Analytical Approach for Quantifying Noise from Advanced Operational Procedures

ASCENT Project 23

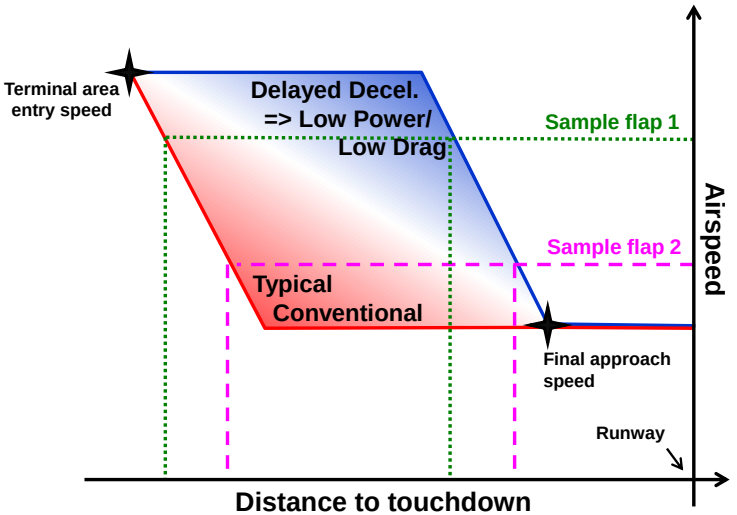
Project managers: Chris Dorbian, FAA
Stephen Merlin, FAA

Principal investigators: R. John Hansman, MIT
Philip Morris, Penn State University (PSU)
Victor Sparrow, PSU

This work is funded by the US Federal Aviation Administration (FAA) Office of Environment and Energy as a part of ASCENT Project 23. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the FAA or other ASCENT Sponsors.

Motivation

- Advanced operational procedures may have the potential to reduced aircraft noise and associated population exposure
  - RNAV/RNP, Continuous Descent Approaches, Delayed Deceleration Approaches, Climb Thrust Scheduling, etc.
- Traditional aircraft noise analysis assumes that engine noise dominates aerodynamic noise
  - Assumption may have been valid for earlier generation jet engines
- Current analytical approach does not fully capture noise impacts from aircraft configuration or other operational techniques which may have noise benefits
  - Integrated Noise Model (INM) / Aviation Environmental Design Tool (AEDT)



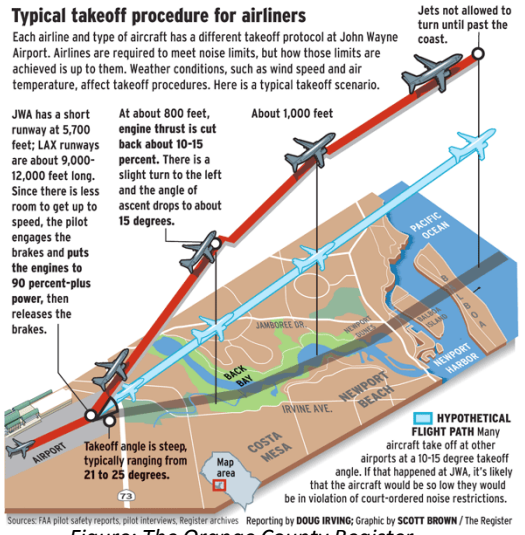


Figure: The Orange County Register

TASOPT - ANOPP Noise Analysis Framework

TASOPT Inputs:

Operating/mission parameters

Aircraft sizing/performance parameters

Engine sizing/performance parameters

Flight Procedure Type:

Altitude

Velocity

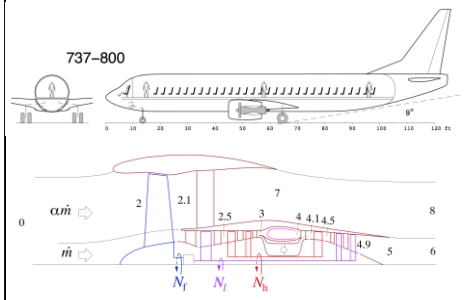
Configuration

*Flight Procedure Generator currently in development

TASOPT

Flight Procedure Generator*

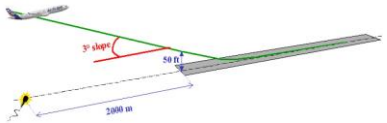
TASOPT Outputs:



Aircraft/engine performance & geometry

Flight Procedure:

Thrust, velocity, & position per time



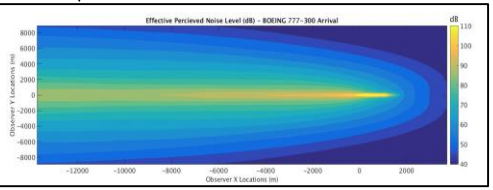
ANOPP Control Inputs:

Propagation settings

Observer locations

ANOPP

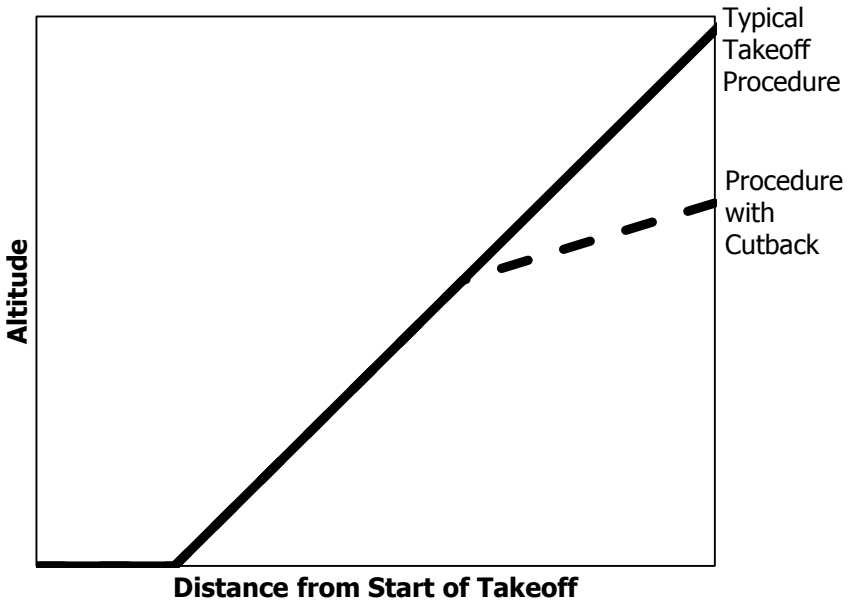
SEL, EPNL, LMAX contours for each observer location



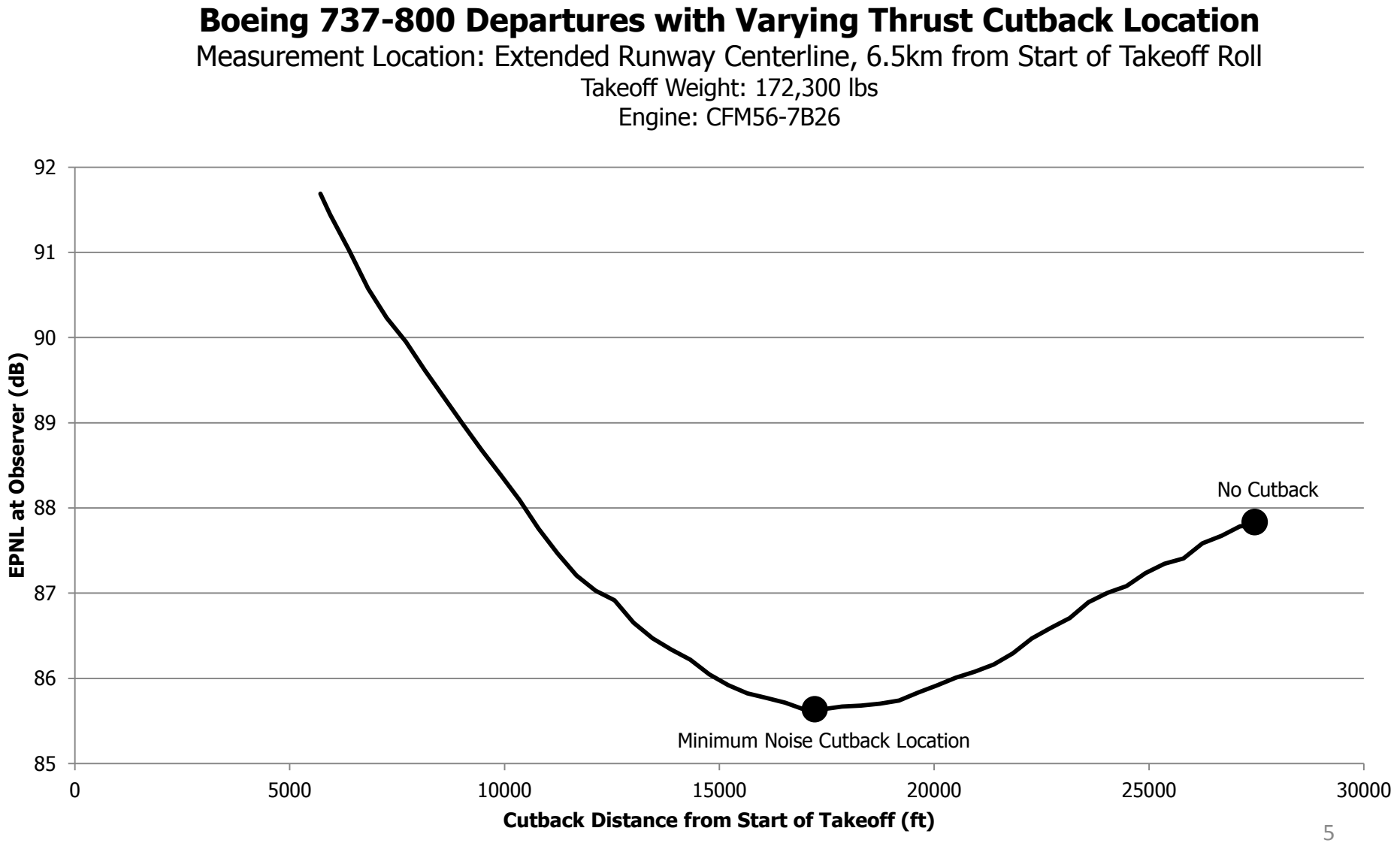
Example Application of Noise Analysis Tool: Thrust Cutback on Departure

- Typical takeoff procedure uses constant takeoff thrust throughout initial climb segment
  - Safety & efficiency benefits
- Thrust cutback after takeoff during initial climb can be used to reduce noise for nearby communities
  - Specific location of cutback determines overall impact of procedure

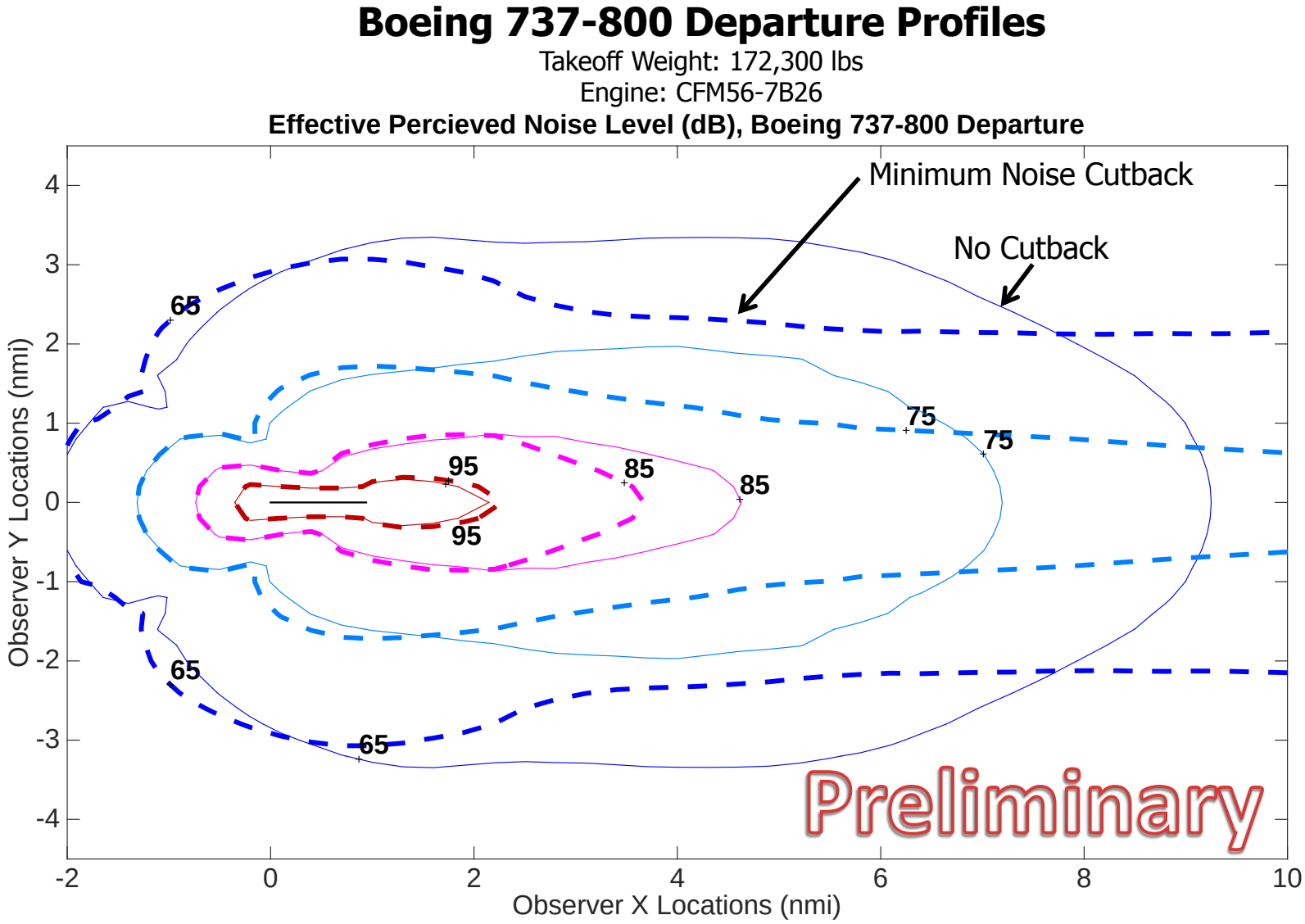
Variation of Departure Flight Profile with Thrust Cutback Location



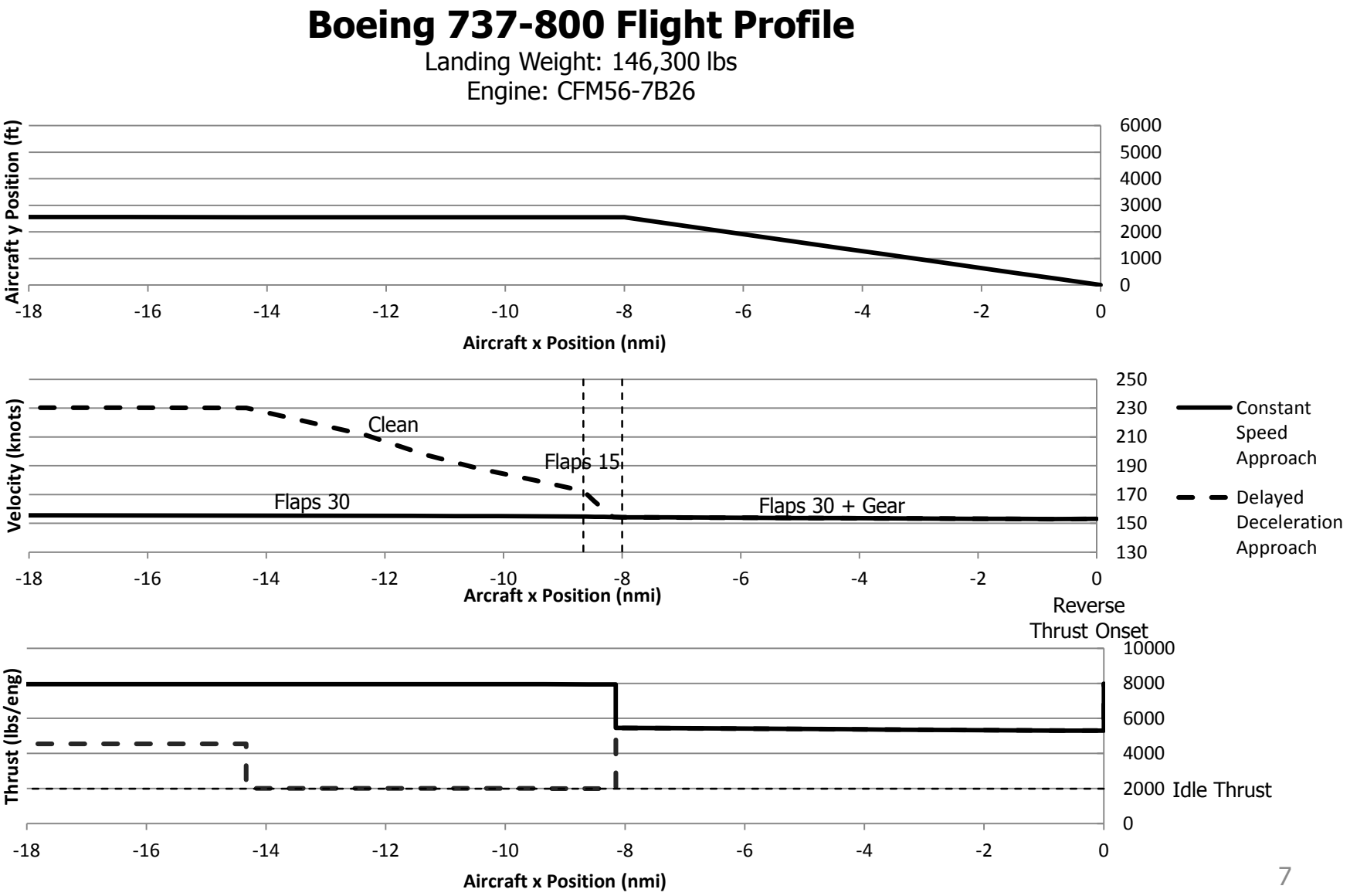
Impact of Thrust Cutback Location on Single-Observer Departure Noise



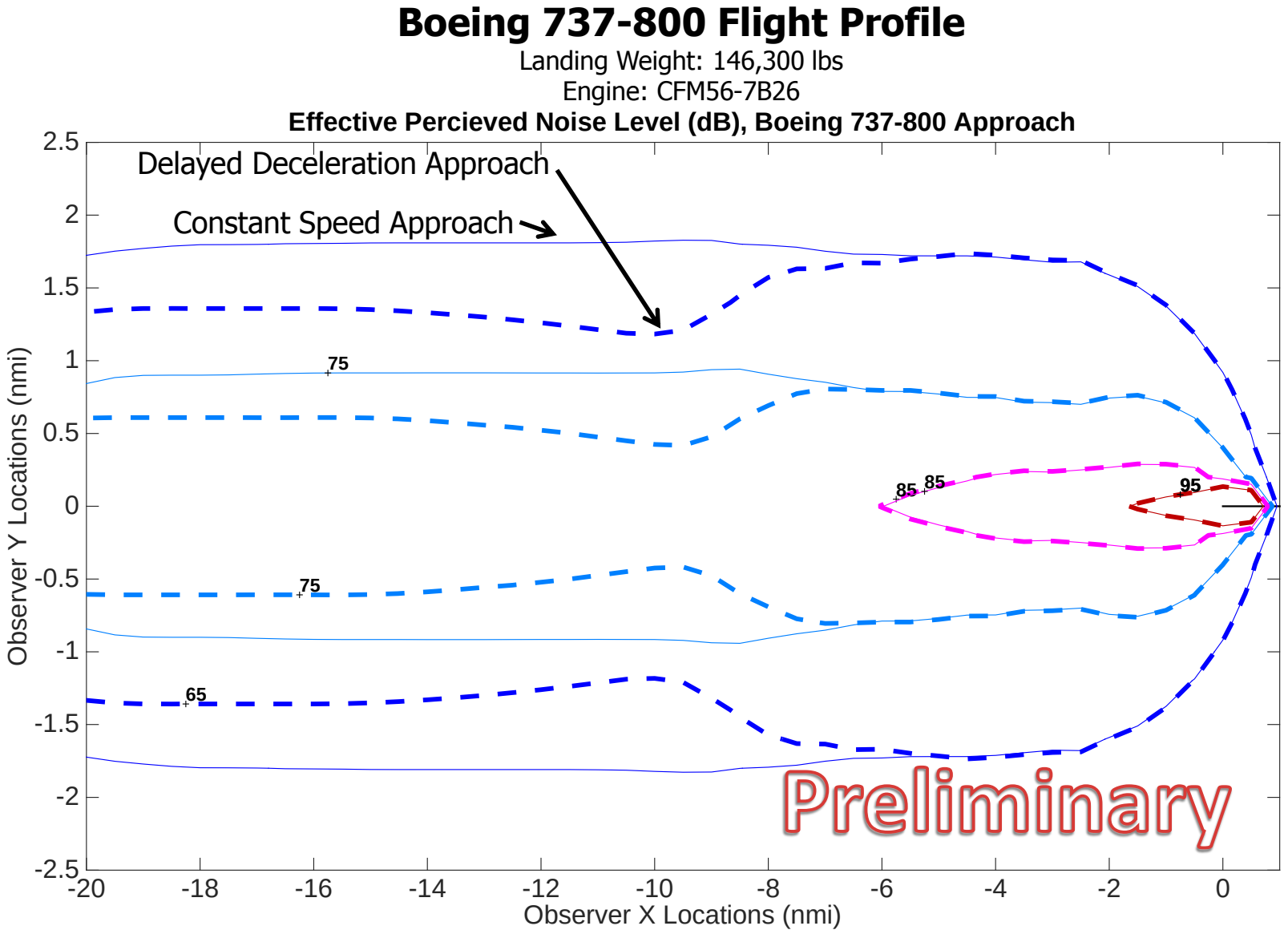
Impact of Thrust Cutback Location on Departure Noise Contour Geometry



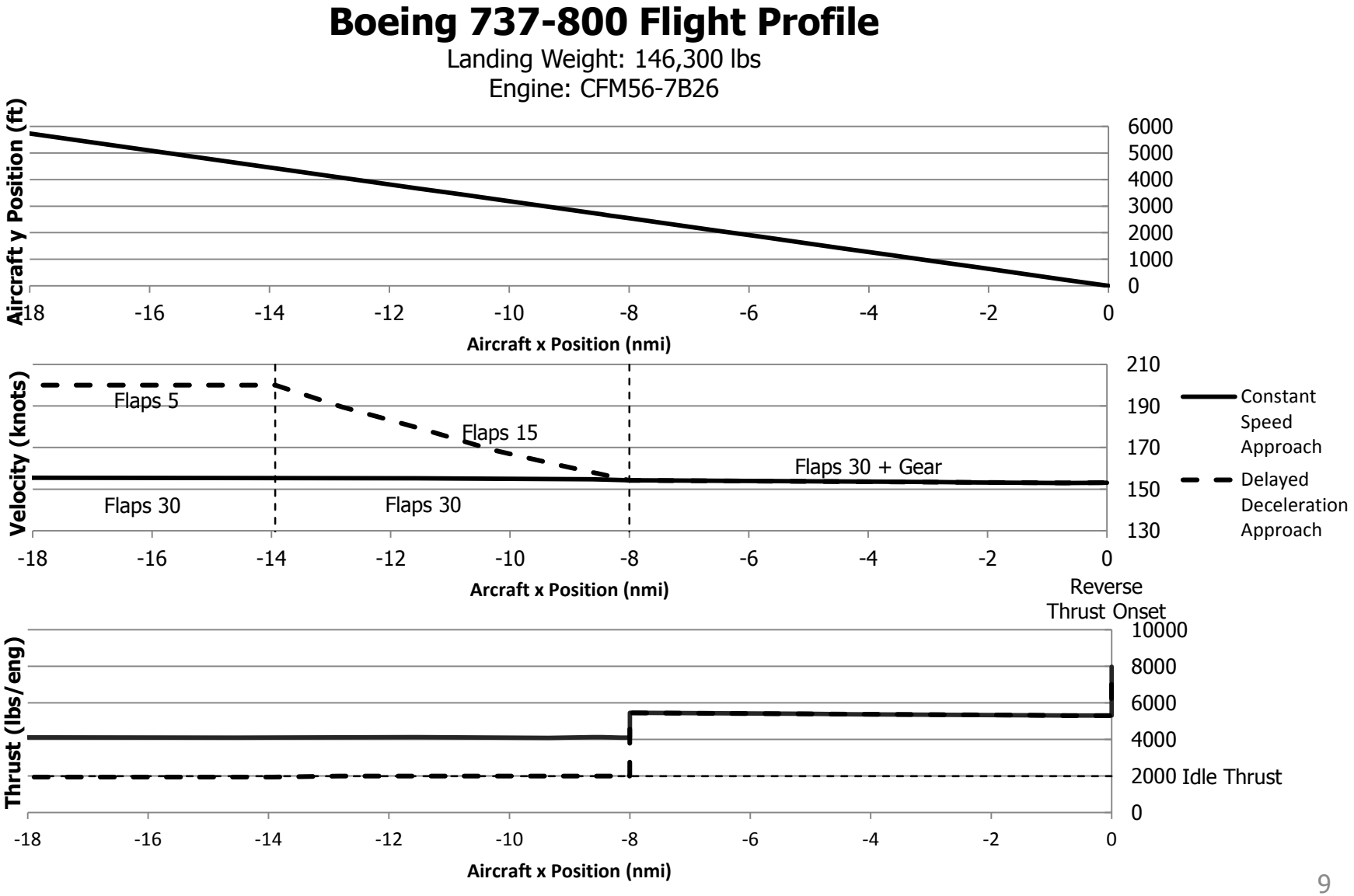
Delayed Deceleration Approach Profile: Glideslope Intercept from Level Flight



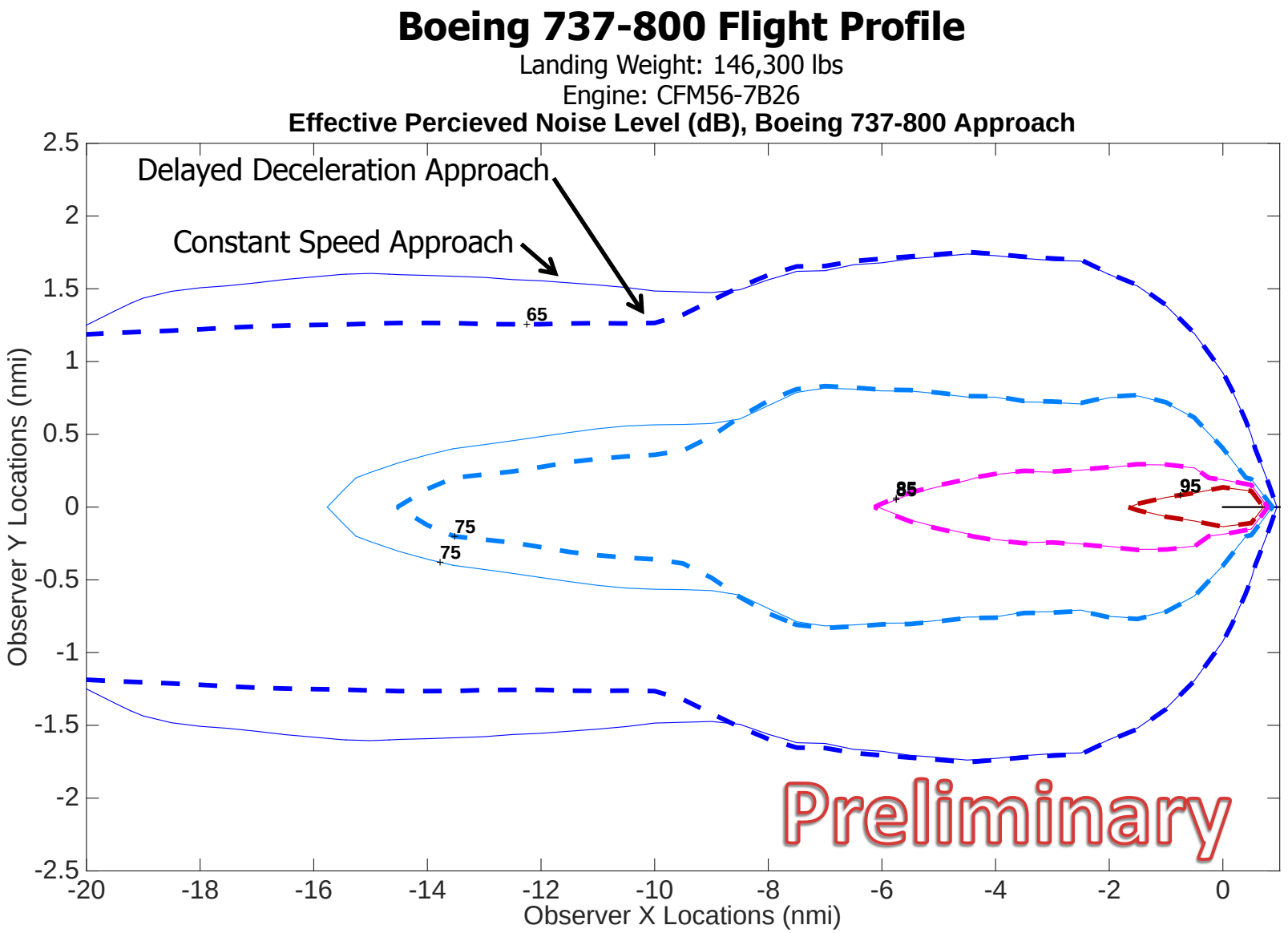
Impact of Delayed Deceleration Approach on Noise Contour Geometry



Delayed Deceleration Approach Profile: Continuous 3-degree Glideslope



Impact of Delayed Deceleration on Noise Contour



Summary

- The objective of ASCENT 23 is to expand noise analysis capabilities such that benefits from advanced operational procedures (aerodynamic noise, masking, etc.) are reflected during the environmental review process
- Next steps:
  - Continue development of flight procedure generator
    - TASOPT refinements for improved drag modeling
  - Validation of aircraft noise models against noise certification test database
  - Implement representative fleet of aircraft types in full TASOPT/ANOPP noise architecture