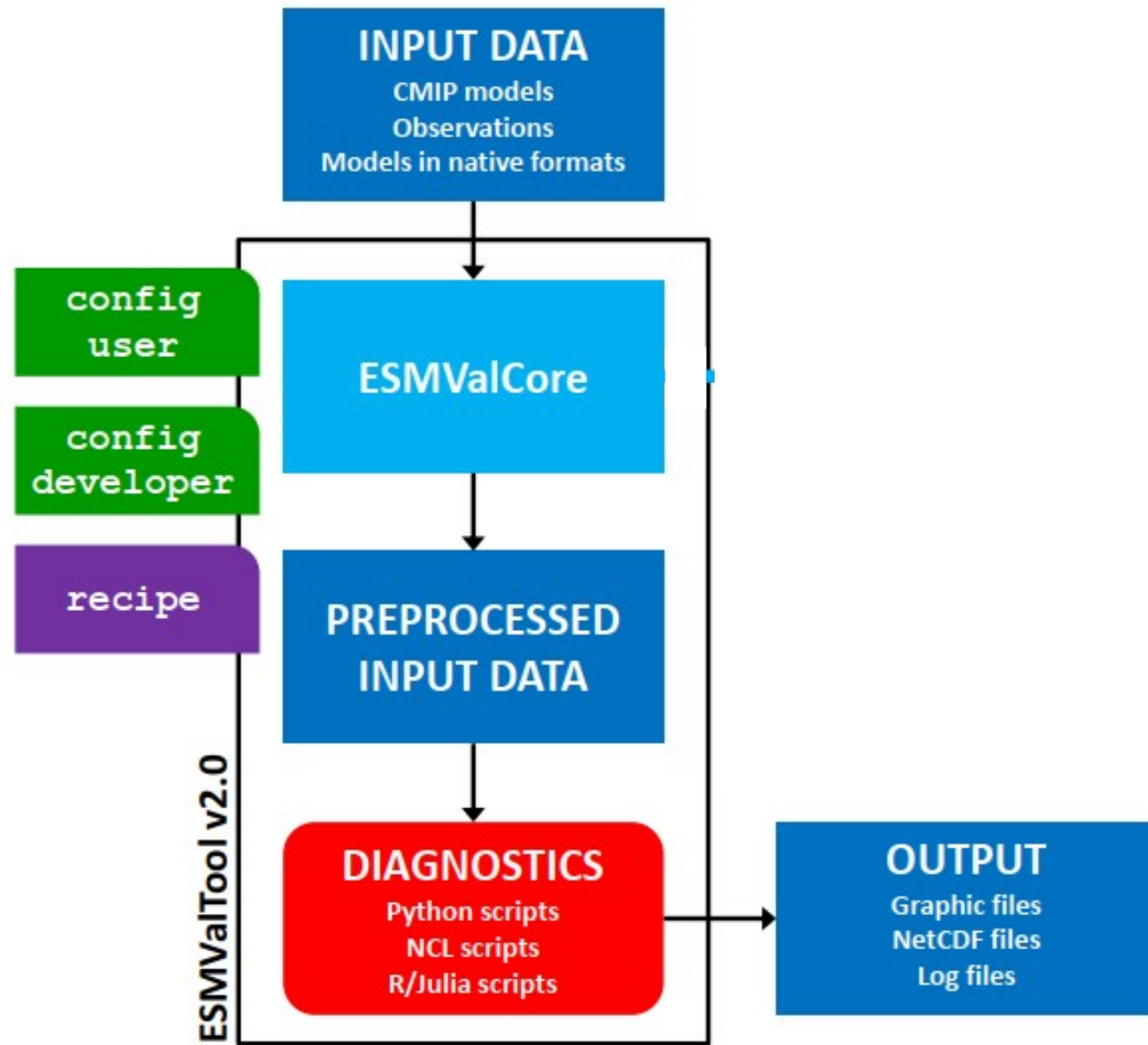ESMValTool development team • esmvaltool.org

- Diagnostics and performance metrics tool for the evaluation of Earth System models

- Multiproject effort (IS-ENES3, C3S-MAGIC, CRESCENDO, etc.)

- Open source community development

- Following community standards (W3C PROV, YML, CF/CMOR, pep8, etc.)

- development team of 150 scientists/40 institutions

- many users (including IPCC)
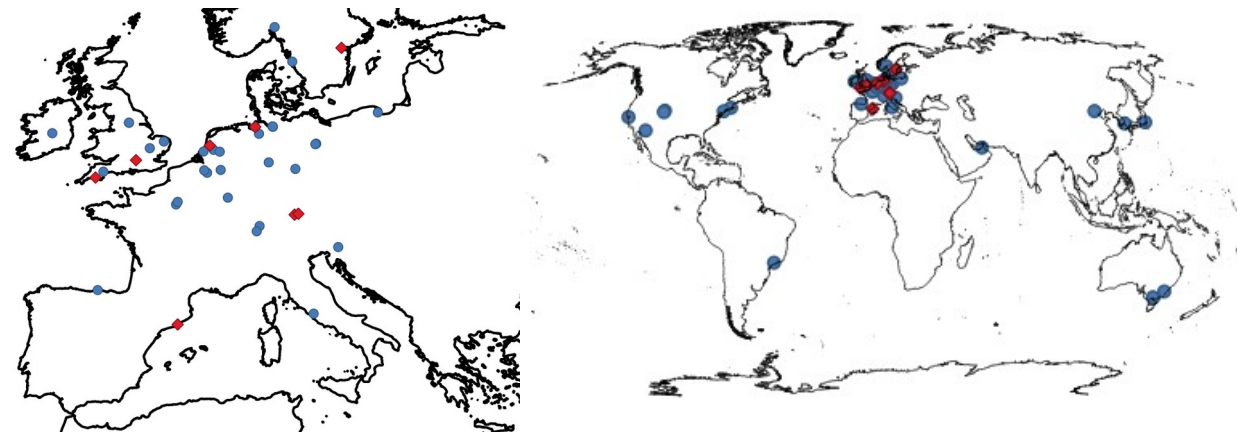
Recipes

```
datasets:

  - {dataset: ERA-Interim, project: OBS,    tier: 3,   type: reanaly,   version: 1,        start_year: 1980, end_year: 2005}

  - {dataset: CanESM2,      project: CMIP5, mip: Amon, exp: historical, ensemble: r1i1p1, start_year: 1980, end_year: 2005}


preprocessors:

  regrid_to_reference:

    regrid:

      target_grid: reference_dataset

      scheme: linear


diagnostics:

  example:

    description: Example for Bremen ESMValTool practicals.

    variables:

      tas:

        preprocessor: regrid_to_reference

        field: T2Ms

        reference_dataset: ERA-Interim

    scripts:

      example_script:

        script: bremen_practicals/exercise_1.py
```

Datasets

Preprocessor settings

Variables

Diagnostic script

Developments of the ESMValTool of the last year.
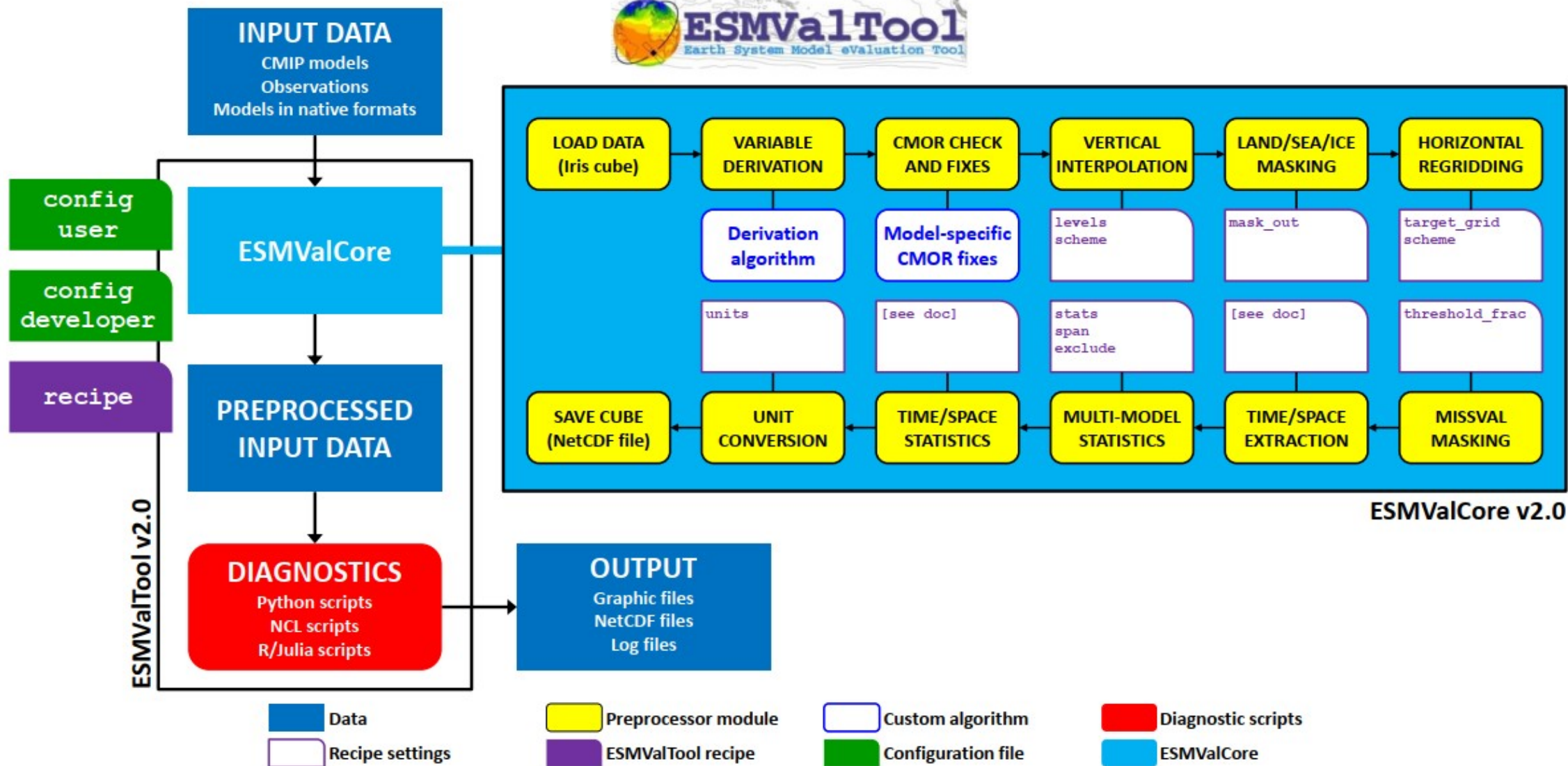
Latest technical advances

- Frequent releases / 8 in 2019 (2 ESMValTool / 6 ESMValCore)

- technical separation of core and diagnostic part

- new preprocessor functions

- new diagnostics

- enhanced CMORizer scripts

- enhancement of documentation

- Support for diagnostics in R and Julia (in addition to Python & NCL)

- Conda installation

- new features like provenance

Latest technical advances

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Provenance in the ESMValTool

traceability and reproducibility

Provenance information

- Creation date

- Host and user

- Version number of the ESMValTool

- List of recipes / diagnostics run

- Variables and models processed

- List of all model files that have been used including + Tracking ID (read from metadata if available)

- Patches applied to model data (if any)

- List of all observations used including references

- Contributing authors and acknowledgment of projects

Tagging: meta data attached to NetCDF and image files
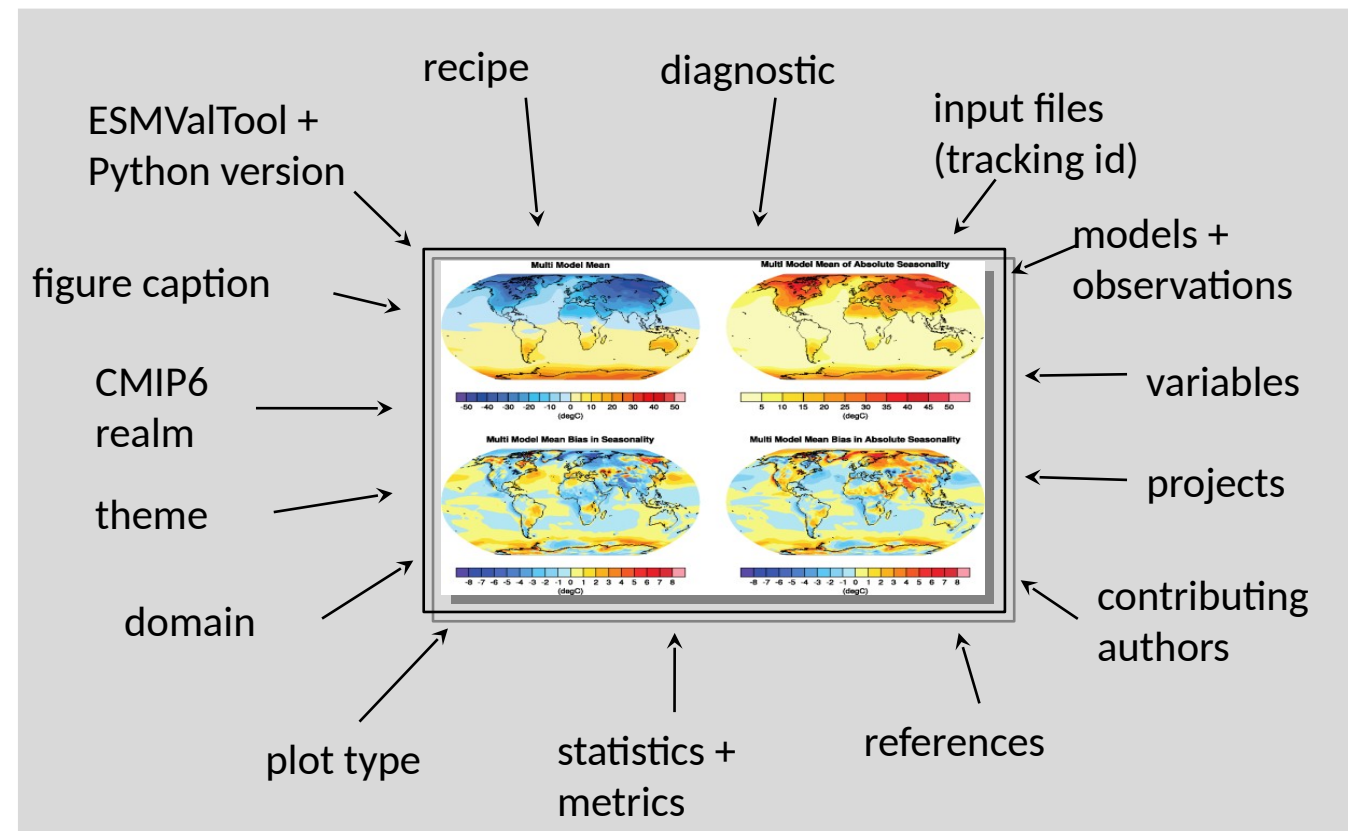
Provenance in the ESMValTool

traceability and reproducibility

- document and organize the results, while keeping track of all the input data used to produce them

- using the W3C-PROV standard (compatible with other (external) tools for viewing and processing provenance information). https://www.w3.org/TR/prov-overview/

- collected at run-time and attached to any output (plots and netCDF files) produced by the tool (also saved to a separate log file)
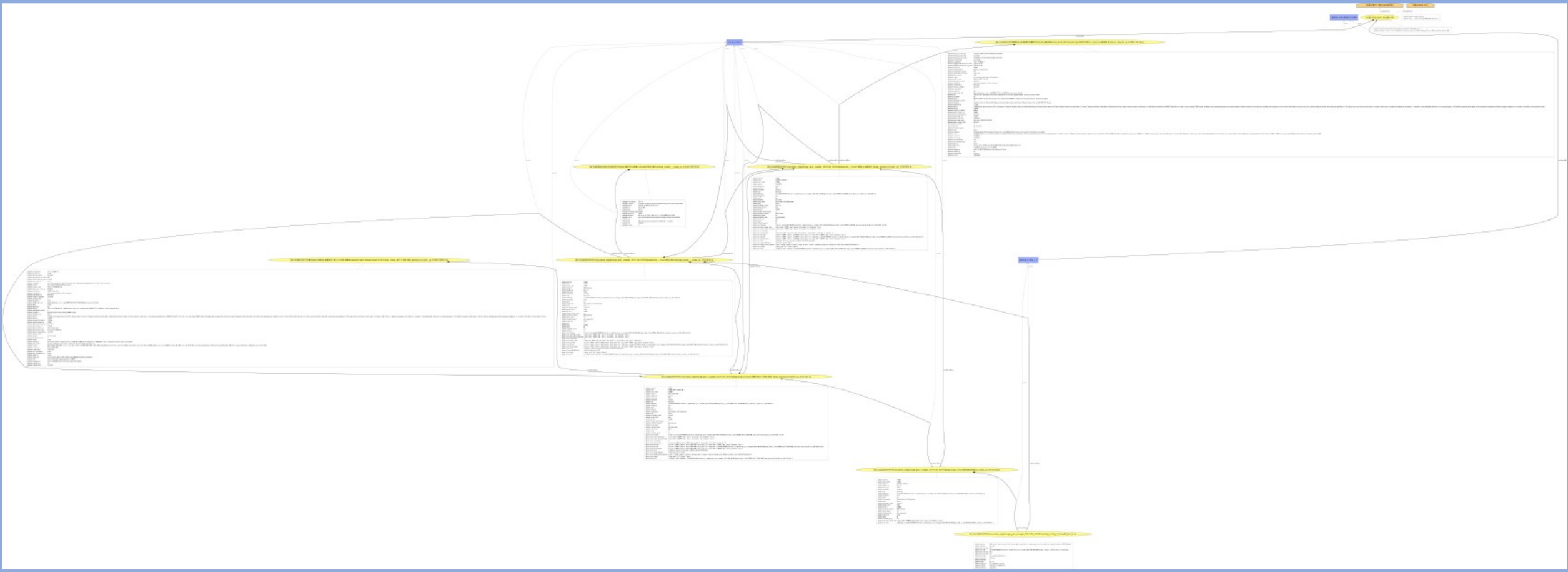
Provenance information is saved as:
- **svg**-file
- **xml**-file
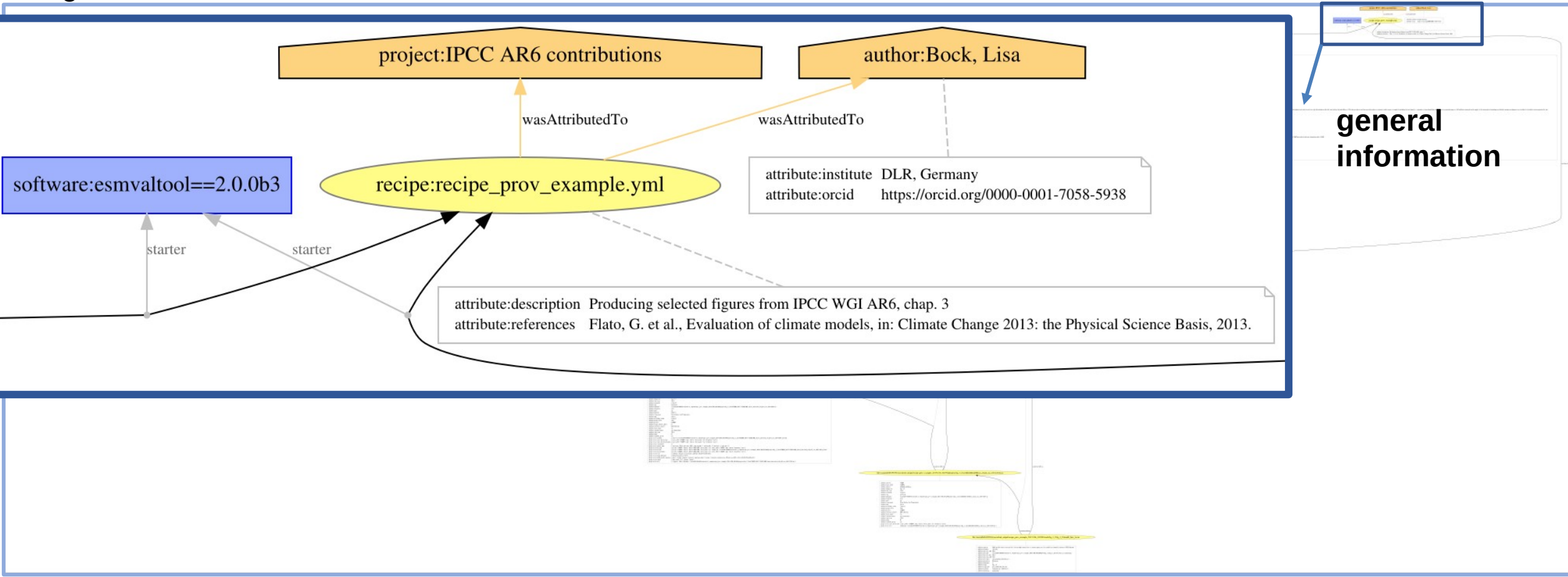- **attribute** of the netCDF-file
- **exif-header** to png file

Provenance in the ESMValTool
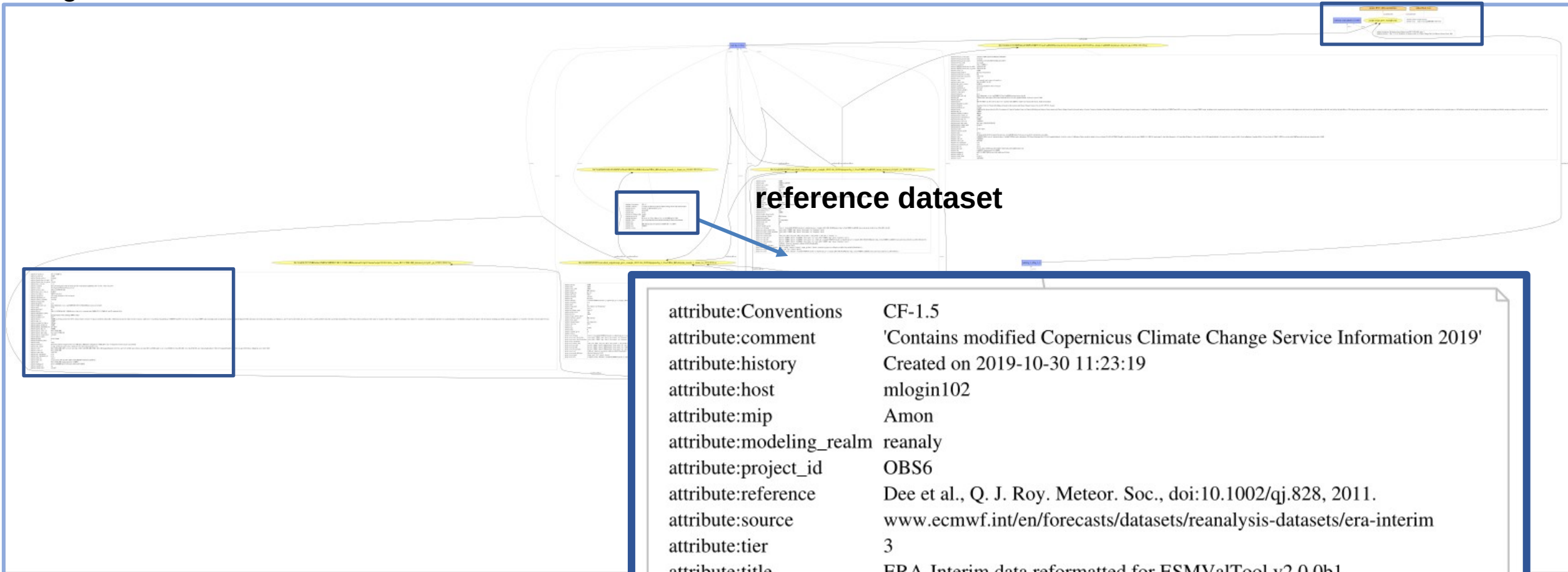
svg-file:

Provenance in the ESMValTool

svg-file:

general information

svg-file:

input dataset

attribute	value
attribute:Conventions	CF-1.7 CMIP-6.2
attribute:activity_id	CMIP
attribute:branch_method	Standard
attribute:branch_time_in_child	0.0
attribute:branch_time_in_parent	2289.0
attribute:cmor_version	3.3.2
attribute:comment	The model integration starts from the piControl experiment equilibrium state (1st Jan. of the year 2289)
attribute:contact	Dr. Tongwen Wu(twwu@cma.gov.cn)
attribute:creation_date	2018-11-26T05:08:26Z
attribute:data_specs_version	01.00.27
attribute:description	DECK: historical
attribute:experiment	all-forcing simulation of the recent past
attribute:experiment_id	historical
attribute:external_variables	areacella
attribute:forcing_index	1
attribute:frequency	mon
attribute:further_info_url	https://furtherinfo.es-doc.org/CMIP6.BCC.BCC-CSM2-MR.historical.none.r1i1p1f1
attribute:grid	T106
attribute:grid_label	gn
attribute:history	2018-11-26T05:08:26Z ; CMOR rewrote data to be consistent with CMIP6, CF-1.7 CMIP-6.2 and CF standards.;N/A
attribute:initialization_index	1
attribute:institution	Beijing Climate Center, Beijing 100081, China
attribute:institution_id	BCC
attribute:license	CMIP6 model data produced by BCC is licensed under a Creative Commons Attribution ShareAlike 4.0 International License (https://creativecommons.org/lic
attribute:mip_era	CMIP6
attribute:nominal_resolution	100 km
attribute:parent_activity_id	CMIP
attribute:parent_experiment_id	piControl
attribute:parent_mip_era	CMIP6
attribute:parent_source_id	BCC-CSM2-MR
attribute:parent_time_units	days since 1850-01-01
attribute:parent_variant_label	r1i1p1f1
attribute:physics_index	1
attribute:product	model-output
attribute:realization_index	1
attribute:realm	atmos
attribute:references	Model described by Tongwen Wu et al. (JGR 2013; JMR 2014; submmitted to GMD,2018). Also see http://forecast.bcccsm.ncc-cma.net/htm
attribute:run_variant	forcing: greenhouse gases,solar constant,aerosol,volcano mass,land use,ozone
attribute:source	BCC-CSM 2 MR (2017): aerosol: none atmos: BCC_AGCM3_MR (T106; 320 x 160 longitude/latitude; 46 levels; top level 1.46 hPa) atmosChem: none land:
attribute:source_id	BCC-CSM2-MR
attribute:source_type	AOGCM
attribute:sub_experiment	none
attribute:sub_experiment_id	none
attribute:table_id	Amon
attribute:table_info	Creation Date:(30 July 2018) MD5:e53ff52009d0b97d9d867dc12b6096c7
attribute:title	BCC-CSM2-MR output prepared for CMIP6
attribute:tracking_id	hdl:21.14100/007da5e5-12bb-4fe9-8df9-5cd473280650
attribute:variable_id	tas
attribute:variant_label	r1i1p1f1

Provenance in the ESMValTool

svg-file:

reference dataset

attribute:Conventions	CF-1.5
attribute:comment	'Contains modified Copernicus Climate Change Service Information 2019'
attribute:history	Created on 2019-10-30 11:23:19
attribute:host	mlogin102
attribute:mip	Amon
attribute:modeling_realm	reanaly
attribute:project_id	OBS6
attribute:reference	Dee et al., Q. J. Roy. Meteor. Soc., doi:10.1002/qj.828, 2011.
attribute:source	www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era-interim
attribute:tier	3
attribute:title	ERA-Interim data reformatted for ESMValTool v2.0.0b1
attribute:user	b309057
attribute:version	1

attribute:variable_group	tas
preprocessor:cleanup	{'remove': ['/scratch/b/b309059/esmvaltool_output/recipe_prov_example_20191106_082904/preproc/fig_3_2/tas/CMIP6_BCC-CSM2-MR_Amon_historical_r1i1p1f1_
preprocessor:cmor_check_data	{'cmor_table': 'CMIP6', 'mip': 'Amon', 'short_name': 'tas', 'frequency': 'mon'}
preprocessor:cmor_check_metadata	{'cmor_table': 'CMIP6', 'mip': 'Amon', 'short_name': 'tas', 'frequency': 'mon'}
preprocessor:concatenate	{}
preprocessor:extract_time	{'start_year': 2014, 'end_year': 2015, 'start_month': 1, 'end_month': 1, 'start_day': 1, 'end_day': 1}
preprocessor:fix_data	{'project': 'CMIP6', 'dataset': 'BCC-CSM2-MR', 'short_name': 'tas', 'cmor_table': 'CMIP6', 'mip': 'Amon', 'frequency': 'mon'}
preprocessor:fix_file	{'project': 'CMIP6', 'dataset': 'BCC-CSM2-MR', 'short_name': 'tas', 'output_dir': '/scratch/b/b309059/esmvaltool_output/recipe_prov_example_20191106_082904/preproc
preprocessor:fix_metadata	{'project': 'CMIP6', 'dataset': 'BCC-CSM2-MR', 'short_name': 'tas', 'cmor_table': 'CMIP6', 'mip': 'Amon', 'frequency': 'mon'}
preprocessor:load	{'callback': <function concatenate_callback at 0x2b342aab6ea0>}
preprocessor:mask_fillvalues	{'threshold_fraction': 0.95}
preprocessor:multi_model_statistics	{'span': 'overlap', 'statistics': ['mean'], 'output_products': {'mean': <esmvalcore.preprocessor.PreprocessorFile object at 0x2b342dad54a8>}}
preprocessor:regrid	{'target_grid': '2x2', 'scheme': 'linear'}
preprocessor:save	{'compress': False, 'filename': '/scratch/b/b309059/esmvaltool_output/recipe_prov_example_20191106_082904/preproc/fig_3_2/tas/CMIP6_BCC-CSM2-MR_Amon_h

preprocessor information
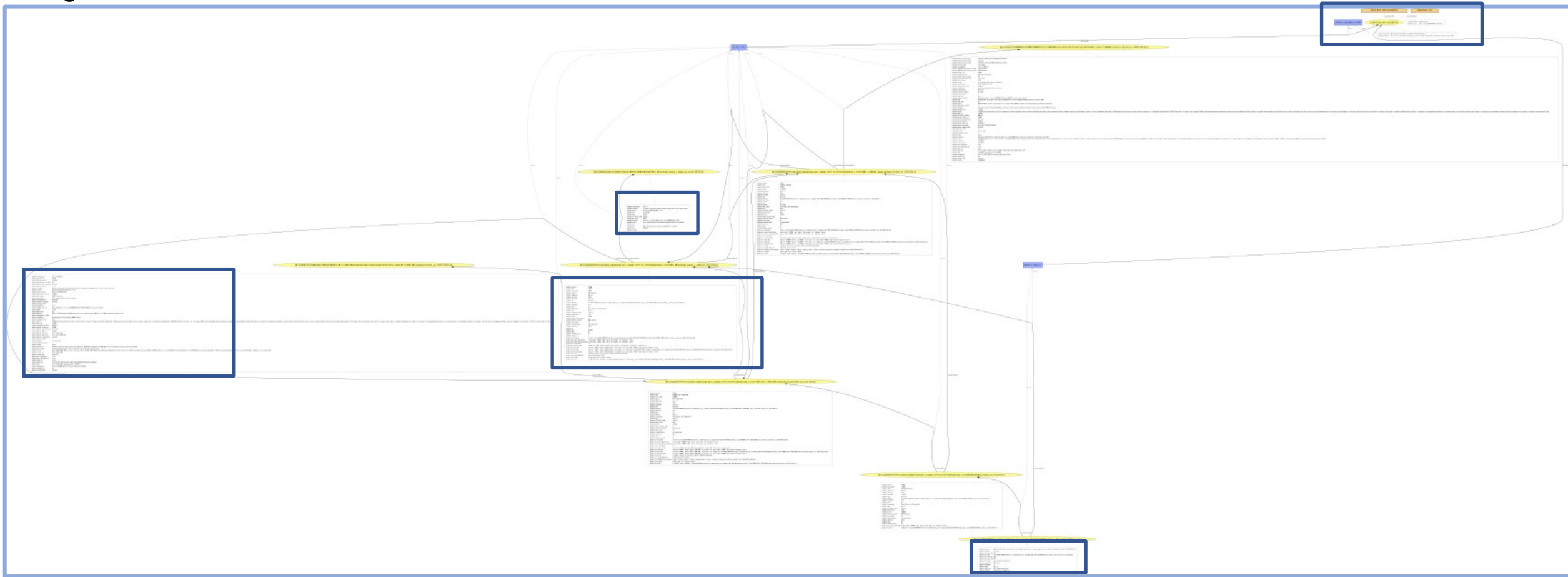
Provenance in the ESMValTool

svg-file:

attribute:caption	Multi model values, from top left to bottom right: mean, bias, root mean square error for variable tas (annual), reference = ERA-Interim.
attribute:domains	('global',)
attribute:plot_abs_diff	False
attribute:plot_file	/scratch/b/b309059/esmvaltool_output/recipe_prov_example_20191106_082904/plots/fig_3_2/fig_3_2/model_bias_tas_annual.png
attribute:plot_rel_diff	False
attribute:plot_rms_diff	True
attribute:plot_types	('geographical distribution',)
attribute:projection	Robinson
attribute:references	()
attribute:script	fig_3_2
attribute:script_file	ipcc_ar6/model_bias.ncl
attribute:statistics	('climatology', 'difference')
attribute:timemean	annualclim

**diagnostic
information**

Provenance in the ESMValTool

svg-file:

Resources

Code available at:

- https://github.com/ESMValGroup/ESMValTool
- https://github.com/ESMValGroup/ESMValCore

Documentation available at:

- https://esmvaltool.readthedocs.io/

Installation via conda:

- https://anaconda.org/esmvalgroup/esmvaltool
- https://anaconda.org/esmvalgroup/esmvalcore

Issues available at:

- https://github.com/ESMValGroup/ESMValTool/issues

Tutorial under development by the NL-eScience center (NLeSC):

- https://github.com/ESMValGroup/tutorial
  development version online at
  https://esmvalgroup.github.io/tutorial/
- Tutorial scheduled for the EGU 2020

Papers

- *Righi et al. Geosci. Model Dev., 13, 1179–1199, 2020, https://doi.org/10.5194/gmd-13-1179-2020*
- *Eyring et al. 2019 (in review) https://www.geosci-model-dev-discuss.net/gmd-2019-291*
- *Weigel et al. 2020 (in prep.)*
- *Lauer et al. 2020 (in prep.)*

Workshops

- *Technical ESMValTool coding workshop, October 2019, Germany (DLR)*
- *Technical ESMValTool coding workshop, June 2019, Germany (DLR)*
- *ESMValTool backend coding workshop, February 2019, Germany (DLR)*

Governance

A formal governance structure is currently developed.