USGS National Hydrologic Model (NHM)

- USGS NHM developed to aid local to national water management by providing consistent process based daily estimates of water balance components
- Fills knowledge gaps in ungauged areas to provide nationally-consistent, locally informed, stakeholder relevant results
- Currently calibrated for historical period in contiguous U.S. with operational functionality being developed.
- Expansion to Alaska, Hawaii, Guam, other islands ongoing
- Run with daily Precipitation Runoff Modeling System (PRMS) or monthly water balance model (MWBM)

Alaska Domain Extension

- 14,800 hydrologic response units (HRUs)
- Developed through merging of USGS NHD and Environment Canada NHN
- 459 stream gages
- Additional physically-based modules for Alaskan domain: glaciers, permafrost

Model Forcing

Daymet v3 – precipitation displays highly localized patches, long record, consistent with NHM application in lower 48
Weather Research and Forecast Model (WRF) – likely best guess, but relatively short record length 2002 - 2016
NCEP Climate Forecast System Reanalysis (CFSR) – long record length, shown by previous studies to capture climatic dynamics in the region, coarse resolution if not downscalable

Model Calibration

Before calibration: Fourier Amplitude Sensitivity Test (FAST) efficiently estimates non-linear hydrologic model parameter sensitivity to identify parameters to focus on during calibration

Step 1: byHRU Calibration - a water-balance volume calibration which uses alternative data products with error bounds as calibration targets which produces spatially distributed parameters.

Step 2: byHW Calibration - byHRU calibrated parameter values are now used as the initial parameter estimates for byHW calibration. Focuses on smaller headwater basins to calibrate streamflow timing

Step 3: byHWobs Calibration - uses available measured streamflow to fine tune parameters where measured streamflow is available

Next steps

- Potential focus and test basins to isolate permafrost dynamics (Kuparuk River), depression storage (lower Yukon) glacier influence (Lemon Creek)
- Potential overlap with NASA SNOWEX / ABOVE?

Table of calibration targets and sources

<table>
<thead>
<tr>
<th>Target</th>
<th>Source</th>
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<tr>
<td>Runoff (RUN)</td>
<td>Monthly Water Balance Model (Bock et al., 2016)</td>
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<tr>
<td>Actual ET (AET)</td>
<td>SSEBop (Senay, et al., 2013)</td>
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<tr>
<td>Monthly Water Balance Model (Bock et al., 2016)</td>
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<tr>
<td>Recharge (RCH)</td>
<td>Empirical regression estimates of total recharge (Reitz et al., 2017)</td>
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<td>Soil Moisture (SOM)</td>
<td>MERRA-Land (<a href="https://gmao.gsfc.nasa.gov/reanalysis/MERRA-LandData">https://gmao.gsfc.nasa.gov/reanalysis/MERRA-LandData</a>)</td>
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<tr>
<td>Snow Covered Area (SCA)</td>
<td>WaterGAP 2.2a (<a href="https://earthdata.nasa.gov/">Döll et al., 2014</a>)</td>
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Streamflow time series plot showing periods of approved high quality values in black and estimated values during periods of ice influence in grey