

METIS Cheat Sheet

Webpage: <https://jgcri.github.io/metis/>
Github: <https://github.com/JGCRI/metis>
[Cheat sheet](#)

Install

Metis is an R package. The code in this cheat sheet are all meant to be run in R Studio unless stated otherwise.

Install R: <https://www.r-project.org/>
Install R Studio: <https://www.rstudio.com/>
Then in R studio:

```
install.packages("devtools")  
devtools::install_github("JGCRI/rgcam")  
devtools::install_github("JGCRI/metis")
```

Note: The first time installation can take a while to get the required packages and data.

RESTART R Studio

UBUNTU additional steps:

Then in a terminal:

```
sudo add-apt-repository ppa:ubuntugis/ppa  
sudo apt-get update  
sudo apt-get install libudunits2-dev libgdal-dev  
libgeos-dev libproj-dev libmagick++-dev
```

MAC OSX additional steps:

Then in a terminal:

```
brew install pkg-config  
brew install gdal  
brew install imagemagick@6
```

metis.readgcam

metis.readgcam() reads data from a GCAM database and formats it for metis charts and maps
[metis.readgcam Extended Examples](#)

KEY INPUTS

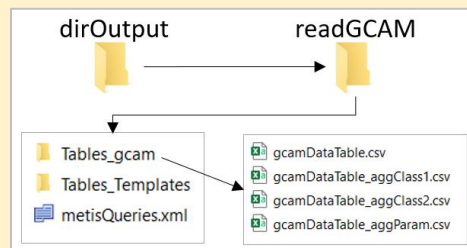
- gcamdatabase **OR** dataProjFile (try exampleGCAMproj)
- scenOrigNames (**Optional**) (Subset scenarios)
- regionsSelect (**Optional**) (Subset regions)
- paramsSelect (**Optional**) (Param list on **Page 3**)
- dirOutputs (**Optional**) (Default is working dir/outputs)

CODE

```
library(metis)  
  
dataGCAM <- metis.readgcam (  
  #gcamdatabase = "Path_to_GCAMdatabase",  
  dataProjFile = metis::exampleGCAMproj)  
  
df <- dataGCAM$data  
dfParam <- dataGCAM$dataAggParam  
dfClass1 <- dataGCAM$dataAggClass1
```

KEY OUTPUTS

- Function returns a list with data ("df" above) **AND**
- Data also saved in dirOutputs/readGCAM folder



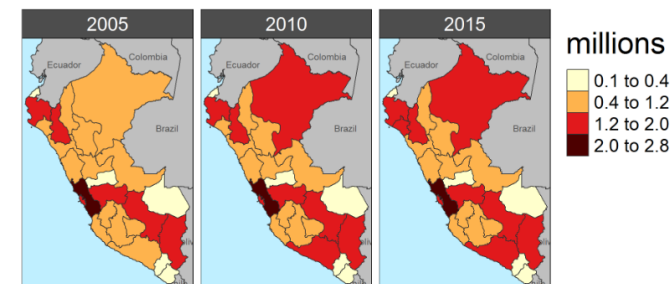
- gcamDataTable.csv has all data
- gcamDataTable_aggClass1.csv has data aggregated to class1 (same for class 2 and param)

Other Key Functions

metis.mapsProcess

Page 2

- All maps pre-loaded (GCAM regions, basins, states)
- Difference maps for multiple scenarios
- Animations for multiple years
- Easily customize scales to highlight data



Colors, maps, params

Page 3

- List of metis color palettes
- List of metis maps
- List of available parameters

metis.chartsProcess

In progress..

- Easily process GCAM outputs
- Connect to a database Or .proj file
- Filter by scenario, region, year and params

metis.mapsProcess

[metis.mapsProcess Extended Examples](#)

[Map GCAM Results Example](#)

Structure

KEY INPUTS

myFile.csv file

OR

R Data Frame

subRegion	value
TX	32
AZ	54

```
data = data.frame(  
  subRegion = c("TX", "AZ"),  
  value = c(32, 54))
```

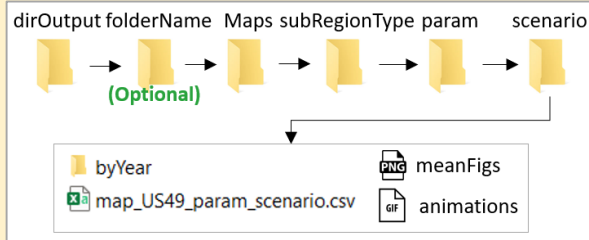
Optional Columns: param, scenario, year, class, units

CODE

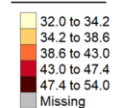
```
library(metis);  
metis.mapsProcess(data) # OR  
metis.mapsProcess("path/To/myFile.csv")
```

KEY OUTPUTS

- Maps saved in the working directory as follows:



FreeScale



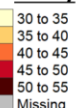
Each map
own scale

Kmeans



Same scale across
years and classes

Pretty

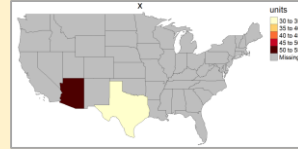


List of Maps and Color Palettes on [Page 3](#)

Pre-loaded Maps (Automatically find maps for data if available)

US49

```
data = data.frame(subRegion = c("TX", "AZ"),  
  value = c(32, 54), year=c(2010, 2010))  
metis.mapsProcess(polygonTable = data)
```



Countries and cropToBoundary

```
data = data.frame(subRegion = c("India", "China"), value = c(32, 54))  
metis.mapsProcess(polygonTable = data, cropToBoundary=T)
```



GCAM Basins

```
data = data.frame(subRegion = c("La_Plata", "Amazon"),  
  value = c(32, 54))  
metis.mapsProcess(polygonTable = data, cropToBoundary=T)
```



Multiple Scenarios, Years and Classes

Multi-scenario Diff plots

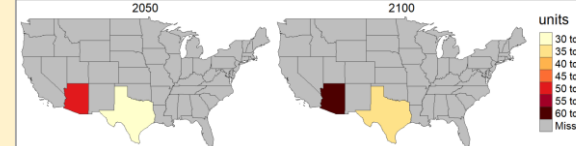
```
data = data.frame(subRegion = c("TX", "TX", "AZ", "AZ"),  
  scenario = c("scen1", "scen2", "scen1", "scen2"),  
  value = c(32, 38, 54, 63))  
metis.mapsProcess(polygonTable = data, scenRef="scen1")
```

DiffAbs_scen2_scen1
DiffPrnt_scen2_scen1
scen1
scen2



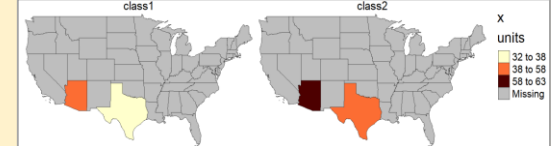
Multi-Year Animation/Mean

```
data = data.frame(subRegion = c("TX", "TX", "AZ", "AZ"),  
  year = c("2050", "2100", "2050", "2100"), value = c(32, 38, 54, 63))  
metis.mapsProcess(polygonTable = data,  
  folderName="multiyear")
```



Multi-Class

```
data = data.frame(subRegion = c("TX", "TX", "AZ", "AZ"),  
  class = c("class1", "class2", "class1", "class2"),  
  value = c(32, 38, 54, 63))  
metis.mapsProcess(polygonTable = data)
```



Customize Scales, Colors, Background

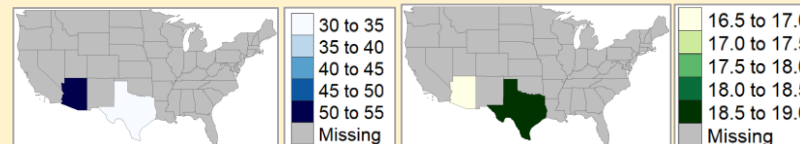
Set scale ranges

```
data = data.frame(subRegion = c("TX", "TX", "AZ", "AZ"),  
  scenario = c("scen1", "scen2", "scen1", "scen2"),  
  value = c(32, 38, 54, 63))  
metis.mapsProcess(polygonTable = data,  
  scaleRange = c(30, 50), scaleRangeDiffPrnt = c(10, 30))
```



Change Palettes

```
data = data.frame(subRegion = c("TX", "TX", "AZ", "AZ"),  
  scenario = c("scen1", "scen2", "scen1", "scen2"),  
  value = c(32, 38, 54, 63))  
metis.mapsProcess(polygonTable = data, scenRef="scen1",  
  classPalette = "pal_wet", classPaletteDiff = "pal_green")
```



Extended Boundary

```
data = data.frame(  
  subRegion = c("India", "China"), value = c(32, 54))  
metis.mapsProcess(polygonTable = data,  
  extension = T)
```



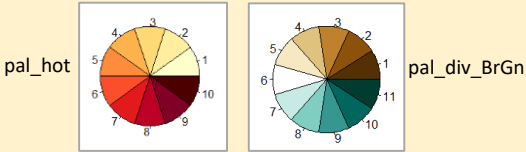
Colors, maps, params

[Colors, Maps, Params Extended Examples](#)

Selected Color Palettes

- pal_hot
- pal_wet
- pal_green
- pal_spectral
- pal_metis
- pal_div_RdBl
- pal_div_RdBlu
- pal_div_BrGn
- pal_16

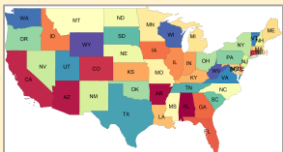
```
library(metis); ?metis.colors() # See all palettes
metis.colors("pal_hot")
```



Selected Maps List

- mapCountries
- mapStates
- mapUS49
- mapUS49County
- mapUS49HUC2
- mapGCAMReg32
- mapGCAMBasinsUS49
- mapIntersectGCAMBasin32Reg
- mapIntersectGCAMBasinCountry
- mapHydroShed1
- mapHydroShed2
- mapHydroShed3
- mapUS49HUC4
- mapGCAMBasins
- mapGCAMLand

```
library(metis); head(mapGCAMReg32@data)
metis::metis.map(mapUS49, labels=T)
```



metis.readGCAM paramsSelect list

Pick individual parameters or the param-set name (energy, electricity, transport, water, socioecon, ag, livestock, land, emissions)

<u>energy</u>	<u>electricity</u>	<u>socioecon</u>	<u>emissions</u>
<ul style="list-style-type: none">energyPrimaryByFuelEJenergyPrimaryRefLiqProdEJenergyFinalConsumBySecEJenergyFinalByFuelBySectorEJenergyFinalSubsecByFuelTranspEJenergyFinalSubsecByFuelBuildEJenergyFinalSubsecByFuelIndusEJenergyFinalSubsecBySectorBuildEJenergyFinalConsumByIntlShpAvEJenergyPrimaryByFuelMTOEenergyPrimaryRefLiqProdMTOEenergyFinalConsumBySecMTOEenergyFinalbyFuelMTOEenergyFinalSubsecByFuelTranspMTOEenergyFinalSubsecByFuelBuildMTOEenergyFinalSubsecByFuelIndusMTOEenergyFinalSubsecBySectorBuildMTOEenergyFinalConsumByIntlShpAvMTOEenergyPrimaryByFuelTWhenergyPrimaryRefLiqProdTWhenergyFinalConsumBySecTWhenergyFinalbyFuelTWhenergyFinalSubsecByFuelTranspTWhenergyFinalSubsecByFuelBuildTWhenergyFinalSubsecByFuelIndusTWhenergyFinalSubsecBySectorBuildTWhenergyFinalConsumByIntlShpAvTWh	<ul style="list-style-type: none">elecByTechTWhelecCapByFuelelecFinalBySecTWhelecFinalByFuelTWhelecNewCapCostelecNewCapGWelecAnnualRetPrematureCostelecAnnualRetPrematureGWelecCumCapCostelecCumCapGWelecCumRetPrematureCostelecCumRetPrematureGW <div><u>transport</u></div> <ul style="list-style-type: none">transportPassengerVMTByModetransportFreightVMTByModetransportPassengerVMTByFueltransportFreightVMTByFuel <div><u>water</u></div> <ul style="list-style-type: none">watConsumBySecwatWithdrawBySecwatWithdrawByCropwatBioPhysConswatIrrWithdrawBasinwatIrrConsBasinwatSupRunoffBasin	<ul style="list-style-type: none">gdpPerCapitagdpgdpGrowthRatepop <div><u>ag</u></div> <ul style="list-style-type: none">agProdbyIrrRfdagProdBiomassagProdForestagProdByCrop <div><u>livestock</u></div> <ul style="list-style-type: none">livestock_MeatDairybyTechMixedlivestock_MeatDairybyTechPastorallivestock_MeatDairybyTechImportslivestock_MeatDairybySubsector <div><u>land</u></div> <ul style="list-style-type: none">landIrrRfdlandIrrCroplandRfdCroplandAlloclandAllocByCrop	<ul style="list-style-type: none">emissNonCO2BySectorGWP5emissNonCO2BySectorGTP5emissNonCO2BySectorOrigUnitsemissLUCemissCO2BySectorNoBioemissNonCO2ByResProdGWP5emissMethaneBySourceGWP5emissByGasGWP5FFIemissByGasGWP5LUCemissBySectorGWP5FFIemissBySectorGWP5LUCemissNonCO2ByResProdGTP5emissMethaneBySourceGTP5emissByGasGTP5FFIemissByGasGTP5LUCemissBySectorGTP5FFIemissBySectorGTP5LUC

```
library(metis)
df1 <- metis.readgcam(dataProjFile=metis::exampleGCAMproj, paramsSelect="energy", saveData =
df2 <- metis.readgcam(dataProjFile=metis::exampleGCAMproj, paramsSelect="elecByTechTWh",
saveData = F)
head(df1$data); head(df2$data)
```

```
library(metis)
df1 <- metis.readgcam(dataProjFile=metis::exampleGCAMproj, paramsSelect="energy", saveData = F)
df2 <- metis.readgcam(dataProjFile=metis::exampleGCAMproj, paramsSelect="elecByTechTWh",
                      saveData = F)
head(df1$data); head(df2$data)
```