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Comparison of Two Data-driven Airborne Wind Energy Oriented Long-term Weather Forecast Methods

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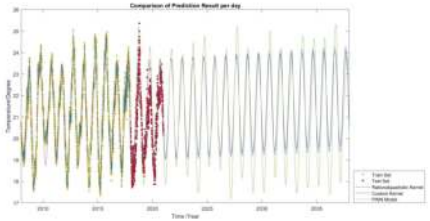
Recently there has been a rising interest in airborne wind energy (AWE) oriented weather forecast research. Especially, it is crucial for energy production prediction, health prognosis of critical components and maintenance scheduling. However, to the best of the authors' knowledge, the current research on AWE oriented long-term weather forecast is limited. To fill this gap, we developed and benchmarked two data-driven long-term weather forecast methods oriented for AWE. In the first method, we implemented a rational quadratic kernel and a custom kernel function based Gaussian Process (GP) model. In the second method, a Physics-Informed Neural Networks(PINNs) model [1] with modified loss function is used. To demonstrate the performance of the proposed methods, we implemented a case study using ten years' publicly available data (2008-2017) as the training set and three years' data(2018-2020) as testing set [2]. The performance of the two methods is analyzed by comparing their Mean Absolute Error (MAE) and Root Mean Square Error (RMSE). The comparison of the prediction results and historical weather data is presented in Fig.1. On the one hand, the GP based method shows an advantage on daily prediction accuracy. On the other, the PINNs based prediction method also shows great potential to consider the influence of geographical location and altitude.



Comparison of the real time data and the results derived by the two proposed method.

References:

[1] G.-J. Both, S. Choudhury, P. Sens, and R. Kusters, "DeepMoD: Deep learning for model discovery in noisy data," Journal of Computational Physics, vol. 428, p. 109985, Mar. 2021, doi:10.1016/j.jcp.2020.109985.

[2] National Centers For Environmental Prediction/National Weather Service/NOAA/U.S. Department Of Commerce, "NCEP FNL Operational Model Global Tropospheric Analyses, continuing from July 1999." UCAR/NCAR - Research Data Archive, p. 524.792 Gbytes, 2000. doi:10.5065/D6M043C6.