2002 MM5 Sensitivity Runs

Missouri Department of Natural Resource
Air Pollution Control Program
Regional Modeling Group

St. Louis 8 hr Ozone/PM2.5 Technical Meeting
EastWest Gateway, St. Louis MO
June 16, 2004

Overview

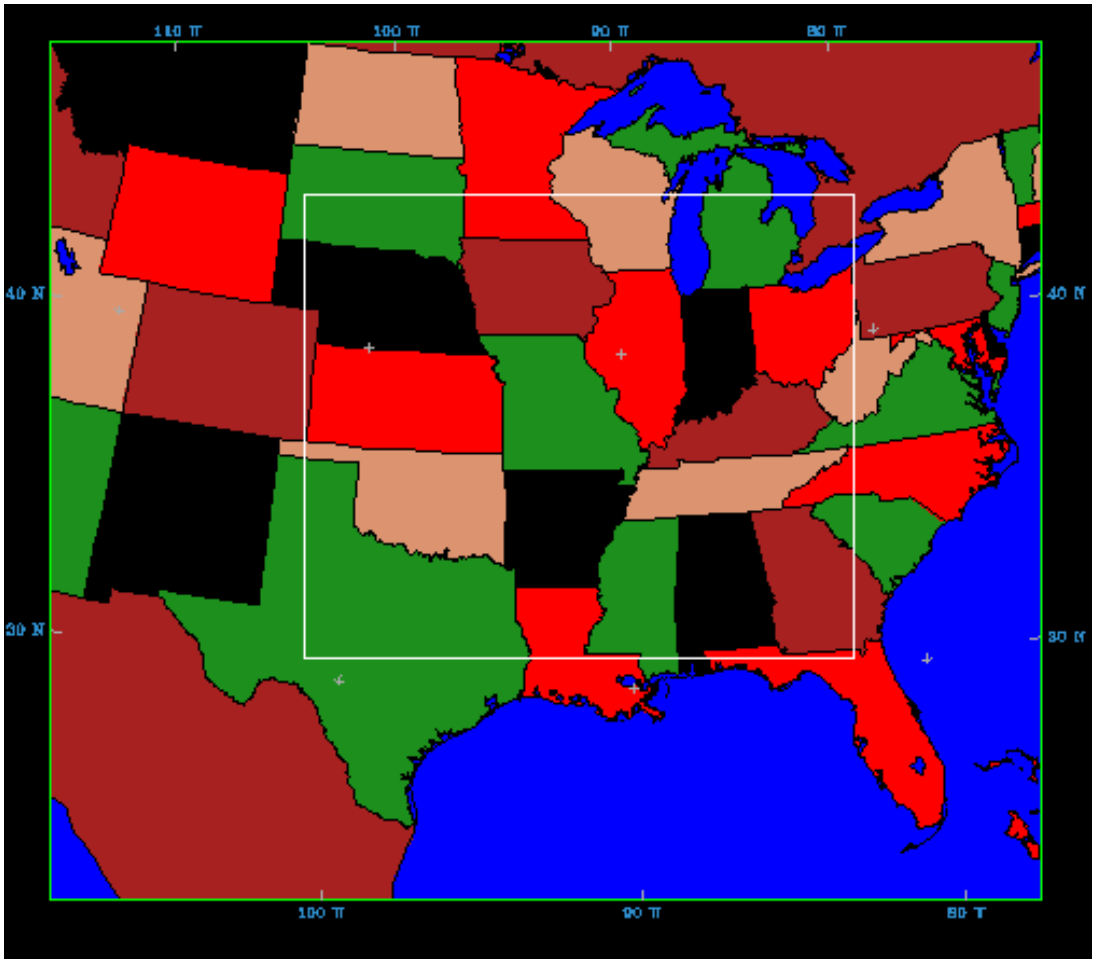
- **Basic Information**
  - Model Configuration
    - Domain
    - Input Data
    - Physic Options
  - Computational Requirements

- **Evaluation**
  - January & July 2002
  - Metstat (Surface Statistics)

- **Summary and Conclusions**

MM5 Domain

- Domain 1 (36km)
  - MM5 165x129x34
  - CMAQ 147x111x18
- Domain 2 (12km)
  - MM5 180x100x34
  - CMAQ 162x82x18
- Evaluation Criteria
  - Synoptic Evaluation
  - Statistical Evaluation using METSTAT and surface data
  - WS, WD, T, RH



Configurations

- **Run 1 (Blackadar)**
  - CP = Kain-Fritsch II
  - Moisture = Reisner II
  - Radiation = RRTM
  - PBL = Blackadar
  - Surface = 5-layer soil model
- **Run 2 (Eta)**
  - CP = Kain-Fritsch II
  - Moisture = Reisner II
  - Radiation = RRTM
  - PBL = Eta PBL
  - Surface = OSU-LSM
- **Run 3 (MRF)**
  - CP = Kain-Fritsch II
  - Moisture = Reisner II
  - Radiation = RRTM
  - PBL = MRF PBL
  - Surface = 5-layer soil model
- **Run 4 (Pleim-Xiu)**
  - CP = Kain-Fritsch II
  - Moisture = Reisner II
  - Radiation = RRTM
  - PBL = Pleim-Xiu
  - Surface = Pleim-Xiu LSM

January MM5 Performance Plots

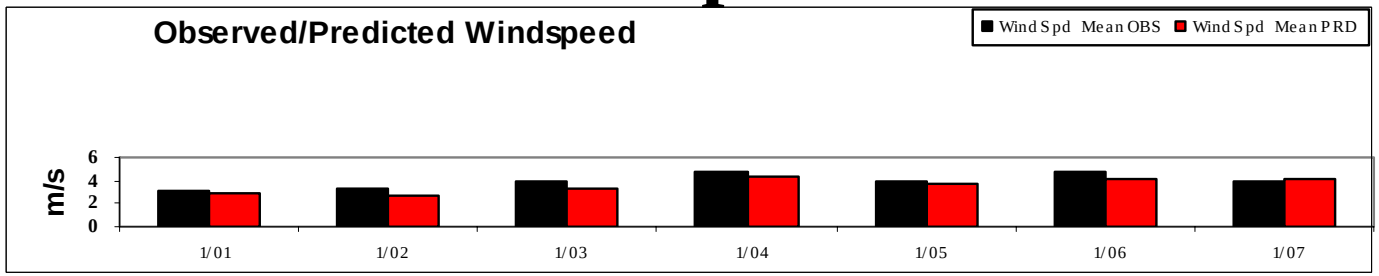
- **Daily Performance Plots**
  - Bar graphs of performance metrics:
    - Daily output from January 1-7 and January 8-14
- **Hourly Performance Plots**
  - Line graphs of performance metrics:
    - Daily output from January 1-7 and January 8-14
      - Observed/Predicted
        - Wind Speed
        - Temperature
        - Humidity
      - Bias/Gross Error
        - Wind Speed
        - Temperature
        - Humidity

January MM5 Performance Plots

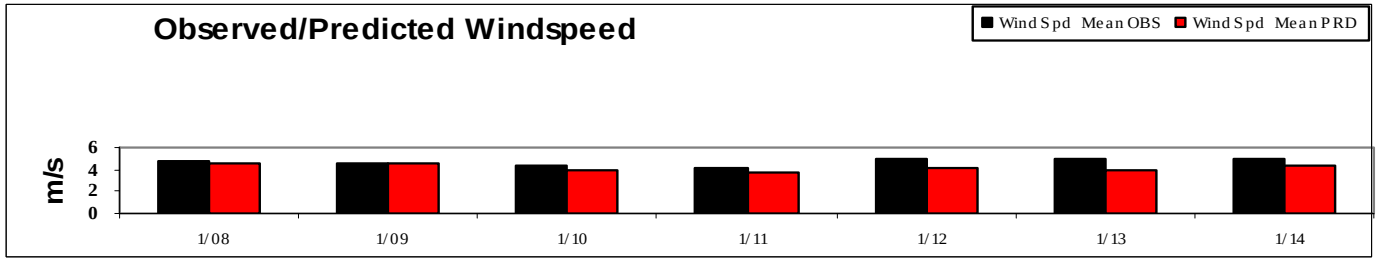
Daily Analysis

Comparison of Daily Observed/Predicted Wind Speed

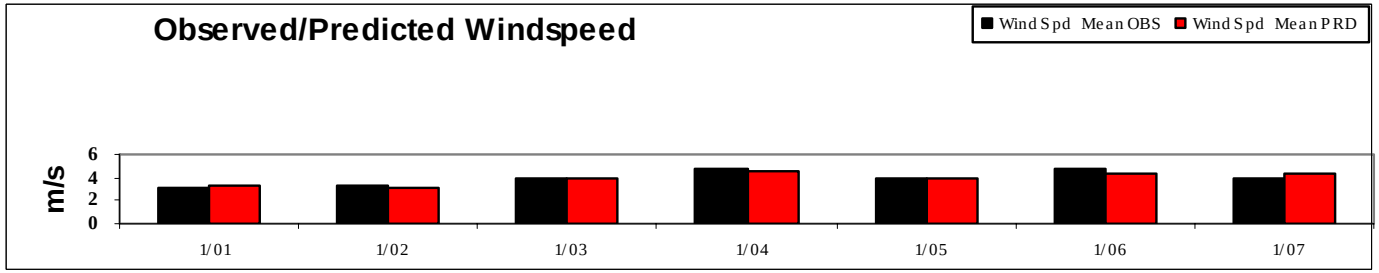
Eta
Day 1-7



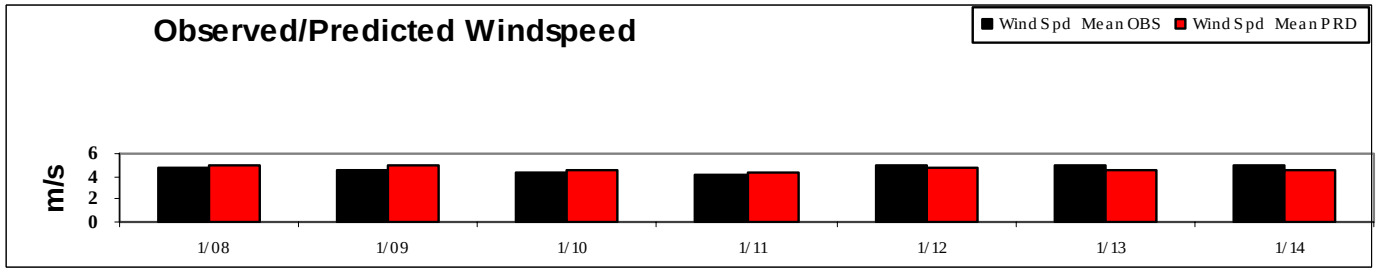
Eta
Day 8-14



Pleim-Xiu
Day 1-7

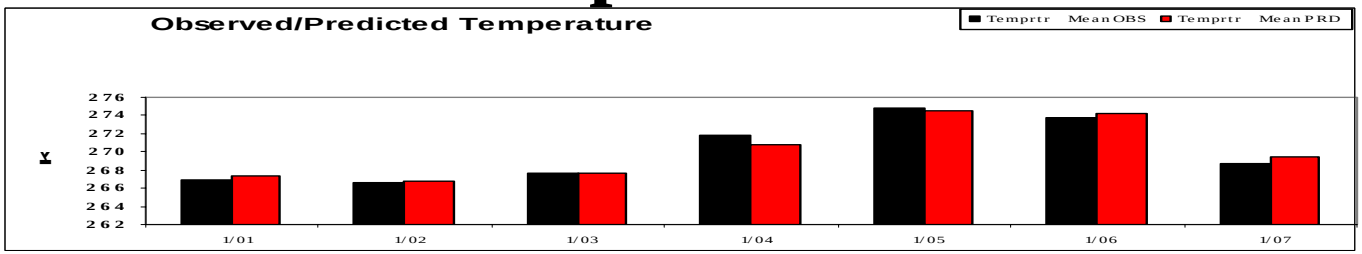


Pleim-Xiu
Day 8-14

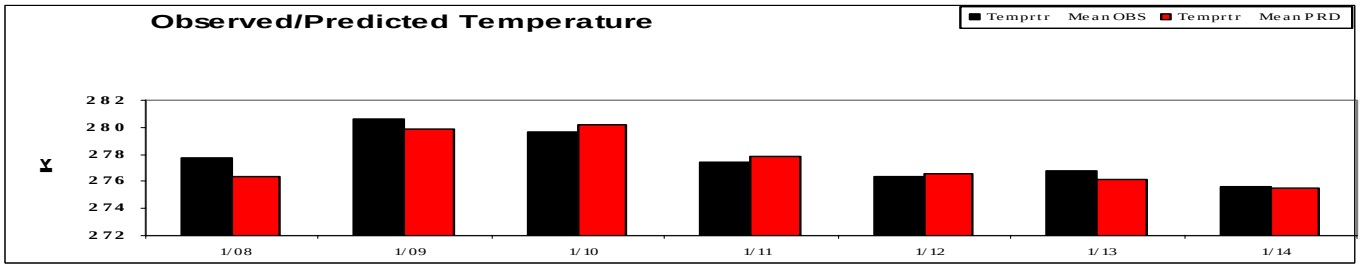


Comparison of Daily Observed/Predicted Temperature

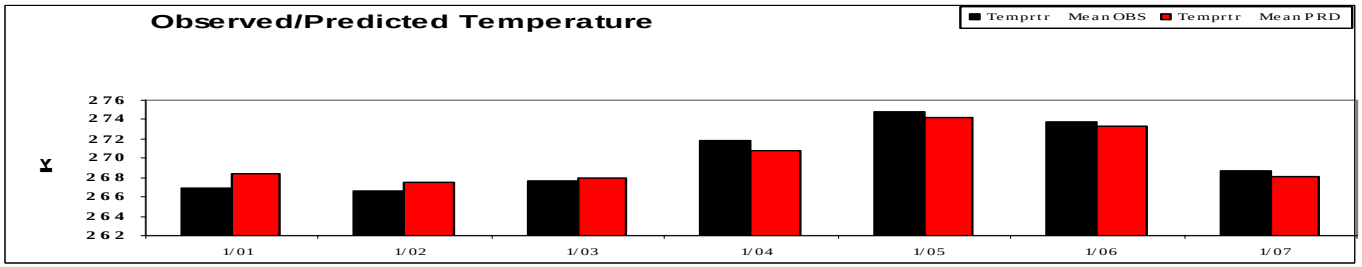
MRF
Day 1-7



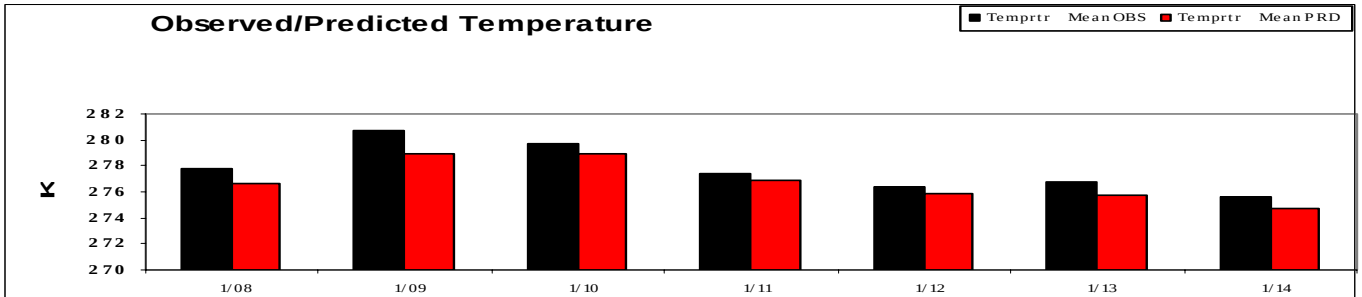
MRF
Day 8-14



Pleim-Xiu
Day 1-7

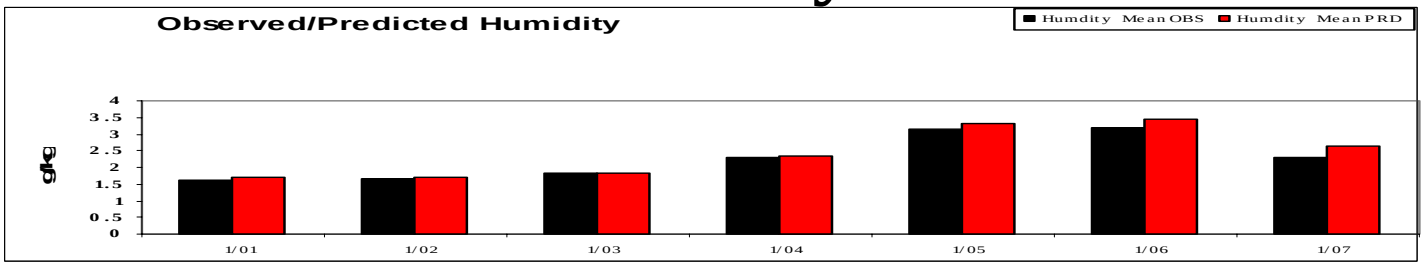


Pleim-Xiu
Day 8-14

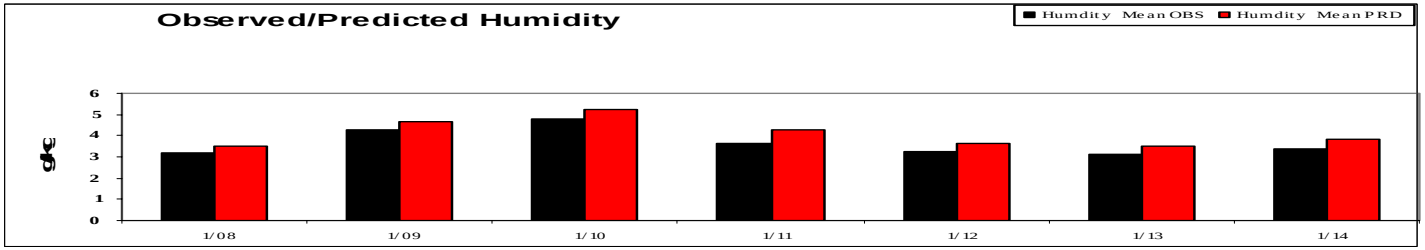


Comparison Daily Observed/Predicted Humidity

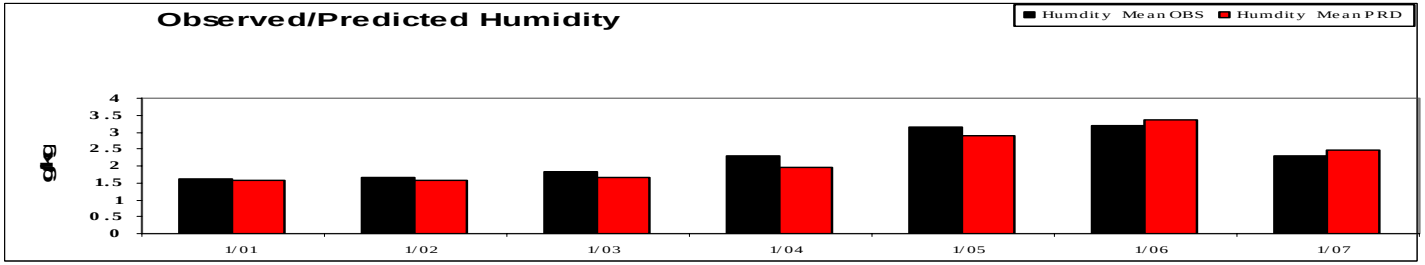
Eta
Day 1-7



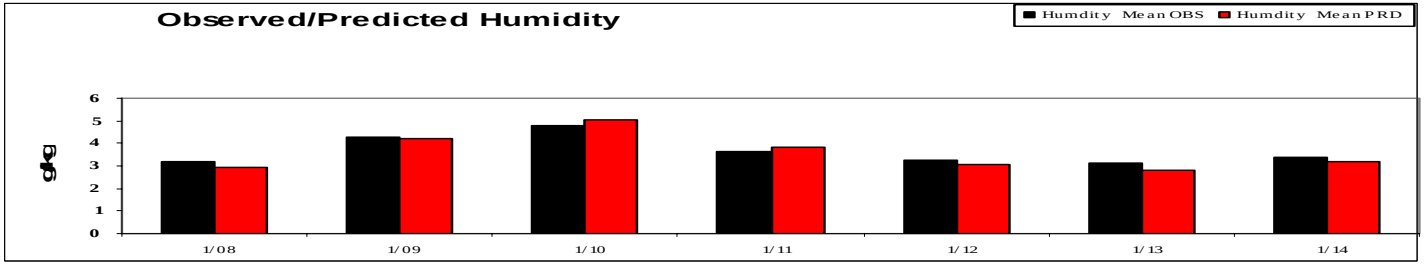
Eta
Day 8-14



Pleim-Xiu
Day 1-7

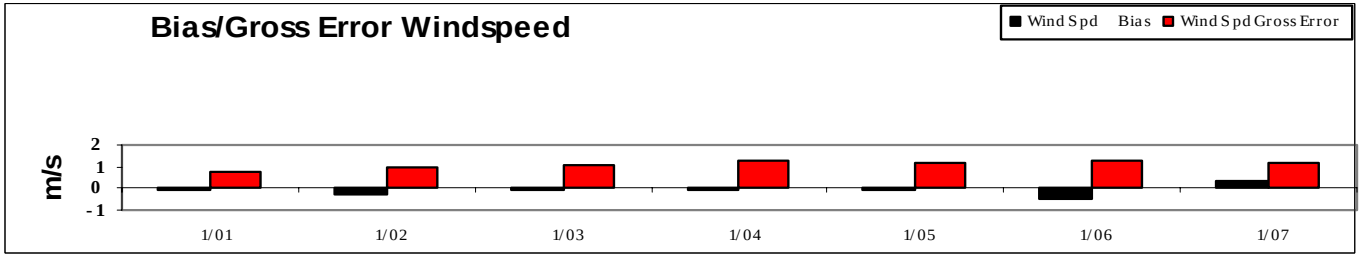


Pleim-Xiu
Day 8-14

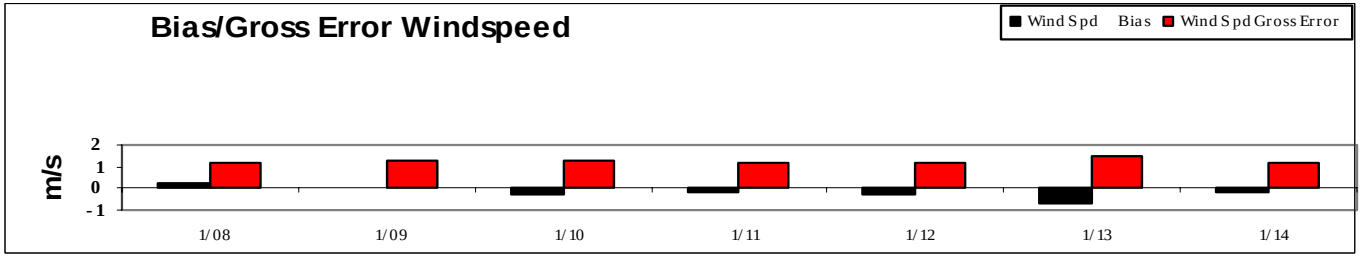


Comparison of Daily Bias/Gross Error Windspeed

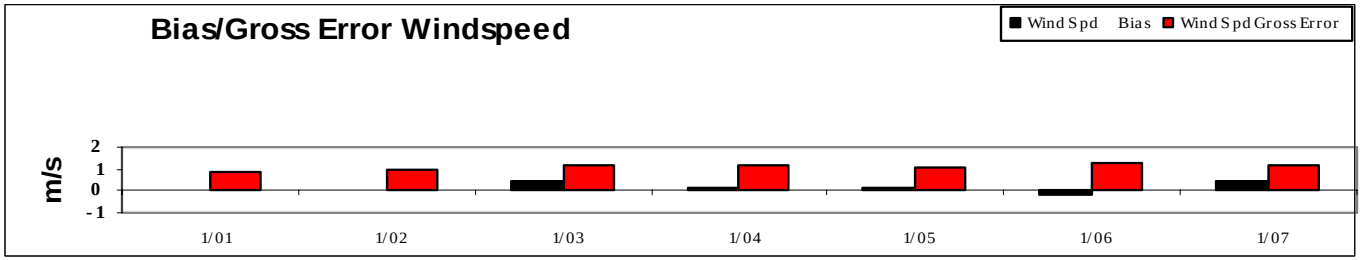
Eta
Day 1-7



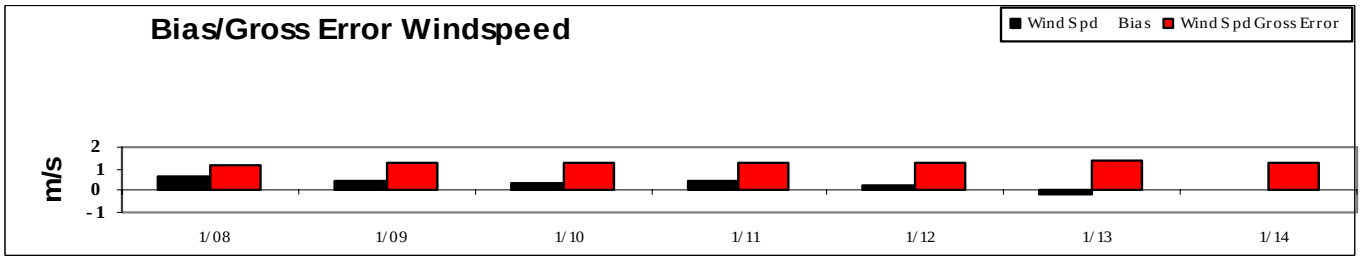
Eta
Day 8-14



Pleim-Xiu
Day 1-7

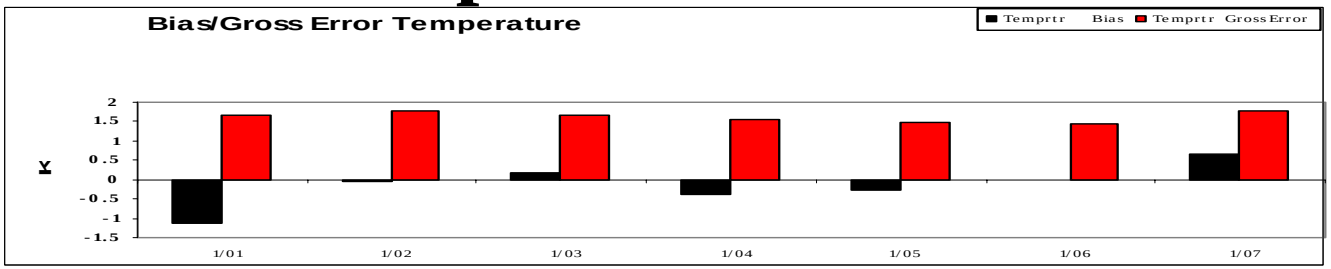


Pleim-Xiu
Day 8-14

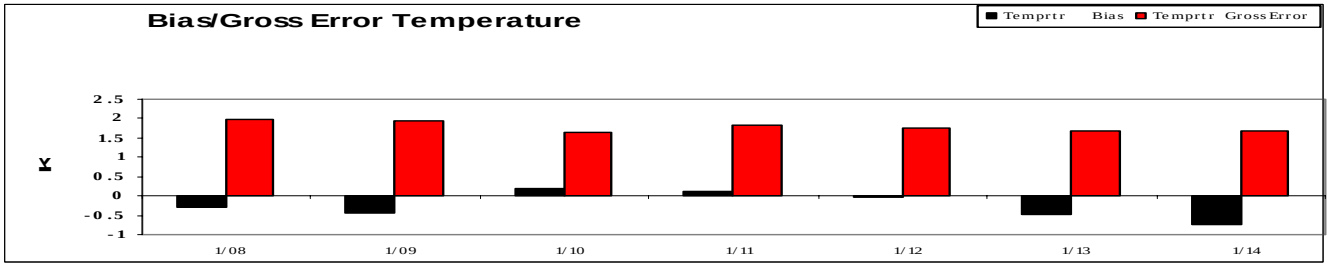


Comparison of Daily Bias/Gross Temperature Error

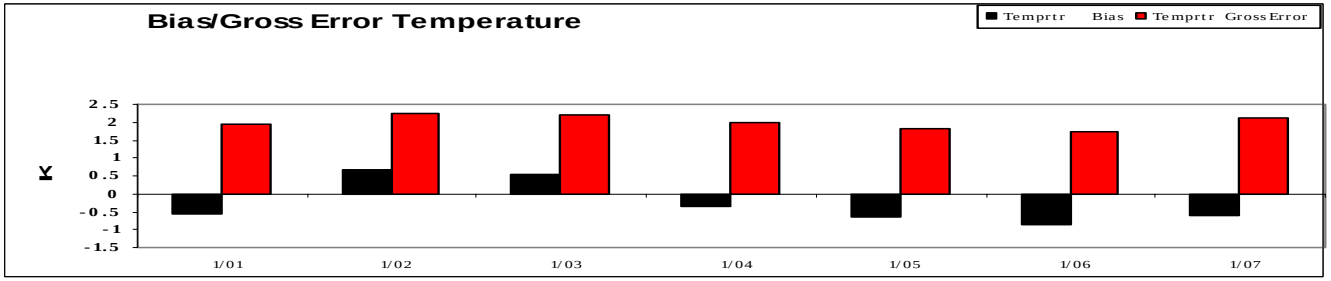
MRF
Day 1-7



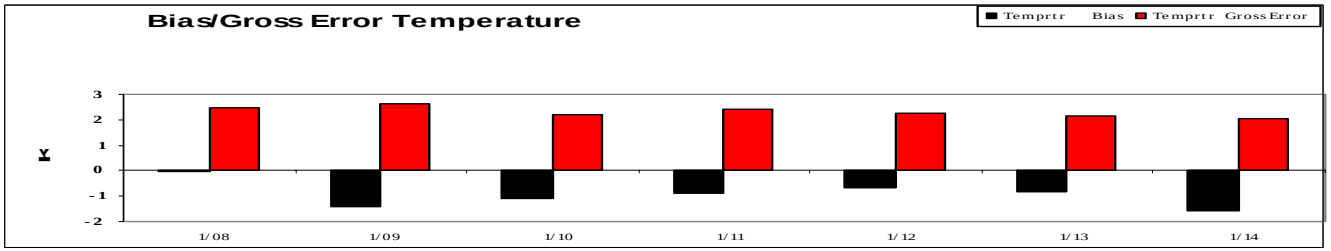
MRF
Day 8-14



Pleim-Xiu
Day 1-7

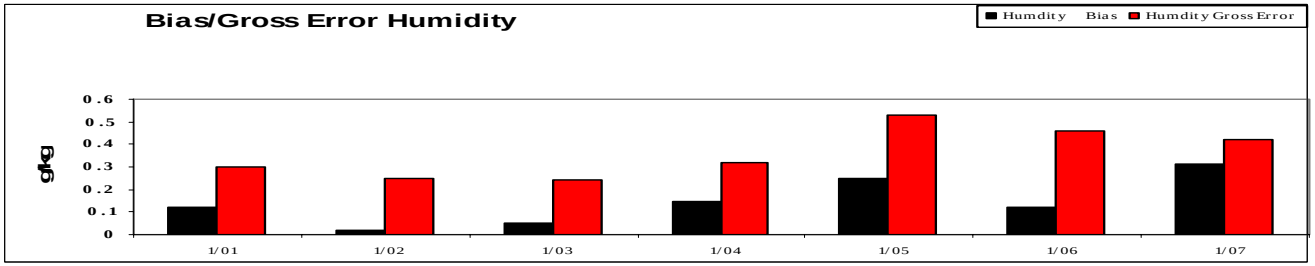


Pleim-Xiu
Day 8-14

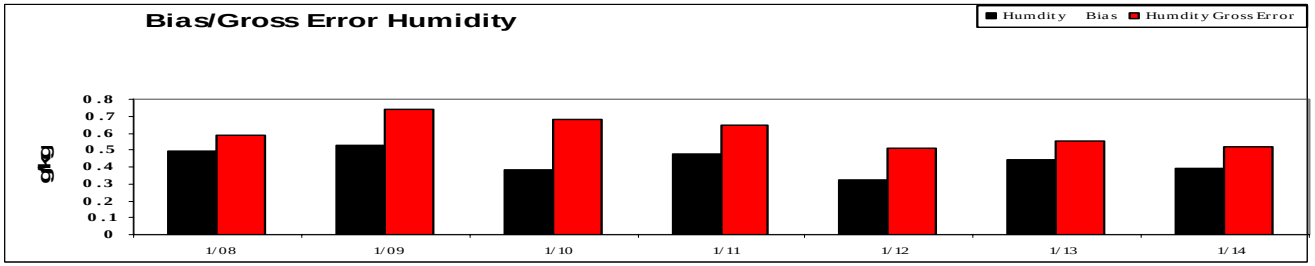


Comparison of Daily Bias/Gross Humidity Error

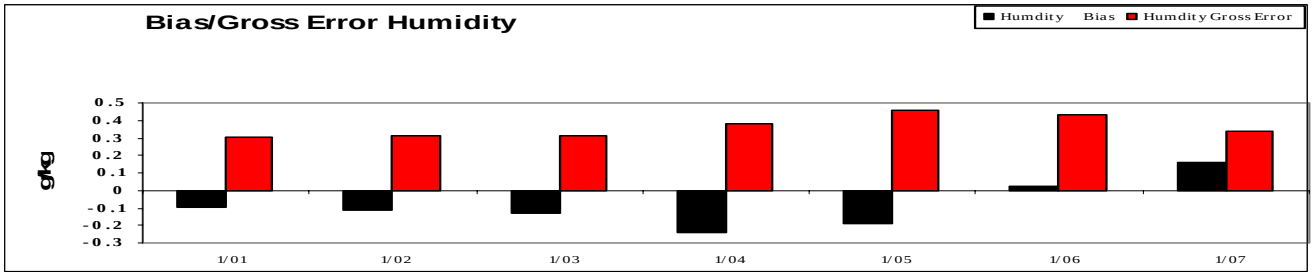
Eta
Day 1-7



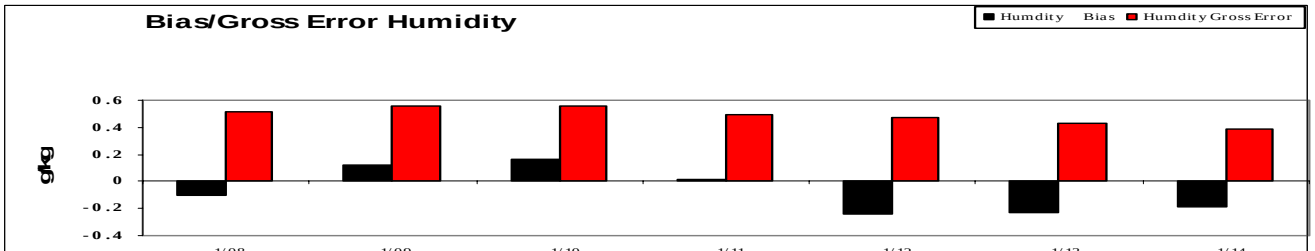
Eta
Day 8-14



Pleim-Xiu
Day 1-7



Pleim-Xiu
Day 8-14

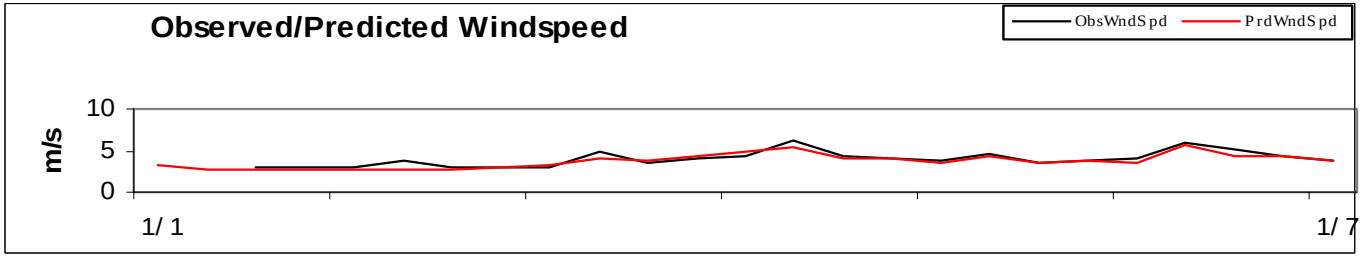


January MM5 Hourly Performance Plots

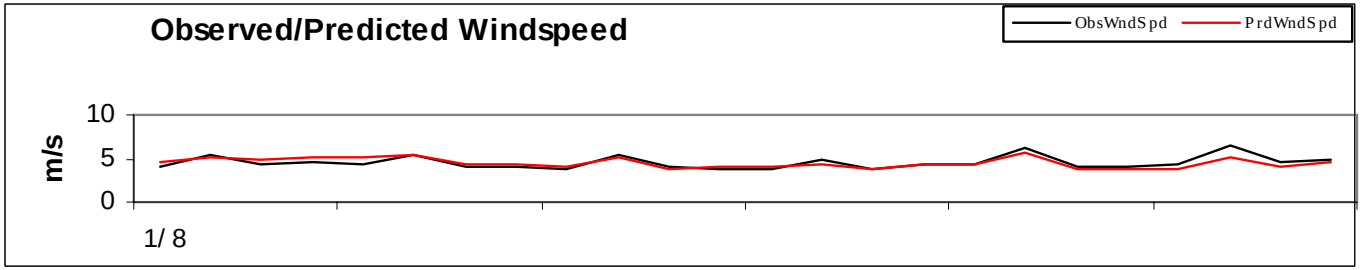
Hourly Analysis

Comparison of Hourly Observed/Predicted Wind Speed

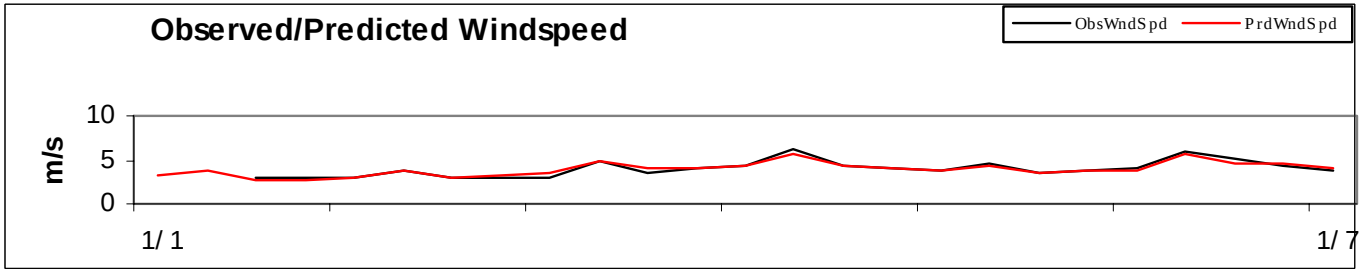
MRF
Day 1-7



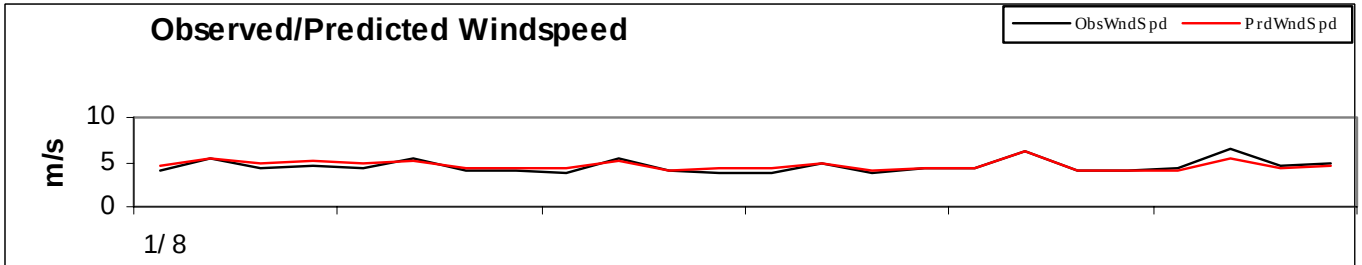
MRF
Day 8-14



Pleim-Xiu
Day 1-7

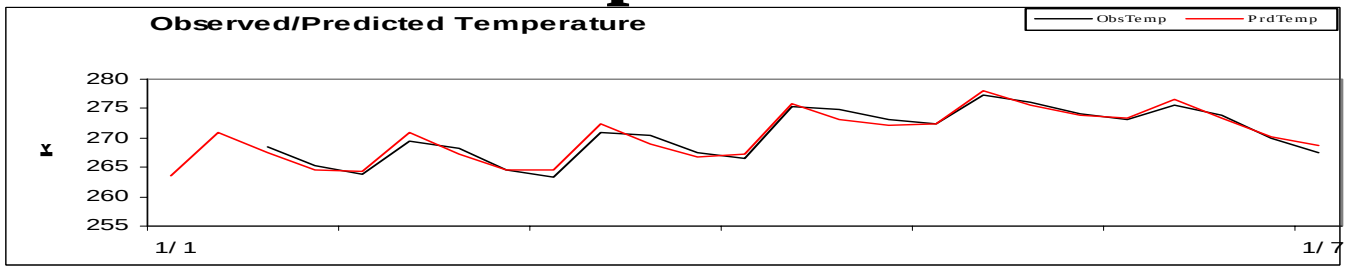


Pleim-Xiu
Day 1-7

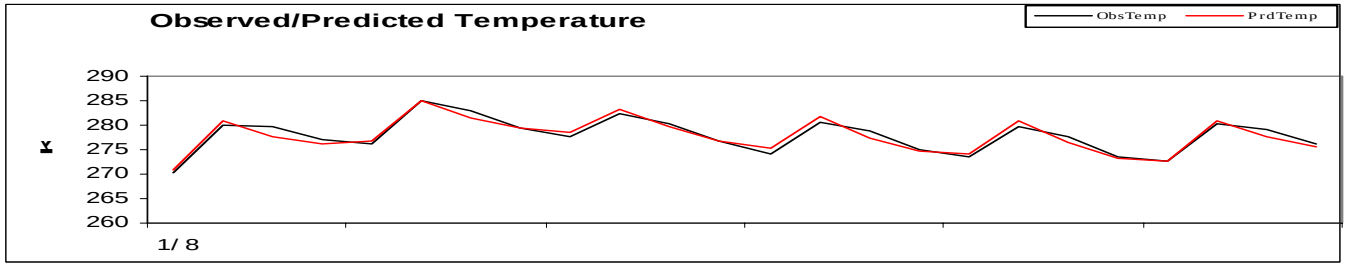


Comparison of Hourly Observed/Predicted Temperature

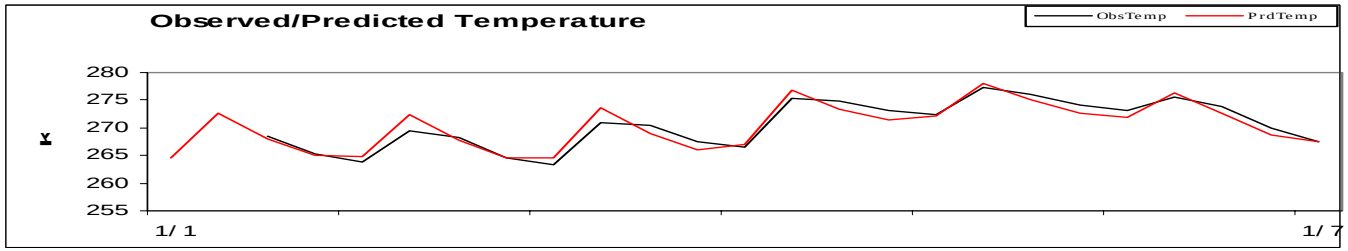
MRF
Day 1-7



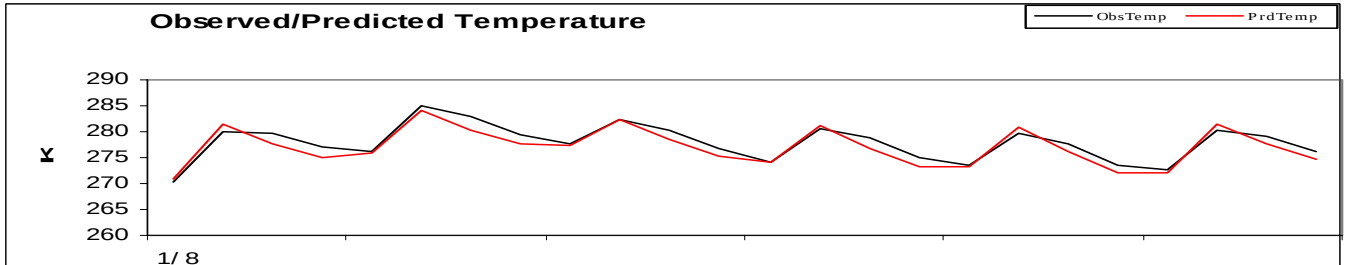
MRF
Day 8-14



Pleim-Xiu
Day 1-7

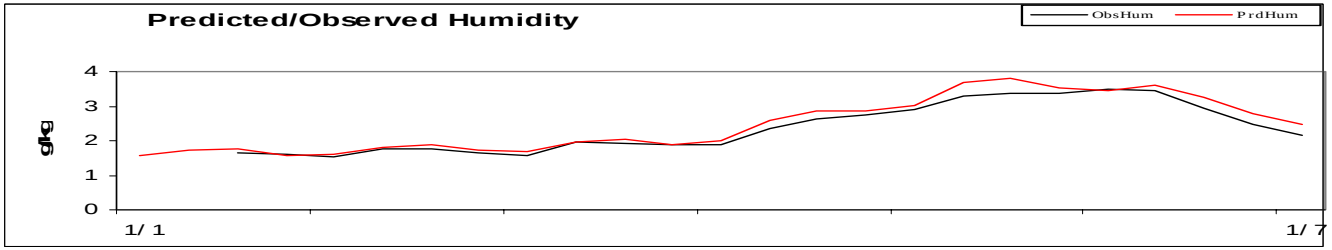


Pleim-Xiu
Day 8-14

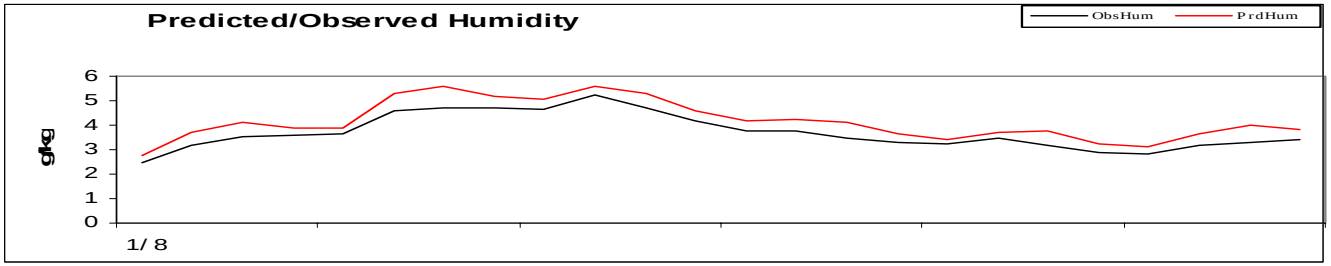


Comparison of Hourly Observed/Predicted Humidity

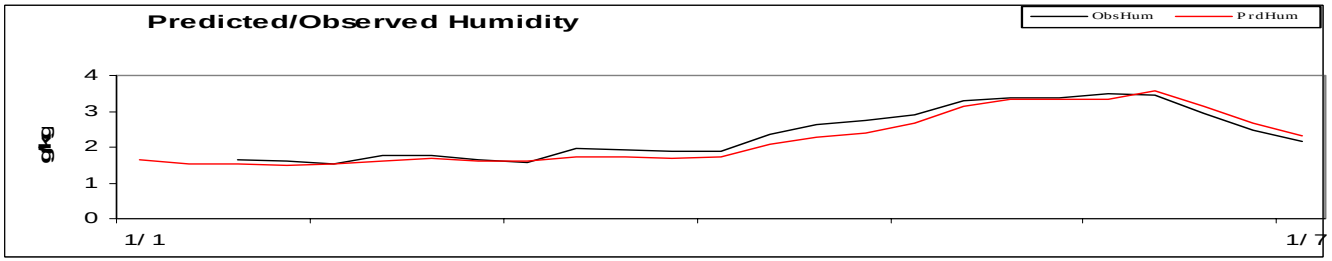
Eta
Day 1-7



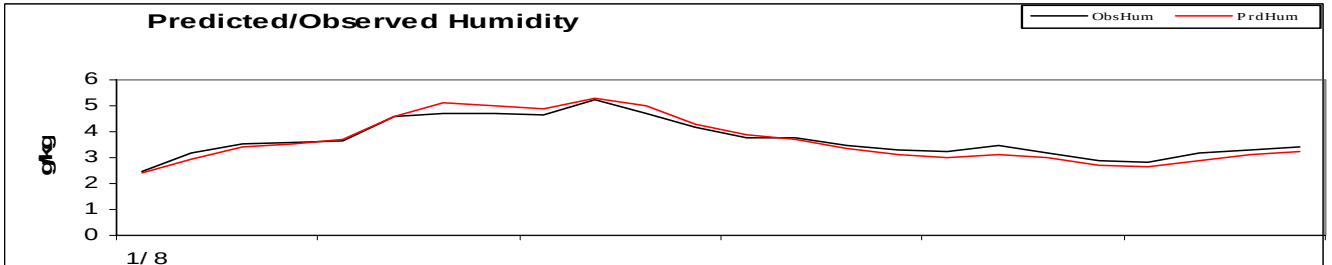
Eta
Day 8-14



Pleim-Xiu
Day 1-7

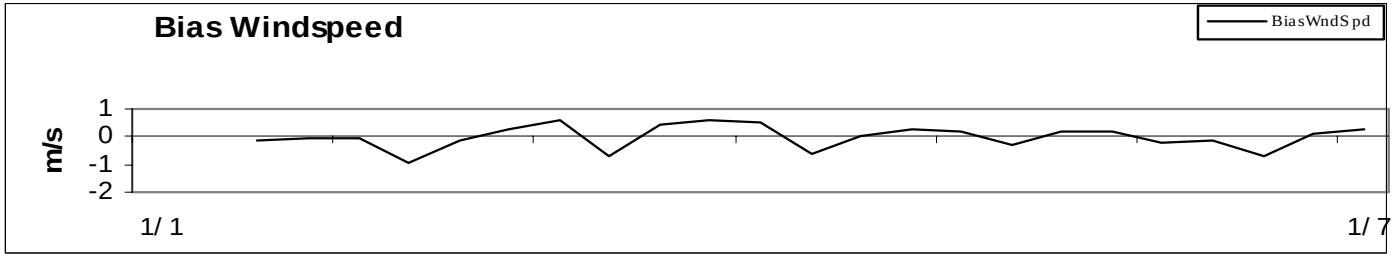


Pleim-Xiu
Day 8-14

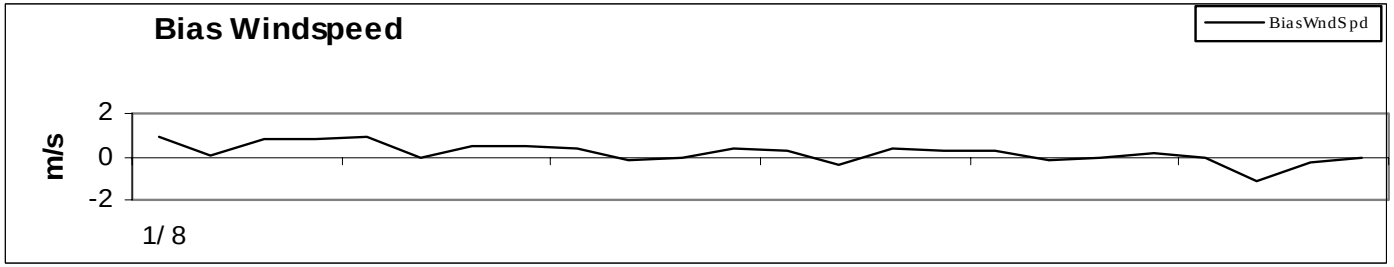


Comparison of Hourly Bias Error Windspeed

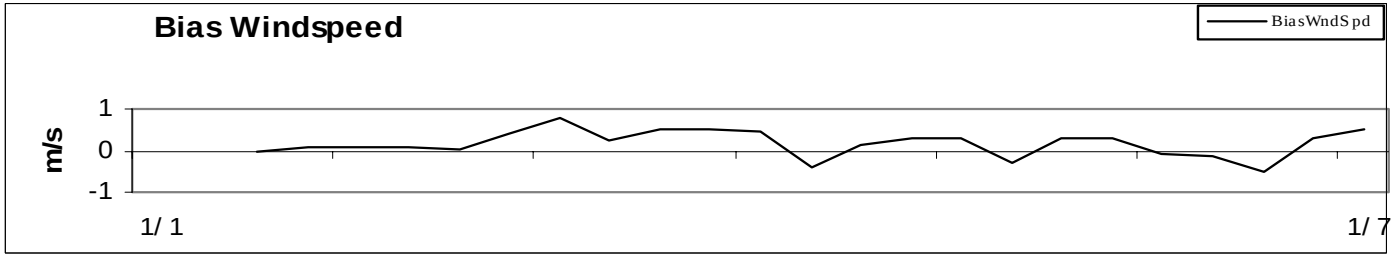
MRF
Day 1-7



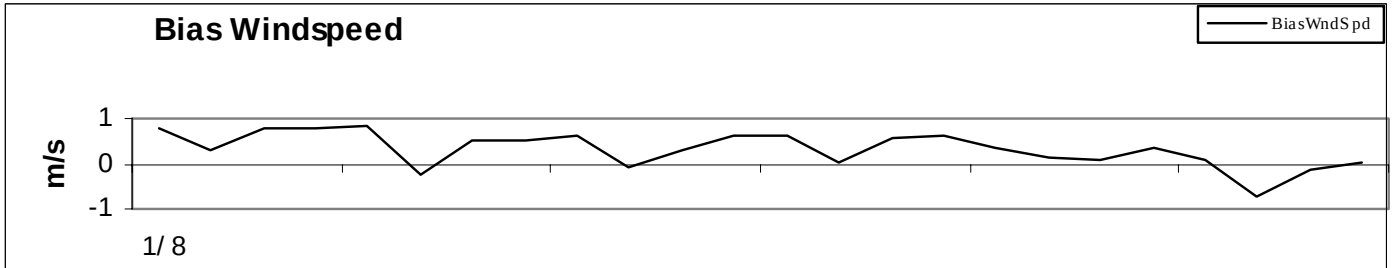
MRF
Day 8-14



Pleim-Xiu
Day 1-7

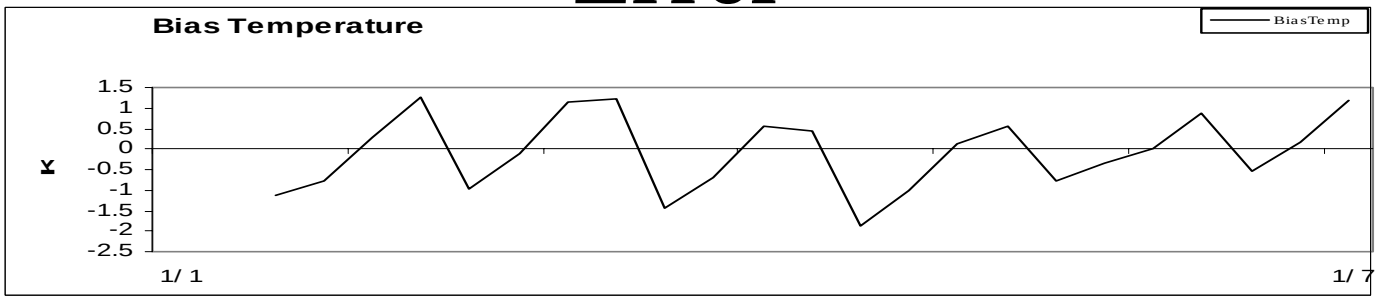


Pleim-Xiu
Day 8-14

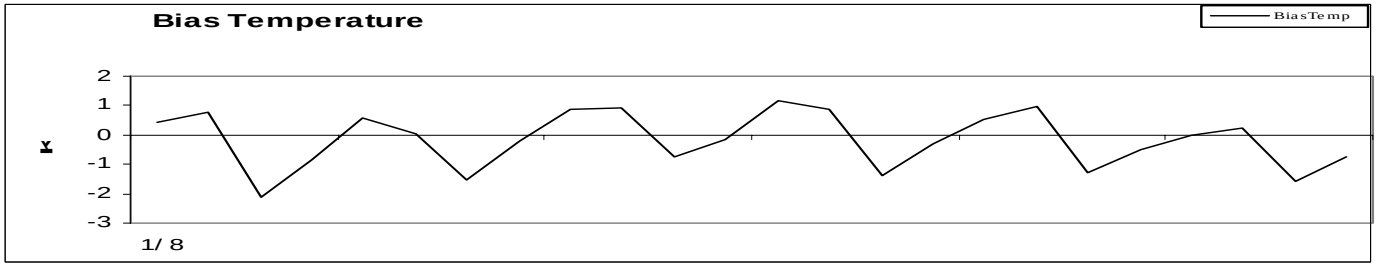


Comparison of Hourly Temperature Bias Error

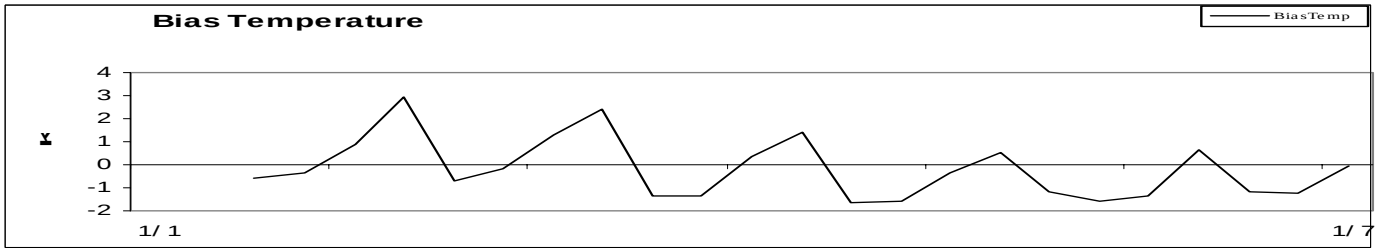
MRF
Day 1-7



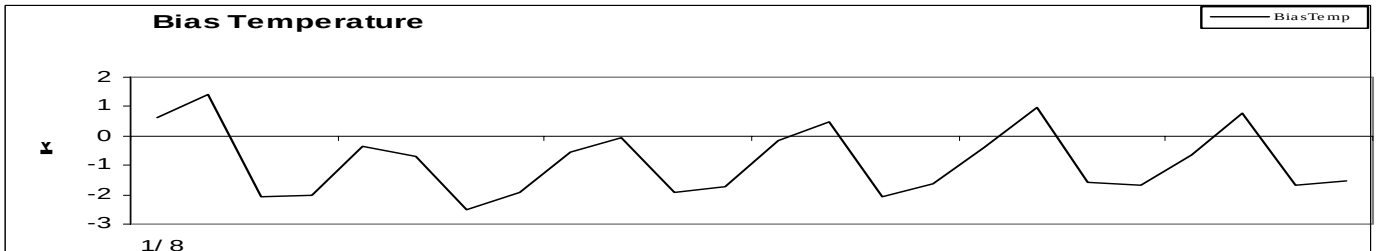
MRF
Day 8-14



Pleim-Xiu
Day 1-7

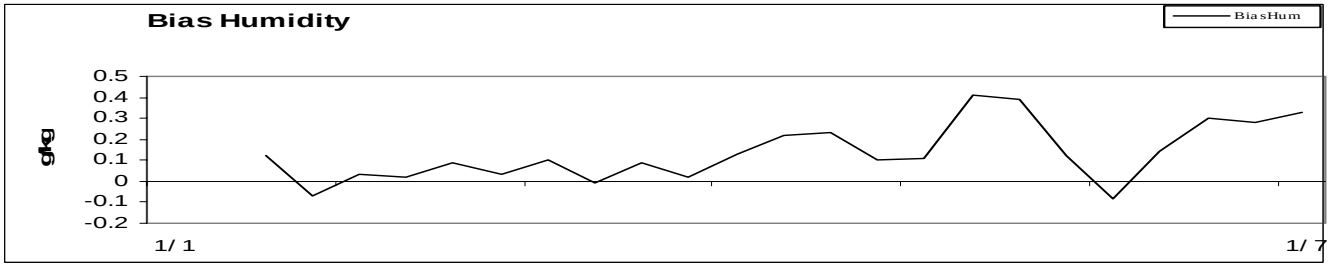


Pleim-Xiu
Day 8-14

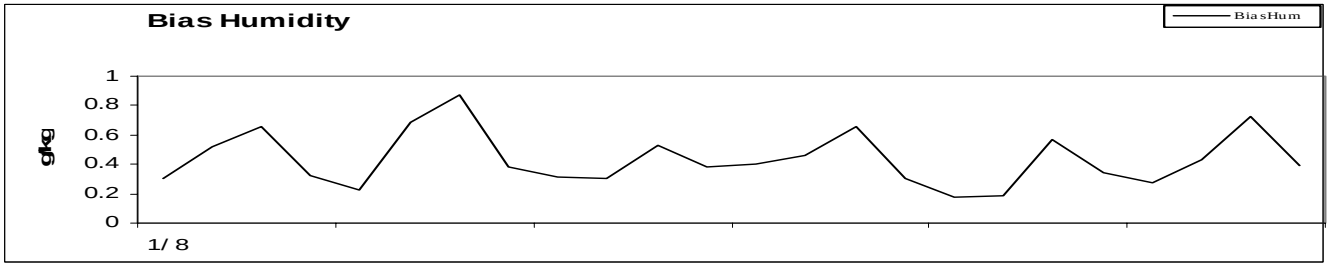


Comparison of Hourly Humidity Bias Error

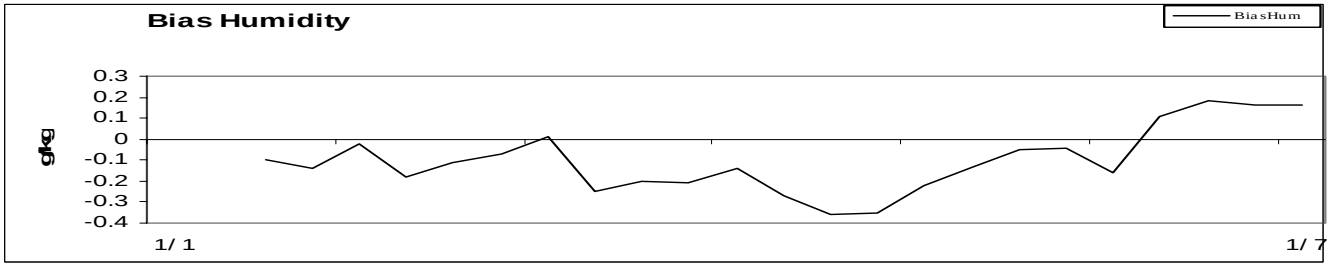
Eta
Day 1-7



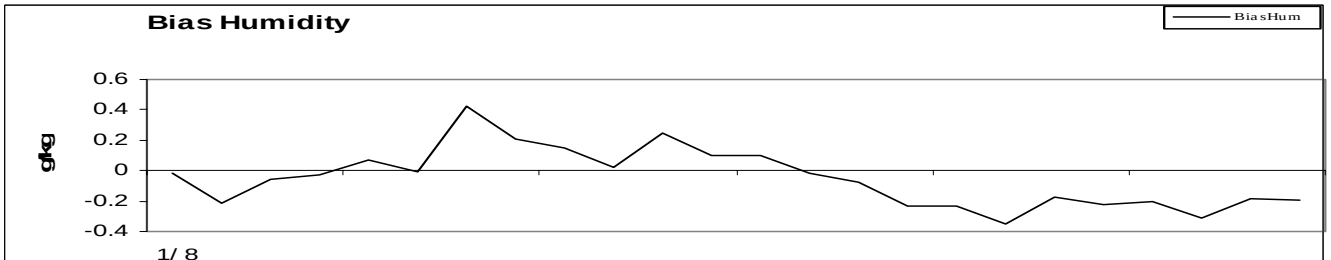
Eta
Day 8-14



Pleim-Xiu
Day 1-7



Pleim-Xiu
Day 8-14



Summary 2002 MM5 Model Performance

- **All four MM5 model runs preformed well in daily analysis**
  - Generally the Pleim-Xiu scheme was the best overall performer for wind speed/direction
    - BIAS wind speed of + 0.09 mph
    - IOA of 72%
    - BIAS wind direction of + 2.61º
  - MRF preformed well in temperature evaluations
    - Bias temperatures of -.21K
    - IOA temperatures of 96%
  - Pleim-Xiu and Eta schemes were the best overall performer for humidity
    - Bias humidity of -0.05 and 0.1 g/kg
    - IOA humidity of 95%

Summary 2002 MM5 Model Performance

- **All four MM5 model runs also preformed well in hourly analysis**
  - Pleim-Xiu scheme was again the best overall performer for wind speed/direction
    - BIAS wind speed of + 0.08 mph
    - IOA of 70%
    - BIAS wind direction of + 2.96º
  - MRF preformed well in temperature evaluations
    - Bias temperatures of -.3K
    - IOA temperatures of 94%
  - Pleim-Xiu and Eta schemes were the best overall performer for humidity
    - Bias humidity of -0.06 and 0.24 g/kg
    - IOA humidity of 95%

Preliminary Recommendations 2002 MM5 Modeling

- **Run MM5 PX for July at 36 km grid**
- **Run MM5 PX for July and January 2002 using 12 km grid to determine whether higher resolution improves model performance**
- **If performance issues persist, may want to consider sensitivity tests**
  - LSM Scheme
  - PBL Scheme
  - Nudging Data and Assumptions
  - Other

Comments/Questions

- **Calvin Ku**
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Thank You!