

An Introduction to Ferret-NOAA for LMDZ output analysis

Official userguide :

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

How to install :

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 initialization 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 environment 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

A few 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 instantaneous value every 6 hour).

! Now compare the daily-mean value from the averaged value over 4 instantaneous 6-hourly 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 meridionally-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*