ASCENT Project 54

AEDT Evaluation and Development Support

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Cost Share Partner: Delta Air Lines

Objective:

- Provide data and methods to continue to improve the aircraft weight, takeoff thrust, and departure and arrival procedure modeling capabilities within AEDT
- Utilize real-world data flight and noise monitoring data to improve departure, full flight, and arrival modeling
- Conduct system evaluation of AEDT features

Project Benefits:

- The main benefit of this research is to address the gaps in AEDT related to departure profiles that are outdated and arrival procedures that might not reflect current airport operations.

Research Approach:

- Using real-world data (flight data, noise monitoring data) develop methods to automatically model actual operations in AEDT
- Perform comparisons between thousands of real flights against the outputs of AEDT's performance models for arrival, departure, and en-route phases to obtain statistics about the overall agreement with existing AEDT definitions
- Perform system testing and evaluation of AEDT features to identify discrepancies, quantify differences, and document possible improvements for future efforts

Major Accomplishments (to date):

- Compared AEDT profiles with real-world operations for arrival and departure procedures to identify key differences
- Implemented method for full flight modeling using airline data for comparison against AEDT
- Performed system testing on various AEDT features and made recommendations

Future Work / Schedule:

- Complete comparison of arrival profiles at all identified airports
- Complete comparison of full-flight modeling in AEDT with real-world flight operations

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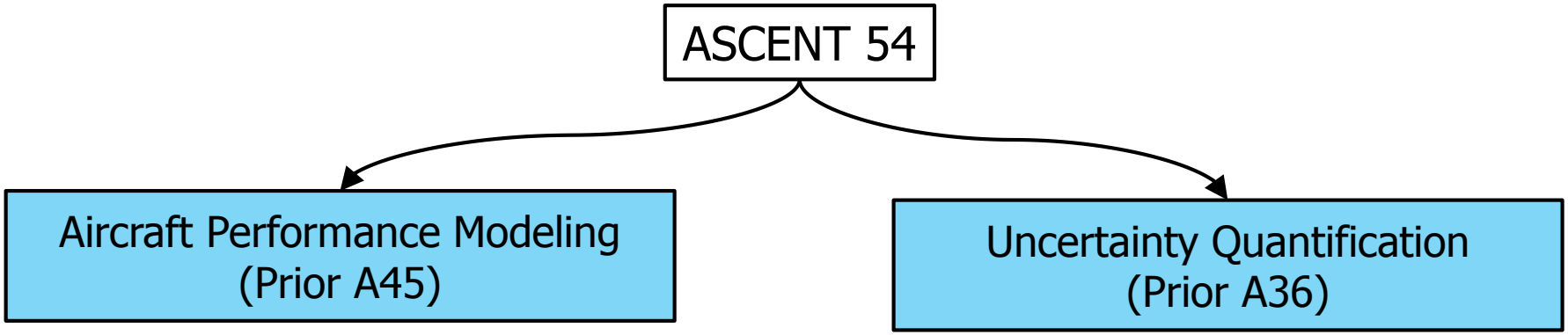
Outline

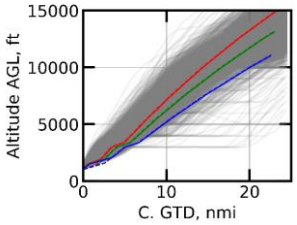
- ASCENT 54 project is comprised of two main thrusts:

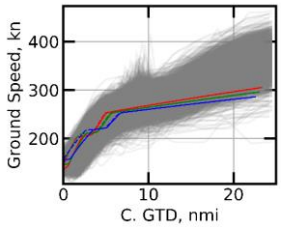


- The primary impact of this thrust is to improve the accuracy of AEDT so its environmental modeling can better represent real aircraft operations
- The improvements to AEDT will support airport noise compatibility programs and planning with more accurate results to better inform federal financial support of those programs
- This thrust addresses improvements and comparisons to real-world operations for arrival, departure, and full-flight modeling options in AEDT

- Perform system testing to evaluate the accuracy, functionality, and capabilities of AEDT and support the future development process
- Identify gaps in the tool's functionality and areas for further research and development

Departure Modeling: Comparing NADP to Real-world Flights and High-Altitude Operations





Real World Trajectories

NADP Trajectories

Data Processing

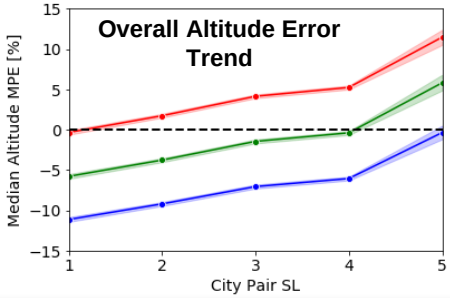
- Resample
- Align starting point

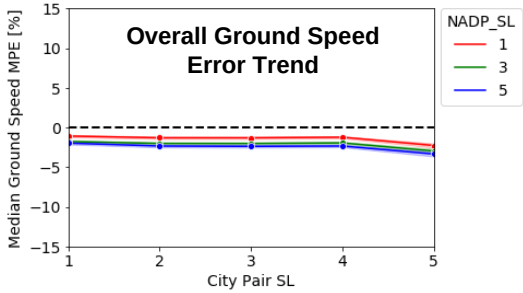
Compute Comparison Metric (Altitude & Ground Speed) Mean Percentage Error [MPE] (+ if NADP is higher)

Overall trends

Difference computed at fixed ground track distance intervals and averaged over the trajectory

Aircraft: B737-800, A320-211
Airport: KSFO, KATL, KSLC, KDEN
NADP Profiles:
- NADP 1-1
- NADP 2-11



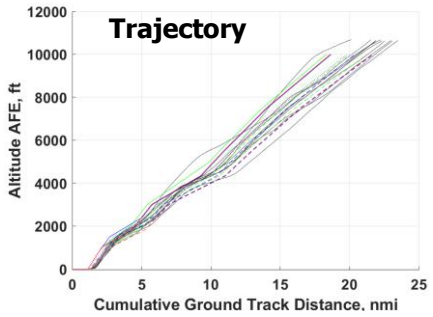


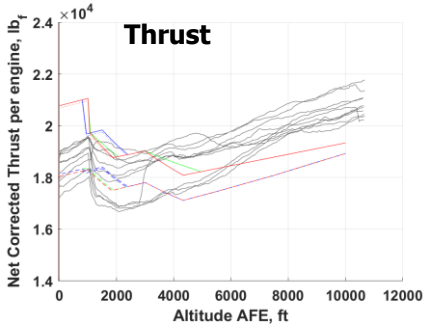
NADP altitude profile is representative. However, ground speed is slower compared to real-world trajectories

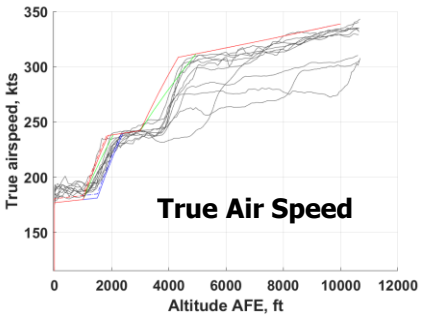
Method

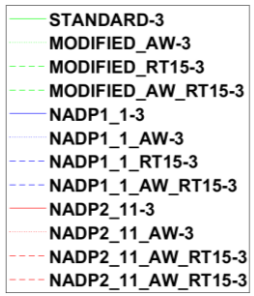
1. Identify top 3 airports with high field elevation for which validation flight data is available
2. Collect the departure flights from validation data at each airport
3. Model the corresponding flights with AEDT's departure profiles – STANDARD, NADP1, and NADP2
4. Compare performance results against the validation flights

NADP departure profiles adequately represent high-altitude airport departure operations







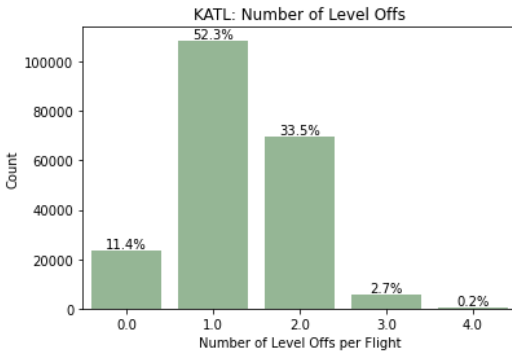


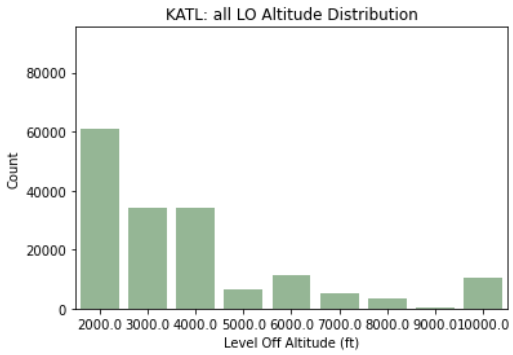
Arrival Models and Full Flight Models

Objective: Improve the accuracy of AEDT arrival models by analyzing real-world flight data by characterization of flights by level-offs (LOs)

Method:

- ❑ Identify LOs using vertical speed and analyze trends for each airport and each ANP ID airframe defined in AEDT.
- ❑ Analyze metrics such as number of LO per flight, most common LO altitude and LO distance, change in velocity across a LO, etc.



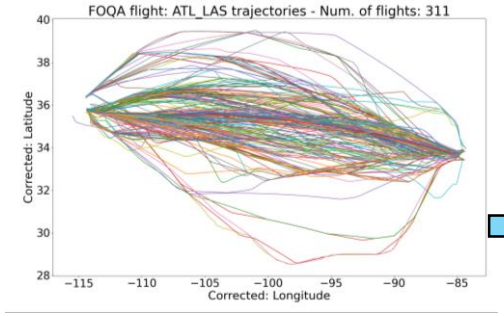


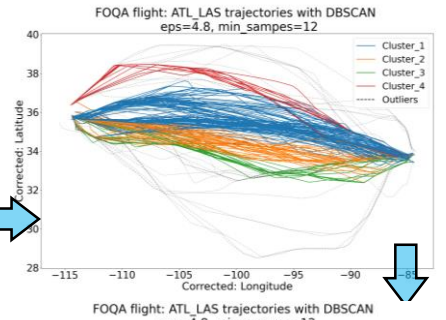
Analysis on-going to complete top 100 airports within the U.S.

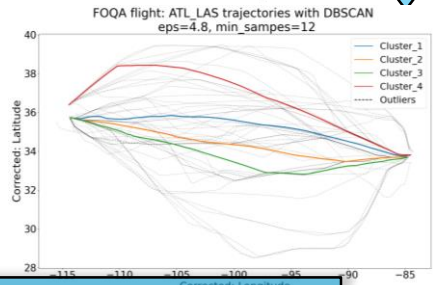
Objective: Conduct full flight modeling within AEDT without the use of sensor paths in order to investigate the accuracy of performance modeling in AEDT compared to actual airline flight data, where all states of the aircraft are known including thrust, weight and fuel flow

Method:

- ❑ Obtain average patterns between city pairs, investigate how the full flight modeling within AEDT differs from FOQA data depending on performance modeling options (ANP model / BADA4) and weather data (Airport average annual weather / High fidelity weather – MERRA-2)







Full-flight modeling capability explored in depth; analysis on-going to provide detailed comparisons

System Evaluation on AEDT Features

- Developed TGO/CIR profiles, conducted V&V analysis and delivered the developed profiles to Volpe for implementation
- Evaluated the performance model selection features contingent on BADA4 approval status
- Validated the calculation of speciated OGs (to post-processing step)
- UQ analysis on fixed point trajectory processing in BADA 4 Workflows
- System testing on the ASIF import of spectral data feature
- Made recommendations and findings for these AEDT features