Forecasting of Wind for Energy in Southern Idaho

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More Information at: nusculus.com
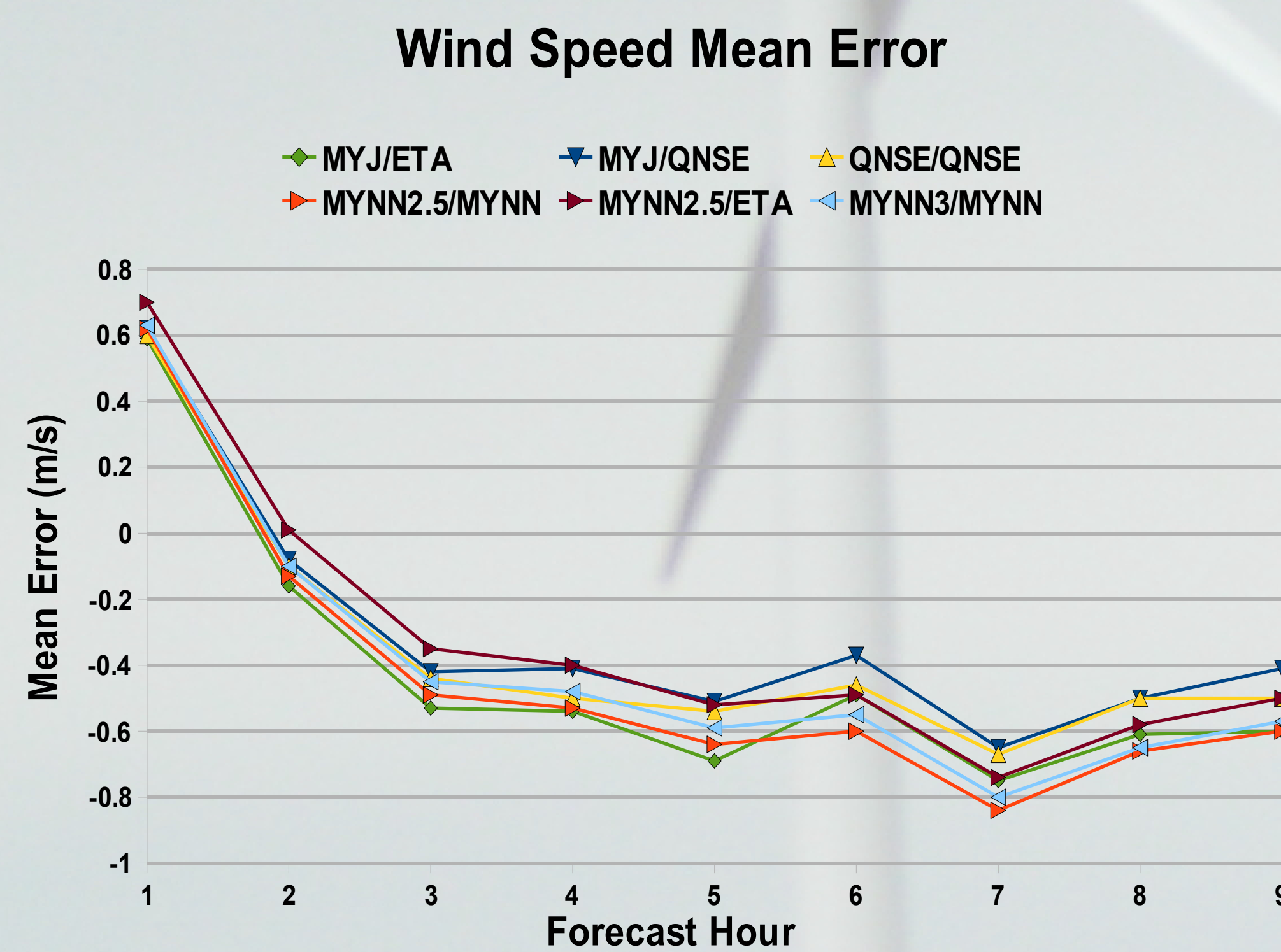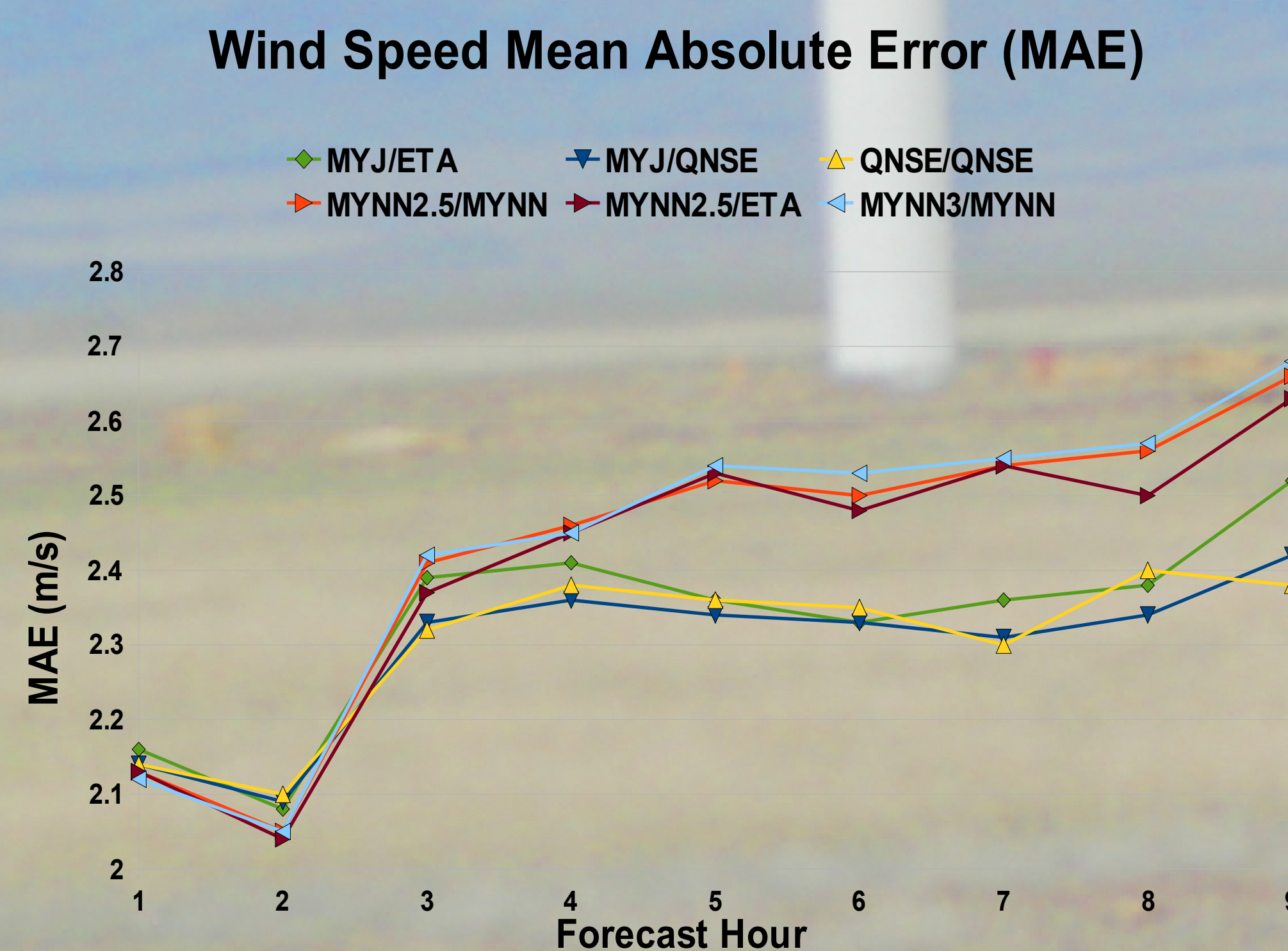
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Motivation:
Accurate, reliable wind forecasts are needed so utility companies can effectively use wind generated electricity on the power grid without the high cost of standby generators.

WRF Version 3.1

◈ New Planetary Boundary Layer Schemes.
◈ New Surface Layer Schemes.
◈ Potential Change from Code Fixes.

Wind Speed Mean Error

Legend: MYJ/ETA, MYJ/QNSE, QNSE/QNSE, MYNN2.5/MYNN, MYNN2.5/ETA, MYNN3/MYNN

◈ Above, initialization data (RUC) apparently provided low wind speeds.
◈ As model progressed, forecasts were high.
◈ Below, error increased over time for some schemes but remained almost flat for others.
◈ Time period was Dec 20, 2008 to Mar 20, 2009 using 396 forecasts at varying times of day.

Wind Speed Mean Absolute Error (MAE)

Legend: MYJ/ETA, MYJ/QNSE, QNSE/QNSE, MYNN2.5/MYNN, MYNN2.5/ETA, MYNN3/MYNN

Grid Variations

◈ Standard model had three square domains: 52 X 52, 36 X 36, and 30 X 30 cells.
◈ Extended model: 92 X 92, 72 X 72, 48 X 48.
◈ Cell sizes were 9 km, 3 km, and 1km.
◈ "Two Domains" was run with innermost domain removed.
◈ "Middle Data" was run with three domains but speeds were taken from middle domain.

Wind Speed Mean Absolute Error (MAE)
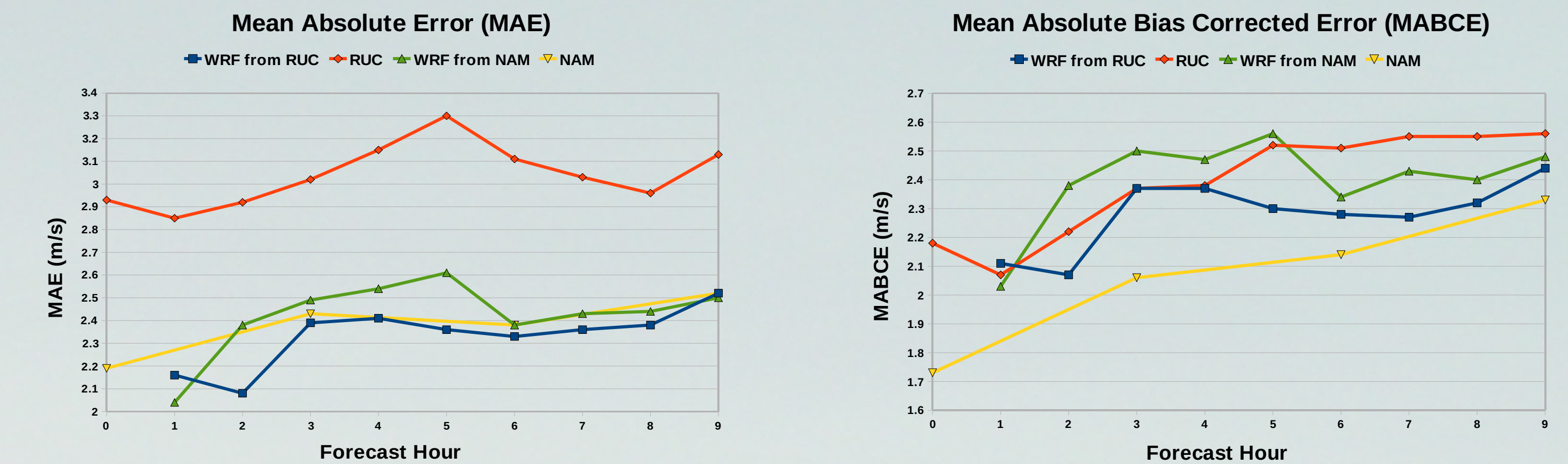
Legend: Standard, Expanded, Two Domains, Middle Data
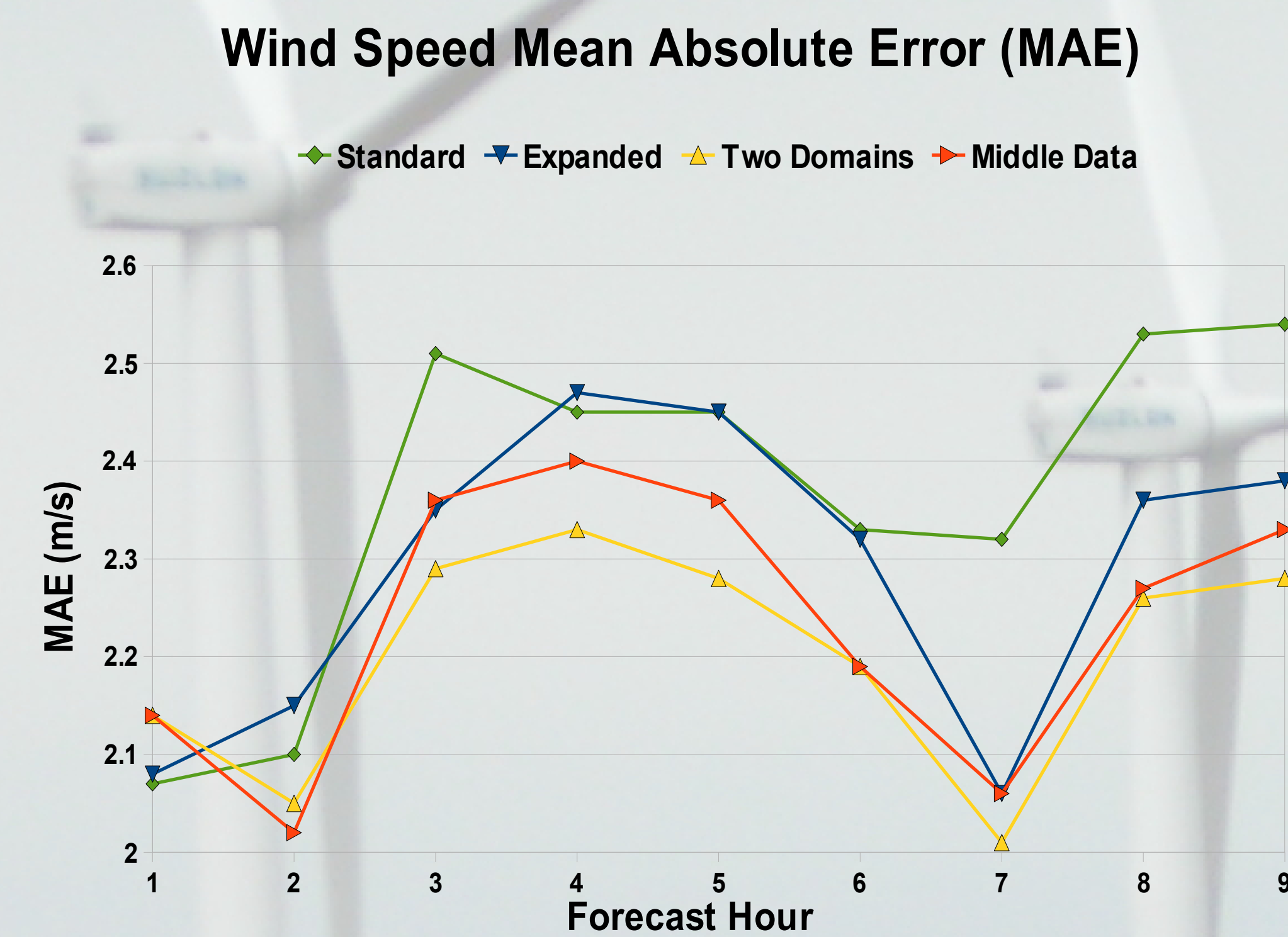
◈ Lean domains similar to expanded domain.
◈ Better results using data from 3 km domain, and inner nest did not help middle domain.
◈ Below, same tests but error was first corrected for identified bias. More realistic, minor help.
◈ Test based on 198 forecasts, WRF 3.0.1.1
◈ Same time period previously mentioned.

Mean Absolute Bias Corrected Error (MABCE)

Legend: Standard, Expanded, Two Domains, Middle Data
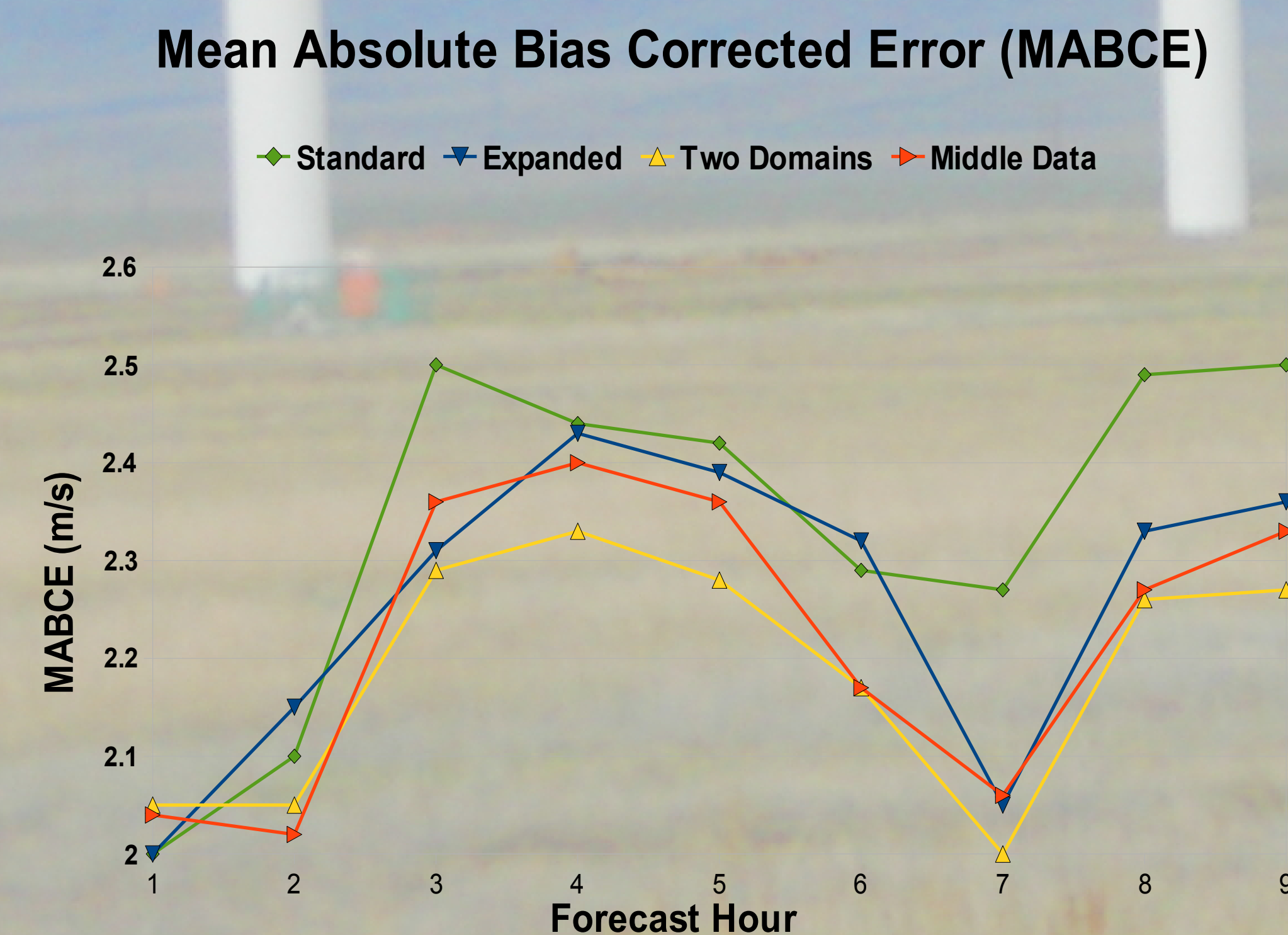
WRF and Initialization Data

◈ WRF run using standard grids, MYJ/ETA.
◈ RUC and NAM was run through WPS, then metgrid files were interpolated to Sodar location.

Mean Absolute Error (MAE)

Legend: WRF from RUC, RUC, WRF from NAM, NAM

Mean Absolute Bias Corrected Error (MABCE)

Legend: WRF from RUC, RUC, WRF from NAM, NAM

Equipment and Location

◈ Picture below is the Triton sodar, made by Second Wind Inc, and was used for verification.
◈ Data from WRF was bilinearly interpolated to sodar location within innermost domain.
◈ Sodar recorded wind speeds at 10 heights from 40 to 200 meters, but all data shown is from 80 meters, which is the turbine hub height.
◈ WRF source code was customized to accumulate wind speeds from all time steps for creation of periodic averages at fixed heights.
◈ Sodar and wind farm are located in south Idaho on the Snake River Plain.
◈ Terrain is farmland, grassland, and shrubland. Moderately complex.
◈ The background image is of the actual wind farm and surrounding area used in this research.

Triton Used for Verification

Acknowledgments