Pathways for dispersion in urban areas revealed by the DAPPLE experiment

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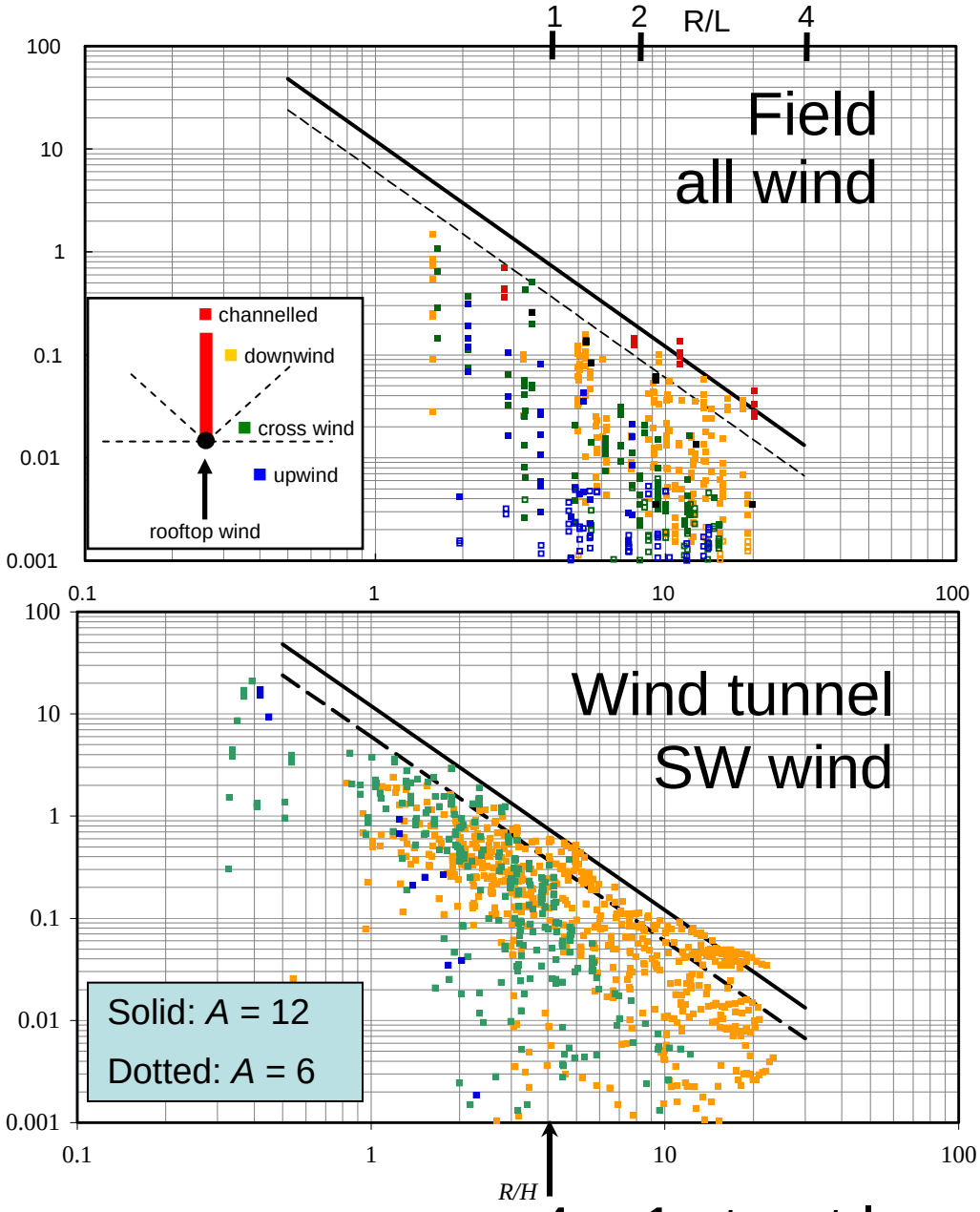
What area would be contaminated?

- How does the plume disperse in urban area?
  - Need ground level dosage

$$D(R,\phi) = D_{\max}(R) f(R,\phi)$$

  - Decay with distance from source $D_{\max}$
  - Horizontal spread of plume f
- What aspects of city control this area?
  - Building geometry
  - Street network
- What aspects of met control this area?
  - Wind speed & direction
  - Stability effects - ignored here



4 = 1 street length

Decay from source: D_{max}

- Normalization

$$D^* = \frac{DU_H H^2}{M}$$

- R/H < 4
  - Not ordered
- R/H > 4
  - Ordered
  - Upper bound

$$D_{max} = \frac{AM}{U_H R^2}$$

Lateral spread: f

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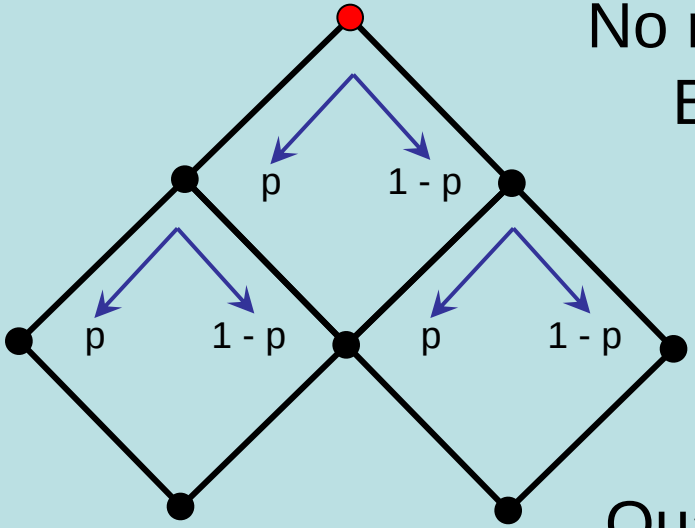
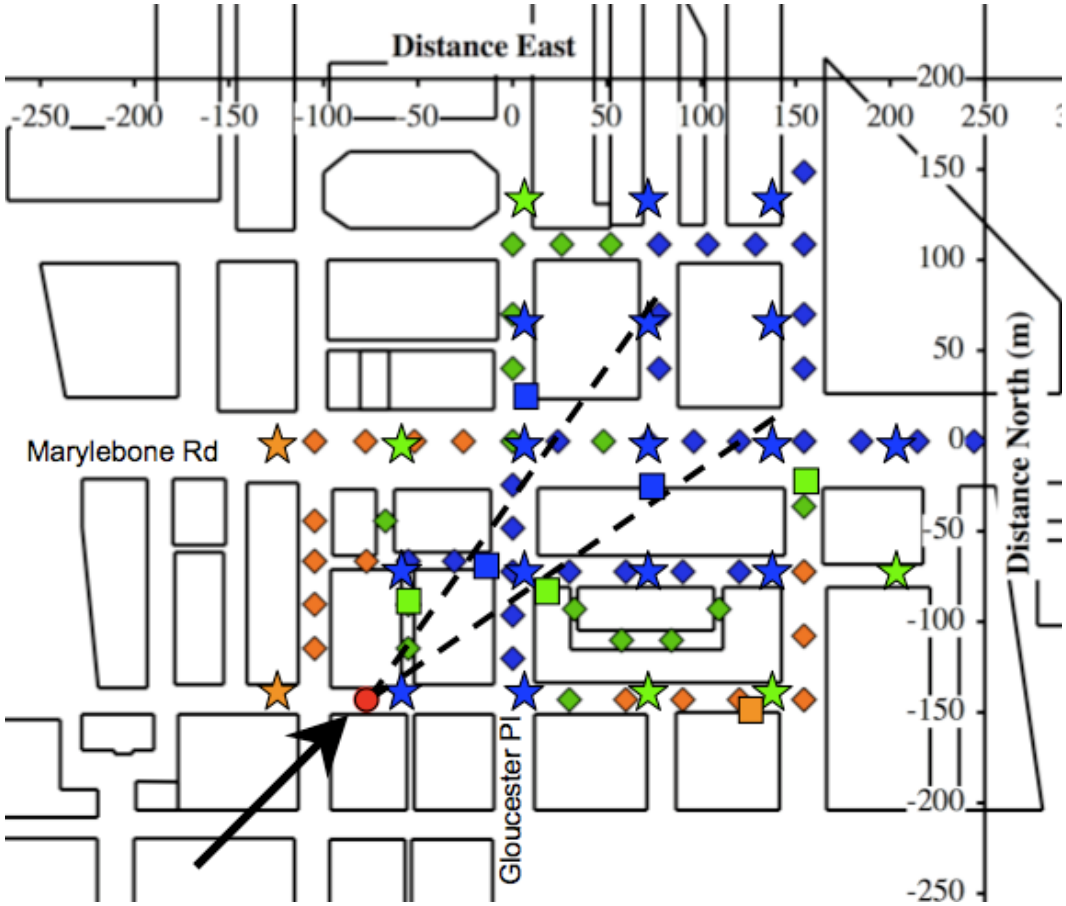


No need to analyze BL exchange for lateral spread

Quantitative model

Lateral spread of plume: f

$$D(R,\phi) = D_{\max}(R)\, f(R,\phi)$$



Plot contours of f

Blue: plume core (f > 0.65)

Green: plume edge (0.65 > f > 0.1)

Orange: outside plume (0.1 > f).

Diamonds: wind tunnel measurements

Squares: full-scale measurements

Stars: branching network model

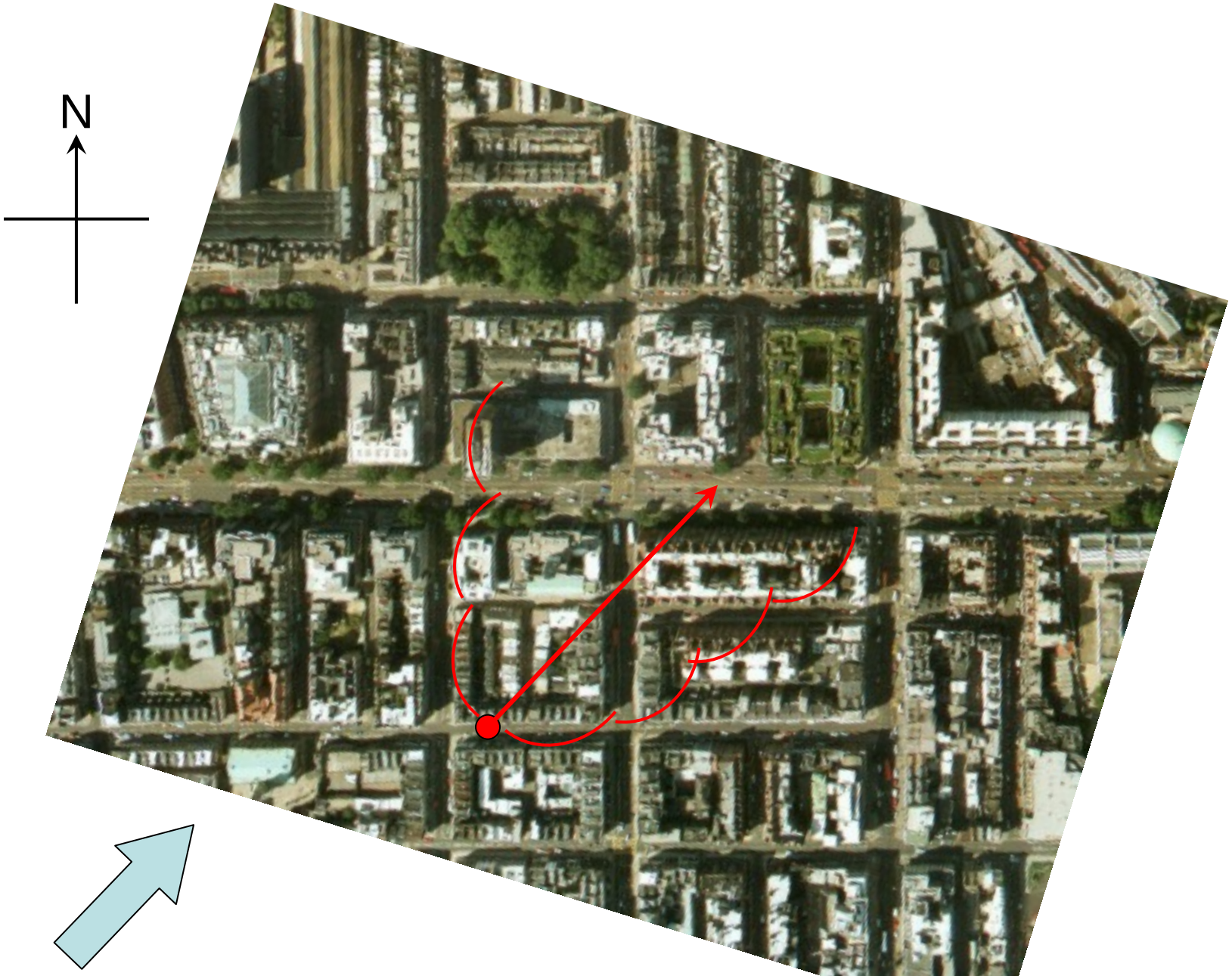
Dashed line: Briggs (1973) spread

$$f = BR$$

Conclusions

- Normalization
  - Collapses wind tunnel and field data
- Decay with distance from source
  - Follows R^{-2} law
  - Robust to wind direction
  - Suggests more general validity?
- Horizontal spread of plume
  - Branching through street intersections
  - Topology of street network is controlling factor?

Figure 1. Aerial view of DAPPLE site



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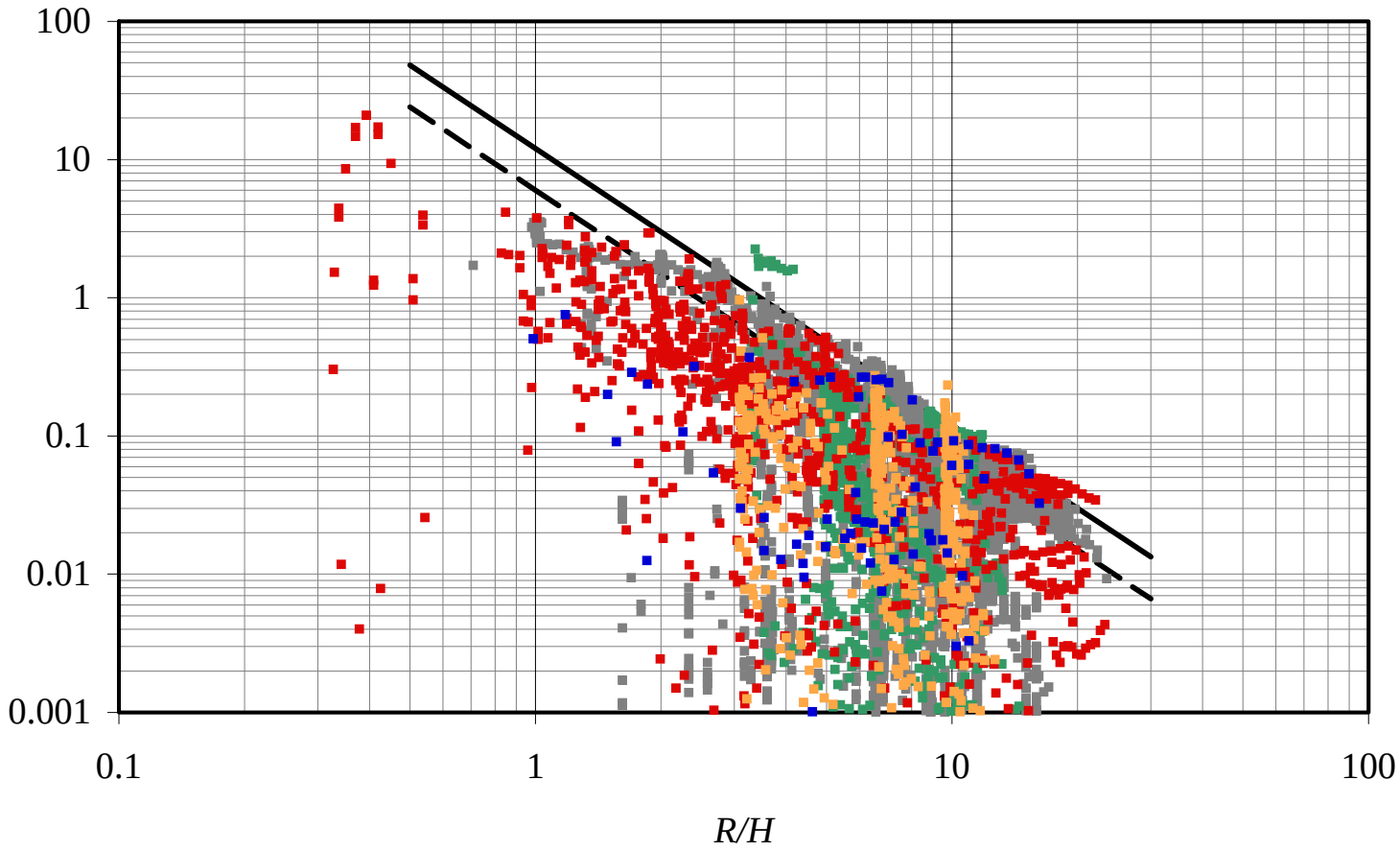

Wind tunnel: all data

Colour coded by wind direction: grey: 45º; green: 90º; red: 50º; orange: 270º blue: 114º