A Quality Assessment of the Real-Time Mesoscale Analysis (RTMA) for Aviation

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Introduction

Missing weather reports cause flight delays, cancelations, and diversions that create headaches for travelers and financial losses for the nation's commercial airlines.

Example from 01 March 2018: Flight from Columbus, GA to Atlanta delayed 401 minutes due to missing METAR observation.

- Station was repaired, but flight crew timed out before takeoff

Beginning in July 2015, the Environmental Modeling Center (EMC) has provided temperature data interpolated from the RTMA at airport locations across the United States (i.e., airport weather status list) to serve in lieu of missing temperature reports.

The purpose of this work is to present a quality assessment of the RTMA and provide recommendations for expanding the airport weather status list to include additional weather elements besides temperature.

The Real-Time Mesoscale Analysis (RTMA)

The RTMA is an hourly, 2D-Var analysis system that produces analyses of sensible weather elements (De Pondeca et al. 2011):

- 2 m temperature, 2 m dew point, surface pressure, 10 m wind, 10 m gust, ceiling, visibility, and cloud cover

Figure 1: CONUS, Alaska, Hawaii, and Puerto Rico RTMA domains. Each domain uses a grid spacing of 2.5 km, except for Alaska (3 km).

Experiment Design

- The quality assessment is performed through retrospective data denial experiments (two weeks per season) run on the CONUS, Alaska, Hawaii, and Puerto Rico domains.
- Parallel data denial experiments:
  - **CONTROL:** Assimilates all available observations
  - **EXP:** Rejects observations from Part 139 airports
- As a baseline, these experiments are also compared against the first guess fields (**NODA**)

Table 1: Retrospective periods

Period	Start	End
Summer 2017	00Z on 27 June 2017	23Z on 10 July 2017
Fall 2017	00Z on 01 October 2017	23Z on 14 October 2017
Winter 2018	00Z on 01 January 2018	23Z on 14 January 2018
Spring 2018	00Z on 01 April 2018	23Z on 14 April 2018

Results

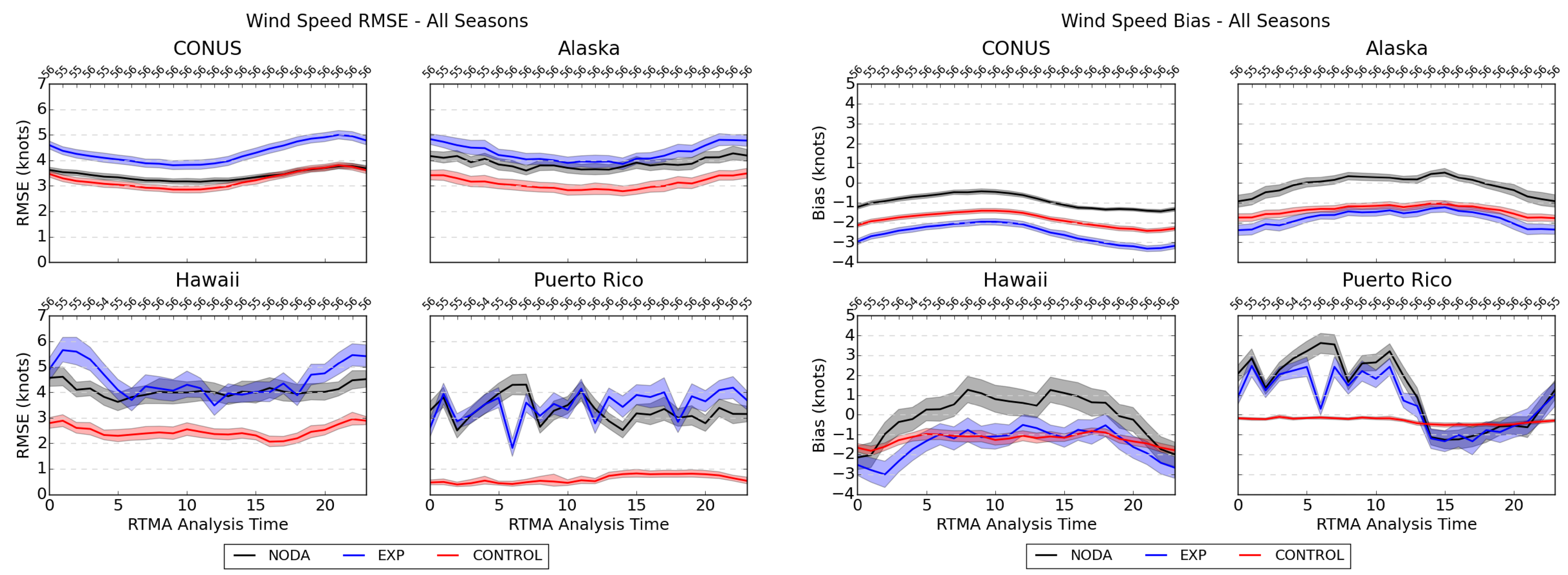

Figure 2: Time series plots of wind speed RMSE and bias across all retrospective periods by domain. The number of analysis cycles reporting wind speed observations for a given cycle hour is provided above the time series for each domain. The shaded area for each experiment corresponds to bootstrapped (n=10000) 95% confidence intervals.

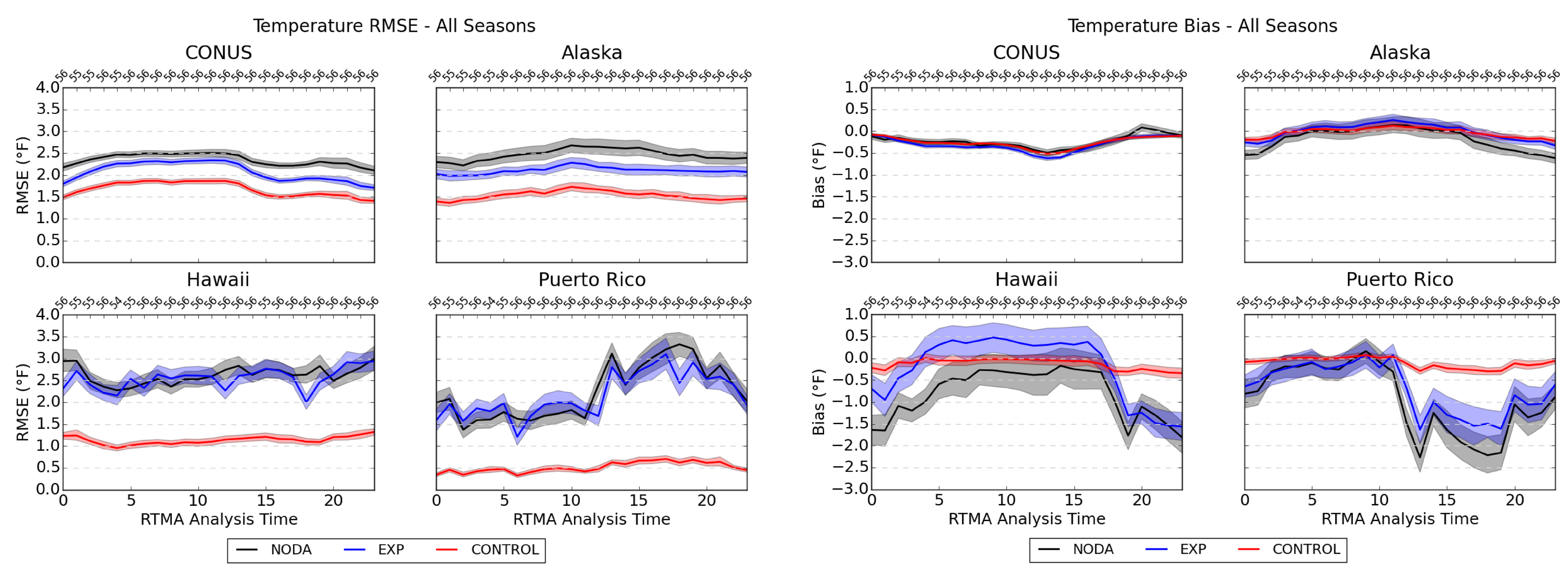

Figure 3: As in Figure 2, except for 2 m temperature.

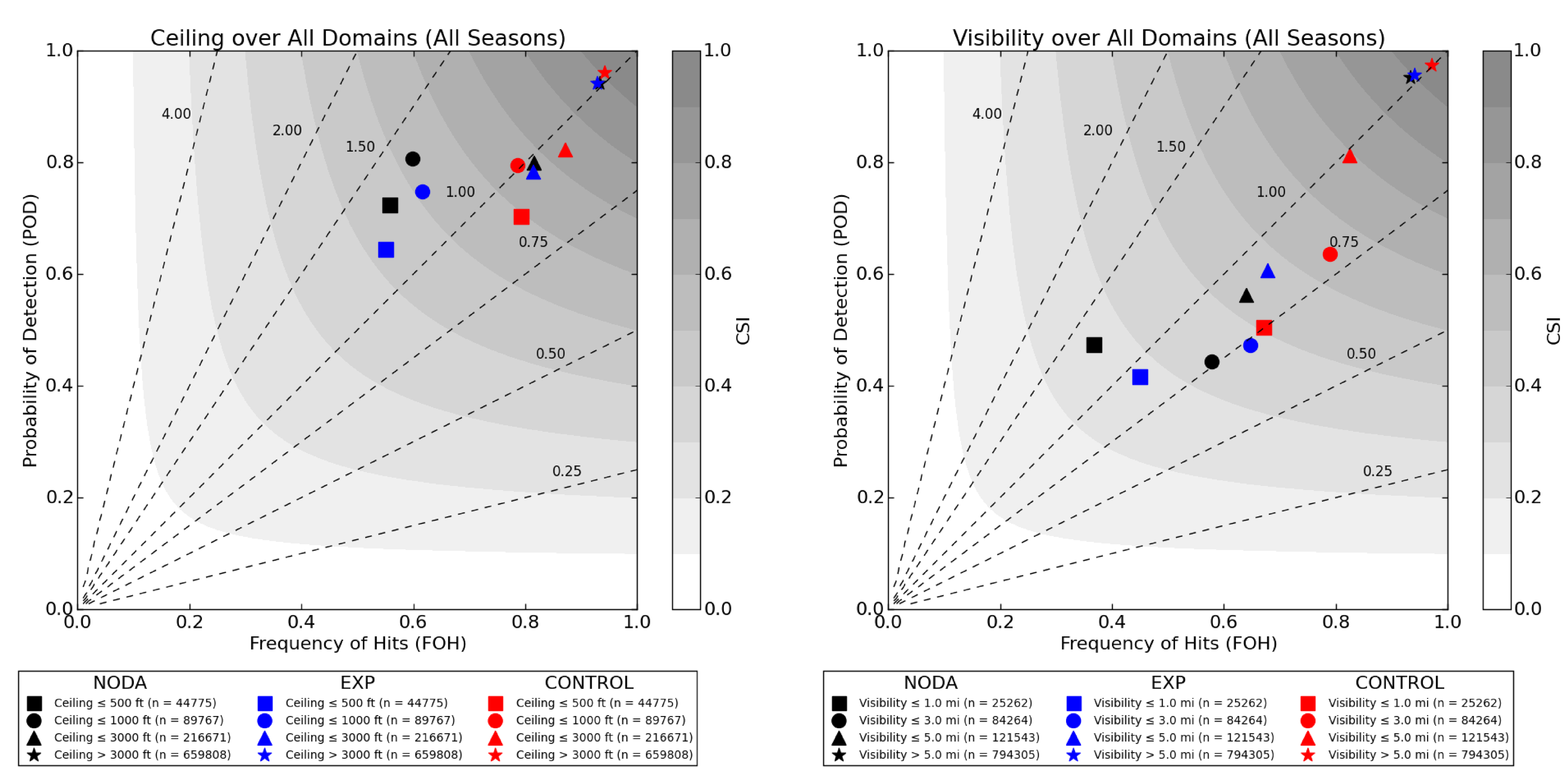

Figure 4: Performance diagrams for ceiling and visibility, aggregated over all domains and retrospective periods. A perfect forecast (i.e., no misses or false alarms) would occupy the upper-right corner of the diagram.

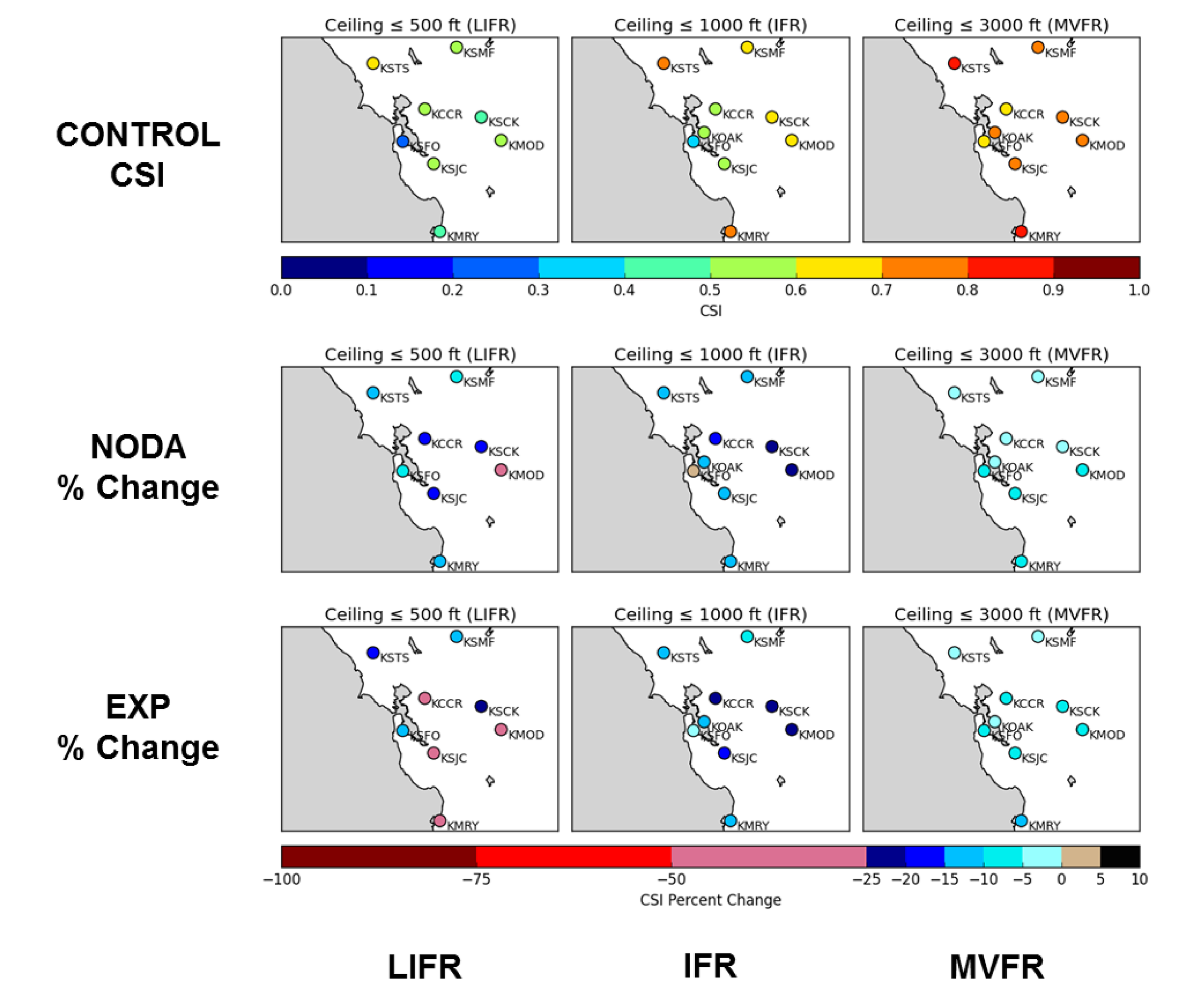

Figure 5: Station maps of ceiling statistics aggregated across all retrospective periods, focused on the San Francisco Bay area in California.

Discussion

- In general, EXP is degraded relative to CONTROL for wind speed, temperature, ceiling, and visibility.
- Mesonet observations impart a low bias to the RTMA wind speed analysis owing to nonstandard instrument siting; this low bias will be mitigated in the next version (April 2020).

Future Work

- Future work could be performed to withhold observations from a smaller, representative subset of Part 139 airports (e.g., coastal, mountainous, urban, and rural regions).
- As the final version of the 2D RTMA/URMA will be implemented this spring, similar analysis could be performed for a prototype version of 3D-RTMA (scheduled for implementation in FY2023).

References

De Pondeca, M. S. F. V., and Coauthors, 2011: The Real-Time Mesoscale Analysis at NOAA's National Centers for Environmental Prediction: Current Status and Development. *Wea. Forecasting*, **26**, 593–612.

Morris, M. T., J. R. Carley, E. Colón, A. Gibbs, M. S. F. V. De Pondeca, and S. Levine, 2020: A Quality Assessment of the Real-Time Mesoscale Analysis (RTMA) for Aviation. *Wea. Forecasting*, Accepted.

Please see the following presentations/posters on the RTMA:

- 8A.3: A Description of the v2.8 RTMA/URMA Upgrade and Progress toward 3D RTMA
- 15.1: Using Mesonet Observation Metadata to Improve the RTMA Wind Analysis
- 5A.4: Multigrid Beta Function Approach for Modeling of Background Error Covariance in the Real-Time Mesoscale Analysis (RTMA)
- J59.3: MPI Redecomposition and Remapping Algorithms Used within a Multigrid Approach to Modeling of the Background Error Covariance for High-Resolution Data Assimilation
- 3A.2: Testing and Refinement of a Three-Dimensional Real-Time Mesoscale Analysis (3D-RTMA) for Severe Weather, Aviation, Operational Forecasting, and Other Nowcast Applications
- 12C.3: Evaluation of Multiple Analysis Systems in the 2019 HWT Spring Forecasting Experiment
- Poster #432: Improved Surface Analysis for 3D-RTMA

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