

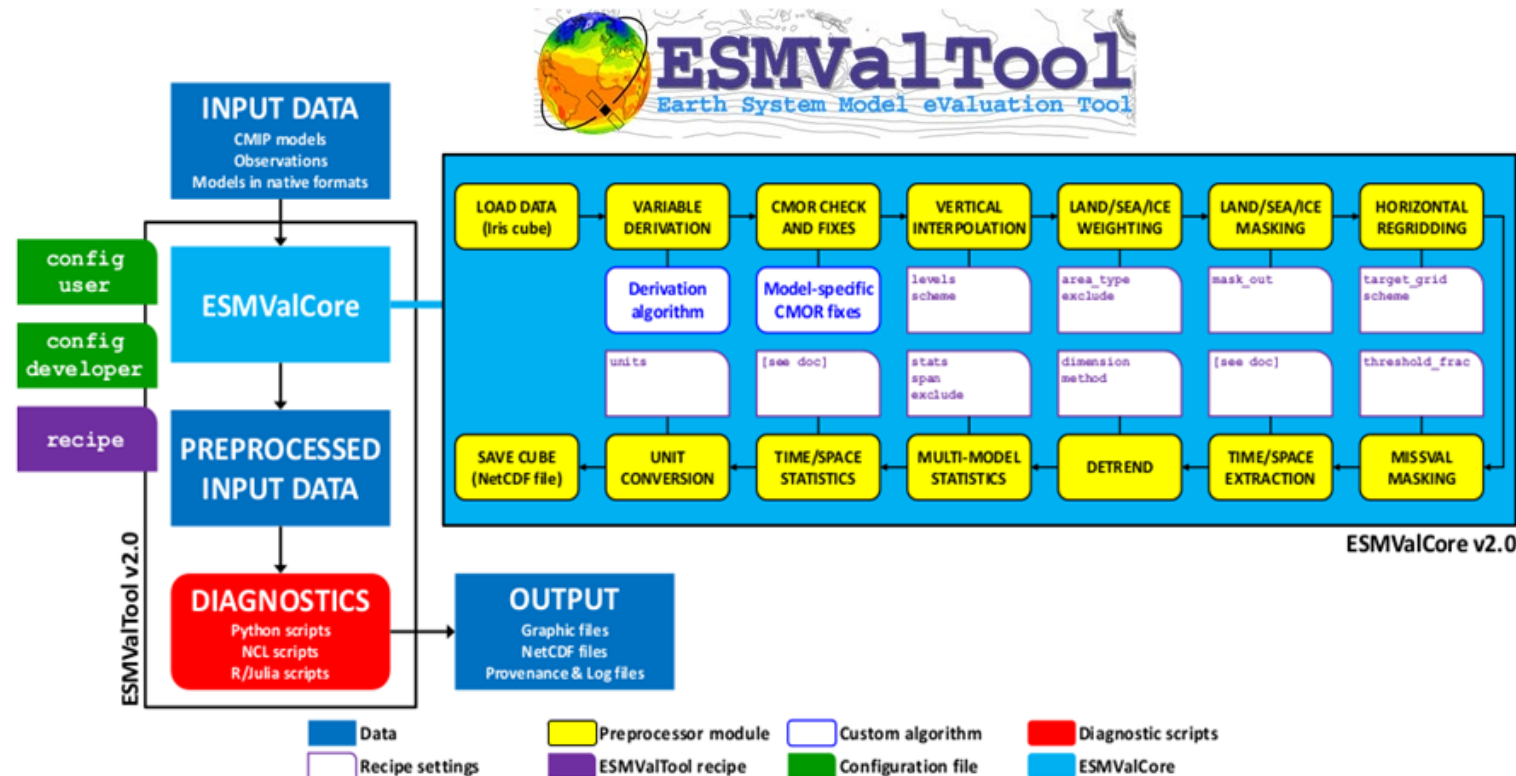
ESMValTool: Main achievements and plans for the future

Rémi Kazeroni (DLR)
Saskia Loosveldt Tomas (BSC)
on behalf of the ESMValTool & ESMValCore development teams

1. Introduction

Release v2.0 – August 2020

- Open-source project on [GitHub](#)
- **International development team** (~63 institutions, 200 developers, 17 funding projects)
- Based on **community standards** (W3C PROV, CF/CMOR, YML, pep8, ...)
- Core part written in Python 3 (iris, dask, ...)
- Support for diagnostics in **Python, NCL, R, and Julia**
- **3 releases per year** (currently at v2.7)
- **Online [documentation](#)**
- **[Tutorial](#) and [website](#)**
- **Technical and scientific documentation:**
5 peer-reviewed publications



Community & Meetings

- 2 co-PIs: Birgit Hassler (DLR) and Alistair Sellar (UK Met Office)
- 3 teams have been created: Scientific, Technical Lead Development Teams, User Engagement Team
- Monthly community meetings
- 7 technical workshops held (in-person, hybrid, virtual)
- Team meetings and WP telcos

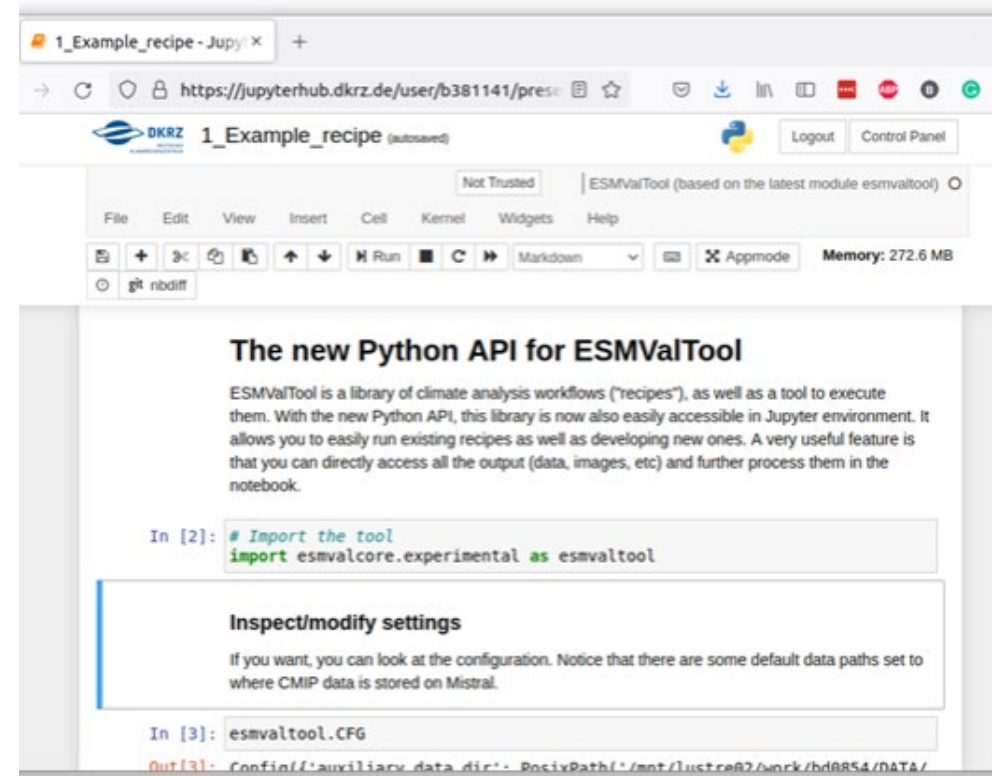
2. Deployment and usage

➤ Status

- Installation in Linux / MacOS X
 - Conda/Mamba and Docker or Singularity
- Deployment on conda-forge
- Availability on several HPC systems
 - as a module
 - as a Jupyter kernel

➤ Next steps

- Developments in the python API to improve the usage of the tool with Jupyter notebooks



3. Continuous development and testing

➤ Status

- Enhancement and improvement of automated testing
 - Use of continuous integration services (Circle CI, GitHub Actions, Codacy, Codecov, ...)
 - Regression testing of all recipes prior to releases and publication of the output to a [web portal](#)
 - A new tool has been added to compare output of different runs of a recipe
 - Deployment of a Virtual Machine and a bot at DKRZ used to test recipes under development

➤ Next steps

- Development of recipe test workflows
 - Automate the detection of changes in recipe output due to changes in the core

4. Performance

➤ Status

- Improvements in Iris
 - Lazy regridding with iris and through the iris-esmf package
 - Lazy aggregators to perform statistics on the data
- Improvements in ESMValCore
 - Additional preprocessor functions: v2.0: 51 → v2.7: 72
 - Use of iris and dask in many preprocessor functions to handle the data in a lazy way

➤ Next steps

- Make all preprocessors lazy
- Further performance improvements to support higher resolution data



5. Coupling to ESGF and access to observational datasets

➤ Status

- Input data read from local ESGF node
- Missing data automatically downloaded from ESGF nodes
- New interface to prepare observational datasets
 - Scripts to download raw data from source servers
 - Simplified process to reformat raw data to CMOR standards

Dataset name	Tier	Auto-download	Last access
APHRO-MA	3	Yes	2020-03-06
AURA-TES	3	Yes	2018-12-08
BerkeleyEarth	2	Yes	2020-02-25
CALIPSO-GOCCP	2	Yes	2020-01-27
CDS-SATELLITE-ALBEDO	3	Yes	2019-04-01
CDS-SATELLITE-LAI-FAPAR	3	Yes	2019-07-03
CDS-SATELLITE-SOIL-MOISTURE	3	Yes	2019-03-14
CDS-UIERRA	3	Yes	2019-11-04
CDS-XCH4	3	Yes	2019-03-11
CDS-XCO2	3	No	2019-03-19
CERES-EBAF	2	No	2019-11-26
CERES-SYN1deg	3	No	2019-02-07
CowtanWay	2	Yes	2020-02-26
CRU	2	Yes	2019-05-16
CT2019	2	Yes	2020-03-23
Duveiller2018	2	Yes	2019-04-30
E-OBS	2	Yes	2020-02-25
Epplery-VGPM-MODIS	2	Yes	2019-05-15
ERA-Interim-Land	3	No	2019-11-04
ERA-Interim	3	No	2019-09-05
ESACCI-AEROSOL	2	Yes	2019-01-24
ESACCI-CLOUD	2	Yes	2019-02-01
ESACCI-FIRE	2	Yes	2019-01-24
ESACCI-LANDCOVER	2	No	2019-01-10
ESACCI-OC	2	Yes	2019-02-27
ESACCI-OZONE	2	Yes	2019-02-01

examples of supported observational datasets

➤ Next steps

- Enhanced coupling to ESGF nodes
 - Possibility to select the default input data source (local data, ESGF servers)
 - Automatically filling ESMValTool recipes based on data availability on ESGF
- Observational datasets
 - Discussions on how to ease access to reformatted observational data
 - Collaboration with the CREATE-IP project

6. Evaluation and monitoring of operational (native) model output

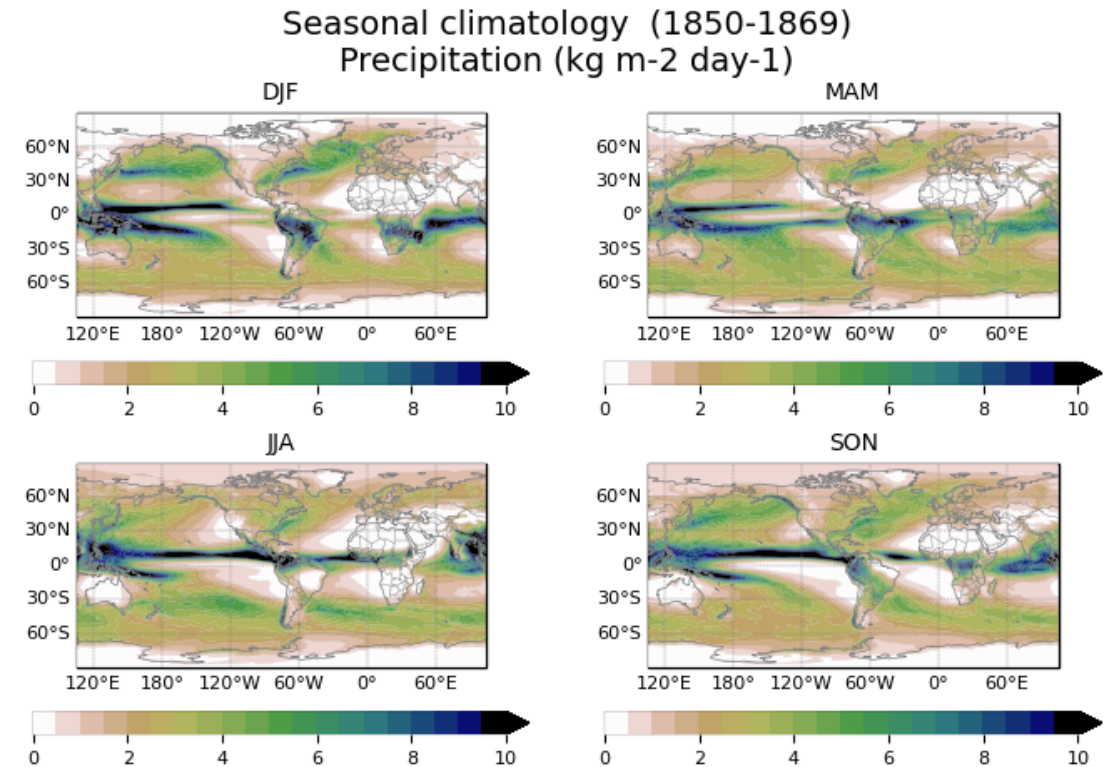
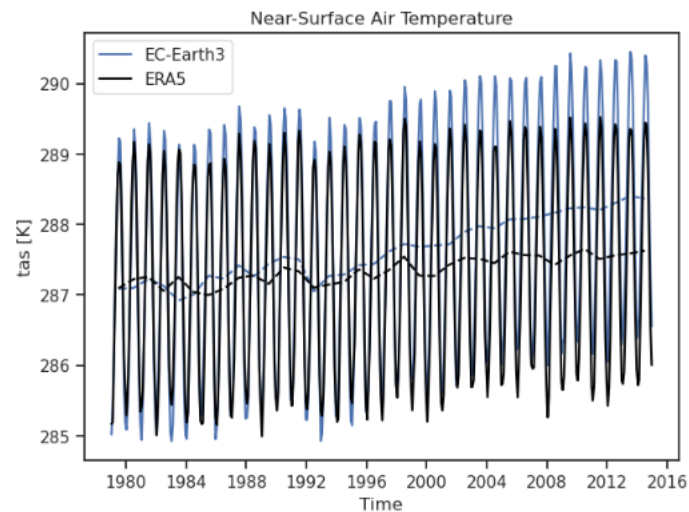
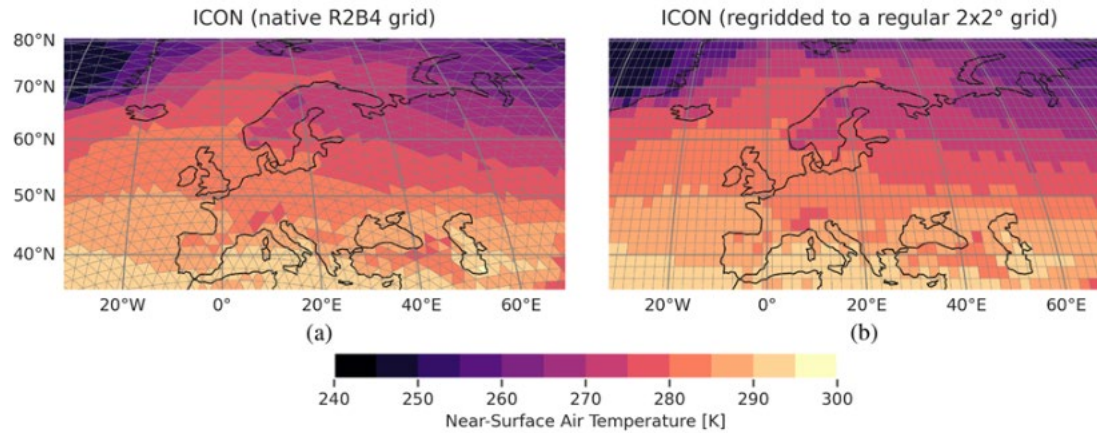
➤ Status

- Supported native models, including on-the-fly CMORisation
 - CESM2
 - EC-Earth
 - EMAC
 - ICON
 - IPSL-CM6
- Addition of diagnostics for monitoring purposes
 - Plot any variable
 - Climatologies (seasonal, monthly), time series, annual cycles, vertical profiles, biases

➤ Next steps

- Add support for more models

6. Evaluation and monitoring of native model output



7. Seamless evaluation

➤ Status

- Flexibilisation of the handling of the time coordinate
 - {start_year, end_year} → timerange ISO 8601 + wildcards
 - timerange: '19800302/19820403'
 - timerange: '1980/P5Y'
 - timerange: '*/P2Y5M'
 - Loading of DCPD data (predictions instead of projections)
- Support for CORDEX datasets
 - Addition of the project and its CMOR tables
 - Fixes in the metadata for selected variables
 - General grid fix to describe the data in the standardised CORDEX domains

➤ Next steps

- Support more CORDEX datasets



Coordinated Regional Climate Downscaling Experiment

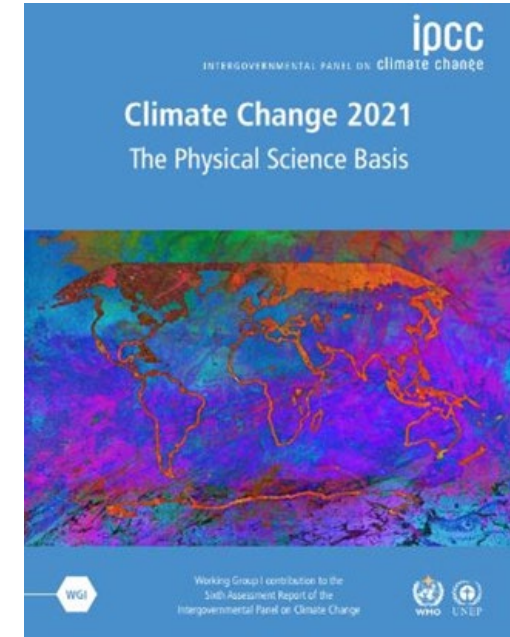
8. Inclusion of recipes and diagnostics

➤ Status

- Steady increase of the number of recipes available
 - v2.0: 94 → v2.7: 127
- Requirements for a fast and scalable evaluation workflow
 - User requirement survey conducted by Assimila Limited
 - Workshop @ BSC
- Traceability (recording of provenance)
- ESMValTool was used to produce about 50 figures in the IPCC WGI AR6
 - 38 scientists contributed to the development of IPCC diagnostics in ESMValTool

➤ Next steps

- Widening the user base and range of applications covered by the diagnostics
- Integration of more AR6 recipes into the public version of ESMValTool



Resources



➤ Links

- Code on GitHub:
 - <https://github.com/ESMValGroup/ESMValTool>
 - <https://github.com/ESMValGroup/ESMValCore>
- Documentation:
 - <https://docs.esmvaltool.org>
- Installation with conda:
 - <https://anaconda.org/conda-forge/esmvaltool>
 - <https://anaconda.org/conda-forge/esmvalcore>
- Issues available at:
 - <https://github.com/ESMValGroup/ESMValTool/issues>
- F.A.Q.:
 - <https://github.com/ESMValGroup/ESMValTool/discussions>
- Tutorial:
 - https://esmvalgroup.github.io/ESMValTool_Tutorial/
- Website:
 - <https://www.esmvaltool.org/>
- User mailing-list:
 - esmvaltool@listserv.dfn.de
- User Engagement Team mailing-list:
 - esmvaltool_user_engagement_team@listserv.dfn.de

➤ Papers

- *Righi et al., Geosci. Model Dev., 13, 1179-1199, 2020.*
<https://doi.org/10.5194/gmd-13-1179-2020>
- *Eyring et al., Geosci. Model Dev., 13, 3383-3438, 2020.*
<https://doi.org/10.5194/gmd-13-3383-2020>
- *Lauer et al., Geosci. Model. Dev., 13, 4205-4228, 2020.*
<https://doi.org/10.5194/gmd-13-4205-2020>
- *Weigel et al., Geosci. Model Dev., 14, 3159-3184, 2021.*
<https://doi.org/10.5194/gmd-14-3159-2021>
- *Schlund et al., Geosci. Model Dev., 16, 315-333, 2023.*
<https://doi.org/10.5194/gmd-16-315-2023>

THE CONSORTIUM

Coordinated by CNRS-IPSL, the IS-ENES3 project
gathers **22 partners** in **11 countries**



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