Evaluating Weather Forecasts of Precipitation Start and End Times

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Motivation

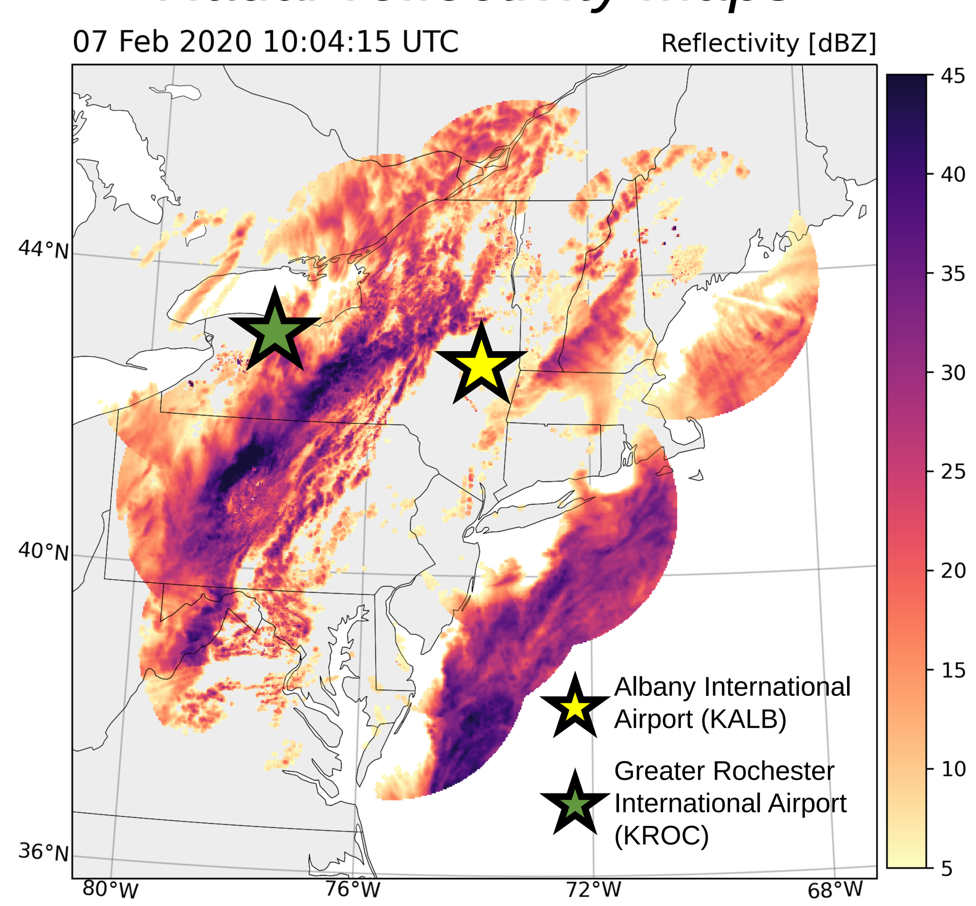
Weather forecast models often struggle to correctly predict the timing of precipitation events. Even an error of an hour or two on when snow will start to fall can have large impacts on airline schedules or on the timing of school closures. As an example, we compare the start and end times of precipitation for two stations during a winter storm in February 2020.

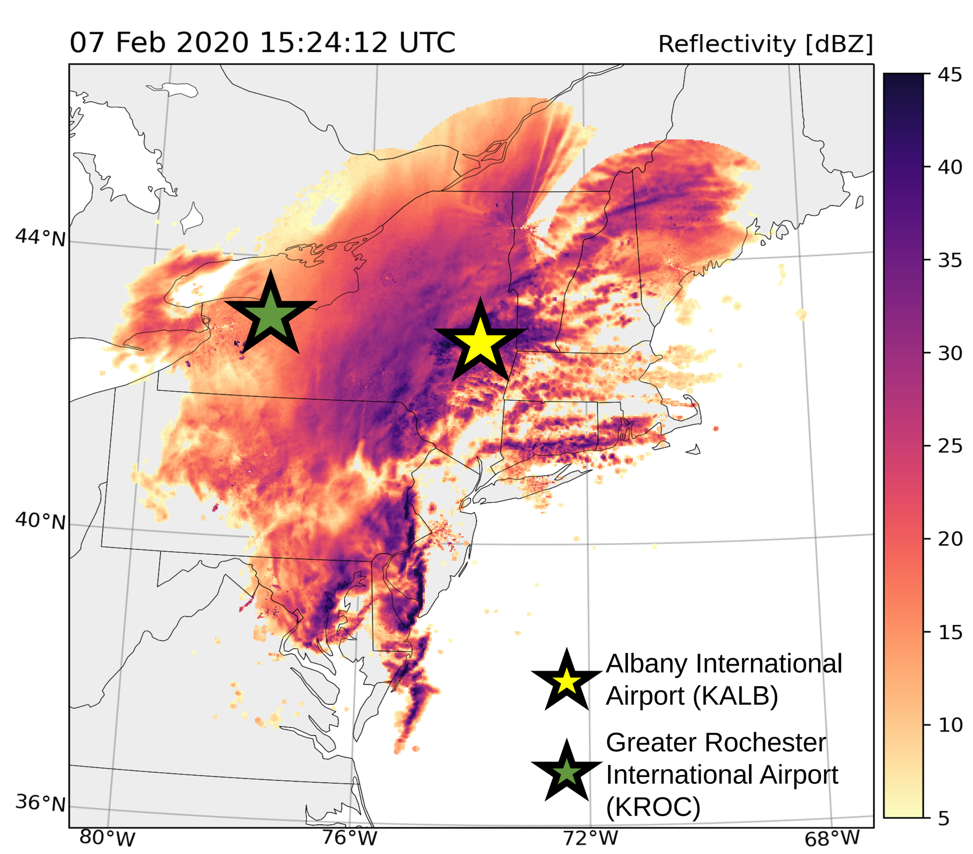
Methods

We examine the start and end times of precipitation forecasts compared to the observed precipitation event to quantify the model's error. We use the National Oceanic Atmospheric Administration's (NOAA) Global Forecast Model (GFS) and observational data from NOAA's Integrated Surface Database. Three model initialization times (lead times) are assessed: 72 hours, 48 hours, and 24 hours. In theory, the forecast for a shorter lead time should be better than ones for longer lead times. We used a threshold of 0.5 mm/hr to define precipitation events. Error, in hours, is found by subtracting the observed from the model start and end times. If there are more than 8 hours between the end of one event and the start of another, they are considered as separate storms.

Illustration of Methodology for a Single Storm

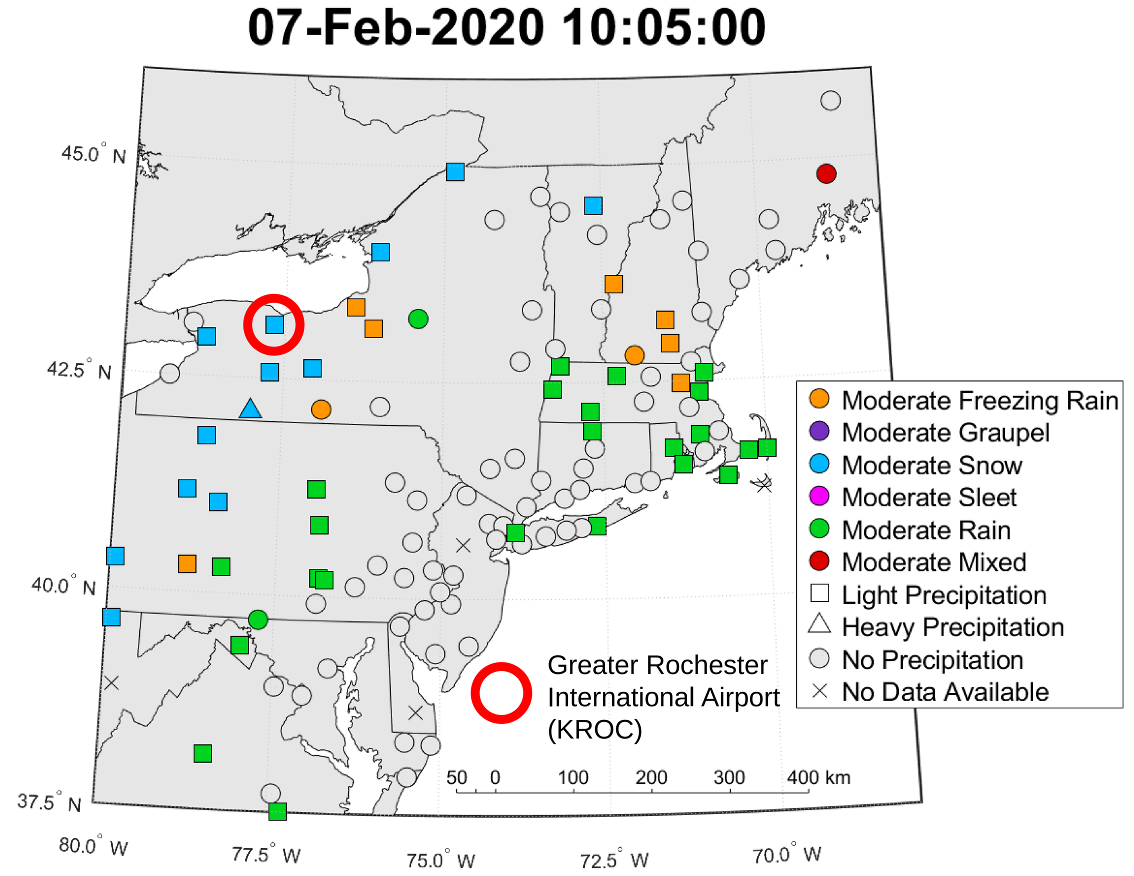
Radar reflectivity maps



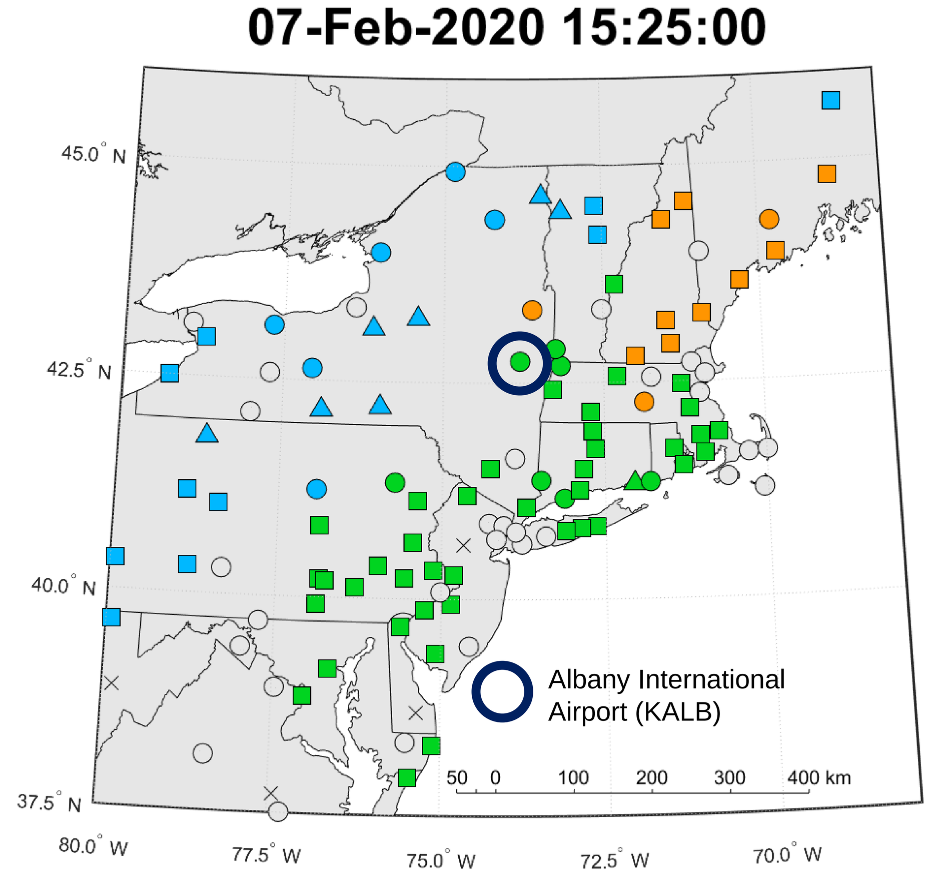


Surface precipitation maps

07-Feb-2020 10:05:00

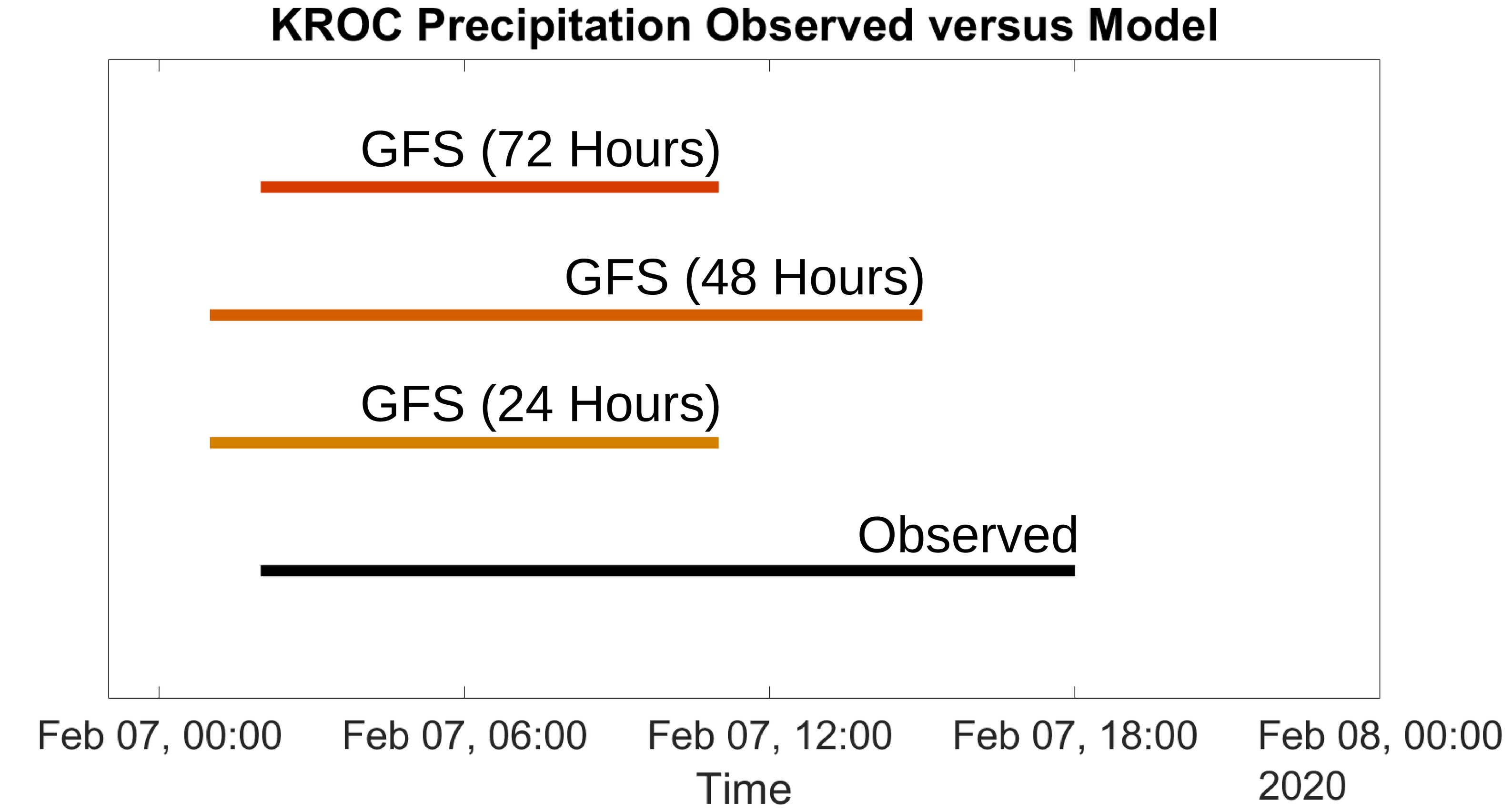


07-Feb-2020 15:25:00

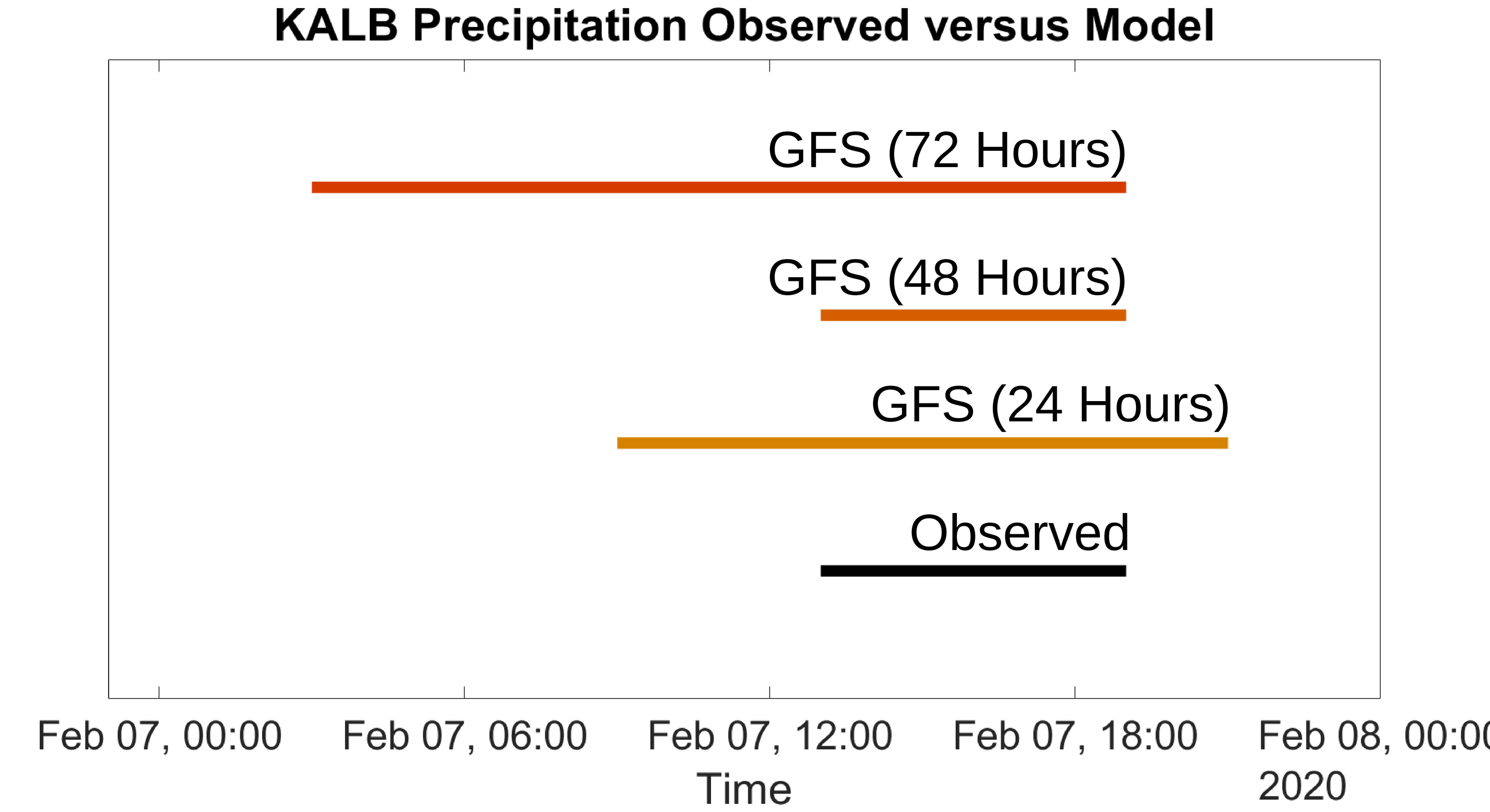


Comparison of precipitation event durations among model lead times and observations using a 0.5 mm/hr threshold

KROC Precipitation Observed versus Model



KALB Precipitation Observed versus Model



Comparison of precipitation start and end time errors among model lead times and observations

KROC

Start Time

Lead times	Error (hr)
72	0
48	+1
24	+1

End Time

Lead times	Error (hr)
72	+7
48	+3
24	+7

KALB

Start Time

Lead times	Error (hr)
72	+10
48	0
24	+4

End Time

Lead times	Error (hr)
72	0
48	0
24	-2

Summary

- Compared to the observations for the 7 Feb 2020 storm, the weather model got the arrival time in western NY close to accurate but incorrectly forecast the storm area and motion such that storm durations in western NY were too short, and the storm arrival in eastern NY was too slow.

Future Work

- Expand analysis to multiple different events over several seasons.
- Determine if there are systematic biases in storm start and end timing, and duration errors related to different large scale weather patterns.
- Test the sensitivity of the results to lower precipitation event definition thresholds of > 0 mm/hr and > 0.3 mm/hr.

Acknowledgements

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