WRF-Hydro v3.0 Change Log
Reported: April 19, 2015
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Summary:
Version 3 of the WRF-Hydro system includes numerous enhancements to model componentry and to model computational performance. The main modification made include:

- Numerous updates to the NoahMP land surface model
- Parallelization of the NoahMP land model driver
- Parallelization of I/O to improve model computational performance for large domains and very high resolution runs including large netcdf file support with netcdf4.
- Improved memory management for large domain/high resolution runs
- Reformulation of the exponential bucket model to permit fill/spill capability in addition to normal exponential model discharge.
- Support for gfortran compilation on MacOS
- Expanded ArcGIS pre-processing support for WRF-Hydro
- R-based statistical evaluation package with USGS streamflow data support

For a more complete description of WRF-Hydro model componentry and I/O specifications please refer to the WRF-Hydro documentation. A full list of code modifications and bug fixes is as follows:

Full list of changes bug fixes and code enhancements:
1. Fixed issues with Intel ifort compiler which caused problems on Yellowstone.
2. Numerous changes to both LSM and routing restart files have been made and verified for bit-for-bit matching upon restart.
3. Major modification to exponential discharge functions from the baseflow bucket model formulation. Current code now has an altered mathematical function that enforces a maximum bucket level(volume) which thereby limits mathematical discharge estimation from exponential function, permits a 'spill' of the bucket once the bucket is 'full' and limits the discharge from the bucket so that the bucket can not be overdrawn (i.e. have negative values for GW bucket levels). Along with this fix were fixes to the manner in which the buckets collect water under lake points which are masked out as 'no_data' from the Noah and NoahMP LSMs. Surface runoff and subsurface runoff terms at lake points are now forced to 0. Code modified: module_GW_baseflow.F
4. Added function to module_GW_baseflow.F to permit collection of surface runoff from land surface models when overland flow routing is turned off. Collected surface water is combined with sub-surface runoff and discharged in the same manner as specified by the user in the hydro.namelist file.
5. Modified gridded channel routing to improve overall computational performance. Changed downstream end boundary condition from critical depth flow condition to constant flux. Instances where critical depth boundary condition on high flows on fine scale grids caused channel model to crash. Added a very small epsilon value to the channel slope to minimize non-descript gradient specification in diffusive wave formulation.
6. Fixed a compiling error with GFORTRAN when compiling on MacOS. Bug fix supplied by Erick Fredj.

7. Fixed method for updating time-varying vegetation fraction from forcing (*LDASIN*) files.
8. Parallelized the HRLDAS land model driver component of WRF-Hydro for the NoahMP land surface model. This upgrade enables the gridded land model to be run on multiple cores and significantly improves runtime and scaling performance on large HPC systems and for large &/or high resolution domains.
9. Fixed restart issues for sequential runs.
10. Fixed the monthly restart specification in both Noah and NoahMP namelists. Monthly restarts are now possible by setting the restart frequency in to = -99999 in either the namelist.hrldas or hydro.namelist files, respectively.
11. Numerous enhancements have been made to the I/O structures in order to minimize memory requirements and improve performance when deployed over large computational domains. This includes parallel I/O for restart files when domains are very large.
12. Added functional support of large netcdf I/O available in netcdf4.
13. Bug fixes for the performance of the glacier land category within the NoahMP scheme have been made. These fixes are largely internal to the NoahMP land model. Changed NoahMP glacier outputs for undefined variables from large negatives to 0 for truly 0 fluxes (canopy water and C), so accumulator variables are not impacted by large negatives. A bug related to the passing of surface head to/from the NoahMP glacier land category was fixed.
14. Bug fixes have been made for the subsurface routing code in the calculation of lateral saturated hydraulic conductivity and excessive depletion of soil moisture.
15. Fixed units bug related to the RAINRAE output in the LDASOUT file from NoahMP.
16. As part of the work to improve I/O performance on very large domain/high resolution grids 3d soil fields have been reconfigured into 2d for I/O. User's wanting to put or keep soil variable can re-instate those options in the code and re-compile or can combine soil fields as a post-process.
17. The 'max_greenfrac' calculation in NoahMP was updated.
18. New water budget accumulation terms were added to NoahMP.
19. Improved memory management for the channel model to improve performance on the gridded channel routing.
20. Modified the initialization of LAI for the Noah and NoahMP land surface model driver.
21. Added a minimum time step (minDTCT) for gridded channel routing. This will keep model from crashing and getting infinitely hung up but it does result in truncation errors if channel model should become unstable.
22. Initial development has begun on re-implementing the 'on-the-fly' downscaling of meteorological data to the fine grid. This functionality is NOT yet fully implemented and will be completed in the near future.