Pilot Assistance System for Low Noise Approaches – A320-ATRA Flight Tests at Frankfurt Airport

Institute of Flight Systems

DLR - German Aerospace Center

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ICANA

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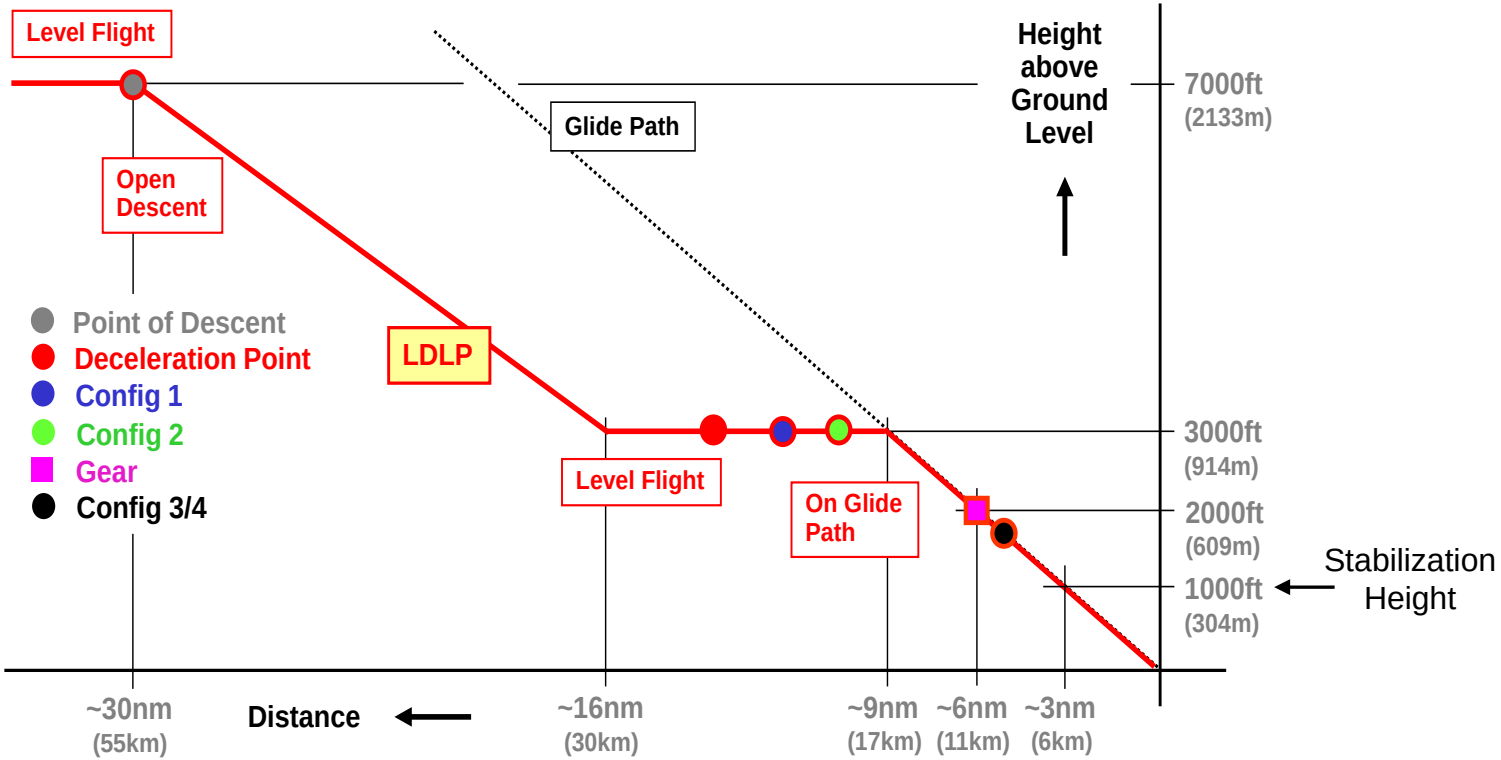
Partners

- DLR
  - Institute of Flight Systems
  - Flight Experiments
  - Technology Marketing
- Gemeinnützige Umwelthaus GmbH
- Frankfurt Airport
- Deutsche Flugsicherung GmbH
- Airline Pilots from
  - Condor
  - Germanwings
  - Lufthansa
  - Niki

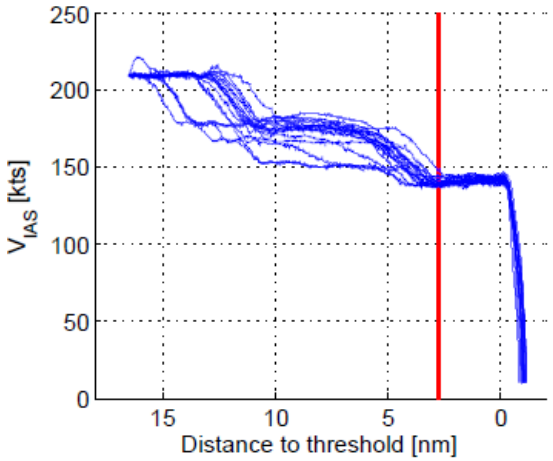
Sequences for a Low Drag Low Power Approach

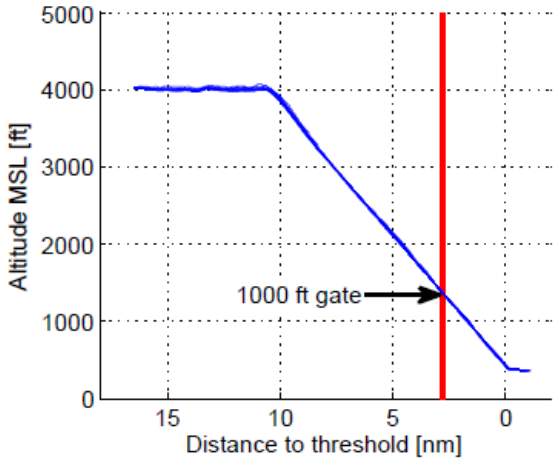
- decrease of altitude (potential energy) and airspeed (kinetic energy) until touchdown
- successive configuration changes for aircraft landing
  - **high lift flap settings (approach config. „1“ & „2“, landing config. „3“ & „4“)**
  - **gear extension**
- intermediate approach altitude for deceleration (min. 3000 ft above RWY threshold)
- stabilization height (typically 1000 ft above RWY threshold)

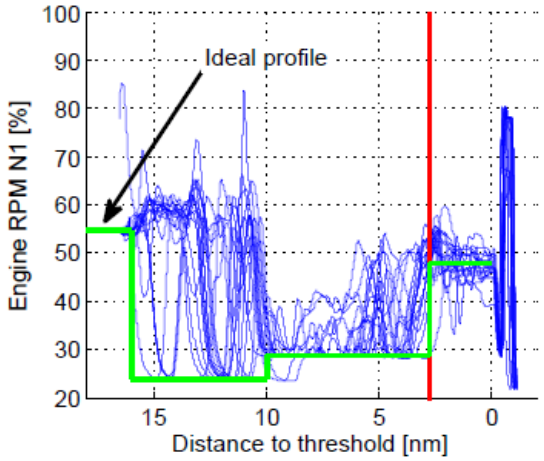


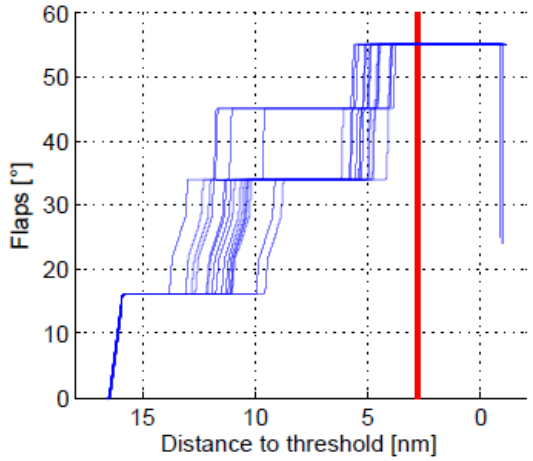
Problem Discovered from Simulator Studies

Test in an A330 simulator → fully controlled environment (always same conditions)









System Concept

- recommendations for pilot actions for more precise configuration changes of aircraft along flight path based on the A/C's energy status

- providing action instructions for
  - speed settings
  - high lift system configuration
  - gear extension
  - speed brake deflections (if unavoidable!)
  - thrust increase (if unavoidable!)

- continuous update of recommendations considering
  - ATC instructions
  - imprecise pilot actions (too late or too early actions)
  - actual wind changes

- Intuitive display of information using EFB

System Overview

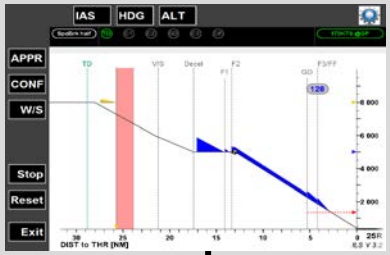
FMS

assistance system

initial offline planning

online update

display



aircraft

pilot

ATC

Flight Test Preparation

Display Integration into EFB of ATRA (L & R of cockpit)

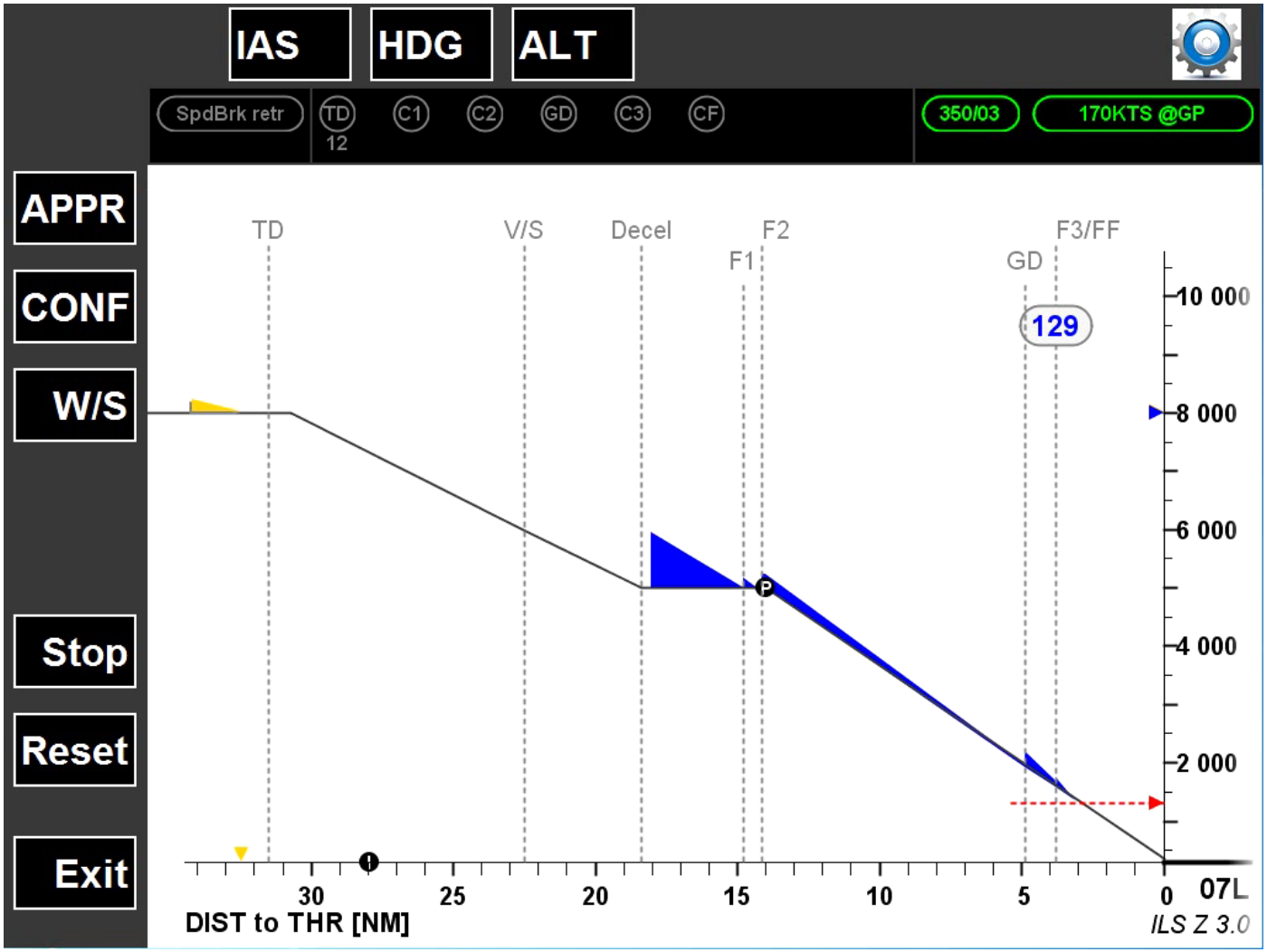
- Implementation of the complete Software as App
- Development of an efficient menu navigation for the required pilot inputs
- Extension of the system enabling its use in an operational environment

AVES Flight Simulator trials with test and airline pilots

- System/display adaptations
- Pilot familiarization for flight trials

Certification for flight testing / Permit to Fly

Display Concept



Flight Tests at International Airport in Frankfurt
26-28th September 2016

flight tests funded by “Gemeinnützige Umwelthaus GmbH”
“Non-Profit Environmental Organization Ltd”

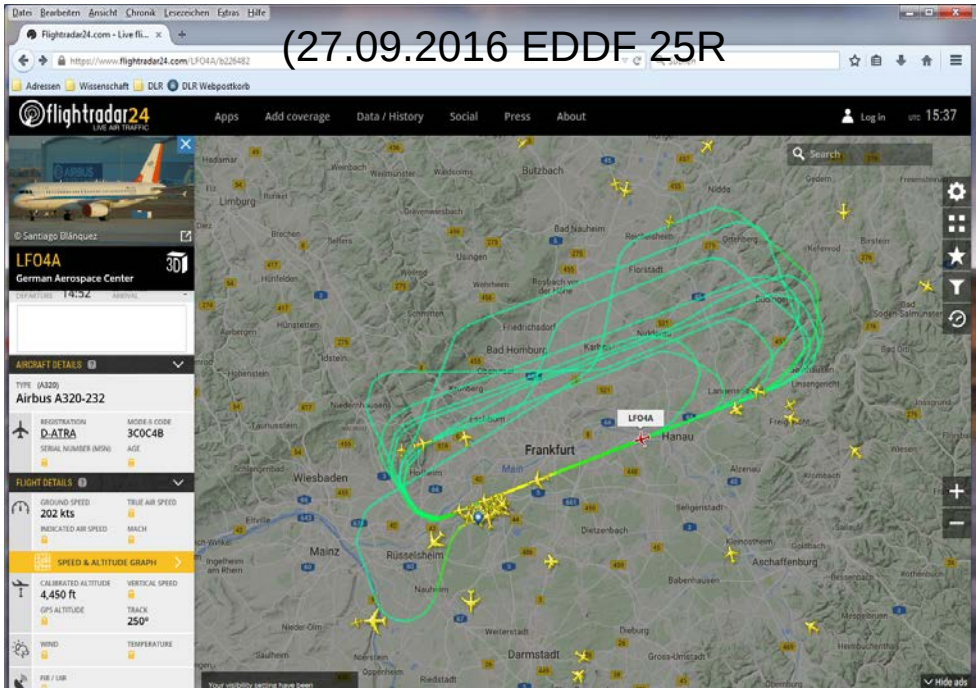
Goals

- demonstration und testing in an operational environment (real traffic scenario and ATC instructions)
- airport with heavy traffic
- flights performed by airline pilots
- ground noise measurements and evaluation
- pilot assessments
- conclusions for further development/adaptation/extension of the system towards application for daily flight operations

Experiment Scenario

RWY north (25R/07L, GP 3°/3.2°)

Ground tracks of 3. flight test series



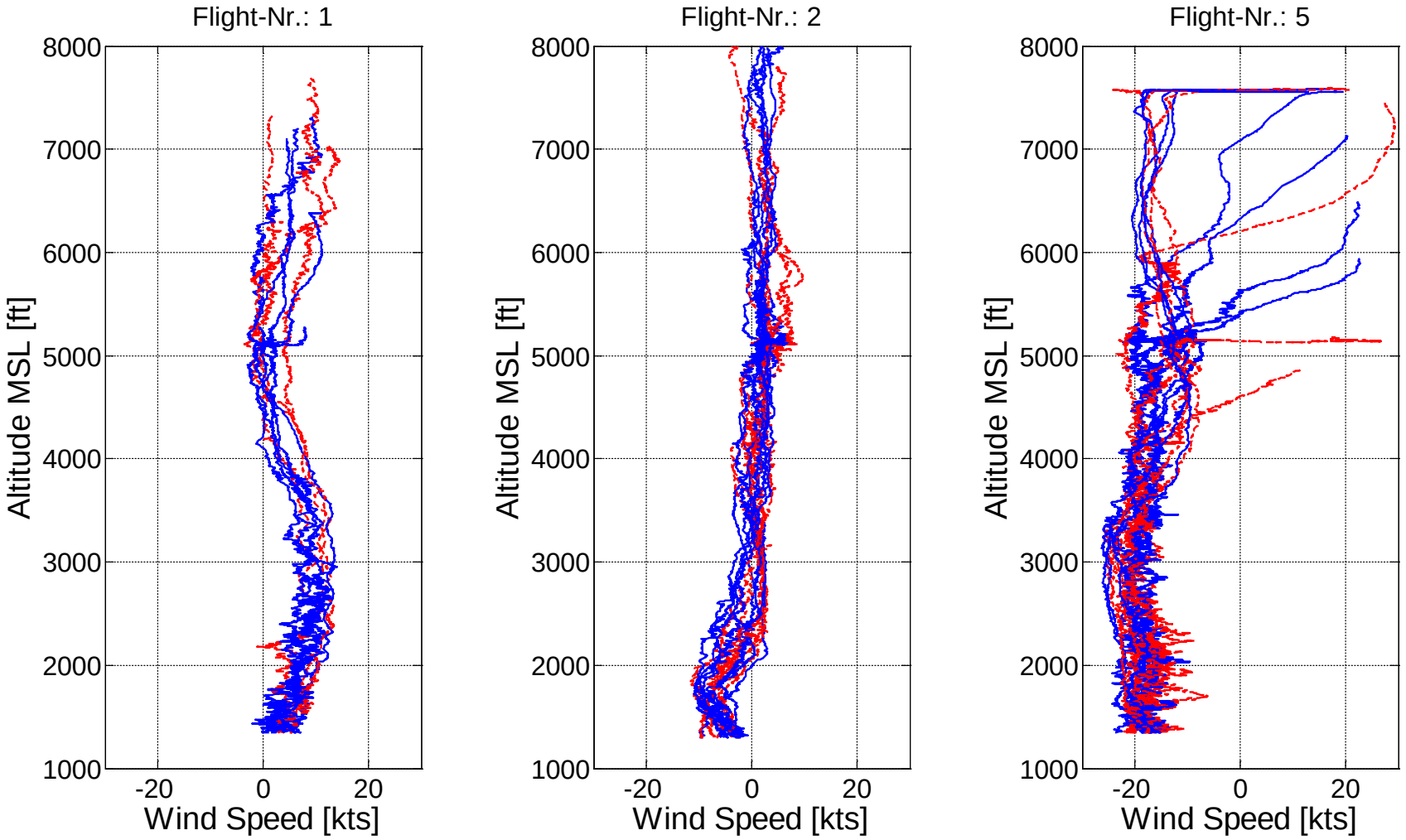
- 5 flight test series in 3 days
- 17 pilots from 4 Airlines
- over all 25 flight hours
- 74 approaches
  - w/o display
  - with display

Collected data

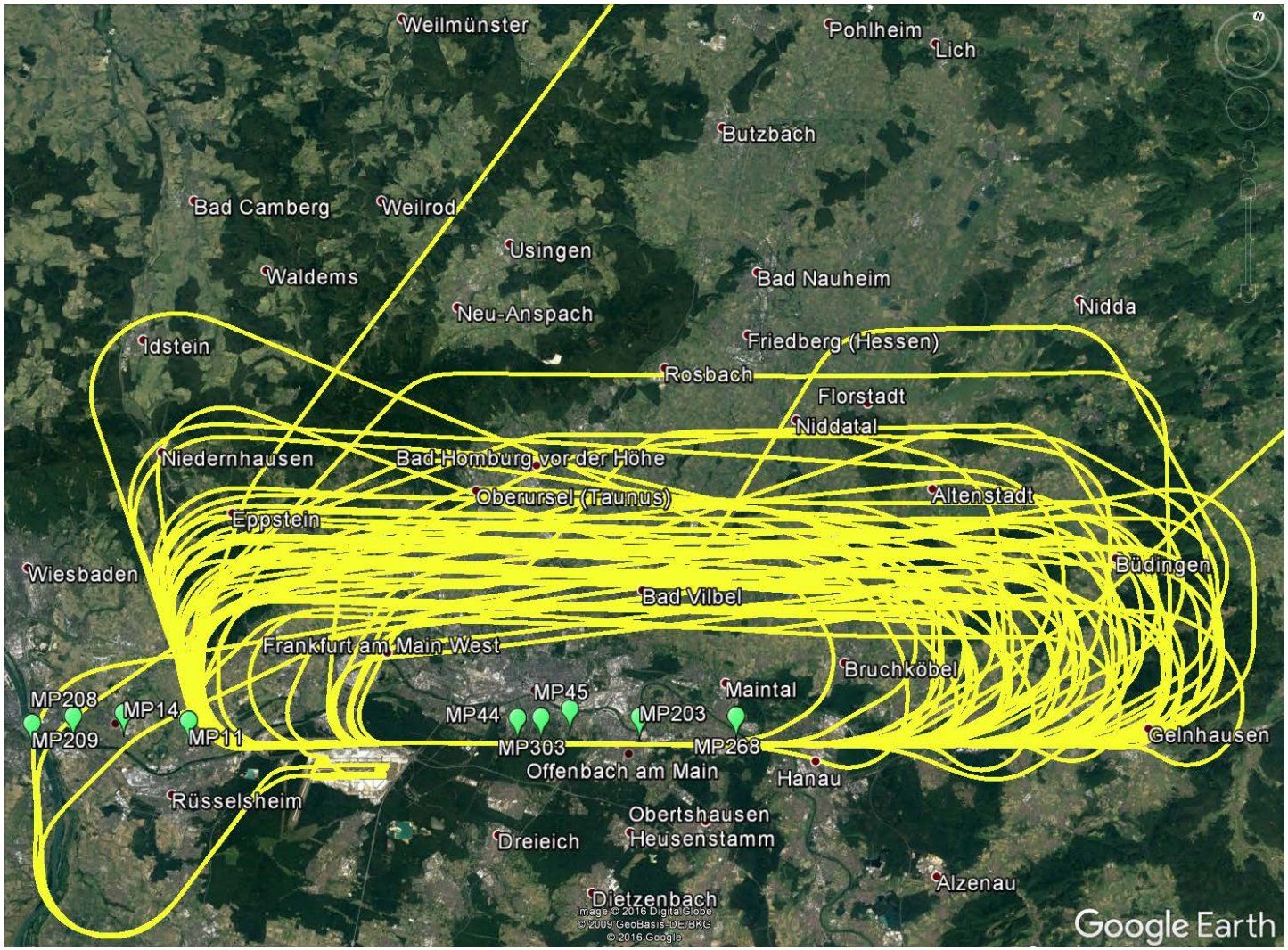
- Cockpit data (ATRA FTI recordings)
- Noise measurements on ground
- Pilot questionnaires

First Results

Wind Profiles During Experiments

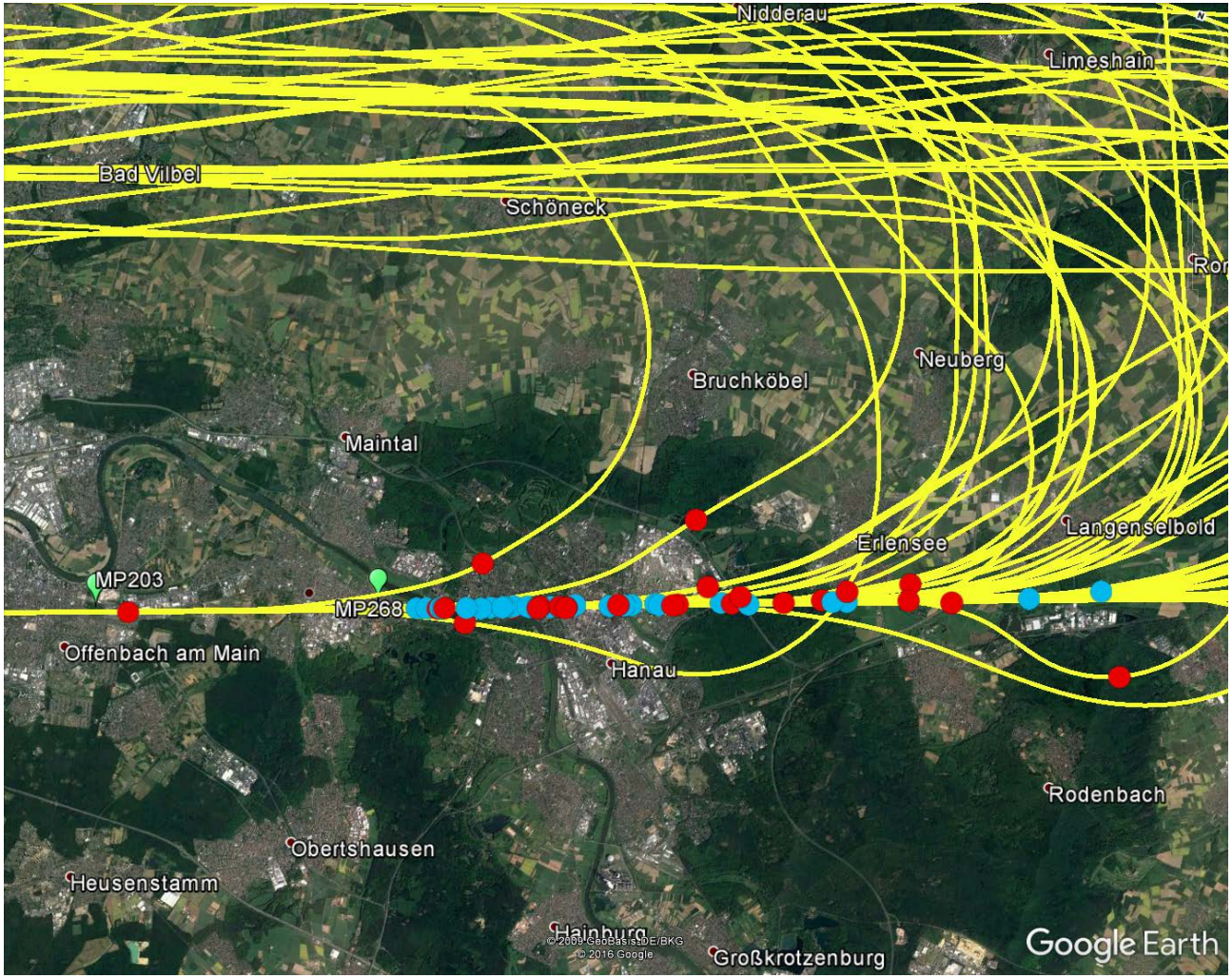


Flight paths 25R



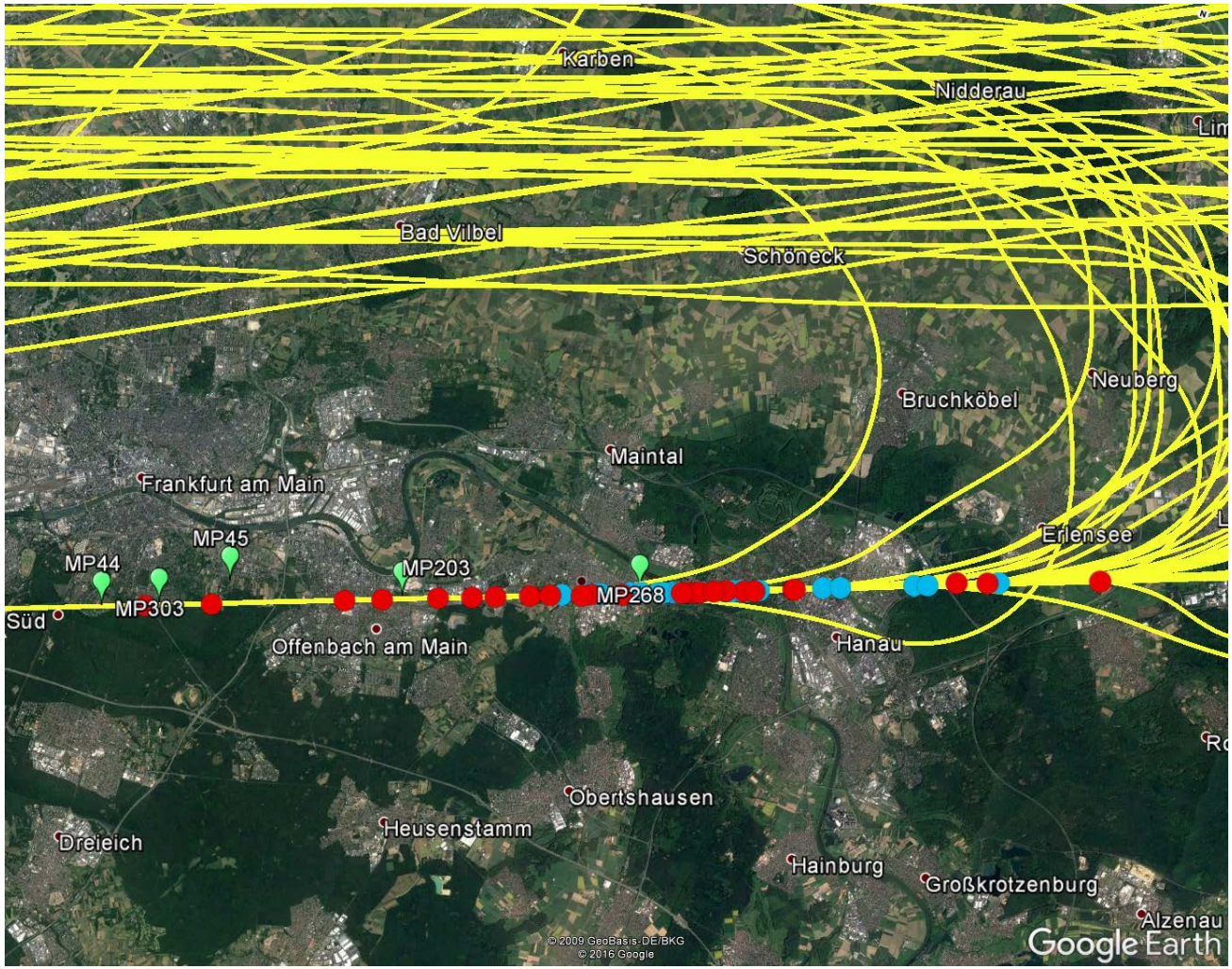
First Results

High Lift System Configuration: Flaps 1



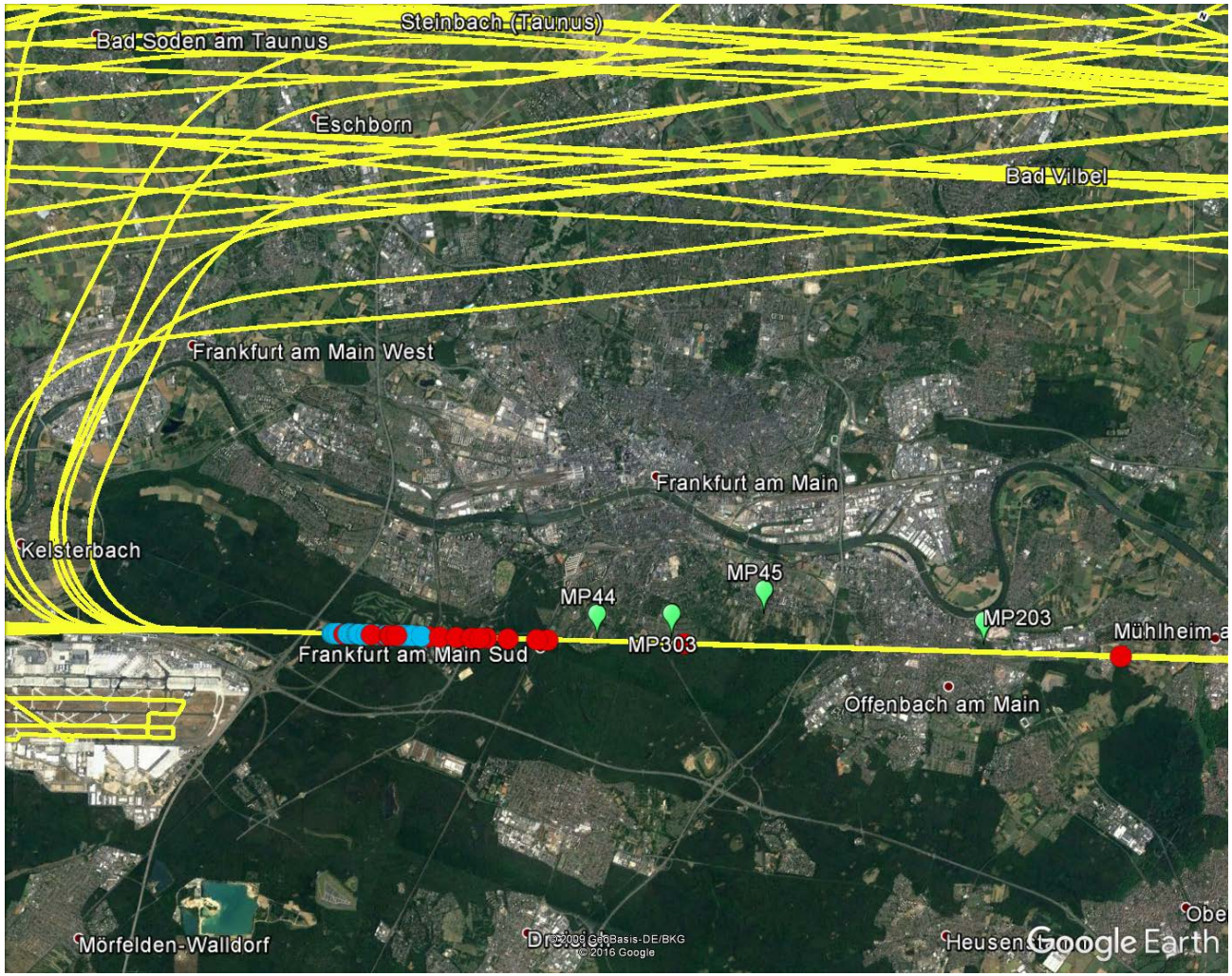
First Results

High Lift System Configuration: Flaps 2



First Results

High Lift System Configuration: Flaps 3

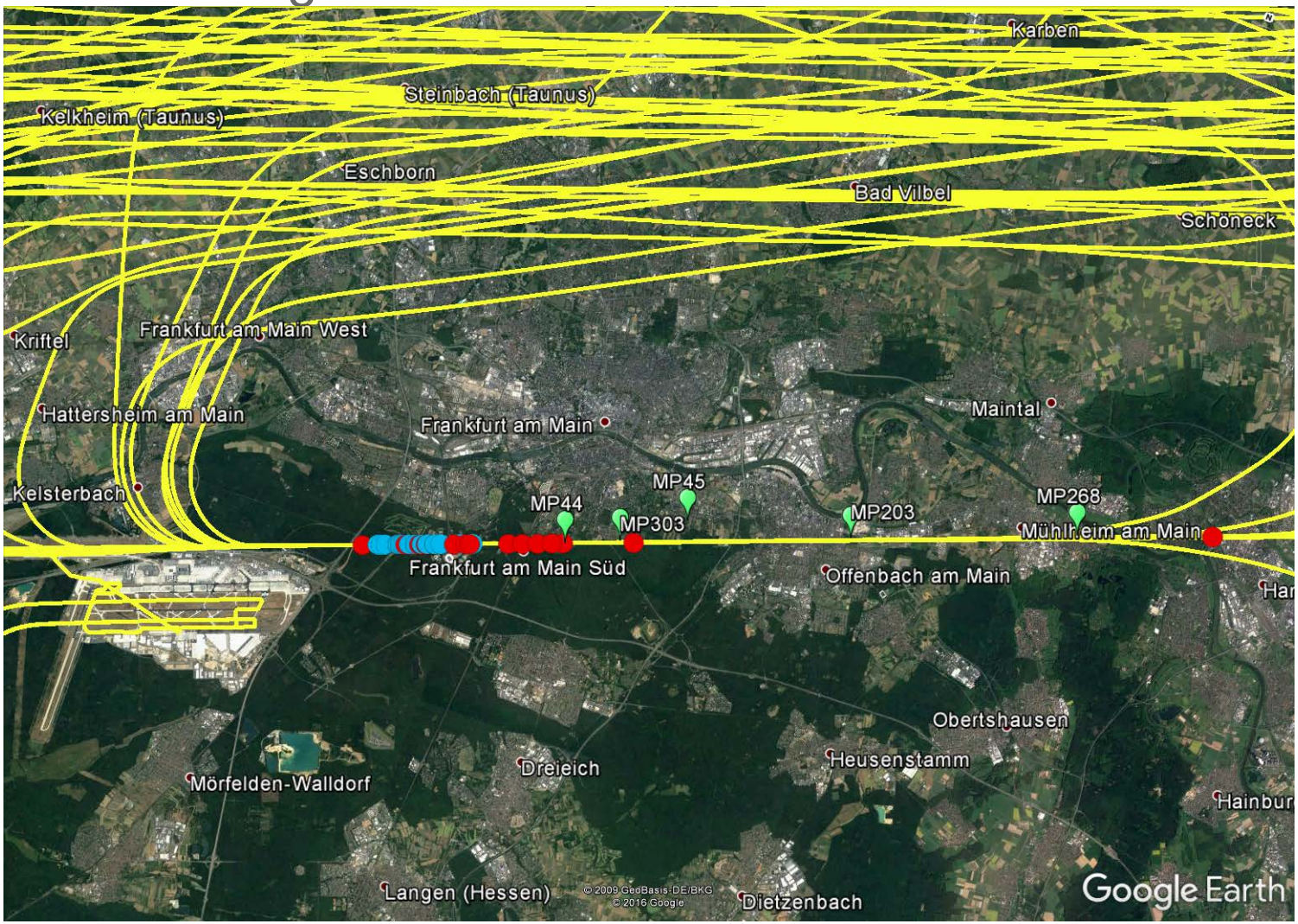


First Results

High Lift System Configuration: Flaps Full

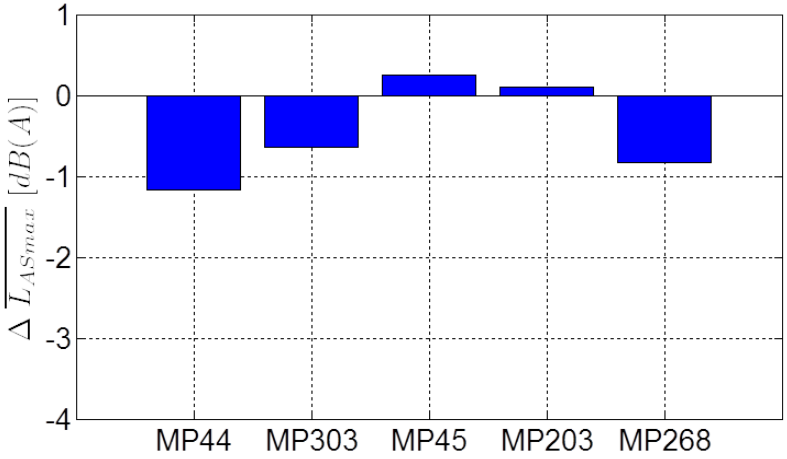
First Results

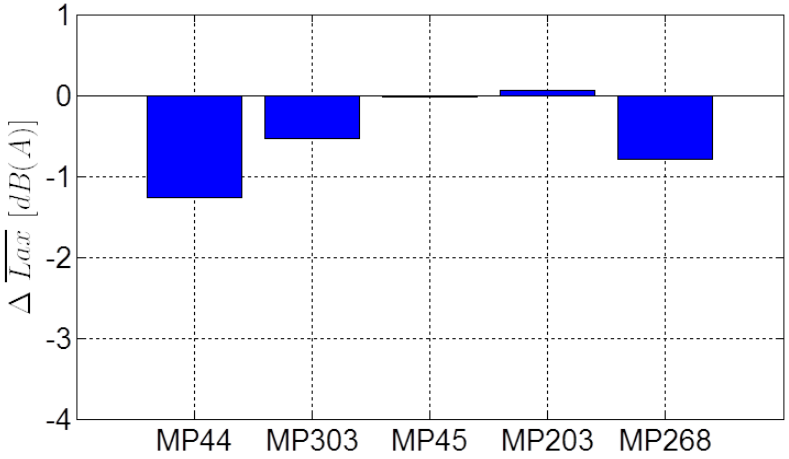
“Gear Down all green” Positions

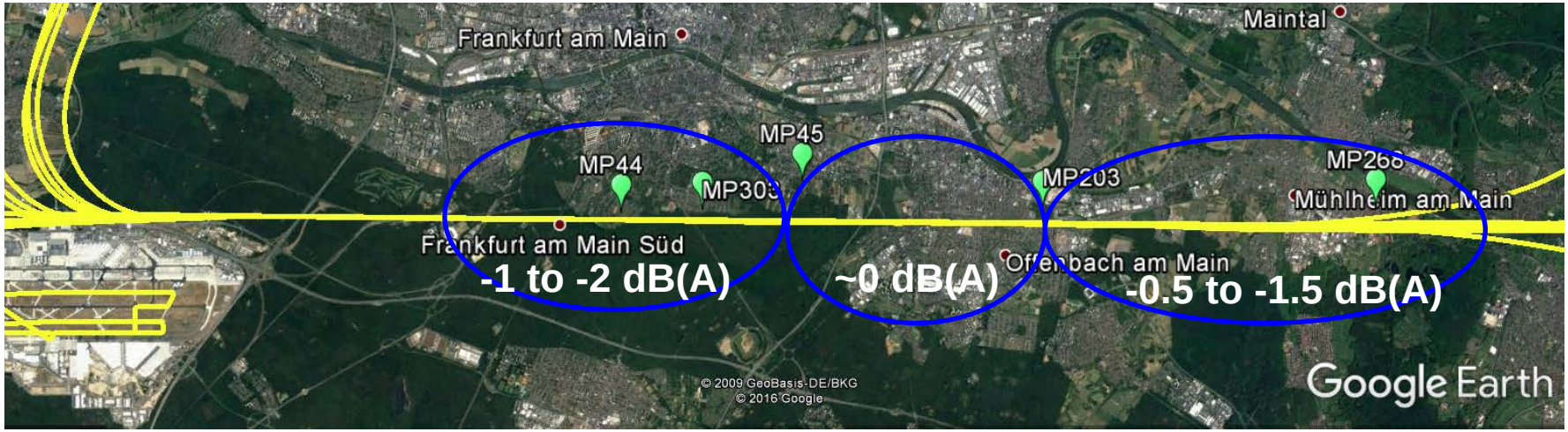


First Results

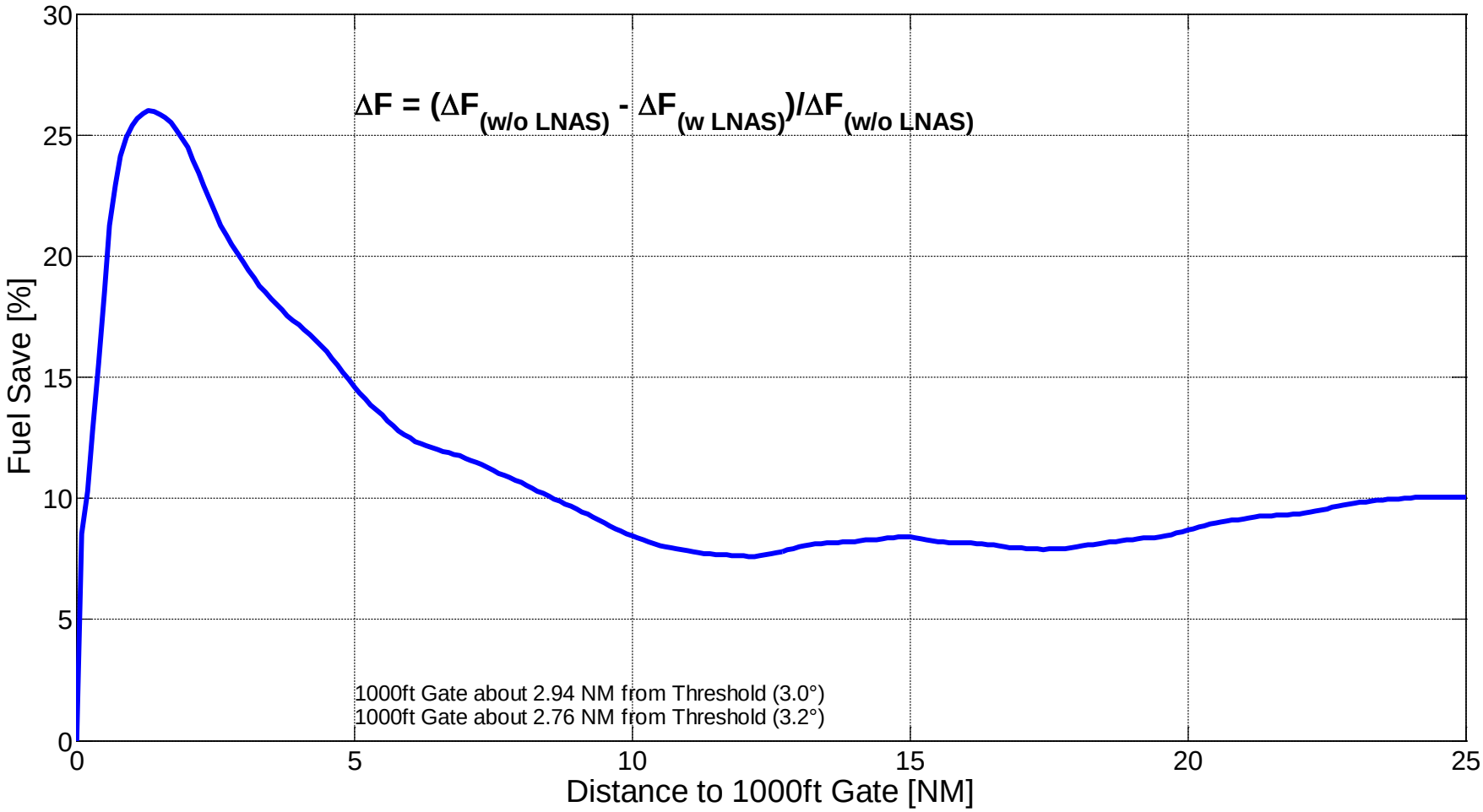
Noise Reduction







First Results
Fuel Savings



Summary

- Noise reduction confirmed
- Fuel savings demonstrated
- Pilots responses
  - in general very positive
  - intuitive and simple graphical representation, level of automation is appropriate
  - very relevant for use under real operations
  - good assistance in difficult situations (tailwind, ATC speed)
  - early prediction of A/C conditions at stabilization height is very helpful
- Further improvement of the system intended

A. Boos:
Press visit onboard ATRA after flight tests in Frankfurt

Outlook

- Further evaluation of collected data
- Adaptation of the system enabling its use in regular and daily operations
- Operation in regular flights with partner airlines and over a one year period airports
- Extension of the system for departure


Thanks for your attention !
Questions ?