An overview of the mitigation of urban air pollution through vegetation with specific reference to forestry
Outline

- Introduction
- Overview of urban air pollution
- Pollution abatement through vegetation
- Removal rates and methods of measurement
- Indoor air pollution and abatement
- Conclusions
1 Introduction

Ecosystems services / disservices of urban vegetation

Fishece (2016)
Illustrations by S.J. Livesley, G.M. McPherson, and C. Calfapietra.
2 Overview of urban air pollution

- CO
- NOx
- SOx
- VOCs
- BVOCs
- Smog

(Ozone depletion: Ozone ($O_3$) destruction by chlorine and bromine allows more ultraviolet radiation to reach the earth.

Greenhouse effect: Some longwave radiation is absorbed by greenhouse gases and re-emitted to the earth. Leads to increased warming – the enhanced greenhouse effect.

Air quality: In the presence of sunlight, reactions between volatile organic compounds (VOCs) and nitrogen oxides ($NO_x$) can lead to the formation of smog.)
3 Pollution abatement through vegetation

Absorption

- CO$_2$
- SO$_2$
- NO$_3$

Release

- O$_2$
- H$_2$O
- BVOC

Particulates wash off in “first flush”
4 Removal rates and methods of measurement

- **UFORE / iTREE** (Nowak & Crane) measures total urban forest population
- **Barcelona 2008** (Baro et al. 2014)
  - >300 tons pollutants removed
  - Modest figure for entire city
  - >50% was PM$_{10}$
  - > 180 tons of BVOCs emitted
  - USD 2.38 million value
- Micro-scale modelling finds less favourable results (Setala et al. 2012)
- Green roofs’ impact also notable (Speak et al. 2012)
5 Indoor air pollution and abatement

- Indoor Air Pollution = 1.6 million deaths in India annually (burning of combustibles)
- VOCs (benzene, formaldehyde) are main pollutants
- NASA study of 10 plants (Wolverton 1989) confirmed significant removal rates of benzene and formaldehyde
- Kamal Meattle’s TED Talk

6 Conclusions

- Combined approach to pollution management
- PM10 removal is significant
- Other pollutant removal is notable
- PM10 / NO3 removal in winter outweighs O3 generation in summer (due to BVOCs)
- Tree species with low BVOC rates must be prioritized
- Active management of urban forests required
- If so, it is a cost-effective option for particularly PM10 removal
7 References


Note: additional references available in paper itself