

# IMAGINE WP4

## Aircraft Noise – Towards a New Model



imagine

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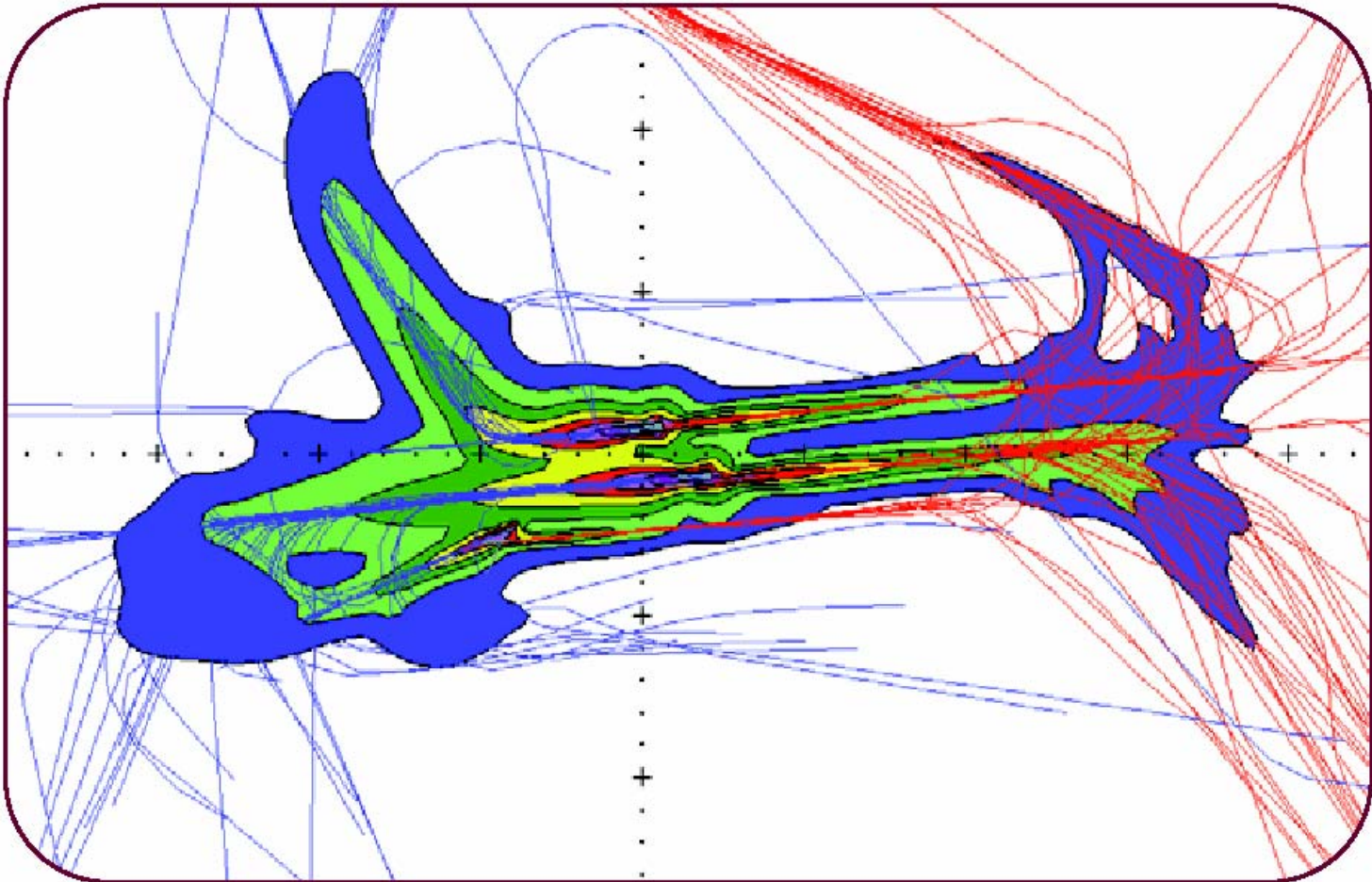
EUROCONTROL Experimental Centre

Vienna, 20<sup>th</sup> June 2006



# Aircraft Noise Maps

imagine\*



# Aircraft Noise Modelling Today

- Guidelines

- From 1980s
- Integrated methods - source and propagation integrated into data
- Four similar documents – all slightly different from each other
  - ECAC Doc 29 - undergoing revision
  - SAE AIR 1845 etc. - undergoing revision
  - ICAO Circular 205
    - will be replaced when Doc29R and 1845R released
  - “Nordic Guidelines” – NOR2000
- European Noise Directive 2002/49/EC defined “interim model”
  - based on 1997 revision of Doc 29
- Problem of aircraft noise and performance data
  - Not defined in original guidance



# Aircraft Noise Modelling Today

- Models

- Integrated methods – e.g. FAA's Integrated Noise Model (INM)
  - Based on SAE AIR1845
    - other guidelines taken into account
  - Collection of standard flight profiles
    - Height
    - Speed
    - Thrust
  - Aircraft databases
    - Noise-Power-Distance (NPD) curves
    - Performance data
  - Methods are very simplified and difficult to validate
  - Large amount of aircraft data – 250 aircraft
- Simulation methods – e.g. Swiss FLULA
  - Complicated source model
  - Good experience for IMAGINE



# Aircraft Noise Modelling Today

- Problems with current models
  - INM etc.
    - Terrain reflectivity-effects not taken into account
      - Being improved due to work done for US Parks Service
    - Terrain shielding not taken into account
      - That's why the Swiss developed FLULA!
    - Lateral attenuation algorithms not good
      - Being improved in new guidelines
    - Based on standard aircraft flight profiles
      - Not always realistic
    - All noise sources integrated into data
      - Noise correlated only to power settings
    - Not easy to model new procedures where aircraft configuration changes from standard
      - New research version produced for use in Sourdine II
  - FLULA etc.
    - Not much data - only 75 aircraft



# Imagine – Extending Harmonoise

- Harmonoise was a 5FP projet
  - Uniform noise model for road and rail
  - In line with EU Noise Directive (“END”) 49/2002/EC
  - Two models:
    - Engineering model – what the modellers will use
    - Reference – used to validate the engineering model
- Imagine extends Harmonoise to Industry and Air
  - Imagine WP4 provides model for assessment of environmental noise levels near airports
- Imagine WP4 Partners
  - AEAT-NL, Anotec, Boeing R&TE, CSTB, deBakom, EMPA, EEC, TNO



# Imagine WP4 - Aircraft Noise Sources

- Objective:
  - method for assessment of environmental noise levels near airports
    - harmonised, accepted and reliable
    - links well with HARMONOISE methods for noise propagation description
    - large acceptance in the field of future users and other stakeholders.
- Aim: To develop
  - two fully-implemented methods for calculating aircraft noise;
    - Reference and Engineering
    - $L_{den}$  and  $L_{night}$
  - supporting method for measuring sound power and directional characteristics of aircraft noise sources;
  - conversion method to transform available source data (NPDs and others) into required type of representation.



# Aircraft Noise Sources – 4 Basic Tasks

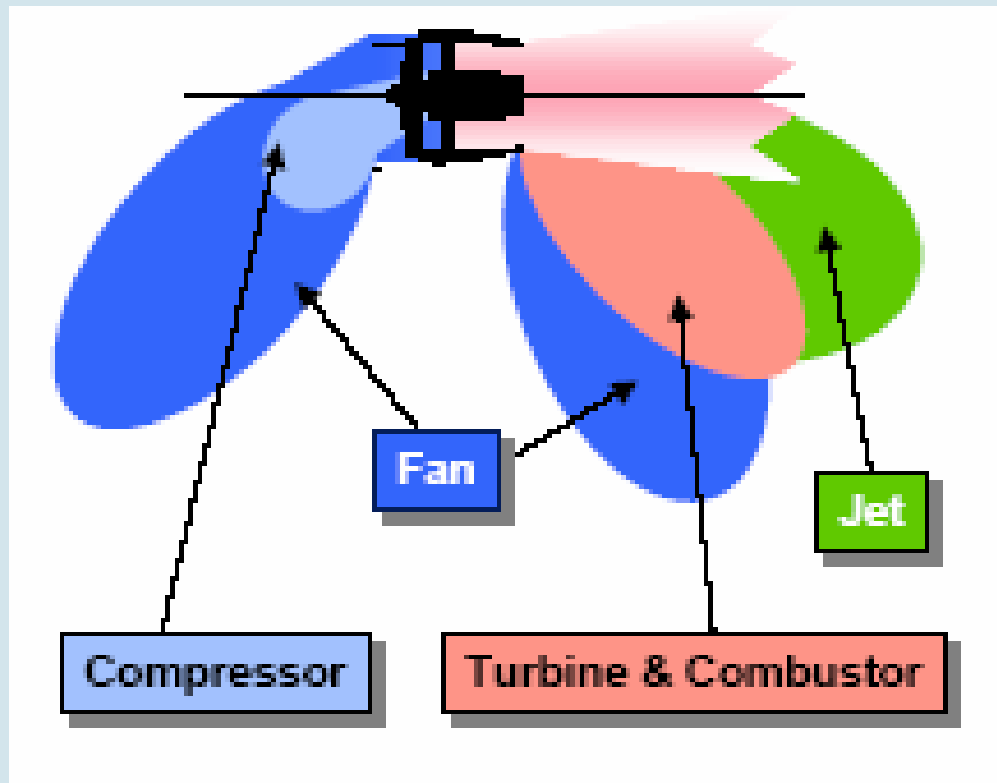
## 1. Reference Source Model Development

- Development of a source model for aircraft noise sources;
  - Noise source complicated: varies according to:
    - mode of flight
    - weight of aircraft
      - proportional to thrust
      - large change during flight due to fuel use
    - aircraft configuration
      - 50% of noise on approach
      - gear up/down, flaps, slats etc.
  - need to be able to model sources for given mode-of-flight / configuration / thrust
- Development of measurement methods for sound power and directional characteristics.



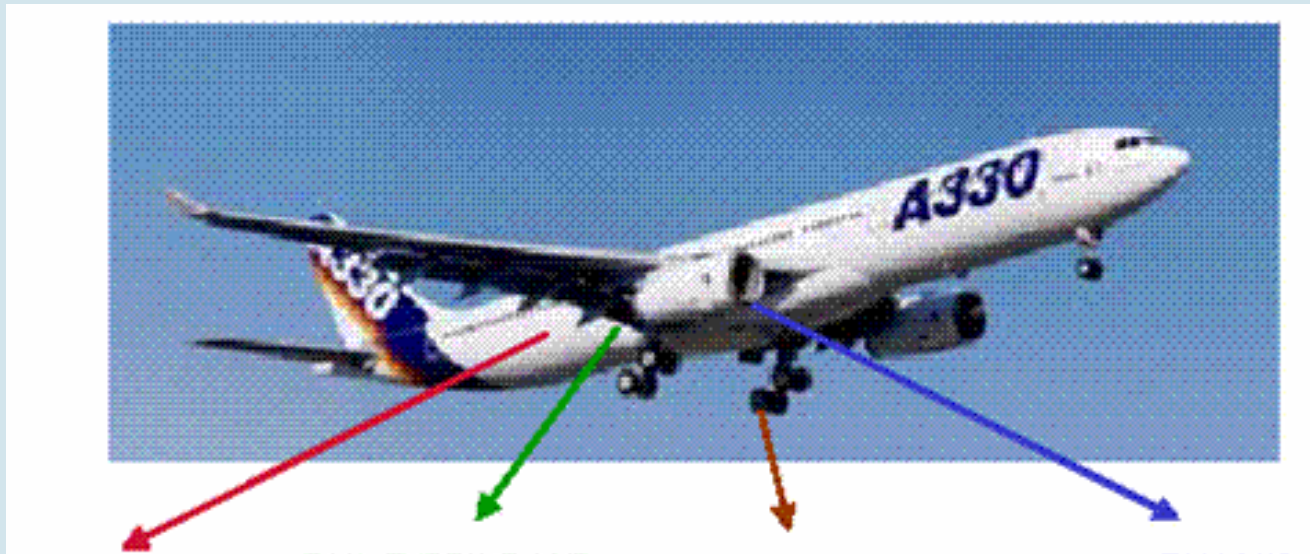
# Complicated Noise Sources

- High directivity of engine noise



# Complicated Noise Sources

- Many airframe noise sources
  - Up to 50% of total during approach



Friction

Flaps/Slats

Gear

*Nacelles\**

\* Nacelles are really an engine problem, not air-frame.



# Aircraft Noise Sources – 4 Basic Tasks

## 2. Source Data Conversion Method Development

- Development of a method for converting existing data into the required type of source characterisation;
  - Current data are integrated “Noise Power Distance” curves;
- Conversion of NPD and other data into source data.
  - No greater source accuracy than INM
    - but allows propagation effects to be taken into account
  - Need source data for a large number of aircraft
  - Not enough time or budget to do major conversion effort
- Will eventually have to be created through flight trials ...
  - Expensive
- ... or by using the complicated models that aircraft manufacturers have
  - great reticence among manufacturers to allow such precise data into the public domain



# Aircraft Noise Sources – 4 Basic Tasks

## 3. Propagation Method Development

- Adaptation of the HARMONOISE Reference and Engineering propagation model
  - for source-receiver configurations relevant for aircraft noise sources;
- Propagation physics same for all elevation angles. However,
  - Not all physics included in Harmonoise
    - not all was needed so equations defined at too low a level
  - Physics included needs verifying
    - typical angles of incidence and meteorological effects specifically relevant to aircraft noise will be taken into account.



# Aircraft Noise Sources – 4 Basic Tasks

## 4. Model Validation

- Validation of the adapted models
- Flight tests will be performed near Madrid
  - Early September 2006
  - Cessna Citation
- Project ends 30<sup>th</sup> November 2006
  - Final meeting in Budapest, 25<sup>th</sup> October
  - Meetings organised with software developers



# European Noise Directive

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- Strategic Noise Maps for 2007
  - Interim method based on ECAC Doc 29 (1997)
  - May use Doc 29R if ready in time
  - Aircraft noise and performance data
- Strategic Noise Maps for 2012
  - Imagine will be ready
  - Probably not with full source data
  - Point source data reverse engineered from NPD data
  - Need financing and political will for full source data
  - Either from flight trials or from manufacturers
  - Will modellers accept using Imagine rather than their current INM-like models?



# Aircraft Noise Sources

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Thank you

