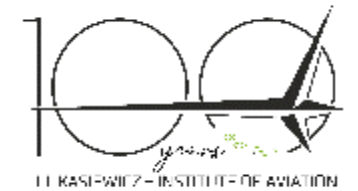


# IFAR INTRODUCTION

## ICAS IFAR LECTURE: Quiet aviation research for sustainable tomorrow

Dr. Eng. Cezary Szczepański  
Director General  
Łukasiewicz Research Network – Institute of Aviation

IFAR Chairman





**IFAR**

**INTERNATIONAL FORUM  
FOR AVIATION RESEARCH**

**Global research.  
Shared challenges.**



# One global network

**40,000**  
**researchers**

Public aeronautical R&D  
institutions, connected  
across continents.

Voluntary · non-binding · action-oriented



# IFAR turns exchange into collaboration

## 01 Leaders connect

Principals meet at IFAR Summits to align priorities and exchange strategic perspectives.

## 02 Experts cooperate

Technical working groups create bilateral and multilateral research opportunities.

## 03 Talent grows

The Early Career Network gives young researchers an international platform and peer network.

## 04 Partners scale impact

Long-term collaboration with ICAS and ICAO carries ideas into the wider aviation community.



# With ICAS, collaboration becomes visible

## 2014 Partnership begins

A shared platform for the aeronautical science community.

## 2024 Florence

Seven IFAR presentations and papers, a joint lecture and the IFAR–ICAS MoU.

## 2026 Sydney

Invited sessions on quieter aviation, AI applications and other emerging topics.



7

papers & presentations

1

joint lecture

MoU

signed in Florence

exchange → shared stage → joint action



One shared  
challenge:

QUIETER  
AVIATION

This brings us to today's IFAR General Lecture.

How can research collaboration help aviation become quieter — for passengers, airports and communities?



# IFAR GENERAL LECTURE

## QUIETER AVIATION RESEARCH FOR A SUSTAINABLE TOMORROW

Dr. Emilia Villani

Aeronautics Institute of Technology

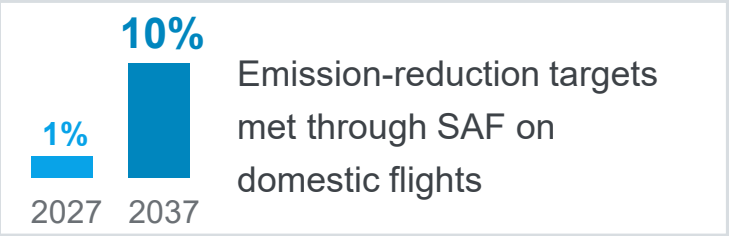


# BRAZIL'S NATIONAL POLICY FOR CO<sub>2</sub> REDUCTION IN CIVIL AVIATION

## PILLAR 01

### Technological

Sustainable Aviation Fuel +  
Aircraft Technology

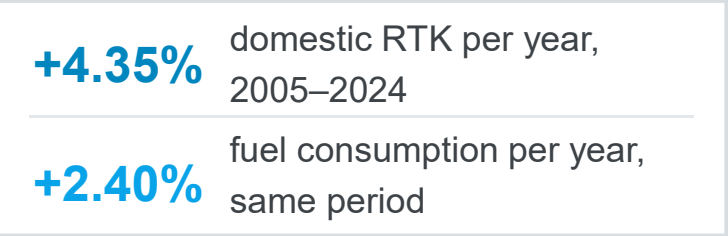


- ✓ **Supply build-out:** announced biorefineries add 1,100 thousand m<sup>3</sup>/year; ANP-approved routes span HEFA, ethanol and alternative feedstocks
- ✓ **Embraer initiatives:** aircraft efficiency, SAF compatibility, hybrid-electric propulsion, eVTOLs

## PILLAR 02

### Operational

Efficiency improvements in  
airspace, airlines & airport ops

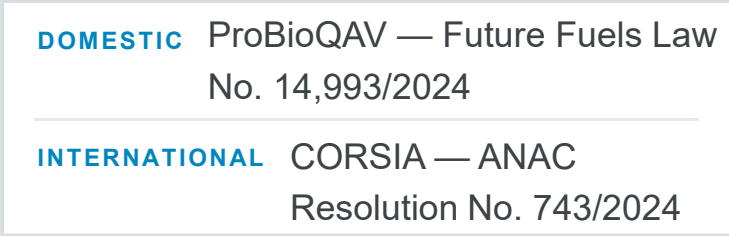


- ✓ DECEA's **SIRIUS Program** for airspace modernization
- ✓ **Sustainable Airports Program** ranks operators
- ✓ **SustentAr Program** recognizes airline initiatives

## PILLAR 03

### Policy

Binding law on domestic &  
international markets



- ✓ Annual **SAF decarbonization targets** for domestic aviation
- ✓ **Brazilian Sustainable Taxonomy** to direct green investments
- ✓ Full incorporation of **ICAO's CORSIA** provisions
- ✓ Ministry of Ports and Airports **ESG policy**



# BRAZIL'S REGULATORY PATHWAY FOR AAM/UAM



## Aircraft & Infrastructure

### Certification track

- ✓ Nov/2024: Final airworthiness criteria for Eve's eVTOL
- ✓ May/2025: Powered-Lift Level 2 safety objectives consultation
- ✓ Jul/2026: Eve's eVTOL **noise certification criteria** in public consultation

### Vertiport sandbox

- ✓ Campo de Marte & São José dos Campos, 2 years
- ✓ Scope: physical infrastructure, firefighting, airspace access and **noise requirements**



## Airspace (SISCEAB)

### UAM ConOps (PCA 351-7/2024)

- ✓ Reduced segregation
- ✓ Performance-based navigation
- ✓ Digital flight rules
- ✓ Increased automation
- ✓ **Noise** as a system design criteria



## National Policy

### National AAM Policy

- ✓ Mar/2026: Public consultation
- ✓ 7 thematic axes including environment and society: **noise tolerance and equitable access** addressed as policy



# SILENT AIRCRAFT PROGRAM

Launched by Embraer in 2006 with FAPESP and FINEP to study how airframe and engine noise is generated and propagated in commercial jets and how to suppress it at the source

- ✓ **Noise sources mapped:** wings, flaps, landing gear, fuselage flow, and jet & fan sources
- ✓ **Three methods integrated:** computational aeroacoustics, semi-empirical models, and wind-tunnel plus flight test
- ✓ **Patented noise attenuators** plus a national aeroacoustics competence base that did not exist before
- ✓ **Global recognition:** the quietest single-aisle jet in service; researchers nominated for the European Inventor Award 2024



**-65%**

E2 noise footprint

**-25%**

CO<sub>2</sub> emissions/pax

**200+**

researchers, 4 countries

# FLIGHT MOBILITY AND INNOVATION CENTER



[www.flymov.com.br](http://www.flymov.com.br)



## Main Research Lines

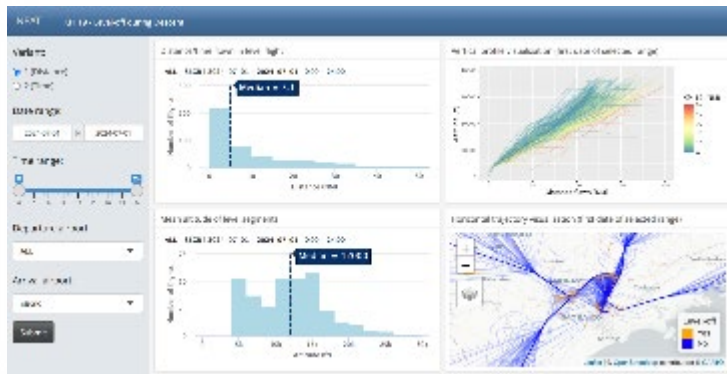
- ✓ Aero-Propulsive Integration for Electric Aircraft
- ✓ Machine Control for Electric Propulsion
- ✓ Decision Methods for Autonomous Systems
- ✓ Advanced Design for Metallic Additive Manufacturing
- ✓ Intelligent Aircraft Final Assembly

# OTHER PROJECTS: SIRIUS PROGRAM / SISCEAB

## Enhancing Enviromental Performance of Air Traffic

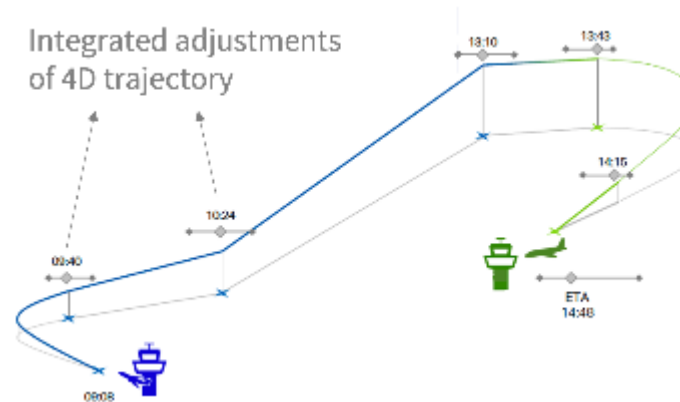
### 01 Operational efficiency

- ✓ Improved flight trajectory efficiency assessments: ICAO/GANP performance framework; advanced data analytics
- ✓ Cutting fuel burn, noise and emissions through PBN expansion and optimised trajectories (CCO / CDO)



### 02 2040 — trajectory-based

- ✓ 4D trajectory-based operations (TBO) with SWIM / FF-ICE data sharing
- ✓ Integrated Air Traffic Flow Management supported by automated tools

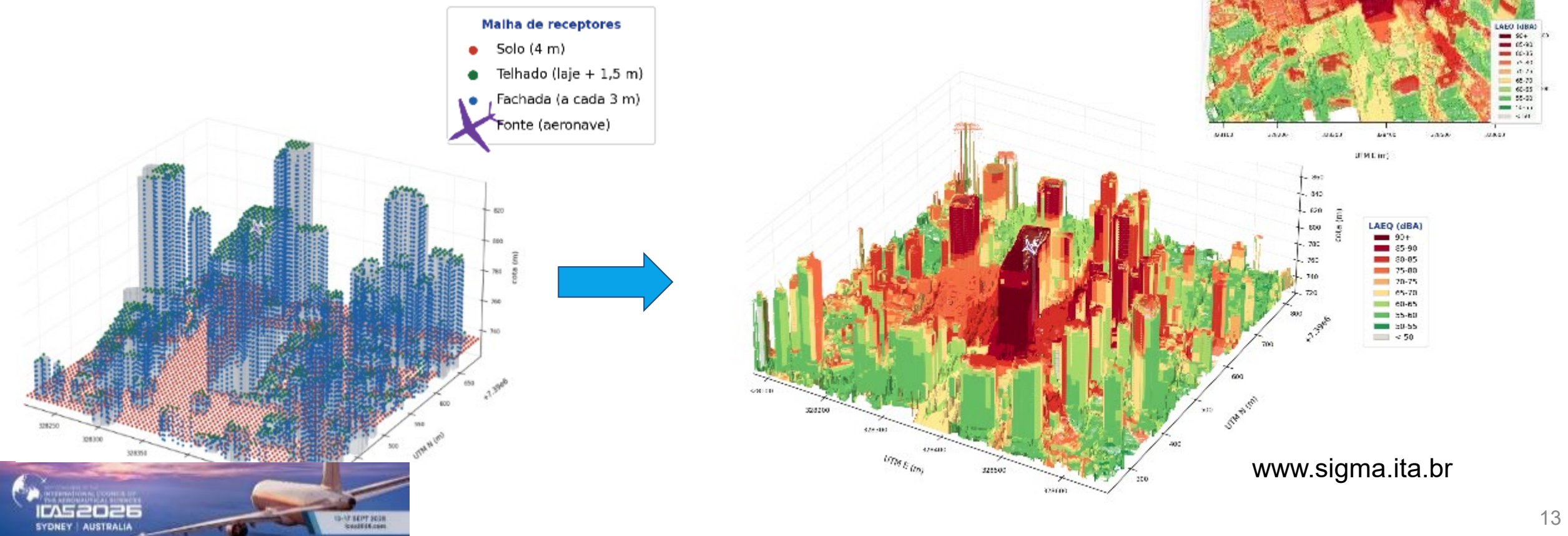


DECEA 2040 — CONOPS ATM Brasil

# OTHER PROJECTS: SIGMA-CITY

## UAM Noise Modeling — Sao Paulo Case Study

- ✓ Assessment of different aircraft and flight phases
- ✓ Identification of noise exposure areas surrounding potential vertiport sites
- ✓ Supporting sustainable integration of Urban Air Mobility into cities



DLR Aviation Strategy

# - **The Significance of Acoustic Research in Context of Climate Compatible Aviation** -

ICAS IFAR LECTURE: Quiet aviation research for sustainable tomorrow



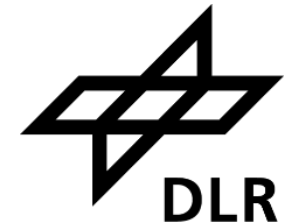
Dr. Markus Fischer

Divisional Board Member Aeronautics, German Aerospace Center (DLR)

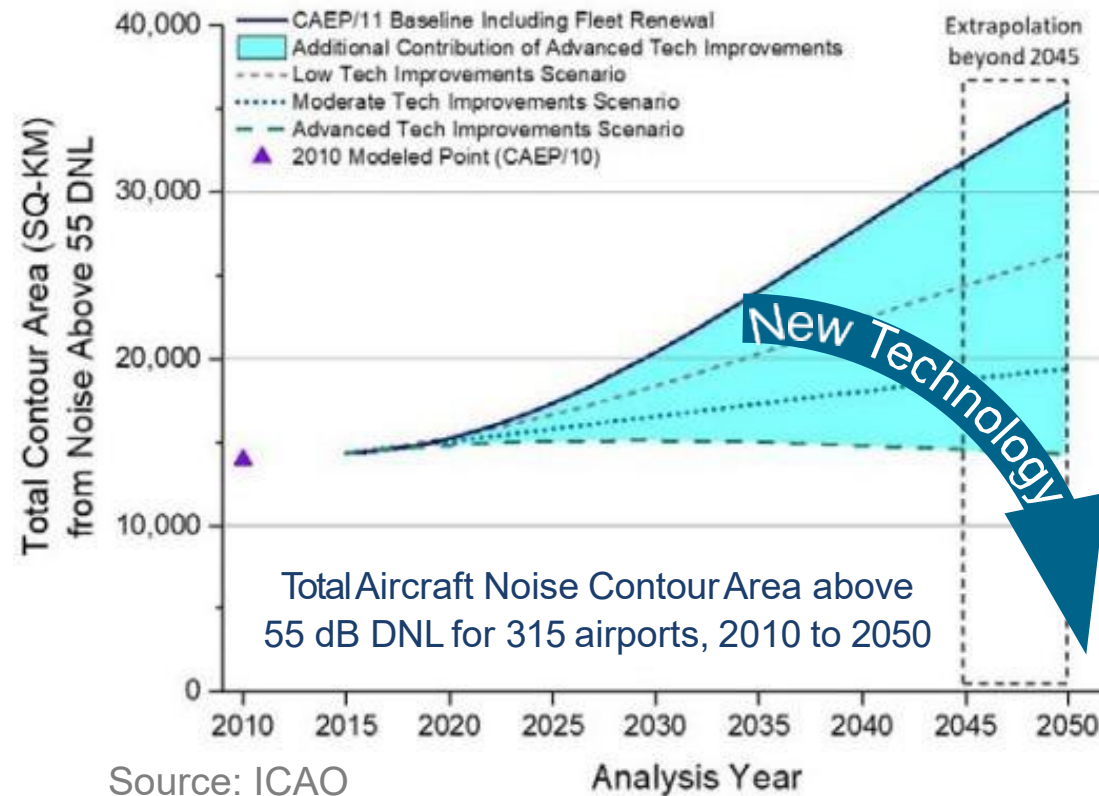
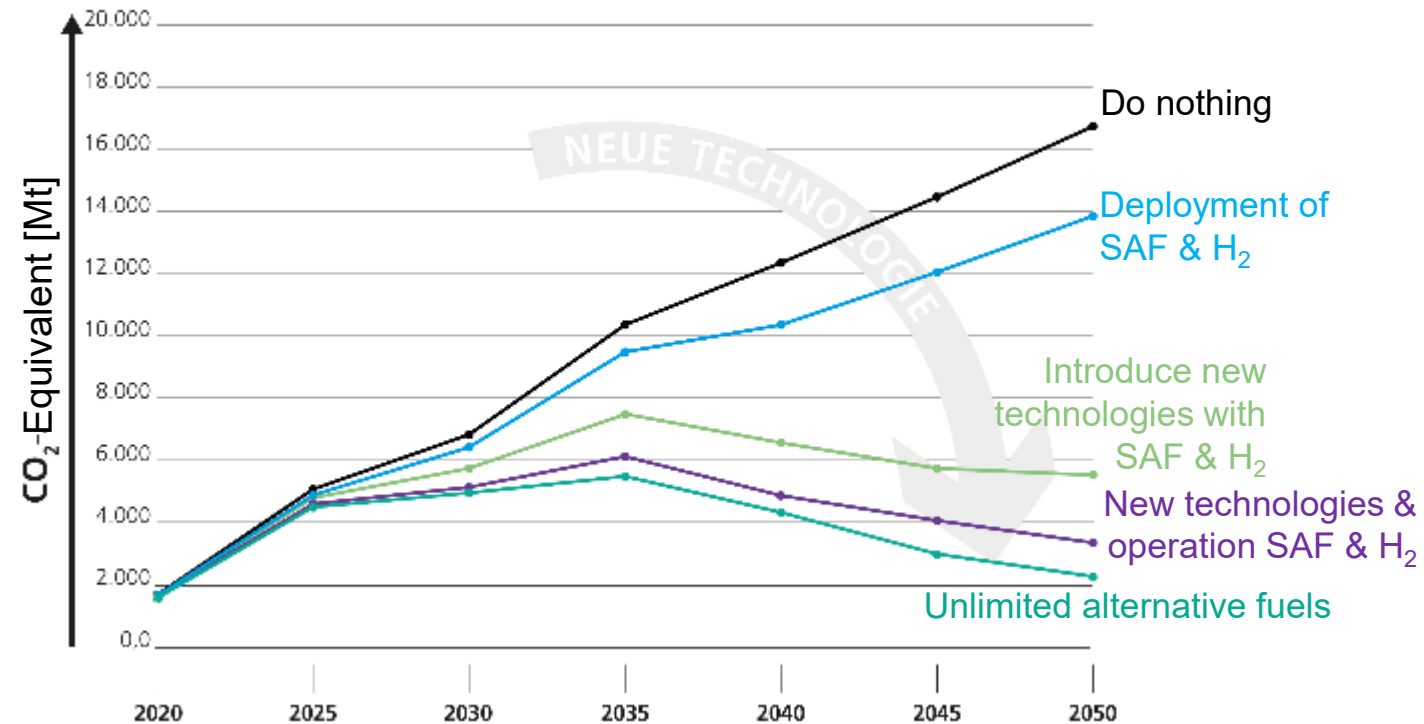


# Presentation Content and Structure

- **Reduction of Chemical Emissions and Noise**
- **Low Noise Aircraft Design**
- **Airframe Noise Research**
- **Acoustic Methods and Tools**



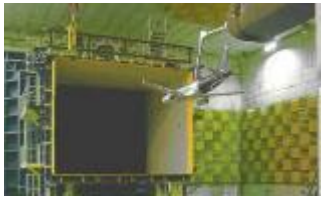
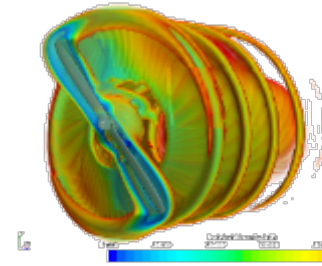
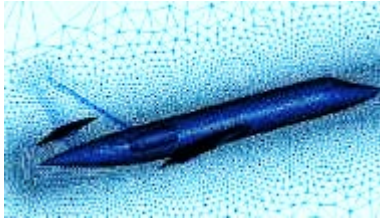
## *Technology openness and a multidisciplinary approach in research is key*



Source: DLR

## Component level

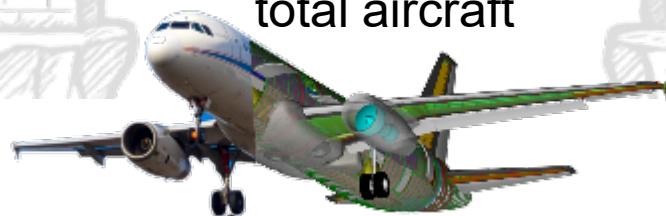
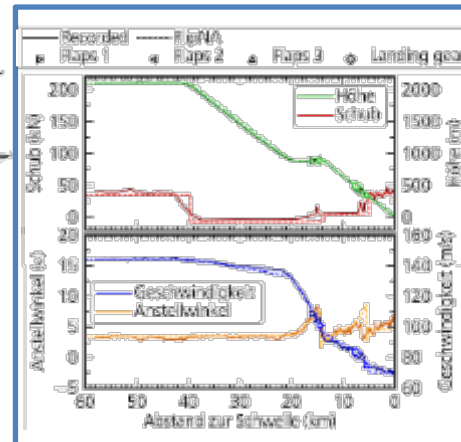
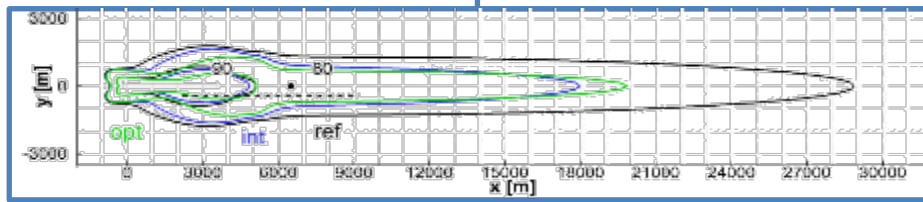
disciplines /  
technologies



detail assessment

## Aircraft level

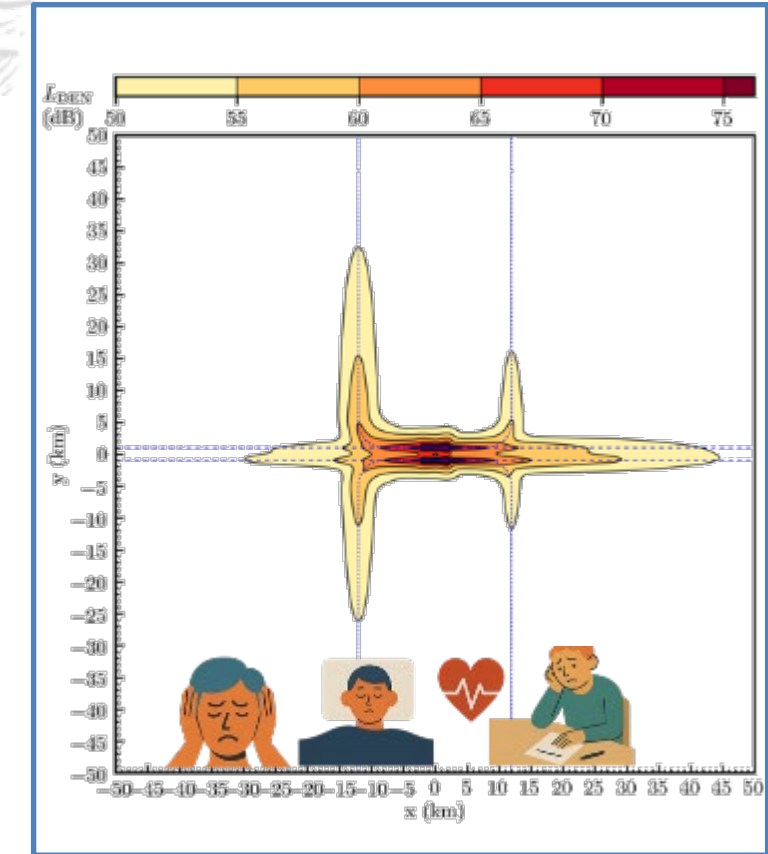
total aircraft



total a/c assessment

## Scenario level

fleet / traffic

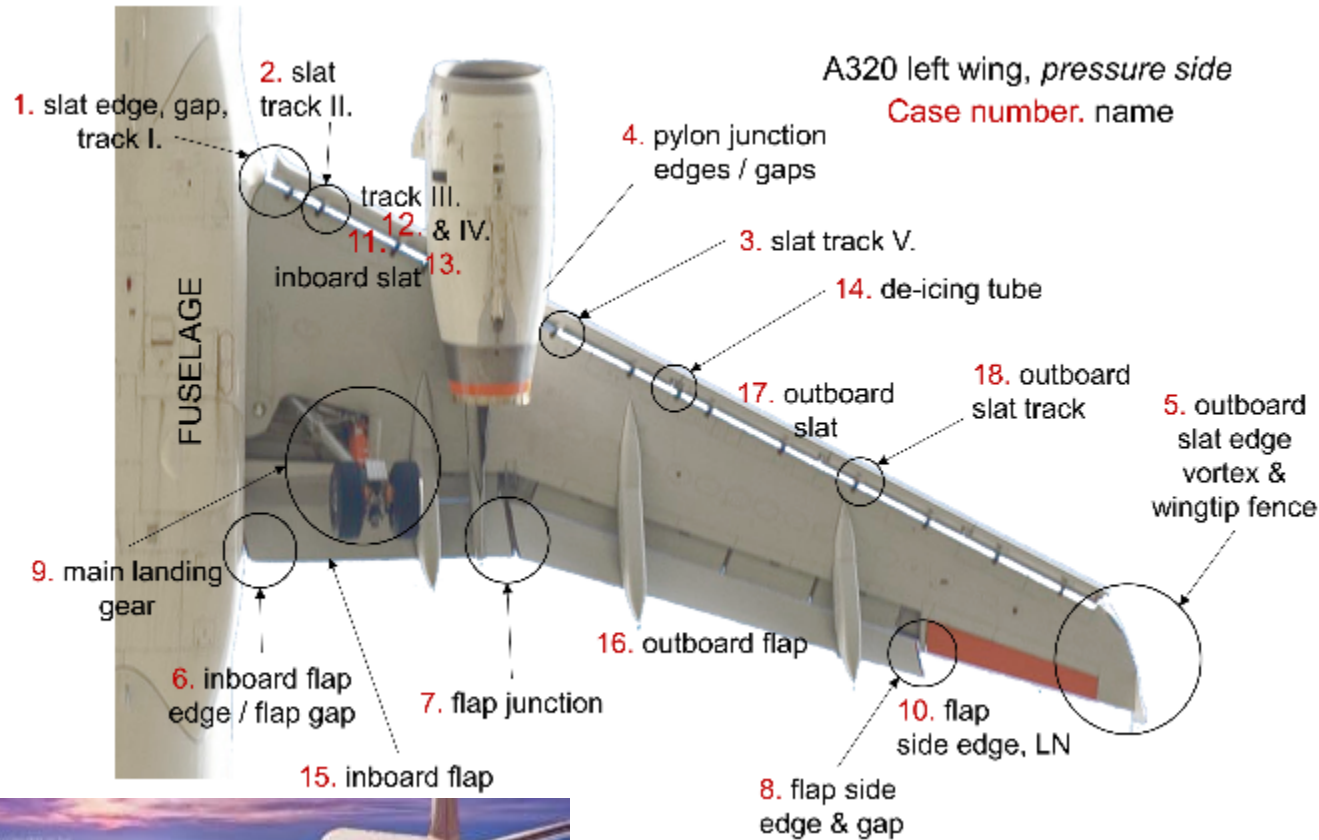
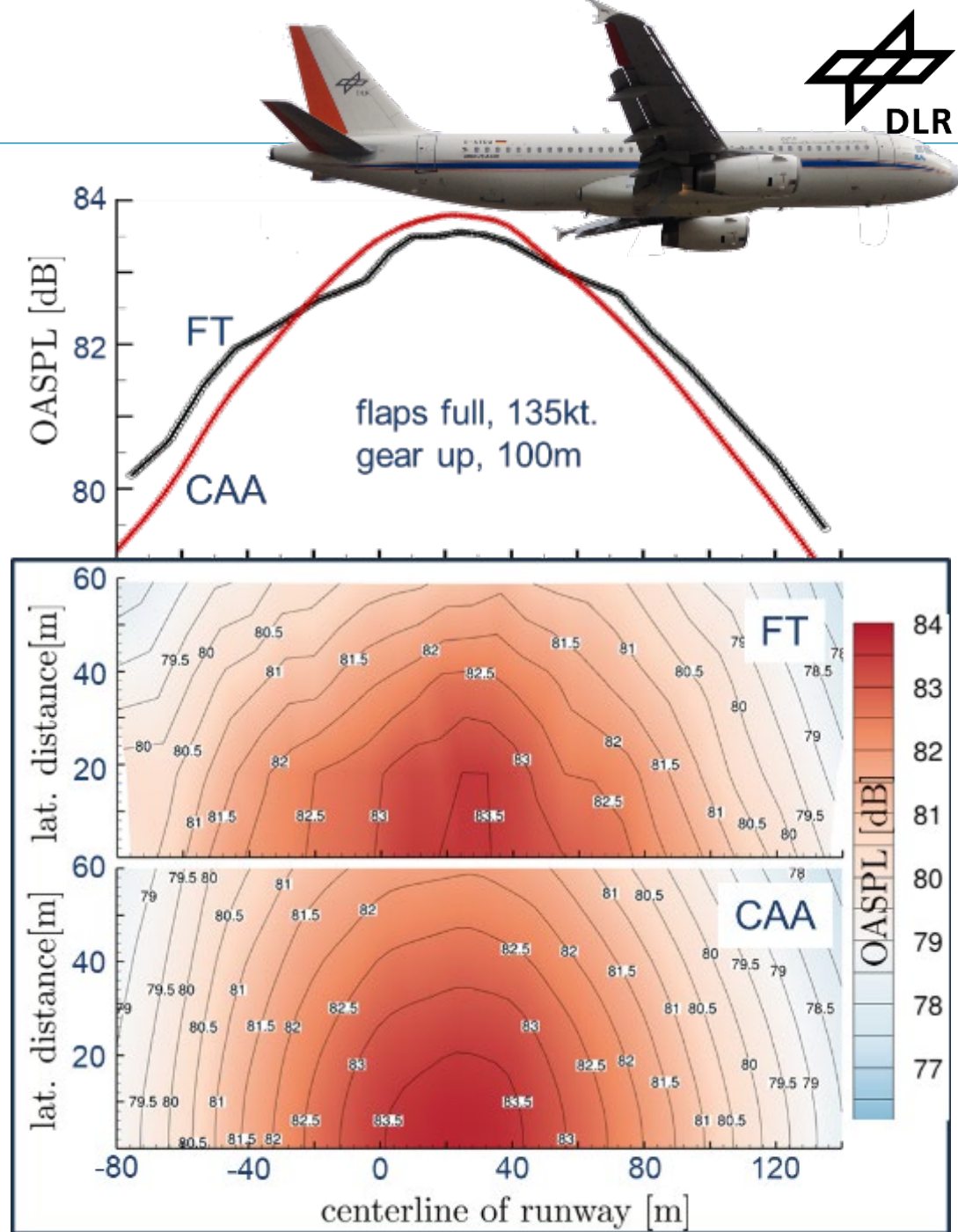


overall assessment

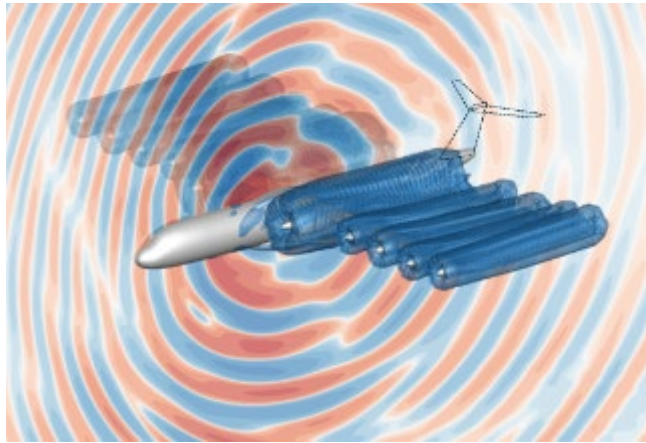
# Low Noise Aircraft Design

## Full scale flyover simulation (ATRA/SIAM)

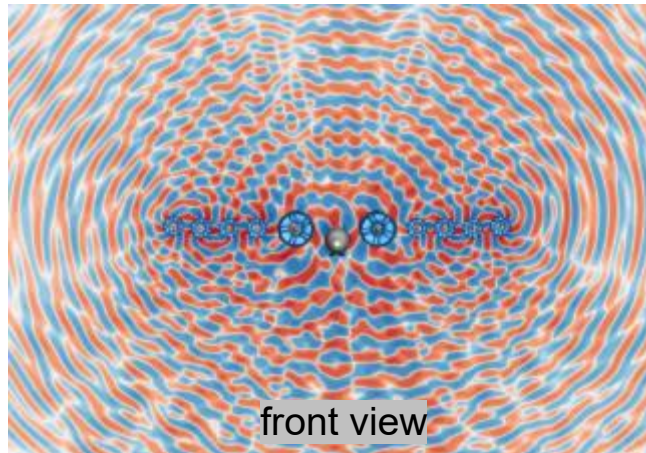
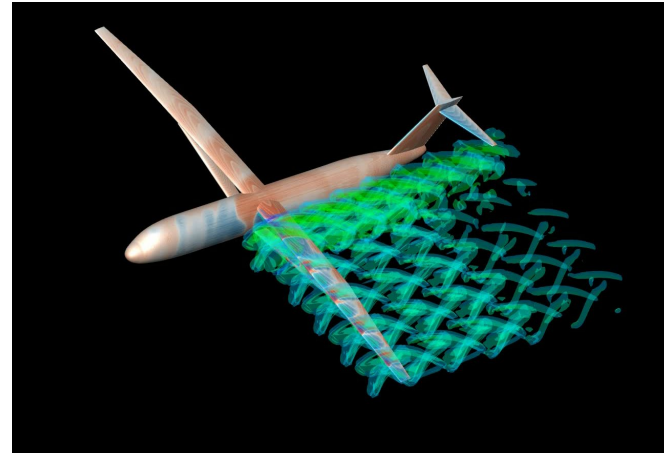
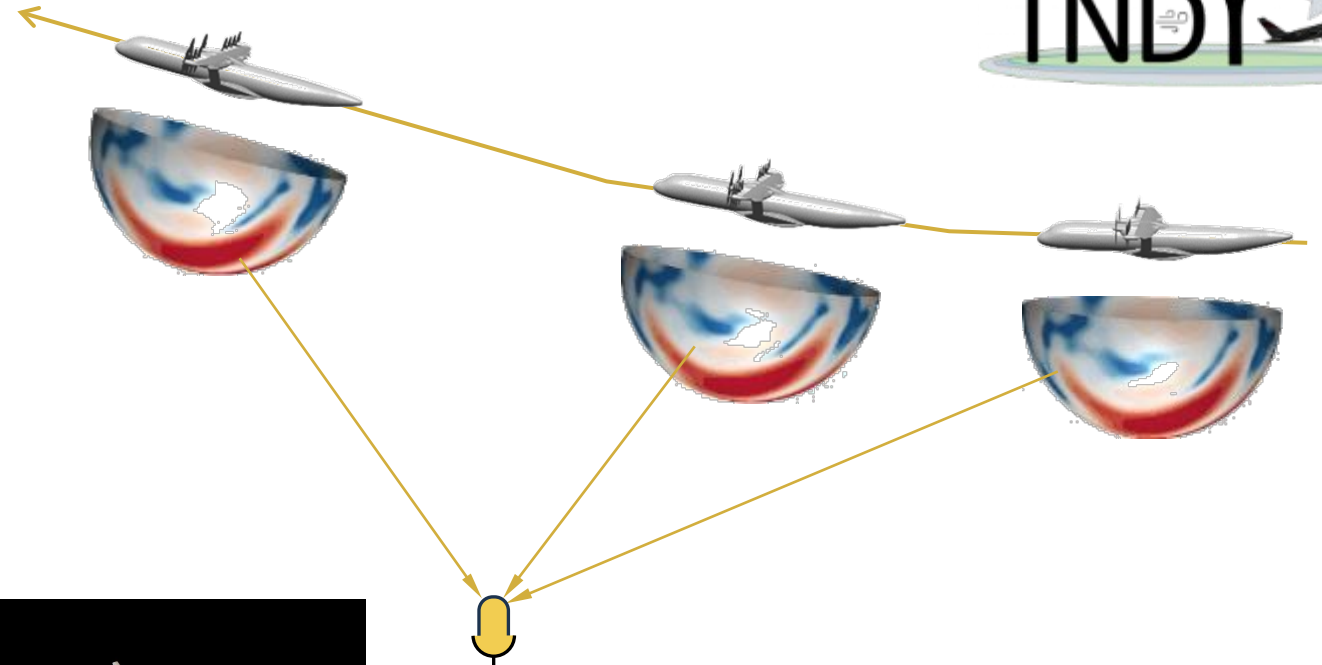
- mean flow: TAU
- sources: FRPM
- acoustics: DISCO++/FW-H



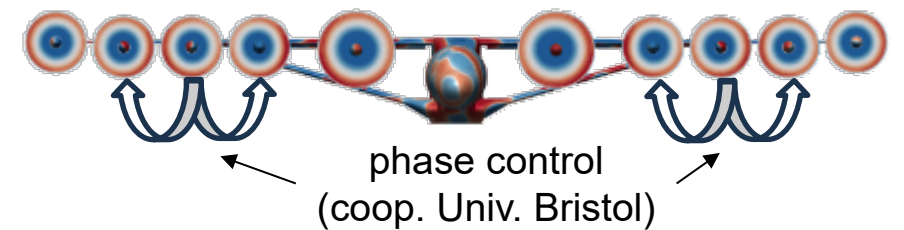
## Noise of distributed propulsion aircraft



DLR RANS-CAA actuator disk/line  
propeller noise prediction full scale



DLR flyover prediction IMMIS+



Noise-Optimized procedure LAE = **79.41** dbA

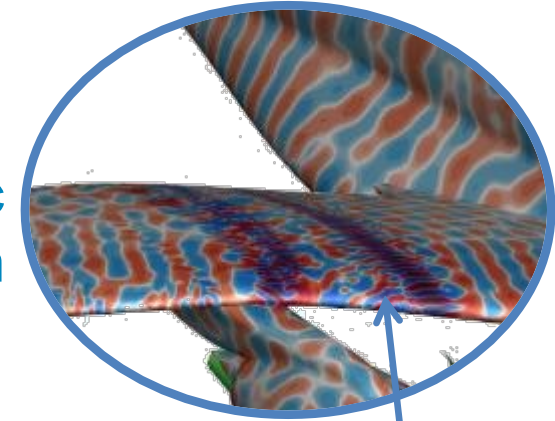
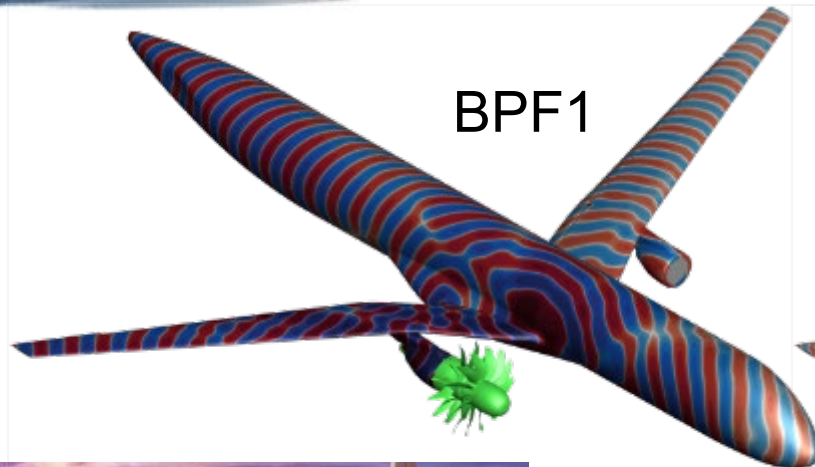
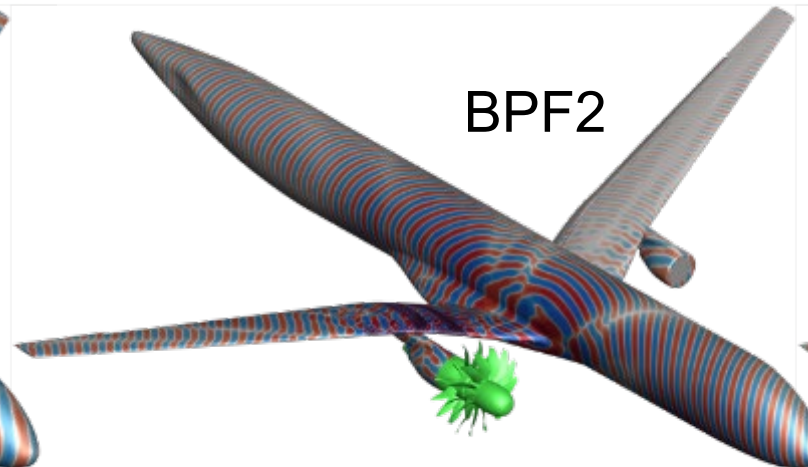
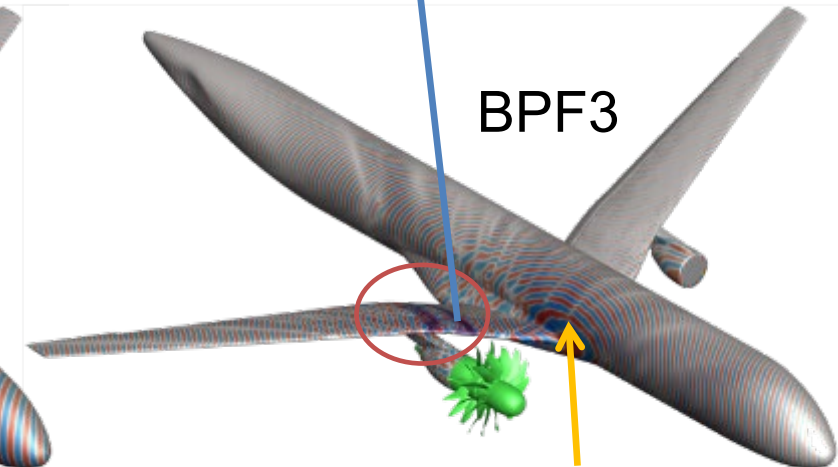
Noise-Optimized procedure with phase control LAE = 77.45 dbA

## Cabin noise excitation by open fan propulsor

- DLR uRANS-BEM approach to predict full scale aircraft surface pressure fluctuations



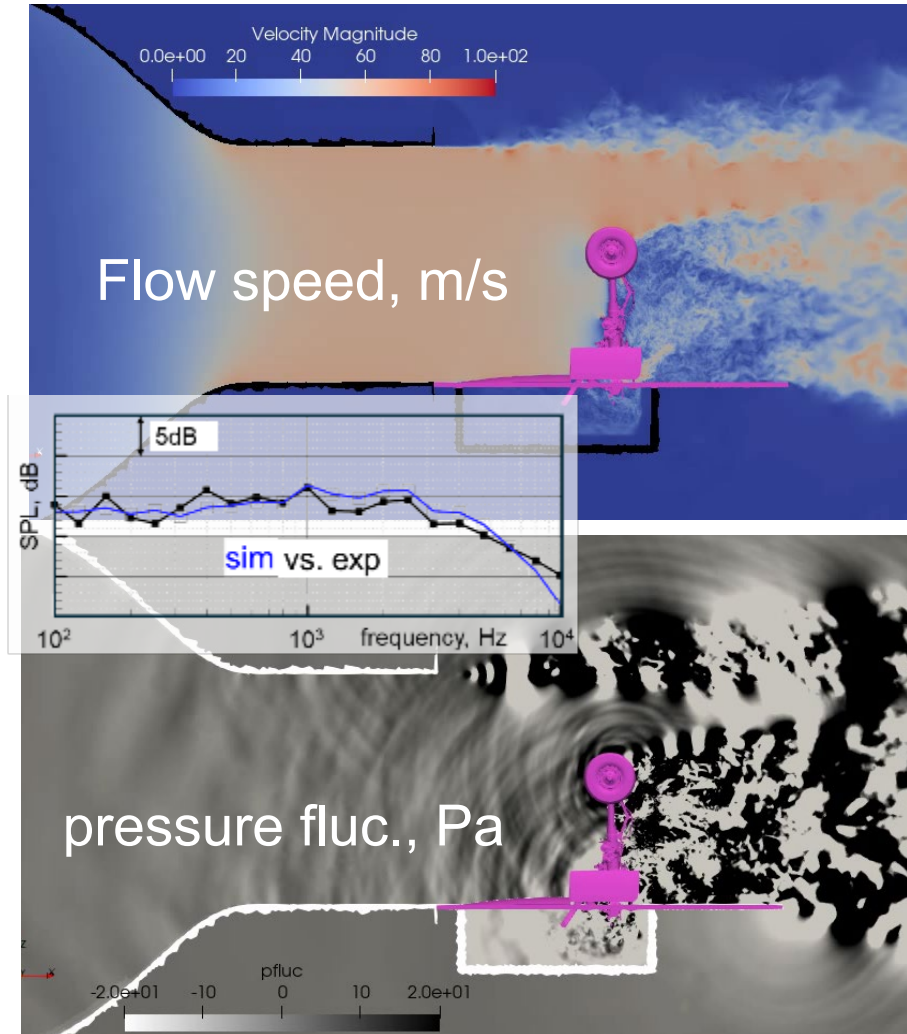
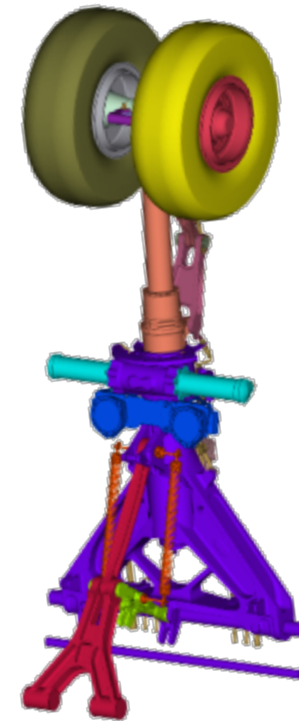
hydrodynamic  
excitation



acoustic excitation

S. Proskurov et al. AIAA 2025-1817

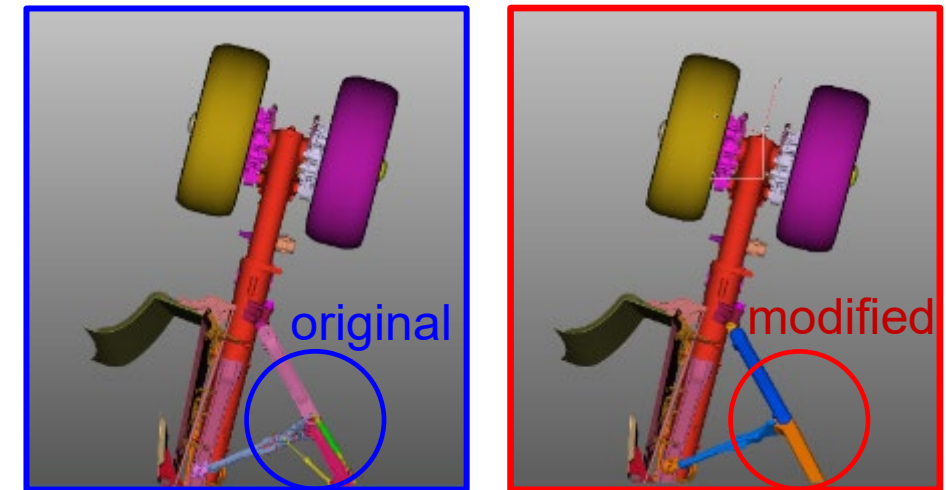
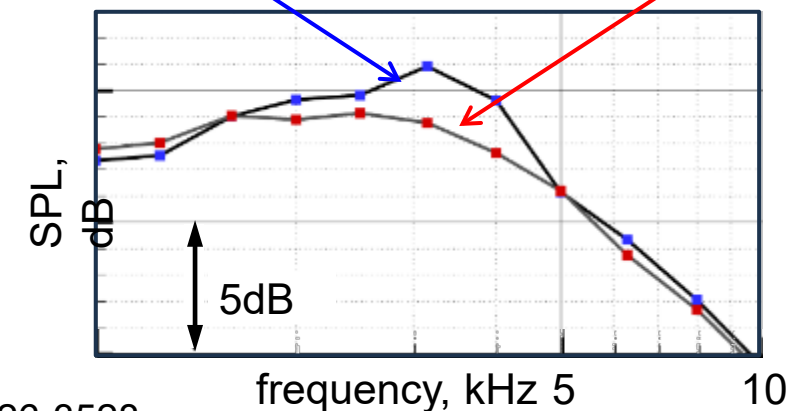
## Landing gear noise prediction + low noise design



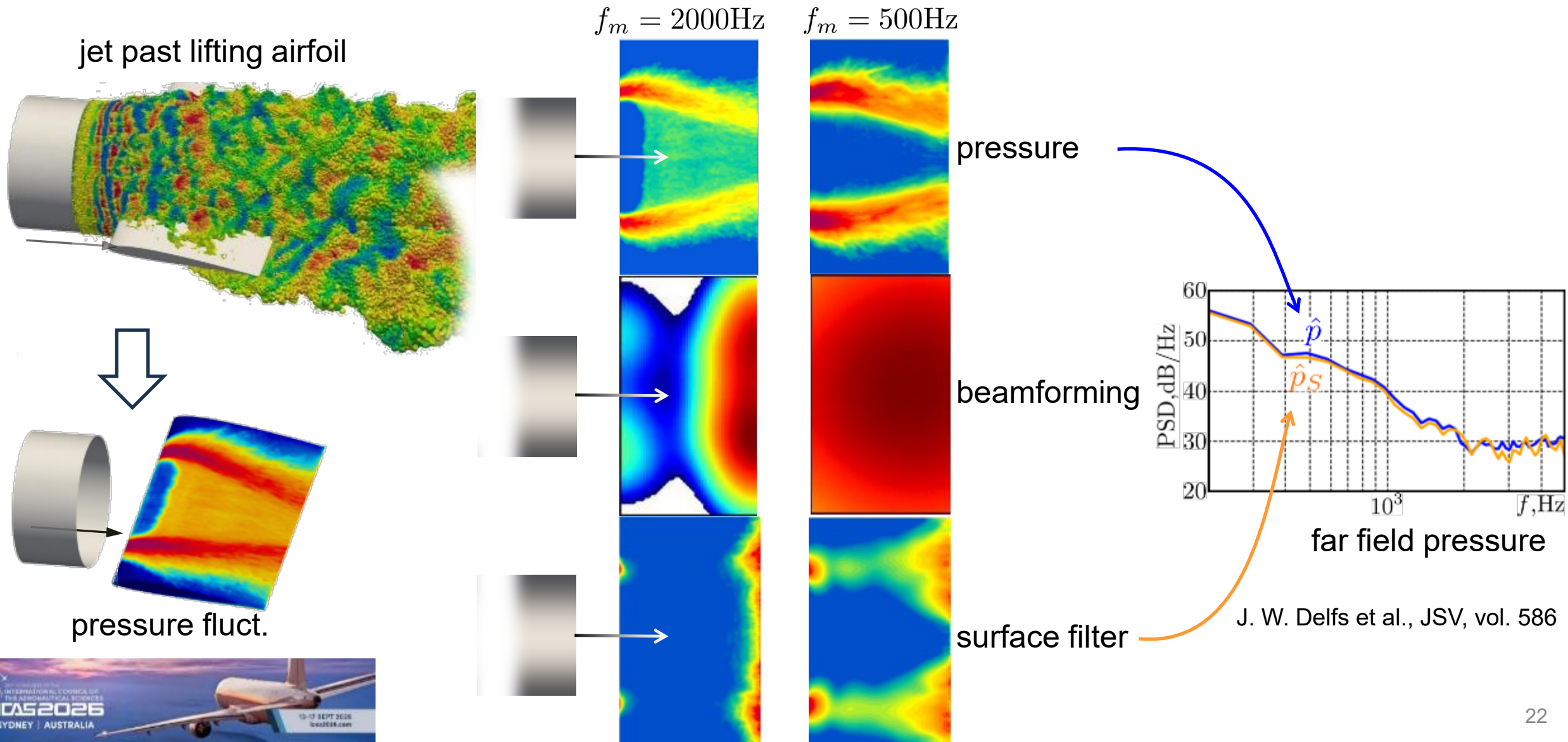
Real LG complexity

## Co-operation ProLB (Lattice-Boltzmann)

## Acoustic assessment of low noise modifications



## New concept for source localization – acoustic surface pressure –



Thank You!



# NASA Aeronautics on Quiet Aviation Research for a Sustainable Tomorrow

Dr. Nateri Madavan  
NASA Advanced Air Vehicles Program



Slides prepared by Shannon Eichorn  
NASA Advanced Air Vehicles Program

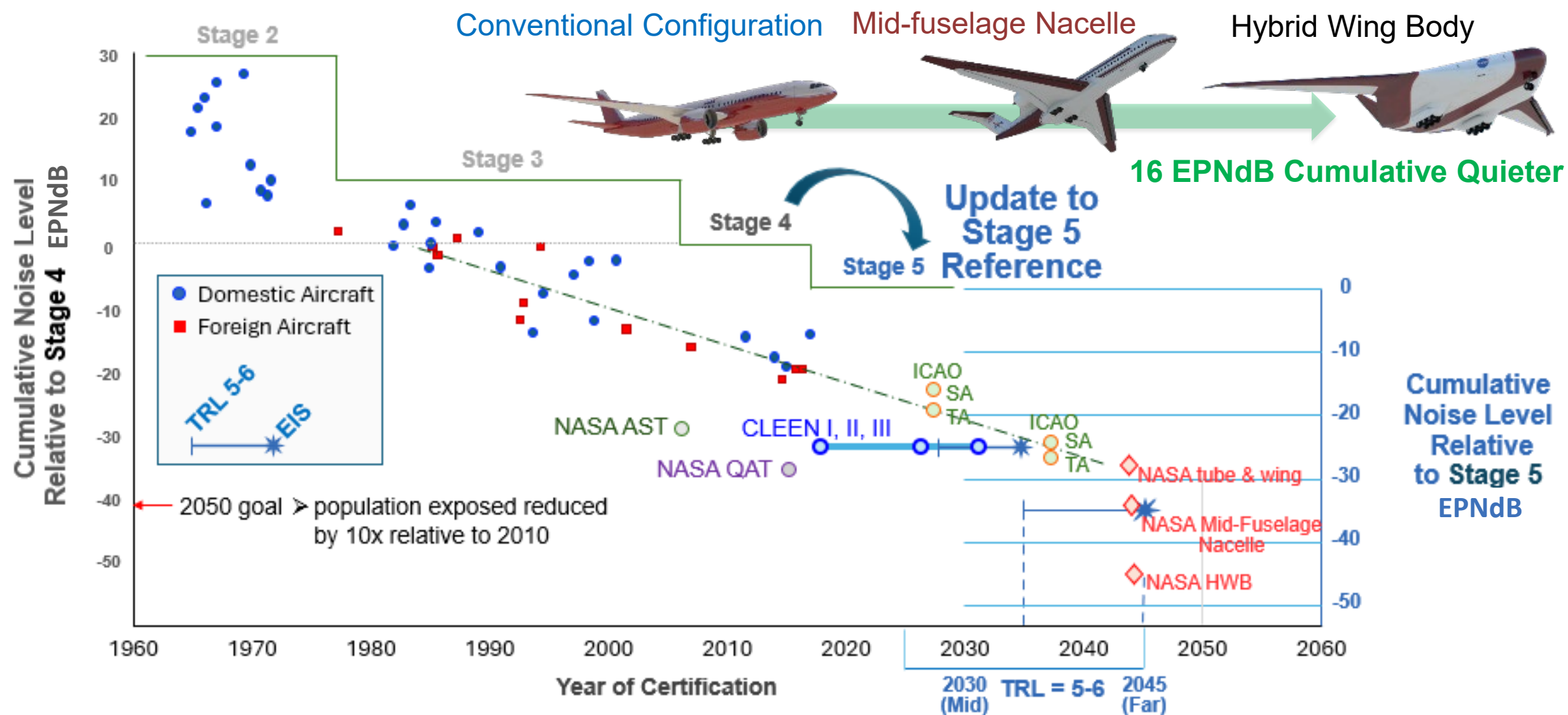


# Driving Change with Updated Subsonic Airliner Metrics

| Subsonic Aircraft<br>Technology Benefits <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Technology Generations<br>(Technology Readiness Level = 5 – 6) |                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Mid Term<br>By 2030                                            | Far Term<br>By 2040 – 2050  |
| Energy Consumption <sup>2,3</sup><br>(below CAEP 10)                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 35%                                                            | 50%                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                | 35%<br>w/ non-drop-in fuels |
| LTO NO <sub>x</sub> Emissions <sup>3,4</sup><br>(below CAEP 8)                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 75%                                                            | >75%                        |
| LTO nvPM Emissions<br>(below CAEP 11)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 50%                                                            | 75%                         |
| Noise<br>(cum. Below Stage 5)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 25 dB                                                          | 35 dB                       |
| <p>1) Aircraft operations improvements may yield significant system-level efficiencies and reduced atmospheric impacts in time at the fleet and vehicle levels</p> <p>2) CAEP 10 metric is energy-based; energy use per available seat-mile also tracked</p> <p>3) Life-cycle benefits from synthetic aviation fuels (SAFs) is additional, with possible trades between energy efficiency and non-drop-in fuels recognized in the Far Term</p> <p>4) CAEP standards for Cruise NO<sub>x</sub> are not yet established</p> |                                                                |                             |

Standards-based metrics and traceable goals drive transformative configuration and technology.

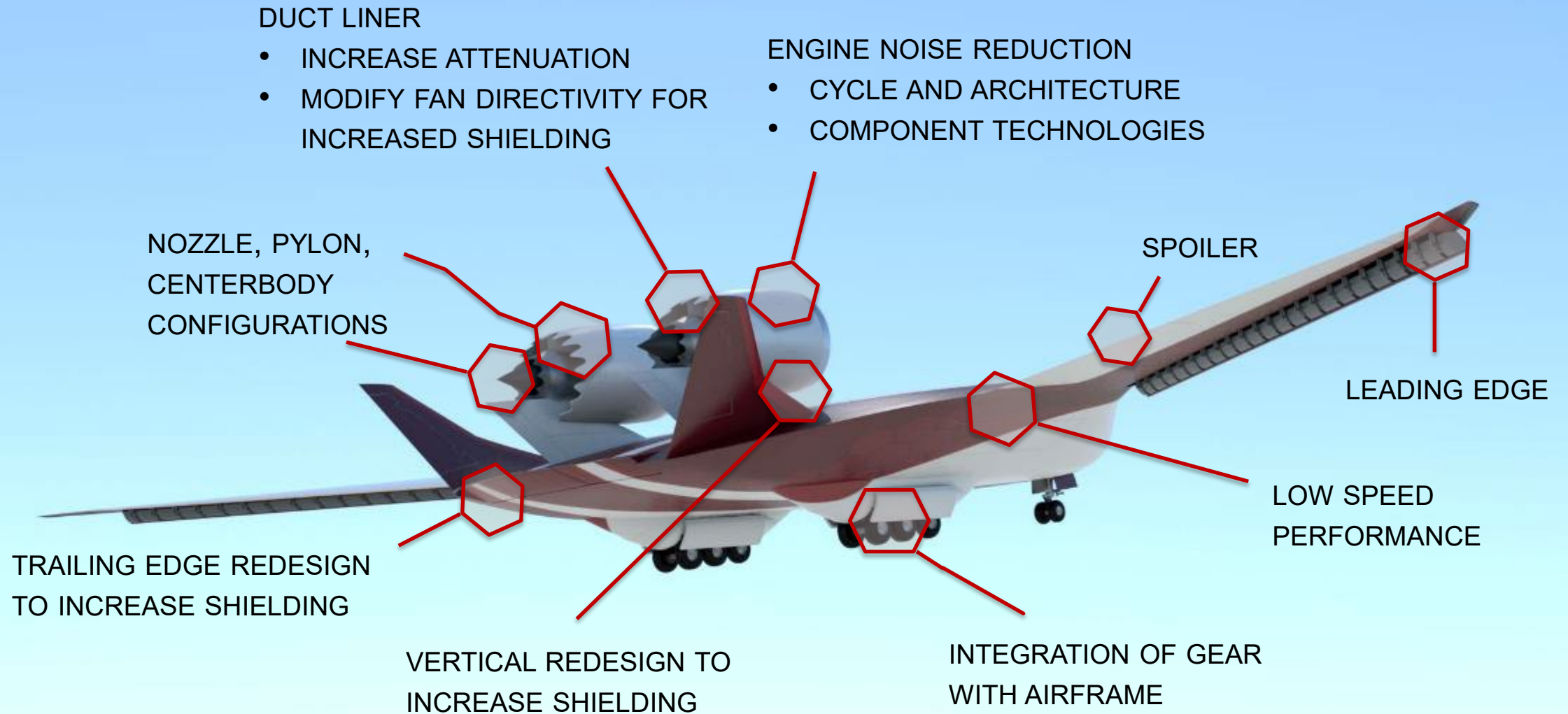
# Aircraft Noise Trends, Stages, and Goals



Aggressive goals require unconventional configurations.

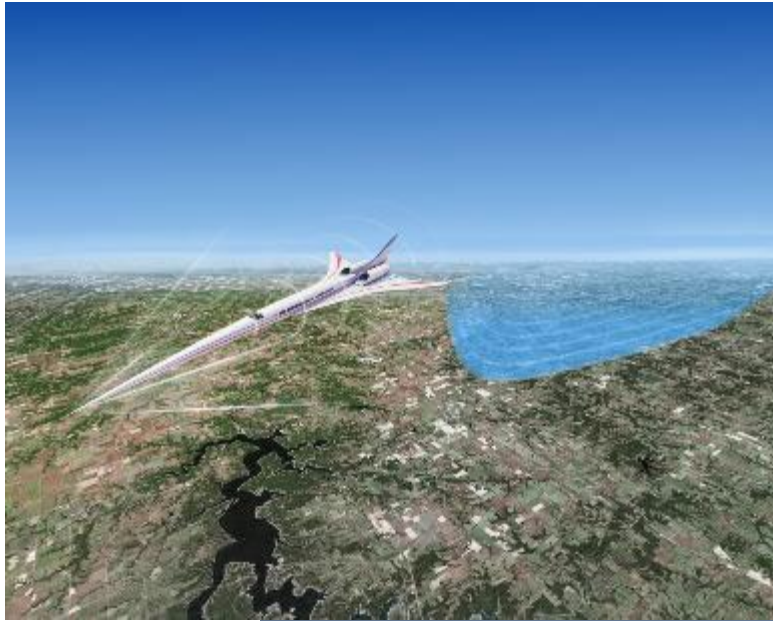
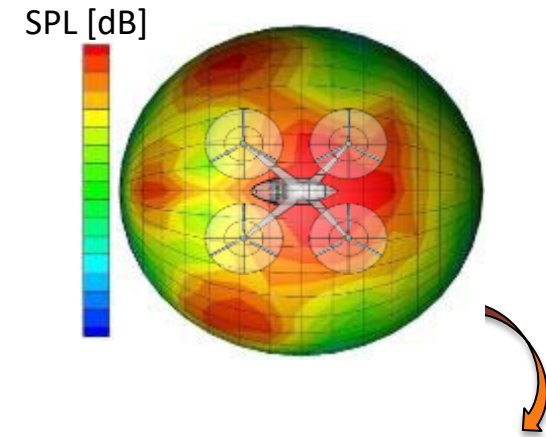
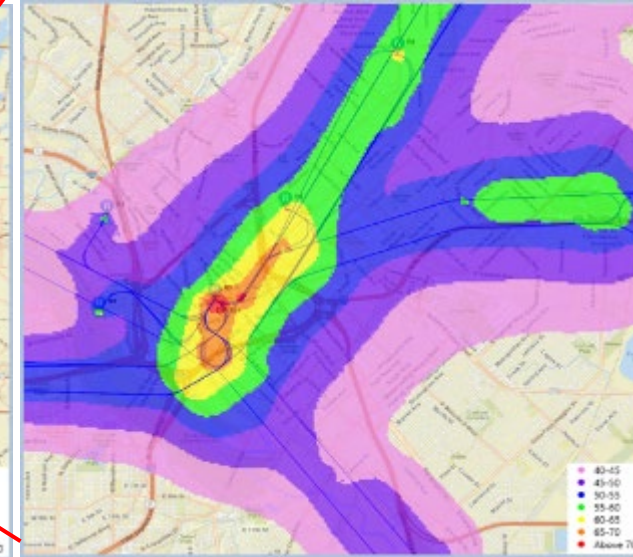


# Technologies for Tomorrow's Quieter Aircraft

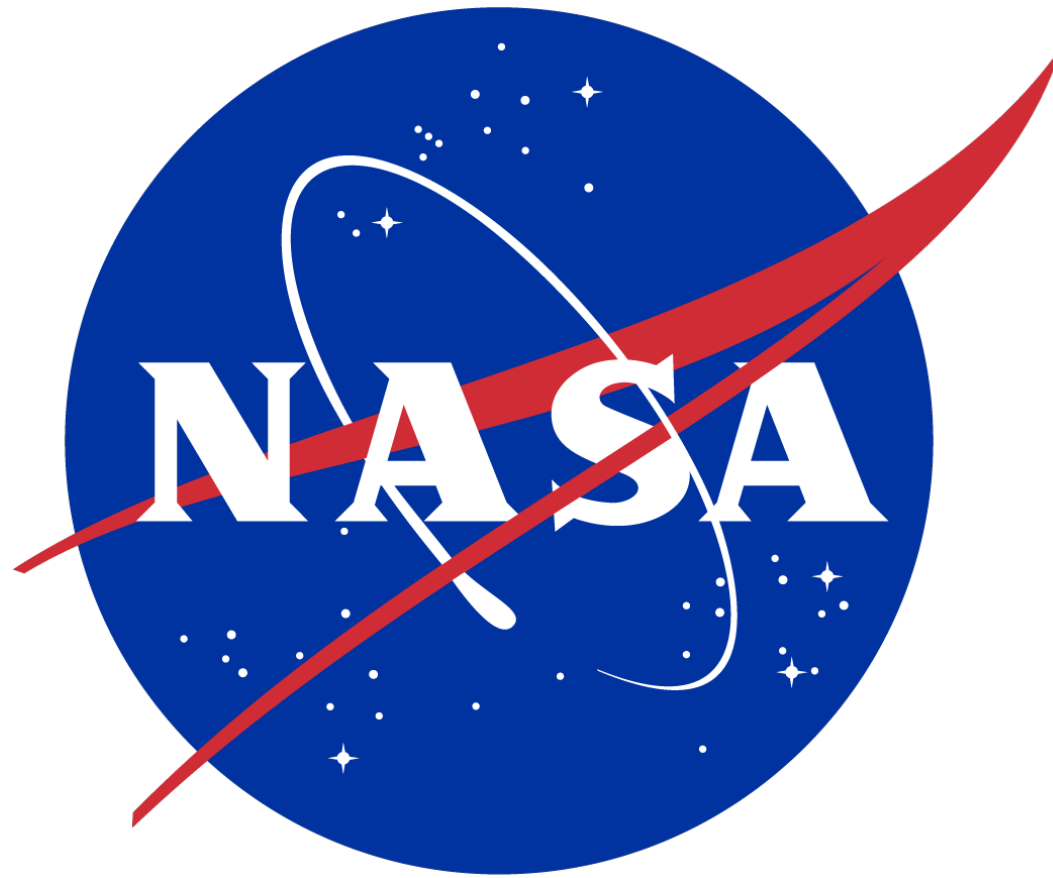


Develop all technologies to reach NASA's noise reduction goal.

# Emerging Markets: Supersonic and Advanced Air Mobility Noise



Noise reduction is a key enabler for new markets.





# Noise Mitigation & Acoustic Annoyance Reduction: ONERA Aeronautics Strategy

ICAS IFAR Lecture Quiet Aviation Research For Sustainable Tomorrow

Ph. Beaumier, Aeronautics Director  
ONERA

ONERA

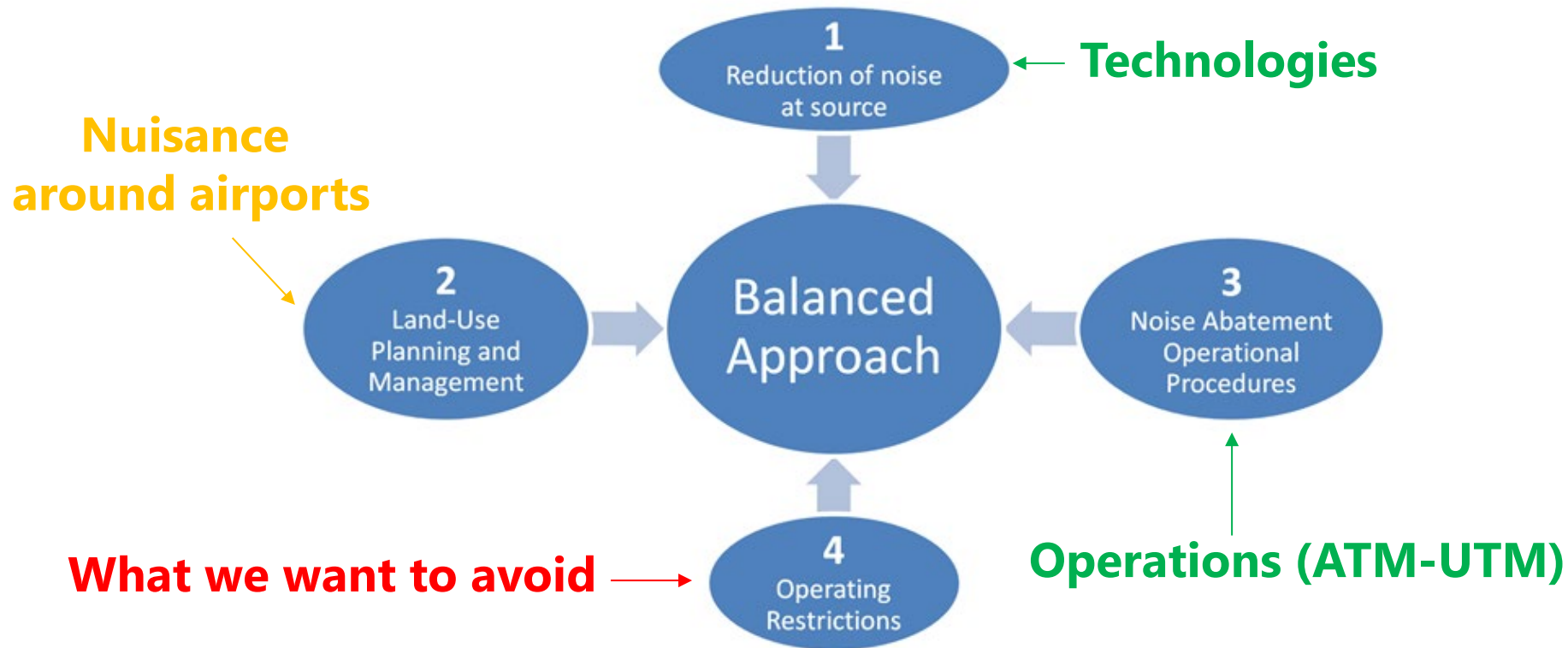
THE FRENCH AEROSPACE LAB



# ICAO Balanced Approach to Aircraft Noise Management

Aircraft noise: most significant cause of **adverse community reaction** related to airports expansion

**Balanced Approach:** 4 categories of measures to reduce noise around an airport



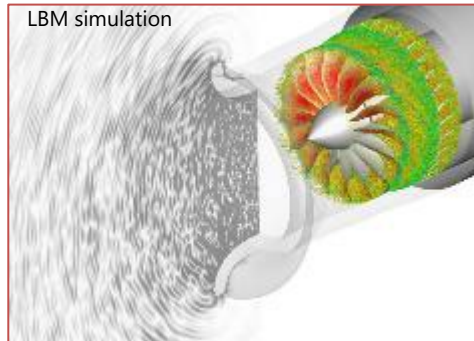
Inspired from: <https://www.icao.int/environmental-protection/aircraft-noise>

# ONERA Assets For Quiet Aviation Research

ONERA: a historical contributor to **noise reduction technologies**



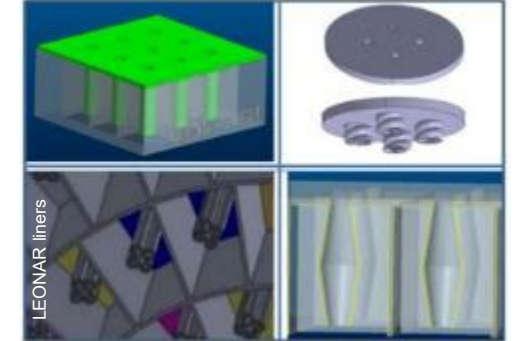
*Science*



*Numerical  
Tools*



*Experimental  
Facilities*



*Technologies*



**Nuisance issue:** addressed more recently (noise + non-acoustical factors)



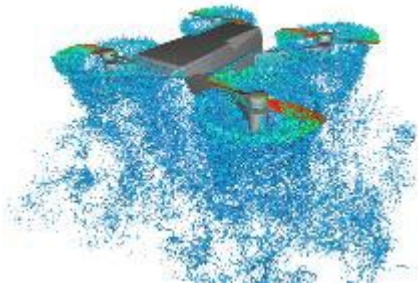
# Major Evolutions Foreseen For The Next Decades

## Multiple architectures of aircraft/engine to be envisaged

New entrants: drones/eVTOLs, supersonic aircraft (new challenges in terms of perception)

NextGen SMR (2035): quite different architectures can be envisaged

N+2 generation (2050): technological breakthroughs



*Quadrotor drone*



*Rolls-Royce UltraFan*



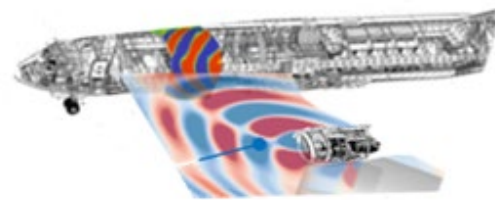
*CFM OpenFan*



*ARTEM BWB concept*

## Uncertain objectives

Emerging constraints: How will regulatory framework evolve?



Increased **weight of acoustic constraints** in multi-disciplinary decisions/options

# Our objectives for the next decades

Contribute to the whole acoustic maturation of new aircraft/powerplant architectures

Put **overall aircraft noise** objectives at the heart of our activities

- ① Overall Aircraft Design and Optimization under acoustic constraints  
What makes the overall aircraft noise (objectives, metrics)?

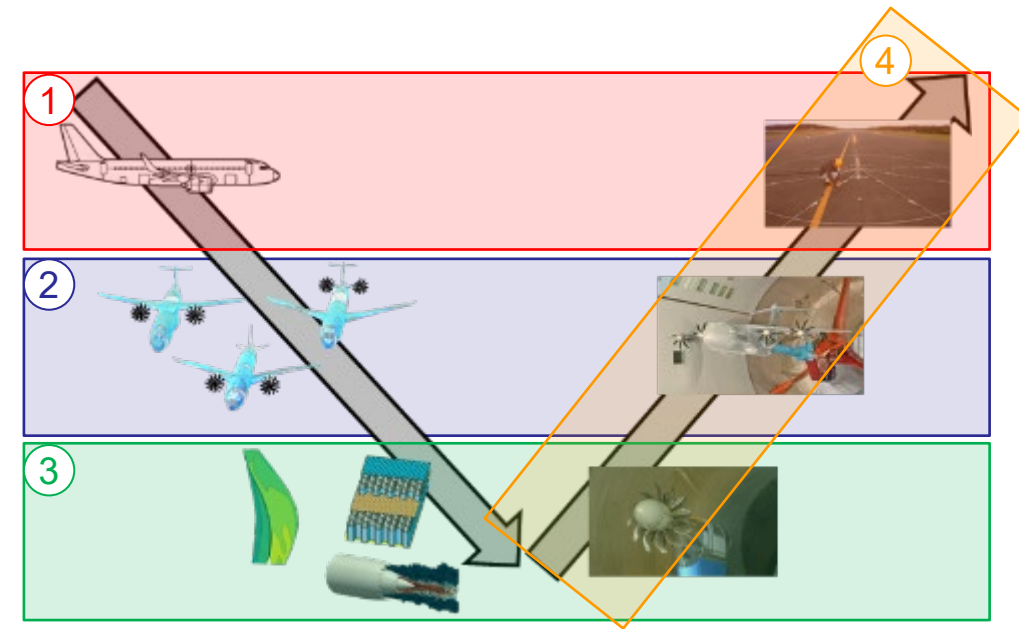
**Simulate** sub-systems radiated noise in representative conditions

Integration/installation effects

**Design** innovative noise reduction technologies

Explore and understand complex technologies

**Understand and validate** through numerical and experimental means



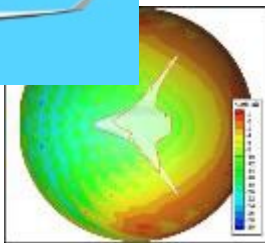
# Main scientific barriers - 1

## ① Put overall aircraft noise objectives at the heart of our activities

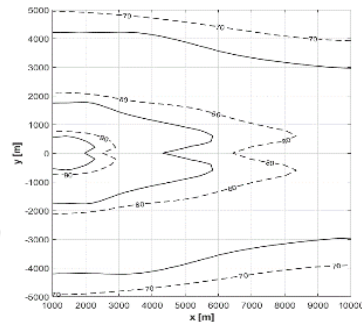
Predicting the impact of **any kind of aircraft** architecture (sources, propagation)

Understanding the **link between noise and nuisance** (metrics, AI)

Taking into account **new constraints** (eg: cabin noise)



Acoustic impact of a BWB configuration  
(ARTEM project)



## ② Simulate sub-systems radiated noise in representative conditions

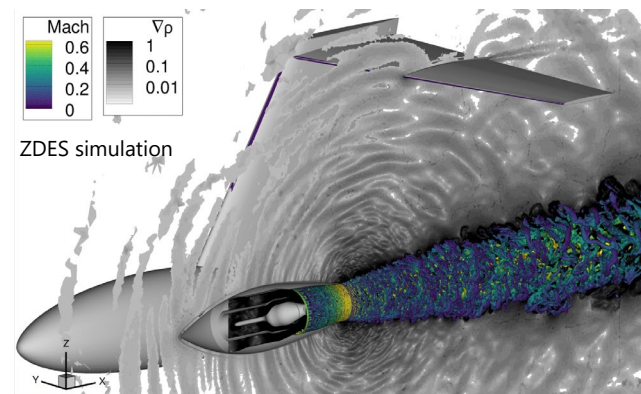
Capacity to model **tonal** and **broadband** noise

Improve/Combine **High Fidelity Tools**:

LBM: transonic, boundary layers

Navier-Stokes: grid generation and computational time

Need of 'short' **restitution time** solutions



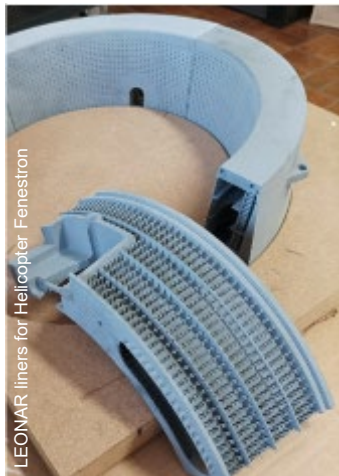
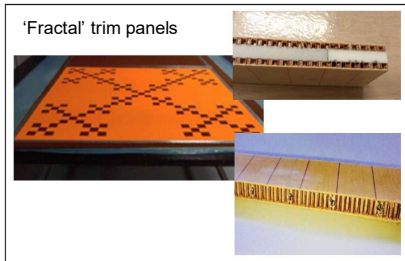
# Main scientific barriers - 2

## ③ Design innovative noise reduction technologies

For acoustic **design**:

Develop optimization methods (adjoint, AI) including new constraints

**Technologies:** meta liners, smart panels, shape design, morphing, ...



## ④ Understand and validate through numerical and experimental means

Wind-tunnels **anechoic characteristics** improvements

Acoustic treatment

Correction of measurement biases (boundary layers)

Development of adapted **metrology**:

MEMS sensors for acoustics



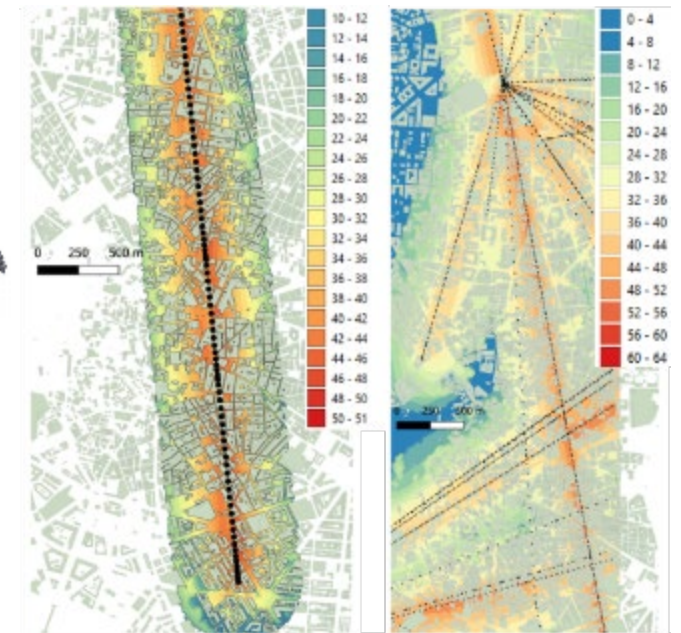
# Conclusions

**Balance** between **noise** reduction and reduced **CO<sub>2</sub>** emissions will be essential in the future

Improvement of **low noise technologies** is mandatory to counter-balance increased air traffic

More emphasis should be put on **nuisance**

Will it be enough?



*Single drone flying over urban environment [SEL-A]*

*Noise map produced by a drone fleet in urban environment [LAmax]*