THE IMPLICATIONS OF THE VARIABILITY OF NATIONAL AND REGIONAL AIR QUALITY REGULATIONS ON THE MODELLING OF AIRPORT AIR QUALITY WITHIN GLOBAL AVIATION AND ENVIRONMENT

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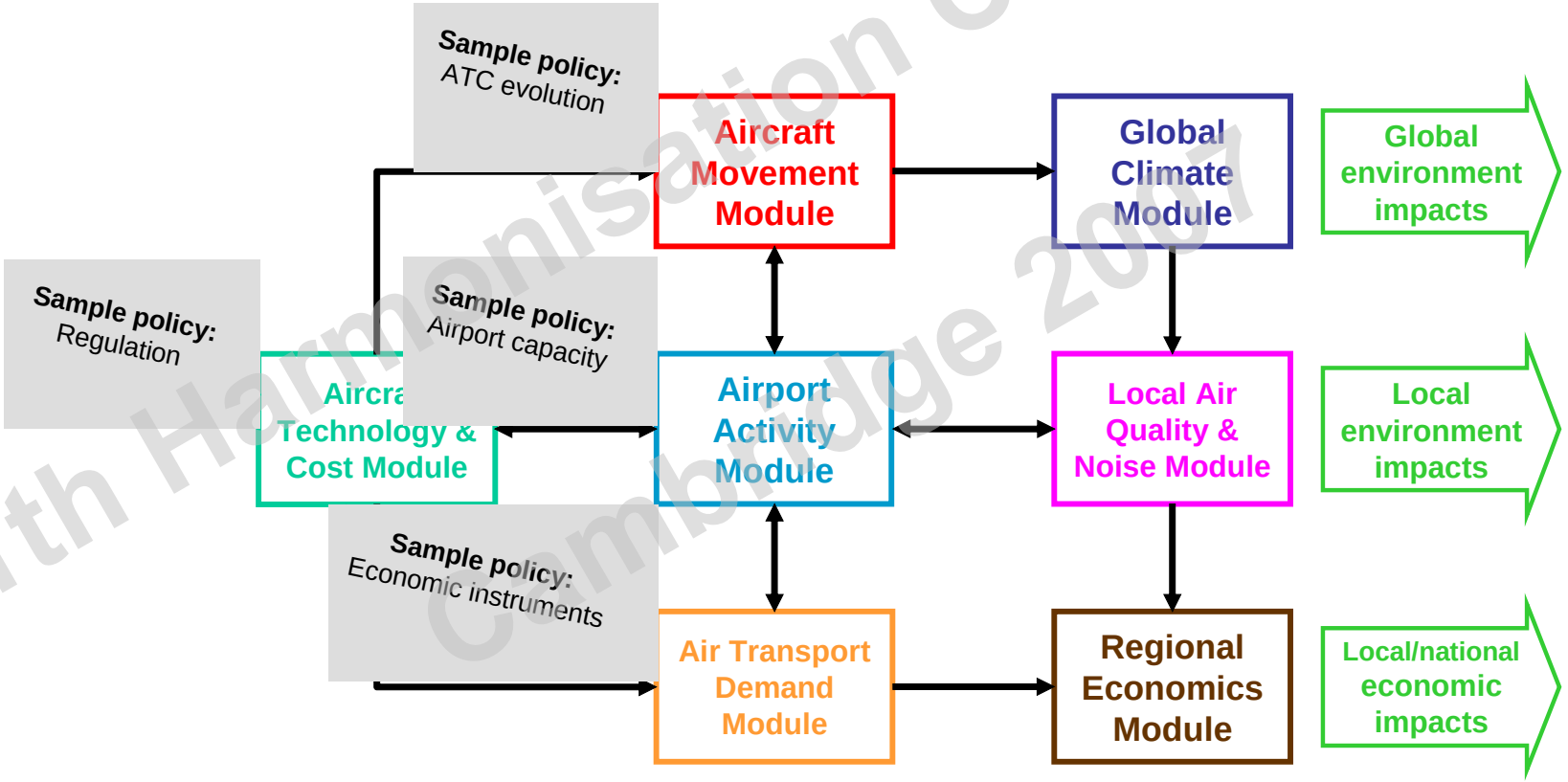
AVIATION INTEGRATED MODELLING PROJECT

WWW.AIMPROJECT.AERO

AIM

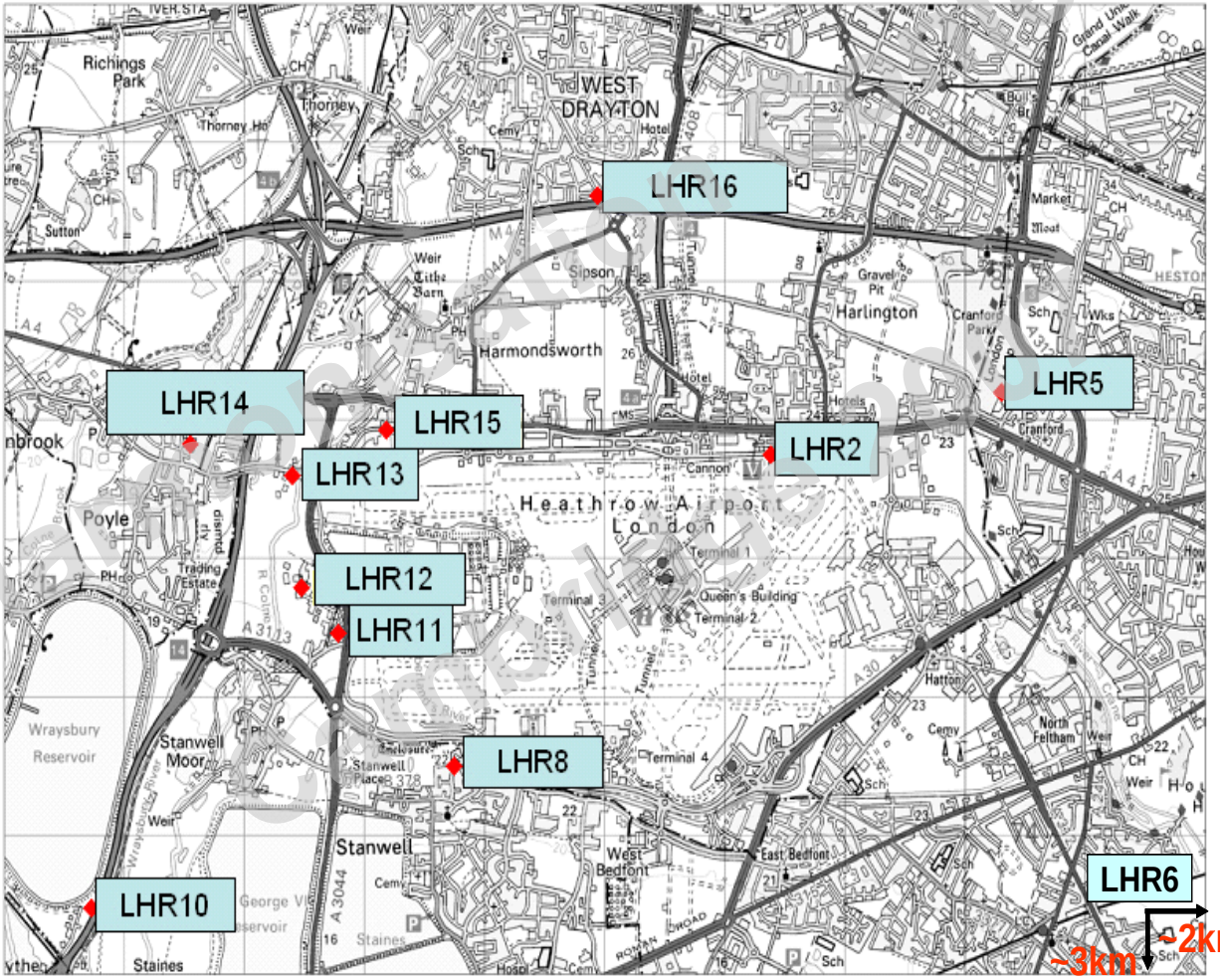
Aviation Integrated Modelling General Architecture



UK AND EU LIMIT VALUES

Pollutant	Monitored	Concentration	Enforced by End of
NO_2	Annual Mean	40 µg/m^3	2005/2010?
	1 Hour Mean	200 µg/m^3 (18 times)	2005/2010?
PM_{10}	Annual Mean	40 µg/m^3	2004/2005
	24 Hour Mean	50 µg/m^3 (35 times)	2004/2005
Ozone	Daily max 8 Hour Mean	100 µg/m^3 (10 times)	2005

MONITORING SITES NEAR HEATHROW



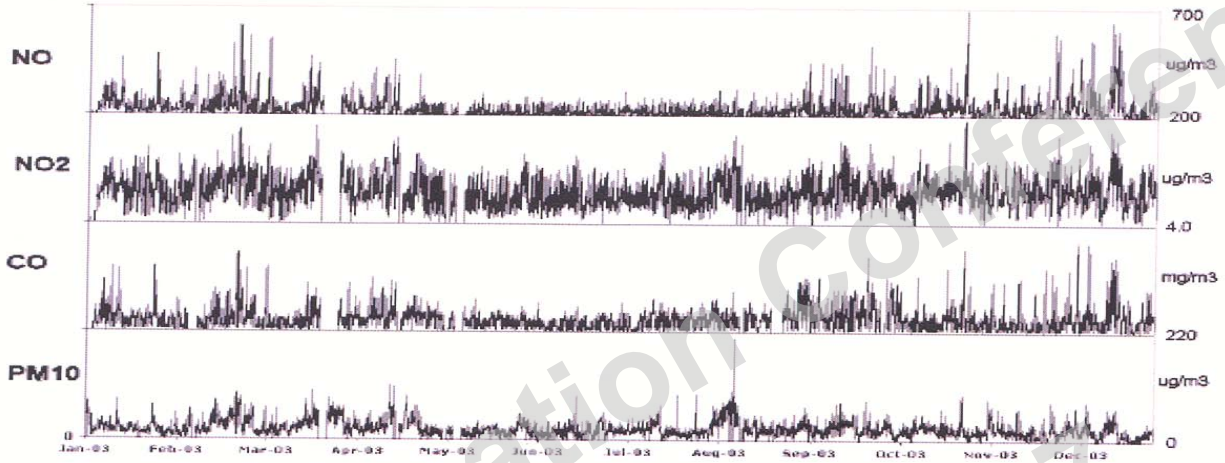


Figure 4. Time Series of Hourly Averaged Concentrations at LHR2 – 2003

Table 5. Monthly Average Air Pollutant Concentrations at LHR2 and Harlington, 2003

	LHR2											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
NO µg m^{-3}	59	68	54	43	21	23	26	29	53	59	59	87
NO_2 µg m^{-3}	57	67	65	63	47	47	49	57	64	63	63	64
NO_x µg m^{-3}	147	171	148	128	79	82	89	102	146	153	154	197
CO mgm^{-3}	0.5	0.5	0.4	0.6	0.4	0.3	0.4	0.5	0.8	0.5	0.4	0.6
PM_{10} µg m^{-3} (TEOM)	21	31	30	29	17	18	21	31	27	23	21	21

WHITE PAPER "THE FUTURE OF AIR TRANSPORT" DECEMBER 2003

- **GOVERNMENT SUPPORT FOR THIRD RUNWAY AT HEATHROW IF COMPLIANCE WITH AIR QUALITY LIMITS CAN BE MET**

- **TIMING 2015-2020**

- **ACTION MUST BE TAKEN TO TACKLE *NO_2 PROBLEM***

- **GOVERNMENT WOULD INSTITUTE A PROGRAMME OF ACTION TO CONSIDER HOW THESE CONDITIONS CAN BE MET**

- **THIS COMMITMENT CARRIED FORWARD THROUGH PROJECT FOR THE SUSTAINABLE DEVELOPMENT OF HEATHROW (PSDH)**

PROJECT FOR THE SUSTAINABLE DEVELOPMENT OF HEATHROW (PSDH)

THREE PANELS OF AIR QUALITY-RELATED EXPERTS:

–DISPERSION MODELLING
–MONITORING OF AIR POLLUTION
–EMISSION SOURCE DATA

•EACH PANEL …. BALANCED MEMBERSHIP

•HUMAN HEALTH RELATED AIR QUALITY STANDARDS

•PRIMARY FOCUS ON ANNUAL AVERAGE CONCENTRATIONS OF NITROGEN DIOXIDE NO_2 AND SECONDLY BY PARTICULATE MATTER PM_{10}

•PSDH REPORT FROM DfT JULY 2006, SUBMITTED TO PARLIAMENT JULY 19 2006; OPENLY AVAILABLE

COST - BENEFITS

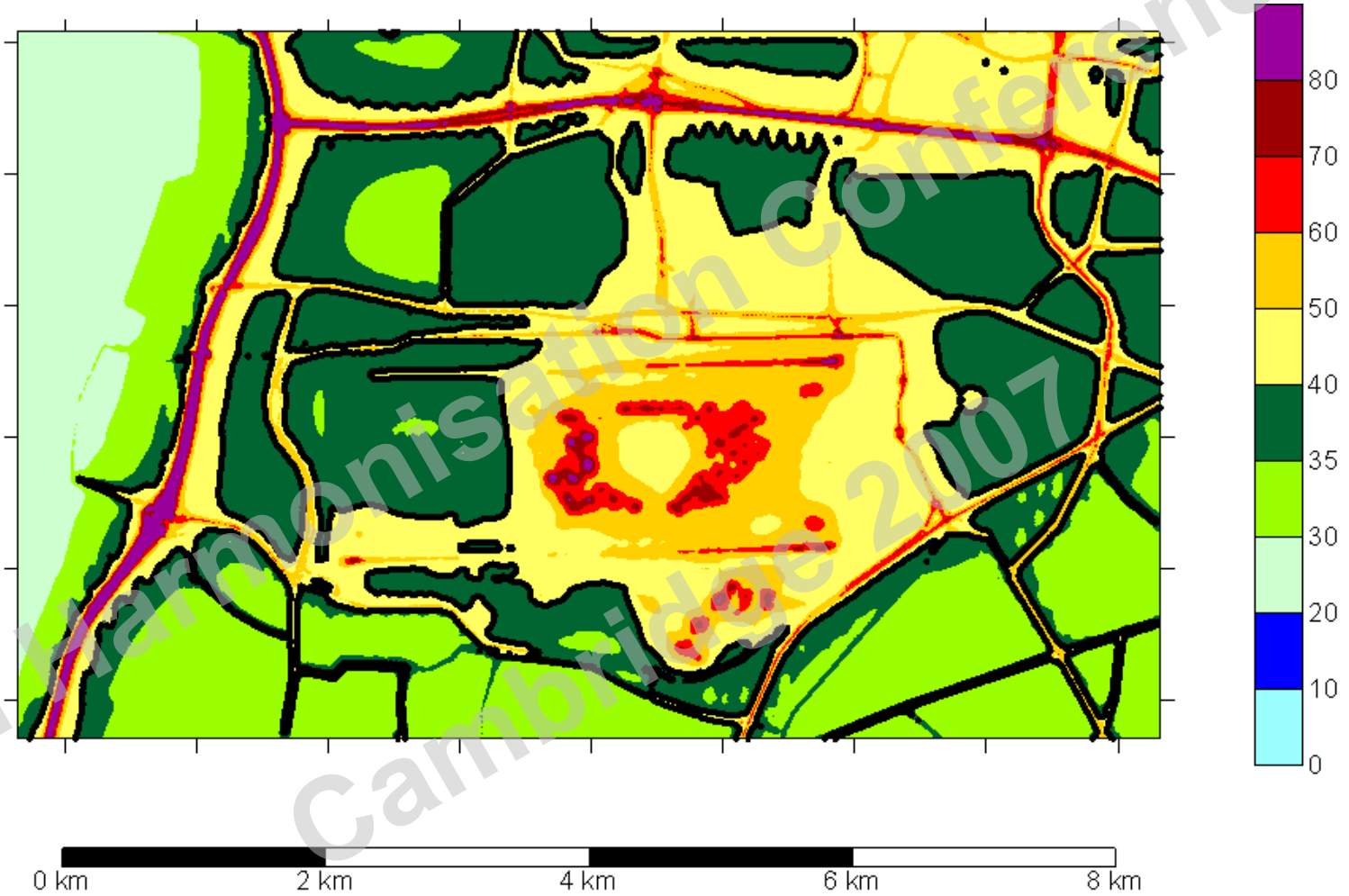
The White Paper: Heathrow Airport is of vital importance to the UK economy, …. Supporting 100,000 jobs (direct and indirect). A short third runway would yield net economic benefits of £ 6 billion (net present value) .

BA says two extra runways for the South East could generate £ 65 billion of economic benefits. BBC News 24; 2 December 2003

However of possibly greater concern is the cost of not expanding and becoming less competitive with other airports in other countries. The cost of delayed or stunted economic growth can be estimated but I was unable to find estimates for this cost.

Background concentrations for NO_x, NO_2, and PM_{10}

		2002
NO_x as NO_2 ($\mu g/m^3$)	Annual average	31
	Maximum hourly average	592
	99.79th percentile	348
NO_2 ($\mu g/m^3$)	Annual average	19
	Maximum hourly average	134
	99.79th percentile	103
PM_{10} ($\mu g/m^3$)	Annual average	26
	Maximum hourly average	130
	90.41st percentile of 24 hour averages	54
	98.08th percentile of 24 hour averages	80



CERC PREDICTION:TOTAL NO_2

OVERVIEW

Activity

Emissions control based on NOx

Dispersion/Reaction/Deposition

Concentrations control based on NO_2

Exposure

Health Effects

Observation: Many/most engineering colleagues working on NOx emissions were unaware that there were no air quality regulations on NOx

Note that annual mean regulatory standard is 40 μg/ m3.
Heathrow airport in particular and parts of London have great difficulty in meeting this limit value.
This is less than half the annual mean federal regulatory standard in the US of 100 μg/ m3.

WHY?

Move London to the US solves the problem.

EMISSIONS AND DISPERSION MODELLING SYSTEM (EDMS)

•FROM US FEDERAL AVIATION ADMINISTRATION

•COMPREHENSIVE MODEL – INTEGRATED EMISSION DATABASE FOR LARGE VARIETY OF AIRCRAFTS + AERMOD DISPERSION MODEL

•NO_2 IS **NOT** PREDICTED BY THIS MODEL

•A POST-PROCESSING NO2 CORRELATION WAS USED

•ANNUAL AVERAGE CONCENTRATION FOR NO2 WAS WELL PREDICTED AND THIS IS THE CRITICAL REGULATORY PARAMETER

Observation: Little interest in the US regarding NO_2

ASK STEVE HANNA: HARVARD SCHOOL OF PUBLIC HEALTH

"Yesterday I listened to a lecture by Doug Dockery (HSPH Department Head) on how health standards are set. Alan Eschenroeder is leading the class. Doug talked about the WHO standards (40 μg/m^3 annual average for NO2) and said that most countries do not enforce the WHO standards. After I asked about the discrepancy between US and Europe standards for NO2 annual average. They were surprised. They said that NO2 has largely dropped off the radar screen in the US and it is thought to be important only as a precursor to ozone and PM. He said that he was wondering why the Europeans do so many NO2 health studies in comparison to few by the US. I mentioned about the concerns at airports and in cities in Europe and he said he was wondering why Europe was doing so many airport and urban traffic studies, too.

This seems like a peculiar situation.

Steve"

AN INTERESTING COMMENT!

WHERE HAS THIS REGULATORY VALUE FOR ANNUAL AVERAGE NO2 COME FROM?

Source is the WHO air quality guidelines of 1996.

EU CAFÉ did ask a WHO working group to review the most recent scientific evidence on the adverse health effects of PM, O3 and NO2 and this led to a report WHO, 2003. For NO2 " new evidence does not provide sufficient information to justify a change in the guideline value". It was also noted that because of a lack of evidence the former group WHO, 1996 selected a value from a prior review.

Also .." given the role of NO2 as a precursor of other pollutants and as a marker of traffic related pollution …..

EU CAFÉ later provided some follow up questions WHO, 2004 including " what was the basis for maintaining the WHO NO2 annual specific guideline", essentially asking for evidence. It was concluded that "NO2, as a marker of a complex mixture of traffic-related pollution is consistently associated with adverse effects on health at relatively low levels of long-term average exposure.

OBSERVATIONS

The regulatory limit values for annual average nitrogen dioxide concentrations vary considerably on a global scale, up to a factor of 2.5 between Europe and the USA.

FROM BOB MAYNARD (CHAIRED THE WHO WORKING GROUPS)PERSONAL COMMUNICATION

You rightly point out that the US standard is 100. This is, I think, based on a less recent examination of the evidence base. Whether the US EPA will recommend a lower figure on their next review of NO2 can only be conjectured.

The relevant limit value has been difficult to meet in Europe in urban areas and near to many airports, but not within the USA

- **Consequently there is a marked difference in the efforts in the US and Europe regarding NO2 as a pollutant, in research funding and, consequently, in national commitment of scientific expertise**

NO2 appears to be being interpreted in Europe as a marker for a complex mixture of traffic related pollutants

It is not at all clear that mitigation efforts to reduce NO2 concentrations will be transferred to reductions in the health effects on the population

(Also recent evidence indicates that it is not at all clear that reducing NOx emissions will reduce NO2. It doesn't proportionately. Near Heathrow between 1993 and 2004 NOx reduced by 6 µg/m^3 per year whereas NO2 reduced by 0.5 µg/m^3)

The large national or regional variability in some regulated pollutants and the implied health effects on the population may lead to difficulties in developing equitable monetisation within global aviation/environment models, such as those being developed in the US for ICAO/ CAEP that will probably be used globally