



POTSDAM INSTITUTE FOR  
CLIMATE IMPACT RESEARCH

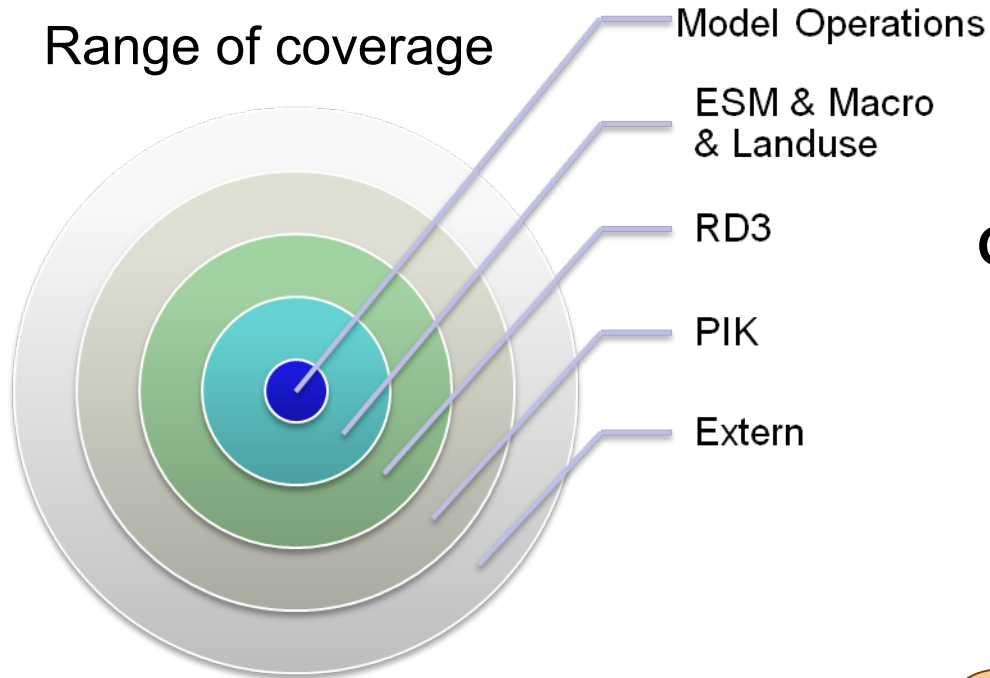
# Tools climate and energy modelers use

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**„Professional Skills in Energy Analysis and Policy“ Seminar  
Madison, WI**

**26 Oct 2017**

# Model Operations Group @ PIK



**Group Agenda / Research Focus:**  
Increase Efficiency

## Model efficiency

### tools

- code optimization
- modularization

## Work efficiency

### tools

- standardization
- technical consulting
- management tools

# Outline

- **Essential tools**
- **Before the modeling starts**
- **Modeling**
- **Post-processing**
- **Increase efficiency**

<https://www.pik-potsdam.de/research/sustainable-solutions/models/remind>

# Introduction

## Some important aspects of our work

- **Transparency**
- **Open Source and Open Data**
- **Size matters!**



# Essential Tools

## Shell scripting

- What's interesting about it?
- It looks amazingly boring, but it's actually the most powerful tool that you can use on a computer
- graphics not only consume resources, they remove methods for abstraction and creativity



# Essential Tools

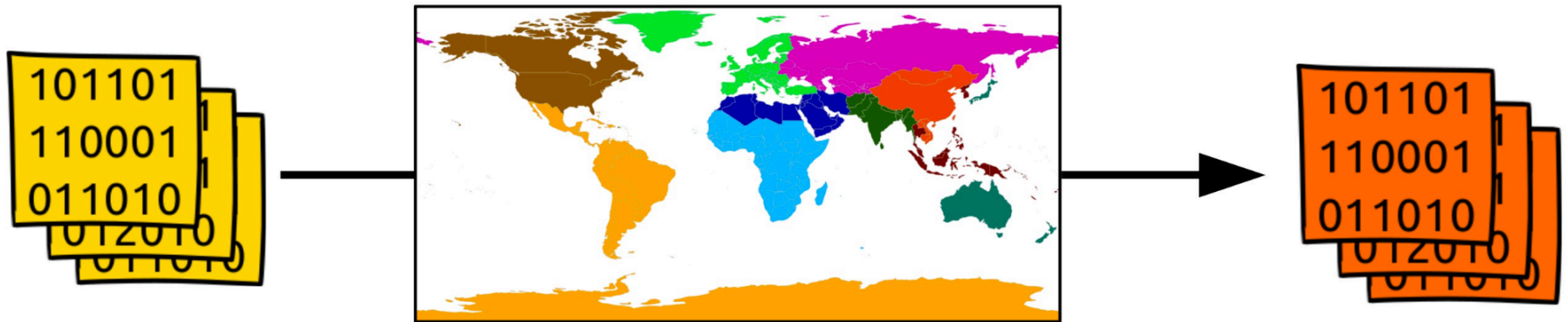
## R or Python

- **What's interesting about it?**
- **Very powerful mathematical tools and programming languages at the same time!**
- **PIK R-CRAN for software management and dissemination**
- **<https://www.pik-potsdam.de/rd3mod/R/src/contrib/>**

# Data handling

The problem:

How to convert big data to meet your modeling needs?

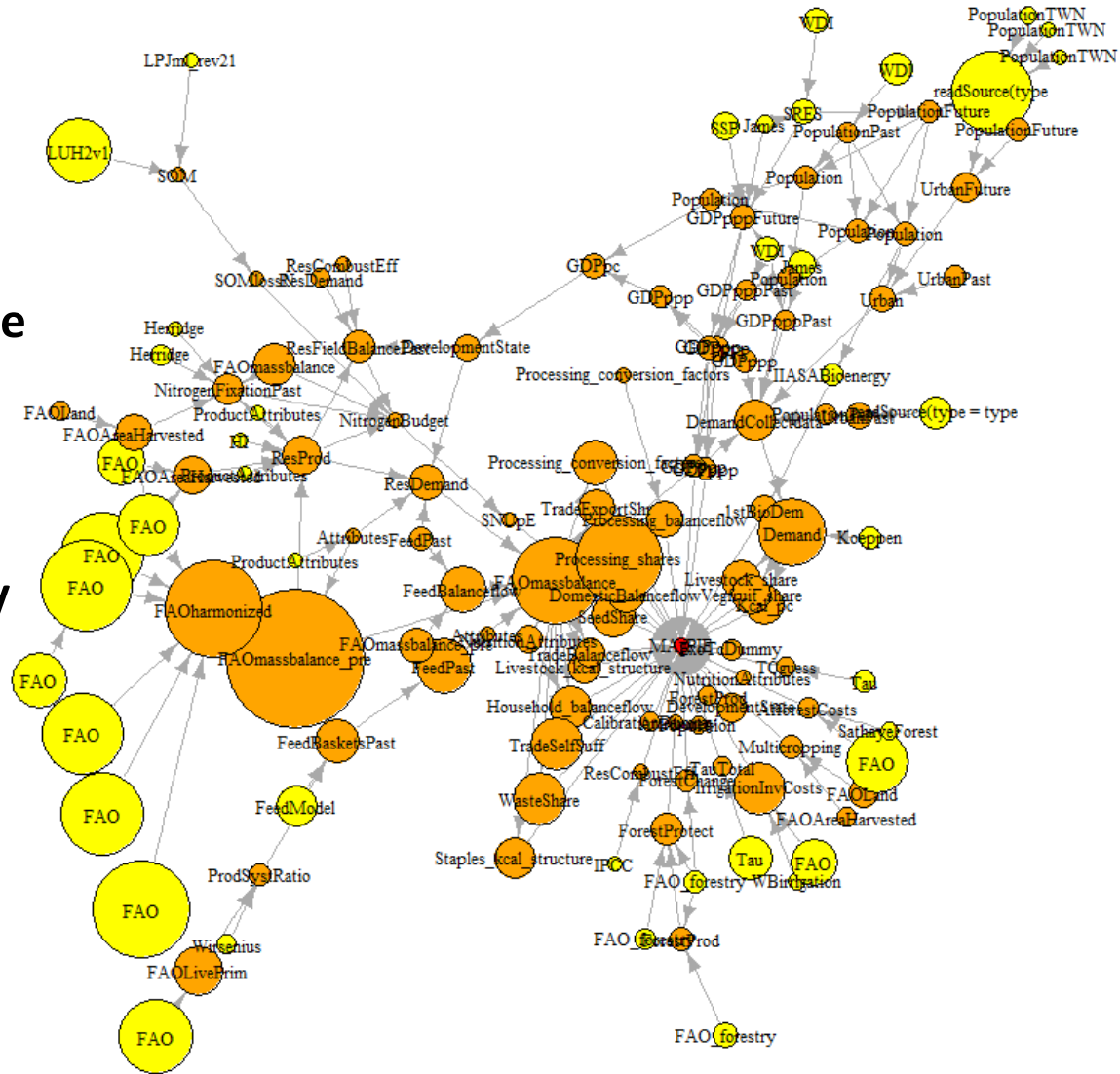


# Data handling

R-Package MADRat

“May All Data be Reproducible and Transparent”

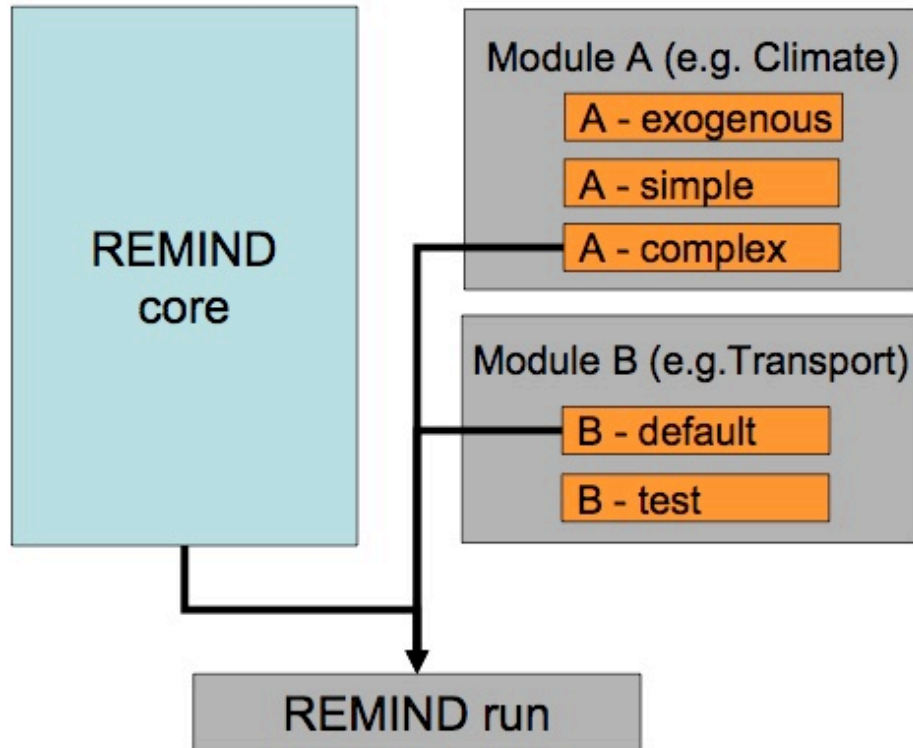
<https://github.com/pik-piam/madrat>





# Modularization in GAMS

- **Big model, thousands of files of code**
- **How to put order in an efficient way (that will last)?**



Created by Paint X

# Modularization in GAMS

The image displays four screenshots of a GAMS file explorer, illustrating the modularization of a project. Each screenshot shows a hierarchical view of files and folders, with green checkmarks indicating the status of each item.

- Top Left Screenshot:** Shows the 'core' folder selected. It contains subfolders 'modules' and 'output', and a file 'main.gms'. The 'input' folder is also visible, containing a list of files: 'bounds.gms', 'datainput.gms', 'declarations.gms', 'equations.gms', 'loop.gms', 'output.gms', 'postsolve.gms', 'preloop.gms', 'presolve.gms', and 'sets.gms'.
- Top Right Screenshot:** Shows an empty view, likely representing a different state or a placeholder.
- Bottom Left Screenshot:** Shows the 'modules' folder selected. It contains subfolders '10\_climate', '20\_growth', '21\_tax', '22\_subsidizeLearning', and '30\_biomass'. The 'core' folder is also visible, containing 'main.gms'.
- Bottom Right Screenshot:** Shows the 'box' folder selected. It contains subfolders 'magicc' and 'off', and a list of files: '10\_climate.gms', 'box.gms', 'magicc.gms', and 'off.gms'. The 'input' folder is also visible, containing the same list of files as in the top left screenshot.

# Data visualization and validation

**How to visualize big data, again and again?**

**How to validate model results against reference data?**

**<https://github.com/IAMconsortium/iamc>**

# Scrum

- Agile framework for completing complex projects
- Originally was formalized for software development projects
- Works well for any complex, innovative scope of work

<https://www.scrumalliance.org/why-scrum>



# Energy-Economy-Climate Model REMIND

