SEDOO-AERIS

MIMOSA - Modélisation Isentrope du transport Méso-échelle de l'Ozone Stratosphérique par Advection

Technical Document & User Manual

	Name	Organisation	Date	Visa
Written by:	Daria Malik	Magellium	24/10/2023	
Checked by:	Vanessa Pedinotti	Magellium		
Approved by:	Béatrice Berthelot	Magellium		

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Contents

1. MIMOSA Overview

MIMOSA is a high-resolution potential vorticity advection model developed in Fortran by A. Hauchecorne (Hauchecorne et al., 2002). It is initialized at a time `t` from ECMWF data (horizontal wind fields U and V, temperature and pressure) on an orthogonal grid centered on the north pole. MIMOSA calculates then advects the potential vorticity on isentropic surfaces with a resolution of 1/3 or 1/6 degree in latitude and longitude.

MIMOSA has been updated to allow the use of ECMWF input data on model levels. This document describes the prerequisites necessary for the operational version of MIMOSA, the extraction of the ECMWF data necessary for the simulation, the simulation progress and the output of the simulation.

All of the MIMOSA executables and dependencies are wrapped up into a Singularity container.

1.1 MIMOSA architecture

The main Fortran program that launches simulations is the `mimosa.f90` script. The `makefile` added with the source files in the `src` directory of the git repo allows the MIMOSA compilation with the gfortran compiler installed in the Singularity container. The executable will be located in the container in the following path : `/usr/local/MIMOSA/src/mimosa.x`

The executable needs to be launched from the working directory where the input file `input.namelist` and the ECMWF meteorological data are present (Fig. 1). This input file contains multiple simulation parameters such as start and end date of the simulation, spatial and temporal resolutions of the input data and output results, and others. These parameters will be detailed later in the document. The output files `[pvg/tg/ug/vg]_[date][time].[theta]` are in binary format and correspond respectively to the potential vorticity, temperature, U wind field, V wind field. The "`g`" suffix means that the result is computed for the global map. Other possible suffixes are "`n`" and "`s`" for the North and South hemispheres respectively.

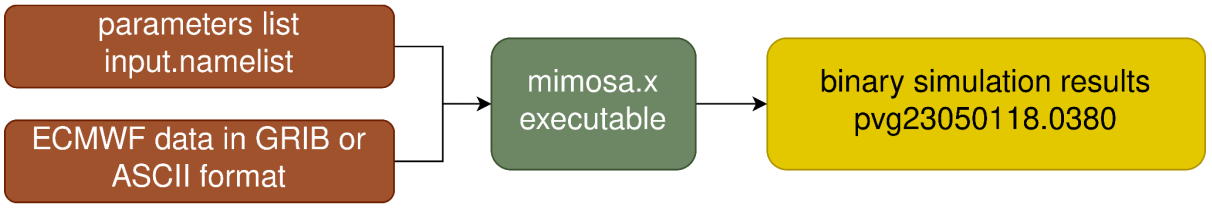


Figure 1 : scheme of the MIMOSA simulation input/output

1.2 MIMOSA input files

1.2.1 input.namelist

The `input.namelist` file contains multiple parameters that allow to define the MIMOSA simulation. The syntaxe of the file is in the Annexe 1. The Table 1 describes in details the parameters that must be set for any simulation.

Table 1 : MIMOSA input parameters description

Parameter name	***Description***	***Values***
zone	Defines the geographical area of the simulation	1 = north (-10N, 90N) 2 = south (-90N, 10N) 3 = global (-90N, 90N)
intype	Defines the type of input files	1 = ASCII (.ECMR) 2 = GRIB (.grib)
iand	Defines the starting date and time of the simulation	year (YY)
moisd		month (MM)
jourd		day (DD)
iheured		hour (HH)
ianf	Defines the ending date and time of the simulation	year (YY)
moisf		month (MM)
jourf		day (DD)
iheuref		hour (HH)
initpv	Defines if the simulation is new or a restart.	0 = if a ph* file from a previous run should be read 1 = initialization is needed
teta	Defines the isentropic surface (K), shouldn't be greater than 950K for isobaric input files (intype = 1)	

nx	Number of grid points along longitudes in input ECMWF files	
ny	Number of grid points along latitude in input ECMWF files	
np	Number of pressure levels (intype = 1) or number or model levels (inType = 2)	
pres	Allows to define the pressure levels of isobaric file (intype = 1). Not needed for GRIB files (intype = 2). If there is more than 50 levels, declaration of pres variable in mimosa.f95	value1, value2, value3… (separated by the comma)
paslat	Input ECMWF data resolution along latitude	
paslong	Input ECMWF data resolution along longitude	
latminecmr	Define the minimum and maximum latitude of ECMWF grid	
latmaxecmr	Define the maximum and maximum latitude of ECMWF grid	
ndeg	Defines the number of MIMOSA grid points per degree of latitude and longitude	either 3 or 6
nlis2d	Defines the number of points use for the smooth	15 for default
nhgrid	Defines the number of hours between two call to regrid	6 for default
nwrite	Defines the number of hours between two outputs of PV files	6 for default
nhmod	Defines the number of hours between two ECMWF files	
nhrelax	Defines the number of hours of relaxation time	240 for default

nprhmod	Defines the hour of the first ECMWF file	
nprwrite	Defines the first hour of PV file	
indifexpl	Defines if explicit diffusion is activated	0 = no explicit diffusion 1 = explicit diffusion
diff	Defines the value of the explicit diffusion if it is activated	4050 for default
nrun	Defines the name of the directory where the output will be stored	1 → directory RUN01 2 → directory RUN02 15 → directory RUN15
nwtemp	Defines the time between two output of temperature or wind	
wind_out	Defines if wind horizontal components files will be saved as output	0 = no output of wind files 1 = output of wind files
t_out	Defines if temperature files will be saved as output	0 = no output of temperature 1 = output of temperature
stations_out	Defines if PV, temperature and PV profiles of stations files will be saved	0 = no output of station files 1 = output of station files

The `initpv` parameter allows to define if the simulation has to be launched with the initialisation, or if the recovery files (described further in the document) should be read from a previous launch. In summary, the simulation for days D_1 through D_2 must be launched in the initialization mode if there was no simulation ending on the day (D_1 - 1). If there were a simulation for days D_X through (D_1 - 1), recovery files will be present in the working directory of this simulation, and the simulation D_1-D_2 can be launched in the same directory with the `initpv=0`. If the D_1-D_2 simulation is launched in a new directory, recovery files will not be found by the algorithm, and the code will exit on error. Launching in a new empty directory must be made with the `initpv=1` parameter, to initialize the simulation. If the new simulation covers an absolutely new date range and is not in a continuity of the existing simulations, the `initpv` parameter must be set to 1 too.

1.3 MIMOSA Output Files

The MIMOSA simulation produces two types of binary outputs: potential vorticity/temperature/wind fields binary files which are estimated for the requested dates and hours, recovery files needed to simulate long time series, and station files (if requested).

1.3.1 Output estimated variables

Output binary files of the estimated variables are named with the following syntax:

- `pvXYYMMDDHH.THETA`
- `tXYYMMDDHH.THETA`
- `uXYYMMDDHH.THETA`
- `vXYYMMDDHH.THETA`

where

- `pv/t/u/v` correspond to the above mentioned variables
- `X = g/n/s` depending on the requested simulation geographical zone
- `YYMMDDHH` is the output date and time (2 digits year, month, day and hour)
- `THETA` is the value of the isentropic level of this output

The output files are in binary unformatted Fortran format and contain two parts: the header and the data itself.

The header contains 30 4-bytes integers :

Table 2 : header description of the MIMOSA binary output

Integer index	***Description***	***Integer index***	***Description***
0	Year	*15*	Timestep in hours
1	Month	*16*	Hour of the first ECMWF input file
2	Day	*17*	Output spatial resolution in points/degree

3	Hour	*18*	Output temporal resolution
4	Initialization year	*19*	Number of longitude points in MIMOSA output grid
5	Initialization month	*20*	Number of latitude points in MIMOSA output grid
6	Initialization day	*21*	Timestep in hours
7	Initialization hour	*22*	Hours before regrid
8	Isentropic level	*23*	Relaxation time (hours)
9	West boundary of the input ECMWF grid	*24*	NOT USED
10	South boundary of the input ECMWF grid	*25*	
11	East boundary of the input ECMWF grid	*26*	
12	North boundary of the input ECMWF grid	*27*	
13	Number of longitude points in input ECMWF grid	*28*	
14	Number of latitude points in input ECMWF grid	*29*	

The data that follows the header is a sequence of 4-bytes floats; the length of this sequence is the total number of "pixels" estimated by the simulation = header[19] x header[20]. The order of the data in the sequence is a row order, which means that the first header[19] points is the first row of the data, the next header[19] points is a second row etc. This data can be plotted as 2D variables to visualize simulation results (Fig. 2).

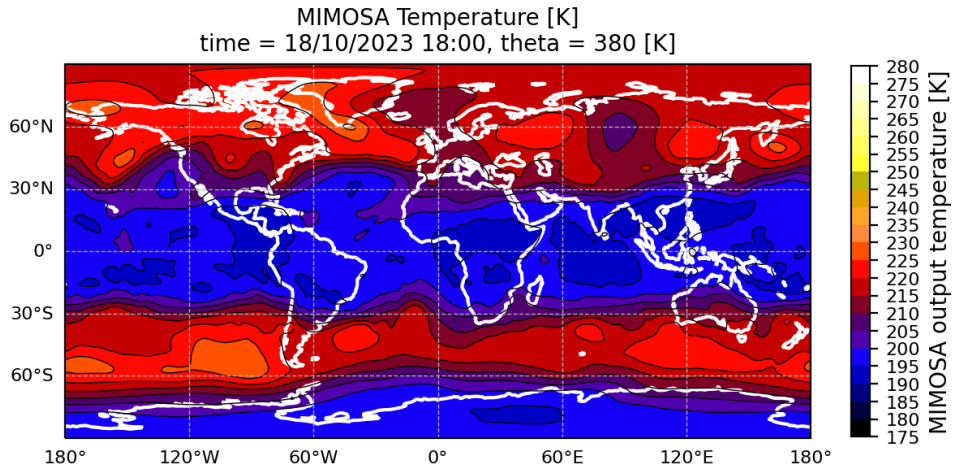


Figure 2 : example of the MIMOSA output temperature visualization

1.3.2 Recovery files

Recovery files are also binary outputs which allow running long simulations and are reused by MIMOSA for quicker computations. The name of these files follows the syntaxe `[phn/phs]YYMMDDHH.THETA`, where the `YYMMDDDHH` and `THETA` parts have the same meaning as in the variable output name syntaxe. These recovery files will be used by the simulation if `initpv=0`, and if the new simulation launched in this same directory starts on the next day from the end of the previous simulation.

1.3.3 Stations files output

The stations outputs correspond to the estimated PV and temperature values extracted above ground sites. These files are written in the ASCII format and are composed of two main parts: the header and the estimated variables (Fig. 3).

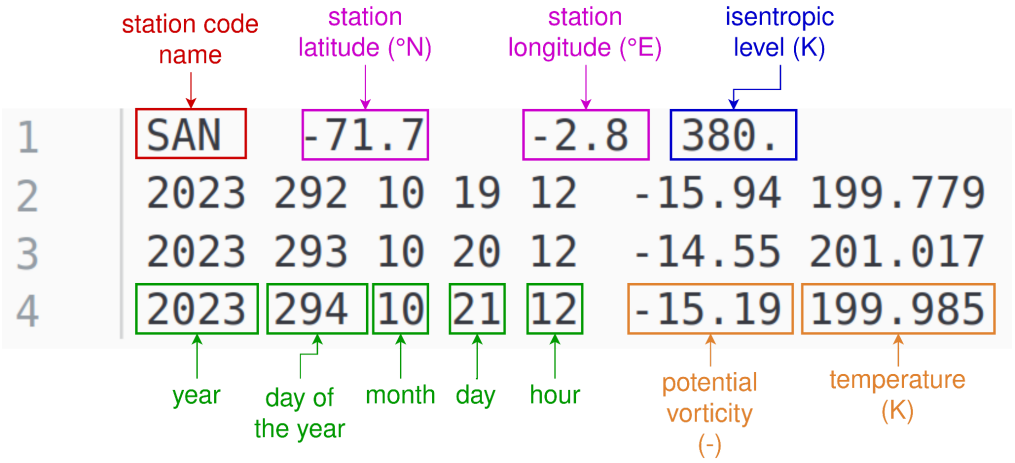


Figure 3 : MIMOSA stations output example

2. MIMOSA simulation for User

2.1 MIMOSA Singularity container

MIMOSA Fortran source code is containerized into a Singularity container, which allows any user to run it without previous libraries installation and Fortran configurations (except the installation of the Singularity application itself).

The file `mimosa-container.def` is a Singularity Definition File, which is a set of blueprints explaining how to build a custom container. It includes specifics about the base OS to build or the base container to start from, software to install, environment variables to set at runtime, files to add from the host system, and container metadata. The command which allows the build of a .sif Singularity image is:

```
sudo singularity build mimosa.sif mimosa-container.def
```

⚠One must have sudo rights on the system where the container is built. Once it is done, the image can be run anywhere and without sudo rights.

2.2 MIMOSA User interface

The user interface for the easier simulation launches is a bash script `mimosa-user-script.sh` which requires a configuration file from the user as input, `mimosa.conf`. The script then takes care of writing an `input.namelist` file for MIMOSA Fortran executable, launching the simulation itself and creating additional output files for users. This bash script must be executed inside of the MIMOSA Singularity container.

The input configuration file is a txt file where principal simulation parameters are defined by the user. After the simulation is done, the script calls a Python `post-process-moimosa.py` script which takes the binary output from Fortran and recreates it in different additional formats for future user's analysis. For each simulation, additional outputs from Python script are :

- PNG plots of the estimated variable on the global/North pole/South pole maps
- one netCDF file for each of the binary outputs
- netCDF files where multiple binary outputs are combined along the `time` dimension

2.2.1 Bash script for the simulation launch

Bash script constitutes a link between user configuration file and the MIMOSA executable in the Singularity container. The script reads the user configuration file, writes a special configuration for the Fortran executable (`input.namelist`), launches

the simulation and calls the post-processing Python script. The only input for this Bash interface is the path to the user configuration file described earlier.

Table 3 : help function of the MIMOSA user Bash script

```
Singularity> ./mimosa-user-script.sh --help
#               .-'';'-.
#              ,'    <_,-.`.           MIMOSA tool for
#            /)    ,--,_>\_\            high-resolution
#           |'    (       \_ |             potential vorticity
#           |_     `-.     / |               advection model
#            \`-.    ;   _(`/
#              `.(     \/ ,'
#                `-.....-'
#
# This script handles the MIMOSA simulation input
# parameters and launches the simulation, as well as
# the post-processing for the output additional
# reformating and results visualization
#
# Usage:  [options] arguments
# Options:
#   -h, --help      Show this help message and exit
# Arguments:
#   --config conf_fielpath  This argument must correspond to the configuration
# file where the user defines input parameters needed for the extraction
```

2.2.2 User configuration file

User configuration file is a txt file `mimosa.conf` where it is possible to set up multiple different variables and parameters of the simulation. The file can be renamed if needed, as its path is given as input to the bash script by the user.

The variables defined in this file correspond to the variables described for the `input.namelist` file.

Table 4 : example content of the mimosa.conf file

```
SIMUDIR="/root/mimosa_simulation_1"
NRUN=3
SYEAR=23
SMONTH=10
SDAY=18
SHOUR=12
EYEAR=23
EMONTH=10
EDAY=21
EHOUR=12
ZONE=3
```

```
INTYPE=1
INITPV=1
THETA=( 380 475 550 675 )
NX=180
NY=91
NP=17
PRES="300.,250.,200.,150.,100.,70.,50.,30.,20.,10.,7.,5.,3.,2.,1."
PASLAT=2
PASLONG=2
LATMIN=-90
LATMAX=90
NDEG=6
NLIS2D=15
NHGRID=6
NWRITE=6
NHMOD=12
NHRELAX=240
NPRHMOD=0
NPRWRITE=0
INDIFEXPL=0
DIFF=4050
NWTEMP=6
WINDOUT=0
TOUT=1
STATIONS=1
```

2.2.3 Python post-processing script

The Python script post-process-mimosa.py allows to recreate the binary simulation results into a more readable format such as netCDF, and create visual representations of the estimated variables. The script creates one netCDF file for each of the simulation outputs, and one netCDF file for each of the variable/isentropic level combinations. In these combined files, the data is merged along the time dimension, while in the individual file the data corresponds to one variable on one isentropic level at a time `t`.

For the simulation launched via the bash script, the post-processing Python script must be located in the same directory as the Bash script; it is launched automatically after the simulation has finished. If needed, the Python code can also be used individually for already existing simulations results (see the usage below).

Table 5 : help function of the Python post-processing script

```
usage: post-process-mimosa.py [-h] [--start-date START_DATE] [--end-date
END_DATE] [--out-dir OUT_DIR] [--im-dir IM_DIR]

Post-processing of the MIMOSA Fortran output files for the creation of netCDF
copies and results visualization

optional arguments:
  -h, --help            Show this help message and exit
   --start-date START_DATE   Start date of the files to process in YYMMDD
format
  --end-date END_DATE      End date of the files to process in YYMMDD format
   --out-dir OUT_DIR          Path to the directory with the Fortran binary
output files
  --im-dir IM_DIR          Path to the directory where to save visualization
```

2.3 MIMOSA simulation launch

The Basn script has to be executed inside the Singularity container where MIMOSA was installed (`mimosa.sif`). There are multiple methods to do so.

2.3.1 Interactive launch

If you want to launch the simulation in the interactive mode and be able to continue to work in the Singularity container, you can follow these steps:

1. launch Singularity container in the shell mode

```
singularity shell path/to/the/container.sif
```

2. launch Bash script with the simulation configuration

```
/my/path/mimosa-user-script.sh --config my/path/to/mimosa.conf
```

If the input data or your working directory are not exactly directories owned by your user, or can't be seen by the container (for example, if you are performing simulations on a server with multiple users and shared folders and volumes), you might need to bind these directories to the container with the `--bind` option. After the `--bind` keyword you can separate by commas a list of absolute paths to the folders that you would like to be seen by the Singularity container :

```
singularity shell \
--bind /root/input_data/, /home/working_folder/simu_x \
path/to/the/container.sif
```

After the bind, you can use same absolute paths to access these folders in the Singularity container. Based on your host system, most of the files and folders owned by your user will be seen, but sometimes special access may be required, and the `--bind` option can help you to link these folders to your container.

2.3.2 Non-interactive launch

It is also possible to launch the script in one go with the singularity exec command :

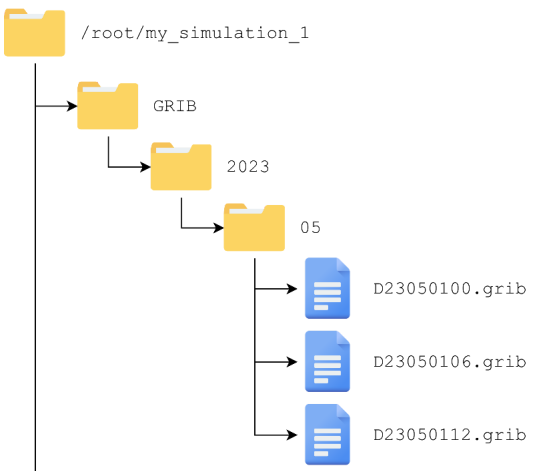
```
singularity exec path/to/the/container.sif \
     /my/path/mimosa-user-script.sh \
     --config my/path/to/mimosa.conf
```

The `--bind` option can be used here in the same manner as in the example above with singularity shell.

All of the methods described above can be wrapped into cron, bash scripts or slurm jobs depending on one's needs and number of simulations.

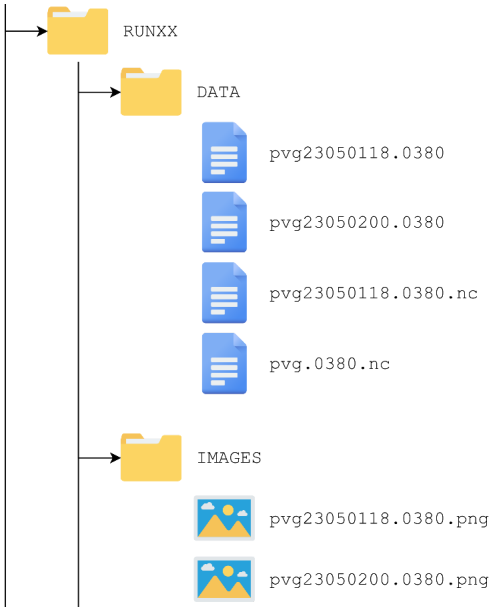
2.4 MIMOSA working directory structure

MIMOSA bash script can be called from any directory, as long as the correct path to the working directory with input files is indicated in the configuration file. The rules and the structure of the working directory are detailed below.

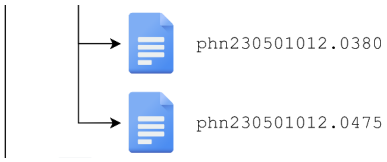


⚠

➔ The working directory must contain a folder named `GRIB` (or `ECMR`, based on the type of your data), where the input ECMWF data is stored. The data must be arranged by corresponding year and month in separate folders with respective names in `YYYY` and `MM` format.



➔ When the simulation is done, the folder `RUNXX` is created in the working directory, containing folders `DATA` and `IMAGES`. `DATA` contains the binary and netCDF output files, while the `IMAGES` contains the PNG plots of the output.



➔ Recovery files needed for the long timeseries simulations will be placed in the `RUNXX` folder. If they will be needed by the next simulation, they must remain in this directory, as the program will search for these files in the `[working_dir_path]/RUNXX` path. Otherwise, they can be deleted or moved into another directory.

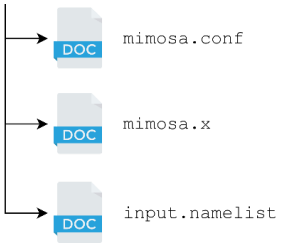


Figure 4 : MIMOSA working directory structure

➔ The executable `mimosa.x` will be copied from the source location to your working directory by the Bash script. The configuration file can be stored in this directory, but it is not mandatory and it won't be copied from its original location to the working path by the Bash script. The `input.namelist` is created by the Bash script.

If it is not possible to run simulations in the directory where the input ECMWF data is placed or to copy the data into the working directory, a potential solution would be to create a symbolic link [1] from the working directory to your data

directory. For example, if your data is stored at `/home/data/ECMWF/2023` and your working directory is `/home/user/mimosa/simulation_1`, you can follow these steps :

1. go to your working directory
2. create a symbolic link → `ln -s /home/data/ECMWF/2023 ./ECMWF`
3. launch simulation as usual

This way, the symbolic link will point to the true directory where the ECMWF data is stored, but from the simulation point of view the data will be seen as stored in the current working directory.

3. ECMWF data extraction for MIMOSA

The input data for the simulations is meteorological data : wind, temperature and logarithm of surface pressure, coming from the ECMWF database. To extract and prepare the data in the correct format, the script `mimosa-extract-grib.sh` or `mimosa-extract-ecmr.sh` should be used. These scripts extract the data either in the GRIB or ASCII (ECMR) format, respectively. The user can configure the start and end date of the data, as well as the spatial resolution, and the data class (only in the GRIB version).

The configuration of two data extractions are as follows:

- GRIB data
  - extracted on ECMWF 137 model levels
  - the timestep is 3 hours if the requested date range is up to J+6; if the end date exceeds the J+6 limit, the timestep is 6 hours
- ECMR data
  - extracted on 17 pressure levels
  - the timestep is 12 hours

The script must be launched on the ECMWF MARS server (ecs, hpc or other). The data extraction was tested with a member-state user account. Other more public accounts might customize the script based on the MARS services or APIs available for their type of user. The data is extracted and stored in the directory requested in the input configuration; afterwards, the data can be used for the simulation.

3.1 GRIB data fields and format

In the case where the input data is in the GRIB format, the data has to be organized in a certain manner: all variables for the same date and time should be packed together in one file. The name of the file must follow the syntax `DYYMMDDHH.grib`, where `YYMMDDHH` correspond to the year (2 digits), month, day and hour of the data packed in the file.

The mandatory meteorological fields are:

- U component of wind (U)[1]
- V component of wind (V)
- temperature (t)
- logarithm of surface pressure (lnsp)

[1] the short name of the field in the parentheses corresponds to the short name of this field in the ECMWF MARS database

The data in the file must be stored in the following order :

1. lnsp
2. t,u,v on the level 1
3. t,u,v on the level 2
4. t,u,v on the level 3
5. etc

An example of the `grib_ls` command on one of the files is presented on Fig. 5 below.

edition	centre	date	dataType	gridType	stepRange	typeOfLevel	level	shortName	packingType
2	ecmf	20230501	an	regular_ll	0	hybrid	1	lnsp	grid_simple
2	ecmf	20230501	an	regular_ll	0	hybrid	1	t	grid_simple
2	ecmf	20230501	an	regular_ll	0	hybrid	1	u	grid_simple
2	ecmf	20230501	an	regular_ll	0	hybrid	1	v	grid_simple
2	ecmf	20230501	an	regular_ll	0	hybrid	2	t	grid_simple
2	ecmf	20230501	an	regular_ll	0	hybrid	2	u	grid_simple
2	ecmf	20230501	an	regular_ll	0	hybrid	2	v	grid_simple
2	ecmf	20230501	an	regular_ll	0	hybrid	3	t	grid_simple
2	ecmf	20230501	an	regular_ll	0	hybrid	3	u	grid_simple
2	ecmf	20230501	an	regular_ll	0	hybrid	3	v	grid_simple
2	ecmf	20230501	an	regular_ll	0	hybrid	4	t	grid_simple
2	ecmf	20230501	an	regular_ll	0	hybrid	4	u	grid_simple
2	ecmf	20230501	an	regular_ll	0	hybrid	4	v	grid_simple

Figure 5 : example of grib_ls command output for the MIMOSA meteorological input grib file

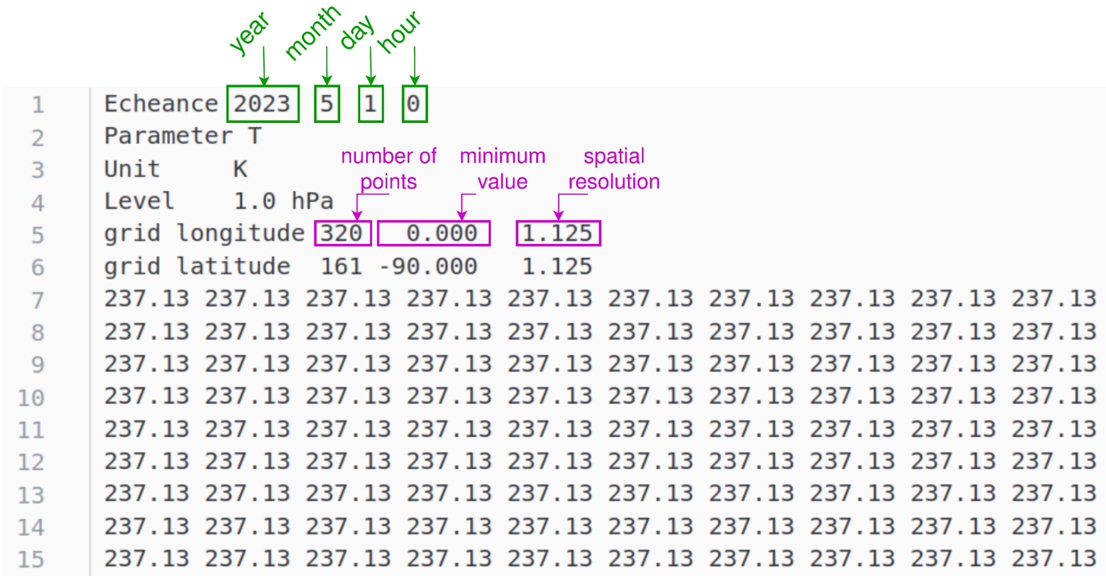
The script `mimosa-extract-grib.sh` allows to extract the data, sort it in the correct order and rename files with correct names for the Fortran executable. Based on the start and end date, the data will be extracted from the analysis and/or forecast database. The timestep is 3 hours if the requested date range is up to J+6; if the end date exceeds the J+6 limit, the timestep is 6 hours.

3.2 ECMR data fields and format

The script `mimosa-extract-ecmr.sh` allows to extract the data from ECMWF server and format it in the ASCII format with `.ECMR` extension. The variables in this case are only temperature and U/V wind fields, without the logarithm of surface pressure.

The data is extracted on the 17 pressure levels: 1,2,3,5,7,10,20,30,50,70,100,150,200,250,300,400,500 hPa. Based on the start and end date, the data will be extracted from the analysis and/or forecast database. The timestep is 12 hours.

The data in ASCII files is organized in matrixes of 10 columns, so that the (number of rows x 10) = total number of data points. An example of such a matrix is presented on the Fig. 6; matrices for other variables and levels for this date are saved further in the file one after another.



```
Echeance 2023 5 1 0
Parameter T
Unit     K
Level    1.0 hPa
grid longitude 320  0.000  1.125
grid latitude  161 -90.000  1.125
237.13 237.13 237.13 237.13 237.13 237.13 237.13 237.13 237.13 237.13
237.13 237.13 237.13 237.13 237.13 237.13 237.13 237.13 237.13 237.13
237.13 237.13 237.13 237.13 237.13 237.13 237.13 237.13 237.13 237.13
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237.13 237.13 237.13 237.13 237.13 237.13 237.13 237.13 237.13 237.13
```


Figure 6 : example of the ASCII content of the MIMOSA input ECMWF data

As in the case of the GRIB data, the Bash script allows the user to extract the data, store it in the correct order and format and rename files according to the rules.

3.3 Data extraction input parameters

The script takes as input a configuration txt file. This configuration file contains all the parameters that the user can change and configure:

```
START_DATE="20230101"
END_DATE="20230105"
DATA_CLASS="od"
SPATIAL_RESOLUTION="1.125"
DATA_DIR=$(pwd)
WORKING_DIR=$(pwd)
```

Input parameters for the GRIB extraction

```
START_DATE="20231018"
END_DATE="20231022"
SPATIAL_RESOLUTION="1.125"
DATA_DIR=$(pwd)
WORKING_DIR=$(pwd)
```

Input parameters for the ECMR extraction

The `DATA_DIR` and `WORKING_DIR` variables correspond respectively to the directory where the extracted data will be stored and where the working files (like request files) will be stored. These two variables can point to the same or different directories. If these directories do not exist, they will be created by the script.

2.4 Data extraction launch

To extract the data, you should follow next steps:

1. log in to the ECMWF MARS server
2. set up parameters in your configuration file [.conf]
3. do

```
path/to/the/mimosa-extract-[grib/ecmr].sh \
    --config path/to/the/conf_file.conf
```

The script will launch the extraction based on your set up parameters. It is advised to launch this script as a SLURM job on the MARS server, otherwise the shell will be inaccessible and the script might take longer to perform. To launch this script as a job, you can use the following syntax :

```
sbatch --wrap="path/to/the/mimosa-extract-[grib/ecmr].sh --config \
                    path/to/the/conf_file.conf"
```

This command will launch a SLURM job with your configuration file and create a .out log file in the directory from where the command was called. You can consult the SLURM documentation [2] to see how you can customize this call and add features like job name or mail user for notifications.

References

[1] Linux man page of the ln command
https://www.mankier.com/1/ln

[2] SLURM sbatch command input options
https://slurm.schedmd.com/sbatch.html

[3] ECMWF MARS server filesystems
https://confluence.ecmwf.int/display/UDOC/HPC2020%3A+Filesystems

[4] MARS catalogue
https://apps.ecmwf.int/mars-catalogue/

Annexes

Annexe 1 : input.namelist syntax

```
!========================================================================!
!                 __  __ _____ __  __  ____   _____                      !
!                |  \/  |_   _|  \/  |/ __ \ / ____|  /\                  !
!                | \  / | | | | \  / | |  | | (___   /  \                 !
!                | |\/| | | | | |\/| | |  | |\___ \ / /\ \                !
!                | |  | |_| |_| |  | | |__| |____) / ____ \               !
!                |_|  |_|_____|_|  |_|\____/|_____/_/    \_\              !
!========================================================================!
!
! CARACTERISCS OF THE RUN
!
&run
!-----
! ZONE defines the geographical area :
!   → 1 for the Northern Hemisphere [-10N, 90N]
!   → 2 for the Southern hemisphere [-90N, 10N]
!   → 3 for the both Hemisphere   [-90N, 90N]
zone = 3
!-----
! INTYPE defines the type of input files :
!   → 1 for ASCII isobaric files (*.ECMR)
!   → 2 for GRIB encoded model levels files (*.grib)
intype  = 2
!-----
! IAND, MOISD, JOURD, IHEURED define the starting date of the simulation
!  → Year  (YY)
iand    = 23
!  → Month (MM)
moisd   = 05
!  → Day   (DD)
jourd   = 01
!  → Hour  (HH)
iheured = 12
!-----
! IANF, MOISF, JOURF, IHEUREF define the final date of the simulation
!  → Year  (YY)
ianf    = 23
!  → Month (MM)
moisf   = 05
!  → Day   (DD)
jourf   = 02
!  → Hour  (HH)
iheuref = 12
!-----
! INITPV defines if the simulation is new or a restart
```


.

```
!  → 1 if initialization is need
!  → 0 if a ph* file from a previous run should be read
initpv  = 1
!-----
! TETA defines the isentropic surface (K)
!   → shouldn't be greater than 950K for isobaric input files (intype = 1)
teta    = 625
/
!
! CARACTERISCS OF ECMWF GRID
!
&grid
!-----
! NX, NY and NP define the number of points of the ECMWF grid
!   → Number of grid points along longitudes
nx = 320
!   → Number of grid points along latitudes
ny = 161
!   → Number of pressure levels (intype = 1) or number or model levels (inType = 2)
np = 137
!-----
! PRES allows to define the pressure levels of isobaric file (intype = 1)
!   → this variable is not needed for GRIB files (intype = 2)
!   → If there is more than 50 levels, declaration of pres variable in mimosa.f95
pres(1) =
1000.,975.,950.,925.,900.,875.,850.,825.,800.,775.,750.,700.,650.,600.,550.,500.,450.,400.,350.,300.,250.,225.,2
00.,175.,150.,125.,100.,70.,50.,30.,20.,10.,7.,5.,3.,2.,1.
!-----
! PASLAT and PASLONG define the horizontal resolution of the ECMWF grid
!   → resolution along latitude
paslat = 1.125
!   → resolution along longitude
paslong = 1.125
!-----
! LATMINECMR and LATMAXECMR define the minumum and maximum latitude of ECMWF grid
!   → minimum latitude
latminecmr = -90
!   → maximum latitude
latmaxecmr = 90
/
!
! CONFIGURATION OF THE SIMULATION
!
&config
!-----
!  NDEG defines the number of MIMOSA grid points per degree of latitude and longitude
!       → value should be 3 or 6
ndeg   = 6
!-----
!  NLIS2D defines the number of points use for the smooth
nlis2d = 15
!-----
! NHGRID defines the number of hours between two call to regrid
nhgrid = 6
!-----
! NWRITE defines the number of hour between two outputs of PV files
```


.

```
nwrite = 6
!-----
! NHMOD defines the number of hours between two ECMWF files
nhmod = 6
!-----
! NHRELAX defines the number of hours of relaxation time
nhrelax = 240
!-----
! NPRHMOD defines the hour of the first ECMWF file
nprhmod = 0
!-----
! NPRWRITE defines the first hour of PVF file
nprwrite = 0
!-----
! Explicit diffusion
! INDIFEXPL defines if explicit diffusion is activated
!   → 0 no explicit diffusion
!   → 1 explicit diffusion
indifexpl = 0
! DIFF defines the value of the explicit diffusion if it is activated
diff = 4050
/
!
! OUTPUT OF THE SIMULATION
!
&output
!-----
! NRUN defines the name of the directory where MIMOSA outputs will be saved
!   → if nrun =  5, files will be saved in RUN05 directory
!   → if nrun = 16, files will be saved in RUN16 directory
nrun = 1
!-----
! NWTEMP defines the time between two output of temperature or wind
nwtemp = 6
!-----
! WIND_OUT defines if wind horizontal components files will be saved
!   → 0 no output of wind files
!   → 1 output of wind files
wind_out = 0
!-----
! T_OUT defines if temperature files will be saved
!   → 0 no output of temperature files
!   → 1 output of temperature files
t_out = 1
!-----
! STATIONS_OUT defines if PV and temperature and PV profiles at stations files will be saved
!   → 0 no output of stations files
!   → 1 output of stations files
stations_out = 0
/
```


.