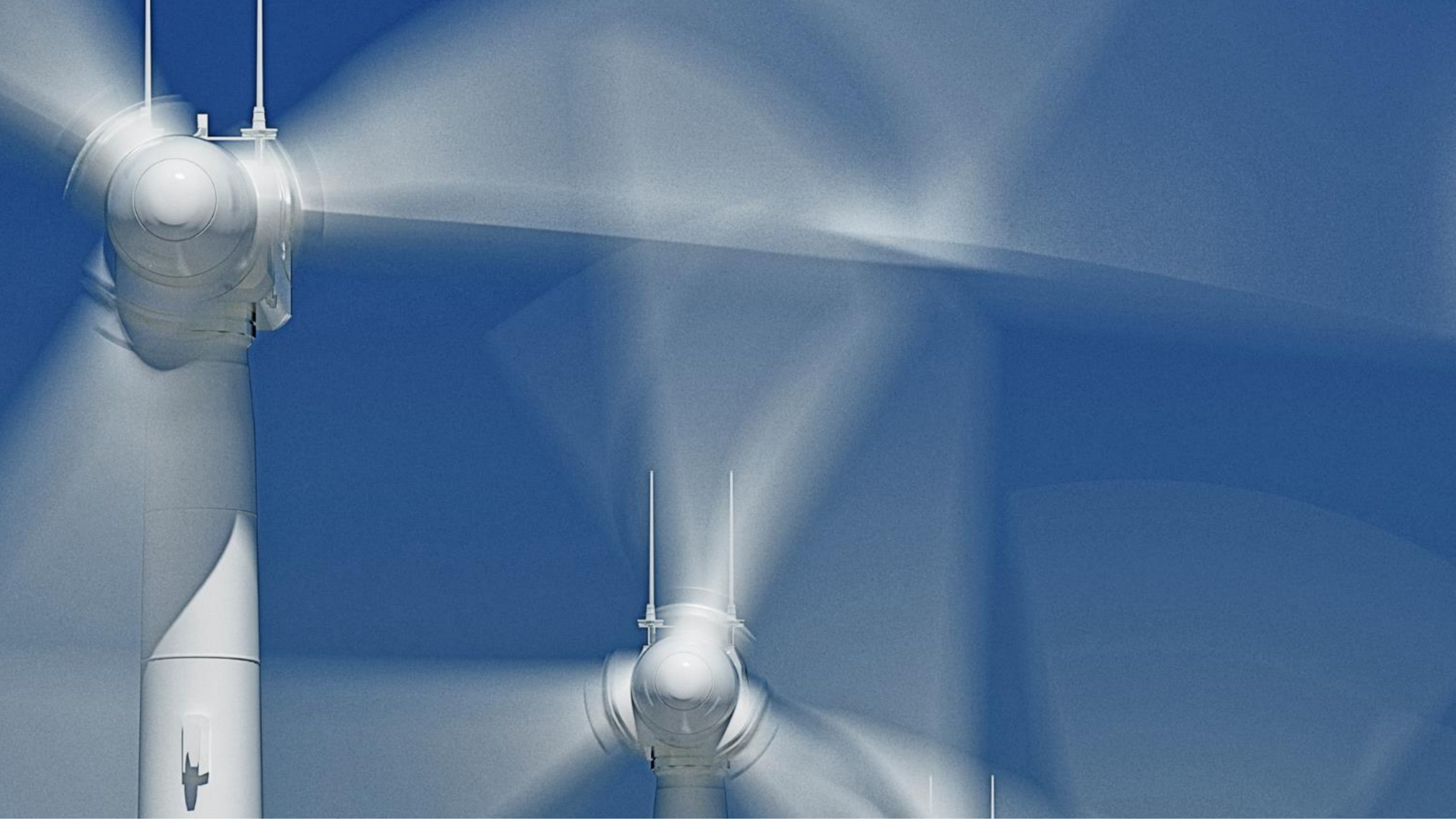


The Variable Relationship Between Observed and Reanalysis Wind Speeds: Effects on MCP Bias

Jennifer F. Newman, REsurety, Inc.
Co-Authors: Daniel Pollak, Matthew Livingston, Carl Ostridge

Introduction: What is MCP?

Measure: Met towers measure the local wind resource (typically for a period of 2-5 years)

Correlate: Local met data are correlated to a long-term reference dataset (ASOS or re-analysis data)

Predict: Correlation parameters are used to predict how the local wind resource will vary over a long-term time period

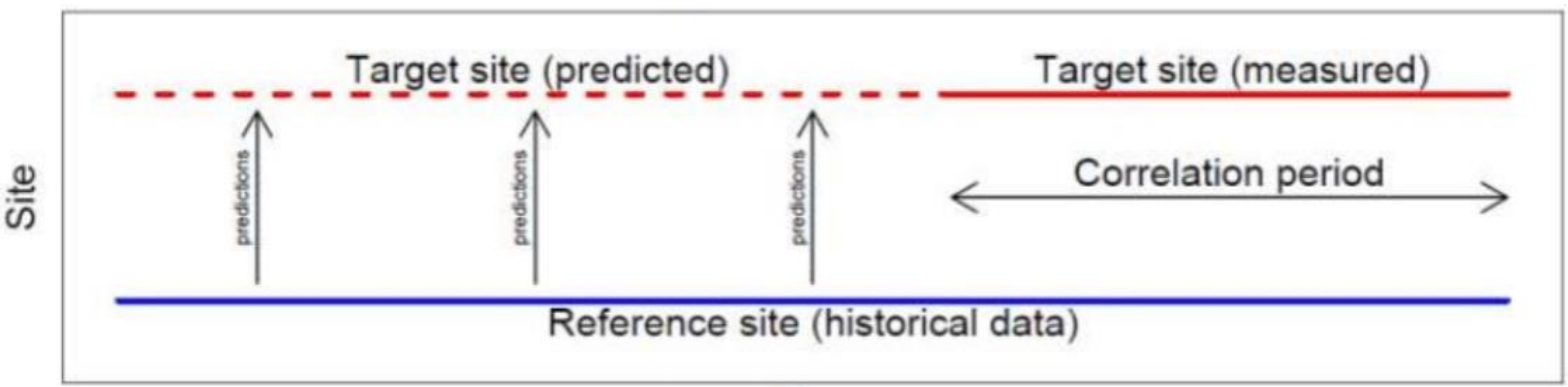


Image Credit: Jie Zhang

Key Assumptions of MCP

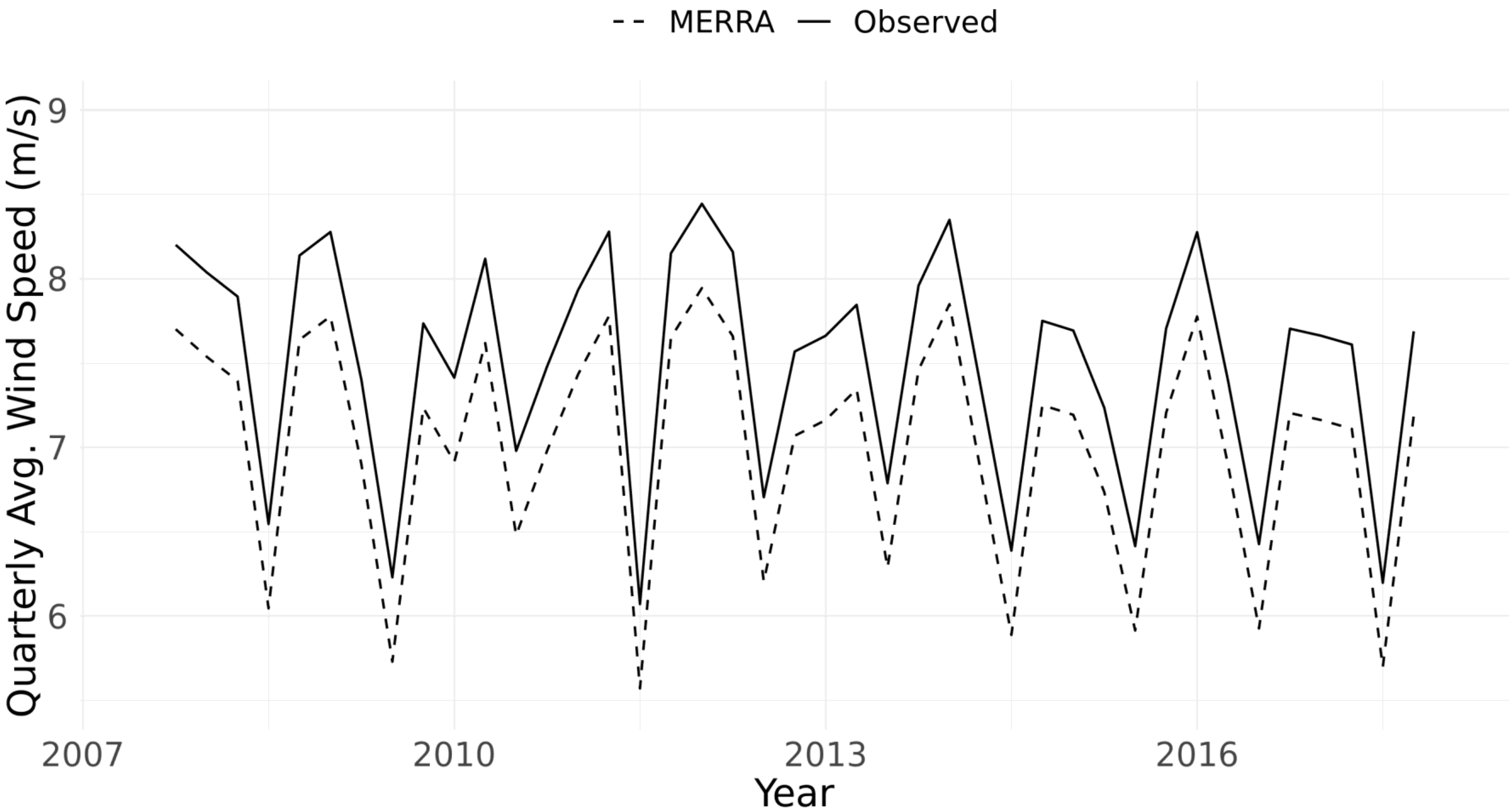
Assumption: Reference data can be extrapolated and downscaled using primarily statistical methods
Reality: Downscaling a 50-km resolution re-analysis dataset to a discrete point is a complex process

Assumption: What happened in the past will happen in the future
Reality: Wind resource is expected to shift as a result of climate change[1]

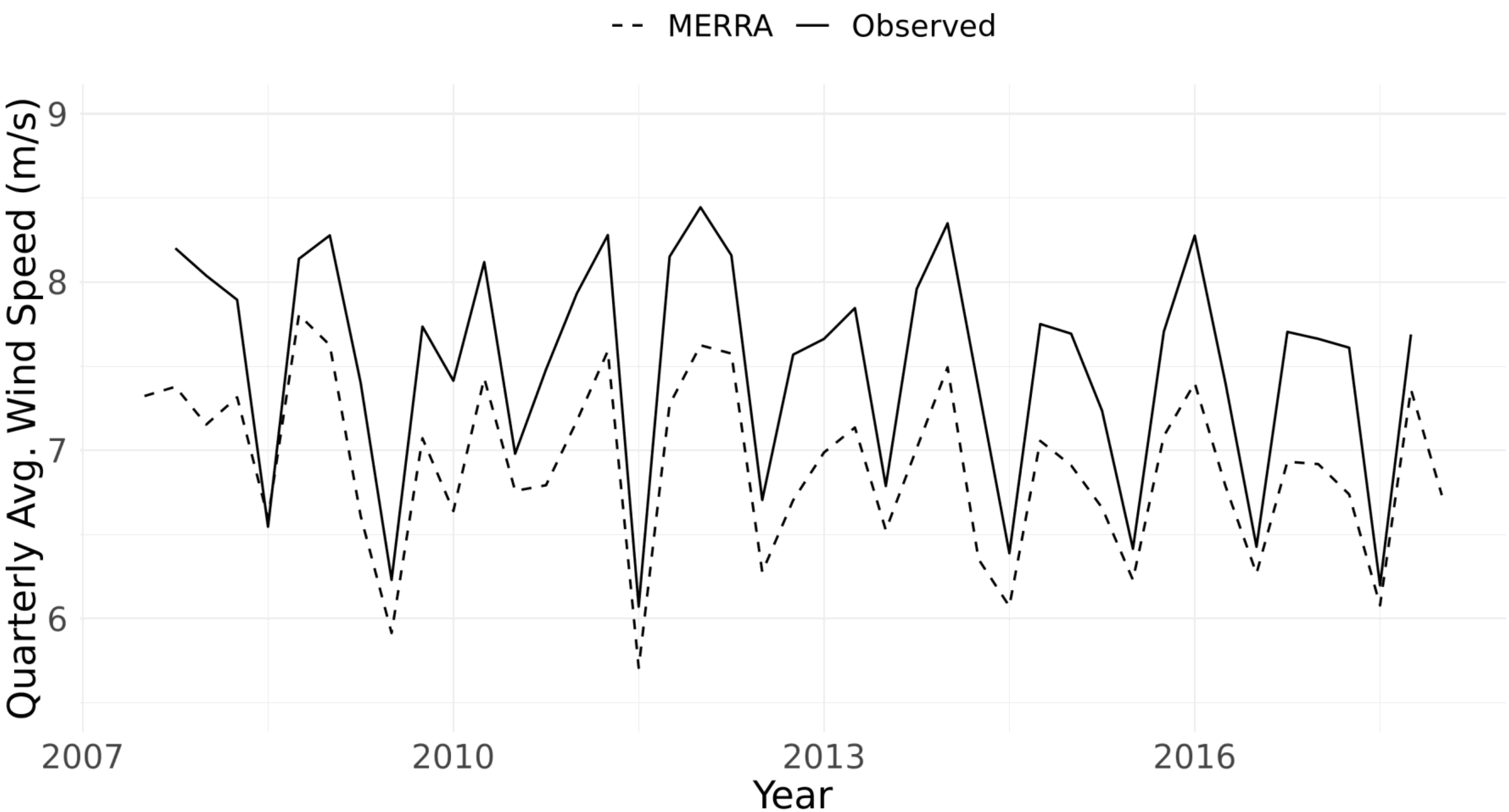
Assumption: Correlation parameters developed during the training period are applicable across all time periods
Reality: Training parameters can vary depending on the particular training period

[1]Karnauskas, K.B., J. K. Lundquist, and L. Zhang, 2018: Southward shift of the global wind energy resource under high carbon dioxide emissions, *Nature Geoscience*, **11** (1), 38–43.

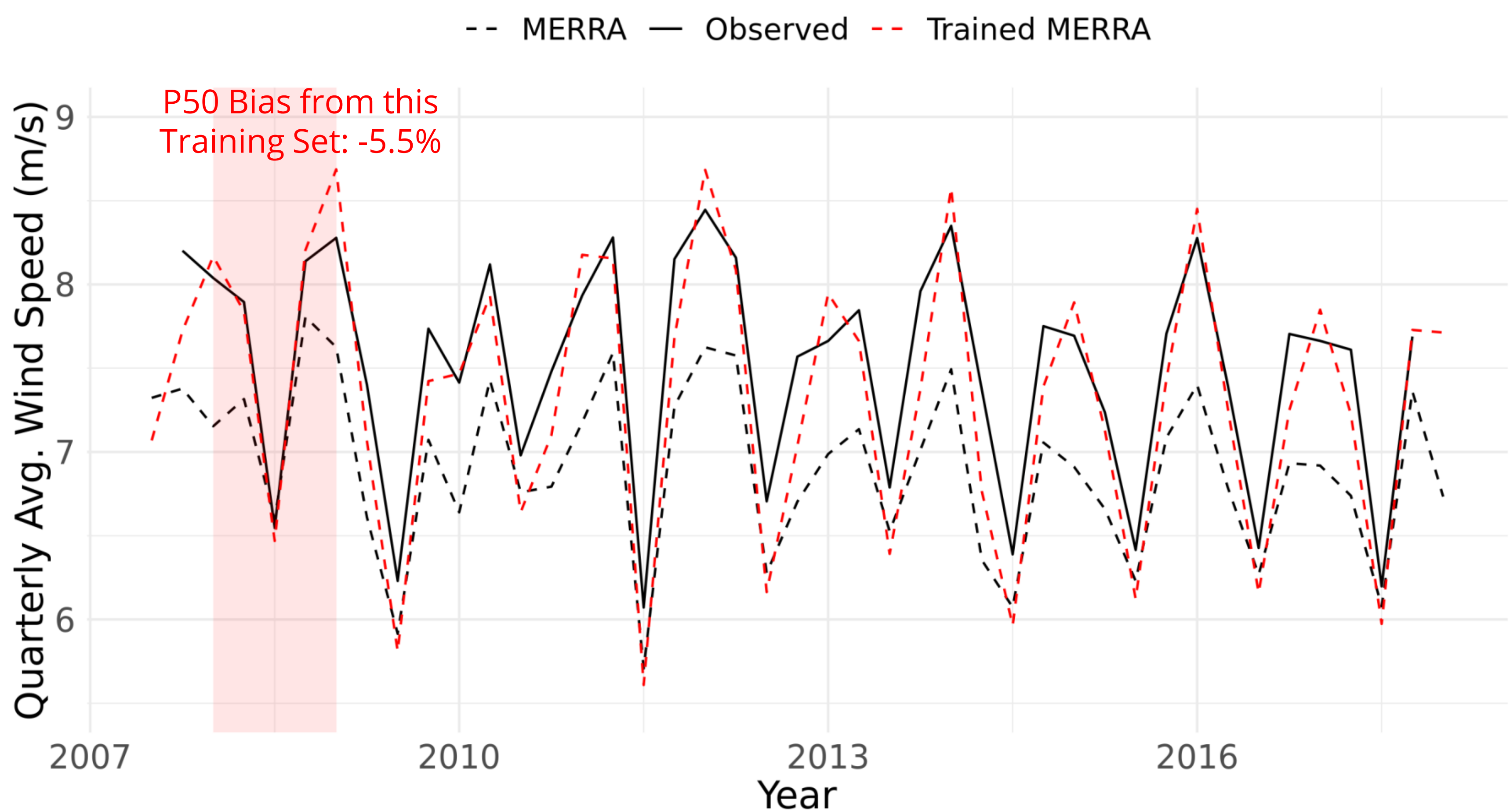
Assumption: Consistent Bias Between Target and Reference Sites



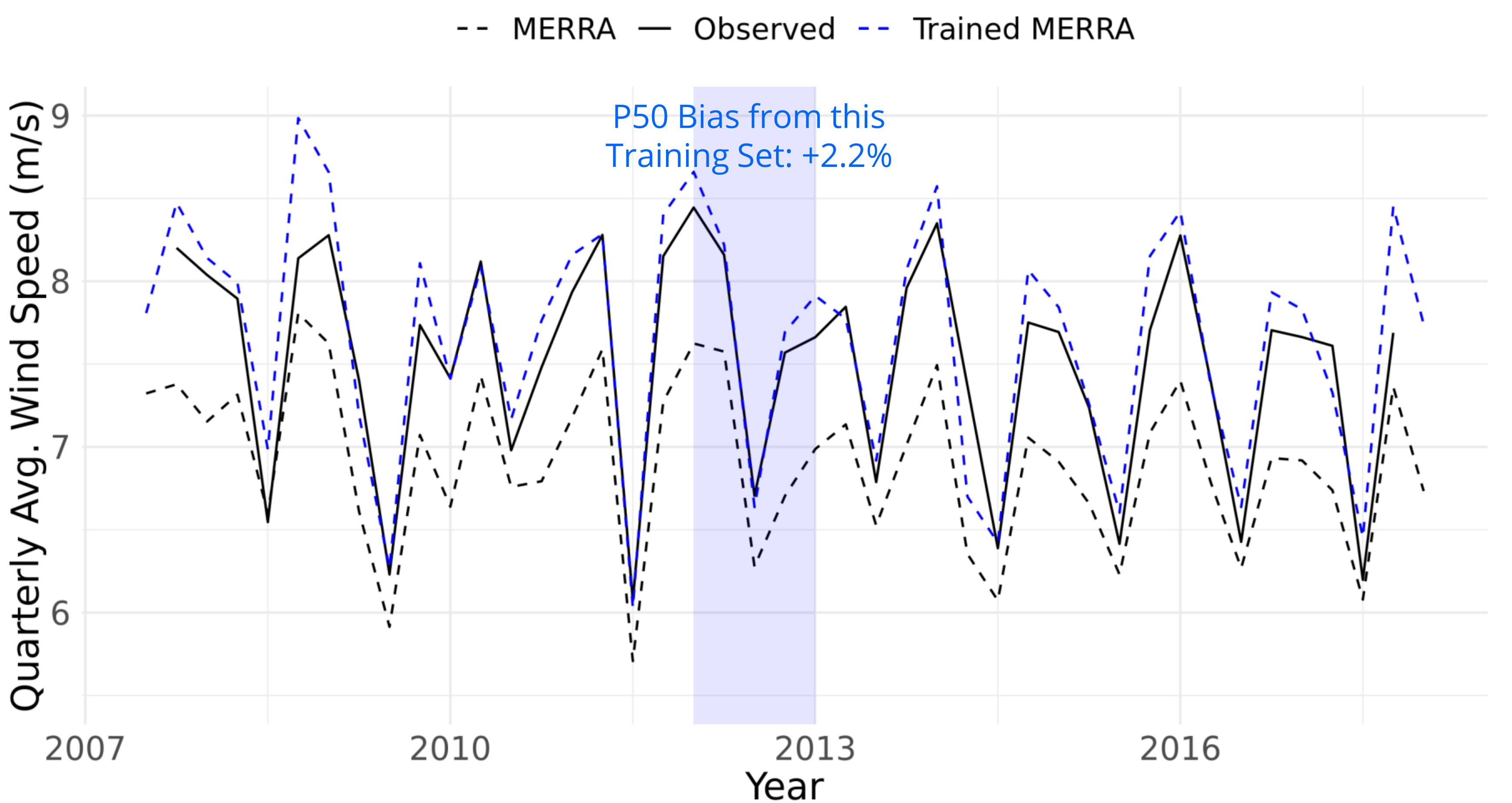
Reality: Variable Bias Between Target and Reference Sites



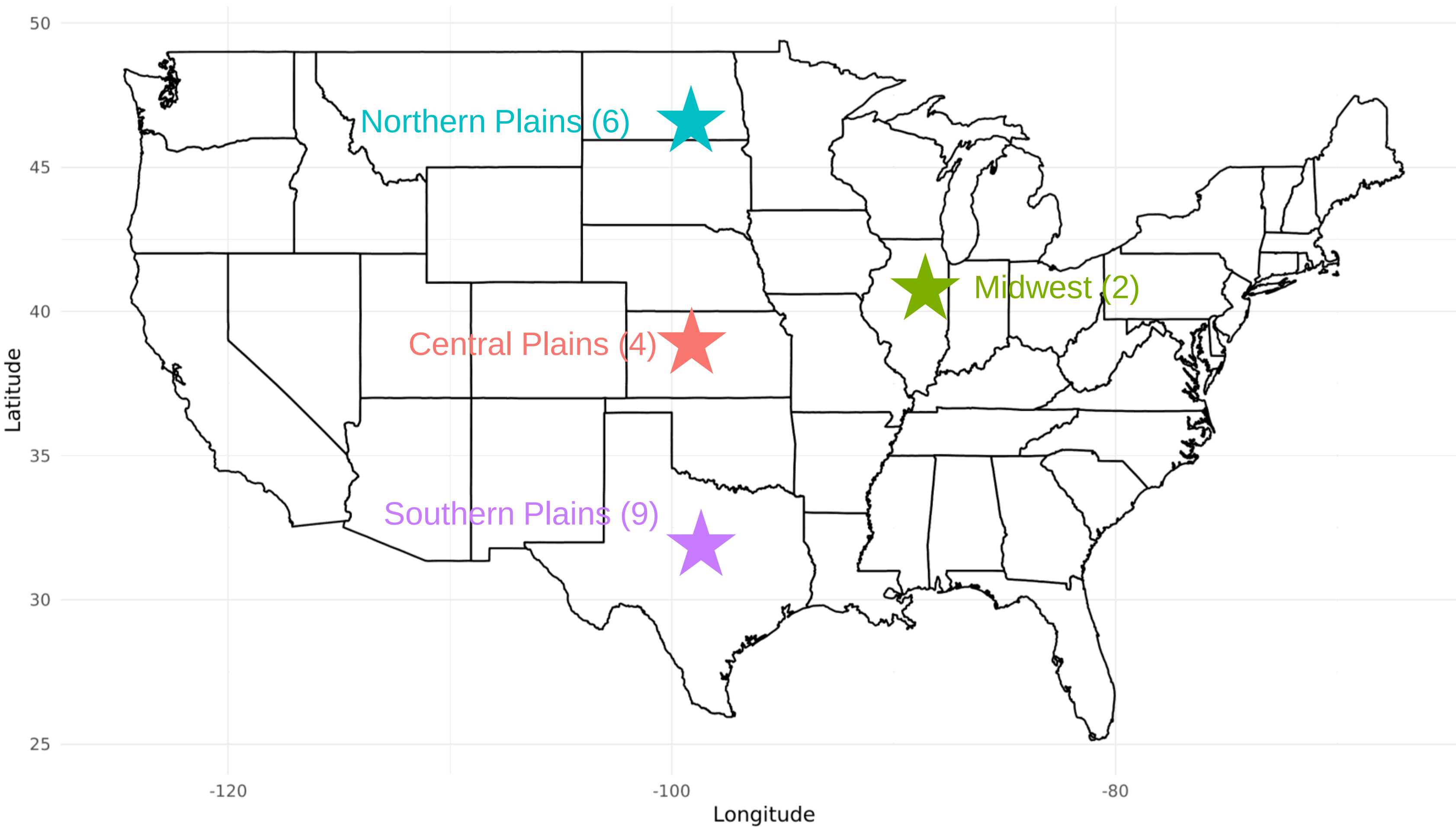
Effect of Training During a Low Bias Period



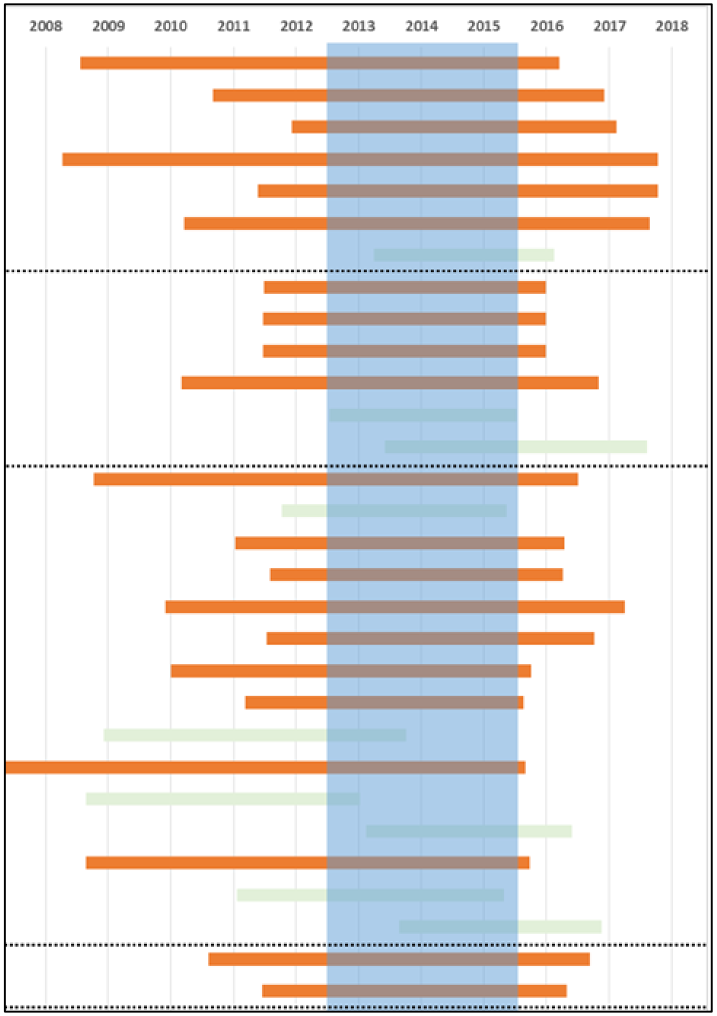
Effect of Training During a High Bias Period



How Does Training Period Affect Bias for 21 Towers?



Overlapping Time Period: July 2012 – July 2015



- Common 3-year time period was selected for training and testing MCP methods
- Period contains part of the “wind drought” of 2015

Application of MCP

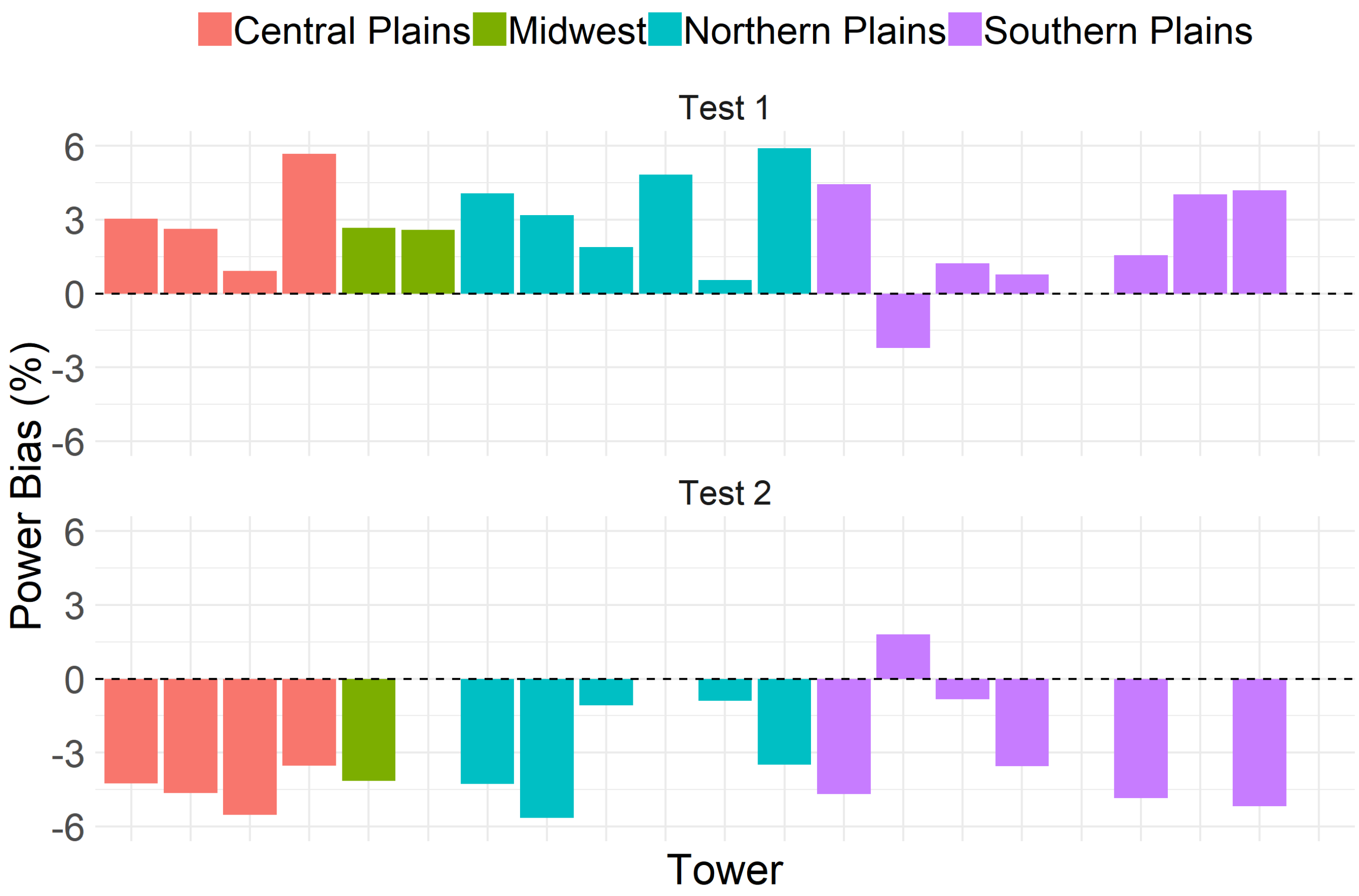
- MCP applied twice to each tower
  - Test 1: Train on first 2 years, test on last year
  - Test 2: Train on last 2 years, test on first year

- Proprietary MCP method was used
  - Takes diurnal and seasonal effects into account
  - Debiases in the energy space

- 2.5 MW power curve applied to observed and trained wind speeds to calculate P50 bias

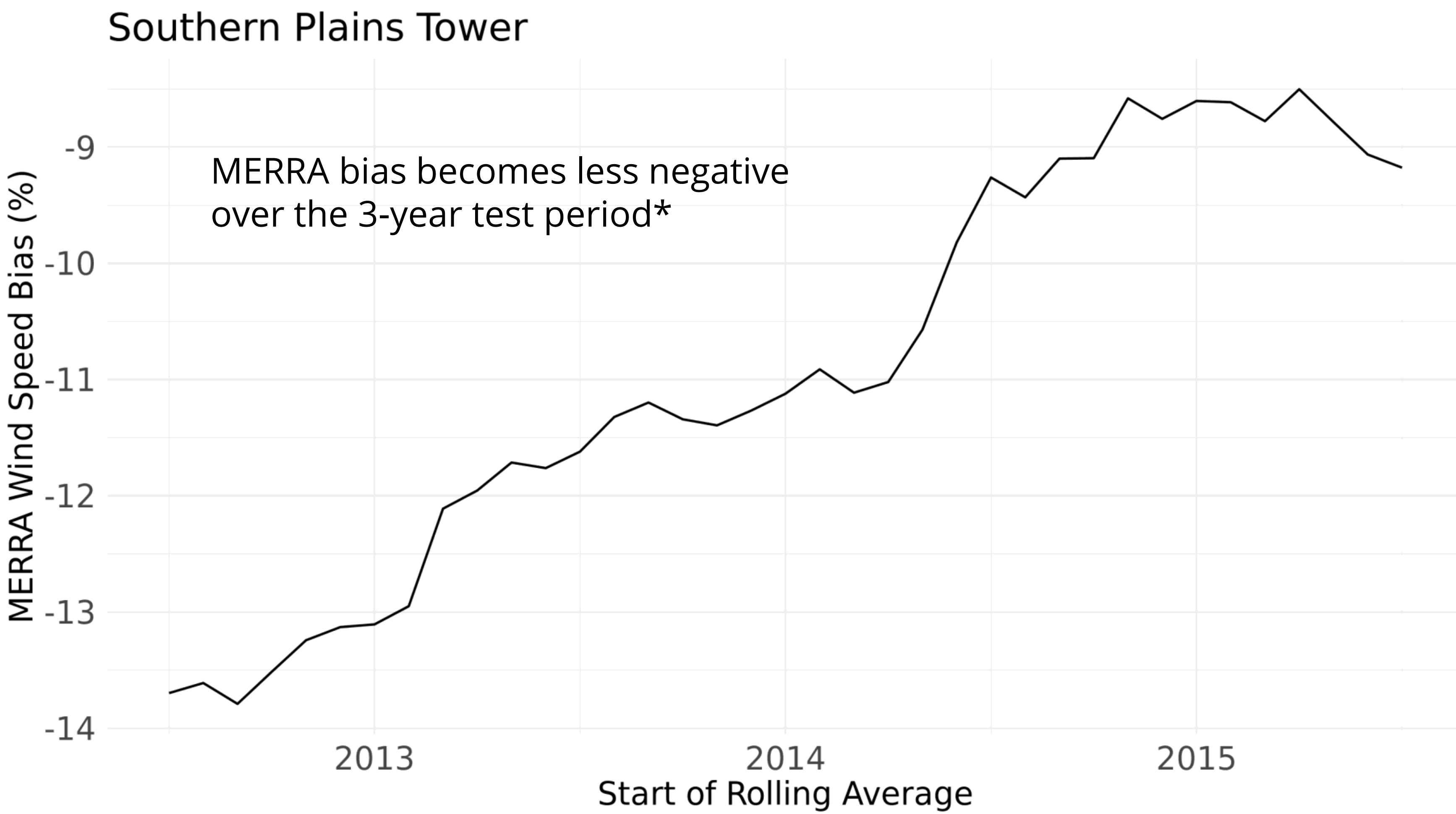
- P50 Bias (%) = $\text{mean}(\text{Power}_{mdl} - \text{Power}_{obs})/\text{mean}(\text{Power}_{obs})$

Results: Out-Of-Sample P50 Bias by Tower



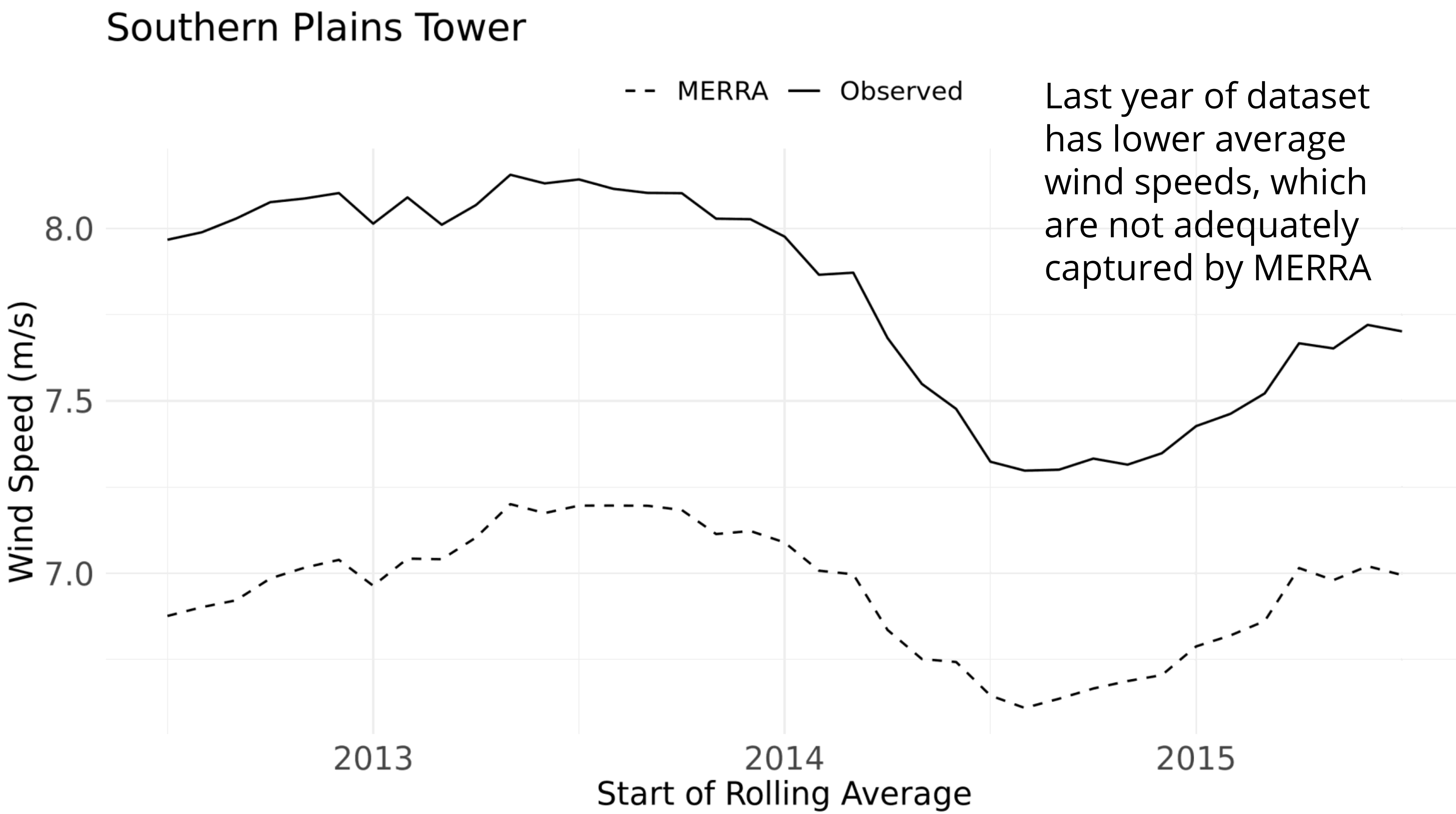
Sign of bias changes for nearly every tower when training and testing sets are swapped

How Is Wind Speed Bias Changing With Time?



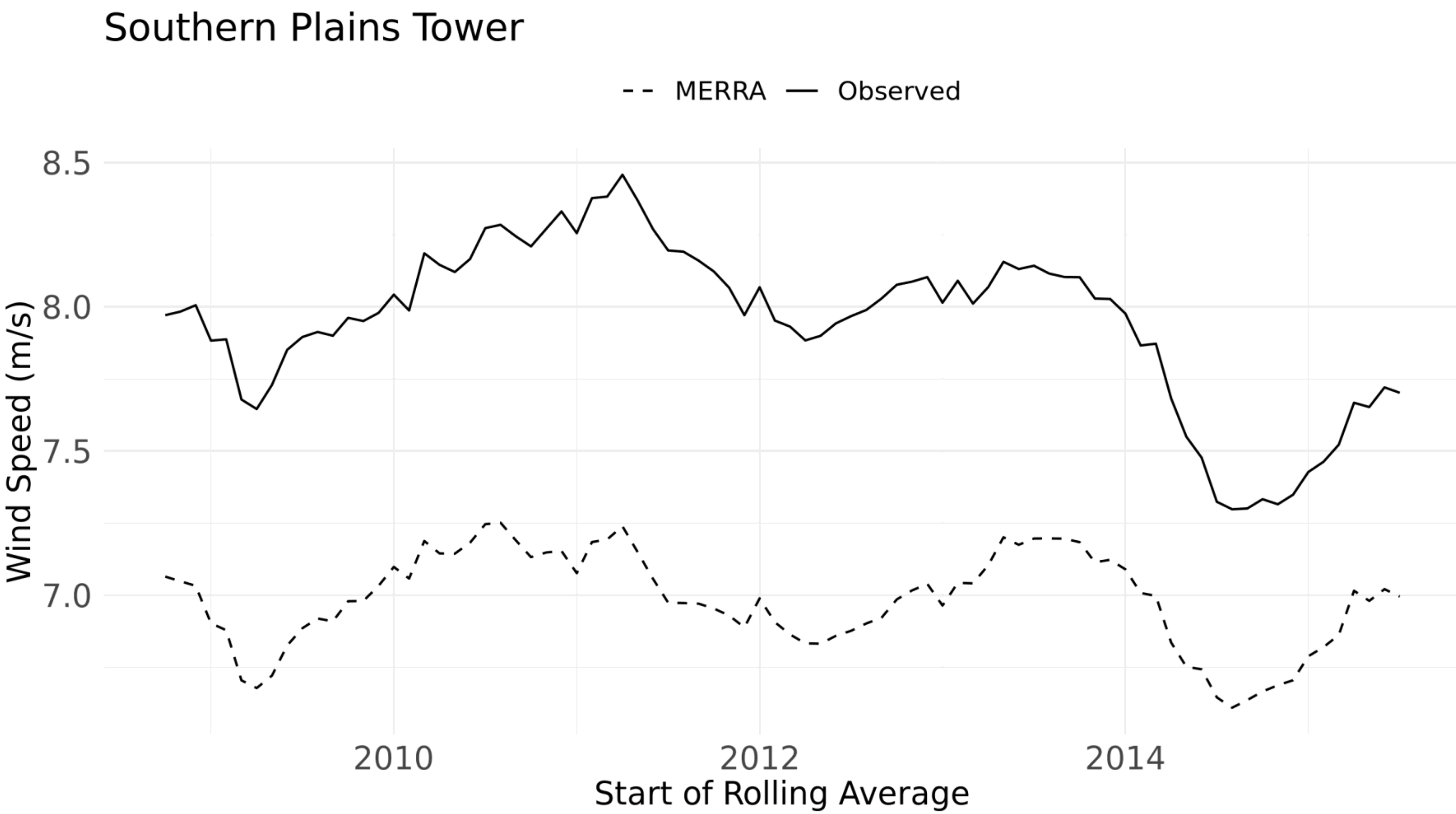
*Research using long record length towers suggests that changes in MERRA bias are likely cyclical over longer time periods

Why Is Wind Speed Bias Changing With Time?

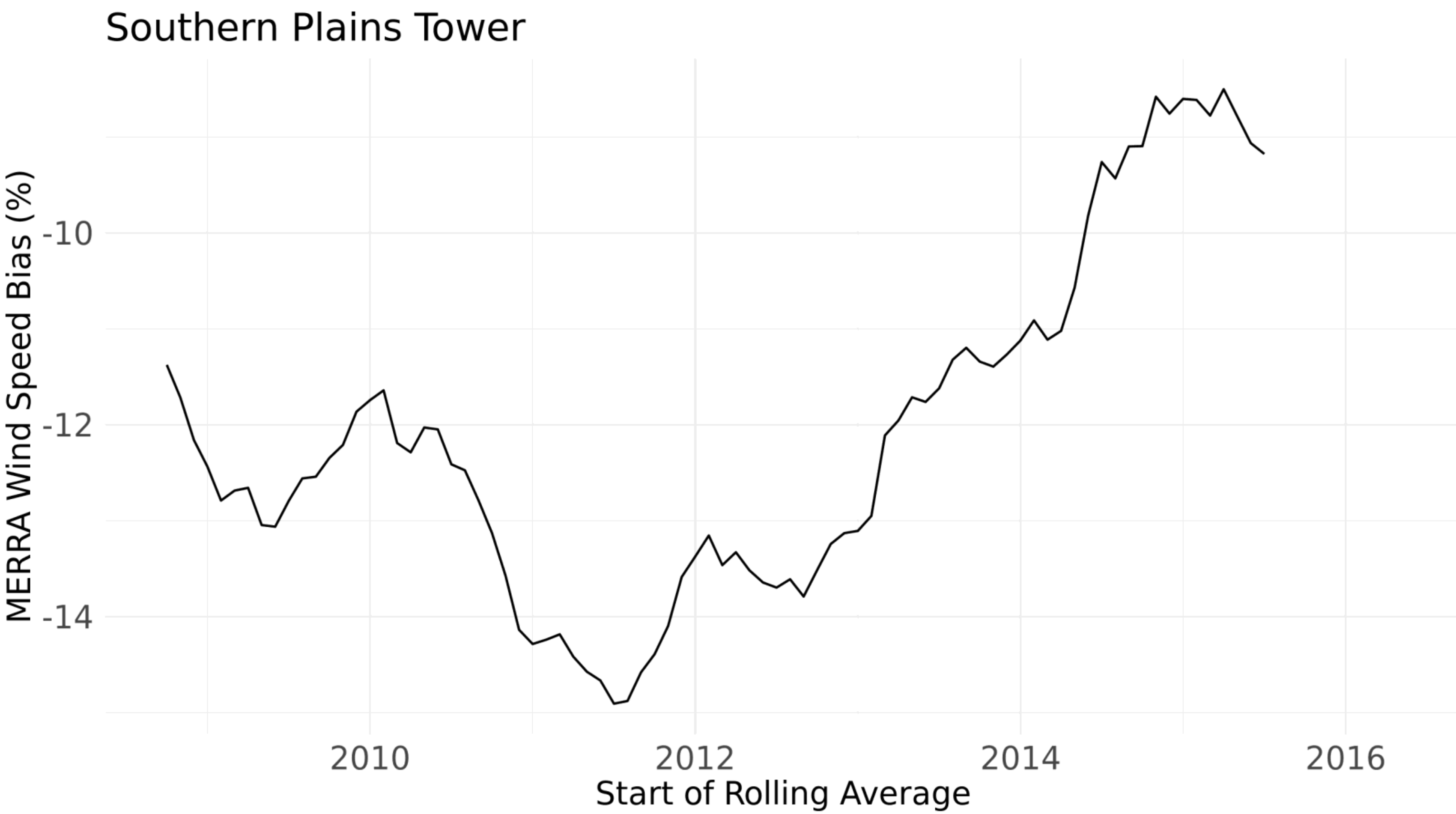


Last year of dataset has lower average wind speeds, which are not adequately captured by MERRA

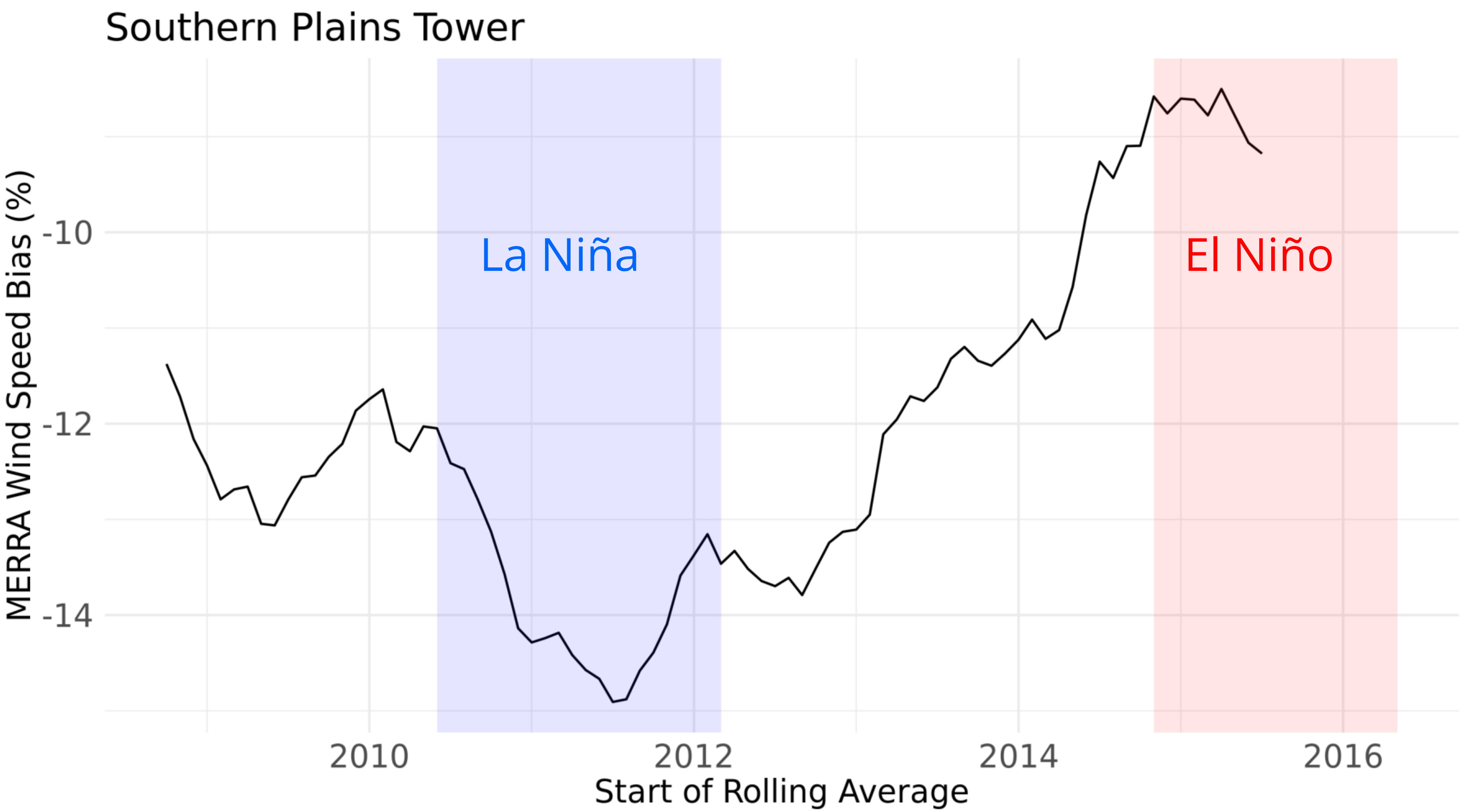
Potential Link to Climate Oscillations



Potential Link to Climate Oscillations



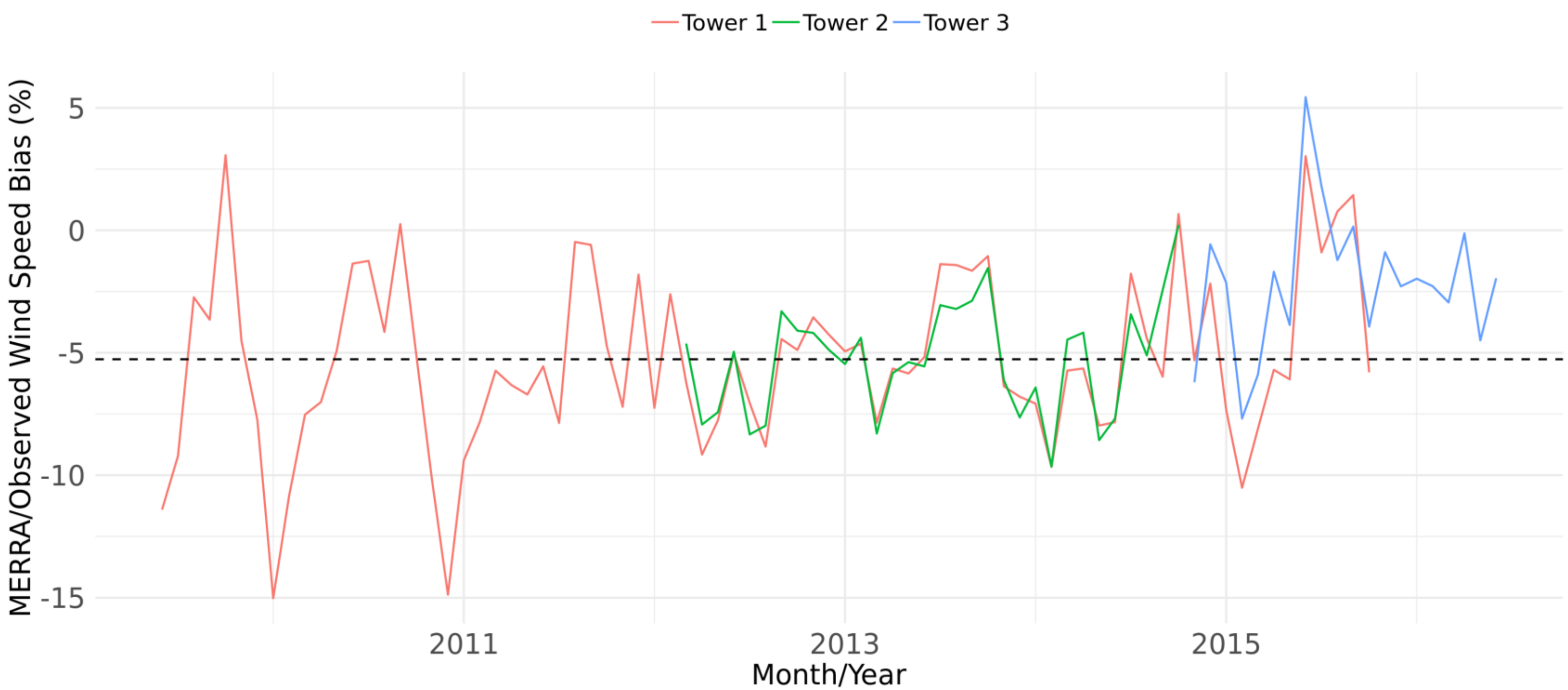
Potential Link to Climate Oscillations



REsurety

Mitigation Strategies

- Assign higher uncertainty to towers with short record lengths, particularly if towers collected data during an anomalously low or high wind period
- When longer record length towers are available, examine bias time series



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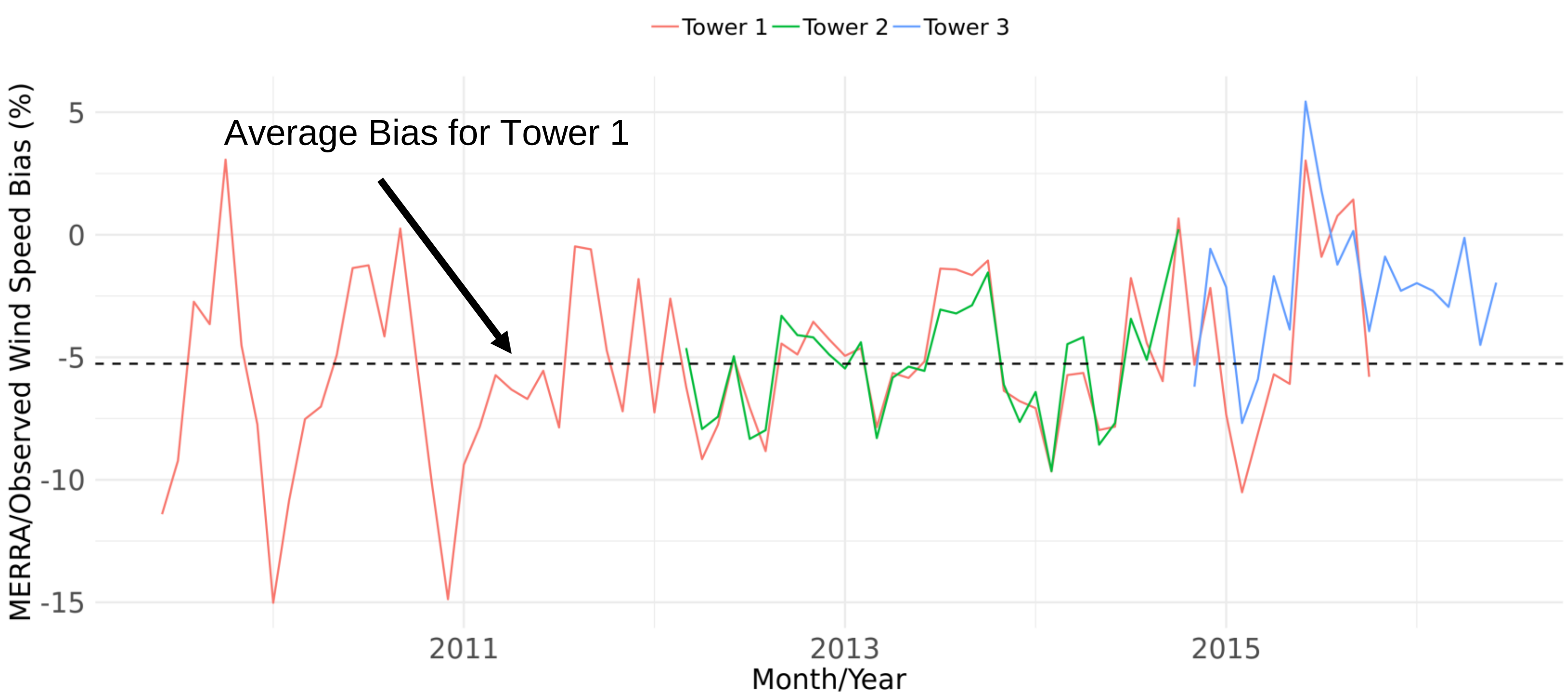

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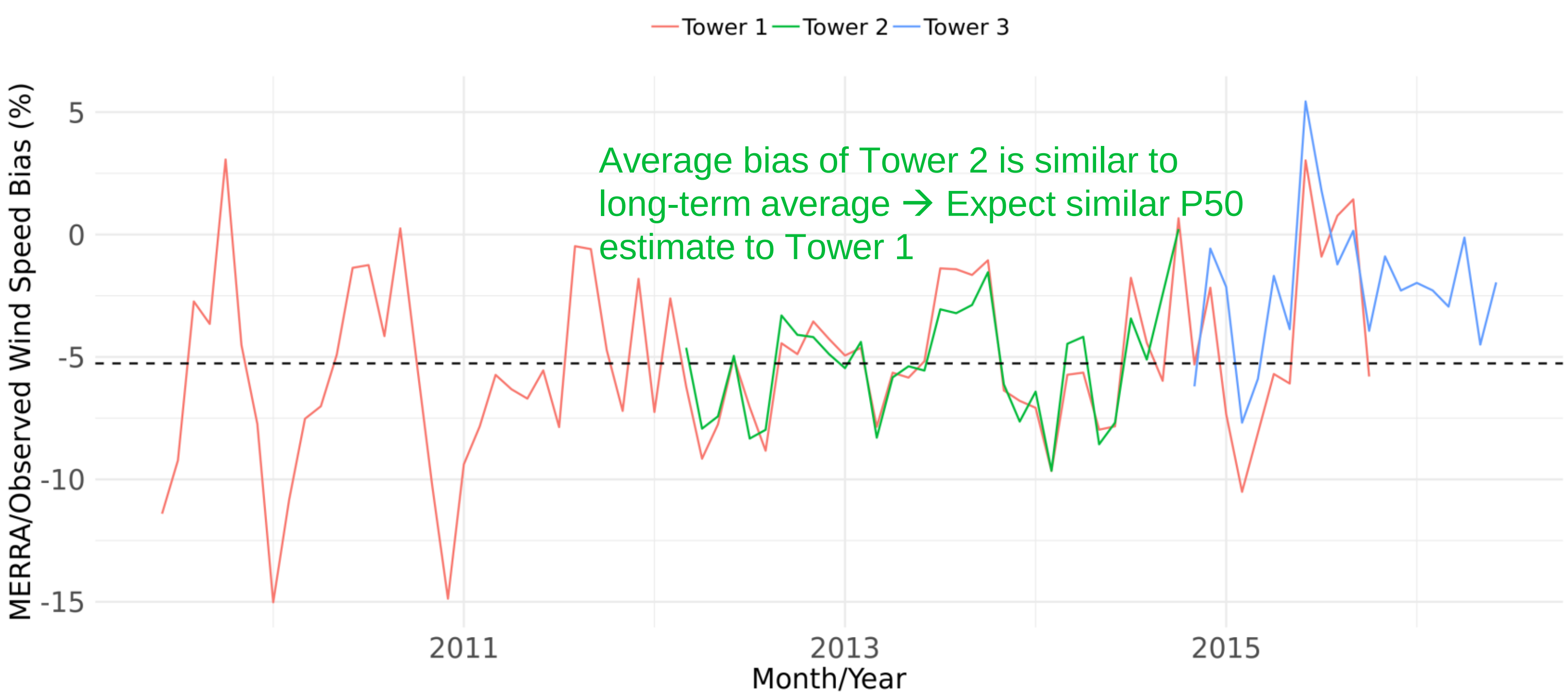

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