Two links to NCEP Production Suite

- Operational model running on WCOSS
  - National Water Model (NWM)

- Downstream users of NCEP Production Suite
  - NWM (HRRR, RAP, GFS, CFS, NAM-Nest, MRMS)
  - Hydrologic Ensemble Forecast Service (HEFS) (GEFS, CFS, RFC, WPC)
  - Snow Data Assimilation System, SNODAS (HRRR, RAP, NAM)
• SNODAS snowpack analysis and forecasts
  – Operational since 2003 at NOHRSC, analyses and forecasts to 72 hours
  – Detailed 1km snowpack model and data assimilation system producing analyses and HRRR/RAP/NAM-forced forecasts of snow depth, density, temperature, evaporation, water content and melt
Downstream Application: Hydrologic Ensemble Forecast Service (HEFS)

- Provides daily ensemble streamflow forecasts at point locations, <1 day to >1 year
- Implemented and validated at all RFCs, uses GEFSv10, CFSv2, WPC and RFC input
- HEFS forecasts and 30-year hindcasts are used for flood forecast operations and decision support-Forecast Informed Reservoir Operations (FIRO)
- HEFS coordination with NCEP/EMC, OAR/ESRL and others
  - Transition to GEFSv12 for re-calibration and validation - end use of GEFSv10 early 2021
  - Approaches for thinning reforecasts, while meeting service requirements
  - Activities highlight need for long periods of reforecasts across applications
• Full spectrum hydrologic model, providing complementary hydrologic guidance
• NWM was upgraded to V2.0 in June 2019 by OWP, NCEP and NCAR
• Hydrologic core is WRF-Hydro, a community-based hydrologic modeling framework

**RFC AHPS**

**NWM**

River Forecast Centers: Authoritative forecasts at ~3,600 RFC Points

NWM: Guidance at 2.7 million NHDPlus river segments, filling in coverage gaps and enriching existing points
Goal: Develop Real-time Flood Inundation Mapping Systems

FY18/19 APG: Two sources of data

- Official WGRFC Forecasts
  - NWM “Replace and Route”
  - Available below AHPS points
- NWM Forecasts
  - Operational NWM used as input
  - Available for ~2.7 million reaches
- Use Height Above Nearest Drainage (HAND) method to translate streamflow to inundation forecasts

Proposed DOC FY20/21 APG

- Replace and Route over CONUS domain
- NWM-based FIM Maps over NERFC

Provides actionable information as to the timing and extent of flood waters
National Water Model: Development Trajectory

**v1.0**
Foundation: 2016
Water resource model
2.7 million reaches

**v1.1/1.2/2.0**
Hawaii, medium range ens., physics upgrades, improved modularity, MPE ingest, longer Analyses/Fcsts

**v2.1**
Next Upgrade: Early 2021
Expansion to PR and Great Lakes, reservoir modules, forcing bias-correction, open-loop config, and improved Hawaii forcing

**v3.0**
Future Upgrade: 2022
Coastal coupling, expansion to Alaska, shallow groundwater, infiltration physics and hydro-fabric upgrades
Coastal Hydraulics and Coupling
  ○ Freshwater-estuary-ocean model coupling
  ○ Simulate compound flooding—freshwater, storm surge and tides

Expansion to south-central Alaska (with APRFC)
  ○ Initial Cook Inlet/Copper River Basin, then full Alaska
  ○ Accompanying cold land physics upgrades

Inland Hydrologic and Hydraulic Routing
  ○ Improved routing for backwater and complex channels
  ○ Accompanying hydrofabric upgrades for routing and FIM

Improved infiltration scheme
  ○ Foundational physics upgrade, evolving Noah-MP
  ○ Will improve partitioning of rainfall→runoff and infiltration

Shallow groundwater model (with USGS)
  ○ Will improve upon current NWM bucket model
  ○ Key to simulating low-flow conditions
● OWP is planning for future integration of NWM components into the UFS
● Goal is to support local- to global-scale simulations, working toward a coupled land-atmosphere-ocean modeling capability
● Foundational activity which will enable NWM integration: Redesign of NWM architecture (Next-Gen NWM)
● Leveraging GSA 18F team, redesign underway with USGS and NCAR
  ○ Need for re-design informed by the CAC-WP
  ○ GSA 18F process leverages agile development process; code sprints will be transparent with broader community
  ○ Aid collaboration, maximize development efficiency via new modular architecture
  ○ More easily support addition of appropriate models for any surface discretization
  ○ TIN/unstructured mesh and heterogenous physics required to support coupling and scaling of NWM to provide underlying hydrology to UFS
  ○ Plan to couple with UFS via NEMS cap
Expanded Partnerships and Activities: NWM and UFS

- Current WRF-Hydro-based architecture upgraded until NextGen NWM ready
- Other near-term collaborations related to UFS / Earth System Modeling
  - National groundwater model component for NWM with USGS
  - Coastal coupling with National Ocean Service
    - Coastal Act
    - Real-time coupled forecast operations
  - LSM component transfer activities with EMC where possible
    - Common Noah-MP base (~v4.1 for NWM V2.1)
  - Coordination on snow DA with Land/Hydro SIP team
  - Potential UFS pathfinder efforts to examine coupling current NWM+HRRR