CLEAN AVIATION

# CLEAN AVIATION INFO DAY

# REVIEW OF CLEAN SKY 2 AND RESEARCH PERSPECTIVES

## 27th April, Toulouse

P. Schmollgruber (ONERA)

ONERA
THE FRENCH AEROSPACE LAB

Co-funded by the European Union

# ONERA AT A GLANCE



- National Research Center in Aeronautics and Space
- A public enterprise of an industrial and commercial nature (“EPIC”) founded in 1946
- 3 activity sectors : Defense, Aeronautics, Space
- About 2000 employees
  - 1300 engineers and managers
  - 280 PhD
  - 110 have the certificate to conduct Research (HDR)
  - 7300 hours of teaching in various universities
- Production
  - 315 congress papers
  - 243 peer reviewed journal
  - 1068 technical reports
- Budget
  - 234 M€
  - 120 M€ come from direct contracts

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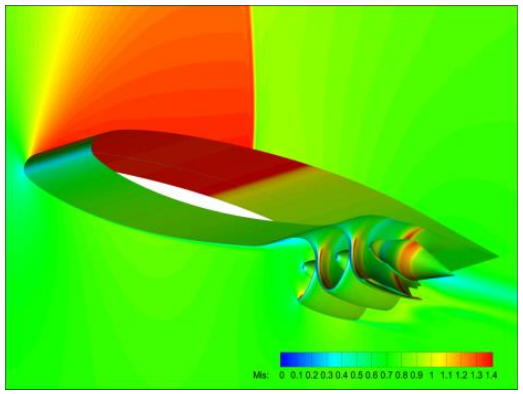
# ONERA AT A GLANCE

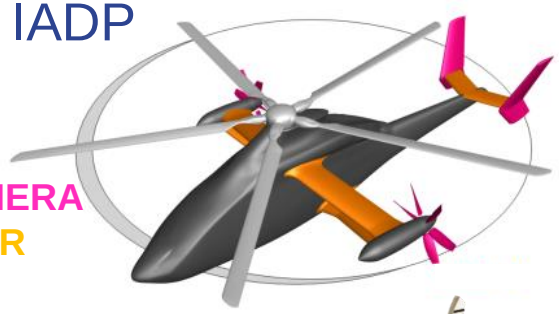


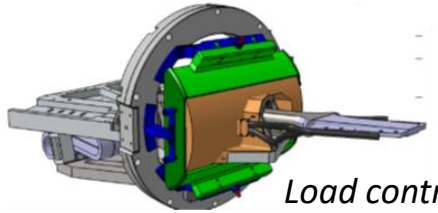
- The activity is distributed on 7 departments and the Wind Tunnel Directorate
  - DAAA: Aerodynamics, Aero elasticity, Acoustics
  - DMPE: Multiphysics for Energetics
  - DMAS: Materials and Structures
  - DEMR: Electromagnetism and Radar
  - DOTA: Optics and associated techniques
  - DPHY: Physics, instrumentation and space environment
  - DTIS: Information processing and systems
- In Aeronautics, activities cover many phases of the aircraft development
- Strategic axes associated to the roadmaps
  - Reduction of the environmental footprint of transport aircraft
  - New simulation capabilities

# ONERA CONTRIBUTION TO CLEAN SKY 2

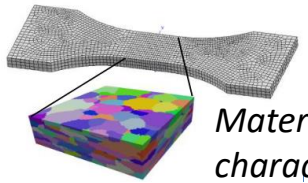
- Clean Sky 2 is a great opportunity for all ONERA Departments to
  - Contribute to technology maturation towards greener aviation
  - Develop their scientific competences based on an Experiment / Modelling / Numerical simulation approach

- The ONERA Departments have been involved in many Strategic Platform Demonstrators
  - Large Passenger Aircraft IADP
  - Regional Aircraft IADP
  - Fast Rotorcraft IADP
  - ITD Airframe
  - ITD Engines
  - ITD Systems

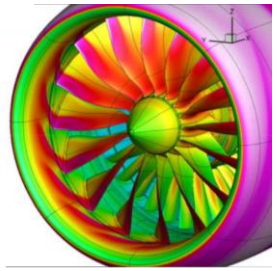


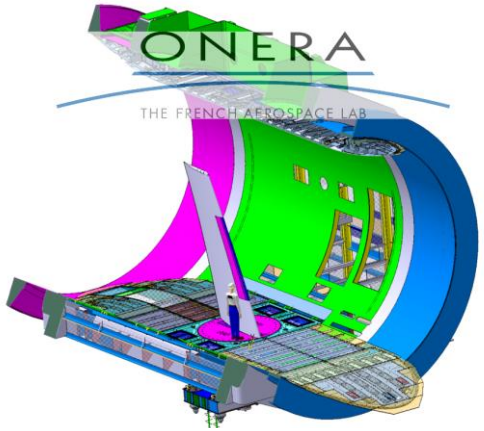


*Load control*


*Extended Laminarity*


*Material characterization*


*Blade design for Turboprop*


*UHBR integration*



*HLFC performance model*

- ONERA involved in 4 Thematic Topics

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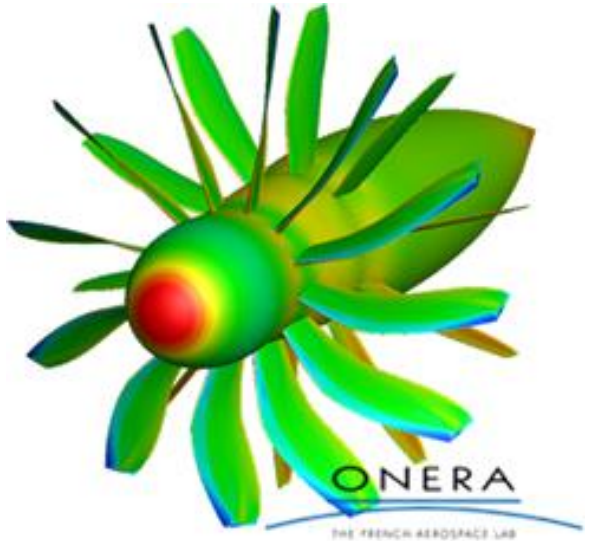
# ONERA CONTRIBUTION TO CLEAN SKY 2

- Contribution to the Open Rotor And Stator propulsion system development
  - Fuel burn reduction
  - Less complex and lighter than CROR solution




- Activity
  - Aerodynamic blade design and optimization of the complete ORAS (rotor and stator) delivering targeted thrust in Cruise and Take Off conditions
  - More than 60 rotor geometries tested
  - Possible compromise between Cruise efficiency and Take Off thrust
  - Influence of RPM on rotor efficiency and flow physics

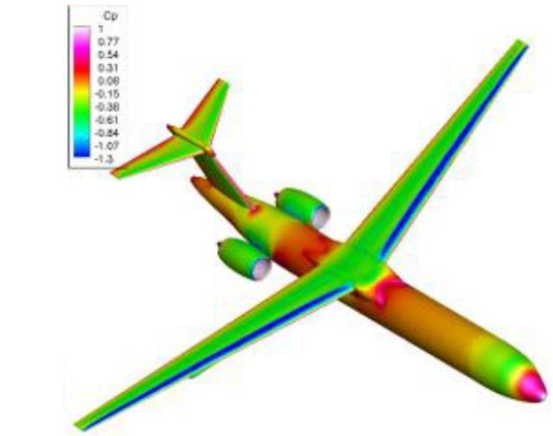
- Next steps
  - Performance / noise tradeoffs to be assessed

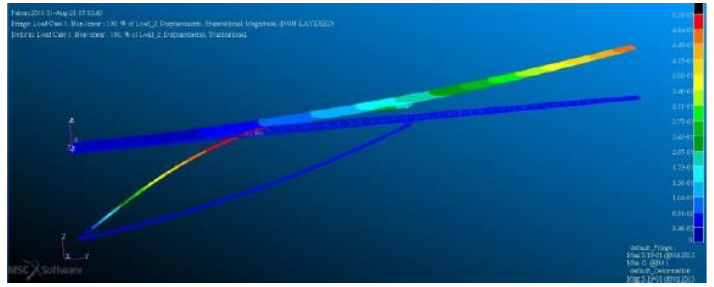
# ONERA CONTRIBUTION TO CLEAN SKY 2

- Investigating High Aspect Ratio Wings (Thematic topic)
  - Key technology allowing a reduction of induced drag
  - Introduction of a strut

- Activity
  - Assessment of the potential gain associtated to the new architecture
  - Multifidelity Overall Aircraft Design process
  - Integration of high-fidelity aerodynamic and structural analyses to accurately predict physics aspects

- Next steps to consolidate the analysis
  - Impact of wing thickness distribution
  - Explore laminar wing options



static deflection (+2.5g sizing case)

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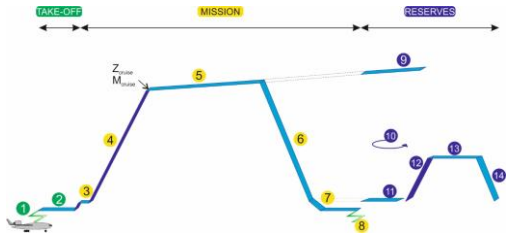
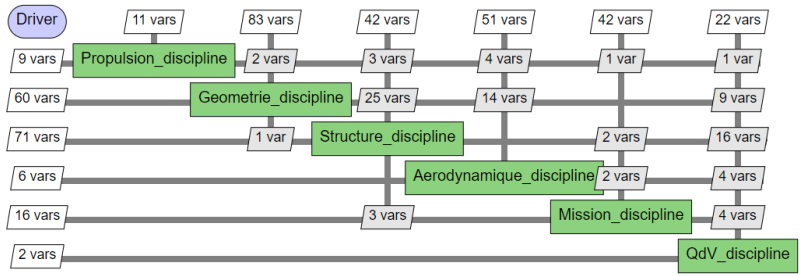
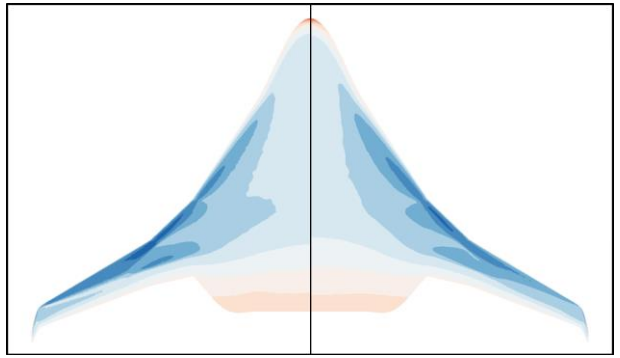
# ONERA CONTRIBUTION TO CLEAN SKY 2

- Investigating the BWB concept
  - Aerodynamically efficient
  - Available internal volume
  - Many options at propulsion level

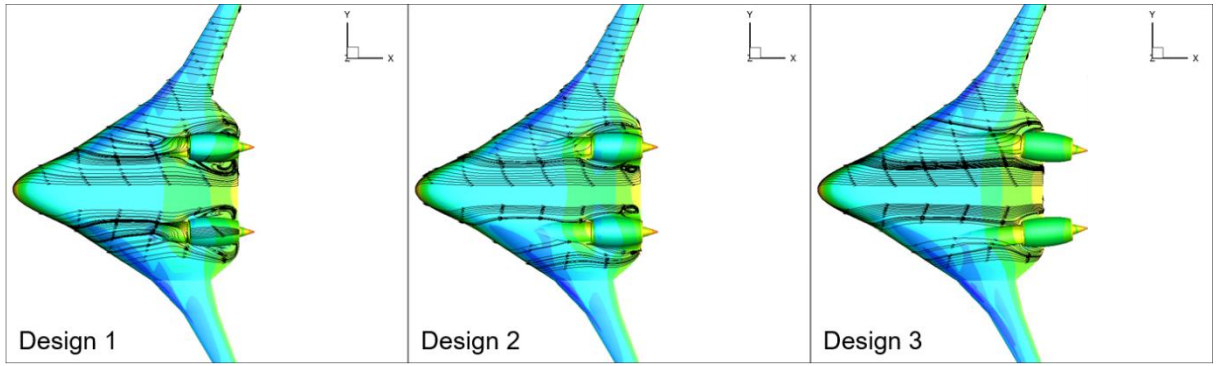



- Activity
  - Benefits from a 4 year project internally funded
  - Overall Aircraft Design process based on OpenMDAO
  - High fidelity analyses for aeroshape optimization
  - BLI version on-going



- Next steps
  - Consolidation of the BLI option
  - Assess the Distributed Electric Propulsion

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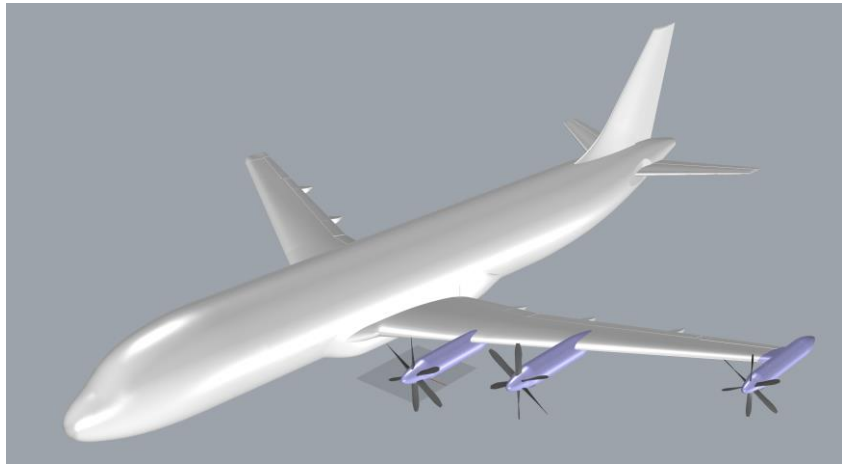
# ONERA CONTRIBUTION TO CLEAN SKY 2

- Derisking Distributed Electric Propulsion (DEP)
  - Scaled Flight Testing
  - Validation of the approach through the Scaled Flight Demonstrator
  - Flight testing the dynamic behavior of DEP
- Collaborative activity with the validation on-going


*Minimal changes to the SFD for DEP investigations*



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# ONERA CONTRIBUTION TO CLEAN SKY 2


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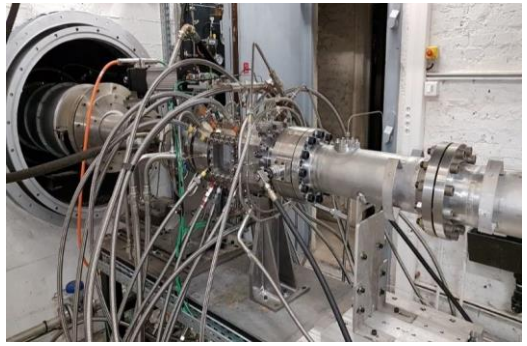
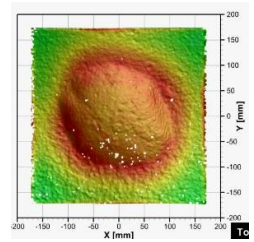
# TOWARDS CLEAN AVIATION

- Very positive feedback about Clean Sky 2
  - Exchanges with Industry, Research Centers and Universities
  - New partnerships have been defined
  - Good balance between application and scientific activities with 11 PhDs co-funded (2018-2023)
- Key new challenges for Civil Aviation to be investigated in Clean Aviation
  - Flight Physics
  - Propulsion integration
  - Hydrogen aspects (combustion, storage, materials, safety)
- ONERA is looking forward to the next collaboration in the frame of Clean Aviation



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