

# How To Build and Run WRF-Hydro V5 Coupled to the Weather Research and Forecasting (WRF) Atmospheric Model



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## Overview

In the fully coupled configuration, WRF-Hydro serves as a hydrological extension package to the Weather Research and Forecasting (WRF) atmospheric model for the purpose of performing hydrometeorological (e.g. rainfall, runoff, groundwater flow, streamflow) simulations and predictions. **Before beginning the process of building the coupled WRF | WRF-Hydro system, make sure that the standalone versions of WRF and WRF-Hydro successfully build and execute on your system.** Debugging problems with the coupled model is much easier once any potential issues with the standalone models have been exposed and addressed. We also recommend that you recompile and test the standalone version of WRF-Hydro if any changes or model developments are made to the WRF-Hydro code. These steps will help ensure that the coupled version will compile and execute successfully and will help with troubleshooting any problems that may arise.

## Building Coupled WRF | WRF-Hydro

The following steps describe the process of building the coupled WRF | WRF-Hydro system:

1. Download and unpack the required source code:

Download the source code for WRF

```
wget https://github.com/wrf-model/WRF/archive/v4.0.1.tar.gz
tar -xzvf *.tar.gz
mv WRF* WRF
rm *.tar.gz
```

Download the source code for WPS

```
wget https://github.com/wrf-model/WPS/archive/v4.0.1.tar.gz
tar -xzvf *.tar.gz
mv WPS* WPS
rm *.tar.gz
```

Download the source code for WRF-Hydro

```
wget https://github.com/NCAR/wrf\_hydro\_nwm\_public/archive/v5.0.3.tar.gz
tar -xzvf *.tar.gz
rm *.tar.gz
```

Replace the old version of WRF-Hydro distributed with WRF with updated WRF-Hydro source code

```
rm -r WRF/hydro
cp -r wrf_hydro*/trunk/NDHMS WRF/hydro
```

2. Ensure that any required dependencies are available on your system and that proper environment variables for paths and compile time options are set:

Please refer to the WRF documentation for a full list of software dependencies and associated environment variables to set so that these libraries are recognized at compile time. WRF-Hydro does not require any additional libraries beyond those needed for WRF. However, users should note that we no longer allow for a serial compile and a limited subset of compilers is supported (PGI, Intel, and GNU).

Set compile time options for WRF | WRF-Hydro  
*Edit the provided template (WRF/hydro/template/setEnvar.sh) as desired*  
source WRF/hydro/template/setEnvar.sh

3. Configure and compile WRF with WRF-Hydro

Note that the WRF\_HYDRO environment variable (included in the setEnvar.sh script) is what triggers a coupled compile. To recompile WRF as standalone model set WRF\_HYDRO to 0.

Move to the WRF base directory  
cd WRF

Run configure and select appropriate options  
./configure  
*Select the dmpar option for your compiler*  
*Select option 1 - basic nesting*

Run compile and once complete check the log file for errors and warnings  
./compile em\_real >& compile.log

4. Configure and compile WPS

Note that if you already have the desired version of WPS compiled on your system you do not need to recompile. WRF-Hydro does not interact with the pre-processing system.

Move to the WPS base directory  
cd ../WPS

Run configure and select appropriate options  
./configure  
*Select the option for your compiler*

Run compile and once complete check the log file for errors and warnings  
./compile >& compile.log

# Running Coupled WRF | WRF-Hydro

The following steps describe the process of running the coupled WRF | WRF-Hydro system:

1. Ensure the necessary files are available from previous steps in the WPS and WRF run process

*Check that the required `wrfinput_d0x` and `wrfbdy_d01` (initial and boundary condition files) for your simulation have been created and are available in the run directory*

2. Add required files for WRF-Hydro to the appropriate locations

Move to the WRF run directory

```
cd ../WRF/run
```

Create a DOMAIN directory for WRF-Hydro domain files

```
mkdir DOMAIN
```

*Move all the necessary WRF-Hydro domain files (e.g. `Fulldom_hires.nc`, `Route_Link.nc`, etc.) for your configuration of WRF-Hydro to the DOMAIN directory*

*Copy the template WRF-Hydro `hydro.namelist` from the WRF-Hydro source code and any necessary \*.TBL files (e.g. `CHANPARAM.TBL`) for your configuration into the run directory. Note that the land surface model parameter files (e.g. `SOILPARAM.TBL`, `MPTABLE.TBL`) are already distributed with WRF.*

3. Edit the WRF and WRF-Hydro namelists as needed

*Edit the WRF namelist (`namelist.input`) as needed to set WRF physics options and simulation output and timing options. Note that the options typically set in `namelist.hrdas` in standalone WRF-Hydro simulations are set in this `namelist.input` for coupled simulations.*

*Edit the WRF-hydro namelist (`hydro.namelist`) as needed to set WRF-Hydro physics and output options as well as paths to required input files. Note: It is essential that the first option in the `hydro.namelist` file (`sys_cpl = 2`) be set to specify that the run is a coupled WRF/WRF-Hydro run. To do so, set `'sys_cpl' = 2`.*

4. Run the coupled model

Execute the model run using the proper syntax for running on your system (example below)

```
mpirun -np 4 ./wrf.exe >& wrf_coupled.log
```