

Machine Learning Modeling for Additional SDGE Stations (Second Half)

SDGE Wind Gust ML Flowchart

Hourly WRF : ens_cfsr_004
ens_cfsr_004_d01
Period: 2013-07-31 to 2019-07-31

Response Variable: observed gust
Period: 2012-10-02 to 2019-09-02

Combined Training Data for Each Station

Add 15 more stations: RIN, ARH, OLV, HDM, WAL, CRI, SOB,
MGR, LLC, HMD, NHG, WCV, DHV, OMB, SCR

Model I: Random Forest for All Wind Conditions
Predictor Selection/Model Parameter Selection
Rank Importance/Bias Pattern Check

Calculate bias with best predictor/parameter combination
Re-train bias with high wind condition in model II

Model II: Gradient Boosting Tree
Retrain Bias on High Wind Time-Points Only
Predictor/Parameter Selection; Resample Strategy

Determine high wind threshold: gust percentile
Bias correct high wind time-points only

Gust Prediction: bias corrected forecast value
combining model I and model II

Model Construction

SDG&E provides Major Events and
important stations

Check Model Results
Training Performance/Testing Performance
test six historical events: leave-one-out

Forecast vs Observed vs WRF Gust
Check Bias/RMSE
Check event/daily max difference
Check under- or over-estimation
Check time-lag issue/timeseries pattern

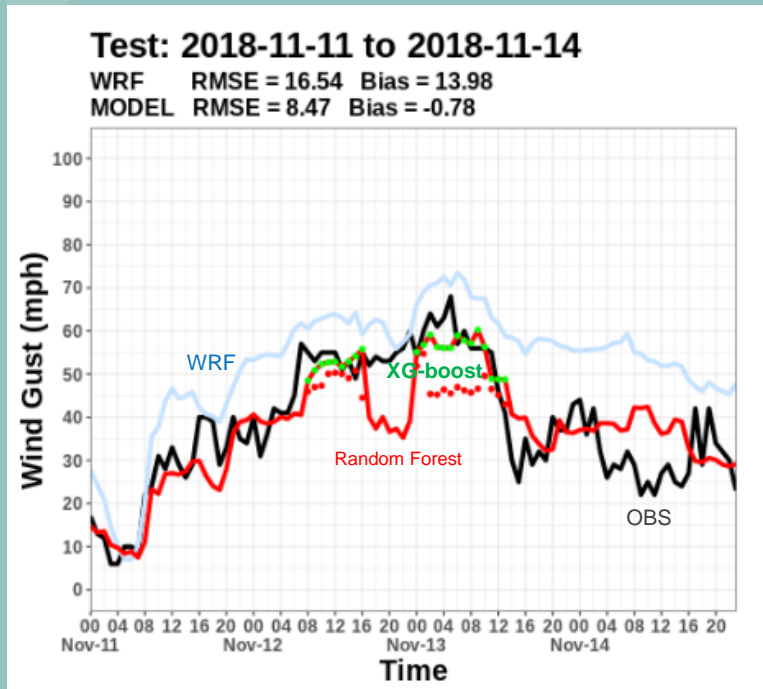
Model Validation



Validation Results for Additional Stations

Validation Results for Additional Stations

Sample Validation Plot



15 More Stations:

Rincon (RIN)
Archie Moore (ARH)
Olivenhain (OLV)
Hodges Dam (HDM)
West Alpine (WAL)
Cristianitos (CRI)
Solana Beach (SOB)
Mussey Grade (MGR)
Lilac (LLC)
Hidden Meadows (HMD)
Nate Harrison Grade (NHG)
Wisecarver (WCV)
Deerhorn Valley (DHV)
Otay Mesa Border (OMB)
San Clemente Ridge (SCR)

RFW and/or Extreme FPI dates:

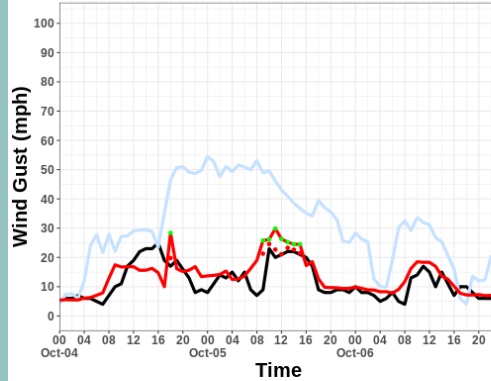
Oct. 4-6, 2013
Nov. 5, 2013
Dec. 14-15, 2013
Jan. 13-17, 2014
Jan. 23-24, 2014
Apr. 30-May 1, 2014
May 11-15, 2014
Nov. 4-6, 2014
Nov. 16-18, 2014
Nov. 24-26, 2014
Apr. 15-16, 2015
Oct. 9-10, 2017
Oct. 14-15, 2017
Oct. 22-25, 2017
Dec. 4-10, 2017
Dec. 14-15, 2017
Jan. 27-29, 2018
Jul. 6, 2018
Oct. 15-16, 2018
Oct. 19, 2018
Nov. 8-9, 2018
Nov. 11-14, 2018

Note: OC-only RFWs were only included if the event as a whole was significant (i.e. Apr. 30th)

Wind Gust ML Validation for Rincon

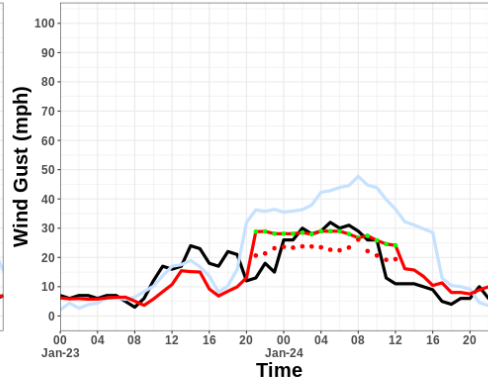
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 22.97 Bias = 18.89
MODEL RMSE = 4.82 Bias = 1.75



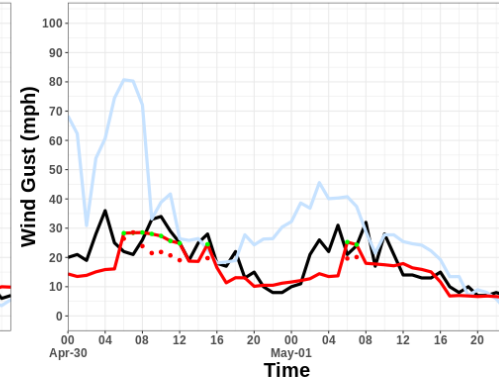
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 12.34 Bias = 6.55
MODEL RMSE = 6.17 Bias = 0.18



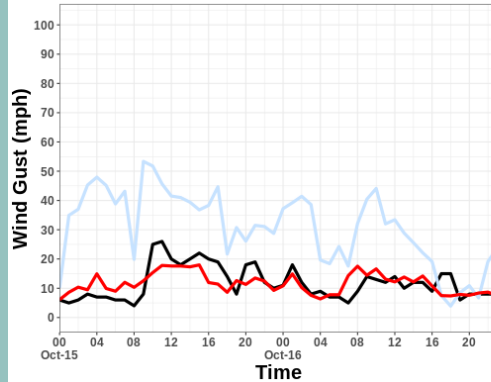
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 21.50 Bias = 13.95
MODEL RMSE = 6.68 Bias = -3.16



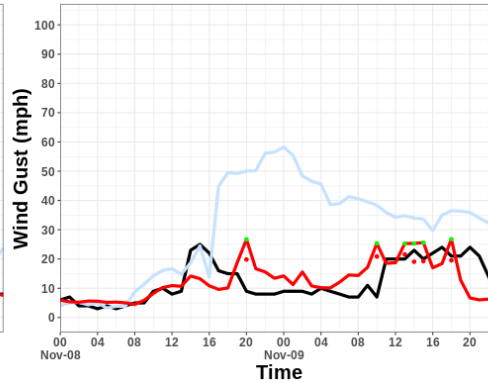
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 22.50 Bias = 19.07
MODEL RMSE = 4.54 Bias = -0.13



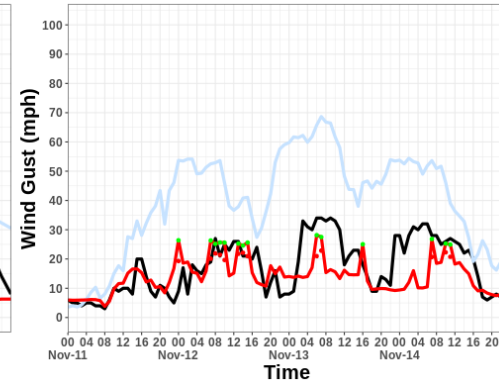
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 24.70 Bias = 18.39
MODEL RMSE = 6.97 Bias = 0.63



Test: 2018-11-11 to 2018-11-14

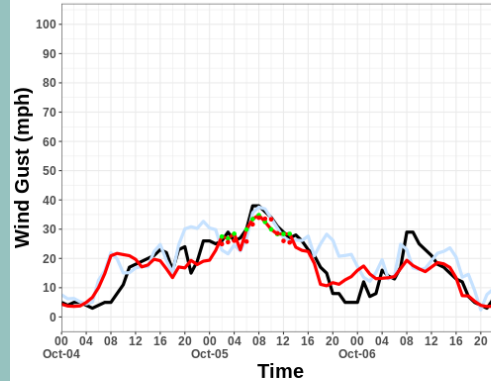
WRF RMSE = 26.31 Bias = 22.53
MODEL RMSE = 8.57 Bias = -3.01



Wind Gust ML Validation for Archie Moore

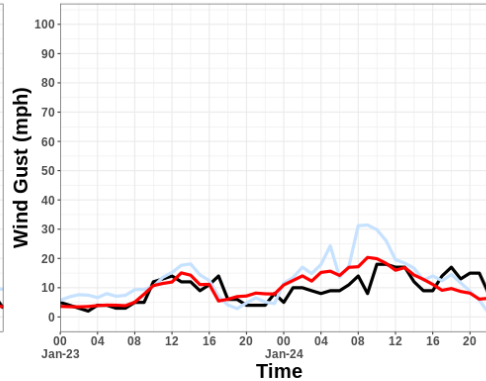
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 7.00 Bias = 3.06
MODEL RMSE = 5.24 Bias = -0.19



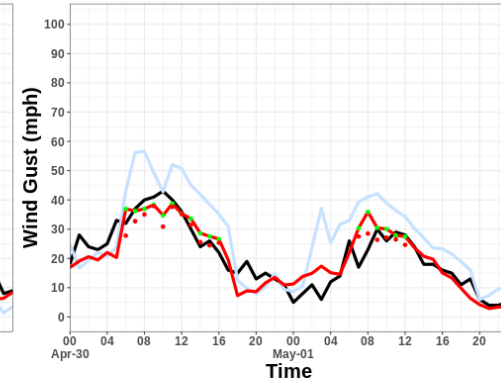
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 6.77 Bias = 3.11
MODEL RMSE = 4.09 Bias = 0.89



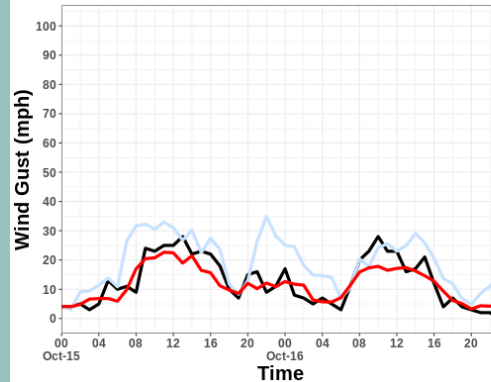
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 11.22 Bias = 7.03
MODEL RMSE = 5.24 Bias = -0.13



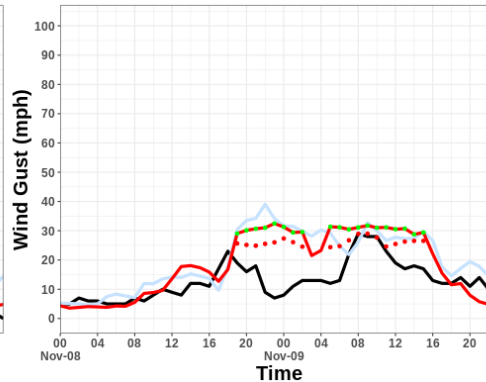
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 8.95 Bias = 6.28
MODEL RMSE = 4.19 Bias = -1.15



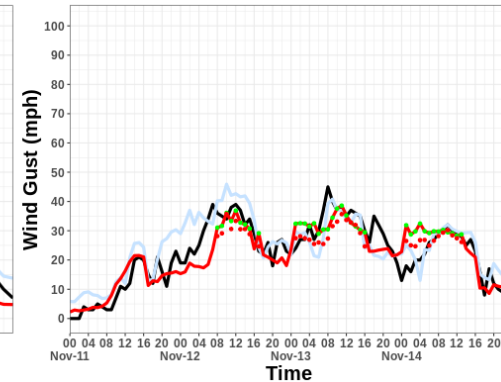
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 10.90 Bias = 7.23
MODEL RMSE = 10.10 Bias = 5.71



Test: 2018-11-11 to 2018-11-14

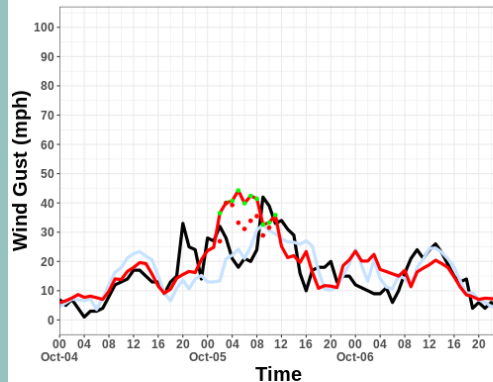
WRF RMSE = 6.00 Bias = 2.36
MODEL RMSE = 5.70 Bias = -0.78



Wind Gust ML Validation for Olivenhain

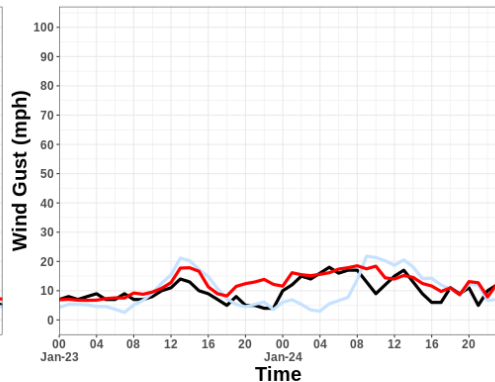
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 7.00 Bias = -0.02
MODEL RMSE = 8.22 Bias = 1.84



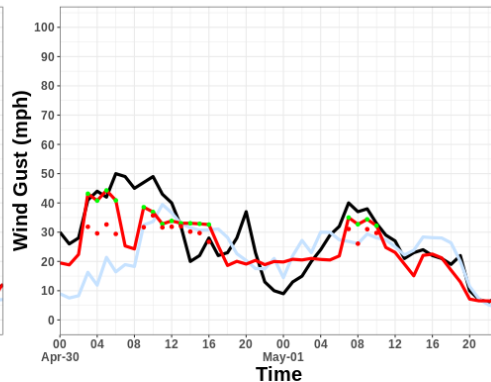
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 5.91 Bias = -0.09
MODEL RMSE = 3.81 Bias = 2.22



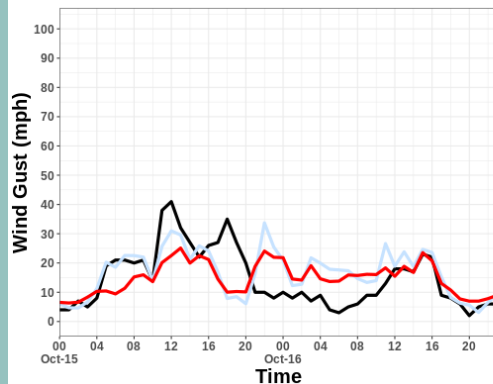
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 13.04 Bias = -4.68
MODEL RMSE = 8.12 Bias = -2.95



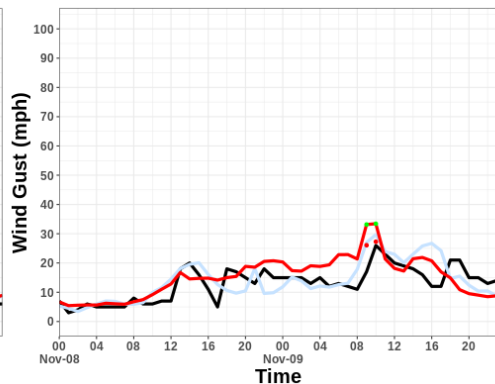
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 9.23 Bias = 2.05
MODEL RMSE = 8.89 Bias = 0.14



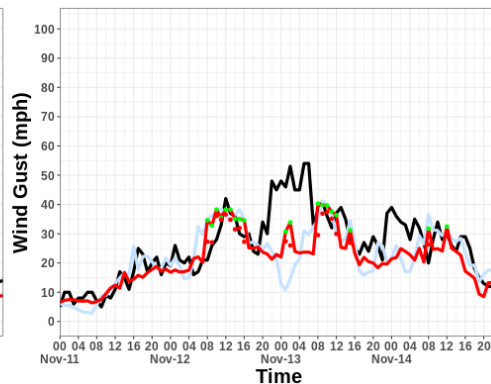
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 5.17 Bias = 0.82
MODEL RMSE = 5.59 Bias = 2.11



Test: 2018-11-11 to 2018-11-14

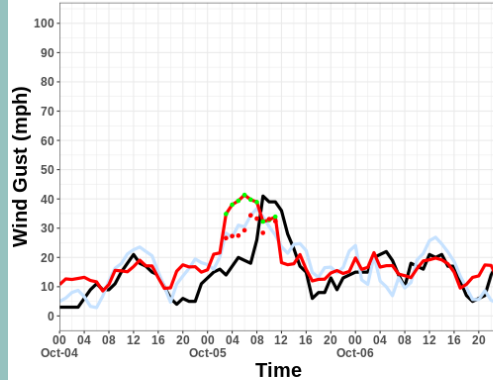
WRF RMSE = 10.95 Bias = -3.52
MODEL RMSE = 9.58 Bias = -4.48



Wind Gust ML Validation for Hodges Dam

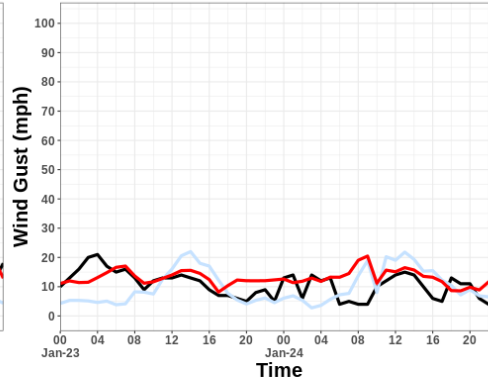
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 7.07 Bias = 2.13
MODEL RMSE = 8.04 Bias = 3.24



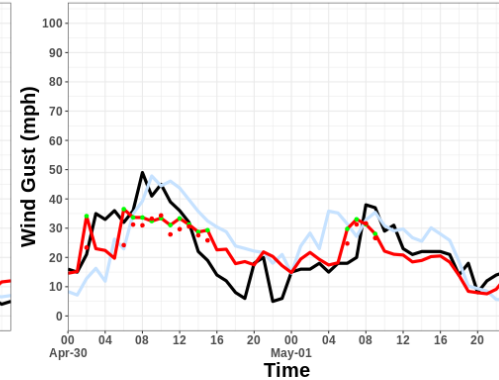
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 7.20 Bias = -0.79
MODEL RMSE = 5.34 Bias = 2.37



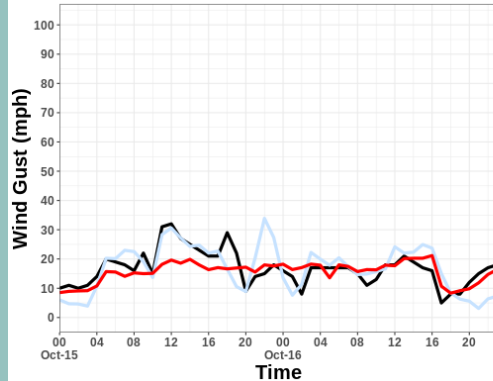
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 10.27 Bias = 3.15
MODEL RMSE = 7.90 Bias = -0.29



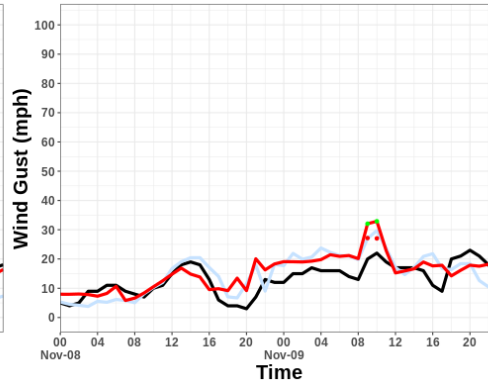
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 6.17 Bias = 0.01
MODEL RMSE = 4.78 Bias = -1.18



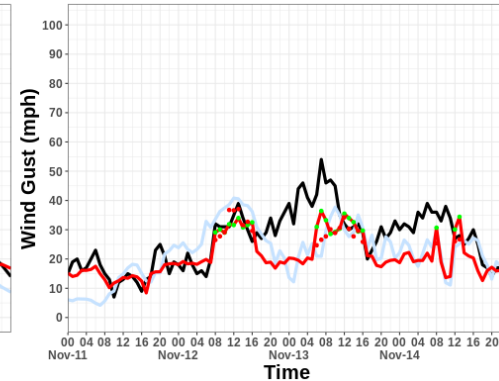
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 5.30 Bias = 1.80
MODEL RMSE = 5.16 Bias = 2.27



Test: 2018-11-11 to 2018-11-14

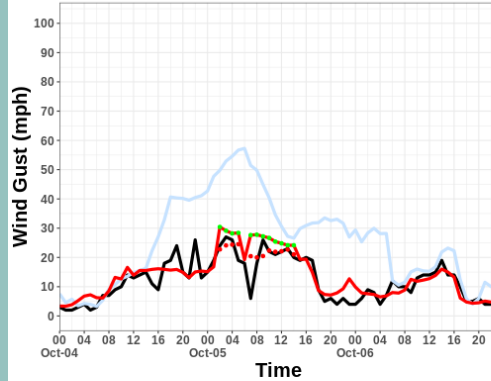
WRF RMSE = 10.64 Bias = -4.28
MODEL RMSE = 9.67 Bias = -5.78



Wind Gust ML Validation for West Alpine

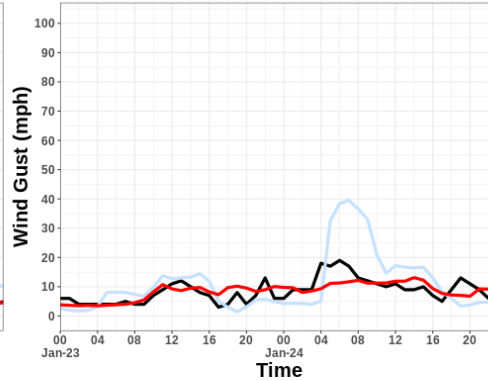
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 17.63 Bias = 13.07
MODEL RMSE = 4.42 Bias = 1.34



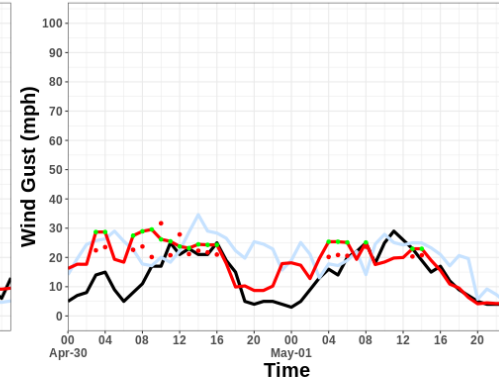
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 8.26 Bias = 2.18
MODEL RMSE = 3.22 Bias = -0.15



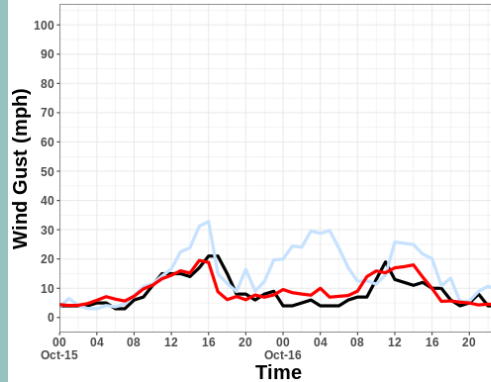
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 10.54 Bias = 7.43
MODEL RMSE = 8.17 Bias = 4.66



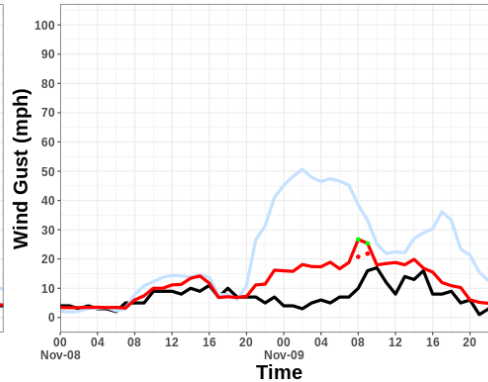
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 10.33 Bias = 6.61
MODEL RMSE = 3.58 Bias = 0.81



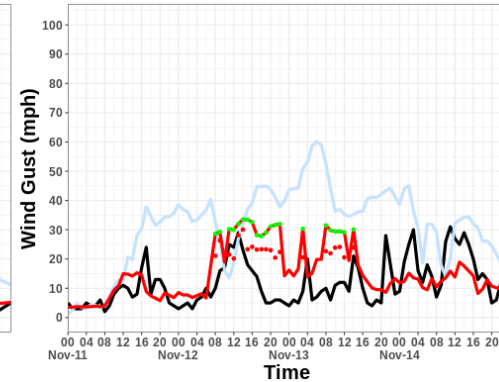
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 21.12 Bias = 14.67
MODEL RMSE = 6.70 Bias = 4.49



Test: 2018-11-11 to 2018-11-14

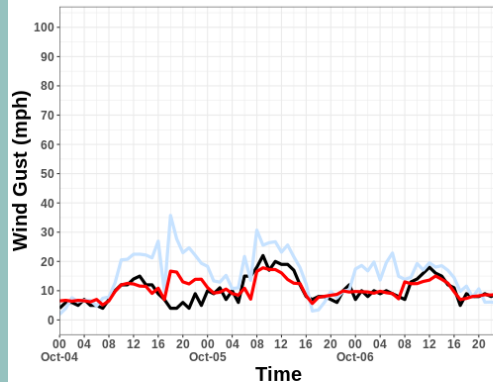
WRF RMSE = 24.59 Bias = 19.37
MODEL RMSE = 10.51 Bias = 3.59



Wind Gust ML Validation for Cristianitos

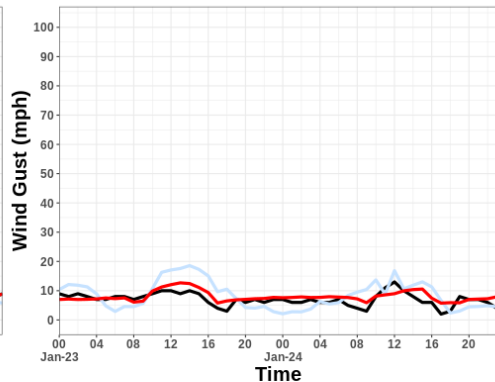
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 8.44 Bias = 5.41
MODEL RMSE = 3.48 Bias = 0.37



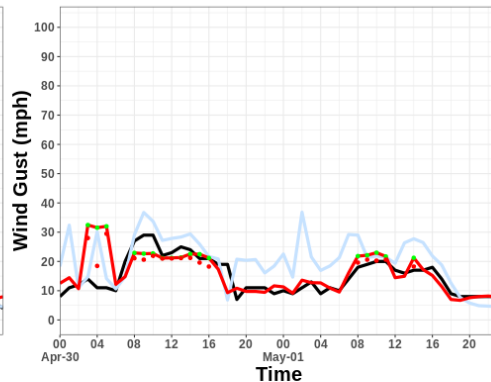
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 4.48 Bias = 1.45
MODEL RMSE = 2.09 Bias = 0.96



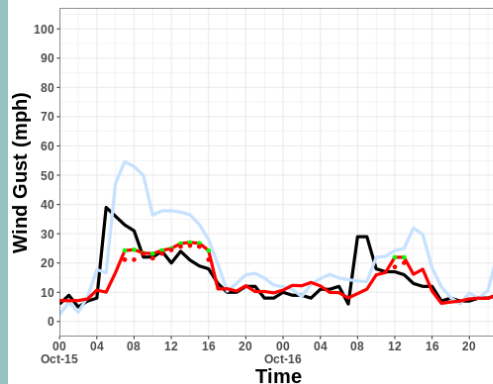
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 8.84 Bias = 5.60
MODEL RMSE = 5.81 Bias = 0.93



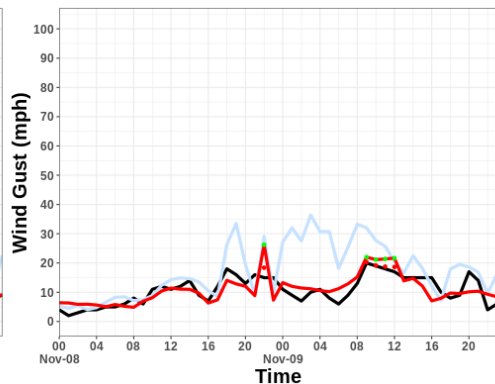
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 10.99 Bias = 5.87
MODEL RMSE = 7.09 Bias = -0.74



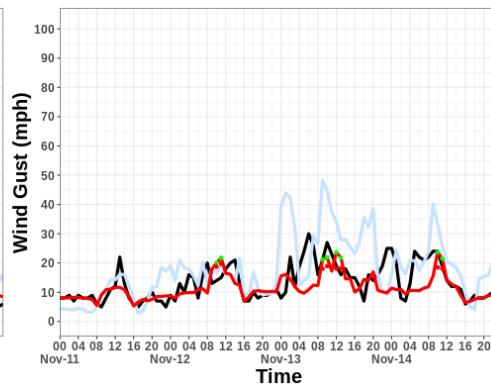
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 10.38 Bias = 6.57
MODEL RMSE = 3.71 Bias = 0.18



Test: 2018-11-11 to 2018-11-14

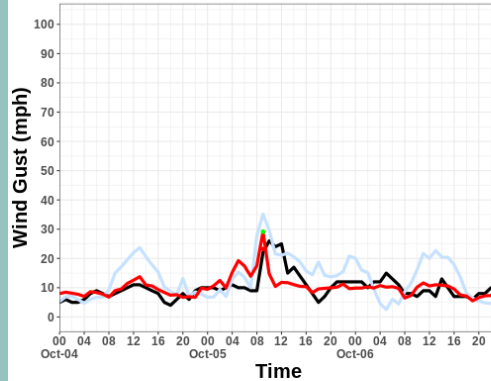
WRF RMSE = 10.31 Bias = 4.63
MODEL RMSE = 5.60 Bias = -1.84



Wind Gust ML Validation for Solana Beach

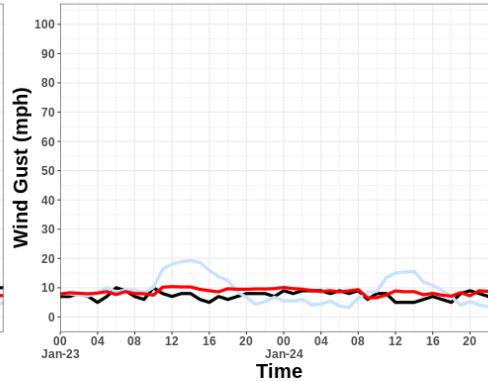
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 6.88 Bias = 3.36
MODEL RMSE = 3.91 Bias = 0.17



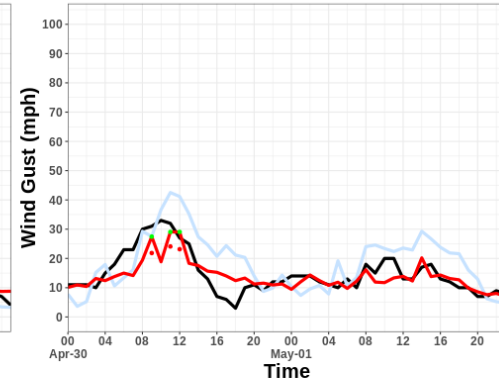
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 5.54 Bias = 1.84
MODEL RMSE = 2.11 Bias = 1.36



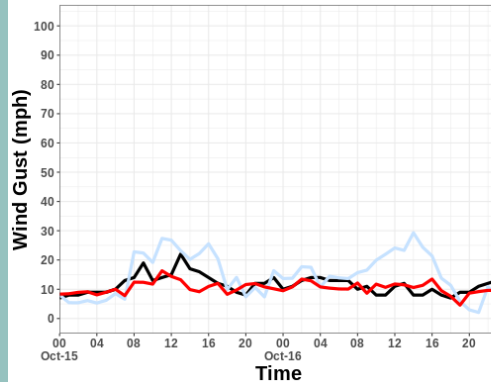
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 8.21 Bias = 3.74
MODEL RMSE = 4.62 Bias = -0.92



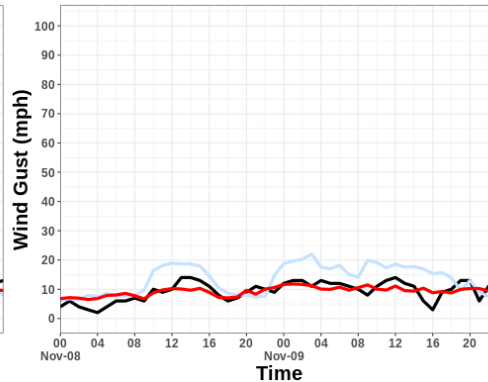
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 7.45 Bias = 3.40
MODEL RMSE = 3.04 Bias = -0.99



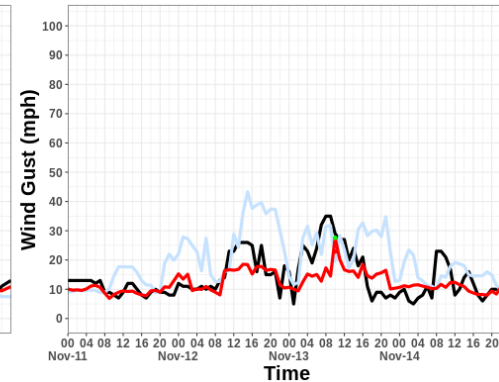
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 5.70 Bias = 4.10
MODEL RMSE = 2.49 Bias = -0.02



Test: 2018-11-11 to 2018-11-14

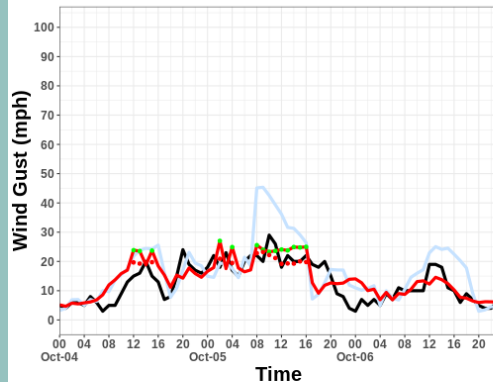
WRF RMSE = 10.52 Bias = 5.82
MODEL RMSE = 5.92 Bias = -1.89



Wind Gust ML Validation for Mussey Grade

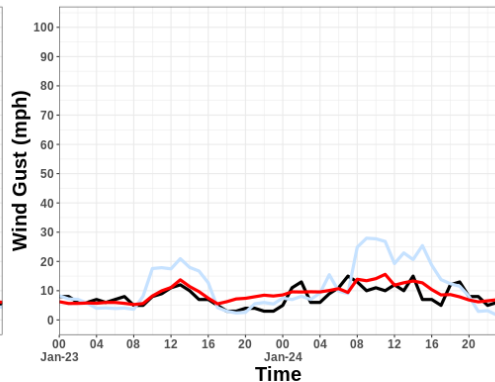
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 7.92 Bias = 4.05
MODEL RMSE = 4.85 Bias = 1.33



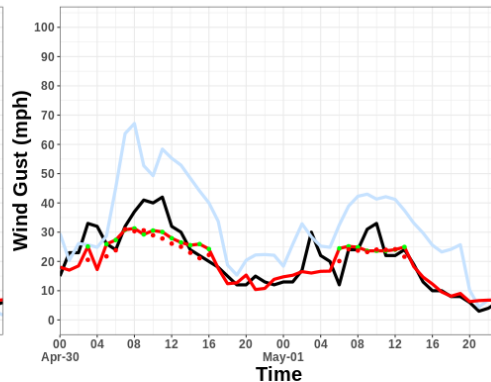
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 7.32 Bias = 3.44
MODEL RMSE = 2.86 Bias = 0.92



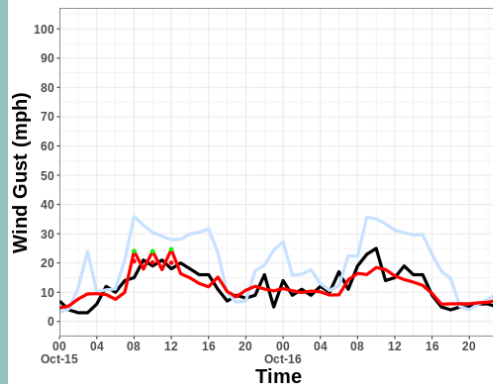
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 14.76 Bias = 11.77
MODEL RMSE = 5.50 Bias = -1.54



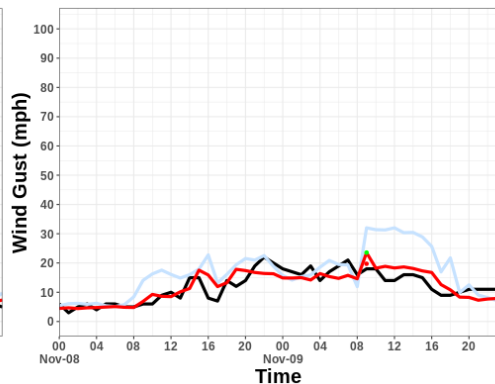
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 10.34 Bias = 7.86
MODEL RMSE = 3.79 Bias = -0.07



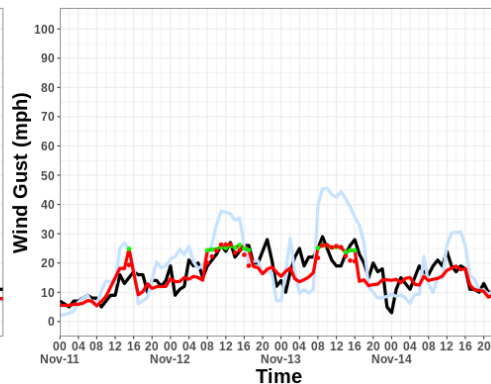
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 7.77 Bias = 4.57
MODEL RMSE = 3.26 Bias = 0.16



Test: 2018-11-11 to 2018-11-14

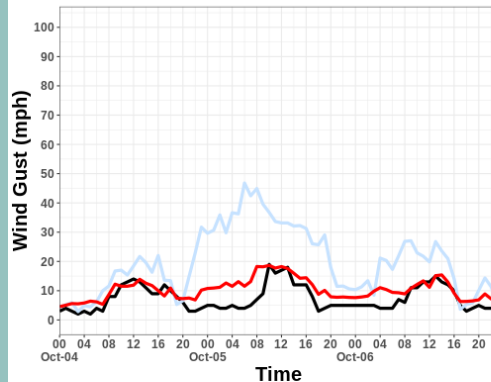
WRF RMSE = 9.09 Bias = 2.58
MODEL RMSE = 4.34 Bias = -0.75



Wind Gust ML Validation for Lilac

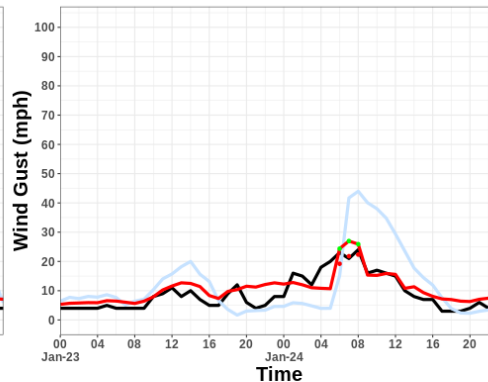
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 16.32 Bias = 12.52
MODEL RMSE = 4.17 Bias = 3.02



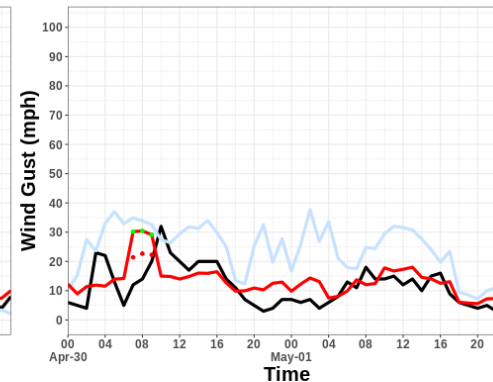
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 9.43 Bias = 2.87
MODEL RMSE = 3.44 Bias = 1.62



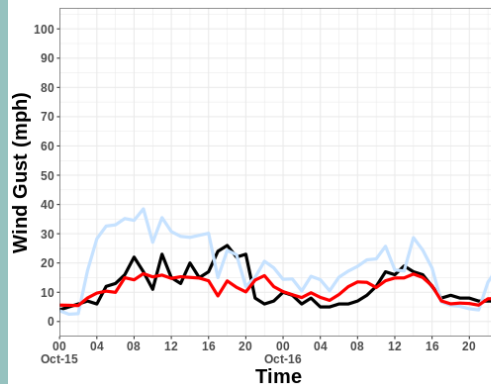
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 15.28 Bias = 12.87
MODEL RMSE = 6.69 Bias = 1.74



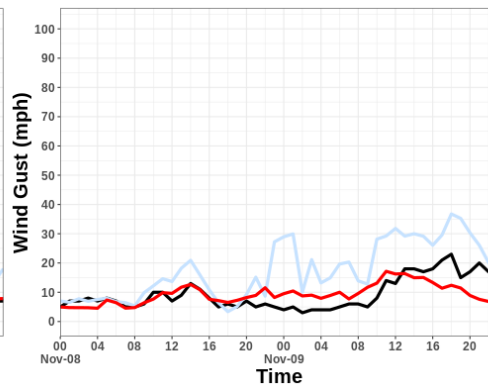
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 10.97 Bias = 7.46
MODEL RMSE = 4.97 Bias = -0.70



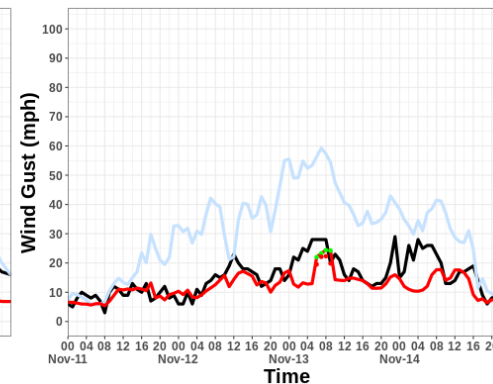
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 10.80 Bias = 7.98
MODEL RMSE = 4.72 Bias = -0.14



Test: 2018-11-11 to 2018-11-14

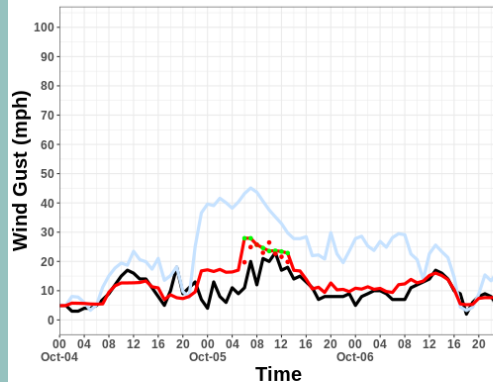
WRF RMSE = 18.87 Bias = 15.51
MODEL RMSE = 5.53 Bias = -2.83



Wind Gust ML Validation for Hidden Meadows

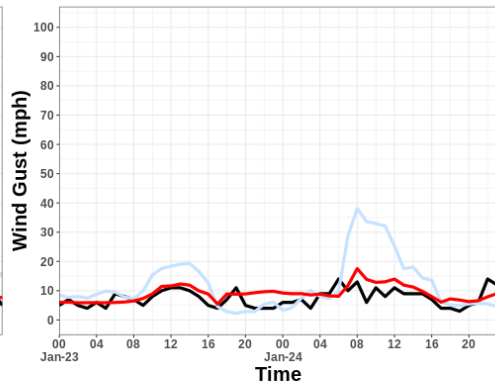
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 15.70 Bias = 12.12
MODEL RMSE = 4.74 Bias = 2.05



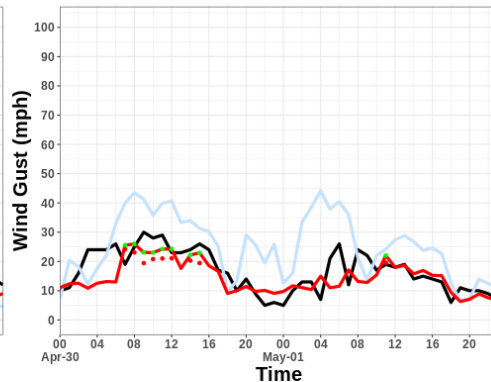
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 9.24 Bias = 4.48
MODEL RMSE = 3.13 Bias = 1.55



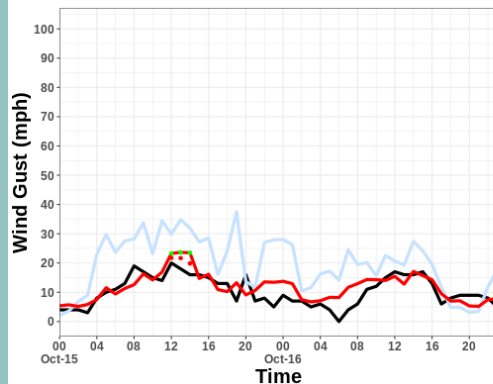
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 12.68 Bias = 8.51
MODEL RMSE = 5.80 Bias = -2.13



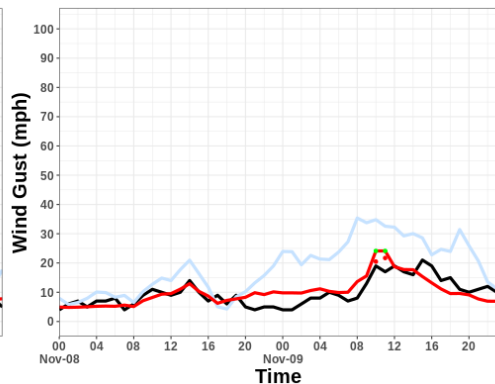
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 12.39 Bias = 9.49
MODEL RMSE = 3.90 Bias = 1.37



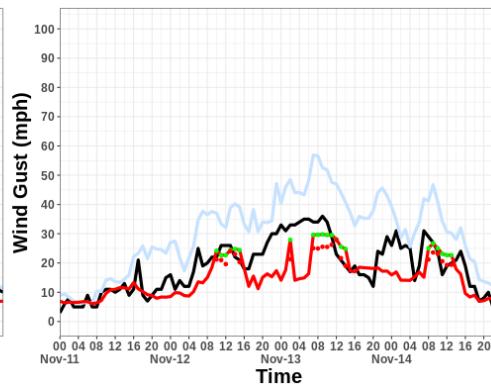
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 11.25 Bias = 8.66
MODEL RMSE = 3.29 Bias = 0.41



Test: 2018-11-11 to 2018-11-14

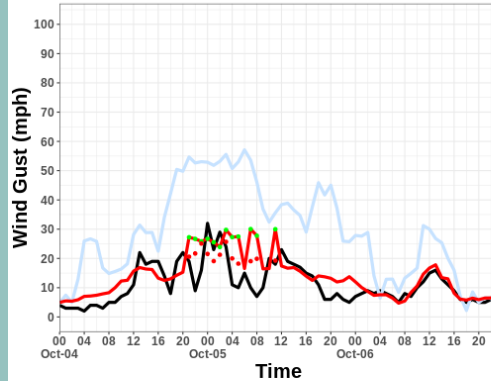
WRF RMSE = 13.03 Bias = 11.21
MODEL RMSE = 7.29 Bias = -3.67



Wind Gust ML Validation for Nate Harrison Grade

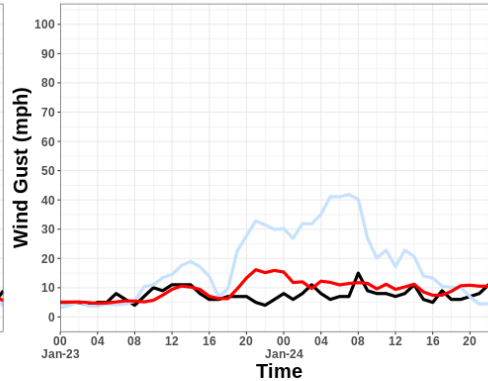
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 21.63 Bias = 17.32
MODEL RMSE = 6.36 Bias = 2.58



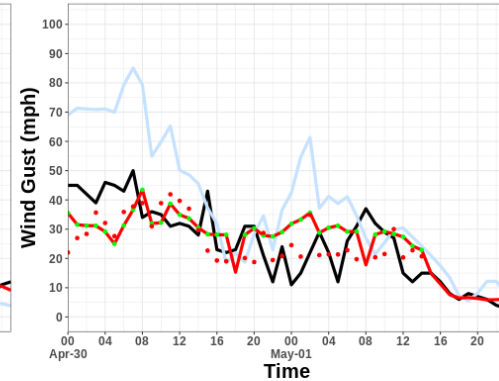
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 15.41 Bias = 10.11
MODEL RMSE = 3.94 Bias = 1.85



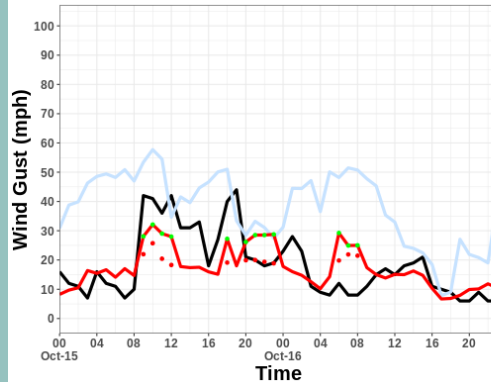
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 20.08 Bias = 13.92
MODEL RMSE = 9.66 Bias = 0.46



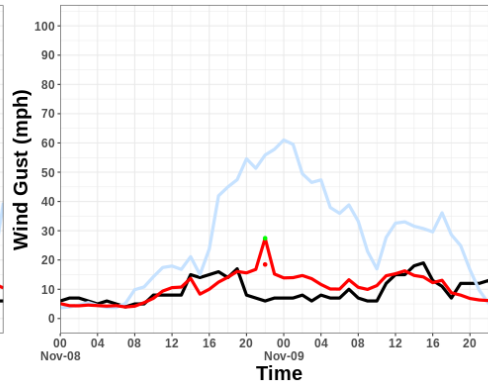
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 24.36 Bias = 19.87
MODEL RMSE = 9.21 Bias = -0.97



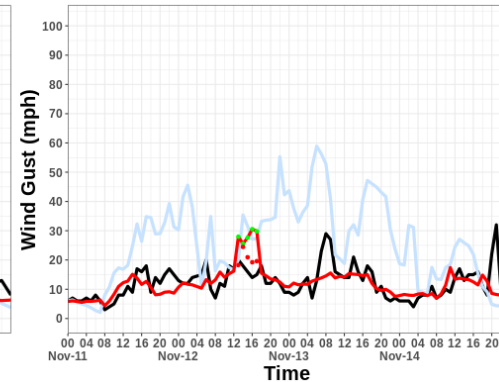
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 24.76 Bias = 17.56
MODEL RMSE = 5.13 Bias = 1.16



Test: 2018-11-11 to 2018-11-14

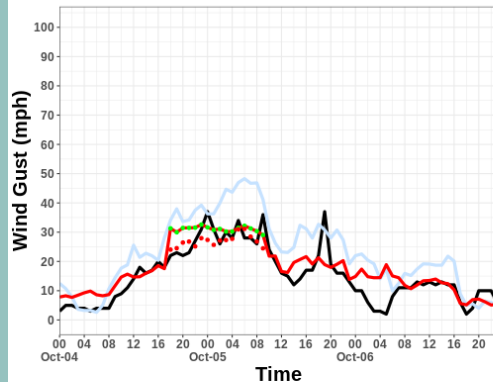
WRF RMSE = 18.84 Bias = 13.34
MODEL RMSE = 5.41 Bias = -0.20



Wind Gust ML Validation for Wisecarver

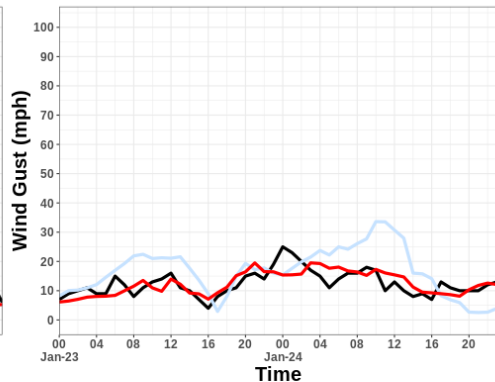
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 9.73 Bias = 7.57
MODEL RMSE = 5.40 Bias = 2.40



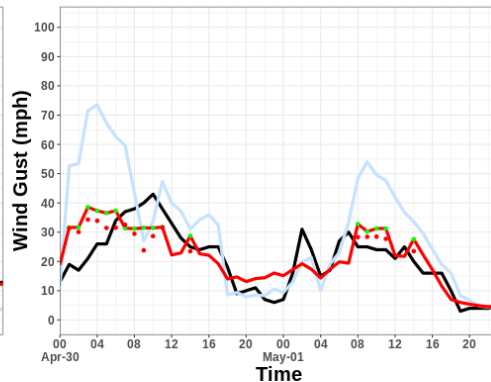
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 8.64 Bias = 4.15
MODEL RMSE = 3.40 Bias = 0.05



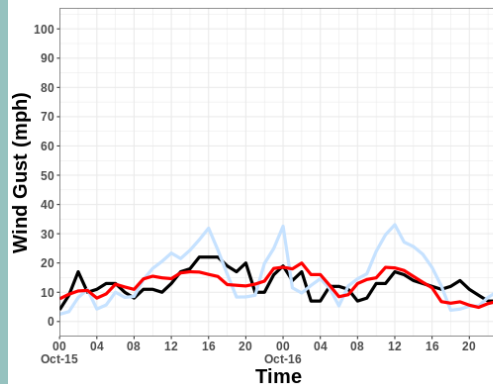
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 17.76 Bias = 9.69
MODEL RMSE = 7.18 Bias = 1.08



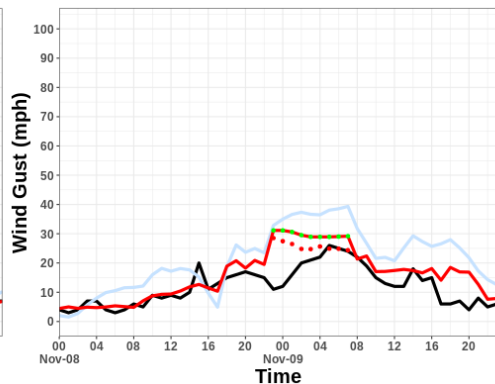
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 7.75 Bias = 2.29
MODEL RMSE = 4.28 Bias = -0.05



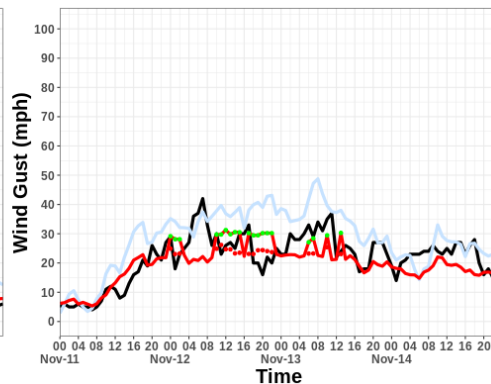
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 11.63 Bias = 9.24
MODEL RMSE = 6.54 Bias = -3.91



Test: 2018-11-11 to 2018-11-14

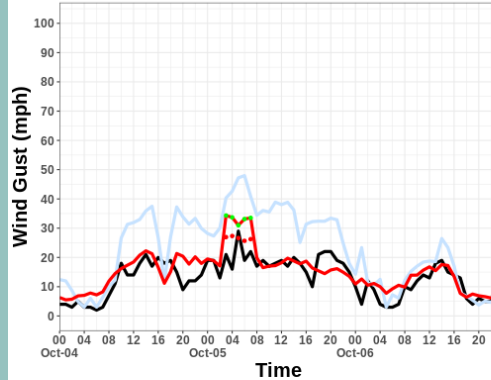
WRF RMSE = 9.36 Bias = 6.51
MODEL RMSE = 6.46 Bias = -1.82



Wind Gust ML Validation for Deerhorn Valley

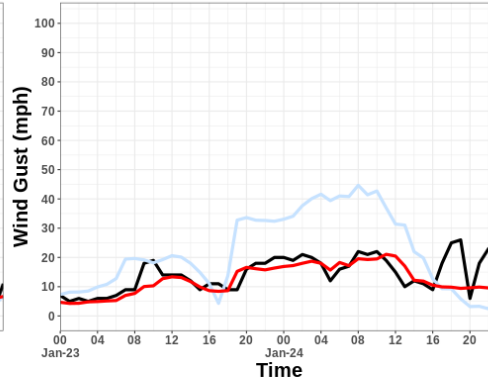
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 12.84 Bias = 9.63
MODEL RMSE = 5.25 Bias = 2.23



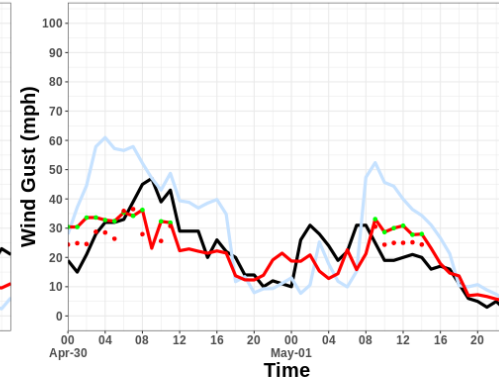
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 14.28 Bias = 7.61
MODEL RMSE = 5.22 Bias = -2.01



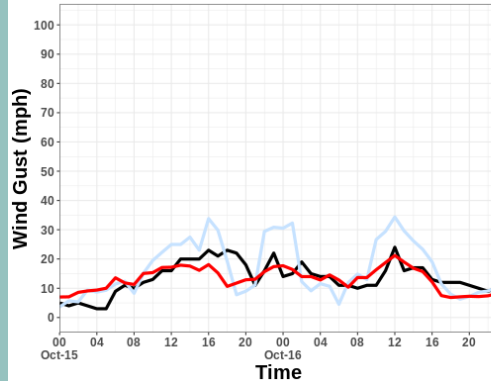
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 14.79 Bias = 7.71
MODEL RMSE = 8.21 Bias = -0.08



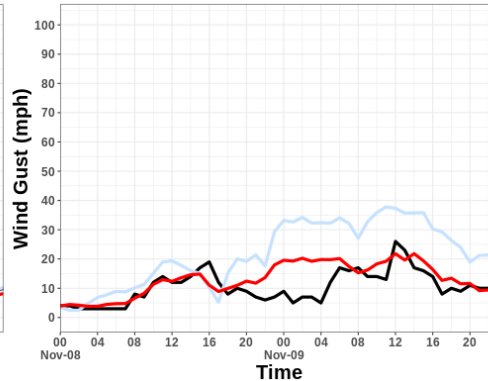
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 7.66 Bias = 3.16
MODEL RMSE = 4.07 Bias = -0.43



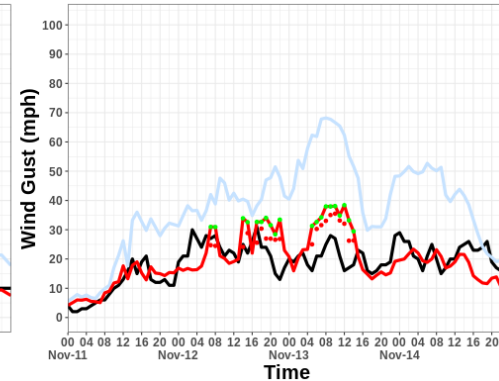
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 14.50 Bias = 11.21
MODEL RMSE = 5.46 Bias = 2.60



Test: 2018-11-11 to 2018-11-14

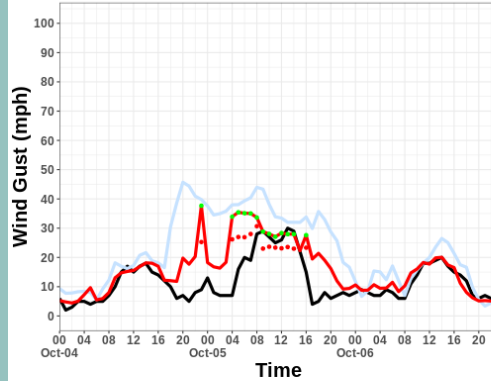
WRF RMSE = 22.50 Bias = 18.87
MODEL RMSE = 7.24 Bias = 0.99



Wind Gust ML Validation for Otay Mesa Border

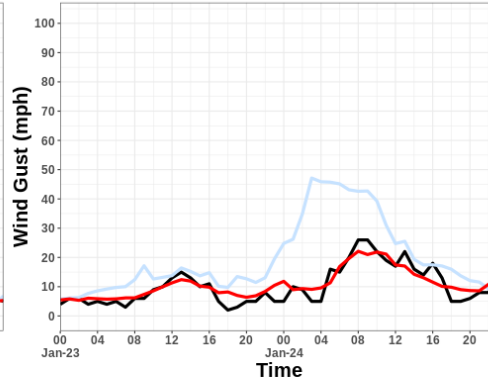
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 15.41 Bias = 10.75
MODEL RMSE = 7.83 Bias = 4.29



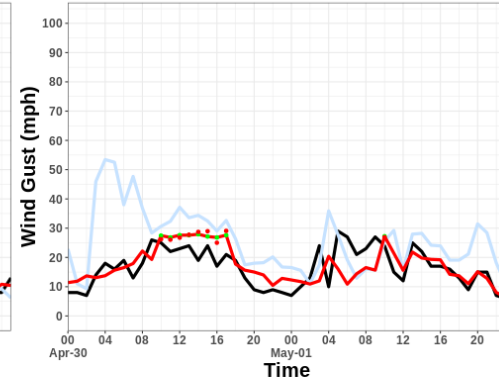
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 13.99 Bias = 9.50
MODEL RMSE = 3.00 Bias = 0.57



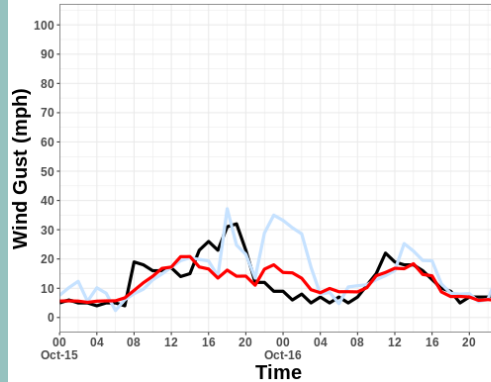
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 14.11 Bias = 9.26
MODEL RMSE = 5.80 Bias = 0.73



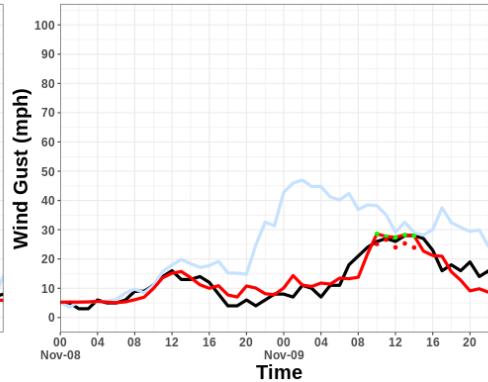
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 8.75 Bias = 3.04
MODEL RMSE = 5.51 Bias = -0.57



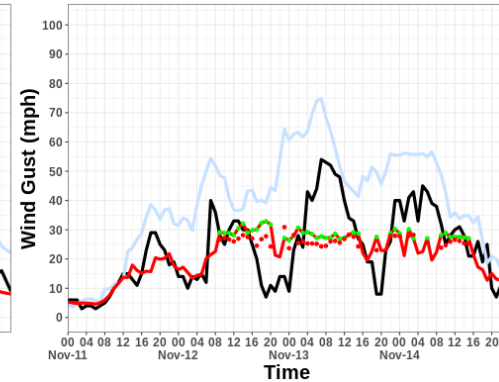
Test: 2018-11-08 to 2018-11-09

WRF RMSE = 16.80 Bias = 12.03
MODEL RMSE = 3.39 Bias = -0.06



Test: 2018-11-11 to 2018-11-14

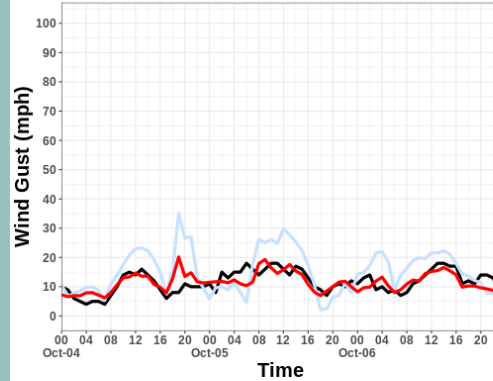
WRF RMSE = 20.13 Bias = 15.95
MODEL RMSE = 10.42 Bias = -1.98



Wind Gust ML Validation for San Clemente Ridge

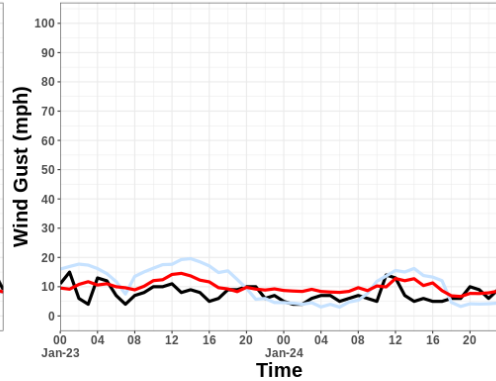
Test: 2013-10-04 to 2013-10-06

WRF RMSE = 7.40 Bias = 3.65
MODEL RMSE = 2.99 Bias = -0.14



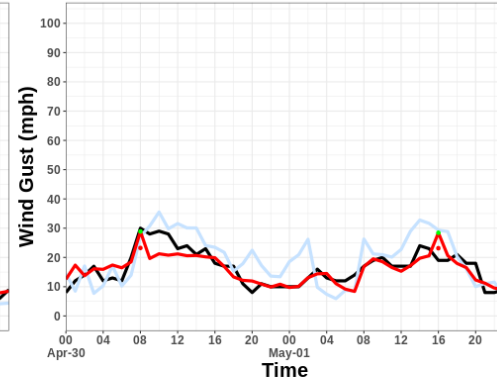
Test: 2014-01-23 to 2014-01-24

WRF RMSE = 6.19 Bias = 3.23
MODEL RMSE = 3.71 Bias = 2.26



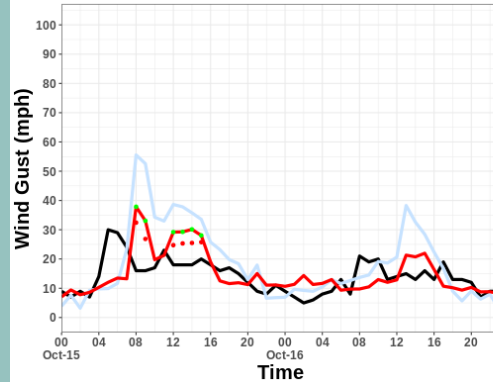
Test: 2014-04-30 to 2014-05-01

WRF RMSE = 6.58 Bias = 2.89
MODEL RMSE = 3.45 Bias = -0.47



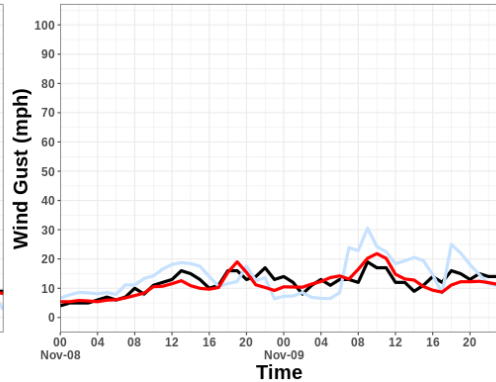
Test: 2018-10-15 to 2018-10-16

WRF RMSE = 12.21 Bias = 4.33
MODEL RMSE = 7.54 Bias = 0.80



Test: 2018-11-08 to 2018-11-09

WRF RMSE = 5.45 Bias = 2.13
MODEL RMSE = 2.61 Bias = -0.53



Test: 2018-11-11 to 2018-11-14

WRF RMSE = 6.77 Bias = 0.08
MODEL RMSE = 4.05 Bias = -1.68

