripts, test climate files, and AgMIP Excel File Template download location:
https://webdrive.gsfc.nasa.gov/longauth/600/nicholas.hudson/HEr80oC

1. The above link is the zipped folder structure containing the R scripts, test files, AgMIP Excel file template, WorldClim datasets and latitude and longitude datasets for GCMs in the correct folder locations. **We advise that you download the most recent versions of these scripts to ensure optimal performance and most robust analysis.**

Script Name	Brief description of functionality
acr_findspot.R	Returns the i and j coordinates of a given location given its latitude and longitude and a models lat and lon arrays
agmip_farmclimate.R	Formerly "acr_agmip022.R" and "acr_agmip021.R", produces monthly climate files from WorldClim data for *n* farms around the seed weather station. ***UPDATED for Version 2.1***
run_agmip_farmclimate.R	Runs "agmip_farmclimate.R" to produce monthly climate files in AgMIP format.
agmip_simple_delta.R	Creates delta scenarios from CMIP5 GCMs and BCSD.
run_agmip_simple_delta.R	Runs "agmip_simple_delta.R" to produce basic future scenario files in .AgMIP format.
agmip_simple_mandv.R	Formerly "acr_agmip100.R", adjusts a climate time series for AgMIP mean and variability scenarios.
run_agmip_simple_mandv.R	Formerly "acr_agmip120.R", runs "agmip_simple_mandv.R" to produce climate time series in AgMIP format.
agmip_simple2full.R	Converts basic future scenarios (Srad, Tmax, Tmin, Rain) output from "agmip_simple_delta.R" and "agmip_simple_mandv.R" into full future scenarios with relative humidity-controlled vapor pressure based upon daily Tmax.
run_agmip_simple2full.R	Runs "agmip_simple2full.R" to produce full future scenario files in .AgMIP format.
acr_agmip2metric.R	Produces a record of climate metrics in a given season
run_metrics.R	Runs "acr_agmip2metrics.R"

The R scripts are all located in the directory "~/R/r". This zip file also comes with a test baseline file, "USAM0XXX.AgMIP" located in "~/R/data/Climate/Historical" and an example future scenario created from "**run_agmip_simple_delta.R**" and "**run_agmip_simple2full.R**" that can be found in "~/R/data/Climate/Fullscenario".

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Additionally, we have provided a template to create .AgMIP historical baseline files. This template is called "AgMIP Excel File Template v2.0.xls" and is located in the folder "~/R/data/Climate//Historical". This Excel template file uses a Visual Basic macro to create properly formatted base files and has been designed to place the newly created base files into the same directory in which the Excel template file is located. Therefore if you will be using "AgMIP Excel File Template v2.0.xls" to create your baseline .AgMIP files, the Excel file will not have to be moved. Please note, to use this feature in Excel, you must run Excel as an "Administrator", which can be done by right-clicking the Excel icon and selecting "Run as Administrator".

Lastly, the zip file contains WorldClim datasets in "~/R/data/WorldClim" and latitude and longitude datasets for GCMs in "~/R/data/CMIP5/latlon".

NOTE: We recommend that you keep the zip file containing the R scripts, the Excel template file and the .AgMIP test file as a back-up in the event that these files become corrupted. This is not necessary for the other zip files you will be downloading in the remaining four links.

2. Place the remaining files ***listed below*** (all CMIP5 input files including meanpr, fwetpr1, meantasmax, meantasmin, stdtasmas, and stdtasmin) in "~/R/data/CMIP5/climfiles"

Mean precipitation and the frequency of wet days (meanpr and fwetpr1) file download location:
https://webdrive.gsfc.nasa.gov/longauth/600/nicholas.hudson/vXZZuYC

Mean maximum and minimum temperatures (meantasmax and meantasmin) file download location:
https://webdrive.gsfc.nasa.gov/longauth/600/nicholas.hudson/0erCIC3

Standard deviation of maximum and minimum temperatures (stdtasmax and stdtasmin) file download location:
https://webdrive.gsfc.nasa.gov/longauth/600/nicholas.hudson/xdIPIC3

The files contained in these zipped folders should all be placed in "~/R/data/CMIP5/climfiles" such that there are no folders located in "~/R/data/CMIP5/climfiles", just the 360 climate files.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

★Creating baseline .AgMIP files with "AgMIP Excel File Template_v2.0.xls"

Before we begin running R, we will walk through an explanation of how to create baseline .AgMIP files with "AgMIP Excel File Template_v2.0.xls". We are currently seeking to create a script that will help in the historical period gap filling and bias correction according to the AgMIP protocols described in Section 4 of the **AgMIP Guide for Regional Integrated Assessment: Handbook of Methods and Procedures**, but it is useful to be able to create .AgMIP files in Excel regardless. If you prefer to create the baseline .AgMIP files manually, **Appendix 1** provides a detailed outline for creating these files in Excel.

The baseline .AgMIP file should contain the 31-year (1980-2010) daily historical climate data for a particular station or set of climate data. This section will explain how to:

1. Open the Excel file and enable macros
2. Enter your climate data into the spreadsheet and create a baseline .AgMIP file using the macro enabled functionality
3. Create baseline .AgMIP files without the macro

★Opening "AgMIP Excel File Template.xls"

The provided baseline AgMIP creation template was designed to quickly create properly formatted .AgMIP files to be used throughout the remainder of this Guide. If you have already designed your baseline files, you can skip this subsection.

> **NOTE:** This template Excel file automatically produces baseline .AgMIP files within the folder in which "AgMIP Excel File Template_v2.0.xls" is saved. Accordingly, we recommend that you leave this template file in "~/R/data/Climate/Historical" so that the created .AgMIP baseline files are placed in the correct folder location and do not have to be moved later.

The spreadsheet includes a Visual Basic macro (essentially an Excel script designed to make complicated or redundant tasks easier) which has been designed to assist with the creation of the .AgMIP file. This spreadsheet's macro is compatible with all Windows versions of Excel created since 2003. If you are using a Mac and running Excel 2008, you will not be able to run this macro as Mac's 2008 version of Excel does not use Visual Basic. All other versions of Excel should be able to run this macro. If you would like to run this macro, please open Excel as an "Administrator", which can be done by right-clicking the Excel icon and selecting "Run as Administrator". If you are unable to run the macro, or do not wish to enable this functionality,

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

the template can still be used to produce properly formatted baseline .AgMIP files as described in the subsection, **Creating baseline .AgMIP files without the enabled macro**.

To retain the ability of the macro, you will have to enable the macro when you open "AgMIP Excel File Template_v2.0.xls". Each version has a different way of enabling the macro. Generally, when you open the Excel file, a security alert will appear prompting you to decide whether to enable the macro or disable this feature. Enabling the macro will retain the functionality that is discussed in the next step. If you disable the macro, you can skip the next subsection and proceed to the subsection, **Creating baseline .AgMIP files without the enabled macro**, to learn how to use the template without the macro.

If you are having difficulties enabling the macro, the Windows Office website has helpful information on enabling macros for Excel versions **2003**, **2007** and versions **2010 and 2013**.

Creating baseline .AgMIP files with the enabled macro

After enabling the macro, you should see the cover sheet, named "Input Data", of the spreadsheet. Essentially all you have to do to create the baseline .AgMIP file is fill in all of the light green fields. Specifically:

1. Enter the information for your baseline file header into the "User Entered Values" section on the left in the light green fields. This includes filling out information for the header of your .AgMIP file to be created. We highly recommend that you fill in these fields to properly document the data as the AgMIP Climate scripts have been designed to automatically use this information. There are six "User Entered Values" required for the header which should be unique for each station's set of climate data.

   8 digit baseline .AgMIP file name - The first 4 digits are used to describe the location of your climate (meteorological) station. The first 2 digits are an abbreviation for the country, which can be found at the website <**http://www.web-l.com/country-codes/**> (e.g. US = United States). The second 2 digits refer to the specific site location (e.g. AM = Ames, Iowa). The fifth through eighth digits (0XXX) should remain unchanged. For example, a file created for Ames, Iowa, USA would be named "USAM0XXX.AgMIP" and "USAM0XXX" would be entered into this field. The naming convention will be described in further detail in the subsection, **Explanation of output files**.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Creating baseline .AgMIP files with "AgMIP Excel File Template_v2.0.xls" - 16

Latitude (LAT) – latitude of the station in degrees North

Longitude (LONG) – longitude of the station in degrees East

Elevation (ELEV) – elevation of the station in meters

Thermometer height (REFHT) - the height of the station thermometer in meters above the entered station elevation

Anemometer height (WNDHT) - the height of the station anemometer in meters above the entered station elevation

2. Arrange your 31-year (1980-2010) daily climate dataset in the proper column order (where Srad = solar radiation, Tmax = temperature maximum, Tmin = temperature minimum, Rain = precipitation, Wind = wind speed, Dewp = dew point, Vprs = vapor pressure, and Rhum = relative humidity) into the table in the bottom left corner of the sheet "Input Data" (in the light green fields).

   You should fill missing values with -99. If you do not have data for Wind and/or Rhum, you can retrieve this data from the Ag-MERRA dataset. Dewp and Vprs will require additional conversion and can be left as missing (entered as -99) for the purposes of the R routines described in this Guide.

   Upon entering the data correctly into these columns, the orange boxes' color should turn light green and display "Yes".

3. Once the data has been arranged correctly, simply press the green button titled "Create .AgMIP file" to produce your new baseline .AgMIP file. This new file will be created in the same file you have positioned "AgMIP Excel File Template_v2.0.xls". Confirm the presence of your new baseline .AgMIP file in "~/R/data/Climate/Historical". If you have successfully produced your baseline .AgMIP file, you can proceed to the next section, **Running AgMIP Climate Scenario Generation scripts**.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Creating baseline .AgMIP files without the enabled macro

NOTE: This subsection is only for individuals who have not been able to enable the macro or who have opted not enable the macro. If you have successfully created your .AgMIP baseline file, you can proceed to the next section, **Running AgMIP Climate Scenario Generation scripts**.

If the macro will not work or you have chosen not to enable the macro, the template can still useful for you. Follow steps 1-2 in **Creating baseline .AgMIP files with the enabled macro** to correctly enter your data into the first sheet (Input Data) of "AgMIP Excel File Template_v2.0.xls".

After you have entered your header information and climate data into the light green fields, go to the second sheet, Baseline Data. This shows the properly formatted data and header. All you have to do to create the .AgMIP file is to save this sheet. To do this, follow these steps:

1. Select "File > Save As"
2. Select the location "~/R/data/Climate/Historical/"
3. In "File name:" enter the name of your baseline file in quotes. That is, enter the name you have entered into the field **8 digit baseline .AgMIP file name** on the sheet "Input Data" with the .AgMIP extension. For example, if you entered "USAM0XXX" into that field, enter "USAM0XXX.AgMIP" into the "File name:" field including the quotes.
4. In "Save as type:" select "Formatted Text (Space Delimited)
5. Select "Save"
6. A warning will appear alerting you that this format will not support multiple sheets. Select "OK".
7. There will be another warning about compatibility issues. Select "Yes".
8. Your file should now be saved, however, you will want to close the now altered Excel spreadsheet and select "Don't Save" to ensure the initial "AgMIP Excel File Template_v2.0.xls" is not altered in this process.

The macro actually works around this "Don't Save issue" by copying and pasting the data from the second sheet (Baseline Data) onto a new workbook. This can be difficult though as older versions of Excel do not have the functionality of Paste Special as the newer versions (both numerical and columnar formatting need to be retained). We encourage users to follow the above workflow and only paste the data into a new workbook if they feel comfortable ensuring that the formatting of the data is not lost in the pasting process.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Creating baseline .AgMIP files with "AgMIP Excel File Template_v2.0.xls" - 18

Confirm the presence of your new baseline .AgMIP file in "~/R/data/Climate/Historical". If you have successfully produced your baseline .AgMIP file, you can proceed to the next section, Running AgMIP Climate Scenario Generation scripts.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

★Running AgMIP Climate Scenario Generation scripts

At this point, you should have:

- Downloaded and installed R and necessary packages as explained in the section **Installation**
- Downloaded the input data and R scripts placing these files into the proper folder structure as described in the section **Downloading AgMIP Climate Scenario Generation Scripts and Data**
- Created your baseline .AgMIP files as outlined in the section **Creating baseline .AgMIP files with "AgMIP Excel File Template_v2.0.xls"**

If you have accomplished the above, you are now ready to run the AgMIP Climate scripts in R.

The following section will explain:

1. The input variables that will be modified for each of the run scripts
2. How to modify the run scripts
3. How to source the run scripts
4. An explanation of the output files

The subsection **Explanation of input variables to be changes in the run scripts** details the input variables that must be defined in the run scripts, the subsection **Modifying variables in the run scripts** generalizes how to prepare the run script and the subsection **Sourcing the run scripts** demonstrates how to run the script. If you have any questions with the naming convention imposed on the output files, please refer to the subsection **Explanation of output files**.

★Explanation of input variables to be changed in the run scripts

We will be changing the run scripts to reflect the information for your specific location and analytical requirements. The run scripts all begin with **"run"** and call the scripts that are identically named but do not begin with "run" (e.g. "**run_agmip_farmclimate.R**" calls "agmip_farmclimate.R" and "**run_agmip_simple_delta.R**" calls "agmip_simple_delta.R"). These scripts have been designed so that you only have to edit the run scripts and should not have to open the other scripts.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

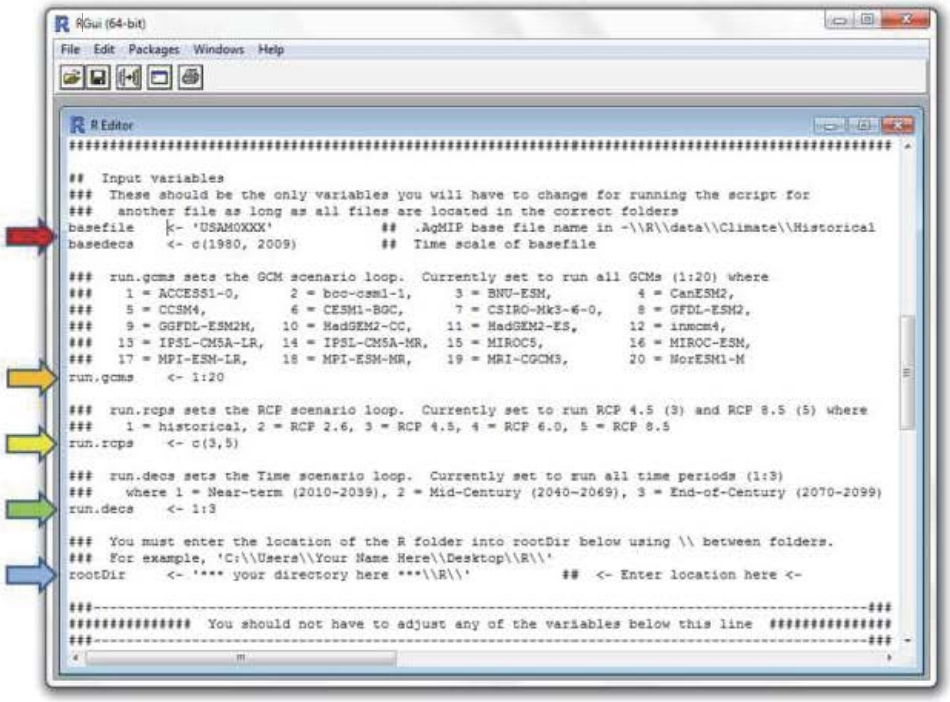
Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Running AgMIP Climate Scenario Generation scripts - 20

Essentially, the run scripts set the variables and parameters of the analysis. These run scripts are also designed to loop through multiple scenarios, thus producing many .AgMIP files with multiple scenario changes imposed upon the baseline data (different emission scenarios or future time periods, for example).

All of the run scripts have been similarly designed and share many of the same input variables. To simplify the explanation for using these AgMIP Climate scripts, we have provided a list of the input variables in this subsection that will need to be changed prior to running, or "sourcing", of the scripts. To clarify, each run script will require that some, but not all, of the input variables listed in this subsection be defined.

We recommend that you read through this subsection to become familiar with the input variables that you will be changing. It is our intention that this subsection will be used as a reference later if you have a question about a particular input variable. In the next subsection, Modifying variables in the run scripts, we will describe how to change these input variables. Below is a screenshot of the "Input Variables" section of the script "run_agmip_simple_delta.R".



Colored arrows identify the input variables that will need to be adjusted for this run script. The "#" symbol is used to "comment out" lines and provides you with information about the input variables. The script skips lines that have been commented when it is being sourced.

The next few pages describe the input variables that you will be required to adjust prior to sourcing the run scripts.

rootDir – This variable, as identified by the blue arrow in the screenshot on the previous page, sets the location, or root directory, of your "~/R/" folder discussed in the subsection, **Creating folders for R scripts and input data**. If you created the recommended folder structure, defining this variable is straightforward. There is a line in every run script that reads:

```
rootDir     <- '*** your directory here ***\\R\\'
```

Simply replace the text "******* your directory here*******" with the location of your newly created R directory in the script using double forward slashes (\\) to separate folders. For example, if the location of the R folder is

```
C:\Users\Your Name Here\Desktop\R\
```

then the **rootDir** should look as follows

```
rootDir     <- 'C:\\Users\\Your Name Here\\Desktop\\R\\'
```

IMPORTANT: The variable **rootDir** should not change from run to run. We recommend that you save the run script with updated **rootDir** to reflect the location of "~/R/" so you do not have to enter this information for every run. The other input variables should be changed with each new run to reflect the specific parameters of your current analysis.

basefile – This is the **8 digit baseline .AgMIP file name** described in the subsection **Creating baseline .AgMIP files with the enabled macro** and identified by the red arrow on the previous page. The first four digits describe the location of the station/site while the last four digits denote the type of scenario that was imposed on the historic data. Specifically, the first 2 digits are an abbreviation for the country, which can be found at the website <**http://www.web-l.com/country-codes/**>, while the second 2 digits refer to the specific site location and are up to you to assign. For a baseline file, the last four digits should be "0XXX". For example, we have

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

defined the **basefile** for Ames, Iowa, USA to be "USAM0XXX". Thus the run script input variable line would look like

```
basefile    <- 'USAM0XXX'
```

More information about the naming convention can be found in the subsection, **Explanation of output files**.

seedfile – Similar to **basefile, seedfile** is the 8 digit code of your baseline climate file. The input variable **seedfile** is used in the script "**run_agmip_farmclimate.R**" as this will be the dataset from which other local farm sites' climate files will be constructed. For example, the 8 digit code of the **seedfile** would be "KEMB0XXX" if the baseline AgMIP file was named "KEMB0XXX.AgMIP".

shortregion – Another input variable used exclusively with "**run_agmip_farmclimate.R**", **shortregion** is a 2 digit identifier used for a particular region for which you will be producing multiple files. Typically, it is sufficient to simply strip off the country code. For example, the country code "KE" can be stripped off the **seedfile** "KEMB0XXX" leaving the regional code "MB". The resulting output files from "**run_agmip_farmclimate.R**" will be named "MB010XFX.AgMIP", "MB020XFX.AgMIP", "MB030XFX.AgMIP"…

end.code – This input variable, used exclusively in "**run_agmip_simple2full.R**", denotes the last two (seventh and eighth) digits of the files to be adjusted. For example, if you want to adjust all of the files of the structure "USAM**XA.AgMIP" with a baseline file of "USAM0XXX.AgMIP" to the full format, the
would be "XA". This would set the run script to cycle through the scenarios (defined by , **run.rcps**, and **run.decs**) of all the files in "~/R/data/Climate/Simplescenario" that begin with "USAM" and end with "XA".

basedecs – This variable, also identified by the red arrow in the screenshot, assigns the beginning and end year of the dataset's 30-year time interval. Typically, the test file runs from January 1, 1980 to December 31, 2009, thus the years entered for the test file's 30-year time interval are 1980 and 2009. To assign
seedfile – Similar to **basefile, seedfile** is the 8 digit code of your baseline climate file. The input variable **seedfile** is used in the script "**run_agmip_farmclimate.R**" as this will be the dataset from which other local farm sites' climate files will be constructed. For example, the 8 digit

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

code of the **seedfile** would be "KEMB0XXX" if the baseline AgMIP file was named "KEMB0XXX.AgMIP".

shortregion – Another input variable used exclusively with "**run_agmip_farmclimate.R**", **shortregion** is a 2 digit identifier used for a particular region for which you will be producing multiple files. Typically, it is sufficient to simply strip off the country code. For example, the country code "KE" can be stripped off the **seedfile** "KEMB0XXX" leaving the regional code "MB". The resulting output files from "**run_agmip_farmclimate.R**" will be named "MB010XFX.AgMIP", "MB020XFX.AgMIP", "MB030XFX.AgMIP"…

end.code – This input variable, used exclusively in "**run_agmip_simple2full.R**", denotes the last two (seventh and eighth) digits of the files to be adjusted. For example, if you want to adjust all of the files of the structure "USAM**XA.AgMIP" with a baseline file of "USAM0XXX.AgMIP" to the full format, the
would be "XA". This would set the run script to cycle through the scenarios (defined by , **run.rcps**, and **run.decs**) of all the files in "~/R/data/Climate/Simplescenario" that begin with "USAM" and end with "XA".

basedecs to run from 1980 to 2009, this input variable would be assigned as

```
basedecs      <- c(1980,2009)
```

If you have data for 2010, you have the option of either selecting the time period from 1980 to 2009 or 1981 to 2010. If you chose to select 1981 to 2010, you would enter the input variable as

```
basedecs      <- c(1981,2010)
```

to assign
seedfile – Similar to **basefile**, **seedfile** is the 8 digit code of your baseline climate file. The input variable **seedfile** is used in the script "**run_agmip_farmclimate.R**" as this will be the dataset from which other local farm sites' climate files will be constructed. For example, the 8 digit code of the **seedfile** would be "KEMB0XXX" if the baseline AgMIP file was named "KEMB0XXX.AgMIP".

shortregion – Another input variable used exclusively with "**run_agmip_farmclimate.R**", **shortregion** is a 2 digit identifier used for a particular region for which you will be producing multiple files. Typically, it is sufficient to simply strip off the country code. For example, the

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

country code "KE" can be stripped off the **seedfile** "KEMB0XXX" leaving the regional code "MB". The resulting output files from "**run_agmip_farmclimate.R**" will be named "MB010XFX.AgMIP", "MB020XFX.AgMIP", "MB030XFX.AgMIP"…

end.code – This input variable, used exclusively in "**run_agmip_simple2full.R**", denotes the last two (seventh and eighth) digits of the files to be adjusted. For example, if you want to adjust all of the files of the structure "USAM**XA.AgMIP" with a baseline file of "USAM0XXX.AgMIP" to the full format, the
would be "XA". This would set the run script to cycle through the scenarios (defined by , **run.rcps**, and **run.decs**) of all the files in "~/R/data/Climate/Simplescenario" that begin with "USAM" and end with "XA".

basedecs to run over this time scale. Generally you should not have to change this input variable.

headerplus – This variable allows you to enter additional information into the first line of the produced AgMIP files. Typically it is sufficient to simply enter in the location of the site (Ames, Iowa, USA or Embu, Kenya, for example). Occasionally it is useful to include information about where the file data is from or how the file data was calculated. You should not have to change this input variable, but feel free to include additional information as you see appropriate.

run.gcms – This variable, identified by the orange arrow, is used to control which GCMs will be used to create the output files. Below are two tables of the GCMs with their corresponding value.

GCM	run.gcms value
ACCESS1-0	1
bcc-csm1-1	2
BNU-ESM	3
CanESM2	4
CCSM4	5
CESM1-BGC	6
CSIRO-Mk3-6-0	7
GFDL-ESM2	8
GGFDL-ESM2M	9
HadGEM2-CC	10

GCM	run.gcms value
HadGEM2-ES	11
inmcm4	12
IPSL-CM5A-LR	13
IPSL-CM5A-MR	14
MIROC5	15
MIROC-ESM	16
MPI-ESM-LR	17
MPI-ESM-MR	18
MRI-CGCM3	19
NorESM1-M	20

The run scripts are set to run through all 20 of the GCMs will the following line:

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

```
run.gcms      <- 1:20
```

The script is designed to run through the GCMs as they are ordered in the variable gcmname (the same ordering as appears in the table above). The ordering of the GCMs is also provided in the commented lines directly above this input variable (as can be seen in the screenshot). Say, for example, you want to run the script for BNU-ESM2M, HadGEM2-CC and MIROC5 which are positioned as the 3rd, 10th and 15th in gcmlist. You would then define as

```
run.gcms      <- c(3,10,15)
```

If you only want to run the first five GCMs follow the same procedure and enter the line

```
run.gcms      <- c(1,2,3,4,5)
```

Or alternatively,

```
run.gcms      <- 1:5
```

run.rcps – This input variable, identified by the yellow arrow, is used to control which emissions scenarios (RCPs) will be used to create the output files. Below is a table denoting the values of **run.rcps** along with the corresponding emissions scenario (RCPs).

RCP	run.rcps value
Historical	1
RCP 2.6	2
RCP 4.5	3
RCP 6.0	4
RCP 8.5	5

NOTE: While the script is designed to run RCP 2.6 (2) and RCP 6.0 (4), the data for these two emissions scenarios has not been included in the data provided by the links in the subsection **Downloading R scripts and data from WebDrive**. Thus, you should only define **run.rcps** as a 1, 3, or 5 (historical, RCP 4.5, or RCP 8.5) for the script to function correctly.

As can be seen in the screenshot, the run script "run_agmip_simple_delta.R" is set to run RCP 4.5 (3) and RCP 8.5 (5) with the following line:

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Running AgMIP Climate Scenario Generation scripts - 26

```
run.rcps      <- c(3,5)
```

If you wish to produce files from another emissions scenario simply redefine **run.rcps**. For example, if you only want to run the script from the emissions scenario RCP 8.5 (5), set the input variable to 5 using the following line:

```
run.rcps      <- 5
```

If you want to run the script for the historical scenario (1) as well as RCP 4.5 (3) and RCP 8.5 (5) you can use the line

```
run.rcps      <- c(1,3,5)
```

IMPORTANT: Some of the run scripts ("**run_agmip_simple_mandv.R**" in particular) require a large amount of local memory. As such, we recommend that you run ***one emissions scenario at a time*** for "**run_agmip_simple_mandv.R**". If the script breaks while you are running one of the AgMIP Climate scripts due to memory issues, consider reducing the number of emissions scenarios or number of future the time periods. After the run has successfully completed, reboot your computer (to reset your local memory) and run the other time periods and emissions scenarios you will require.

run.decs – Another input variable, as identified by the green arrow, used to control the output files produced by the run scripts. This input variable is used to control which time periods will be used. Below is a table of the three preset future time periods.

Future time period	run.decs value	First year	Last year
Near-term	1	2010	2039
Mid-Century	2	2040	2069
End-of-Century	3	2070	2099

Similar to and **run.rcps**, this variable is easily adjusted. Below is a line demonstrating how to produce output files for Near-term and End-of-Century future time scenarios

```
run.decs      <- c(1,3)
```

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

If you wish to produce files over just the Mid-Century time period, use the line provided below.

```
run.decs      <- 2
```

datashort – This variable is used to define your sub-region for WorldClim files and is used exclusively by the script "**run_agmip_farmclimate.R**". Your region is determined by the table below and you should enter your region into the input variable **datashort**.

Datashort	Region Name	S. Lat	N. Lat	W. Lon	E. Lon
EAfrica	Eastern Africa	20˚S	22˚N	20˚E	53˚E
WAfrica	Western Africa	3˚N	25˚N	18˚W	15˚E
SAfrica	Southern Africa	36˚S	8˚S	11˚E	51˚E
Pakistan	Pakistan	23˚N	38˚N	60˚E	80˚E
IGB	Indo-Gangetic Basin	15˚N	38˚N	65˚E	97˚E
SIndiaSriLanka	S. India and Sri Lanka	5˚N	30˚N	70˚E	90˚E

If, for example, your region is located at 5˚N, 35˚E, you would enter the input variable as

```
datashort     <- 'EAfrica'
```

due to your location in the subregion of Eastern Africa.

sitelat – Another input variable used exclusively with "**run_agmip_farmclimate.R**". This input variable defines the series of site latitudes for which you are creating climate baseline files. This variable should be defined in terms of degrees North such that the values range from -90˚N (South Pole) to 90˚N (North Pole).

For example, below is the line from the run script that will produce 3 output .AgMIP files for farms at latitudes -0.7˚N, -0.6˚N and -0.75˚N respectively.

```
sitelat     <- c(-00.70, -00.60, -00.75)
```

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

IMPORTANT: AgMIP Climate Scenario Generation scripts since version 2.0 of the Guide extract information from the header of the .AgMIP files, thus the coordinates of the **seedfile** should not be included in the **datashort** – This variable is used to define your sub-region for WorldClim files and is used exclusively by the script **"run_agmip_farmclimate.R"**. Your region is determined by the table below and you should enter your region into the input variable **datashort**.

sitelon – Same as **datashort** – This variable is used to define your sub-region for WorldClim files and is used exclusively by the script **"run_agmip_farmclimate.R"**. Your region is determined by the table below and you should enter your region into the input variable **datashort**.

Datashort	Region Name	S. Lat	N. Lat	W. Lon	E. Lon
EAfrica	Eastern Africa	20˚S	22˚N	20˚E	53˚E
WAfrica	Western Africa	3˚N	25˚N	18˚W	15˚E
SAfrica	Southern Africa	36˚S	8˚S	11˚E	51˚E
Pakistan	Pakistan	23˚N	38˚N	60˚E	80˚E
IGB	Indo-Gangetic Basin	15˚N	38˚N	65˚E	97˚E
SIndiaSriLanka	S. India and Sri Lanka	5˚N	30˚N	70˚E	90˚E

If, for example, your region is located at 5˚N, 35˚E, you would enter the input variable as

```
datashort     <- 'EAfrica'
```

due to your location in the subregion of Eastern Africa.

sitelat, but with longitude. This variable should be defined in terms of degrees East such that 90˚W should be entered either as -90˚E or as 270˚E. For example, below is the line from the run script.

```
sitelon     <- c(37.54, 37.58, 37.69)
```

This example denotes that the run script will produce 3 output .AgMIP files for farms at longitudes 37.54˚E, 37.58˚E and 37.69˚E respectively.

Modifying variables in the run scripts

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

NOTE: For the purposes of this tutorial, we recommend that you perform the following modifications of the AgMIP Climate scripts using the R GUI to gain some familiarity with R's user interface. However, if you are familiar with R and feel more comfortable amending the scripts in your preferred text editor, feel free to do so.

This subsection explains the steps that are required to prepare a run script for use on your computer. This subsection generalizes how to make the adjustments to the script. The subsection, **Suggested workflows for the run scripts**, explains specifically how to run each of the AgMIP Climate run scripts. Like the previous subsection, **Explanation of input variables to be changed in the run scripts**. We recommend that you read through this subsection to get an idea of how to modify the run scripts and refer to it later if you have questions when working through the workflows presented in the subsection, **Suggested workflows for the run scripts**. The following section will explain:

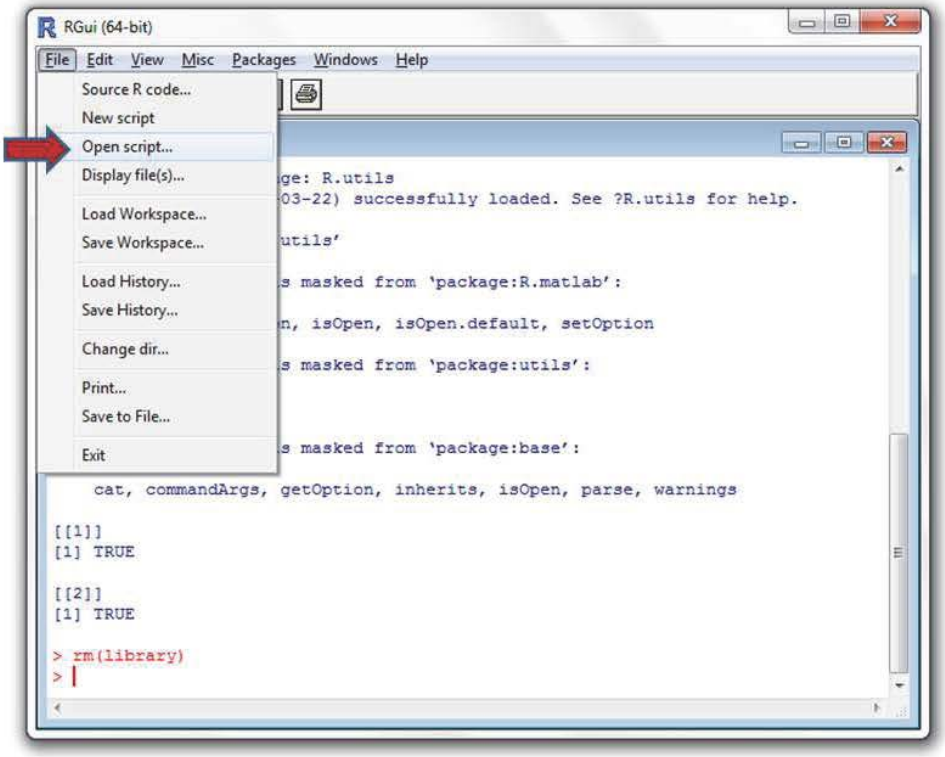
1. How to open a script in R
2. How to modify **rootDir** to tailor the run script for your computer
3. How to modify the other input variables

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Running AgMIP Climate Scenario Generation scripts - 30

We will begin by opening the run script you are interested in running. After opening R, there are a couple ways you can open the run script. You can either

- **Select "File > Open script…" from the menu bar along the top of the R window as indicated by the red arrow, or**
- **Press the open button, , in the toolbar (hidden in the below image by the drop-down window).**



If you followed the recommended folder structure outlined in the subsection, Creating folders for R scripts and input data, the scripts will be located in the folder "~/R/r/".

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Once you have opened the run script in the R editor, the next step is to adjust **rootDir** to reflect the location of your "~/R/" folder. Scroll down section "Input variables" below the run script heading to the line that reads:

```
rootDir     <- '*** your directory here ***\\R\\'
```

Enter the path to your root directory, that is the location of your "~/R/" folder, discussed in the subsection, **Creating folders for R scripts and input data** in the run script using double forward slashes (\\) to separate the folders. For an example, refer to **rootDir**.

NOTE: If you will be running these scripts for multiple station locations, we recommend that you save the run script at this point in time. The input variable **rootDir** should not change from run to run and thus you can save the run script to avoid having to adjust this variable for every run. The other input variables will be changed for different runs, so saving the script here is a logical saving point.

After **rootDir** is assigned, you will not have to change any of the other folder locations as the folder structure is hardwired into the scripts. The AgMIP Climate scripts were intentionally designed this way to make this process as simple as possible.

After saving the run script, you will have to define the input variables (described in the previous subsection, **Explanation of input variables to be changed in the run scripts**) prior to every run. You can edit the script either in R editor or another text editor of your choosing. We will continue to use R editor in this Guide.

Each AgMIP Climate Scenario Generation script has a section for the input variables that must be assigned to run the script successfully. The next section, **Suggested workflows for the run scripts**, outlines the input variables that will need to be defined. These input variables will need to be defined prior to every run. After properly defining these input variables, you would be ready to run, or source, the AgMIP climate script.

IMPORTANT: At this point you have to save the run script to "~/R/r/". ***We recommend that you save the script as a separate file with a unique name*** (e.g. "run_agmip_farmclimate_stn1" or "run_agmip_simple2full_USAM_delta3") to reflect the particular station, dataset or analysis. This will retain the initial AgMIP run script as a template for future analyses.

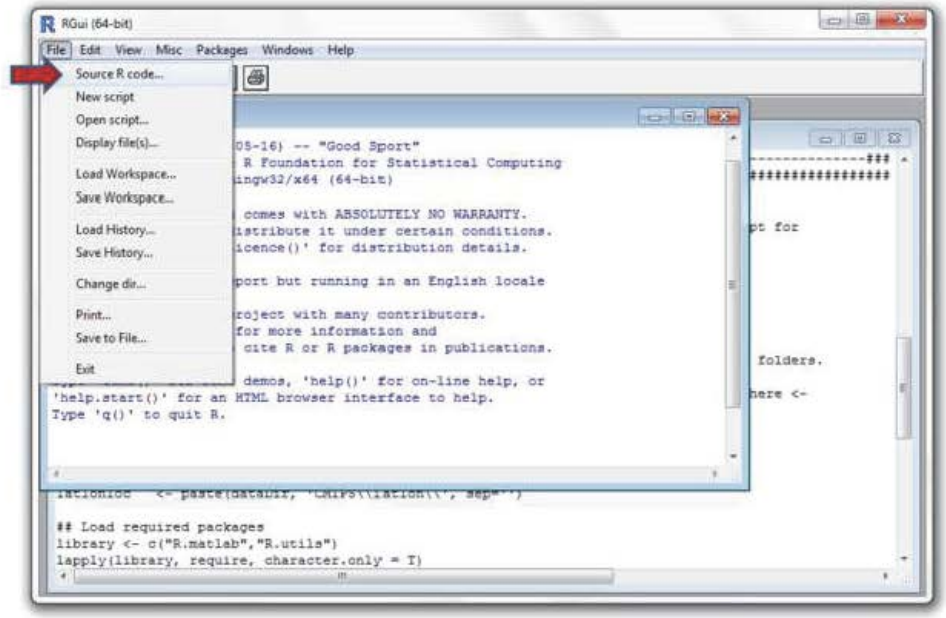
Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Running AgMIP Climate Scenario Generation scripts - 32

Sourcing the run scripts

After defining the input variables of your run script and saving the run script with a unique name to "~/R/r/", return to the R Console window. To run your amended run script, select "File > Source R code…" from the menu bar as is indicated by the red arrow in the screenshot below. It is important that you are in the R Console, otherwise "Source R Code" will not be an option in the File dropdown menu.

IMPORTANT: You must save the run script with your changes to the input variable definitions for the scripts to be sourced correctly.



After you select "Source R code…", navigate to "~/R/r/" and select your amended and saved run script. Typically the run scripts will take a few hours to run as they are batch creating multiple files based on a variety of scenarios.

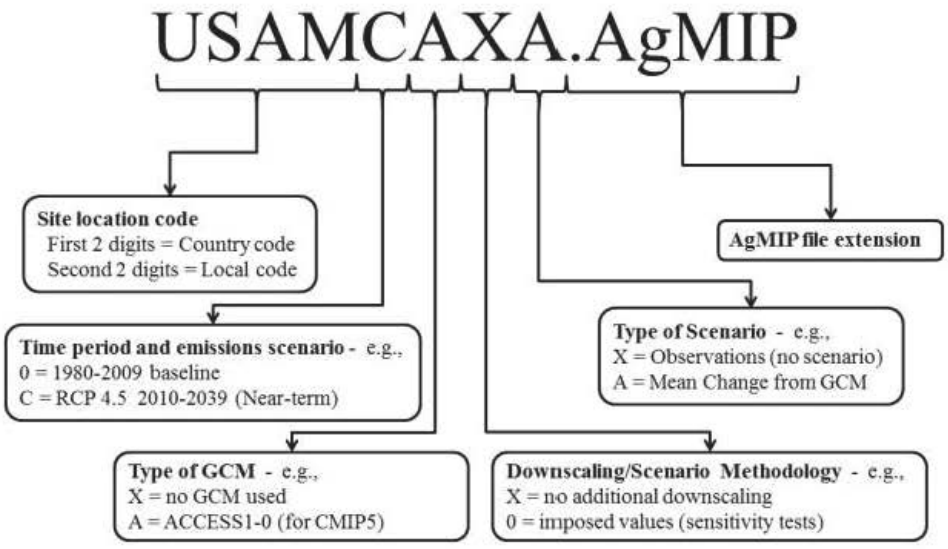
Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

The next section, **Explanation of output files**, describes the naming convention that is used with the 8 digit AgMIP file names. The following section, **Suggested workflows for the AgMIP Climate run scripts**, outline suggested procedures for using the different AgMIP run scripts.

Explanation of output files

The provided AgMIP run scripts create a series of files that are named with an eight digit code. This naming convention was created to help convey details of the scenarios so that they may be understood by other AgMIP participants and the AgMIP IT tools.

Below is a brief explanation of the key (pages 33-34) for this code. The file in the figure below is the first file that would be created from running "**run_agmip_simple_delta.R**" with the preset parameters using the given test AgMIP baseline file, "USMA0XXX.AgMIP".



The first 4 digits, as described by **8 digit baseline .AgMIP file name** in the subsection **Creating baseline .AgMIP files with the enabled macro** and **basefile** in the subsection **Explanation of input variables to be changed in the run scripts**, are used to describe the location of the climatological (meteorological) station where your historical dataset was collected. In the above example, the code "USAM" is used to describe the location where the first 2 letters are an abbreviation for the country (US = United States). The website, <**http://www.web-**

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

l.com/country-codes/>, provides 2 letter codes for countries and we recommend that you use these abbreviations for the first two digits of your 8 digit code.

The second 2 digits refer to the site location and are up to you to define. For the code "USAMCAXA", the "AM" is used to denote Ames, Iowa. Use your discretion when choosing these digits. These digits should help create a unique code for your file so try to avoid redundant digits.

The fifth digit describes the time period and emissions scenario. Generally, the run scripts are designed to loop through multiple time periods and emissions scenarios when producing new files and this digit is automatically assigned to reflect the parameters imposed upon the dataset. In the example on the previous page, the fifth digit, C, denotes that the file uses RCP 4.5 over the future time period from 2010-2039. A baseline AgMIP file has a zero (0) as the fifth digit defining that the file's time period runs from 1980-2009 and does not have an imposed emissions scenario.

The sixth digit typically denotes the imposed GCM scenario from CMIP5. For the purposes of many of the analyses that will be conducted in the future, the CMIP5 GCM outputs will be used unless otherwise mentioned. In the example, the sixth digit is an "A", which tells us that this particular file had a GCM scenario imposed on the baseline data from ACCESS1-0. A baseline AgMIP file has an X as the sixth digit denoting that there was no GCM used in the creation of the file. Similar to the fifth digit, the sixth digit is typically assigned within the AgMIP run script loops.

The seventh digit is used to impose additional downscaling or sensitivity tests on the baseline dataset. Generally this variable is unchanged when using the scripts described in this Guide unless you impose downscaling or scenario methodology independently. As a result, this digit is usually X, denoting that there has been no additional downscaling.

The eighth digit tells us the type of scenario that has been imposed for this particular file. For the example code on the previous page, "USAMCAXA", the eighth digit, "A", tells us that there has been a mean change imposed a calculated from a GCM. This digit is typically assigned by the loop in the run script, but in when using the script "run_agmip_simple2full.R" you will need to identify this variable to specify files that you would like to be expanded to full files. The eighth digit is an "X" for the baseline AgMIP files, defining the file to be a dataset of daily observations.

The next two pages (pages 33-34) list the key for the fifth, sixth, seventh and eighth digits of the AgMIP file naming convention. The first four digits are user defined and thus do not require a key.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Fifth Digit is time period and emissions scenario:

0 = 1980-2009 baseline		C = RCP4.5	2010-2039 (Near-term)
1 = A2-2005-2035 (Near-term)		D = RCP6.0	2010-2039 (Near-term)
2 = B1-2005-2035 (Near-term)		E = RCP8.5	2010-2039 (Near-term)
3 = A2-2040-2069 (Mid-Century)		F = RCP2.6	2040-2069 (Mid-Century)
4 = B1-2040-2069 (Mid-Century)		G = RCP4.5	2040-2069 (Mid-Century)
5 = A2-2070-2099 (End-of-Century)		H = RCP6.0	2040-2069 (Mid-Century)
6 = B1-2070-2099 (End-of-Century)		I = RCP8.5	2040-2069 (Mid-Century)
S = sensitivity scenario		J = RCP2.6	2070-2099 (End-of-Century)
A = observational time period (determined in file)		K = RCP4.5	2070-2099 (End-of-Century)
		L = RCP6.0	2070-2099 (End-of-Century)
B = RCP2.6	2010-2039 (Near-term)	M = RCP8.5	2070-2099 (End-of-Century)

Sixth Digit is source of baseline data (if baseline scenario):

X = no GCM used
0 = imposed values (sensitivity tests)
Q = Bias-corrected MERRA
T = NASA POWER
U = NARR
V = Bias-corrected CFSR
W = MERRA
Y = NCEP CFSR
Z = NCEP/DoE Reanalysis-2

Sixth Digit is GCM (if CMIP3 scenario – these are not required for AgMIP full assessments):

X = no GCM used
0 = imposed values (sensitivity tests)
A = bccr
B = cccma cgcm3
C = cnrm
D = csiro
E = gfdl 2.0
F = gfdl 2.1
G = giss er
H = inmcm 3.0
I = ipsl cm4
J = miroc3 2 medres
K = miub echo g
L = mpi echam5
M = mri cgcm2
N = ncar ccsm3
O = ncar pcm1
P = ukmo hadcm3

Sixth Digit is GCM (if CMIP5 scenario):

0 = imposed values (sensitivity tests)
A = ACCESS1-0
B = bcc-csm1-1
C = BNU-ESM
D = CanESM2
E = CCSM4
F = CESM1-BGC
G = CSIRO-Mk3-6-0
H = GFDL-ESM2G
I = GFDL-ESM2M
J = HadGEM2-CC
K = HadGEM2-ES
L = inmcm4
M = IPSL-CM5A-LR
N = IPSL-CM5A-MR
O = MIROC5
P = MIROC-ESM
Q = MPI-ESM-LR
R = MPI-ESM-MR
S = MRI-CGCM3
T = NorESM1-M

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Running AgMIP Climate Scenario Generation scripts - 36

Seventh Digit is downscaling/scenario methodology:

X = no additional downscaling
0 = imposed values (sensitivity tests)
1 = WRF
2 = RegCM3
3 = ecpc
4 = hrm3
5 = crcm
6 = mm5i
7 = RegCM4
A = GiST
B = MarkSIM
C = WM2
D = 1/8 degree BCSD
E = 1/2 degree BCSD
F = 2.5minute WorldClim
W = TRMM 3B42
X = CMORPH
Y = PERSIANN
Z = GPCP 1DD

Eighth Digit is Type of Scenario:

X = Observations (no scenario)
A = Mean Change from GCM
B = Mean Change from RCM
C = Mean Change from GCM modified by RCM
D = Mean Temperature Changes Only
E = Mean Precipitation Changes Only
F = Mean and daily variability change for Tmax, Tmin, and P
G = P, Tmax and Tmin daily variability change only
H = Tmax and Tmin daily variability and mean change only
I = P daily variability and mean change only
J = Tmax and Tmin daily variability change only
K = P daily variability change only

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Suggested workflows for the run scripts

The following section details the specific workflows that should be used to run the AgMIP Climate Scenario Generation scripts. The previous section, **Running AgMIP Climate Scenario Generation scripts**, has generalized how to run these scripts while this section will present detailed workflows for the AgMIP Climate Scenario Generation scripts.

If you have any questions about the input variables, refer to the subsection, **Explanation of input variables to be changed in the run scripts** or simply click on the input variable for which you have a question.

In the overall workflow, this subsection picks up after you have successfully created your baseline .AgMIP file as described in the section **Creating baseline .AgMIP files with "AgMIP Excel File Template_v2.0.xls"**. This subsection then details how to:

1. Create new baseline AgMIP files for sites in the region of your climate station using "**run_agmip_farmclimate.R**".
2. Impose mean changes on the climate variables temperature maximum (Tmax), temperature minimum (Tmin) and precipitation (Rain) based on the GCMs with different emissions scenarios and across different time scales using "**run_agmip_simple_delta.R**".
3. Impose mean and variability changes to the climate variables temperature maximum (Tmax), temperature minimum (Tmin) and precipitation (Rain) based on the GCMs with different emissions scenarios and across different time scales using "**run_agmip_simple_mandv.R**".
4. Convert file simple output files created by either "**run_agmip_simple_delta.R**" or "**run_agmip_simple_mandv.R**" to full files (including wind speed (Wind) and relative humidity (Rhum) from the baseline AgMIP file and modified dew point (Dewp), vapor pressue (Vprs) derived from changes to Tmax) using "**run_agmip_simple2full.R**".

To reiterate, the run scripts are designed to batch produce a number of .AgMIP files by calling the script of the same name but without the "run" prefix (for example, "**run_agmip_farmclimate.R**" calls "agmip_farmclimate.R" and "**run_agmip_simple2full.R**" calls "agmip_simple2full.R"). The run scripts are designed to loop through multiple scenarios to reduce the number of times you will need to run these scripts. The following workflows explain how these run scripts should be used and have some information on how they can be tailored for your needs.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

run_agmip_farmclimate.R

The run script "**run_agmip_farmclimate.R**" creates baseline .AgMIP files for a series of locations (farms) in a given region. This script can be used to create climate files for a large number of farm locations that are close to a central weather station where the historical climate series has been quality controlled. If the farms are greater than ~100km away it may be better to pull the sites directly from Ag-MERRA dataset.

The workflow is fairly simple if you have placed all of the files in the correct location as described in **Creating folders for R scripts and input data**. All you will have to do is switch a couple of the input variables in the run script prior to each run.

To run this script,

1. Open R and then open the run script "**run_agmip_farmclimate.R**" to edit the input variables. You could also edit the run script in a text editor if you prefer.
2. Change the **rootDir** to reflect the location of the folder "R" and **datashort** to reflect your WorldClim sub-region.
3. Save the updated run script as your template "**run_agmip_farmclimate.R**" script.

Adjust the input variables **seedfile, shortregion, headerplus, datashort** – This variable is used to define your sub-region for WorldClim files and is used exclusively by the script "**run_agmip_farmclimate.R**". Your region is determined by the table below and you should enter your region into the input variable **datashort**.

Datashort	Region Name	S. Lat	N. Lat	W. Lon	E. Lon
EAfrica	Eastern Africa	20°S	22°N	20°E	53°E
WAfrica	Western Africa	3°N	25°N	18°W	15°E
SAfrica	Southern Africa	36°S	8°S	11°E	51°E
Pakistan	Pakistan	23°N	38°N	60°E	80°E
IGB	Indo-Gangetic Basin	15°N	38°N	65°E	97°E
SIndiaSriLanka	S. India and Sri Lanka	5°N	30°N	70°E	90°E

If, for example, your region is located at 5°N, 35°E, you would enter the input variable as

```
datashort     <- 'EAfrica'
```

due to your location in the subregion of Eastern Africa.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

4. **sitelat**, and **sitelon** to reflect your station information (of the base file). For **headerplus**, simply enter the location of the station (for example, "Ames, Iowa, USA" or "Nioro, Senegal).
5. Save the amended script with a unique name (for example, "run_agmip_farmclimate_1.R" or "run_agmip_farmclimate_Station144.R") to "~/R/r/".
6. Confirm the presence of your baseline file, "****0XXX.AgMIP" in "~/R/data/Climate/Historical/".
7. Source (run) the script from the R Console.
8. Try not to use your computer if possible to improve run time of script.
9. After the script has completed, the baseline .AgMIP files for a series of locations should be located in "~\\R\\data\\Climate\\Historical\\". Confirm the presence of these files.

Although we did not provide you with a test file for this script, there is an example of an output from "**run_agmip_farmclimate.R**" shown in **Appendix 2**. The example file demonstrates the format of the .AgMIP files produced by this run script. This script should run quickly but will take more time depending on the number of sites for which you are producing baseline .AgMIP files.

> **Note:** When closing R, you will be asked to save your workspace. This saves the working environment (data, functions, etc.) and should not be necessary for the purposed of running the AgMIP Climate scripts.

run_agmip_simple_delta.R

This script creates delta scenarios from CMIP5 GCMs and BCSD in the AgMIP standard format. You can either use your baseline AgMIP file or the newly created AgMIP files produced by "**run_agmip_farmclimate.R**" as the input **basefile** for this run script. We are currently working on a run script that would loop through a series of **basefiles** to simplify larger batch runs.

To run this script,

1. Open R and then open the run script "**run_agmip_simple_delta.R**" to edit the input variables. You could also edit the run script in a text editor if you prefer.
2. Change the **rootDir** to reflect the location of the folder "~/R".
3. Save the updated run script as your template "**run_agmip_simple_delta.R**" script.

Adjust the input variables **basefile** and

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

seedfile – Similar to **basefile**, **seedfile** is the 8 digit code of your baseline climate file. The input variable **seedfile** is used in the script "**run_agmip_farmclimate.R**" as this will be the dataset from which other local farm sites' climate files will be constructed. For example, the 8 digit code of the **seedfile** would be "KEMB0XXX" if the baseline AgMIP file was named "KEMB0XXX.AgMIP".

shortregion – Another input variable used exclusively with "**run_agmip_farmclimate.R**", **shortregion** is a 2 digit identifier used for a particular region for which you will be producing multiple files. Typically, it is sufficient to simply strip off the country code. For example, the country code "KE" can be stripped off the **seedfile** "KEMB0XXX" leaving the regional code "MB". The resulting output files from "**run_agmip_farmclimate.R**" will be named "MB010XFX.AgMIP", "MB020XFX.AgMIP", "MB030XFX.AgMIP"…

end.code – This input variable, used exclusively in "**run_agmip_simple2full.R**", denotes the last two (seventh and eighth) digits of the files to be adjusted. For example, if you want to adjust all of the files of the structure "USAM**XA.AgMIP" with a baseline file of "USAM0XXX.AgMIP" to the full format, the
would be "XA". This would set the run script to cycle through the scenarios (defined by , **run.rcps**, and **run.decs**) of all the files in "~/R/data/Climate/Simplescenario" that begin with "USAM" and end with "XA".

basedecs to reflect the relevant information of your baseline AgMIP file. You can also adjust the variables , **run.rcps**, and **run.decs** if you only require a subset of these input variables.

IMPORTANT: If you are having issues completing the script due to local memory issues, consider adjusting , **run.rcps**, and **run.decs**. Running subsets will produce fewer output files and use less of your local memory. After completing such a subset it is important to reboot your computer prior to running the next subset.

4. Save the amended script with a unique name (e.g. "run_agmip_simple_delta_Stn12.R" or "run_agmip_simple_delta_Farm67.R") to "~/R/r/".
5. Confirm the presence of your **basefile** in "~\\R\\data\\Climate\\Historical\\"
6. Source (run) the script from the R Console
7. Try not to use your computer if possible to improve run time of script.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

8. After the script has completed, the basic delta adjusted files should be located in ~\\R\\data\\Climate\\Simplescenario\\. Confirm the presence of these files.

The .AgMIP files produced by "**run_agmip_simple_delta.R**" only contain the climate variables Srad, Tmax. Tmin, and Rain. If you require any of the other climate variables (Wind, Dewp, Vprs, and/or Rhum) you can use "**run_agmip_simple2full.R**" to create full files. The subsection **Creating "full" files from "run_agmip_simple_delta.R" outputs** explains how to do this.

If you chose to source "**run_agmip_simple_delta.R**" with the test file, "USAM0XXX.AgMIP" to produce the simple future scenario files in .AgMIP format, you can check the first created file, "USAMCAXA.AgMIP", against the data shown in **Appendix 3**. However, the data shown in this Appendix is the output from "**run_agmip_simple_delta.R**" and "**run_agmip_simple2full.R**" so remember that the example displays data for wind speed (WIND), dew point (DEWP), vapor pressure (VPRS), and relative humidity (RHUM) as well.

run_agmip_simple_mandv.R

The script "agmip_simple_mandv.R" applies mean and variability changes to temperature maximum (Tmax), temperature minimum (Tmin) and precipitation (Rain) of the input baseline .AgMIP file. The other climate variables (Srad, Wind, Dewp, Vprs, Rhum) are not adjusted by this script.

Running this script is similar to "**run_agmip_simple_delta.R**" in that you should only have to change the root directory (**rootDir**), adjust the input variables, and the run script will impose a series of changes to the baseline file to create a batch of output files. Below is a suggested workflow for running "**run_agmip_simple_mandv.R**":

To run this script,

1. Open R and then open the run script "**run_agmip_simple_mandv.R**" to edit the input variables. You could also edit the run script in a text editor if you prefer.
2. Change the **rootDir** to reflect the location of the folder "~/R".
3. Save the updated run script as your template "**run_agmip_simple_delta.R**" script. Adjust the input variables **basefile** and **headerplus** to reflect the relevant information of your baseline AgMIP file. Change **headerplus** from "Ames, Iowa, USA" to the text with the station or site location. We recommend that you leave the text "with mean and daily

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

variability changes for Tmax, Tmin and P". You can also adjust the variables , **run.rcps**, and **run.decs** to run a subset of these input variables.

IMPORTANT: This run script, "**run_agmip_simple_mandv.R**" will quickly use up your local memory. We recommend that you only run one emissions scenario (as defined by **run.rcps**) and one time period (as defined by **run.decs**) per run to ensure the script finishes without encountering any memory issues. It is important to remember to restart your computer after completing a run if you intend on running another analysis.

4. Save the amended script with a unique name (e.g. "run_agmip_simple_mandv_Stn12.R" or "run_agmip_simple_mandv_Farm67.R") to "~/R/r/".
5. Confirm the presence of your **basefile** in "~\\R\\data\\Climate\\Historical\\"
6. Source (run) the script from the R Console
7. Try not to use your computer if possible to improve run time of script.
8. After the script has completed, the basic delta adjusted files should be located in ~\\R\\data\\Climate\\Simplescenario\\. Confirm the presence of these files.

The .AgMIP files produced by "**run_agmip_simple_mandv.R**" only adjust the climate variables Tmax. Tmin, and Rain. The other climate variables (Srad, Wind, Dewp, Vprs, and Rhum) are pasted into this file from the AgMIP file you specified as the **basefile**. If you require that Dewp and Vprs are updated to reflect changes in Tmax, you can use "**run_agmip_simple2full.R**" to create full files. The subsection **Creating "full" files from "run_agmip_simple_mandv.R" outputs** explains how to do this.

IMPORTANT: The script "**agmip_simple_mandv.R**" occasionally has difficulties applying the mean and variability changes without significantly changing the distribution and will notify you that there is a poor fit. The script is designed to then loop through and try to apply the changes two more times. If the run script is unable of applying the changes after three tries, the script will fill in that particular month with -99 values.

If you encounter this issue, you can try to run the script again (after it has completed creating the other output files and rebooting your computer) specifically for this file by using , **run.rcps**, and **run.decs**. If the problem persists, please contact us so we can help you resolve this issue and produce the .AgMIP files you require for your research.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

run_agmip_simple2full.R

The script "agmip_simple2full.R" converts basic future scenarios (Srad, Tmax, Tmin, Rain) into full scenarios with relative humidity-controlled dew point and vapor pressure based upon daily Tmax. The script fills Wind and Rhum with the data from the input baseline AgMIP file and computes new values for Dewp and Vprs based on Tmax and Rhum.

The run script can be used for output AgMIP files from "run_agmip_simple_delta.R" and from "run_agmip_simple_mandv.R". Both have slightly different workflows, thus there are two subsections, **Creating "full" files from "run_agmip_simple_delta.R" outputs** and **Creating "full" files from "run_agmip_simple_mandv.R" outputs**, describing how to use this run script.

Creating "full" files from "run_agmip_simple_delta.R" outputs

After running "run_agmip_simple_delta.R" you will have a series of basic delta adjusted .AgMIP files located in "~/R/data/Climate/Simplescenario/". These new AgMIP files contain adjusted data for temperature maximum (Tmax), temperature minimum (Tmin) and precipitation (Rain) as well as the baseline data for solar radiation (Srad).

If you require the full delta adjusted .AgMIP files with wind speed (Wind), dew point (Dewp), vapor pressure (Vprs), and the relative humidity (Rhum), you will have to run the script "run_agmip_simple2full.R". This run script will paste the baseline values for Wind and Rhum and will calculate new values for Dewp and Vprs using relative humidity controlled vapor pressure based on daily Tmax..

> **IMPORTANT:** The script, "run_agmip_simple2full.R", uses the outputs from "run_agmip_simple_delta.R" to create the full delta adjusted .AgMIP files. Thus "run_agmip_simple_delta.R" **must be run prior to** "run_agmip_simple2full.R" for the script to function correctly.

To run this script,

1. Open R and then open the run script "run_agmip_simple2full.R" to edit the input variables. You could also edit the run script in a text editor if you prefer.

2. Change the **rootDir** to reflect the location of the folder "~/R".
3. Save the updated run script as your template "**run_agmip_simple2full.R**" script.

Adjust the input variables **basefile** and

to reflect the relevant information of your baseline AgMIP file. For AgMIP files produced by "**run_agmip_simple_delta.R**", the variable

should be defined as "XA" unless you have made other downscaling adjustments to the files. You should also adjust the variables , **run.rcps**, and **run.decs** to run a subset of these input variables based on the files you produced by "**run_agmip_simple_delta.R**" and the files for which you require a full climate dataset.

4. Save the amended script with a unique name (e.g. "run_agmip_simple2full_1.R" or "run_agmip_simple2full_deltas.R") to "~/R/r/".
5. Confirm the presence of your **basefile** in "~/R/data/Climate/Historical/" as well as the simple files to be converted in "~/R/data/Climate/Simplescenario/".
6. Source (run) the script from the R Console
7. Try not to use your computer if possible to improve run time of script.
8. After the script has completed, the basic delta adjusted files should be located in ~\\R\\data\\Climate\\Fullscenario\\. Confirm the presence of these files.

If you chose to run "**run_agmip_simple_delta.R**" and "**run_agmip_simple2full.R**" with the test file, "USAM0XXX.AgMIP" to produce the full future scenario files in .AgMIP format, you can check the first created file "USAMCAXA.AgMIP", against the data shown in **Appendix 3**.

Creating "full" files from "run_agmip_simple_mandv.R" outputs

If you require that the mean and variability change is also applied dew point (Dewp) and vapor pressure (Vprs), the run script "**run_agmip_simple2full.R**" can be used to expand these files. The script "**run_agmip_simple2full.R**" was updated for version 2.0 of the Guide to use the files produced by "**run_agmip_simple_mandv.R**" (found in "~/R/data/Climate/Simplescenario"). The run script calculates new daily values for Dewp, and Vprs based on the baseline relative humidity (Rhum) and the newly calculated temperature maximum (Tmax). The run script produces new "full" files located in "~/R/data/Climate/Fullscenario".

To run this script and convert the simple files to full,

1. Open R and then open the run script "**run_agmip_simple2full.R**" to edit the input variables. You could also edit the run script in a text editor if you prefer.
2. Change the **rootDir** to reflect the location of the folder "~/R".

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

3. Save the updated run script as your template "**run_agmip_simple2full.R**" script. Adjust the input variables **basefile**, and to reflect the relevant information of your baseline AgMIP file. For AgMIP files produced by "**run_agmip_simple_mandv.R**", the variable should be defined as "XF" where "X" denotes "no additional downscaling" and "F" denotes "Mean and daily variability change for Tmax, Tmin, and P". If you have made additional downscaling adjustments to your AgMIP files to be converted, adjust accordingly. You can also adjust , **run.rcps**, and **run.decs** to run a subset of these input variables based on the files you produced by "**run_agmip_simple_mandv.R**" and the files for which you require a full climate dataset.
4. Also, you should change the **headerplus** information to read "<your site location, country> with mean and daily variability changes for Tmax, Tmin and P"
5. Save the amended script with a unique name (e.g. "run_agmip_simple2full_2.R" or "run_agmip_simple2full_mandv_1.R") to "~/R/r/".
6. Confirm the presence of your **basefile** in "~/R/data/Climate/Historical/" as well as the simple files to be converted in "~/R/data/Climate/Simplescenario/".
7. Source (run) the script from the R Console
8. Try not to use your computer if possible to improve run time of script.
9. After the script has completed, the basic delta adjusted files should be located in ~\\R\\data\\Climate\\Fullscenario\\. Confirm the presence of these files.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Next Steps…

This concludes Version 2.0 of the Guide for Running AgMIP-Climate Scenario Generation Tools with R in Windows. We will be expanding this Guide in the future to include other climate scenario tools. Your feedback is helpful and we appreciate any suggestions or recommendations you may have to improve this Guide.

If you have further questions, contact please feel free to contact Nicholas Hudson at **nih2106@columbia.edu**.

Thanks again for your collaboration and good luck with R!

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Appendix 1: Creating .AgMIP files in Excel

This appendix describes how to create .AgMIP files in Excel manually without use of "AgMIP Excel File Template_v2.0.xls".

Here's the general approach:
1) Arrange data series in excel spreadsheet with proper column order, proper units, etc. Missing values should be filled with -99 (you can get RHUM and wind speed from the MERRA-based dataset I provided if you do not have these, but Tdew and VPRS will need additional conversion and can be left as missing for the purposes of the R routines described in this Guide.

2) Highlight all of the four columns that indicate date: @DATE, YYYY, MM, and DD (e.g., their first entries are "1980001 1980 1 1"), right click, and select "format cells". Select the number category and then change the number of Decimal places to 0.

3) Highlight the columns corresponding to SRAD, TMAX, TMIN, RAIN, WIND, DEWP, and VPRS, right click, and select "format cells". Select the number category and then change the number of Decimal places to 1.

4) Highlight the column corresponding to RHUM, right click, and select "format cells". Select the number category and then change the number of Decimal places to 0.

5) Right-click on the column letter at the top of the excel spreadsheet for the @DATE column (e.g., the "A" for Column A), select "Column Width" and set the column width to 7.

6) Right-click on the column letter at the top of the excel spreadsheet for the YYYY column (e.g., the "B" for Column B), select "Column width", and set the column width to 6.

7) Right-click on the column letter at the top of the excel spreadsheet for the MM and DD columns ("C" and "D"), select "Column width", and set the column width to 4.

8) Right-click on the column letter at the top of the excel spreadsheet for the remaining columns (SRAD to RHUM; "E" to "L"), select "Column width", and set the column width to 6.

9) Select "Save as" from the file menu and save as type "Formatted Text (Space Delimited)". Type in a full name with the extension (e.g., "USNY0XXX.AgMIP").

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

10) You may need to click yes on a dialog box asking if you want to save only this sheet, and after you click that you can cancel any other dialog boxes or separate save as screens that may appear.

11) Open the .AgMIP file in notepad and then copy 5-line header from a different existing .AgMIP file and paste it on top of the AgMIP file you just created. Modify header as necessary (e.g., header, 4-letter code, latitude, longitude, elevation). TAV is the average of all Tmax and Tmin in the dataset, and AMP is half of the difference between the warmest average monthly temperature and the coolest average monthly temperature averaged over the entire dataset. REFHT is the height of the thermometer and WNDHT is the height of the anemometer (put -99 if unknown).

12) Save the file to record these modifications.

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Appendix 2: Example file for "agmip_farmclimate.R"

Below is an example output data file created by "run_agmip_farmclimate.R" and located in "~\\R\\data\\Climate\\Historical\\". This data file is provided so that you can confirm that your script ran correctly. The first 32 days of the data have been provided below as well as the last 5 days of the data set (December 27-31, 2010).

*WEATHER DATA : Embu, Kenya, cast to site 01 using WorldClim-derived climatological differences

@ INSI	LAT	LONG	ELEV	TAV	AMP	REFHT	WNDHT				
MB01	-0.700	37.540	1097	20.4	2.0	-99.0	-99.0				
@DATE	YYYY	MM	DD	SRAD	TMAX	TMIN	RAIN	WIND	DEWP	VPRS	RHUM
1980001	1980	1	1	23.0	24.4	12.6	0.0	238.4	18.0	20.9	67
1980002	1980	1	2	23.8	27.1	12.1	0.0	202.7	19.6	23.1	63
1980003	1980	1	3	21.5	25.3	10.1	0.0	234.7	16.0	18.3	56
1980004	1980	1	4	23.9	26.2	12.3	0.0	220.0	15.9	18.2	52
1980005	1980	1	5	24.3	29.7	13.7	0.0	197.3	21.8	26.5	62
1980006	1980	1	6	23.1	25.9	12.1	0.0	163.4	17.7	20.4	60
1980007	1980	1	7	23.2	27.6	10.3	0.0	173.3	18.7	21.8	58
1980008	1980	1	8	24.4	27.6	12.9	0.0	213.5	16.9	19.4	51
1980009	1980	1	9	21.8	25.6	12.9	0.0	181.7	16.2	18.6	56
1980010	1980	1	10	23.8	26.7	12.5	0.0	104.6	14.7	16.9	47
1980011	1980	1	11	23.5	28.2	12.2	0.0	186.3	16.5	18.9	48
1980012	1980	1	12	19.9	25.9	14.1	0.0	199.3	15.3	17.5	51
1980013	1980	1	13	22.7	25.9	13.1	0.0	196.4	15.6	17.9	52
1980014	1980	1	14	22.4	26.2	11.6	0.0	212.4	16.5	18.9	54
1980015	1980	1	15	22.4	27.5	12.7	0.0	254.4	17.4	20.1	54
1980016	1980	1	16	20.2	25.9	15.1	0.0	179.7	17.1	19.7	58
1980017	1980	1	17	23.6	25.9	12.6	0.0	255.5	16.8	19.3	57
1980018	1980	1	18	21.3	27.1	13.3	0.0	183.0	16.8	19.2	52
1980019	1980	1	19	23.2	27.2	13.6	0.0	187.3	15.6	17.8	48
1980020	1980	1	20	24.1	27.8	11.6	0.0	237.0	17.1	19.7	51
1980021	1980	1	21	23.3	28.1	12.7	0.0	281.5	15.3	17.6	45
1980022	1980	1	22	23.6	27.1	13.1	0.0	247.3	16.1	18.5	50
1980023	1980	1	23	22.7	27.6	14.6	0.0	188.2	13.8	15.9	42
1980024	1980	1	24	21.0	29.5	14.5	0.0	146.4	16.6	19.1	45
1980025	1980	1	25	22.2	28.3	15.4	0.7	107.6	17.2	19.9	50
1980026	1980	1	26	22.1	25.2	18.1	0.3	118.5	16.7	19.2	59
1980027	1980	1	27	19.5	25.5	15.0	0.0	155.6	20.9	25.1	76
1980028	1980	1	28	3.5	25.9	16.1	0.0	148.9	19.7	23.3	68
1980029	1980	1	29	18.4	26.5	14.6	0.0	136.2	14.9	17.1	48
1980030	1980	1	30	3.1	25.8	18.1	0.0	102.9	15.2	17.4	51
1980031	1980	1	31	2.9	26.8	16.7	5.4	127.4	16.8	19.3	54
1980032	1980	2	1	20.0	26.0	16.1	0.0	150.4	17.5	20.2	59
...											
2010361	2010	12	27	18.7	26.0	17.3	5.8	77.5	16.2	18.5	54
2010362	2010	12	28	24.0	24.2	16.7	2.5	71.1	15.8	18.1	59
2010363	2010	12	29	20.1	26.0	15.0	0.0	75.4	14.4	16.5	48
2010364	2010	12	30	19.8	25.6	13.9	0.0	78.8	15.5	17.7	53
2010365	2010	12	31	23.7	26.2	14.3	0.0	70.7	13.2	15.3	44

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

Appendix 3: Example file for "agmip_simple_delta.R" and "agmip_simple2full.R"

Below is the data from "USAMCAXA.AgMIP", the first file that is created by "run_agmip_simple_delta.R" and "run_agmip_simple2full.R" located in "~\\R\\data\\Climate\\Fullscenario\\". This data file is provided so that you can confirm that your script ran correctly. The first 32 days of the data have been provided below as well as the last 5 days of the data set (December 27-31, 2010).

*WEATHER DATA : USAMCAXA - baseline dates maintained for leap year consistency

@ INSI	LAT	LONG	ELEV	TAV	AMP	REFHT	WNDHT				
USAM	42.017	-93.750	329	11.2	14.6	-99.0	-99.0				
@DATE	YYYY	MM	DD	SRAD	TMAX	TMIN	RAIN	WIND	DEWP	VPRS	RHUM
1980001	1980	1	1	1.2	1.3	-1.5	0.0	3.1	-0.3	6.0	89
1980002	1980	1	2	4.7	-0.3	-2.6	0.0	4.9	-7.6	3.5	58
1980003	1980	1	3	1.9	-0.3	-4.8	0.0	4.3	-9.0	3.1	52
1980004	1980	1	4	3.8	0.2	-2.6	0.0	4.1	-5.2	4.2	67
1980005	1980	1	5	1.0	0.2	-3.2	1.5	3.4	-2.5	5.1	82
1980006	1980	1	6	8.5	1.9	-7.0	2.1	9.1	-0.8	5.7	82
1980007	1980	1	7	6.7	-6.4	-15.9	0.0	8.2	-13.4	2.2	58
1980008	1980	1	8	6.7	-8.7	-16.5	0.0	2.9	-17.1	1.6	51
1980009	1980	1	9	2.2	-11.4	-20.4	1.5	3.7	-16.2	1.8	68
1980010	1980	1	10	8.0	6.3	-13.7	0.0	8.0	5.3	8.9	93
1980011	1980	1	11	4.0	11.3	-9.8	0.0	11.9	7.3	10.2	76
1980012	1980	1	12	8.6	0.8	-13.7	0.0	6.1	-10.4	2.8	43
1980013	1980	1	13	8.6	12.5	1.3	0.0	6.7	2.4	7.3	50
1980014	1980	1	14	2.1	6.9	-3.2	0.0	4.1	-1.0	5.7	57
1980015	1980	1	15	1.0	8.6	4.6	0.0	4.1	7.2	10.2	91
1980016	1980	1	16	1.9	7.5	2.4	24.4	5.6	7.4	10.3	99
1980017	1980	1	17	3.7	2.5	-2.6	1.2	5.6	-0.6	5.9	80
1980018	1980	1	18	1.4	1.3	-3.2	0.0	2.7	1.2	6.6	99
1980019	1980	1	19	1.3	1.3	-4.3	2.1	4.3	-0.0	6.1	91
1980020	1980	1	20	3.1	1.3	-8.2	0.0	2.1	-6.1	3.9	58
1980021	1980	1	21	10.4	1.3	-7.0	0.0	4.2	-0.0	6.1	91
1980022	1980	1	22	8.8	1.9	-5.4	0.0	8.2	-1.2	5.6	80
1980023	1980	1	23	2.9	-4.2	-10.9	0.0	4.0	-13.4	2.2	49
1980024	1980	1	24	5.0	6.9	-7.0	0.0	5.7	3.9	8.1	81
1980025	1980	1	25	6.9	5.8	-4.8	0.0	5.9	3.5	7.8	85
1980026	1980	1	26	7.5	-4.2	-14.3	0.0	6.1	-11.5	2.6	57
1980027	1980	1	27	5.9	-9.8	-13.2	0.0	4.5	-16.2	1.8	60
1980028	1980	1	28	9.0	-8.7	-12.6	0.0	4.6	-14.7	2.0	62
1980029	1980	1	29	4.8	-9.2	-16.5	0.0	3.8	-14.6	2.0	65
1980030	1980	1	30	12.7	-9.8	-12.6	1.5	4.7	-12.6	2.3	80
1980031	1980	1	31	4.7	-10.9	-19.8	0.0	3.8	-13.2	2.2	83
1980032	1980	2	1	6.7	-8.5	-22.8	0.0	3.0	-11.4	2.6	80
...											
2010361	2010	12	27	3.5	1.1	-0.3	0.0	2.0	-0.8	5.8	87
2010362	2010	12	28	4.8	1.7	-0.1	9.0	1.4	-0.7	5.8	84
2010363	2010	12	29	3.3	2.8	1.5	2.8	4.2	1.8	7.0	93
2010364	2010	12	30	2.6	4.0	1.7	0.0	5.1	2.0	7.1	87
2010365	2010	12	31	3.4	1.3	-1.5	0.9	5.3	-2.5	5.1	76

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.

This page intentionally left blank

Handbook of Climate Change and Agroecosystems Downloaded from www.worldscientific.com
by NASA GODDARD SPACE FLIGHT CENTER LIBRARY on 04/14/15. For personal use only.