An Introduction to Ferret-NOAA
for LMDZ output analysis

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Official userguide :

https://ferret.pmel.noaa.gov/Ferret/documentation/users-guide

How to install :

1/First option with conda (recommended)

To install Ferret in a conda distribution (python distribution), you can follow this tutorial :

wget https://repo.anaconda.com/archive/Anaconda3-2022.10-Linux-x86_64.sh
chmod +x Anaconda3-2022.10-Linux-x86_64.sh
bash Anaconda3-2022.10-Linux-x86_64.sh

Choose the default parameters, answer yes to all questions, including the initilization of the environment.
Restart your terminal (to source the .bashrc file)

At the beginning of the prompt line of the terminal, the word (base) should appear, meaning that the default conda environnement is ready; then :
conda create -n FERRET -c conda-forge pyferret ferret_datasets python=3.9 --yes
conda activate FERRET
Now, the word (ferret) should appear at the beginning of the prompt line
Go to the simulation directory, run pyferret, and you are good to go

2/Second option through installation of ferret-vis (not tested)

sudo apt install -y ferret-vis ferret-datasets

```
for file in /home/*/.bashrc ; do
    sed -i" -e '/ferret-vis/d' $file
    cat <<.......eod>> $file
    . /usr/share/ferret-vis/bin/ferret_paths # ferret-vis
    alias ferret=ferret_c
    export FER_DATA=". \$FER_DATA"
 .......eod
done

cd /usr/share/ferret-vis

sudo wget http://www.lmd.jussieu.fr/~lmdz/data_ferret.tar
sudo tar xvf data_ferret.tar
sudo \rm -f data_ferret.tar
```

Application examples :

First, download two LMDZ output files (a daily-mean file: histday.nc ; a 6-hourly file : histhf.nc).

wget https://www.lmd.jussieu.fr/~evignon/ferret_lmdz/histday.nc
wget https://www.lmd.jussieu.fr/~evignon/ferret_lmdz/histhf.nc

Those files are in a netcdf format containing four dimensions : longitude, latitude, vertical levels (presnivs) and the time (time_counter)

Open ferret

ferret

!Open the two datasets :

use histday.nc
use histhf.nc

!Have a look at the content of those two files typing

show data
! Note that each variable contains either 3 or 4 dimensions. For the histday.nc (daily-mean) file, as the simulation ran only 1 day, the length of the time dimension is 1.
! histday.nc is the first dataset (d=1) while histhf is the second dataset you opened (d=2).
! Now list the content of the variable tsol (surface temperature) for the first dataset

list tsol[d=1]

!or equivalently

list/d=1 tsol

! Big array, isn't it
! Now look for the surface temperature at the grid point containing Paris (longitude=2.352°, latitude=48.857°) :

list tsol[d=1,x=2.352,y=48.857]

! Note that x is the longitude axis and y is the latitude axis.
! Do the same thing for the second dataset (6-hourly file)

list tsol[d=2,x=2.352,y=48.857]

! Four numbers appear (one instantenous value every 6 hour).
! Now compare the daily-mean value from the averaged value over 4 instaneous 6-houly values :

list tsol[d=1,x=2.352,y=48.857]-tsol[d=2,x=2.352,y=48.857,l=@ave]

! Note that l is the time axis index.

! Now plot the time evolution of the surface temperature at the longitude and latitude of Paris from the 6-hourly dataset :

! Open a figure
set window 1
plot tsol[d=2,x=2.352,y=48.857]
! The previous command is equivalent to
plot/d=2/x=2.352/y=48.857 tsol

! change the y-axis extent to [270,320]K :
plot/vlimits=275:285 tsol[d=2,x=2.352,y=48.857]

! In the same figure, plot the 2-m temperature t2m in thick blue line :
plot/o/COLOR=blue/THICK=2 t2m[d=2,x=2.352,y=48.857]

! Now plot tsol and t2m in two separated subplots in a new figure

set window 2
set view upper
plot/vlimits=275:285 tsol[d=2,x=2.352,y=48.857]
set view lower
plot/vlimits=275:285 t2m[d=2,x=2.352,y=48.857]

! In a third figure, plot a map of the magnitude of the wind speed at the fourth time step at the closest-to-surface model vertical level from the histhf file. The vertical axis index is k.
! Note that in LMDZ output files, vertical level numbers increase downward

! calculate the windspeed from the zonal and meridional components
let ws=(vitu[d=2]^2+vitv[d=2]^2)^ 0.5

set window 3
shade ws[k=39,l=4]
! or with a smoothed shading :
fill ws[k=39,l=4]
! display the coastlines
go land
! change the colormap, restrict the plots to northern hemisphere and change the values range from -10 to 10 :
! https://ferret.pmel.noaa.gov/Ferret/faq/ferret-color-palettes

shade/palette=cmocean_curl/vlimits=0:90/levels=(-10,10,1) ws[k=39,l=4]
! add the contour of the temperature
contour/o temp[d=2,k=39,l=4]
go land

! Now plot a fourth figure in which you plot a cross-section of the meriodionally-averaged zonal wind. Change also the title of the figure with ‘what a great plot’

set window 4
shade/title=« what a great plot » vitu[i=@ave,d=1]

! and now save the figure
frame/file=myfigure.gif

! Now exit ferret
exit

Now you are able to use ferret in an interactive mode. Note that you can also write ferret scripts (.jnl files) that you can run afterward. Download a script example (which corresponds to the ensemble of commands we have run so far) :
wget https://www.lmd.ipsl.fr/~evignon/ferret_lmdz/example_ferret.jnl

Then open ferret and run the script

ferret
go example_ferret.jnl