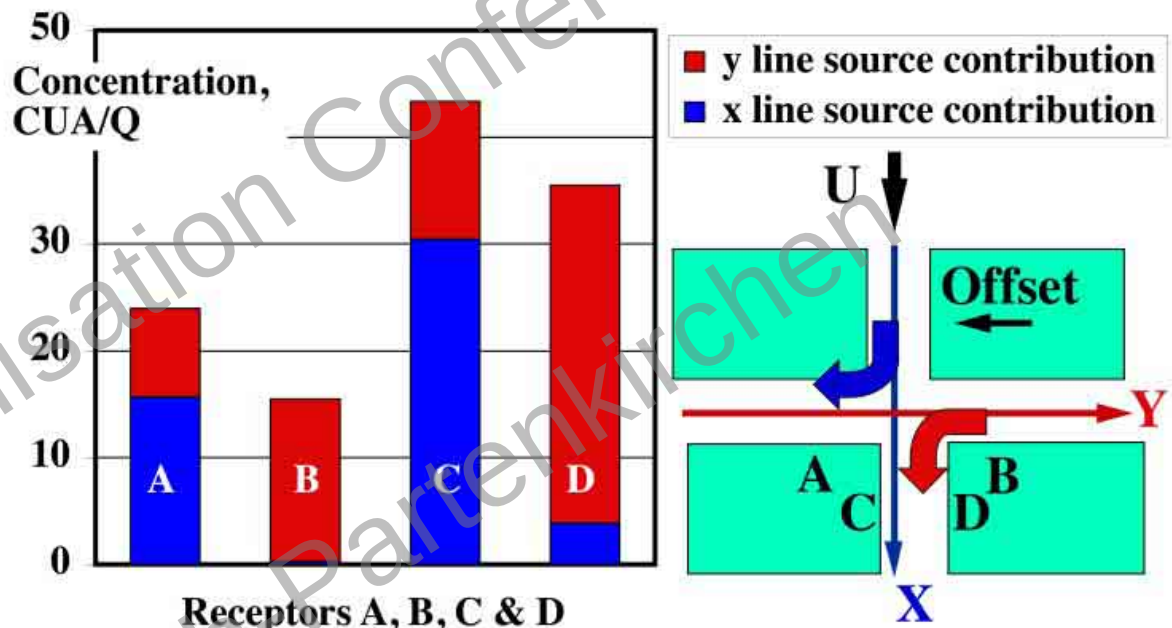
EPSRC Infrastructure & Environment Programme

Dispersion of Air Pollutants & their Penetration into the Local Environment



Project summary

Field - wind tunnel - modelling

Plans & activities

Project Structure

- Surrey - project management, wind tunnel modelling
- Bristol - tracer studies
- Cambridge - tracer studies, modelling & applications
- Imperial - field site management, exposure, modelling & applications
- Leeds - traffic movement, emissions, pollution & wind field measurement
- Reading - meteorology, wind field & modelling

London -> ALG/APRIL/EA/Local Government/TfL

Government -> Home Office

DEFRA (A/Q Division), DSTL (Porton Down), HSE, NRPB, Met. Office

Objectives

DAPPLE aims:

- to treat short range pollutant dispersion
- to address personal exposure
- to improve predictive ability
- to aid air quality planning and management
- to improve models for emergency response
- to develop decision support tools & methodologies
- to develop best practice guidelines for model application
- to assess the inherent uncertainty in model use
- to provide generic output

Key Times

2002 April: project start

2003 Spring: field trial

Monitoring: 28 April to 23 May

Tracer study: 15th May

Summer: results analysis, interim output & workshop

2004 Spring: main field trials

19th April to 11th June (and beyond)

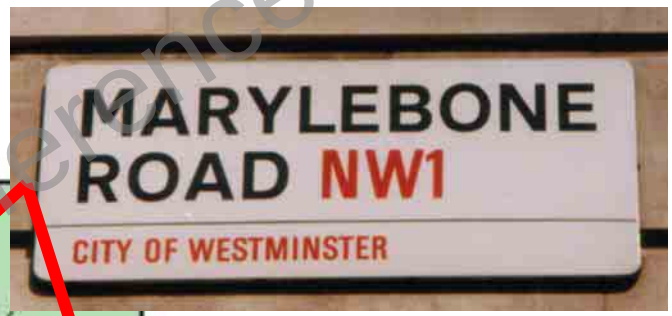
2005 Continued analysis; results, workshop, dissemination

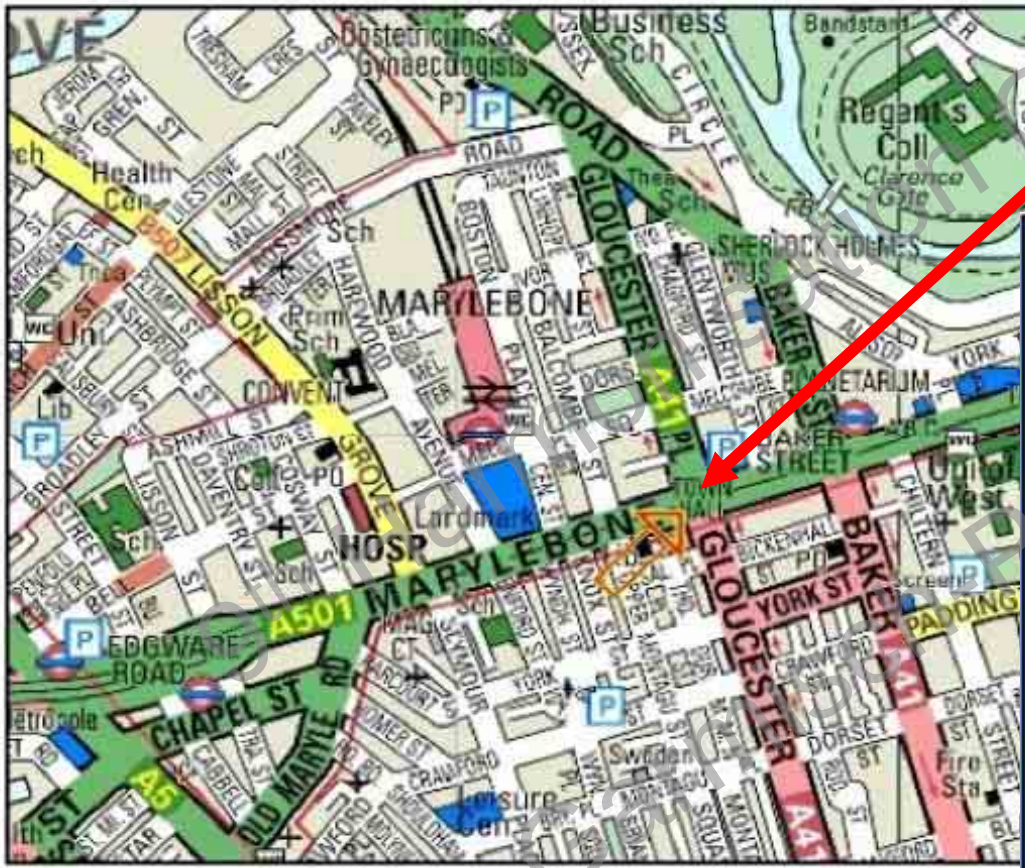
2006 March - project end; final reports and workshops

Main Activities

- Traffic movement
- Emissions
- **Pollutant monitoring (CO, NOx, CO_2)**
- **Wind and meteorology**
- **Tracer studies (PFC, SF_6)**
- Personal exposure measurement (position, CO, particles)
- **Wind tunnel modelling**
- **Computer modelling (LES -> empirical)**
- Analysis
- Knowledge transfer

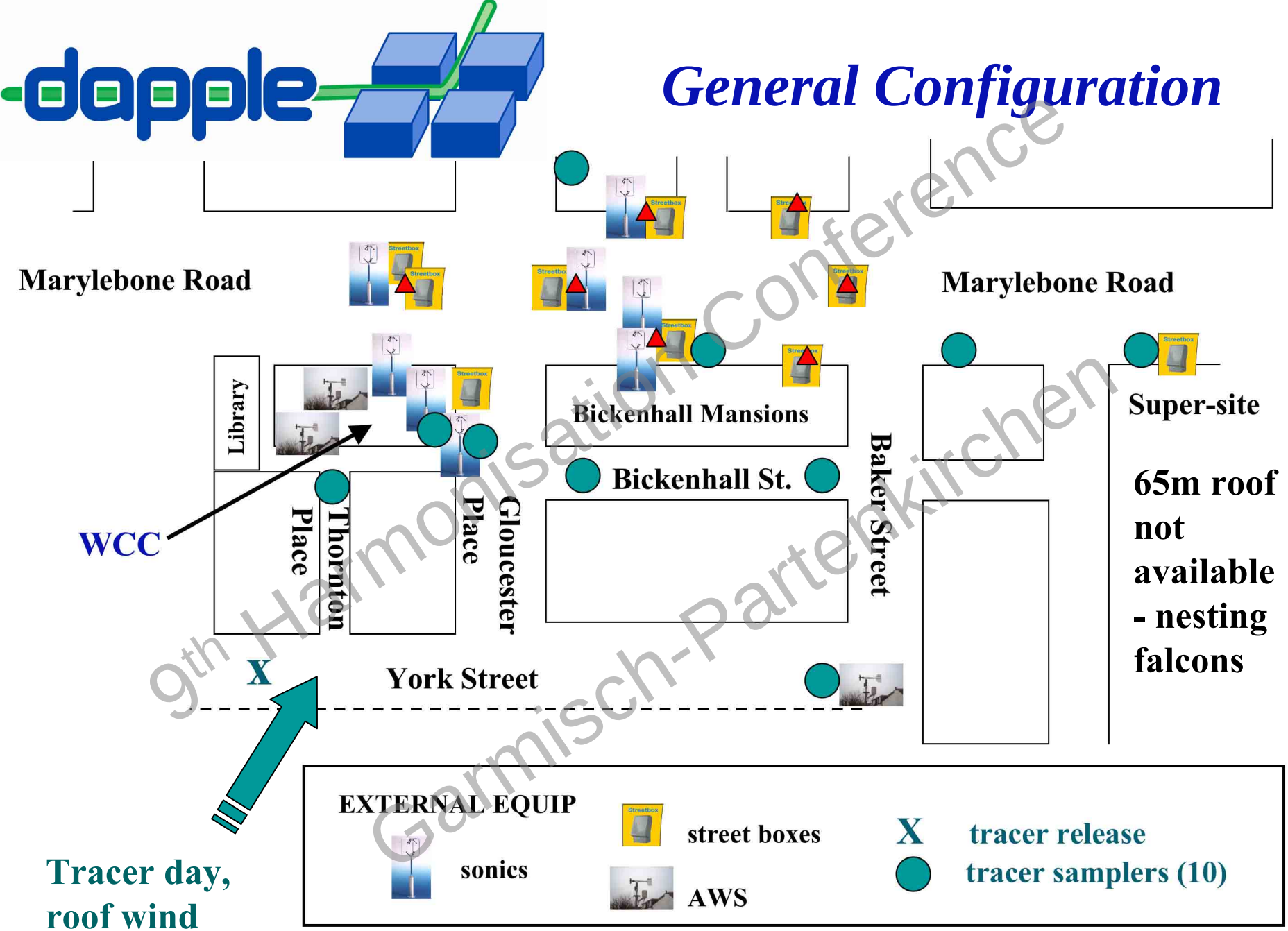
Field Site





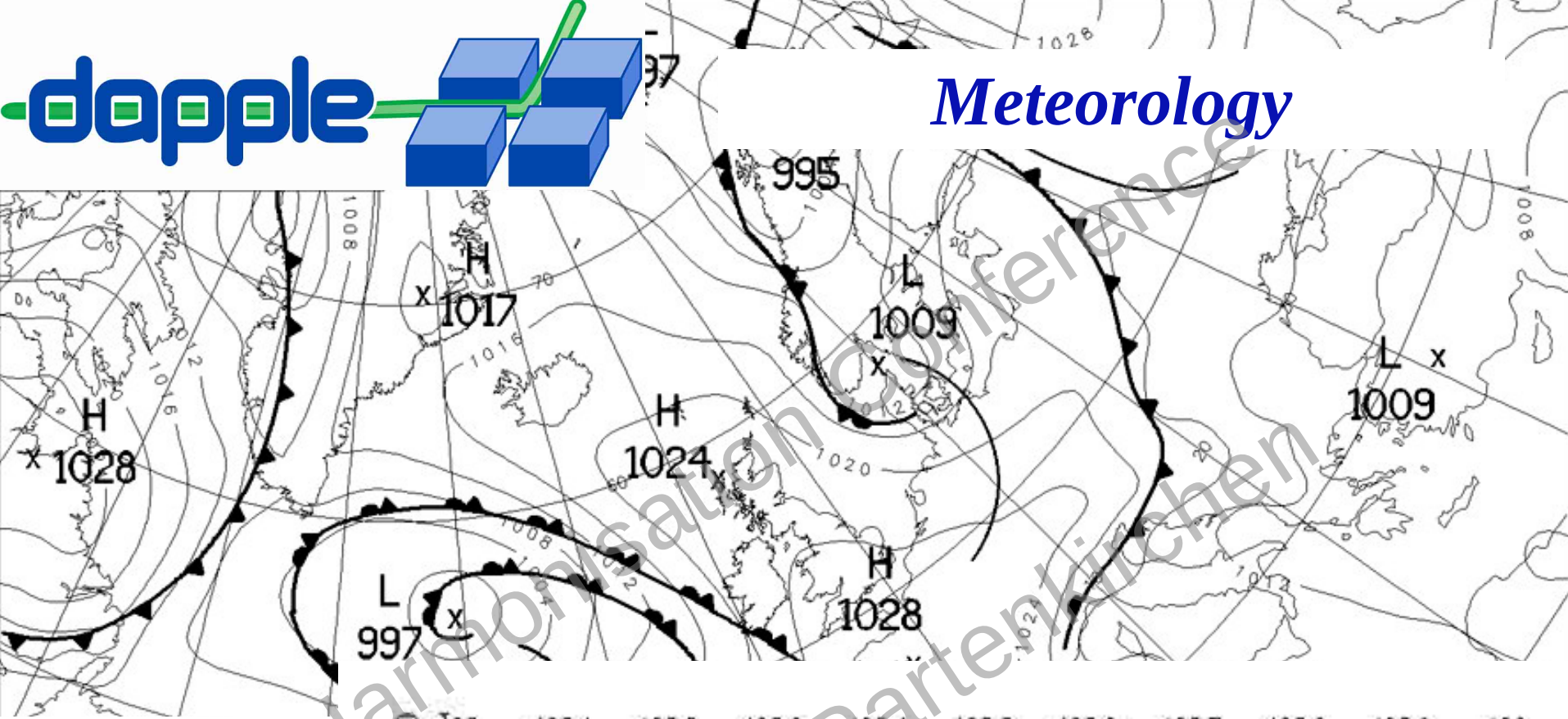
Exposure routes

General Configuration

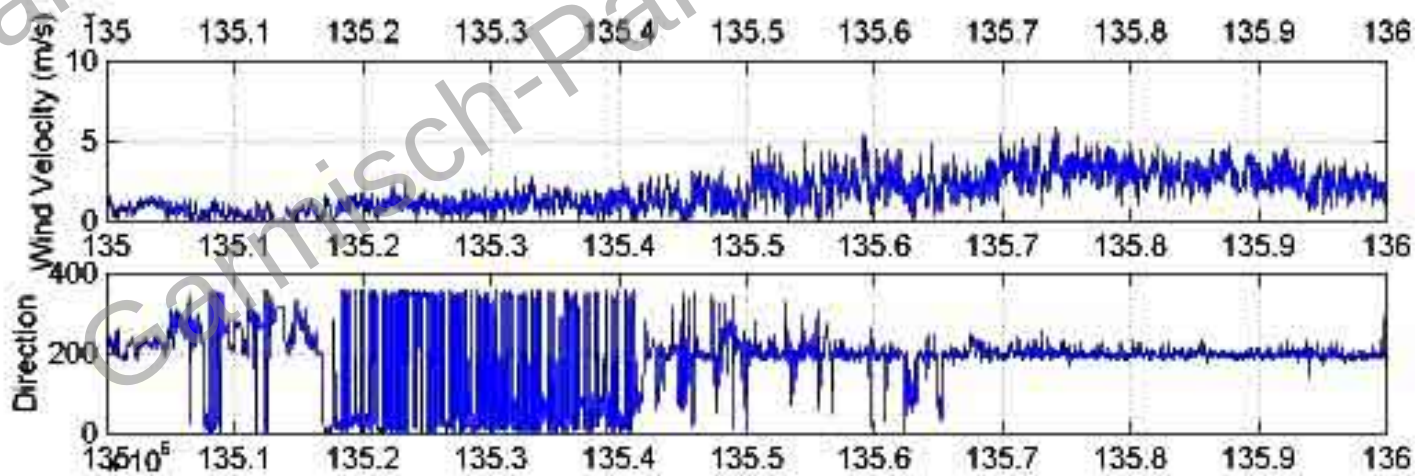


Tracer day, roof wind

Meteorology



Reference speed and direction



WCC Roof AWS

Tracer Experiment

perfluorocarbon

Tracers: PMCH, SF6

15 minute release

SF6 1.5 minute offset

10 sampling units

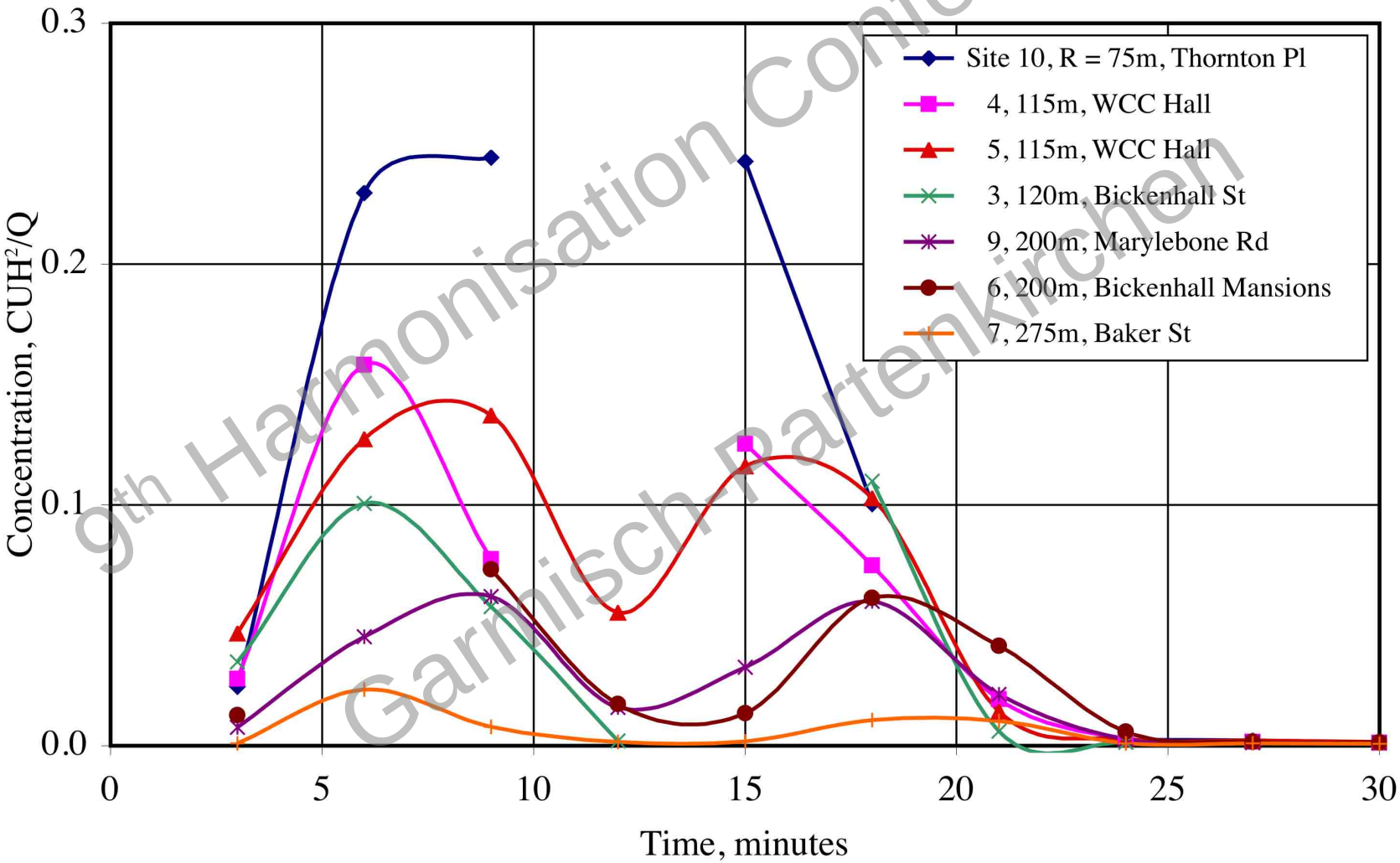
10x5L tedlar bags per unit

3 min samples

NICI mass spectrometry

negative ion chemical ionisation

PFC Tracer Results



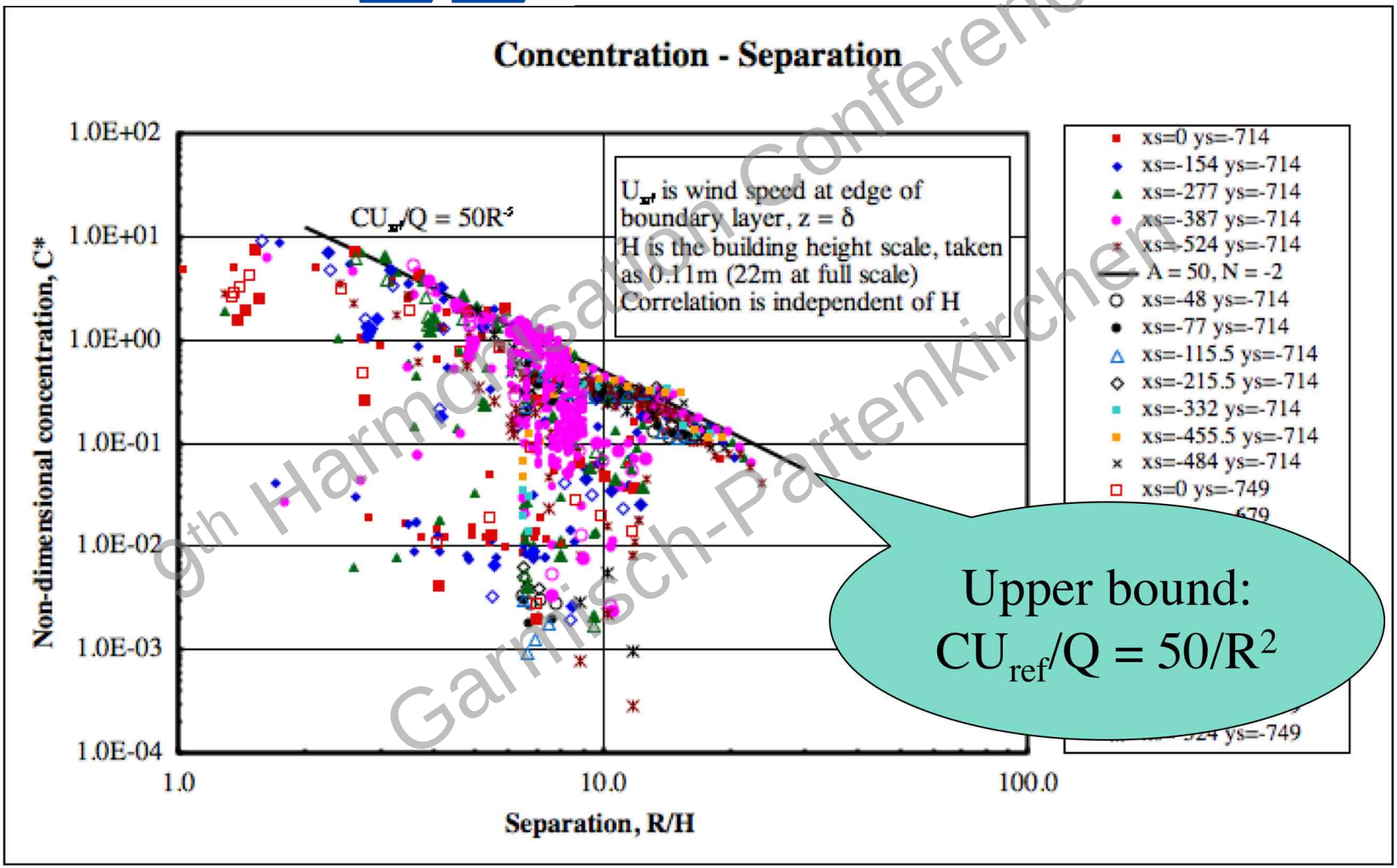
Wind Tunnel Studies

Section of model in EnFlo w/t

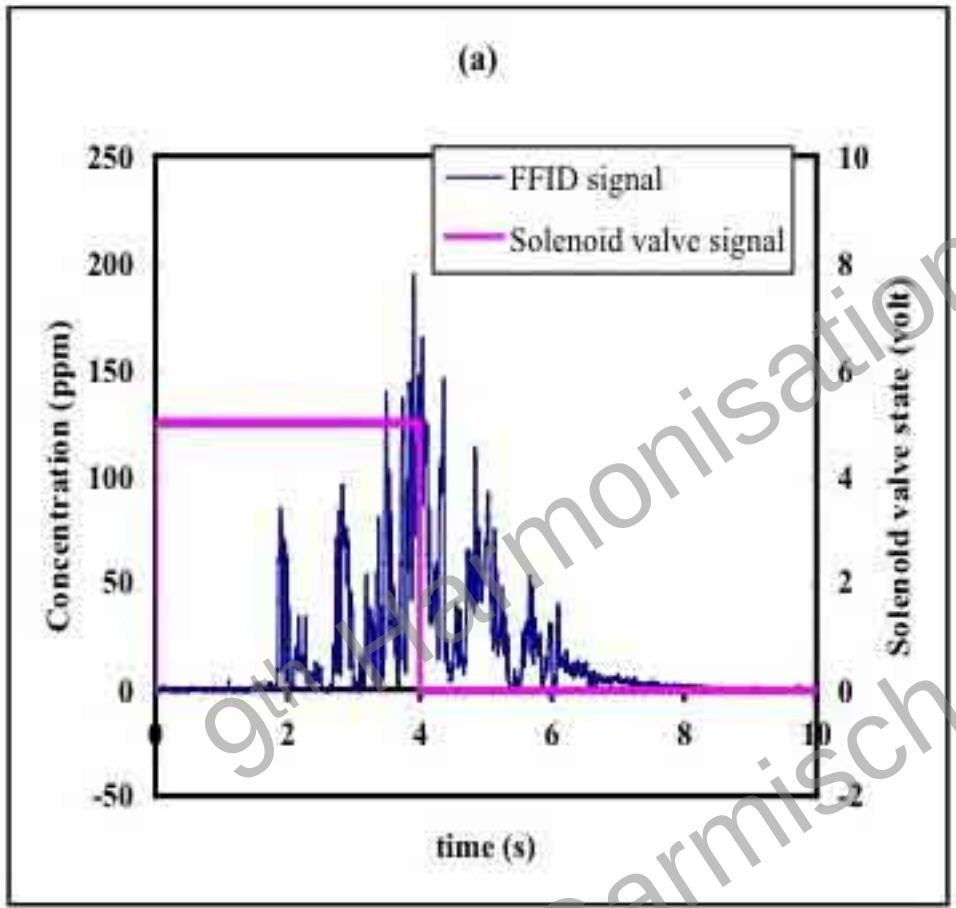
- **Air flow and turbulence**
- **Concentrations**
- **Mass flux**
- **Continuous and short duration emissions**

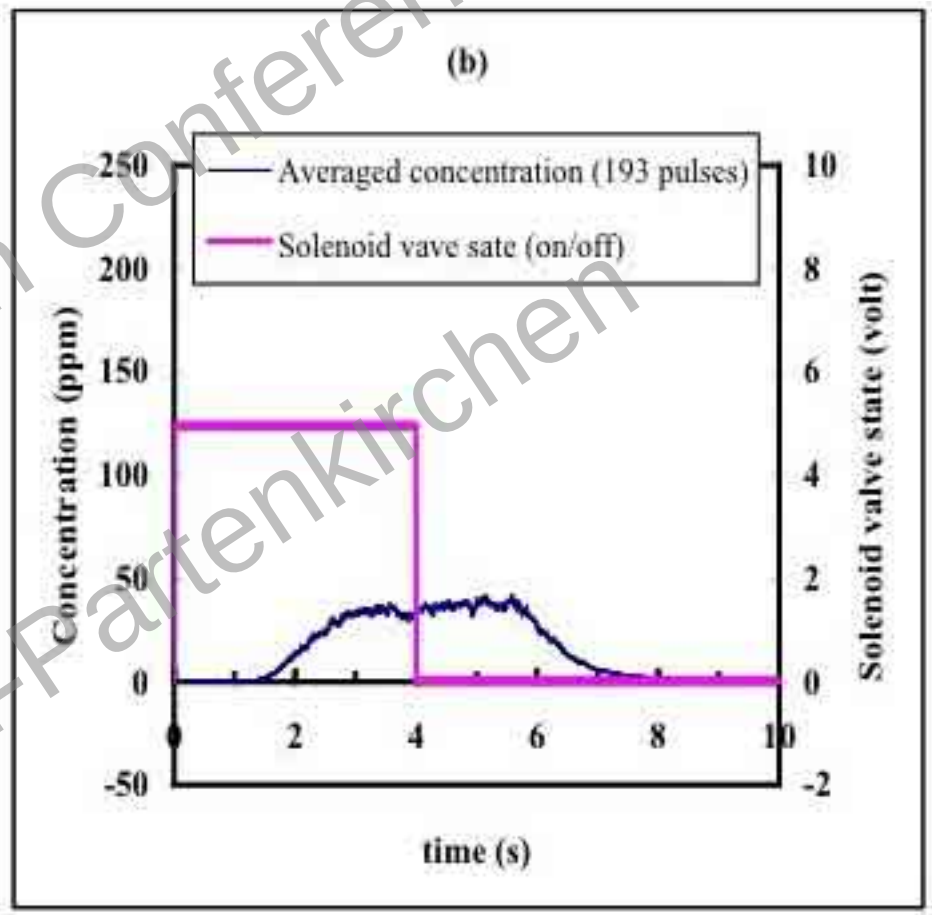
ENVIRONMENTAL FLOW RESEARCH CENTRE
NATIONAL POWER

Continuous Emissions



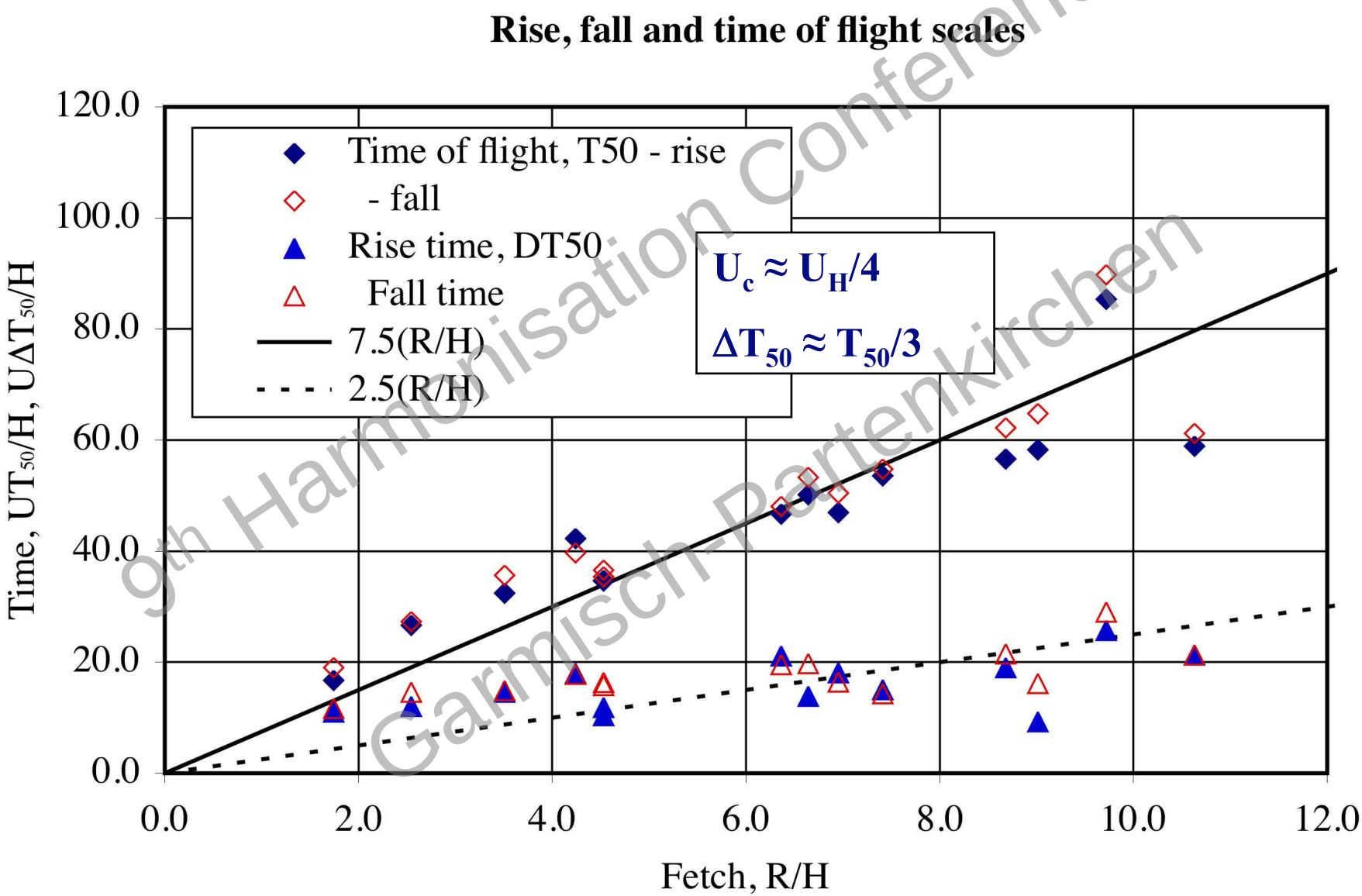
Short Duration Release



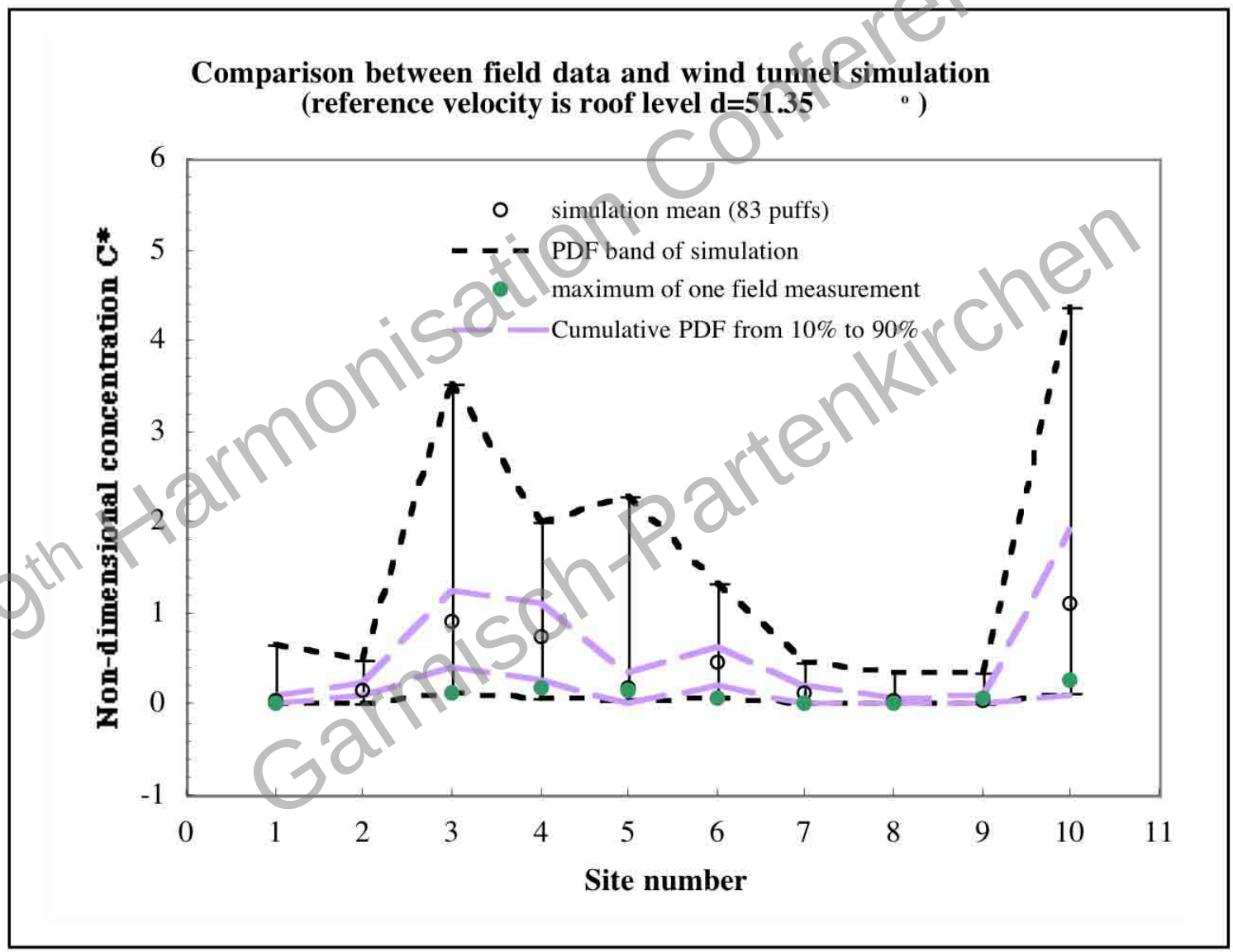


Single realisation and ensemble average from 193 releases

Short Duration Emissions



W/T & Tracer Data

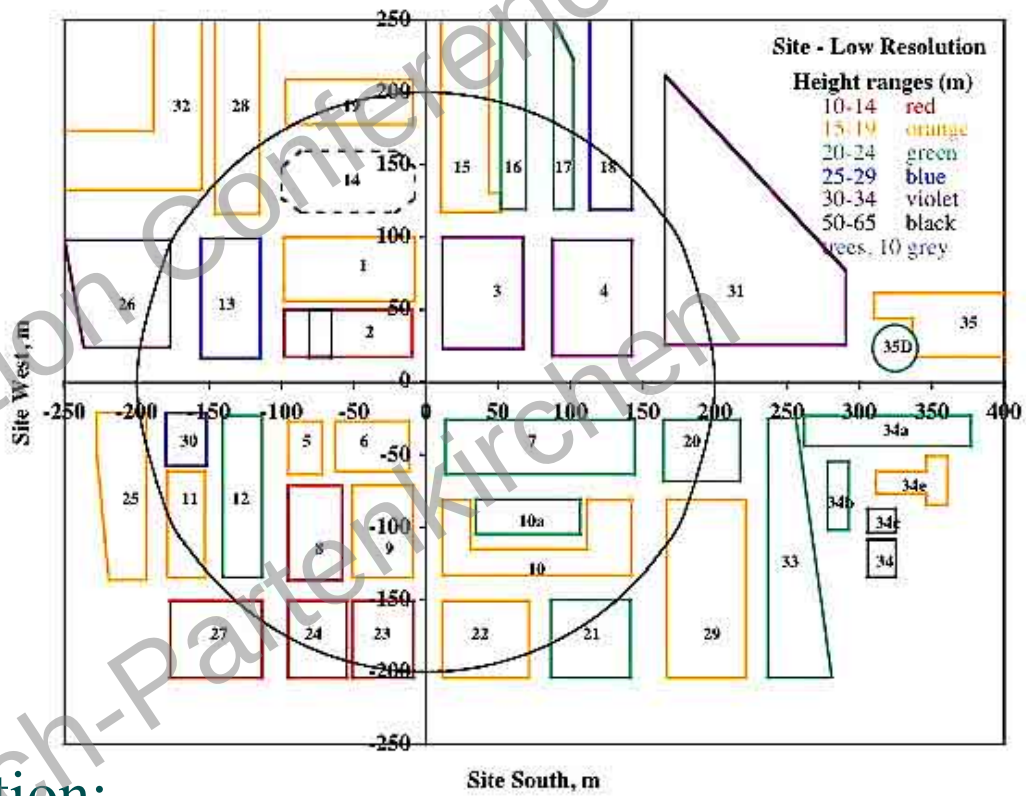


Junction Flow

Modelling

To inform understanding:

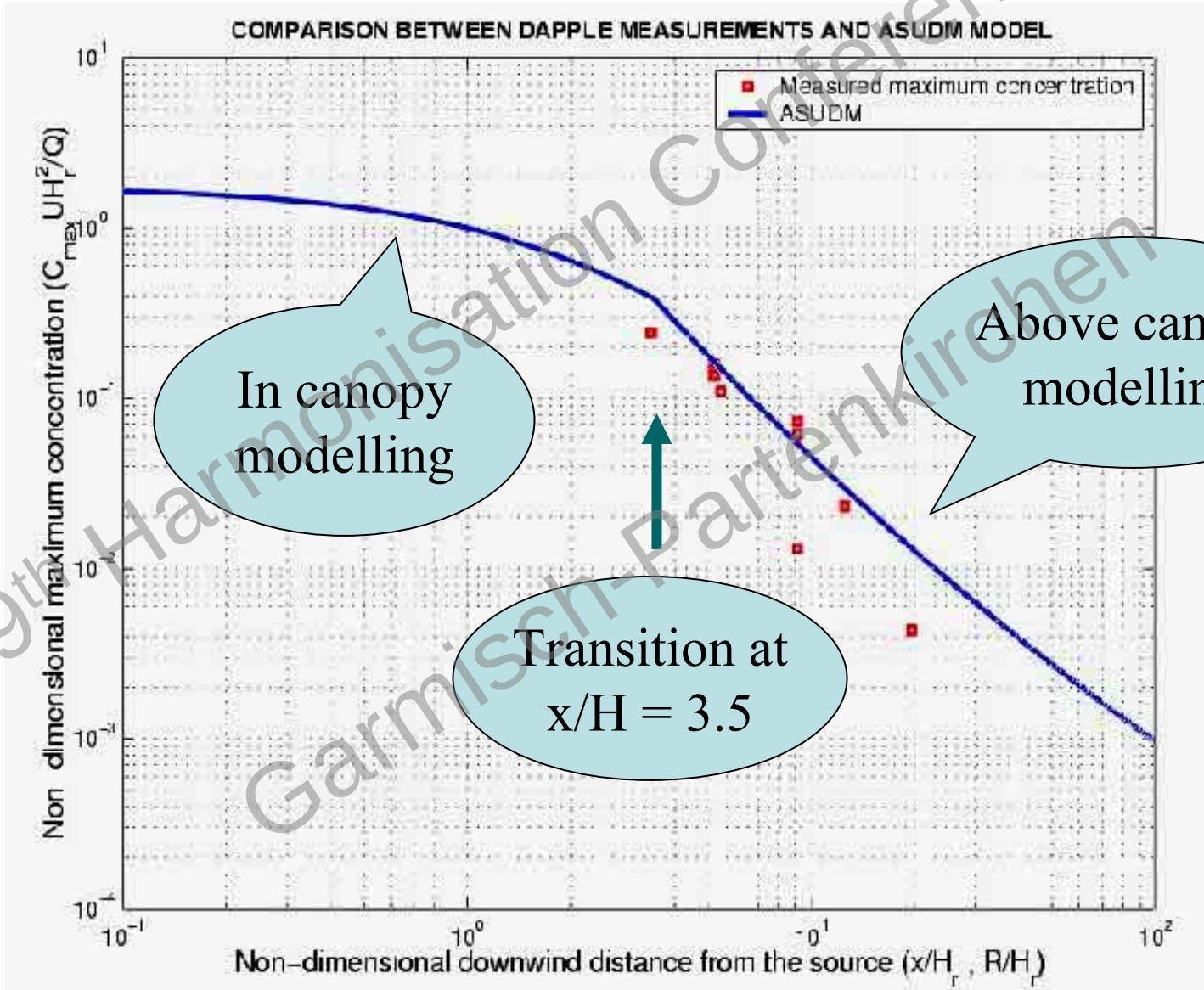
- LES
- RANS
- Urban Canopy Model



For practical application:

- OSPM, ADMS
- UDM, ASUDM, ESUDM
- Simple empirical rules

ASUDM & Tracer Data



Some Initial Conclusions

Plumes: $C_{max}U_H/Q \sim 50/R^2$
Significant variations across streets

Puffs: $U_{advection} \approx U_H/4$
Rise time/Travel time ≈ 1/3; ditto decay time
Peak/Mean ≈ 3.5 to 4 or more

Field: Successful tracer study

Wind field: Channelling along streets; switching at intersection

Enhancements for next trials:

Capability for releasing three different PFC tracers from three locations

Deployment of 1 minute real time instrumentation for SF6

Improved logistics - more samplers

Greater freedom in choice of source locations (limited by traffic and other concerns) and sampler deployment

www.dapple.org.uk

Completion Spring 2006