
v1.1 Documentation

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CHAPTER 1

Introduction

mizuRoute is a river routing model framework that can host various river routing methods that transport runoff output from a hydrologic model along the river network. This document describes mizuRoute setting and input data. The routing schemes used in mizuRoute is described in [GMD paper](#).

mizuRoute expects 2 or 3 input data depending on how runoff data is provided. If runoff data is provided at each river network HRU (RN_HRU), river network data and runoff data are expected. Otherwise, mizuRoute needs to remap runoff at hydrologic model HRU (HM_HRU) to river network HRU with areal weight averaging. In this case, one additional data, remapping data, is required. All the data need to be stored in netCDF.

Basic netCDF requirement (variable, dimension, etc) are discussed below. Dimension and variable names list mizuRoute default name but can be whatever. If they are not default name, the variable names need to be specified in *control file*. Some of variables and dimensions (even if they are the same as default name) have to be specified in *control file*.

2.1 River network data

River network netCDF holds river reach-reach topology, reach-hru topology, and river and hru physical parameters. The tables below list minimum requirement. Full list of reach/hru physical parameters possibly included are *full list of river and hru physical parameters*.

It is recommended that river network topology is built within mizuRoute instead of computing outside, while physically parameters are ideally provided per reach and hru.

Dimensions required

| Dimension | Description |
|-----------|---|
| seg | river reach |
| hru | river network catchment or hru (hydrologic response unit) |

Minimum variables required

| Variable | Dimension | Unit | Type | Description |
|-----------|-----------|------|------|---|
| segId | seg | – | int | unique id of each stream segment |
| HRUId | hru | – | int | unique hru ID |
| downSegId | seg | – | int | id of the downstream segment |
| hruSegId | hru | – | int | id of the stream segment the HRU flows into |
| area | hru | m2 | real | hru area |
| slope | seg | – | real | slope of segment |
| length | seg | m | real | length of segment |

Negative or zero (≤ 0) value for downSegId is reserved for no downstream reach, meaning that such reach or hru does not flow into any reach. (i.e., basin outlet). For this reason, segID is required to use positive integer value (> 0).

2.2 Runoff data

Runoff (total runoff) data can be provided as 1) 2D [time, RN_hru], 2) 2D [time, HM_hru] or 3) 3D [time, i, j].

- Option 1. runoff is given at each river network HRU
- Option 2. runoff is given at each hydrologic model HRU (non-grid)
- Option 3. runoff is given at grid

Dimensions

| Option | Dimension | Description |
|--------|-----------|---|
| 1,2,3 | time | time dimension |
| 1 | RN_HRU | river network catchment or HRU dimension |
| 2 | HM_HRU | hydrologic model catchment or HRU dimension |
| 3 | i | x direction dimension |
| | j | y direction dimension |

Variables

| Op- tion | Variable | Dimension | Unit | Type | Description |
|-------------|----------|-----------------|---|------|-------------------------|
| 1,2,3 | time | time | [time-unit] since yyy-mm-dd 00:00:00 | real | time |
| 1 | RN_hruID | RN_hru | – | int | river network HRU ID |
| 2 | HM_hruID | HM_hru | – | int | hydrologic model HRU ID |
| 1 | runoff | time, RN_hru | [length-unit]/[time-unit] | real | total runoff |
| 2 | | time, HM_hru | | | |
| 3 | | time, i, j | | | |

Attributes: Time variable need at least 2 attributes- *units* and *calendar*. Four types of calendar can be handled. These are noleap, standard, gregorian, and proleptic_gregorian. Time unit format is shown in the table.

2.3 Runoff mapping data

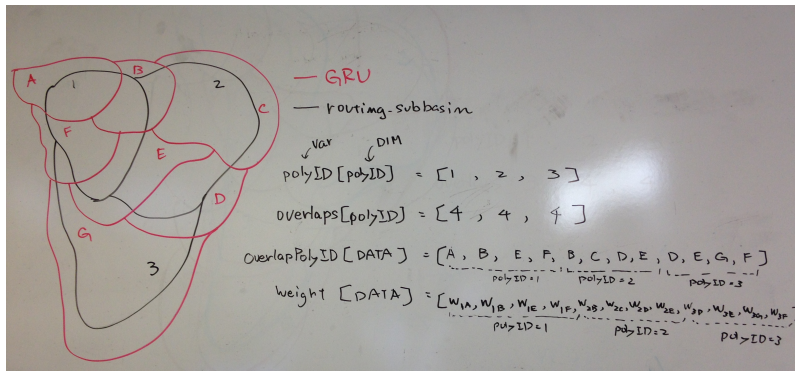
For runoff input options 2 and 3, runoff mapping data, also in netCDF format, is necessary to compute runoff value for each river network HRU

| Option | Dimension | Description |
|--------|-----------|--|
| 2,3 | hru | River network HRU |
| 2,3 | data | Vectorized overlapping HRU (or grid boxes) |

Required runoff mapping netCDF variables

| Option | Variable | Dimension | Unit | type | Descriptions |
|--------|-----------|-----------|------|------|---|
| 2,3 | RN_hruId | hru | — | int | River network HRU ID |
| 2,3 | nOverlaps | hru | — | int | number of overlapping HM_HRUs for each RN_HRU |
| 2,3 | weight | data | — | real | areal weight of overlapping HM_HRUs |
| 2 | HM_hruId | data | — | int | ID of overlapping HM_HRUs |
| 3 | i_index | data | — | int | i(x) direction index overlapping grid boxes |
| | j_index | data | — | int | j(y) direction index overlapping grid boxes |

Hope this picture helps you understand mapping netCDF variables.



CHAPTER 3

Control file

Control file is a simple text file, defining various model controls such as simulation time, file names and locations, routing options etc. Variables in control file are read in the beginning of the code (see `./build/src/read_control.f90`) and saved in fortran variable specified by tag (inside `<>` in table) and as public variables (see `./build/src/public_var.f90`). Some of control variables have their default values, but most of them are not defined. Those undefined variables need to be defined in control file. Other variables in supplement table have their default values but can be also included in control file to overwrite the values. The order of variables in the control file does not matter. However, grouping variables into similar themes is recommended for readability.

Minimum required variables depends on runoff input options.

Example of control file is given in `./route/settings/SAMPLE.control` or see Examples at bottom of this page.

Some of rules

- Exclamation mark is for comment and after exclamation mark is ignored for reading.
- Format: `<tag> variable ! comments`
- tag is Fortran variable name and cannot be changed and have to be enclosed by `<>`
- need `!` after variable, otherwise getting error.
- Do not leave any lines empty in control file

The following variables (not pre-defined in the code) need to be defined in control file.

| option | tag | Description |
|--------|---------------------------------|---|
| 1,2,3 | <code><case_name></code> | simulation case name. This used for output netCDF, and restart netCDF name |
| 1,2,3 | <code><ancil_dir></code> | Directory that contains ancillary data (river network, remapping, and parameter namelist) |
| 1,2,3 | <code><input_dir></code> | Directory that contains runoff data |
| 1,2,3 | <code><output_dir></code> | Directory that contains runoff data |
| 1,2,3 | <code><param_nml></code> | Spatially constant parameter namelist (should be stored in <code><ancil_dir></code>) |
| 1,2,3 | <code><sim_start></code> | time of simulation start. format: yyyy-mm-dd or yyyy-mm-dd hh:mm:ss |
| 1,2,3 | <code><sim_end></code> | time of simulation end. format: yyyy-mm-dd or yyyy-mm-dd hh:mm:ss |

Continued on

Table 1 – continued from previous page

| option | tag | Description |
|--------|------------------------|---|
| 1,2,3 | <fname_ntopOld> | name of input netCDF for River Network |
| 1,2,3 | <lname_sseg> | dimension name for reach in river network netCDF |
| 1,2,3 | <lname_nhru> | dimension name for RN_HRU in river network netCDF |
| 1,2,3 | <fname_qsim> | netCDF name for HM_HRU runoff |
| 1,2,3 | <lname_qsim> | variable name for HM_HRU runoff |
| 1,2,3 | <lname_time> | variable name for time |
| 2 | <lname_hruid> | variable name for HM_HRU ID |
| 3 | <lname_xlon> | dimension name for x, lon, or i dimension |
| 3 | <lname_ylat> | dimension name for y, lat, or j dimension |
| 1,2,3 | <lname_time> | dimension name for time |
| 1,2,3 | <lname_hruid> | dimension name for HM_HRU |
| 1,2,3 | <units_qsim> | units of input runoff. e.g., mm/s |
| 1,2,3 | <dt_qsim> | time interval of simulation time step in second. e.g., 86400 sec for daily step |
| 1,2,3 | <is_remap> | Logical to indicate runoff needs to be remapped to RN_HRU. T or F |
| 2,3 | <fname_remap> | netCDF name of runoff remapping |
| 2,3 | <lname_hruid_in_remap> | variable name for RN_HRUs |
| 2,3 | <lname_weight> | variable name for areal weights of overlapping HM_HRUs |
| 2 | <lname_qhruid> | variable name for HM_HRU ID |
| 3 | <lname_i_index> | variable name of xlon index |
| 3 | <lname_j_index> | variable name of ylat index |
| 2,3 | <lname_num_qhru> | variable name for a numbers of overlapping HM_HRUs with RN_HRUs |
| 2,3 | <lname_hru_remap> | dimension name for HM_HRU |
| 2,3 | <lname_data_remap> | dimension name for data |
| 1,2,3 | <route_opt> | routing schem options: 0-> Sum, 1->IRF, 2->KWT, 3->KW, 4->MC, 5->DW, otherwise error. |

1. routing option

- it is possible to specify multiple options (e.g., 0125 -> run with SUM, IRF KWT and DW).

Variables that have default values but can be overwritten

| tag | Default values | Description |
|---------------------|---------------------|--|
| <ntopAugment-Mode> | F | logical to indicate river network augmentation mode. See note 1. |
| <seg_outlet> | -9999 | outlet reach ID for subsetting river basin. See note 2 |
| <fname_ntopNew> | <fname_ntopOld>_new | output netCDF name for augmented river network. See note 1 and 2 |
| <newFileFrequency> | yearly | frequency for new output files (single, daily, monthly or yearly) |
| <hydGeometryOption> | 1 | option for hydraulic geometry calculations (0=read from file, 1=compute) |
| <topoNetworkOption> | 1 | option for network topology calculations (0=read from file, 1=compute) |
| <computeReachList> | 1 | option to compute list of upstream reaches (0=do not compute, 1=compute) |
| <doesBasinRoute> | 1 | hillslope routing options. 0-> no (already routed), 1->IRF |
| <calendar> | From runoff input | specified calendar name. See note 3. |
| <time_units> | From runoff input | specified time units <unit> since yyyy-mm-dd (hh:mm:ss). See note 4 |
| <netcdf_format> | netcdf4 | netcdf format for output netcdf. other options: classic, 64bit_offset. |

1. River network subset mode.
 - if <seg_outlet> is given, the river network topology and parameters read from <fname_ntopOld> are written in <fname_ntopNew> and the program stops.
2. River network augmentation mode.
 - All the computed river network topology and parameters are written in <fname_ntopNew> and the program stops.
3. if <calendar> is specified, calendar attribute of time variable in runoff input is not read. Options available are: noleap, 365-day, standard, gregorian, or proleptic_gregorian. case sensitive
4. If <time_units> is specified, unit attribute of time variable in runoff input is not read. Unit options are: days, minutes, hours or seconds.

Often case, river network data has different variable names than defaults. In this case, variable names can be specified in control file as well. See [River parameters](#).

3.1 Restart options

mizuRoute does not write restart netCDF as default. The following control variables are used to control restart dropoff timing and use restart file for continuous run from the previous simulations. The restart file is written at previous time step to the specified time. In other words, if Specified is used for <restart_write> and 1981-01-01-00000 is specified in <restart_date>, mizuRoute writes restart file at 1980-12-31 00:00:00 for daily time step. The restart file name uses the time stamp at user specified timing. yearly, monthly, daily options also follow this convention.

The restart file name convention: <case_name>.r.yyyy-mm-dd-sssss.nc

| tag | Description |
|------------------|---|
| <restart_dir> | directory for restart files. default is <output_dir> |
| <restart_write> | restart output options. never (default), last, specified, yearly, monthly, daily. |
| <restart_date> | restart time in yyyy-mm-dd (hh:mm:ss). required if <restart_write> = "Specified" |
| <restart_month> | periodic restart month (default 1). Effective if <restart_write>="yearly" |
| <restart_day> | periodic restart day (default 1). Effective if <restart_write>="yearly" or "monthly" |
| <restart_hour> | periodic restart hour (default 0). Effective if <restart_write>="yearly", "monthly", or "daily" |
| <fname_state_in> | input restart netCDF name. If not specified, simulation start with cold start |

3.2 Output variables

The following variables, besides time, basinID (RN_hru ID) and reachID can be output in netCDF. Users can control which variables are output by setting <variable_name> to T or F in control file. All the variables are set to T by default. The output file name includes a time stamp at the first time step.

The output file name convention: <case_name>.h.yyyy-mm-dd-sssss.nc

| output variables | Descriptions |
|----------------------|---|
| <basRunoff> | runoff depth at RN_hru, remapped from HM_hru. See note 1 and 2. |
| <instRunoff> | runoff volume [m3/s] at reach, converted by multiplying basRunoff by RN_hru area . See note 2 |
| <dlayRunoff> | runoff volume [m3/s] at reach, after hillslope routing instRunoff. see Note 2 |
| <sumUpstream-Runoff> | accumulated delayed runoff volume (dlyRunoff) over all upstream reaches. |
| <KWTroute-dRunoff> | runoff volume [m3/s] after Kinematic wave tracking (KWT) reach routing dlayRunoff. See note 3 |
| <IRFroutedRunoff> | runoff volume [m3/s] after IRF reach routing dlayRunoff. See note 3 |
| <KWroudedRunoff> | runoff volume [m3/s] after KW (Kinematic Wave) reach routing dlayRunoff. See note 3 |
| <MCroudedRunoff> | runoff volume [m3/s] after MC (Muskingum-Cunge) reach routing dlayRunoff. See note 3 |
| <DWroudedRunoff> | runoff volume [m3/s] after DW (Diffusive wave) reach routing dlayRunoff. See note 3 |

1. The unit of runoff depth is the same as the unit used in runoff data
2. If runoff depth from runoff data is already delayed by hill-slope routing outside mizuRoute, <doesBasinRoute> should be set to 0. In this case, runoff volume computed from basRunoff is populated in <dlayRunoff> and <instRunoff> is not output.
3. routed runoff corresponding to the scheme is not output if users deactivate a particular routing scheme with <route_opt> tag.

3.3 Data assimilation options

mizuRoute can read gauge observed discharge data (in netCDF) along with gauge meta ascii data. To read gauge observation and gauge metadata, the following control variables need to be specified.

| tag | Description |
|-------------------|--|
| <gageMetaFile> | gauge meta data (two column csv format): gauge_id (non-numeric ID is accepted), seg_id |
| <fname_gageObs> | gauge discharge data |
| <vname_gageFlow> | variable name for discharge [m3/s] |
| <vname_gageSite> | variable name for gauge site name (character array) |
| <vname_gageTime> | variable name for time |
| <dname_gageSite> | dimension name for site |
| <dname_gageTime> | dimension name for time |
| <strlen_gageSite> | maximum gauge name string length |

Data assimilation is the direct insertion that is performed at a list of reaches in the metadata. Two parameters- <QerrTrend> and <ntsQmodStop> are needed. <QerrTrend> tells how bias computed at observation time at each reach evolves in the subsequent future <ntsQmodStop> time steps. To activate data assimilation of observed discharge into simulated discharge, the following control variables need to be specified.

| tag | Description |
|---------------|---|
| <qmodOption> | activation of direct insertion. 0 -> do nothing, 1=> discharge direct insertion |
| <QerrTrend> | temporal discharge error trend. 1->constant, 2->linear, 3->logistic, 4->exponential |
| <ntsQmodStop> | the number of time steps when flow correction stops |

3.4 Control file examples

These are examples for three cases of runoff input. These are just templates to start with. Users need to specify appropriate directories, netCDF variables/dimension names based on their data

Option 1 - runoff input is given at RN_HRU:

```
!_
↳*****
! ***** DEFINITION OF MODEL CONTROL INFORMATION_
↳*****
!_
!_
!_
↳*****
! Note: lines starting with "!" are treated as comment lines -- there is no limit on_
↳the number of comment lines.
!   lines starting with <xxx> are read till "!"
!_
!_
↳*****
! DEFINE DIRECTORIES
! -----
<ancil_dir>          ./ancillary_data/                ! directory_
↳containing ancillary data (river network, remapping netCDF)
<input_dir>          ./input/                        ! directory_
↳containing input data (runoff netCDF)
<output_dir>         ./output/                       ! directory_
↳containing output data
!_
↳*****
! DEFINE SIMULATION CONTROLS
! -----
<case_name>          cameo_v1.2                      ! simulation name -_
↳used for output netcdf name
<sim_start>          1950-01-01 00:00:00              ! time of simulation_
↳start. year-month-day (hh:mm:ss)
<sim_end>            1950-12-31 00:00:00              ! time of simulation_
↳end.   year-month-day (hh:mm:ss)
<fname_state_in>     cameo_v1.2.mizuRoute.r.1950-1-1-00000.nc ! netCDF name for_
↳the model state input
<restart_write>       specified                       ! restart write_
↳option. never, last, specified (need to specify date with <restart_date>)
<restart_date>        1950-08-31 00:00:00             ! restart date
<route_opt>          012345                          ! option for routing_
↳schemes 0-> SUM, 1->IRF, 2->KWT, 3->KW, 4->MC, 5->DW, otherwise error
!_
↳*****
! DEFINE FINE NAME AND DIMENSIONS
! -----
<fname_ntopOld>       ntopo_entire.nc                 ! name of netCDF_
↳containing river segment data
<lname_sseg>          seg                             ! dimension name of_
↳the stream segments
<lname_nhru>          hru                             ! dimension name of_
↳the RN_HRUs
!_
↳*****
(continues on next page)
```

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```

! DEFINE DESIRED VARIABLES FOR THE NETWORK TOPOLOGY
! -----
<seg_outlet>          -9999                      ! reach ID of outlet_
↳streamflow segment. -9999 for all segments
!_
↳*****
! DEFINE RUNOFF FILE
! -----
<fname_qsim>          runoff.RN_HRU.nc           ! name of netCDF_
↳containing the runoff
<vname_qsim>          RUNOFF                     ! variable name of_
↳HRU runoff
<vname_time>          time                       ! variable name of_
↳time in the runoff file
<vname_hruid>         hru                        ! variable name of_
↳runoff HRU ID
<dtype_time>          time                       ! dimension name of_
↳time
<dtype_hruid>         hru                        ! dimension name of_
↳HM_HRU
<units_qsim>          mm/s                       ! units of runoff
<dt_qsim>             86400                      ! time interval of_
↳the runoff
!_
↳*****
! DEFINE RUNOFF MAPPING FILE
! -----
<is_remap>            F                          ! logical to_
↳indicate runoff needs to be mapped to river network HRU
!_
↳*****
! Namelist file name
! -----
<param_nml>           param.nml.default          ! spatially constant model_
↳parameters
!_
↳*****

```

Option 2 - runoff input is given at HM_HRU:

```

!_
↳*****
! ***** DEFINITION OF MODEL CONTROL INFORMATION_
↳*****
!_
↳*****
!_
↳*****
! Note: lines starting with "!" are treated as comment lines -- there is no limit on_
↳the number of comment lines.
!   lines starting with <xxx> are read till "!"
!
!_
↳*****
! DEFINE DIRECTORIES
! -----
<ancil_dir>           ./ancillary_data/          ! directory_
↳containing ancillary data (river network, remapping netCDF)

```

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```

<input_dir>                ./input/                                ! directory_
↪containing input data (runoff netCDF)
<output_dir>               ./output/                              ! directory_
↪containing output data
!_
↪*****
! DEFINE SIMULATION CONTROLS
! -----
<case_name>                 cameo_v1.2                            ! simulation name _
↪used for output netcdf name
<sim_start>                 1950-01-01 00:00:00                   ! time of simulation_
↪start. year-month-day (hh:mm:ss)
<sim_end>                   1950-12-31 00:00:00                   ! time of simulation_
↪end.   year-month-day (hh:mm:ss)
<fname_state_in>           cameo_v1.2.mizuRoute.r.1950-1-1-00000.nc ! netCDF name for_
↪the model state input
<restart_write>             specified                              ! restart write_
↪option. never, last, specified (need to specify date with <restart_date>)
<restart_date>              1950-08-31 00:00:00                   ! restart date
<route_opt>                 012345                                ! option for routing_
↪schemes 0-> SUM, 1->IRF, 2->KWT, 3->KW, 4->MC, 5->DW, otherwise error
!_
↪*****
! DEFINE FINE NAME AND DIMENSIONS
! -----
<fname_ntopOld>             ntopo_entire.nc                        ! name of netCDF_
↪containing river segment data
<lname_sseg>                seg                                    ! dimension name of_
↪the stream segments
<lname_nhru>                hru                                    ! dimension name of_
↪the RN_HRUs
!_
↪*****
! DEFINE DESIRED VARIABLES FOR THE NETWORK TOPOLOGY
! -----
<seg_outlet>                -9999                                ! reach ID of outlet_
↪streamflow segment. -9999 for all segments
!_
↪*****
! DEFINE RUNOFF FILE
! -----
<fname_qsim>                runoff.HM_HRU.nc                       ! name of netCDF_
↪containing the HRU runoff
<lname_qsim>                RUNOFF                                ! variable name of_
↪HRU runoff
<lname_time>                time                                    ! variable name of_
↪time in the runoff file
<lname_hruid>               hru                                    ! variable name of_
↪runoff HRU ID
<lname_time>                time                                    ! dimension name of_
↪time
<lname_hruid>               hru                                    ! dimension name of_
↪HM_HRU
<units_qsim>                mm/s                                  ! units of runoff
<dt_qsim>                   86400                                ! time interval of_
↪the runoff
!_

```

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```

! DEFINE RUNOFF MAPPING FILE
! -----
<is_remap>          T                                ! logical to_
↪indicate runoff needs to be mapped to RN_HRU
<fname_remap>       spatialweights_HM_HRU_RN_HRU.nc    ! name of netCDF for_
↪HM_HRU-RN_HRU mapping data
<vname_hruid_in_remap> polyid                        ! variable name of_
↪RN_HRU in the mapping file
<vname_weight>      weight                            ! variable name of_
↪areal weights of overlapping HM_HUs for each RN_HRU
<vname_qhruid>       overlapPolyId                    ! variable name of_
↪HM_HRU ID
<vname_num_qhru>     overlaps                          ! variable name of_
↪numbers of HM_HRUs for each RN_HRU
<dtype_hru_remap>    polyid                            ! dimension name of_
↪RN_HRU (in the mapping file)
<dtype_data_remap>   data                              ! dimension name of_
↪ragged HM_HRU
!_
↪*****
! Namelist file name
! -----
<param_nml>          param.nml.default                ! spatially constant_
↪model parameters
!_
↪*****

```

Option 3 - runoff input is given at grid:

```

!_
↪*****
! ***** DEFINITION OF MODEL CONTROL INFORMATION_
↪*****
!_
↪*****
! Note: lines starting with "!" are treated as comment lines -- there is no limit on_
↪the number of comment lines.
!   lines starting with <xxx> are read till "!"
!_
↪*****
! DEFINE DIRECTORIES
! -----
<ancil_dir>          ./ancillary_data/                ! directory_
↪containing ancillary data (river network, remapping netCDF)
<input_dir>          ./input/                          ! directory_
↪containing input data (runoff netCDF)
<output_dir>         ./output/                        ! directory_
↪containing output data
!_
↪*****
! DEFINE SIMULATION CONTROLS
! -----
<case_name>          cameo_v1.2                      ! simulation name -_
↪used for output netcdf name

```

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```

<sim_start>          1950-01-01 00:00:00          ! time of simulation_
↳start. year-month-day (hh:mm:ss)
<sim_end>            1950-12-31 00:00:00          ! time of simulation_
↳end.   year-month-day (hh:mm:ss)
<fname_state_in>     cameo_v1.2.mizuRoute.r.1950-1-1-00000.nc ! netCDF name for_
↳the model state input
<restart_write>      specified                    ! restart write_
↳option. never, last, specified (need to specify date with <restart_date>)
<restart_date>       1950-08-31 00:00:00          ! restart date
<route_opt>          012345                      ! option for routing_
↳schemes 0-> SUM, 1->IRF, 2->KWT, 3->KW, 4->MC, 5->DW, otherwise error
!_
↳*****
! DEFINE FINE NAME AND DIMENSIONS
! -----
<fname_ntopoOld>      ntopo_entire.nc              ! name of netCDF_
↳containing river segment data
<dtype_sseg>          seg                          ! dimension name of_
↳the stream segments
<dtype_nhru>          hru                          ! dimension name of_
↳the RN_HRUs
!_
↳*****
! DEFINE DESIRED VARIABLES FOR THE NETWORK TOPOLOGY
! -----
<seg_outlet>         -9999                        ! reach ID of outlet_
↳streamflow segment. -9999 for all segments
!_
↳*****
! DEFINE RUNOFF FILE
! -----
<fname_qsim>          runoff.HM_HRU.nc             ! name of netCDF_
↳containing the HRU runoff
<vname_qsim>          RUNOFF                       ! variable name of_
↳HRU runoff
<vname_time>          time                         ! variable name of_
↳time in the runoff file
<dtype_time>          time                         ! dimension name of_
↳time
<dtype_xlon>          lon                          ! dimension name of_
↳x(j)
<dtype_ylat>          lat                          ! dimension name of_
↳y(i)
<units_qsim>          mm/s                         ! units of runoff
<dt_qsim>             86400                       ! time interval of_
↳the runoff
!_
↳*****
! DEFINE RUNOFF MAPPING FILE
! -----
<is_remap>           T                            ! logical to_
↳indicate runoff needs to be mapped to RN_HRU
<fname_remap>         spatialweights_HM_HRU_RN_HRU.nc ! name of netCDF for_
↳HM_HRU-RN_HRU mapping data
<vname_hruin_remap>   polyid                       ! variable name of_
↳RN_HRU in the mapping file
<vname_weight>        weight                       ! variable name of_
↳areal weights of overlapping HM_HRUs for each RN_HRU

```

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```

<vname_i_index>          i_index          ! variable name of_
↪xlon index
<vname_j_index>          j_index          ! variable name of_
↪ylat index
<vname_num_qhru>         overlaps         ! variable name of_
↪numbers of HM_HRUs for each RN_HRU
<dname_hru_remap>        polyid           ! dimension name of_
↪RN_HRU (in the mapping file)
<dname_data_remap>       data             ! dimension name of_
↪ragged HM_HRU
!_
↪*****
! Namelist file name
! -----
<param_nml>              param.nml.default ! spatially constant_
↪model parameters
!_
↪*****

```

CHAPTER 4

River parameters

Full list of river parameters, both physical and topological ones, can be output in netCDF as river network augmentation mode. Those augmented variables can be read in from augmented network netCDF and variable names need to be specified in *control file*

To read additional augmented network parameters, <hydGeometryOption> and <topoNetworkOption> needs to be turned on (specified as 0) in *control file*

Names of the river network variables (both network topology and physical parameters) can be also specified in *control file*, if they are different than their default names. The format is

<varname_PARAMETER_DEFAULT_NAME> NEW_NAME !

Dimensions

| Dimension | Description |
|-----------|---|
| seg | river reach |
| hru | river network catchment or hru (hydrologic response unit) |
| upSeg | immediate upstream reaches |
| upHRU | HRUs contributing to a reach |
| upAll | all the upstream reaches |

4.1 physical parameters

| Variable | Dimension | Unit | Type | Description |
|---------------|-----------|------|------|---|
| width | seg | – | real | channel width |
| man_n | seg | – | real | mannings n |
| hruArea | upHRU | m2 | real | area of each contributing HRU |
| weight | upHRU | – | real | weight assigned to each HRU |
| basArea | seg | m2 | real | total area of contributing HRUs |
| upsArea | seg | m2 | real | area above the top of the reach. 0 if headwater |
| totalArea | seg | m2 | real | area above the bottom of the reach (bas + ups) |
| timeDelayHist | uh | sec | real | time delay histogram for each reach (only UH routing) |

4.2 Topology parameters

Extra or augmented river reach and hru topology are typically computed internally. It is recommended to compute instead of generating outside mizuRoute

Variables

| Variable | Dimension | Unit | Type | Description |
|-----------------|-----------|------|------|--|
| segIndex | seg | – | int | reach Index |
| downSegId | seg | – | int | downstream reach ID |
| downSegIndex | seg | – | int | downstream reach index |
| upSegIds | upSeg | – | int | Immediate upstream reach IDs for each reach |
| upSegIndices | upSeg | – | int | immediate upstream reach indices for each reach |
| allUpSegIndices | upAll | – | int | all the upstream reach indices for each reach |
| rchOrder | seg | – | int | routing processing order |
| goodBasin | upSeg | – | int | flag to indicate immediate upstream HRUs are good HRU (area>0) |
| HRUindex | hur | – | int | RN_HRU index |
| hruSegIndex | hur | – | int | index of the reach below each HRU |
| hruContribIx | upHRU | – | int | indices of HRUs contributing flow to each reach |
| hruContribId | upHRU | – | int | IDs of HRUs contributing flow to each reach |

CHAPTER 5

testCase data

Users are encouraged to test with [Cameo basin testCase](#).