AERO2K

Aviation Emissions Inventory for 2002 and 2025

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EC-AERODAYS, Vienna

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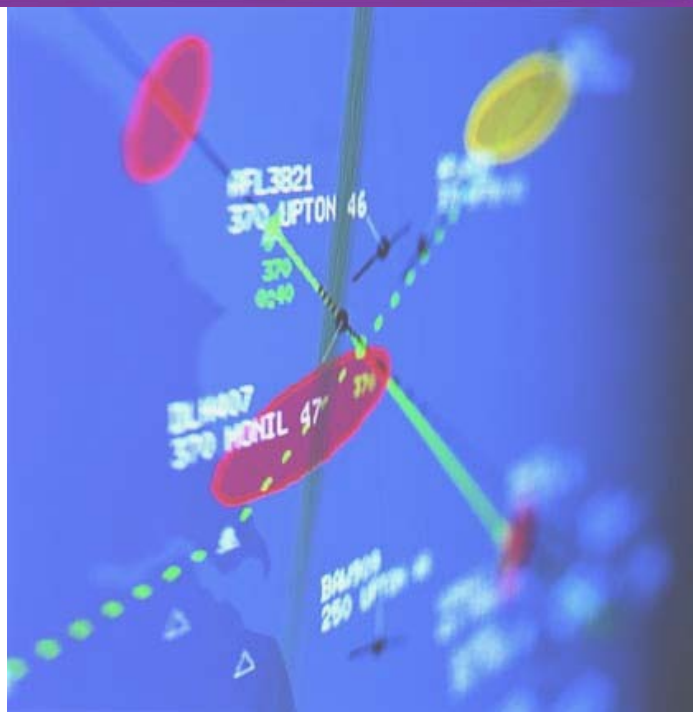
Question

- How many tonnes of CO2 are emitted from aircraft per year?
  - 500 tonnes
  - 500 000 tonnes
  - 500 000 000 tonnes
  - 500 000 000 000 tonnes
  - More?

- Answer comes later

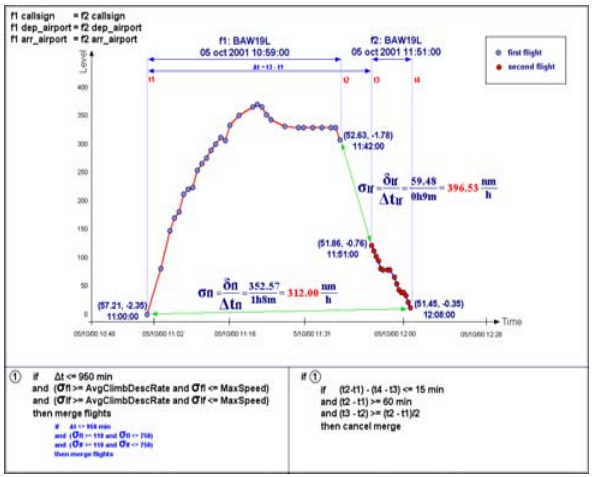
Contents



- Recent aviation emission inventories
- The AERO2K Inventory
- 2002 Results from AERO2K
- Comparison with other inventory results
- 2025 Results from AERO2K

Recent Aviation Emissions Inventories

- Recent Inventories
  - NASA/Boeing – 1976, 1984, 1992, 1999
  - DLR - 1992
  - ANCAT/EC2 – 1992
- Recent inventory forecasts
  - 2015 – NASA/Boeing, DLR, ANCAT/EC2



- Global aviation emissions inventories are computer intensive tasks. Greater computing power allows better assumptions
- AERO2k uses this greater available computing power to provide a new inventory for 2002 and a new forecast for 2025

AERO2k Inventory – Project Overview

Project Partners:

- QinetiQ (UK, Co-ordinator),
- DLR (Germany),
- Manchester Metropolitan University (UK),
- NLR (The Netherlands),
- Department of Trade and Industry (UK)
- Airbus France (France)
- Eurocontrol (European Agency)

AERO2K was partially funded by EC Framework 5 Programme

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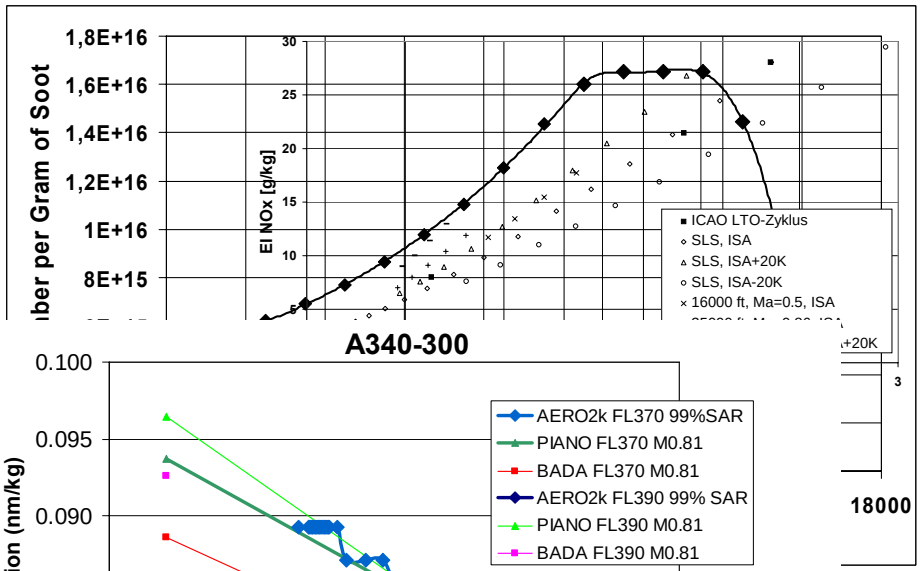
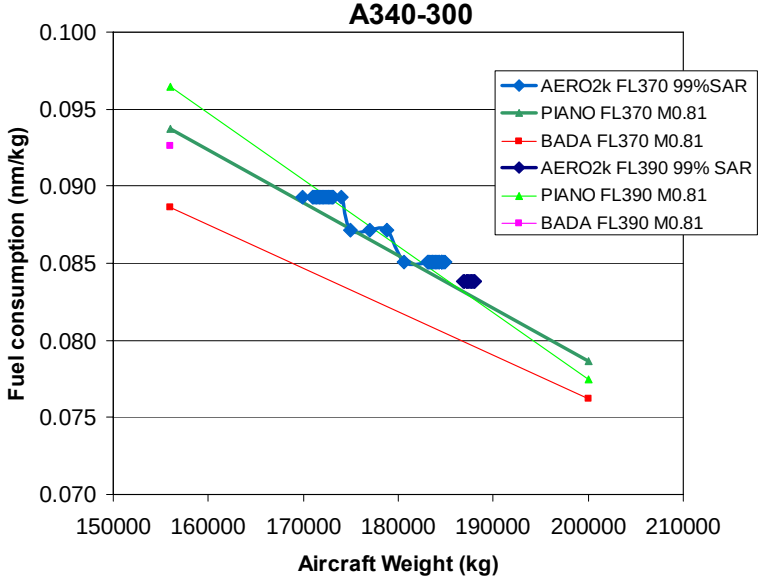
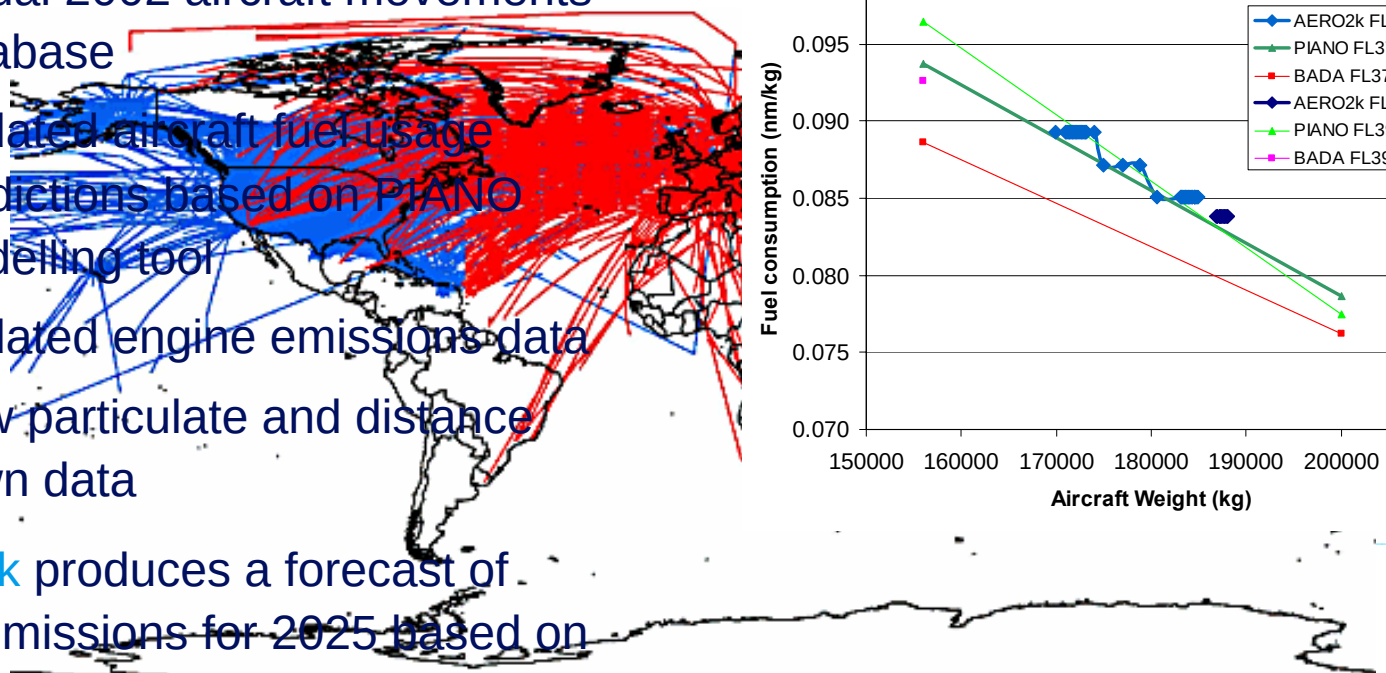
The AERO2k Inventory

- AERO2K creates a database of global aviation emissions for the year 2002 based on:
  - Actual 2002 aircraft movements database
  - Updated aircraft fuel usage predictions based on PIANO modelling tool
  - Updated engine emissions data
  - New particulate and distance flown data
- AERO2k produces a forecast of global emissions for 2025 based on predicted aircraft movements

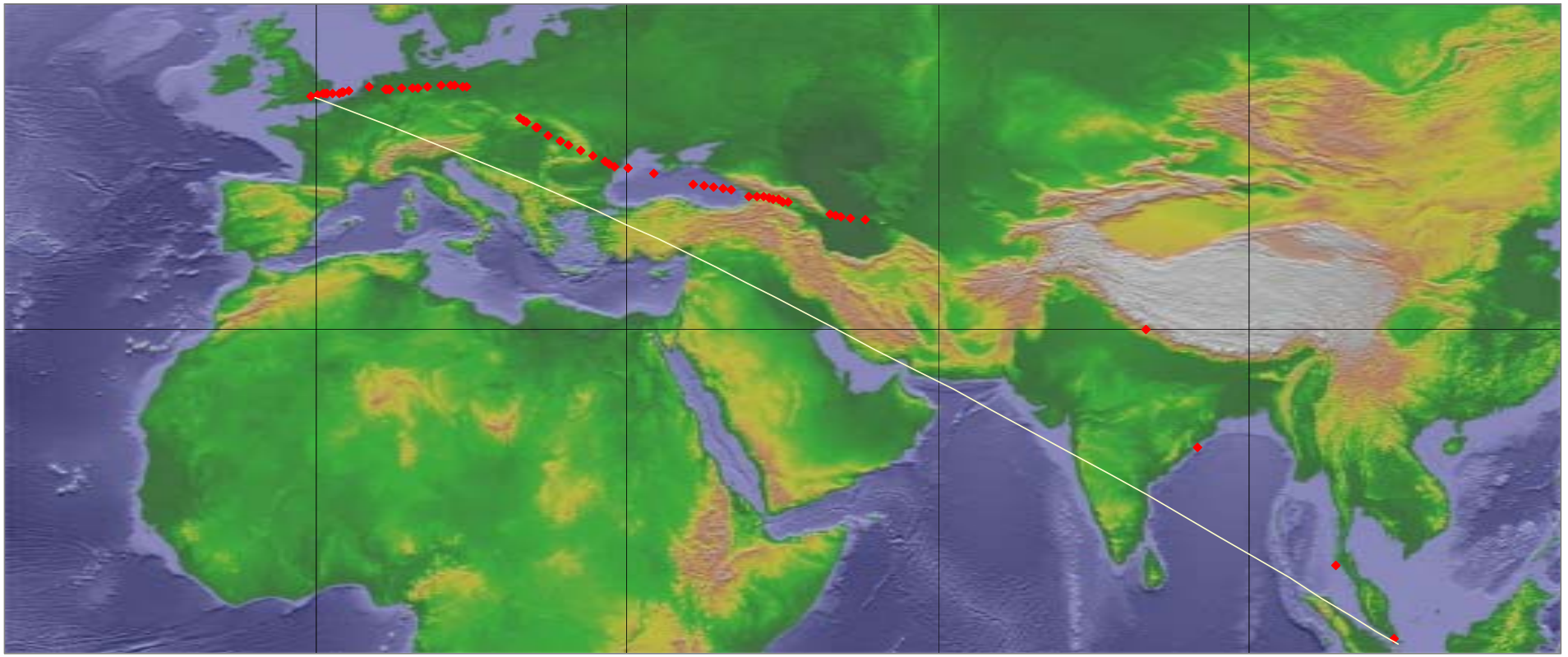






AERO2k Inventory

Flight Trajectory - Improvement over Great Circle Assumption

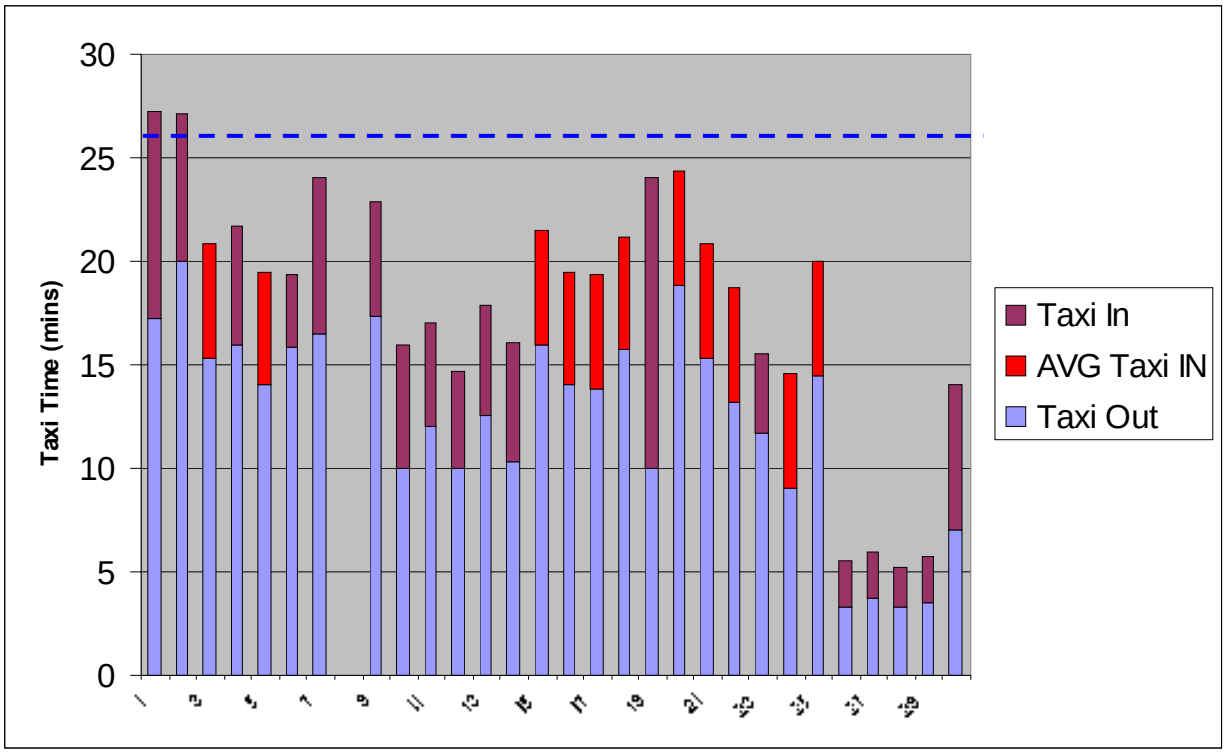


B747-400 Singapore to London

AERO2K Inventory – Taxi Times (Europe)

Centre for Air Transport and the Environment

- LTO times-in-mode for individual airports are computed.



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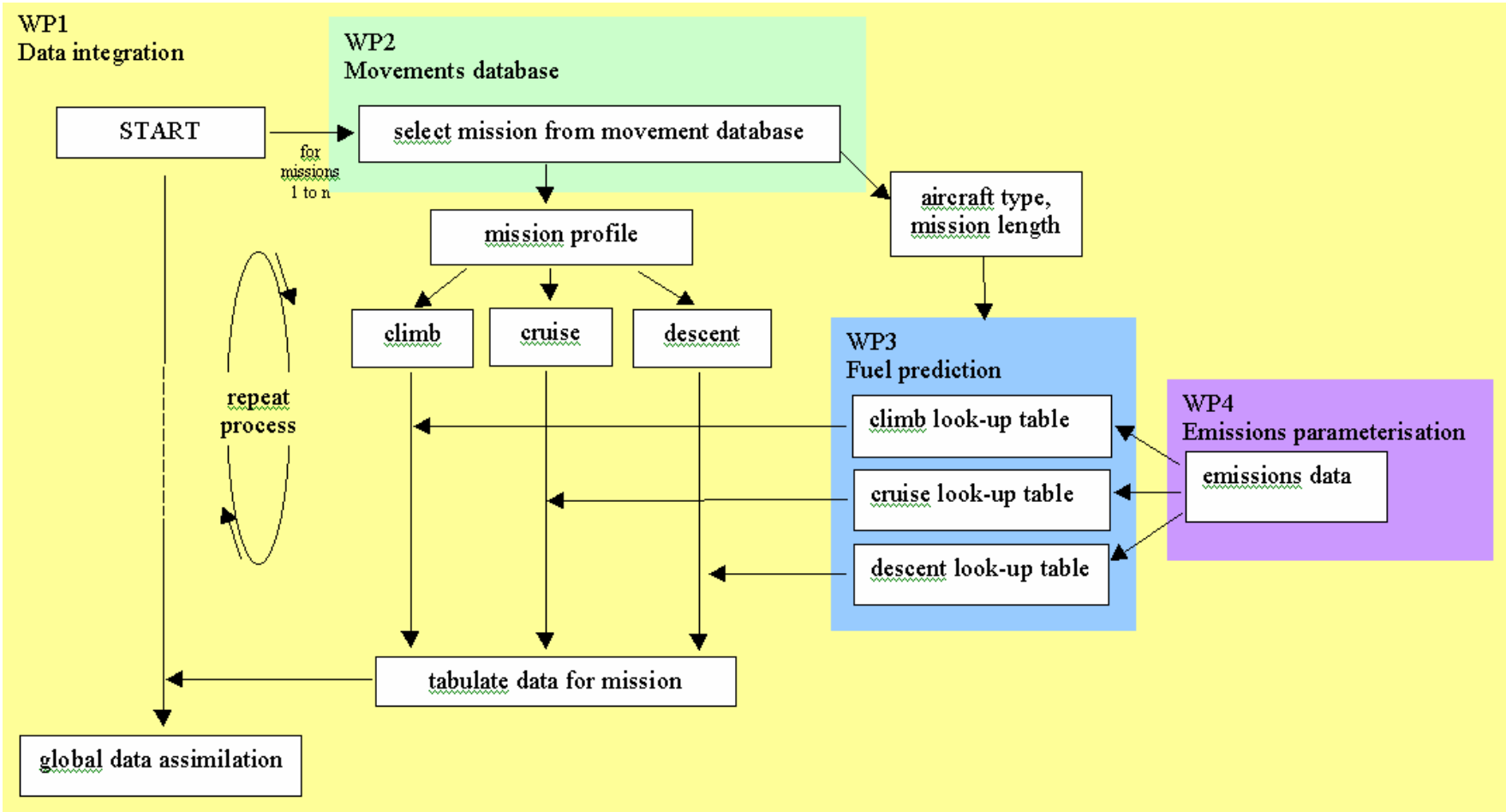
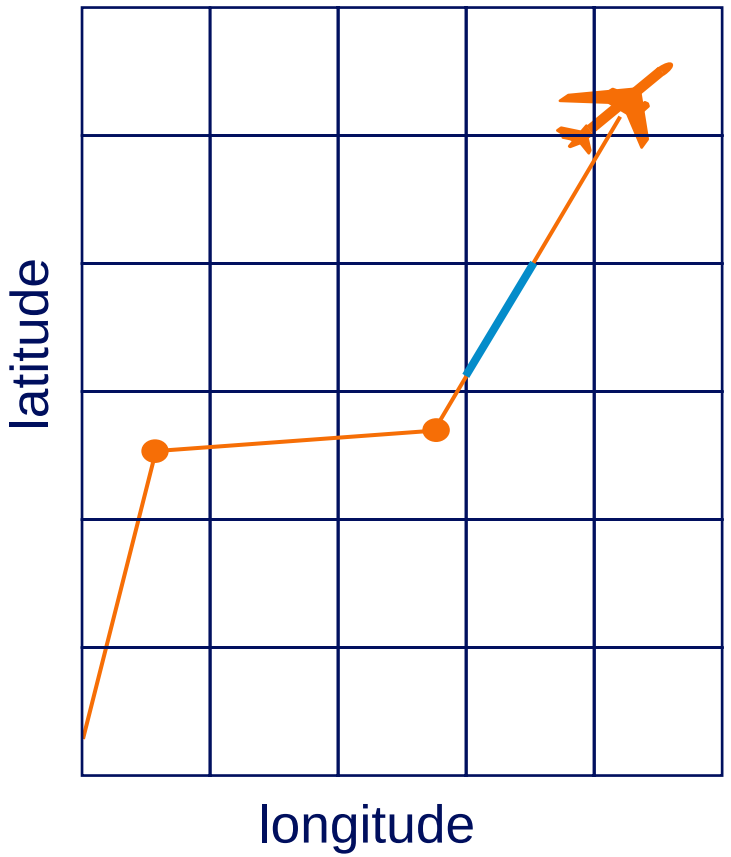
AERO2K Inventory – Data Integration

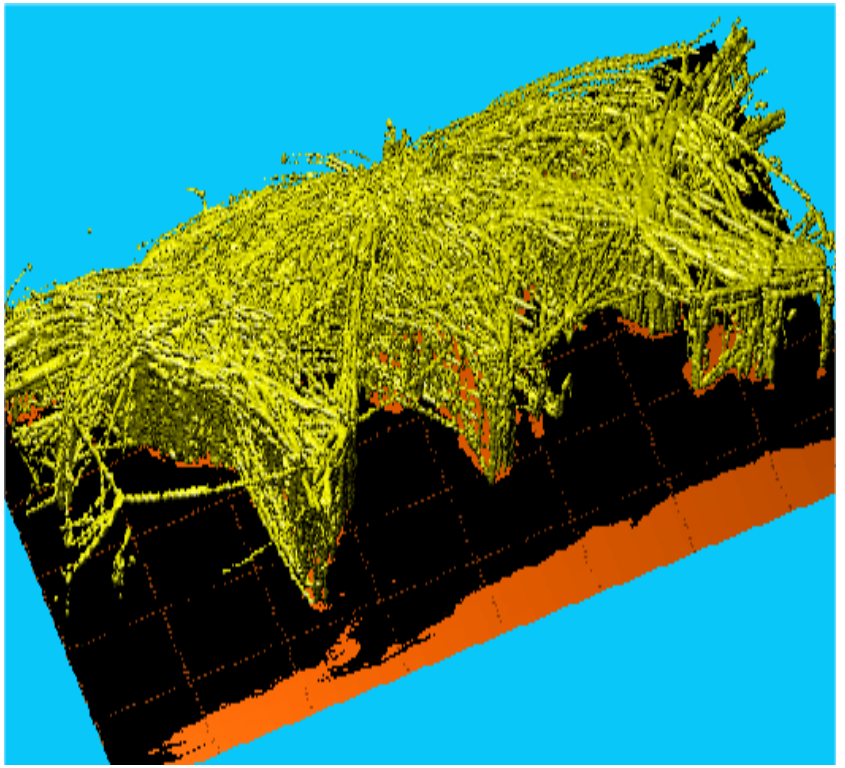


AERO2K Inventory – Allocation onto global grid



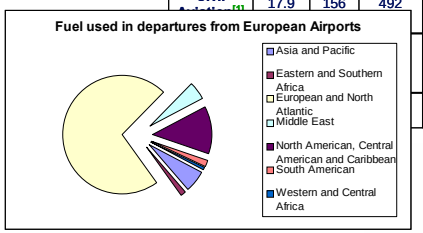
- Fuel and emissions are allocated onto global grids.
- The method determines length of path flown in each cell (e.g. blue line on flight path shown).
- Fuel and emissions allocated accordingly.

AERO2k Output



1. Global Gridded Data for 2002 and 2025
   - Distance flown - new
   - Fuel used
   - CO2, H2O, NOx, CO, HC
   - Estimate of particulate mass and number – new
2. Global, regional and national totals for these parameters

	Distance Flown	Fuel Used	CO_2 Produced	H_2O Produced	CO Produced	NO_x Produced	HC Produced	Soot Produced	Particles Produced
	Nautical miles x 10^{-9}	(Tg)	(Tg)	(Tg)	(Tg)	(Tg)	(Tg)	(Tg)	(X 10^{-25})
Civil	17.9	156	492	193	.507	2.06	.631	.0039	4.03
					24.1	.627	.178	.644	n/a	n/a
					217	1.13	2.24	1.27	n/a	n/a



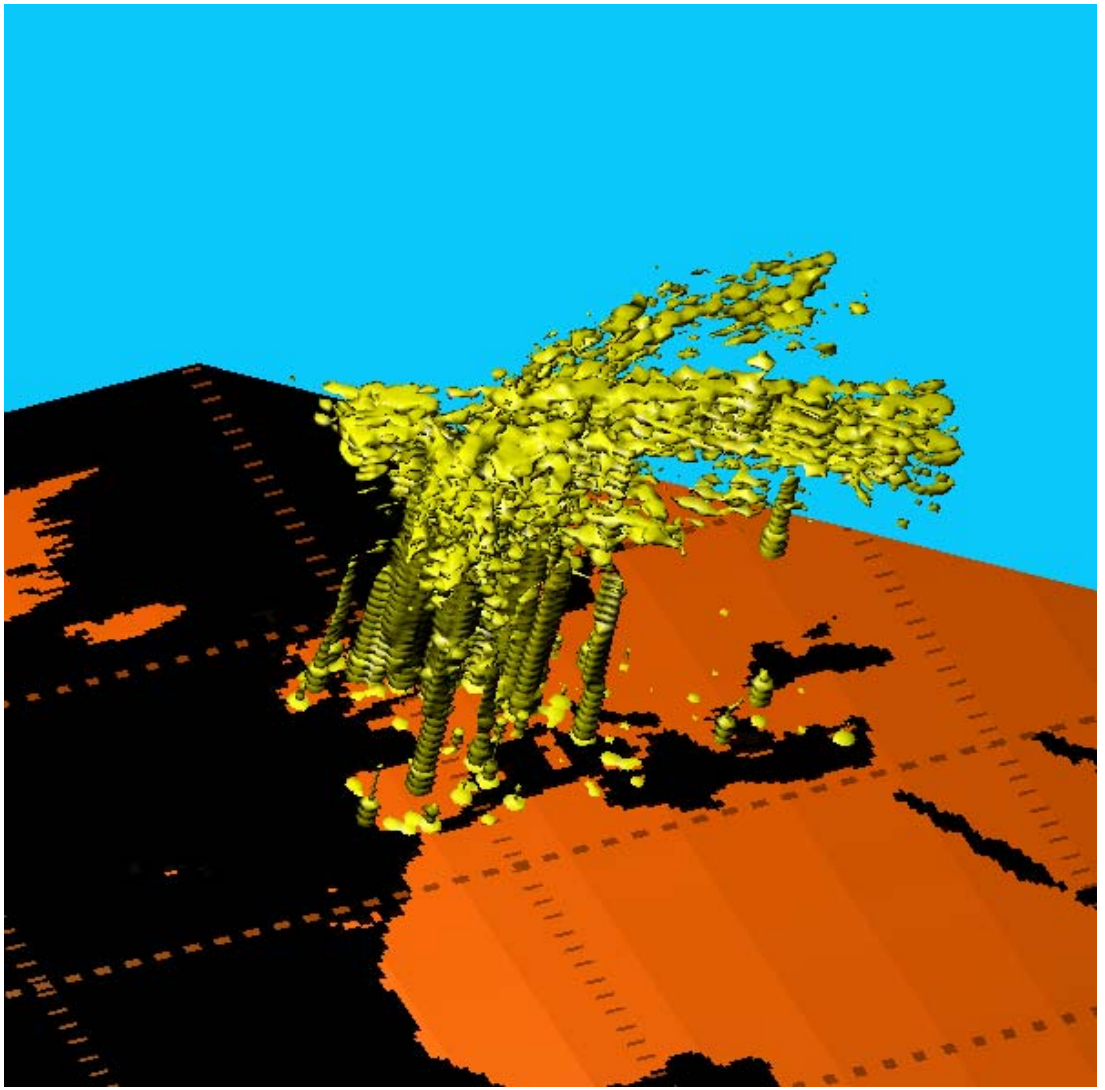
AERO2k Inventory - Application

- Applications of AERO2K
  - Climate impact modelling – Gridded Results
  - Policy discussion – Global and regional totals
    - SBSTA
    - IPCC/ICAO
    - A firm basis for policy and scenario assessment
- Results

  - Next slides …

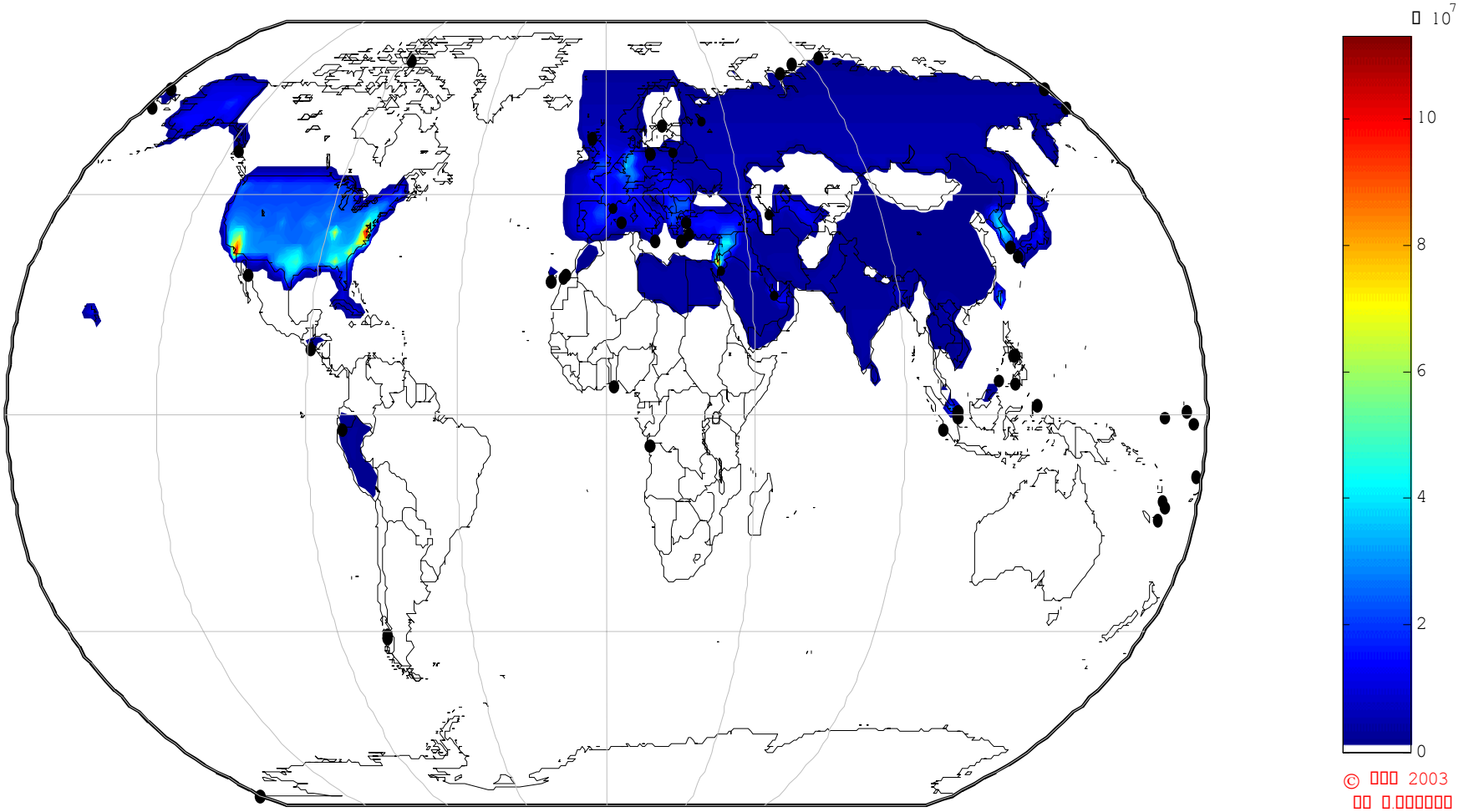
AERO2k Results – Gridded results are available at:

http://www.cate.mmu.ac.uk/aero2k



2002 internal and Eastbound traffic from Europe

AERO2k Military Gridded Results - 2002



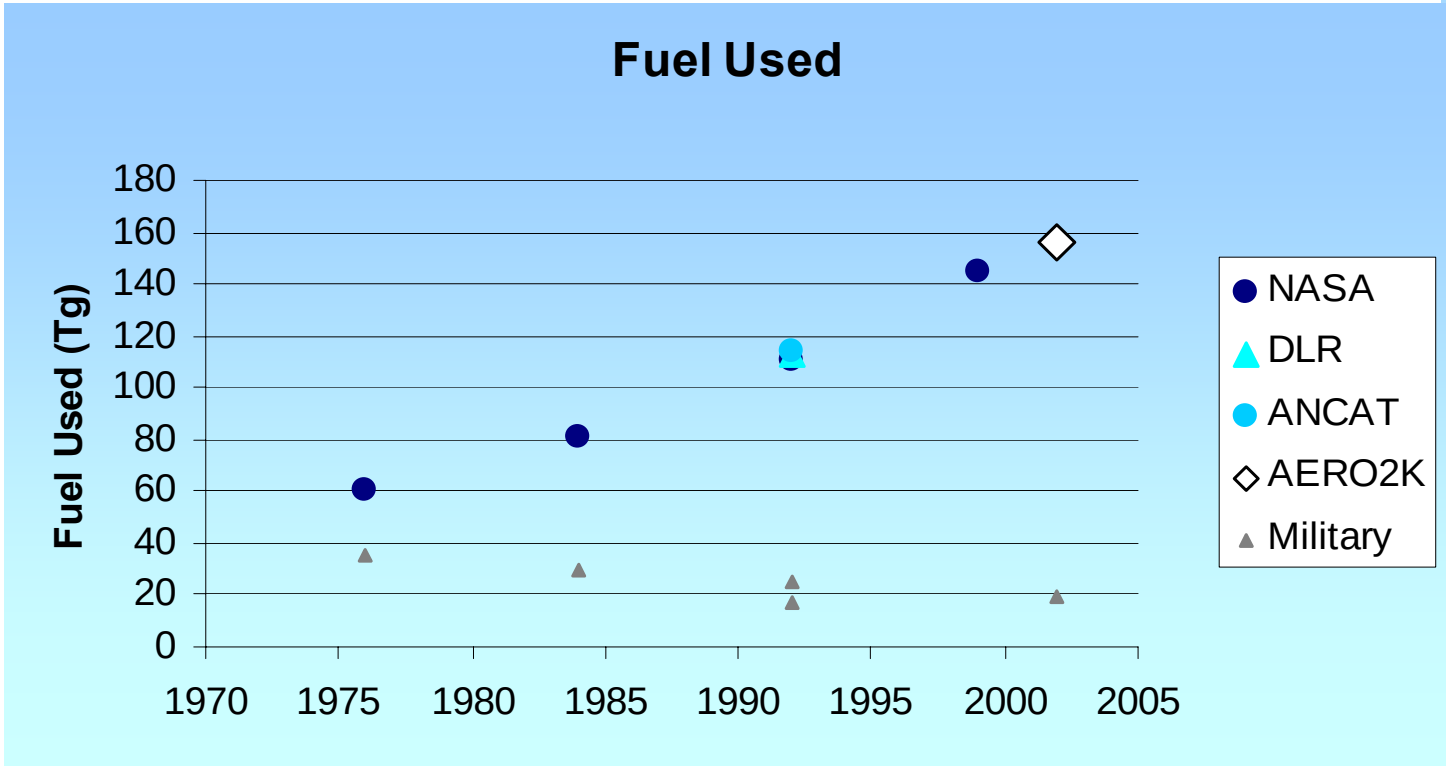
2002 Military Fuel usage - Global

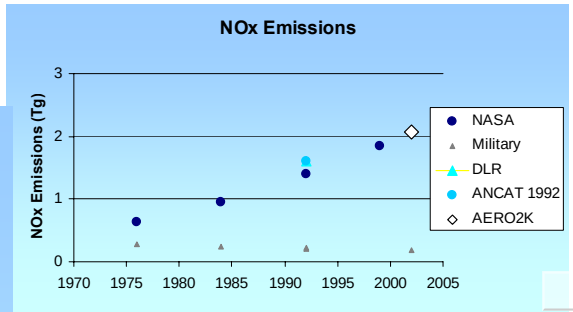
AERO2k Results – 2002 Global totals

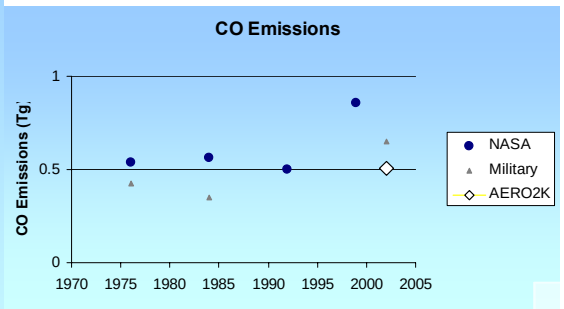
	Distance Flown	Fuel Used	CO_2 Produced	H_2O Produced	CO Produced	NO_x Produced	HC Produced	Soot Produced	Particles Produced
	Nautical miles x 10^{-9})	(Tg)	(Tg)	(Tg)	(Tg)	(Tg)	(Tg)	(Tg)	(X 10^{-25})
Civil Aviation [1]	17.9	156	492	193	.507	2.06	.063	.0039	4.03
Military Aviation	n/a	19.5	61.5	24.1	.627	.178	.064	n/a	n/a
Total	n/a	176	553	217	1.13	2.24	0.127	n/a	n/a

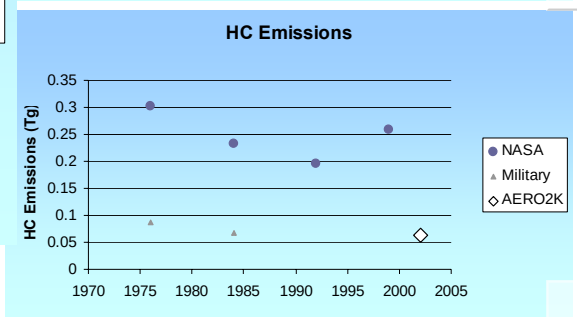
[1] Civil aviation includes IFR flights only

AERO2K Global Totals – 2002
Comparison with other inventories

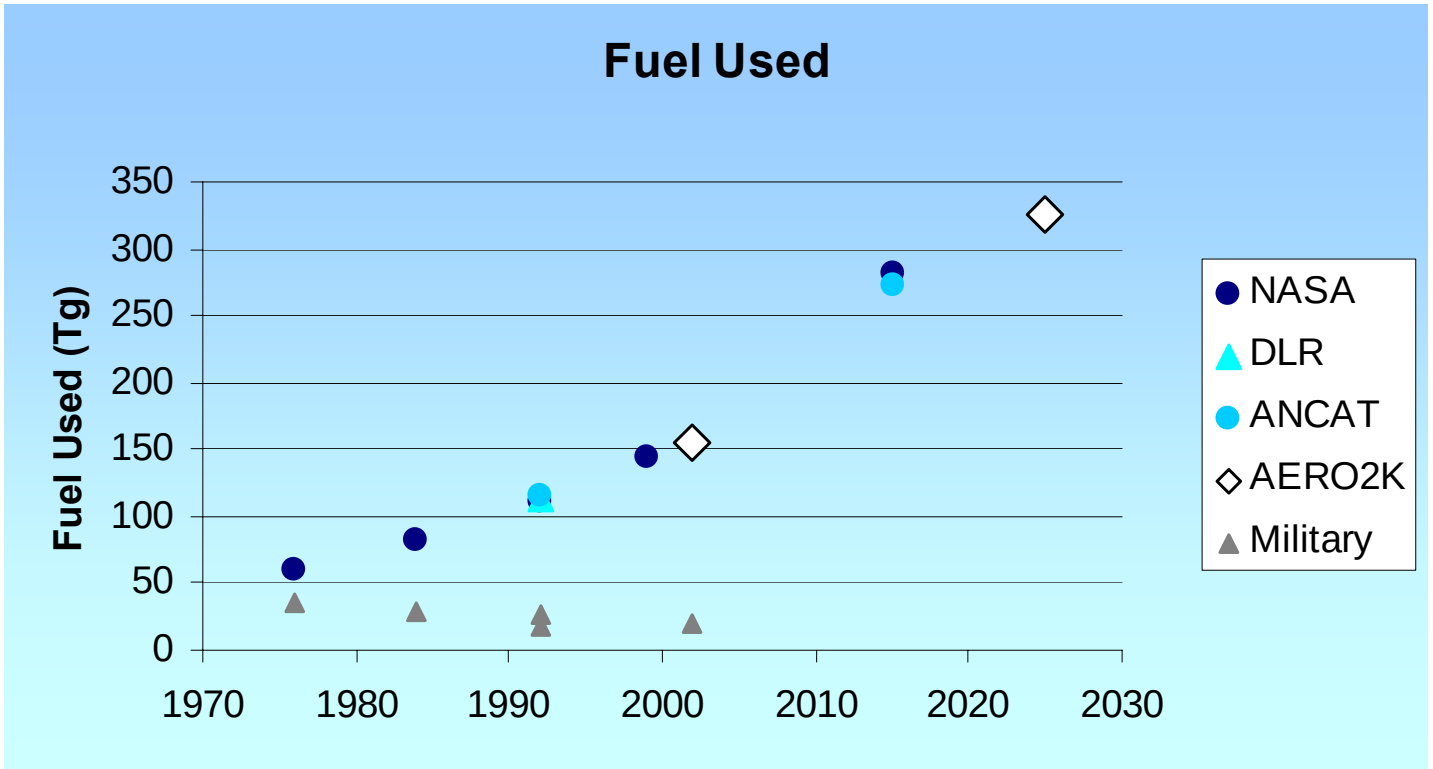


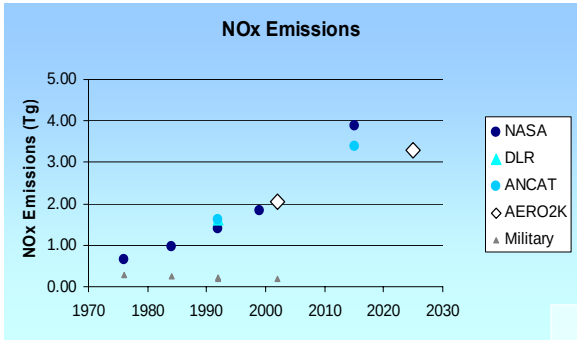


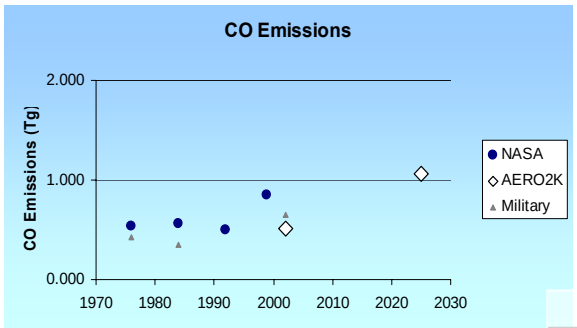


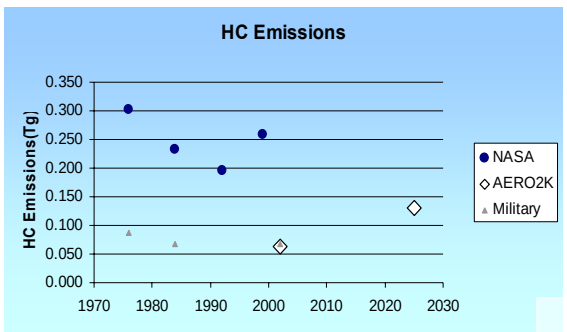


AERO2K Global Totals – 2025 Comparison with other forecasts

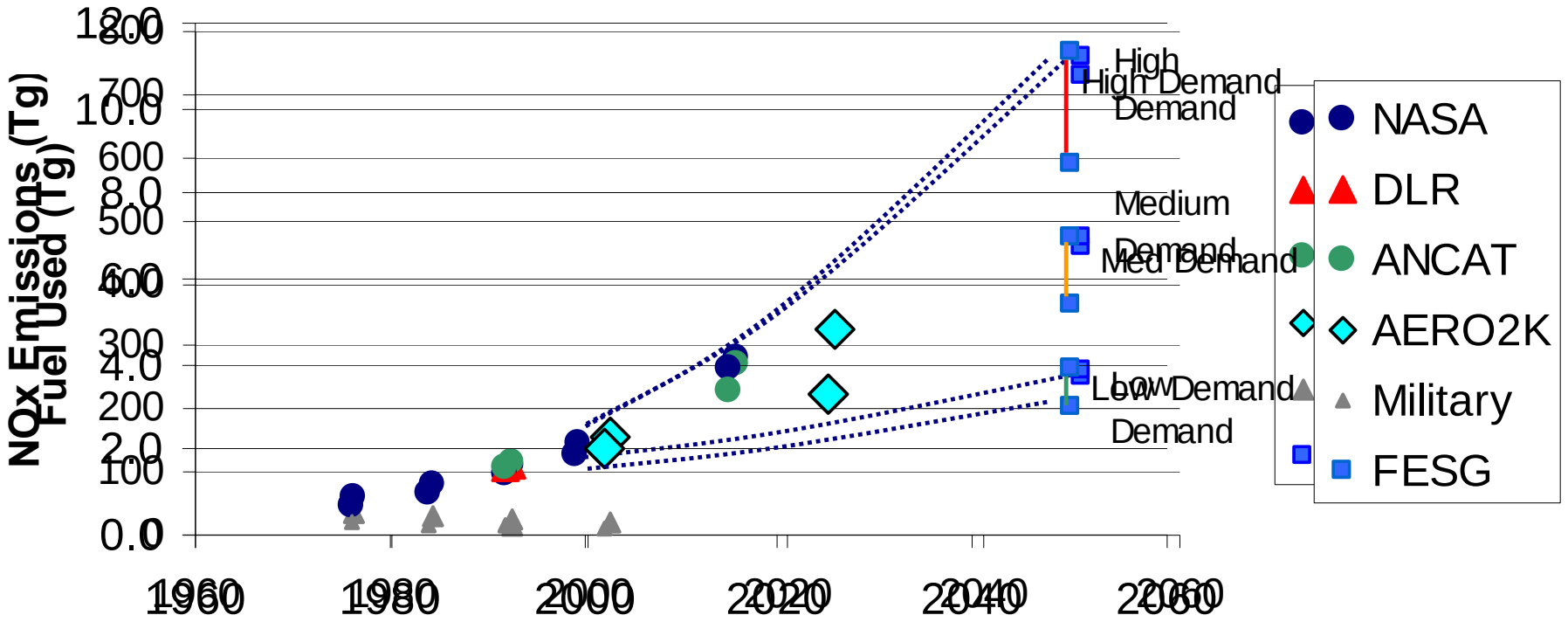








AERO2K Global Totals
Comparison with FESG scenarios to 2050



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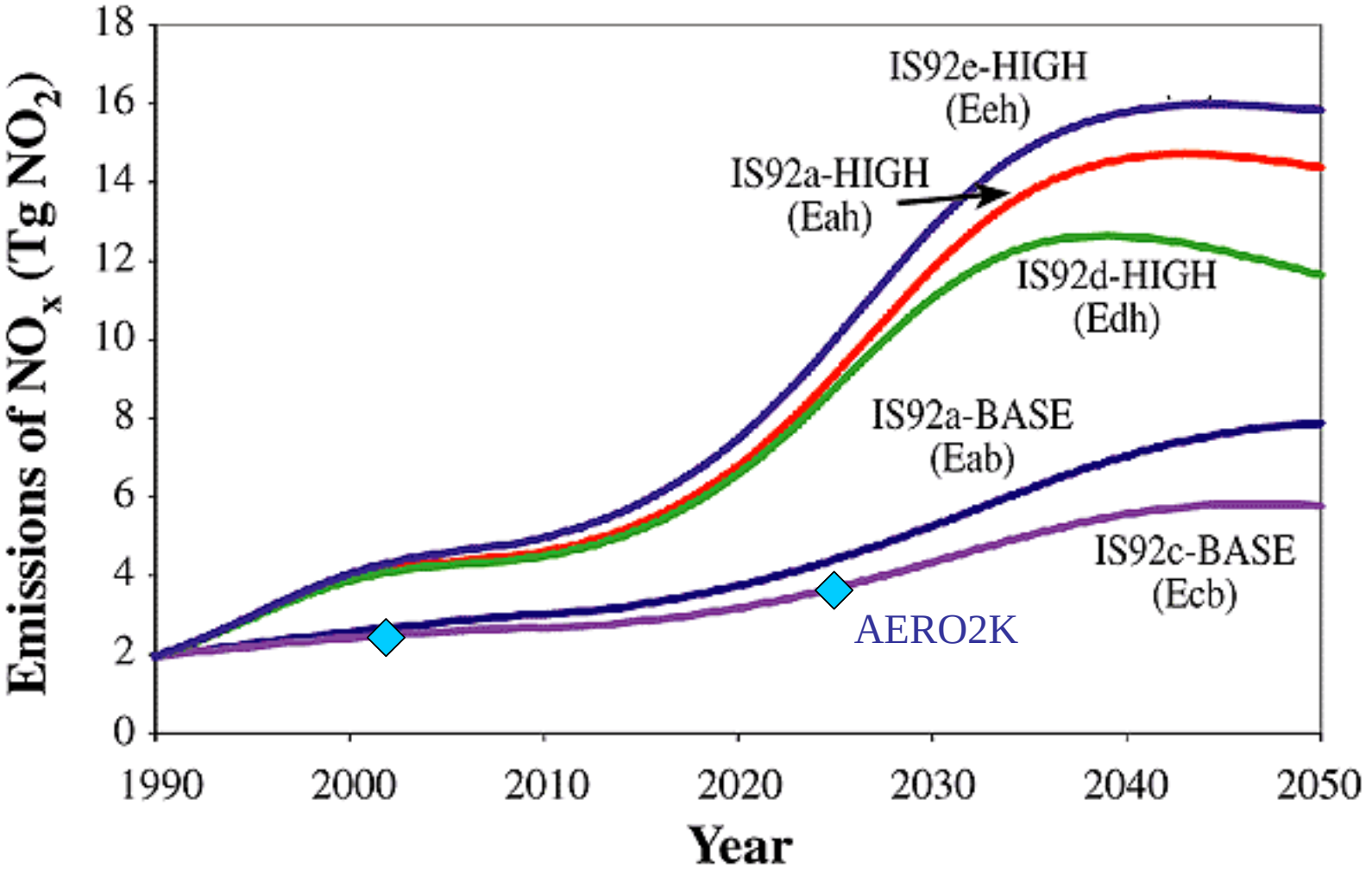
AERO2K Global Totals
Comparison with EDF scenarios to 2050

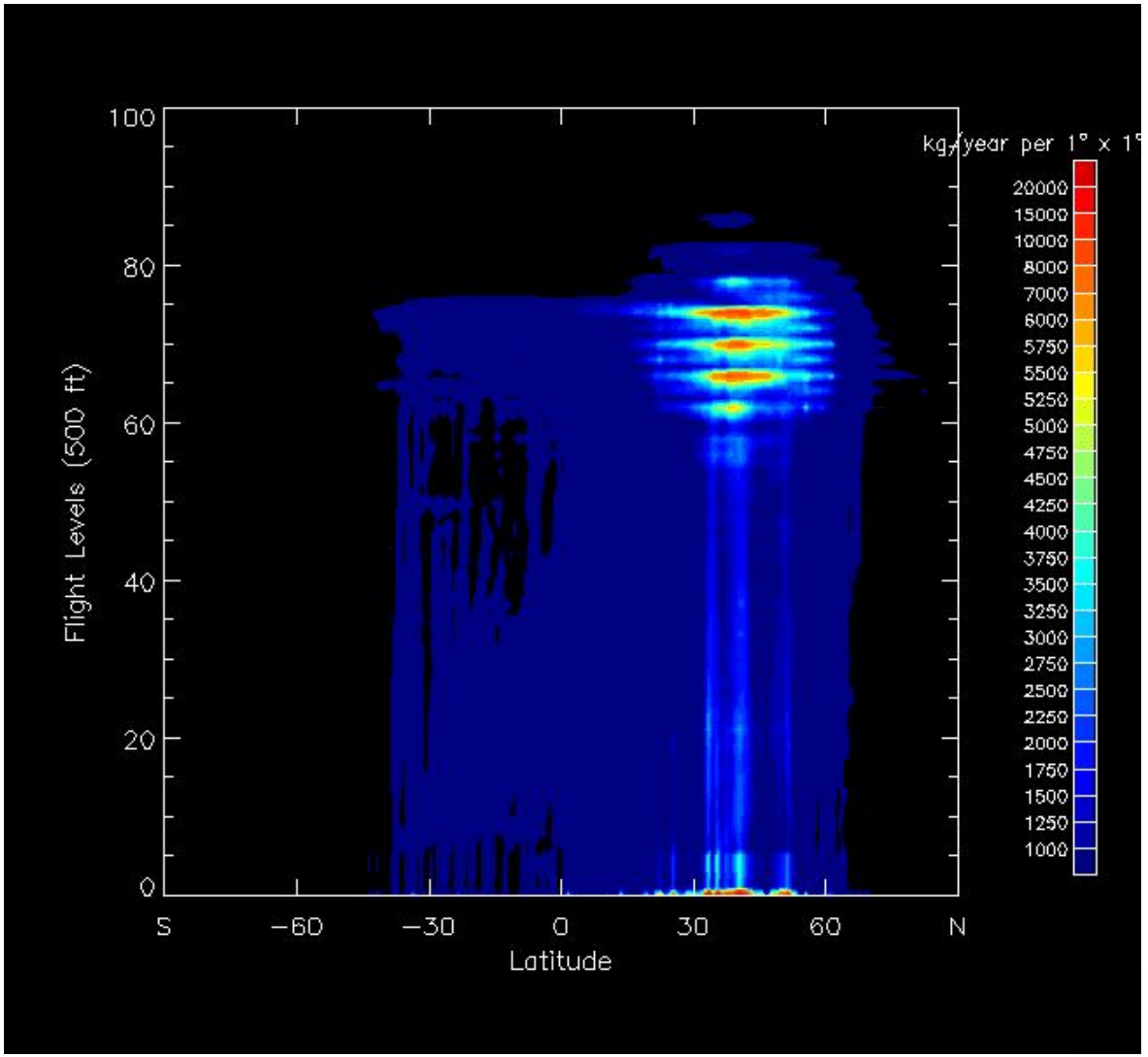


Future Application - General

- AERO2K software tool can be re-run or developed further to produce, for example,
  - selected datasets (eg national emissions, by aircraft type, by airline)
  - other forecasts (eg using FESG forecast)
  - other base years or forecast years
  - comparison of data with other inventories/methodologies (UNFCCC)

- In the meantime, the AERO2K data provides a firm foundation for modelling of aviation climate effects and for generation of scenario datasets to inform policy decisions
- Results and reports are available at:
  http://www.cate.mmu.ac.uk/aero2k

Stratification of NOx emissions (2002)



Source: Marcus Koehler, University of Cambridge

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Thank you

DLR■Manchester Metropolitan University■NLR■DTI■Airbus France■EUROCONTROL■QinetiQ

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