Local Meteorological Modeling to Support Flight Training Operations

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Introduction

Spatial and temporal variability in atmospheric conditions directly impact pilot safety and training objectives. Specific conditions of frequent concern to the ERAU Prescott flight training operations include boundary layer wind shear and turbulence. These conditions are most common during spring and summer months due to vertical wind shear, unstable air temperature profiles and thunderstorm-produced gust fronts. Case study comparisons of a high resolution meteorological forecasting model can demonstrate the value of operational modeling in support of a flight training program.

Methods

The Weather Research and Forecasting (WRF) numerical meteorological model has been implemented to produce gridded forecasts of wind shear and other parameters in the vicinity of the Love Field (KPRC) pilot training operations for the ERAU Flight Center in Prescott, Arizona. Students in the Department of Meteorology gain experience in the setup and running of the WRF mesoscale model as part of research projects supported by the NASA Space Grant program. This activity contributes to developing research expertise and forecasting skill.

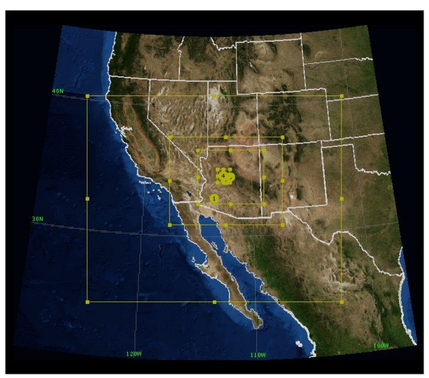

Figure 1 depicts the geographic domain for the nested simulation model, with the highest resolution grid centered over Prescott, Arizona.

Results

Case studies are being used for assessment and refinement of forecast model applications at KPRC. Data obtained from the glass-cockpit Garmin1000 instrument systems on the ERAU training aircraft provide data for intercomparison of observed and predicted meteorological conditions.

Figure 2 indicates the approach and landing path of an ERAU Prescott training aircraft, using aircraft position data recorded by the G1000 onboard instrumentation system.

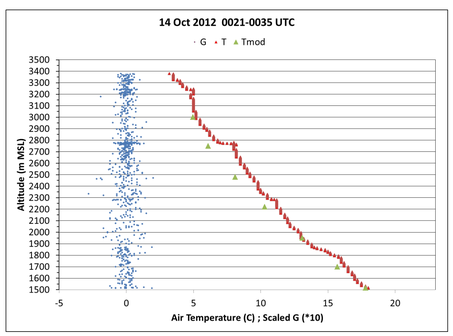

Figure 3 shows vertical profiles of the g-force (G) indicating turbulence characteristics during approach and landing, obtained from the Garmin1000 instrumentation aboard the training aircraft, and comparison of air temperature profiles from the G1000 (T) with the WRF model forecast (T_{mod}). The correspondence of aircraft measurements and model results indicates a valid forecast simulation of the temperature profile parameters. Thermodynamic stability and other vital meteorological conditions are directly impacted by the atmospheric profile parameters.

Summary

Implementation of the WRF model for local-scale meteorological prediction is providing case study opportunities to assess model performance for flight-relevant atmospheric conditions. Positive outcomes will allow development of graphical forecast products to improve operational safety and to generate research datasets relevant to trainee performance in a variety of meteorological scenarios such as wind shear conditions.

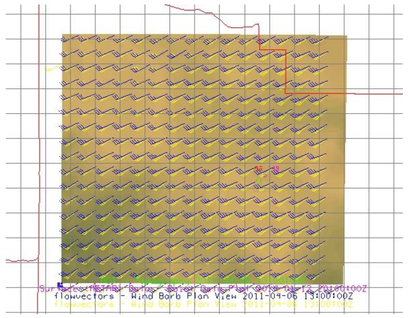

Figure 4 presents an example of a tailored graphic produced from WRF model output that shows wind barbs and vertical wind shear conditions between two levels for the local region centered on the ERAU-Prescott flight training operations (KPRC airport at center-right location of model domain graphic).

Future Applications

The methodology developed through this research will be applied to an upcoming NSF-supported deployment of the University of Wyoming instrumented King Air at ERAU-Prescott. A two-week project during Spring 2014 will provide research flight experience for ERAU students and faculty aboard the King Air. Datasets collected during these flights will be utilized for additional case studies.

Acknowledgements

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