

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

This Addendum explains how to produce climate metrics from the climate series and climate change scenarios created by the R scripts outlined in version 2.1 of the Guide for Running AgMIP Climate Scenario Generation Tools with R. This Addendum follows the AgMIP Climate team's methodology as outlined in the AgMIP Guide for Regional Integrated Assessment: Handbook of Methods and Procedures (both documents available for download at www.agmip.org)

Details how to:

- calculate seasonal and/or yearly climate metrics from .AgMIP file(s)

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

This Addendum presents a preliminary workflow for calculating metrics and will be incorporated in subsequent versions of the Guide. 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.

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Background

Version 1.0 of this Addendum for Running AgMIP Climate Scenario Generation Tools with R provides a detailed explanation for running “[run_acr_agmip2metrics.R](#)”. This Addendum requires the use of the most recent versions of both “[run_acr_agmip2metrics.R](#)” and “acr_agmip2metrics.R”. If you did not receive these two scripts with this Addendum, please contact Nicholas Hudson (nih2106@columbia.edu) for the most up-to-date versions of the scripts.

This Addendum assumes you have:

- Properly installed R
- Created the folder hierarchy housing the necessary scripts and data in the proper locations
- Produced climate series and/or climate change scenarios in the .AgMIP format

For further information on how to do any of the above steps, please see version 2.1 of the Guide for Running AgMIP Climate Scenario Generation Tools with R in Windows.

Getting Started

This section explains where to save the new scripts “[run_acr_agmip2metrics.R](#)” and “acr_agmip2metrics.R” to properly produce climate metrics from your .AgMIP files.

Place files into correct location within folder hierarchy

With this Addendum, you should have received the most up-to-date versions of “[run_acr_agmip2metrics.R](#)” and “acr_agmip2metrics.R”. Place these files into the “r” folder with the path “~/R/r/”. If you have set your folder hierarchy up correctly, you should see a number of other R scripts in this folder as well.

You may be asked if you would like to replace “acr_agmip2metrics.R”. Replace the old version with the version you received with this Addendum.

Also, there may be a script, “run_metrics.R” in this folder. You can delete this script as “[run_acr_agmip2metrics.R](#)” is the updated version of “run_metrics.R”.

Before we begin, you should also confirm that your .AgMIP files, for which you would like to produce climate metrics, are located in “~/R/data/Climate/Historical/”.

Producing climate metrics with “run_acr_agmip2metrics.R”

After placing the new versions of “[run_acr_agmip2metrics.R](#)” and “acr_agmip2metrics.R” into “~/R/r/” and confirming the presence of your .AgMIP files in “~/R/data/Climate/Historical/”, you are ready to calculate climate metrics.

The following section will:

1. Explain the input variables that will be modified for each of the run scripts
2. Outline a potential workflow for sourcing “[run_acr_agmip2metrics.R](#)”

Explanation of input variables to be changed in the run scripts

The input variables are used to set the parameters of the analysis as well as define the metrics you wish to produce. The next few pages describe the input variables that you will be required to adjust prior to sourcing the run scripts.

rootDir – This variable sets the location, or root directory, of your “~/R/” folder. 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.

infile – This is the 8 digit.AgMIP file name of the file(s) for which you want to produce climate metrics. This script is designed to loop through multiple .AgMIP files as long as they are located in the correct folder (~/R/data/Climate/Historical/), but will also function correctly if you choose to only produce metrics for one .AgMIP file. Make sure that you include each of 8 digit names within quotes and separated by commas.

For example, if you wanted to produce metrics for the five .AgMIP files, “XX010XXX.AgMIP”, “XX020XXX.AgMIP”, “XX030XXX.AgMIP”, “XX040XXX.AgMIP”, and “XX050XXX.AgMIP”, simply enter in the following line:

```
infile    <- c('XX010XXX',
               'XX020XXX',
               'XX030XXX',
               'XX040XXX',
               'XX050XXX')
```

If you only want to run one .AgMIP file either of the following entries would work:

```
infile    <- c('XX010XXX')
```

Or,

```
infile    <- 'XX010XXX'
```

jd.start – This input variable specifies the start date for the period of the metrics calculations conducted by “[run_acr_agmip2metrics.R](#)” and will typically align with (or be set slightly before) the planting date. This variable should be defined by the Julian day number, or ordinal date, of a 365 day year (not a leap year). The table below displays a reference to help you easily calculate these values.

Calendar date	jd.start/jd.end value
January 1	1
February 1	32
March 1	60
April 1	91
May 1	121
June 1	152
July 1	182
August 1	213
September 1	244
October 1	274
November 1	305
December 1	335

The script is designed to allow you to set different start and end dates (**jd.end**) if you are calculating the metrics for multiple .AgMIP files. If you are running the script for multiple .AgMIP files with different start dates, define this input variable as

```
jd.start    <- c(XXX,YYY,ZZZ)
```

where XXX is the start date of the first .AgMIP file listed in the input variable **infile**, YYY is the second start date, and ZZZ the third. If you are running the script to calculate metrics for multiple .AgMIP files with the same start date, you can either define **jd.start** as above such that XXX = YYY = ZZZ or you could define **jd.start** as

```
jd.start    <- rep(XXX,Y)
```

where XXX is the start date and Y is the number of .AgMIP files listed in the input variable **infile**. If you are only calculating the metrics for one .AgMIP file you can either define **jd.start** as

```
jd.start    <- c(XXX)
```

or,

```
infile      <- XXX
```

jd.end – Similar to **jd.start**, this input variable specifies the end date for the period of the metrics calculations conducted by “[run_acr_agmip2metrics.R](#)” and will typically align with (or be set slightly after) the harvest date.

To calculate metrics for the entire year simply set **jd.start** to 1 and **jd.end** to 365.

clim.var – This input variable defines the climate variable that will be analyzed by “[run_acr_agmip2metrics.R](#)”. To define this variable, simply enter in the value that corresponds with the climate variable you want to analyze using the table below. These climate values are derived from the column number of the .AgMIP files.

Climate Variable	.AgMIP abbreviation	clim.var value
Solar radiation	Srad	5
Maximum temperature	Tmax	6
Minimum temperature	Tmin	7
Precipitation	Rain	8
Wind velocity	Wind	9
Dew point temperature	Dewp	10
Vapor pressure	Vprs	11
Relative Humidity	Rhum	12
Average temperature	Tavg	13

Note that there is also the option to conduct the analysis for the average temperature by defining **clim.var** as 13.

analysis.type – This input variable sets the metric that will be calculated. The table on the following page describes the eight types of analysis that can be conducted by “[run_acr_agmip2metrics.R](#)”

reference – This input variable determines the threshold or baseline value for “[run_acr_agmip2metrics.R](#)” used in the calculations of analysis type “count”, “exceedance”, “meanconsecutivedays”, and “maxconsecutivedays”. The other analysis types do not require a value for the input variable reference, but should be set to a value, “-99” for example, for the script to function properly. View the table on the next page for more examples of how to set this input variable.

special.operator – Similar to **reference**, this input variable is used in the calculations of analysis type “count”, “exceedance”, “meanconsecutivedays”, and “maxconsecutivedays” by the script “[run_acr_agmip2metrics.R](#)”. If **special.operator** is set to “-1”, the script calculates the analysis below the threshold value set by the input variable **reference**. If **special.operator** is not equal to “-1”, the script calculates the metric defined by **analysis.type** above the threshold value set by **reference**. View the table on the next page for more examples of how to set this input variable.

analysis.type	Description	Example			
			clim.var	reference	special.operator
'mean'	the average of the selected climate variable	Mean rainfall	8	-99	-99
'max'	the maximum of the selected climate variable	Maximum solar radiation	5	-99	-99
'min'	the minimum of the selected climate variable	Minimum relative humidity	12	-99	-99
'std'	the standard deviation of the selected climate variable	Standard deviation of average temperature	13	-99	-99
'count'	the number of days the selected climate variable is greater than the threshold value defined by the input variable 'reference'	Number of wet days (number of days when precipitation is > 0 mm)	8	0	1
'exceedance'	totals the daily amount by which the selected climate variable is greater than the threshold value defined by the input variable 'reference'	GDD – Growing Degree Days (number of degrees over the baseline reference, in this example 20 °C)	6	20	1
'meanconsecutivedays'	calculates the mean number of consecutive days when the selected climate variable is greater than the threshold value defined by the input variable 'reference'	Mean consecutive days over 40 °C	6	40	1
'maxconsecutivedays'	calculates the maximum number of consecutive days when the selected climate variable is greater than the threshold value defined by the input variable 'reference'	Maximum consecutive days under 5 °C	7	5	-1

Suggested workflow for run_acr_agmip2metrics.R

The run script “[run_acr_agmip2metrics.R](#)” produces a record of climate metrics in a given user-defined season over the 31 year time series for .AgMIP files. This script can be used to calculate metrics for one .AgMIP file or for a series of .AgMIP files and allows the user to specify different time periods for the different .AgMIP files.

The workflow is fairly simple if you have placed all of the files in the correct location as described in the subsection, Creating folders for R scripts and input data (from the Guide for Running AgMIP Climate Scenario Generation with R v2.1). To run the script, all you will have to do is define a few input variables prior to each run and the metrics calculations should be completed quickly.

To run this script,

1. Open R and then open the run script “[run_acr_agmip2metrics.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 “R” folder.
3. Save the updated run script as your template “[run_acr_agmip2metrics.R](#)” script.
4. Adjust the input variables **infile**, **jd.start**, **jd.end**, **clim.var**, **analysis.type**, **reference**, and **special.operator** to reflect the metric calculation you would like the script to perform. If you are calculating an analysis of the type “mean”, “max”, “min”, or “std”, make sure to set the variables **reference** and **special.operator** even though these values will not be used in these particular calculations. Should you be conducting an analysis of the type “count”, “exceedance”, “meanconsecutivedays”, or “maxconsecutivedays” it is important to define **reference** as the threshold variable and **special.operator** to “-1” if you want to calculate these metrics below the reference value. If you are calculating a “count”, “exceedance”, “meanconsecutivedays”, or “maxconsecutivedays” analysis over the threshold value, it does not matter how you define **special.operator** as long as it is numeric and not equal to “-1”.
5. Save the amended script with a unique name (for example, “run_acr_agmip2metric_numwetdays.R” or “run_acr_agmip2metric_USAM_GDD.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. After the script has completed, the results from each input .AgMIP file will be displayed in the R Console along with a header containing information about the individual run.

Additionally, the variable “metric” in the workspace contains the same information and can easily be viewed by entering

```
View(metric)
```

into the R Console. Each .AgMIP file listed in **infile** will have the metrics stored in this variable “metric” as a column and can also be easily retrieved. The first column lists the years and the second lists the metrics calculated for the first .AgMIP file so to look at just the metrics calculated for the first .AgMIP file listed in **infile**, enter

```
metric[,2]
```

To view the third .AgMIP file listed in **infile** as well as the years, simply enter

```
metric[,c(1,4)]
```

With a few simple lines you should be able to extract the metrics you just calculated.

Note: We have also developed the capability to create .csv outputs containing the metrics calculated by “[run_acr_agmip2metrics.R](#)”. If you are interested in this additional functionality, please let us know.

We are currently attempting to determine what would be the most useful output for the metrics calculated by these scripts. Please let us know which method will be the most helpful for your workflow by contacting Nicholas Hudson (nih2106@columbia.edu).

Next Steps...

This concludes Version 1.0 of the Addendum for Running AgMIP Climate Scenario Generation Tools with R in Windows. We will be expanding this Addendum in the future to include other climate series and climate change scenario evaluation tools. Your feedback is helpful and we appreciate any suggestions or recommendations you may have to improve these tools.

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!