

LIDAR Deployments in Europe

- Vincent Treve
EUROCONTROL Experimental Center

- **The LIDAR technology**
 - How does' it work ?
 - LIDAR capabilities
 - Different usages of this technology
- **European LIDAR deployments**
 - CREDOS
 - WIDAO
 - TBS

The LIDAR technology

How does' it works?

LIDAR or Laser Imaging Detection And Ranging

In other words: "A high frequency radar"

————→ small wave length —————→ Detection of small particles

The LIDAR technology

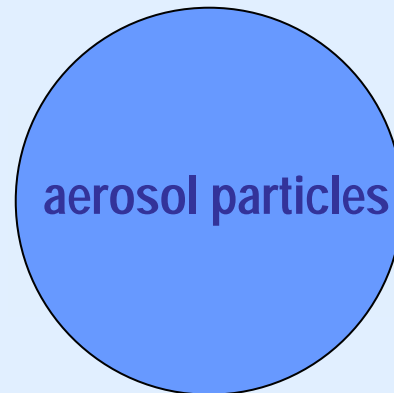
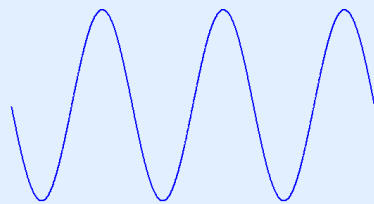
How does' it works?

LIDAR or Laser Imaging Detection And Ranging

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From
LIDAR →



←—————→
Computation of the distance to the aerosol
particles based on the "Time to Fly"

The LIDAR technology

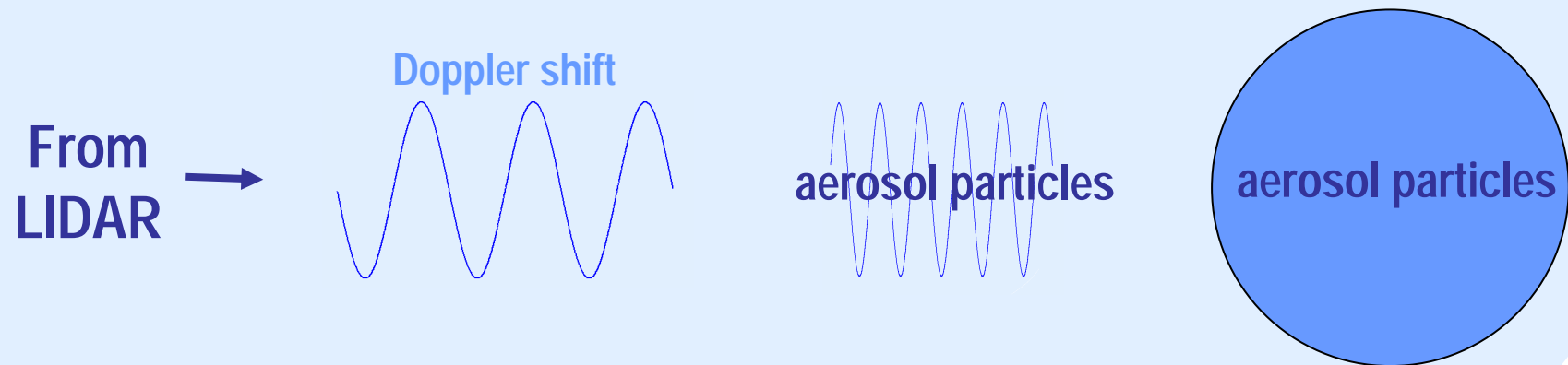
How does' it works?

LIDAR or Laser Imaging Detection And Ranging

In other words: "A high frequency radar"

————→ small wave length ————→ Detection of small particles

————→ Doppler measurement



Axial velocity measurement

The LIDAR technology

How does' it works?

Different LIDAR systems



WindTracer®, Lockheed Martin
Coherent Technology (LMCT)



ZephIT™, QinetiQ



WindCube,
Leosphere

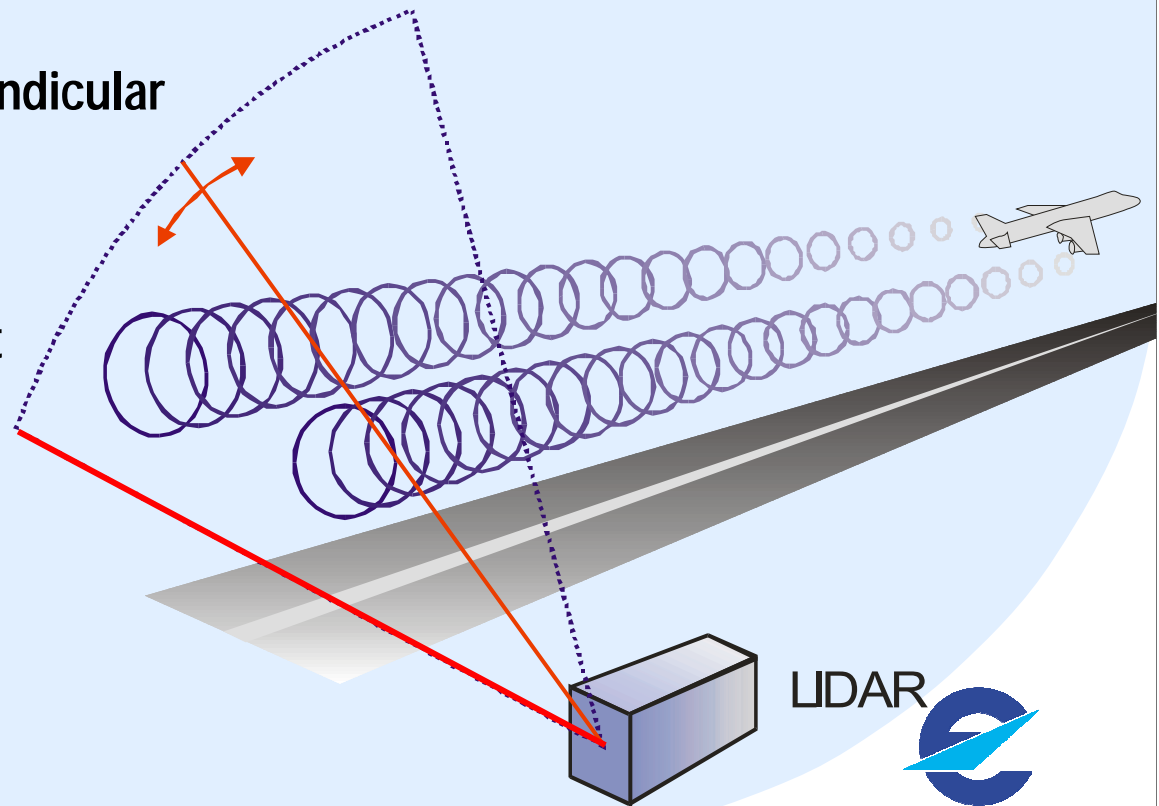
Fibered
LASER

The LIDAR technology

LIDAR Capabilities

Both technologies scan 2D planes for detecting Wake Vortices

- Limited range (WindCube) or blind zone (WindTracer®) impose site constraints
- Ideal LIDAR position is perpendicular to aircraft trajectory.
- Measurement can be conducted laterally...

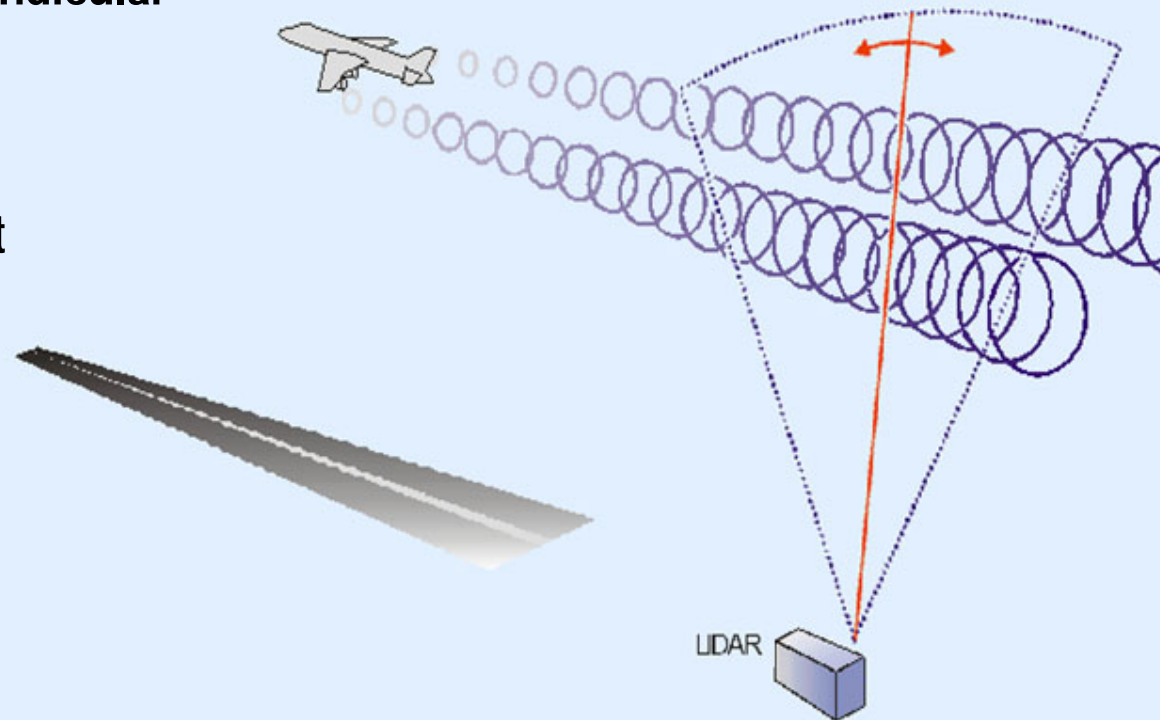


The LIDAR technology

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- Ideal LIDAR position is perpendicular to aircraft trajectory.
- Measurement can be conducted laterally...
- ... or from below.



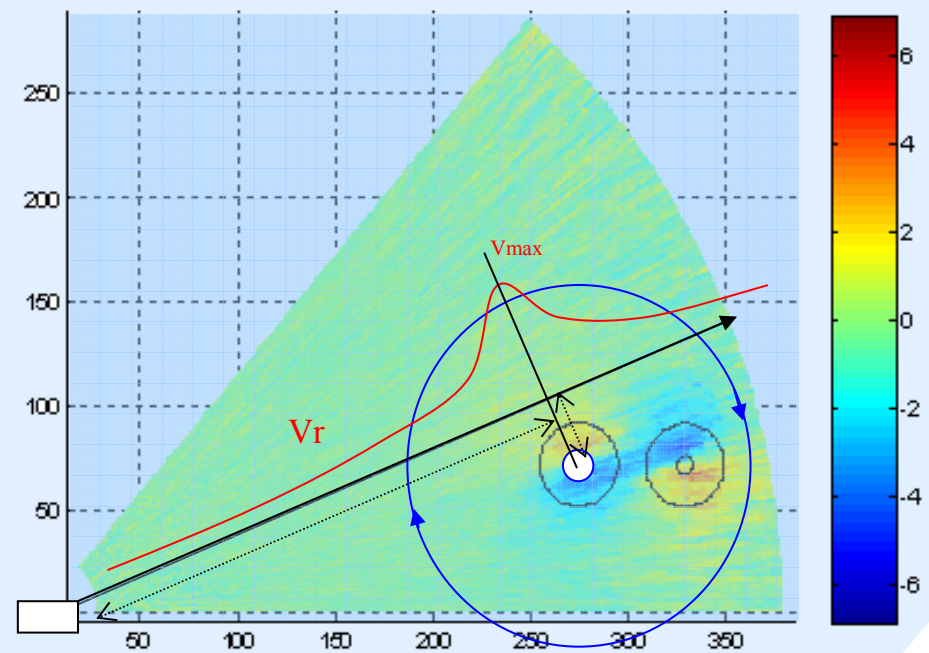
The LIDAR technology

LIDAR Capabilities

Different capabilities of this technology

Wake vortex detection and tracking :

- Axial velocity measurement (hardware)



ONERA / Leosphere results

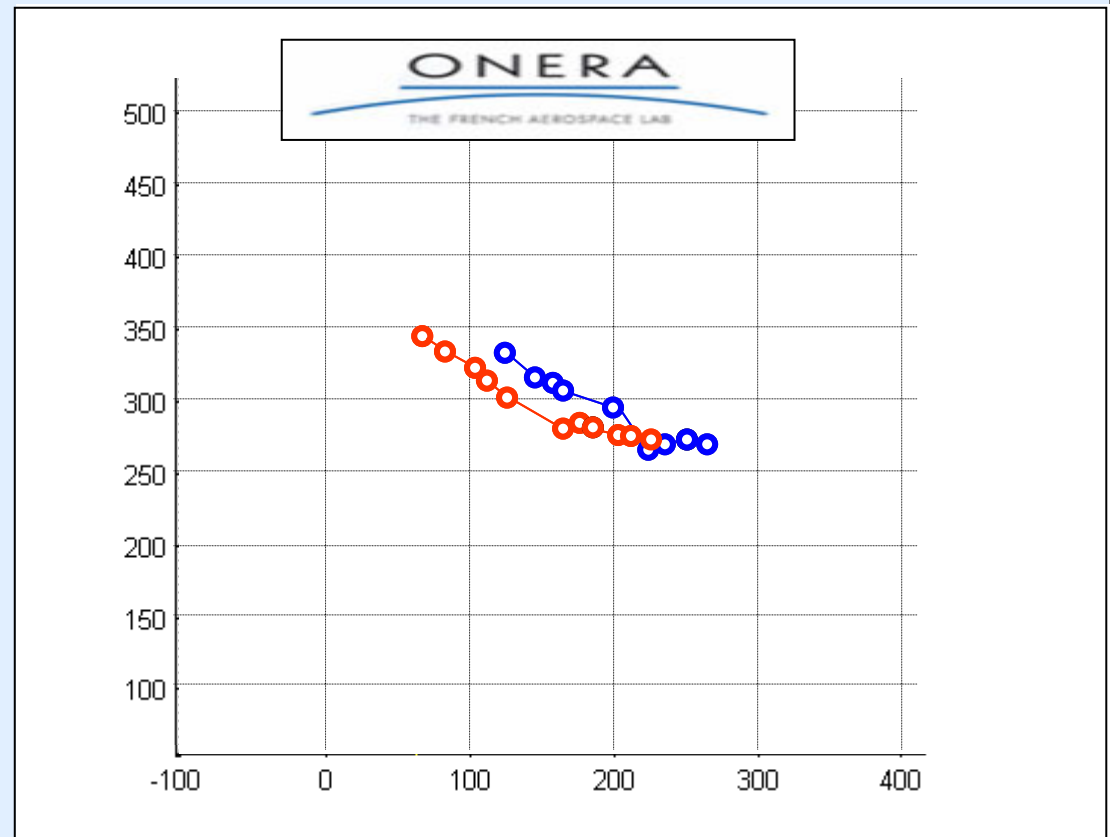
The LIDAR technology

LIDAR Capabilities

Different capabilities of this technology

Wake vortex detection and tracking :

- Axial velocity measurement (hardware)
- Conversion in 2D vortex position and strength (software)



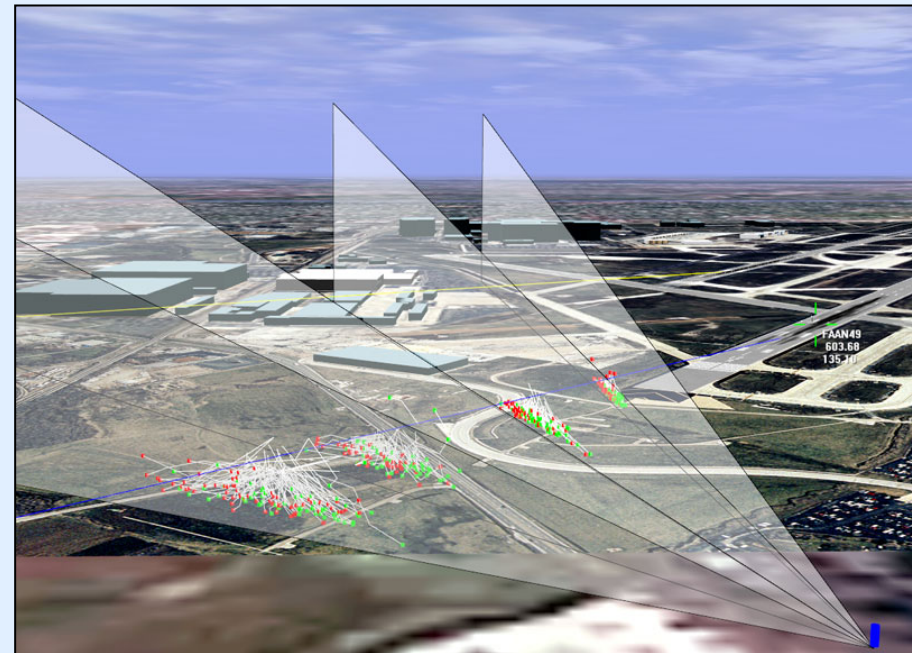
The LIDAR technology

LIDAR Capabilities

Different capabilities of this technology

Wake vortex detection and tracking :

- Axial velocity measurement (hardware)
- Conversion in 2D vortex position and strength (software)
- Multiple scan angle capability



The LIDAR technology

LIDAR Capabilities

Different capabilities of this technology

Wake vortex detection and tracking :

- Axial velocity measurement (hardware)
- Conversion in 2D vortex position and strength (software)
- Multiple scan angle capability

Wind profile measurement :

- Simultaneous wake and wind profile measurement in the scanning plane or
- Periodic 3D mapping of the wind

The LIDAR technology

Different usages of LIDAR

Different usage of this technology

Research : (qualitative)

Temporary deployments for :

- Investigation of Wake Vortex transport and decay
- Improvement of Wake Vortex model

Validation and assessment : (quantitative)

Temporary deployments for :

- Validation of systems or models
- Safety assessment of new operational concepts

Operational surveillance :

Permanent deployments for :

- New operational concept monitoring
- Wake vortex alerting system
- Tactical aircraft sequencing

LIDAR deployments in Europe

3 campaigns

CREDOS (Frankfurt Main - EDDF) : Ongoing

- Research
- Validation
- Assessment

WIDAO (Paris CDG - LFPG) : About to start

- Research
- Validation
- Assessment

TBS (London Heathrow - EGLL) : 2008

- Research
- Validation
- Assessment

LIDAR deployments in Europe

CREDOS (Frankfurt Main – EDDF)

Research objectives :

- Investigate Wake Vortex behavior IGE and NGE: Mainly Heavy departing aircraft
- Improve Wake Vortex models IGE and NGE

Validation objectives :

- Validate Wake Vortex models
- Validate ONERA LIDAR technology

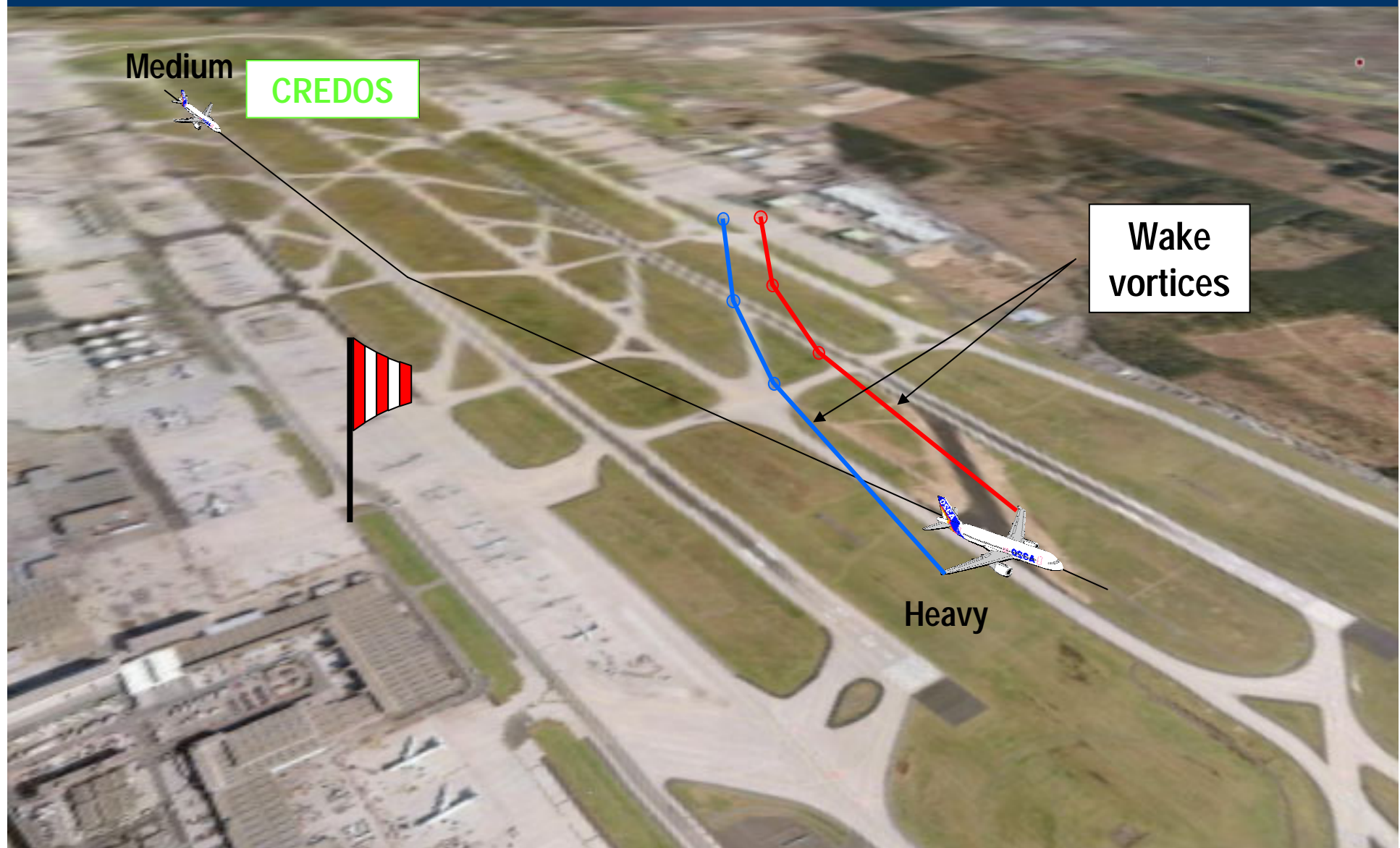
Safety assessment objectives :

Assess the safety of reduced cross wind departure separations :

- In correlating cross wind and vortex transport
- In correlating wind along the departure trajectory with measured ground wind

LIDAR deployments in Europe

CREDOS



LIDAR deployments in Europe

CREDOS

Equipment available

LIDAR systems :

US
LIDAR

DLR
LIDAR

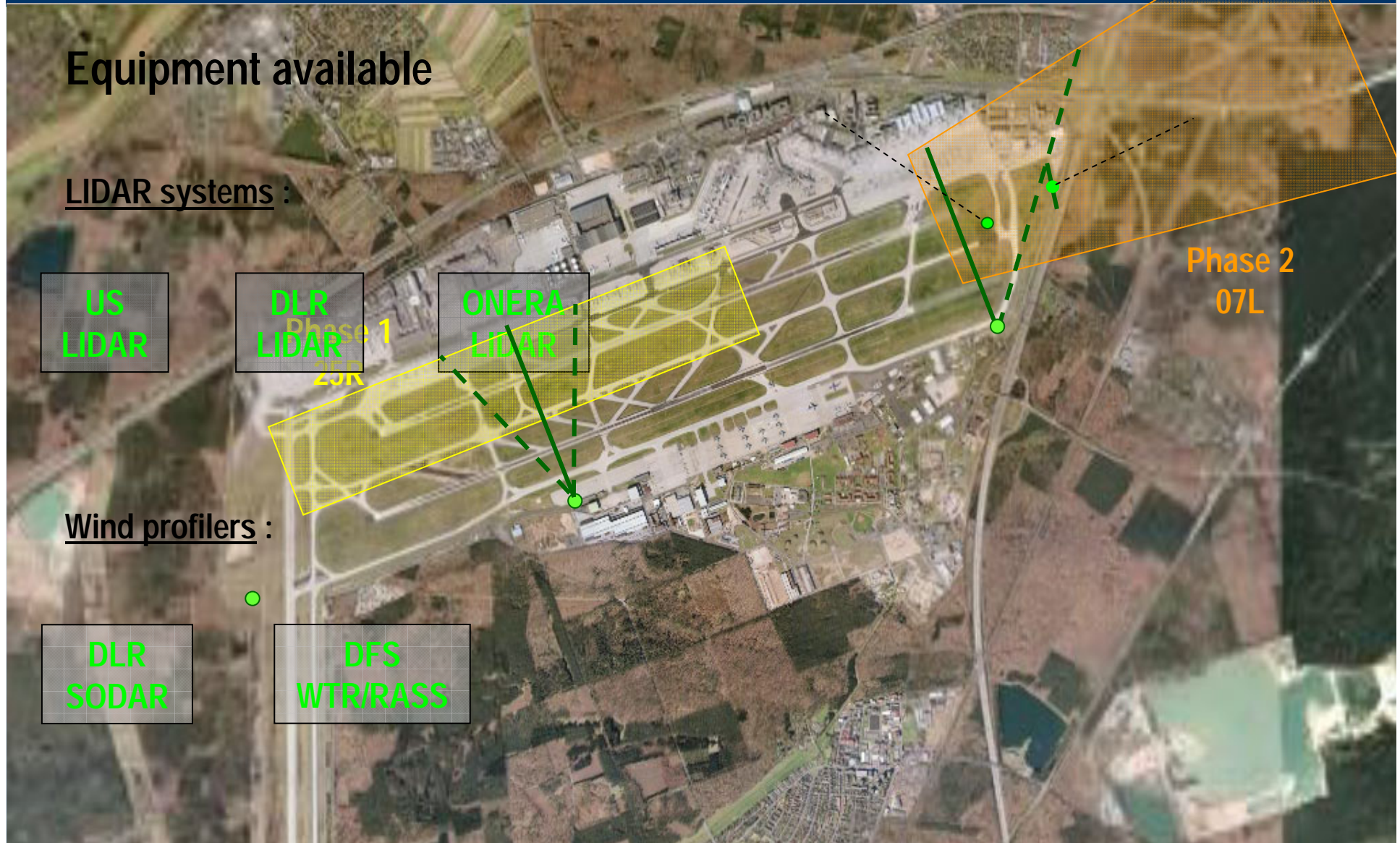
ONERA
LIDAR

Wind profilers :

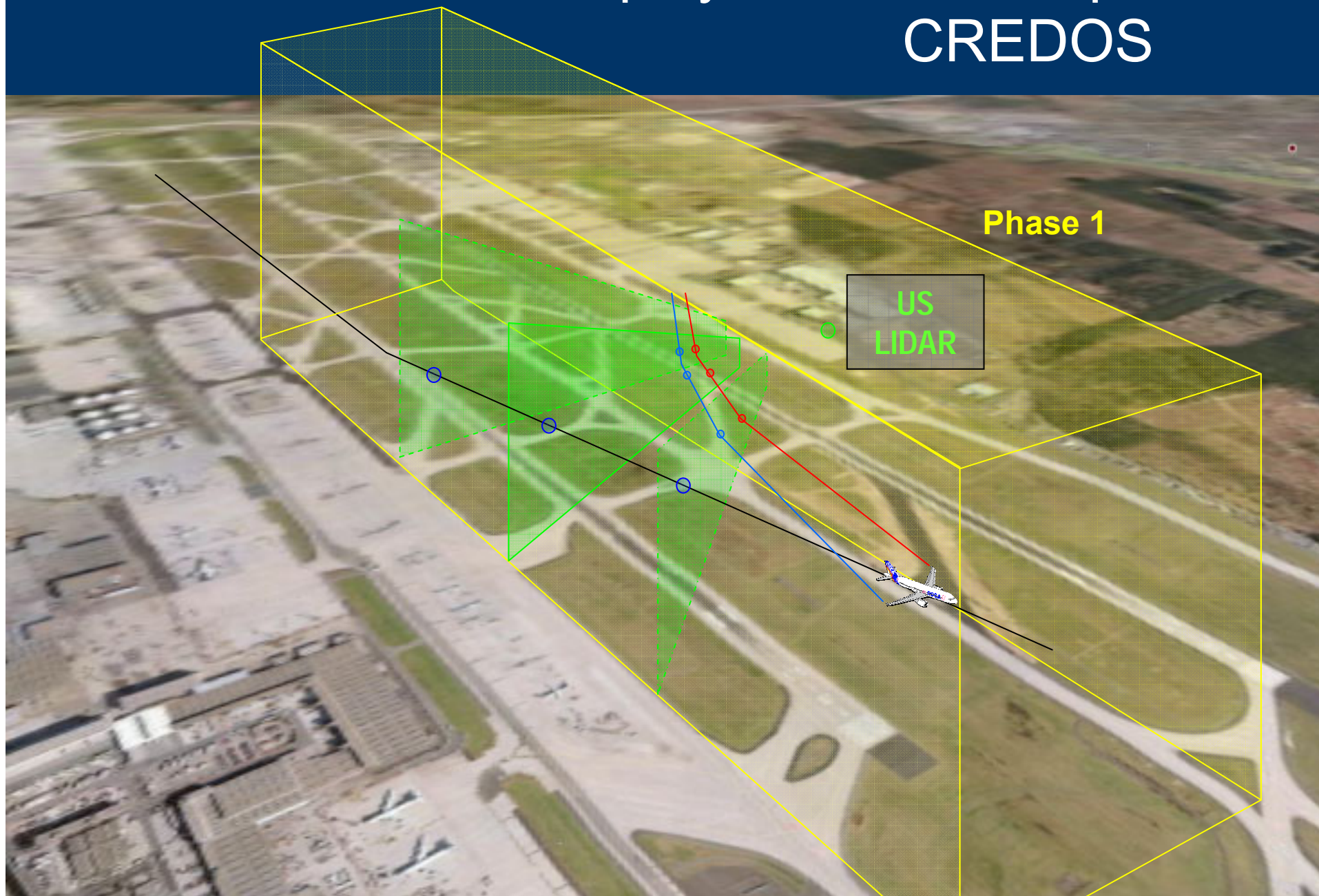
DLR
SODAR

DFS
WTR/RASS

Phase 2
07L



LIDAR deployments in Europe CREDOS



LIDAR deployments in Europe

CREDOS



LIDAR deployments in Europe

WIDAO (Paris CDG – LFPG)

Research Objectives (second priority)

- Enrich data collection for further background wake vortex study

Validation objectives (second priority)

- Validate Radar technology for wake vortex detection and measurement (conditional)

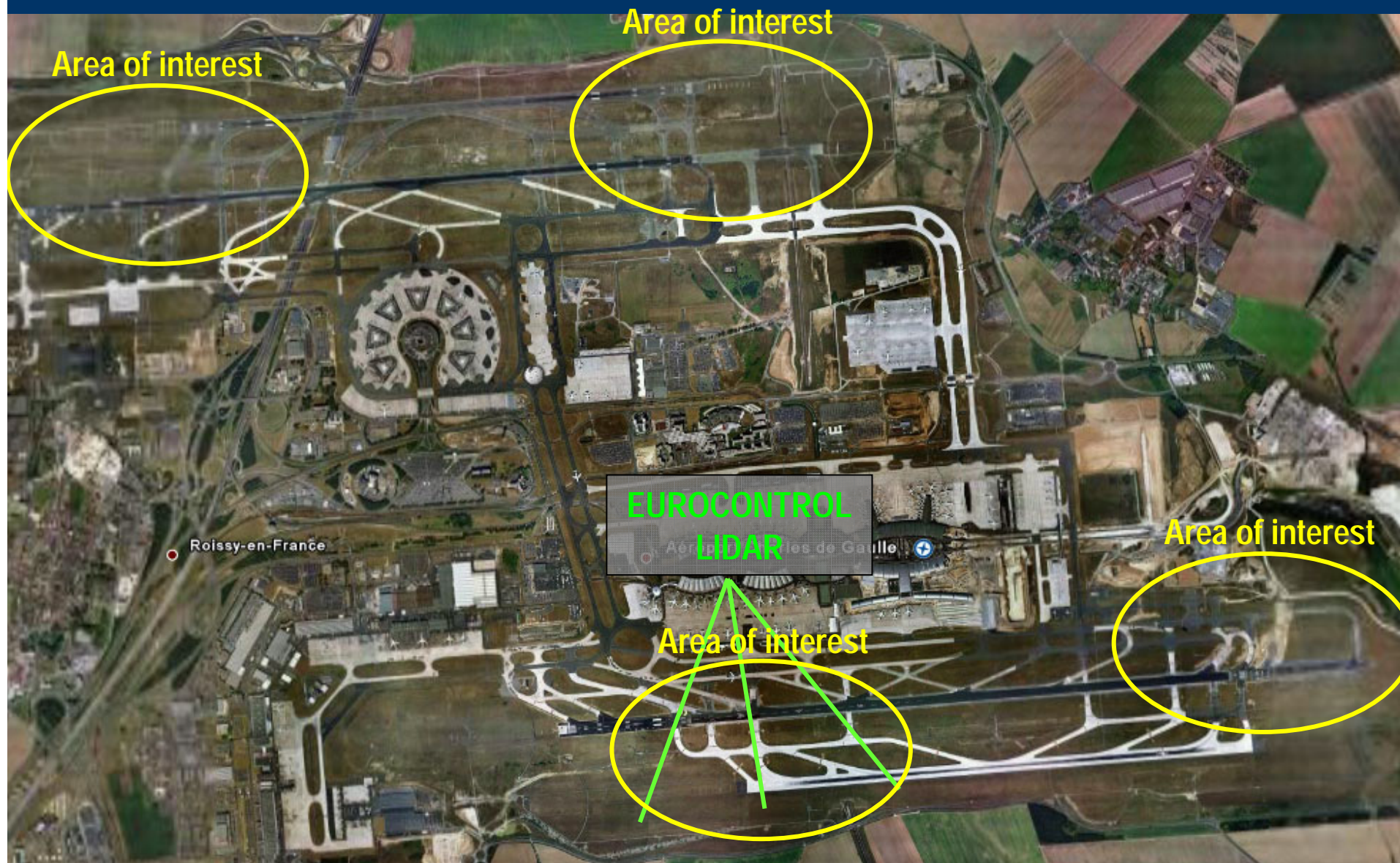
Safety assessment Objectives (first priority)

Relieve the dependency constraints between arrival and departure on CSPR :

- Medium departure while Heavy arriving
- Heavy departure while Medium arriving

LIDAR deployments in Europe

WIDAO



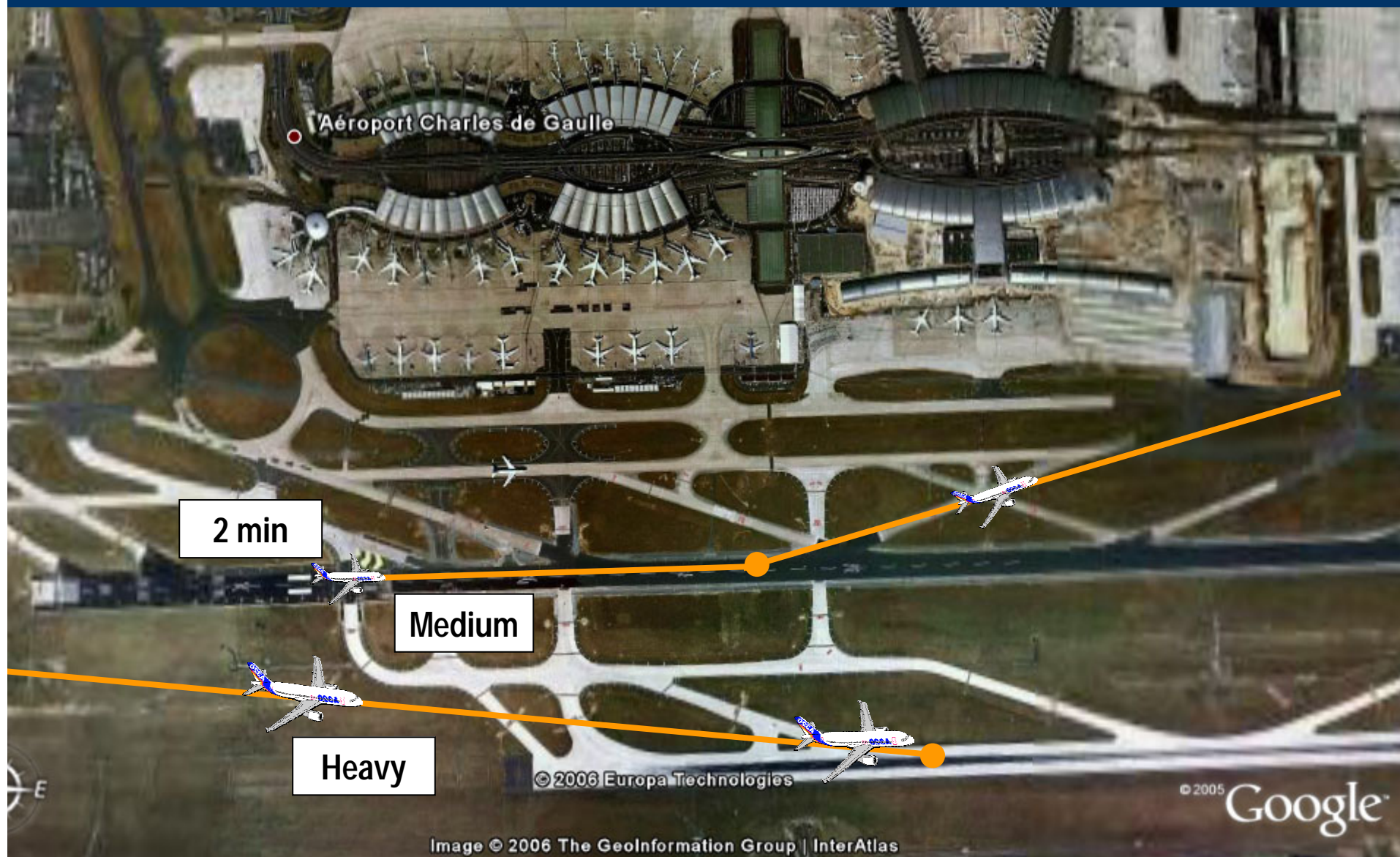
LIDAR deployments in Europe

WIDAO



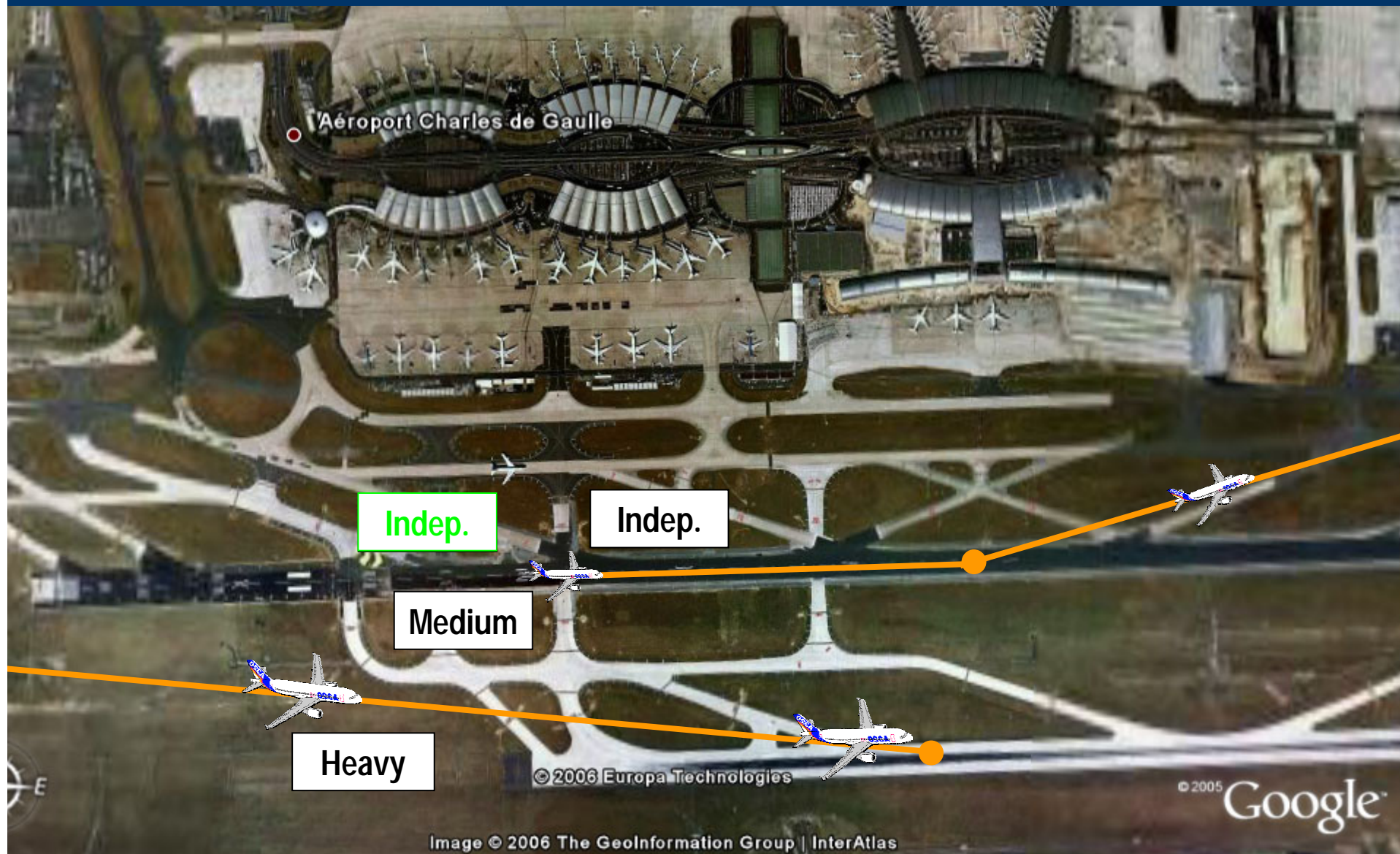
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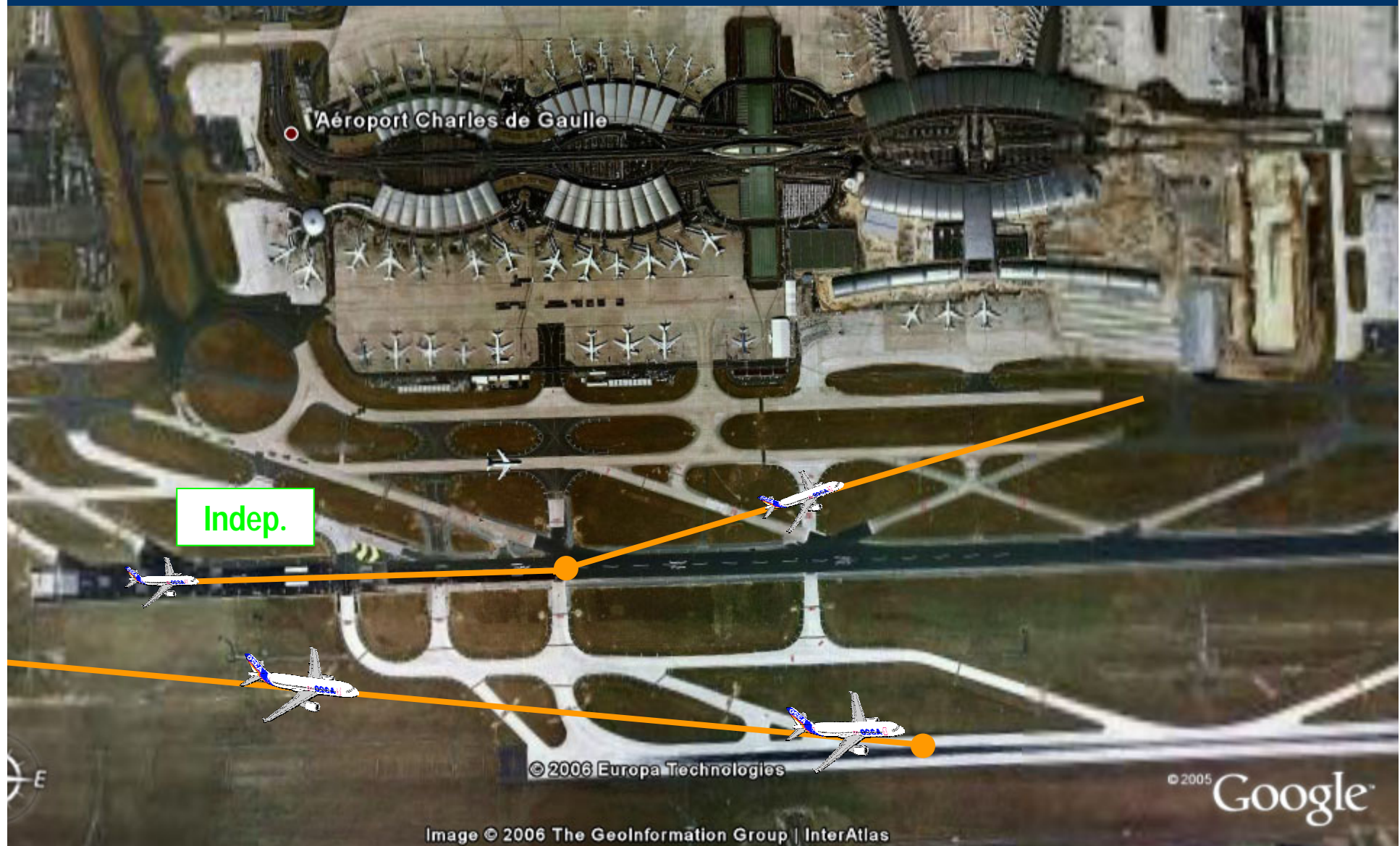
LIDAR deployments in Europe

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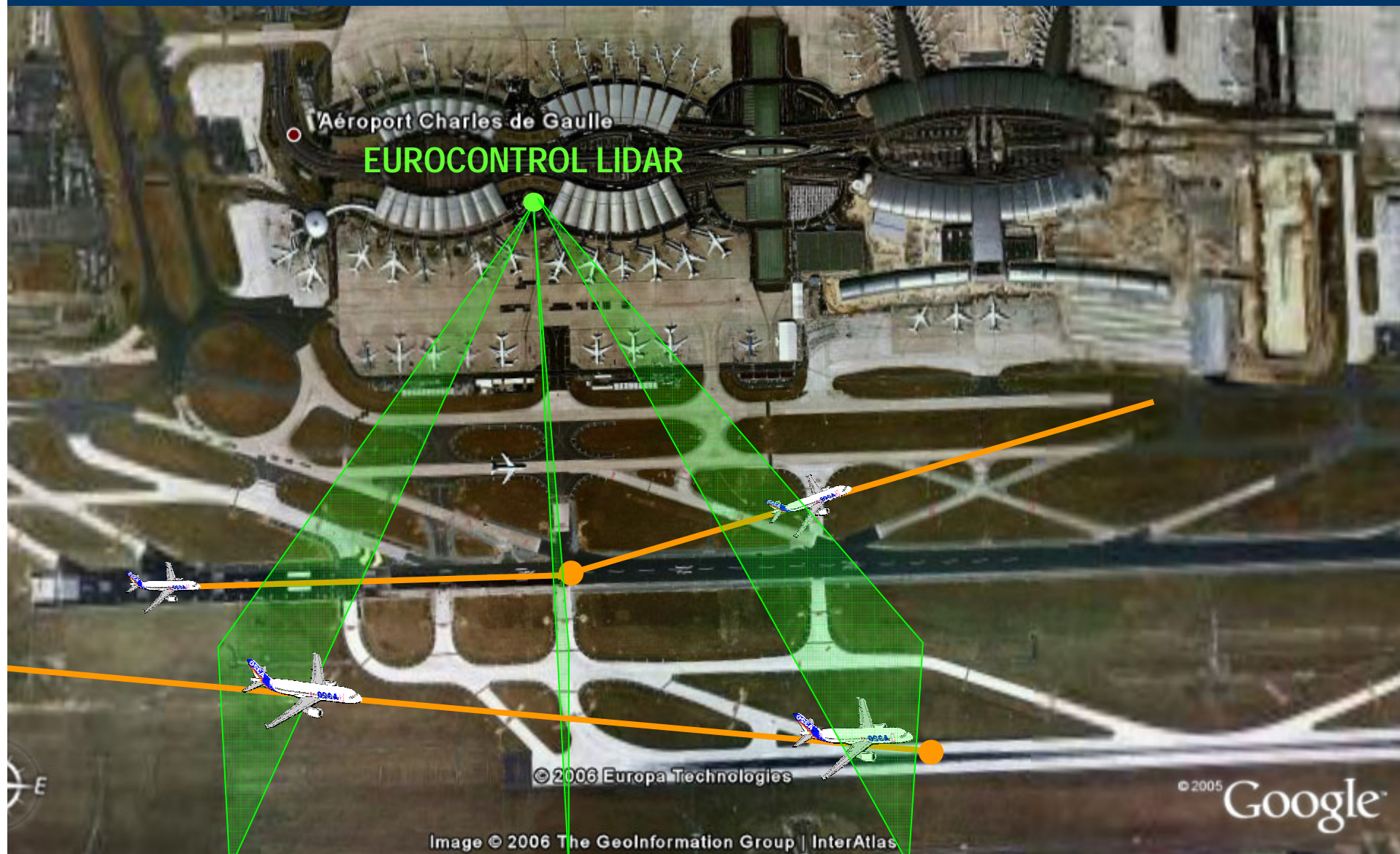
LIDAR deployments in Europe

WIDAO



LIDAR deployments in Europe

WIDAO



LIDAR deployments in Europe

TBS (Preliminary)

Objectives of the TBS LIDAR deployment (London Heathrow - EGLL)

Research objective (second priority)

- Investigate wake vortex behavior IGE and NGE (especially when generated by Heavy)

No technological validation objectives for the moment ??

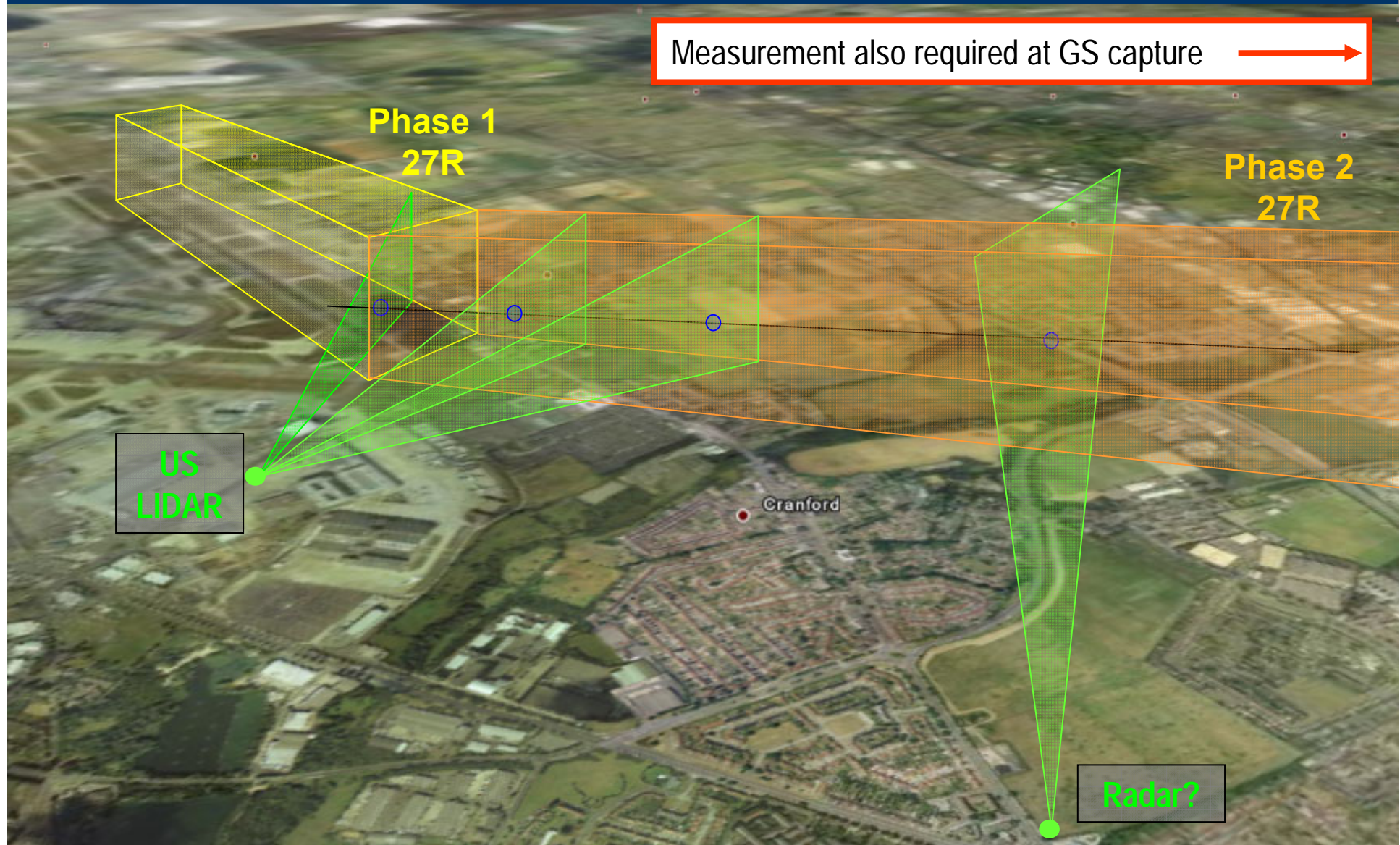
Safety assessment objectives (first priority)

Establish the safety of time based separations under significant head wind condition :

- In the final approach phase
- Along the glide slope
- At the interception

LIDAR deployments in Europe TBS (Preliminary)

Measurement also required at GS capture →



Questions ?

