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.

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.

UBUNTU additional steps:

```
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:

```
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

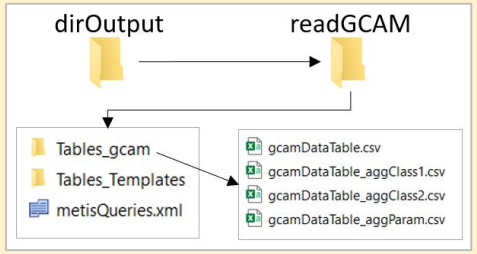
```
library(metis)

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



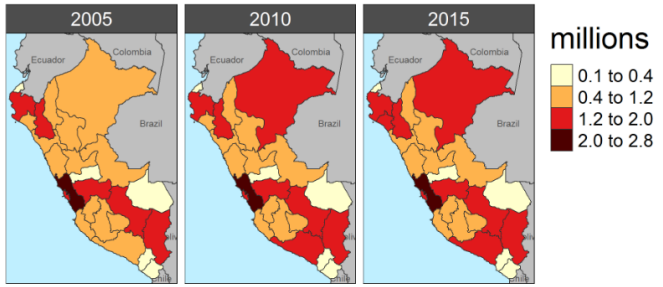
- gcamDataTable.csv has all data
- gcamDataTable_aggClass1.csv has data aggregated to class1 (same for class 2 and param)

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))
```

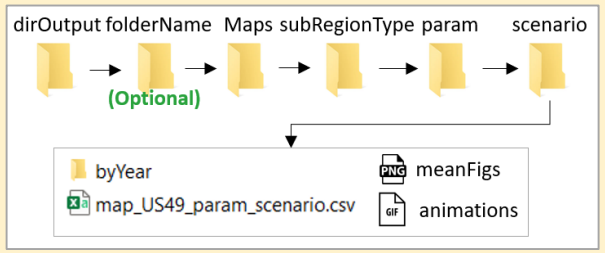
Optional Columns: param, scenario, year, class, units

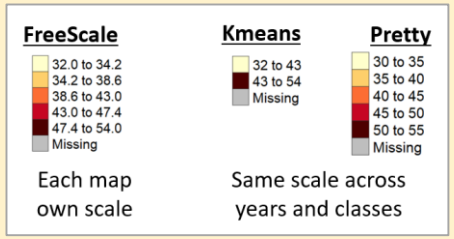
CODE

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

KEY OUTPUTS

- Maps saved in the working directory as follows:



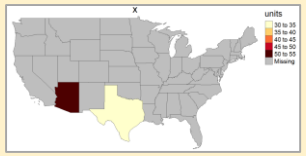


List of Maps and Color Palettes on **Page 3**

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)
```

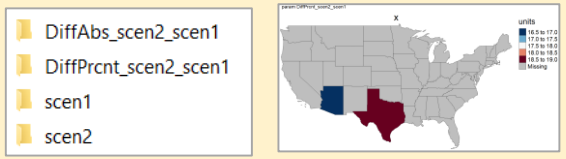
GCAM Basins

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

Multiple Scenarios, Years and Classes

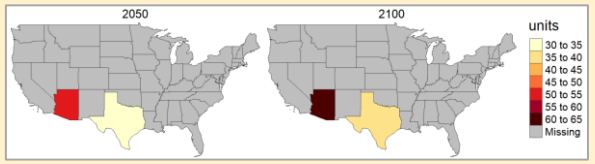
Multi-scenario Diff plots

```
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")
```



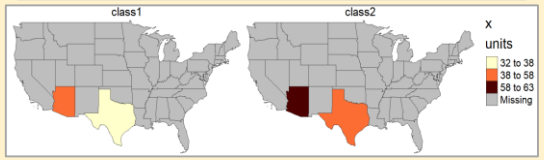
Multi-Year Animantion/Mean

```
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

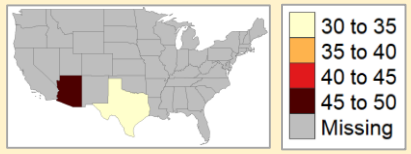
```
data = data.frame(subRegion = c("TX","TX", "AZ", "AZ"),
class = c("class1","class2","class1","class2"),
value = c(32, 38, 54, 63))
metis.mapsProcess(polygonTable = data)
```



Customize Scales, Colors, Background

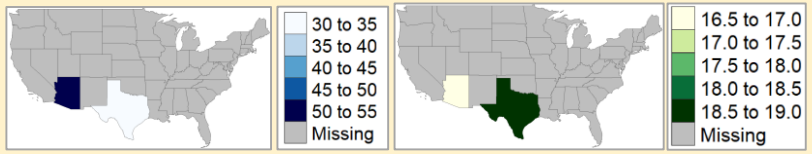
Set scale ranges

```
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), scaleRangeDiffPrcnt = 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)
```

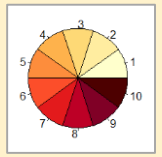
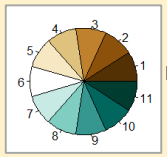
Colors, maps, params

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

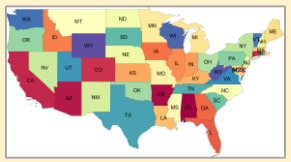
```
library(metis);  ?metis.colors() # See all palettes
metis.colors("pal_hot")
```

pal_hot   pal_div_BrGn

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)

energy

- energyPrimaryByFuelEJ
- energyPrimaryRefLiqProdEJ
- energyFinalConsumBySecEJ
- energyFinalByFuelBySectorEJ
- energyFinalSubsecByFuelTranspEJ
- energyFinalSubsecByFuelBuildEJ
- energyFinalSubsecByFuelIndusEJ
- energyFinalSubsecBySectorBuildEJ
- energyFinalConsumByIntlShpAvEJ
- energyPrimaryByFuelMTOE
- energyPrimaryRefLiqProdMTOE
- energyFinalConsumBySecMTOE
- energyFinalbyFuelMTOE
- energyFinalSubsecByFuelTranspMTOE
- energyFinalSubsecByFuelBuildMTOE
- energyFinalSubsecByFuelIndusMTOE
- energyFinalSubsecBySectorBuildMTOE
- energyFinalConsumByIntlShpAvMTOE
- energyPrimaryByFuelTWh
- energyPrimaryRefLiqProdTWh
- energyFinalConsumBySecTWh
- energyFinalbyFuelTWh
- energyFinalSubsecByFuelTranspTWh
- energyFinalSubsecByFuelBuildTWh
- energyFinalSubsecByFuelIndusTWh
- energyFinalSubsecBySectorBuildTWh
- energyFinalConsumByIntlShpAvTWh

electricity

- elecByTechTWh
- elecCapByFuel
- elecFinalBySecTWh
- elecFinalByFuelTWh
- elecNewCapCost
- elecNewCapGW
- elecAnnualRetPrematureCost
- elecAnnualRetPrematureGW
- elecCumCapCost
- elecCumCapGW
- elecCumRetPrematureCost
- elecCumRetPrematureGW

transport

- transportPassengerVMTByMode
- transportFreightVMTByMode
- transportPassengerVMTByFuel
- transportFreightVMTByFuel

water

- watConsumBySec
- watWithdrawBySec
- watWithdrawByCrop
- watBioPhysCons
- watIrrWithdrawBasin
- watIrrConsBasin
- watSupRunoffBasin

socioecon

- gdpPerCapita
- gdp
- gdpGrowthRate
- pop

ag

- agProdbyIrrRfd
- agProdBiomass
- agProdForest
- agProdByCrop

livestock

- livestock_MeatDairybyTechMixed
- livestock_MeatDairybyTechPastoral
- livestock_MeatDairybyTechImports
- livestock_MeatDairybySubsector

land

- landIrrRfd
- landIrrCrop
- landRfdCrop
- landAlloc
- landAllocByCrop

emissions

- emissNonCO2BySectorGWPAR5
- emissNonCO2BySectorGTPAR5
- emissNonCO2BySectorOrigUnits
- emissLUC
- emissCO2BySectorNoBio
- emissNonCO2ByResProdGWPAR5
- emissMethaneBySourceGWPAR5
- emissByGasGWPAR5FFI
- emissByGasGWPAR5LUC
- emissBySectorGWPAR5FFI
- emissBySectorGWPAR5LUC
- emissNonCO2ByResProdGTPAR5
- emissMethaneBySourceGTPAR5
- emissByGasGTPAR5FFI
- emissByGasGTPAR5LUC
- emissBySectorGTPAR5FFI
- emissBySectorGTPAR5LUC

```
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)
```