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The Alaska Meteorology, Energy, and Transmission (MET) Toolkit dataset

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Abstract. The Alaska Meteorology, Energy, and Transmission (MET) Toolkit is a multi-year, hourly, 2 km gridded meteorological dataset covering the state of Alaska and adjacent marine areas. It is produced by repackaging the National Oceanic and Atmospheric Administration's operational High-Resolution Rapid Refresh Alaska (HRRR-AK) forecast archive into an analysis-ready format. The native 3 km HRRR-AK fields from the 2- to 4-hour-ahead HRRR-AK forecasts are temporally stitched into a continuous hourly record (2019–2025), horizontally regridded on a 2 km grid, and vertically interpolated to fixed heights between 10 m and 500 m above ground level. We characterize the modeled wind and temperature fields and validate the dataset against more than 150 in situ sites plus a single remote-sensing site drawn from the National Data Buoy Center, the U.S. Climate Reference Network, and the Atmospheric Radiation Measurement North Slope of Alaska site. The dataset, released by the National Laboratory of the Rockies, is openly available through the Wind Resource Database and the Open Energy Data Initiative at https://doi.org/10.25984/3441605 (Bodini et al., 2026b), is distributed in the same format as its sister flagship MET Toolkit datasets over the contiguous United States, Hawaii, and Guam, and is intended to be extended annually.

1 Introduction

Long-term, high-resolution, validated atmospheric records support power system planning, grid resilience to weather-driven hazards, and operational decision support. They are especially relevant in Alaska, where the observing network is sparse, terrain and land–sea interfaces are complex, and many communities depend on small, islanded and microgrid power systems. Grid and transmission planners, operational forecasters, atmospheric scientists, and energy systems analysts require such records for resource characterization, weather-driven hazard assessment, and situational awareness, including for distributed generation in remote, off-grid communities.

The National Laboratory of the Rockies (NLR) maintains a portfolio of openly available, analysis-ready atmospheric datasets for energy applications. Over Alaska, NLR has released the WIND Toolkit Long-term Ensemble Dataset (WTK-LED) Alaska and its Climate variant, a longer, coarser climate-scale Weather Research and Forecasting (WRF) model simulation (Draxl et al., 2024). However, the driving ERA5 reanalysis outperformed these regional simulations across most metrics in a limited validation against near-surface observations (Draxl et al., 2024).

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The National Oceanic and Atmospheric Administration's (NOAA's) operational High-Resolution Rapid Refresh Alaska (HRRR-AK; Dowell et al., 2022; James et al., 2022) offers an alternative: a 3 km convection-allowing forecast run since mid-2018 with Rapid Refresh (RAP) initial and boundary conditions (Benjamin et al., 2016). Its native archive, however, is organized for real-time forecasting as discrete cycles rather than a continuous record, and prior Alaska evaluations have emphasized surface pressure (McCorkle et al., 2018) and ceiling and visibility (Pinto et al., 2020), with winds and temperature only validated at limited sites for the coarser RAP (Bray et al., 2021).

Following the companion contiguous U.S. (CONUS) data article (Bodini et al., 2026c), this paper repackages the native HRRR-AK into a continuous, analysis-ready Alaska record – the Alaska Meteorology, Energy, and Transmission (MET) Toolkit – and characterizes and validates its wind and temperature fields against in situ and remote-sensing observations. The resulting dataset provides a multiyear (2019–2025), hourly, 2 km meteorological record over the entire Alaska domain, with vertical levels from 10 m to 500 m above ground level, openly available in an analysis-ready format and derived directly from NOAA's operational forecast. Because the dataset is a faithfully repackaged operational forecast product on a regular spatiotemporal grid, it is also well suited as training and benchmarking data for machine-learning weather emulators, statistical and generative downscaling, and data-driven nowcasting in a data-sparse, high-latitude region. The validation presented here characterizes the spatial, seasonal, diurnal, and wind speed/temperature dependence of model error against more than 150 observational sites, allowing other researchers to select sites, seasons, and height ranges appropriate to their application and to compare against other Alaska data products. Finally, the dataset is distributed in the same format and on the same data platform as the sister CONUS, Hawaii, and Guam flagship datasets released by NLR, so workflows and tooling built for those products transfer directly, supporting consistent multi-region analyses.

The remainder of this paper is organized as follows. Section 2 describes the HRRR-AK source model, and Sect. 3 the construction of the dataset. Section 4 describes the content of the released dataset and characterizes the modeled fields. Section 5 presents the validation against observations, and Sect. 6 discusses the limitations of the dataset. Data availability is described before the conclusions.

2 Source model: HRRR-Alaska

The Alaska MET Toolkit is derived from NOAA's operational HRRR-AK forecast. HRRR-AK is a 3 km, convection-allowing configuration of the operational HRRR, nested within the RAP (Dowell et al., 2022; James et al., 2022; Benjamin et al., 2016) and built on the Advanced Research WRF (WRF-ARW) dynamical core. It has run operationally since 11 July 2018 (an experimental version existed from December 2016 but is not in the public Amazon Web Services (AWS) archive). HRRR-AK produces hourly forecast output and is initialized on a 3-hourly cycle (rather than the 1-hourly cycle used for HRRR over CONUS), uses the MYNN-EDMF planetary boundary layer scheme (Olson et al., 2019), and takes initial and boundary conditions from the RAP. Table 1 includes more technical details on HRRR-AK.

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Table 1. Principal technical specifications of the Alaska MET Toolkit and the underlying HRRR-AK.

	HRRR-AK (source model)	Alaska MET Toolkit
Period of record	2018–present (operational)	2019–2025
Model/origin	WRF-ARW, v3.9+	Repackaged HRRR-AK forecast
Horizontal resolution	3 km	2 km (regridded)
Model Δt	20 s	–
Output resolution	Hourly output (15 min for a subset of 2D fields), 3-hourly initialization	Hourly
Vertical levels	50 hybrid sigma-pressure (terrain-following) levels	10 m to 500 m above ground level
Boundary conditions	RAP	Inherited from HRRR-AK
Sea surface temperature forcing	Global Forecast System (GFS)	Inherited from HRRR-AK
Planetary boundary layer scheme	Mellor–Yamada–Nakanishi–Niino Eddy Diffusivity Mass Flux (MYNN-EDMF)	Inherited from HRRR-AK
Surface layer scheme	MYNN	Inherited from HRRR-AK
Land surface model	Rapid Update Cycle (RUC)	Inherited from HRRR-AK
Microphysics	Thompson–Eidhammer	Inherited from HRRR-AK
Data assimilation	Yes	Inherited from HRRR-AK
File format	GRIB2	HDF5

3 Construction of the dataset

The Alaska MET Toolkit dataset is produced by downloading the operational HRRR-AK archive, vertically interpolating and regridding the fields, and writing the analysis-ready HDF5 output. Each year is processed independently. The main steps of the processing chain are as follows:

- *Data source and forecast-hour selection.* Native-level (wrfnat) HRRR-AK GRIB2 files are read directly from the NOAA Open Data archive on Amazon S3 (s3://noaa-hrrr-bdp-pds/). For each hour we use the shortest available forecast lead of at least 2 h from the most recent initialization that reaches that valid hour; the f00 analysis is avoided because it contains data-assimilation artifacts. Because HRRR-AK initializes every 3 h, the f02 forecast covers one hour in three, and the two intervening hours are supplied by f03 and f04 from the same cycle (e.g., the 00:00 UTC cycle supplies 02:00, 03:00, 04:00 UTC; the 03:00 UTC cycle supplies 05:00, 06:00, 07:00 UTC). The record therefore alternates among f02–f04 leads on a repeating 3-hourly pattern. Unlike the CONUS HRRR archive, the AWS HRRR-AK archive contained no missing forecast files over our period, so no gap-filling or lead substitution beyond the f02–f04 scheme was required.

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- *Variable extraction and wind rotation.* The configured variables are extracted from their native level types – hybrid model levels for the three-dimensional fields, and the 2 m and surface levels for the single-level fields. Grid-relative wind components are rotated to true north and east.

- *Vertical interpolation.* Heights above ground are computed by subtracting the model surface elevation from geopotential height, and three-dimensional fields are interpolated from the native hybrid levels to a fixed set of heights – 10, 20, 40, 60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300, 400, and 500 m above ground level – using linear interpolation in height. Because HRRR-AK's native hybrid levels are closely spaced relative to these target heights, every target lies between adjacent model levels, so linear interpolation is expected to introduce limited error and avoids assumptions about surface roughness or stability that power- and log-law profiles require.

- *Horizontal regridding.* The native 3 km HRRR-AK fields are regridded onto a 2 km grid. Regridding uses a four-nearest-neighbor, inverse-distance-weighted mapping between the source and target grids, computed once and reused for all files. Wind is regridded as separate U and V components, after which speed and direction are recomputed on the target grid. We note that the 2 km target grid is adopted for consistency with the CONUS, Hawaii, and Guam NLR products; because it is finer than the native 3 km source, the regridding adds no spatial information. Moreover, the effective resolution is coarser than even the native grid spacing: established spectral analyses show that internal numerical diffusion limits WRF-based models to an effective resolution of roughly $7\,\Delta x$ (Skamarock, 2004). Consequently, although the dataset is provided on a 2 km grid, the underlying HRRR-AK – and by extension this dataset – resolves physical features only at scales of approximately 20 km.

- *Output.* Processed fields are written to annual HDF5 files – in the same time-series layout and format as the NLR CONUS, Hawaii, and Guam products – with each dataset storing its scale factor, units, and fill value. Timestamps are provided in UTC, and each hourly record contains the instantaneous model output valid at the top of the hour.

4 Dataset description

The Alaska MET Toolkit is a gridded meteorological dataset covering the state of Alaska and adjacent marine areas (Bodini et al., 2026b). Its principal technical specifications are summarized in Table 1. The dataset spans 2019–2025 at hourly temporal resolution on a 2 km horizontal grid, with variables provided at the fixed above-ground heights used by the NLR WIND Toolkit and MET Toolkit datasets (10 m to 500 m). It is produced from the native NOAA HRRR-AK forecast and is distributed in the same HDF5 format as the CONUS, Hawaii, and Guam flagship datasets (Bodini et al., 2026c, a) and other NLR wind datasets such as NOW-23 (Bodini et al., 2024), so that established access tools apply directly.

Specifically, the released dataset contains hourly fields of boundary layer height, latent heat flux, sensible heat flux, roughness length, friction velocity, skin temperature, and precipitation rate (surface fields); relative humidity and specific humidity (at 2 m); atmospheric pressure at 0 m, 100 m, 200 m, and 300 m; air temperature at 2 m alongside an 18-level vertical profile (10 m;

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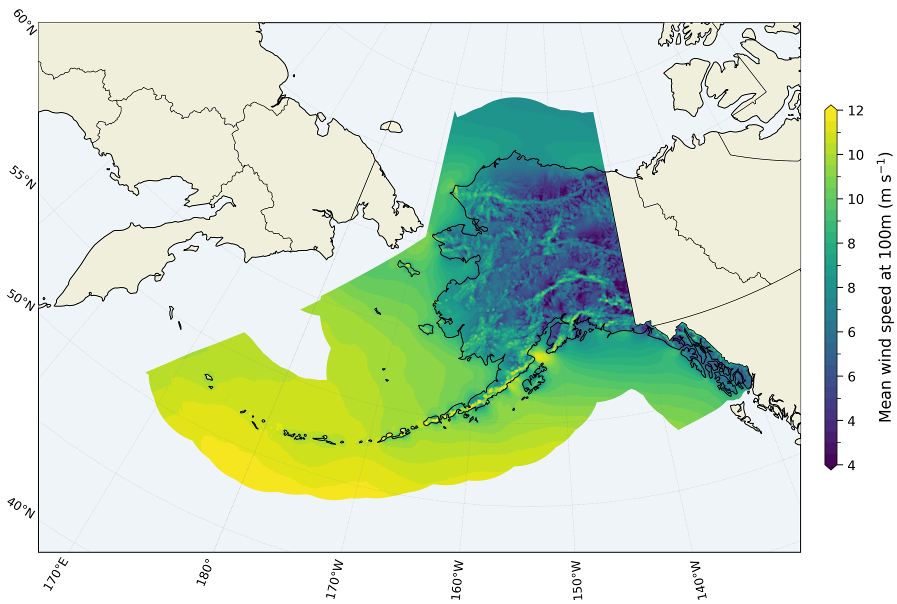

Figure 1. Mean 100 m wind speed from the Alaska MET Toolkit (2019–2025).

every 20 m from 20 to 300 m; and 400 m and 500 m); and coincident 18-level vertical profiles for both wind speed and wind direction across the same vertical levels (10 m to 500 m).

Radiation and solar irradiance variables are not included in this release; users requiring physically consistent solar fields can extract shortwave and longwave radiation directly from the native HRRR-AK archive, and evaluating those fields is left to future work.

Figure 1 shows the mean 100 m wind speed over the domain for 2019–2025. The strongest mean winds occur over marine areas and along the western coast, with lower mean winds over the sheltered interior and complex terrain.

The seasonal and diurnal variability of the 100 m wind field is shown in Figs. 2 and 3, expressed as the departure of each month's (respectively, each UTC hour's) mean from the overall mean. Modeled wind speed is higher in winter, with the largest seasonal amplitude over marine areas, and higher in the UTC hours corresponding to local night over most of the domain, with the largest diurnal amplitude over land.

Figure 4 compares the mean wind speed of the Alaska MET Toolkit with the two legacy NLR data products over Alaska (Draxl et al., 2024) over their overlapping period (2019–2020). Across most of the domain the Alaska MET Toolkit models lower mean wind speed than both WTK-LED Alaska and WTK-LED Climate. We note that given the generally small Alaska MET Toolkit wind speed bias documented below and that WTK-LED has been shown to be outperformed by its ERA5 forcing over Alaska (Draxl et al., 2024; noting that ERA5 itself is not bias-free, particularly over complex terrain), these differences most plausibly reflect WTK-LED overestimating mean wind speed; Fig. 4 is presented as a cross-product comparison, not a validation.

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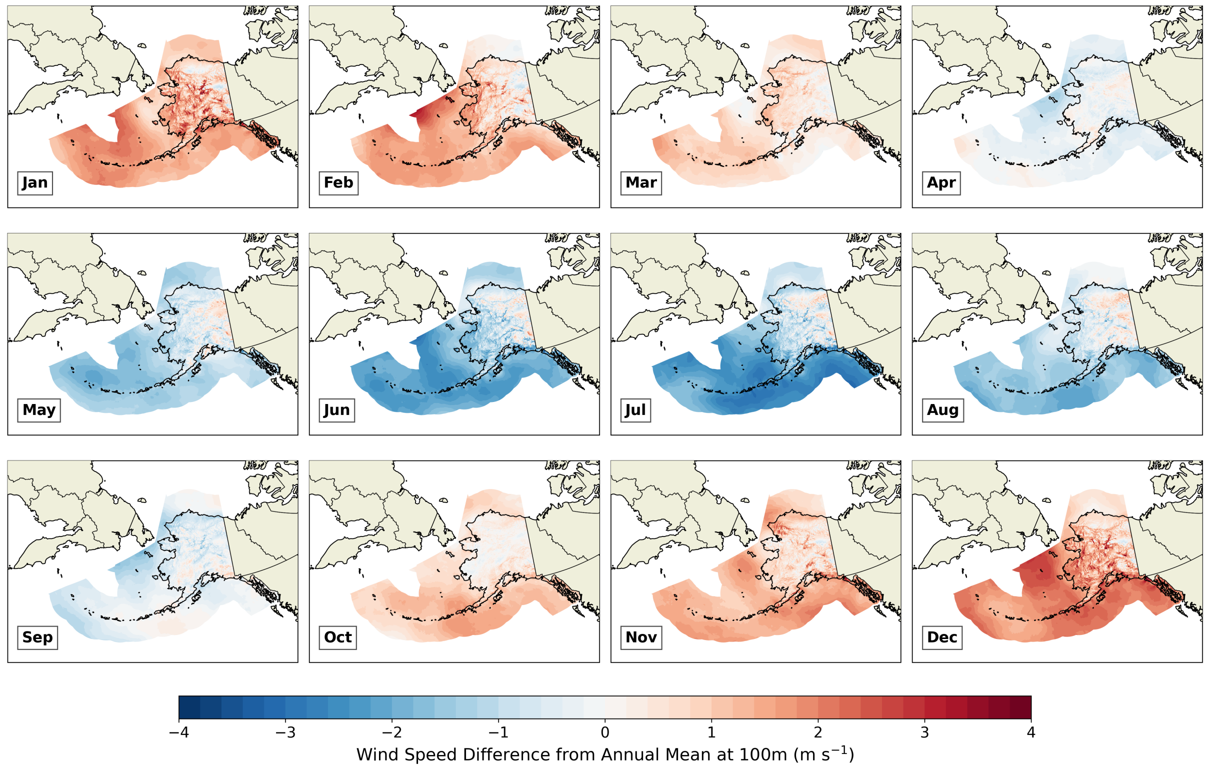

Figure 2. Seasonal cycle of 100 m wind speed in the Alaska MET Toolkit, expressed as each month's mean minus the overall annual mean over 2019–2025.

5 Validation against observations

5.1 Validation observations

The Alaska MET Toolkit was validated against 155 observation sites spanning three publicly available observation networks (Fig. 5):

- National Data Buoy Center (NDBC) stations and buoys (https://www.ndbc.noaa.gov; Hamilton, 1986) provide near-surface wind and temperature at a range of anemometer/sensor heights at coastal and marine sites. We note that several of these anemometers are mounted on lighthouses, docks, port cranes, and buildings rather than free-standing meteorological masts. Structural flow distortion and wake effects can bias the measured winds at such sites; no structure-specific corrections were applied beyond the provider's standard quality control.

- The U.S. Climate Reference Network (USCRN, https://www.ncei.noaa.gov/access/crn/, Diamond et al., 2013; Lee et al., 2026) provides quality-controlled wind speed and temperature at 1.5 m above ground level at long-term stations.

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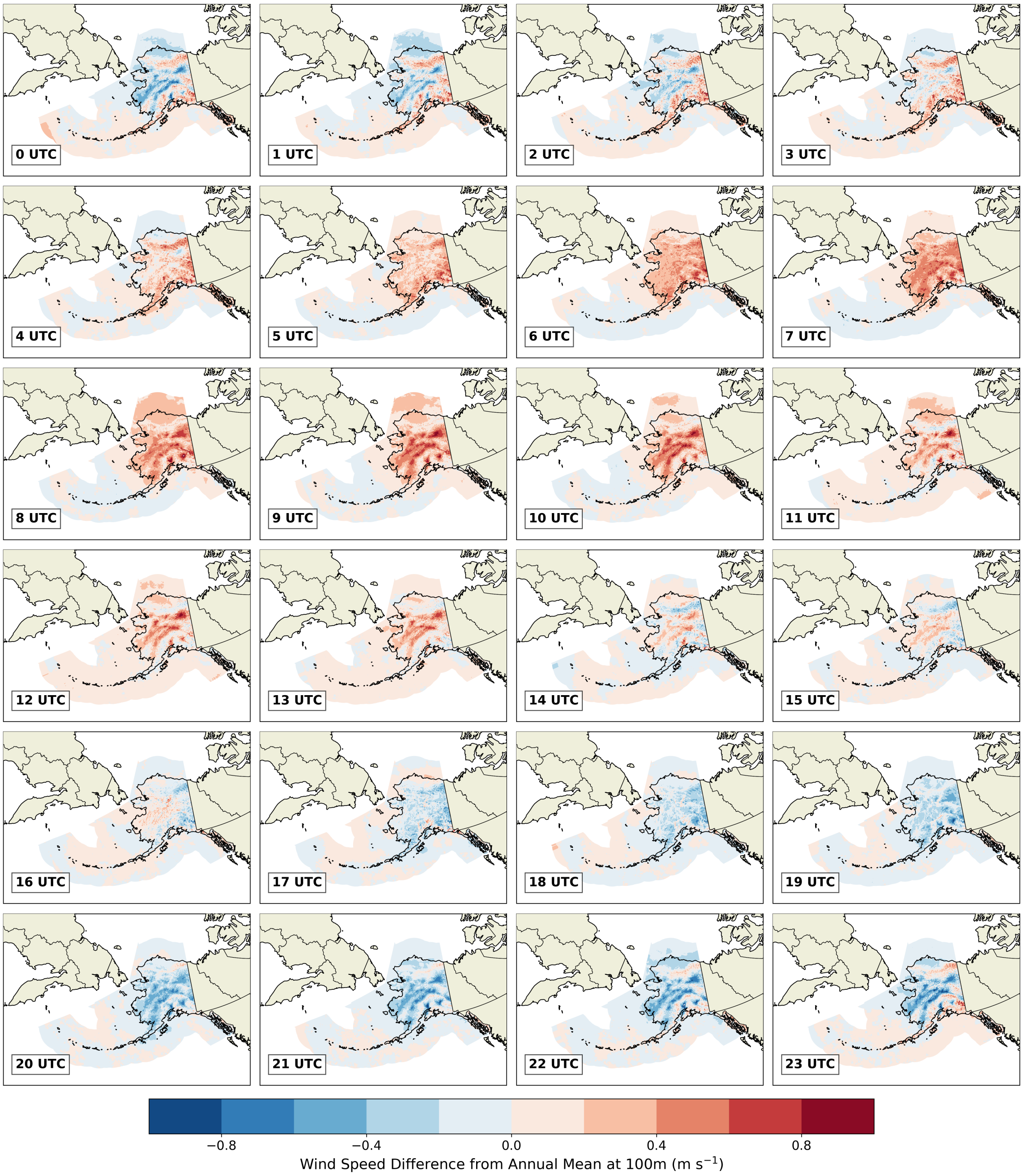

Figure 3. Diurnal cycle of 100 m wind speed in the Alaska MET Toolkit, expressed as each UTC hour's mean minus the overall mean over 2019–2025. Departures are computed in UTC; as the domain spans roughly three time zones, a fixed UTC hour maps to different local times across the domain.

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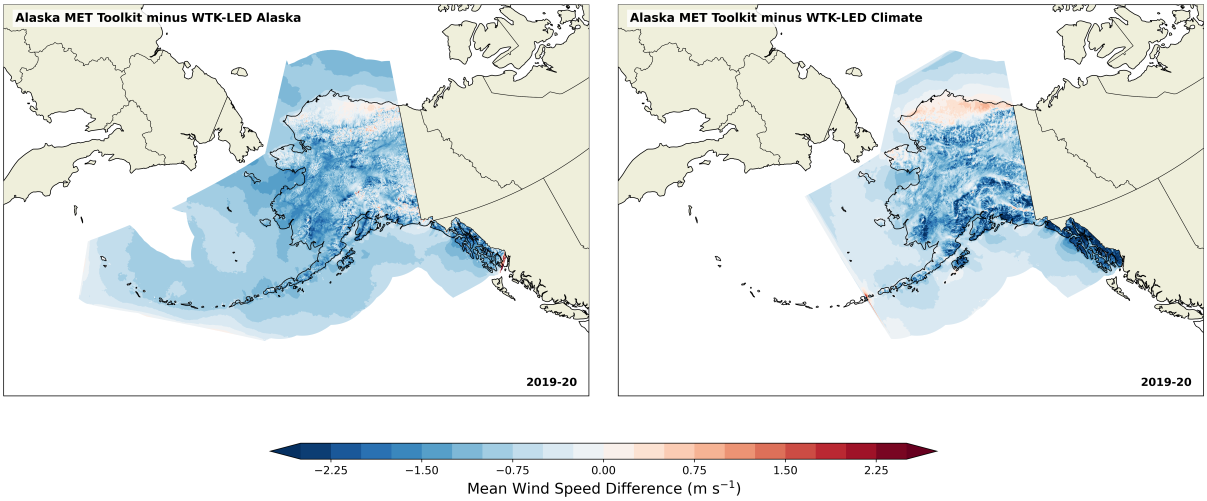

Figure 4. Mean 100 m wind speed difference between the Alaska MET Toolkit and (left) WTK-LED Alaska and (right) WTK-LED Climate, over the overlapping 2019–2020 period.

– The U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) North Slope of Alaska site (NSA, site C1, Utqiaġvik, Verlinde et al., 2016) operates a scanning Doppler lidar, in operation since July 2014, that resolves the wind profile through the lower boundary layer (Pearson et al., 2009). Over the 2019–2025 validation period, the lidar range-gate resolution changed in July 2021, defining two measurement sub-periods (17 m gates before, 29 m gates after).

A complete list of the observational sites used for model validation is included in Table A1 in Appendix A.

5.2 Validation approach

Model and observation pairs were formed as follows:

– *Spatial alignment:* the modeled data were extracted from the nearest-neighbor grid cell to each observational site.

– *Temporal alignment:* observations were matched to the instantaneous hourly HRRR time stamps within a ±10 min tolerance.

– *Vertical alignment:* modeled data were linearly interpolated to each sensor height; for sensor heights below 10 m – the lowest stored model height – a surface-layer logarithmic profile was used to extrapolate below the dataset's lowest level, distinct from the in-profile linear interpolation used to build the dataset and following established near-surface extrapolation methods (Optis et al., 2021). The logarithmic extrapolation used the model-derived roughness length and assumed neutral atmospheric stability.

– *Lidar quality control:* only lidar returns with a carrier-to-noise ratio greater than −23 dB were retained.

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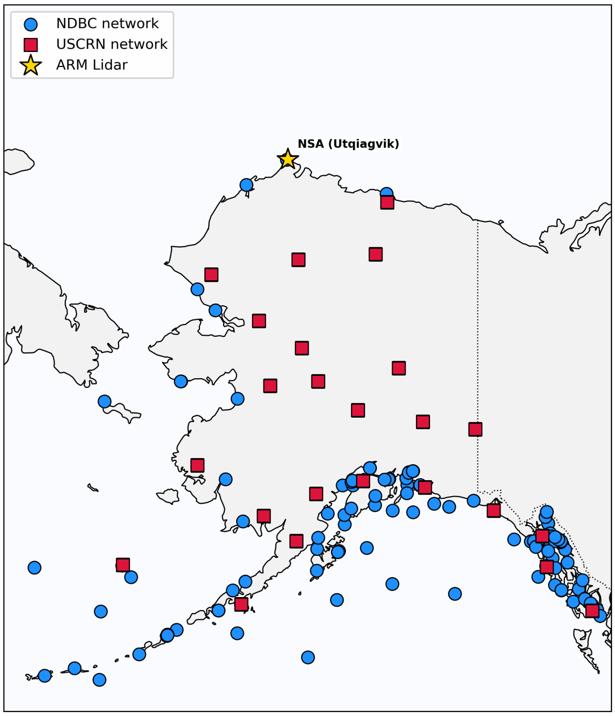

Figure 5. Observation sites used to validate the Alaska MET Toolkit: National Data Buoy Center (NDBC) stations and buoys (circles), United States Climate Reference Network (USCRN) stations (squares), and the U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) scanning Doppler lidar at the North Slope of Alaska (NSA) site (star), Utqiaġvik.

At each site and height, we report the wind speed (or temperature) bias,

$$\text{bias} = \frac{1}{n}\sum_{i=1}^{n}\left(U_{\text{model},i} - U_{\text{obs},i}\right), \tag{1}$$

145 the centered root-mean-square error (cRMSE),

$$\text{cRMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left[\left(U_{\text{model},i} - \overline{U_{\text{model}}}\right) - \left(U_{\text{obs},i} - \overline{U_{\text{obs}}}\right)\right]^2}, \tag{2}$$

and the Pearson correlation coefficient r. In the equations above, $U_{\text{model},i}$ and $U_{\text{obs},i}$ are the modeled (Alaska MET Toolkit) and observed values of the evaluated variable for the ith collocated sample; n is the number of matched model–observation pairs at the given site and height over the evaluation period; an overbar denotes the sample mean over those n pairs. This metric suite follows the one adopted for the validation of previous NLR wind datasets (e.g., Bodini et al., 2024).

Errors were additionally stratified by month, by hour of day, by observed wind speed (or temperature) bin, and – for the multi-height NDBC network and the ARM lidar – by measurement height. Because the Alaska MET Toolkit repackages a single deterministic forecast, an ensemble-based uncertainty estimate is not available; the stratified validation statistics presented in

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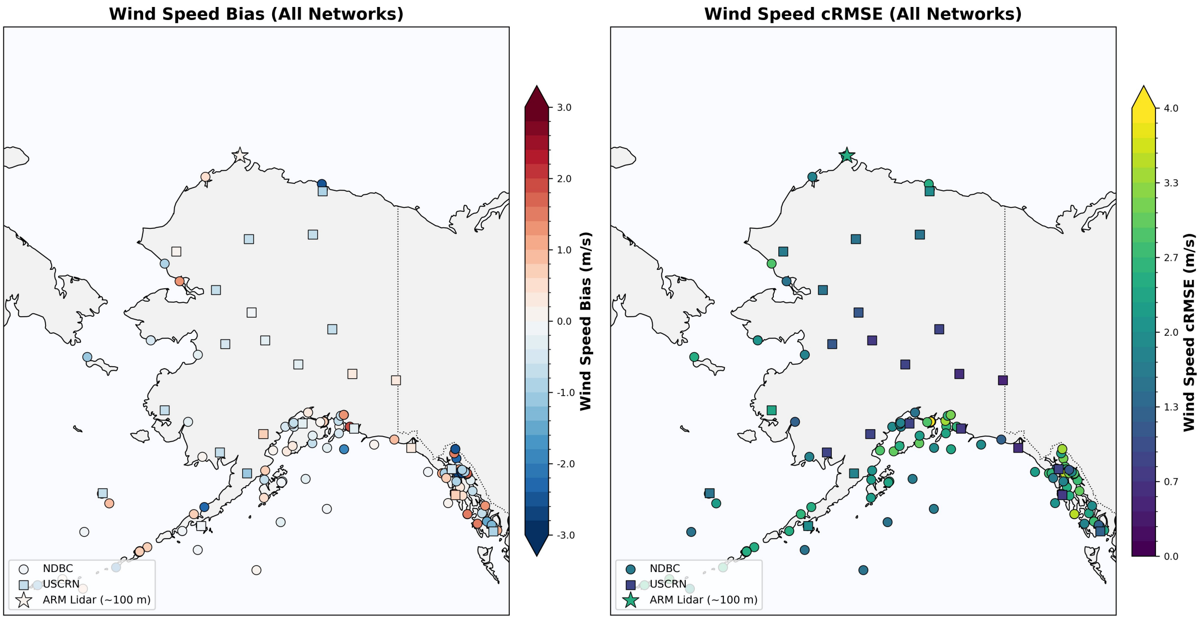

Figure 6. (Left) Wind speed bias and (right) wind speed cRMSE of the Alaska MET Toolkit across all networks. Marker shape denotes network.

the following sections therefore constitute the primary quantitative estimate of dataset uncertainty, and users should consult the sites, seasons, and heights most relevant to their application when assessing expected errors.

5.3 Wind speed validation

For wind speed, the Alaska MET Toolkit shows generally low bias across the domain, with site biases predominantly within $\pm 1\,\mathrm{m\,s^{-1}}$ and cRMSE values broadly in the $1\,\mathrm{m\,s^{-1}}$ to $3\,\mathrm{m\,s^{-1}}$ range (Fig. 6).

Stratifying the wind speed error reveals clear seasonal and diurnal cycles and a strong dependence on the observed wind speed itself, consistent across the NDBC and USCRN networks (Figs. 7 and 8). The median bias becomes increasingly negative at the highest observed wind speeds, and the diurnal and seasonal structure is broadly consistent with the near-surface error patterns reported for RAP over Arctic Alaska by Bray et al. (2021). Note that the change in the HRRR's wind speed bias as a function of wind speed over CONUS, and how to account for this when using these forecasts, has been discussed by Fovell and Capps (2025).

At the ARM scanning Doppler lidar, which measures the wind profile up to several hundred meters above the surface, the sign of the wind speed bias changes with height (Fig. 9). The lidar observations reveal a mean low-level jet (LLJ) near 250 m to 300 m that is not well reproduced by the model in either lidar measurement period (Fig. 10). The two profiles correspond to two instrument configurations: 17 m range gates (January 2019–July 2021) and 29 m range gates (July 2021–December 2025). An analysis of the HRRR wind forecasts relative to profiling observations off the east coast of the U.S. during the third Wind

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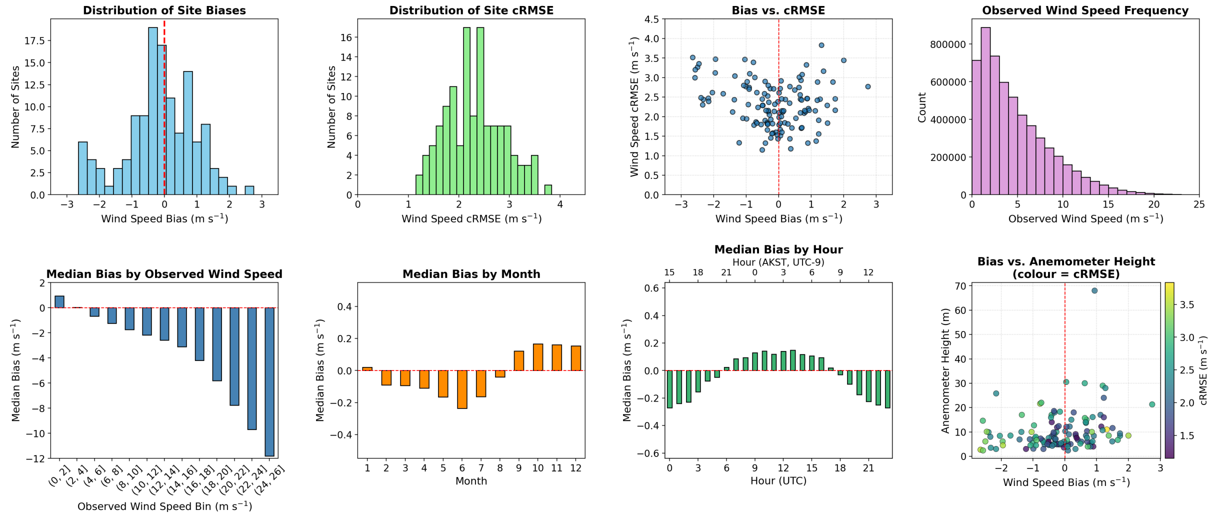

Figure 7. Wind speed error structure across NDBC sites (various measurement heights): distributions of site bias and cRMSE; bias versus cRMSE; observed wind speed frequency; median bias by observed wind speed bin, by month and by hour; and bias versus anemometer height (colored by cRMSE).

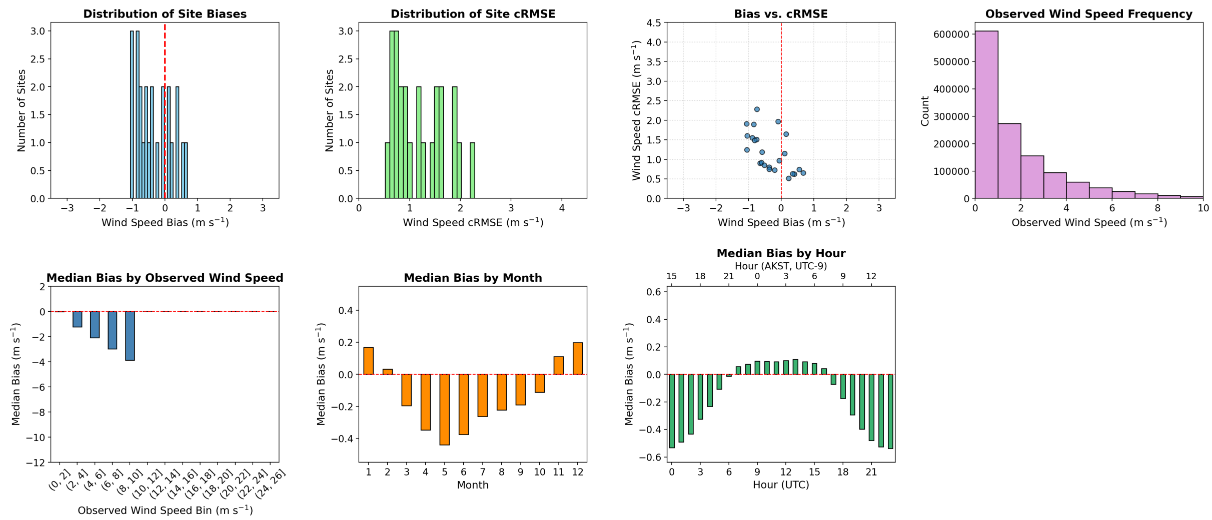

Figure 8. Wind speed error structure across USCRN sites (all 1.5 m above ground level): distributions of site bias and cRMSE; bias versus cRMSE; observed wind speed frequency; and median bias by observed wind speed bin, by month and by hour.

Forecast Improvement Project demonstrated that the HRRR has slightly too much mixing within the MYNN-EDMF scheme, which resulted in weaker LLJs predicted by the model (Adler et al., 2026).

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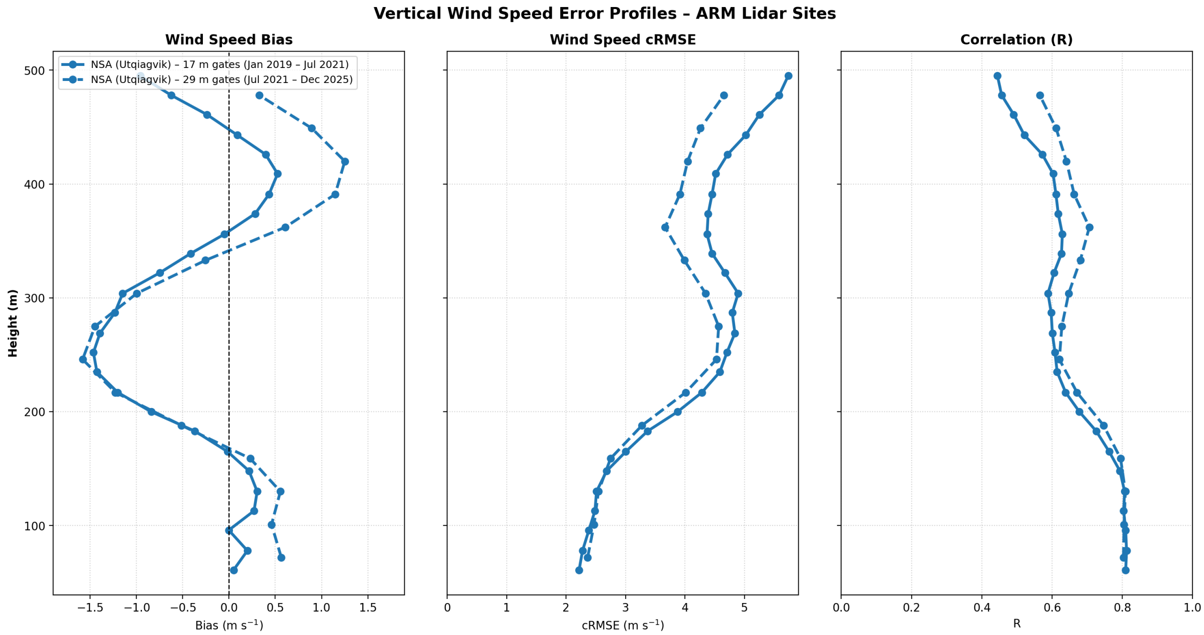

Figure 9. Wind speed bias, cRMSE, and correlation versus height at the ARM North Slope of Alaska lidar site, shown separately for the 17 m gate (January 2019–July 2021: solid) and 29 m gate (July 2021–December 2025: dashed) lidar configurations.

5.4 Air temperature validation

Air temperature also shows generally low bias across the domain, with site biases predominantly within ±1 °C and cRMSE values broadly in the 1 °C to 3 °C range, increasing to approximately 4 °C at some interior USCRN sites (Fig. 11). A clear diurnal cycle and a dependence on the observed temperature itself are evident across both the NDBC and USCRN networks (Figs. 12 and 13): the median bias is small and predominantly negative across months and hours of the day, and becomes largest in magnitude (approximately −1 °C to −1.5 °C) at the warmest observed temperatures, whereas at the coldest observed temperatures it differs in sign between the two networks (negative across NDBC sites and positive across USCRN sites).

6 Limitations

The following limitations should be considered when using the Alaska MET Toolkit:

- The dataset inherits the characteristics and errors of HRRR-AK.
- Only wind speed and air temperature are validated in this work. All other released variables are provided as repackaged from HRRR-AK without independent evaluation against observations.

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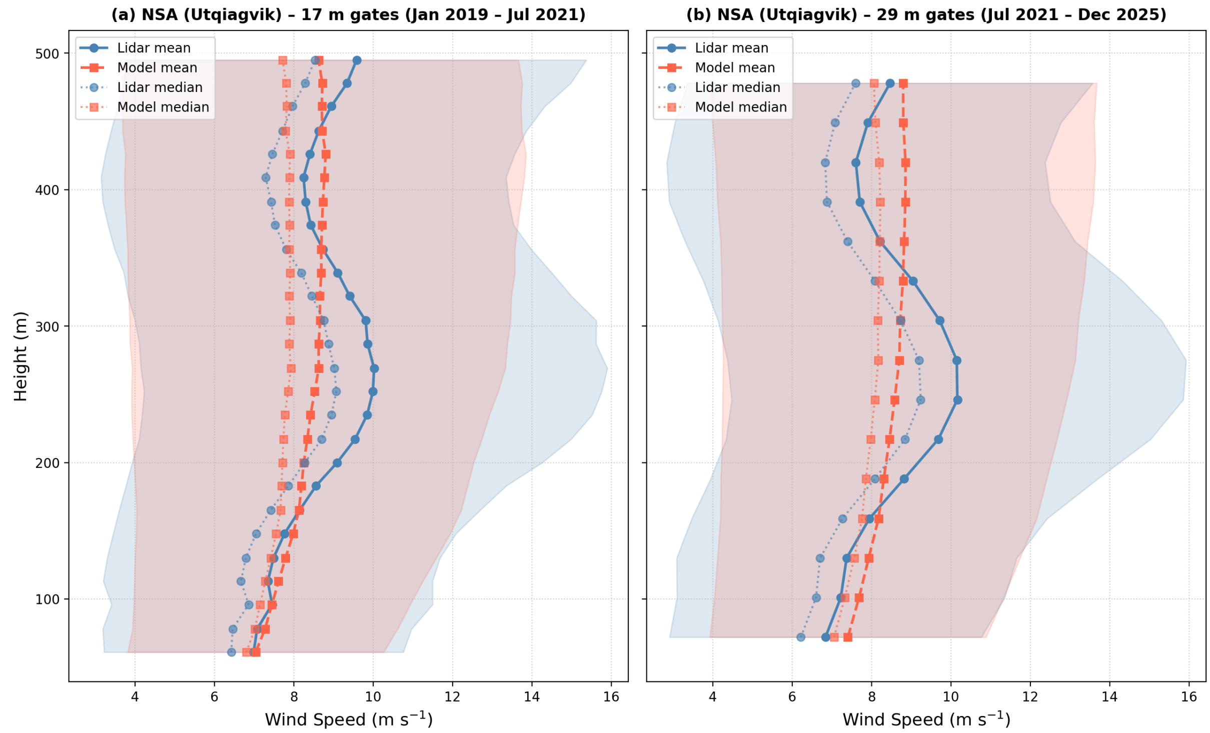

Figure 10. Mean and median observed and modeled wind speed profiles at the ARM lidar (shading: ±1 standard deviation) for the two measurement periods: (a) 17 m gates and (b) 29 m gates. The observed mean LLJ near 250–300 m is not captured by the model.

– The record begins in 2019; the experimental HRRR-AK available from December 2016 is not in the public AWS archive and is not included in our processing.

– The dataset spans the operational transition from HRRR-AK version 3 to version 4, implemented on 2 December 2020, so the record is not strictly homogeneous across this date; part of any apparent change near the 2020/2021 boundary may reflect the model upgrade rather than the atmosphere.

– A mean LLJ observed at the ARM lidar site is not reproduced in the model (Fig. 10). This assessment rests on the single ARM site and should not be generalized across the domain, though it is consistent with the known tendency of boundary-layer schemes to under-represent jets in stably stratified conditions (Adler et al., 2026).

– Modeled errors are largest at the highest wind speeds and most extreme temperatures, with pronounced seasonal and diurnal structure (Figs. 7, 8, 12, and 13).

– We release these data for resource characterization, energy system analysis, and grid resilience studies, based on the validation presented here. Because the validation observations are sparse and are mostly near surface, users should understand this validation basis before relying on the data for decision-making.

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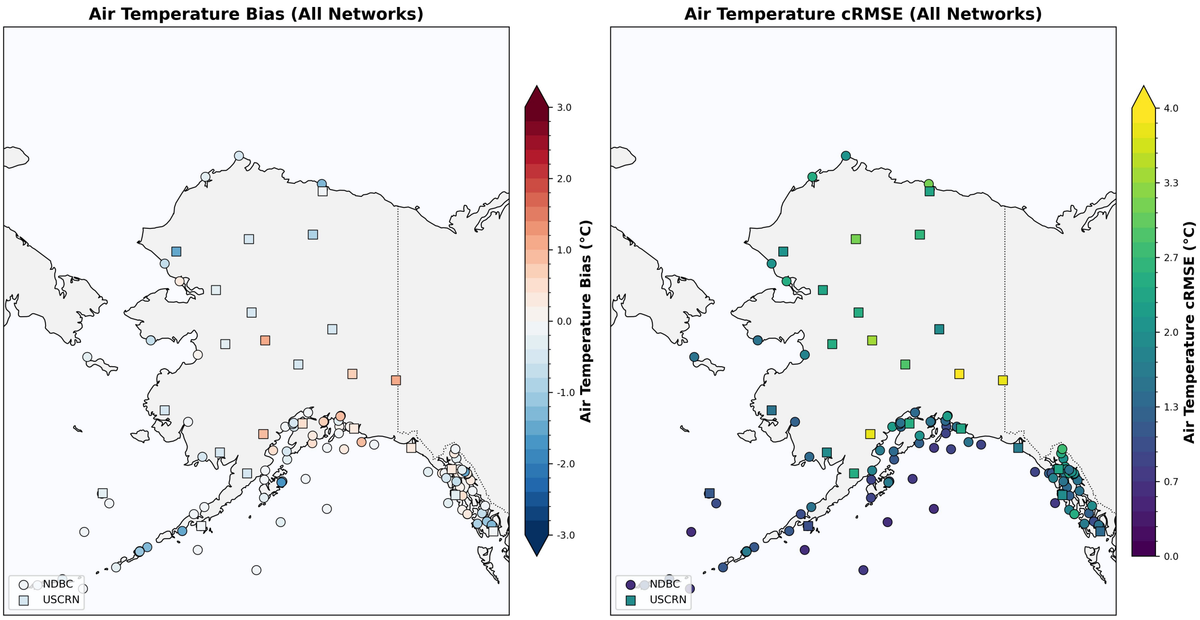

Figure 11. (Left) Air temperature bias and (right) air temperature cRMSE of the Alaska MET Toolkit across the NDBC and USCRN networks.

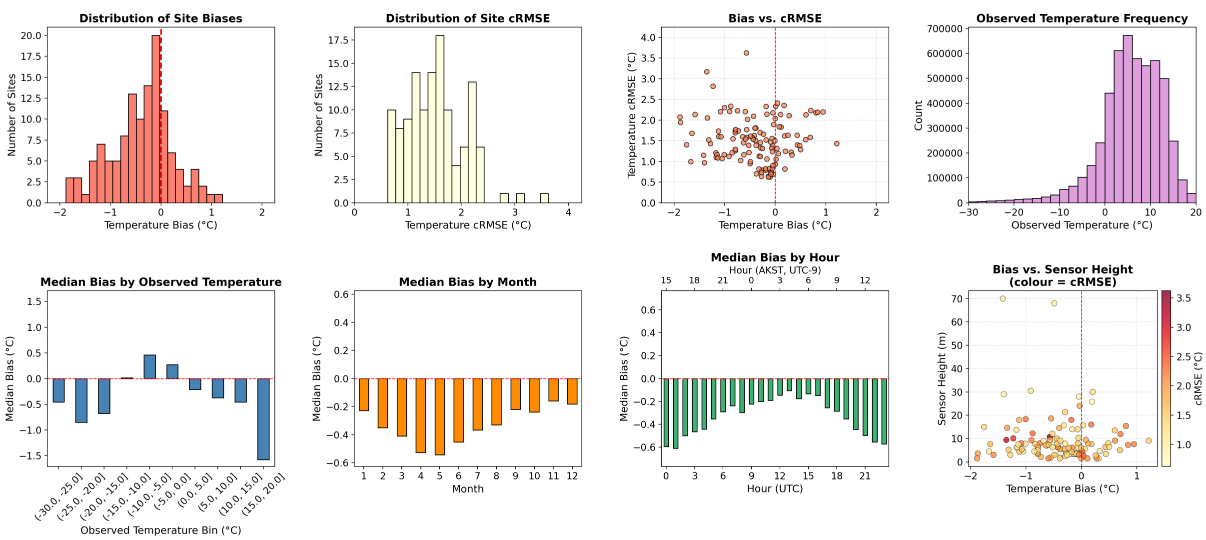

Figure 12. Air temperature error structure across NDBC sites: distributions of site bias and cRMSE; bias versus cRMSE; observed temperature frequency; median bias by observed temperature bin, by month and by hour; and bias versus sensor height (colored by cRMSE).

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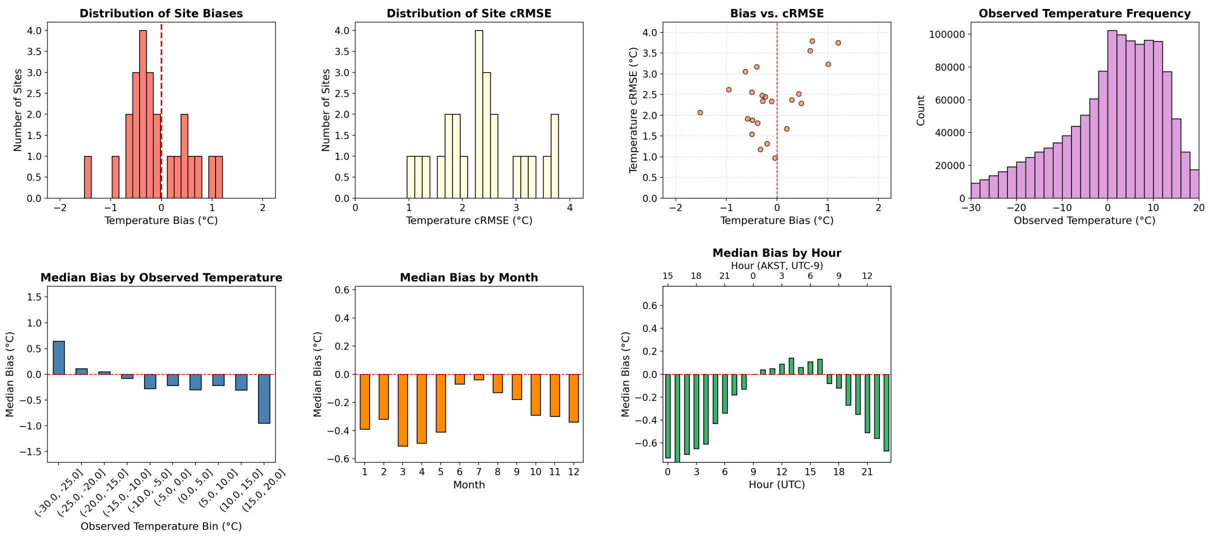

Figure 13. Air temperature error structure across USCRN sites: distributions of site bias and cRMSE; bias versus cRMSE; observed temperature frequency; and median bias by observed temperature bin, by month and by hour.

7 Data availability

The Alaska MET Toolkit dataset is openly available at no cost through the Open Energy Data Initiative (OEDI) at https://doi.org/10.25984/3441605 (Bodini et al., 2026b), under a Creative Commons Attribution 4.0 (CC BY 4.0) license; no registration is required for access. The full dataset (approximately 20 TB) is stored as annual HDF5 files in the NLR public data bucket on AWS (s3://nrel-pds-wtk/met_toolkit/alaska/), part of the AWS Open Data program, and can be listed and downloaded anonymously (e.g., `aws s3 ls --no-sign-request s3://nrel-pds-wtk/met_toolkit/alaska/`). The files can also be accessed and manipulated programmatically with the open-source REsource eXtraction (rex) Python package (Rossol and Buster, 2021), which includes usage examples for the MET Toolkit datasets, and is available at https://github.com/NatLabRockies/rex and archived on Zenodo (Rossol and Buster, 2021). Alternatively, the Wind Resource Database (https://wrdb.nlr.gov) allows users to explore the data interactively and easily download CSV extracts at selected sites and regions, which can also serve as sample data for the full dataset. Support requests can be directed to wrdb@nlr.gov.

8 Conclusions

The Alaska MET Toolkit repackages NOAA's operational HRRR-AK forecast archive into a continuous, analysis-ready, hourly meteorological record spanning 2019–2025 on a 2 km grid, with wind, temperature, and additional surface and near-surface variables at fixed heights from 10 m to 500 m above ground level. Validation against 155 observational sites from the NDBC, USCRN, and ARM networks shows generally low wind speed and temperature biases across the domain, with error magnitudes that depend on season, time of day, observed magnitude, and height; a mean low-level jet observed at the ARM North Slope

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of Alaska lidar is not reproduced by the model. The dataset is distributed in the same HDF5 format and on the same platforms as the sister CONUS, Hawaii, and Guam MET Toolkit datasets, so established workflows and tooling transfer directly, and it is intended to be extended annually as the operational HRRR-AK archive grows. We anticipate the dataset will support wind resource characterization, energy system and grid resilience analyses, and the development of machine-learning applications in this data-sparse, high-latitude region.

Appendix A: List of observational sites

Table A1 lists the observational sites used to validate the Alaska MET Toolkit.

Table A1: List of observational sites used to validate the Alaska MET Toolkit. IDs are NDBC station codes, USCRN WBAN numbers, and the ARM facility code. Heights are above ground level; site elevation is meters above mean sea level. "–" indicates the variable was unavailable or QC-excluded. Period of record is each station's full operational span; all model–observation matching is performed over the 2019–2025 evaluation period.

ID	Name	Data host	Latitude (° N)	Longitude (° E)	Elevation (m)	Wind height (m)	Temperature height (m)	Period of record
46001	Western Gulf of Alaska	NDBC	56.296	-148.027	0	4.9	3.7	1997–Present
46060	West Orca Bay	NDBC	60.571	-146.795	0	4.9	3.7	1995–Present
46061	Seal Rocks	NDBC	60.231	-146.84	0	4.9	3.4	1999–Present
46066	South Kodiak	NDBC	52.776	-154.992	0	5	3.4	2000–Present
46070	Southwest Bering Sea	NDBC	55.048	175.246	0	5	3.7	2006–Present
46071	Western Aleutians	NDBC	51.04	179.764	0	4.9	3.4	2002–Present
46072	Central Aleutians	NDBC	51.645	-172.145	0	4.9	3.4	2001–Present
46073	Southeast Bering Sea	NDBC	55.008	-172.012	0	4.9	3.4	2005–Present
46075	Shumagin Islands	NDBC	53.969	-160.794	0	4.9	3.4	2003–Present
46076	Cape Cleare	NDBC	59.508	-148.005	0	4.9	3.4	2005–Present
46077	Shelikof Strait	NDBC	57.869	-154.211	0	4.9	3.4	2001–Present
46078	Albatross Bank	NDBC	55.561	-152.599	0	5	3.4	2003–Present
46080	Portlock Bank	NDBC	57.91	-150.129	0	4.9	3.4	2002–Present
46081	Western Prince William Sound	NDBC	60.802	-148.283	0	4.9	3.4	2003–Present
46082	Cape Suckling	NDBC	59.67	-143.353	0	5	3.4	2002–Present
46083	Fairweather Ground	NDBC	58.276	-138.024	0	4.9	3.4	2001–Present
46084	Cape Edgecumbe	NDBC	56.614	-136.04	0	4.9	3.4	2002–Present
ABYA2	Auke Bay Lab Dock	NDBC	58.381	-134.646	9.1	12.2	1.8	2024–2026
ADKA2	Adak Island	NDBC	51.863	-176.632	0	8.5	7.6	2004–Present
AJXA2	Juneau AJ Dock	NDBC	58.287	-134.398	4.57	3	–	2017–Present
AKXA2	Akutan	NDBC	54.132	-165.782	0	13.7	13.7	2020–Present
ALIA2	Alitak	NDBC	56.898	-154.247	0	10.3	9.6	2008–Present
AMAA2	East Amatuli Island Light	NDBC	58.916	-151.952	33.2	–	15.7	2003–Present
ANTA2	Anchorage	NDBC	61.238	-149.89	0	6.8	6.1	2004–Present
APMA2	Anchorage Port	NDBC	61.238	-149.887	0	10.3	10.3	2020–Present
ATKA2	Atka	NDBC	52.232	-174.173	0	8.5	7.8	2008–Present
AUGA2	Augustine Island	NDBC	59.378	-153.348	9.1	6.6	6.4	1999–Present
BEXA2	Bethel	NDBC	60.791	-161.749	0	14	14	2020–Present
BLIA2	Bligh Reef Light	NDBC	60.839	-146.884	0	21.6	21.3	1995–Present

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Table A1: Continued.

ID	Name	Data host	Latitude (° N)	Longitude (° E)	Elevation (m)	Wind height (m)	Temperature height (m)	Period of record
BLTA2	Bartlett Cove	NDBC	58.455	-135.888	0	9.1	5.5	2007–Present
CDEA2	Cape Decision	NDBC	56.01	-134.13	0	10	1.5	2006–Present
CDXA2	Cape Decision (Marine Exchange of Alaska)	NDBC	56.001	-134.136	15.24	9.1	9.1	2017–Present
COXA2	Cordova	NDBC	60.542	-145.766	0	5.5	5.5	2024–2026
CPSA2	Cape Seniavin	NDBC	56.397	-160.142	0	3.5	3.5	2024–Present
CPXA2	Captains Bay	NDBC	53.843	-166.583	0	15	15	2020–Present
CRGA2	Craig	NDBC	55.474	-133.136	0	11.6	2.1	2020–Present
CRVA2	Cordova	NDBC	60.557	-145.755	0	8.4	7.9	2010–Present
CSPA2	Cape Spencer	NDBC	58.21	-136.63	0	10	1.5	2006–Present
CSXA2	Cape Spencer WX	NDBC	58.199	-136.641	0	30	30	2022–Present
DCXA2	Devils Cove	NDBC	58.351	-154.127	0	6	14.5	2025–Present
DHXA2	Deadhorse	NDBC	70.222	-148.419	0	8	8	2020–Present
DPLA2	Dutch Harbor APL	NDBC	53.884	-166.531	0	30.5	30.5	2020–Present
DPOA2	Dutch Harbor Port Office	NDBC	53.903	-166.528	0	6.1	6.1	2020–Present
DPXA2	Dutch Harbor Pilot Station	NDBC	53.889	-166.542	0	9	9	2020–Present
DRFA2	Drift River Terminal	NDBC	60.553	-152.137	15.9	6.6	6.4	1999–Present
ELXA2	Cape St. Elias	NDBC	59.798	-144.6	0	–	13.5	2025–Present
EROA2	Eldred Rock	NDBC	58.97	-135.22	0	6.1	1.5	2006–Present
ERXA2	Eldred Rock (Marine Exchange of Alaska)	NDBC	58.971	-135.221	16.76	6.1	6.1	2017–Present
FFIA2	Five Fingers	NDBC	57.27	-133.631	6.7	22	4.3	1994–Present
FILA2	Flat Island Light	NDBC	59.331	-151.995	17.9	15.7	15.7	2003–Present
GBXA2	Gambell	NDBC	63.777	-171.715	0	10	10	2020–Present
GEXA2	George Island	NDBC	58.213	-136.381	0	5.5	5.5	2020–Present
GIXA2	Guard Island	NDBC	55.446	-131.881	8.8	2.4	2.4	2017–Present
GPXA2	Grave Point	NDBC	58.062	-134.051	0	6	6	2021–Present
GUXA2	Gustavus Dock	NDBC	58.408	-135.726	7	7.6	7.6	2017–Present
HAXA2	Haines Harbor	NDBC	59.234	-135.442	7.6	17	4.6	2017–2026
HMSA2	Homer Spit	NDBC	59.602	-151.417	15	15	–	2012–2026
ICYA2	Icy Bay	NDBC	59.923	-141.359	10	4	–	2012–Present
JLXA2	Juneau Library	NDBC	58.298	-134.404	0	21.3	21.3	2018–Present
JMLA2	Juneau AML Dock	NDBC	58.286	-134.39	5.5	18.3	18.3	2013–Present
JNEA2	Juneau	NDBC	58.298	-134.412	0	8.5	8	2009–Present
JNGA2	Juneau ANG Dock	NDBC	58.291	-134.394	0	3.6	–	2020–Present
KCXA2	King Cove	NDBC	55.057	-162.326	0	29	29	2022–Present
KDAA2	Kodiak Island	NDBC	57.73	-152.514	0	8.4	7.8	2010–Present
KECA2	Ketchikan	NDBC	55.333	-131.625	0	8.2	7.7	2009–Present
KEXA2	Ketchikan Harbor	NDBC	55.352	-131.684	3.66	7	7	2017–Present
KGCA2	King Cove	NDBC	55.062	-162.327	0	6.9	6.3	2008–Present
KGXA2	Kodiak Gull Island	NDBC	57.777	-152.425	0	7.5	7.5	2020–Present
KMXA2	Kodiak Matson Crane	NDBC	57.782	-152.439	0	–	70	2020–Present
KNXA2	Kenai	NDBC	60.552	-151.274	0	9.1	9.1	2020–Present
KOZA2	Kotzebue (Marine Exchange of Alaska)	NDBC	66.901	-162.589	0	16	16	2022–Present
LCNA2	Lincoln Island	NDBC	56.058	-132.69	0	7.5	6.5	2007–Present
LIXA2	Little Island	NDBC	58.54	-135.047	9.14	17	3	2017–2026

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Table A1: Continued.

ID	Name	Data host	Latitude (° N)	Longitude (° E)	Elevation (m)	Wind height (m)	Temperature height (m)	Period of record
MDXA2	Middleton Island	NDBC	59.438	-146.327	0	25.8	25.8	2024–Present
MIXA2	Midway Island	NDBC	57.837	-133.814	0	8	8	2021–Present
MRKA2	Middle Rock Light	NDBC	61.081	-146.653	0	15.9	15.4	1997–Present
MRNA2	Marmion Island	NDBC	58.198	-134.257	3	4	–	2012–Present
MRYA2	Mary Island	NDBC	55.099	-131.182	4	4	–	2012–Present
MVXA2	Mendenhall Valley	NDBC	58.364	-134.606	7.62	11.9	11.9	2017–Present
MXXA2	Marine Exchange of Alaska Office	NDBC	58.301	-134.426	5.18	12.2	12.2	2017–Present
NKTA2	Nikiski	NDBC	60.683	-151.398	0	12.4	3.4	2004–Present
NKXA2	Naked Island	NDBC	58.255	-134.945	12.19	17	3	2017–2026
NLXA2	Nelson Lagoon	NDBC	56.005	-161.177	0	14	14	2021–Present
NMTA2	Nome, Norton Sound	NDBC	64.5	-165.43	0	7.3	4	2004–Present
NMXA2	Nome	NDBC	64.494	-165.44	0	7.1	7.1	2020–Present
NSXA2	Nikiski	NDBC	60.74	-151.311	0	7.3	7.3	2020–Present
OLSA2	Nikolski	NDBC	52.941	-168.871	0	8.4	7.8	2010–Present
PAUA2	St. Paul (Marine Exchange of Alaska)	NDBC	57.124	-170.271	0	28	28	2022–Present
PAXA2	Point Arden	NDBC	58.159	-134.178	0	4	7.3	2018–Present
PBPA2	Point Bishop	NDBC	58.2	-134.15	0	6.7	1.5	2006–Present
PCXA2	Point Craven (Marine Exchange of Alaska)	NDBC	57.463	-134.867	5	6	6	2022–Present
PEXA2	Pelican (Marine Exchange of Alaska)	NDBC	57.958	-136.227	6	6	6	2022–Present
PGXA2	Point Gardner	NDBC	57.016	-134.618	0	4.6	4.6	2018–Present
PILA2	Pilot Rock	NDBC	59.742	-149.47	24	6.6	6.4	1999–Present
PLXA2	Port Alexander	NDBC	56.247	-134.647	0	–	7.9	2009–Present
POTA2	Potato Point	NDBC	61.056	-146.697	7	–	9.1	1995–Present
PPXA2	Point Pigot	NDBC	60.801	-148.357	0	11	5	2022–Present
PRDA2	Prudhoe Bay	NDBC	70.4	-148.527	0	9.9	9.4	2004–Present
PRTA2	Point Retreat	NDBC	58.41	-134.95	0	6.1	1.5	2006–Present
PTLA2	Portland Island	NDBC	58.346	-134.752	4	3	–	2012–Present
RDDA2	Red Dog Dock	NDBC	67.577	-164.065	0	12.7	9.3	2006–Present
RIXA2	Rocky Island	NDBC	58.177	-135.052	13.72	2.7	2.7	2017–Present
SCXA2	Scull Island	NDBC	58.205	-134.646	15.24	2.4	2.4	2017–Present
SDIA2	South Douglas	NDBC	58.277	-134.389	0	3.1	1.5	2006–Present
SGXA2	St. George (Marine Exchange of Alaska)	NDBC	56.599	-169.542	0	68	68	2022–Present
SHXA2	Sitka Harbor	NDBC	57.056	-135.349	4.57	10.7	10.7	2017–Present
SISA2	Sisters Island	NDBC	56.01	-134.13	0	10	1.5	2006–Present
SIXA2	Ship Island	NDBC	55.616	-132.203	0	4.5	4.5	2020–Present
SKDA2	Skagway Ore Dock	NDBC	59.449	-135.331	0	14.6	14.6	2025–Present
SKXA2	Skagway (Marine Exchange of Alaska)	NDBC	59.448	-135.326	4.57	10.1	10.1	2017–Present
SLXA2	Salmon Landing	NDBC	55.339	-131.644	0	18	18	2018–Present
SNDA2	Sand Point	NDBC	55.337	-160.502	0	6.9	6.3	2008–Present
SPXA2	Ship Island	NDBC	55.599	-132.203	0	4.5	4.5	2021–Present
SRXA2	Statter Harbor (Marine Exchange of Alaska)	NDBC	58.383	-134.652	2	6	6	2022–Present

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Table A1: Continued.

ID	Name	Data host	Latitude (° N)	Longitude (° E)	Elevation (m)	Wind height (m)	Temperature height (m)	Period of record
STXA2	Sitka AML	NDBC	57.116	-135.391	0	9.4	9.4	2017–Present
SWXA2	Seward Harbor	NDBC	60.116	-149.434	0	7.6	7.6	2020–Present
SXXA2	Saxman Landing	NDBC	55.315	-131.596	9	5	5	2021–Present
TGXA2	Togiak, Alaska	NDBC	59.055	-160.334	0	12.1	12.1	2024–Present
TKEA2	Tenakee Springs	NDBC	57.779	-135.219	0	3	3	2009–Present
ULRA2	Unalakleet, Unalakleet River	NDBC	63.872	-160.784	0	9.8	9.5	2016–Present
UNLA2	Unalaska	NDBC	53.879	-166.54	0	16.1	7.6	2010–Present
UQXA2	Utqiagvik	NDBC	71.315	-156.722	0	18.6	18.6	2020–Present
VDXA2	Valdez	NDBC	61.127	-146.344	0	8.5	–	2020–Present
VDZA2	Valdez	NDBC	61.125	-146.362	0	8.5	–	2009–Present
WBXA2	Womens Bay Cargo Pier	NDBC	57.729	-152.516	0	4.3	4.3	2025–Present
WCXA2	Ward Cove	NDBC	55.402	-131.729	0	3	3	2021–Present
WFXA2	Womens Bay Fuel Pier	NDBC	57.726	-152.519	0	5.4	5.4	2025–Present
WGXA2	Wrangell Harbor	NDBC	56.467	-132.382	0	24	24	2022–Present
WIXA2	Whittier AMHS	NDBC	60.777	-148.682	0	5.2	–	2020–Present
WRXA2	Wainwright	NDBC	70.636	-160.034	0	18	18	2020–Present
23583	Aleknagik 1 NNE	USCRN	59.28	-158.61	24	1.5	1.5	2019–Present
25379	Sitka 1 NE	USCRN	57.06	-135.33	24	1.5	1.5	2005–Present
25380	Gustavus 2 NE	USCRN	58.43	-135.69	6	1.5	1.5	2012–Present
25381	Metlakatla 6 S	USCRN	55.05	-131.59	32	1.5	1.5	2012–Present
25382	Yakutat 3 SSE	USCRN	59.51	-139.69	8	1.5	1.5	2016–Present
25522	King Salmon 42 SE	USCRN	58.21	-155.92	201	1.5	1.5	2012–Present
25630	Sand Point 1 ENE	USCRN	55.35	-160.47	73	1.5	1.5	2009–Present
25711	St. Paul 4 NE	USCRN	57.16	-170.21	6	1.5	1.5	2005–Present
26494	Fairbanks 11 NE	USCRN	64.97	-147.51	347	1.5	1.5	2002–Present
26562	Port Alsworth 1 SW	USCRN	60.2	-154.32	98	1.5	1.5	2009–Present
26563	Kenai 29 ENE	USCRN	60.72	-150.45	86	1.5	1.5	2010–Present
26564	Ivotuk 1 NNE	USCRN	68.49	-155.75	582	1.5	1.5	2014–Present
26565	Deadhorse 3 S	USCRN	70.16	-148.46	9	1.5	1.5	2014–Present
26566	Huslia 27 E	USCRN	65.66	-155.48	63	1.5	1.5	2023–Present
26567	Galena 44 SW	USCRN	64.34	-158.08	40	1.5	1.5	2023–Present
26655	Red Dog Mine 3 SSW	USCRN	68.03	-162.92	287	1.5	1.5	2010–Present
26656	Bethel 87 WNW	USCRN	61.35	-164.08	47	1.5	1.5	2018–Present
56401	Glennallen 64 N	USCRN	63.03	-145.52	814	1.5	1.5	2013–Present
96404	Tok 70 SE	USCRN	62.74	-141.21	610	1.5	1.5	2011–Present
96405	Cordova 14 ESE	USCRN	60.47	-145.35	25	1.5	1.5	2017–Present
96406	Ruby 44 ESE	USCRN	64.5	-154.13	79	1.5	1.5	2014–Present
96407	Selawik 28 E	USCRN	66.56	-159	7	1.5	1.5	2015–Present
96408	Denali 27 N	USCRN	63.45	-150.87	678	1.5	1.5	2015–Present
96409	Toolik Lake 5 ENE	USCRN	68.65	-149.42	750	1.5	1.5	2017–Present
NSA (C1)	ARM North Slope of Alaska Central Facility, Utqiaġvik	ARM	71.323	-156.62	8	Profile	–	2014–Present

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