Source identification and mapping from ambient measurements

Gustavo Olivares

Outline

- Why?
- Methods
- Results
- Conclusions
- Future plans

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The question?

- How can the impact of traffic and residential wood combustion be quantified and mapped?
- Can gaseous species give information about the particles?
- Are there alternatives to chemical speciation and *source apportionment* methods?

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Why HUA

The aim is for air quality to be managed in an integrated framework with other sustainability concerns such as climate change and social equity. The programme will contribute to this by providing tools for facilitating attainment and review of current air quality standards, along with setting, and subsequently meeting, new, scientifically based air quality standards. The implementation of integrated air quality management will reduce exposure to harmful emissions, and so improve air quality and health outcomes, and, ultimately, reduce the associated cost burdens to New Zealand.

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The (long) plan

- Emission sources need to be identified and quantified
- Spatial distribution of emissions allows spatial exposure quantification
- The use of multipollutant sites strengthens integrated air quality management

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Method

- Campaign data
  - WEDGE
  - ROADSIDE
- Source identification
  - “Z-ratio” method (Jayaratne et al, 2005)
- Source mapping
  - Mobile “Z-ratio”

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Campaigns description

- Woodburning Emission Dispersion in Glen Eden (WEDGE)
- MAQS2 based campaign
  - BC
  - CO2
  - GPS

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Campaigns description

- ROADSIDE
  - Traffic impacts of traffic on roadside communities
- Intensive measurement campaign
  - Background, roadside and “set back” sites
  - CO2, NOx, CO, O3, BC, N, …
  - More information: Ian Longley

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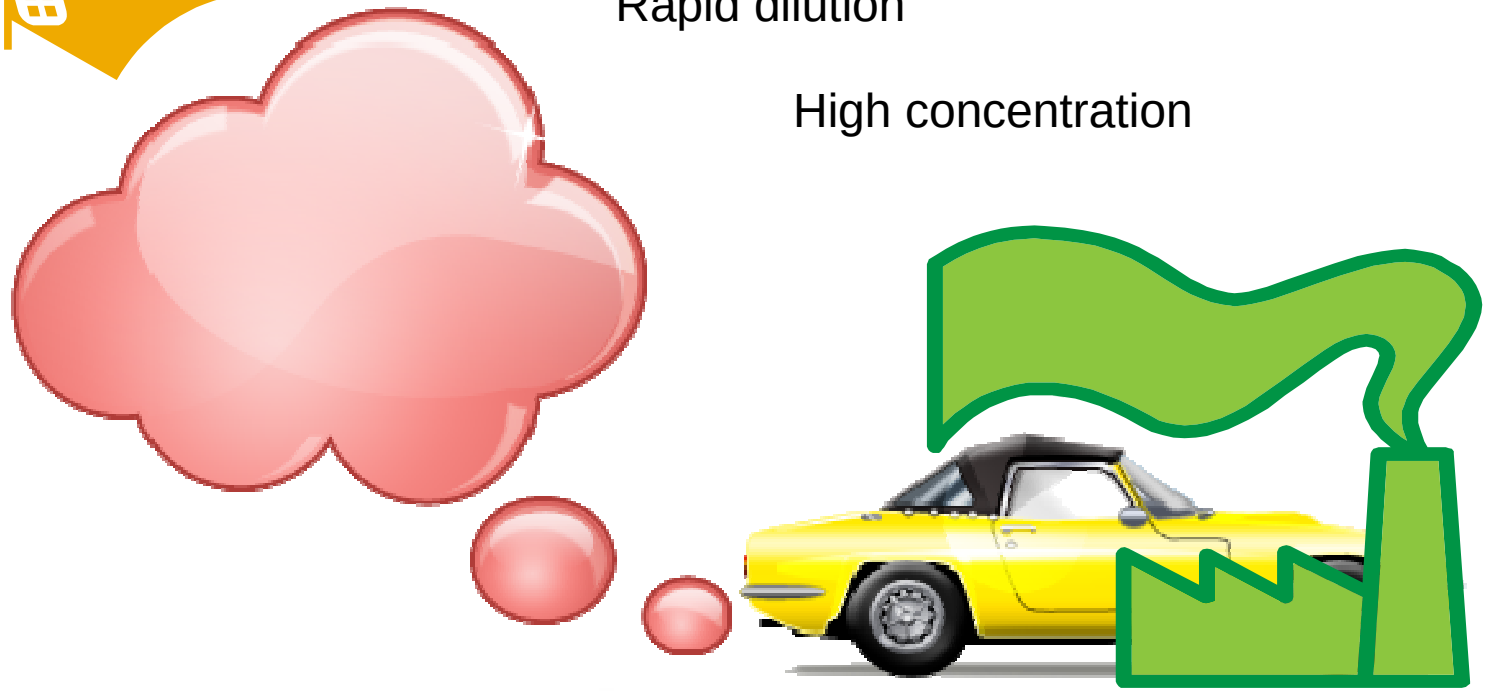
“Z-ratio” method

Measurement site

Low concentration

Rapid dilution

High concentration



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"Z-ratio" method

- Z_i = [Species *i*] / [CO_2]
- CO_2 is an inert atmospheric component at urban scales ➔ Its concentration change only due to dilution …
- If *Species i* is **also inert***:
  - Z is **constant** inside any plume and it is equal to the ratio of the emission factors for *Species i* and CO_2.
- Careful choice of *Species i* can be used to screen the impact of different sources

* Inert in the relevant temporal and spatial scales

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“Z-ratio” method

- Let’s take *Species i* to be **black carbon** (BC)
  - BC is inert on timescales of hours
  - BC is emitted with different intensity by petrol, diesel and wood combustions.

$$EF_{traffic}(BC)/EF_{traffic}(CO_2) \sim (1/3)\ EF_{RWC}(BC)/EF_{RWC}(CO_2)$$

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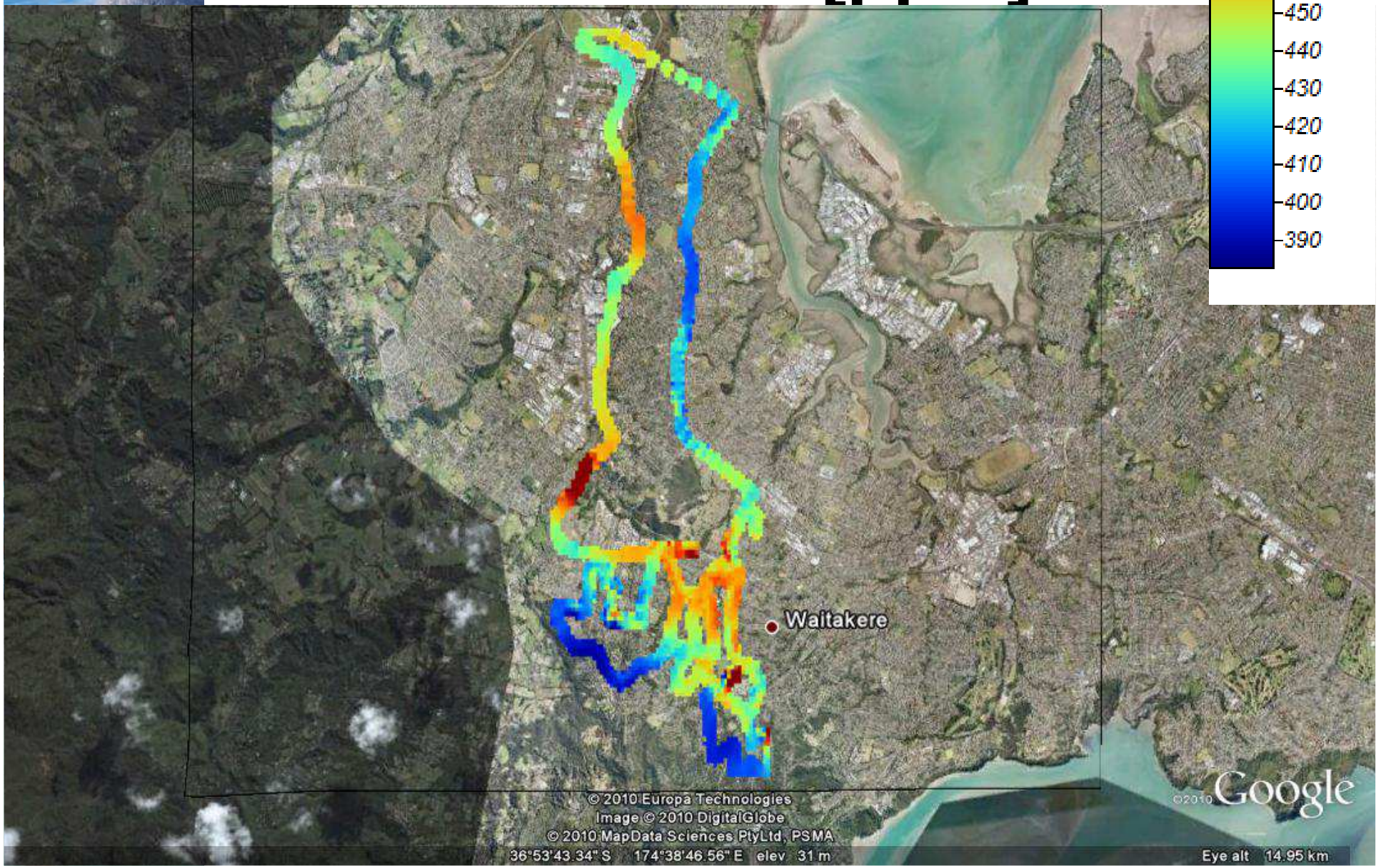
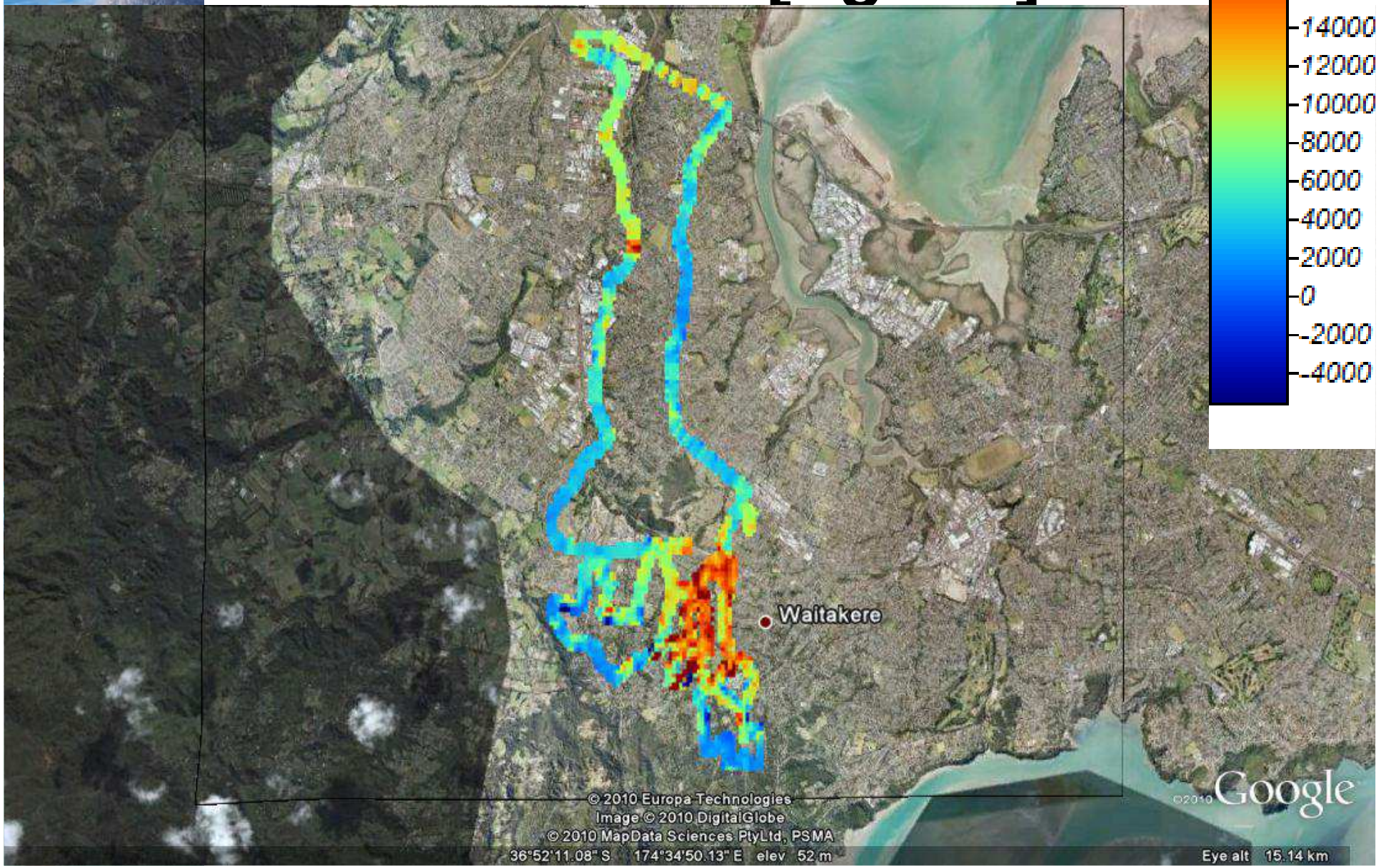
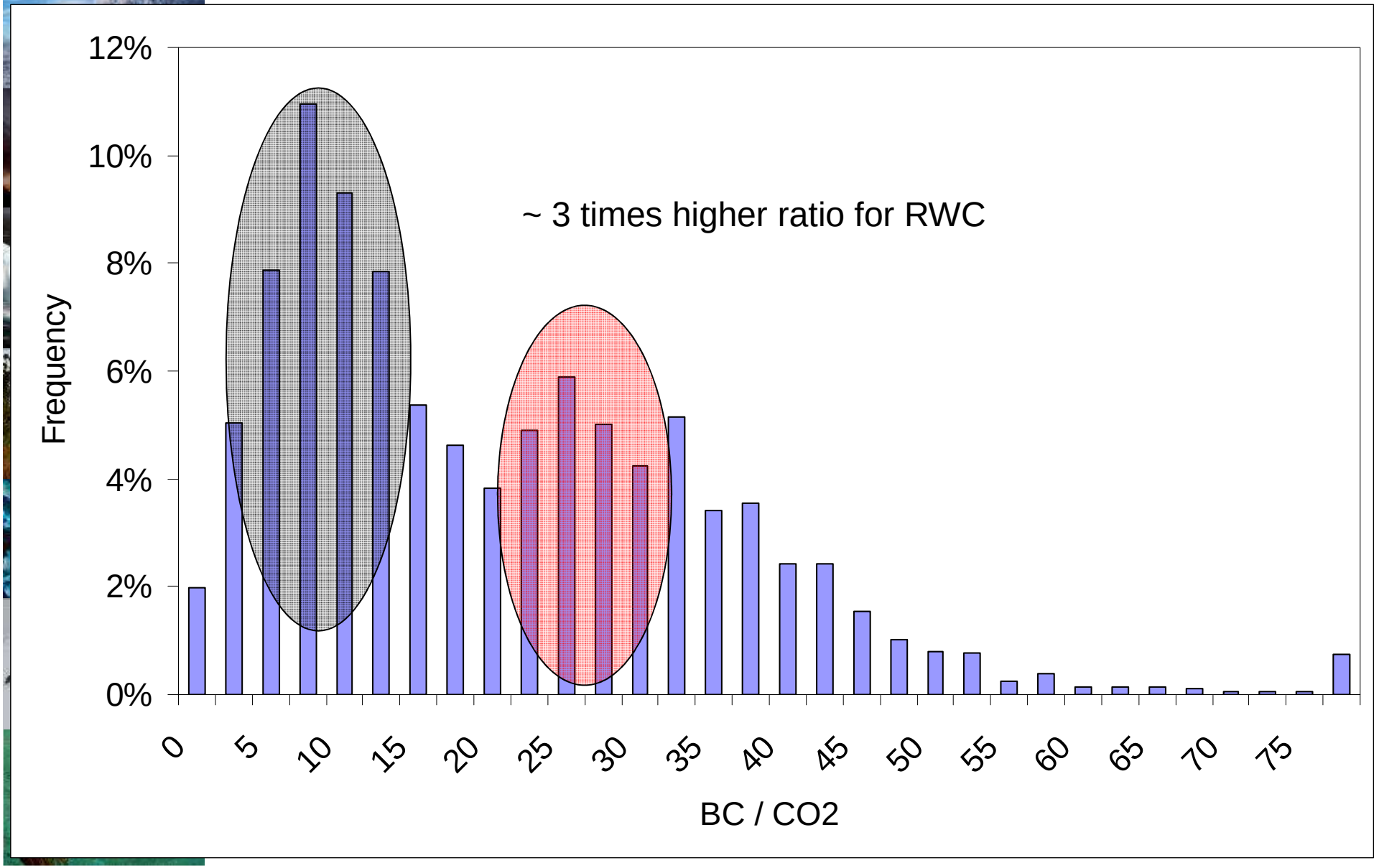
Results CO2 [ppm]



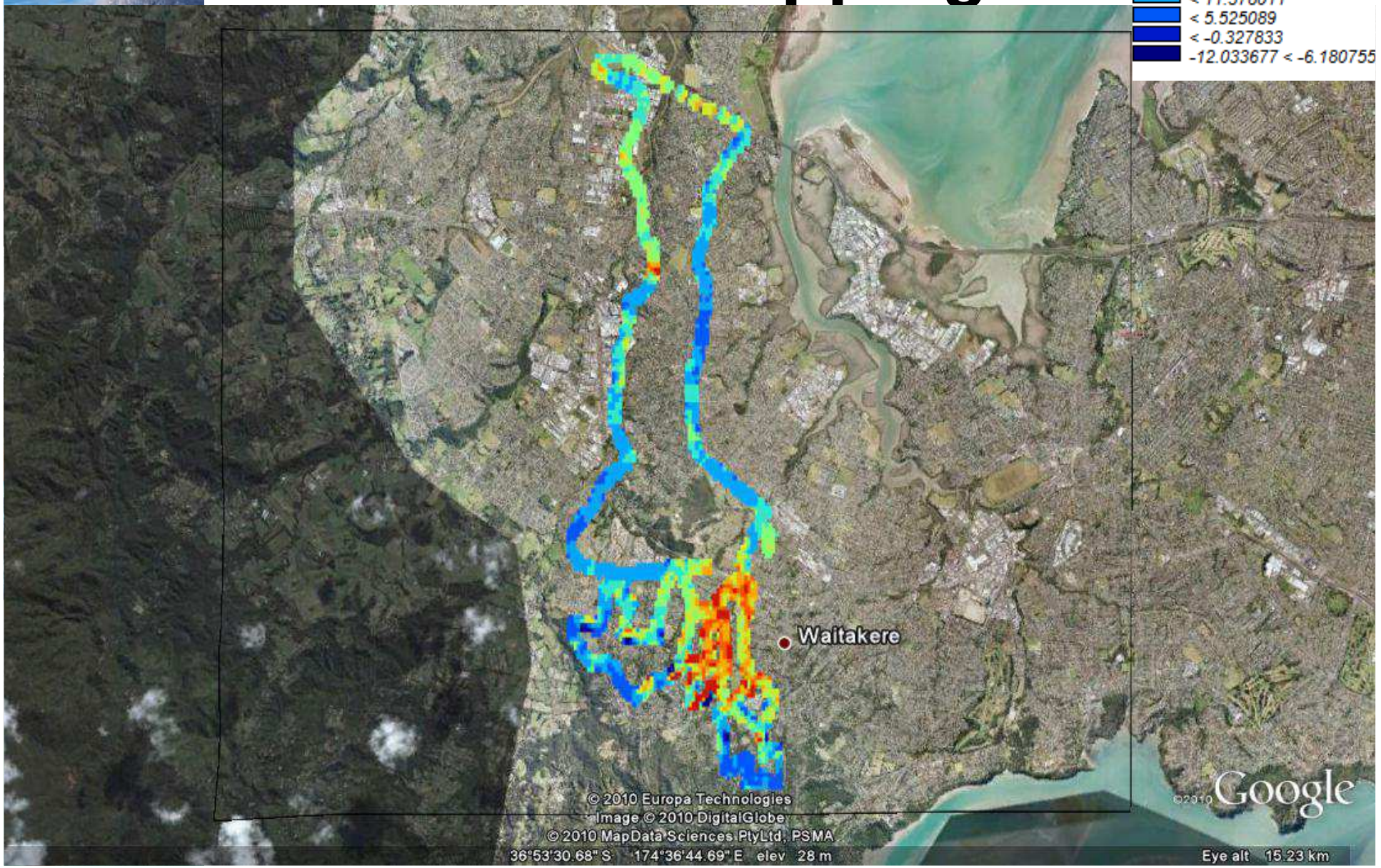
Results BC [ng/m3]



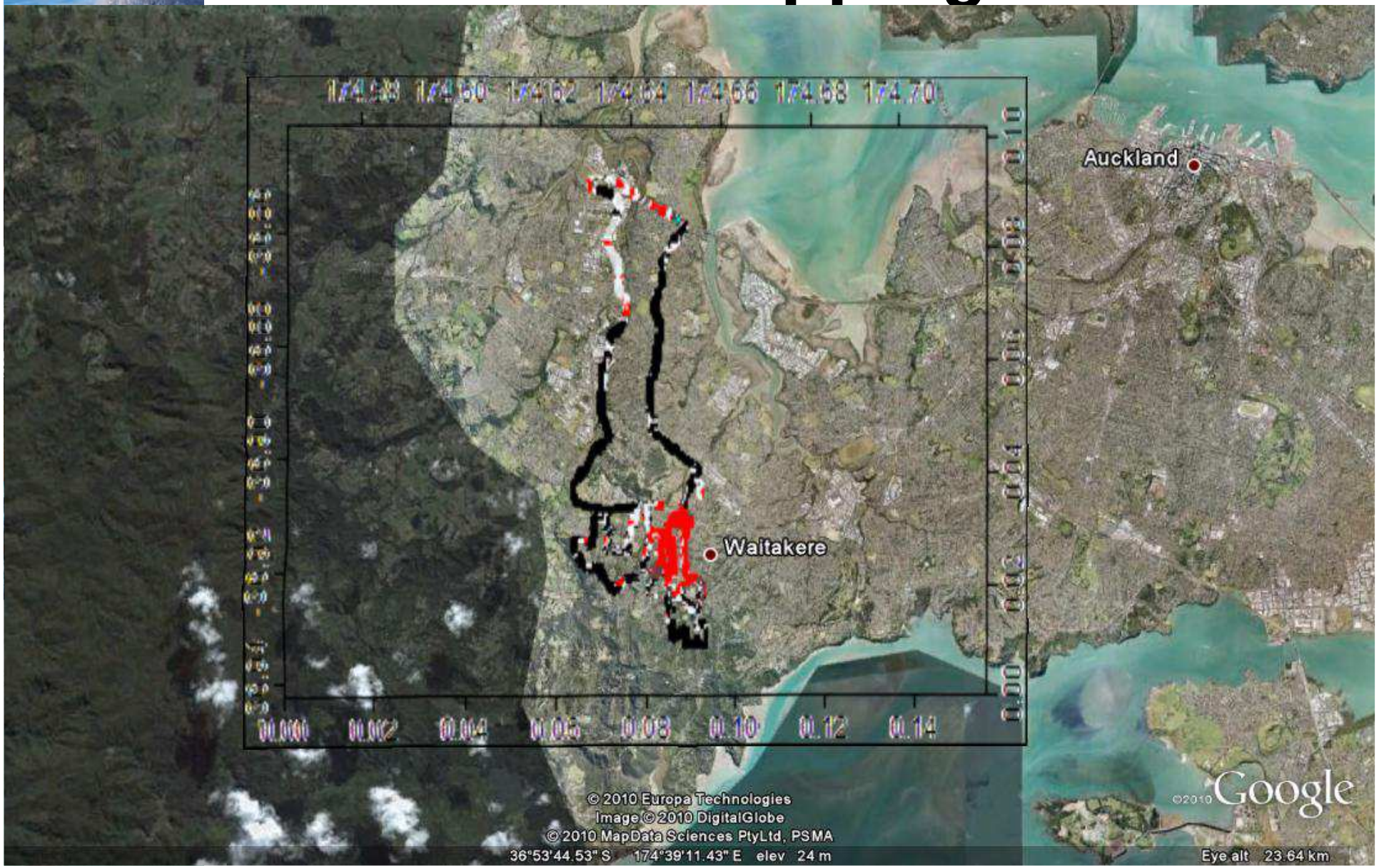
Results BC / CO2



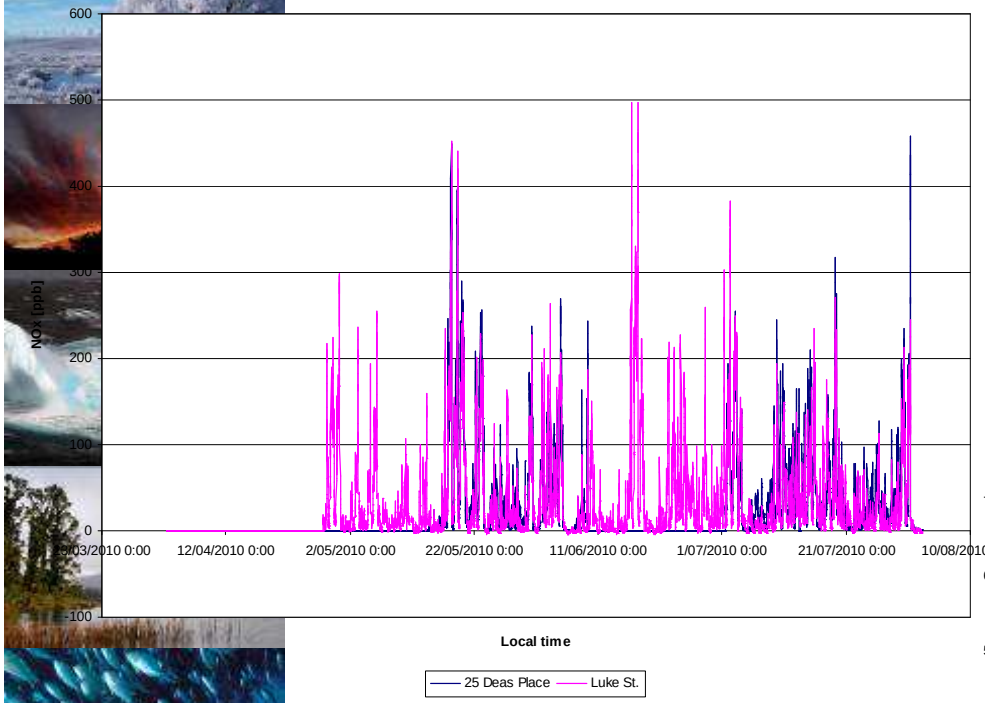
Source mapping

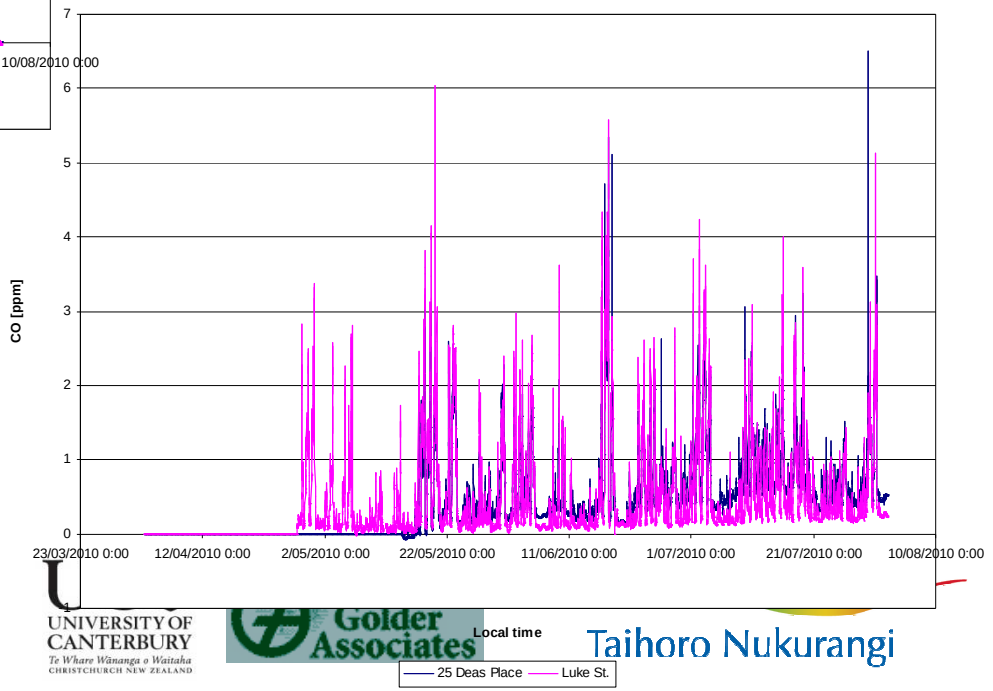


Source mapping



And with a time series?





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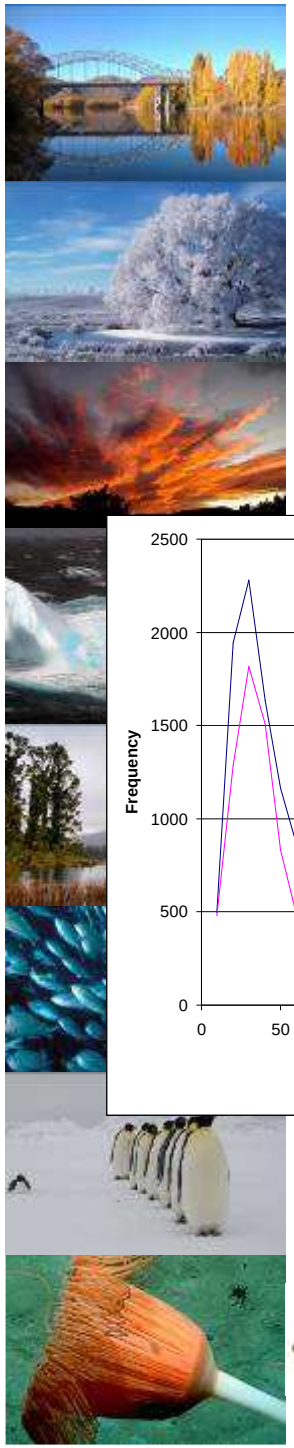
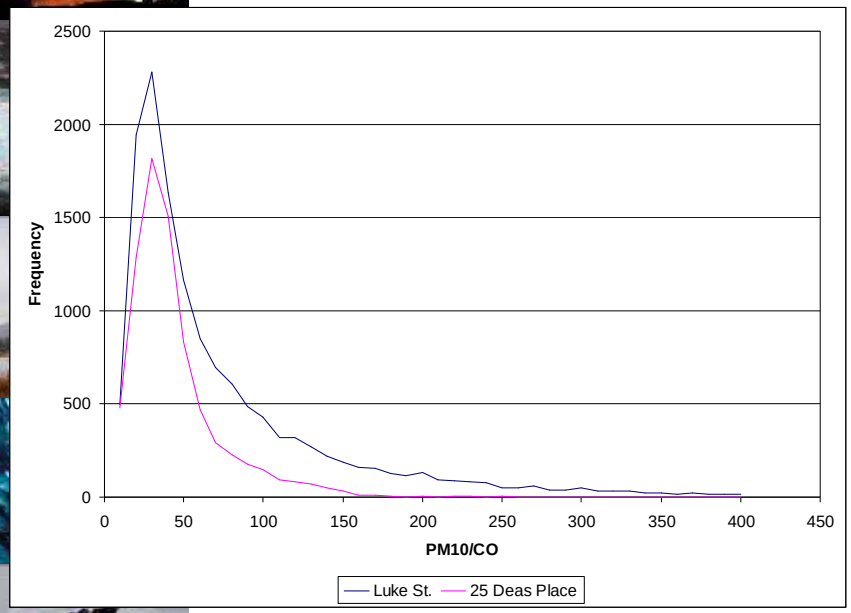
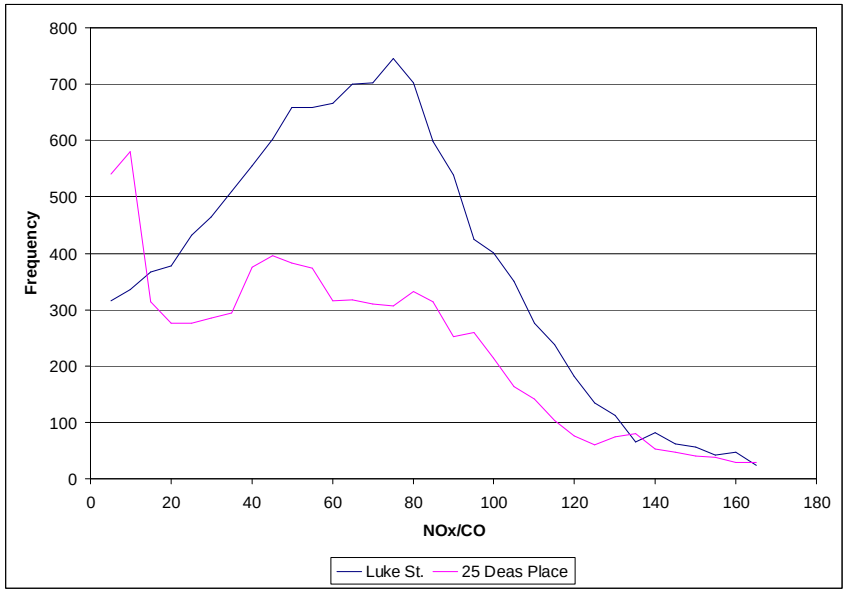


And with a time series?

1 clear source



Interesting!



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Conclusions

- BC / CO2 ratio is useful to discriminate between traffic and residential combustion sources
- Mobile measurements of these pollutants can effectively map the emission areas
- Point measurements can be used for source screening
- Successfully tried in Australia to identify traffic gross emitters.

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Species don't have to be toxic to be useful!

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