# EZclim

*a new Software package for Climate modelling diagnostics*

By Adanna Akwataghibe

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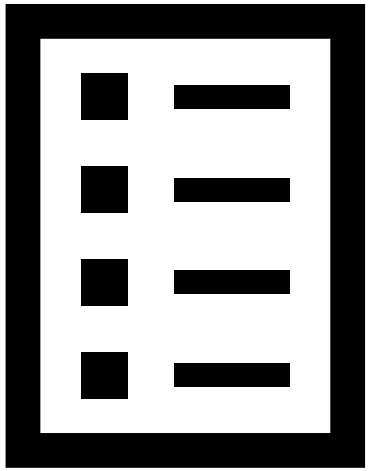
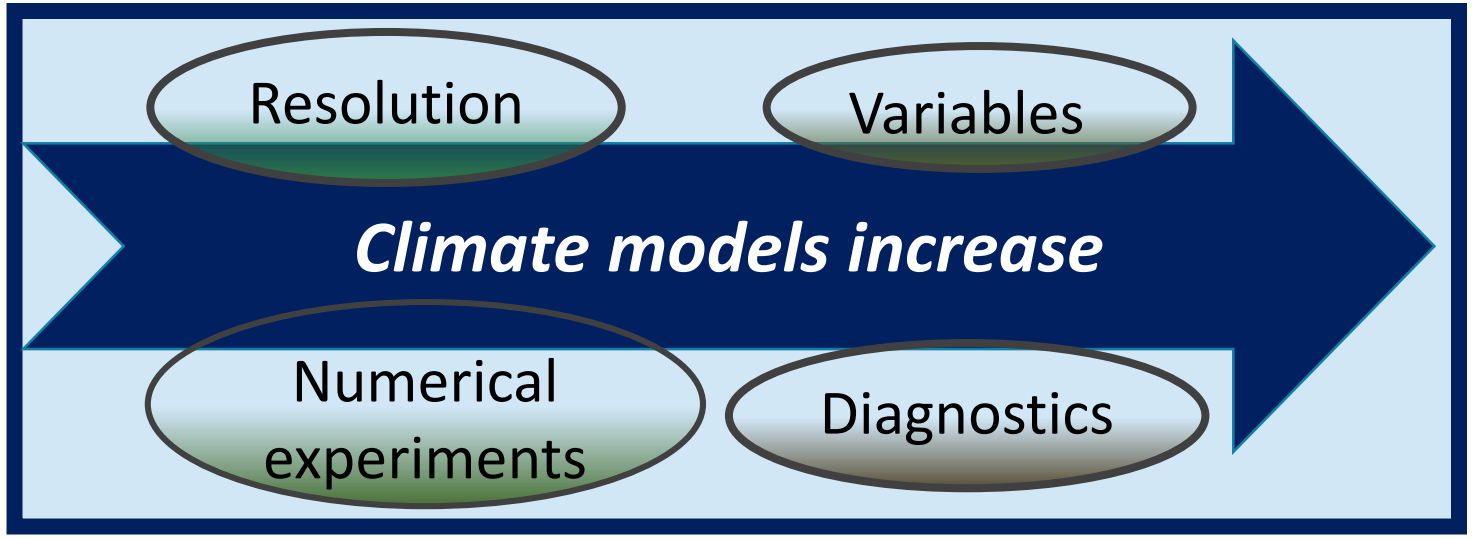


# Rationale and motivation for a new analysis package




UNITED NATIONS

FARMERS INSURANCE

Marex Spectron

RMS

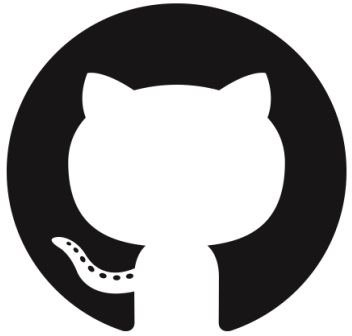
Imperial College London

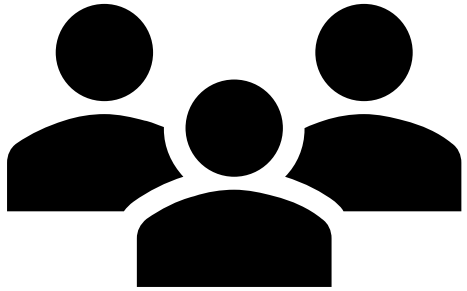
**EZclim**

# EZclim: Objectives

- Bridge gap between users and climate models
- No need to know Python to a high level
  - Iris, xarray, ESMValTools, NCO, CDO
- Single but flexible package

# EZclim: Development

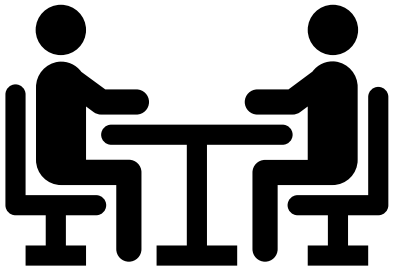




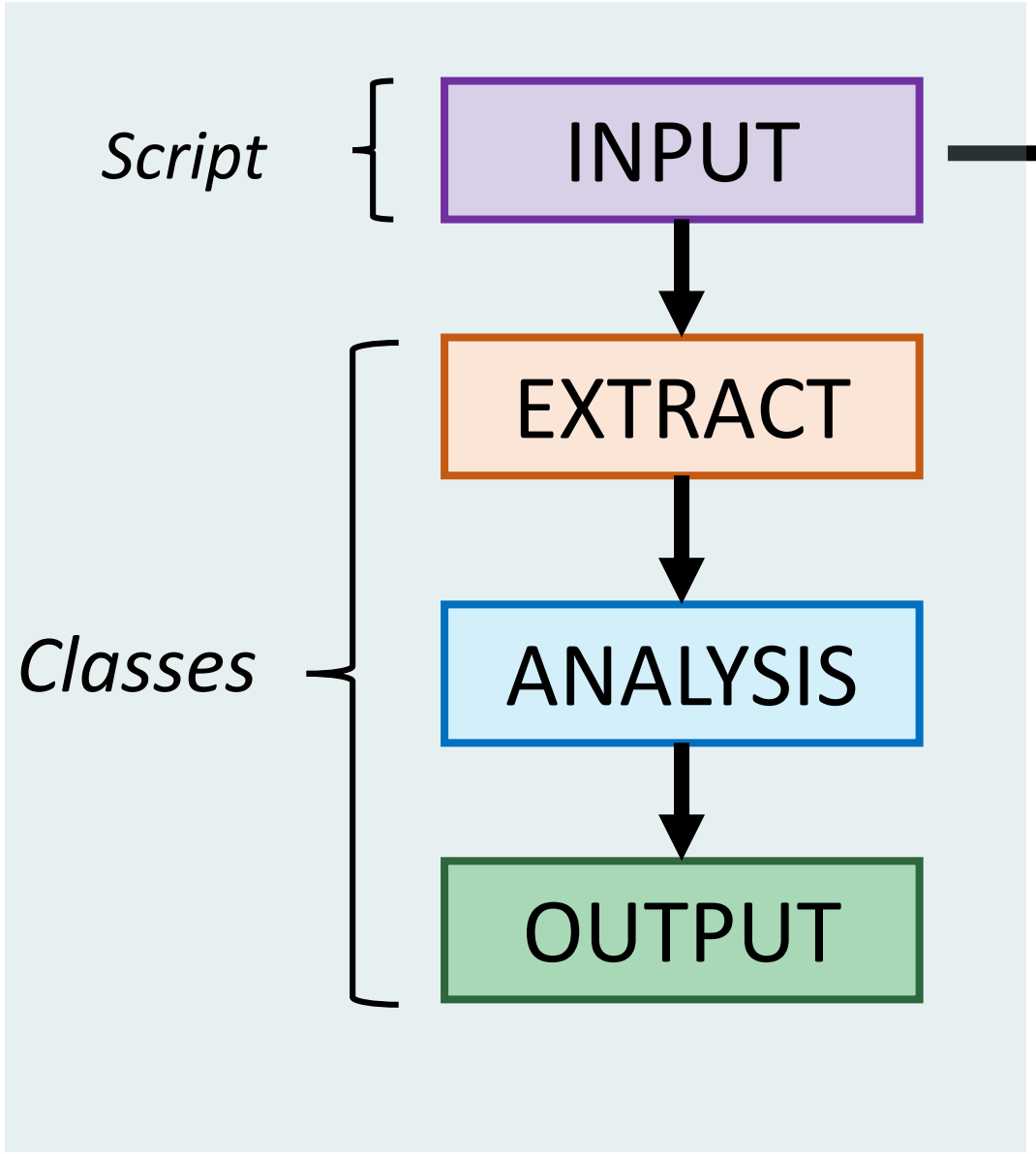
Travis CI

pytest

- Unit tests
- Integration tests
- User tests / collaborative



# EZclim: High level design




```
# REQUIRED ARGUMENTS
# ----------------------------------
Prefix:
Start date of analysis:
Variables:
Number of ensembles: 1
#
# ----------------------------------
# OPTIONAL ARGUMENTS
# ----------------------------------
End date of analysis:
Analysis:
Spatial:
Total ensemble stats:
Plot: 1
Monthly:
Grid:
Sample:
Mask file:
Save Output: True
Covary:
Histogram bin selection:
Longitude centre:
User function:
Calculate areas:
Calculate index:
```

*input.txt*

# EZclim: Customisability

```
# REQUIRED ARGUMENTS
# ------------------------------
Prefix:
Start date of analysis:
Variables:
Number of ensembles:
#
# ------------------------------
# OPTIONAL ARGUMENTS
# ------------------------------
End date of analysis:
Analysis:
Spatial:
Total ensemble stats:
Plot:
Monthly:
Grid:
Sample:
Mask file:
Save Output:
Covary:
Histogram bin selection:
Longitude centre:
Calculate areas:
Calculate index:
User function:
```

*input.txt*

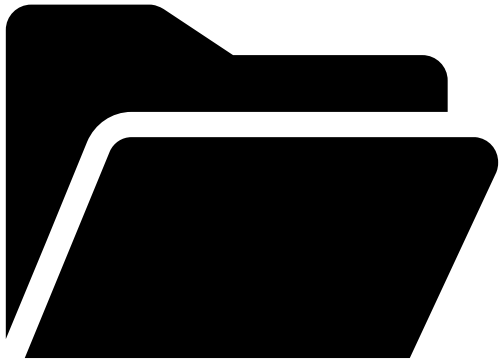
**Example file in INPUT/user_function/example_function.py**

```
def simple_equation(cube):
    """
    Perform simple arithmetic with variables
    :param data: a dictionary of variables and their data (iris.cube)
    :return: result of equation, name of results, unit
    """
    Variables are stored in the cube dictionary
    The names of variables used have to match ones
    in the Variables argument provided in the input
     file or command line.

    temperature = cube['temp'].data
    salinity =  cube['sal'].data

    # Perform equation with temperature and salinity
    result = 2 * temperature + 4 * salinity

    Set the attributes of data
    name = 'result'
    long_name = 'result calculated using simple equation'
    unit = 'K'
    return result, name, long_name, unit
```

# EZclim: Output

**EZclim**

NetCDF files



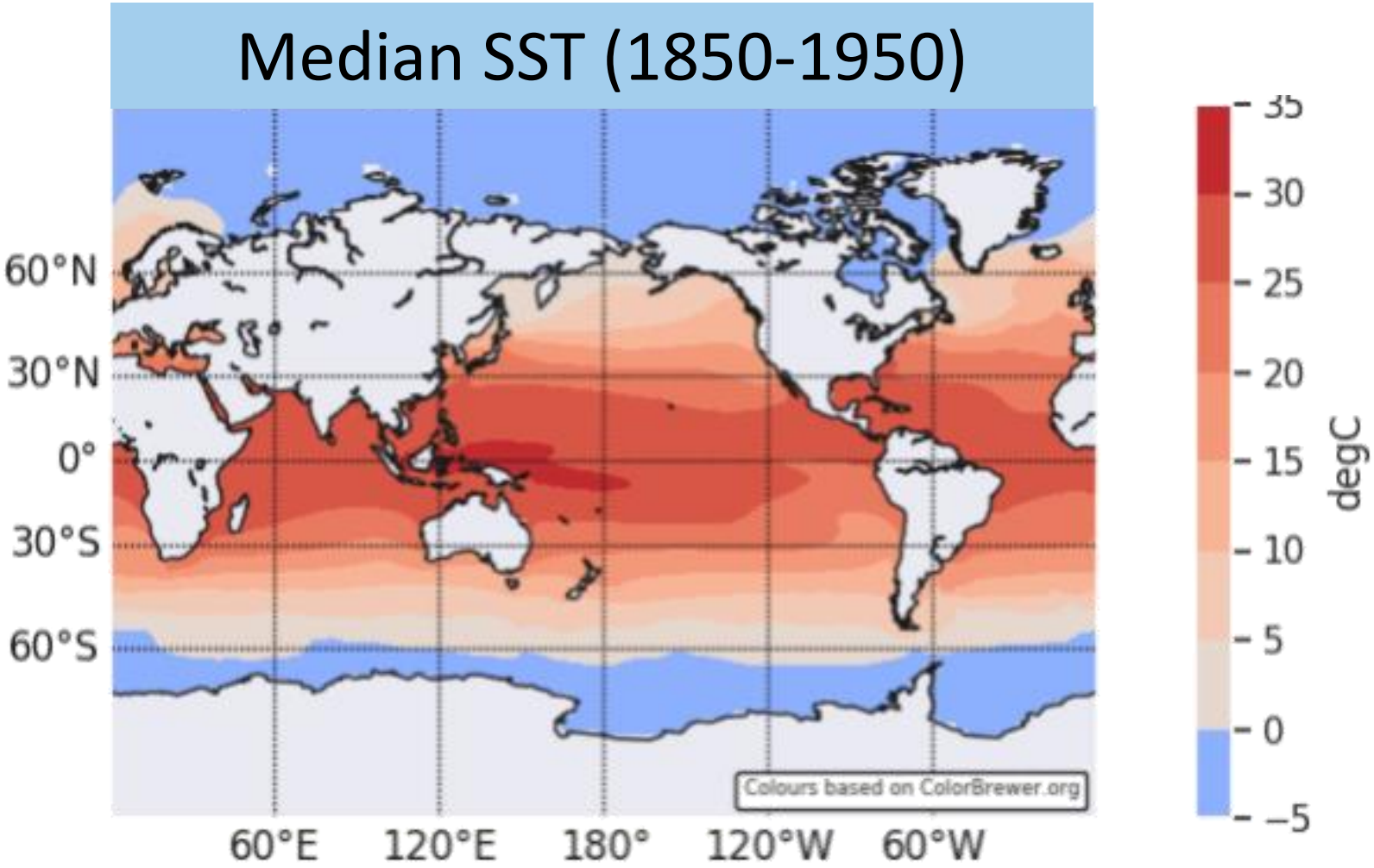
Plots – maps, histograms, time series, box plots

- *On screen*
- *On file*

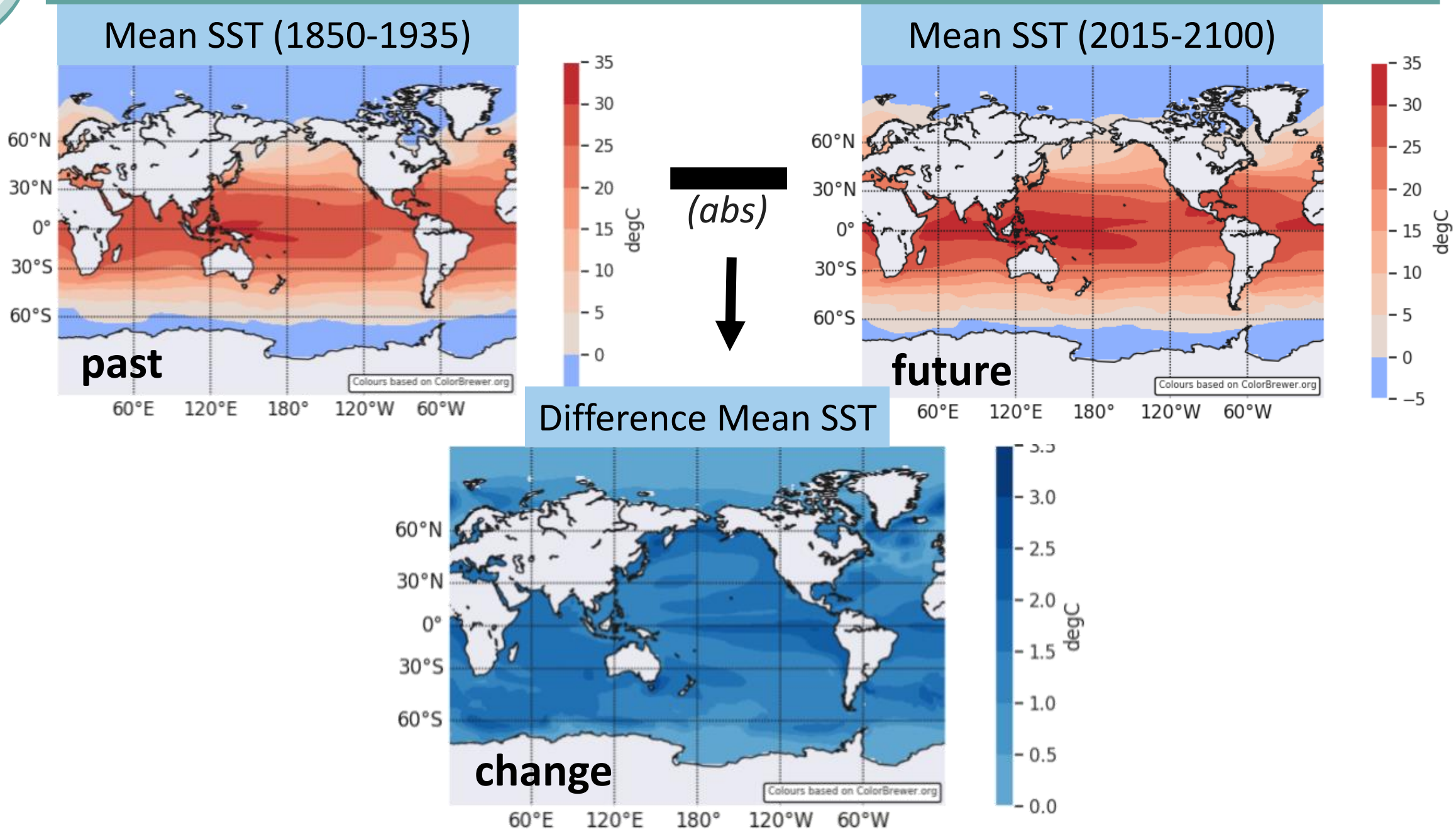
# EZclim: Basic functionality

```
# REQUIRED ARGUMENTS
# ----------------------------------
Prefix: tos
Start date of analysis: 1850
Variables: tos
Number of ensembles: 1
#
# ----------------------------------
# OPTIONAL ARGUMENTS
# ----------------------------------
End date of analysis: 1950
Analysis: median
Spatial:
Total ensemble stats:
Plot: 1
Monthly: True
Grid:
Sample:
Mask file:
Save Output: True
Covary:
Histogram bin selection:
Longitude centre:
User function:
Calculate areas:
Calculate index:
```

*input.txt*

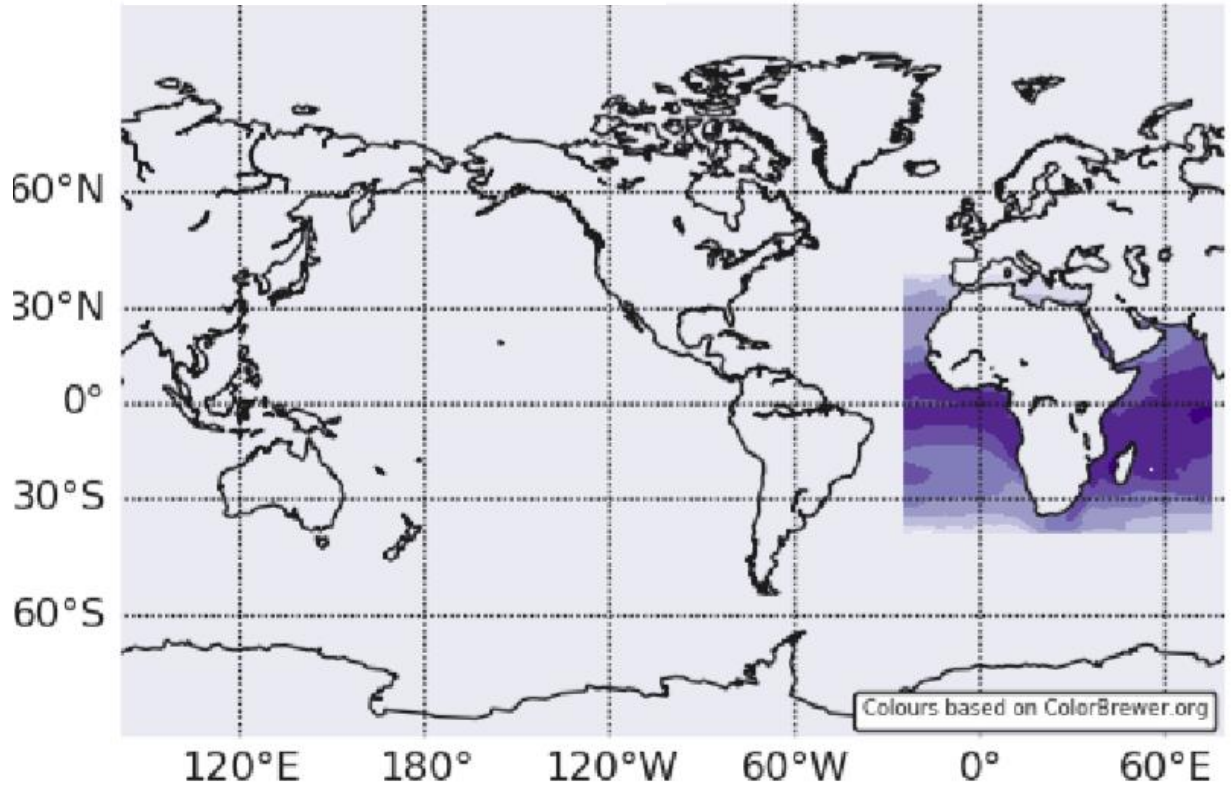


# Ezclim handles climate experiments by design

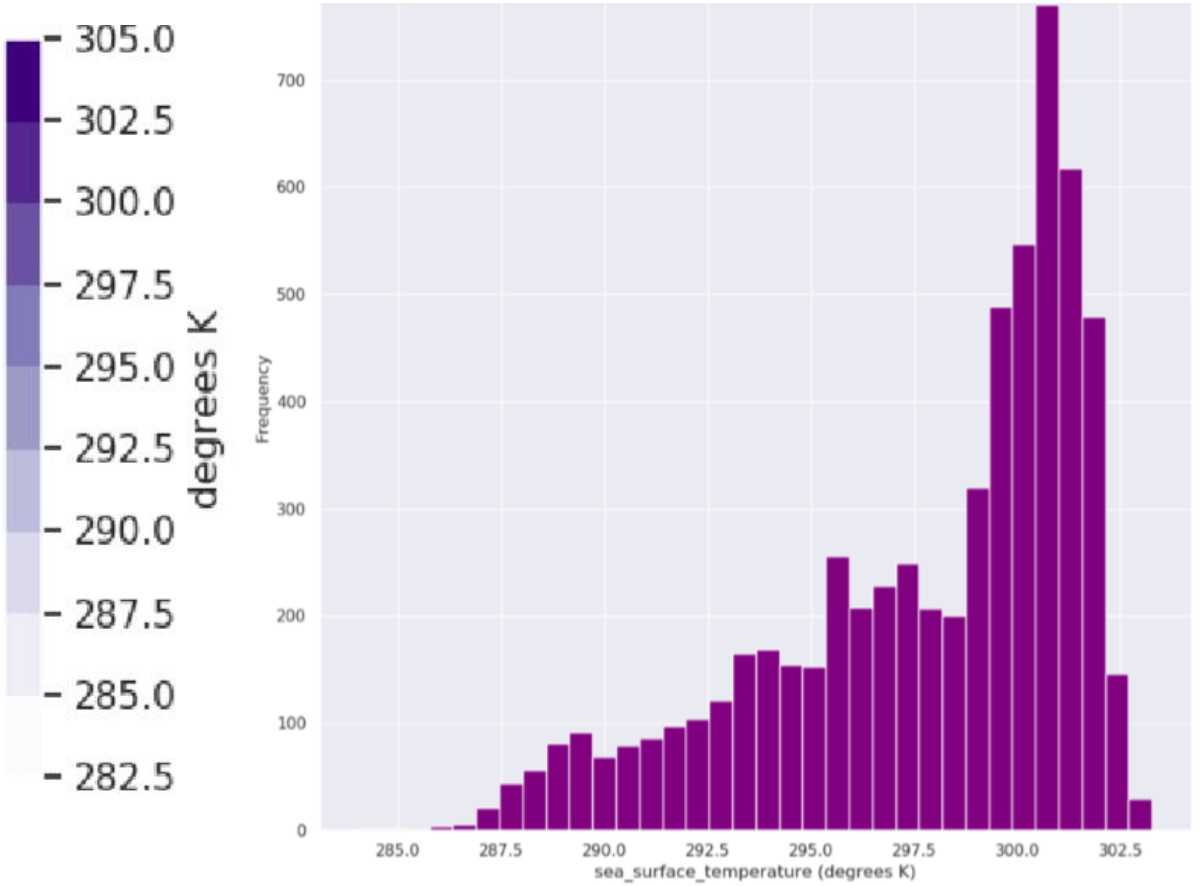


# EZclim: Extracting a region using masks

Sea surface temperature at 1980, within masked region



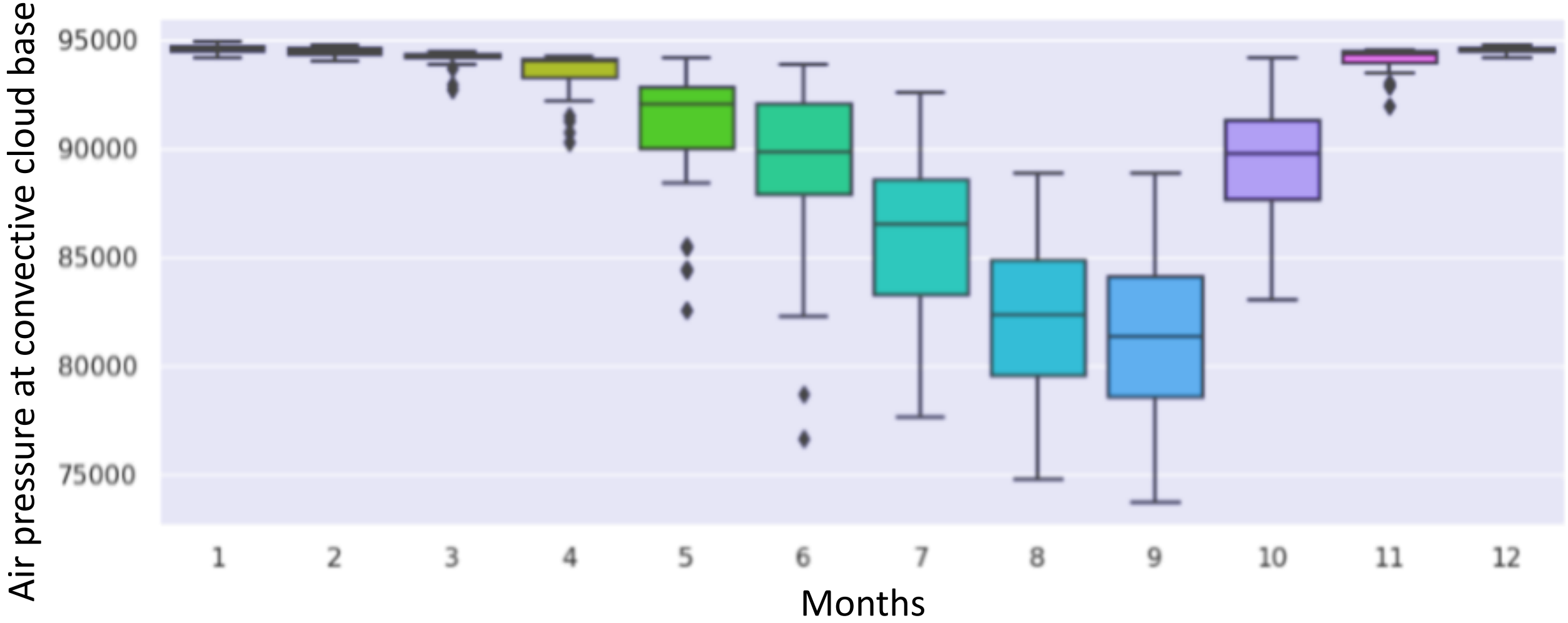

**Isolate data within a polygon**




**Analysis within the selected region (i.e. histogram)**

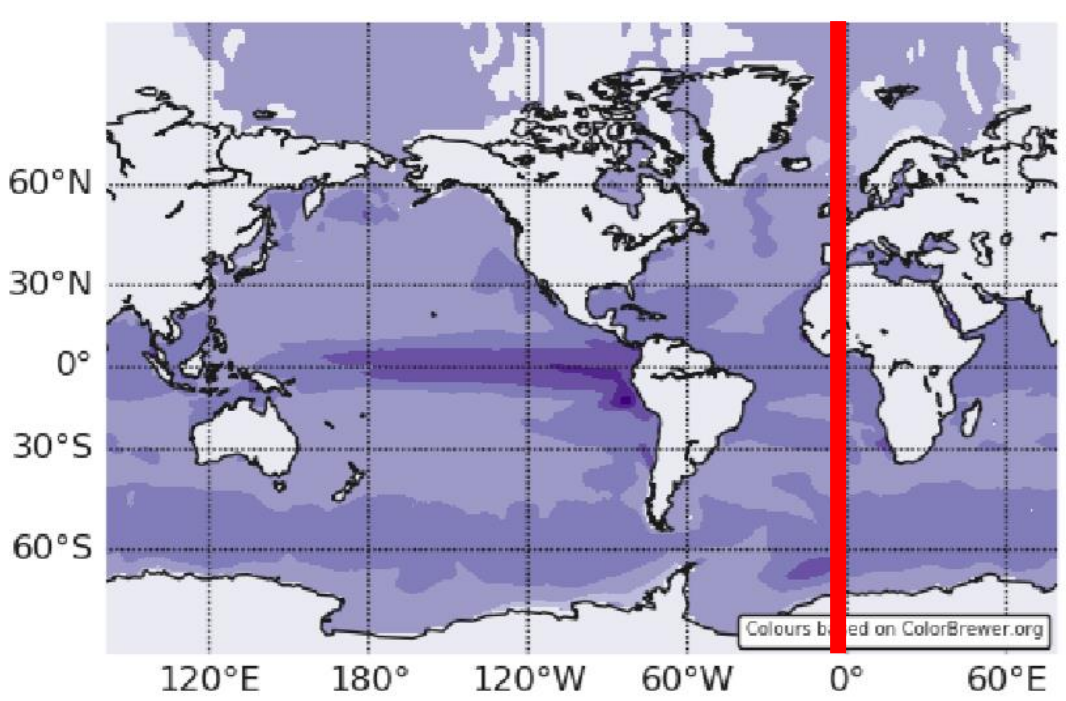
# EZclim: *Grid manipulation* – Sample points and grid points

Air pressure at convective cloud base at grid point (20, 20) between 1979 and 2014

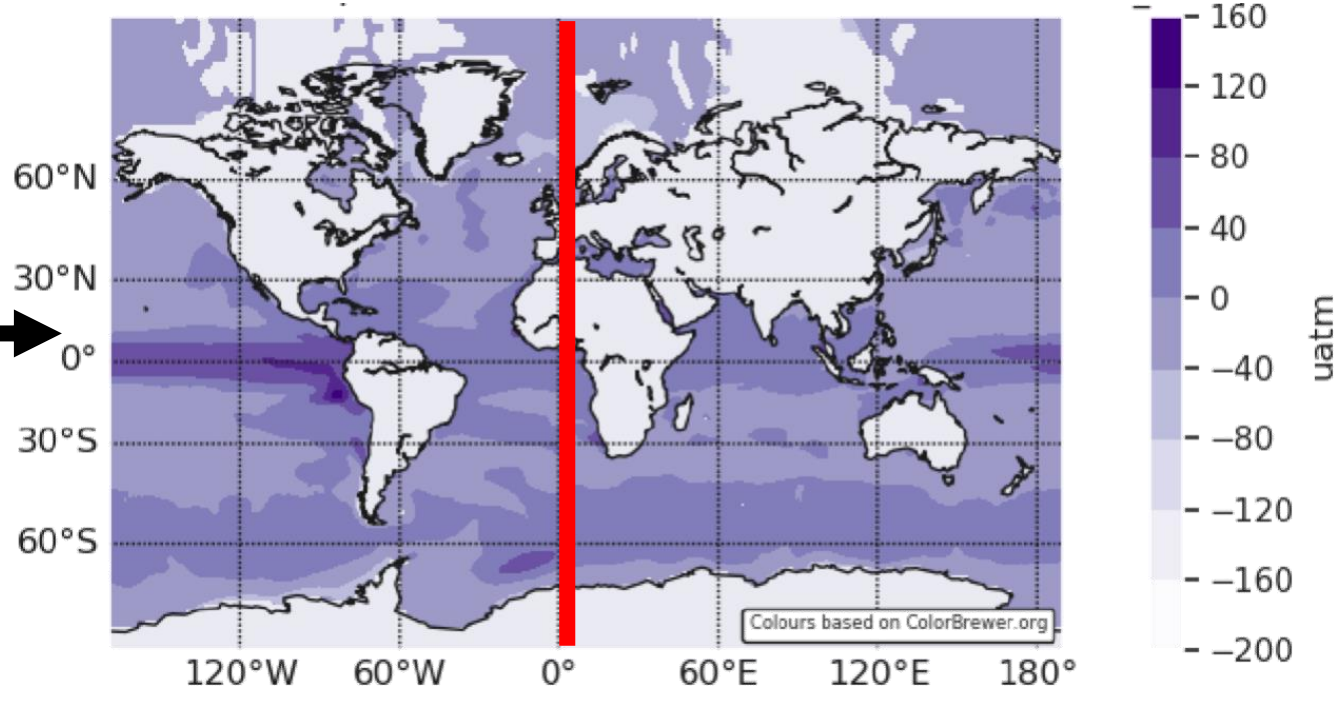


# EZclim: *Grid manipulation* – Rotation

Ocean - atmosphere dissolved inorganic carbon (DIC) gradient (1953 mean from daily outputs)



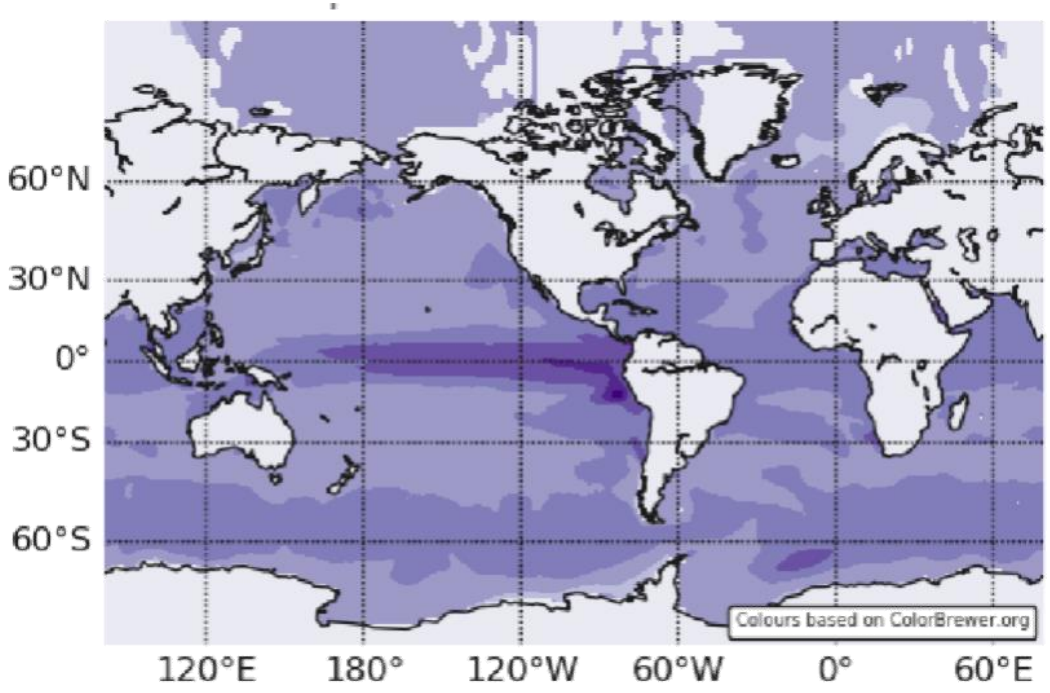

**Centred at 90W**

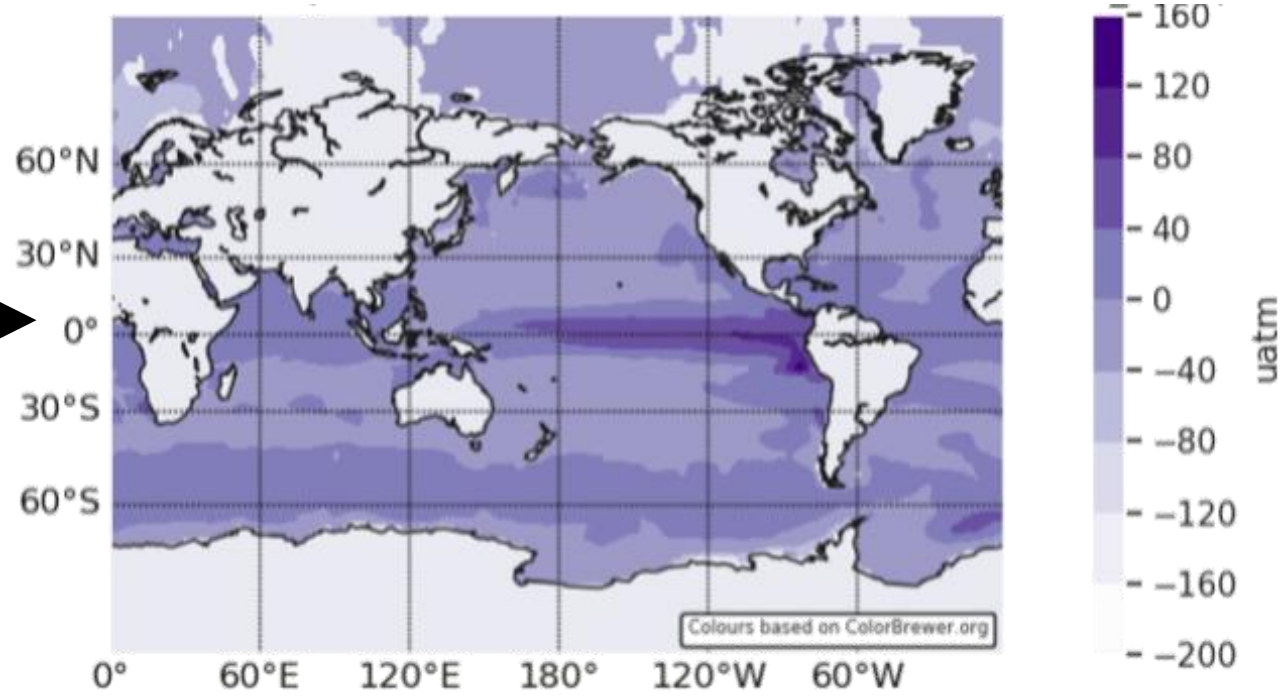



**Rotated to 10E**

# EZclim: *Grid manipulation* – Regridding

Ocean - atmosphere dissolved inorganic carbon (DIC) gradient (1953 mean from daily outputs)




**360 x 200**

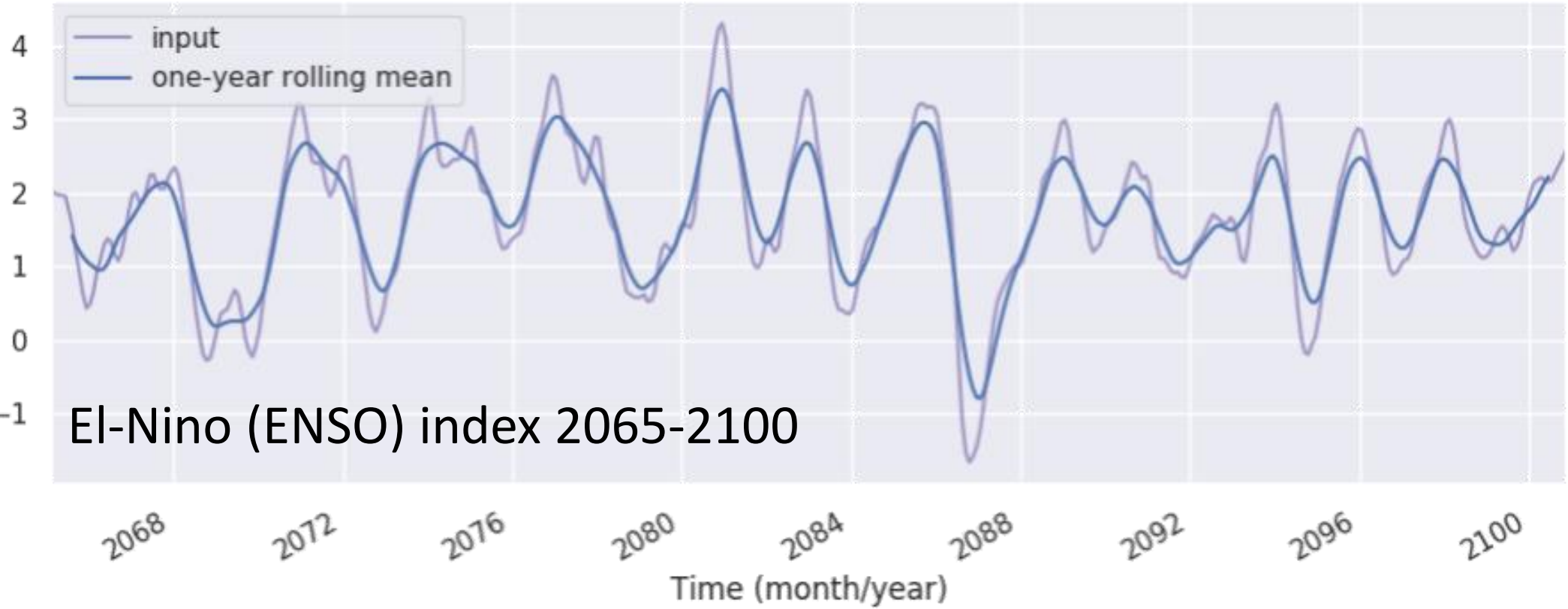
**256 x 128**

**Important for model-model and model-data inter-comparison**

# EZclim: Climate indices + shell script interface

#!/bin/bash → python → Max-Planck-Institut für Meteorologie CDO

MATLAB R C



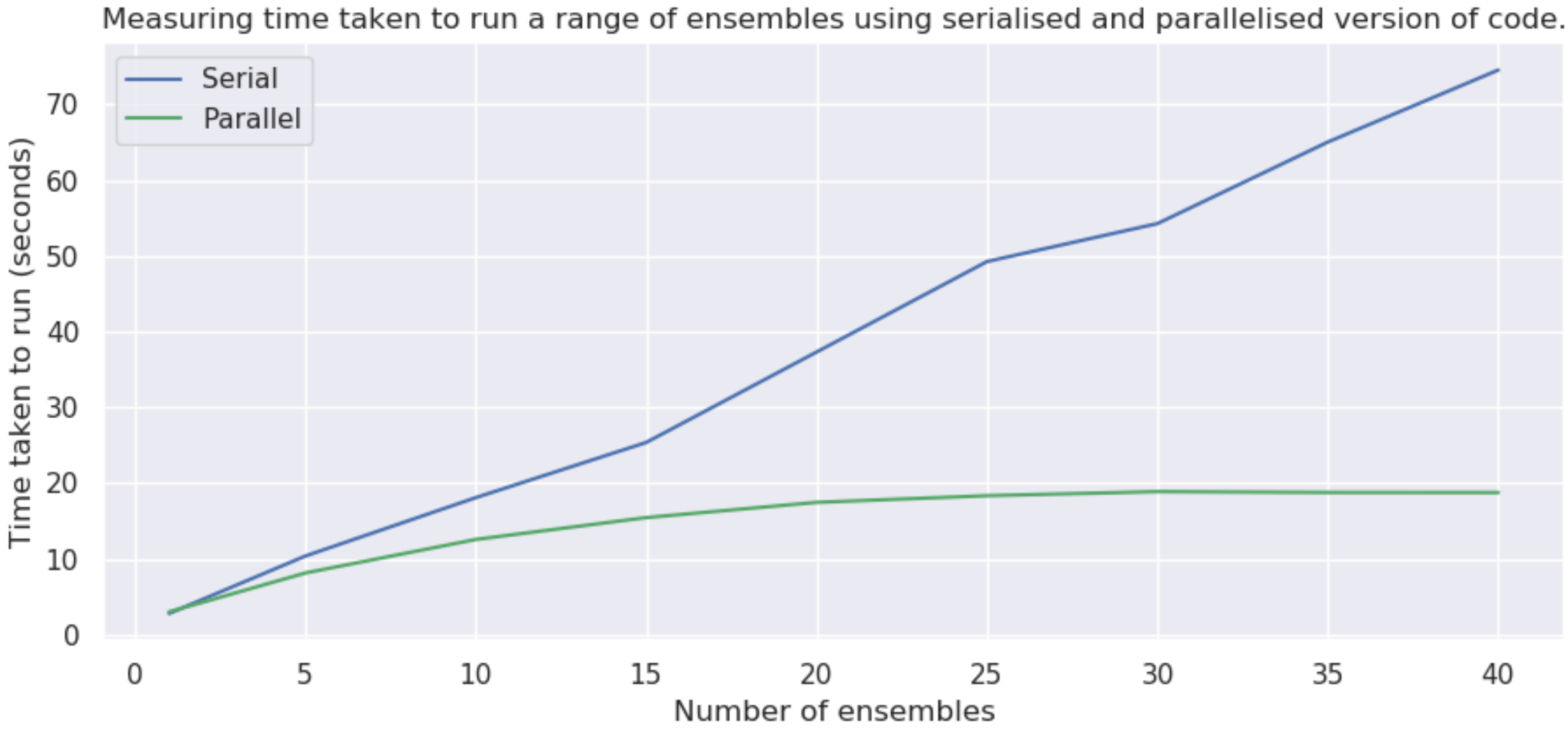

El-Nino (ENSO) index 2065-2100

- ENSO
- PDO
- NAO
- TNO
- AAO
- AO

(Dundovic Davor)

# EZclim: Parallelisation, memory and future work

## For ‘Extract and Analysis’ classes only



# Conclusions

- Well-structured development platform
- Simple interface
- Modular, flexible and customisable
- Caters to experts and non-experts

**EZclim**