v1.1 Documentation

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Contents

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.

CHAPTER 2

Input data

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 speficied 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

Option	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

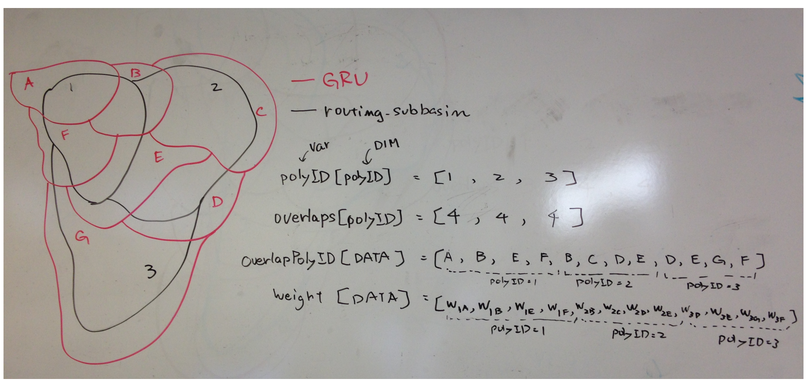
For runoff input options 2 and 3, runoff mapping data, also in netCDF format, is necessary to compute runoff value for each river network HRU

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	weihgt	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 varialbes 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 readibility.

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 make 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	<case_name>	simulation case name. This used for output netCDF, and restart netCDF name
1,2,3	<ancil_dir>	Directory that contains ancillary data (river netowrk, remapping, and parameter namelist)
1,2,3	<input_dir>	Directory that contains runoff data
1,2,3	<output_dir>	Directory that contains runoff data
1,2,3	<param_nml>	Spatially constant parameter namelist (should be stored in <ancil_dir>
1,2,3	<sim_start>	time of simulation start. format: yyyy-mm-dd or yyyy-mm-dd hh:mm:ss
1,2,3	<sim_end>	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	<dname_sseg>	dimension name for reach in river network netCDF
1,2,3	<dname_nhru>	dimension name for RN_HRU in river network netCDF
1,2,3	<fname_qsim>	netCDF name for HM_HRU runoff
1,2,3	<vname_qsim>	variable name for HM_HRU runoff
1,2,3	<vname_time>	variable name for time
2	<vname_hruid>	variable name for HM_HRU ID
3	<dname_xlon>	dimension name for x, lon, or i dimension
3	<dname_ylat>	dimension name for y, lat, or j dimension
1,2,3	<dname_time>	dimension name for time
1,2,3	<dname_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	<vname_hruid_in_remap>	variable name for RN_HRUs
2,3	<vname_weight>	variable name for areal weights of overlapping HM_HRUs
2	<vname_qhruid>	variable name for HM_HRU ID
3	<vname_i_index>	variable name of xlon index
3	<vname_j_index>	variable name of ylat index
2,3	<vname_num_qhru>	variable name for a numbers of overlapping HM_HRUs with RN_HRUs
2,3	<dname_hru_remap>	dimension name for HM_HRU
2,3	<dname_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 augmention mode. See note 1.
<seg_outlet>	-9999	outlet reach ID for subsetted river basin. See note 2
<fname_ntopNew>	<fname_ntopOld>_new.nc	output netCDF name for augmented river network. See note 1 and 2
<newFileFre-quency>	yearly	frequency for new output files (single, daily, monthly or yearly)
<hydGeometryOp-tion>	1	option for hydraulic geometry calculations (0=read from file, 1=compute)
<topoNetworkOp-tion>	1	option for network topology calculations (0=read from file, 1=compute)
<computeReach-List>	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 speficied 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 convension: <case_name>.r.yyyy-mm-dd-sssss.nc

tag	Description
<restart_dir>	directory for restart files. defualt is <output_dir>
<restart_write>	restart ouput 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 timie stamp at the first time step.

The output file name convension: <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 mulitplying 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
<KWroutedRunoff>	runoff volume [m3/s] after KW (Kinematic Wave) reach routing dlayRunoff. See note 3
<MCroutedRunoff>	runoff volume [m3/s] after MC (Muskingum-Cunge) reach routing dlayRunoff. See note 3
<DWroutedRunoff>	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 ouput 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>	imension 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 appropreate 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
<dname_sseg>        seg                                           ! dimension name of␣
↪the stream segments
<dname_nhru>        hru                                           ! dimension name of␣
↪the RN_HRUs
!␣
↪*********************************************************************************************************
```

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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
<dname_time>        time                                        ! dimension name of␣
↪time
<dname_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 runnoff 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
<dname_sseg>            seg                                       ! dimension name of␣
↪the stream segments
<dname_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
<vname_hruid>           hru                                       ! variable name of␣
↪runoff HRU ID
<dname_time>            time                                      ! dimension name of␣
↪time
<dname_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 runnoff 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
<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
! ****************************************************************************************************
```

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_ntopOld>         ntopo_entire.nc                           ! name of netCDF␣
↪containing river segment data
<dname_sseg>            seg                                       ! dimension name of␣
↪the stream segments
<dname_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
<dname_time>            time                                      ! dimension name of␣
↪time
<dname_xlon>            lon                                       ! dimension name of␣
↪x(j)
<dname_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 runnoff 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
```

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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 speficied 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.