

Evaluating the Accuracy of Reanalysis Products for Wind Energy Development: A Comparison with In-Situ Observations KHAN MUHAMMAD ABID, KOJI DAIRAKU, SAURABH KELKAR, Department of Engineering Mechanics and Energy, Regional Hydroclimate Lab

Poster Summary: Reanalysis products are vital for analyzing historical weather patterns in wind energy-focused South Asian countries. Differences between actual and simulated land surface wind speeds emphasize the need for simulated products in long-term assessments. This study compares reanalysis products with station observations to verify wind energy estimations and support wind farm development.

1. Brief Introduction

筑波大学

- **Reanalysis products are crucial** for analyzing historical weather patterns, especially in wind energy resource evaluations.
- South Asian countries prioritize wind energy development to address climate change and meet energy demands.
- Wind speed measurements indicate global terrestrial stilling, a decline in land surface wind speed since the 1960s, followed by a reversal around 2010 (Fan, W., Liu, Y., et al. 2021).

2. Objective

- Highlight the difference between actual and simulated land surface wind speeds.
- **Emphasize the importance of caution** when utilizing reanalysis products.
- Focus on the need for accurate assessment and forecasting of winds in the Subcontinent area.

3. DATA AND METHODOLOGY

		Table 1.	Data		
Data		Time resolution	Variable (10-m)	Period	Horizontal grid spacing
Station data	HadISD	3, 6, 12-hr	Wind Speed		
Reanalysis	ERA5	1-hr	SfcWind	1973-2005	0.25° × 0.25°
	NCEP	6_br	(Uas,Vas)		1.875° × 2.5°
	JRA-55	0-111			$1.25^{\circ} \times 1.25^{\circ}$

Hourly data calculated to daily mean and regridded by the bilinear (bill) interpolation method at reference grid of 0.1 degrees spacing.

The arbitrary threshold of 90% is used as a criterion for selecting station data with valid values **References** (Molina et al., 2022; 2021; Gbode et al., 2019).

4. RESULTS



Figure 1. Location of WMO stations in the South Asia domain.



compared to HadISD

1- Fan, W., Liu, Y., Chappell, A., Dong, L., Xu, R., Ekström, M., ... Zeng, Z. (2021). Evaluation of global reanalysis land surface wind speed trends to support wind energy development using in situ observations. Journal of *Applied Meteorology and Climatology, 60*(1), 33-50. doi:10.1175/jamc-d-20-0037.1 2- Molina, M. O., Careto, J., Gutiérrez, C., Sánchez, E., & Soares, P. (2022). The added value of high-resolution EURO-CORDEX simulations to describe daily wind speed over Europe. doi:10.5194/egusphere-egu22-1043 3- Gbode, I. E., Adeyeri, O. E., Menang, K. P., Intsiful, J. D., Ajayi, V. O., Omotosho, J. A., & Akinsanola, A. A. (2019). Observed changes in climate extremes in Nigeria. Meteorological Applications, 26(4), 642-654.

Table 2. Summary Statistics for 10m wind speed between reanalysis and observations

set	SD (m/s)	RMSE (m/s)	Mean Bias (m/s)	Pearson Correlation Coefficient, R	Coeff. of Determination (R ²)	Climatologic al Mean (m/s)
5	1.33	1.70	0.49	0.52	0.31	2.53
55	0.96	1.40	0.36	0.60	0.40	2.38
Ρ	1.09	1.97	1.19	0.40	0.21	3.15
nalysis (MRE)	0.99	1.49	0.63	0.57	0.37	2.67
SD	1.46					2.04



5. CONCLUSIONS

WCRP

Analyzed the Subcontinent wind surface speed land global three trend using and 36 products reanalysis meteorological stations for 1973-2005.

DDFX

Coordinated Regional Climate Downscaling Experiment

- **Compared** other to JRA55 reanalysis products, correlation higher had а coefficient (0.40), mean bias lower Root Mean (0.36), and Square Error (1.40).
- In the Subcontinent, wind **speed** showed a decreasing trend from 1973 to 2005 based on in-situ measurements, as confirmed by Fan et al. (2021).
- This study emphasizes the need for careful selection of reanalysis datasets in long-term wind energy assessments due to significant data discrepancies.
 - assessment might This help wind energy companies predict changes in production maximize and economic benefits.

ACKNOWLEDGEMENT

This research is supported by the Ministry of Education, Culture, Sports, Science and Technology, Japan under Japanese Government MEXT: Monbukagakusho Scholarship