Effects of Vegetation on Traffic-Related Particulate Matter

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ENVIRONMENT AND NATURAL RESOURCES

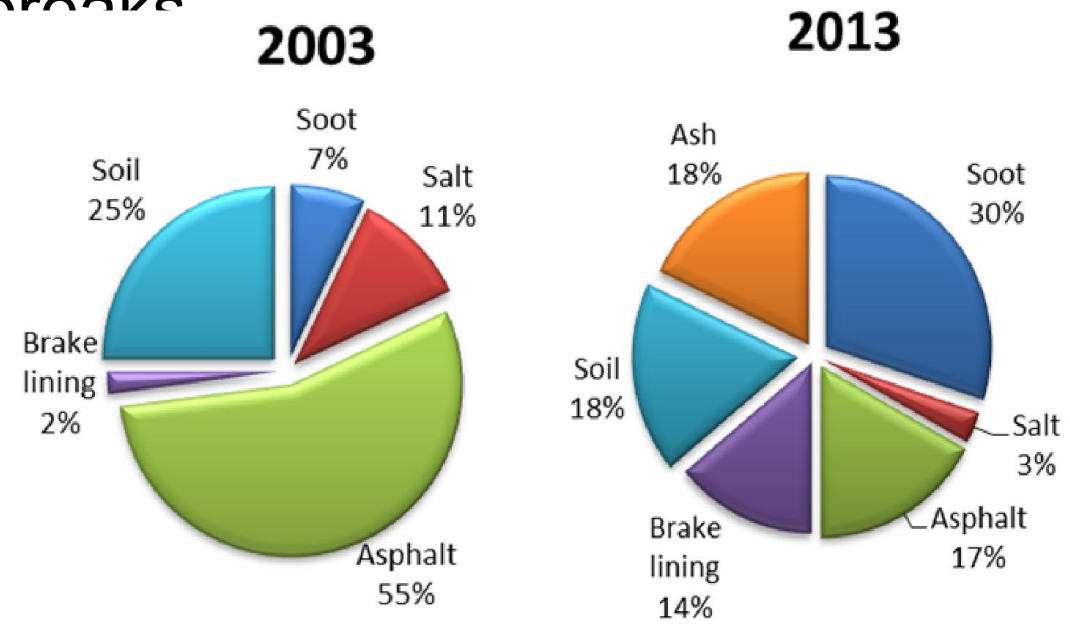
Introduction – About PM

- Particulate matter (PM) – a component of air pollution
- Detrimental effects on health and the environment
- Varies in size and other physical and chemical properties
- Can be either natural or anthropogenic in origin
- Classified by size into:
  - **Coarse particles**: 2.5–10 μm in diameter ($PM_{2.5}$ – PM_{10})
  - **Fine particles**: smaller than 2.5 μm ($PM_{2.5}$)
  - **Ultrafine particles**: smaller than 100 nm ($PM_{0.1}$), or smaller than 1 μm (PM_1) depending on definition

Particulate Matter in Iceland

- Natural sources include sandy deserts, sea spray, subglacial sedments, volcanic eruptions

- Anthropogenic sources include emissions from road traffic and boats, wear and tear from roads, breaks



Composition of PM (coarse and fine) as average percentages from the samples taken during winter in Iceland in 2003 and 2013 (Skuladottir et al., 2003; EFLA, 2013)

Effects of Vegetation on PM: Mechanisms

- Plants can act as barriers by intercepting airborne PM but they can also absorb PM, mainly through leaf stomata
- Due to overall greater leaf surface and more turbulent mixing of air, trees are more efficient in capturing pollutants than shorter vegetation
- Conifers seem to have a higher trapping efficiency than deciduous trees due to finer and more complex structure of their foliage
- Amongst broadleaved trees, it is the ones with coarse and hairy leaves that have higher trapping efficiency

Methods: Instruments

- Equipment - two TSI Optical Particle Sizers (model 3330)

Methods: Locations

- Measurements taken on 3 locations along the Miklabraut road, Reykjavik, Iceland

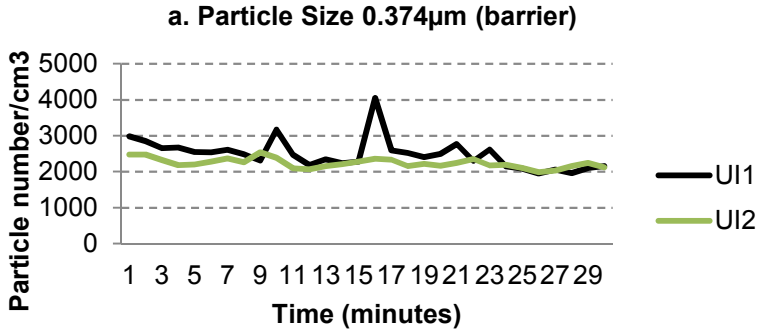
Methods: Location 2

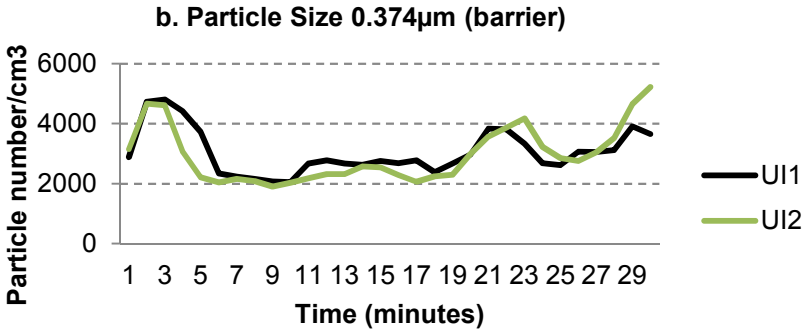
- 365 Media Building – coniferous barrier

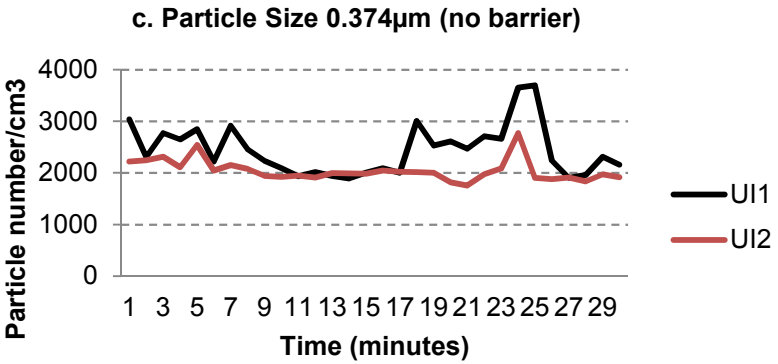
Methods: Location 3

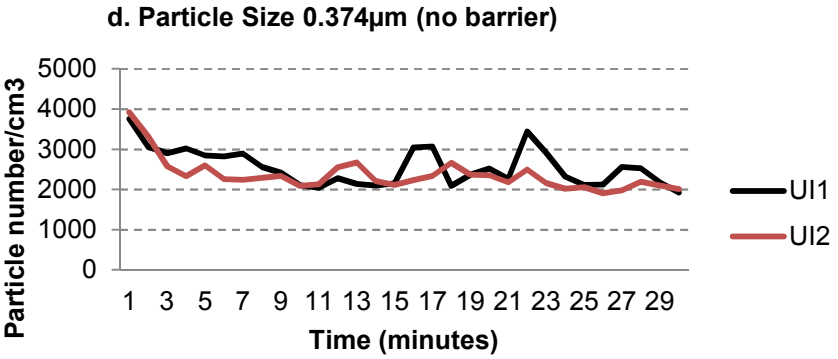
- Location 3, Klambratún – mixed barrier

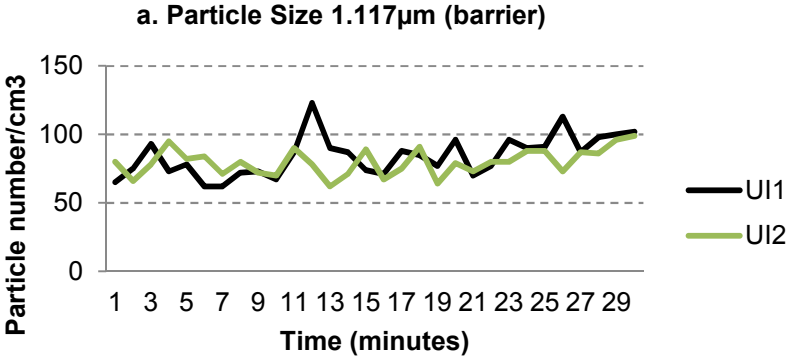
Results: Location 2 (coniferous barrier)

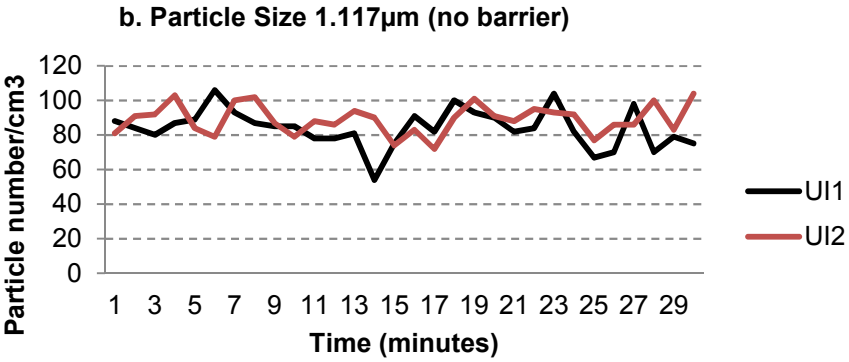




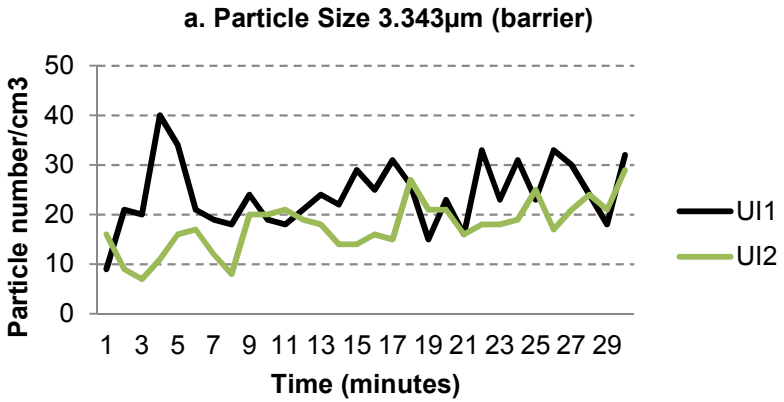


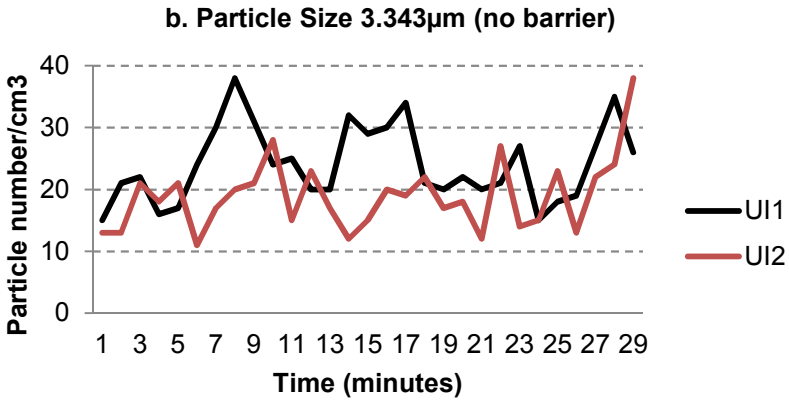


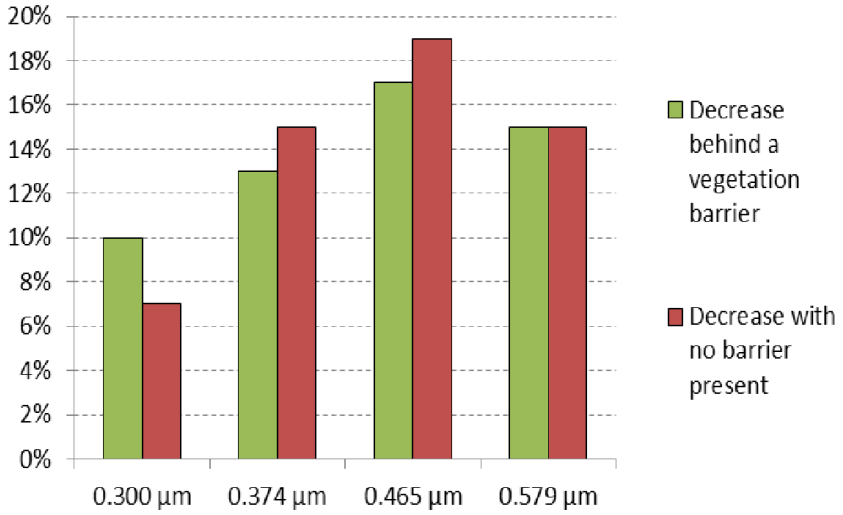


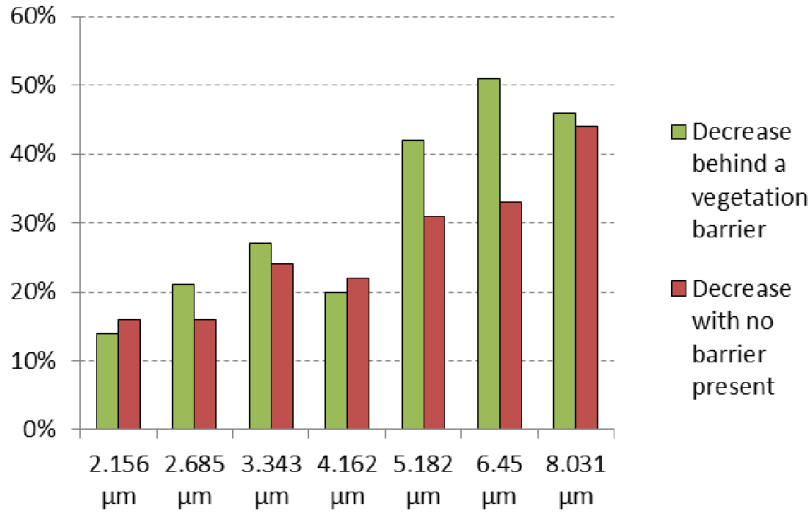


Results: Location 2 (coniferous barrier)

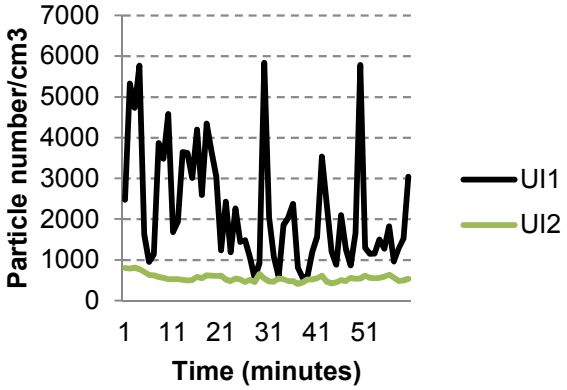


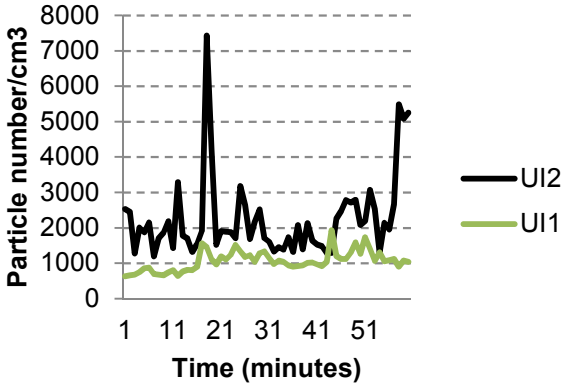


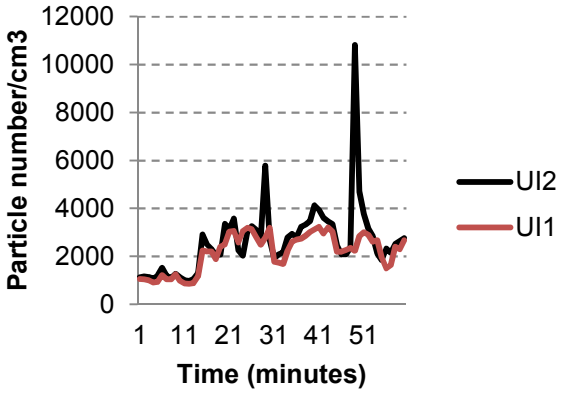


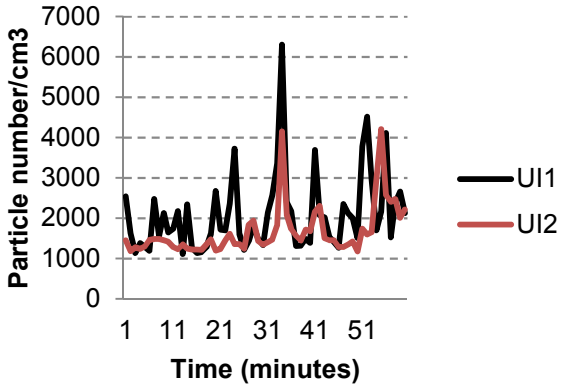


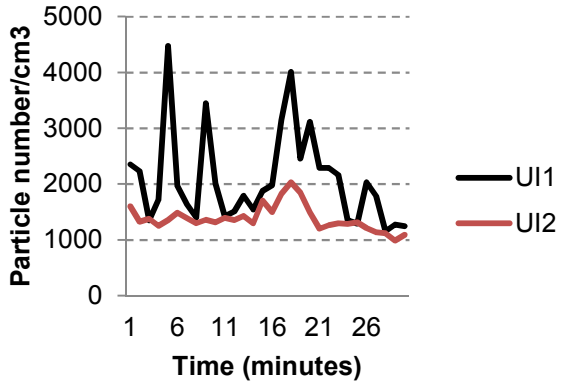
Results: Location 3 (mixed barrier) 0.3 µm



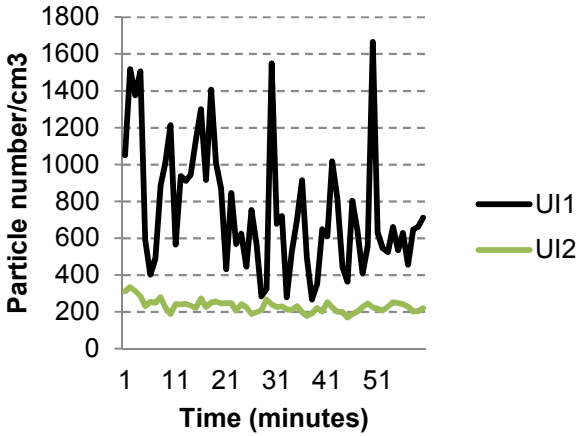


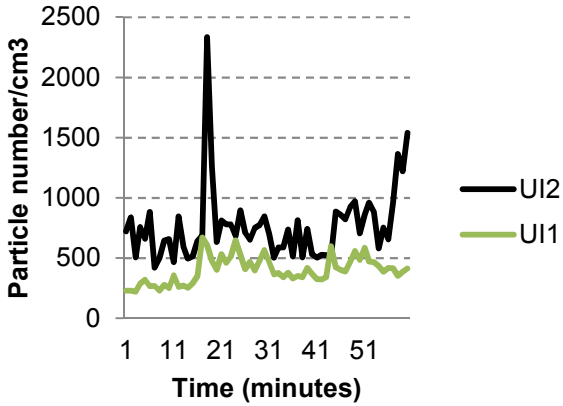


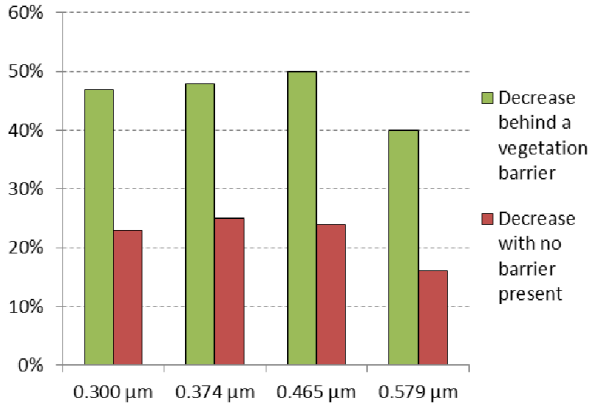


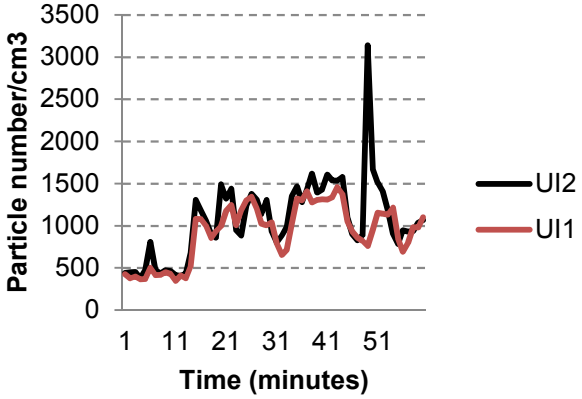


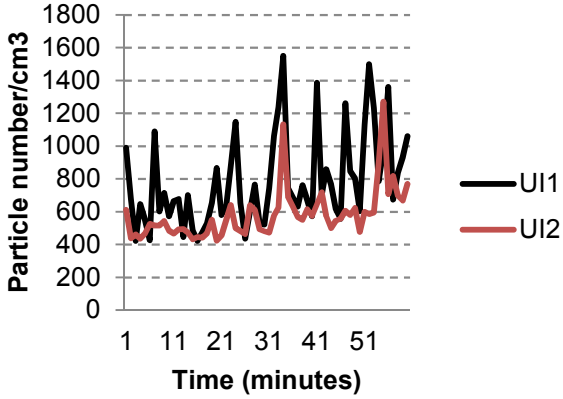
Results: Location 3 (mixed barrier) 0.374 µm

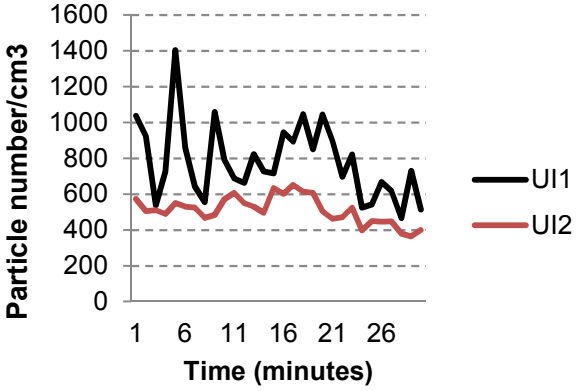




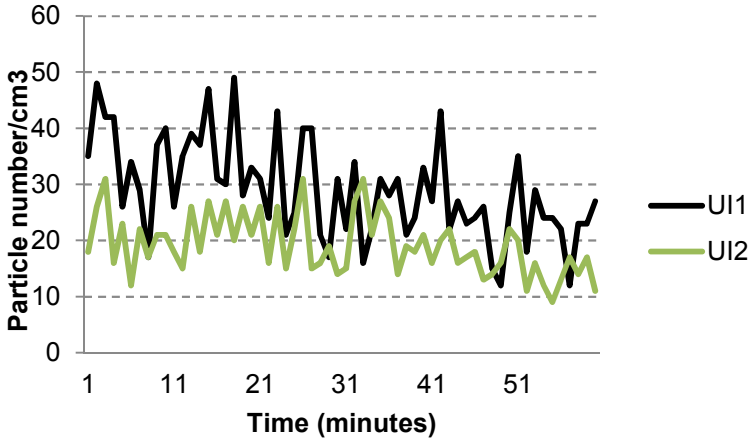


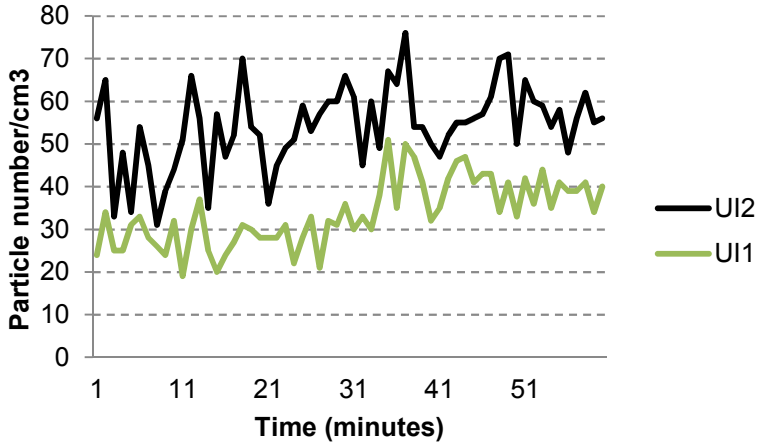


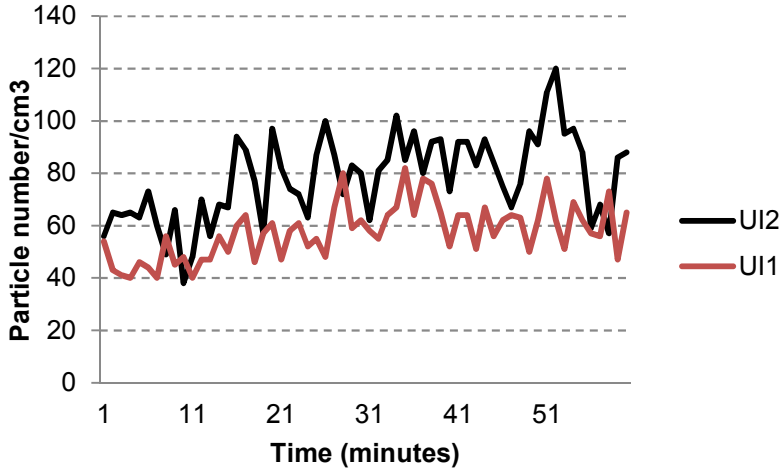


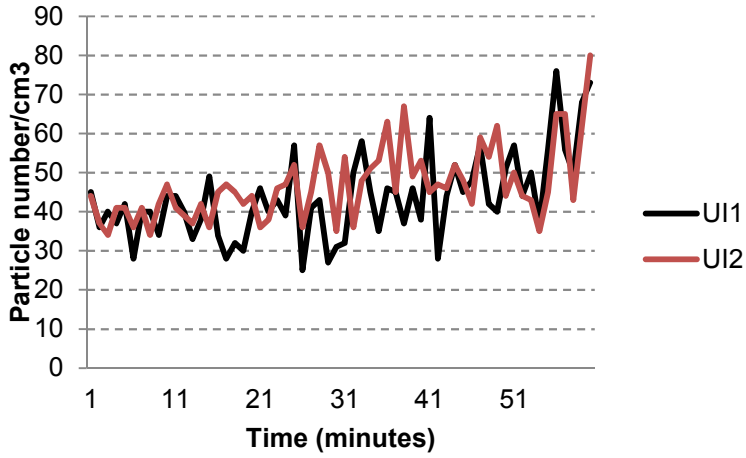


Results: Location 3 (mixed barrier) 1.117 µm

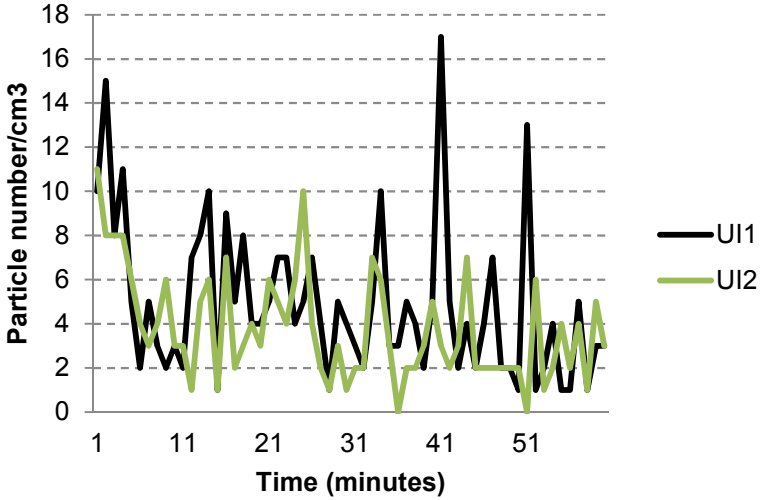


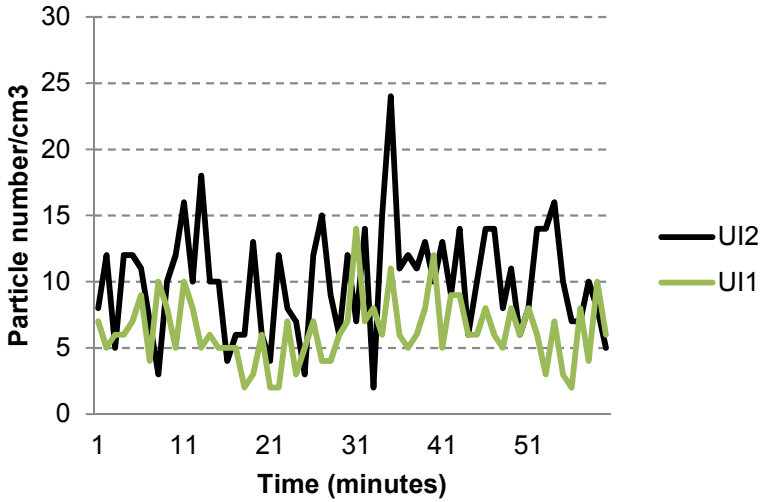


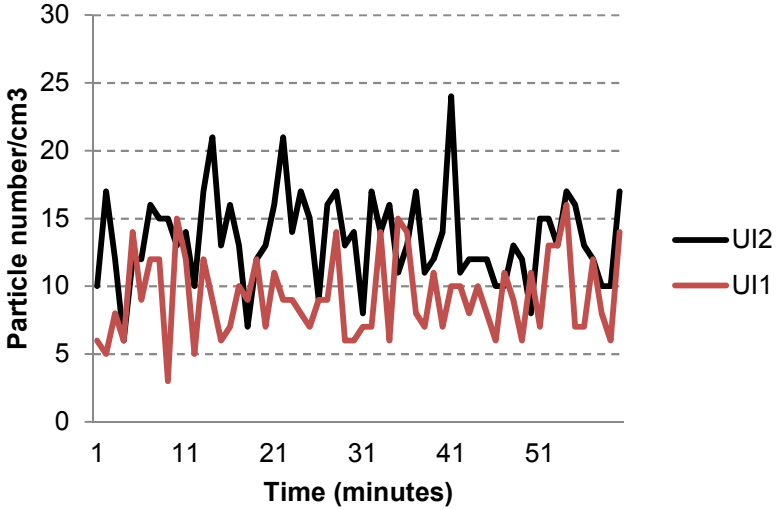


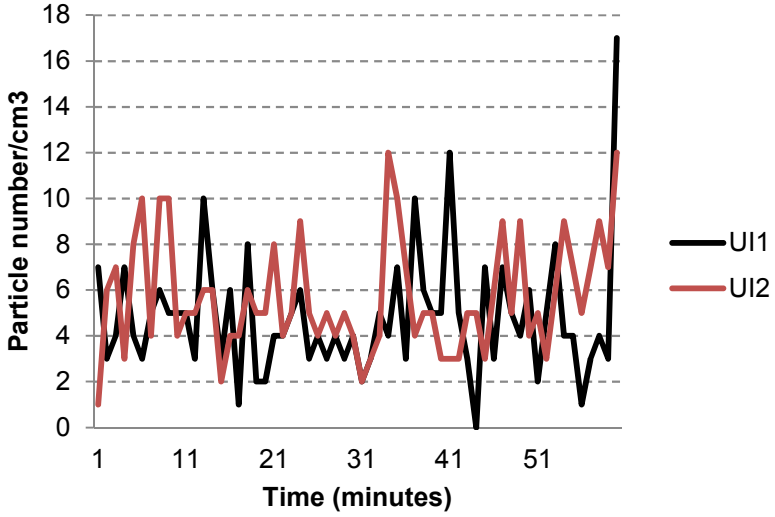


Results: Location 3 (mixed barrier) 4.162 µm









Discussion

- The barrier at Location 2 (coniferous) seemed ineffective in capturing particles
  - 14% decrease both with and without barrier for PM <6 µm
- The barrier at Location 3 (mixed) proved to be **quite effective for particles <0.6 µm**
  - 46% decrease with a barrier, 22% decrease without
- The trees at Location 2 were not in good health which probably reduced their effectiveness drastically
- Particles between 0.6 – 2 µm show very inconsistent results
- Coarse particles (> 2 µm) were generally too few in number to show a reliable trend.

Conclusion

- The impact of a healthy, mixed barrier on particles < 6 μm seems clear – effective in capturing and filtering
- Since this is the fraction of PM that is most detrimental to health it gives enough incentive to continue the research into creating the most effective type of barrier
- Effects on other sizes less conclusive


THINK