

AERO2K

Aviation Emissions Inventory for 2002 and 2025

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QinetiQ

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

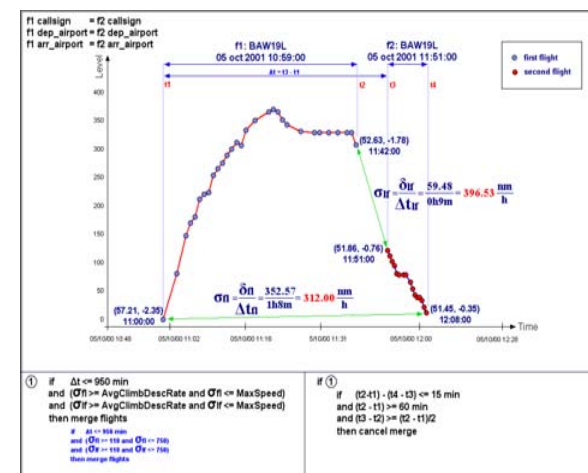
Contents

- 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

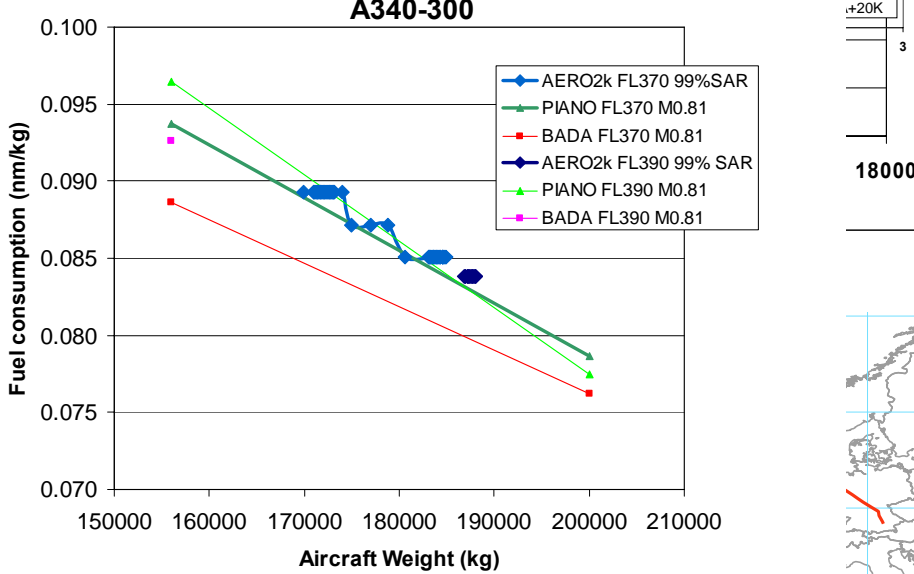
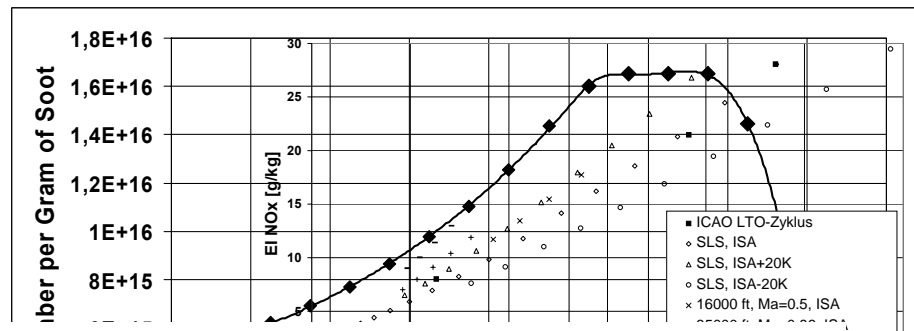
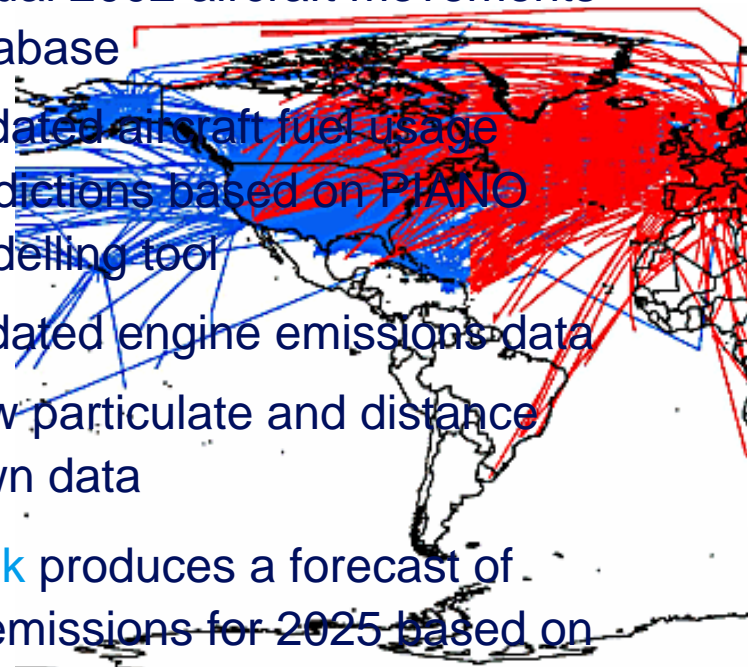
Project Partners:

- 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

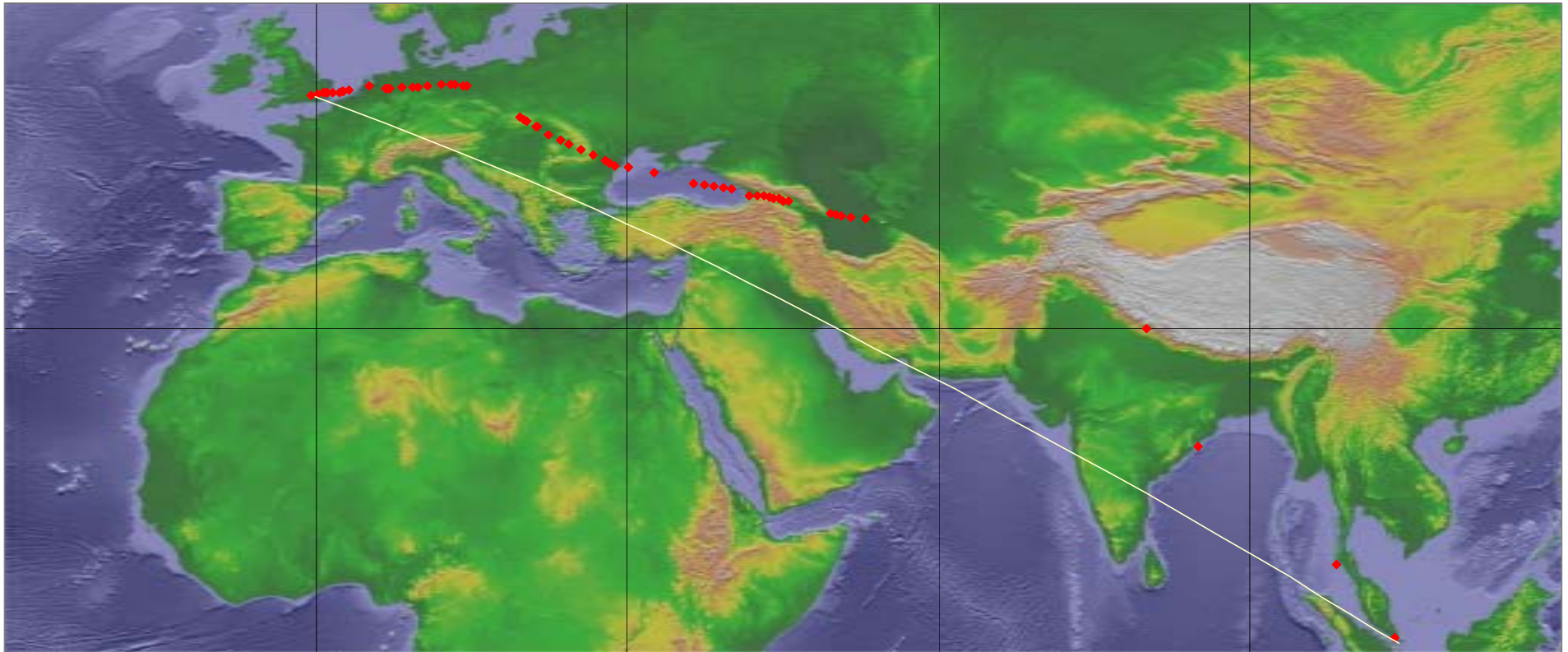
The AERO2k Inventory

- **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



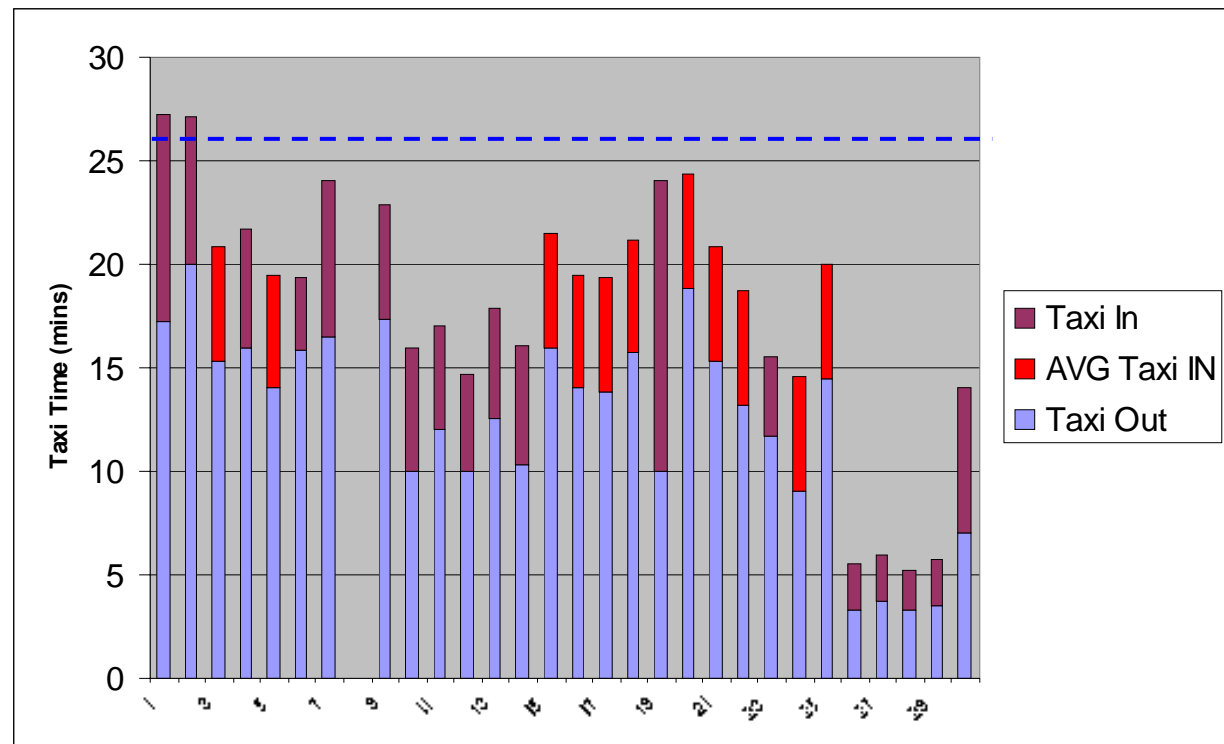
B747-400 Singapore to London

AERO2K Inventory – Taxi Times (Europe)

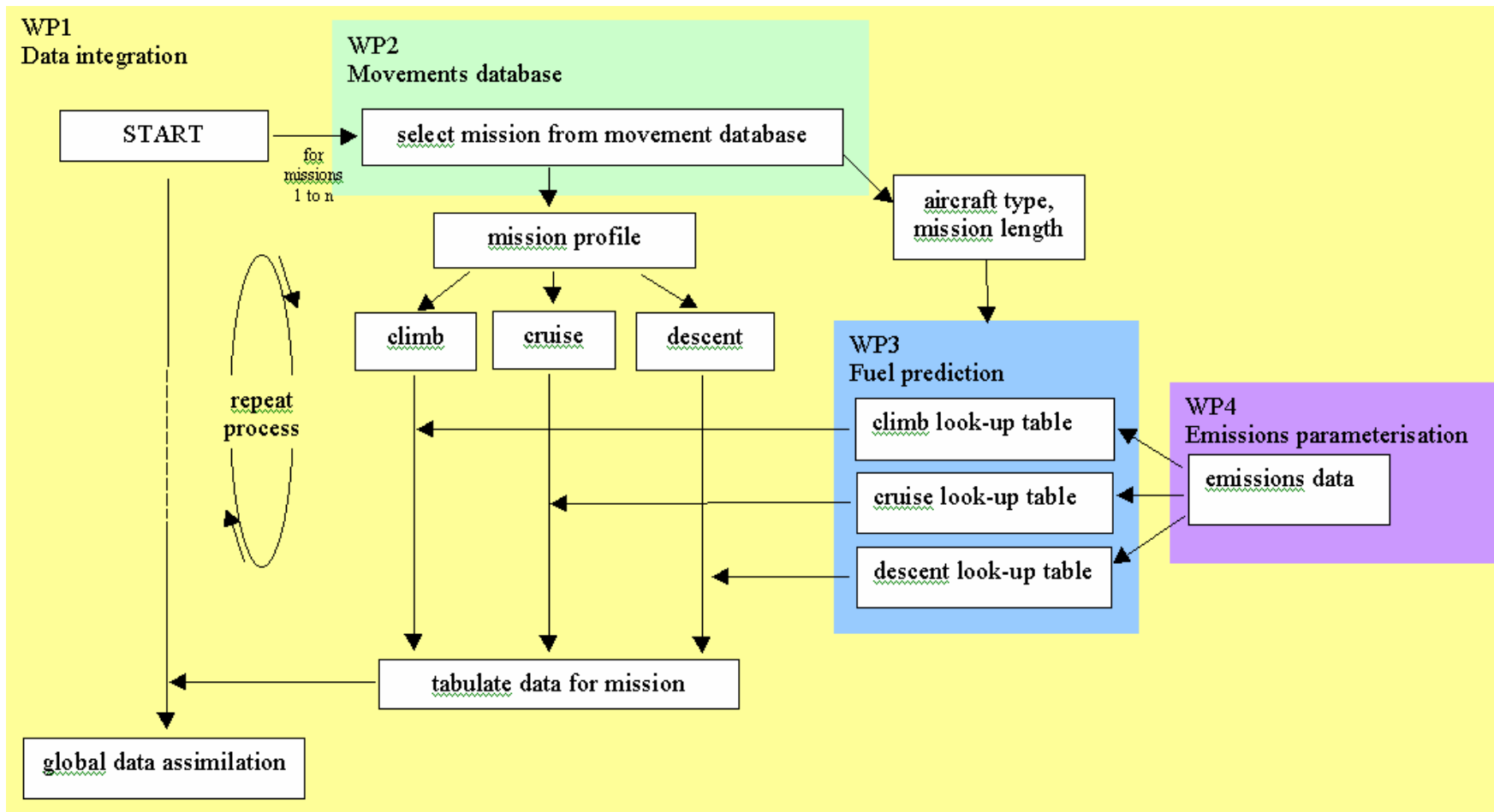
Centre for Air Transport and
the Environment



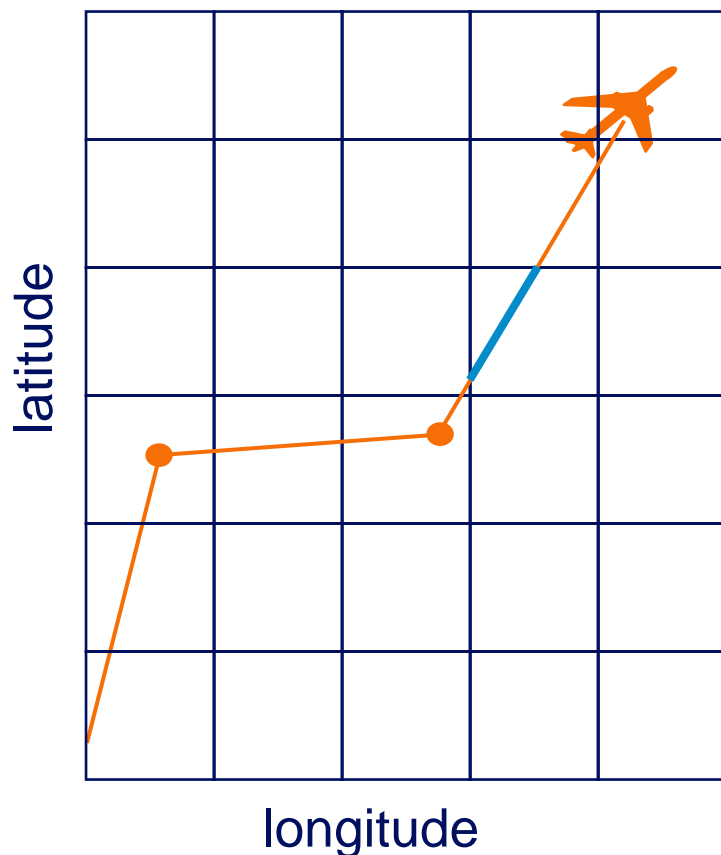
- LTO times-in-mode for individual airports are computed.



AERO2K Inventory – Data Integration



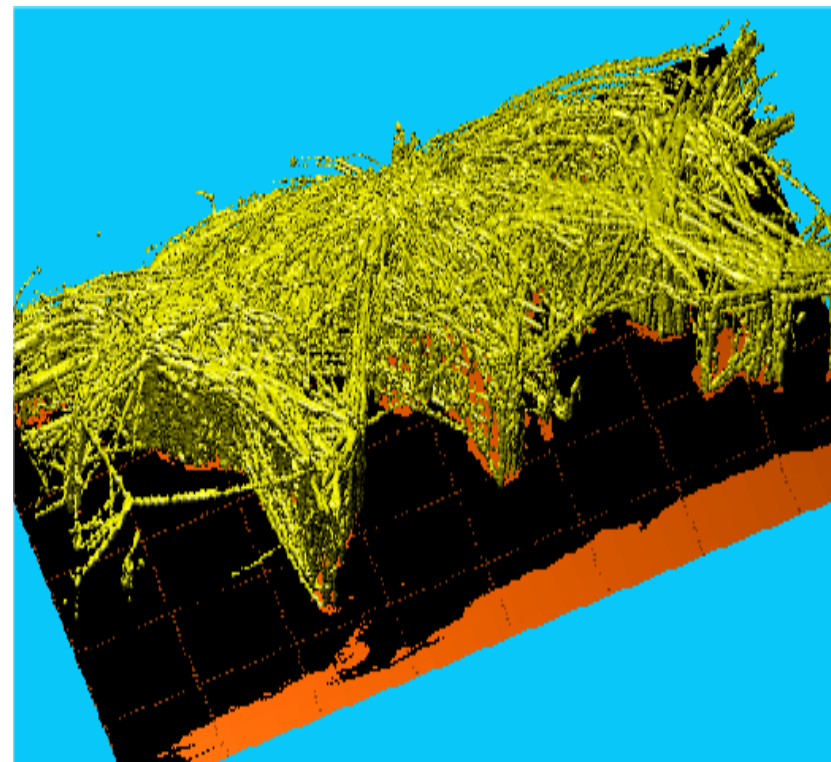
AERO2K Inventory – Allocation onto global grid



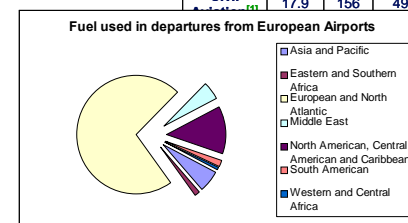
- Fuel and emissions are allocated onto global grids.
- The method determines length of path flown in each cell (e.g. blue line on flight path shown).
- Fuel and emissions allocated accordingly.

AERO2k Output

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



	Distance Flown	Fuel Used	CO ₂ Produced	H ₂ O 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 ⁻²)
Civil	17.9	156	492	193	.507	2.06	.631	.0039	4.03
Asia and Pacific	24.1	.627	.178	.644	n/a	n/a			
217	1.13	2.24	1.27	n/a	n/a				



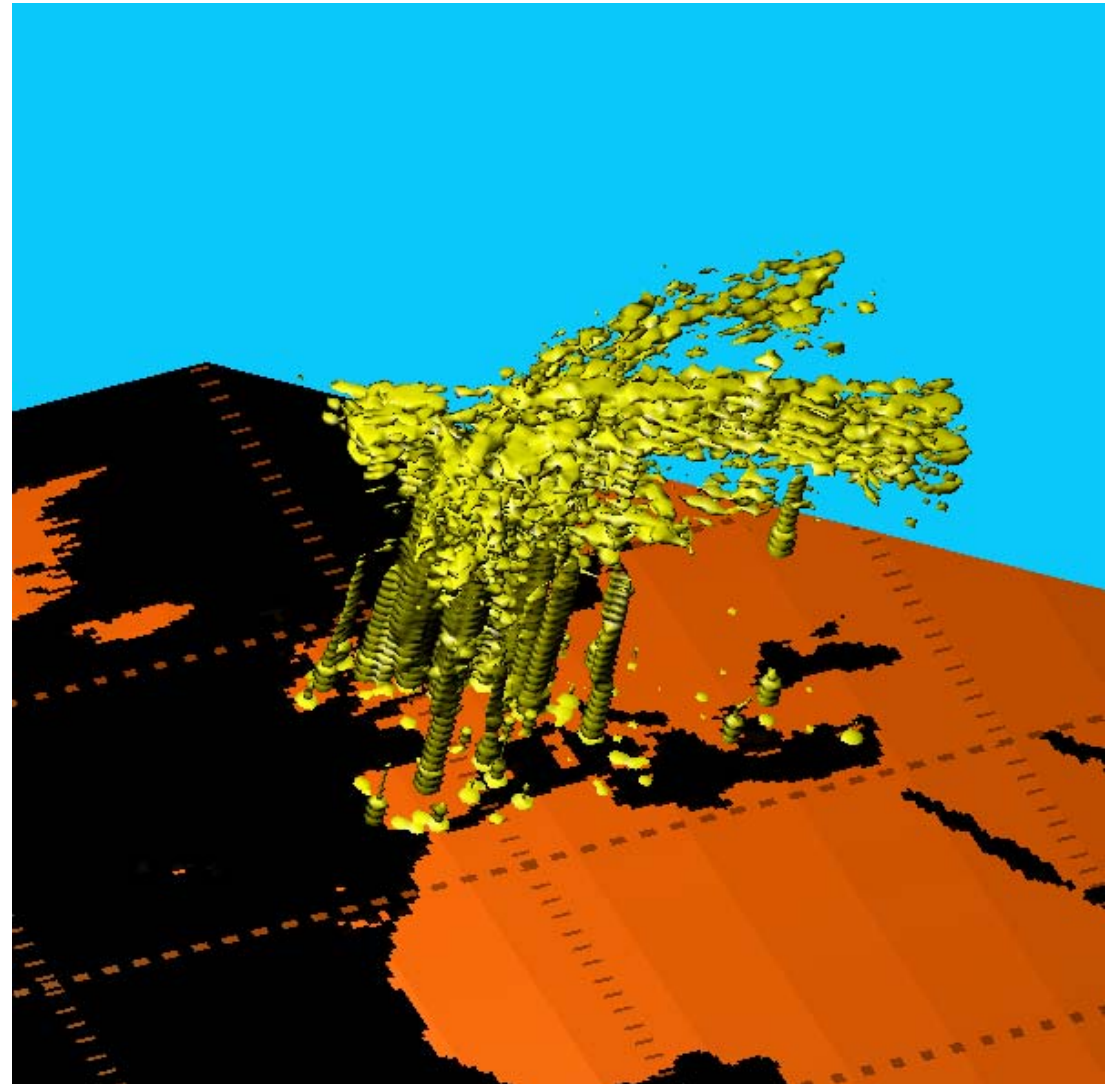
AERO2k Inventory - Application

- 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

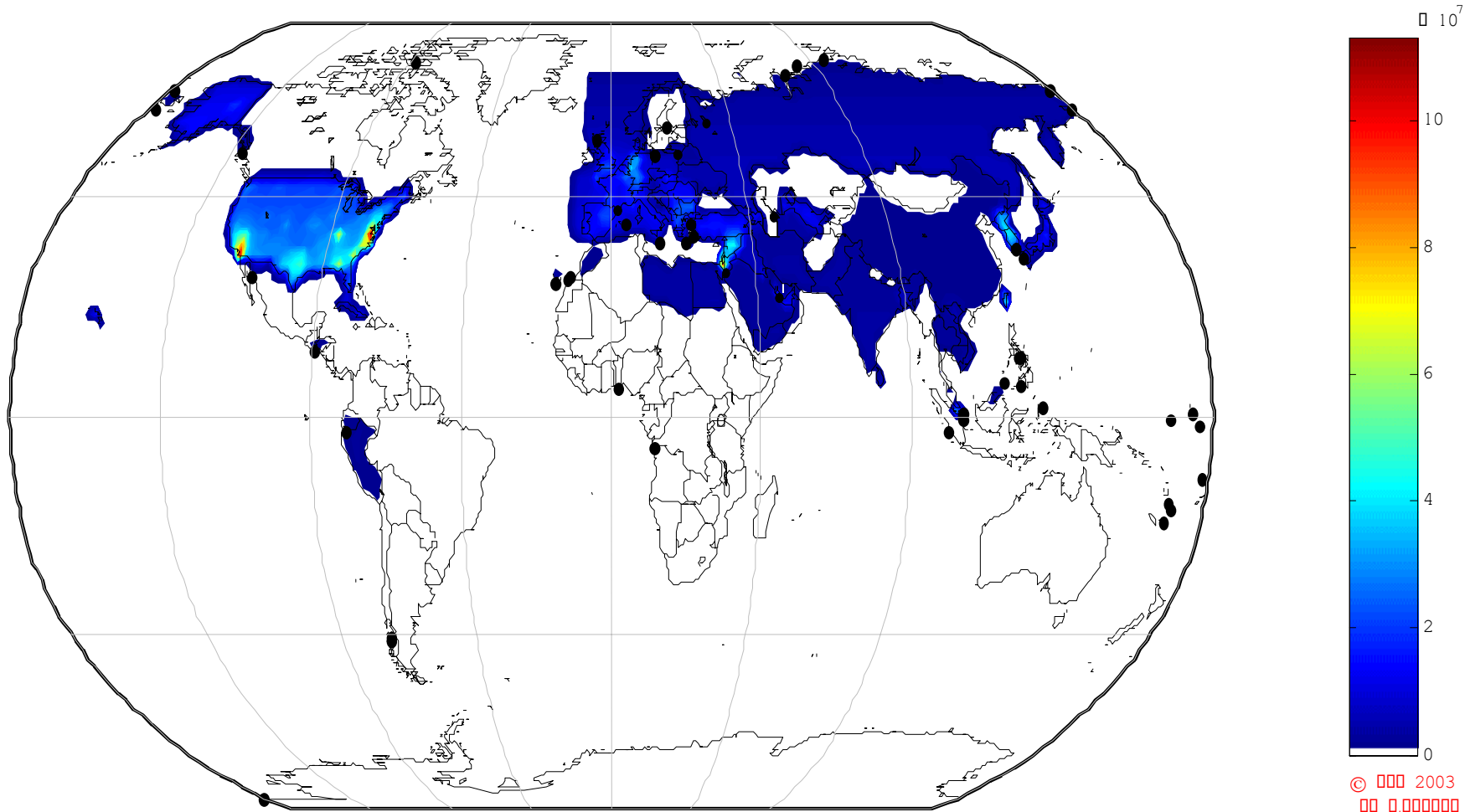
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Gridded results
are available at:

[http://www.cate.mmu.
ac.uk/aero2k](http://www.cate.mmu.ac.uk/aero2k)



2002 internal and Eastbound traffic from Europe

AERO2k Military Gridded Results -



2002 Military Fuel usage - Global

AERO2k Results – 2002 Global totals

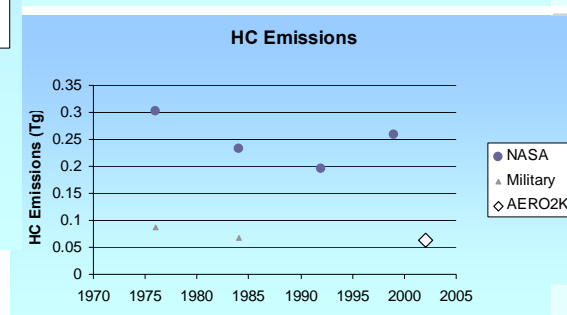
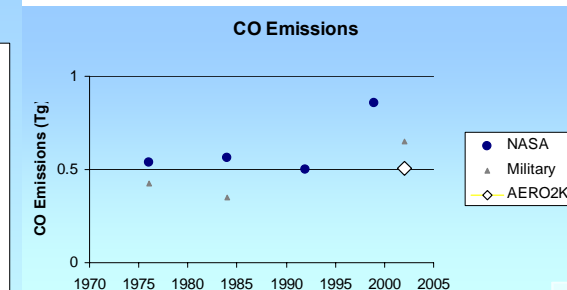
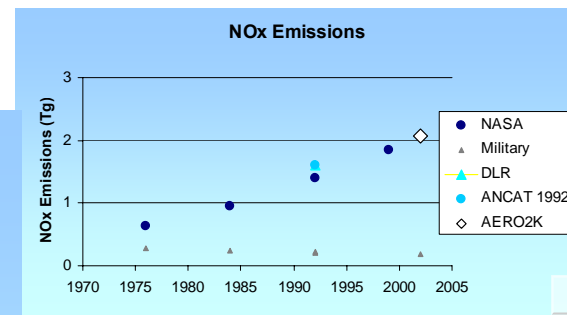
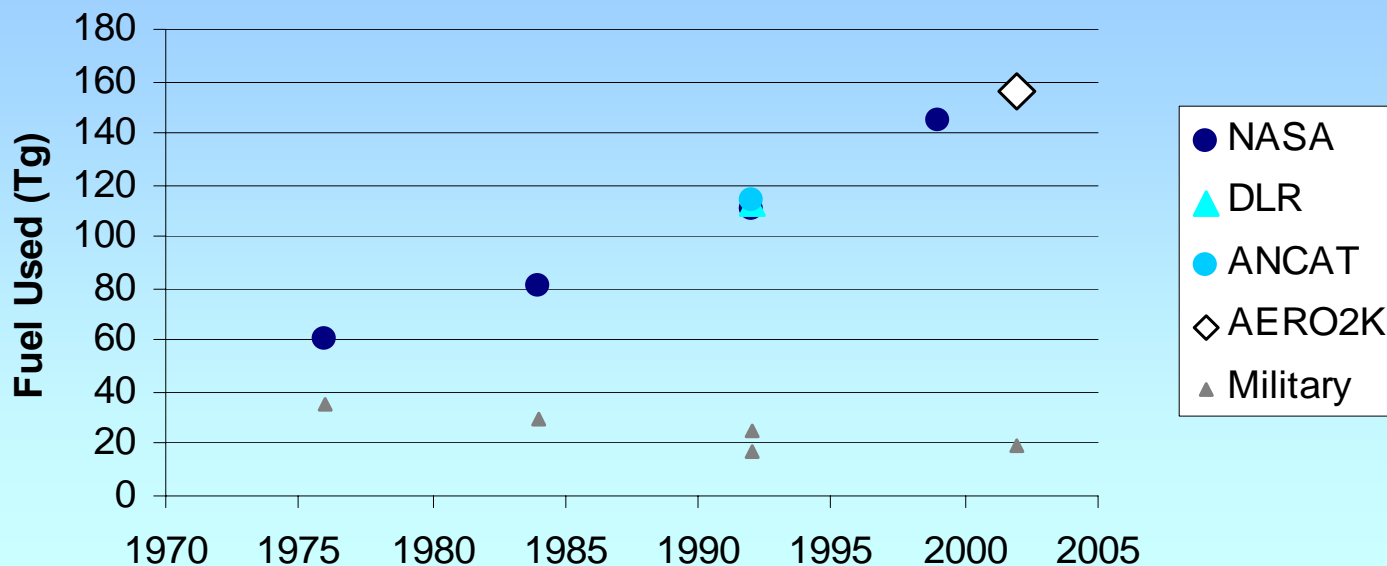
	Distance Flown	Fuel Used	CO ₂ Produced	H ₂ O Produced	CO Produced	NO _x Produced	HC Produced	Soot Produced	Particles Produced
	Nautical miles x 10 ⁻⁹)	(Tg)	(Tg)	(Tg)	(Tg)	(Tg)	(Tg)	(Tg)	(X 10 ⁻²⁵)
Civil Aviation <small>[1]</small>	17.9	156	492	193	.507	2.06	.063	.0039	4.03
Military Aviation	n/a	19.5	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

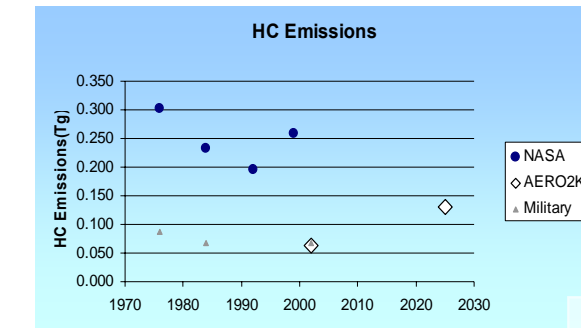
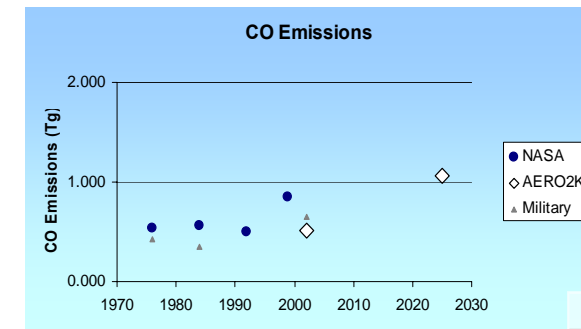
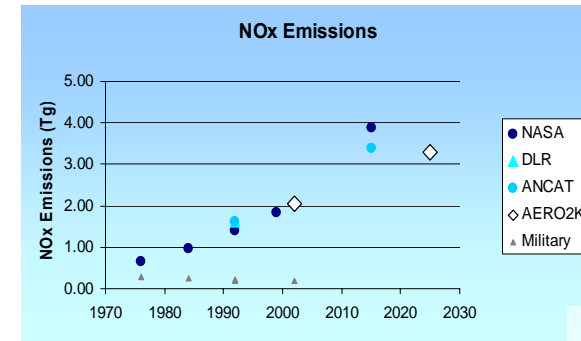
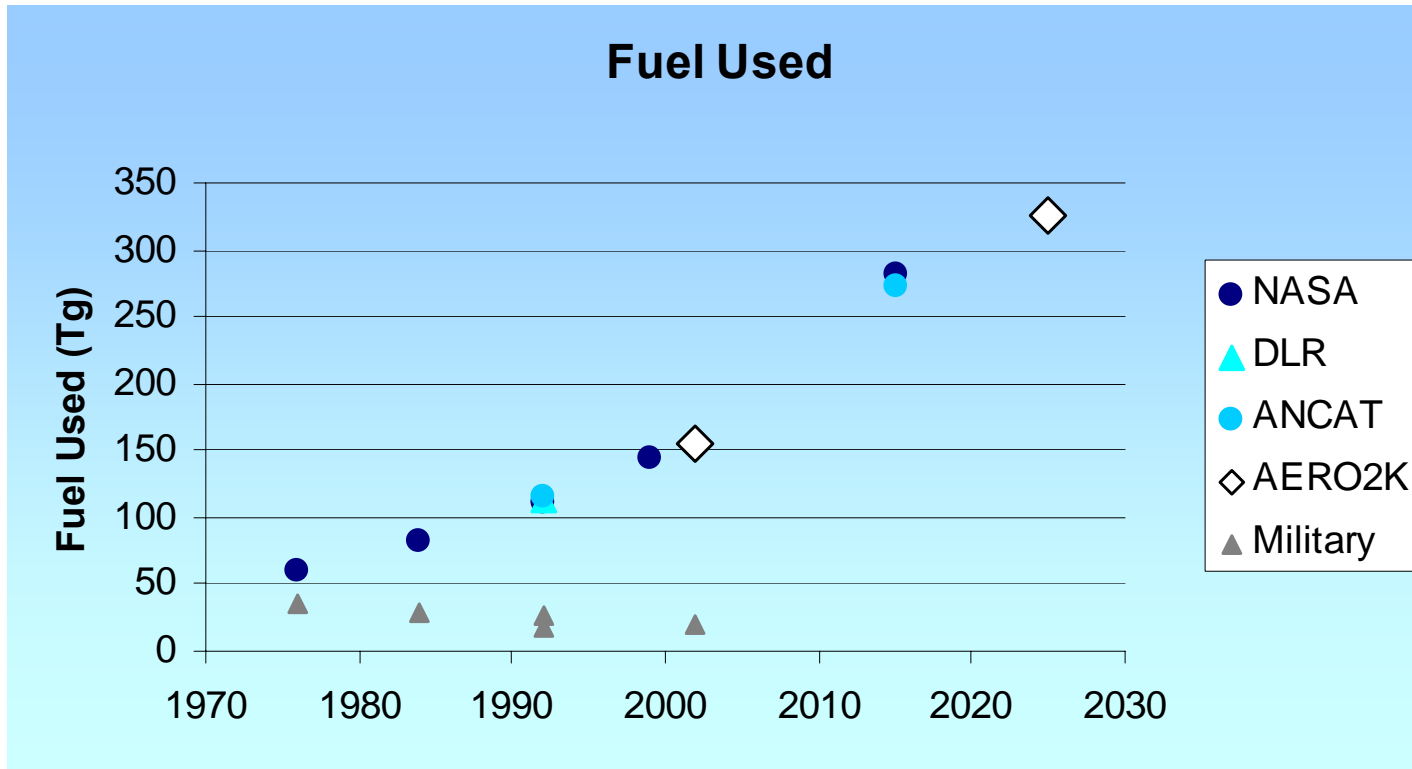
Comparison with other inventories

Fuel Used



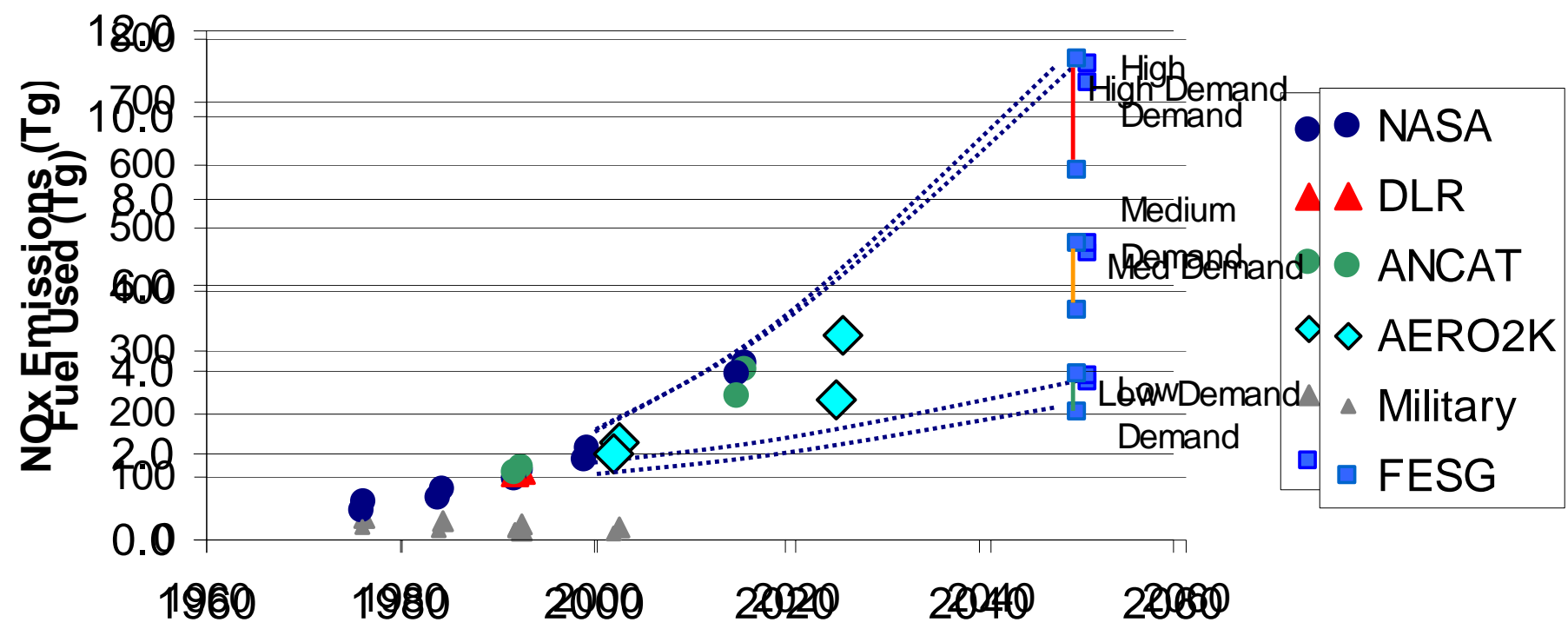
AERO2K Global Totals – 2025

Comparison with other forecasts



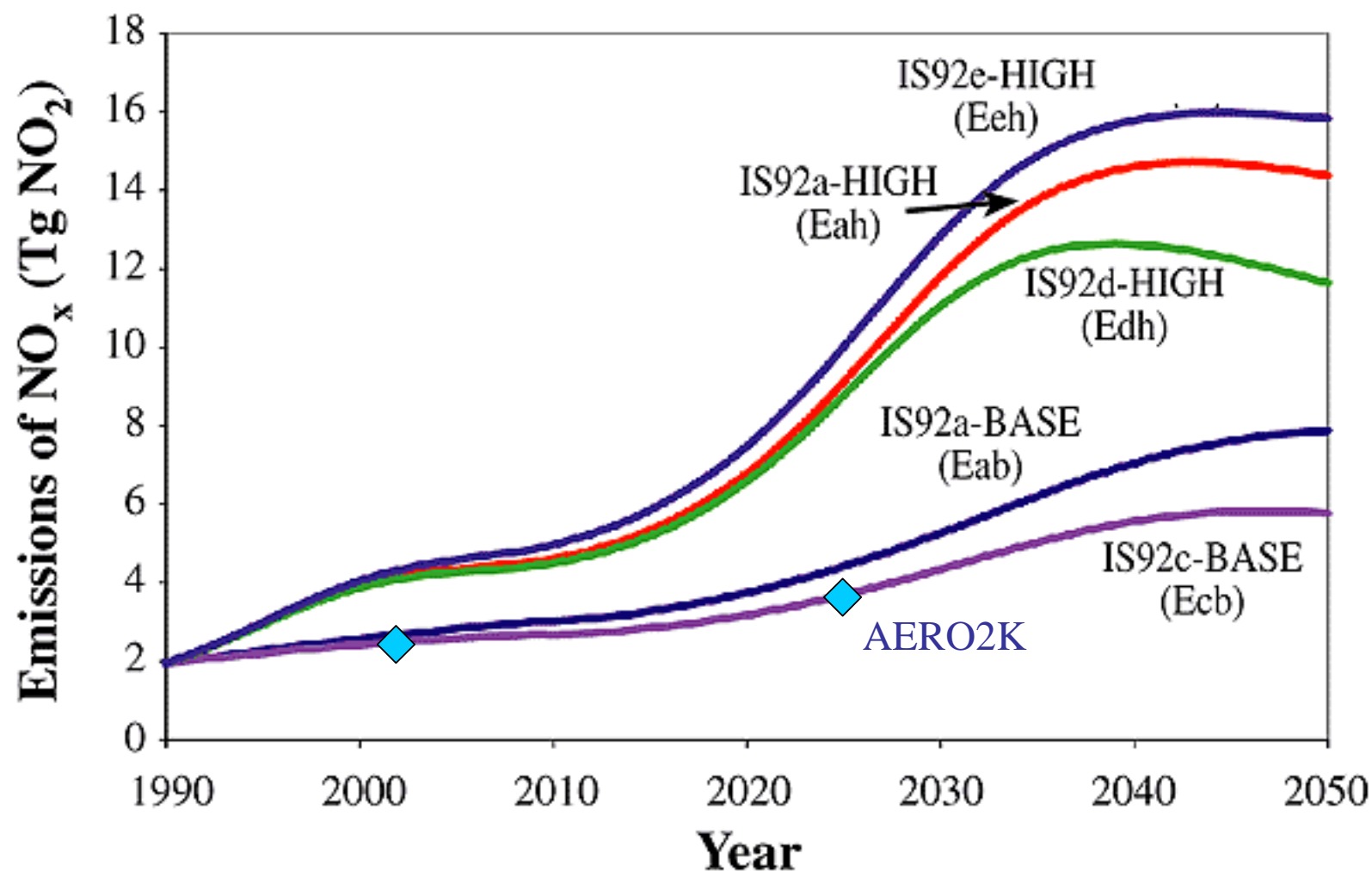
AERO2K Global Totals

Comparison with FESG scenarios to 2050



AERO2K Global Totals

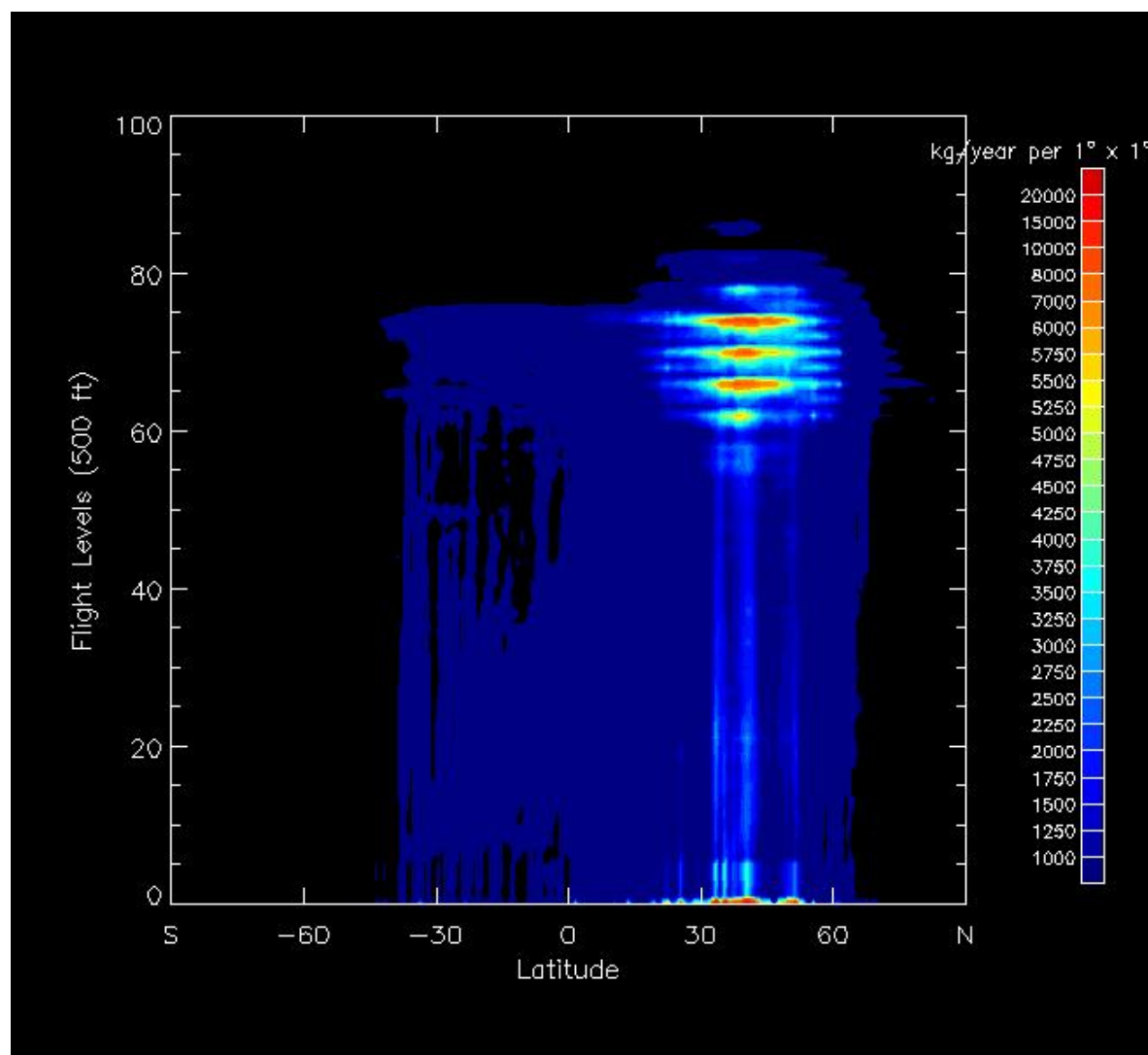
Comparison with EDF scenarios to 2050



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 NO_x emissions (2002)



Source: Marcus Koehler, University of Cambridge



Thank you

QinetiQ

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