

3km CONUS RRFS retro experiments: Impact of Small-scale GWD and Turbulent Orographic Form Drag

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3km RRFS CONUS Reforecasts

0000UTC May 11 - 1800UTC May 20, 2021

- 24-hour forecasts: Initialized daily at 00, 06, 12, 18 UTC
- IC's and LBC's from FV3GFS Reanalyses
- CCPP physics suite: FV3_HRRR with UGWPv1 drag scheme

Control	Curve0	Drag suite turned off
Experiment 1	Curve1	Default drag suite
Experiment 2	Curve2	Topographic variance caps lifted (increased drag)
Experiment 3	Curve3	Exp 2 + but with Turbulent Orographic Form Drag acting over deeper layer

10m windspeed RMS error (METAR verif) -- Forecast lead time: 24 hrs

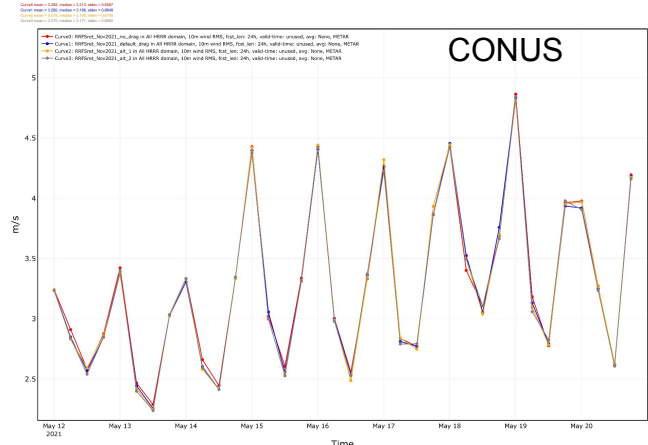
Control: No GWD —

Exp 1: Default GWD —

Exp 2: Enhanced GWD —

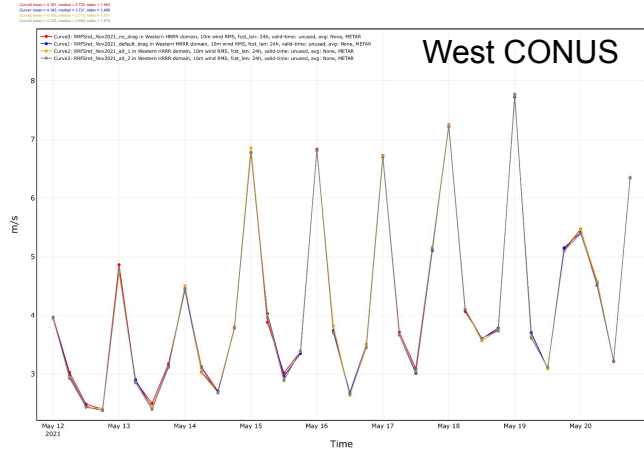
Exp 3: Further enhanced GWD —

Surface: TimeSeries 05/11/2021 00:00 - 05/20/2021 18:00 - no drfs UNMATCHED



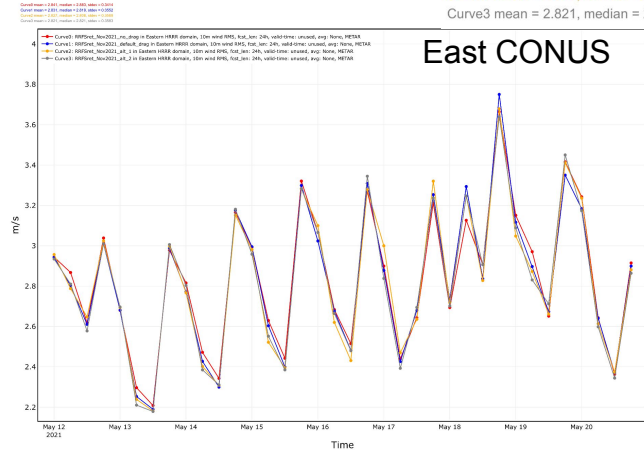
Curve0 mean = 3.292, median = 3.213, stdev = 0.6597
 Curve1 mean = 3.280, median = 3.186, stdev = 0.6648
 Curve2 mean = 3.278, median = 3.168, stdev = 0.6745
 Curve3 mean = 3.270, median = 3.171, stdev = 0.6660

Surface: TimeSeries 05/11/2021 00:00 - 05/20/2021 18:00 - no drfs UNMATCHED



Curve0 mean = 4.161, median = 3.725, stdev = 1.464
 Curve1 mean = 4.143, median = 3.721, stdev = 1.466
 Curve2 mean = 4.145, median = 3.710, stdev = 1.477
 Curve3 mean = 4.132, median = 3.684, stdev = 1.470

Surface: TimeSeries 05/11/2021 00:00 - 05/20/2021 18:00 - no drfs UNMATCHED



Curve0 mean = 2.841, median = 2.883, stdev = 0.3414
 Curve1 mean = 2.831, median = 2.819, stdev = 0.3552
 Curve2 mean = 2.827, median = 2.808, stdev = 0.3589
 Curve3 mean = 2.821, median = 2.821, stdev = 0.3583

10m windspeed bias (METAR verif) -- Forecast lead time: 24 hrs

Control: No GWD —

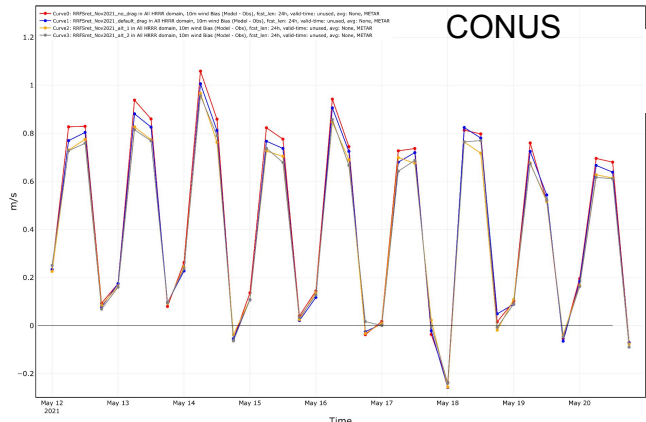
Exp 1: Default GWD —

Exp 2: Enhanced GWD —

Exp 3: Further enhanced GWD —

Surface: TimeSeries 05/11/2021 00:00 - 05/20/2021 18:00 / no drfs UNMATCHED

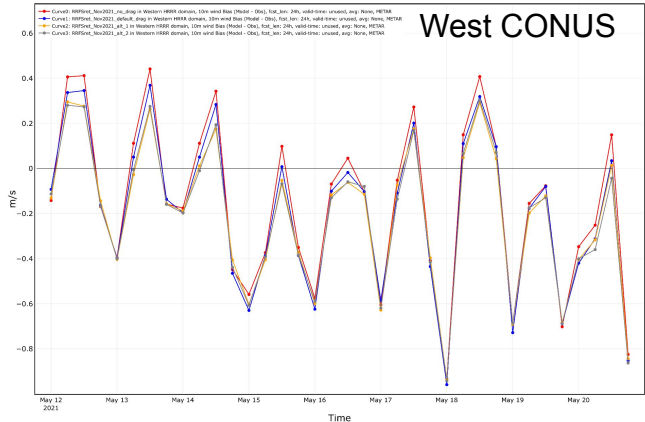
Wind mean = 1.002 median = 1.000 stdv = 1.000
 Wind max = 4.000 median = 3.000 stdv = 1.000
 Wind min = 0.000 median = 0.000 stdv = 1.000



Curve0 mean = 0.4273, median = 0.3897, stdev = 0.3904
 Curve1 mean = 0.4082, median = 0.3885, stdev = 0.3760
 Curve2 mean = 0.3893, median = 0.3799, stdev = 0.3546
 Curve3 mean = 0.3872, median = 0.3864, stdev = 0.3544

Surface: TimeSeries 05/11/2021 00:00 - 05/20/2021 18:00 / no drfs UNMATCHED

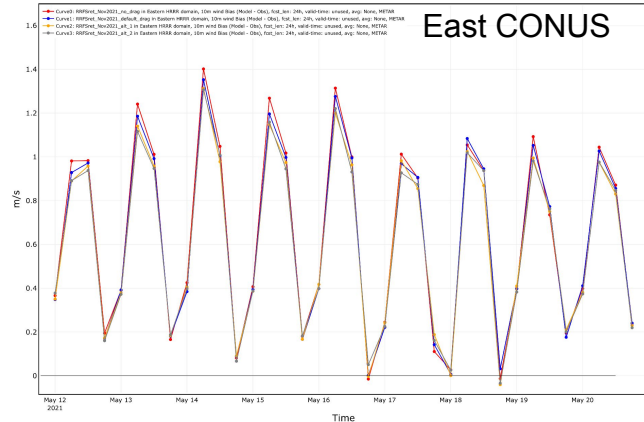
Wind mean = 0.992 median = 1.000 stdv = 1.000
 Wind max = 4.000 median = 3.000 stdv = 1.000
 Wind min = 0.000 median = 0.000 stdv = 1.000



Curve0 mean = -0.1532, median = -0.1485, stdev = 0.3646
 Curve1 mean = -0.1898, median = -0.1226, stdev = 0.3496
 Curve2 mean = -0.2077, median = -0.1372, stdev = 0.3216
 Curve3 mean = -0.2117, median = -0.1474, stdev = 0.3240

Surface: TimeSeries 05/11/2021 00:00 - 05/20/2021 18:00 / no drfs UNMATCHED

Wind mean = 1.002 median = 1.000 stdv = 1.000
 Wind max = 4.000 median = 3.000 stdv = 1.000
 Wind min = 0.000 median = 0.000 stdv = 1.000



Curve0 mean = 0.6423, median = 0.5802, stdev = 0.4372
 Curve1 mean = 0.6295, median = 0.5919, stdev = 0.4232
 Curve2 mean = 0.6103, median = 0.5837, stdev = 0.4042
 Curve3 mean = 0.6089, median = 0.5805, stdev = 0.4027

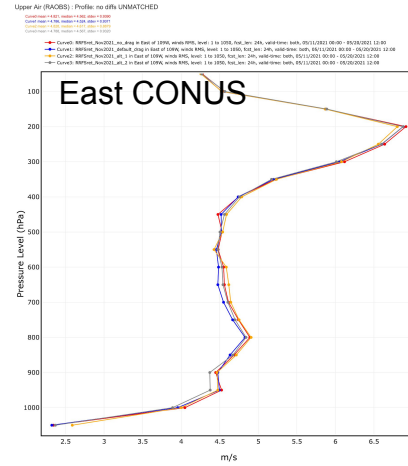
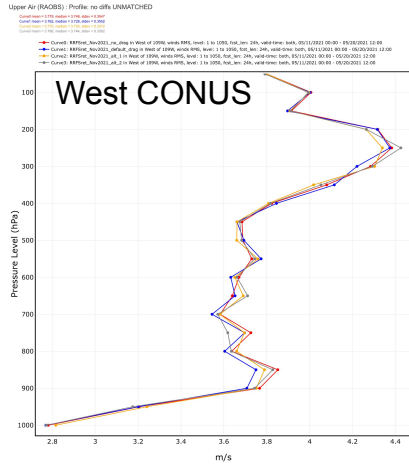
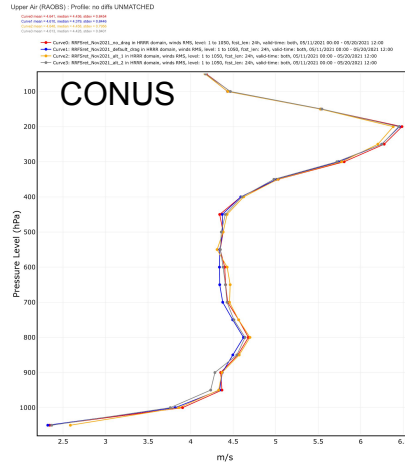
Windspeed RMS error profiles (RAOBS verif) -- Forecast lead time: 24 hrs

Control: No GWD —

Exp 1: Default GWD —

Exp 2: Enhanced GWD —

Exp 3: Further enhanced GWD —



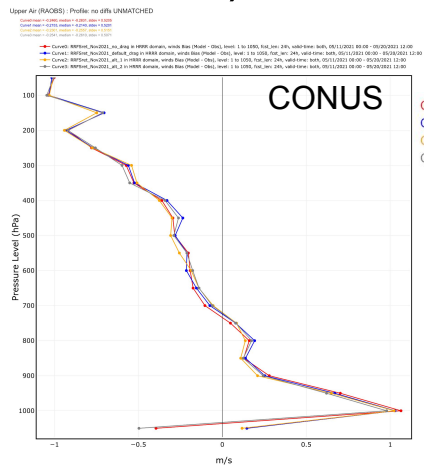
Windspeed bias profiles (RAOBS verif) -- Forecast lead time: 24 hrs

Control: No GWD —

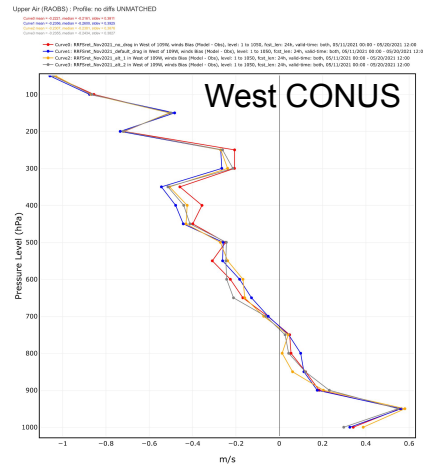
Exp 1: Default GWD —

Exp 2: Enhanced GWD —

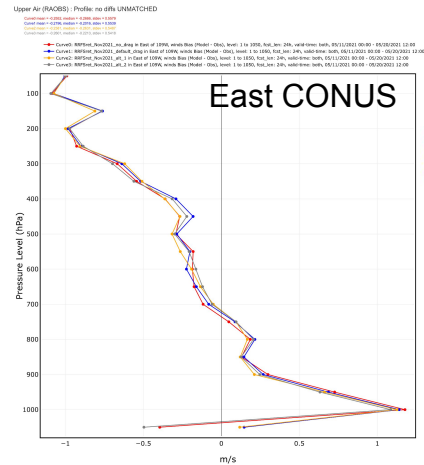
Exp 3: Further enhanced GWD —



Curve0 mean = -0.2460, median = -0.2831, stdev = 0.5205
 Curve1 mean = -0.2153, median = -0.2140, stdev = 0.5201
 Curve2 mean = -0.2301, median = -0.2557, stdev = 0.5151
 Curve3 mean = -0.2541, median = -0.2610, stdev = 0.5071



Curve0 mean = -0.2221, median = -0.2161, stdev = 0.3811
 Curve1 mean = -0.2356, median = -0.2600, stdev = 0.3925
 Curve2 mean = -0.2307, median = -0.2381, stdev = 0.3876
 Curve3 mean = -0.2355, median = -0.2434, stdev = 0.3827



Curve0 mean = -0.2552, median = -0.2666, stdev = 0.5579
 Curve1 mean = -0.2196, median = -0.2016, stdev = 0.5539
 Curve2 mean = -0.2381, median = -0.2631, stdev = 0.5487
 Curve3 mean = -0.2601, median = -0.2213, stdev = 0.5418