Weather Forecasting for Urban Areas

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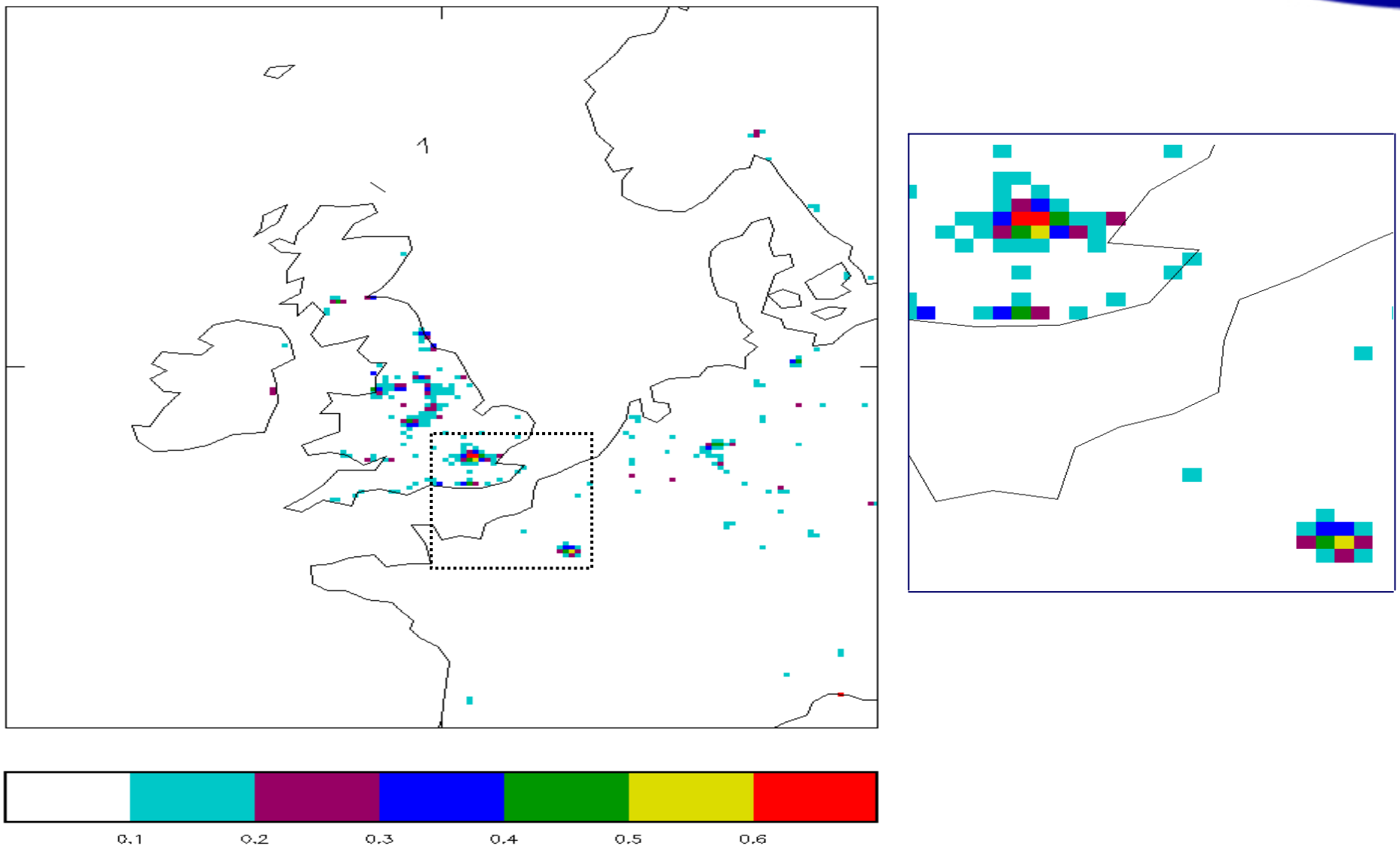
Overview

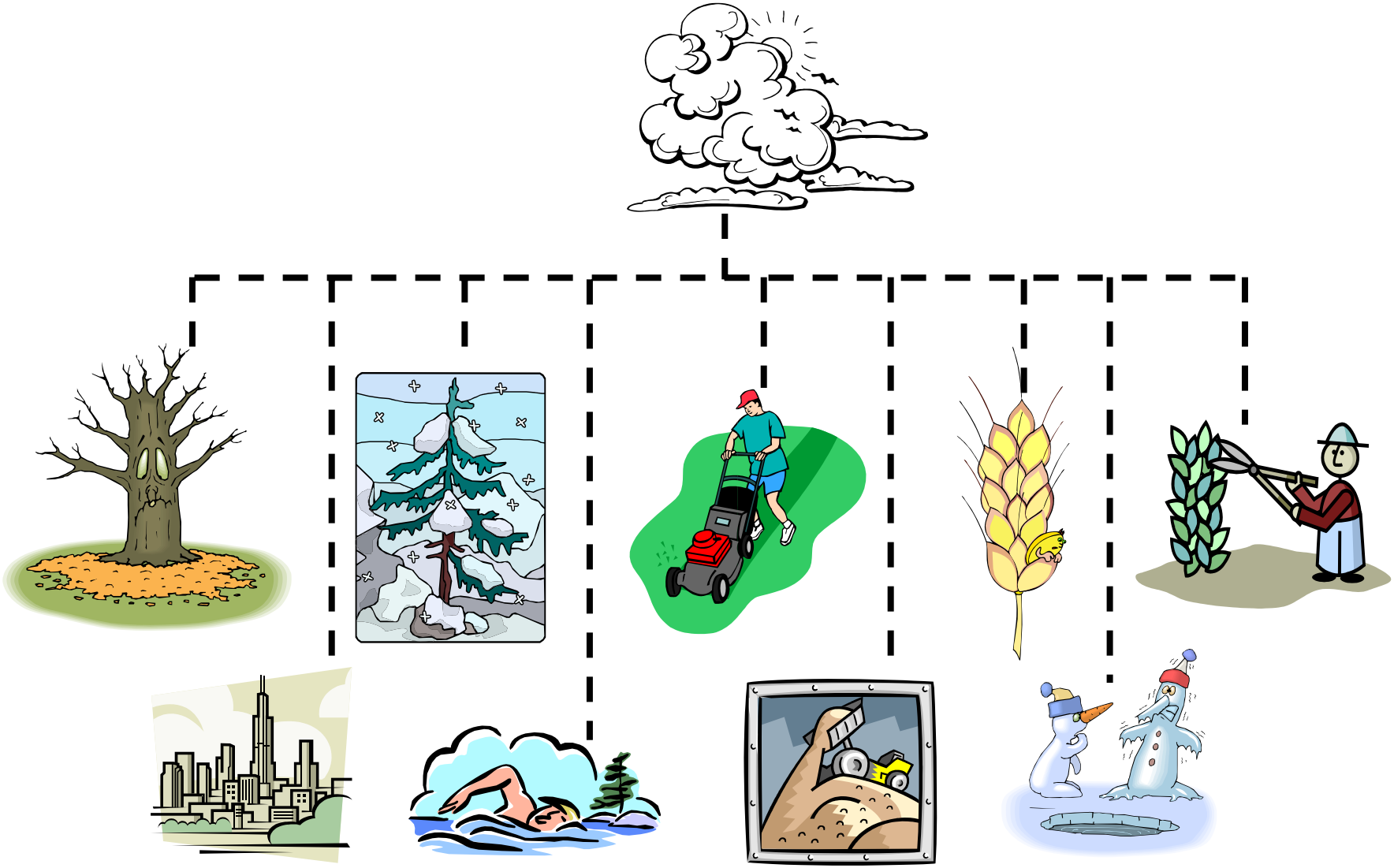
- The urban canopy scheme
- Operational implementation
- Urban model options
- Anthropogenic heat sources
- Identifying Improvements

The urban canopy scheme

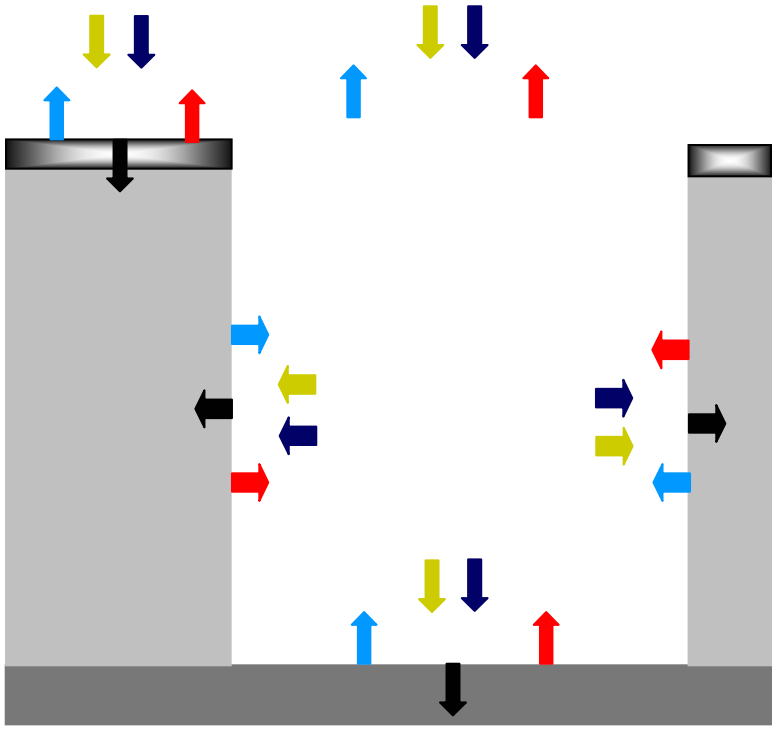
Mesoscale Model Urban Landuse

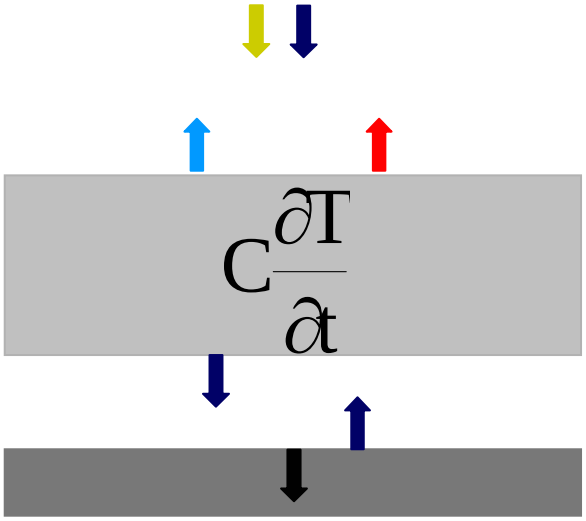


Met Office Surface Exchange Scheme (MOSES)

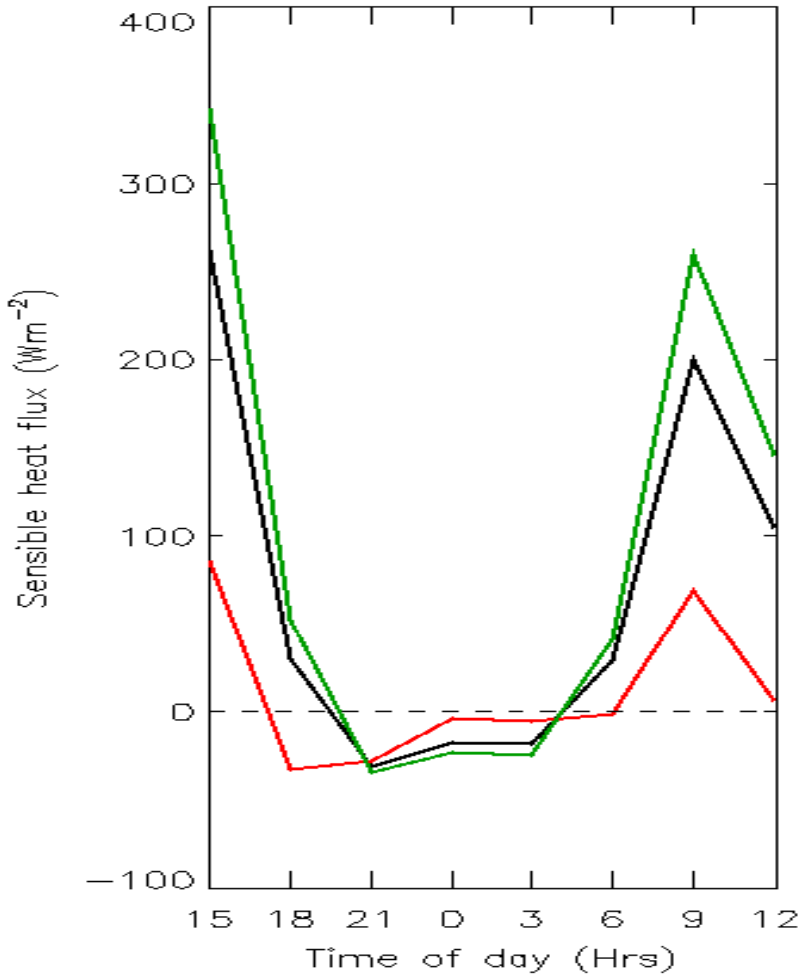


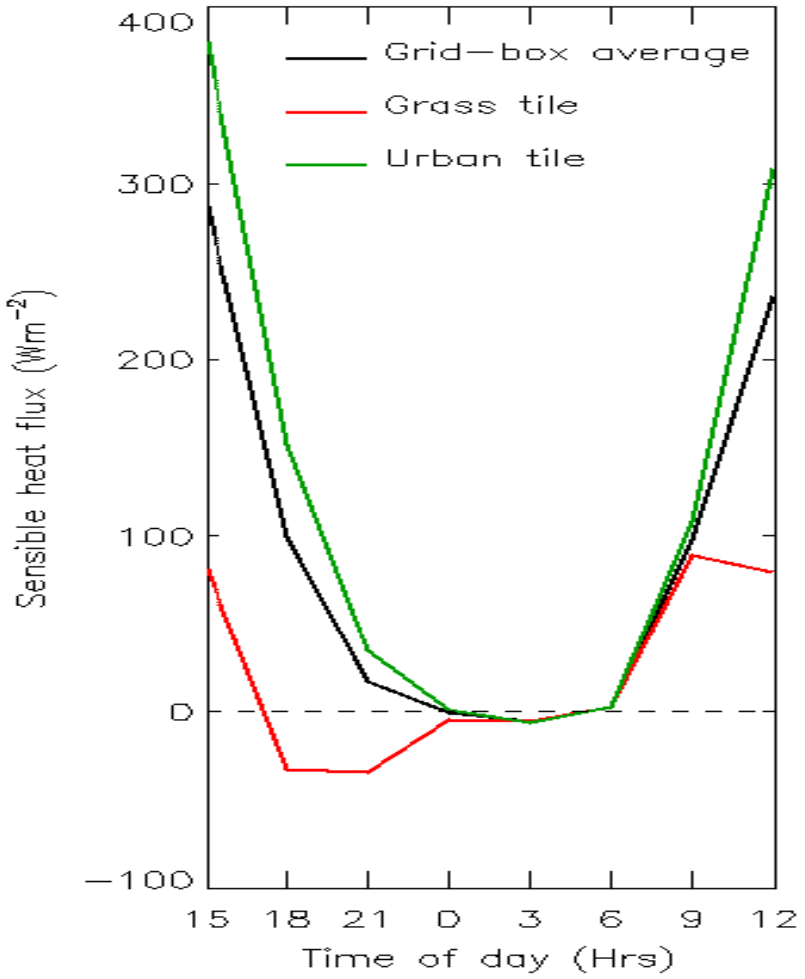
Urban canopy scheme



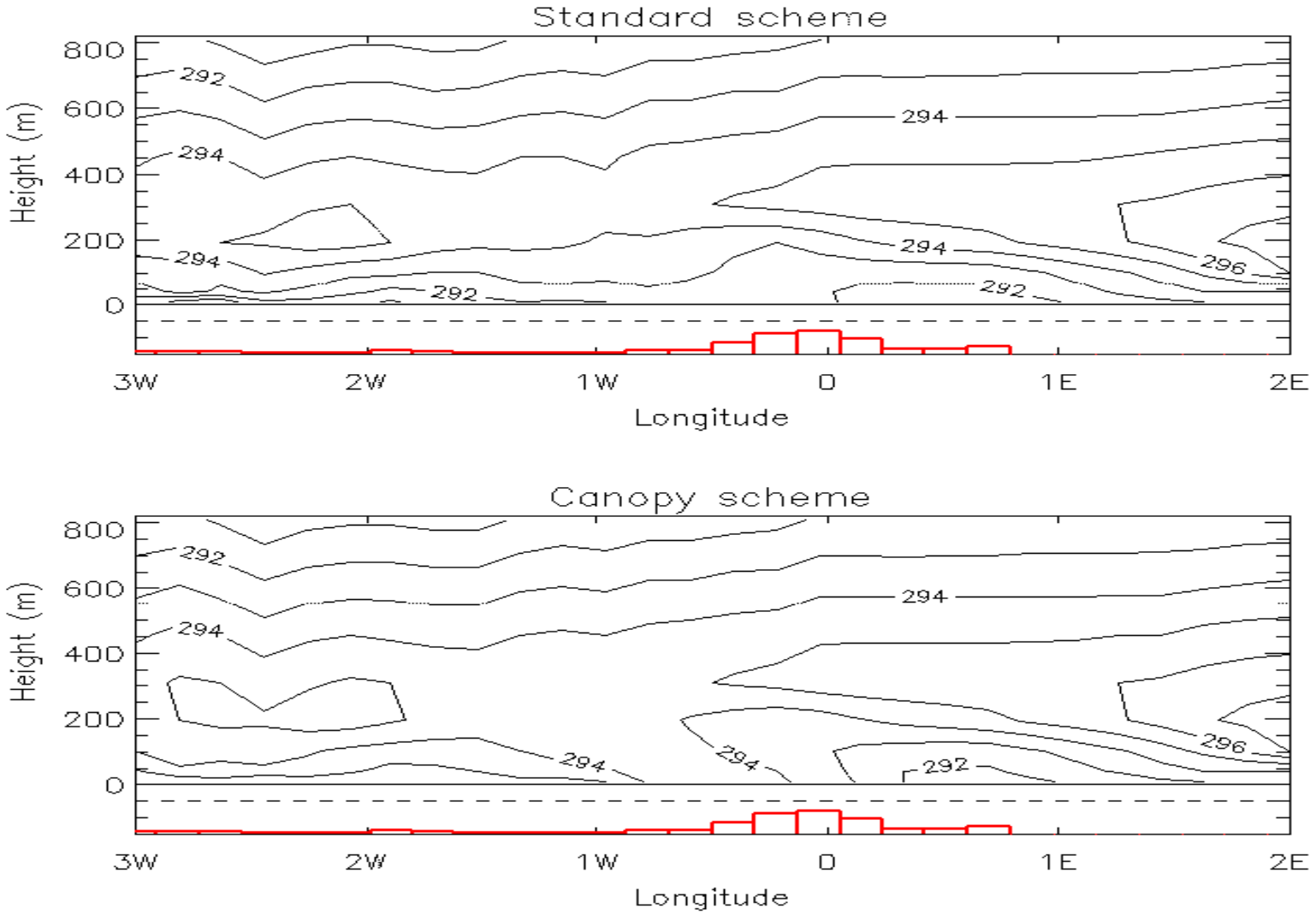


Modelled Surface Heat Flux



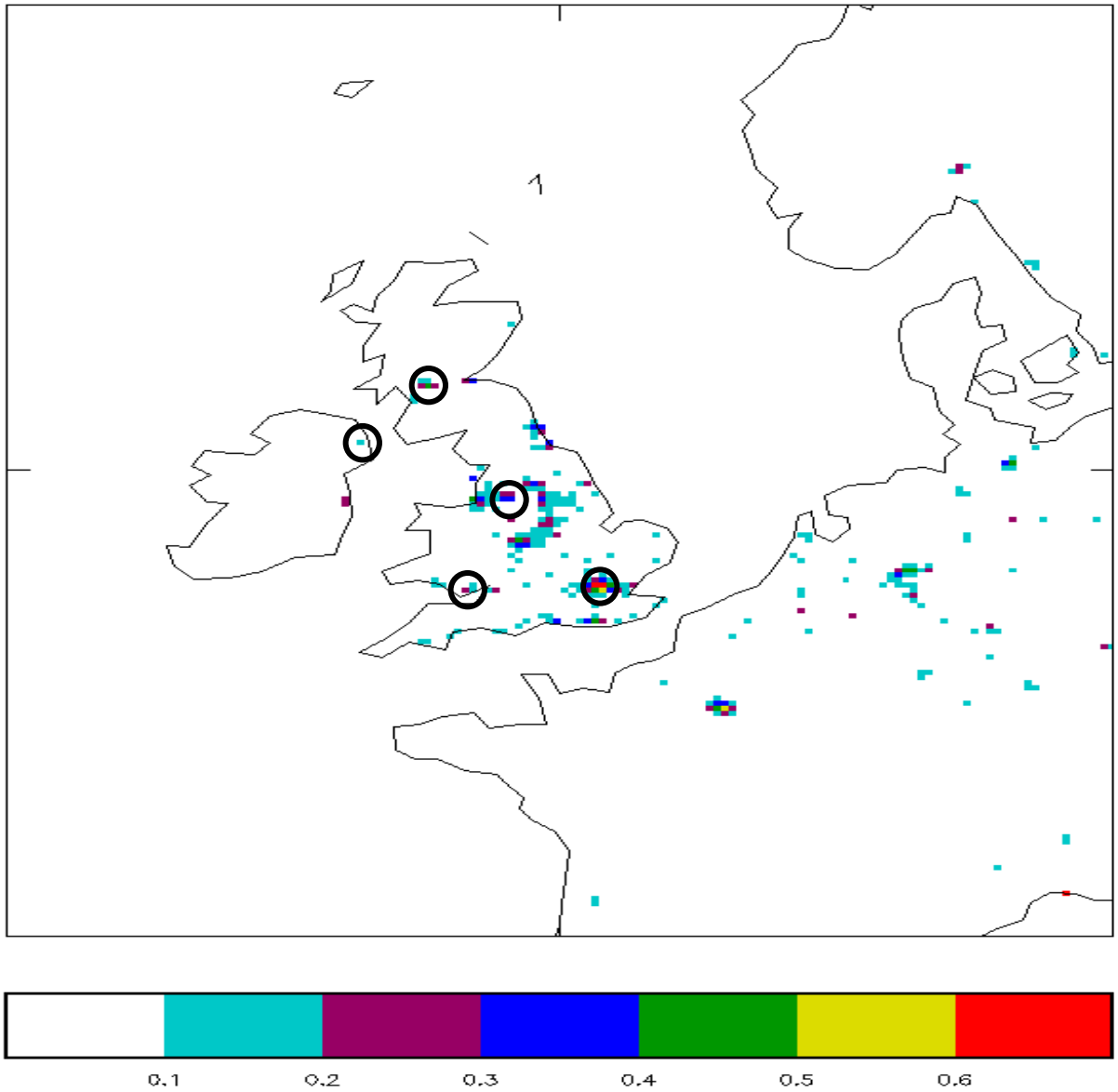


E-W Temperature X-section



Operational Implementation

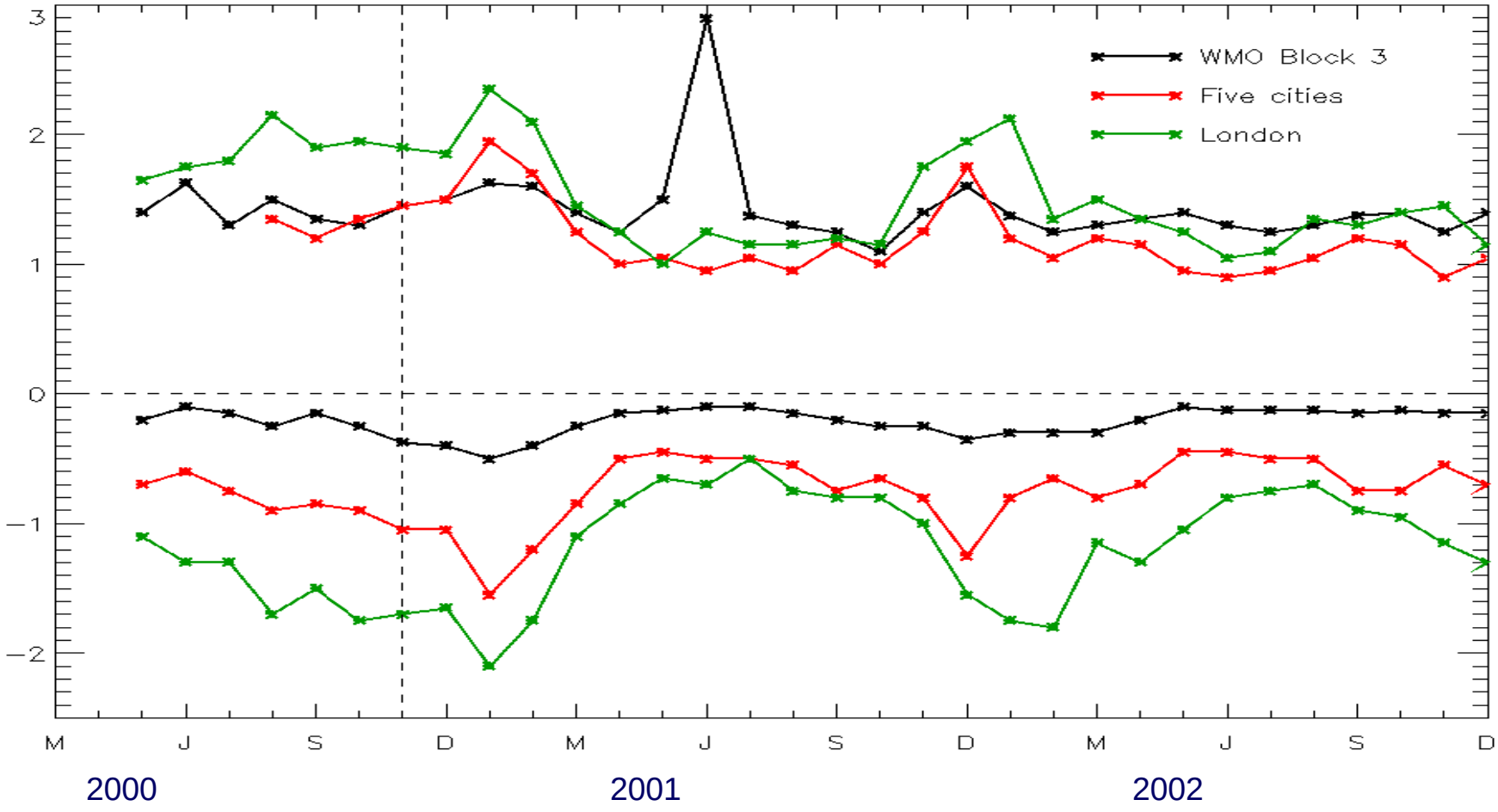
Operational Implementation



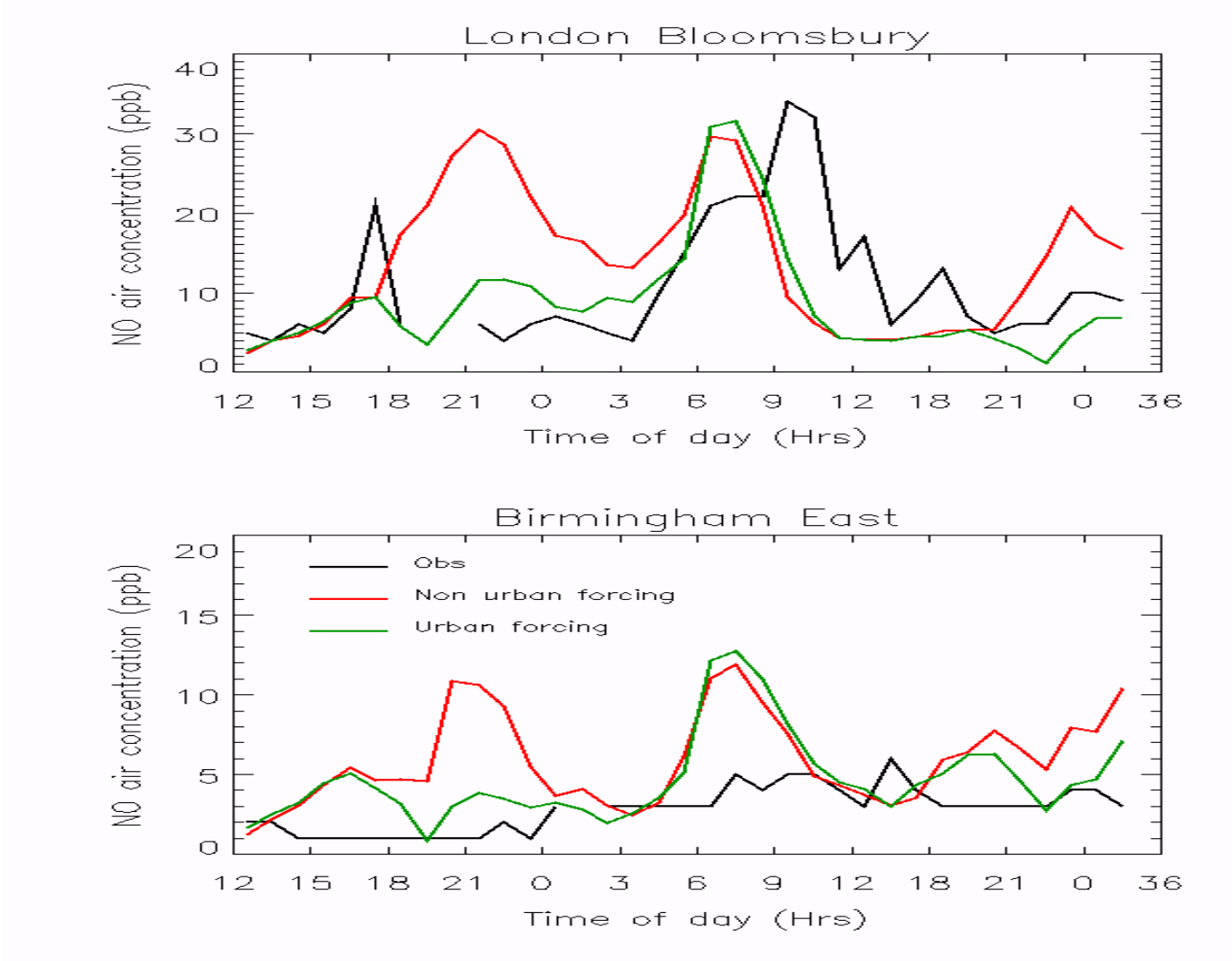
- WMO Block 3 stations
- London
- 5 cities index

Weather forecasting

Met Office operational temperature verification

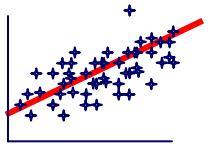
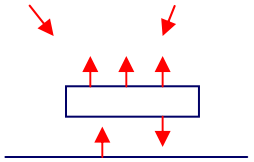
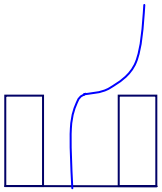
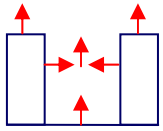
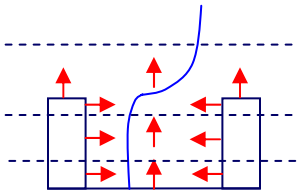


Atmospheric dispersion

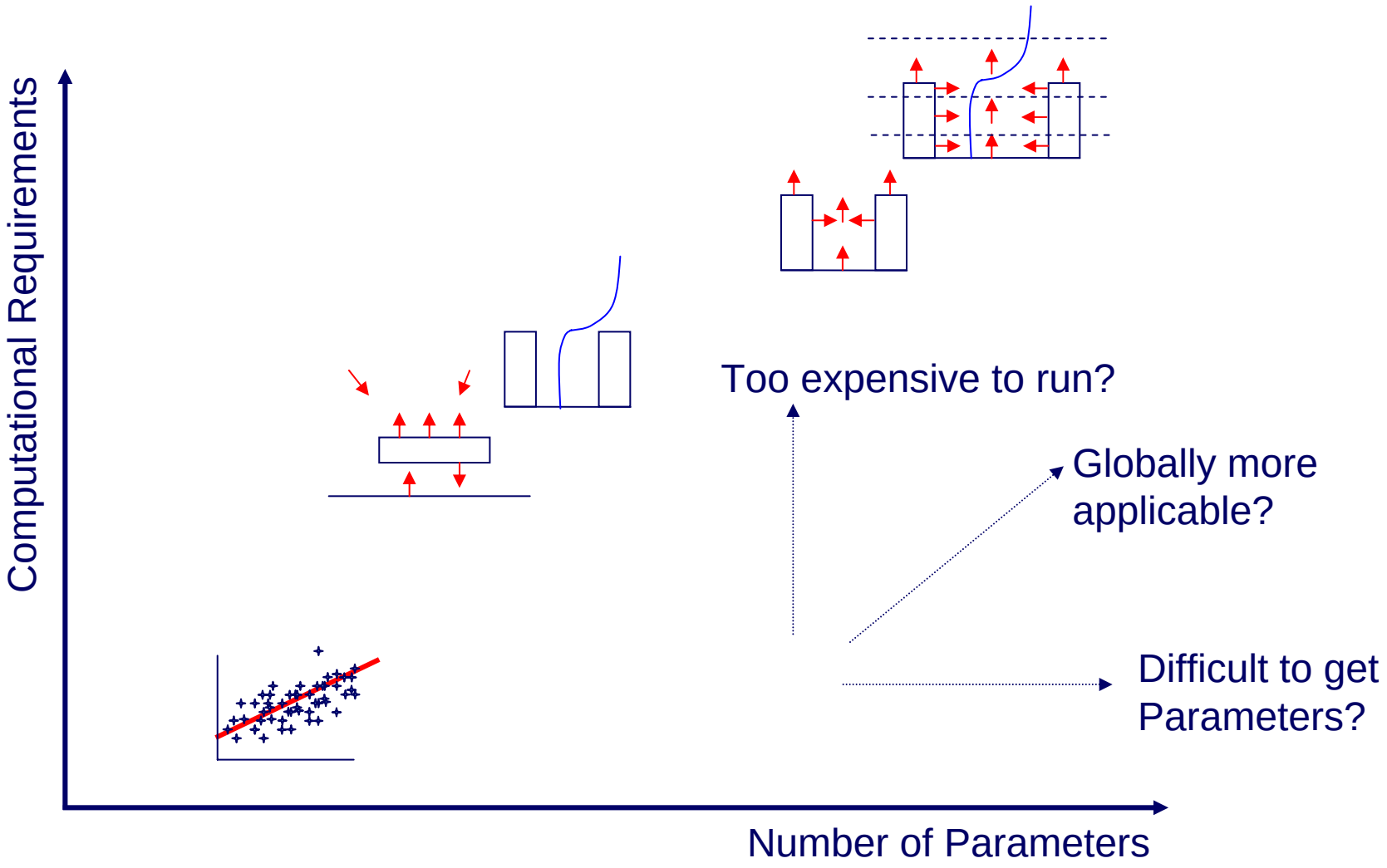


Urban model options

Available models

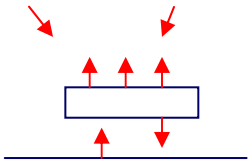
- Empirical models 
- Simplified energy balance models 
- Dynamical models 
- Detailed energy balance models 
- Full energy and dynamical models 

Which model?



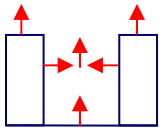
Current Modelling Approaches

- Best



Met Office

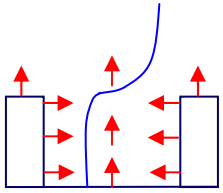
- Masson



Météo France

Environment Canada

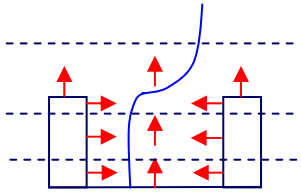
- Brown



COAMPS

MM5

- Martilli

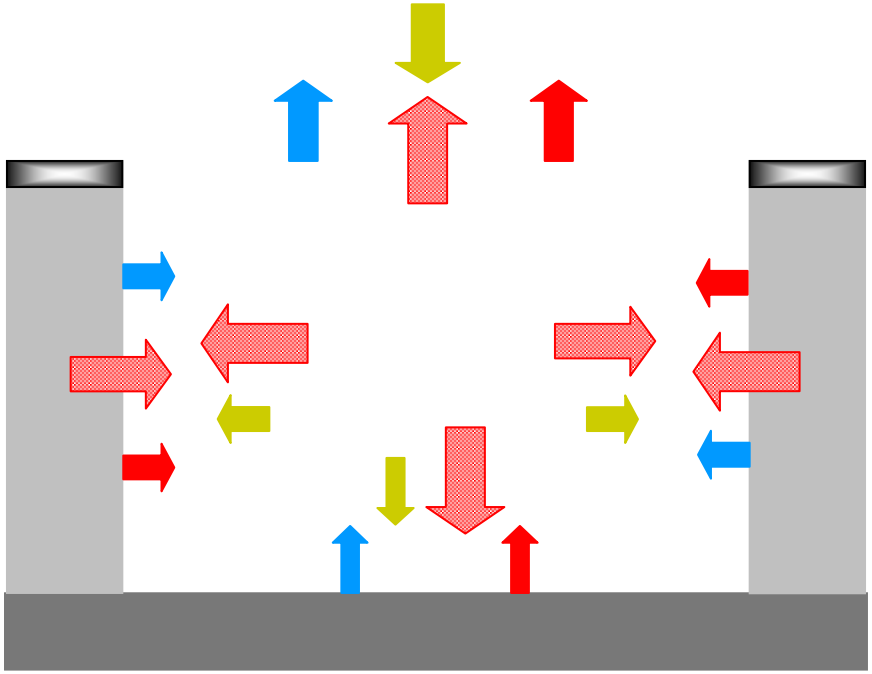


Météo Schweiz

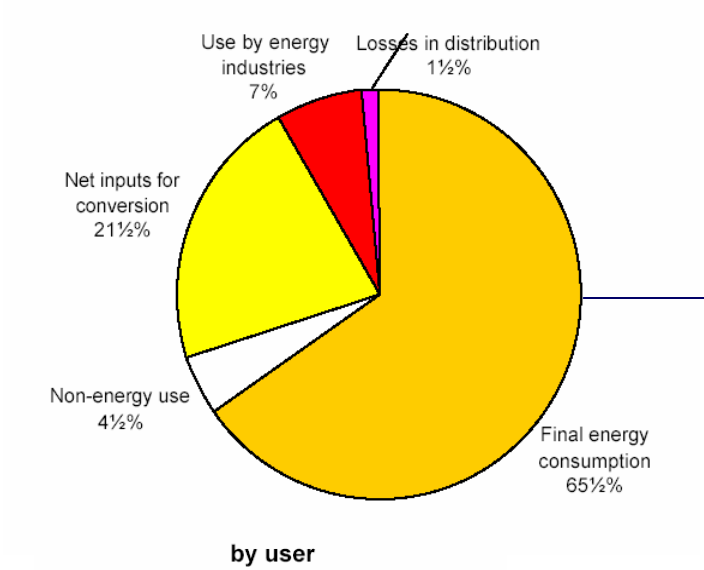
Anthropogenic heat sources

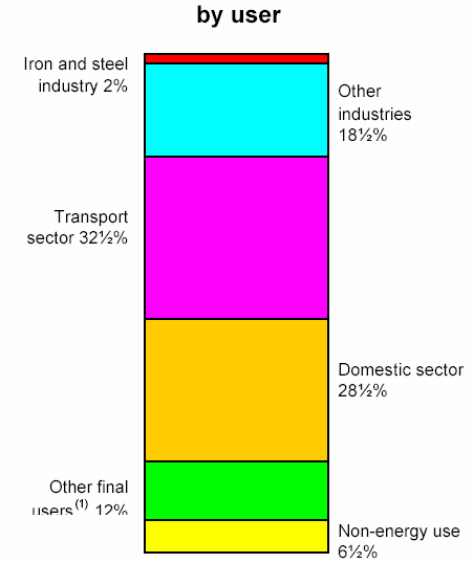
Introducing anthropogenic heat sources

- Fixed internal building temperatures
- Additional source term to energy balance
- Additional source term to surface heat flux



Urban energy consumption estimate for UK



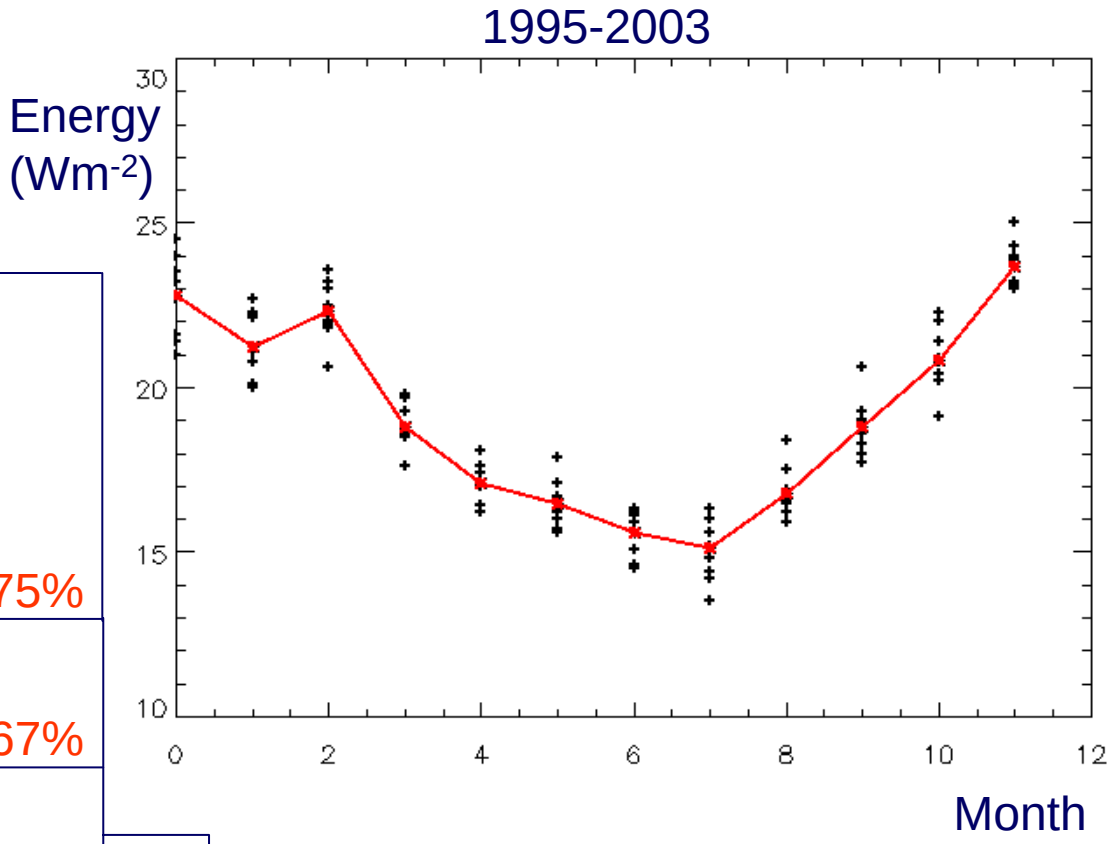


20.5% 75%

32.5% 67%

28.5% 80%

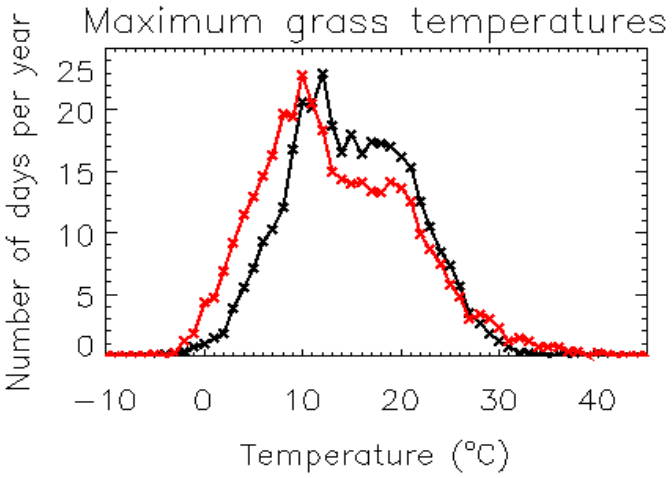
18.5% 50%

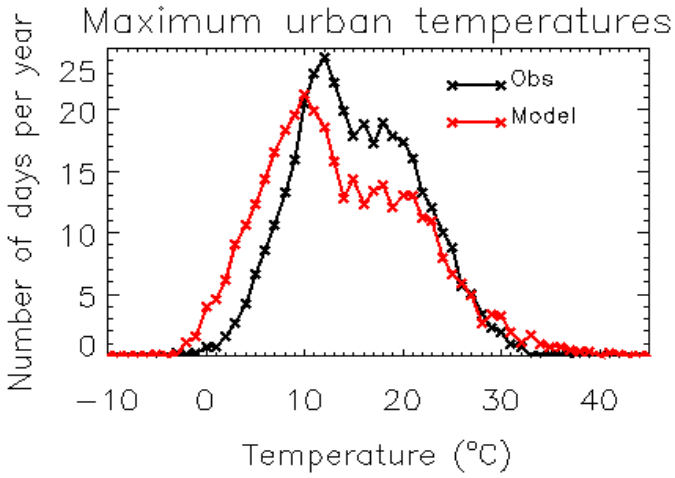


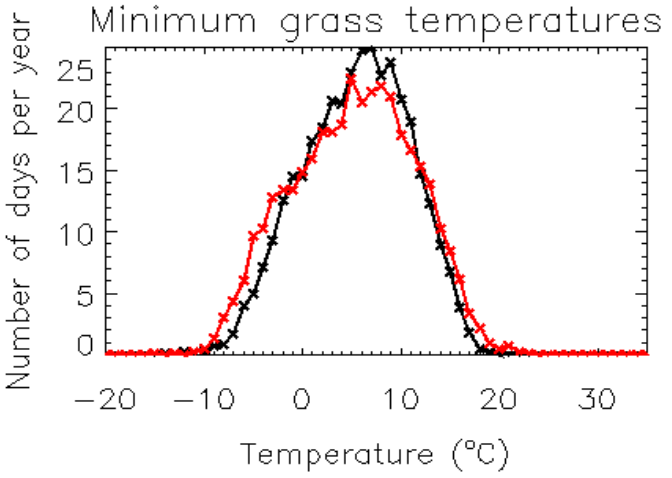
Urban energy use: 48.45%

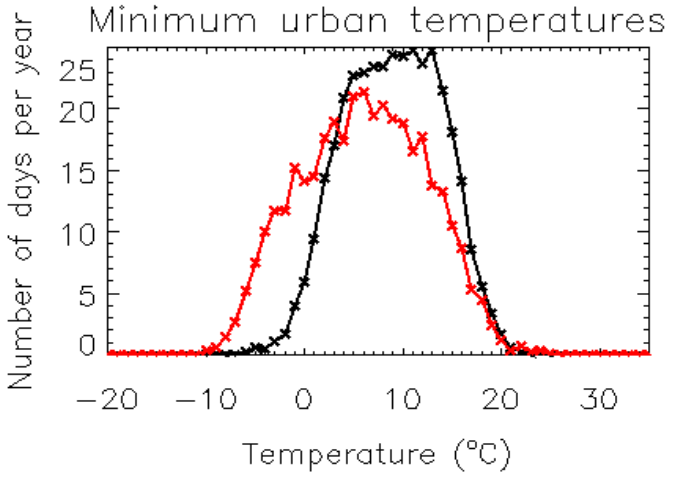
DTI: Digest of United Kingdom Energy Statistics

20 Year Temperature Climatology around London



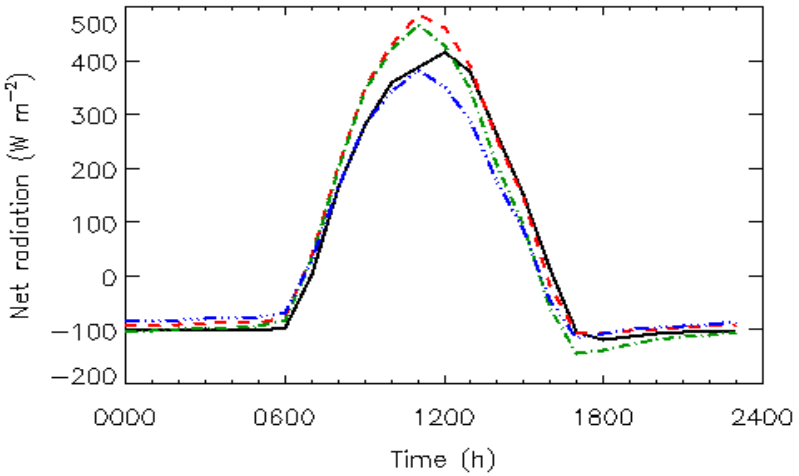


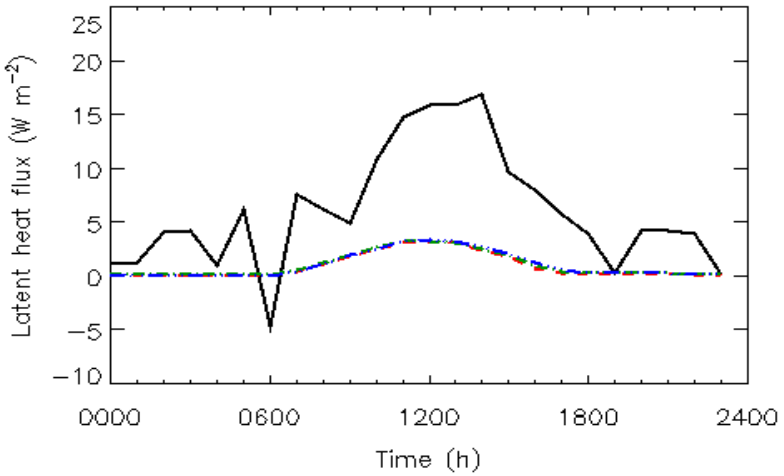


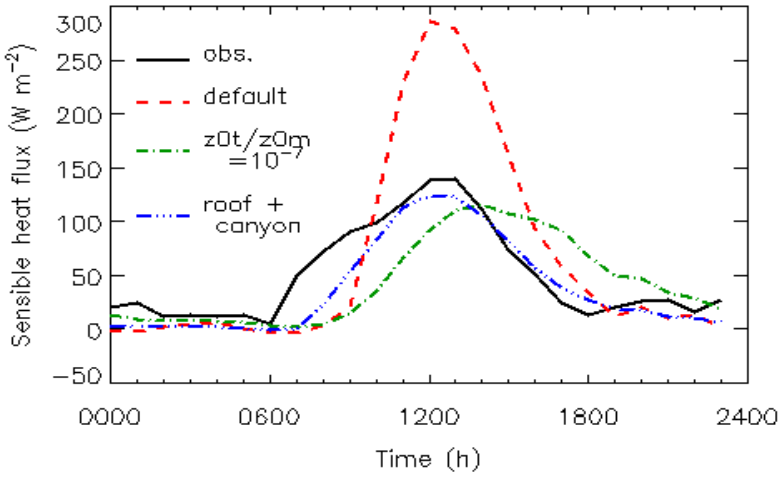


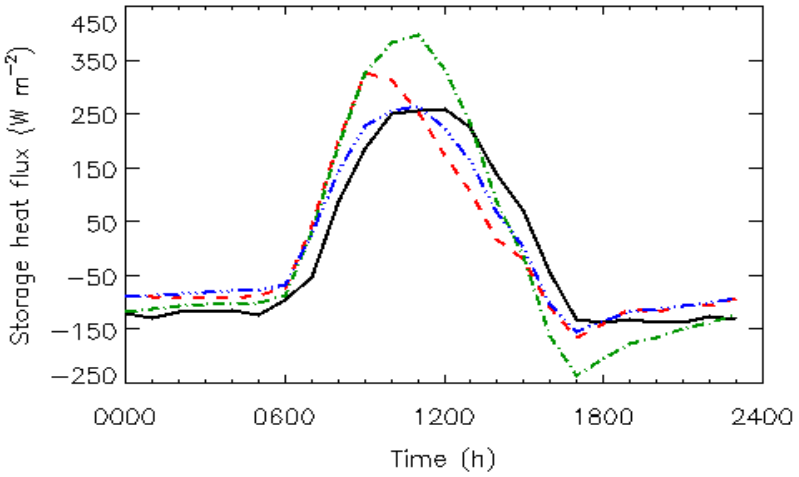
Identifying Improvements

Mexico City

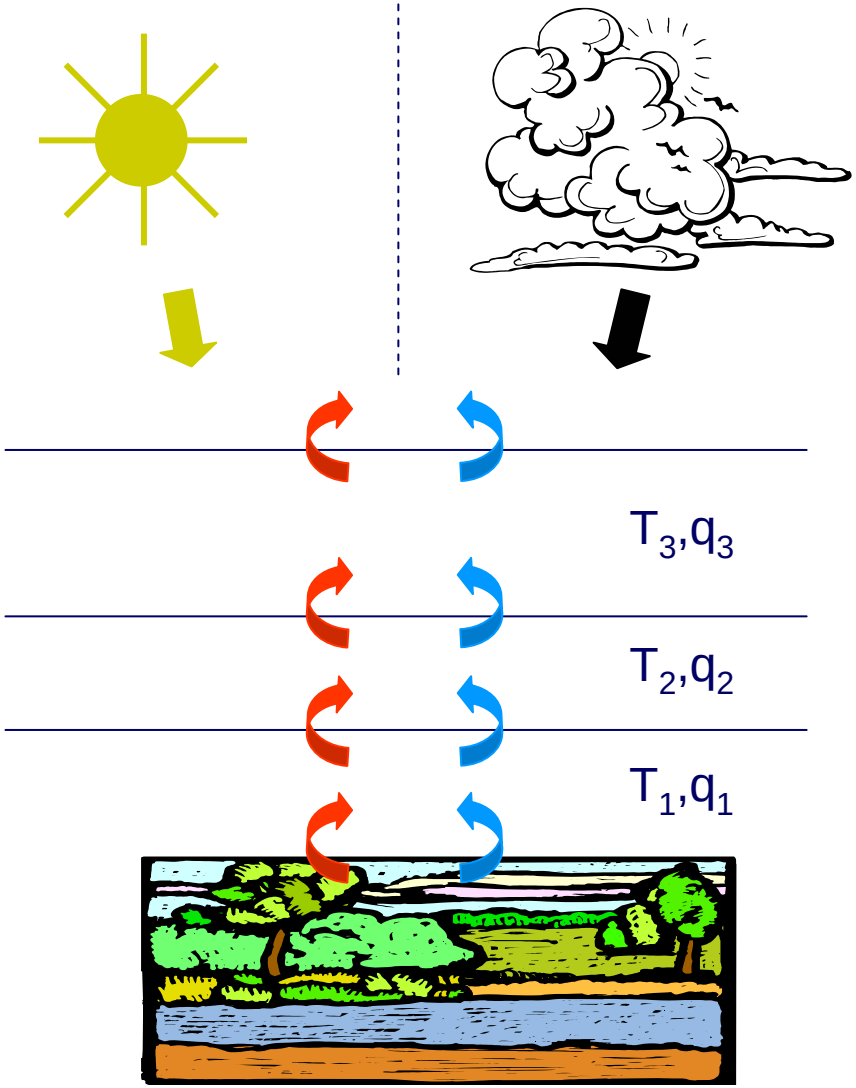


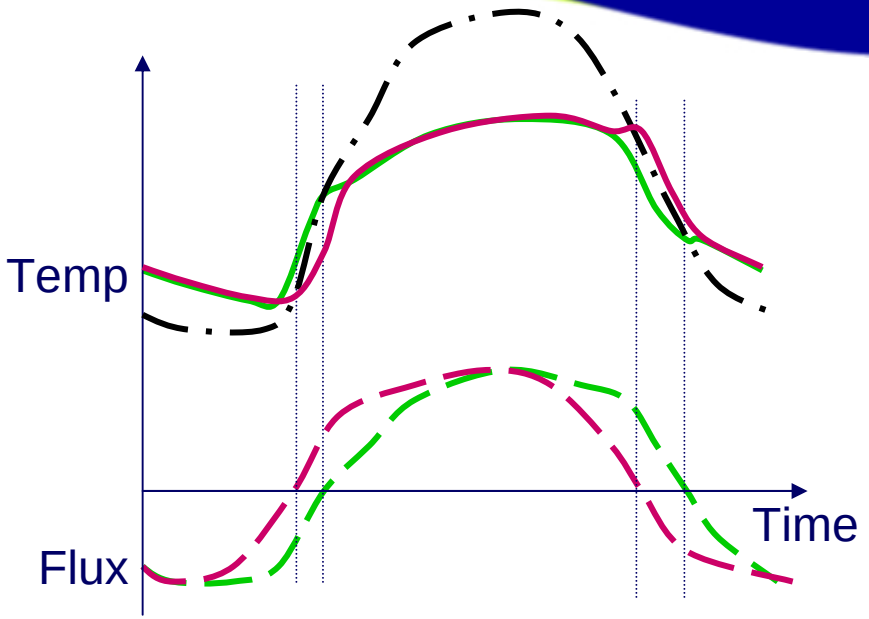


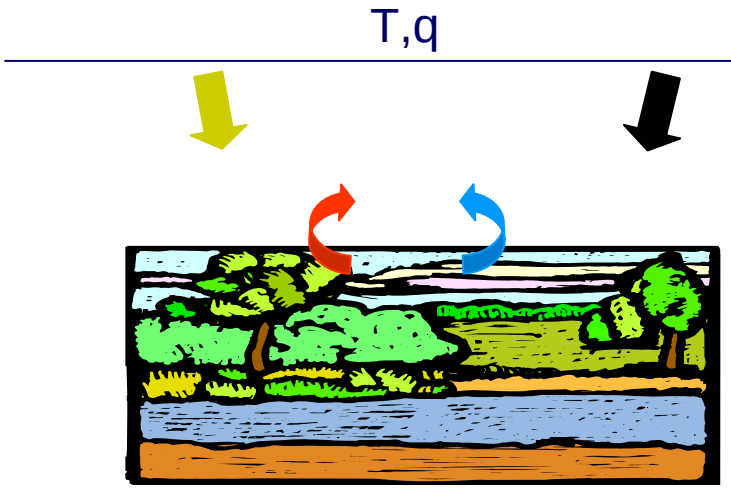




Surface Scheme Coupling







Conclusions

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- Simple schemes can represent some urban phenomenon
- Can achieve significant improvements to operational weather forecasts in urban areas
- Schemes with range of complexities are available and now being implemented
- Need to represent anthropogenic heat sources
- Need observational data to identify problems and develop solutions

State of art and challenges in real-time urban weather forecasting

- State of the art:
  - Recognise that representing urban areas is important
- Challenges:
  - How to accurately represent urban areas without compromising operational requirements (e.g. timeliness)
- Helsinki Testbed:
  - Provide data to help identify dominant urban processes and hence the optimum scheme for operational weather forecast models (e.g. through intercomparison of schemes)