Pacific Northwest
NATIONAL LABORATORY

Querying GCAM Outputs

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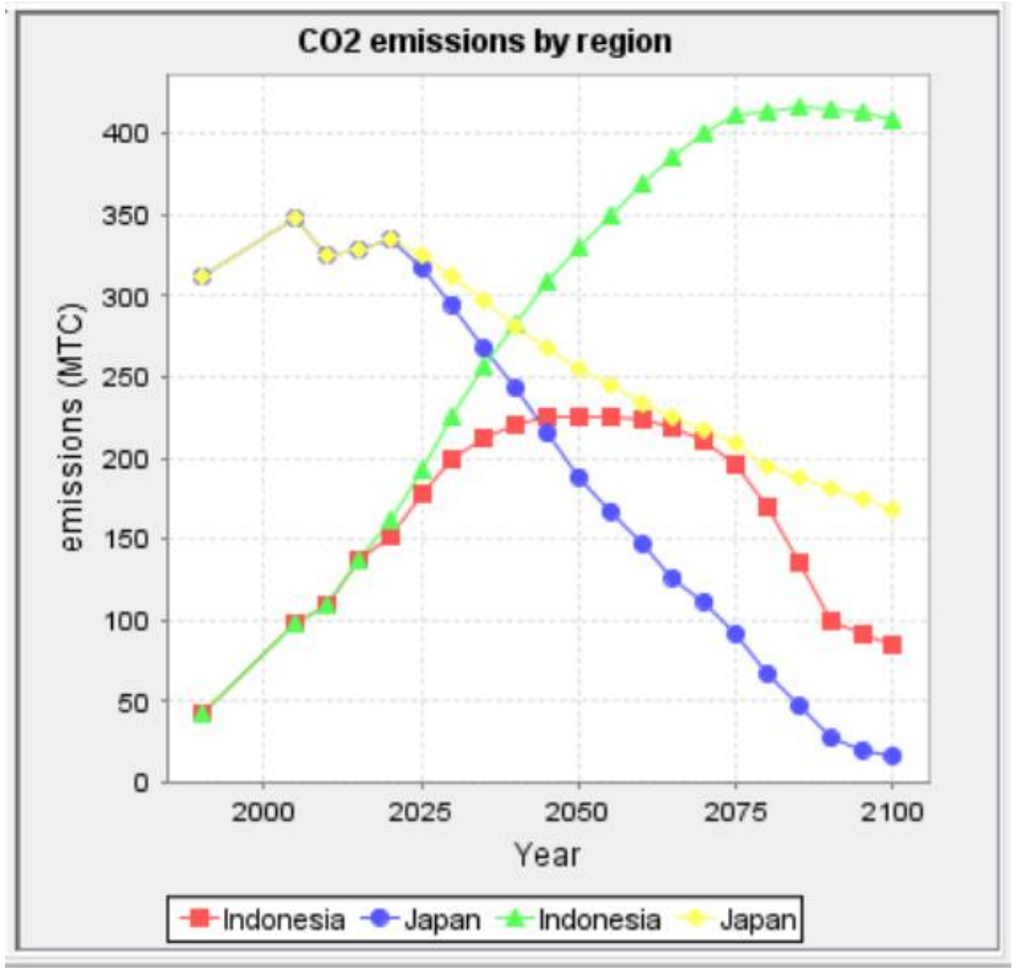
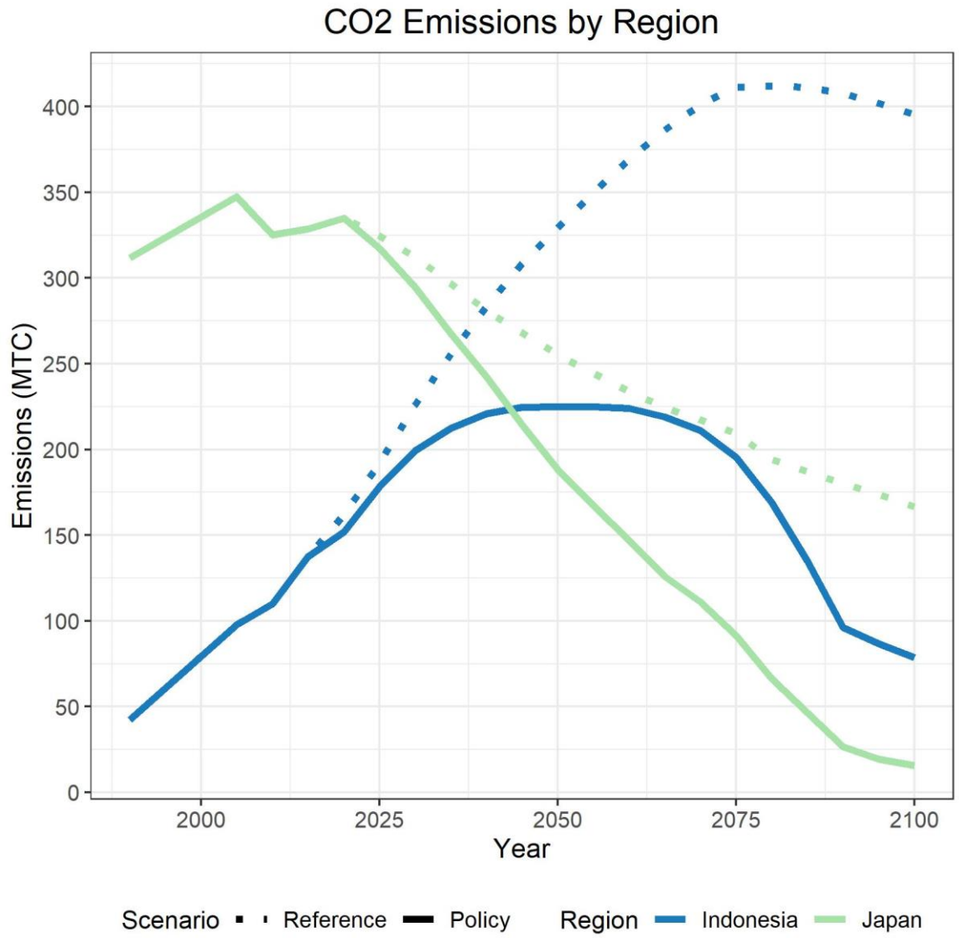
Congrats, you ran GCAM! Now what?

Model Interface



rgcam

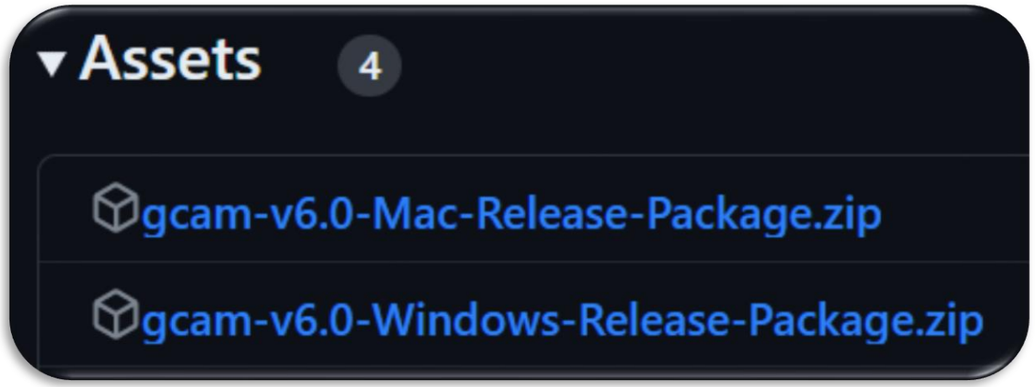


Model Interface

Model Interface (MI) is a program that comes with the Release Version of GCAM, and is used to view GCAM output.

To download MI: https://github.com/JGCRI/gcam-core/releases/tag/gcam-v6.0

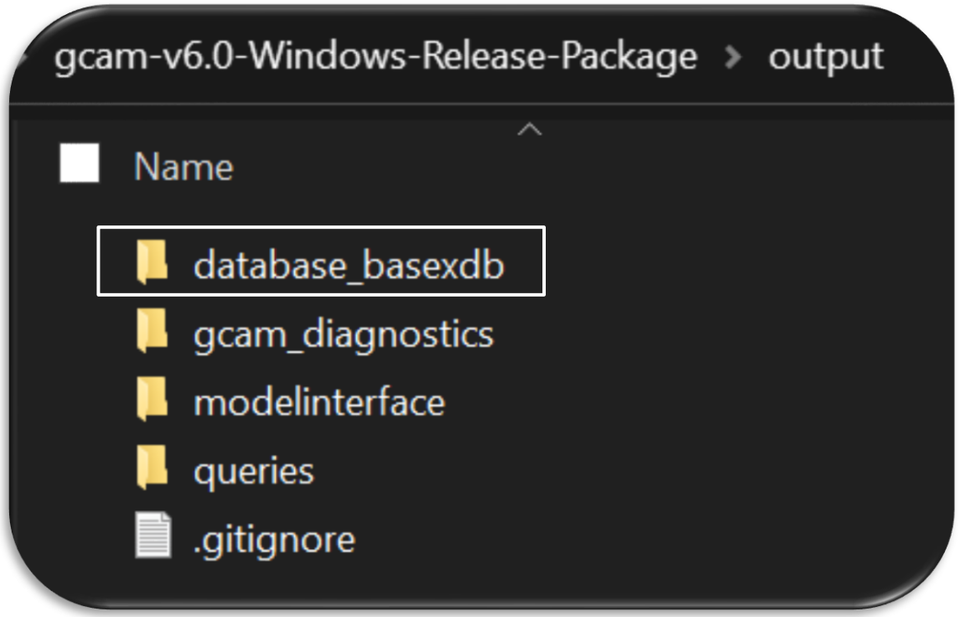
Download the .zip for your operating system, and extract all files.



Model Interface

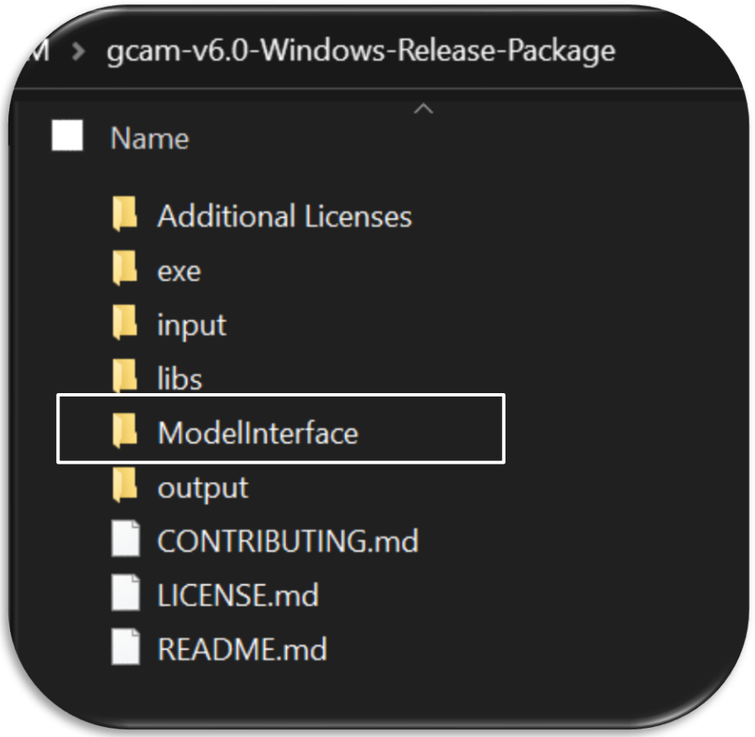
To view GCAM results in MI, we first need a database.

After running GCAM, you will have a database in the **output** folder. It will be called “database_basexdb”, unless you changed the name.

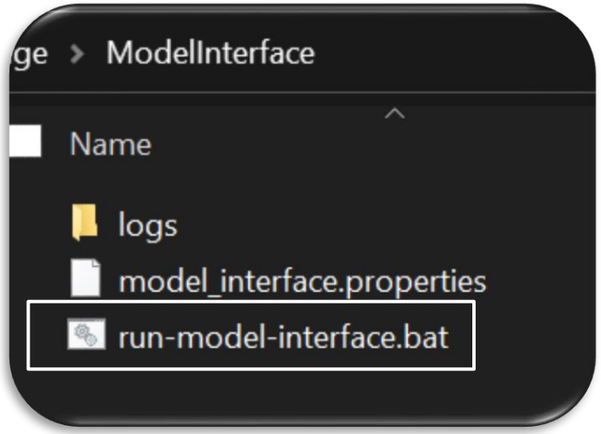


Model Interface

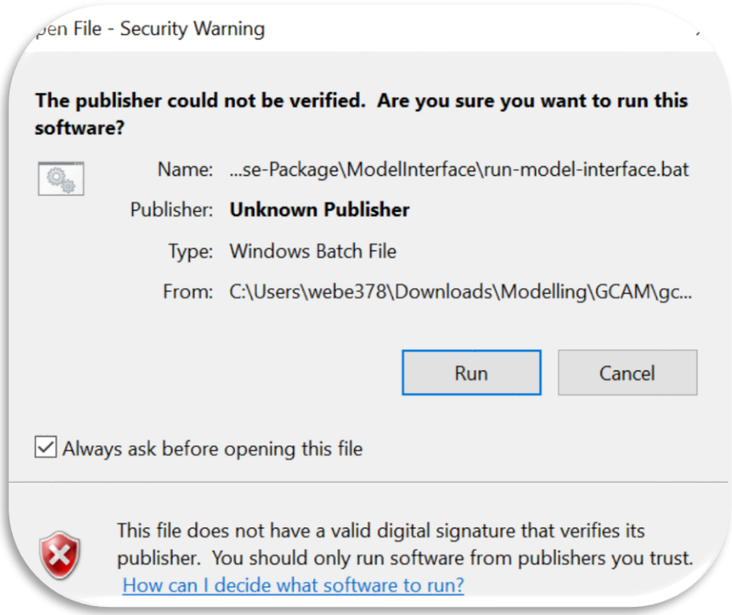
Model Interface lives in the **ModelInterface** folder.



run-model-interface.bat

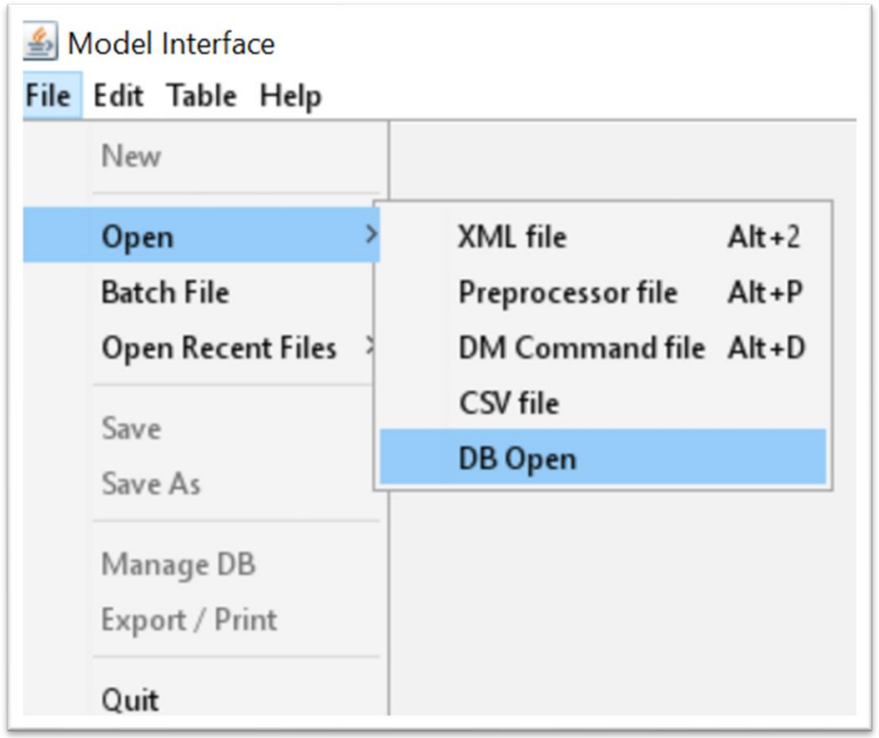


Run

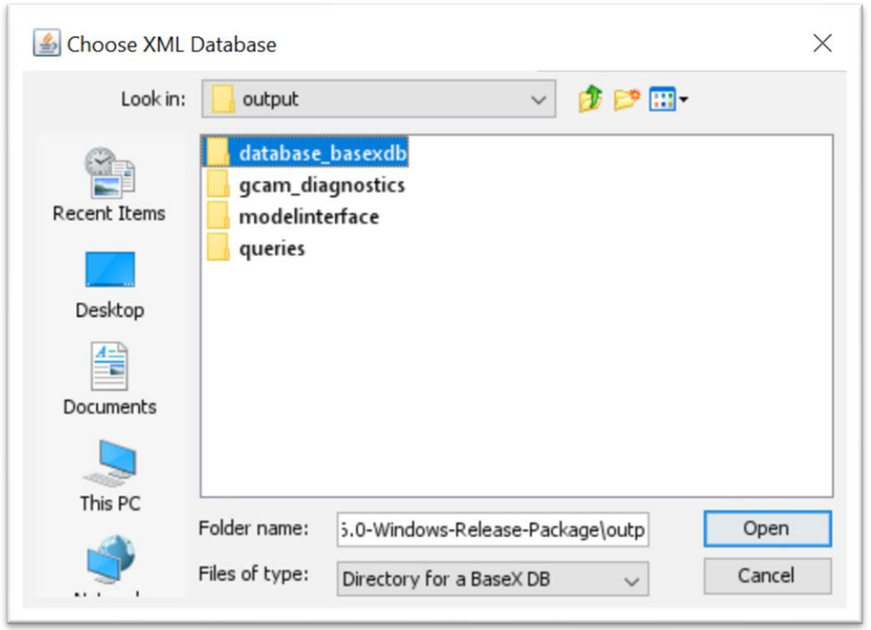


Model Interface

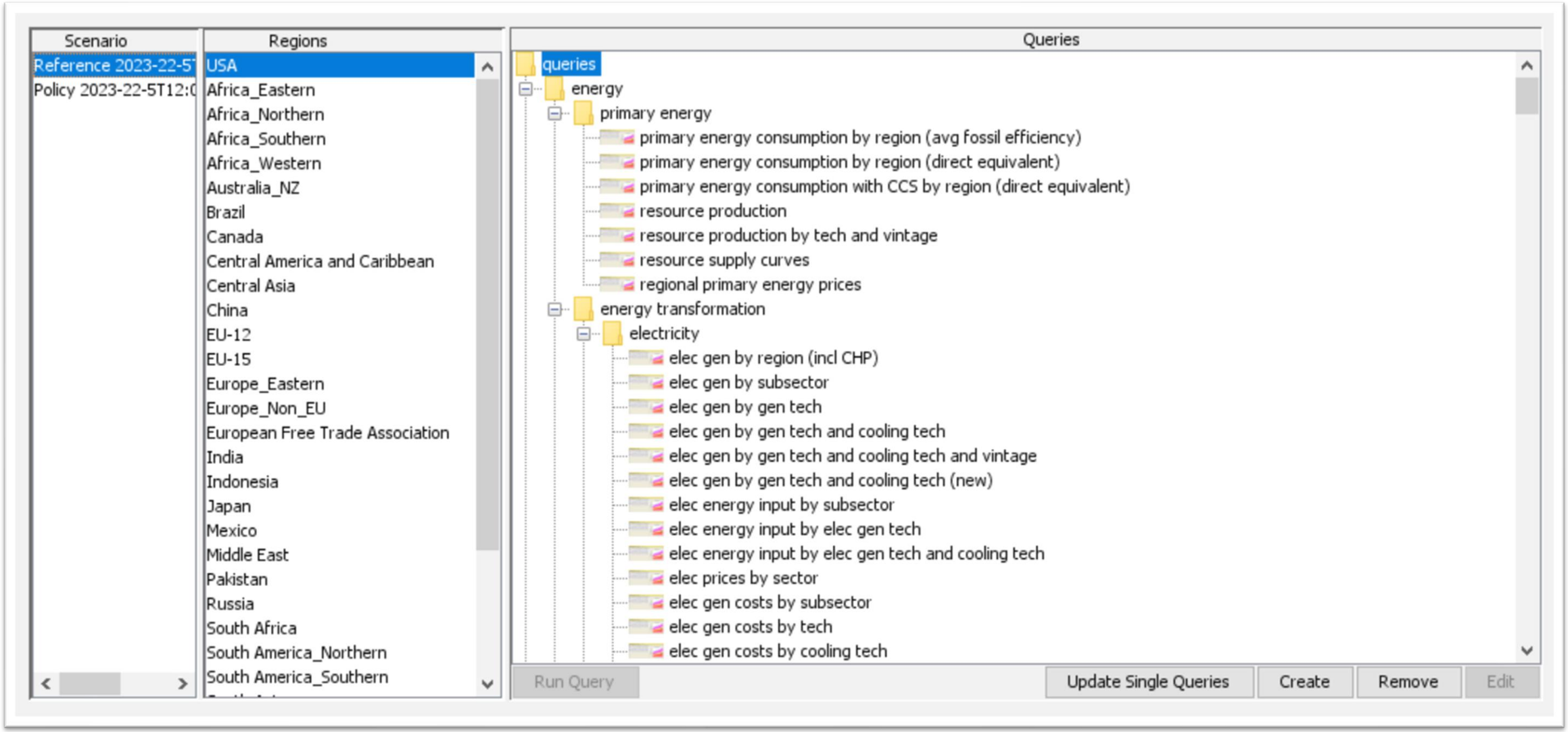
Once open, connect a database by going to File > Open > DB Open



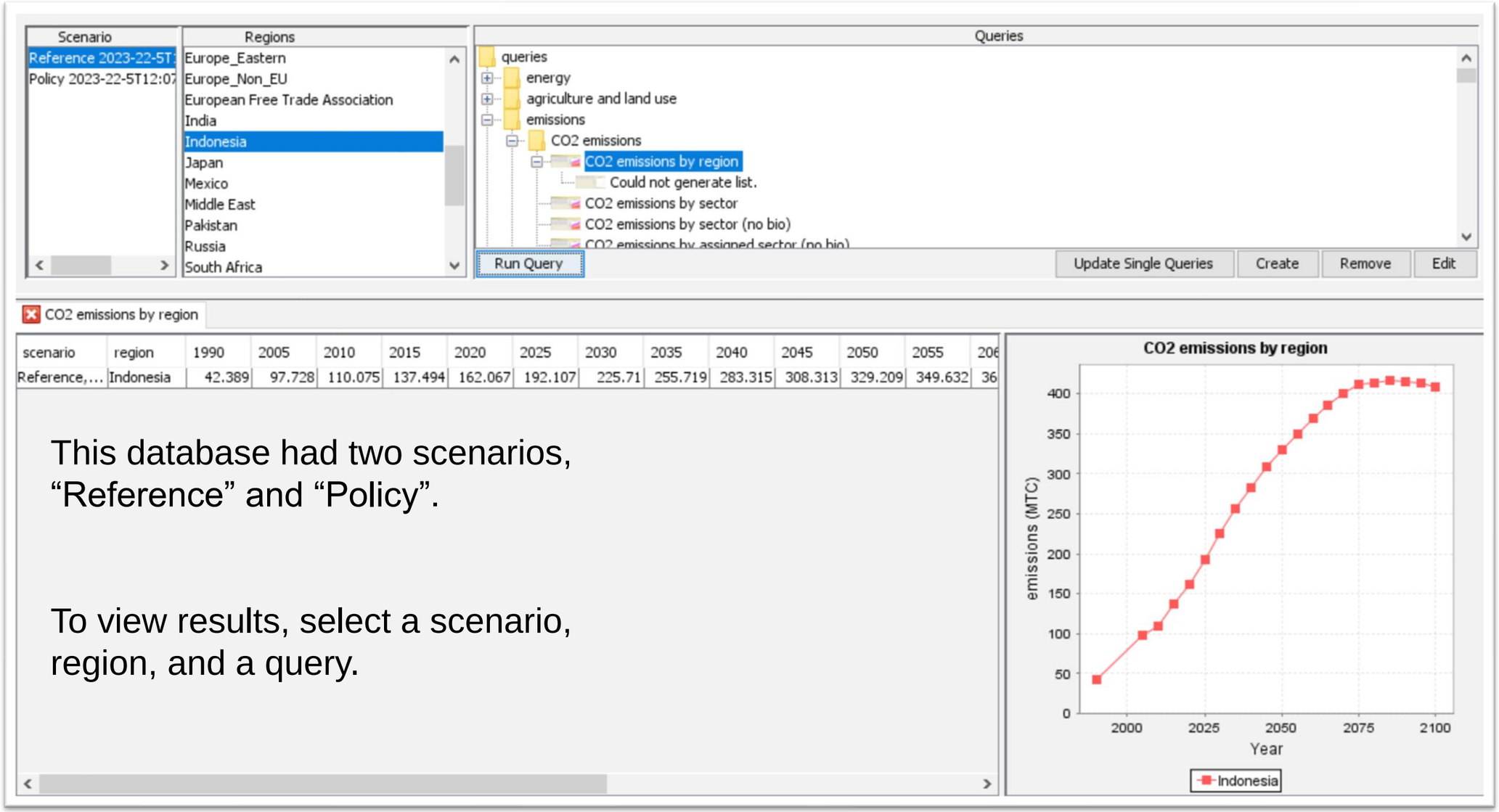
Then, select your database and click Open



Model Interface



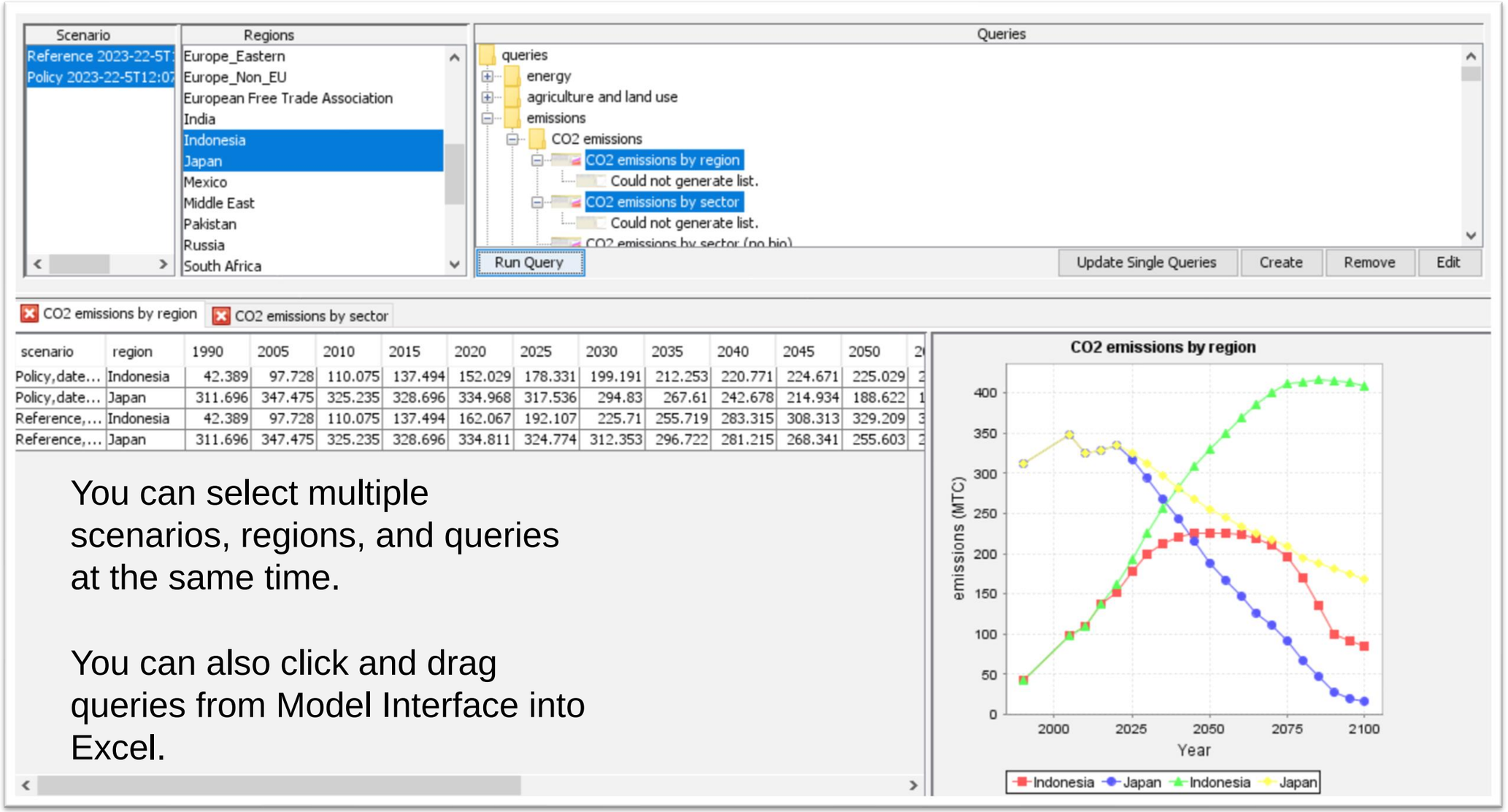
Model Interface



This database had two scenarios, “Reference” and “Policy”.

To view results, select a scenario, region, and a query.

Model Interface



You can select multiple scenarios, regions, and queries at the same time.

You can also click and drag queries from Model Interface into Excel.

rgcam

rgcam is an R package that makes querying and visualizing GCAM output easy.

- Connecting a database
- Querying GCAM outputs
- Visualizing

To install rgcam, open an R session and run:

```
install_github('JGCRI/rgcam', build_vignettes=TRUE)
```

Additional rgcam information: https://github.com/JGCRI/rgcam

rgcam – Connecting a database

Running the `localDBConn` command **connects your database** to rgcam and lists the scenarios available in that database.

```
17  # 1) Connecting a database
18  # localDBConn(`path to your database`, `name of database`)
19  db1 <- localDBConn('./gcam-v6.0-Windows-Release-Package/output', 'database_basexdb')
```

```
> # 1) Connecting a database
> # localDBConn(`path to your database`, `name of database`)
> db1 <- localDBConn('./gcam-v6.0-Windows-Release-Package/output', 'database_basexdb')
Database scenarios:  Reference, Policy
```

rgcam – Querying GCAM output

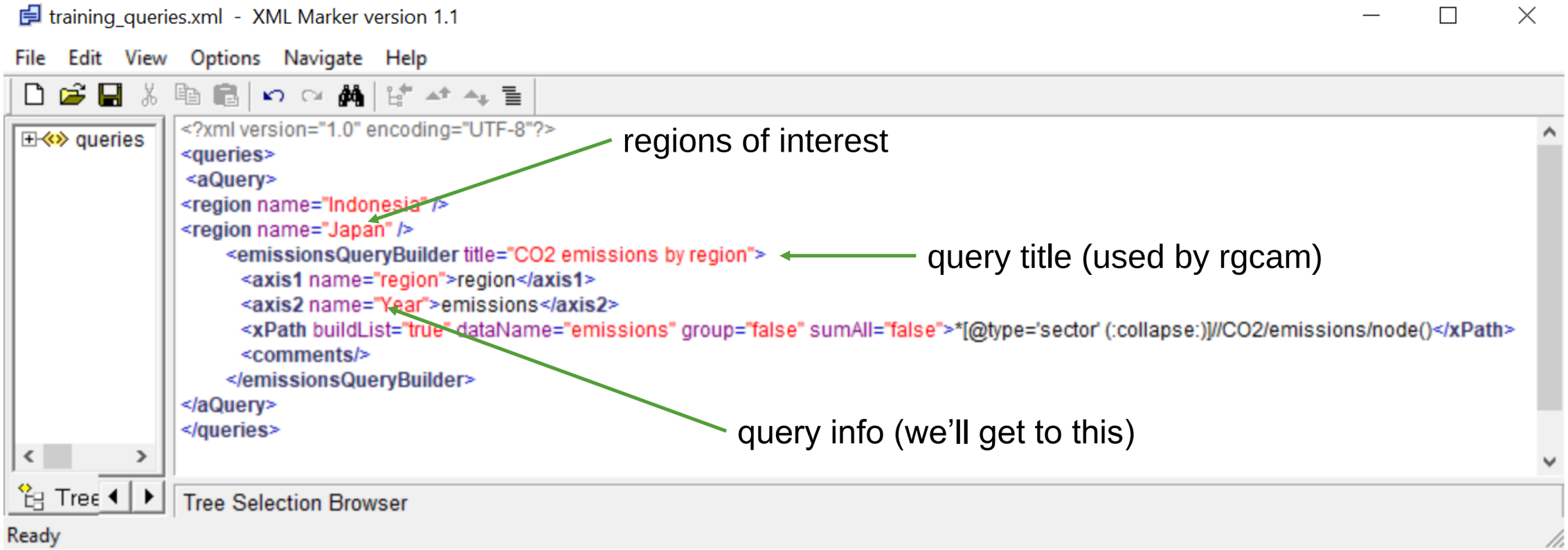
Running the `addScenario` command **extracts the query data** for a scenario in a database.

```
24  # 2) Querying GCAM output
25  # addScenario(database object, `name of file to store rgcam data`, `name of scenario`, `path to/name of query XML`)
26  prj <- addScenario(db1, 'Training.dat', 'Reference', '../GCAM Training/rgcam/training_queries.xml', clobber = TRUE)
27  prj <- addScenario(db1, 'Training.dat', 'Policy', '../GCAM Training/rgcam/training_queries.xml', clobber = TRUE)
```

```
> # 2) Querying GCAM output
> # addScenario(database object, `name of file to store rgcam data`, `name of scenario`, `path to/name of query XML`)
> prj <- addScenario(db1, 'Training.dat', 'Reference', '../GCAM Training/rgcam/training_queries.xml', clobber = TRUE)
Scenario Reference does not exist in this project.  Creating.
> prj <- addScenario(db1, 'Training.dat', 'Policy', '../GCAM Training/rgcam/training_queries.xml', clobber = TRUE)
Scenario Policy does not exist in this project.  Creating.
```

rgcam – Querying GCAM output

Running the `addScenario` command **extracts the query data** for a scenario in a database.



rgcam – Querying GCAM output

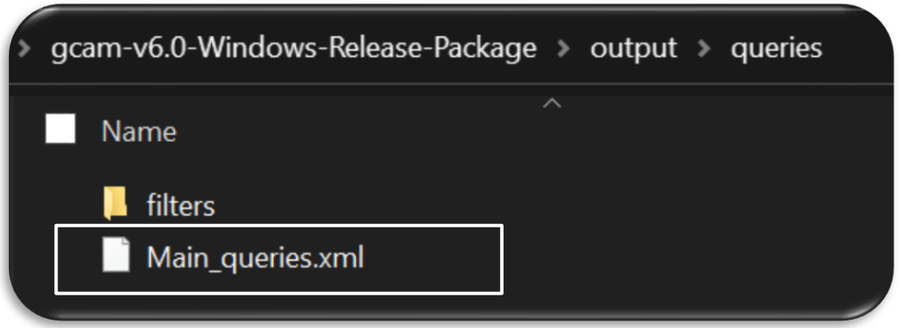
Running the `addScenario` command **extracts the query data** for a scenario in a database.

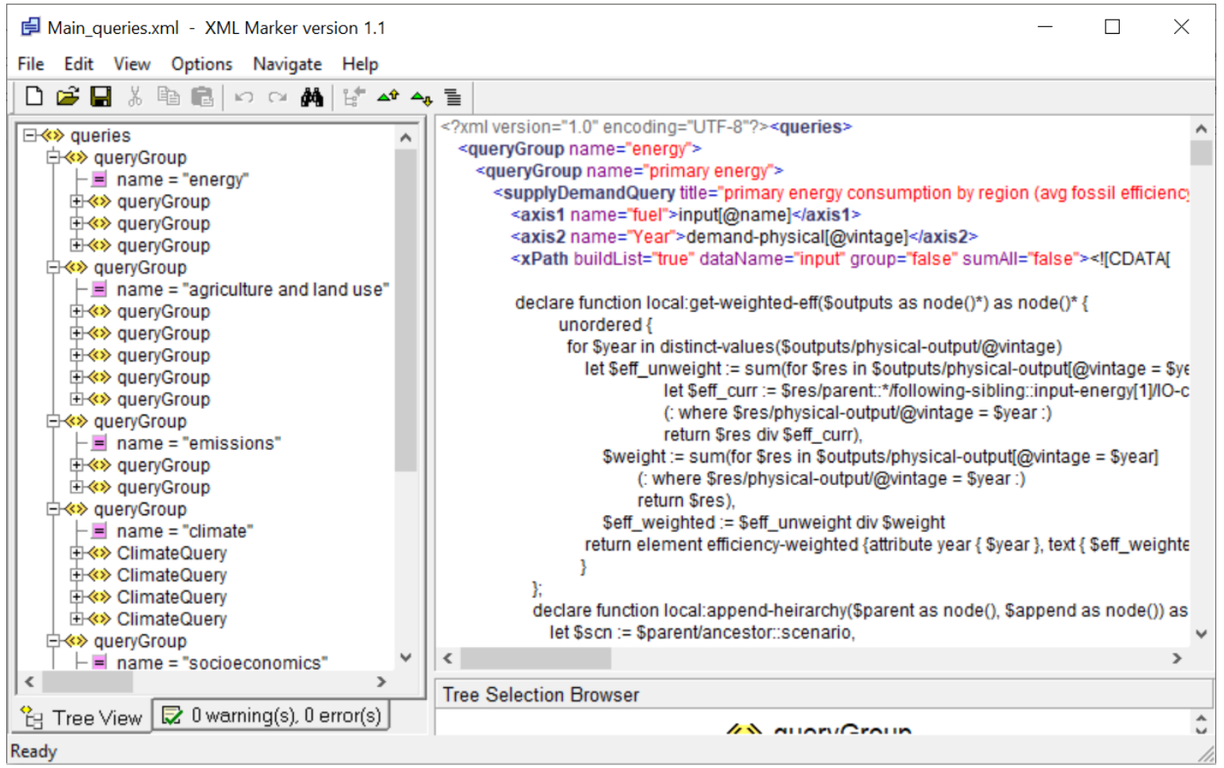
rgcam – Querying GCAM output

To query in rgcam, we need an XML that provides the query info.

We can utilize the Main_queries.xml to get this info.

Main_queries.xml can be found in **output/queries** folder.





rgcam – Querying GCAM output

1) Copy + paste the query you want from Main_queries.xml into your XML used in rgcam (training_queries.xml)
2) Add regions
3) Add `<aQuery>` before, and `</aQuery>` after.

Main_queries.xml

```
<queryGroup name="emissions">
  <queryGroup name="CO2 emissions">
    <emissionsQueryBuilder title="CO2 emissions by region">
      <axis1 name="region">region</axis1>
      <axis2 name="Year">emissions</axis2>
      <xPath buildList="true" dataName="emissions" group="fa
      <comments/>
    </emissionsQueryBuilder>
```

training_queries.xml

```
<queries>
 <aQuery>
<region name="Indonesia" />
<region name="Japan" />
    <emissionsQueryBuilder title="CO2 emissions by region">
      <axis1 name="region">region</axis1>
      <axis2 name="Year">emissions</axis2>
      <xPath buildList="true" dataName="emissions" group="fa
      <comments/>
    </emissionsQueryBuilder>
</aQuery>
</queries>
```

add your next query here, before `</queries>`

rgcam – Querying GCAM output

Running the `getQuery` command **assigns query data** to an object.

```
32  ## Retrieve queries for all scenarios in the database,
33  # getQuery(project object, `query title from XML`)
34  co2_emissions <- getQuery(prj, "CO2 emissions by region")
```

training_queries.xml had one query in it, so we retrieved one table.

We now have a table called `co2_emissions` that contains data from two scenarios, and two regions.

training_rgcam.R | co2_emissions

Filter

	Units	scenario	region	year	value
	All	All	All	[...]	All
1	MTC	Reference	Indonesia	2020	162.0674
2	MTC	Reference	Indonesia	2025	192.1072
3	MTC	Reference	Japan	2020	334.7475
4	MTC	Reference	Japan	2025	324.6737
5	MTC	Policy	Indonesia	2020	152.0291
6	MTC	Policy	Indonesia	2025	178.3314
7	MTC	Policy	Japan	2020	334.9050
8	MTC	Policy	Japan	2025	317.4384

rgcam - Visualizing

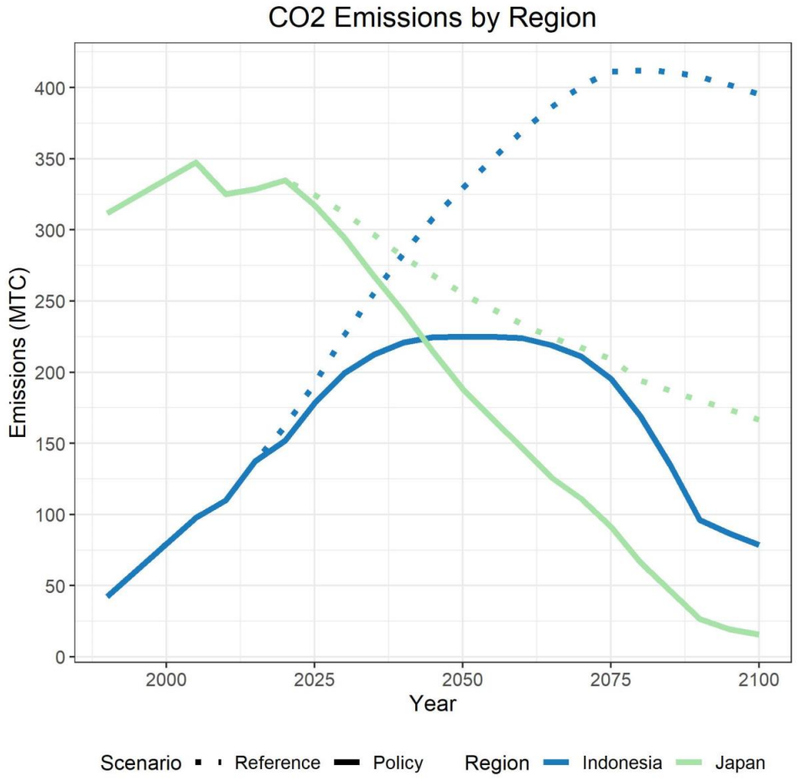
Use your data visualization tools of choice, and add new databases, scenarios, and queries as needed.

```
# ======================================== CO2 Emissions
country_color <- c("Indonesia" = "#1C7BBC",
                   "Japan" = "#A7E3A8")

scenario_line <- c("Reference" = "dotted",
                   "Policy" = "solid")

co2_emissions %>%
  filter(year > 1975) %>%
  rename("MTC" = value,
         "Year" = year,
         "Scenario" = scenario,
         "Region" = region) %>%
  ggplot(aes(Year, MTC)) +
  geom_line(size = 1.5, aes(color = Region, linetype = Scenario)) +
  scale_color_manual(values = country_color) +
  scale_linetype_manual(values = scenario_line) +
  scale_x_continuous(name = "Year", breaks = c(2000, 2025, 2050, 2075, 2100)) +
  scale_y_continuous(name = "Emissions (MTC)", breaks = c(0, 50, 100, 150, 200, 250, 300, 350, 400)) +
  theme_bw() +
  theme(legend.position = "bottom",
        plot.title = element_text(hjust = 0.5, size = 15),
        axis.text = element_text(size = 10),
        axis.title = element_text(size = 12),
        legend.text = element_text(size = 10)) +
  labs(title = "CO2 Emissions by Region")

ggsave("co2_emissions.jpg", height = 6, width = 6)
```



Resources

Model Interface: https://github.com/JGCRI/gcam-core/releases/tag/gcam-v6.0

rgcam: https://github.com/JGCRI/rgcam

R: https://www.r-project.org/

RStudio: https://posit.co/download/rstudio-desktop/

ggplot2: https://ggplot2.tidyverse.org/