In 2020, Hurricane Laura was one of nine tropical cyclones that underwent rapid intensification, culminating in its transformation into a force category-4 hurricane. Just before landfall in Cameron, Louisiana, it reached a maximum intensity of 130 kt (150 mph), rendering it the most powerful tropical cyclone to hit the United States that year. Tragically, the storm resulted in 81 fatalities and an estimated $23 billion in damages. Given the extensive destruction wrought by Hurricane Laura, there is a pressing need for improved accuracy in simulating intricate tropical cyclone wind fields. Computer models are essential for forecasting tropical cyclones and analyzing their physical processes. However, the accuracy of simulated hurricane wind fields over land has yet to be extensively validated, and numerical models are not used to predict over-land wind fields and damages. The main objective of this work is to legitimize the simulation's physics by comparing it to observational data.

The simulated tracks of Hurricane Laura by the WRF parameterized YSU and MYJ schemes deviate considerably to the right of the best track after landfall, leading to potential downstream effects on the intensity and gust factor estimates owing to differences in location.

**OBSERVATIONAL DATA & WRF SIMULATIONS**

We use the Weather Research and Forecast Model (WRF) with two different boundary layer parameterization schemes (MYJ and YSU) to simulate Hurricane Laura. The MYJ and YSU schemes account for the effects of turbulence on momentum and heat transfer using very different methods. The choice of parameterization scheme can impact the simulation of surface-level wind fields of TCs in the WRF model.

At a location inland with approximately open terrain, the anticipated gust factor values at a height of 10 meters are 1.49, while off the coast, the corresponding values are 1.36.

**GUST FACTOR VARIABILITY**

- Gust factors provide information about the variability and intensity of wind gusts during a particular period. By analyzing gust factors, researchers and engineers can better predict the potential impact of wind gusts on structures and infrastructure and develop more accurate wind hazard models. Additionally, gust factor data can validate and improve numerical models, leading to more accurate predictions of over-land surface winds during TC events.

- Gust factor ratio as a function of mean 1-minute wind speed scatter plots are shown below for both the UF tower sites as well as the StickNet site.

- In general, rougher surfaces lower wind speeds but produce higher gust factor ratios, as the wind flow has more turbulence and variability. This is because the roughness elements cause the wind to break into smaller eddies, which can cause gusts. Furthermore, the relationship between the gust factor ratio and mean wind speed is not constant and depends on the roughness characteristics of an area. As a common observation from these figures, gust factors exhibit significant variability at lower wind speeds but stabilize and gain consistency in gust factor values at high winds speeds, in agreement with prior research.

- The simulated wind fields for Hurricane Laura (left) and StickNet observations (right) show differences in wind speed and direction. The StickNet observations are more accurate near the surface, while the model predictions are more accurate at higher elevations. The discrepancies between the model and observations suggest that improvements are needed in the parameterization of surface roughness and wind turbulence in the model.

**REFERENCES**


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