

IN51C-0437 Foundation Model for Atmospheric Prediction and Analysis



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What: FourCastNet, a Fourier-based neural network with a vision transformer, predicts weather, focusing on severe events like hurricanes.

Why: Accurate weather predictions are vital for disaster readiness, resource management, and sustainability, necessitating improved forecasting.

How: FourCastNet is trained using the MERRA2 dataset (2000-2015) to analyze 21 atmospheric variables, generating global forecasts with specific resolutions.

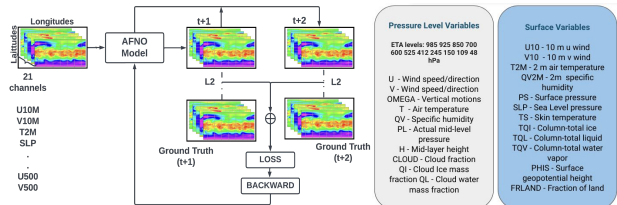


Figure 1: Training architecture used

Model pressure and surface variables

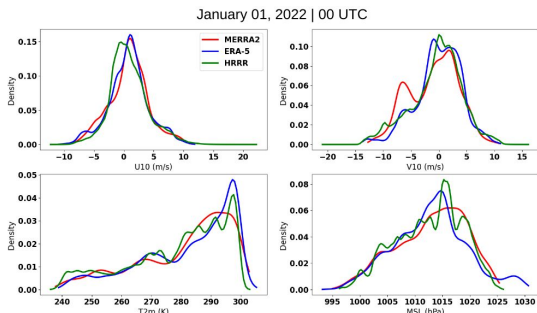


Fig. Probability distribution function of MERRA2 and ERA5 without normalization of U10 (m/s), U10 (m/s), T2m (K) and sea level pressure (SLP) January 01, 2022 00 UTC.

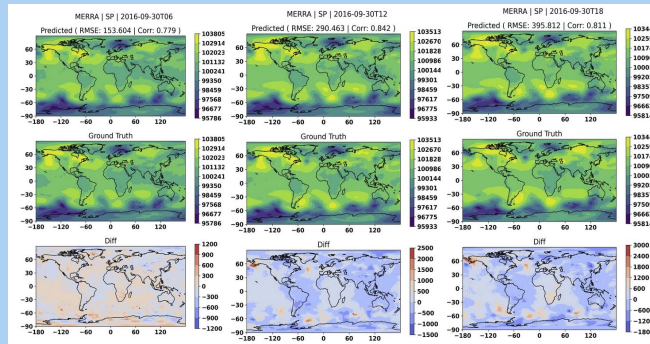


Fig. Spatial distribution of model predicted sea pressure (Pa), ground truth and the predicted - ground truth difference for 30-, 36-, and 42-hour forecast for Hurricane Dorian. (25 August 2019, 06 UTC)

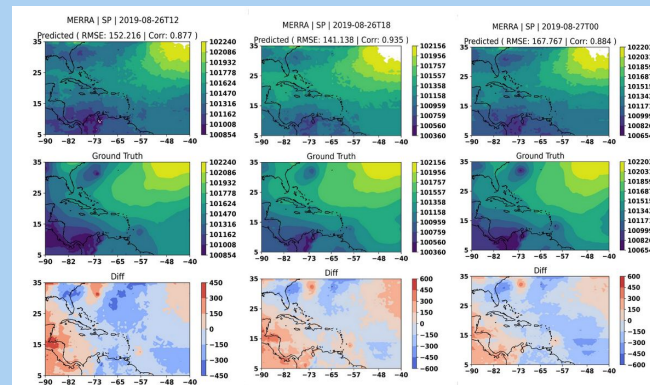
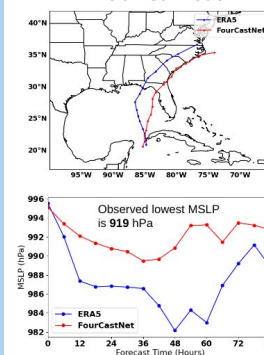


Fig. Global spatial distribution of model predicted sea pressure (Pa), ground truth and the predicted - ground truth difference for 12-, 18-, and 24-hour forecasts. (26 August 2019, 00 UTC)

ERA trained model



MERRA2 trained model

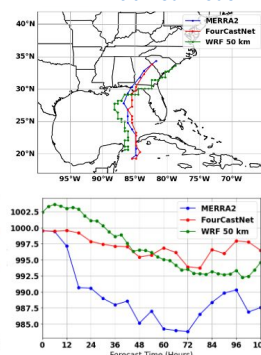


Fig. Track (location of minimum sea level pressure) and intensity (minimum sea level pressure) for Hurricane Michael (2018) from the ERA5 trained model and MERRA2 trained model. Track and intensity are overlapped from the WRF model track, simulated on 50 km spatial resolution.

Analysis Takeaways

FourCastNet can predict severe weather events like hurricanes with a correlation greater than 0.8 for a 3-day forecast.

At a global scale, the model accurately predicts sea level pressure with an accuracy greater than 0.75 for a 1-day forecast, indicating its capability to forecast global weather patterns.

FourCastNet accurately forecasted Dorian 2019. The model demonstrated a correlation greater than 0.9 for a 1-day forecast and greater than 0.8 for a 3-day forecast across all variables, showcasing its ability to estimate hurricane track and intensity accurately up to 3 days in advance.

