FLYING WHALES

CONNECTING THE LAND-LOCKED WORLD TO THE GLOBAL ECONOMY

FLYING WHALES

"The use of **wood** and bio-sourced products should be stimulated in all the industries and especially in the **construction** industry…"

French Ministry for an Ecological and Inclusive Transition

"Forestry and timber product industry is the second contributor to French trade balance deficit"

French Ministry of Economy & Finance

ONF (French National Forest Agency) must increase its logging by :

- Short term: **1 million m³ / year**
- Mid-term (2026): **12 million m³ / year**

Office National des Forêts

France has large additional resources, but **out of reach** (landlocked areas) with existing solutions

INTRINSIC CHARACTERISTICS

- Helium, used as lifting gas, is not flammable

- Helium is compartmentalised in cells and not pressurised, which reduces major leak risks

- The rigid structure allows to:
  - Attach powerful propulsion anywhere on this structure
  - Ensure the integrity of the envelope shape if a helium leak occurs

- A powerful propulsion ensures stability in case of strong wind

- Multiple propulsion points ensure 6 degrees of mechanical freedom

OPERATIONAL FUNCTIONALITIES

- Certified by top aeronautics authorities

- Pilots and load masters trained specifically for airship loading and unloading operations

- Operations centre: monitors the airship fleet in real time

- Weather-optimized flight route planning enables airships to avoid damaging weather

LOW ENVIRONMENTAL FOOTPRINT

- Load and unload hovering: no footprint on operation
- No energy to overcome gravity
- Low carbon emissions, and soon zero emission

LOW COST

- Low operating costs
- No impact on existing infrastructures

FLEXIBLE

- Point to point
- Loading / unloading on hover flight
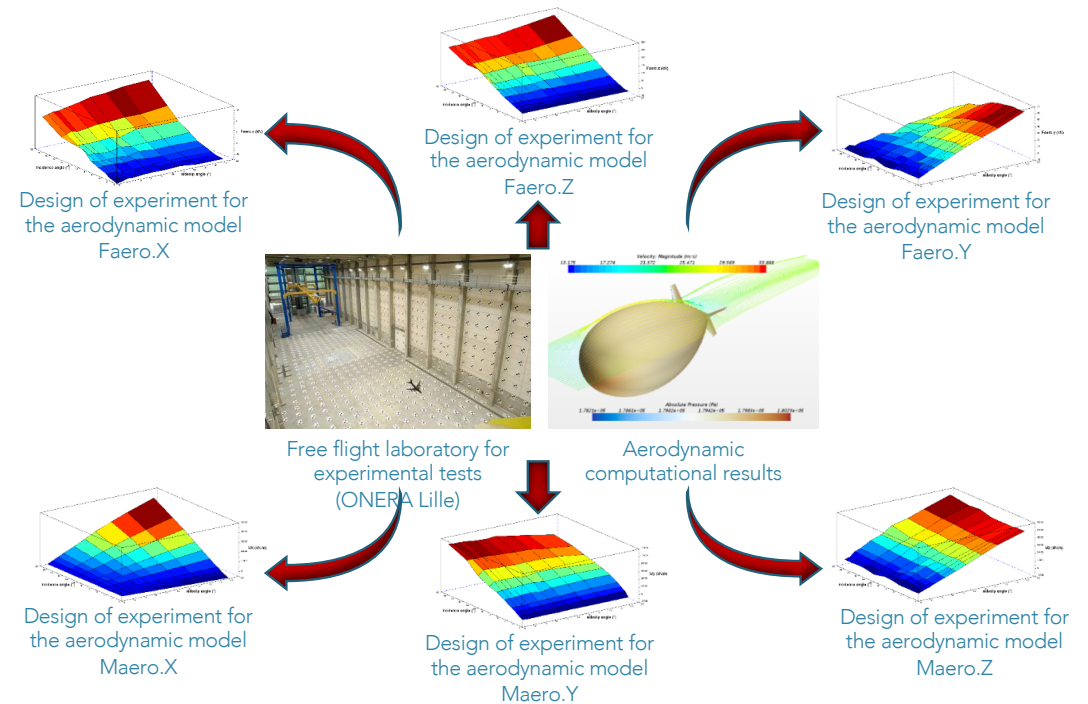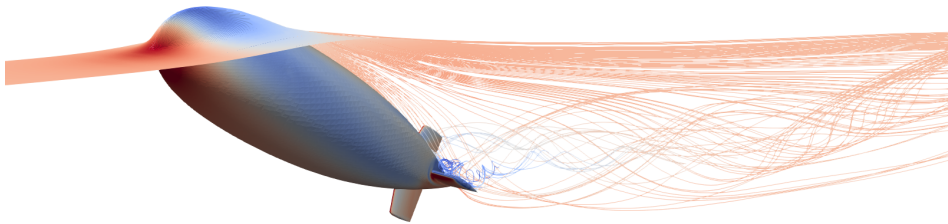- Up to 60 tons payload, in cargo hold or underslings

SAFE

- Helium used as lifting gas
- EASA certified
- Secured ground management

- Generation of the aerodynamic model:
  - ~400 CFD computations to cover the flight envelope
  - The aerodynamic model is generated by computational and experimental means (Onera wind tunnel test campaign

- Generation of the thermal model:
  - CFD

- Evaluation of critical load cases
  - ~5M computations
  - Short scalar computations

Design of experiment for the aerodynamic model Faero.X

Design of experiment for the aerodynamic model Faero.Z

Design of experiment for the aerodynamic model Faero.Y

Free flight laboratory for experimental tests (ONERA Lille)

Aerodynamic computational results

Design of experiment for the aerodynamic model Maero.X

Design of experiment for the aerodynamic model Maero.Y

Design of experiment for the aerodynamic model Maero.Z

# CFD application : combination of cloud computing and Openfoam

- Meshing using Numeca OMNIS : hexaedral unstructured meshing

- Use of Openfoam frees CFD application from licensing hassle
    - Validated industrial flow solver
    - Possible to compute elastically
    - No problem to pre, post and compute at the same time without having to wait for licence availability

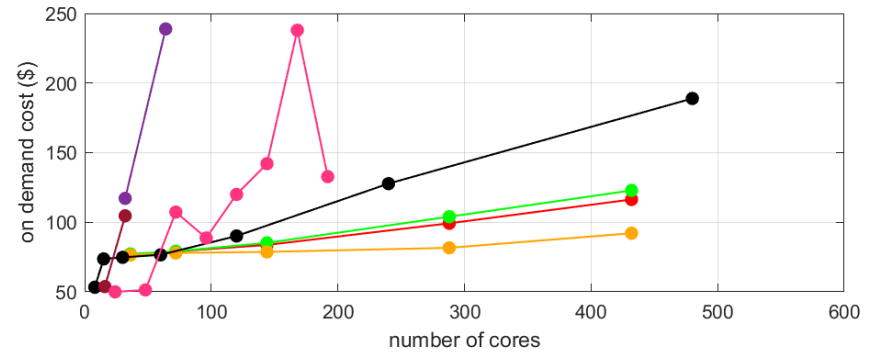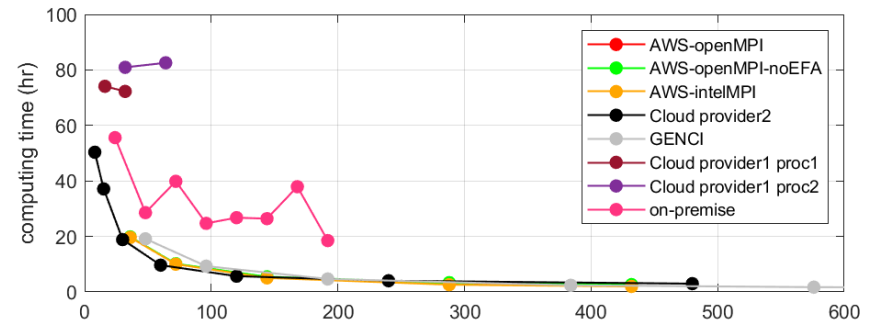- Each user uses his/her own cluster.

Wall streaklines at 20°

 CORPORATE PRESENTATION
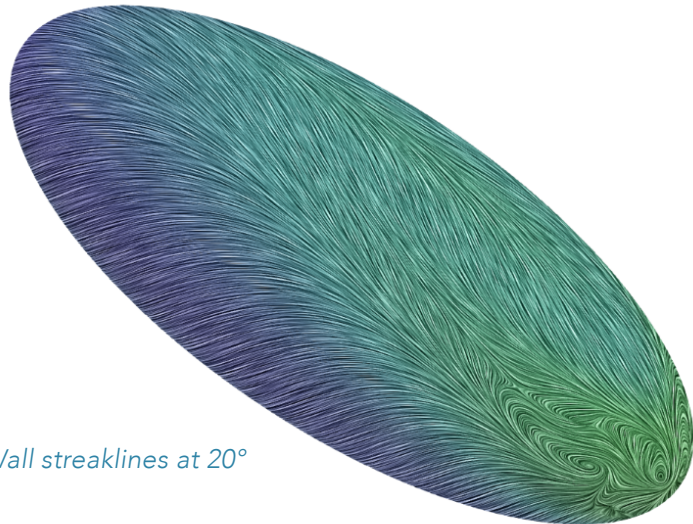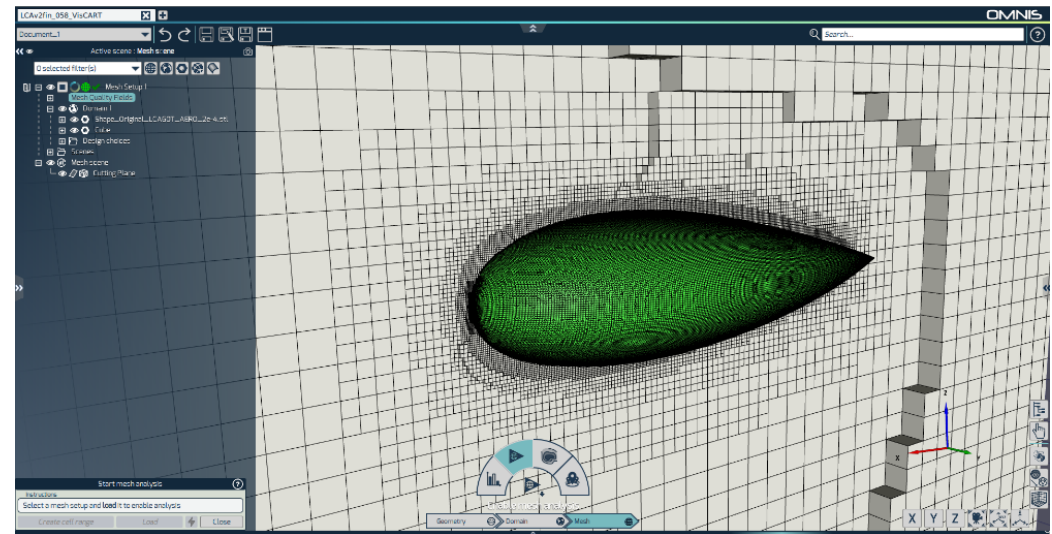
scalability of a 31M cells stationary benchmark (8000 iterations)
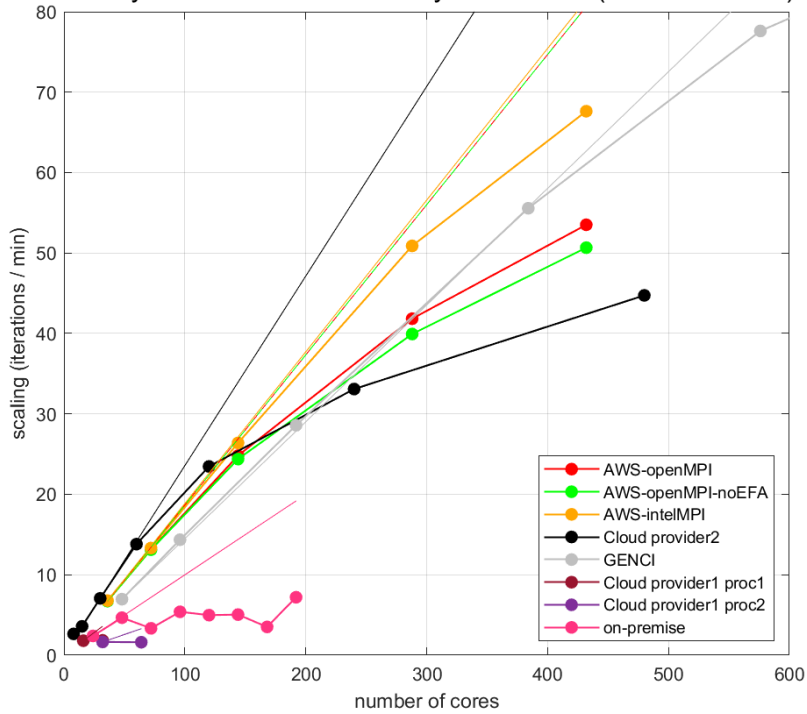
scalability of a 31M cells stationary benchmark (8000 iterations)

- Very high scalability with intelmpi and EFA
- Openmpi does not benefit from EFA

- Combining ressource availability on demand with high scalability allows for an increase in productivity.

AWS scalability: stationary benchmark, 8000 iterations, 31M cells
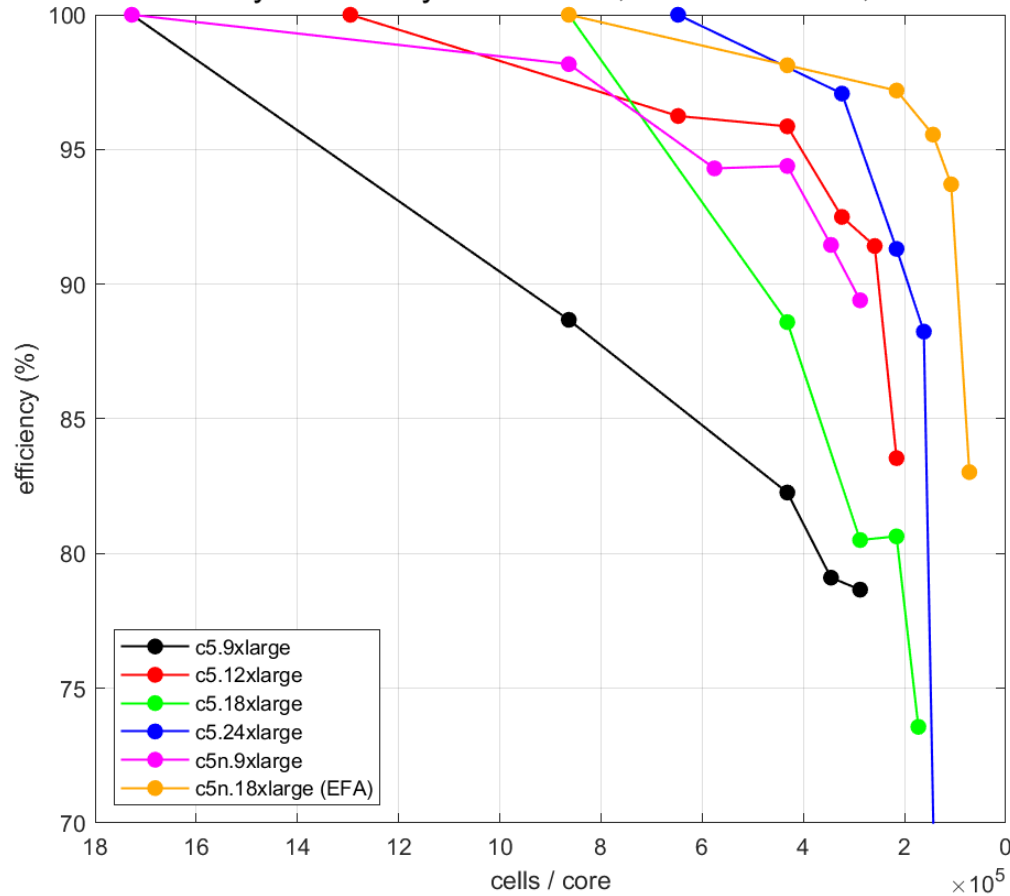
- Machine choice can be adapted as a function of the type of computation
  - Steady computations : a lot of cores on one node
  - Unsteady computations : priority on the interconnect
  - Pre and post processing with specific architecture

- Other future activity could put an emphasis on processor performances (or GPU) more than memory and interconnect : adds flexibility.

FLYING WHALES

THANK YOU