Near-surface monthly and annual mean 3-hr statistics for ERA-Interim (ERAI), Arctic System Reanalysis (ASR) 30 km (ASRv1), and 15 km (ASRv2) compared to ~4500 NCDC observations for December 2006 –November 2007 (Adapted from Bromwich et al., 2016*)

Month	2 m Temperature (°C)									2 m Dew Point (°C)								
	Bias			RMSE			Correlation			Bias			RMSE			Correlation		
	ERAI	ASRv1	ASRv2	ERAI	ASRv1	ASRv2	ERAI	ASRv1	ASRv2	ERAI	ASRv1	ASRv2	ERAI	ASRv1	ASRv2	ERAI	ASRv1	ASRv2
Dec	0.40	0.25	0.05	2.06	1.47	1.11	0.91	0.95	0.96	0.60	0.23	0.00	2.09	1.84	1.50	0.92	0.94	0.95
Jan	0.35	0.17	0.01	2.17	1.44	1.11	0.92	0.96	0.97	0.62	0.29	0.07	2.23	1.92	1.57	0.92	0.94	0.96
Feb	0.28	0.05	-0.01	2.11	1.33	1.18	0.92	0.96	0.97	0.67	0.07	0.29	2.28	1.90	1.84	0.91	0.94	0.94
Mar	0.25	0.02	-0.02	2.09	1.37	1.09	0.92	0.96	0.97	0.55	0.02	0.37	2.22	1.79	1.63	0.90	0.93	0.94
Apr	0.23	0.05	-0.05	1.97	1.27	0.96	0.93	0.97	0.98	0.45	-0.01	0.14	2.14	1.73	1.42	0.88	0.92	0.95
May	0.24	0.05	-0.06	2.00	1.25	1.05	0.92	0.96	0.97	0.25	-0.16	0.12	2.10	1.67	1.44	0.80	0.92	0.94
Jun	0.25	0.03	-0.11	1.99	1.35	1.08	0.91	0.95	0.97	0.02	-0.34	0.31	1.98	1.70	1.44	0.85	0.90	0.92
Jul	0.27	0.01	-0.13	1.93	1.29	1.05	0.91	0.95	0.96	-0.09	-0.04	0.38	1.90	1.58	1.41	0.84	0.89	0.92
Aug	0.28	0.05	-0.08	1.87	1.25	1.07	0.91	0.95	0.96	-0.03	-0.15	0.41	1.81	1.53	1.43	0.85	0.90	0.92
Sep	0.25	0.09	-0.05	1.83	1.23	1.03	0.92	0.96	0.97	0.11	-0.27	0.18	1.85	1.59	1.37	0.90	0.93	0.94
Oct	0.27	0.14	-0.11	1.85	1.25	1.12	0.92	0.96	0.97	0.24	-0.01	0.20	1.82	1.54	1.55	0.92	0.94	0.93
Nov	0.36	0.26	0.07	1.95	1.43	1.10	0.92	0.95	0.97	0.50	0.12	0.19	2.05	1.80	1.53	0.92	0.94	0.95
Annual	0.29	0.10	-0.04	1.99	1.33	1.08	0.92	0.96	0.97	0.32	-0.02	0.22	2.04	1.72	1.51	0.88	0.92	0.94

Month	Surface Pressure (hPa)									10 m Wind Speed (m s^{-1})								
	Bias			RMSE			Correlation			Bias			RMSE			Correlation		
	ERAI	ASRv1	ASRv2	ERAI	ASRv1	ASRv2	ERAI	ASRv1	ASRv2	ERAI	ASRv1	ASRv2	ERAI	ASRv1	ASRv2	ERAI	ASRv1	ASRv2
Dec	0.10	0.07	0.07	1.07	0.90	0.78	0.99	0.99	0.99	0.63	-0.14	0.33	2.34	1.91	1.50	0.66	0.71	0.81
Jan	0.12	0.11	0.12	1.11	0.91	0.78	0.99	0.99	0.99	0.68	-0.11	0.36	2.37	1.94	1.52	0.68	0.73	0.81
Feb	0.10	0.07	0.09	1.03	0.87	0.75	0.99	0.99	0.99	0.51	-0.18	0.29	2.24	1.87	1.45	0.67	0.72	0.81
Mar	0.01	0.04	0.04	1.08	0.93	0.77	0.99	0.99	0.99	0.41	-0.25	0.22	2.22	1.87	1.55	0.67	0.73	0.80
Apr	-0.04	0.01	-0.03	0.91	0.79	0.65	0.98	0.99	0.99	0.18	-0.35	0.14	2.04	1.76	1.39	0.65	0.72	0.81
May	0.14	0.00	-0.08	0.94	0.81	0.67	0.98	0.99	0.99	0.20	-0.40	0.15	2.07	1.77	1.34	0.62	0.70	0.81
Jun	-0.21	-0.01	-0.10	0.91	0.79	0.65	0.98	0.99	0.99	0.18	-0.34	0.17	1.94	1.67	1.28	0.61	0.67	0.80
Jul	-0.24	0.01	-0.09	0.91	0.78	0.64	0.98	0.99	0.99	0.27	-0.29	0.22	1.94	1.64	1.27	0.60	0.66	0.79
Aug	-0.21	0.00	-0.09	0.90	0.77	0.66	0.98	0.99	0.99	0.29	-0.27	0.17	1.93	1.63	1.26	0.60	0.66	0.79
Sep	-0.12	0.02	-0.05	0.92	0.78	0.66	0.99	0.99	0.99	0.48	-0.20	0.27	2.07	1.69	1.36	0.64	0.70	0.79
Oct	-0.07	0.01	-0.06	0.95	0.81	0.73	0.98	0.99	0.99	0.48	-0.16	0.28	2.09	1.70	1.38	0.65	0.71	0.79
Nov	0.04	0.06	0.04	0.99	0.85	0.71	0.99	0.99	0.99	0.59	-0.18	0.31	2.28	1.76	1.50	0.66	0.72	0.80
Annual	-0.03	0.03	-0.01	0.98	0.83	0.70	0.99	0.99	0.99	0.41	-0.24	0.24	2.13	1.78	1.40	0.64	0.70	0.80

Near-surface annual mean 3-hr statistics for ERAI, ASRv1, and ASRv2 compared to ~4500 NCDC observations for December 2006 –November 2007

Name	2 m Temperature (°C)			2 m Dew Point (°C)			Surface Pressure (hPa)			10 m Wind Speed (m s^{-1})		
	Bias	RMSE	Correlation	Bias	RMSE	Correlation	Bias	RMSE	Correlation	Bias	RMSE	Correlation
ERAI	0.29	1.99	0.92	0.32	2.04	0.88	-0.03	0.98	0.99	0.41	2.13	0.64
ASRv1	0.10	1.33	0.96	-0.02	1.72	0.92	0.03	0.83	0.99	-0.24	1.78	0.70
ASRv2	-0.04	1.08	0.97	0.22	1.51	0.94	-0.03	0.70	0.99	0.24	1.40	0.80

NOTE: These results are representative of all years in the ASR period (2000-2012).

Discussion

We have compared near-surface variables from **ASRv1**, **ASRv2**, and **ERAI** to observations from ~4500 surface stations provided by the National Centers for Environmental Information (https://www.ncdc.noaa.gov/) for the period December 2006-November 2007 to compare the broad-scale performance of ASR at increasing horizontal resolution. The results reflect performance at 3 hours, and the **ERAI** is interpolated to produce values between analysis times (0300, 0900, 1500, and 2100).

2 m Temperature: Analysis reveals that **ERAI** and ASR products have small annual mean biases, with the smallest biases represented by **ASRv2**. However, **ASRv2** is colder than both **ASRv1** and **ERAI** with negative biases from February through October. Decreasing annual mean RMSE values from **ERAI** to **ASRv2** indicate that **ASRv2** is an excellent fit to observations and the standard deviation of the unexplained variance is small. This is further supported by increasing skill indicated by higher correlation.

2 m Dewpoint Temperature: Similar to 2 m temperature, annual mean dewpoint bias in **ASRv2** is smaller than **ERAI**, but it is higher than **ASRv1**. Negative monthly dewpoint biases but positive 2 m temperature biases for **ASRv1** from April through October indicate drier than observed conditions. This is supported by other variables in **ASRv1** (e.g., precipitation). Negative 2 m temperature biases but positive dewpoint biases during the summer months in **ASRv2** reflect ample moisture due to the improved cloud processes implemented in **ASRv2**. Again, lower annual mean RMSE and higher correlation in **ASRv2** show an improvement in overall fit and skill.

Surface Pressure: All three reanalyses capture the surface pressure (atmospheric circulation) well with very small biases, low RMSEs, and very high correlations. Consistent with other near-surface variables, the RMSE decreases from **ERAI** to **ASRv2**.

10 m Wind Speed: Annual mean 10 m wind speed biases are smaller in the ASR products compared to **ERAI**, though a positive (negative) bias is demonstrated by **ASRv2** (**ASRv1**). There is quite an improvement in RMSE and correlation between **ERAI** and **ASRv2**, ***where ASRv2 captures two-thirds of the variance***. As we describe in Bromwich et al. (2016*), the improvements in near-surface wind are tied to the finer resolution in ASR and the improved skill in capturing local wind effects near complex terrain. **ASRv1** wind fields have been shown to be well represented, including wind related to topographically-forced wind events (Moore et al., 2016*) and Arctic cyclones (Tilinina et al., 2014*). Though analysis continues, these results suggest that local wind effects are even better captured by **ASRv2**.

*For references, please see http://polarmet.osu.edu/publications/.