

Table 1. SS (light shading) and PS (dark shading) pair-wise differences for the REF and TWIND1 configurations (where the highlighted configuration is favored) for upper air temperature BCRMSE and bias by pressure level, season, and forecast lead time for the 00 UTC and 12 UTC initializations combined over the 5 km CONUS verification domain.

Upper Air Temperature		Annual				Summer				Fall				Winter				Spring			
		f12	f24	f36	f48	f12	f24	f36	f48	f12	f24	f36	f48	f12	f24	f36	f48	f12	f24	f36	f48
BCRMSE	850	--	--	REF	REF	--	--	--	--	--	--	REF	--	--	REF	REF	REF	--	--	--	--
	700	--	--	REF	REF	--	--	--	--	--	REF	REF	REF	--	REF	REF	--	--	TWIND1	--	--
	500	--	REF	REF	--	--	--	--	--	--	REF	REF	REF	--	REF	REF	REF	--	--	--	--
	400	--	--	REF	REF	--	--	--	--	--	--	REF	--	--	--	REF	--	--	--	--	--
	300	--	REF	--	--	--	--	--	--	--	REF	--	--	--	--	--	--	--	--	--	--
	200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	150	--	--	--	REF	--	--	--	--	--	--	REF	REF	--	--	--	--	--	--	--	--
	100	--	--	--	--	--	--	--	--	REF	--	--	--	--	--	--	--	--	--	--	--
Bias	850	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	--	--	--	--	--	--	--	--	TWIND1	TWIND1
	700	REF	REF	REF	REF	--	--	TWIND1	--	REF	REF	REF	REF	REF	REF	REF	REF	--	--	--	--
	500	REF	REF	REF	REF	--	--	--	--	--	REF	--	REF	--	--	REF	REF	--	--	--	--
	400	--	--	REF	REF	--	--	--	--	--	--	--	REF	--	--	--	--	--	--	REF	--
	300	--	--	--	--	--	--	--	REF	--	--	TWIND1	--	--	--	--	--	--	--	--	--
	200	--	--	--	--	--	--	--	--	--	--	TWIND1	TWIND1	--	--	--	--	--	--	--	--
	150	--	REF	REF	REF	--	--	--	--	--	--	REF	REF	--	REF	--	--	--	--	--	--
	100	--	--	--	TWIND1	--	--	--	--	--	--	TWIND1	TWIND1	--	--	--	--	--	--	--	--





Table 4. SS (light shading) and PS (dark shading) pair-wise differences for the REF and TWIND1 configurations (where the highlighted configuration is favored) for surface temperature BCRMSE and bias by season and forecast lead time for the 00 UTC and 12 UTC initializations separately over the 5 km CONUS verification domain.

Surface Temperature		f03	f06	f09	f12	f15	f18	f21	f24	f27	f30	f33	f36	f39	f42	f45	f48		
BCRMSE	00 UTC Initializations	Annual	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	
		Summer	REF	REF	REF	--	--	--	--	--	REF	REF	REF	--	--	REF	--	--	
		Fall	REF *	REF *	REF *	REF *	--	REF	REF	REF	REF *	REF *	REF	REF	--	REF	REF	REF	
		Winter	REF	REF *	REF	REF	REF	REF	REF	REF	REF	REF *	REF *	REF *	REF	REF	REF	REF	REF *
		Spring	REF	REF	REF	--	REF	REF	--	TWIND1	--	--	REF	--	--	--	--	--	TWIND1
	12 UTC Initializations	Annual	--	REF	REF	--	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
		Summer	--	REF	REF	--	REF	REF	REF	--	--	--	--	--	--	--	--	--	--
		Fall	--	REF	REF	REF	REF *	REF *	REF *	REF	--	REF	REF	REF	REF *	REF *	REF *	REF *	REF *
		Winter	REF	--	--	REF	REF *	REF *	REF *	REF	REF	REF	REF	REF	REF *	REF	REF	REF	REF
		Spring	--	--	--	TWIND1	REF	REF	REF	--	--	--	--	--	--	--	REF	--	--
Bias	00 UTC Initializations	Annual	REF *	REF *	REF *	REF *	REF	REF	REF	REF	REF *	REF *	REF *	REF	REF	--	--	--	
		Summer	REF *	REF *	REF *	REF	REF	REF	--	TWIND1	REF	REF	REF	--	TWIND1	--	TWIND1	TWIND1	
		Fall	REF *	REF *	REF *	REF *	REF	REF	REF	REF *	REF *	REF *	REF *	REF *	REF *	REF	--	REF *	
		Winter	REF *	REF *	REF *	REF *	REF *	REF	REF	REF *	REF *	REF *	REF *	REF *	REF *	REF	REF	REF	REF *
		Spring	REF *	REF *	REF *	REF *	REF	REF	--	TWIND1	REF	REF *	REF *	REF	TWIND1	--	TWIND1	TWIND1	
	12 UTC Initializations	Annual	REF	REF	REF	--	REF	REF *	REF *	REF *	--	--	--	--	REF	REF *	REF *	REF *	
		Summer	REF	REF	--	TWIND1	REF	REF	REF	--	TWIND1	TWIND1	TWIND1	TWIND1	--	REF	REF	--	
		Fall	REF *	REF	REF	REF	REF *	REF *	REF *	REF *	REF	REF	--	REF *	REF *	REF *	REF *	REF *	
		Winter	REF	REF	REF	REF	REF *	REF *	REF *	REF *	REF	REF	REF	REF *	REF *	REF *	REF *	REF *	
		Spring	REF	REF	--	TWIND1	REF	REF	REF *	--	TWIND1	TWIND1	TWIND1	TWIND1	--	REF	REF	--	

Table 5. SS (light shading) and PS (dark shading) pair-wise differences for the REF and TWIND1 configurations (where the highlighted configuration is favored) for surface dew point temperature BCRMSE and bias by season and forecast lead time for the 00 UTC and 12 UTC initializations separately over the 5 km CONUS verification domain.

Surface Dew Point Temperature		f03	f06	f09	f12	f15	f18	f21	f24	f27	f30	f33	f36	f39	f42	f45	f48	
BCRMSE	00 UTC Initializations	Annual	--	TWIND1	TWIND1	TWIND1	--	--	--	--	TWIND1	TWIND1	TWIND1	--	--	--	REF	
		Summer	--	--	--	TWIND1	--	--	--	REF	--	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	--	REF
		Fall	--	TWIND1	--	--	--	--	--	--	--	TWIND1	--	--	REF	REF	REF	REF
		Winter	--	TWIND1	TWIND1	--	--	--	--	--	TWIND1	TWIND1	--	--	REF	--	--	REF
		Spring	--	TWIND1	TWIND1	TWIND1	--	--	TWIND1	--	--	TWIND1	TWIND1	TWIND1	--	--	--	--
	12 UTC Initializations	Annual	TWIND1	TWIND1	TWIND1	--	TWIND1	TWIND1	TWIND1	TWIND1	--	--	--	REF	--	TWIND1	TWIND1	--
		Summer	TWIND1	TWIND1	TWIND1	--	--	TWIND1	TWIND1	TWIND1	--	--	--	--	--	TWIND1	TWIND1	--
		Fall	--	TWIND1	--	--	--	TWIND1	TWIND1	--	--	--	--	REF	--	--	--	REF
		Winter	TWIND1	TWIND1	TWIND1	--	TWIND1	TWIND1	TWIND1	TWIND1	--	--	--	--	--	--	--	--
		Spring	TWIND1	TWIND1	TWIND1	--	--	TWIND1	TWIND1	TWIND1	--	--	TWIND1	--	TWIND1	TWIND1	TWIND1	TWIND1
Bias	00 UTC Initializations	Annual	--	--	TWIND1	REF	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	REF	REF	REF	REF	TWIND1	TWIND1	TWIND1
		Summer	--	TWIND1	--	TWIND1	TWIND1	TWIND1	TWIND1	--	--	REF	REF	--	REF	TWIND1	TWIND1	--
		Fall	--	TWIND1	TWIND1	REF	REF	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1 *	REF *	REF	REF *	TWIND1	TWIND1
		Winter	--	--	TWIND1	TWIND1	TWIND1	TWIND1 *	TWIND1 *	TWIND1	TWIND1 *	TWIND1 *	TWIND1 *	REF *	REF *	TWIND1 *	TWIND1 *	TWIND1 *
		Spring	--	TWIND1	TWIND1	--	TWIND1	TWIND1	TWIND1 *	--	--	TWIND1	REF	REF	TWIND1	TWIND1	TWIND1 *	--
	12 UTC Initializations	Annual	TWIND1	TWIND1	TWIND1	--	--	TWIND1	REF	REF	REF	TWIND1	TWIND1	TWIND1	TWIND1	REF	REF	REF
		Summer	TWIND1	TWIND1	TWIND1	--	--	--	REF	--	TWIND1	TWIND1	TWIND1	--	--	REF	--	--
		Fall	--	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1 *	REF *	TWIND1 *	TWIND1	TWIND1	REF *	REF *	REF *	REF *
		Winter	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1	TWIND1 *	TWIND1 *	REF *	TWIND1 *	TWIND1 *	TWIND1	TWIND1 *	REF *	REF *	REF *
		Spring	TWIND1	TWIND1	TWIND1	--	--	--	REF	REF	TWIND1	TWIND1	TWIND1	--	--	--	REF	--

Table 6. SS (light shading) and PS (dark shading) pair-wise differences for the REF and TWIND1 configurations (where the highlighted configuration is favored) for surface wind BCRMSE and bias by season and forecast lead time for the 00 UTC and 12 UTC initializations separately over the 5 km CONUS verification domain.

Surface Wind Speed		f03	f06	f09	f12	f15	f18	f21	f24	f27	f30	f33	f36	f39	f42	f45	f48		
BCRMSE	00 UTC Initializations	Annual	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	--	--	REF	REF	REF	
		Summer	REF	--	--	--	--	--	--	--	REF	REF	--	TWIND1	--	--	--	--	
		Fall	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
		Winter	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
		Spring	REF	REF	REF	--	REF	REF	REF	REF	REF	REF	--	--	--	--	REF	--	REF
	12 UTC Initializations	Annual	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	--
		Summer	--	--	--	--	--	--	--	--	--	--	--	--	REF	--	--	--	TWIND1
		Fall	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
		Winter	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	--
		Spring	REF	REF	REF	REF	REF	REF	--	--	REF	REF	REF	--	REF	REF	--	--	--
Bias	00 UTC Initializations	Annual	TWIND1 *	TWIND1	TWIND1	TWIND1	TWIND1 *	REF *	REF *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1	TWIND1 *	TWIND1 *	REF *	REF *	TWIND1 *	
		Summer	TWIND1	TWIND1	TWIND1	TWIND1	REF	REF *	REF *	TWIND1 *	TWIND1	TWIND1	TWIND1	TWIND1	REF *	REF *	REF *	REF *	
		Fall	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	REF *	REF *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	REF *	TWIND1 *
		Winter	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	REF *	REF *	REF *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	REF *	REF *	TWIND1 *
		Spring	TWIND1 *	TWIND1	TWIND1	TWIND1 *	REF *	REF *	REF *	REF *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	REF *	REF *	REF *	REF *
	12 UTC Initializations	Annual	TWIND1 *	REF *	REF *	TWIND1 *	TWIND1 *	TWIND1	TWIND1	TWIND1	TWIND1 *	REF *	REF *	REF *	TWIND1 *	TWIND1	TWIND1	TWIND1	
		Summer	REF *	REF *	REF *	TWIND1 *	TWIND1 *	TWIND1	TWIND1	TWIND1	TWIND1 *	REF *	REF *	REF *	TWIND1	TWIND1	TWIND1	TWIND1	
		Fall	TWIND1 *	REF *	REF *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	REF *	REF *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	
		Winter	TWIND1 *	REF *	REF *	REF *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	REF *	REF *	REF *	TWIND1 *	TWIND1 *	TWIND1 *	TWIND1 *	
		Spring	REF *	REF *	REF *	REF *	TWIND1 *	TWIND1	TWIND1	TWIND1 *	REF *	REF *	REF *	REF *	TWIND1 *	TWIND1	TWIND1	TWIND1 *	



