Using the HLA, Physical Modeling and Google Earth for Simulating Air Transport Systems Environmental Impact

(09S-SIW-045)

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retour sur innovation

Summary

- The IESTA Program at the French Aerospace Laboratory
- Prototyping the IESTA simulation platform
- Simulation steps
- Using Google Earth for scenario generation and results display
- Conclusions

The IESTA Program at the French Aerospace Laboratory (ONERA – Center of Toulouse – France)

Context and Objectives :

- To design a simulation platform for evaluating new air traffic transport systems focusing on environment, security and capacity
- To unify ONERA skills in physics modeling, systems integration and simulation architectures
- Funding sources: French « Midi-Pyrénées » Region, French State and the European Fund for the Regional Development (FEDER). About 13 MEuros.
- 2 main phases:
  - **Clean Airport** (IESTA.V1 version). Noise and chemical emissions impact on airports vicinity – June 2009
  - **SimSky** (IESTA.V2 version). ATS concepts - 2011

Prototyping the IESTA Platform

Objectives:

- To prepare and facilitate the integration of physics models (only the noise impact model) within the operational platform
- To investigate the capabilities of earth browsers such as *Google Earth* for displaying both simulation scenario and noise impact results in real time

Technical Issues:

- Distributed simulation using the High Level Architecture (HLA) and the *CERTI RTI* (Open source middleware designed at ONERA)
- (09S-SIW-015)
- Google Earth and KML language
- *X_Plane* from Laminar Research for scenario generation (aircraft trajectories)
- Associated tools such as *Goodway* (Flight planner for X-Plane) and *Xplage* (Tracking X-Plane flight output data and depositing the track within a file)
- The prototype is written in C++ using the *Code::Blocks* IDE under Windows XP or Vista

Some Words about Google Earth Browser

Collaborative tool aiming at handling and representing geographical data in 3D over both the earth and space.

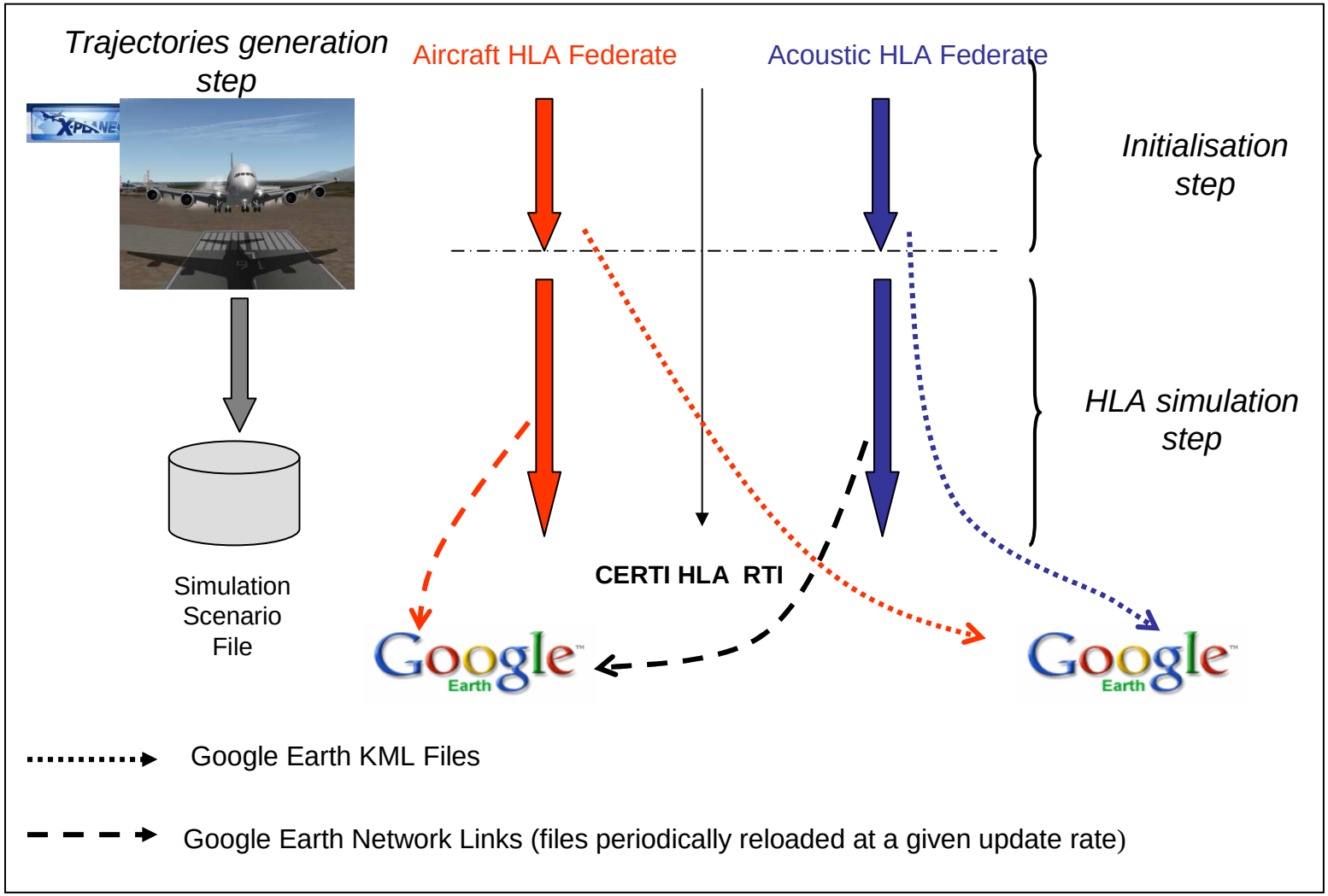
Useful capabilities:

- Richness and completeness of 3D geographical data through satellite imagery
- Collaborative tool
- Many additional tools or capabilities are available with GE:
  - designing geometric shapes(GE SketchUp),
  - calculating distances and surfaces,
  - displaying statistical data in real time (population density, weather data, pandemics, air traffic flows …..)
- Simplicity and efficiency of the KML language, an XML-based language for expressing geographic annotations

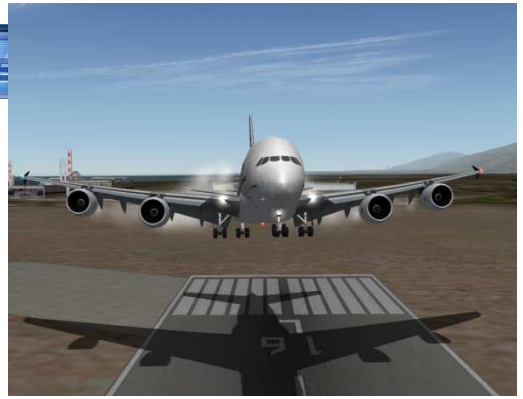
GE Cost: a freeware version, GE Pro (400 $/year)

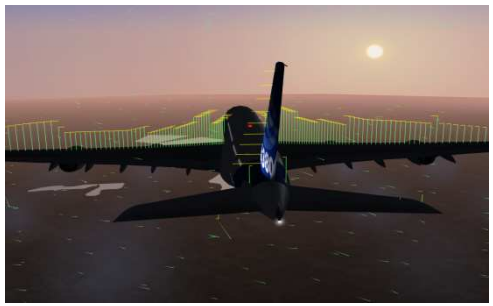
New version (GE 5.0) since January 2009 with Ocean Views

Scenario Generation and Simulation Steps



First Step: Aircraft Trajectories Generation (X-Plane)

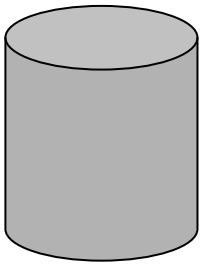




UDP datagrams from X-Plane
(1 every 2 seconds)

XPlage

Aircraft trajectory
Trajectory_xxx.txt



(UTC date, lon, lat, alt, hdg, pitch, roll …)

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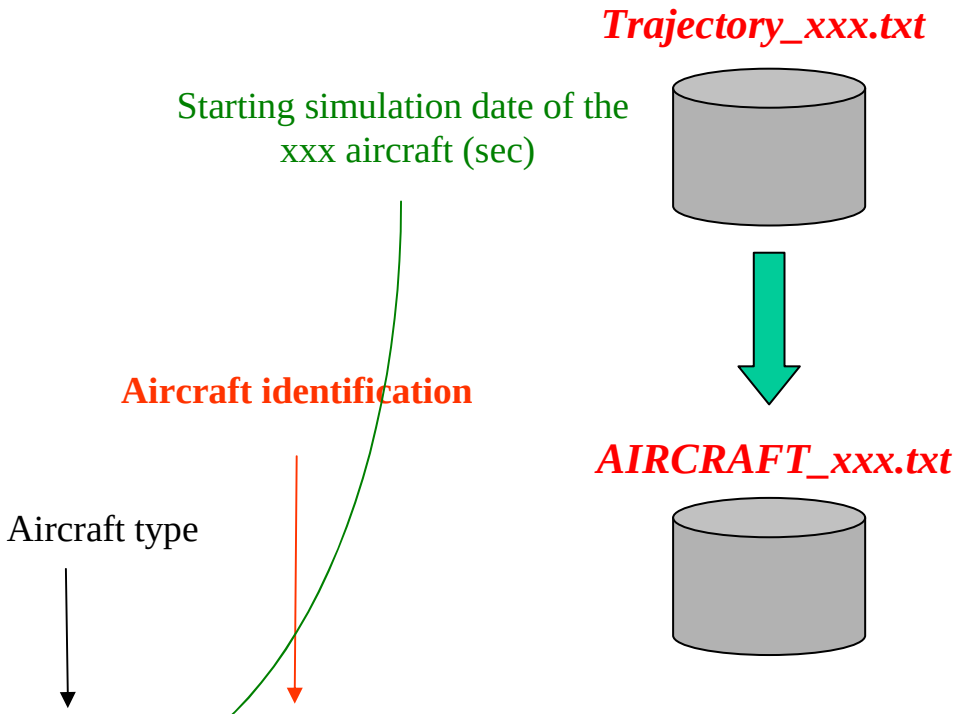
Second Step: Creating a Simulation Scenario (1/2)



A380 **LU401** **A_380_TO_14L_LA_14R**
280
2009-02-20T21:02:44Z **1.357741** **43.637264** **504.369873** **143.139282** **0.019813** **-0.459715**
……..
……..
……..
……..
……..
……..

State vector (X-Plane, XPlage)

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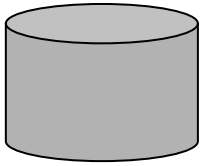
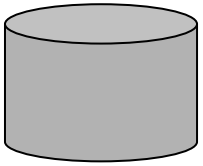
Second Step: Creating a Simulation Scenario (2/2)

INIT_NOISE_IMPACT.txt



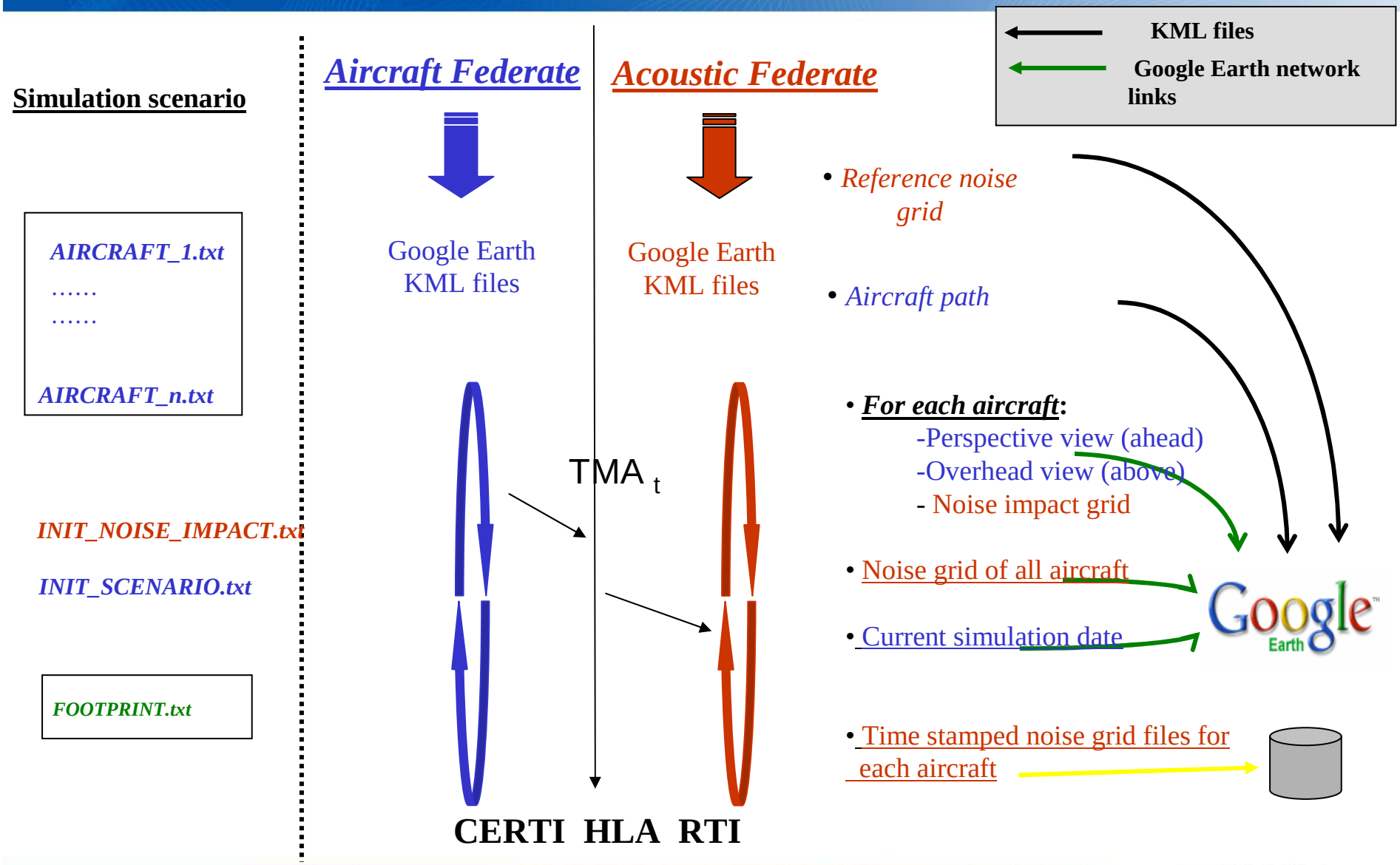
```
TOULOUSE BLAGNAC AIRPORT
43.629 1.364        // Latitude – Longitude of the reference point of the
                       noise grid (Airport control tower)
FIC_GAB_ACOU_CESAR_I/
FIC_GAB_ACOU_SIMOUN/
BLAGNAC_20_03_2007

25 40               // Size of the noise grid (East, North)

800 625             // Size in meters of every grid point  (East, North)

2                   // Number of noise frequencies
125.0 315.0         // Noise frequencies

Output_Files/       // Results directory
IESTA_G1_
10
LB324 LB325 AF326 LB327 LF324 LF325 LF326 LA320 LT543 LU401
5
A320 A340 A380 B747 A300
```

INIT_SCENARIO.txt

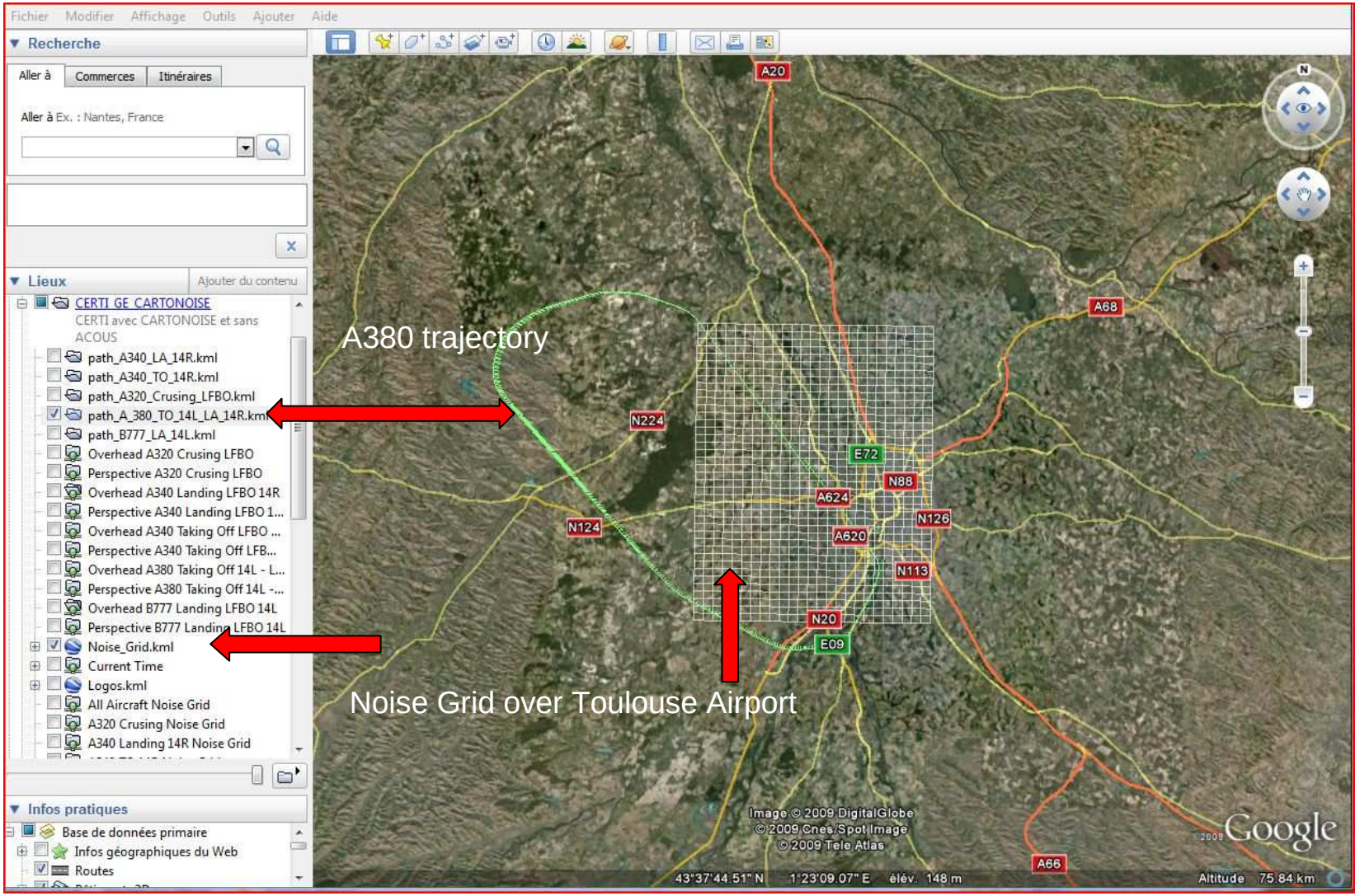


```
5        // Aircraft number

250.0    // Starting simulation date (sec)

2        // Acquisition rate (sec)
```

Third Step: Distributed Simulation through HLA



Google Earth Handling



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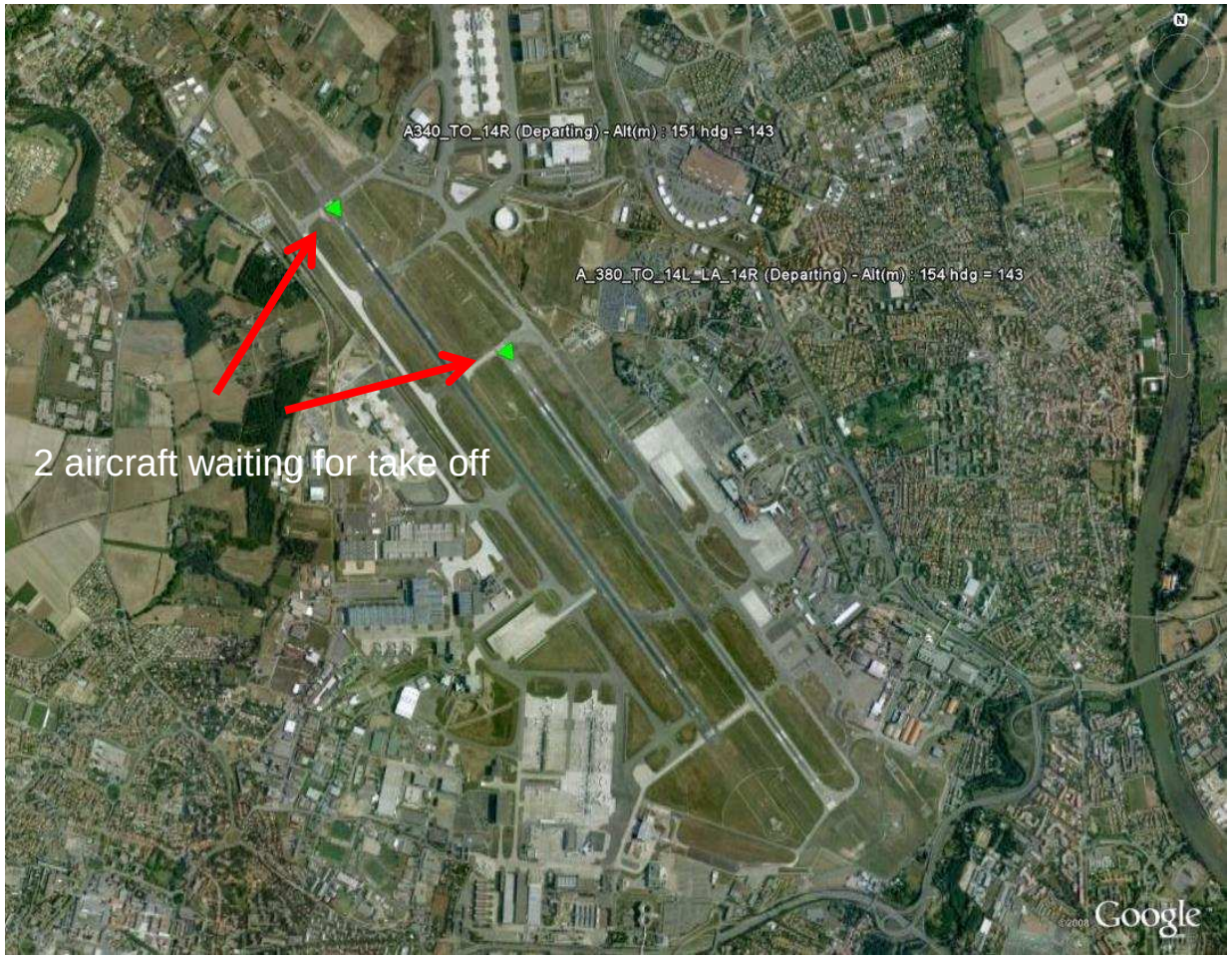
Google Earth Snapshots: Initialisation



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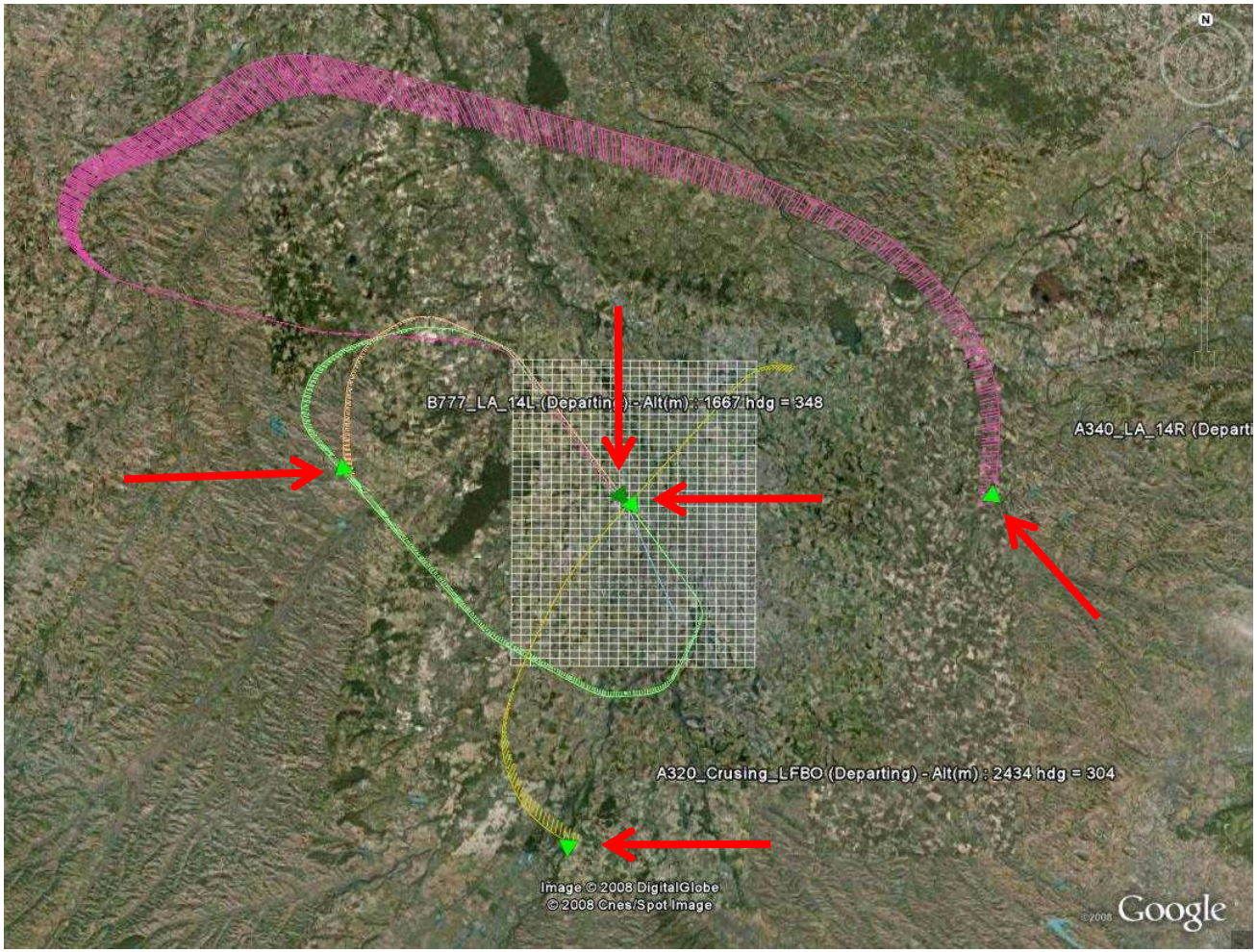
Google Earth Snapshots: Paths and Noise Grid



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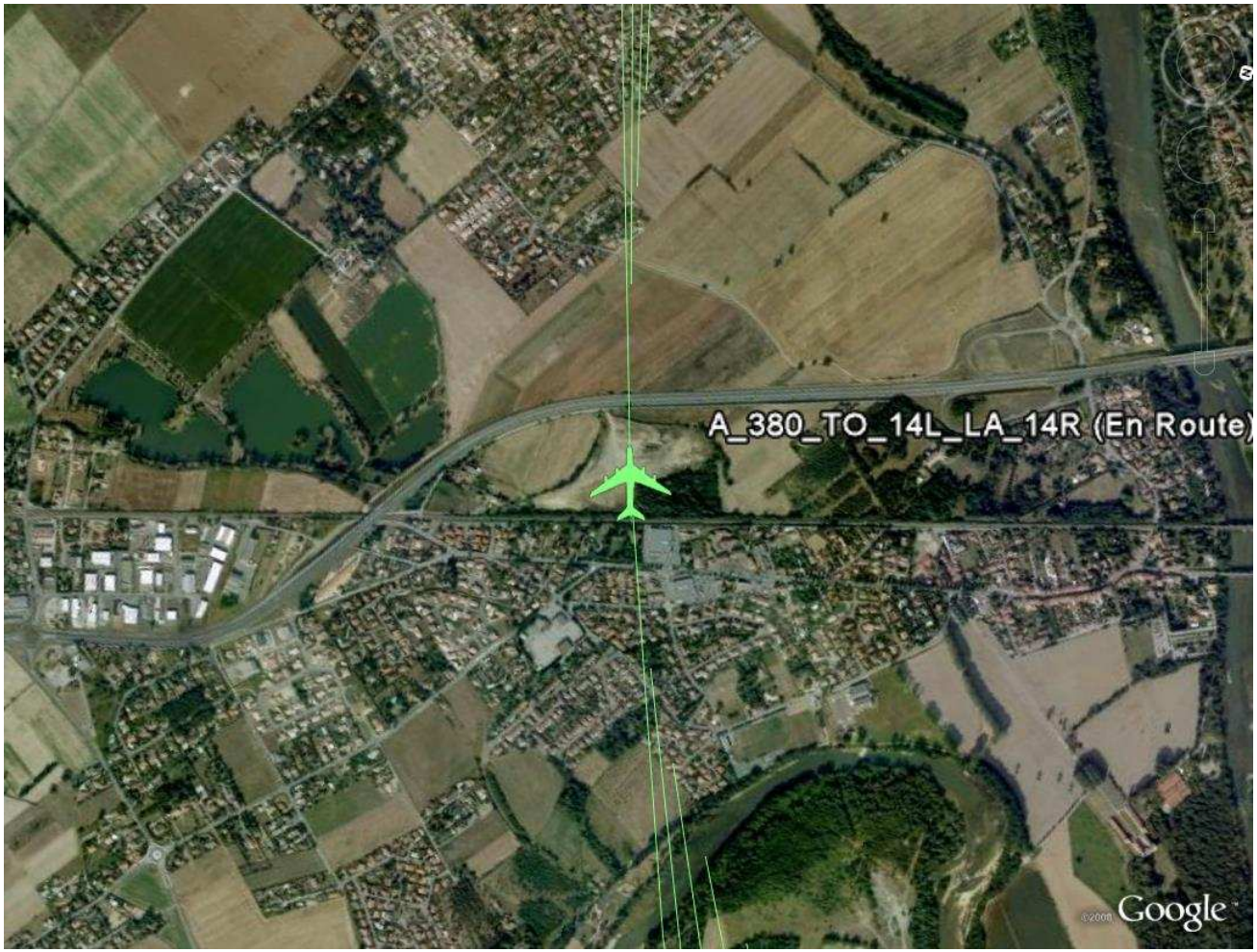
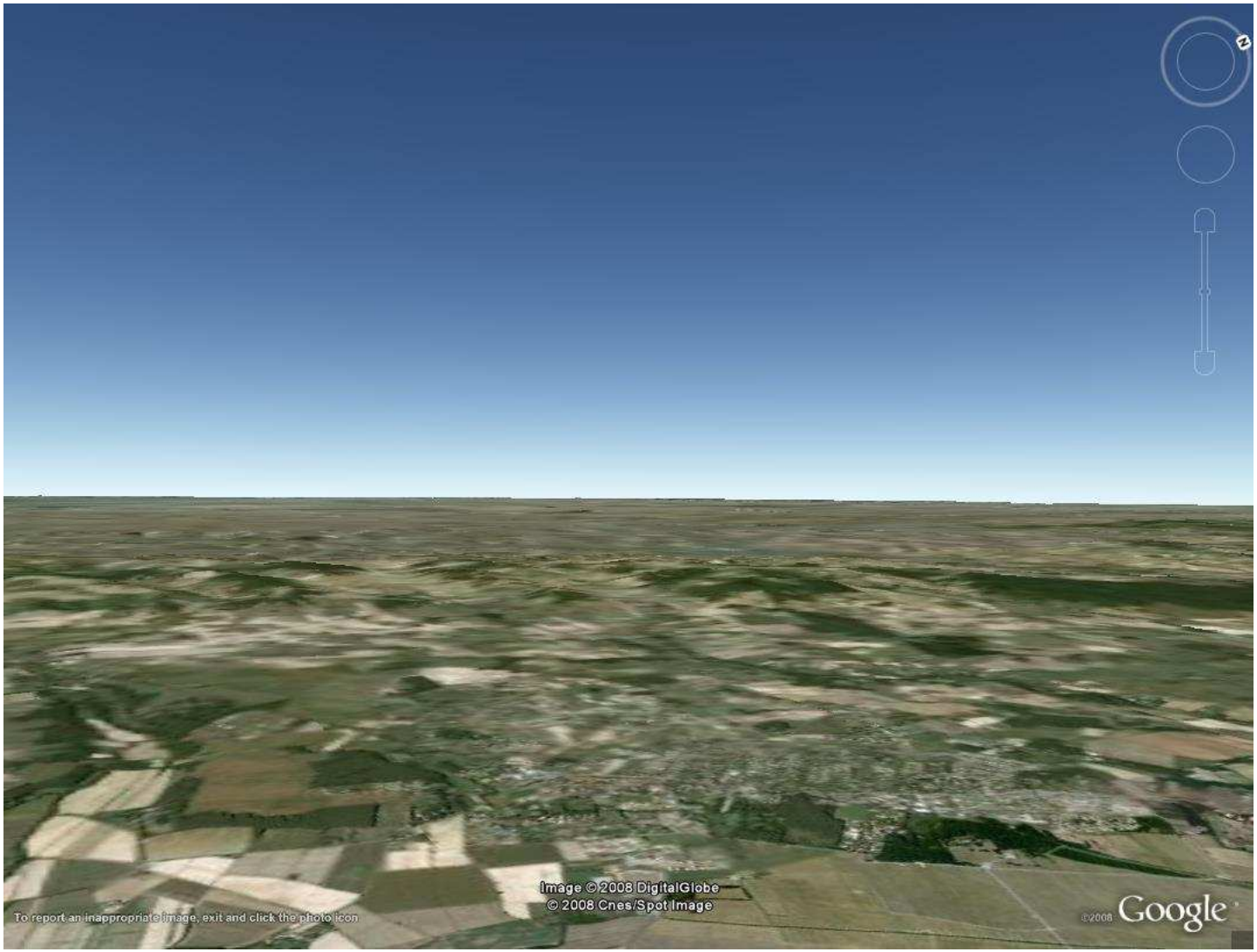
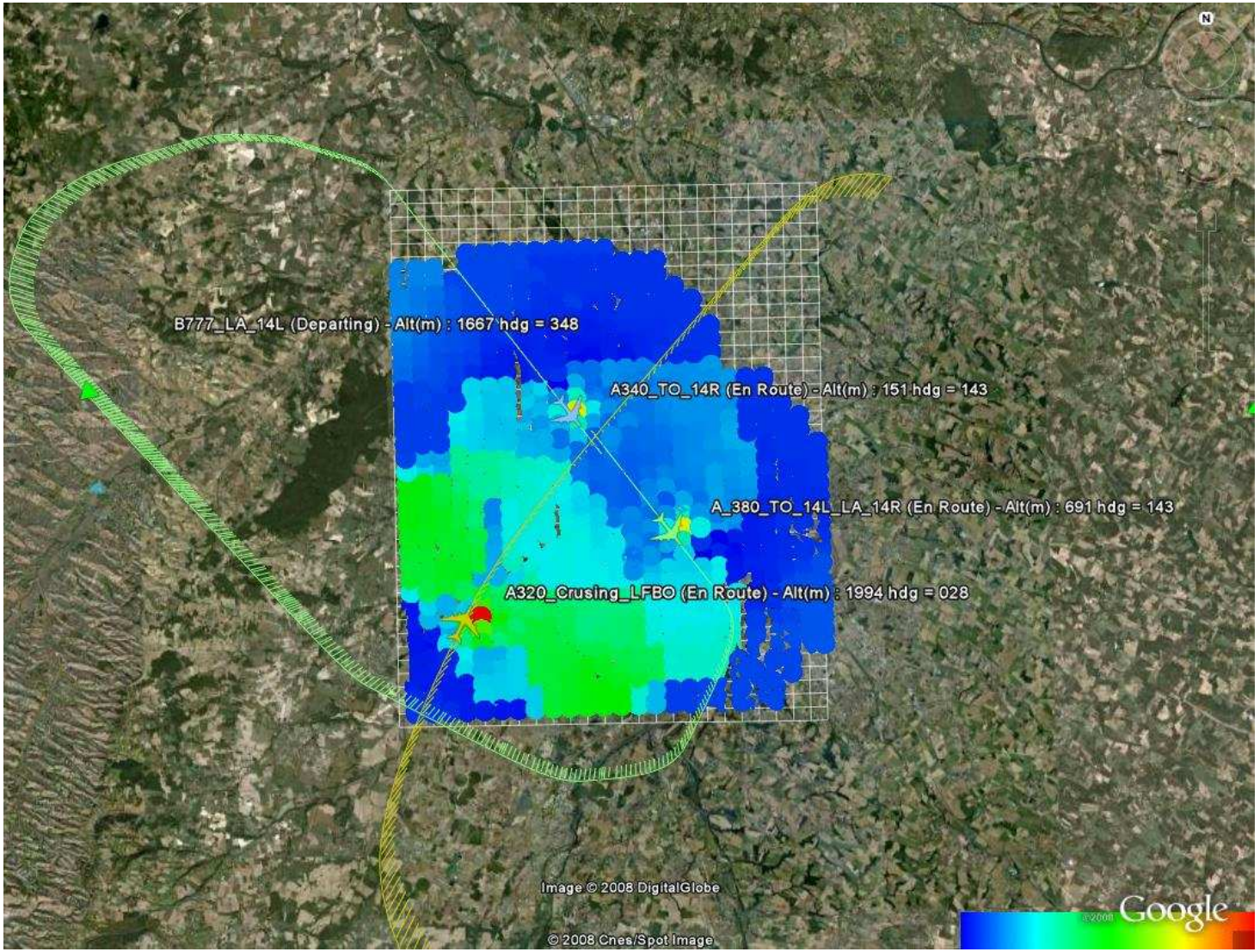
Google Earth Snapshots: Overhead view



Google Earth Snapshots: Perspective View



Google Earth Snapshots: Noise Impact



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Current trends and conclusions

- Just a prototype of the IESTA platform:
  - Designing the IESTA platform (Java HMI for scenario generation, LCD screens for simulation and post computing visualization, computing resources …..)
- Noise modeling and metrics:
  - *LAeq metric* corresponding to the energy average sound level over a period T (in dB)
  - LDEN defined in terms of the “average” levels during daytime, evening, and night-time, and applies a 5 dB penalty to noise in the evening and a 10 dB penalty to noise in the night.
- Integrating chemical species emission and propagation from aircraft engines

Thanks for your attention

Questions and/or comments ?