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# Advanced Continuous Descent Approach Activities at Nottingham East Midlands Airport, UK

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# The Silent Aircraft Initiative (SAI)

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- Research project of



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- Funded by **dti** Department for Trade and Industry
- **Goal:** Develop concept aircraft designs and procedures to reduce noise to below ambient levels at the perimeter of a typical urban airport
- 2025 timeframe



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# The Silent Aircraft Initiative (SAI)

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- Five internal SAI teams:

- Airframe
- Engine
- Integration
- **Operations**
- **UK economy**



- Over 30 researchers & over 20 partners, including:



- Academia (Cranfield, GATech)
- Government (CAA, DfT, NASA)
- Manufacturers (Boeing, Rolls Royce, ITP, Messier Dowty)
- Operators (Airports, Airlines, ATC)
- Suppliers (B&K, Met Office, Wyle Labs)



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# Operations Team Goals

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- Support development of Silent Aircraft
  - ❑ Operations-driven design requirements
- Simulation and analysis tool development
  - ❑ Flyability, Noise, Fuel burn, Emissions, Capacity
- Develop & analyze noise abatement approach procedures
  - ❑ Silent Aircraft (long term)
    - Steep, slow, displaced threshold, delayed gear deployment
  - ❑ Existing aircraft (short term)

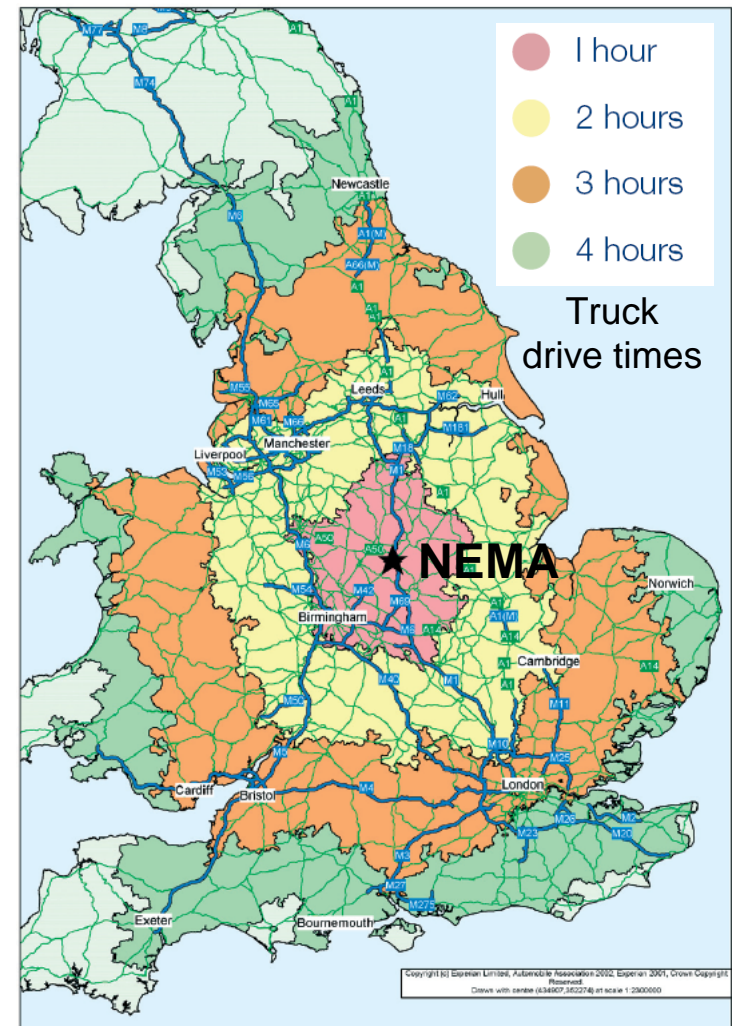
# Location for Short Term Operations Activities

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- Assessment of numerous UK airports...
  - ❑ Gatwick
  - ❑ Heathrow
  - ❑ Luton
  - ❑ Manchester
  - ❑ Nottingham East Midlands Airport (NEMA)
  - ❑ Newcastle
  - ❑ Stansted
- ...against key criteria
  - ❑ Airspace/ATC context
  - ❑ Other noise abatement activities
  - ❑ Potential benefits (local population, traffic, etc.)
  - ❑ Potential problems
  - ❑ Political context
  - ❑ Regulator advice
- Collaboration with NEMA resulted

# NEMA Facts & Figures

- 11<sup>th</sup> biggest regional airport in UK
- Passenger flights to over 100 destinations in 2006
  - ❑ Catchment of 10.6 million people within a 90 min drive
- Largest “pure freight” airport in UK
  - ❑ UK center for Royal Mail, DHL, UPS
  - ❑ 89% mainland England & Wales within 4 hrs trucking time
- First UK airport to achieve ISO14001 accreditation (international environment management standard)



Source: NEMA Draft Master Plan, Feb. 2006



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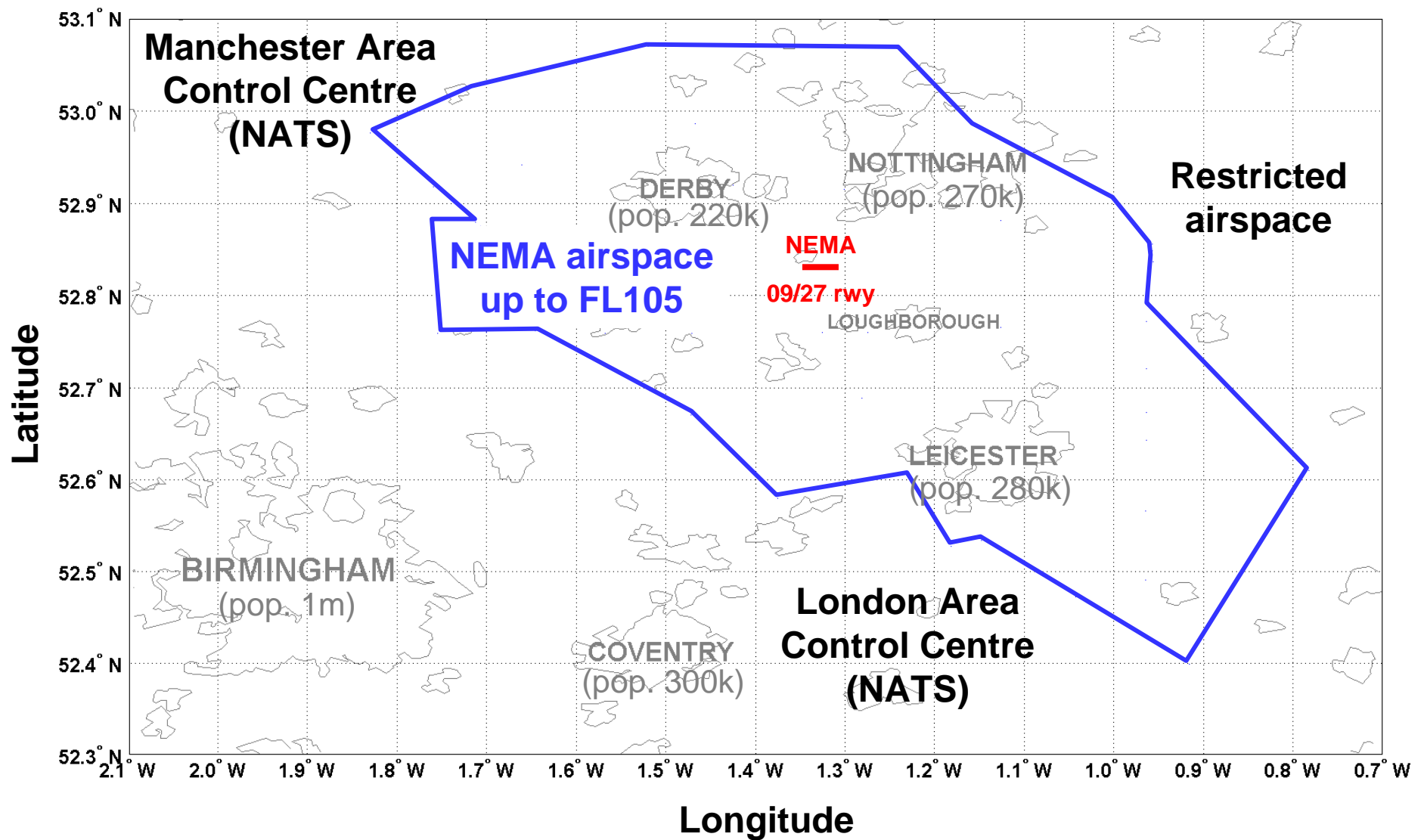
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# NEMA ATC Context



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# NEMA Procedure Development/Trial Objectives

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## Develop approach procedures for reduced noise and fuel burn across range of aircraft types combining:

- Continuous Descent Approach (CDA)
  - Keep aircraft higher and lower thrust for longer
- Precision Area Navigation (P-RNAV)
  - Flight Management System control
- Low Power/Low Drag (LP/LD)
  - Clean aerodynamic configuration

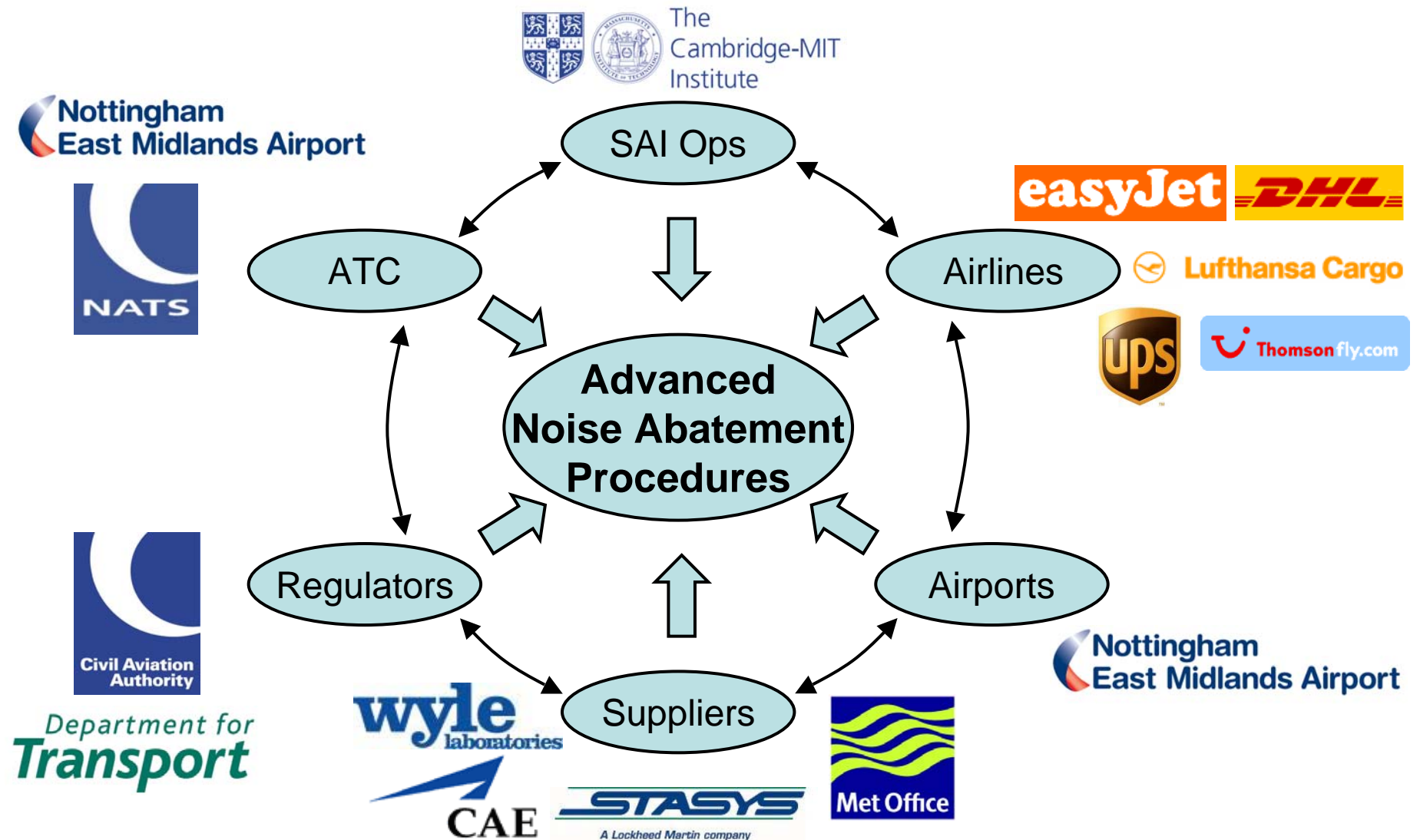
**“Flight  
Idle  
CDAs”**

## Flight trial procedures to examine:

- Achievement of LP/LD P-RNAV CDAs
- Environmental impacts (Noise, Fuel burn & Emissions)
- Operational impacts (Controller, Pilot, Aircraft)



# Strong Collaboration



# Multiple Aircraft Types & Technologies

B757-200F, Honeywell Legacy FMS



MD11F, Honeywell Pegasus FMS

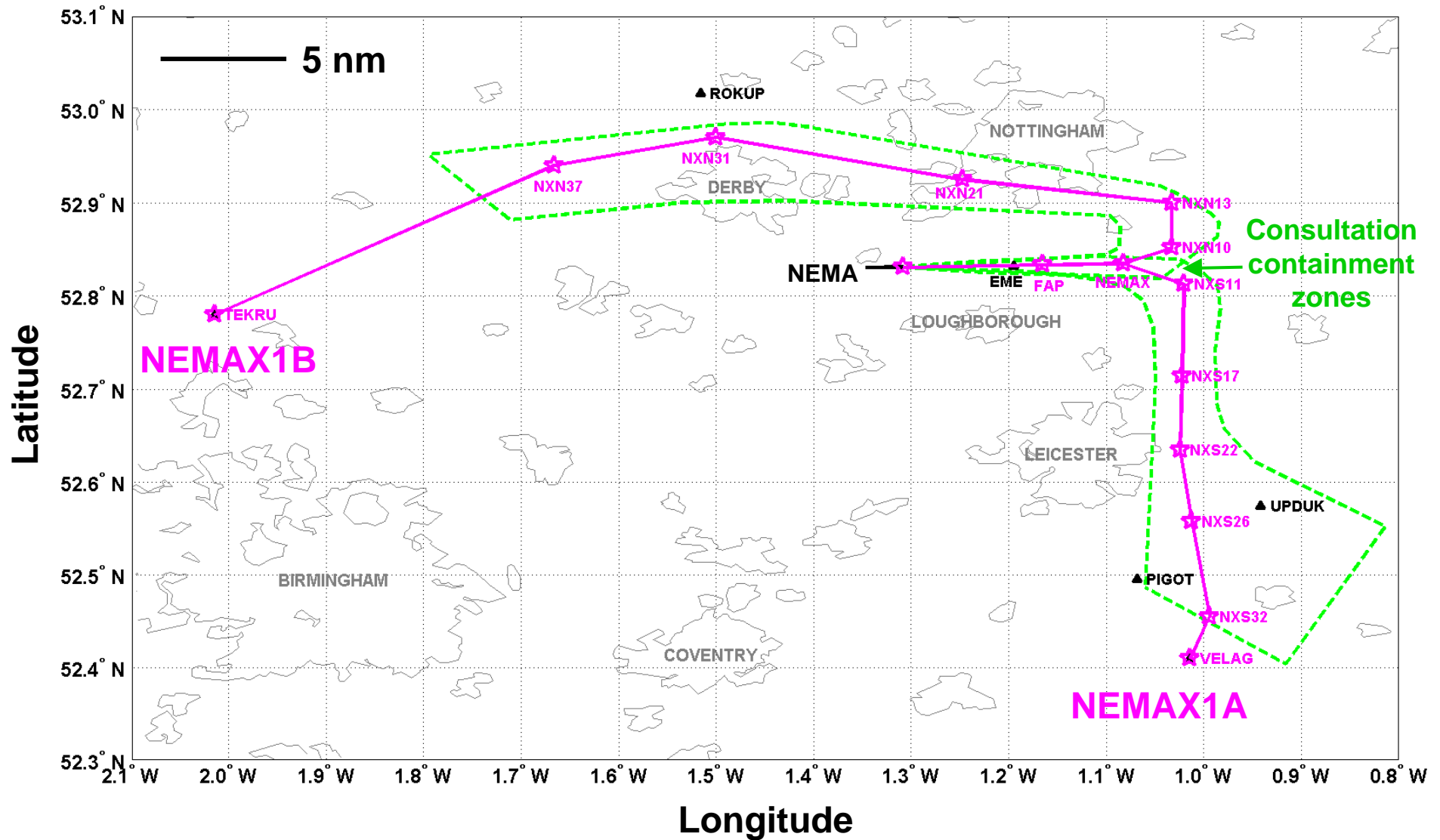


B767-300F, Honeywell Pegasus FMS

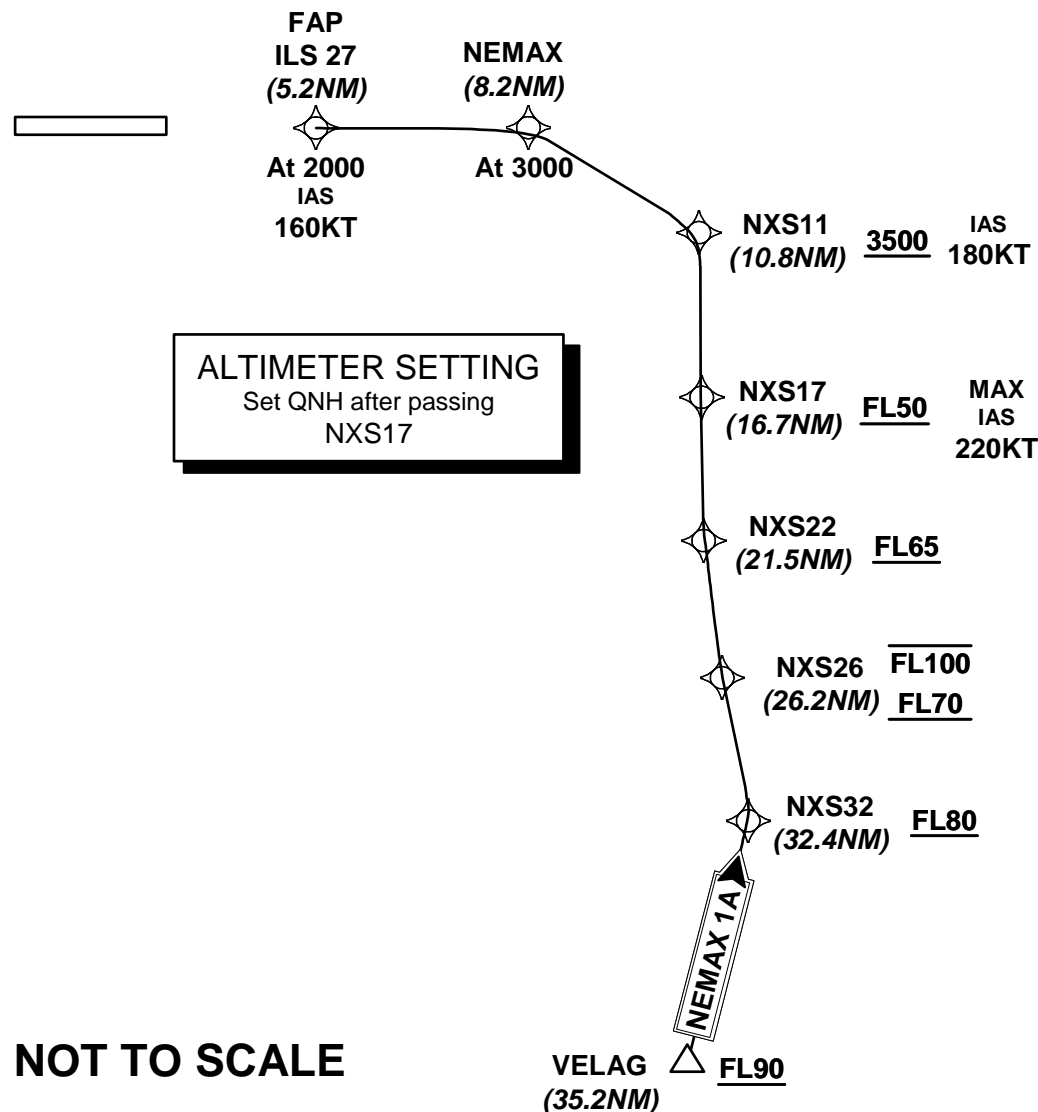


A319, Thales/Honeywell Pegasus FMS

# “NEMAX” Trial Procedures

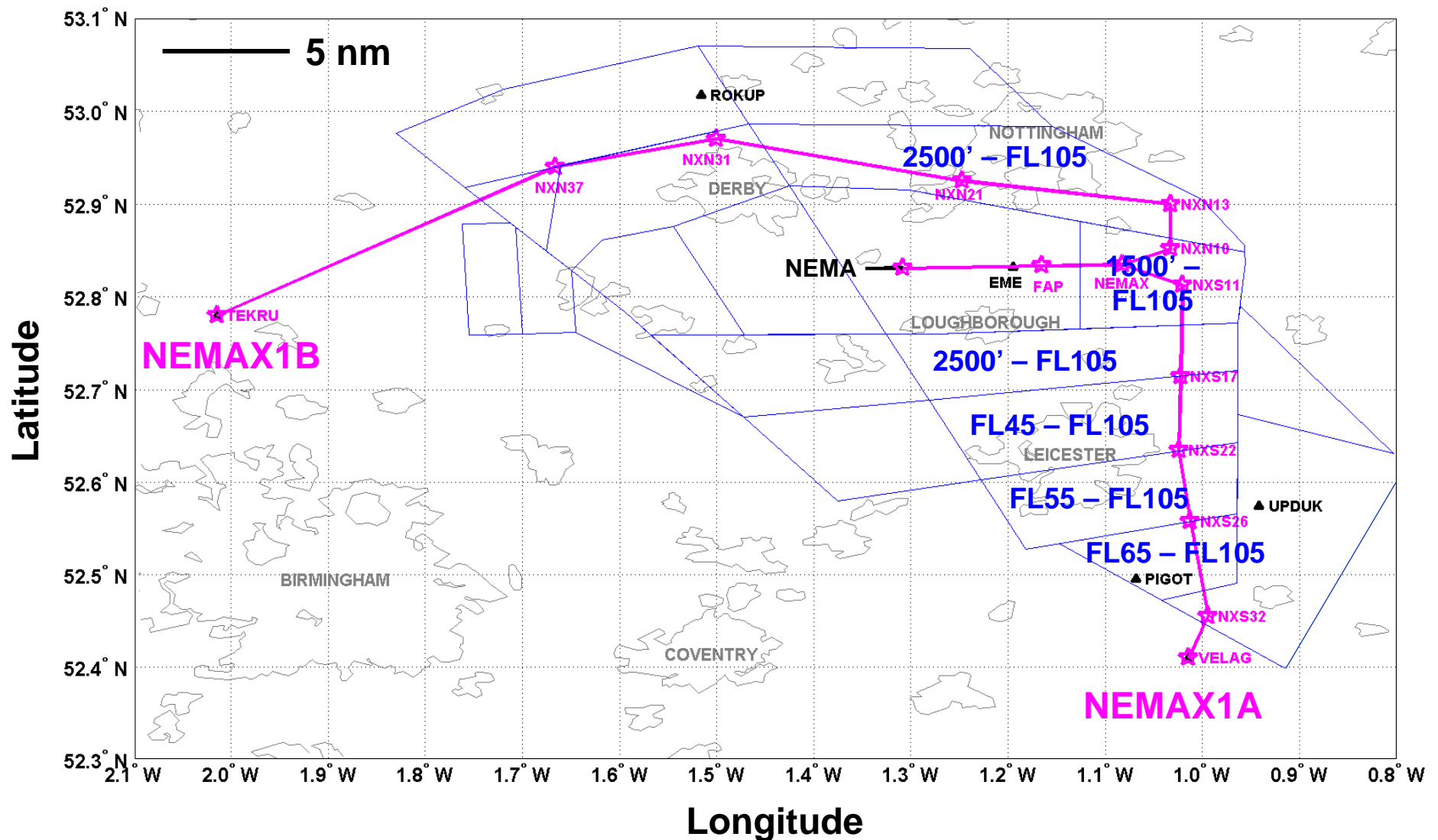


# NEMAX1A Detail

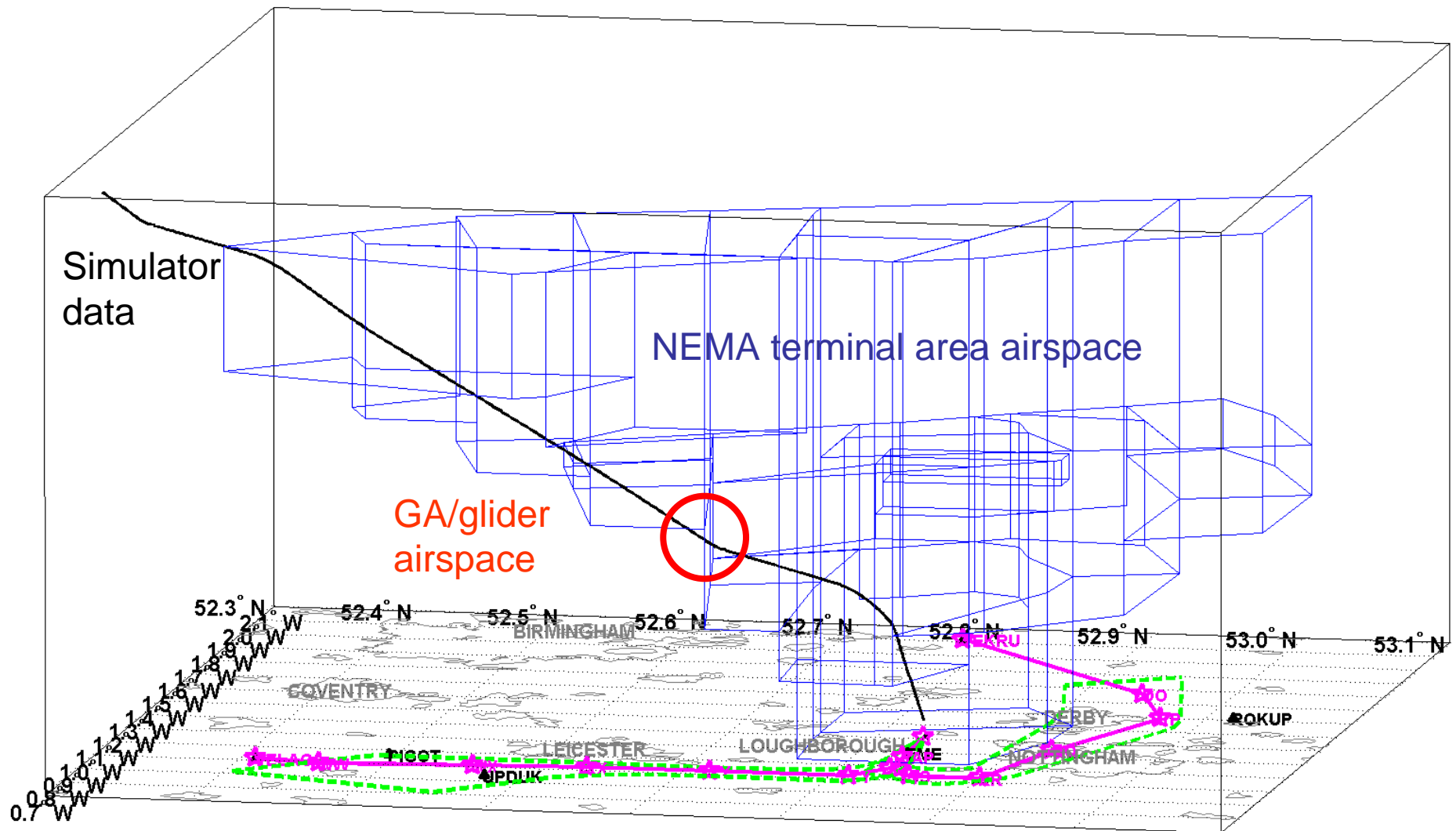


- Lateral profile for consultation zone compliance and low population exposure
- Vertical constraints for airspace compliance & assist CDA vertical profile
- Speed constraints to assist low power/low drag

# Vertical Profile: Controlled Airspace Interactions



# Vertical Profiles: Airspace Challenges



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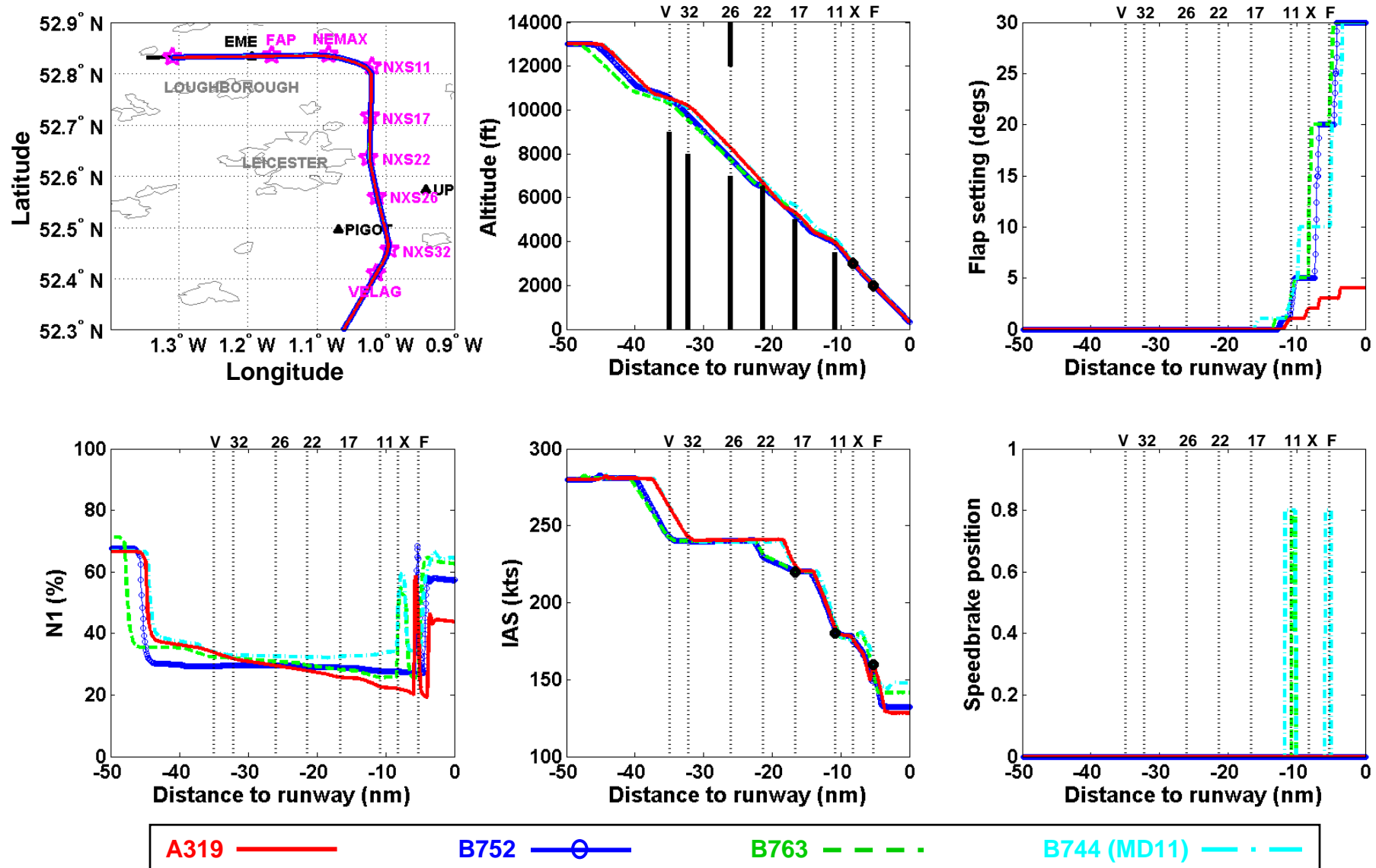
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# MIT Sim Results – NEMAX1A – Zero Wind



# Airline Simulator Studies







- A320 (easyJet) & 767 (UPS)
- Flew both procedures under variety of wind and pressure environments

- Performed well with largely idle thrust and no speedbrakes
- Minor tweaks resulted



# NEMAX Flight Trials

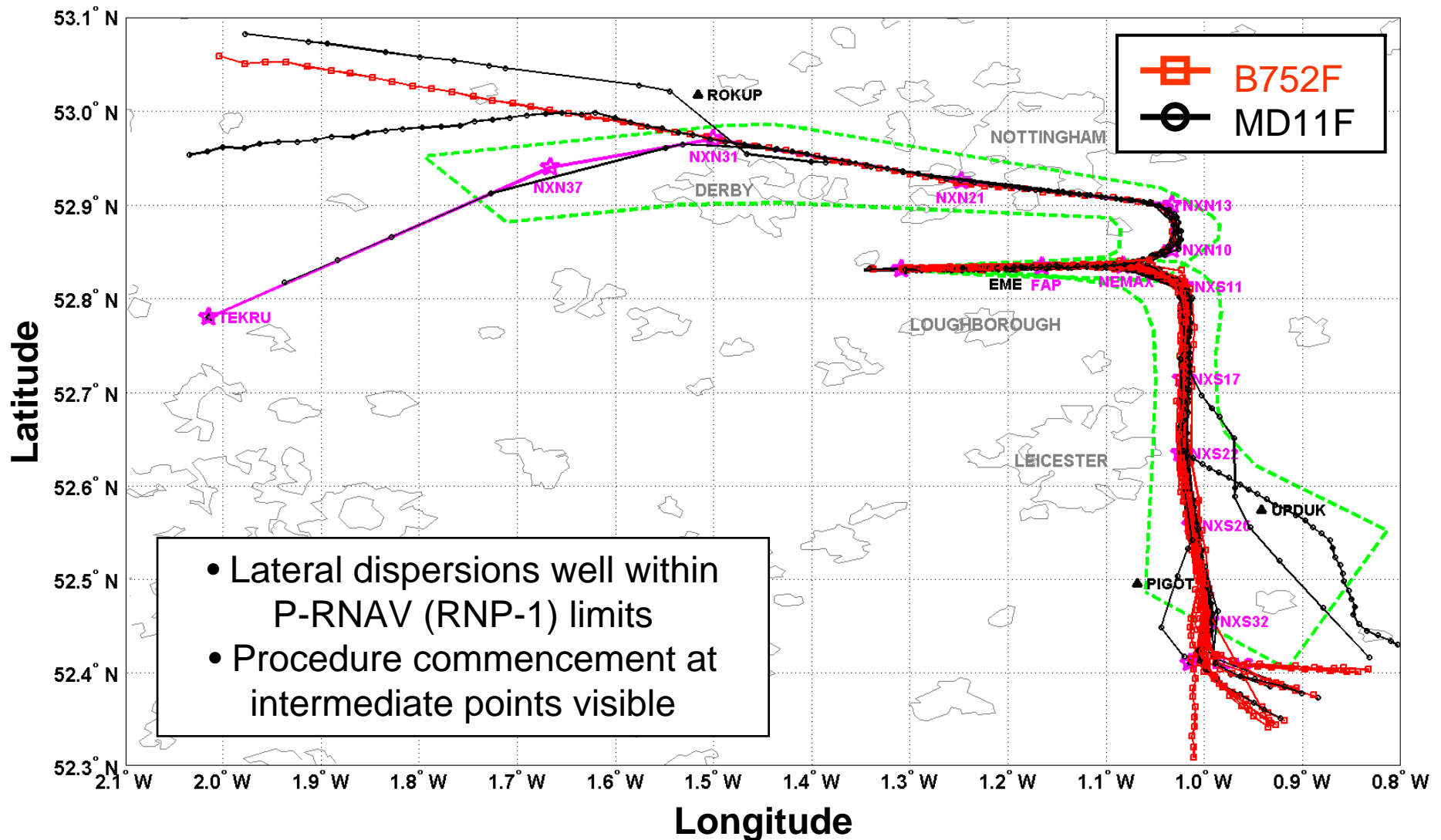
- Procedures published as AIP supplement March 2006
- Trials started May 2006, expected to continue for 6 mths
- Participation to 31 Aug: 67 flights

Operator	Type	NEMAX1A	NEMAX1B
 DHL	B757-200F	37	2
 Lufthansa Cargo	MD11F	19	7
 UPS	B767-300F	3	0
 easyJet	A319	0*	0*

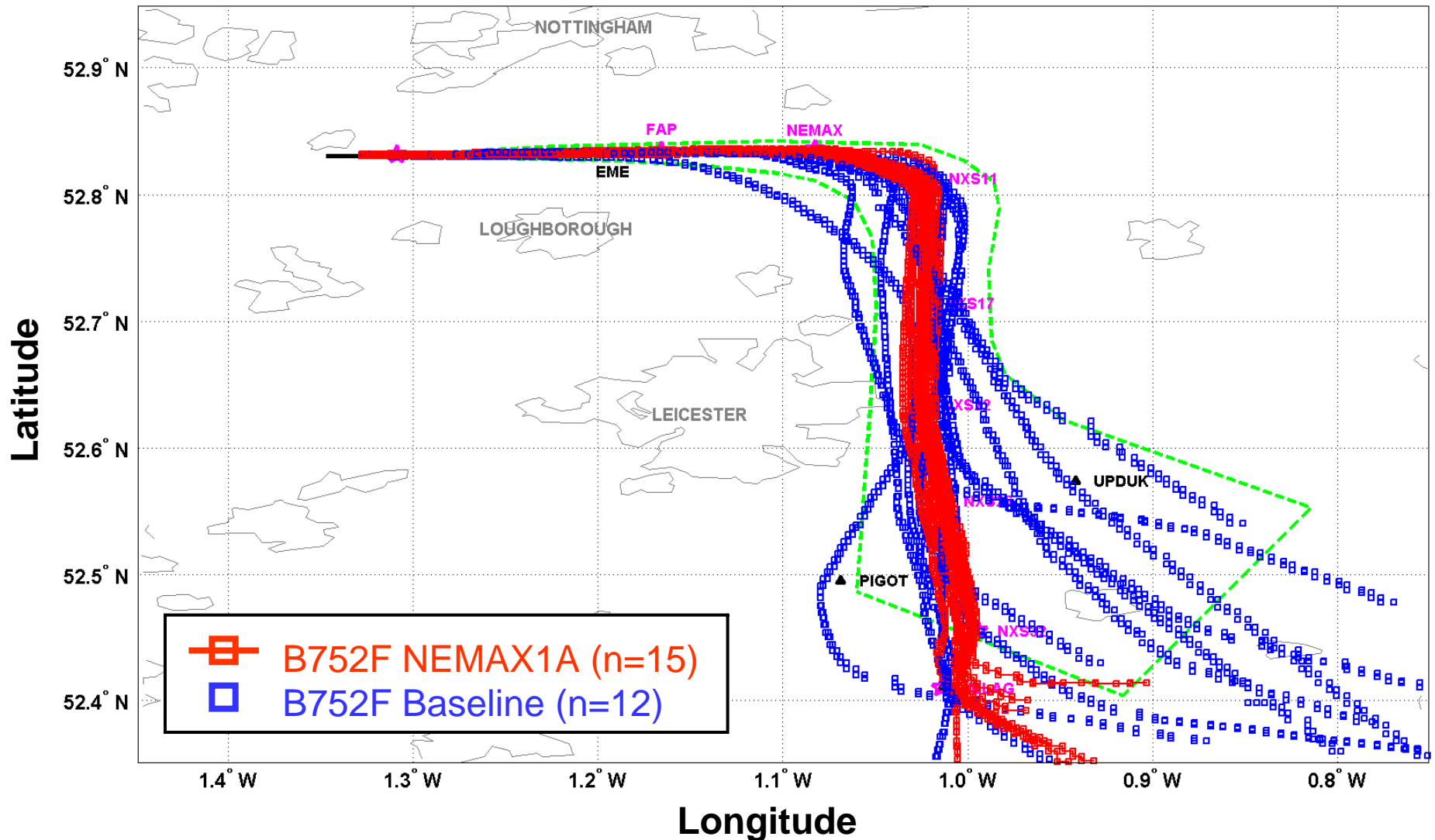
\*Awaiting P-RNAV approval

- Data collection:
  - ❑ Radar data (lat/long/alt)
  - ❑ FDR data (20 states inc. N1 & FF)
  - ❑ Pilot/controller report forms
  - ❑ Noise monitors (3 sites)

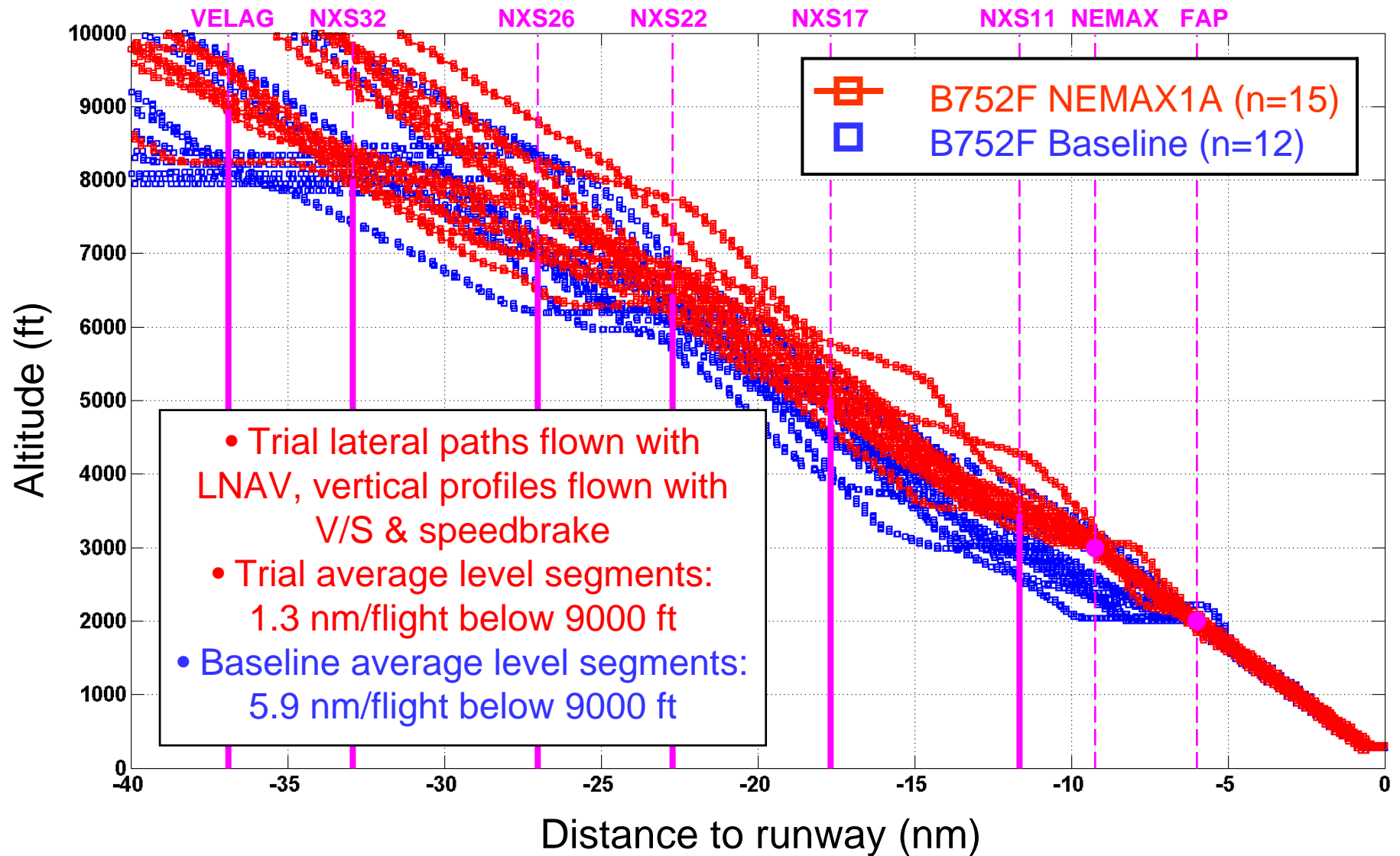
# Flight Trial Ground Tracks



# B752F NEMAX1A/Baseline Ground Tracks

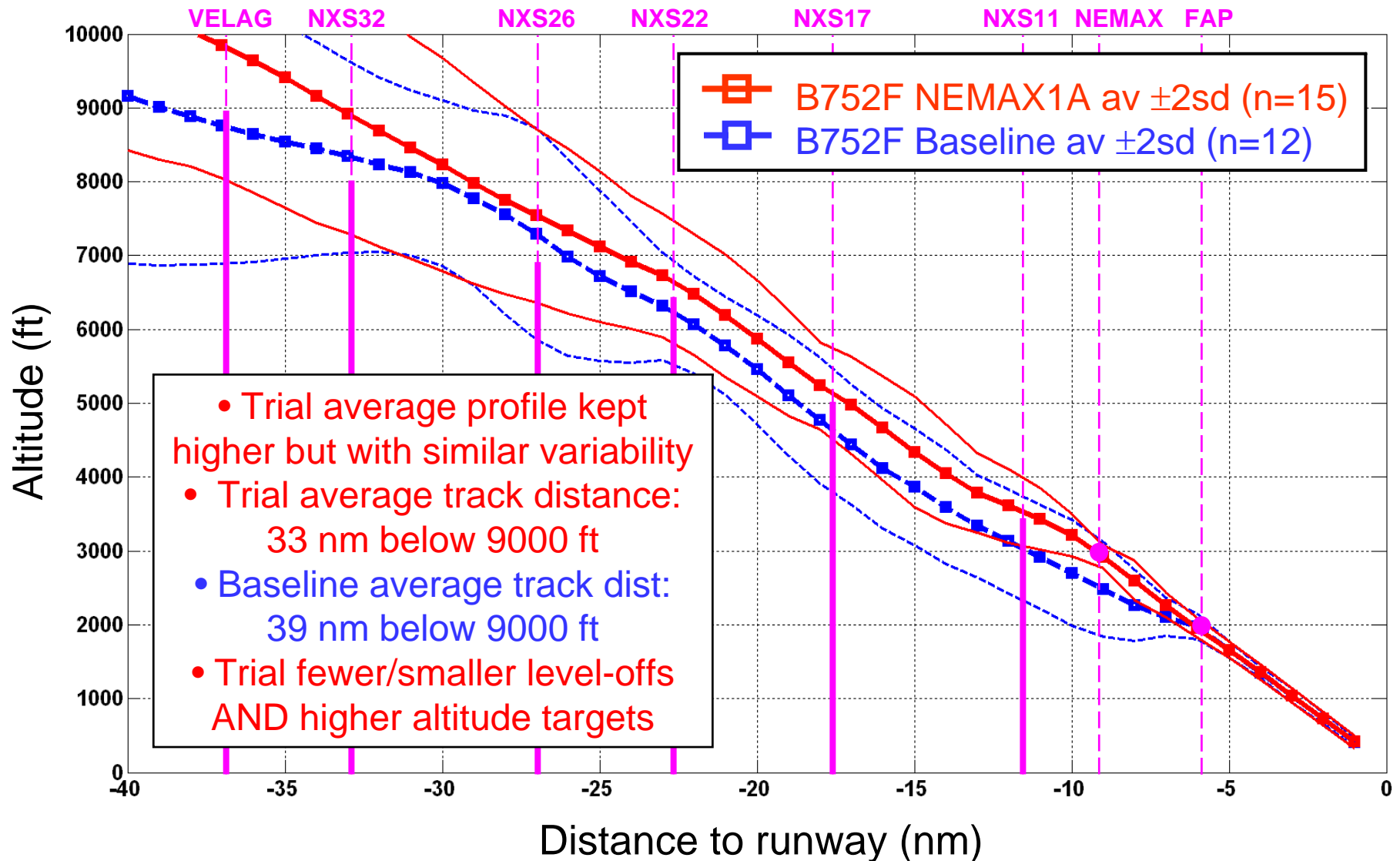


# B752F Actual Vertical Profiles

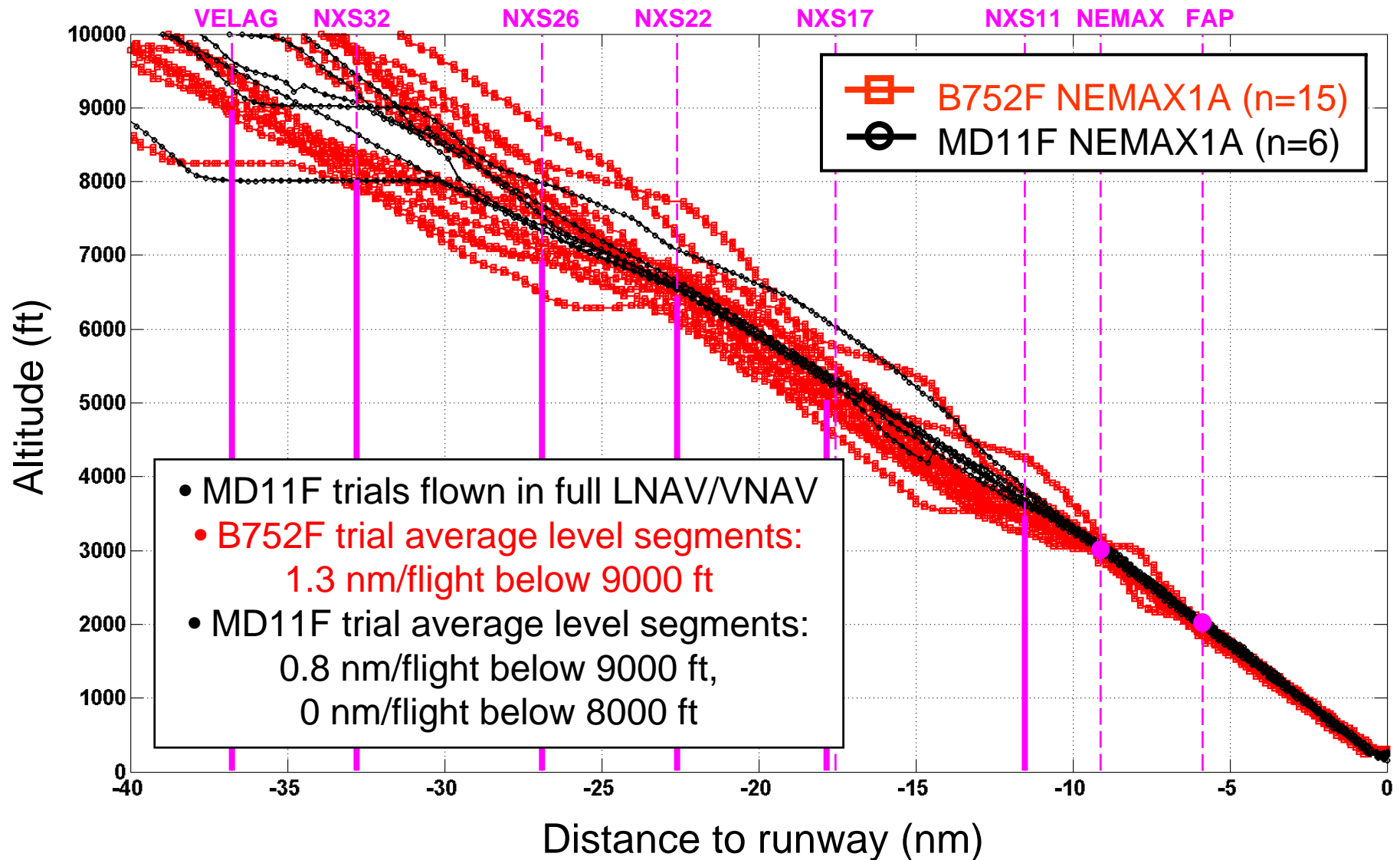




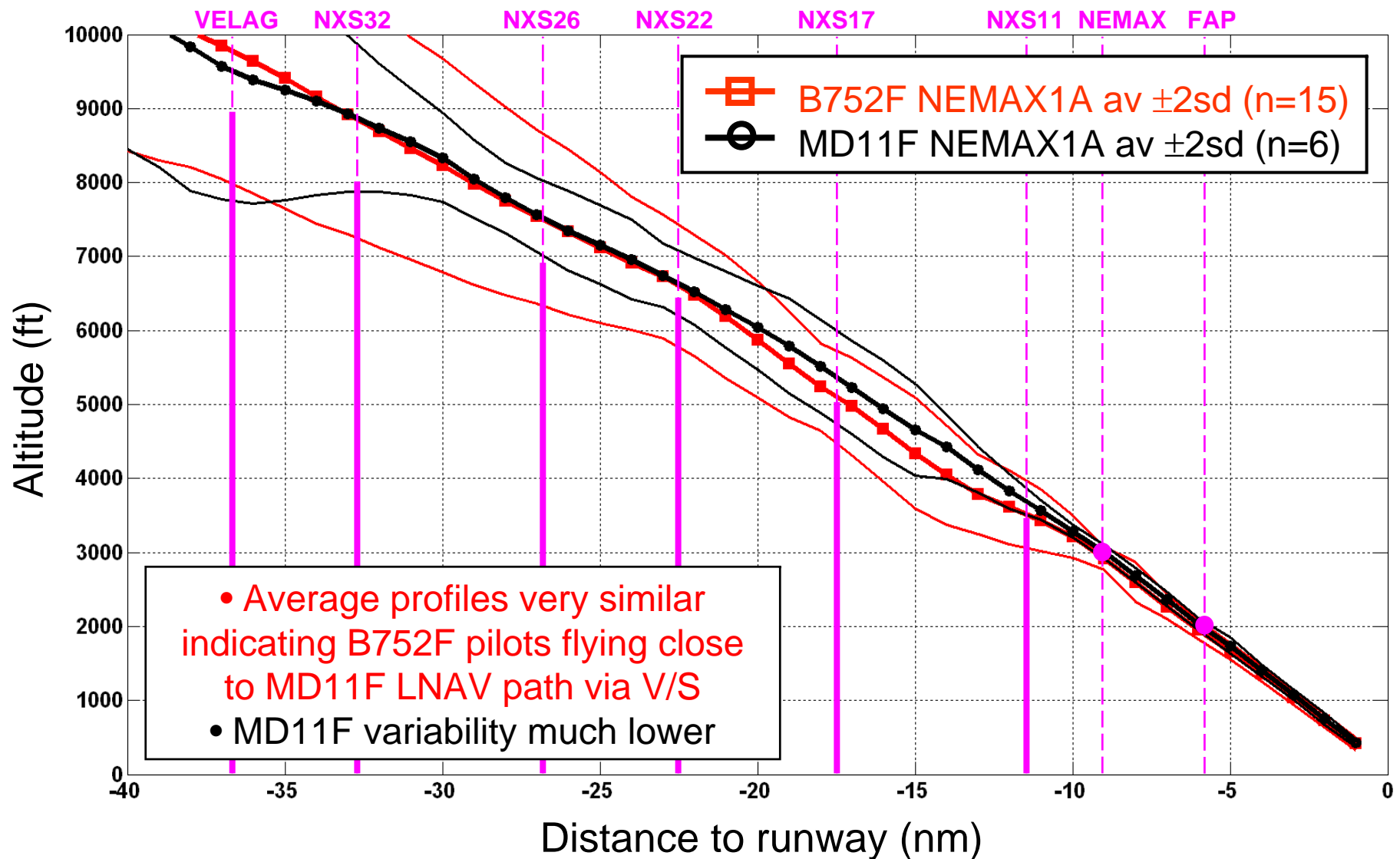
# B752F Average Vertical Profiles



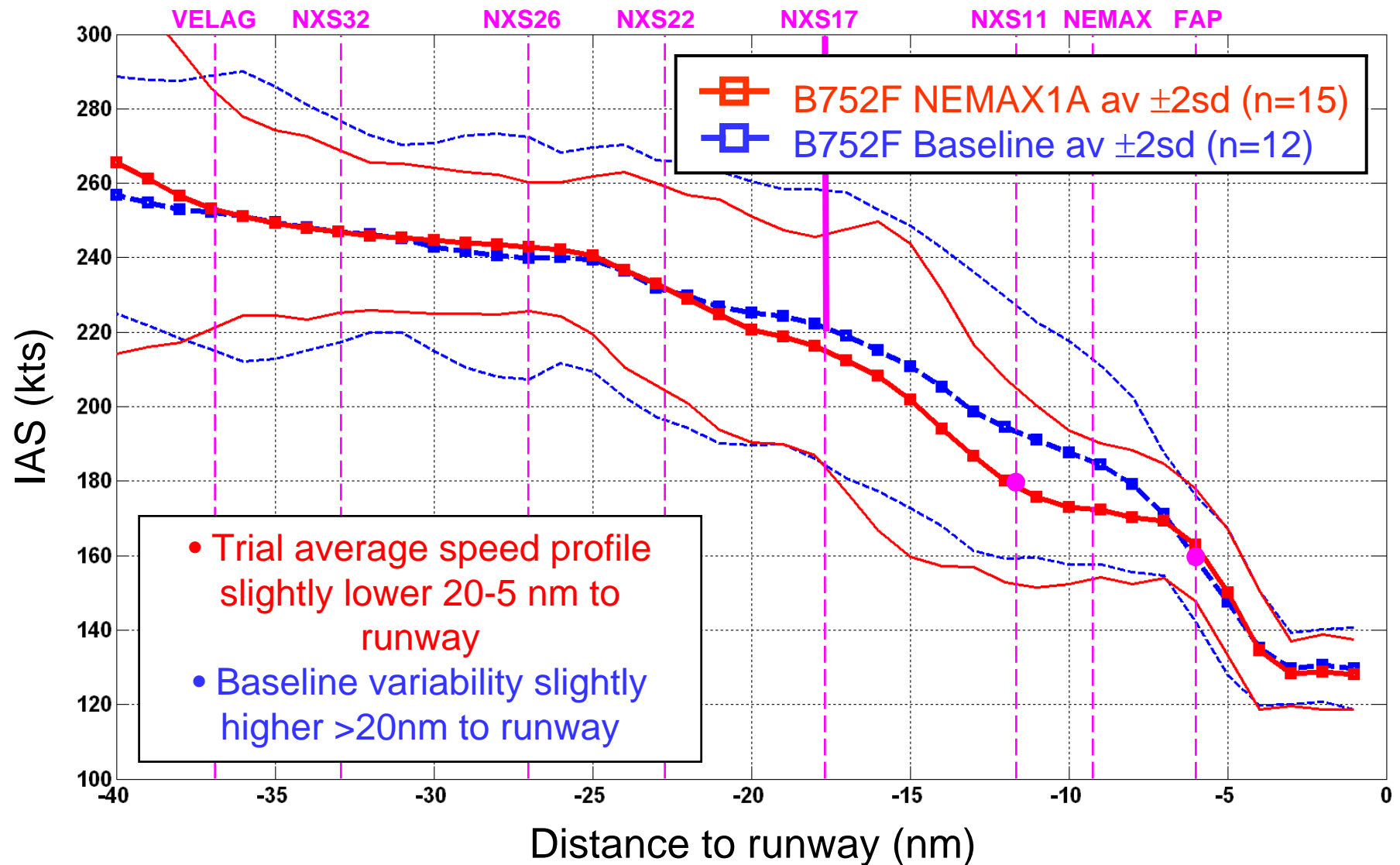
# B752F/MD11F Actual Vertical Profiles



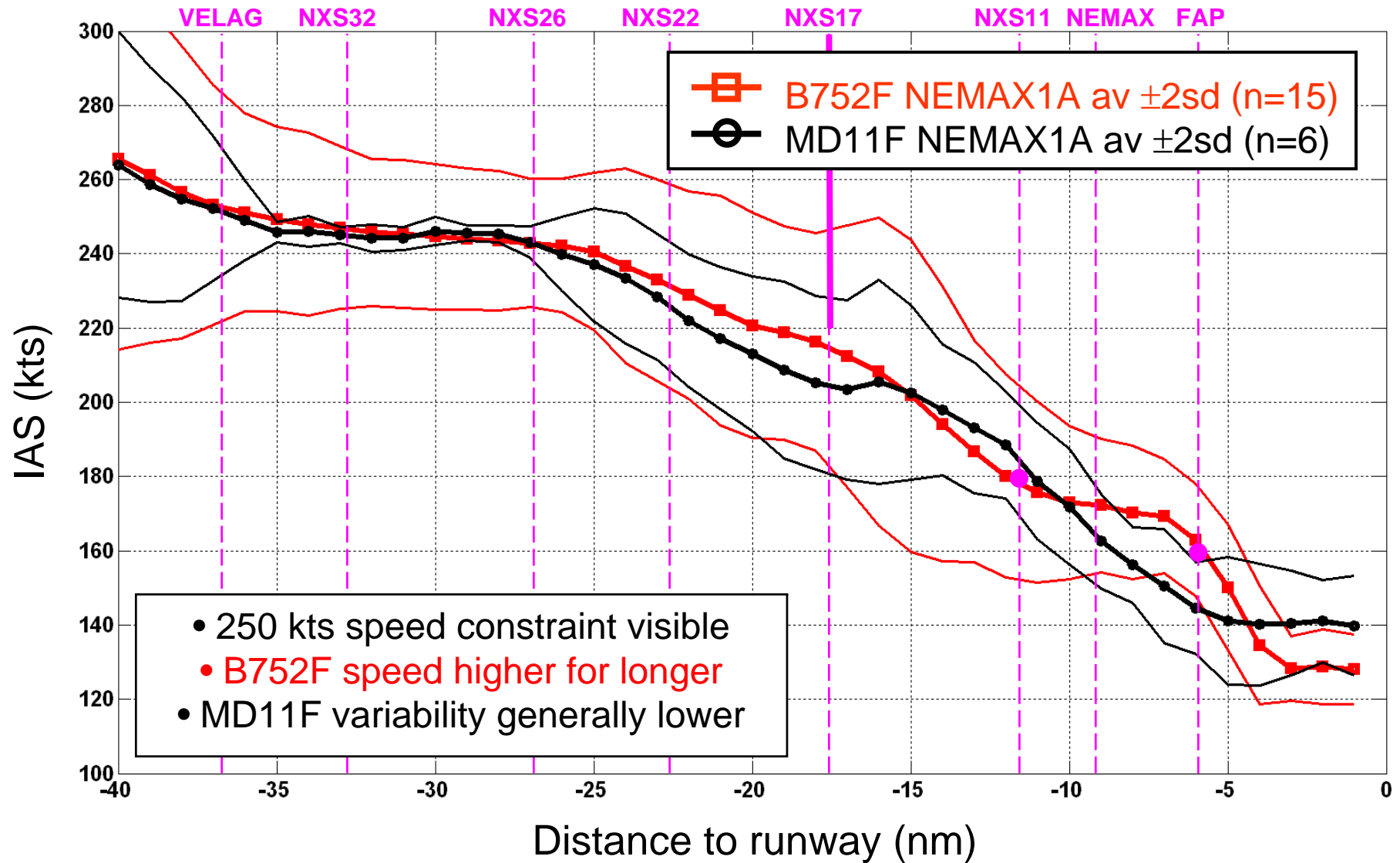
# B752F/MD11F Average Vertical Profiles



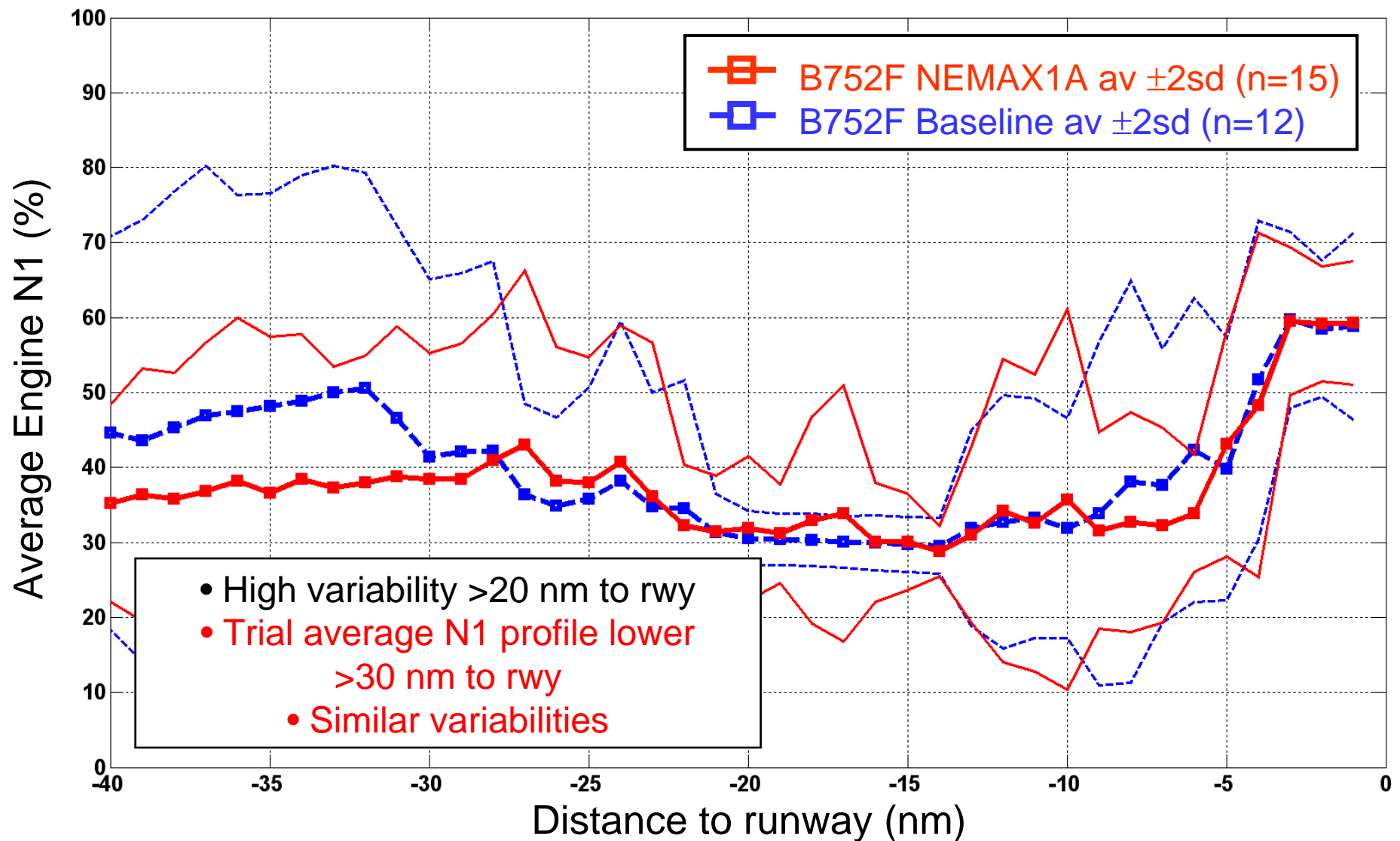
# B752F Average Speed Profiles



# B752F/MD11 Average Speed Profiles

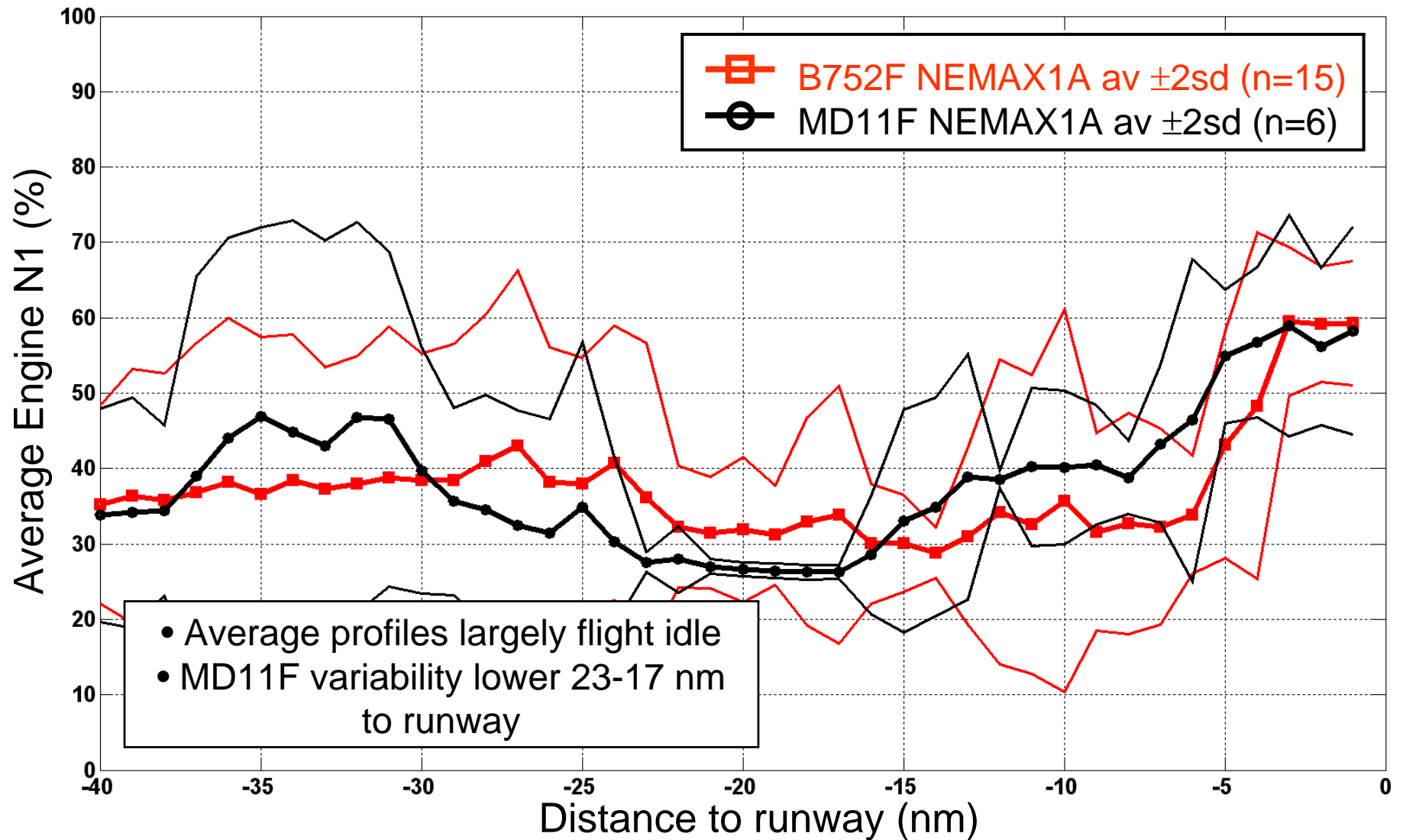


# B752F Average N1 Profiles

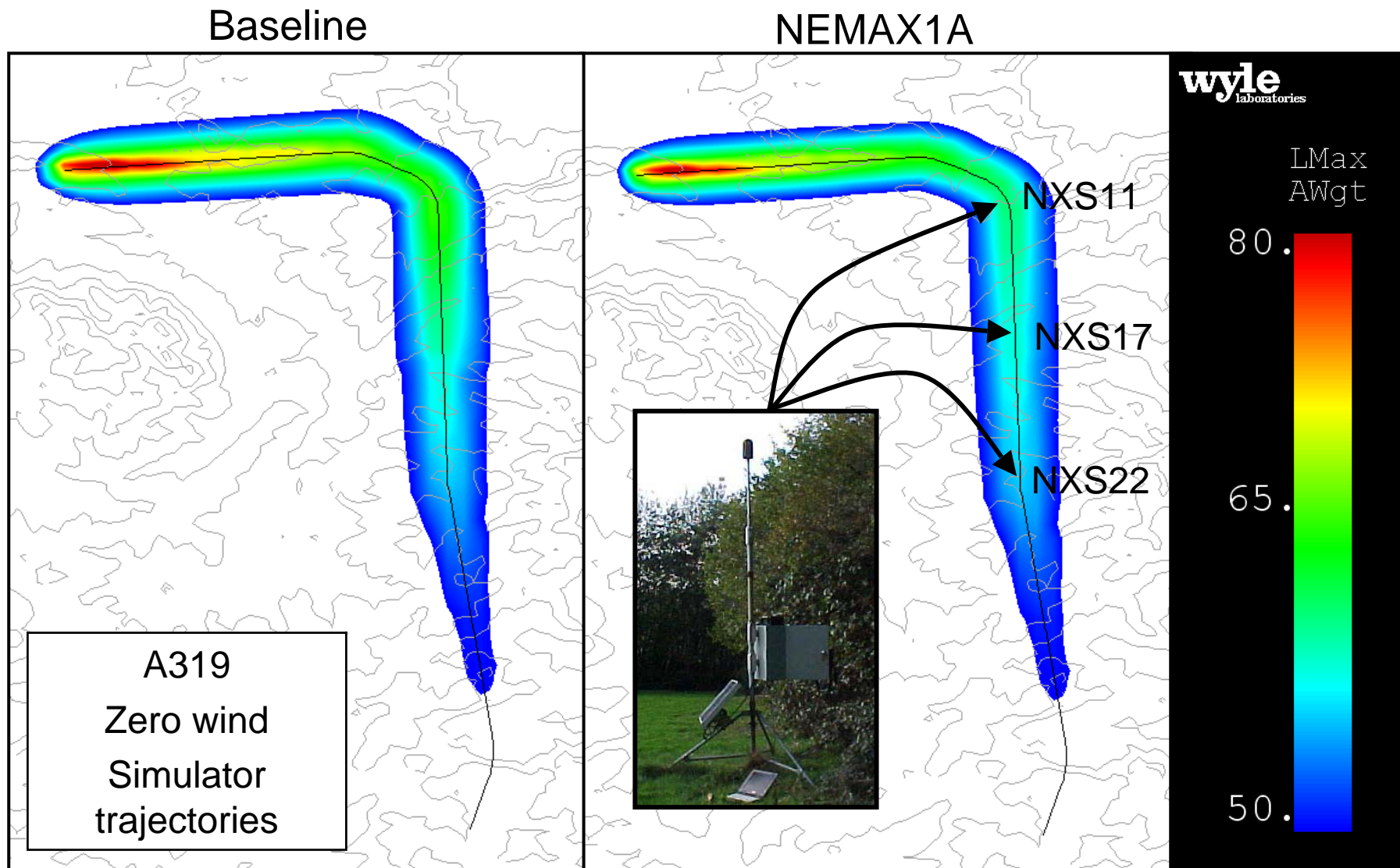




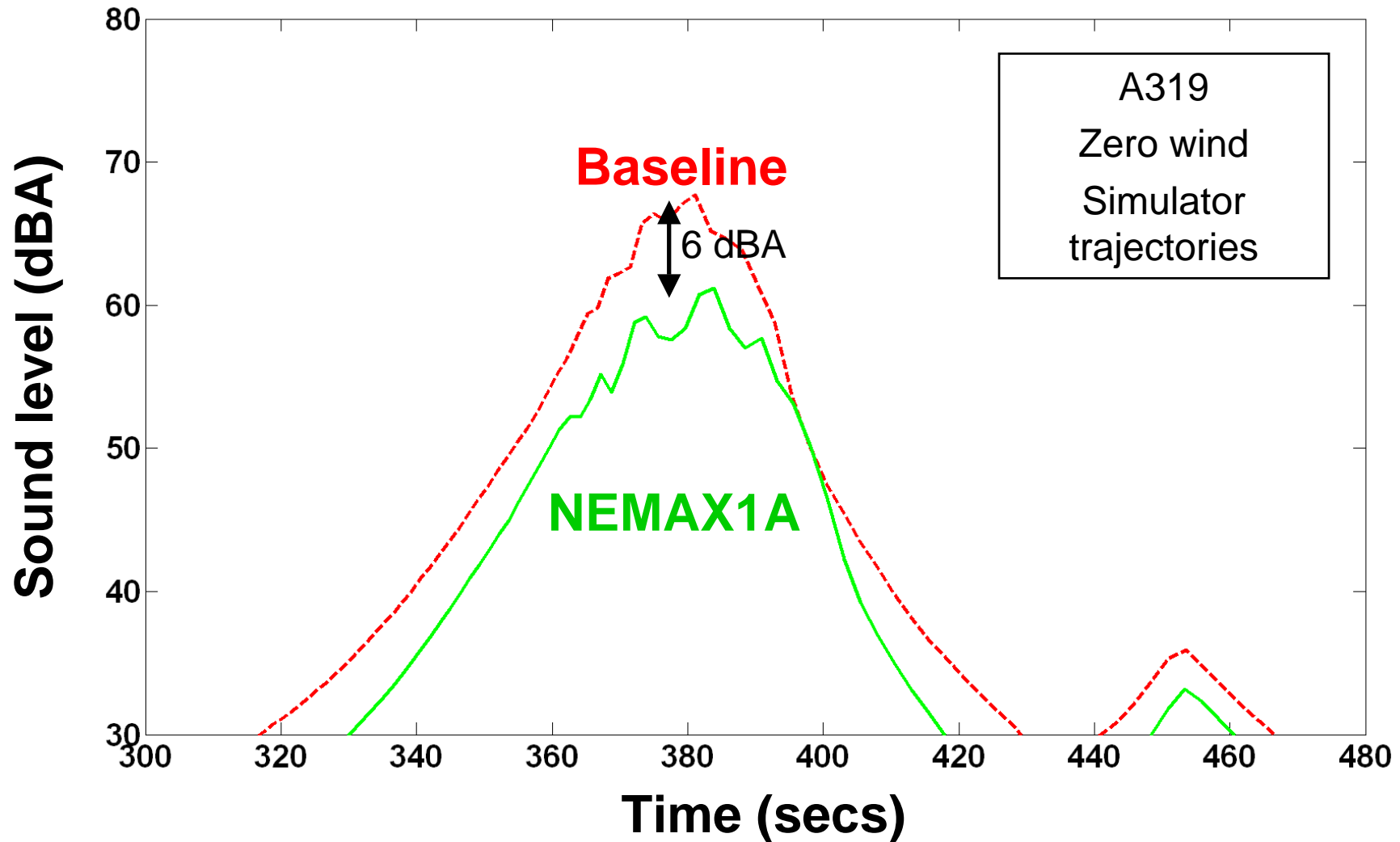
# B752F/MD11 Average N1 Profiles



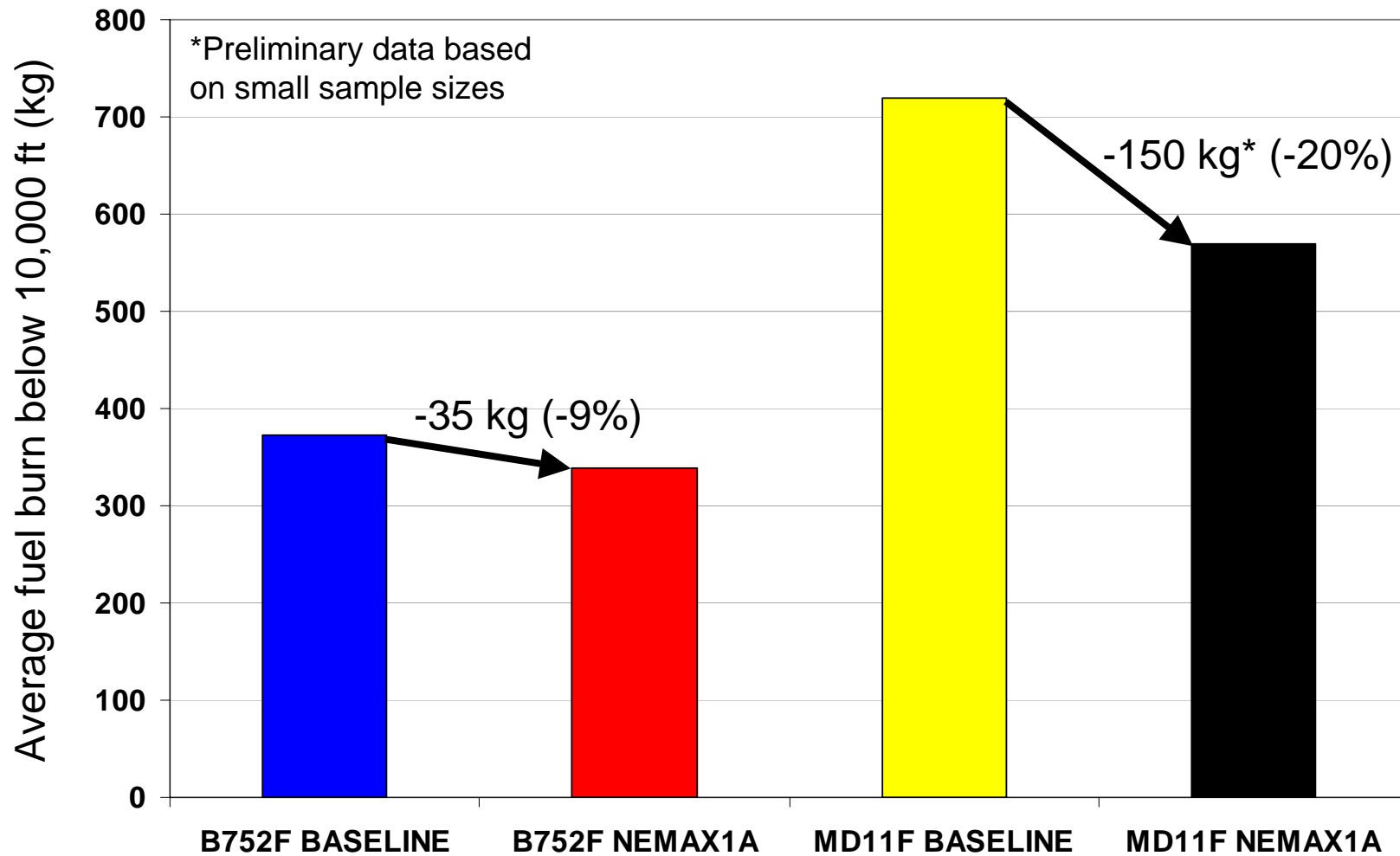
# NEMAX1A Noise Monitoring



# Preliminary NMSim Analysis @ NXS11



# NEMAX1A Fuel Burn



# Preliminary Conclusions

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- NEMA P-RNAV noise abatement approach procedures successfully developed & introduced
- Lateral path concentration as expected
- Vertical path keeps aircraft higher & reduces level flight
  - ❑ Performance dependent on aircraft type/equipage
- Overall impacts on noise, fuel burn & emissions ongoing but initial results look promising
  - ❑ Lateral concentration reduces no. of people exposed to noise
  - ❑ Higher altitudes should reduce noise impacts on ground
  - ❑ LP/LD and flight idle metrics need more data & analysis
- Capacity: up to 30% of traffic could use trial approach

# Need for Definition of Advanced CDA

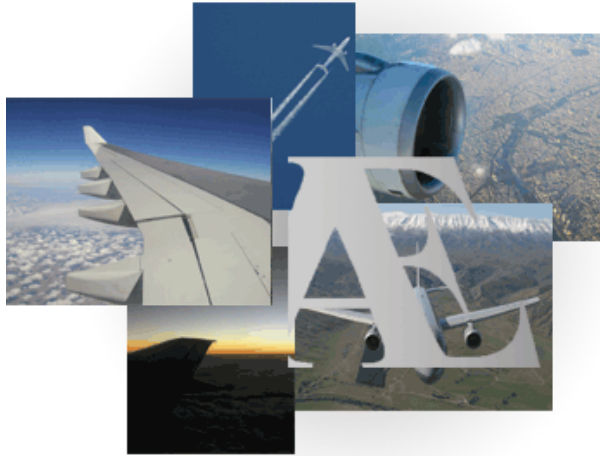
- Current UK industry standard criteria for CDA compliance:
  - ❑ “An arrival is classified as a CDA if it contains, at or below **6000 ft**, no level flight OR one phase of level flight not longer than **2.5 nm**”
  - ❑ Level flight = any flight segment with an altitude change of not more than 50 ft over 2 nm as measured in the NTK system
- Propose need for modified definition for advanced CDAs:
  - ❑ “An arrival is an **advanced CDA** if it contains, at or below **9000 ft**, no level flight OR one phase of level flight not longer than **1 nm**”

	Average level segments below 9000 ft	Current CDA definition compliance	Proposed new CDA definition compliance
B752F base	5.9 nm/flight	67%	8%
B752F trial	1.3 nm/flight	93%	60%
MD11F trial	0.8 nm/flight	100%	83%



# Institute for Aviation and the Environment (IAE)

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CAMBRIDGE

- New inter-disciplinary institute at University of Cambridge
  - Involving 7 depts/centres
- “Fosters a close alliance between academia, industry and government to facilitate the transfer of knowledge by aligning world-leading research with end-user needs”

- **Aviation Integrated Modelling (AIM)**
  - Integrate economics, technology and atmospheric science (on both local and global scales) into a single model system
- **Opportunities for Meeting Env'tl Challenges of Growth in Aviation (OMEGA)**
  - Combine academic capability with knowledge exchange between academia, industry & policymakers to develop future strategies for sustainable aviation