

ESMValTool

A successful open-source software for
evaluations of Earth system models

Sarah Alidoost

Lorentz workshop, September 2022

netherlands
eScience center

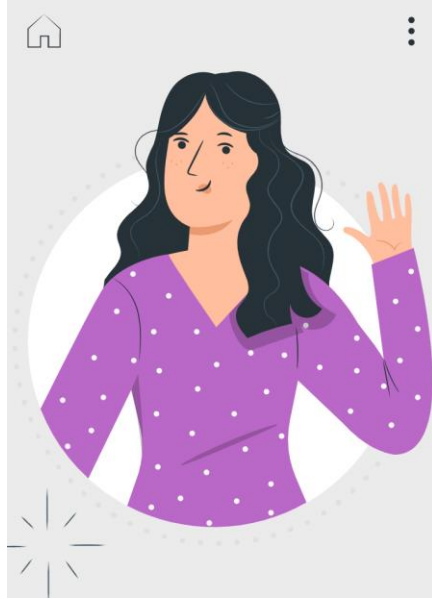
In this presentation:

- Why a community-driven and FAIR software
- What is ESMValTool
- What makes ESMValTool FAIR

References:

- Guide for Reproducible Research: <https://the-turing-way.netlify.app/welcome.html>
- ESMValTool: <https://www.esmvaltool.org>
- Illustrations: <https://storyset.com/>

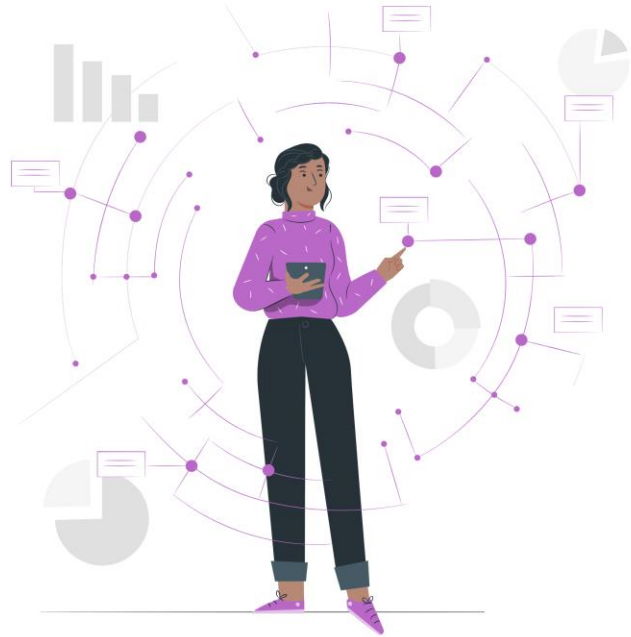




Jane.

Researcher in climate science.



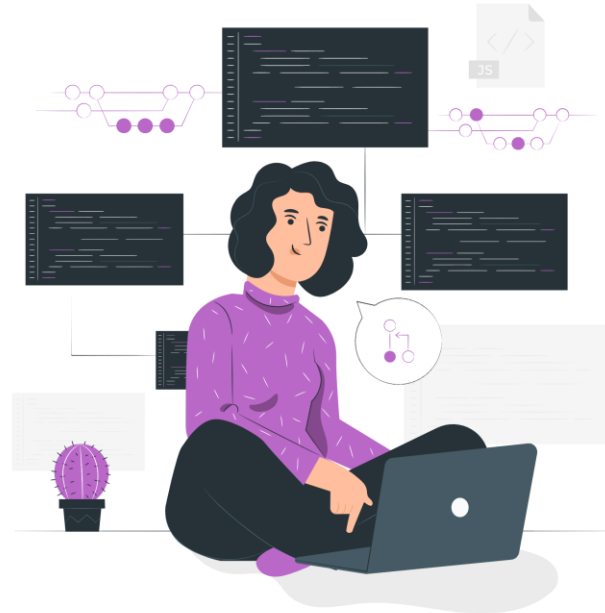


Task:

To analyze a time series of 50 years of air temperature in the past and in the future generated by 10 climate models.

Implementation:

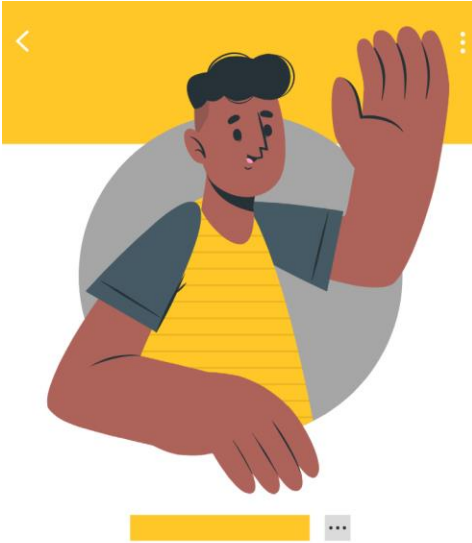
- Finding and downloading data
- Checking data for correctness
- Processing data
- Storing results
- Creating plots



Challenges:

- It takes some time and effort to develop the code.

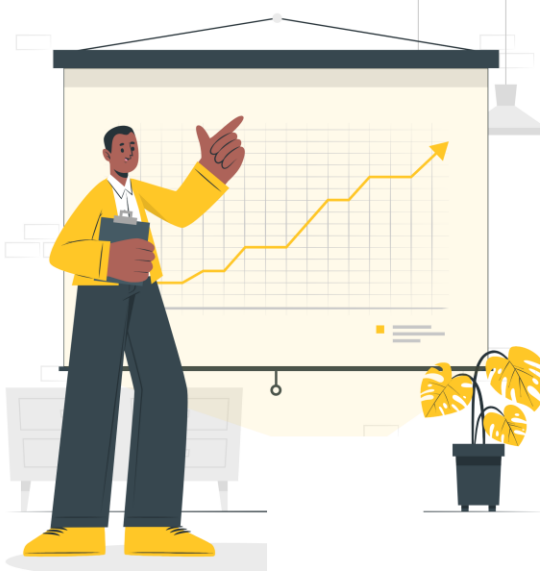




Ben.

Researcher in climate science.





Task:

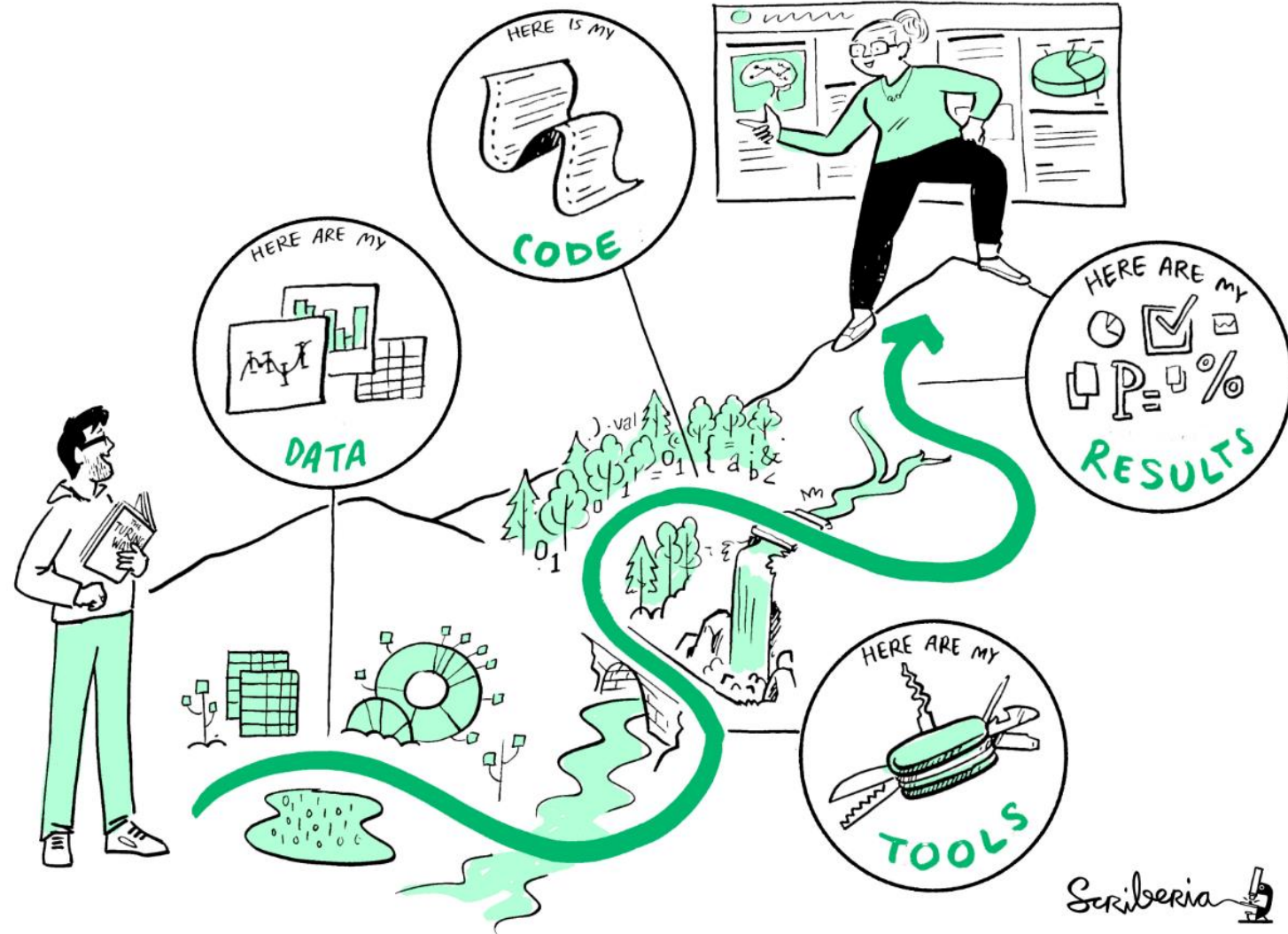
To analyze air temperature and precipitation simulated by 5 other different models.

Challenges:

- All the skills needed to write well-structured code.



“If research data are easily discoverable and re-usable, this lowers the barriers to repeat, verify, and build upon previous work.”

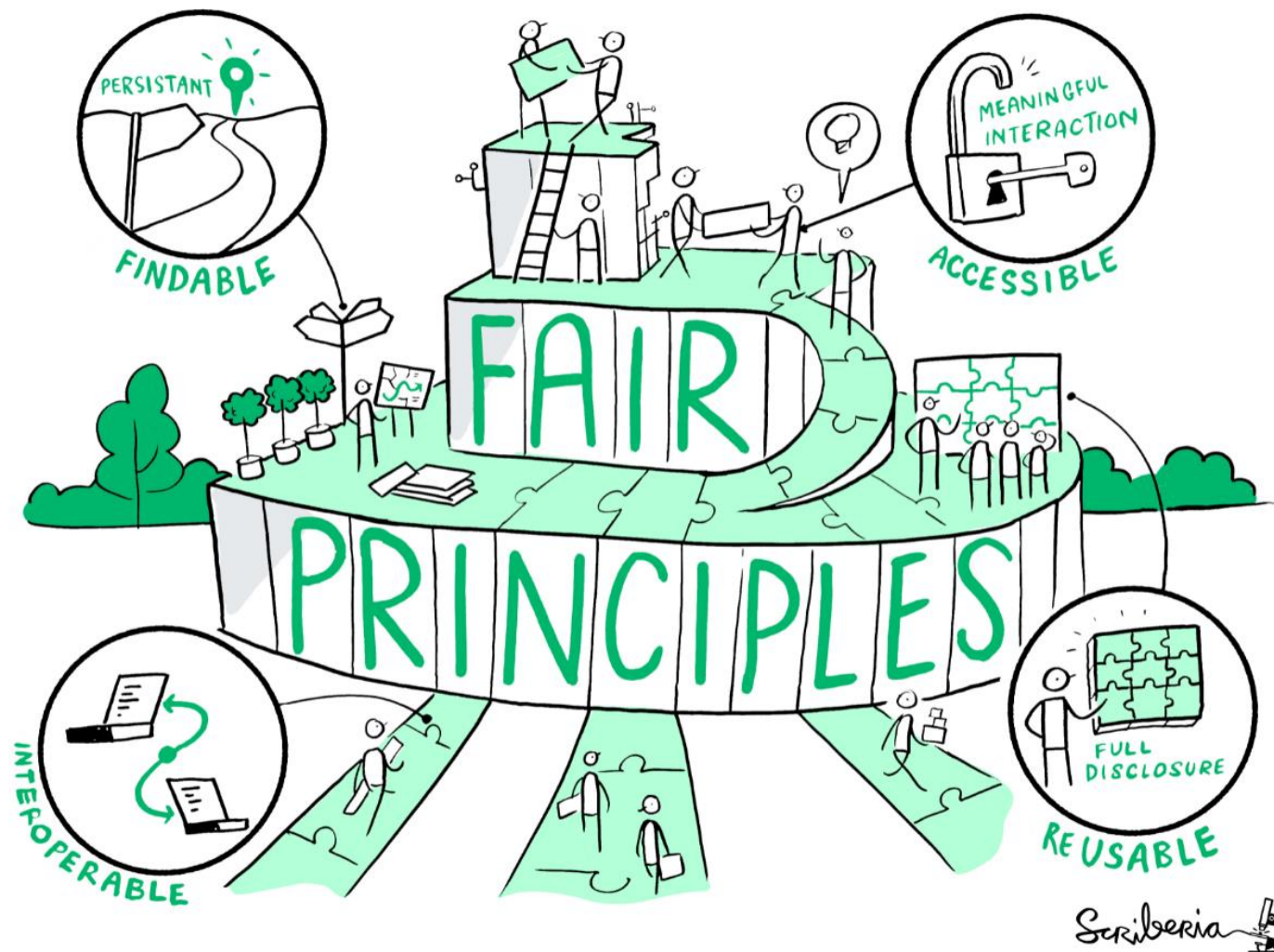


Scriberia 

This image was created by Scriberia for The Turing Way community and is used under a CC-BY licence. Source: <https://doi.org/10.5281/zenodo.3695300>



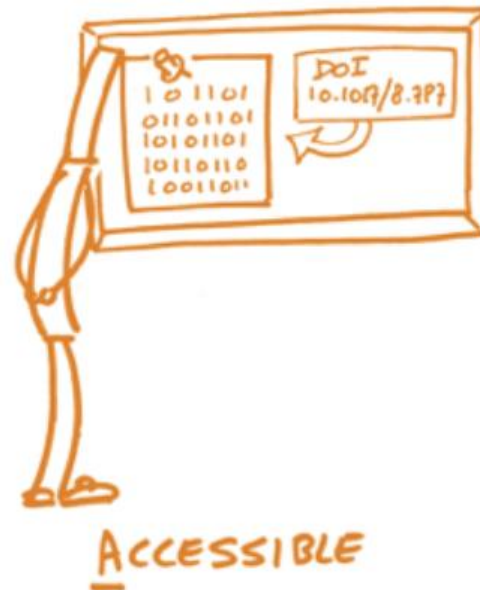
“A guideline for those wishing to enhance the reusability of their data holdings.”



This image was created by Scriberia for The Turing Way community and is used under a CC-BY licence. Source: <https://doi.org/10.5281/zenodo.3695300>

“In general, central to the realization of FAIR are FAIR Digital Objects, which may represent data, software or other research resources.”

FAIR DATA PRINCIPLES

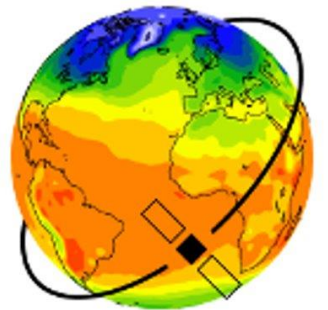


<https://open-science-training-handbook.gitbook.io/book/>




























































A community-driven and FAIR
software in climate science:

Earth System Model Evaluation Tool

<https://www.esmvaltool.org>



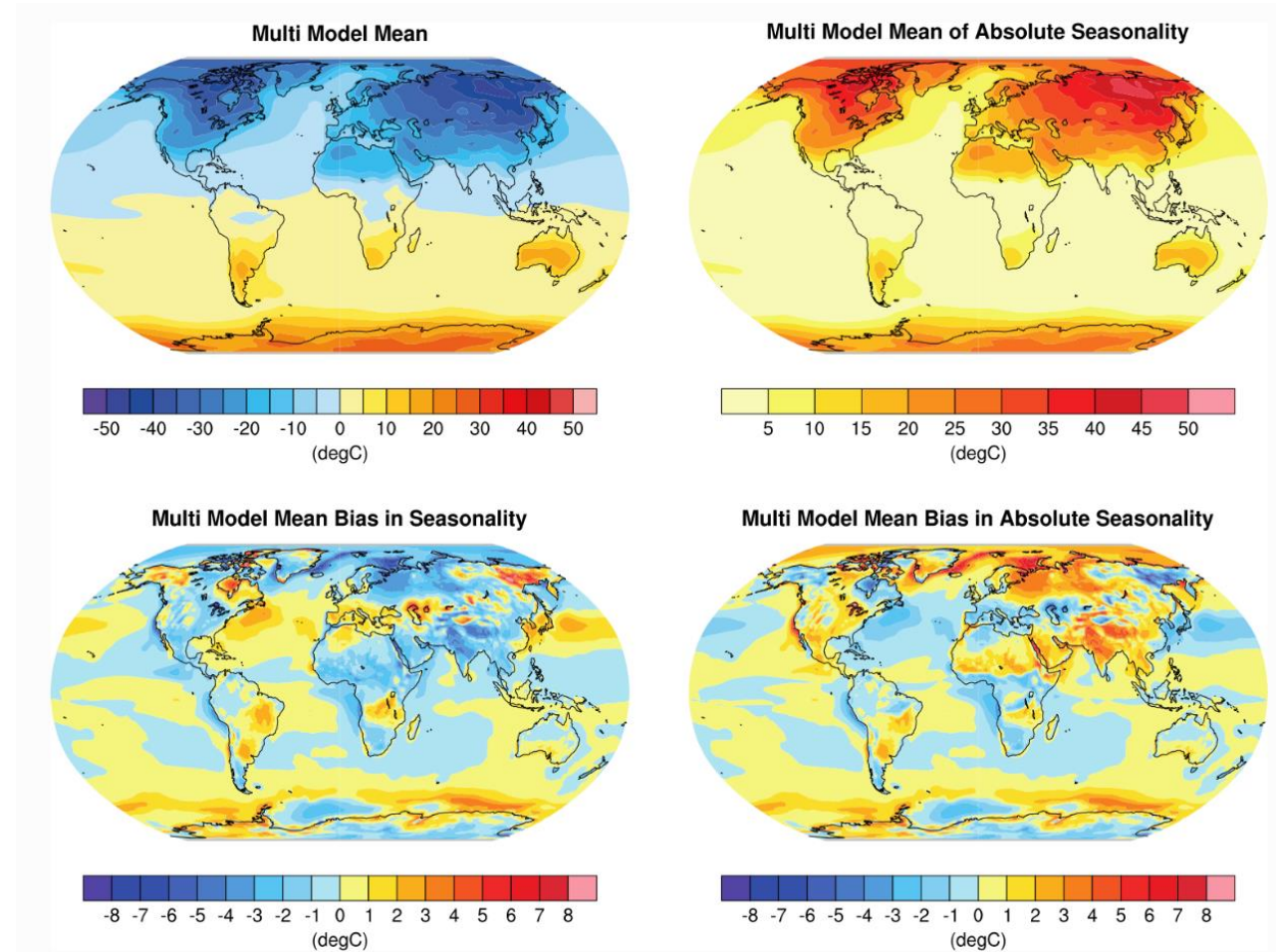
By an international community of scientists and software engineers

14 teams in the ESMValGroup organization		Visibility ▾	Members ▾
<div>ESMValTool-CoreTeam</div> <div>Team members can read, clone, and push to this repository.</div>	<div></div>	17 members	2 teams ▾
<div>ESMValTool-DevelopmentTeam</div> <div>Team members can create new feature branches.</div>	<div></div>	148 members	0 teams
<div>IPCC developer</div> <div>ESMValTool AR6 contributions</div> <div>Secret</div>	<div></div>	39 members	0 teams
<div>ESMValTool-recipe-maintainers</div>	<div></div>	14 members	0 teams
<div>UserEngagementTeam</div> <div>User Engagement Team</div>	<div></div>	11 members	0 teams
<div>tech-reviewers</div> <div>Technical review team</div>	<div></div>	12 members	0 teams
<div>science-reviewers</div> <div>Scientific review team</div>	<div></div>	11 members	4 teams ▾
<div>IPCC-maintainers</div> <div>Maintainers of the AR6 repositories</div>	<div></div>	3 members	0 teams



What is ESMValTool?

It facilitates the analysis of Earth system model's data.



What is ESMValTool?

It provides a standard format for scientific analysis workflow a.k.a. "recipes".



Data finding



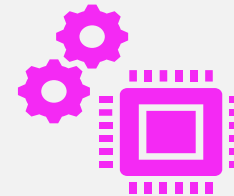
Data selection



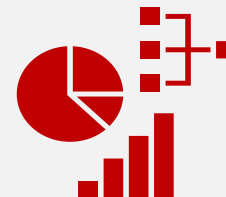
Data fixing



Variable derivation



Running preprocessors



Running diagnostics

What is ESMValTool?

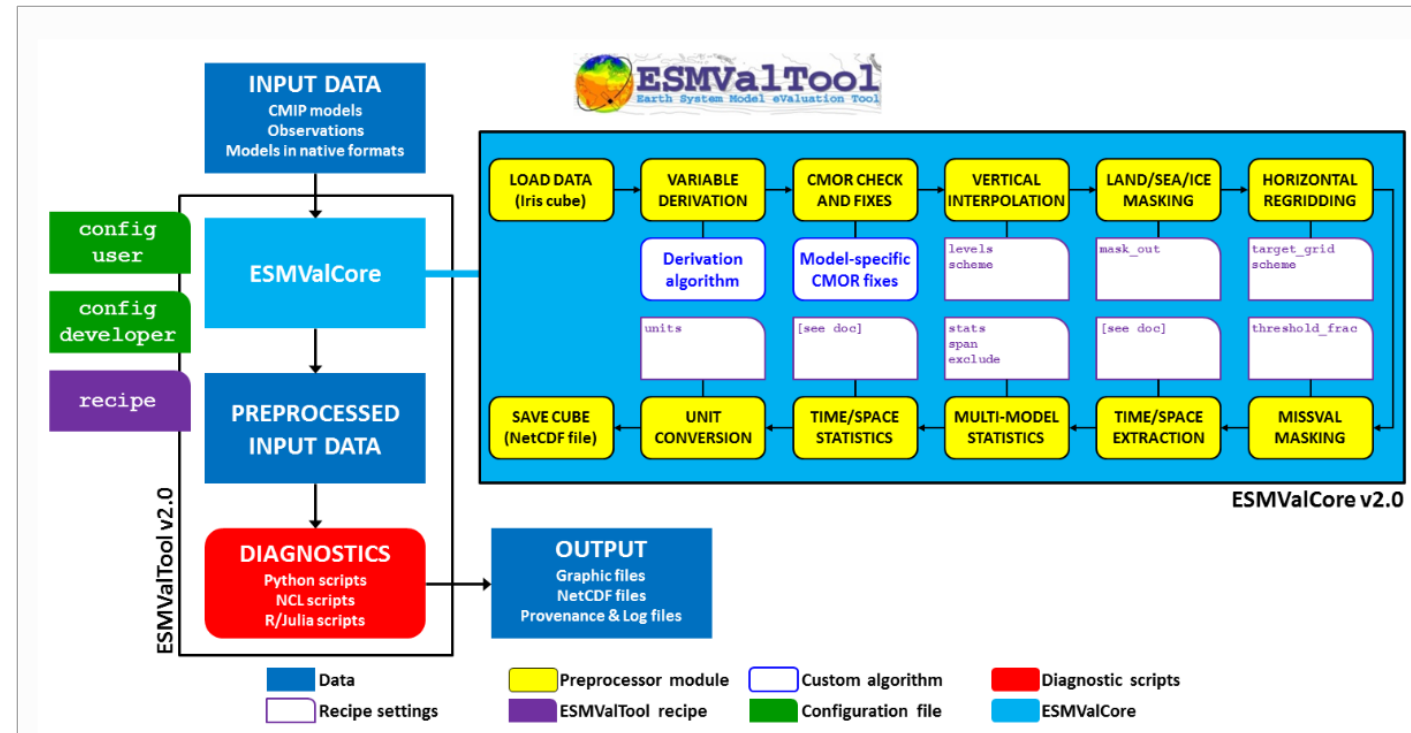
It also provides a collection of recipes.

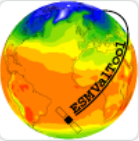
```
1 # ESMValTool
2 # recipe_kcs.yml
3
4 # ESMValTool
5 # recipe_ecs.yml
6
7 # ESMValTool
8 # recipe_anav13jclim.xml
9
10 # ESMValTool
11 # recipe_python.yml
12 ---
13 documentation:
14   description: |
15     Example recipe that plots a map and timeseries of temperature.
16   title: Recipe that runs an example diagnostic written in Python.
17   authors:
18     - andela bouwe
19     - righi_mattia
20   maintainer:
21     - schlund_manuel
22   references:
23     - acknow_project
24   projects:
25     - esmval
26     - c3s-magic
27 datasets:
28   - {dataset: BCC-ESM1, project: CMIP6, exp: historical, ensemble: r1ilplf1, grid: gn}
29   - {dataset: CanESM2, project: CMIP5, exp: historical, ensemble: r1ilpl1}
30 preprocessors:
31   select_january:
32     extract_month:
33       month: 1
34   annual_mean_amsterdam:
35     extract_point:
36       latitude: 52.379189
37       longitude: 4.899431
38       scheme: linear
39   annual_statistics:
40     operator: mean
41   multi_model_statistics:
42     statistics:
43       - mean
44     span: overlap
45 diagnostics:
46   map:
47     description: Global map of temperature in January 2000.
48     themes:
49       - phys
50     realms:
51       - atmos
52     variables:
53       tas:
54         mip: Amon
55         preprocessor: select_january
56         start_year: 2000
57         end_year: 2000
58     scripts:
```



What can ESMValTool do for you?

- Helps to analyze climate data
- Provides provenance and citation information.
- Supports several programming languages and operating systems.
- Helps efficient data processing.






ESMValGroup

Earth System Model eValuation Tool

<https://www.esmvaltool.org> [@ESMValTool](#)


[Overview](#) [Repositories 17](#) [Projects 3](#) [Packages](#) [Teams 14](#) [People 159](#)

Pinned

 **ESMValTool** Public


ESMValTool: A community diagnostic and performance metrics tool for routine evaluation of Earth system models in CMIP

NCL ☆ 157 🔗 95

 **ESMValCore** Public


ESMValCore: A community tool for pre-processing data from Earth system models in CMIP and running analysis scripts.

Python ☆ 26 🔗 28

 **Community** Public

This repository is used for meeting announcements and other community activities.

☆ 2

 **EGU22-short-course** Public

Learn to run ESMValTool from a Jupyter Notebook

Jupyter Notebook ☆ 7 🔗 3

Repositories

Find a repository... Type ▾ Language ▾ Sort ▾

ESMValTool Public

ESMValTool: A community diagnostic and performance metrics tool for routine evaluation of Earth system models in CMIP

NCL ☆ 157 🔗 Apache-2.0 🔗 95 🕒 178 (1 issue needs help) 🔗 57 Updated 37 minutes ago

ESMValTool_Tutorial Public

ESMValTool Tutorial

HTML ☆ 4 🔗 4 🕒 38 🔗 3 Updated yesterday

ESMValCore Public

ESMValCore: A community tool for pre-processing data from Earth system models in CMIP and running analysis scripts.

Python ☆ 26 🔗 Apache-2.0 🔗 28 🕒 252 (2 issues need help) 🔗 39 Updated yesterday

Developments, maintenance, discussions, and collaborations in **public**

<https://github.com/esmvalgroup>

General

Monthly ESMValTool meeting October

bouweandela

General

ESMValTool workshop Nov 2021

axel-lauer

New Top: All ▾ Answered Unanswered Label ▾ New discussion

Categories

View all

General

Ideas

New to ESMValTool

Q&A

Show and tell

Most helpful Last 30 days

zklaus

1

Code of conduct

Use of Wikis

bouweandela started yesterday in General

6

Monthly ESMValTool meeting October

bouweandela started 16 days ago in General

community

3

How can I run an example recipe?

ragtory asked 11 days ago in New to ESMValTool · Unanswered

1

Creating a conda environment is taking a long time

rswamina asked on Apr 24 in New to ESMValTool · Answered

7

Installing ESMValTool in Windows

ledm asked 28 days ago in New to ESMValTool · Answered

17

ESMValTool development version number

bouweandela started 26 days ago in Ideas

3

ESMValTool workshop Nov 2021

axel-lauer started 21 days ago in General

community

0

Workflows
New workflow

All workflows
 Showing runs from all workflows

3,169 workflow runs

Event	Status	Branch	Actor
Conda Base Install Conda Base Install #594: Scheduled	9 hours ago 17m 56s	...	
Test Test #608: Scheduled	12 hours ago 24m 13s	...	
Develop Test Develop Test #402: Scheduled			
Conda-build Conda-build #635: Scheduled			
Source Install Source Install #592: Scheduled			

Anaconda Publish
 Conda Base Install
 Conda lock file creation
 Conda-build
 Conda-lock Install
 Develop Test
 PyPi Build and Deploy
 Source Install
 Test

Replace recipe_era5.yml with recipe_daily_era5.yml #2182
Edit
Open with

Merged bouweandela merged 23 commits into `main` from `refactor_era5_cmorizer` on Aug 20

Conversation 40
 Commits 23
 Checks 2
 Files changed 8
 +444 -445

SarahAlidoost commented on May 27 • edited by bouweandela
 Member

Description

- Closes Including recipe_era5.yml under the folder cmorizer is misleading the users. #1909
- Link to documentation:
 - Updated section "Obtaining input data"
 - New recipe description

Before you get started

- Create an issue to discuss what you are going to do

Checklist

It is the responsibility of the author to make sure the pull request is ready to review. The icons indicate whether the item will be subject to the Technical or Scientific review.

- This pull request has a descriptive title
- Code is written according to the [code quality guidelines](#)
- Documentation is available
- Tests run successfully
- The list of authors is up to date
- All checks below this pull request were successful

New or updated recipe/diagnostic

- Recipe runs successfully
- Recipe is well documented

Reviewers

- Peter9192
- bouweandela
- valeriupredoi

Assignees

No one—assign yourself

Labels

observations

Projects

None yet

Milestone

No milestone

Linked issues

Successfully merging this pull request may close these issues.

Including recipe_era5.yml under the folder ...

Notifications
Customize

Unsubscribe

You're receiving notifications because you're watching this repository.

5 participants

Automated **testing**
and
review processes.



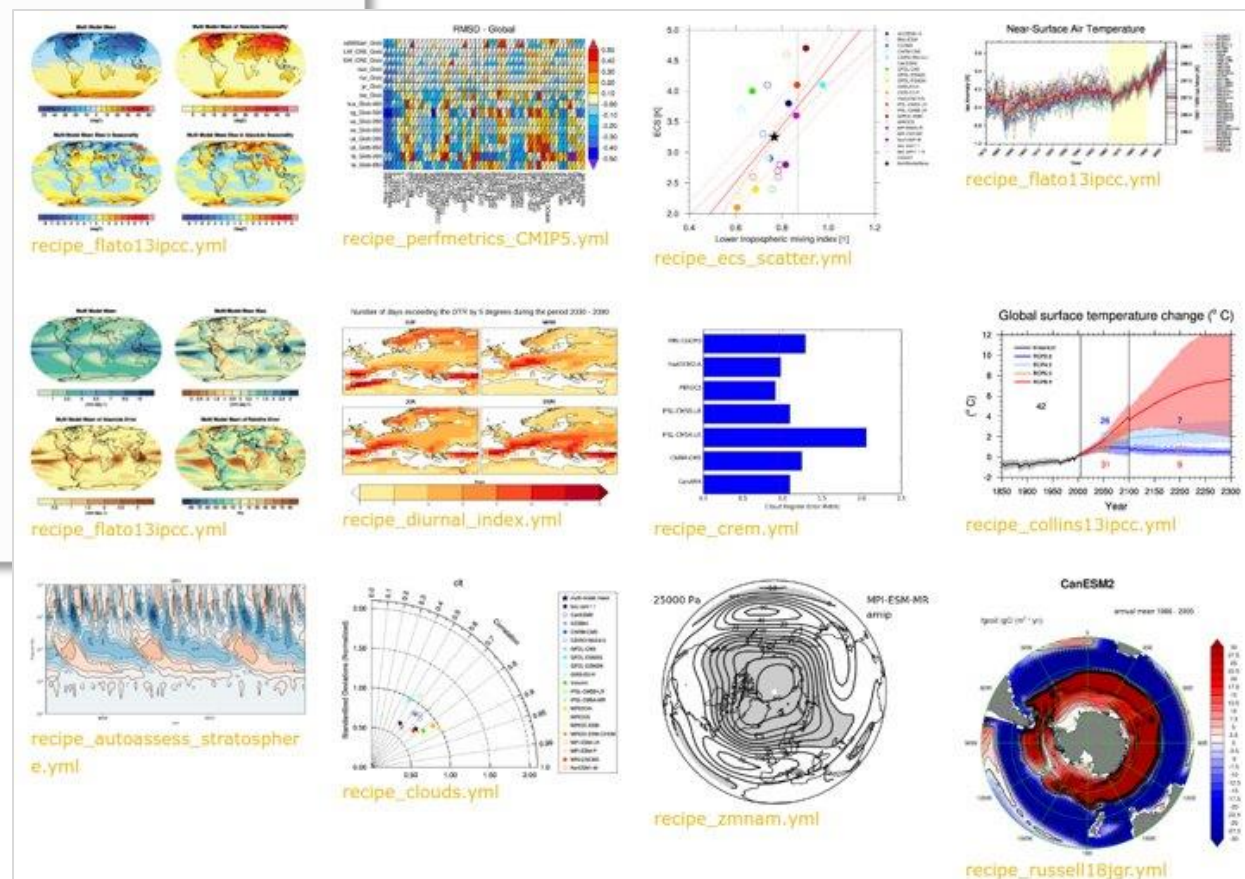
Welcome to ESMValTool's documentation!

ESMValTool

- Introduction
 - About
 - Contact
 - License
 - What ESMValTool can do for you
- Getting started
 - Installation
 - Configuration
 - Running
 - Output
- Gallery
- Available recipes
 - Atmosphere
 - Climate metrics
 - Future projections
 - IPCC

A collection of recipes with extensive **documentation**.

<https://docs.esmvaltool.org/>



ESMValTool Tutorial

This tutorial helps you to use ESMValTool.

The Earth System Model Evaluation Tool (ESMValTool) is a community developed software toolkit that aims to facilitate the diagnosis and evaluation of the causes and effects of model biases and inter-model spread within the CMIP model ensemble.

This tutorial is structured such that the main body of the tutorial, up to the episode 7, can be done in one sitting. From episode 8, each episode is a mini-tutorial covering an advanced aspect of working with ESMValTool. These mini-tutorials can be appended to the main tutorial or worked through independently.

What will you learn in this course

- What is ESMValTool
- How to install ESMValTool
- How to configure ESMValTool for your local system
- How to run ESMValTool
- How to work with ESMValTool's suite of preprocessors
- How to debug your recipes
- How to access and deploy recipes from the ESMValTools gallery (Advanced)
- How to develop your own diagnostics and recipes (Advanced)
- How to contribute your recipes and diagnostics back into ESMValTool (Advanced)
- How to include new observational datasets (Advanced)

Prerequisites

The prerequisites for the tutorial are listed on the [tutorial setup page](#).

An online **tutorial**

https://esmvalgroup.github.io/ESMValTool_Tutorial/

	Setup	Download files required for the lesson
00:00	1. Introduction	What is ESMValTool? Who are the people behind ESMValTool?
00:15	2. Installation	What are the prerequisites for installing ESMValTool? How do I confirm that the installation was successful?
00:35	3. Configuration	What is the user configuration file and how should I use it?
00:55	4. Running your first recipe	How to run a recipe? What happens when I run a recipe?
01:25	5. Conclusion of the basic tutorial	What do I do now? Where can I get help? What if I find a bug? Where can I find more information about ESMValtool? How can I cite ESMValtool?
01:35	6. Writing your own recipe	How do I create a new recipe? Can I use different preprocessors for different variables? Can I use different datasets for different variables? How can I combine different preprocessor functions?
02:20	7. Development and contribution	What is a development installation? How can I test new or improved code? How can I incorporate my contributions into ESMValTool?
02:50	8. Writing your own diagnostic script	How do I write a new diagnostic in ESMValTool? How do I use the preprocessor output in a Python diagnostic?
03:40	9. CMORization: adding new datasets to ESMValTool	CMORization: what is it and why do we need it? How to use the existing CMORizer scripts shipped with ESMValTool? How to add support for new (observational) datasets?
04:40	10. Debugging	How can I handle errors/warnings?

Using ESMValTool:

- Others can understand Jane's analyses



Using ESMValTool:

- Others can understand Jane's analyses
- Ben can re-use code instead of re-implementing it



Using ESMValTool:

- Others can understand Jane's analyses
- Ben can re-use code instead of re-implementing it
- They spend less time developing code



What lessons can the S2S community draw from ESMValTool's approach to community-driven scientific analysis workflows?



**Let's stay
in touch**

<https://www.esmvaltool.org>

<https://github.com/ESMValGroup/>