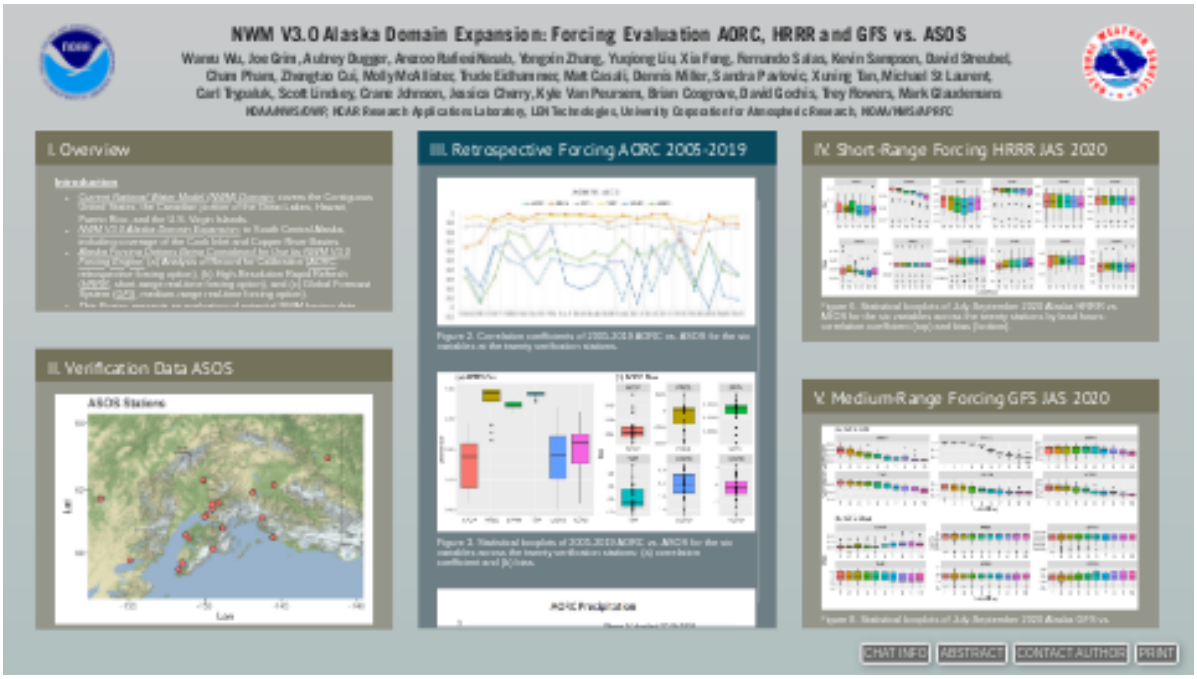
NWM V3.0 Alaska Domain Expansion: Forcing Evaluation AORC, HRRR and GFS vs. ASOS



Wanru Wu, Joe Grim, Aubrey Dugger, Arezoo RafieeiNasab, Yongxin Zhang, Yuqiong Liu, Xia Feng, Fernando Salas, Kevin Sampson, David Streubel, Cham Pham, Zhengtao Cui, Molly McAllister, Trude Eidhammer, Matt Casali, Dennis Miller, Sandra Pavlovic, Xuning Tan, Michael St Laurent, Carl Trypaluk, Scott Lindsey, Crane Johnson, Jessica Cherry, Kyle Van Peursem, Brian Cosgrove, David Gochis, Trey Flowers, Mark Glaudemans

NOAA/NWS/OWP, NCAR Research Applications Laboratory, LEN Technologies, University Corporation for Atmospheric Research, NOAA/NWS/APRFC

PRESENTED AT:

AGU FALL MEETING
Online Everywhere | 1–17 December 2020

I. OVERVIEW

Introduction

- *Current National Water Model (NWM) Domain:* covers the Contiguous United States, the Canadian portion of the Great Lakes, Hawaii, Puerto Rico, and the U.S. Virgin Islands.
- *NWM V3.0 Alaska Domain Expansion:* to South Central Alaska, including coverage of the Cook Inlet and Copper River Basins.
- *Alaska Forcing Options Being Considered for Use by NWM V3.0 Forcing Engine:* (a) Analysis of Record for Calibration (*AORC*, retrospective forcing option), (b) High-Resolution Rapid Refresh (*HRRR*, short-range real-time forcing option), and (c) Global Forecast System (*GFS*, medium-range real-time forcing option).
- *This Poster:* presents an evaluation of potential NWM forcing data sets against the Automated Surface Observing System (*ASOS*) station observations over the NWM V3.0 Alaska modeling domain.

Conclusions and Next Steps

- Assessment indicates datasets suitable for NWM use, while other options are still open.
- Continued discussions with APRFC to determine the optimal set of forcing to use would be the next step.
- Continued forcing engine modifications would be another next step.

References

- *AORC:* internal use only at present, for details please contact Mark Glaudemans (mark.glaudemans@noaa.gov)
- *HRRR:* https://nomads.ncep.noaa.gov/pub/data/nccf/com/hrrr/
- *GFS:* https://www.ncei.noaa.gov/data/global-forecast-system/
- *ASOS:* http://mesonet.agron.iastate.edu/ASOS/

II. VERIFICATION DATA ASOS

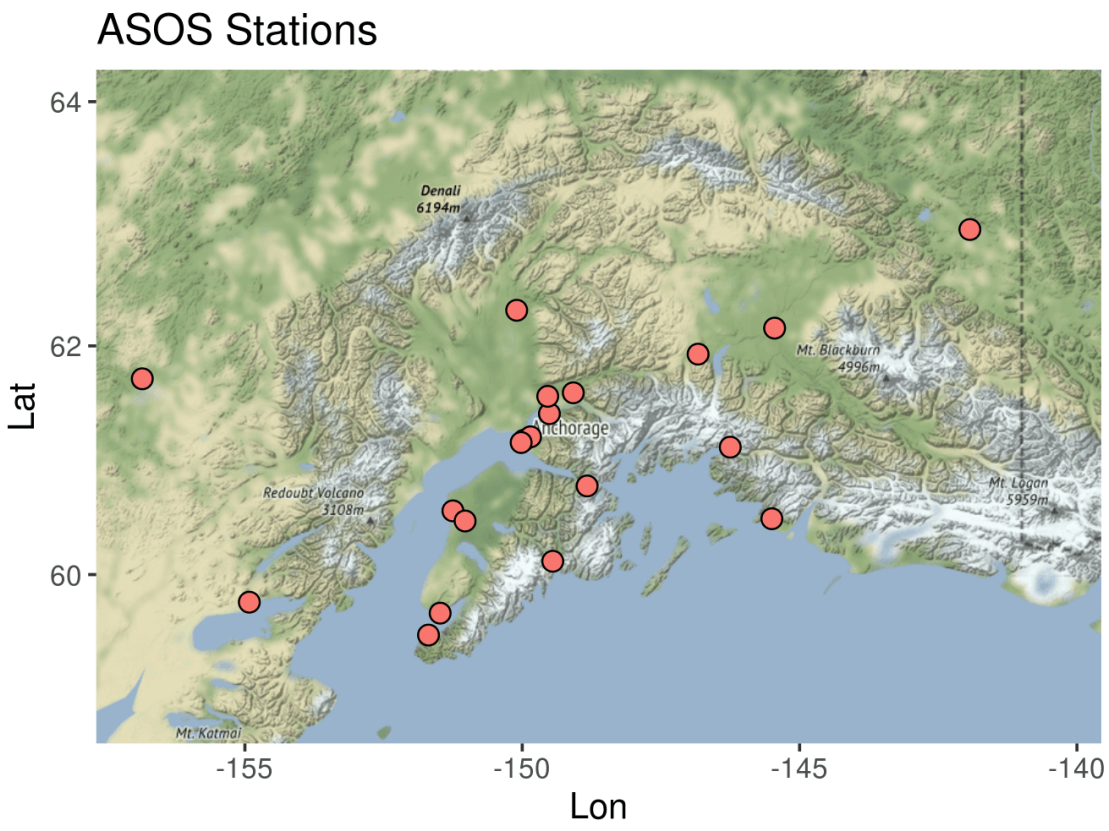


Figure 1. The verfication ASOS stations in the Alaska NWM domain.

Data Description:

- Twenty verification ASOS stations over the NWM V3.0 Alaska domain.
- ASOS from 2005-2019 for the retrospective forcing AORC evaluation.
- ASOS from July-September 2020 for the real-time forcing HRRR and GFS evaluation.
- Six verified variables including (a) surface precipitation *APCP* [mm/h], (b) surface pressure *PRES* [Pa], (c) 2-m specific humidity *SPFH* [kg/kg], (d) 2-m air temperature *TMP* [K], and (e) 10-m wind U *UGRD* and V *VGRD* [m/s].

III. RETROSPECTIVE FORCING AORC 2005-2019

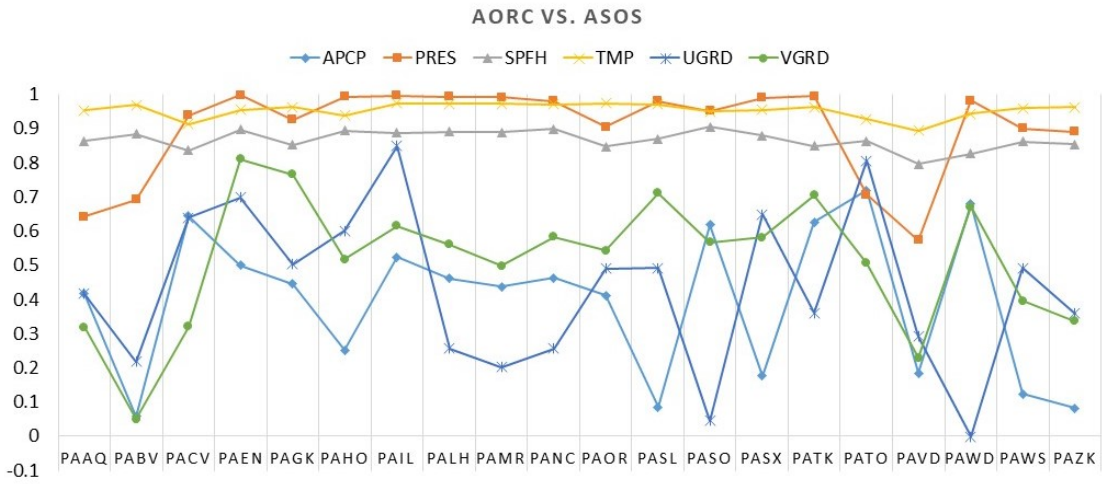


Figure 2. Correlation coefficients of 2005-2019 AORC vs. ASOS for the six variables at the twenty verification stations.

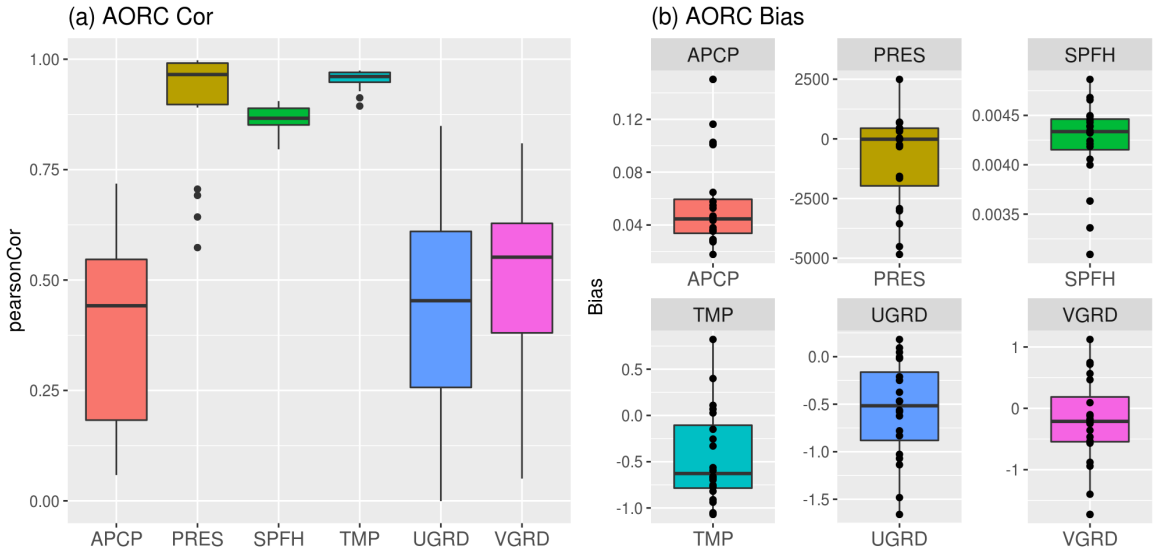


Figure 3. Statistical boxplots of 2005-2019 AORC vs. ASOS for the six variables across the twenty verification stations: (a) correlation coefficient and (b) bias.

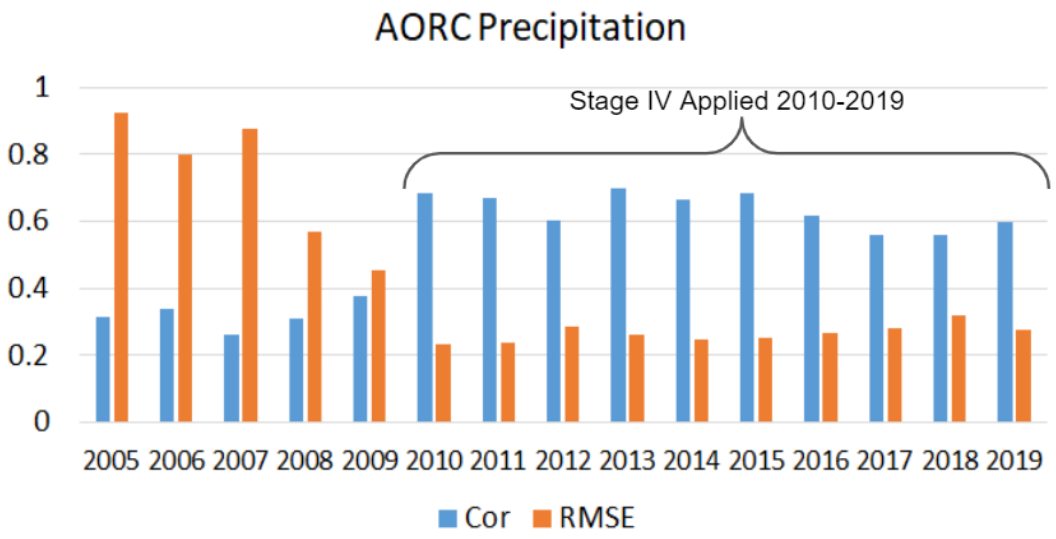


Figure 4. Station average annual correlation coefficient (blue) and root-mean-square error (orange) for AORC precipitation.

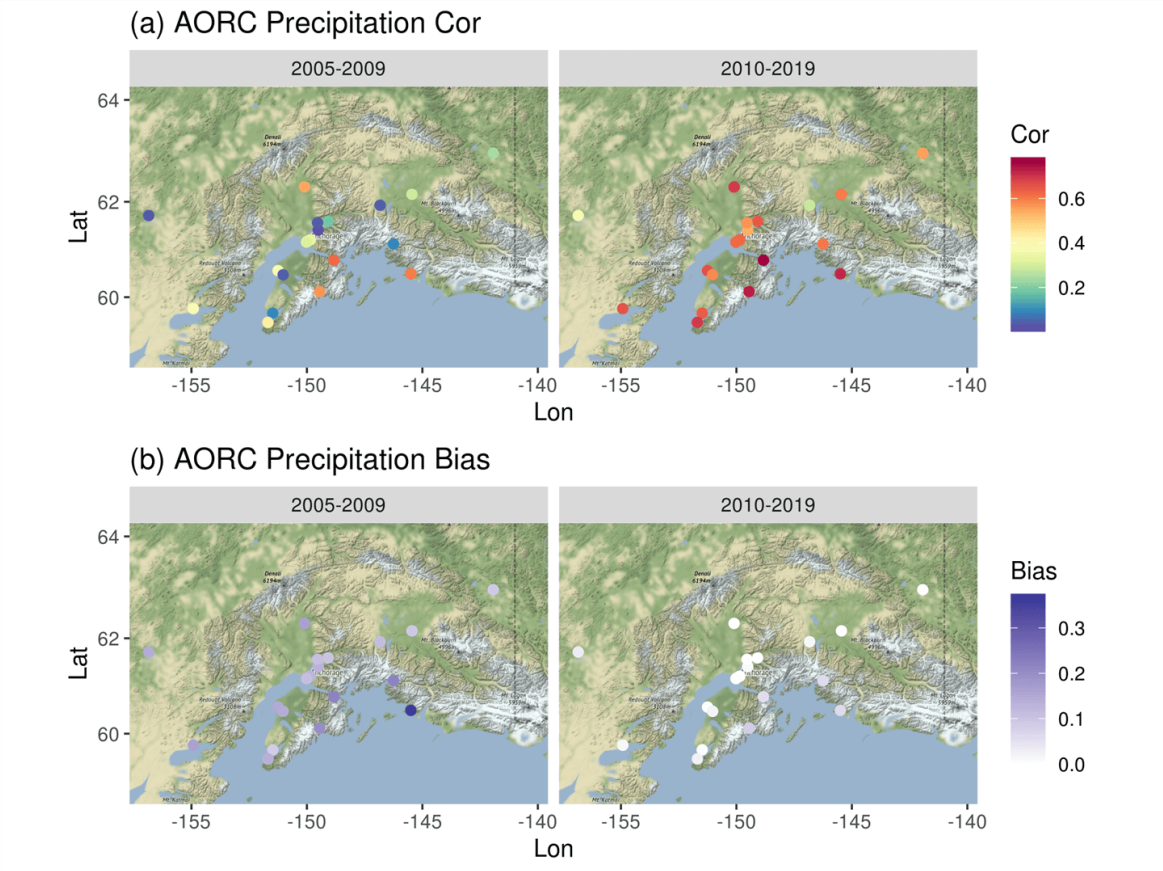


Figure 5. Statistical station maps of AORC vs. ASOS precipitation for 2005-2009 and 2010-2019: (a) correlation coefficient and (b) bias.

AORC Summary:

- Strong correlation with observations for AORC temperature, pressure and humidity.

- Moderate to low correlation with observations for precipitation and wind.
- The biases were noted for the key fields of precipitation (wet) and temperature (cold).
- Ingest of Stage IV QPE into the AORC improved both correlation and RMSE.
- AORC provides a solid foundation for NWM simulations, but regional biases will need to be taken into account when assessing NWM output.

IV. SHORT-RANGE FORCING HRRR JAS 2020

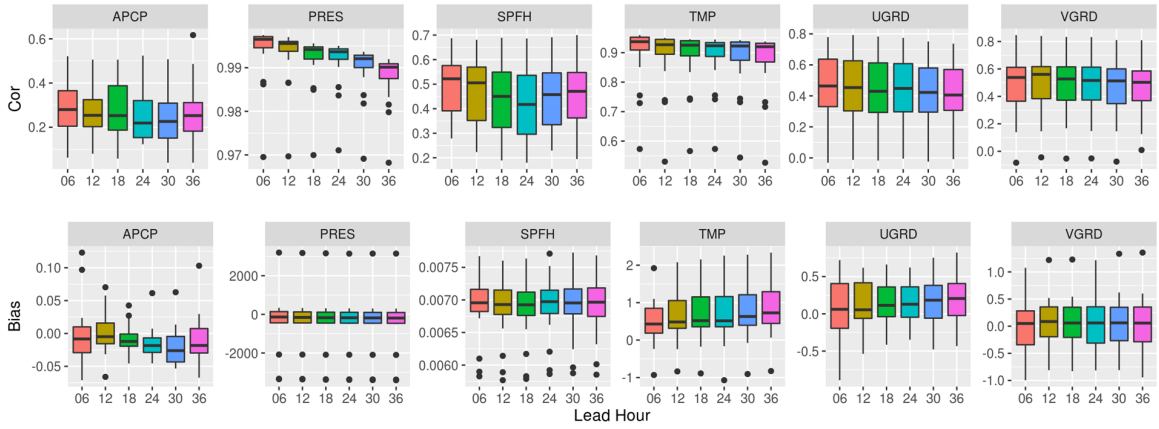
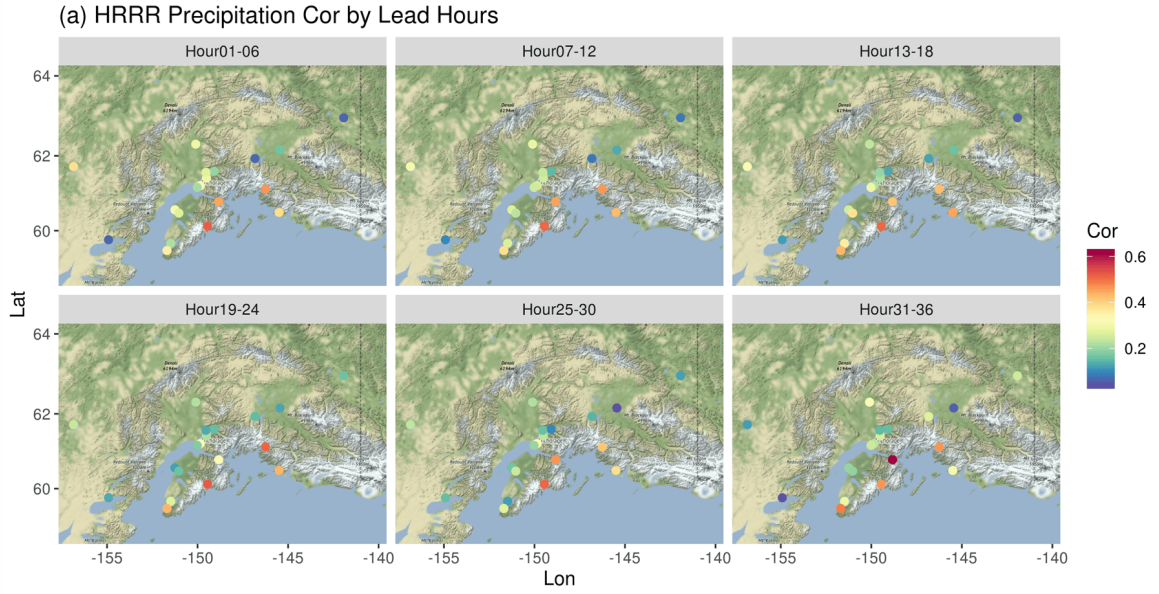


Figure 6. Statistical boxplots of July-September 2020 Alaska HRRR vs. ASOS for the six variables across the twenty stations by lead hours: correlation coefficient (top) and bias (bottom).



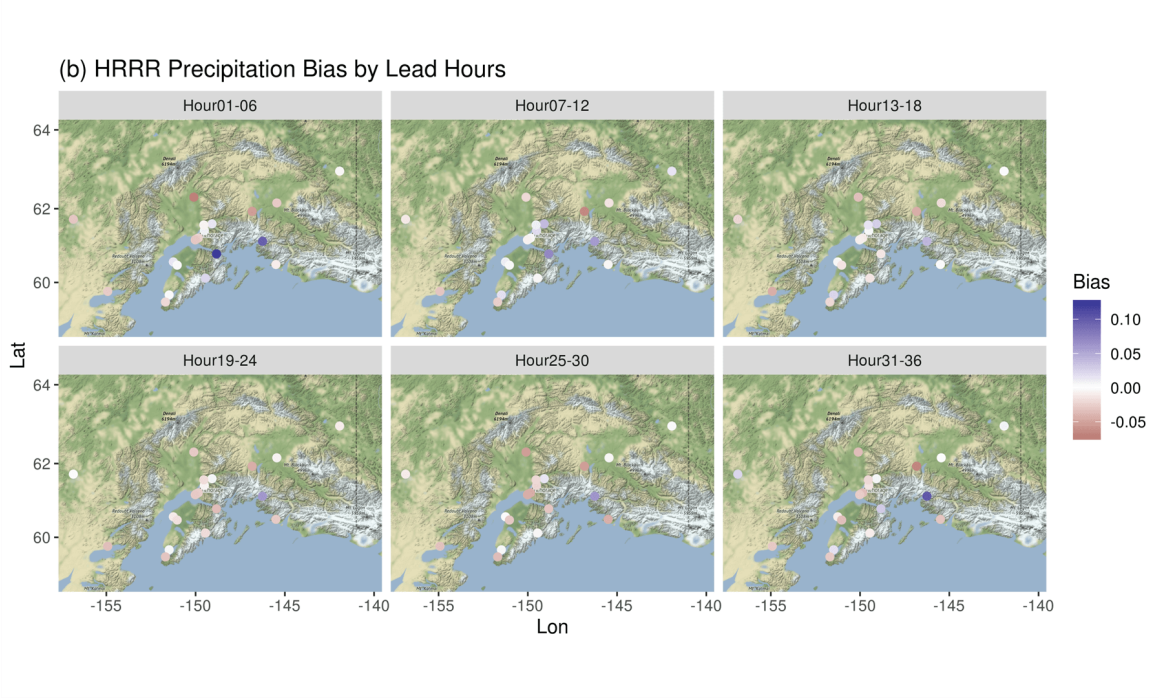


Figure 7. Statistical station maps of Alaska HRRR vs. ASOS precipitation by lead hours in July-September 2020: (a) correlation coefficient and (b) bias.

HRRR Summary:

- Strong correlation with observations for HRRR temperature and pressure.
- Moderate correlation with observations for humidity and wind.
- Relatively low correlation with observations for precipitation.
- Slightly dry biases for precipitation.
- Warm biases for temperature.
- The statistical scores tended to decrease with increasing lead time.

V. MEDIUM-RANGE FORCING GFS JAS 2020

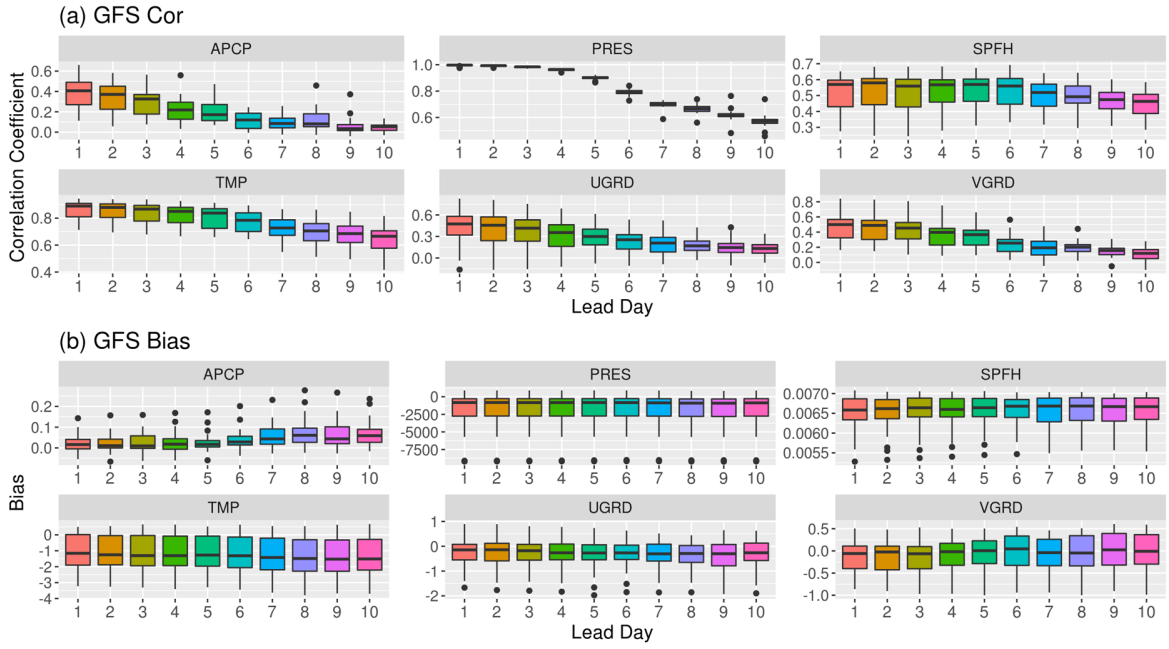
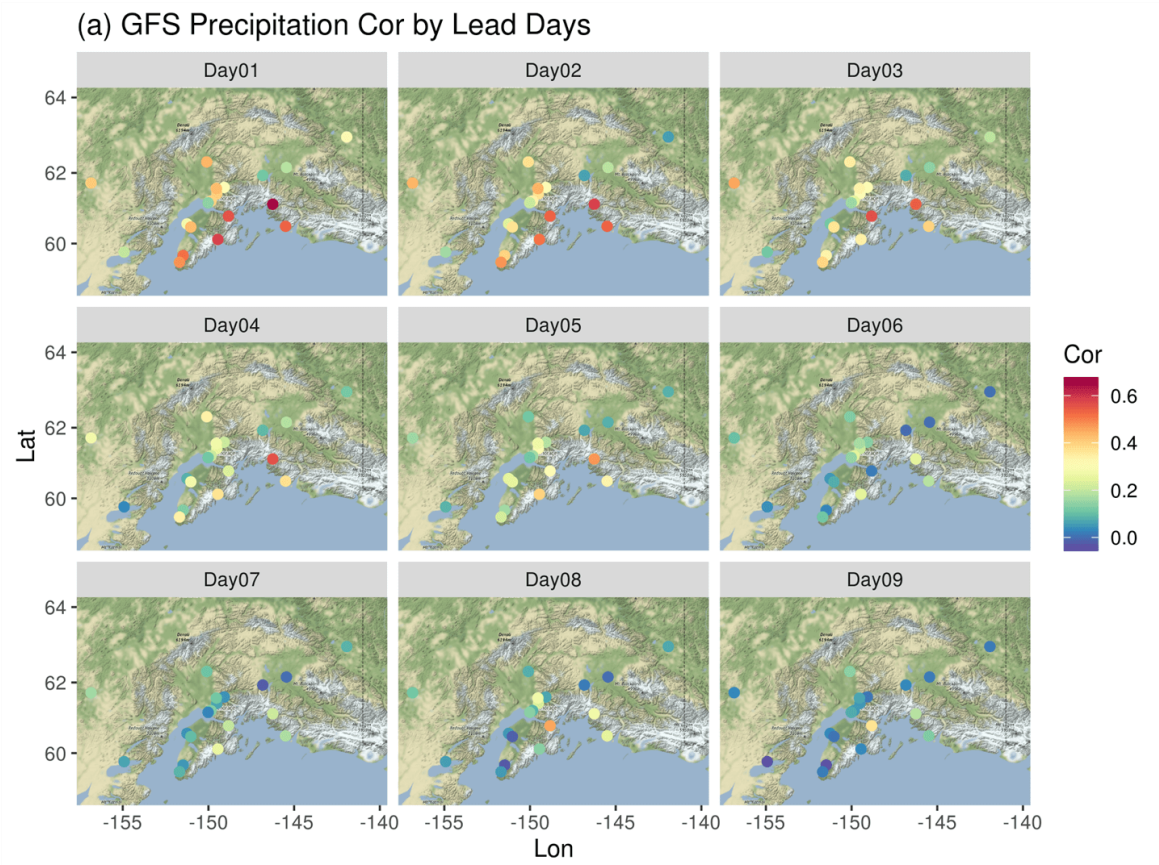


Figure 8. Statistical boxplots of July-September 2020 Alaska GFS vs. ASOS for the six variables across the twenty stations by lead days: (a) correlation coefficient and (b) bias.



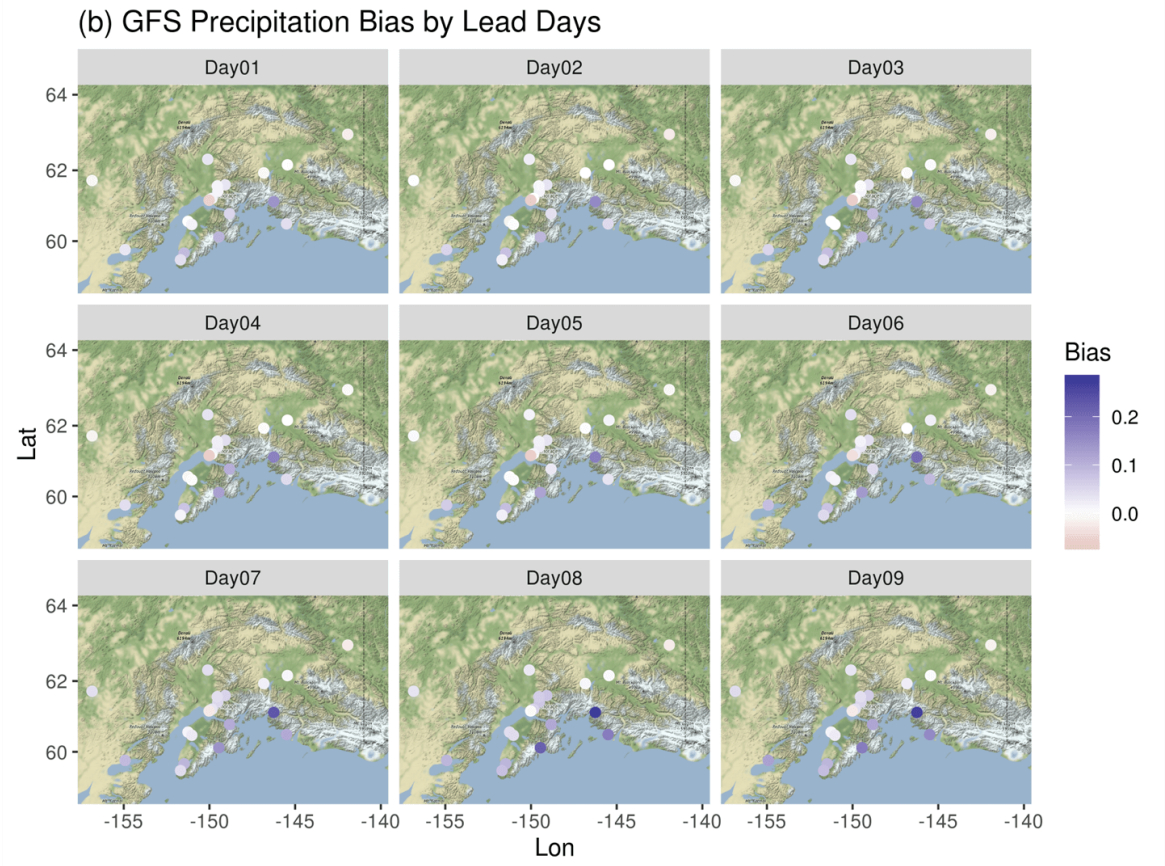


Figure 9. Statistical station maps of Alaska GFS vs. ASOS precipitation by lead days: (a) correlation coefficient and (b) bias.

GFS Summary:

- Strong correlation with observations for GFS temperature and pressure.
- Moderate correlation with observations for humidity and wind.
- Relatively low correlation with observations for precipitation.
- Cold biases for temperature.
- Wet biases and slightly dry biases for precipitation.
- Overall statistical scores decreased with increasing lead time.

ABSTRACT

The National Oceanic and Atmospheric Administration (NOAA) National Water Model (NWM) V3.0 will feature a domain expansion to South Central Alaska that covers the Cook Inlet and Copper River Basins. The NWM is based on the community WRF-Hydro software architecture, and is collaboratively developed via the joint efforts of the NOAA Office of Water Prediction (OWP) and the National Center for Atmospheric Research (NCAR). With the NWM modeling domain expanded from the Contiguous United States (CONUS) to the Canadian portion of the Great Lakes, Hawaii, Puerto Rico, and the U.S. Virgin Islands, adding the Alaska domain not only expands water forecasting coverage for the U.S. public as a whole, but also enhances the capability of the NWM to simulate and forecast in cold climate regions. In the initial stage of the domain expansion, consistent and integrated geospatial datasets are being developed to support model execution (e.g. channel and catchment definitions, soil parameters, glacier coverage etc.), the atmospheric forcings are being identified, evaluated and tested, and preliminary baseline hydrologic and glacier modeling runs are being executed to support improved physics and parameter modifications. This presentation focuses on the atmospheric forcing options that are being considered for use by the NWM V3.0 forcing engine, including the retrospective forcing from the Analysis of Record for Calibration (AORC) for the model benchmark experiment and calibration, and the real-time forcing from the High-Resolution Rapid Refresh (HRRR) and the Global Forecast System (GFS) for the short-range and medium-range hydrologic forecasts. The Automated Surface Observing System (ASOS) station observations over the NWM Alaska modeling domain are applied for the verification of the forcing variables with an emphasis on the key fields of precipitation and temperature. Assessment indicates datasets suitable for NWM use, while other options are still open.