

# ESMValTool

Earth System Model Evaluation Tool



## ESMValTool Tutorial 4<sup>th</sup> May 2023 NCEO and TerraFIRMA

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<sup>6</sup>Plymouth Marine Laboratory



Natural  
Environment  
Research Council

# Today's Tutorial

1. Introduction – presentation

2. Demo

3. Q&A

Break

4. Hands on Exercises with the Software Carpentry online tutorial

5. Feedback

Recording on for 1 and 2.

# Desired Outcomes

- **Understanding** what ESMValTool is and what it can do for you.
- **Starting** with existing recipes and diagnostics.
- **Writing** your own recipes for preprocessing.
- **Parsing** error messages and getting help when stuck.
- **Contributing** to the community (as early as right after this session)!
- **Advanced** tutorial planning!

# ESMValTool

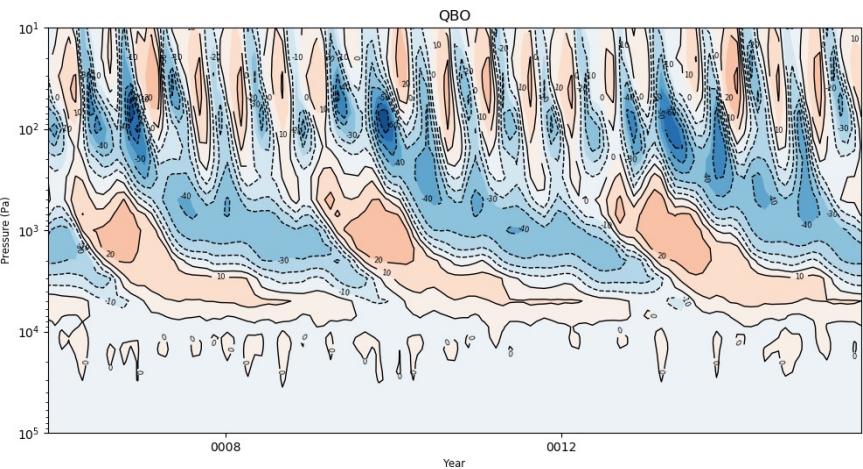
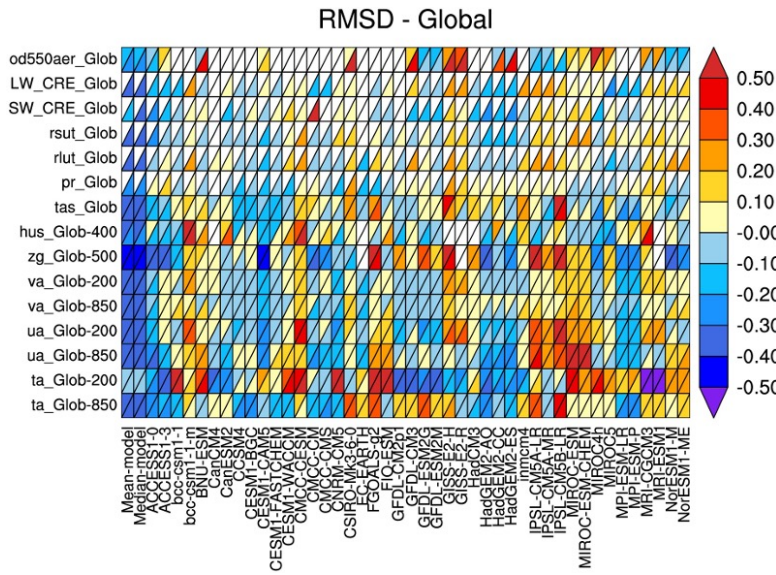
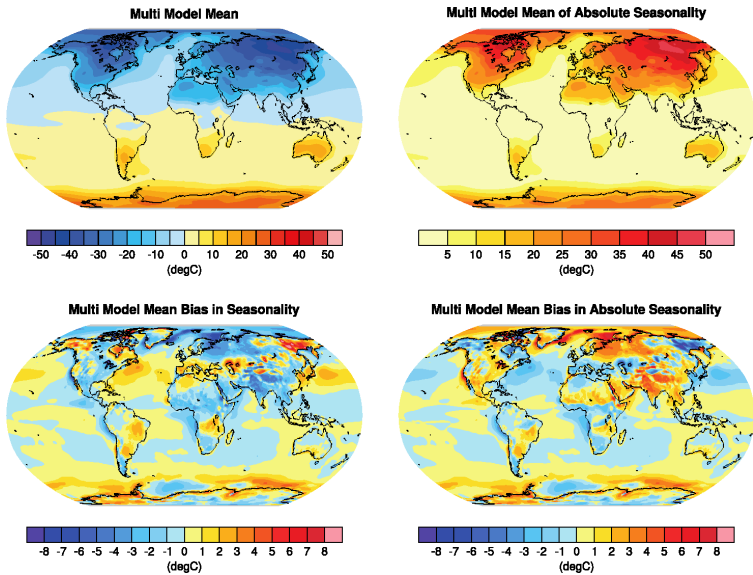
- **E**arth **S**ystem **M**odel **E**valuation **T**ool (ESMValTool)
- community diagnostics and performance metrics tool
- for the evaluation and analysis of Earth System Models
- routine comparison of single or multiple models
- against predecessor versions or observations

# Features

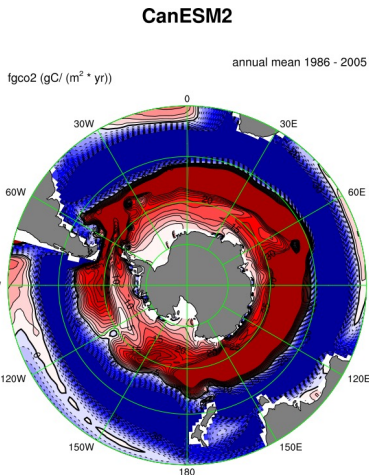
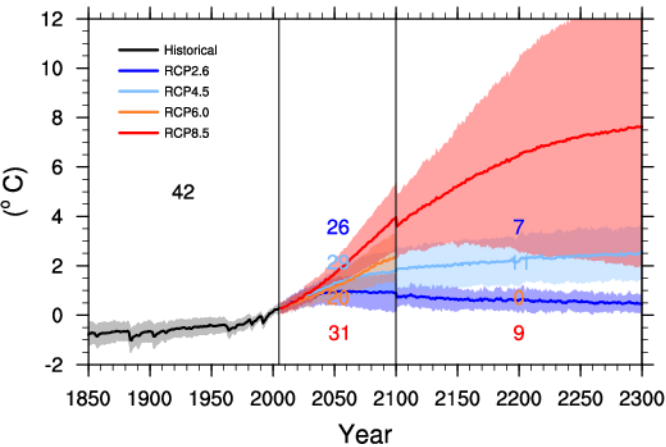
- **Community Effort:** open to users and developers (~63 participating institutions, > 70 CMIP models, 203 developers, 17 funded projects)
- **Wide scope:** diagnostics and performance metrics covering different aspects of the Earth System.
- **High flexibility:** new diagnostics and observational datasets can be easily added.
- **Multi-language support:** Python, NCL, R, Julia...other open source languages possible.
- **Reproducibility of results:** provenance.
- **Well documented:** source code and diagnostics.

# ESMValTool Gallery

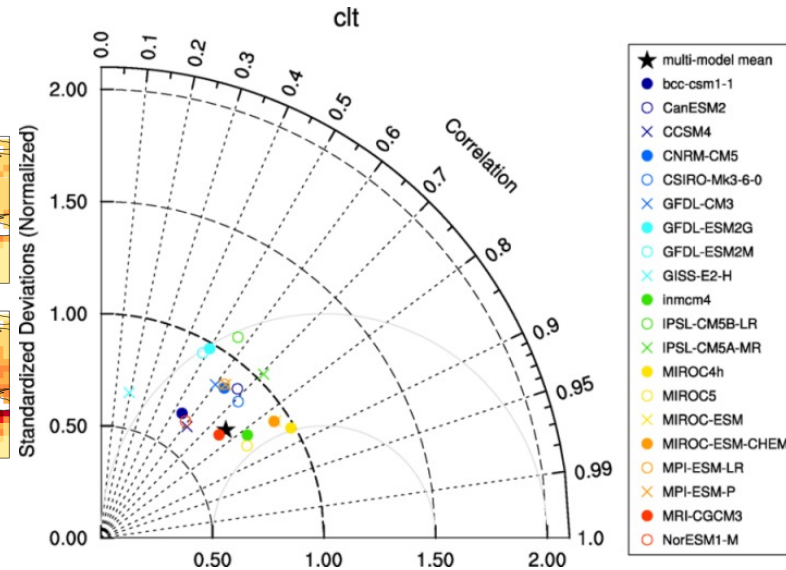
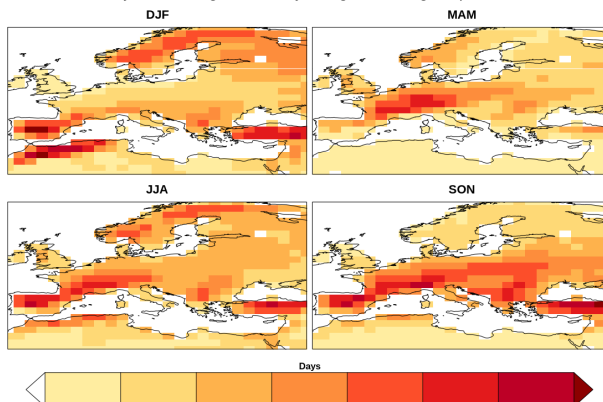
(<https://docs.esmvaltool.org/en/latest/gallery.html>)



Global surface temperature change (°C)



Number of days exceeding the DTR by 5 degrees during the period 2030 - 2080

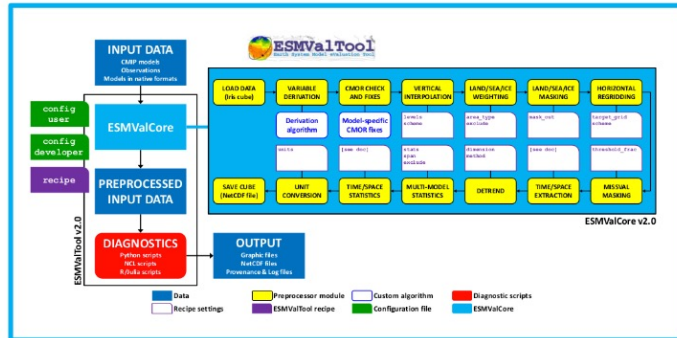




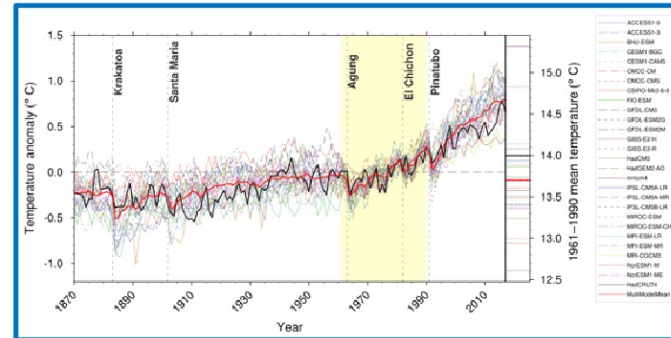
# ESMValTool Science

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

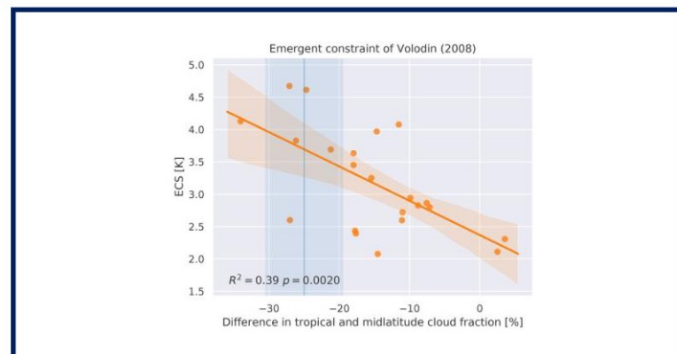
## Righi et al., 2020 Technical overview



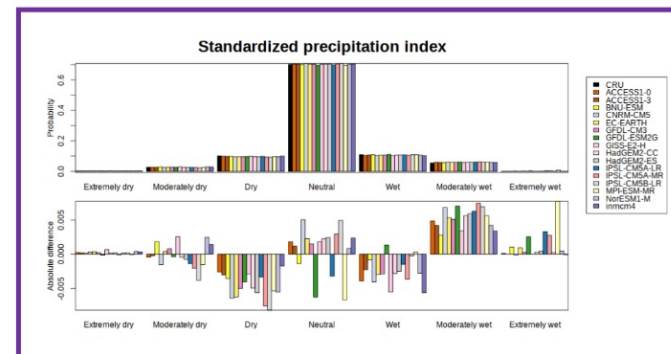
## Eyring et al., 2020 Large-scale diagnostics



## Lauer et al., 2020 Diagnostics for emergent constraints and future projections

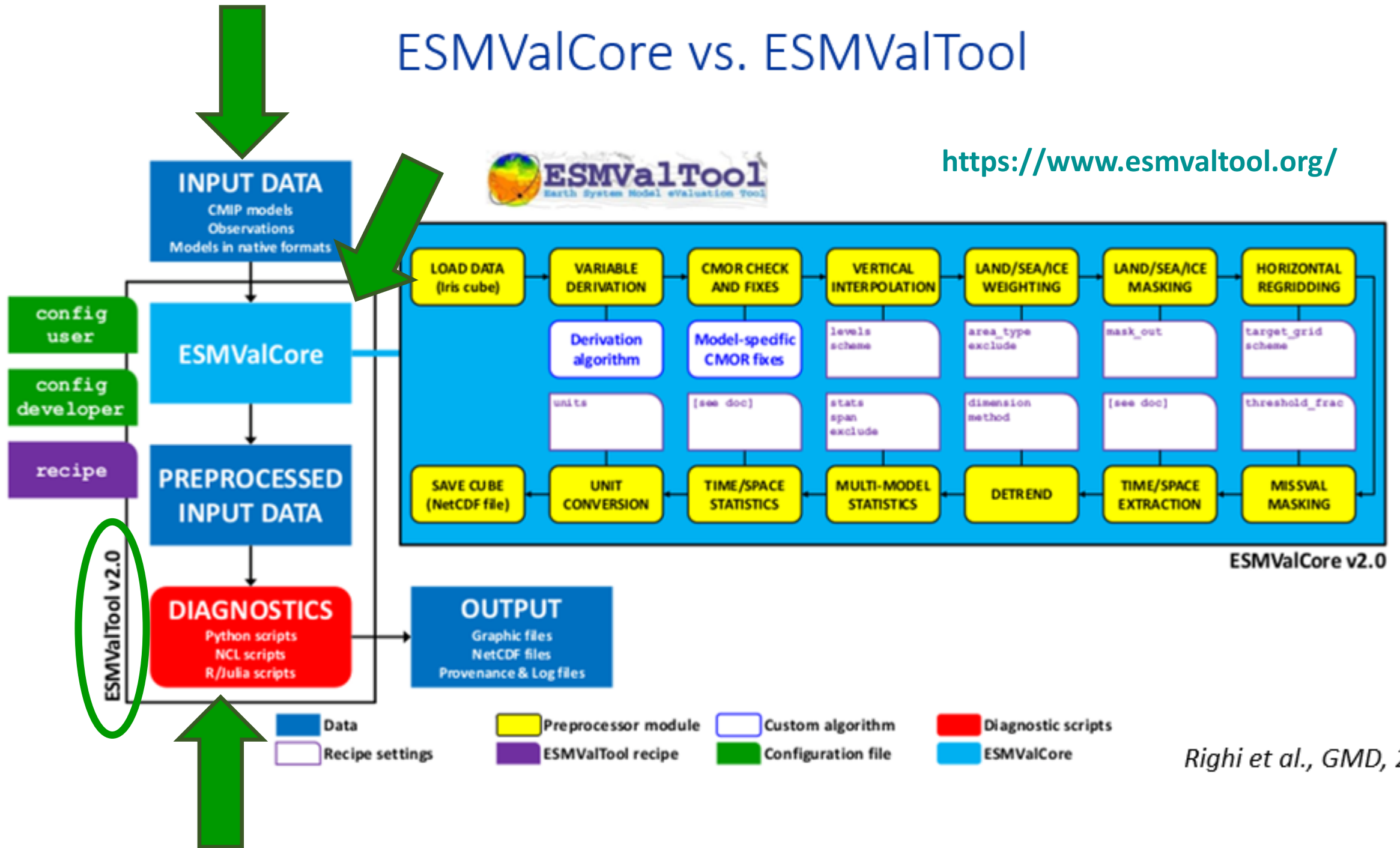


## Weigel et al., 2021 Diagnostics for extreme events, regional and impact evaluation



# ESMValCore vs. ESMValTool

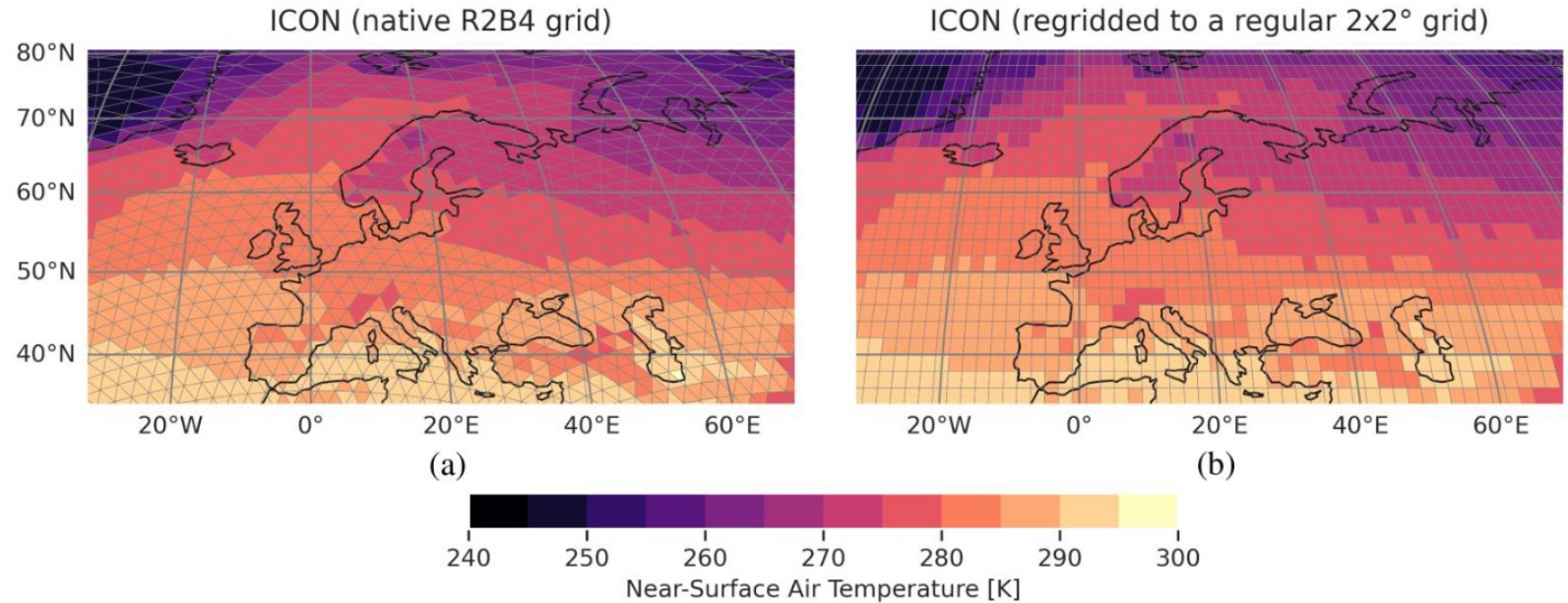
<https://www.esmvaltool.org/>





# Latest ESMValTool features

- Working with native model output: no CMORization of model data necessary; four models currently supported.



- Automatic download from ESGF nodes including support for wildcard characters in recipes.
- Support for CORDEX datasets in a rotated pole coordinated system.
- Working with unstructured grids possible.
- Monitoring capabilities: model simulations can be checked while they are running.

## For users in the UK

- Access to CMIP data via CEDA (BADC)
- Access to CMOR-ized observational data sets (Tiers1/2/3 : **~827GB**)
  - ESA-CCI, ERA, obs4MIPS
- JASMIN specific instructions where possible in the tutorial (more on this later).
- Available as a module on JASMIN

# UK Met Office users

```
> module load scitools/community/esmvaltool/2.8.0
```

Further instructions are available at

<https://metoffice.sharepoint.com/sites/MOESMValToolCommunityofPracticeExt/SitePages/ESMValTool-at-the-Met-Office.aspx#to-use-esmvaltool>.

# ESMValTool Resources

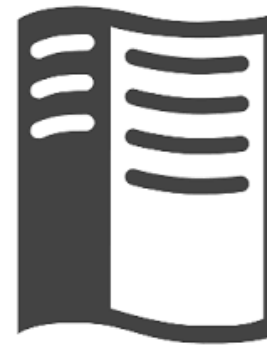
## 1. Github repositories

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



## 2. Documentation

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

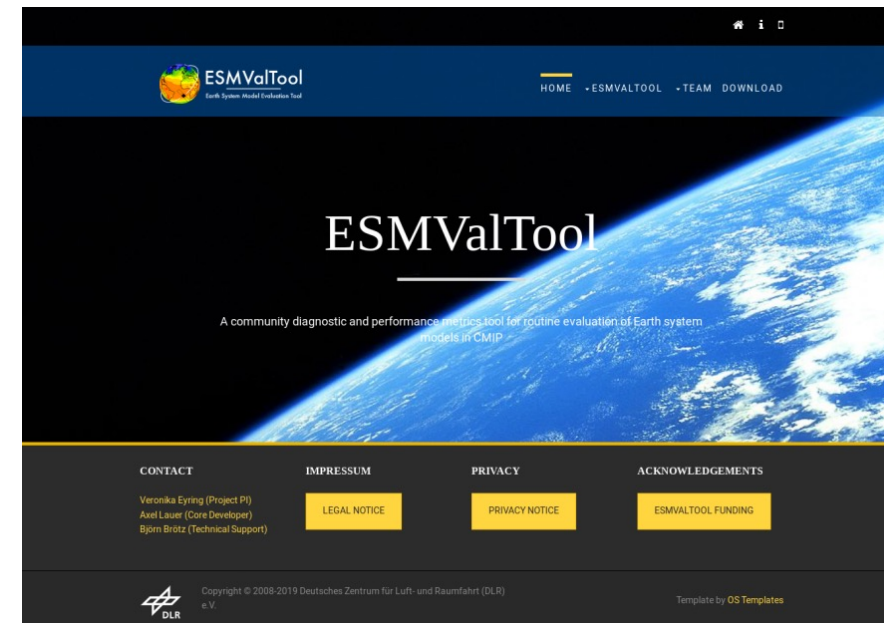


## 3. Tutorial

[https://esmvalgroup.github.io/ESMValTool\\_Tutorial/](https://esmvalgroup.github.io/ESMValTool_Tutorial/)

## 4. Webpage

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



# ESMValTool Tutorial

([https://esmvalgroup.github.io/ESMValTool\\_Tutorial/](https://esmvalgroup.github.io/ESMValTool_Tutorial/))

This lesson is being piloted (Beta version)

Home Setup Episodes ▾ Extras ▾ License Improve this page ✎

## 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](#).



# GitHub Discussions

(<https://github.com/ESMValGroup/ESMValTool/discussions>)

- Ideally suited for new users.
- Easy way to get in contact with developers.

## Categories

∞ View all

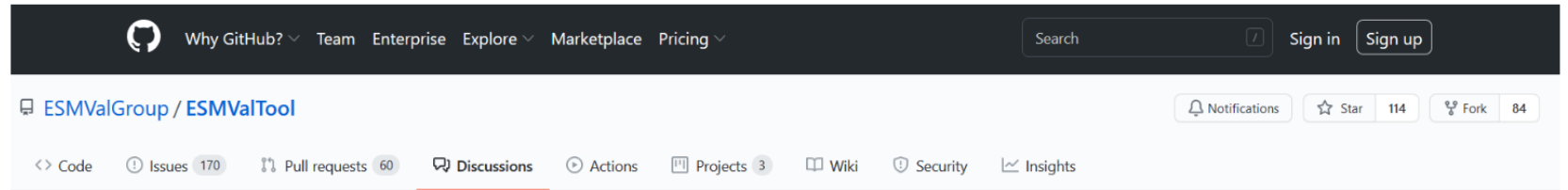
General

Ideas

New to ESMValTool

Q&A

Show and tell



## Categories

∞ View all









General

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New to ESMValTool

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Show and tell

- ↑ 1  **Version numbers**  
bouweandela started 12 days ago in Ideas  5
- ↑ 1  **Resources on climate indices**  
bouweandela started 11 days ago in Ideas  0
- ↑ 1  **Website**  
bouweandela started 11 days ago in Ideas  0
- ↑ 2  **Image gallery**  
bouweandela started 11 days ago in Ideas  1

# ESMValTool Documentation

- Very detailed information about ESMValTool and ESMValCore functionality.



The screenshot shows the ESMValTool documentation website. The left sidebar contains a navigation menu with sections for ESMVALTOOL, ESMVALCORE, and a footer with 'Read the Docs' and 'v: latest'. The main content area displays a 'Welcome to ESMValTool's documentation!' message and a table of contents for the 'Making a recipe or diagnostic' section. A blue callout box highlights the 'Making a recipe or diagnostic' section, showing its sub-items: Introduction, Recipe, Diagnostic, Instructions for personal diagnostic, Functionality, Example of config dictionary, and Dataset.

ESMValTool

Docs » Welcome to ESMValTool's documentation! [Edit on GitHub](#)

## 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
  - Land
  - Ocean
  - Other
- Obtaining input data
  - Models
  - Observations
- Making a recipe or diagnostic
  - Introduction
  - Recipe

### Making a recipe or diagnostic

- Introduction
- Recipe
- Diagnostic**
  - Instructions for personal diagnostic
  - Functionality
  - Example of config dictionary
- Dataset

# Organization and Community Participation

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

# Questions?

**Contact the User Engagement Team at  
[esmvaltool\\_user\\_engagement\\_team@listserv.dfn.de](mailto:esmvaltool_user_engagement_team@listserv.dfn.de)**