

Earth System Model Evaluation Tool (ESMValTool)

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Mini Symposium on Sustainable Research Software Development
for Geo-Information Science and Earth Observation,

ITC, University of Twente, November 2022

netherlands
eScience center

What is ESMValTool?

- It facilitates the analysis of climate data.
- It provides a standard format for scientific analysis workflow a.k.a. "recipes".



Data finding



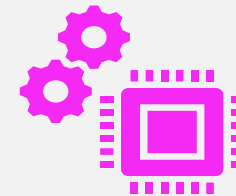
Data selection



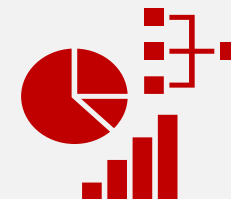
Data fixing



Variable derivation



Running preprocessors

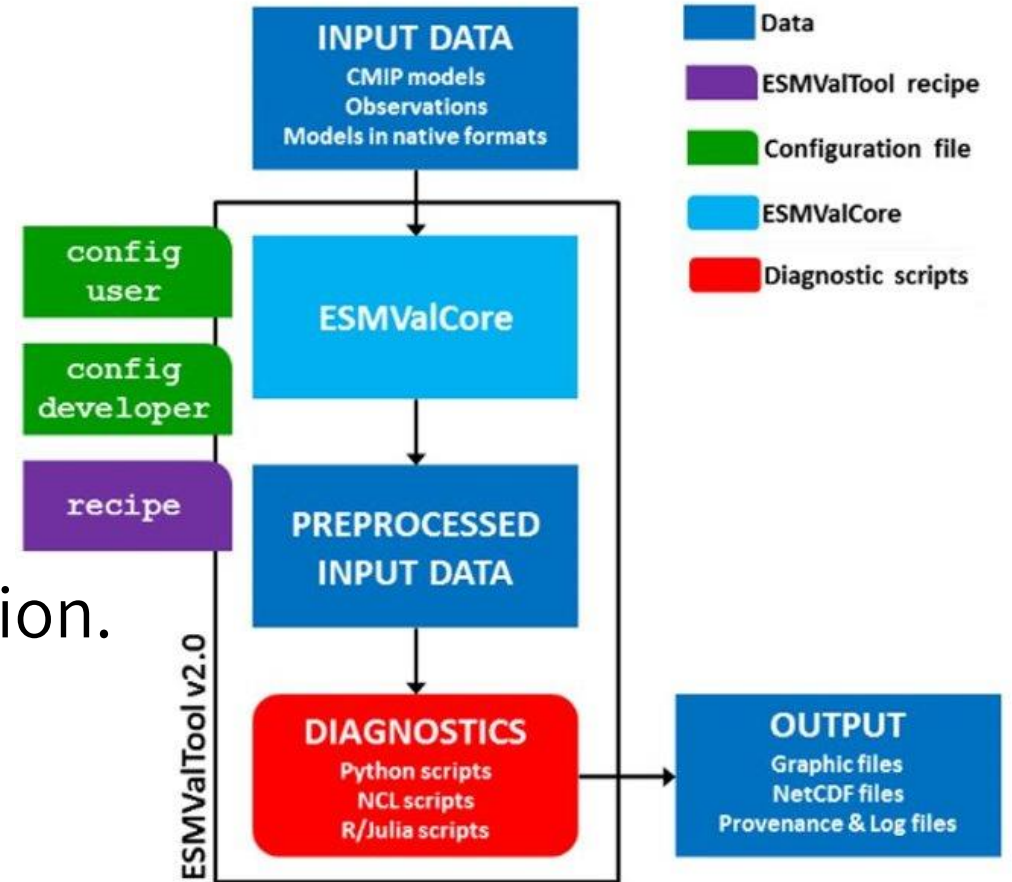


Running diagnostics











What can ESMValTool do for you?

- Helps to analyze climate data.
- Provides a collection of recipes.
- Provides provenance and citation information.
- Helps efficient data processing.

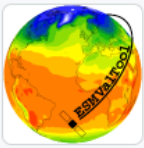


<https://www.esmvaltool.org>

By an international community of scientists and software engineers

14 teams in the ESMValGroup organization		Visibility ▾	Members ▾
<p>ESMValTool-CoreTeam</p> <p>Team members can read, clone, and push to this repository.</p>		17 members	2 teams ▾
<p>ESMValTool-DevelopmentTeam</p> <p>Team members can create new feature branches.</p>		175 members	0 teams
<p>ESMValTool-recipe-maintainers</p>		15 members	0 teams
<p>IPCC-maintainers</p> <p>Maintainers of the AR6 repositories</p>		4 members	0 teams
<p>science-reviewers</p> <p>Scientific review team</p>		11 members	4 teams ▾
<p>SIG Regional</p> <p>Special Interest Group on Regional Models and Evaluation</p>		5 members	0 teams
<p>tech-reviewers</p> <p>Technical review team</p>		10 members	0 teams
<p>UserEngagementTeam</p> <p>User Engagement Team</p>		11 members	0 teams





ESMValGroup

Earth System Model eValuation Tool

<https://www.esmvaltool.org> [@ESMValTool](https://twitter.com/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

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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>

Search all discussions

New Top: All Answered Unanswered Label

New discussion

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General

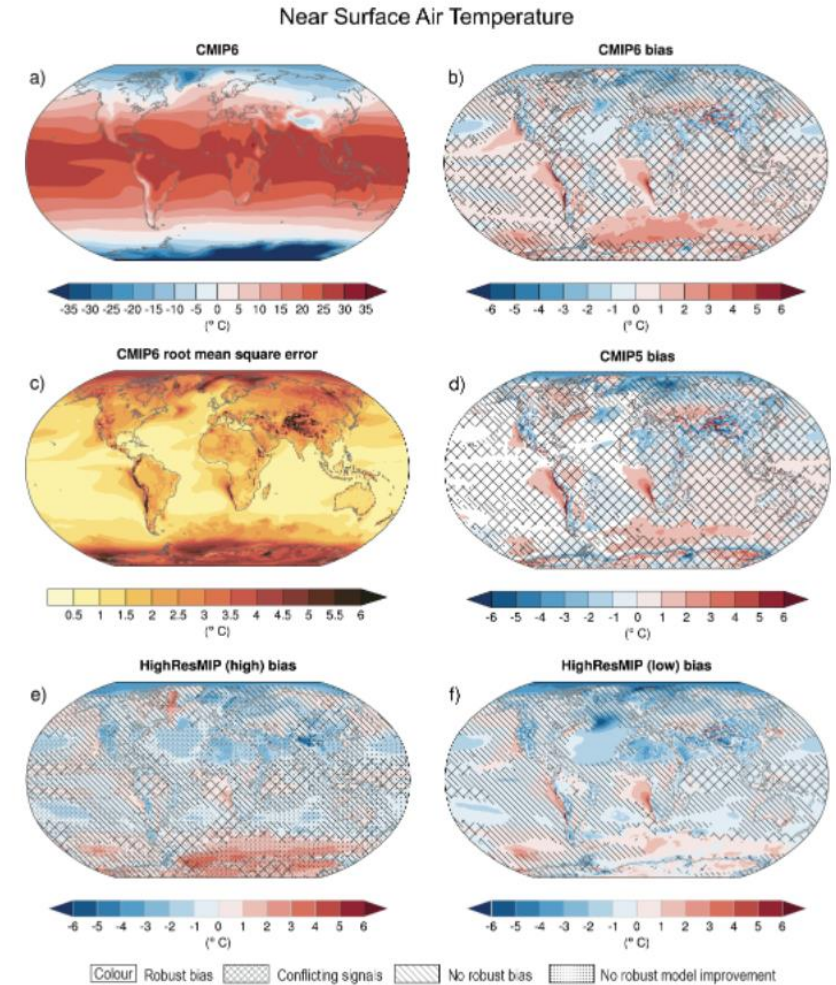
- ↑ 1 Use of Wikis bouweandela started yesterday in General 6
- ↑ 1 Monthly ESMValTool meeting October bouweandela started 16 days ago in General 3
- ↑ 1 How can I run an example recipe? ragtory asked 11 days ago in New to ESMValTool · Unanswered 1
- ↑ 1 Creating a conda environment is taking a long time rswamina asked on Apr 24 in New to ESMValTool · Answered 7
- ↑ 2 Installing ESMValTool in Windows ledm asked 28 days ago in New to ESMValTool · Answered 17
- ↑ 4 ESMValTool development version number bouweandela started 26 days ago in Ideas 3
- ↑ 1 ESMValTool workshop Nov 2021 axel-lauer started 21 days ago in General 0

- Publications with results from ESMValTool

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

- The Mediterranean climate change hotspot in the CMIP5 and CMIP6 projections, *Earth System Dynamics*, 13(1), 321-340, doi: [10.5194/esd-13-321-2022](https://doi.org/10.5194/esd-13-321-2022), **2022**.
- Comparison of Reanalysis and Observational Precipitation Datasets Including ERA5 and WFDE5, *Atmosphere*, 12(11), 1462, doi: [10.3390/atmos12111462](https://doi.org/10.3390/atmos12111462), **2021**
- Evaluating stratospheric ozone and water vapour changes in CMIP6 models from 1850 to 2100, *Atmos. Chem. Phys.*, 21, 5015-5061, doi: [10.5194/acp-21-5015-2021](https://doi.org/10.5194/acp-21-5015-2021), **2021**.
- The Physical Climate at Global Warming Thresholds as seen in the UK Earth System Model, *Journal of Climate*, 1-64, doi: [10.1175/JCLI-D-21-0234.1](https://doi.org/10.1175/JCLI-D-21-0234.1), **2021**.
- Climate model projections from the Scenario Model Intercomparison Project (ScenarioMIP) of CMIP6, *Earth Syst. Dynam.*, 12, 253-293, doi: [10.5194/esd-12-253-2021](https://doi.org/10.5194/esd-12-253-2021), **2021**.
- Earth System Model Evaluation Tool (ESMValTool) v2.0 - diagnostics for extreme events, regional and impact evaluation, and analysis of Earth system models in CMIP, *Geosci. Model Dev.*, 14, 3159-3184, doi: [10.5194/gmd-14-3159-2021](https://doi.org/10.5194/gmd-14-3159-2021), **2021**.
- Earth System Model Evaluation Tool (ESMValTool) v2.0 - diagnostics for emergent constraints and future projections from Earth system models in CMIP, *Geosci. Model Dev.*, 13, 4205-4228, doi: [10.5194/gmd-13-4205-2020](https://doi.org/10.5194/gmd-13-4205-2020), **2020**.
- Context for interpreting equilibrium climate sensitivity and transient climate response from the CMIP6 Earth system models, *Science Advances*, 6, 26, eaba1981, doi: [10.1126/sciadv.aba1981](https://doi.org/10.1126/sciadv.aba1981), **2020**.
- ESMValTool v2.0 - Technical overview, *Geosci. Model Dev.*, 13, 1179-1199, doi: [10.5194/gmd-13-1179-2020](https://doi.org/10.5194/gmd-13-1179-2020), **2020**.
- Emergent constraints on Equilibrium Climate Sensitivity in CMIP5: do they hold for CMIP6?, *Earth Syst. Dynam.*, 11, 1233-1258, doi: [10.5194/esd-11-1233-2020](https://doi.org/10.5194/esd-11-1233-2020), **2020**.
- Constraining uncertainties in CMIP5 projections of September Arctic sea ice extent with observations, *J. Climate*, 33, 4, 1487-1503, doi: [10.1175/JCLI-D-19-0075.1](https://doi.org/10.1175/JCLI-D-19-0075.1), **2020**.
- ...

- Publications with results from ESMValTool
<https://www.esmvaltool.org/publications.html>
- IPCC Sixth Assessment Report



IPCC Sixth Assessment Report Figure 3.3

- Publications with results from ESMValTool

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

- IPCC Sixth Assessment Report

- Revealed: The 11 slides that finally convinced Boris Johnson about global warming

Projections of future climate

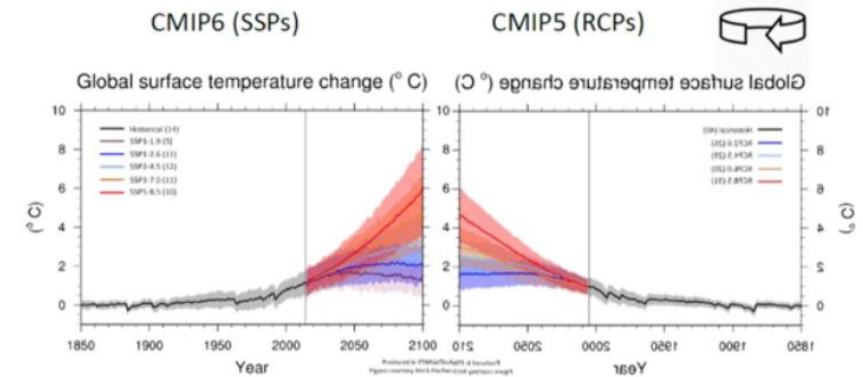


Figure courtesy Erich Fischer  ESMValTool
Earth System Model Evaluation Tool

Slide 7

According to the credit on the image, this figure was created by [Dr Erich Fischer](#), a senior scientist and lecturer in the [Department of Environmental Systems Science](#) at [ETH Zurich](#). It was created using the [Earth System Model Evaluation Tool \(ESMValTool\)](#), which “allows for routine comparison of single or multiple models, either against predecessor versions or against observations”.

Access to CMIP and observational data and a suitable compute cluster

Use a computing cluster with an Earth System Grid Federation (ESGF) node:

- German Climate Computing Center (DKRZ), Germany
- Center for Environmental Data Analysis (CEDA), UK
- Institut Pierre-Simon Laplace (IPSL), France
- Swiss Federal Institute of Technology Zurich (ETHZ), Switzerland
- National Supercomputer Centre (NSC), Sweden
- Barcelona Supercomputing Center (BSC), Spain



Server Options

Select a computing unit:

8 vCPU Intel x86-64, 32 GB RAM

[FAQ: Which computing unit should I select?](#)


Start



File Edit View Run Kernel Application Git Diagram Tabs Settings Help

Introduction_to_ESMValTool x +

+ 🔍 📄 ▶ ⏪ ⏩ Code ↕ 🌐 git

 **ESMValTool** netherlands
Earth System Model Evaluation Tool **eScience center** Geospatial Computing Platform

Working with ESMValTool recipes

```
[ ]: # Import the tool
import esmvalcore.experimental as esmvaltool
```

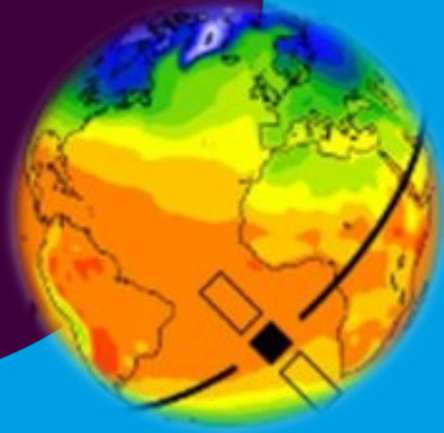
Configuring the tool

```
[4]: esmvaltool.CFG
```

```
[4]: Config({'auxiliary_data_dir': PosixPath('/home/jovyan/private/Sarah/esmvaltool'),
            'compress_netcdf': False,
            'config_developer_file': None,
            'config_file': PosixPath('/home/jovyan/.esmvaltool/config-user.yml'),
            'download_dir': PosixPath('/home/jovyan/private/Sarah/esmvaltool/climate_data'),
            'drs': {'CMIP5': 'ESGF', 'CMIP6': 'ESGF'},
            'exit_on_warning': False,
            'extra_facets_dir': (),
            'log_level': 'info',
            'max_parallel_tasks': 1,
            'offline': True,
            'output_dir': PosixPath('/home/jovyan/private/Sarah/esmvaltool/esmvaltool_output'),
            'output_file_type': 'png',
            'profile_diagnostic': False,
            'remove_preproc_dir': True,
            'resume_from': [],
            'rootpath': {'default': [PosixPath('/home/jovyan/private/Sarah/esmvaltool')]},
            'save_intermediary_cubes': False})
```

Running a recipe

```
[ ]: example_recipe = esmvaltool.get_recipe("examples/recipe_python.yml")
output = example_recipe.run()
```



References

- <https://www.esmvaltool.org>
- <https://github.com/ESMValGroup/>
- <https://docs.esmvaltool.org/>
- <https://www.esmvaltool.org/tutorial.html>

Show and tell

Latest version v2.7.0 release

valeriupredoi

Search all discussions

Sort by: Latest activity Label Filter: New discussion

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- General
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- New to ESMValTool
- Polls
- Q&A
- Show and tell

Most helpful Last 30 days

valeriupredoi	2
remi-kazeroni	1

Code of conduct
www.esmvaltool.org

Discussions

- recipe_extreme_index.yml : trying to apply on monthly datasets**
mpmoine asked 5 days ago in New to ESMValTool · Unanswered 5
- Latest version v2.7.0 release**
valeriupredoi started 17 days ago in Show and tell 11
- CEDA-JASMIN central installation now supports module loading latest version **and** previous stable version**
valeriupredoi started 7 days ago in Show and tell 0
- ClimWIP: Failed to run preprocessor function 'mask_landsea' on the data**
DoMatte asked 20 days ago in New to ESMValTool · Answered 8
- Issues related to the recipe comparison tool**
schlunma started 14 days ago in General 6
- Re-usina pre-processed files or other previous run output?**

Let's stay in touch

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