CSET Technical Overview

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Zubair Maalick + wider CSET team

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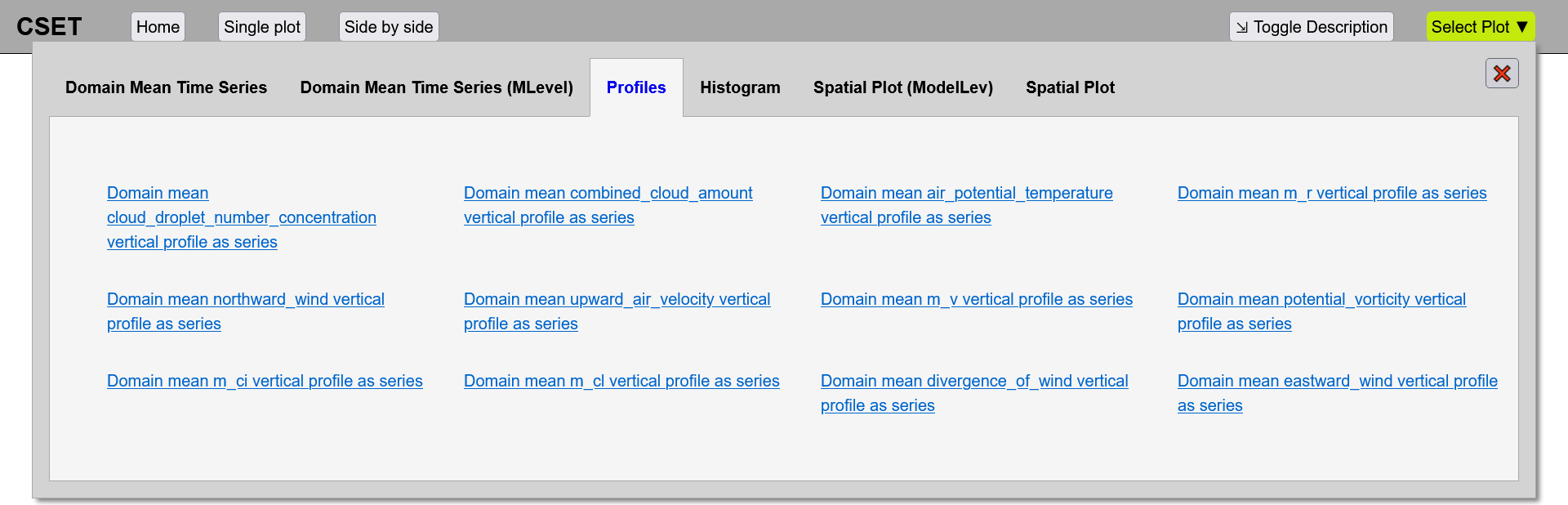
CSET Website

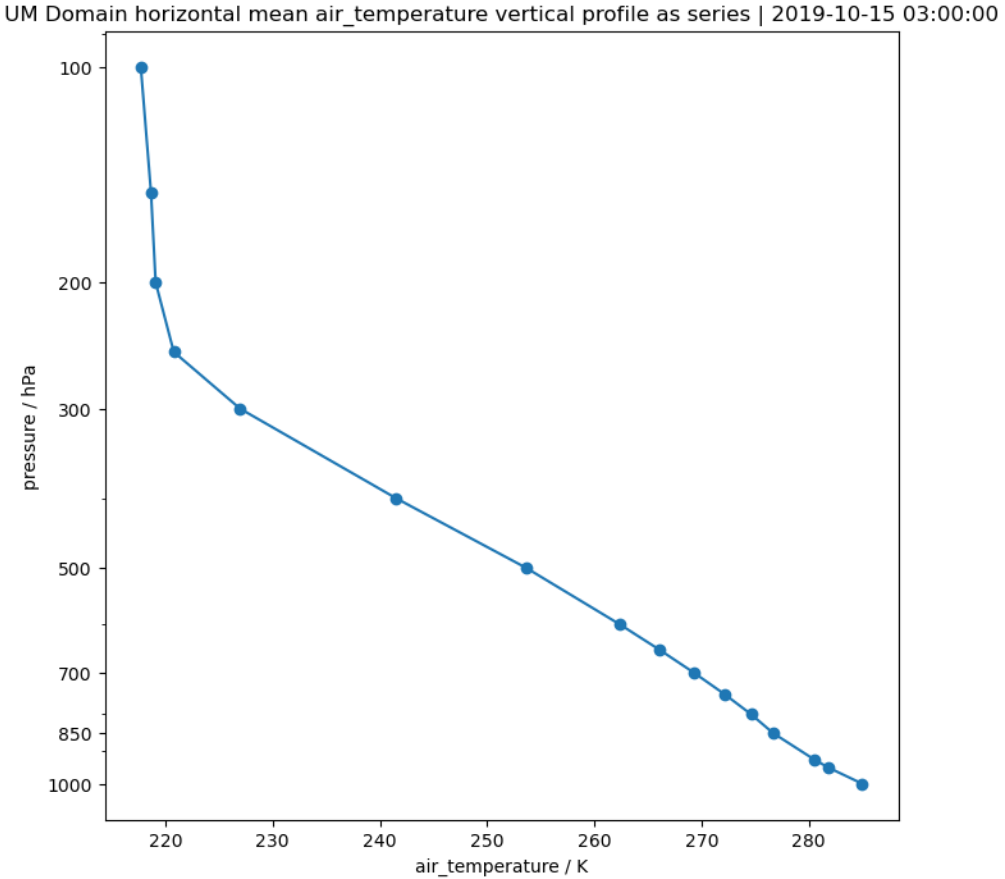
Explore visualised diagnostics in an intuitive web interface.



- Diagnostics are split into categories
- Select the diagnostic you want via a dropdown menu

CSET Home Single plot Side by side ↘ Toggle Description Select Plot ▼

Select plot: 10

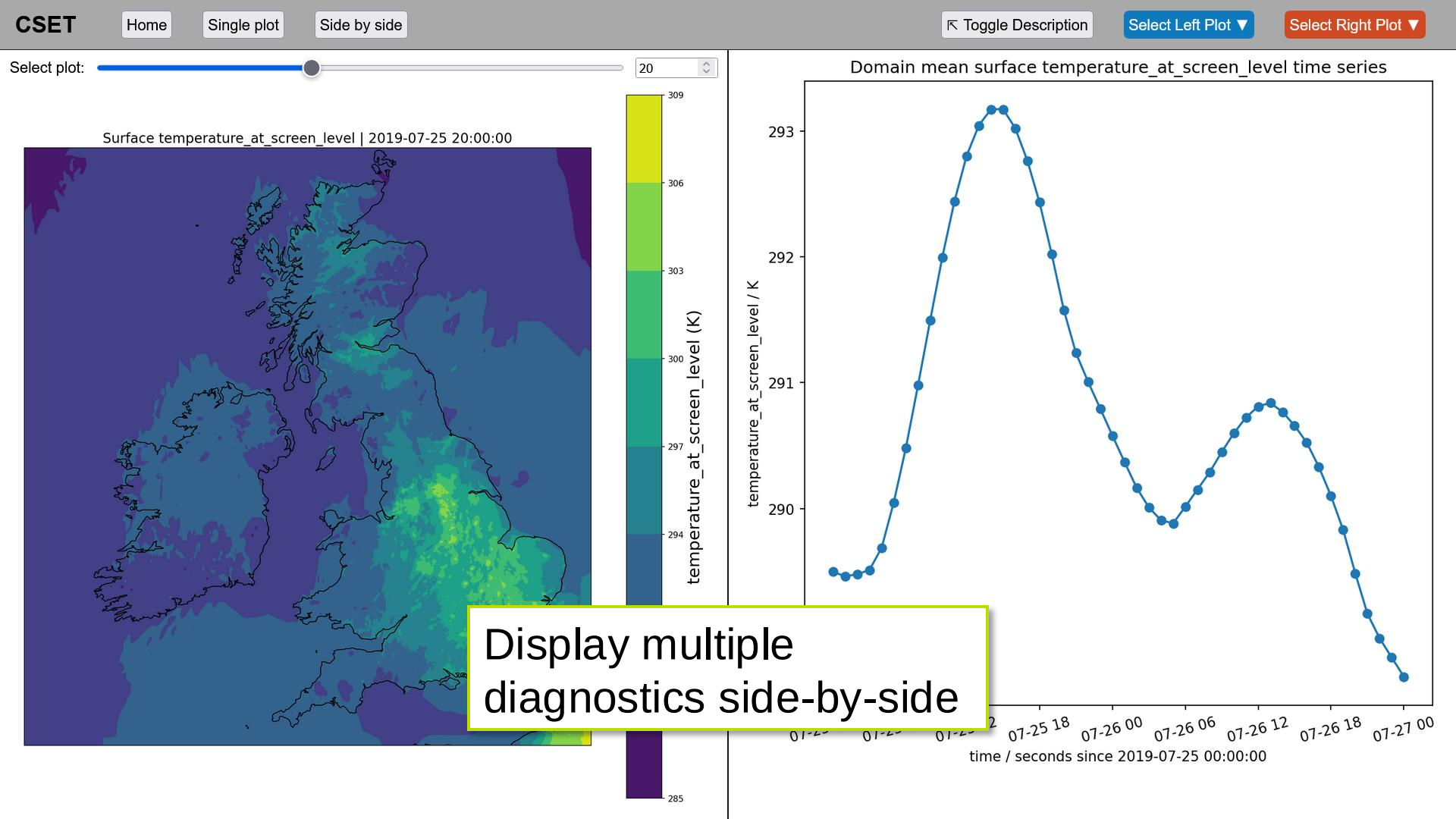


UM Domain horizontal mean air_temperature vertical profile as series

Plots a time series of vertical profiles for the domain mean air_temperature using a log pressure coordinate.

Save Diagnostic

- Slide through any dimension
- Each diagnostic is an embedded webpage for maximum flexibility
- Description of diagnostic with content detail, interpretation advice, and easy download


CSET
Home
Single plot
Side by side
Toggle Description
Select Left Plot
Select Right Plot
Select plot:
20
Surface temperature_at_screen_level | 2019-07-25 20:00:00
309
306
303
300
297
294
285
temperature_at_screen_level (K)
Domain mean surface temperature_at_screen_level time series
293
292
291
290
temperature_at_screen_level / K
07-25 18
07-26 00
07-26 06
07-26 12
07-26 18
07-27 00
time / seconds since 2019-07-25 00:00:00
Display multiple diagnostics side-by-side

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CSET Library

- CSET has a library of operators, the smallest building blocks.
- Operators are composed into recipes.
- Generic operators are useful across many recipes, e.g. reading and plotting.
- Science operators implement a specific technique, e.g. CAPE ratio or age of air. Please get involved to add more!

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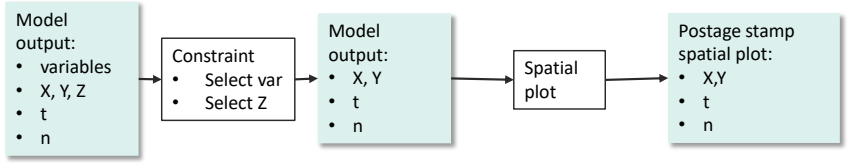
Recipe

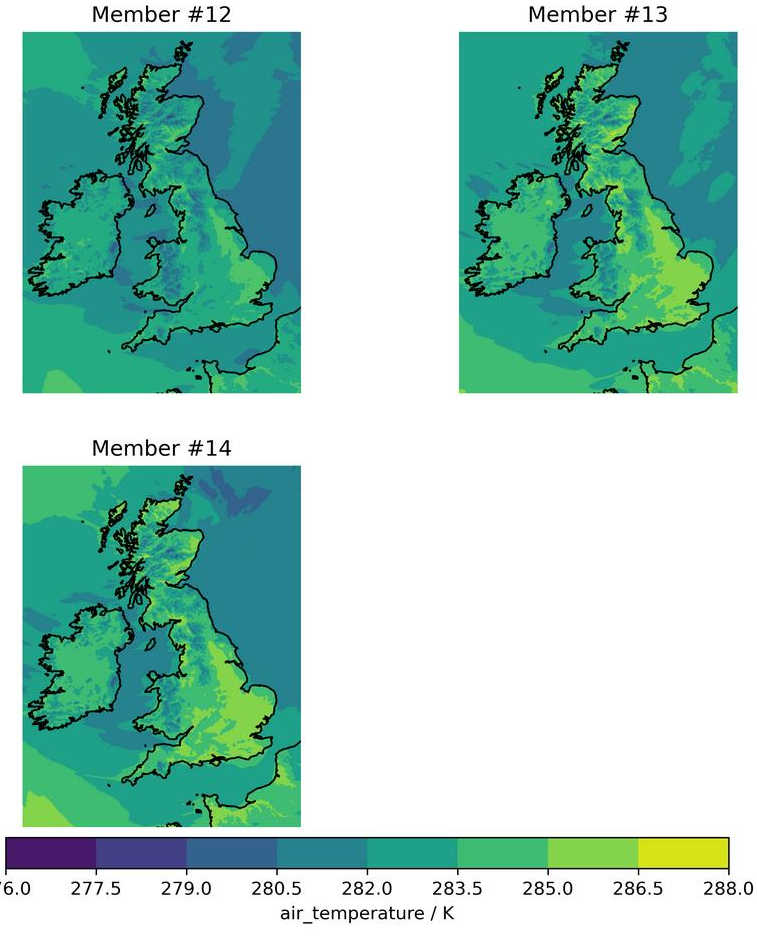
- Operators are combined in recipes
- Written in YAML
- Read top to bottom, with the previous step's output passed into the next step
- Generalised with $VARIABLES




```yaml
category: Surface Spatial Plot
title: Surface $VARNAME
description: |
  Extracts and plots the surface $VARNAME for all times.

steps:
  - operator: read.read_cube
    constraint:
      operator: constraints.generate_var_constraint
      varname: $VARNAME

  - operator: plot.spatial_contour_plot
    sequence_coordinate: time

  - operator: write.write_cube_to_nc
    overwrite: True
```

Select plot: 26

Surface air_temperature | 2023-04-20 10:00:00



Surface air_temperature

Extracts and plots the surface air_temperature for all times.

Save Diagnostic

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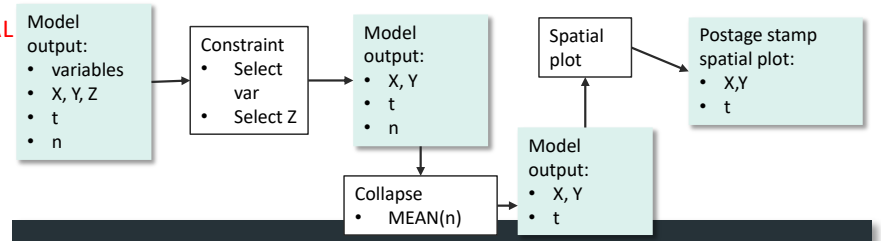
Extended recipe

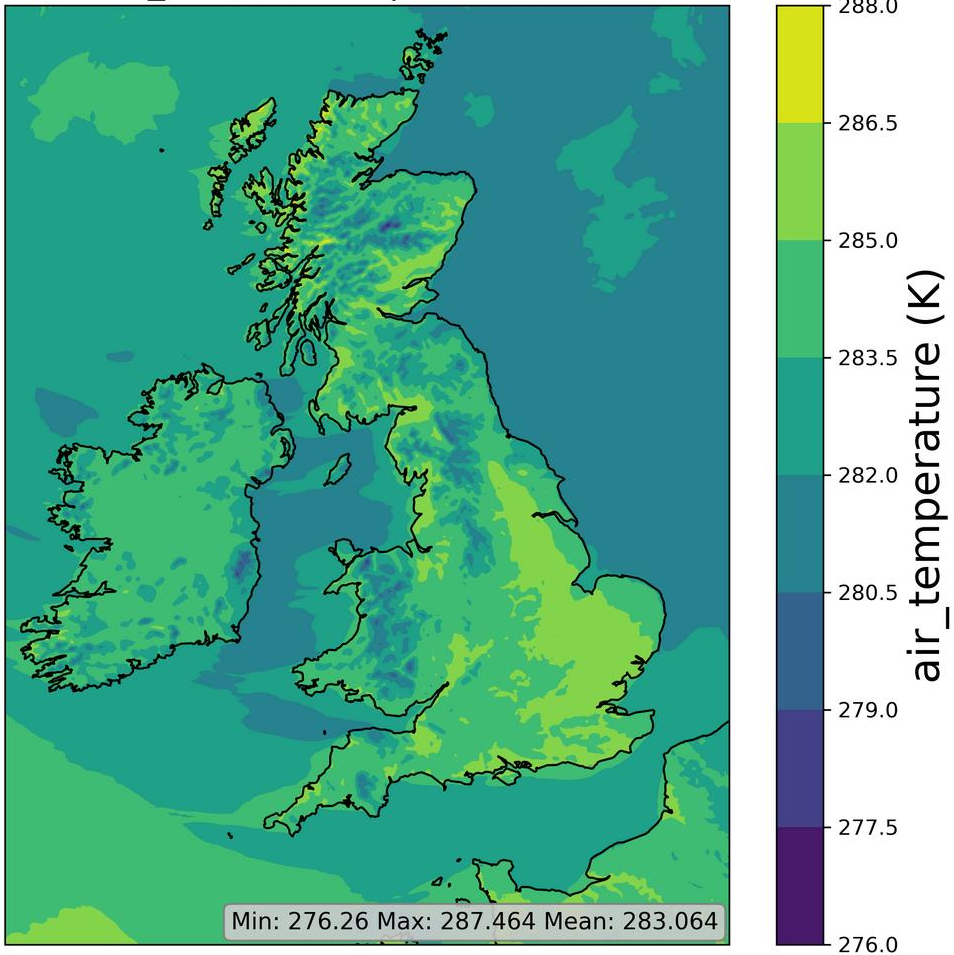
- Additional operators can be easily added
- One step is all that is needed to plot mean of ensemble




```yaml
category: Surface Spatial Plot
title: Surface $VARNAME
description: |
  Extracts and plots the surface $VARNAME for the mean
  of the ensemble for all times.

steps:
  - operator: read.read_cube
    constraint:
      operator: constraints.generate_var_constraint
      varname: $VARNAME

  - operator: collapse.collapse
    coordinate: realization
    method: MEAN

  - operator: plot.spatial_contour_plot
    sequence_coordinate: time

  - operator: write.write_cube_to_nc
    overwrite: True
```

Select plot: 26

Surface air_temperature | 2023-04-20 10:00:00



Surface air_temperature

Extracts and plots the surface air_temperature for the mean of the ensemble for all times.

Save Diagnostic

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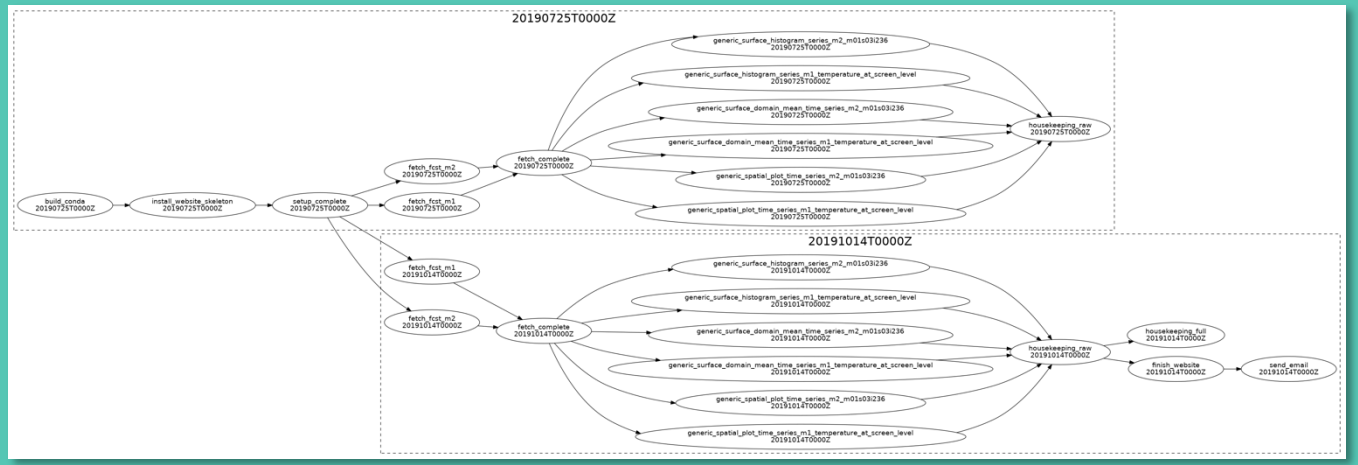
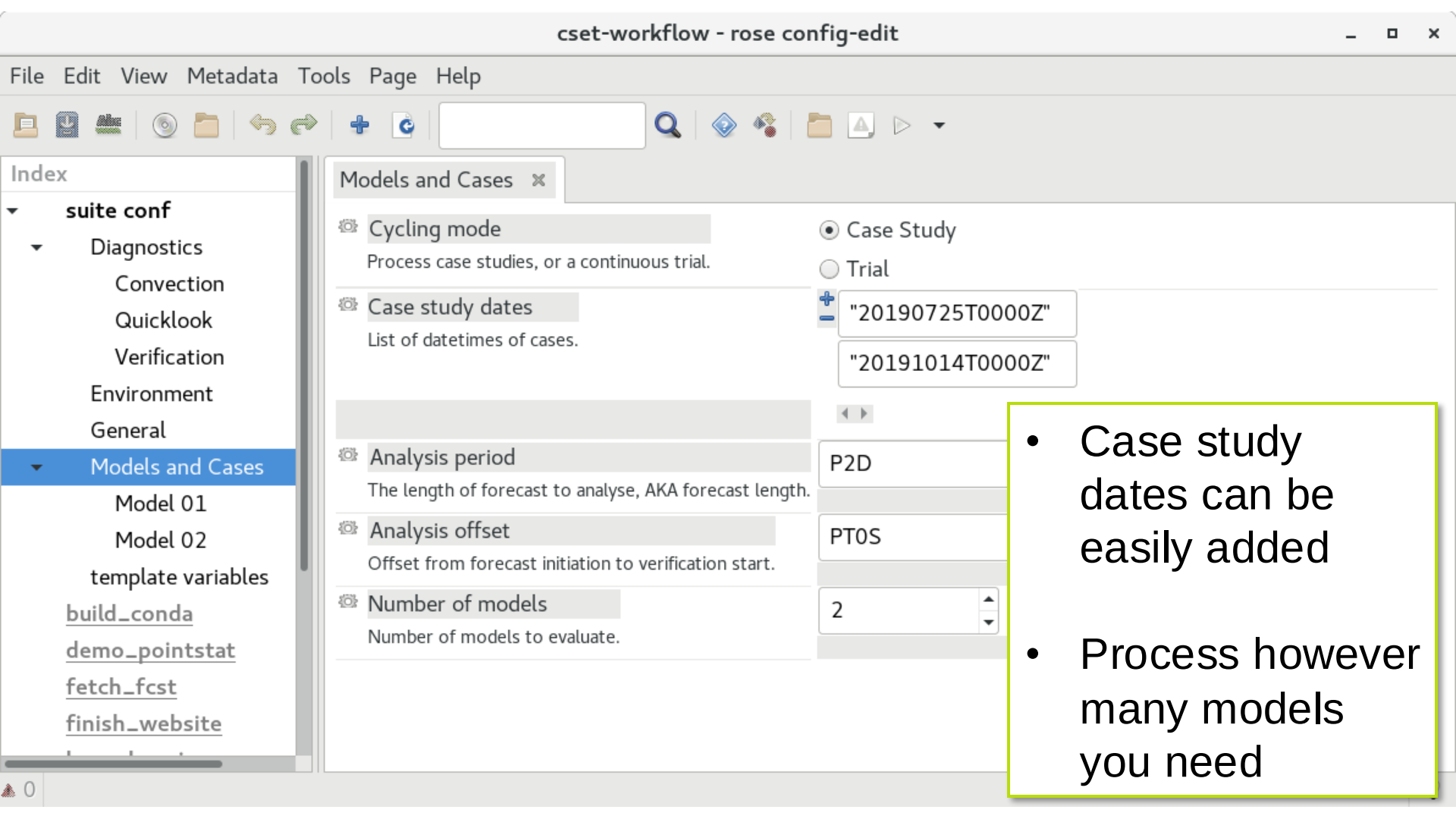
CSET Workflow

CSET makes it easy to cycle over several case studies and models.

- Automatically
- Reproducibly
- Efficiently




cset-workflow - rose config-edit
File Edit View Metadata Tools Page Help
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suite conf
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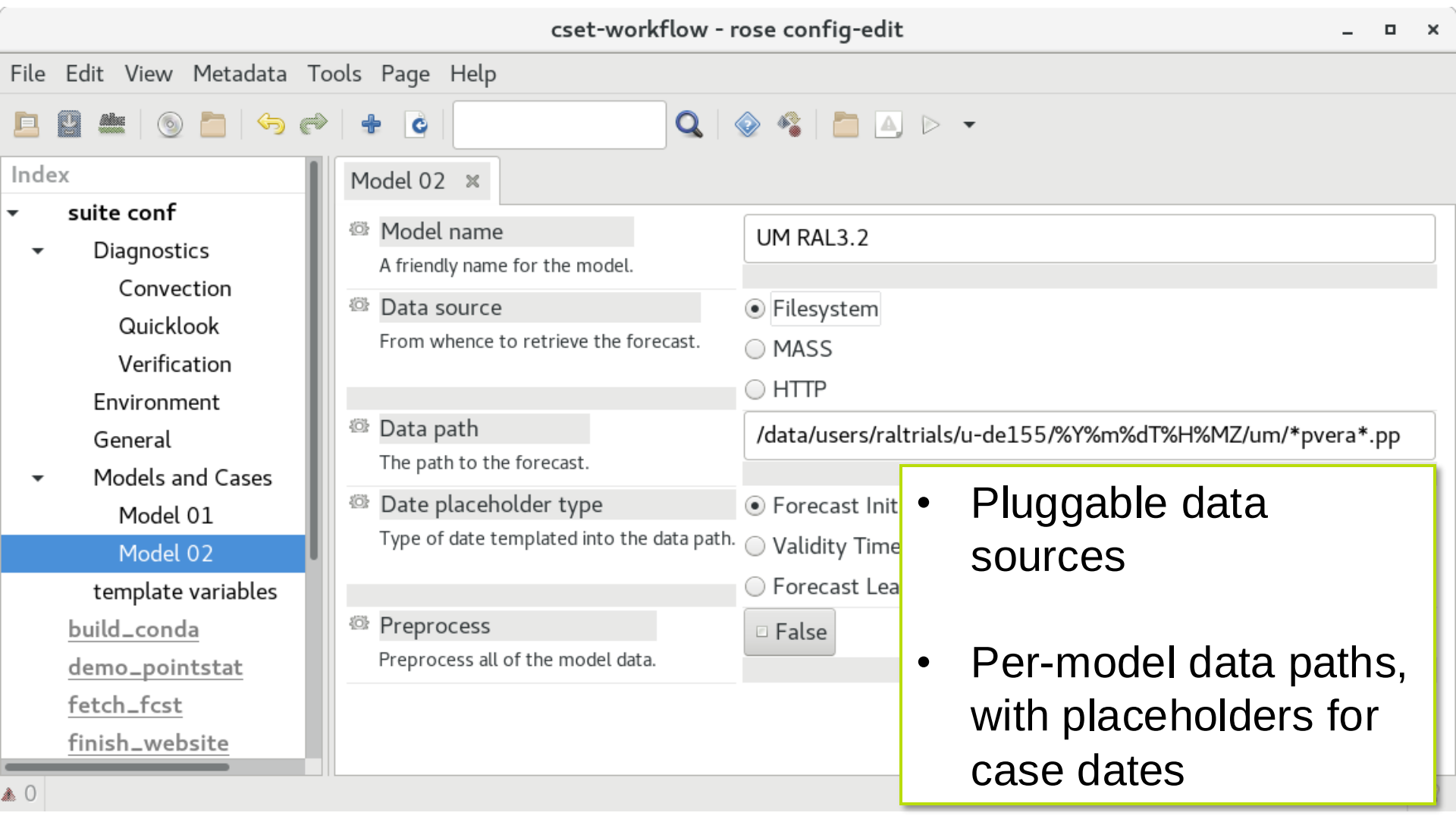
Convection
Quicklook
Verification
Environment
General
Models and Cases
Model 01
Model 02
template variables
build_conda
demo_pointstat
fetch_fcst
finish_website
Models and Cases
Cycling mode
Process case studies, or a continuous trial.
Case Study
Trial
Case study dates
List of datetimes of cases.
"20190725T0000Z"
"20191014T0000Z"
Analysis period
The length of forecast to analyse, AKA forecast length.
P2D
Analysis offset
Offset from forecast initiation to verification start.
PT0S
Number of models
Number of models to evaluate.
2
• Case study dates can be easily added
• Process however many models you need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Model 01
Model 02
template variables
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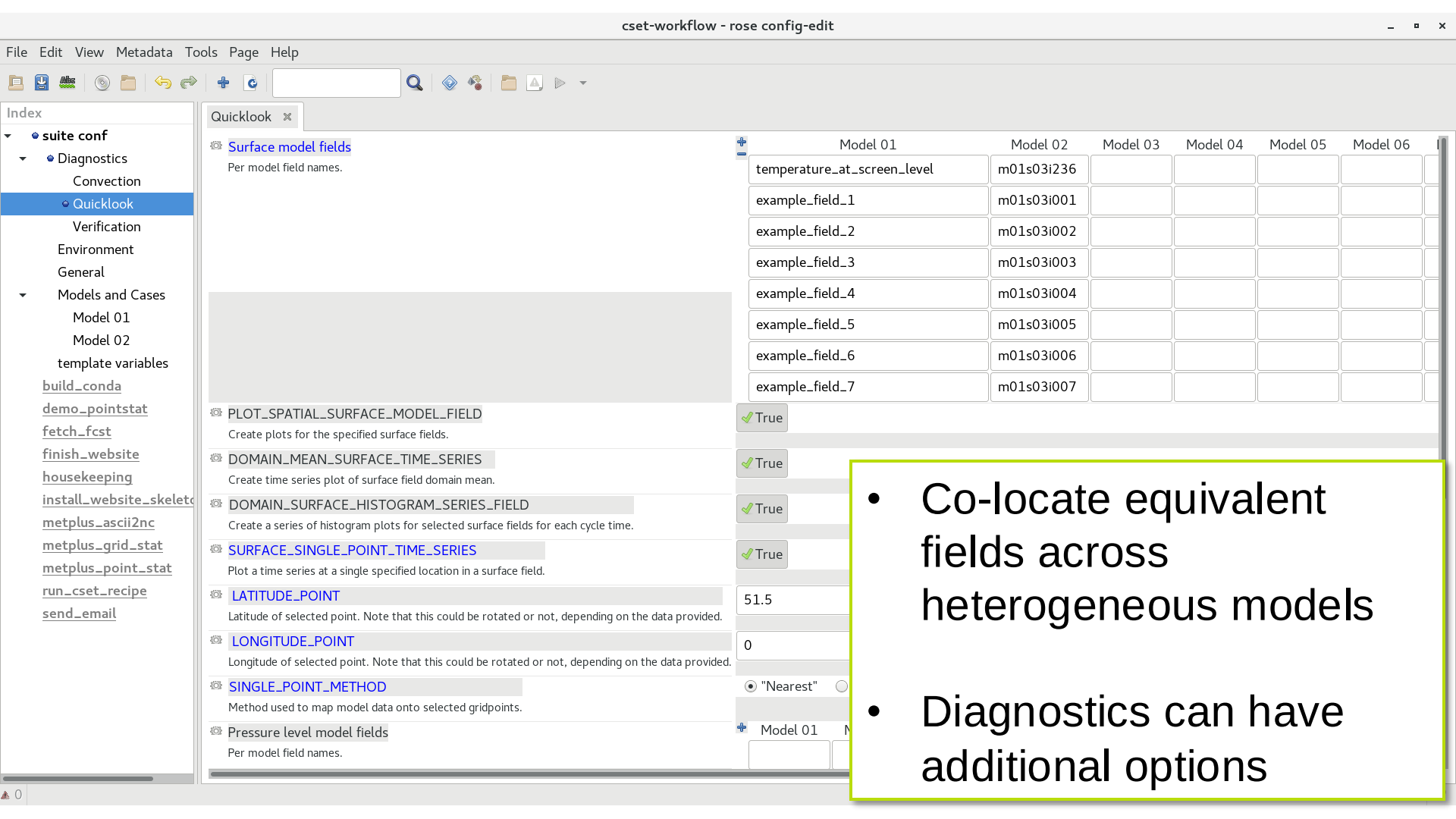
demo_pointstat
fetch_fcst
finish_website
Model 02
Model name
A friendly name for the model.
UM RAL3.2
Data source
From whence to retrieve the forecast.
Filesystem
MASS
HTTP
Data path
The path to the forecast.
/data/users/raltrials/u-de155/%Y%m%dT%H%MZ/um/*pvera*.pp
Date placeholder type
Type of date templated into the data path.
Forecast Init
Validity Time
Forecast Lea
Preprocess
Preprocess all of the model data.
False
• Pluggable data sources
• Per-model data paths, with placeholders for case dates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metplus_point_stat
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send_email
Quicklook
Surface model fields
Per model field names.
Model 01
Model 02
Model 03
Model 04
Model 05
Model 06
temperature_at_screen_level
m01s03i236
example_field_1
m01s03i001
example_field_2
m01s03i002
example_field_3
m01s03i003
example_field_4
m01s03i004
example_field_5
m01s03i005
example_field_6
m01s03i006
example_field_7
m01s03i007
PLOT_SPATIAL_SURFACE_MODEL_FIELD
Create plots for the specified surface fields.
True
DOMAIN_MEAN_SURFACE_TIME_SERIES
Create time series plot of surface field domain mean.
True
DOMAIN_SURFACE_HISTOGRAM_SERIES_FIELD
Create a series of histogram plots for selected surface fields for each cycle time.
True
SURFACE_SINGLE_POINT_TIME_SERIES
Plot a time series at a single specified location in a surface field.
True
LATITUDE_POINT
Latitude of selected point. Note that this could be rotated or not, depending on the data provided.
51.5
LONGITUDE_POINT
Longitude of selected point. Note that this could be rotated or not, depending on the data provided.
0
SINGLE_POINT_METHOD
Method used to map model data onto selected gridpoints.
"Nearest"
Pressure level model fields
Per model field names.
Model 01
• Co-locate equivalent fields across heterogeneous models
• Diagnostics can have additional options

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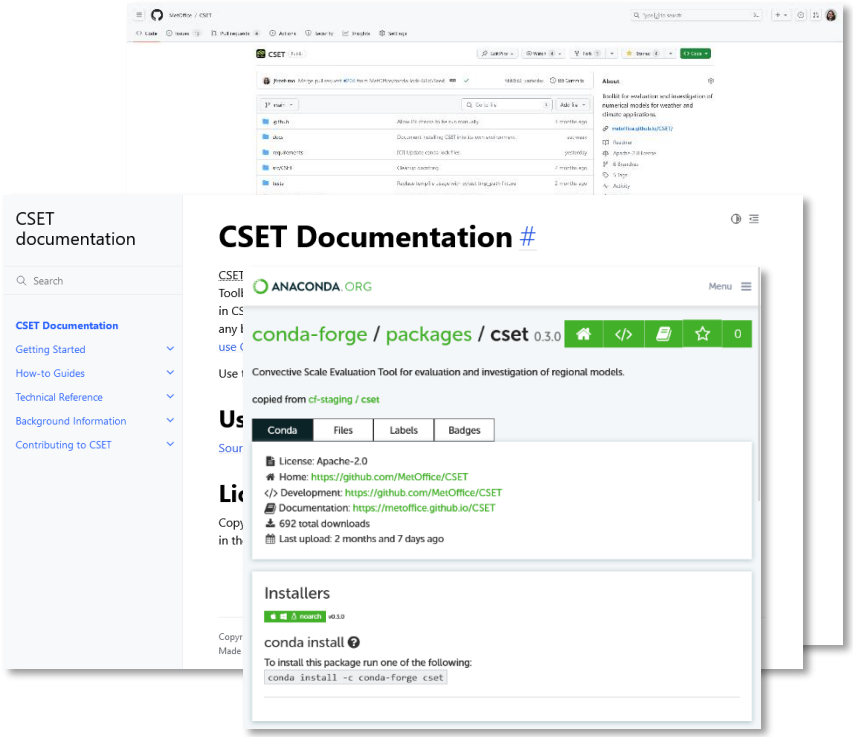
How to use CSET?

- Open-source on GitHub
- Documentation website
- CSET operators on conda-forge
- Get involved to add new science!

CSET workshop on Friday



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Thank you

Links to further information:

- CSET SharePoint page
- Software requirements specification
- Potential diagnostics list (working document)
- Architecture design
- Evaluation strategy

Documentation

- Main documentation: metoffice.github.io/CSET
- Workflow documentation: metoffice.github.io/CSET-workflow

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The code

- https://anaconda.org/conda-forge/cset
- CSET code and workflow

Get engaged

- Open issue on CSET GitHub
- Talk to us
- CSET surgeries coming