Evaluating Weather Forecasts of Winter Precipitation Start Times and End Times

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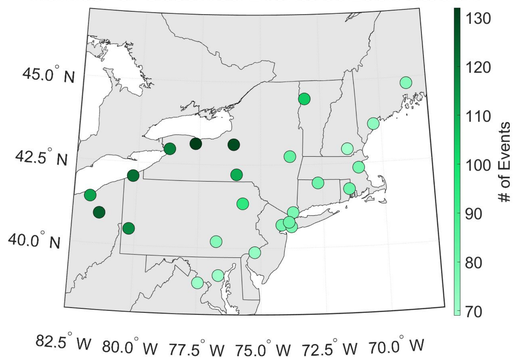
Motivation

Weather forecast models often struggle to correctly predict the start and end times of surface precipitation. Even an error of an hour or two in event timing of snow or wintery mix precipitation will can have large impacts on airline schedules, timing of school closures, and morning or evening commutes.

Methods

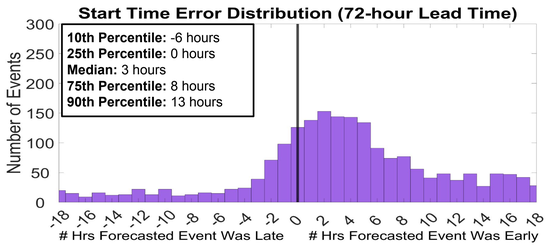
We compare the forecasted storm start times and end times from NOAA's Global Forecast System (GFS) model to the observed start times and end times from Integrated Surface Dataset (ISD) of ASOS stations. We use data from 25 ASOS stations in the northeast US from Dec, Jan, and Feb during the 2020, 2021, and 2022 winter seasons. If there are less than eight hours between the end of one precipitation event and the start of the next event, we consider them to be the same storm. Precipitation events are defined as periods where surface precipitation is > 0 mm/hr. Three GFS lead times are assessed: 72 hours, 48 hours, and 24 hours. A -6 hour start time error means that the GFS model forecasted start time 6 hours later than the actual observed precipitation start time.

Number of Observed Events at Each Station

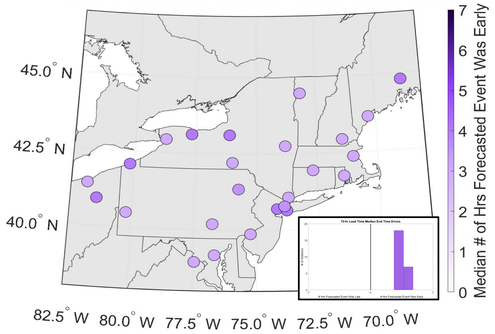


72-Hour Lead Time (>0 mm/hr)

Start Time Error Distribution (72-hour Lead Time)

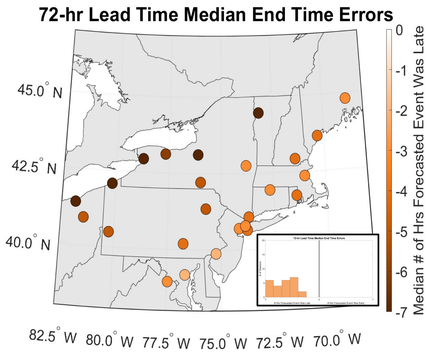


72-hr Lead Time Median Start Time Errors



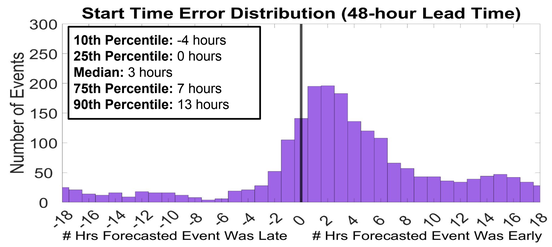
End Time Error Distribution (72-hour Lead Time)

72-hr Lead Time Median End Time Errors

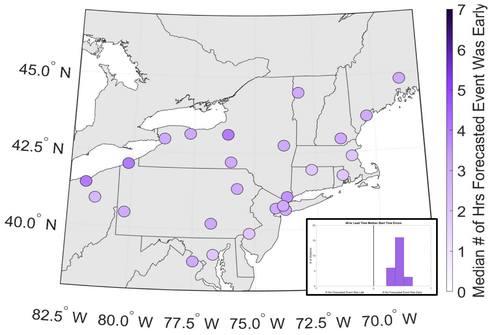


48-Hour Lead Time (>0 mm/hr)

Start Time Error Distribution (48-hour Lead Time)

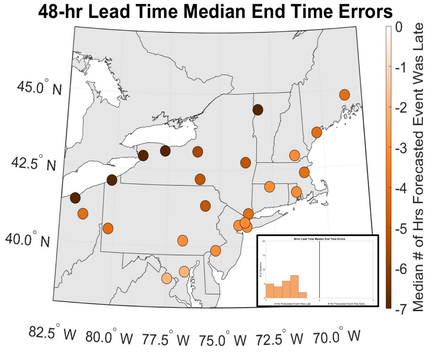


48-hr Lead Time Median Start Time Errors



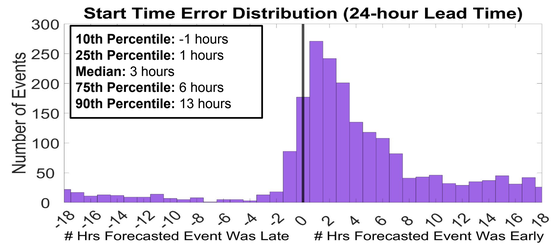
End Time Error Distribution (48-hour Lead Time)

48-hr Lead Time Median End Time Errors

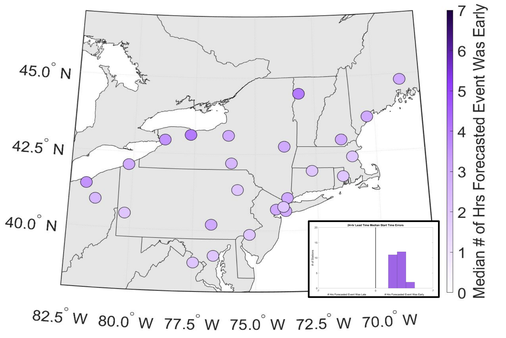


24-Hour Lead Time (>0 mm/hr)

Start Time Error Distribution (24-hour Lead Time)

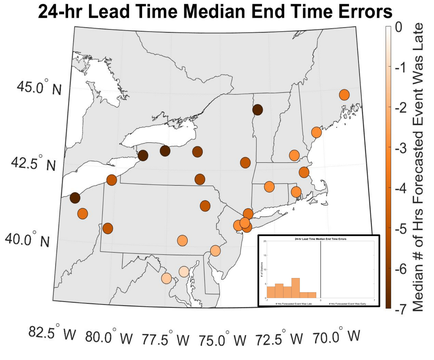


24-hr Lead Time Median Start Time Errors



End Time Error Distribution (24-hour Lead Time)

24-hr Lead Time Median End Time Errors



Conclusions

- As expected, error distributions narrow as lead time decreases, but there is not much difference between error statistics at 48 hour and 24 hour lead times.
- The GFS model tends to predict winter precipitation start time too early (median bias ~ 3 hrs) and precipitation end time too late (median basis ~ -4 hours)
- The largest forecast timing errors are for precipitation event end times near the Great Lakes. The median error per station is > 5 hour late for the three lead times.

Acknowledgements

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