ACTIVE WATER MANAGEMENT WITHIN THE NATIONAL WATER MODEL V3.0: ASSIMILATION OF RESERVOIR OUTFLOW AND GLACIER DAMMED LAKE RELEASES

SESSION H450

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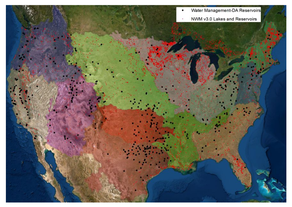
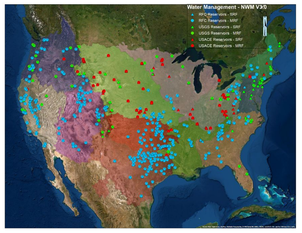
ACTIVE WATER MANAGEMENT IN THE NATIONAL WATER MODEL

- Inclusion of reservoir release data in the National Water Model (NWM) is challenging, yet critical
- The baseline NWM fill and spill reservoir scheme utilizes a simple mass balance lake object with orifice and weir outlets
- NWM v2.1 introduced active water management through 1) assimilating and persisting USACE and USGS observations and 2) assimilating and applying real-time reservoir release forecasts from National Weather Service (NWS) River Forecast Centers (RFCs)
- This approach was enhanced for NWM v3.0 with revised water body parameters, the updating of surface water elevation based on RFC-supplied releases, and a longer persistence look-back period



NWM v3.0 Waterbodies with (black) and without (red) reservoir data assimilation

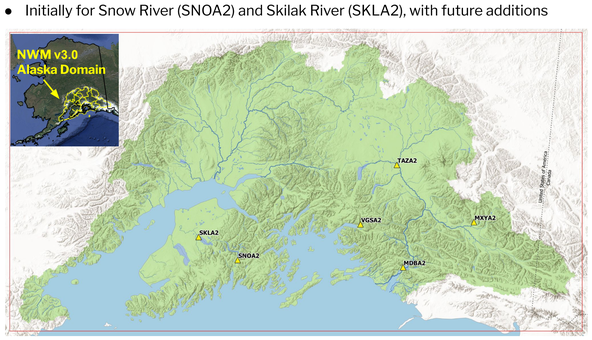


- Reservoir DA is applied at 481 AnA/SRF locations, and 426 MRF locations
- Approximately two-thirds of these sites are RFC forecast DA sites, and one-third are USGS and USACE persistence sites

Distribution of NWM Reservoir DA Sites

ADAPTING THE APPROACH FOR ALASKA

- In NWM v3.0, RFC Forecast data assimilation will also be applied for the first time to address glacier dam lake outburst floods over the new Alaska domain
- RFC GDL anomaly forecasts will be added to the existing NWM background flow
- Initially for Snow River (SNOA2) and Skilak River (SKLA2), with future additions

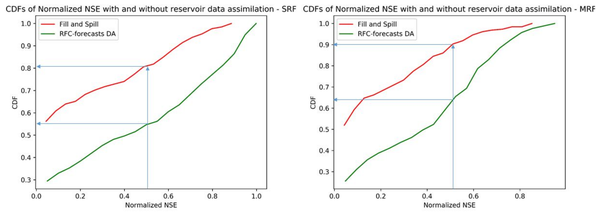


REAL-TIME ASSIMILATION OF RESERVOIR OUTFLOW IMPROVES NWM FORECASTS

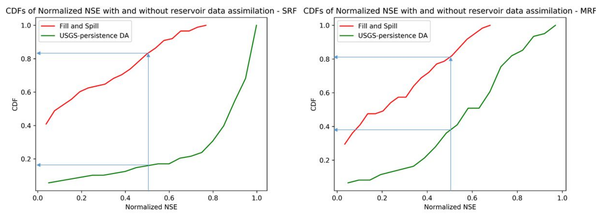
- Simulations were conducted to assess the impact of reservoir outflow assimilation
  - Period: 04/20/2020 - 02/15/2021
  - RFC-forecast: For SRF (MRF), comparison against 269 (266) USGS gauges located downstream of RFC reservoir sites
  - Observation persistence: For SRF (MRF), comparison against 121 USGS and 88 USACE (107 and 60) gauges downstream of persistence reservoir sites
  - Evaluation Metric: Normalized Nash Sutcliffe Efficiency (NNSE)

    NNSE = 1/(2-NSE) (ranges from 0 to 1)
- Results indicate a significant improvement from all assimilation approaches, as indicated by the distribution shift to the right depicted in the figures below

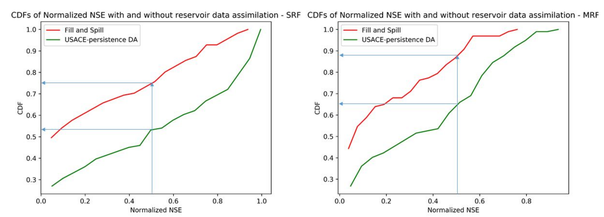
NNSE of NWM Streamflow with and Without Assimilation of RFC Reservoir Outflow Forecasts



NNSE of NWM Streamflow with and Without Persistence of USGS Observations

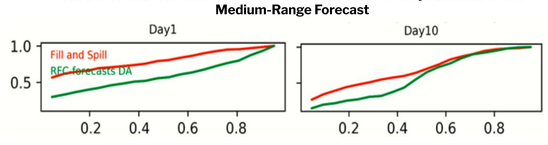


NNSE of NWM Streamflow with and Without Persistence of USACE Observations



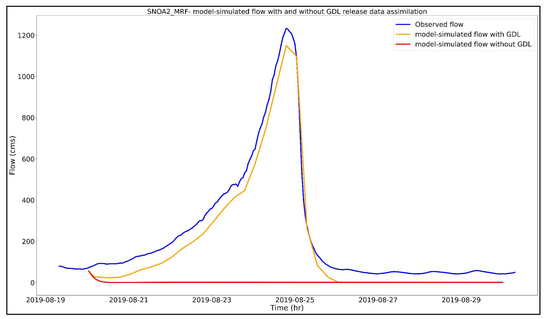
- This improvement persists through day 7 of the medium-range forecast, before trailing off for days 8 through 10.

CDFs of NNSE With and Without RFC Reservoir DA for Days 1 and 10 of the Medium-Range Forecast



IMPROVED STREAMFLOW GUIDANCE FOR ALASKA

- The assimilation of RFC Glacier Dam Lake outburst flood forecast data greatly improves NWM forecast accuracy for these types of events.



- Differences between the NWM simulation and observations may be due to: 1) cold-start initial conditions and 2) the lack of the Crocus snow model (will be used in the final configuration)

Glacier Outburst Flood at Hubbard Glacier in Alaska

SUMMARY AND FUTURE WORK

- Application of reservoir data assimilation (RFC forecast and USGS/USACE persistence) led to large improvements in NWM forecast skill versus the baseline fill and spill approach.
- This same functionality is used over the Alaska domain to assimilate RFC-sourced forecasts of glacial dam lake outburst floods.
- Looking ahead, the DA approaches implemented for NWM v2.1 and v3.0 will be integrated into the NextGen NWM framework.

For more information about the National Water Model please visit: https://water.noaa.gov/about/nwm

Access the NextGen NWM GitHub Code Repository

View this poster and other AGU materials

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