RURAL URBAN INTERFACE – INTEGRATED EMISSIONS AND SMOKE DISPERSION FROM BURNING BUILDINGS

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INTRODUCTION

Infrastructure on the urban-rural fringe is vulnerable to bushfires and requires emergency response if burnt. Materials in buildings, including plastics, electronics, manufactured wood products, stored solvents, paints and pesticides are potential sources of hazardous airborne chemicals if burnt. Integrating likely emissions with local dispersion near buildings with turbulent winds in the atmosphere allows an assessment of hazard from exposure to high concentrations of toxic chemicals.

EMISSIONS

The rural-urban interface is comprised of a complex spatial distribution of many materials and the mass distribution is not uniform. The integration of emitted chemicals is a complex mixing process controlled by the turbulent winds. The 'effective' mean integration only occurs far enough downwind where the dilution is also significant and the hazard risk is less.

DISPERSION MODELS - INTEGRATION OF MULTIPLE SOURCES

The integration problem for multiple sources (and multiple species) requires a collection of puff-generated plumes, one for each node of emission. Importantly the plumes are all correlated by the spatial and time varying structure of the turbulent winds at the point of emission. The two critical nodes shown in Figure 1 contribute two key plumes of chemicals, with the remainder of the house yielding a general background of chemicals of less concern.

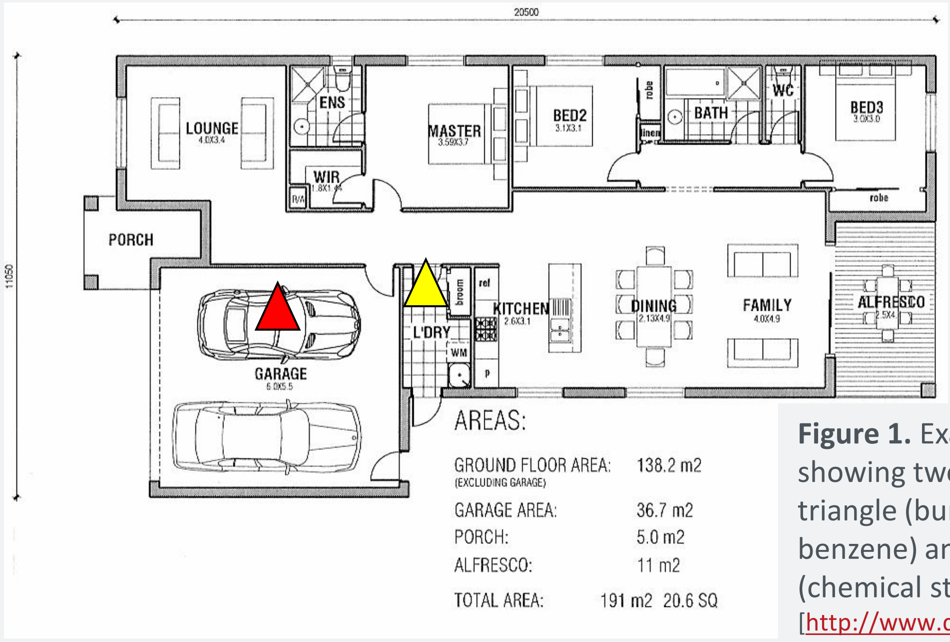
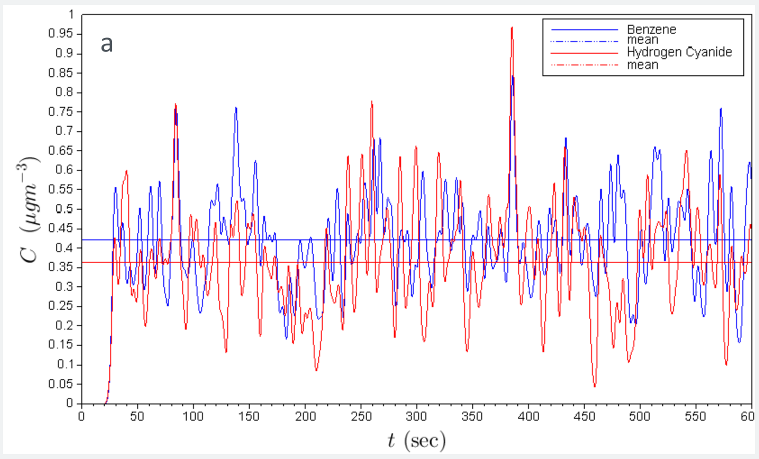


Figure 1. Example House Plan showing two critical nodes: red triangle (burnt vehicle-emissions of benzene) and yellow triangle (chemical store-emissions of HCN) [http://www.displayhouses.com.au]

EXPOSURE ESTIMATES



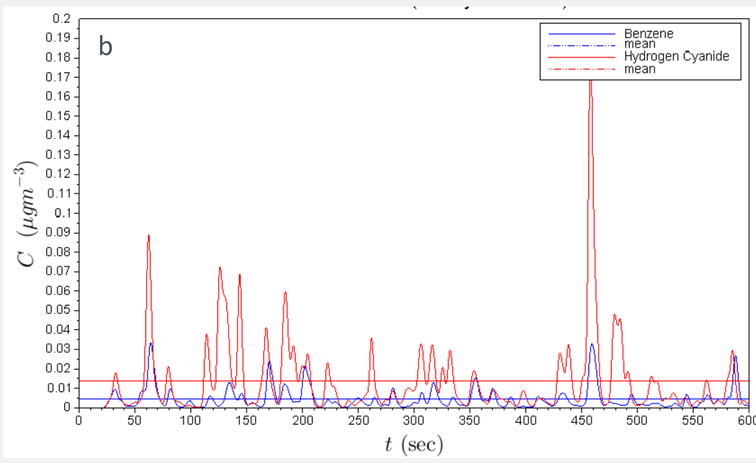


Figure 2. Joint species fluctuating concentrations at a sample point 50 metres downwind of nodes: a. directly downwind of node 1; b. three cross plume widths laterally displaced at the plume edge.

SUMMARY

This simple two-node two species example demonstrates new potential ways to examine airborne toxic hazards, both with an understanding of short-term peaks, but importantly the synergistic effects of joint peaks of multiple toxic species. The results show that high concentration peaks occur jointly and recurring short-term high peaks are often well in excess of mean concentrations pointing to potential complex dose response from such exposures when non-linear toxicological impacts are expected.