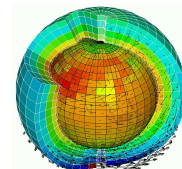


MC-Toolkit meetings



Mickaël Lalande

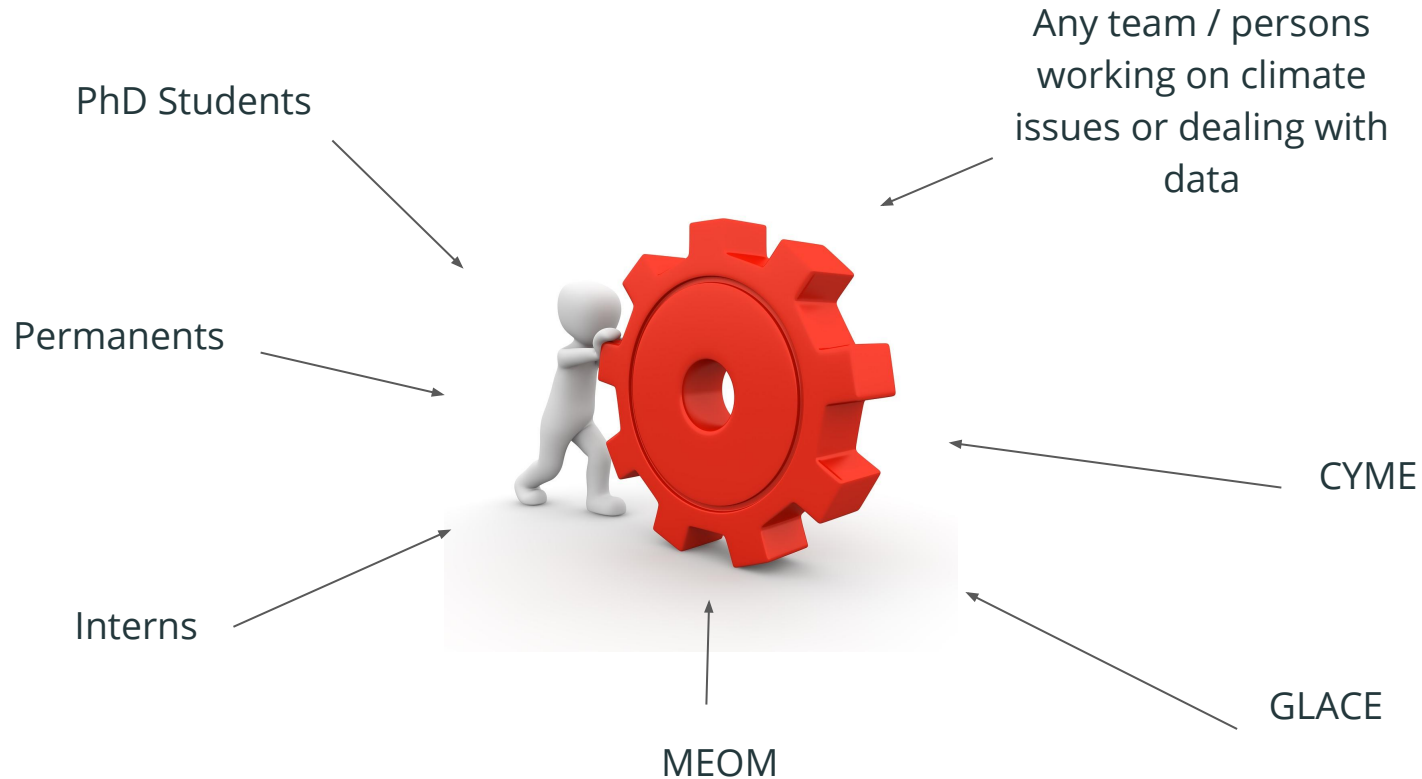


Thèse 2019-2022

Directeurs : Gerhard Krinner et Martin Ménégoz
Institut des Géosciences de l'Environnement (IGE)



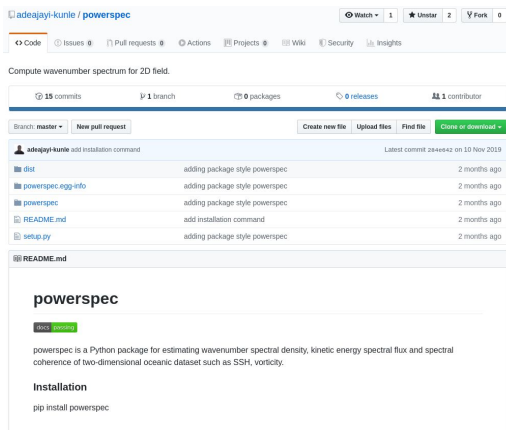
Why this meeting?



My personal experience in MEOM's team -> SATIM meetings



[brodeau/sosie: SOSIE is Only a Surface Interpolation Environment](#)



[adeajayi-kunle/powerspec: Compute wavenumber spectrum for 2D field.](#)



Ideas of topics

In the context of Mardi Café:

- xarray / cdo / climaf (netcdf, climatologies)
- cartopy / ferret / ncl / basemap / proplot (plot)
- cdo, basemap, scipy/stats, ESMx, climaf, sosie (regrid)
- Jupiter Notebook / Jupyter lab (pont ssh, Jupiter lab, plots interactifs)
- Github / Gitlab / svn / bitbucket
- dask (parallelization or MemoryError issues)
- Machine Learning ? (gpu, slack, gricad) -> ml-at-ige slack
- régression linéaire / tendances / analyses statistiques
- EOF
- analyses spectrales
- cmip6 data / reanalyses / obs
- MAR / LMDZ (how to install and launch a simulation?)

More general:

- How to write a paper (latex, overleaf, texmaker, etc.)
- How to deal with the bibliography (mendeley, zotero, etc.)
- How to publish an article (what journals, etc.)

Example of CLIMAF

https://github.com/mickaellalande/MC-Toolkit/blob/master/Presentation/CLIMAF_example.ipynb

jupyter CLIMAF_example (auto-sauvegardé)



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Non fiable

Python 3

Exécuter

Markdown

CLIMAF example (works only on CICLAD)

More informations about CLIMAF: <https://climaf.readthedocs.io/en/master/>

Import main modules

```
Entrée [1]: from climaf.api import *

('LC debug :', False)
CLIMAF install => /ciclad-home/jservon/Evaluation/CLIMAF/climaf_installs/climaf_1.2.12
python => /prodigfs/ipslfs/dods/jservon/miniconda/envs/analyse_env_2.7/bin/python
...
Required softwares to run CLIMAF => you are using the following versions/installations:

CLIMAF version = 1.2.12

ncl 6.6.2 => /prodigfs/ipslfs/dods/jservon/miniconda/envs/analyse_env_2.7/bin/ncl
cdo 1.9.6 => /opt/nco/1.9/bin/cdo
nco (ncks) 4.5.2 => /opt/nco-4.5.2/bin/ncks
ncdump fichier => /prodigfs/ipslfs/dods/jservon/miniconda/envs/analyse_env_2.7/bin/ncdump
...

Cache directory set to : /data/mlalande/climafcache (use $CLIMAF.CACHE if set)
Cache directory for remote data set to : /data/mlalande/climafcache/remote_data (use $CLIMAF_REMOTE_CACHE if set)
warning : Binary cdfutils not found. Some operators won't work
Available macros read from ~/.climaf.macros are : []
```


```
Entrée [2]: # The years considered to plot the biases between IPSL and observational references
first_year=1984
last_year=2014
```

"Load" model data


```
Entrée [3]: req_snow = ds(
    project='CMIP6',
    model='IPSL-CM6A-LR',
    variable='snc',
    tables='LImon',
    frequency='monthly',
    realization='r1i1p1f1',
    period=str(first_year)+'-'+str(last_year),
    ...)
```

Example for xarray











https://github.com/mickaellalande/MC-Toolkit/blob/master/Presentation/xarray_example.ipynb

 jupyter

xarray_example (auto-sauvegardé)

 Se déconnecter

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         Exécuter  Code

Xarray example

Load a snow data set from a model (IPSL-CM6A-LR) and compare it to a reanalysis (NOAA) by seasons during the period 1984 to 2014.

Import main modules

For installation see the Readme at the root of this repository

```
Entrée [1]: # This first line allows to have interactive plots inside the notebook
%matplotlib notebook

import xarray as xr # xarray is for dealing with NetCDF files
import matplotlib.pyplot as plt # for plot
import numpy as np # for maths
import xesmf as xe # for regridding
```

Load model data

Note: xarray doesn't directly load the data. It uses "lazy load", and only load data when a operation is occurring. There are many possibilities to take advantage of this + using Dask if memory issues. See xarray_dask_xesmf_proplot folder (when it will be available).

```
Entrée [2]: model_dataset = xr.open_dataset(
    "data/snc_LImon_IPSL-CM6A-LR_historical_rlilplf1_gr_185001-201412.nc"
)
model_dataset
```

```
Out[2]: <xarray.Dataset>
Dimensions:      (axis_nbounds: 2, lat: 143, lon: 144, time: 1980)
Coordinates:
  * lat          (lat) float32 -90.0 -88.73239 -87.46479 ... 88.73239 90.0
  * lon          (lon) float32 0.0 2.5 5.0 7.5 10.0 ... 350.0 352.5 355.0 357.5
  * time         (time) datetime64[ns] 1850-01-16T12:00:00 ... 2014-12-16T12:00:00
Dimensions without coordinates: axis_nbounds
Data variables:
  time_bounds    (time, axis_nbounds) datetime64[ns] ...
  snc            (time, lat, lon) float32 ...
Attributes:
  Conventions:    CF-1.7 CMIP-6.2
  creation date:  2018-07-11T07:36:35Z
```

Example “ma cuisine”

https://github.com/mickaellalande/MC-Toolkit/blob/master/Presentation/ma_cuisine.py

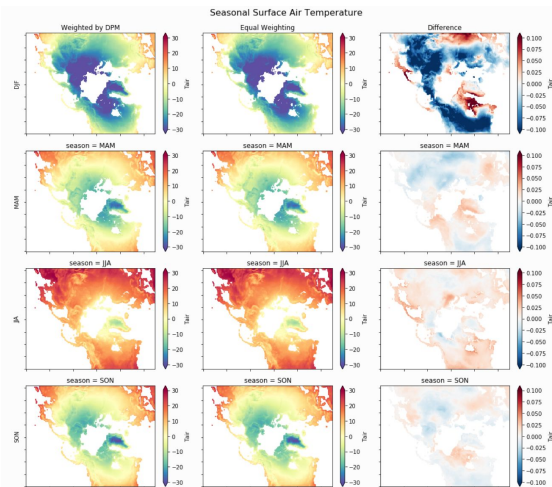
```
jupyter ma_cuisine.py il y a quelques secondes Se déconnecter
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49 # =====
50 # Compute monthly weighted data
51 # =====
52 # http://xarray.pydata.org/en/stable/examples/monthly-means.html
53 dpm = {'noleap': [0, 31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31],
54        '365 day': [0, 31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31],
55        'standard': [0, 31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31],
56        'gregorian': [0, 31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31],
57        'proleptic_gregorian': [0, 31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31],
58        'all leap': [0, 31, 29, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31],
59        '366 day': [0, 31, 29, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31],
60        '360 day': [0, 30, 30, 30, 30, 30, 30, 30, 30, 30, 30, 30, 30]}
61
62 def leap_year(year, calendar='standard'):
63     """Determine if year is a leap year"""
64     leap = False
65     if ((calendar in ['standard', 'gregorian',
66                      'proleptic_gregorian', 'julian']) and
67         (year % 4 == 0)):
68         leap = True
69     if ((calendar == 'proleptic_gregorian') and
70         (year % 100 == 0) and
71         (year % 400 != 0)):
72         leap = False
73     elif ((calendar in ['standard', 'gregorian']) and
74          (year % 100 == 0) and (year % 400 != 0) and
75          (year < 1583)):
76         leap = False
77     return leap
78
79 def get_dpm(time, calendar='standard'):
80     """
81     return a array of days per month corresponding to the months provided in `months`
82     """
83     month_length = np.zeros(len(time), dtype=np.int)
84
85     cal_days = dpm[calendar]
86
87     for i, (month, year) in enumerate(zip(time.month, time.year)):
88         month_length[i] = cal_days[month]
89         if leap_year(year, calendar=calendar) and month == 2:
90             month_length[i] += 1
91     return month_length
92
93
94 # Seasonal climatology (on monthly data set)
95 def season_clim(ds, calendar='standard'):
96     # Make a DataArray with the number of days in each month, size = len(time)
97     month_length = xr.DataArray(get_dpm(ds.time.to_index(), calendar=calendar),
```

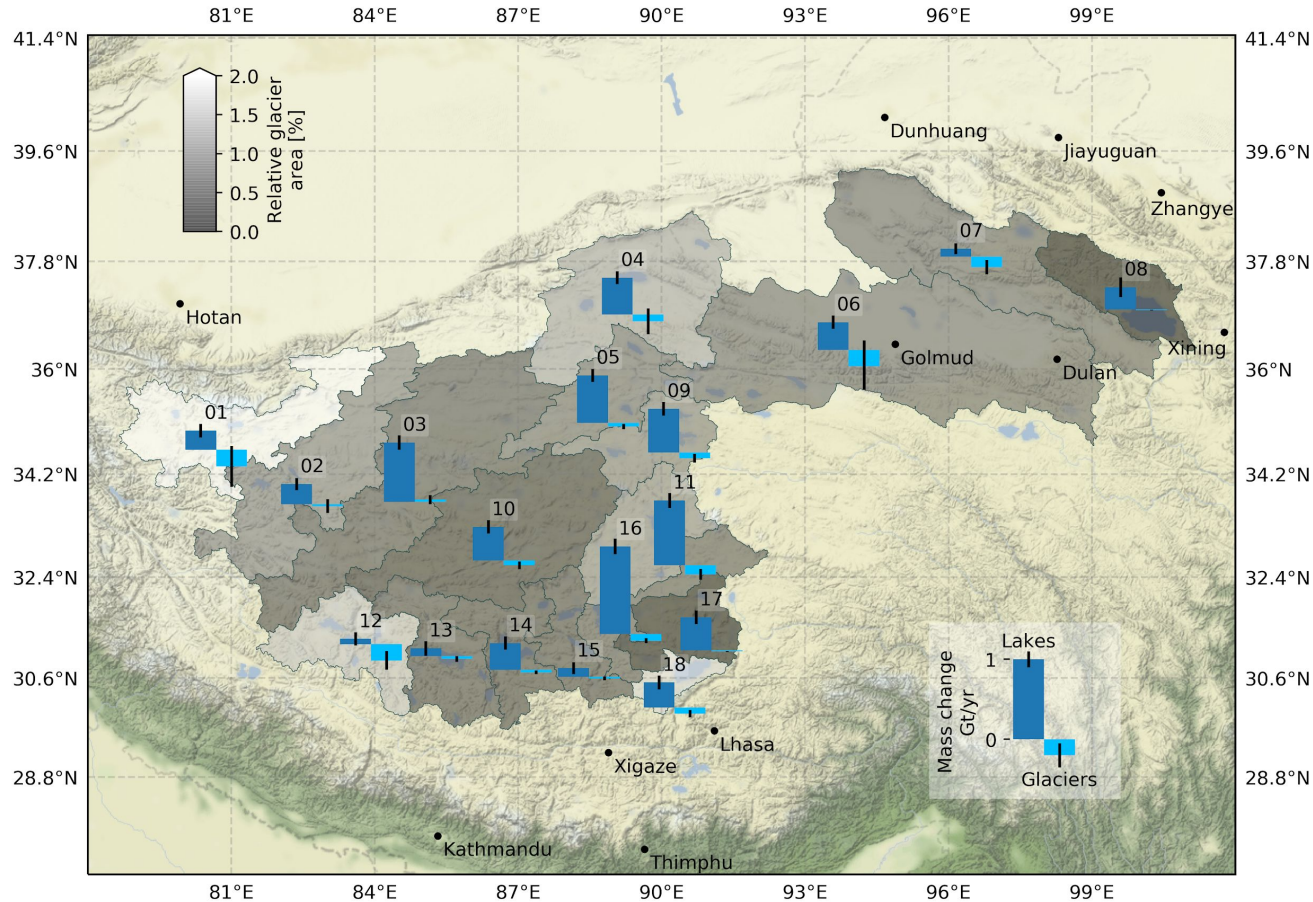
How to take into account the number of days in a month for monthly data analyse?

Code inspired from:

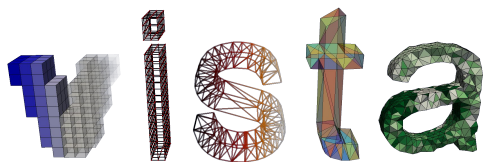
[Calculating Seasonal Averages from Timeseries of Monthly Means — xarray 0.14.1 documentation](#)



Example plots Fanny (with Cartopy)

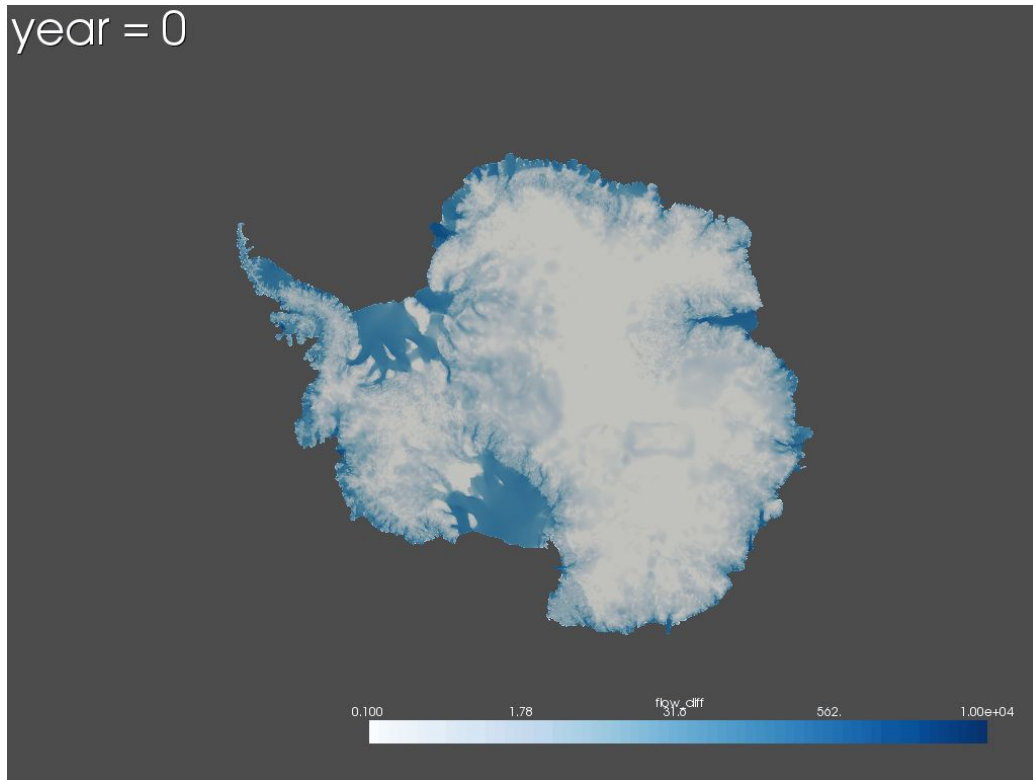


Example Benoit: Velocity differences over Antarctica (with PyVista)



3D plotting and mesh analysis through a
streamlined interface for the Visualization
Toolkit (VTK)

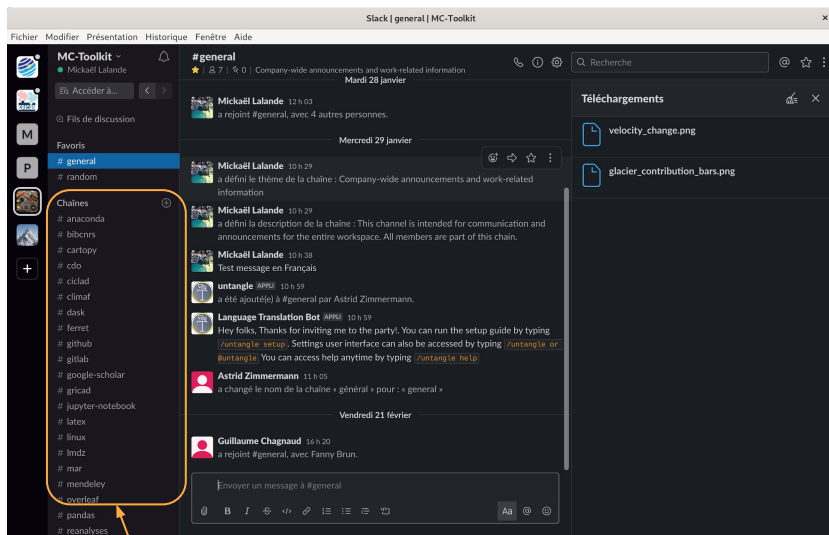
<https://docs.pyvista.org/>



Slack + github

Lien d'invitation **Slack**:

https://join.slack.com/t/mc-toolkit-ige/shared_invite/enQtOTgxMjgzNzgyMjYzLWNlZGUzNTBIN2E0ZDIwNmI1MWRmNTVmNWE3NWUzMjMxN2Y1NGlODE2M2NlZDgxNjYxODAyMjIwODdhMTA0ODA

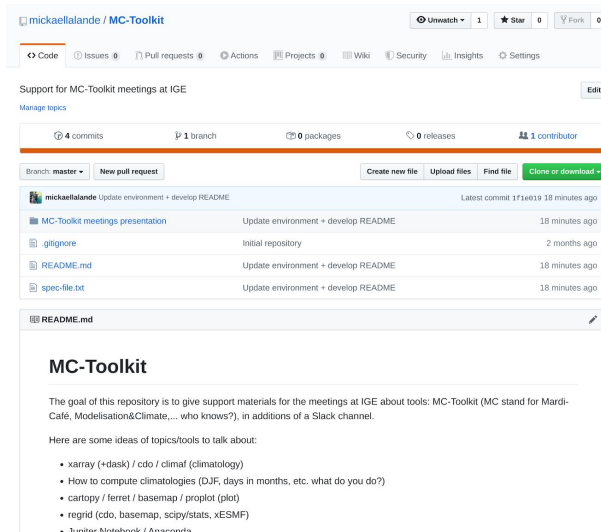


Add the channels that you are interested
So that we can ask question and help each other
with the regarding tool

Github

(to find back the code examples shown during these meetings):

<https://github.com/mickaellalande/MC-Toolkit>



Next meeting?

Same time?

In the context of Mardi Café or other?

MC for Mardi Café / Modélisation Climat / ??

I can start with xarray, climato (ma cuisine), proplot, xesmf
(+ anaconda/jupyter-notebooks/github ? May be before ?)

Possible next meetings:

0. Anaconda/Miniconda + Jupyter-Notebook?
 1. Martin: CLIMAF + R tool
 2. Mickaël: xarray + “ma cuisine”
 3. Mickaël / Fanny: plots (cartopy/proplot)
 4. Benoit: GeoPandas / PyVista
 5. Aurélie: Dask+xarray / Pangeo
 6. ...