NWM v2.1 42-Year Retrospective Full-Physics Run Output

Table 1. General introduction

	Descriptions
Model domain	All of the CONUS, southern Canada, and northern Mexico
Valid time period	February 1979 through December 2020
Model resolution	1-km land surface grid; 250-m terrain routing grid; NHDPlusV2 vector channel routing network and conceptual groundwater basins
Spin up period	Warm started with final states from a 10-year simulation, then acclimated by running February 1979 through December 1979 twice.
Driving data	1. CONUS: Analysis of Record for Calibration (AORC) 2. Outside of CONUS (1979-2006 and 2020): Uniform plausible values used to replace missing values: T2D = 280 K; Q2D = 0.005 kg kg^{-1}; PSFC = 101300 Pa; U2D = 5 m s^{-1}; V2D = 5 m s^{-1}; SWDOWN = 80 W m^{-2}; LWDOWN = 310 W m^{-2}; RAINRATE = 0 mm s^{-1} 3. Outside of CONUS (2007-2019): NCEP North American Regional Reanalysis (NARR)
Output frequency	1. CHRTOUT: Every hour, channel network output 2. LAKEOUT: Every hour, reservoir (lake) output 3. GWOUT: Every hour, conceptual groundwater output 4. LDASOUT: Every 3 hours, land model output 5. RTOUT: Every 3 hours, high-resolution terrain routing output
File format	netCDF, compressed using: nccopy –d 2 <in_file> <in_file.comp>
Restart frequency	Model states (soil moisture, snowpack, channel contents, etc.) were carried along in one continuous 41-year simulation. However, for workflow purposes during 1979-2019 the runs were restarted every three months at 00Z January 1, 00Z April 1, 00Z July 1, and 00Z October 1. This reset the accumulation output fields but did not alter model states.
Accumulation period for accumulate variables	For the accumulation variables (3 hourly UGDRNOFF, ACCET, ACSNOM), the accumulation takes place between restart dates: 1. 00Z January 1 – 21Z March 31 2. 00Z April 1 – 21Z June 30 3. 00Z July 1 – 21Z September 30 4. 00Z October 1 – 21Z December 31
Model time step	1. Forcing data: 3600 seconds 2. Land surface model: 3600 seconds 3. Channel routing: 300 seconds 4. Terrain routing: 10 seconds

Table 2. Variables in the CHRTOUT files (dimensions: feature_id=2776738, time=1, reference_time=1; file sizes: 42MB ~ 55MB)

Variable name	Description	Unit	Dimension
time	Valid output time	minutes since 1970-01-01 00:00:00 UTC	time
reference_time	Model initialization time	minutes since 1970-01-01 00:00:00 UTC	reference_time
crs	Grid mapping projection		
feature_id	Reach ID		feature_id
latitude	Feature latitude	degrees_north	feature_id
longitude	Feature longitude	degrees_east	feature_id
order	Streamflow order		feature_id
elevation	Feature elevation	m	feature_id
streamflow	River flow	$m^3\ s^{-1}$	feature_id
q_lateral	Total runoff into channel reach	$m^3\ s^{-1}$	feature_id
velocity	River velocity	$m\ s^{-1}$	feature_id
qSfcLatRunoff	Runoff from terrain routing into channel	$m\ s^{-1}$	feature_id
qBucket	Flux from conceptual groundwater basin into channel	$m\ s^{-1}$	feature_id
qBtmVertRunoff	Runoff from bottom of soil column to conceptual groundwater basin	m^3	feature_id

Table 3. Variables in the LAKEOUT files (dimensions: feature_id=5783, time=1, reference_time=1; file sizes: 134KB ~ 140KB)

Variable name	Description	Unit	Dimension
time	Valid output time	minutes since 1970-01-01 00:00:00 UTC	time
reference_time	Model initialization time	minutes since 1970-01-01 00:00:00 UTC	reference_time
crs	Grid mapping projection		
feature_id	Lake COMMON ID		feature_id
reservoir_type	1=Level_pool, 2=USGS-persistence,	categorical	feature_id

	3=USACE-persistence, 4=RFC-forecasts		
reservoir_assimilated_value	reservoir assimilated value	$m^3 s^{-1}$	feature_id
latitude	Lake latitude	degrees_north	feature_id
longitude	Lake longitude	degrees_east	feature_id
water_sfc_elev	Water surface elevation	meters	feature_id
inflow	Lake inflow	$m^3 s^{-1}$	feature_id
outflow	Lake outflow	$m^3 s^{-1}$	feature_id

Table 4. Variables in the GWOUT files (dimensions: feature_id=2776738, time=1, reference_time=1; file sizes: 8MB ~ 16MB)

Variable name	Description	Unit	Dimension
time	Valid output time	minutes since 1970-01-01 00:00:00 UTC	time
reference_time	Model initialization time	minutes since 1970-01-01 00:00:00 UTC	reference_time
feature_id	Groundwater basin ID		feature_id
inflow	Groundwater basin inflow	$m^3 s^{-1}$	feature_id
outflow	Groundwater basin outflow	$m^3 s^{-1}$	feature_id
depth	Groundwater basin storage depth	mm	feature_id

Table 5. Variables in the LDASOUT files (dimensions: time=1, x=4608, y=3840, soil_layers_stag=4, snow_layers=3, reference_time=1, vis_nir=2; file sizes: 100MB ~ 300MB)

Variable name	Description	Unit	Dimension
time	Valid output time	minutes since 1970-01-01 00:00:00 UTC	time
reference_time	Model initialization time	minutes since 1970-01-01 00:00:00 UTC	reference_time
x	X coordinate of projection	m	x
y	Y coordinate of projection	m	y
crs	Grid mapping projection		
COSZ	Cosine of zenith angle		(time, y, x)

FSA	Total absorbed shortwave radiation	W m^{-2}	(time, y, x)
FIRA	Total net longwave radiation to atmosphere	W m^{-2}	(time, y, x)
HFX	Total sensible heat to the atmosphere	W m^{-2}	(time, y, x)
LH	Total latent heat to the atmosphere	W m^{-2}	(time, y, x)
ALBEDO	Surface albedo		(time, y, x)
UGDRNOFF	Accumulated underground runoff	mm	(time, y, x)
TRAD	Surface radiative temperature	K	(time, y, x)
SOIL_W	Liquid volumetric soil moisture	m^3 m^{-3}	(time, y, soil_layers_stag, x)
SOIL_M	Volumetric soil moisture (liquid and frozen)	m^3 m^{-3}	(time, y, soil_layers_stag, x)
SNOWH	Snow depth	m	(time, y, x)
SNEQV	Snow water equivalent	kg m^{-2}	(time, y, x)
FSNO	Snow-cover fraction on the ground	fraction	(time, y, x)
ACCET	Accumulated total ET	mm	(time, y, x)
ALBSND	Snowpack direct-beam albedo		(time, y, vis_nir, x)
ALBSNI	Snowpack diffuse-beam albedo		(time, y, vis_nir, x)
EDIR	Direct evaporation flux from the surface	kg m^{-2} s^{-1}	(time, y, x)
ACSNOM	Accumulated melting water out of snowpack bottom layer	mm	(time, y, x)
QRAIN	Rate of liquid precipitation reaching the ground	mm s^{-1}	(time, y, x)
QSNOW	Rate of frozen precipitation reaching the ground	mm s^{-1}	(time, y, x)

Table 6. Variables in the RTOUT files (dimensions: time=1, x=18432, y=15360, reference_time=1, soil_layers_stag=4; file sizes: 47MB ~ 87MB)

Variable name	Description	Unit	Dimension

time	Valid output time	minutes since 1970-01-01 00:00:00 UTC	time
reference_time	Model initialization time	minutes since 1970-01-01 00:00:00 UTC	reference_time
x	X coordinate of projection	m	x
y	Y coordinate of projection	m	y
crs	Grid mapping projection		
zwattablrt	Depth to saturation, rounded to highest saturated layer	m	(time, y, x)
sfcheadsubrt	Ponded water depth	mm	(time, y, x)