

**Event Overview**

Through the late morning and afternoon of 10 August 2020 a derecho (thunderstorm-induced wind storm) struck the Midwest, hitting parts of Iowa and Illinois the hardest. This derecho produced more extreme weather events than most derechos, including maximum measured 10 m wind gusts exceeding 120 m per h and maximum estimated wind gusts (based on damage) of 140 m per h. In addition, an instrumented tower in Ames, IA sampled several instances of winds exceeding 120 m per h at heights as low as 80 m above ground level and sustained winds at lower levels above 100 m per h over a 7-min period. The AWS site at the Clinton, IA airport sampled 60 m+ winds continuously for nearly one hour! At the peak, an estimated 1.4 million customers were without power, and some customers in Iowa were without power for nearly two weeks afterward. Damage was extensive, with a total estimated cost of $11 billion, making this the second-most expensive weather event to impact the U.S. in 2020, and the costliest thunderstorm event in the history of the United States. Four fatalities occurred along with dozens of injuries and significant tree and crop damage.

**Which NWP models were used?**

Short answer: HRRR-like 3-km and 500-m grid spacing NWP models. Any given model configuration was initialized either every hour or every three hours, starting at 00Z 10 August until approx 15Z 10 August. Investigation of predictability of this event relies on the change of forecast trajectory with successive forecast initializations.

Long answer: The WRF model served as the dynamical core of the operational HRRR model, with 3-km grid spacing. HRRRv3 was operational at the time, but the next version, HRRRv4, was running in parallel in a pre-operational mode at the time as well. Some additional HRRR-like forecasts were also used, with other configuration settings.

The 500-m horizontal grid spacing NWP forecasts are a primary feature of this research. Such grid spacings enable effective full resolution of the scale of air flows involved in this event. The 3-km forecasts cannot do this. Secondly, 500-m horizontal grid spacing should allow for increased wind speeds to be depicted, thus indicating that the model is capable of producing the wind speeds in the derecho.

**Operational Forecast Overview**

Many operational forecast agencies did not suggest the potential for a derecho-producing MCS in discussions the night before and the early morning of the convection began organizing into the mature MCS after 1200 UTC. In defense of the miss from the human aspect of the forecast of this event, the guidance from CAM forecasts also generally gave little indication of this event until closer to when it occurred, which made prediction difficult.

**How did the models perform?**

- HRRRv3 and 500-m forecasts initialized before 02Z 10 August performed quite poorly; they did not depict anything resembling the actual event, (no other models were run before 02Z).
- A forecast trajectory bifurcation occurs in many models at around 02Z 10 August, especially in the HRRR. Models cycles starting at 00Z and for several hours later depicted an impressive forecast of the event, capturing not only a bowing MCS moving across Iowa and into Illinois during the late morning through afternoon, but also indicated widespread surface winds, some being extreme. Many of these forecasts of MCSs were within about 1 hour of the longitude of the actual event, although many forecasts placed the MCS track 50-150 km to the north of where it actually occurred. A second forecast trajectory bifurcation occurs roughly between 09Z and 15Z (varying by model, and more gradual) after which the forecasts actually become less accurate.
- The HRRRv4 structure was canonical/nearby textbook in appearance.
- HRRRv4 outperformed HRRRv3, with the 02Z cycle being the lone exception.
- Models using direct reflection assimilation tended to perform better than all other models.
- 500-m Δx models produced an MCS that had more a expansive and “meatier” leading convective line and also higher wind speeds.
- All models had trouble keeping the MCS moving at the speed of the actual event; that is, they had a slow bias in the forward move speed.
- No model was able to produce 10-m wind speeds as high as the maximum measured values, but some got near or above 100 m per h. However, one of the 500-m grid spacing forecasts produced winds in the lowest few km above ground as high as 160 m per h.
- Ultimately, a given forecast’s performance was correlated to how open it kept the warm sector after the cold front, leaving the inflow environment in the MCS undisturbed, and thus was a primary factor determining the predictability of the event.

**Predictability Considerations of the 10 August 2020 Midwest Derecho**

**What’s the point of this poster?**

I grew up in Marion, IA – a location near the epicenter of the worst of this event. Inspired by the hometown destruction, I sought to analyze the aspects of the NWP forecasts that led to this miss of this event. Along the way, I decided to attempt to create better NWP forecasts of this event. This poster discusses my findings of both the predictability analysis and the forecast performance.

**Take home message(s)**

The 500-m grid spacing forecasts did a remarkably good job replicating the three-dimensional structure of the MCS-producing derecho, nearly matching the wind speeds, and tracking in the same direction and over a similar path as the observed event. The 3-km forecasts were more variable. Keeping an undisturbed inflow environment was critical for accurately forecasting this event.