Installing and using CHyM

Workshop smr 3939
Luiza Vargas-Heinz

Download presentation on :
http://clima-dods.ictp.it/Workshops/Hydroclimate_2024/CHyM/

Any questions ca be addressed to
lvargas@ictp.it

Which version to use?

CHyM – TP

Uses temperature and precipitation to calculate the discharge
Can do preprocessing
Has more parameters on namelist

CHyM – roff

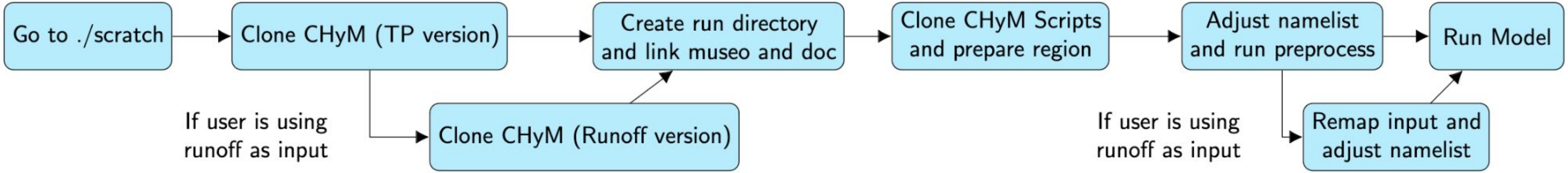
Directly routes the runoff from climate outputs
Quicker but needs preprocessing with TP version and remapping

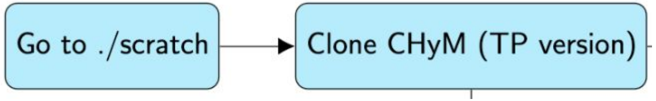
Also an option: directly do post processing on already existing data.
Path for the files:
/home/esp-shared-a/Distribution/Workshops/Hydroclimate_2024/CHyM/simulation_outputs

Discharge outputs available for CHyM Roff simulations ran with climate model input from:

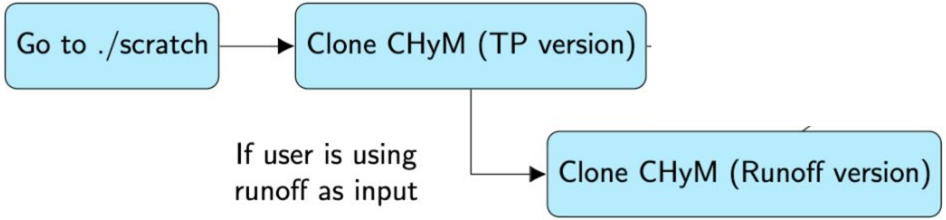
- CMIP5
- CORDEX

With historical and scenario runs (rcp26 and rcp85)

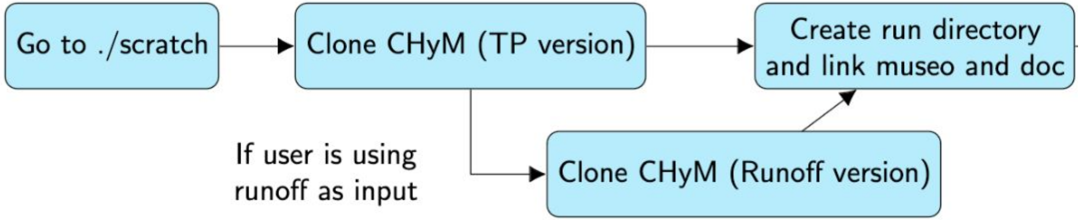

Go to ./scratch
Clone CHyM (TP version)
Create run directory and link museo and doc
Clone CHyM Scripts and prepare region
Adjust namelist and run preprocess
Run Model
If user is using runoff as input
Clone CHyM (Runoff version)
If user is using runoff as input
Remap input and adjust namelist




```
cd /scratch

git clone https://github.com/graziano-giuliani/CHyM

cd CHyM

autoreconf -f -i

./configure

make

make install
```

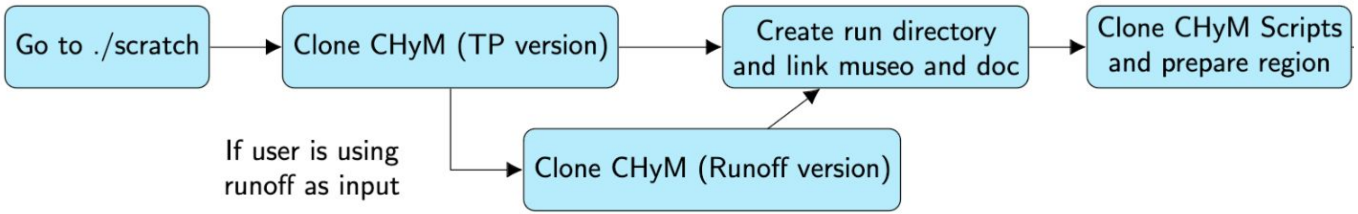



```
cd  /scratch

git clone https://github.com/graziano-giuliani/CHyM-roff

cd  CHyM-roff

autoreconf  -f  -i

./configure

make

make  install
```




```
cd  /scratch

mkdir  run

cd  run

ln  -s  /home/esp-shared-a/Distribution/Workshops/Hydroclimate_2024/CHyM/CHyM_Data/museo  .

ln  -s  /scratch/CHyM/doc  .
```

Attention!
The dot is important here!

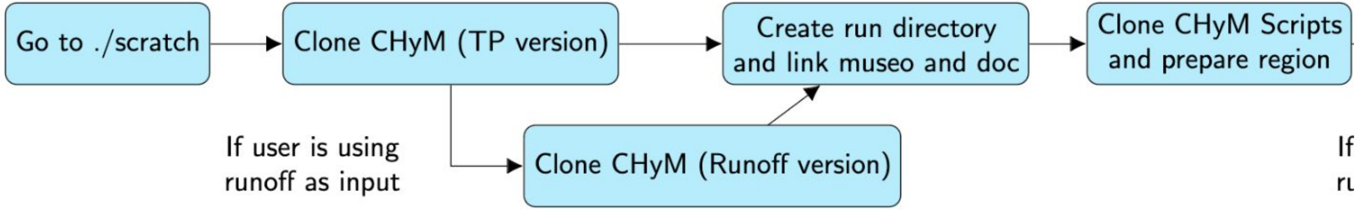


git clone https://github.com/graziano-giuliani/ChymScripts

- Decide region to run (corner coordinates)
- Decide resolution of input DEM (3s or 15s)

```
ln  -s  /home/esp-shared-a/Distribution/Workshops/Hydroclimate_2024/CHyM/hydrosheds  .
ln  -s  /home/esp-shared-a/Distribution/Workshops/Hydroclimate_2024/CHyM/GLCC  .
```

Attention!
The dot is important here!



gdal_translate -ot Float32 -of netCDF -r mode -projwin **-5.79 55.89 46.29 28.23** -tr 0.06 0.06 **hydrosheds/3sdata/eu_dem_3s.tif** dem_mode.nc

ncrename -v Band1,dem dem_mode.nc

ncatted -a _FillValue,dem,d,, dem_mode.nc

ncap2 -s 'where(dem > 32766) dem=-1.0' dem_mode.nc

cp dem_mode.nc mydem.nc

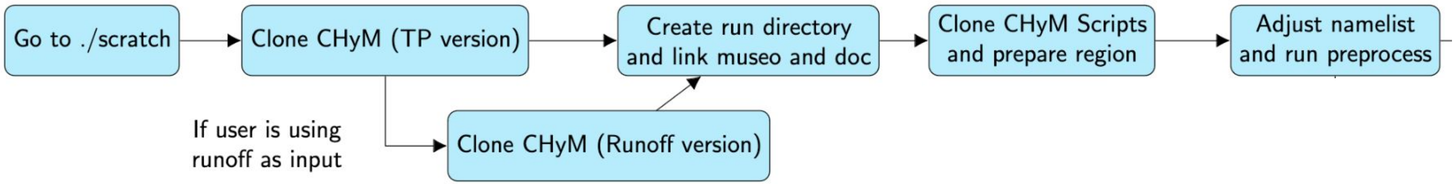
gdal_translate -ot Float32 -of netCDF -r mode -projwin **-5.79 55.89 46.29 28.23** -tr 0.06 0.06 **GLCC/gbogegeo20.tif** luc_mode.nc

ncrename -v Band1,luc luc_mode.nc

cp luc_mode.nc mylnd.nc

Hydrosheds and GLCC available in /home/esp-shared-a/Distribution/Workshops/Hydroclimate_2024/CHyM

Change information in bold



Namelist available in : CHyM/doc/namelist.in

Copy it to your directory !

cp /scratch/CHyM/doc/namelist.in .

&chymconfig

nlon = 330, !—>Number of longitudes points (Integer)

nlat = 280, !—>Number of latitudes points (Integer)

slon = 6.50 , !—>First value of longitude for the selected domain (Real) → **TOP LEFT CORNER**

slat = 44.10 , !—>First value of latitude for the selected domain (Real)

dij = 0.009 , !—>Spatial resolution in degree (Real)

chym_radius = 30., !—>Radius of inluence (km) to be used for CA based interpolation of sparse precipitation data

nsave = 1, !—>Every how many hourly time steps Dynamical fields are saved in the output file

demf = 20, !—>DEM source: 1 means Italy DEM

!—> 2 means world DEM (1 Km of resolution)

!—> 3 means both (Italy DEM and world DEM 1 km)

!—> 4 means NASA World DEM (90 meters of resolution)

!—> 7 means ASTER World DEM (30 meters of resolution) NB: Not available in MUSEO for all the Globe

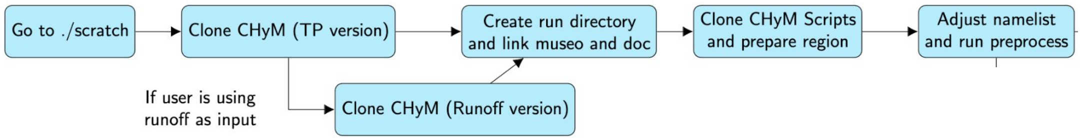
!—> 9 means Hydrosheeds World DEM (90 meters of resolution) NB: Not available in MUSEO for all the Globe

!—> 10 means Hydrosheeds World DEM and DIR map (1 Km of resolution)

chym_sdate = 2008100100, !—>Start date of this run in the format YYYYMMDDHH (Integer)

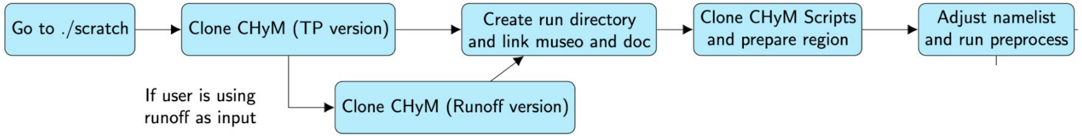
chym_edate = 2008111101, !—>End date of this run in the format YYYYMMDDHH (Integer)

chym_steps = 50, !—>Specifies the number of time integration steps per hour to be used for the solution of the prognostic continuity equation



Change information in bold

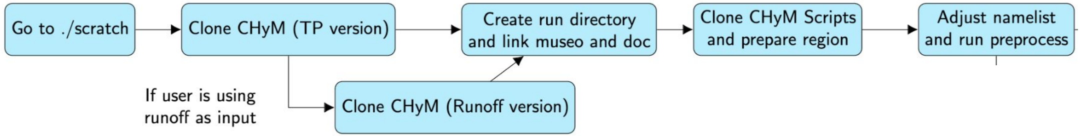
chym_tempfl = 1, !—> 1 means monthly average temperature from global ERA data are sed
!—> 2 Daily average temperatures as simulated by MM5 meteorological model are used, the data set only covers the Italy and the surrounding zone.
!—> 3 Hourly average temperatures as simulated by MM5 meteorological model are used, the data set only covers the Italy and the surrounding zone.
!—> 4 means temperatures are read from RegCM output
!—> 5 Temperature fields are rebuilt from MuSEO sparse data base at hourly time step.
!—> 6 Temperature fields are rebuilt from ERAinterim at 3 hourlytime step.
!—> 7 Temperature fields are rebuilt from ERA5 at hourly time step.
!—> 10 Temperature fields are rebuilt from data stations (it needs to be implemented yet)
chym_restart = 0, !—> 0 means that CHyM have to start a new simulation
!—> 1 means that CHyM have to continue a previous run (chym_rfile as to be defined accordingly)
chym_modis = 0, !—> 0 means no snow cover mask is builded
!—> 1 If this flag is set to 1 the MODIS MuSEO database is used to build the snow cover mask, data are available since 2012
!—> 21 If this flag is set to 21 the ACQWA modis database is used to build the snow cover mask,
! in this case the same flag is changed to the the value -21 by the routine acqwamodis if
! the data are not available (before January 23, 2000 and after December 31, 2009).
chym_ofile = 'output/Po_test' , !—> A string specifying the file where CHyM model will store the results of simulation
chym_sfile = 'output/Po_test.static_fields.nc', !—> A string specifying the file where CHyM model will read the static fields builded in the preproc



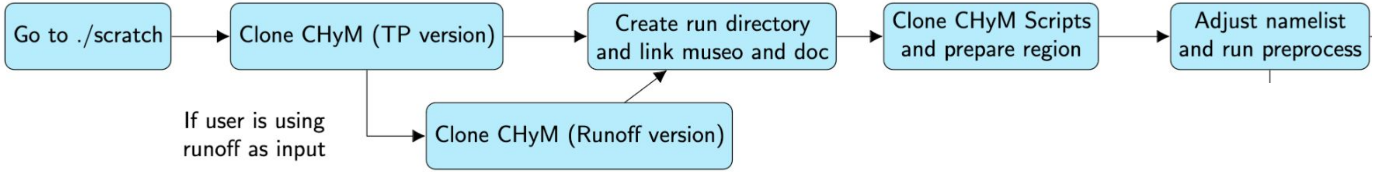
Change information in bold

chym_rfile = 'output/Po_test_2002010100_rst.nc', !—> A string specifying the file where CHyM model will read the restart fields if chym_restart = 1
chym_manning = 'doc/manning.coeff', !—> A string specifying the file where CHyM model will read the manning coefficients
chym_dsource = 'era5', !—> This parameter allows to specify the source(s) to be used to rebuild the precipitation field on
!—> the CHyM grid; it must contains a comma separeted list of any combination of the following words:
!—> "persiann" - Persiann 0.25 deg database must be used
!—> "trmm" - TRIMM database must be used
!—> "ein75" - ERA interim 0.75 deg resolution database must be used
!—> "era5" - ERA5 0.25 deg resolution database must be used
!—> "regcm" - RegCM output file must be used
!—> "txt" - Reaingauges from txt file must be used (see example file inside doc directory)
chym_ifile1 = 'standard', !—> A string specifying the RegCM output file that CHyM will use to retrieve the precipitation fields
chym_ifile2 = '/home/esp-shared-a/Distribution/Workshops/Hydroclimate_2024/CHyM/ERA5/hourly/',

ERA5 data is available as input data (temperature, precipitation and runoff): /home/esp-shared-a/Distribution/Workshops/Hydroclimate_2024/CHyM

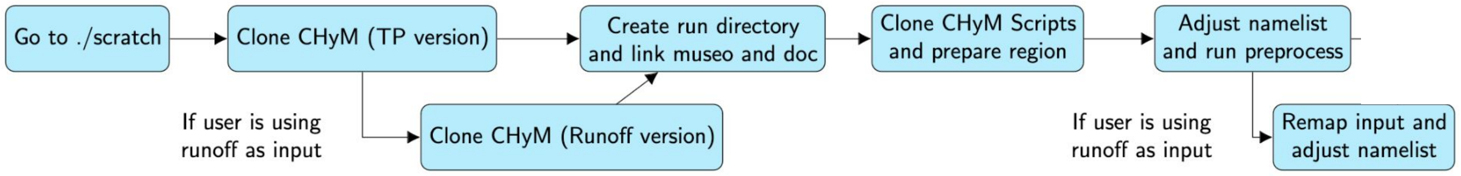


Change information in bold



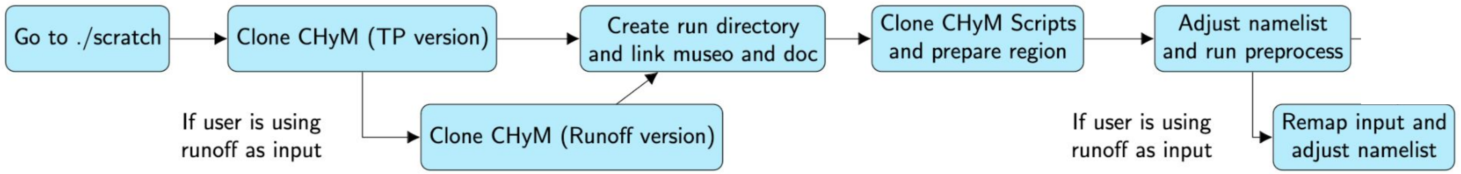
mpirun -np 1 /scratch/CHyM/preproc/preproc namelist.in

ERA5 data is available as input data (temperature, precipitation and runoff): /home/esp-shared-a/Distribution/Workshops/Hydroclimate_2024/CHyM




```
cdo  griddes static_field.nc  >  grid.txt

# Change the grid.txt file if needed to have only one grid

cdo  remapbil,grid.txt  input.nc  input_regridded.nc
```

ERA5 data is available as input data (temperature, precipitation and runoff): /home/esp-shared-a/Distribution/Workshops/Hydroclimate_2024/CHyM



Namelist available in : CHyM-roff/chymini.inp

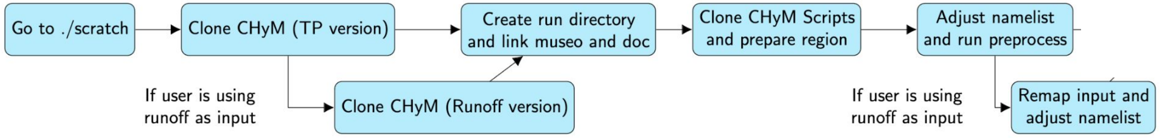
Copy to your run directory!

cp /scratch/CHyM-roff/chymini.inp .

Namelist for CHyM coupled model

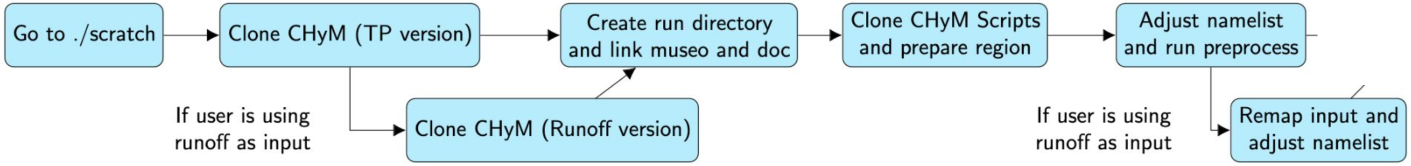
Change information in bold

NLON:
6313
NLAT:
5304
CONVFAC: Unit conversion factor for runoff. Expected kg/m^2/s (mm/s). ERA5 is 1.0/3.6
1.0
ISREAD: Read initialization file (0 = start from rest, 1 = read model initialization file)
0
ISWRIT: time step for writing a restart file (0 = No)
360
NDSTEP : Time step of the model (hours)
24
NSTEP : Number of time steps (days) the model should run 4749
1800
NDTST : Number of model steps per NDSTEP
300
NINIRUN : Start timestep of input runoff data. Put 0 to start from first timestep
0
TSDATE : Start date of this run in the format YYYYMMDDHH (Integer)
1976010101
TEDATE : End date of this run in the format YYYYMMDDHH (Integer)
2070010101

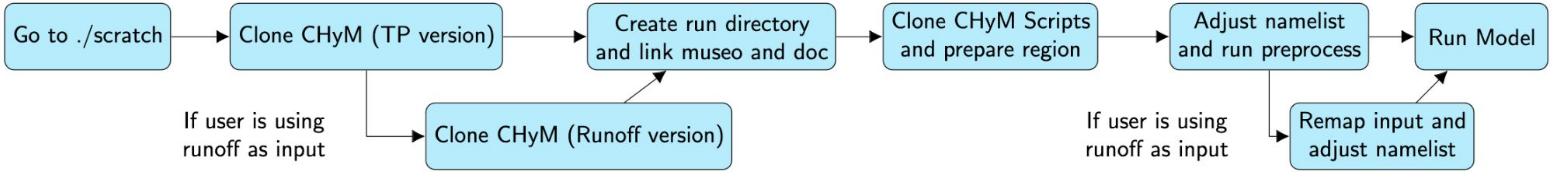


TDNCAL: calendario
Gregorian
TDNSIM: Simulation name (used for output file name and restart file name)
CLMcom-CCLM4-8-17/sim_name
TDNINP: File name of input runoff data
input/mrro
TDNINI: File name of CHyM model initialization file
output/chym_rst_20210101.nc
TDNOUT: File name of CHyM model output file
CLMcom-CCLM4-8-17/chym_dis_1971_old_2000.nc
TDNQMAX: File name of CHyM model qmax file
CLMcom-CCLM4-8-17/qmax_1971.nc
TDNRES: File name of CHyM model restart file
CLMcom-CCLM4-8-17/chym_res_1971_old_2000.nc
TDNSTK: File name of CHyM input static fields file
filestatic_old.nc
The End

ERA5 data is available as input data (temperature, precipitation and runoff): /home/esp-shared-a/Distribution/Workshops/Hydroclimate_2024/CHyM



Change information in bold



Temperature and precipitation :

mpirun -np 1 /scratch/CHyM/main/chym namelist.in

Runoff :

mpirun -np 1 /scratch/CHyM-roff/main chymini.inp

Analysing the outputs

Some post processing commands

The CHyM output will give you data separated by monthly values, so you should merge them before doing any analysis. Run the following command to do so, putting your correct file names.

cdo mergetime [your_files_here.nc] merged.nc

For quick visualization of your data you can run ncview

ncview file.nc

Some post processing commands

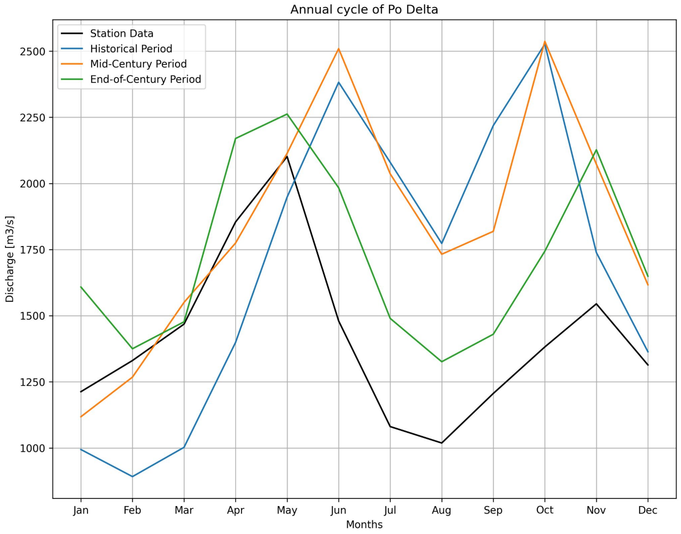
In order to calculate the annual cycle of your data, you can run this command.

cdo ymonmean merged.nc annual.nc

This will give you the monthly average for all grid points. If you want to see the values for a single point, you can use the following command (valid for the grid point 7.35E 44.5N).

ncks -v por -d lon,7.35 -d lat,44.5 annual.nc point1.nc

This will allow you to produce graphs like:



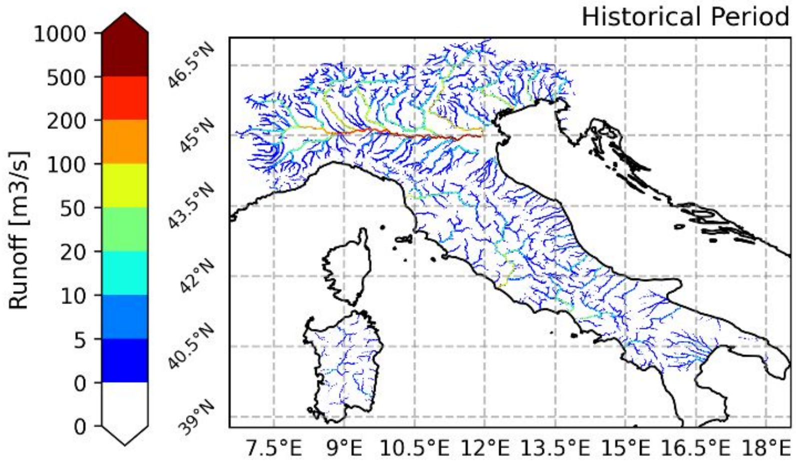
Some post processing commands

In order to calculate the mean of all your discharge data, you can run the following command:

cdo timmean merged.nc mean.nc

An example python script for plotting can be found in the workshop folder and will allow to make a plot similar to this:

http://clima-dods.ictp.it/Workshops/Hydroclimate_2024/CHyM/plot.py



Some post processing commands

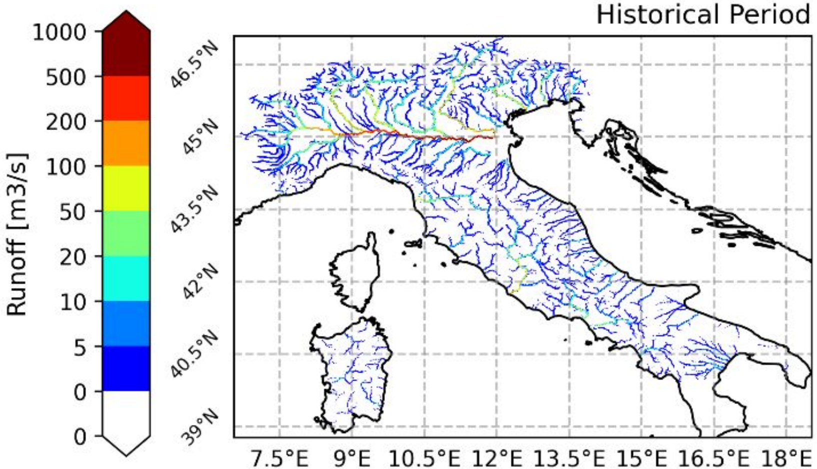
Similarly, you can calculate the seasonal mean of your data like this:

cdo yseasmean merged.nc seas.nc

And then split it by season like this:

cdo splitseas seas.nc seas_

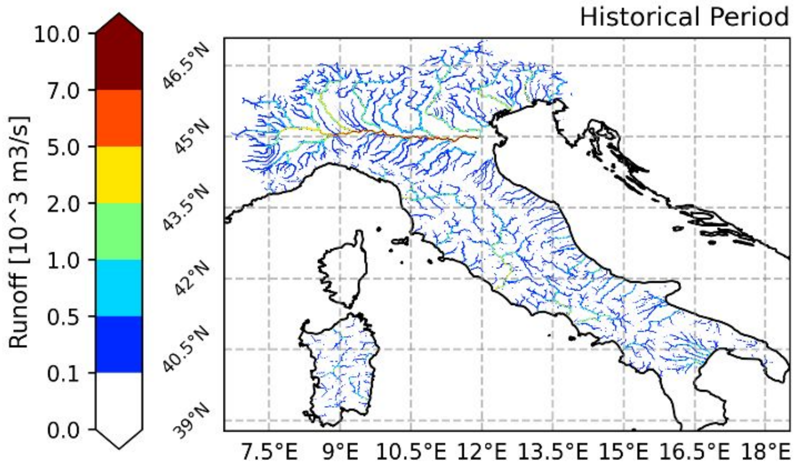
The same python script can be used for plotting:



Some post processing commands

In order to have a look at the high discharge values of your data, you can calculate the maximum discharge value for every year and then calculate the average of those values.

cdo yearmax merged.nc yearmax.nc
cdo timmean yearmax.nc yearmax_mean.nc



Some post processing commands

```
# This will merge your files for easier data handling
cdo   mergetime   [ your_files_here.nc ]   merged.nc

#This will calculate the annual cycle of your discharge data
cdo   ymonmean   merged.nc   annual.nc

#This will give the mean discharge of your data
cdo   timmean   merged.nc   mean.nc

#This will give the seasonal mean of your discharge data
cdo   yseasmean   merged.nc   seas.nc

#This will give the high discharge events of your data
cdo   yearmax   merged.nc   yearmax.nc
cdo   timmean   yearmax.nc   yearmax_mean.nc

#To visualize the data
ncview    file.nc
```

Extra post processing

One way to compute the high discharge value is with Q_{RP}, where RP represents the return period of the flow, i.e. estimated average time between events of that magnitude. For example, Q_{100} refers to a flow with 100 years return period, which is expected to occur around once every 100 years.

For this, first you calculate the yearly maximum discharge for your dataset (**yearmax.nc**) and then you fit those values with an extreme value distribution. The value for your chosen return period is then extracted from that distribution. A python code to compute using a Gumbel distribution this was provided at:

http://clima-dods.ictp.it/Workshops/Hydroclimate_2024/CHyM/QRP.py