Predictive Bias Potential in ERA5 and MERRA-2 Reanalysis Datasets

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Intro

ERA5 and MERRA-2 reanalysis data wind speeds are commonly used in wind energy resource assessments to predict long-term wind speeds for short-term data collection campaigns. Recent ArcVera analysis as well as due diligence review of third-party reports suggests the potential for discontinuity in interannual variations for each data source, which can introduce significant bias if not treated with proper consideration.

Methods

ERA5 and MERRA-2 datasets used for 46 individual projects in the United States, Brazil, South Africa, India, Australia, and the Philippines were considered, to determine potential biases due to:

- Use of ERA5 or MERRA-2 data in standalone fashion, i.e., one source having greater variability
- Relative difference in adjustment to long-term based on lookback period, comparing full reference dataset beginning 2002, or 10 years from project data end date
- Geographic location

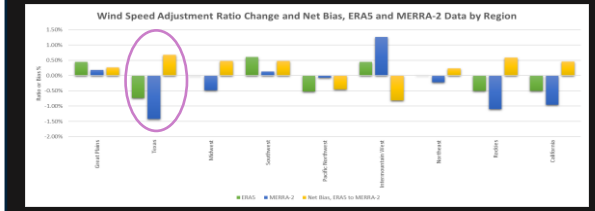
Results

Large-scale trends are not evident in the results, but project-specific biases exist.

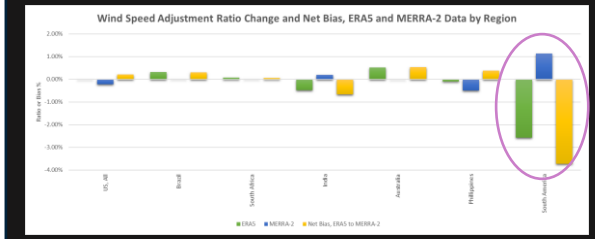
- Differences in full-period to 10-year long-term correction ratio are consistent between regions, within 1% overall
- Outlier cases driver behind strong observed deviations
- Regional trends in interannual variation (IAV) tied to local wind resource

Discussion

Follow best practice when choosing reference datasets. Outlier cases exist and must be treated with care on an individual basis. Always review interannual trends and how well individual datasets track with one another. No consistent trends are evident to make generalized conclusions.

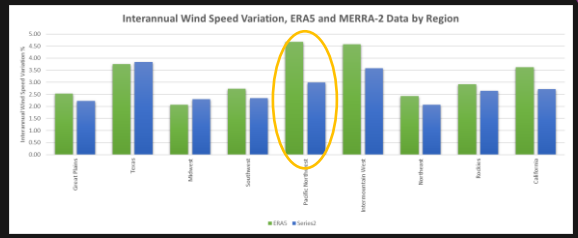


Outlier Case for Inland Texas Skewing Ratio

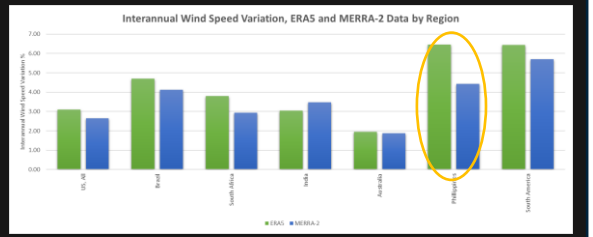


Outlier Case for South America Skewing Ratio

ERA5 Higher Relative IAV in Pacific Northwest



ERA5 Higher Relative IAV in Philippines



CLEANPOWER

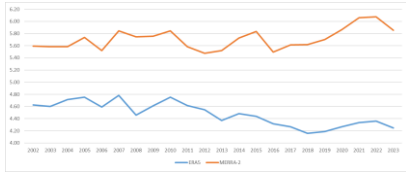
AMERICAN CLEAN POWER

Outlier Cases

Inland Texas, ERA5 Gradual Bias Increase

Southwest, Abrupt Shift in Bias, Both Datasets

South America, Continual Shift in Bias, Both Datasets



Bottom Line:

While ERA5 and MERRA-2 are established and trustworthy data resources for long-term wind speed prediction, they must be evaluated carefully for outlier behaviors to avoid introducing skew or uncertainty to the final wind resource assessment.

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