

Climate Trends and Air Pollution: *Is an Outlook Possible*

(Meteorological Society of NZ, 23-25 November 2005)

Auckland



Nelson



Masterton



Gavin Fisher



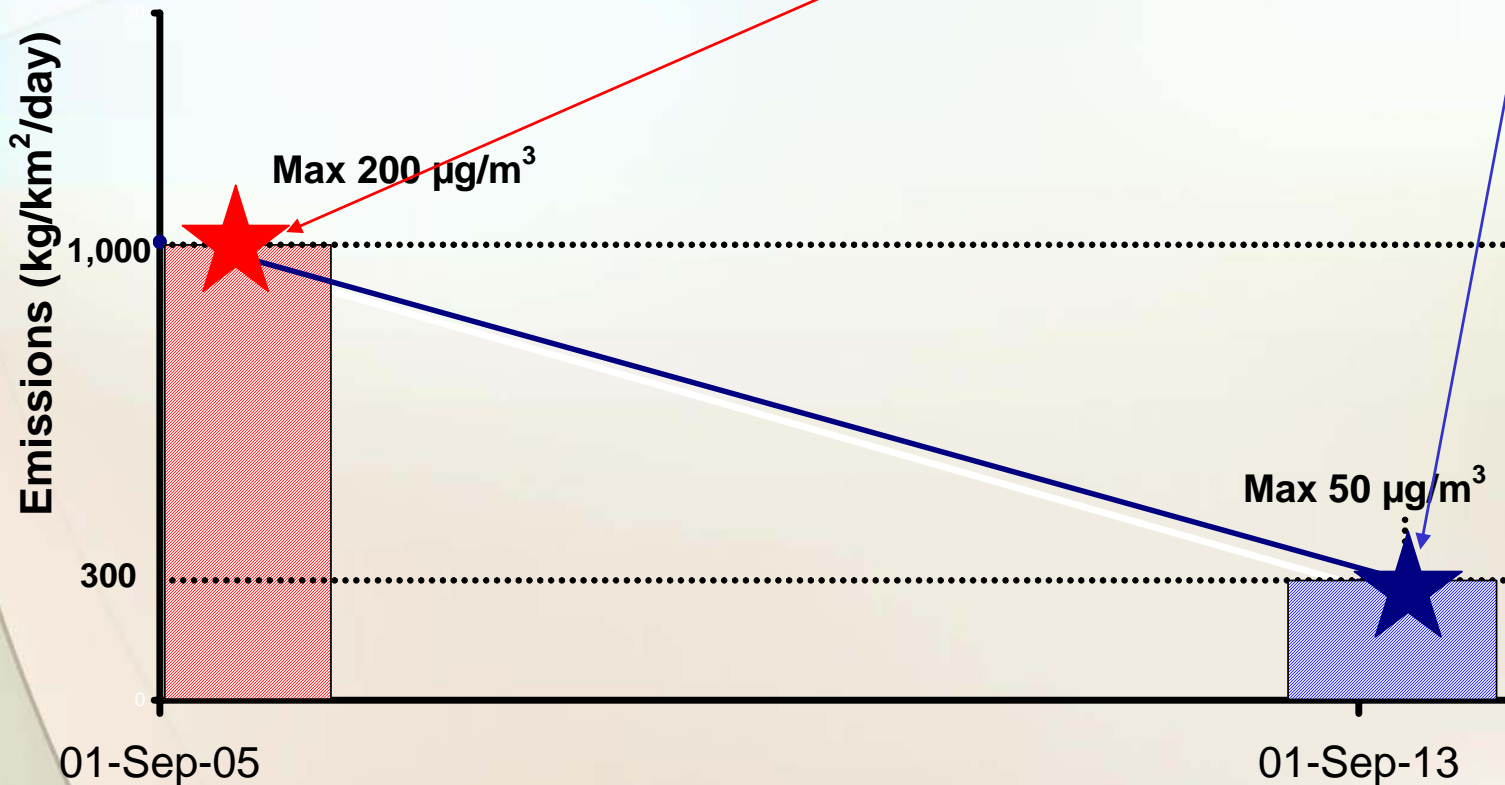
Christchurch



Why?

Because new air quality standards say we have to get from **HERE** to **HERE**
– over the next 8 years – or else!

Straight Line Path: PM₁₀



PM₁₀ and Standards

17 Resource consents for PM₁₀ discharges before 1 September 2013 if concentration in airshed breaches standard

(1) ...

(2) A consent authority must decline an application for a resource consent to which subclause (1) applies if the discharge to be permitted by the resource consent is likely to cause, at any time, the concentration of PM₁₀ in the airshed to be above the straight line path.

.....

Note the emphasis – this is very serious stuff.

Its up to the Regional Councils to make sure they get their regions below the straight line path.

That means for many new policies to reduce PM.

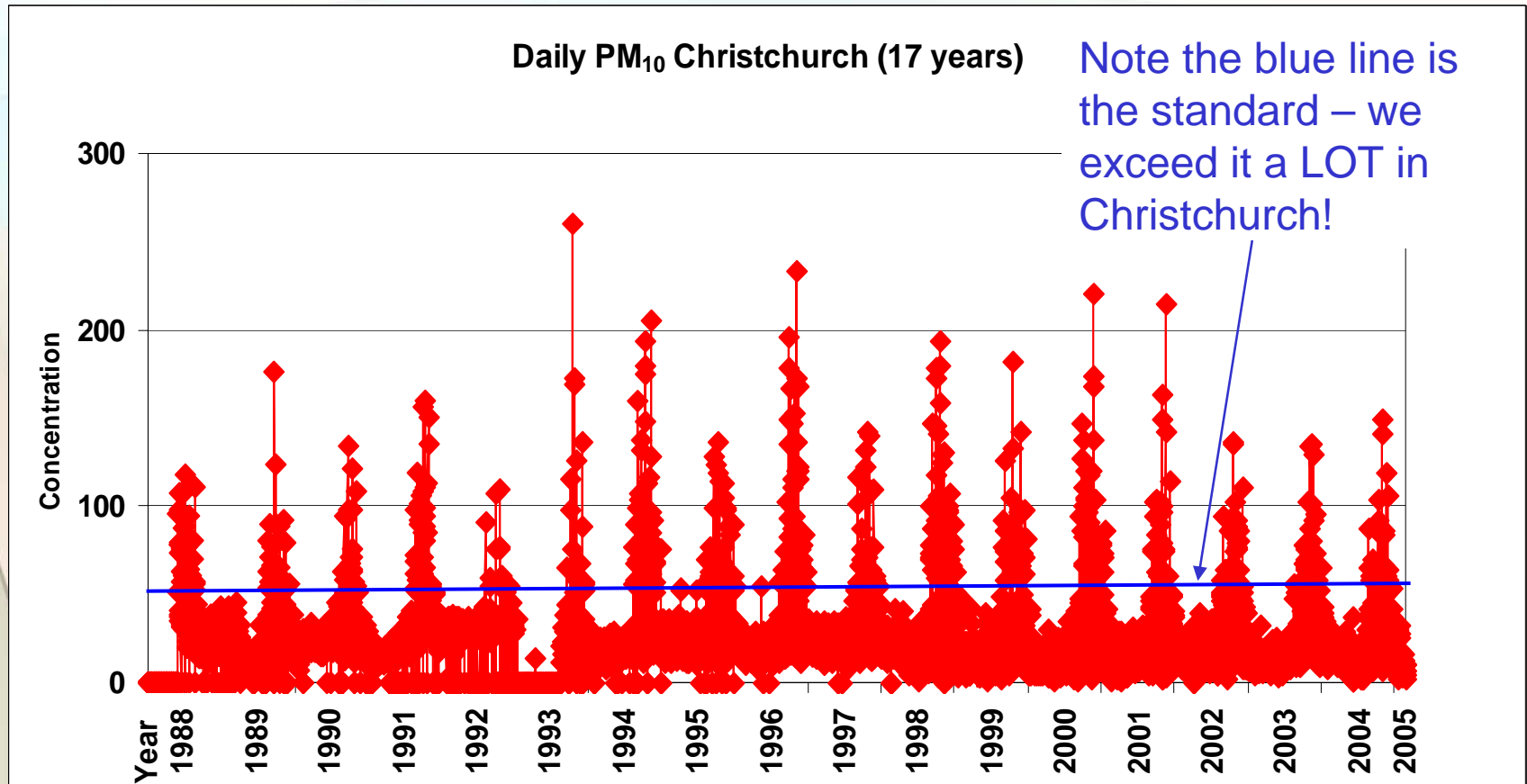
Has major cost implications – so they must be sure they get it right.

How hard is that?

Here's a long term PM₁₀ record.

What's the peak we should take?

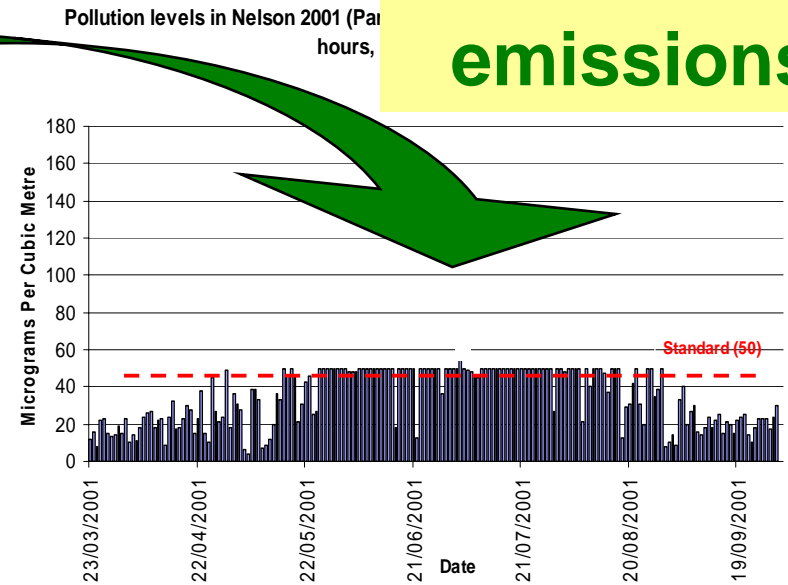
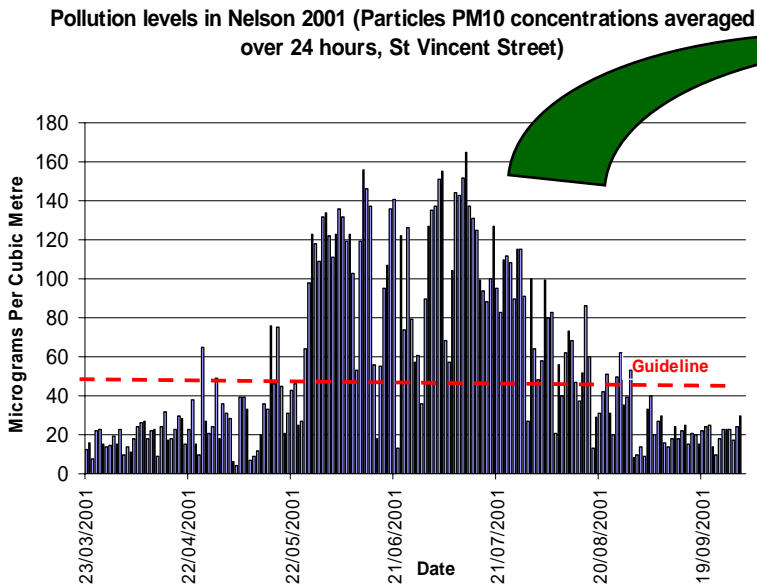
Are the lower values in last 3 years 'real'?



So the 'grass' has to be 'clipped'

In Nelson....they figure....

70%
reduction in
emissions



Note: Alert and Guideline Maximum levels are from the Ministry for the Environment Air Quality Guidelines (for the period 14/05/01 - 20/05/01 23/6/01 and 24/6/01 are not quality controlled)

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Present Air
Quality



What it must be
– 50ug/m³

But...

This is based on ...

- A) Knowing the relationship between emissions and concentrations.**
- B) Getting the emissions values right – now and in the future.**
- C) Believing that what's happening now will be the same in future.**

All of these are climate related!

What's the relationship between PM₁₀ exposure and emissions?

Weather

Cold weather makes people burn more

Calm periods allow pollution to build up

Clear skies and light winds lead to inversions that trap pollution

All sorts of others – recirculation, fumigation, cross boundary transport, photochemical, “Guy Fawke’s” effects – but for most of NZ these are not that important.

Where to start?

Weather is complex – ha –
weather is really really tough!

Let's try some simple climate analysis first

We don't have a very long period of PM₁₀ monitoring in NZ. Auckland holds the record for Total Suspended Particulates – 40 years or so, but a few places have 10+ years for PM₁₀ – Christchurch, Auckland, Gisborne.

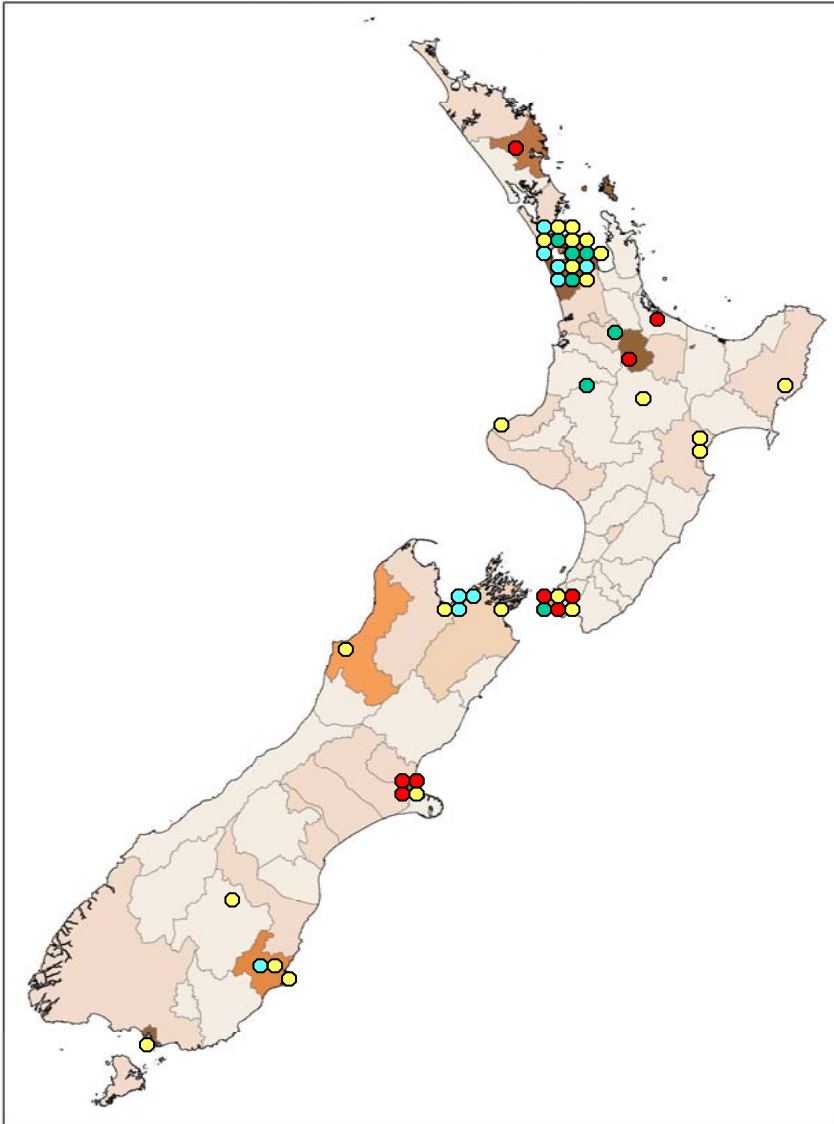
Councils supplied us an update earlier this year – thanks - this is the basic data set (report is on the web site www.niwascience.co.nz/ncces/air_quality)

Data Sources

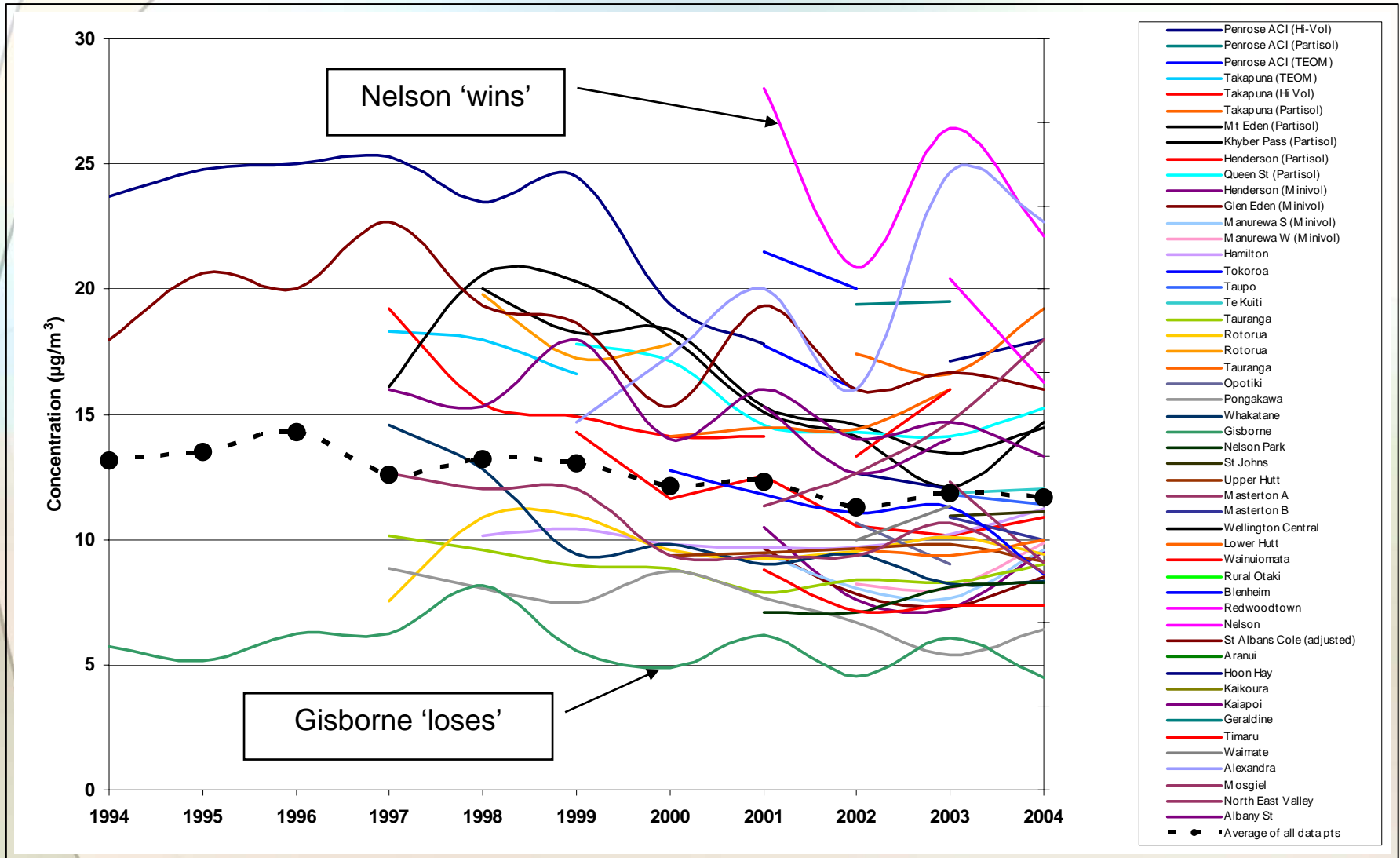
PM₁₀ monitoring sites – 2004.

Nationally 42.

There are quite a few more now (14-15) because of the Standards



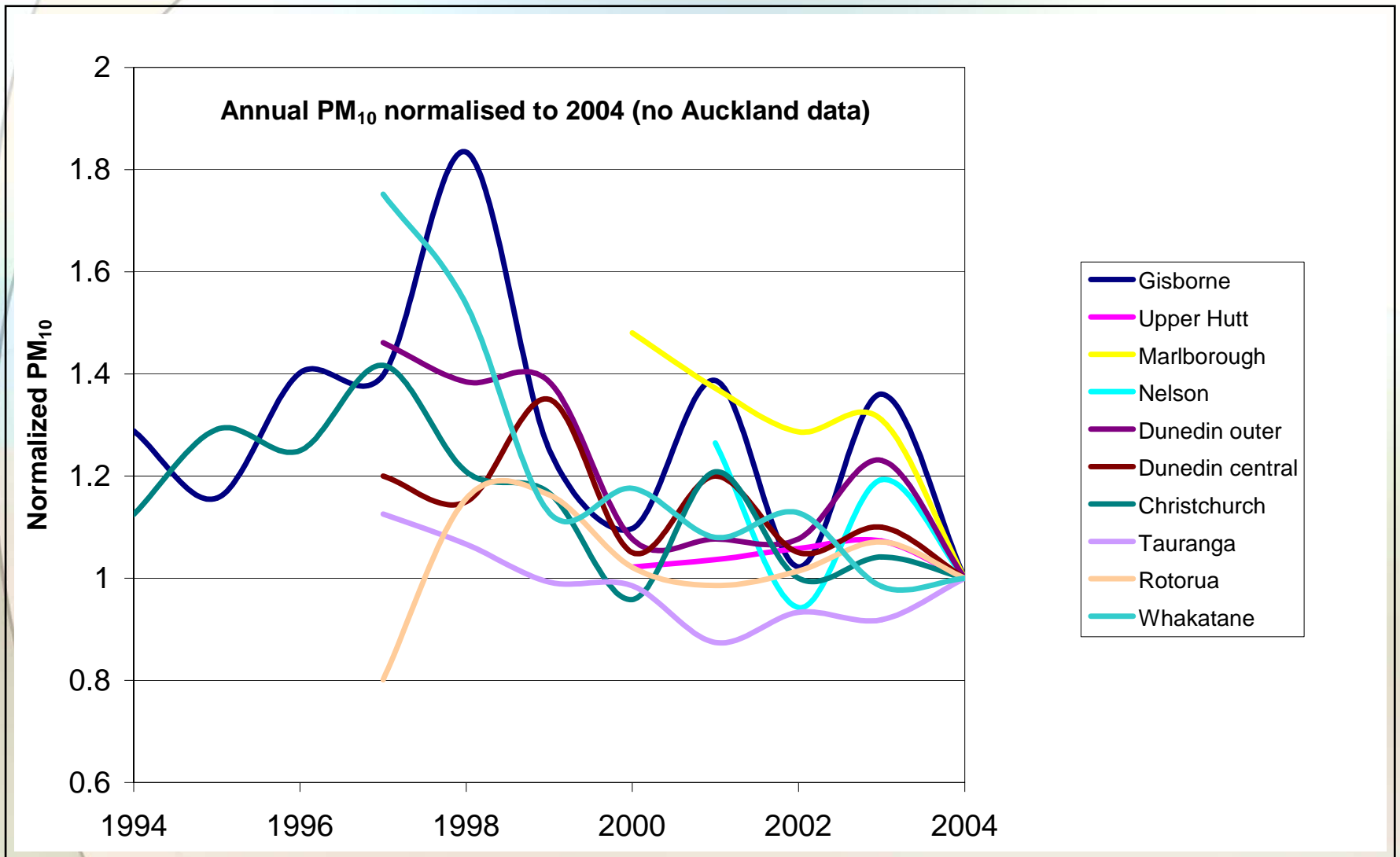
First look – Annual averages



What a mess! But there are hints of climate type cycles in here

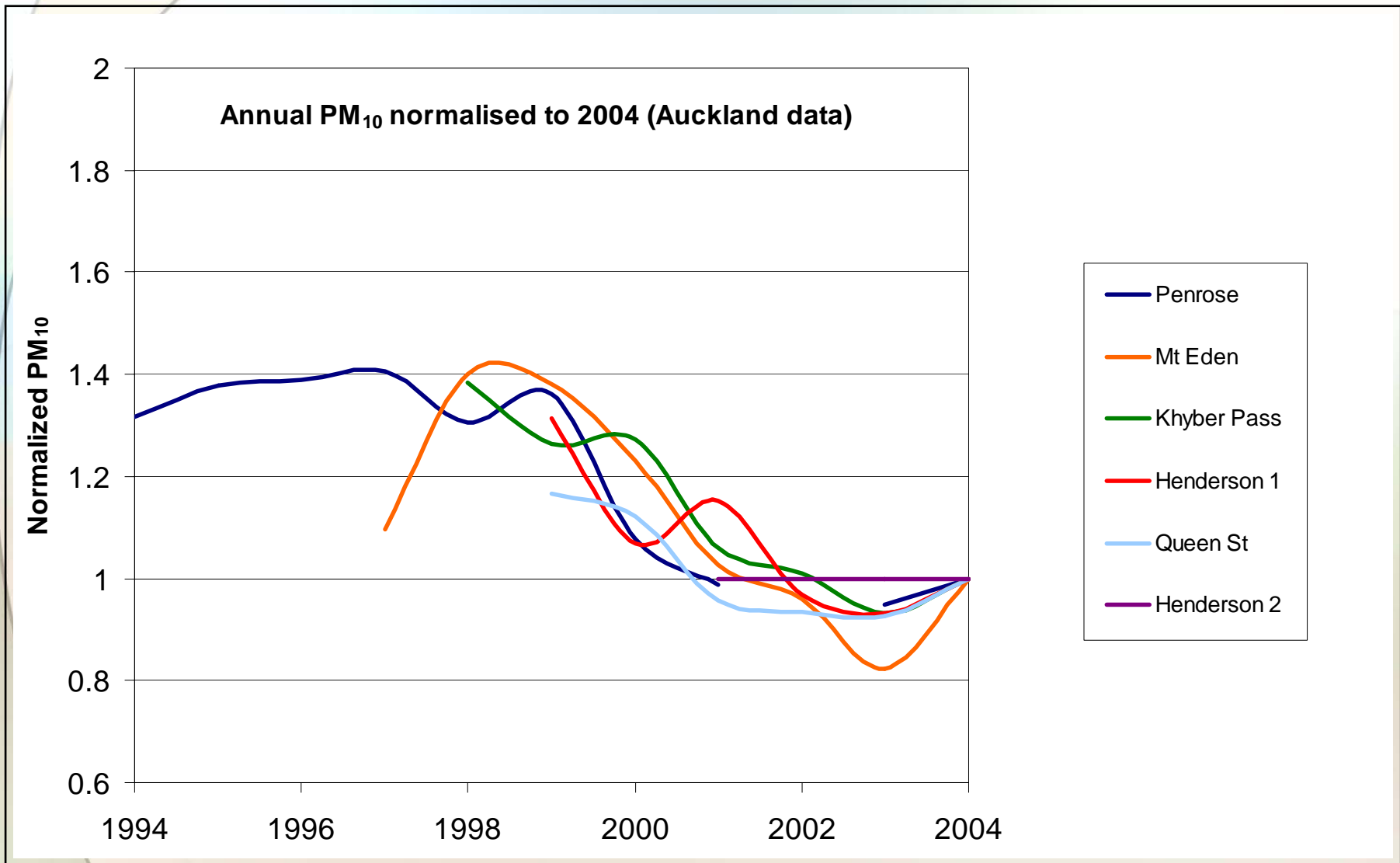
Data courtesy Regional, District and City Councils

Second look – No Auckland



Its looking better

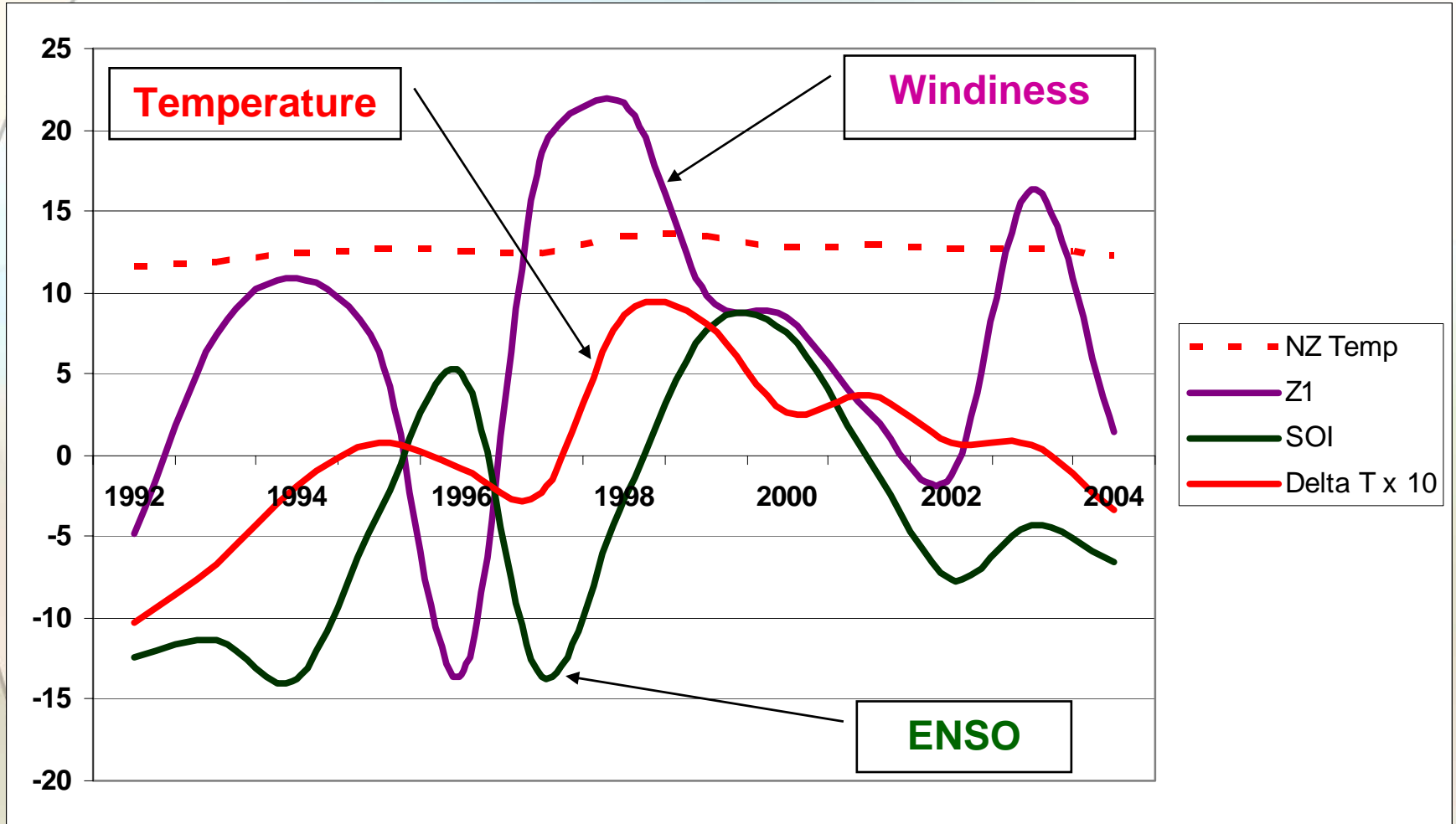
Third look - Just Auckland



What's going on here?

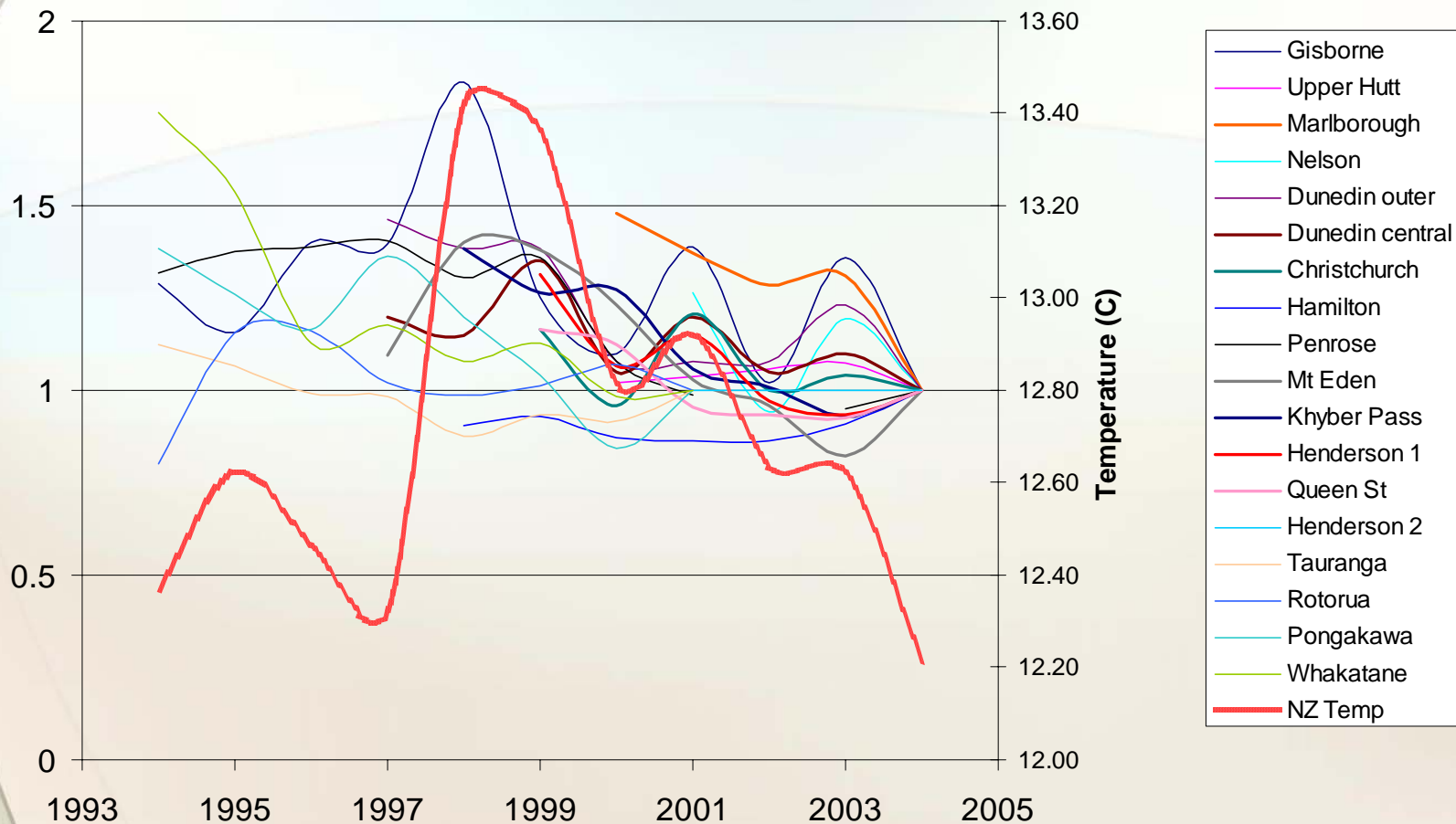
- **Some places going down** (e.g. much of Auckland – but not at all sites!)
- **Some places going up** (e.g. Alexandra, Mosgiel, Tauranga)
- **Some places hovering** (e.g. Gisborne, Rotorua)
- **General overall trend is down slightly – is this because emissions management is working?**
- **Or is it because of weather and climate factors that could turn around anytime?**

Climate indicators



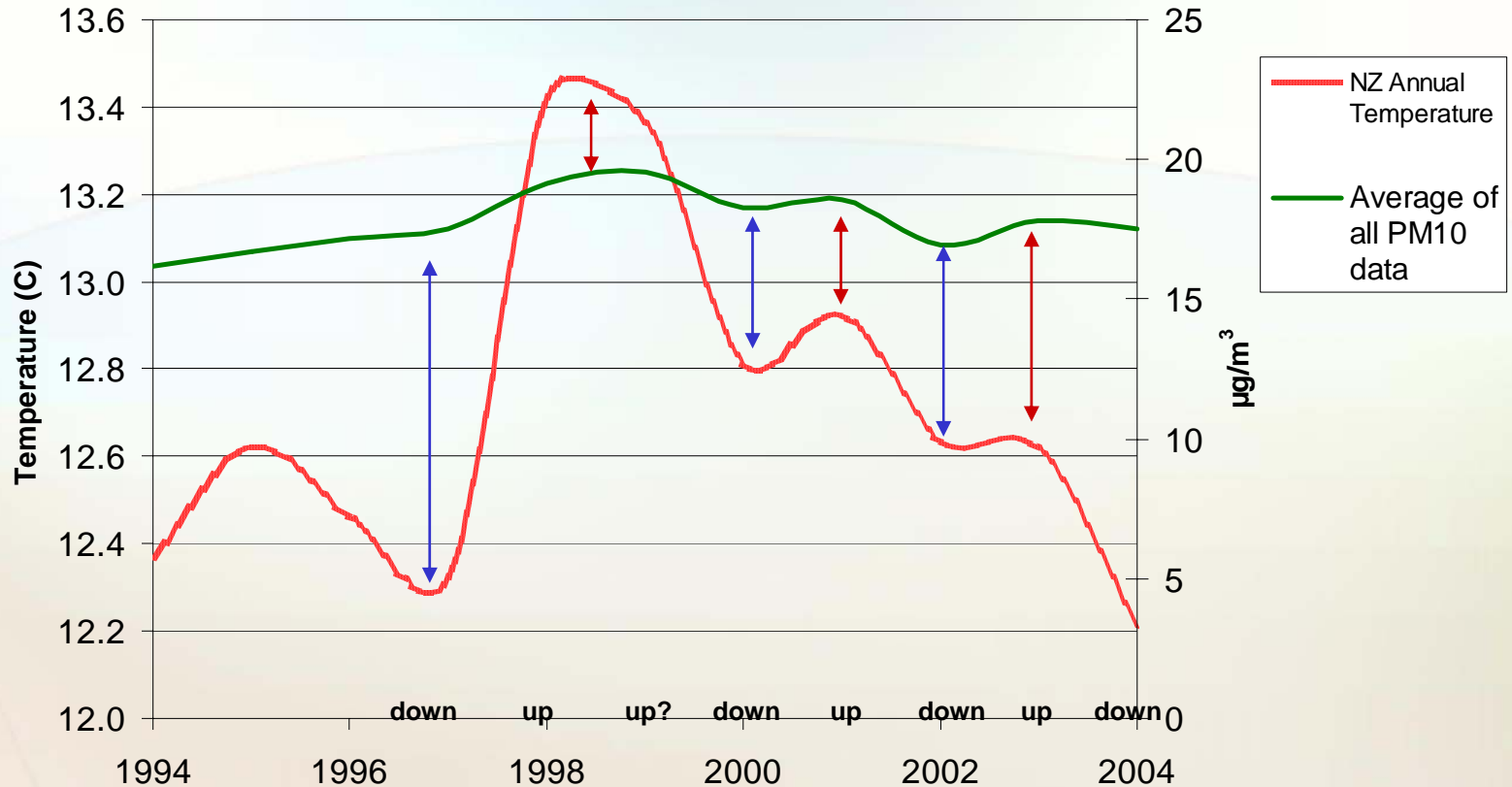
Match them up

All data and NZ average temperature



Bit simpler

Average Temperature and PM₁₀ trend (1994-2004)

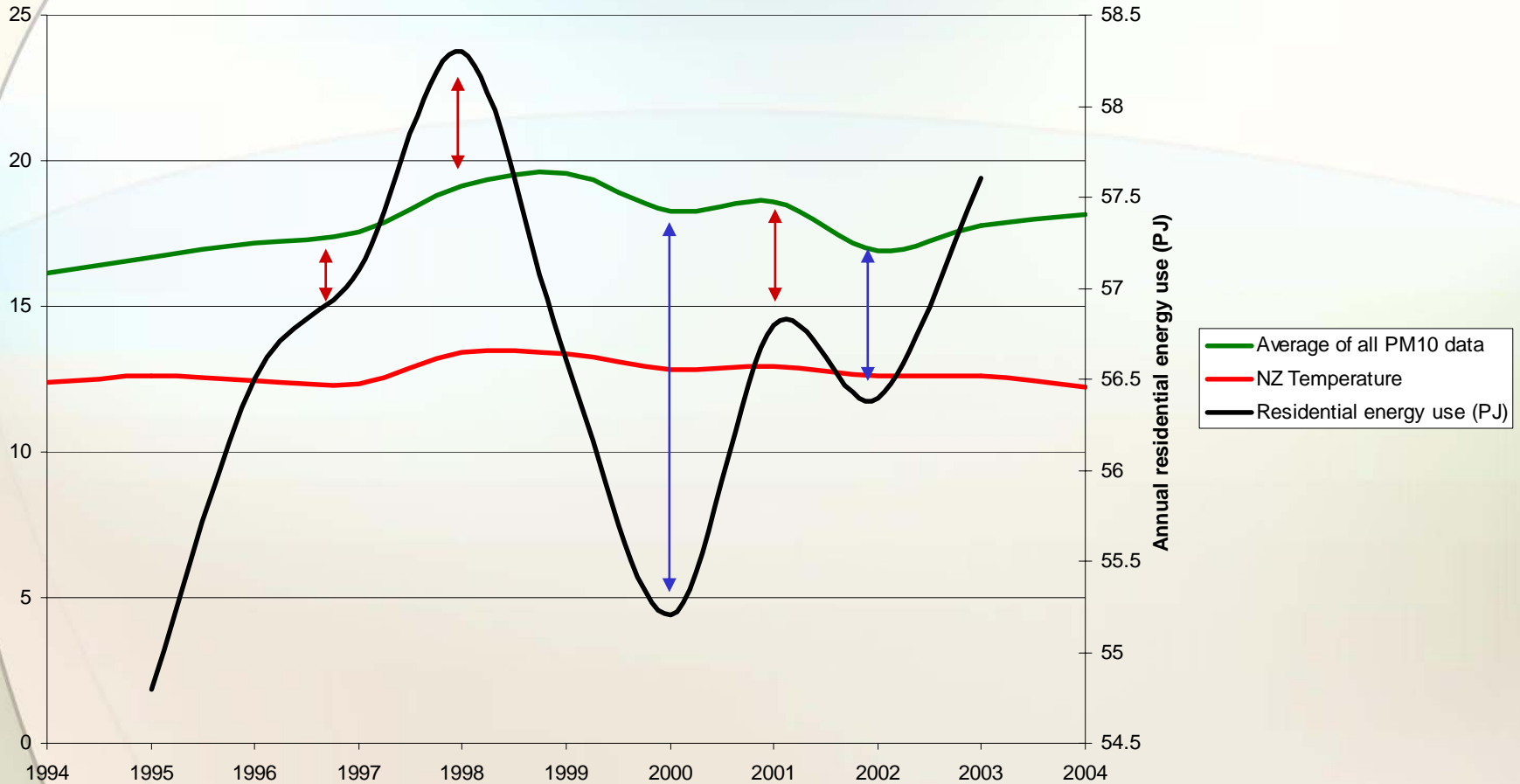


Tantalising alignment of peaks and troughs (no emissions trends in here yet)

Notice higher PM in warmer years – what's going on?

Energy use?

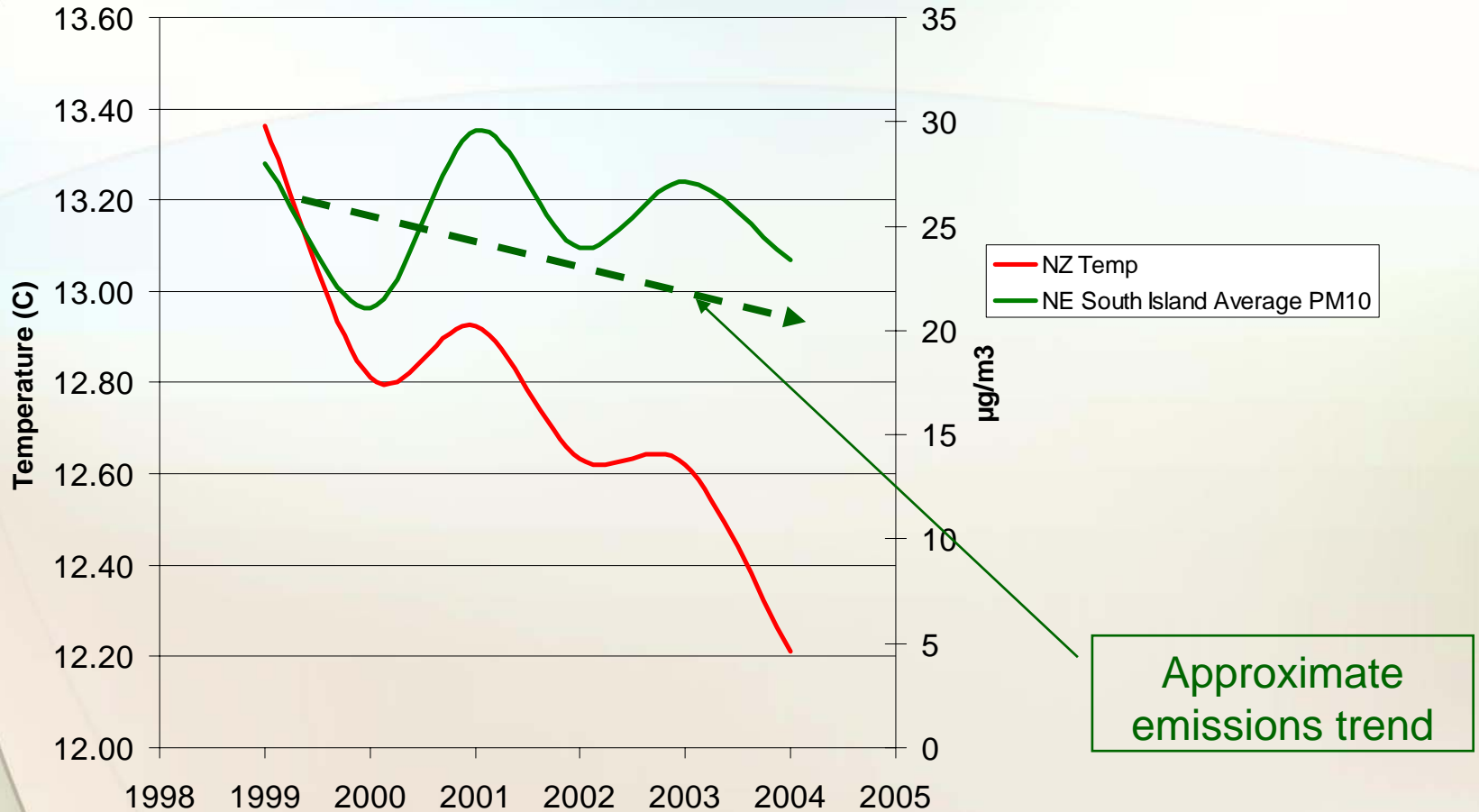
Residential energy



Maybe something – but not striking

Local effects stronger

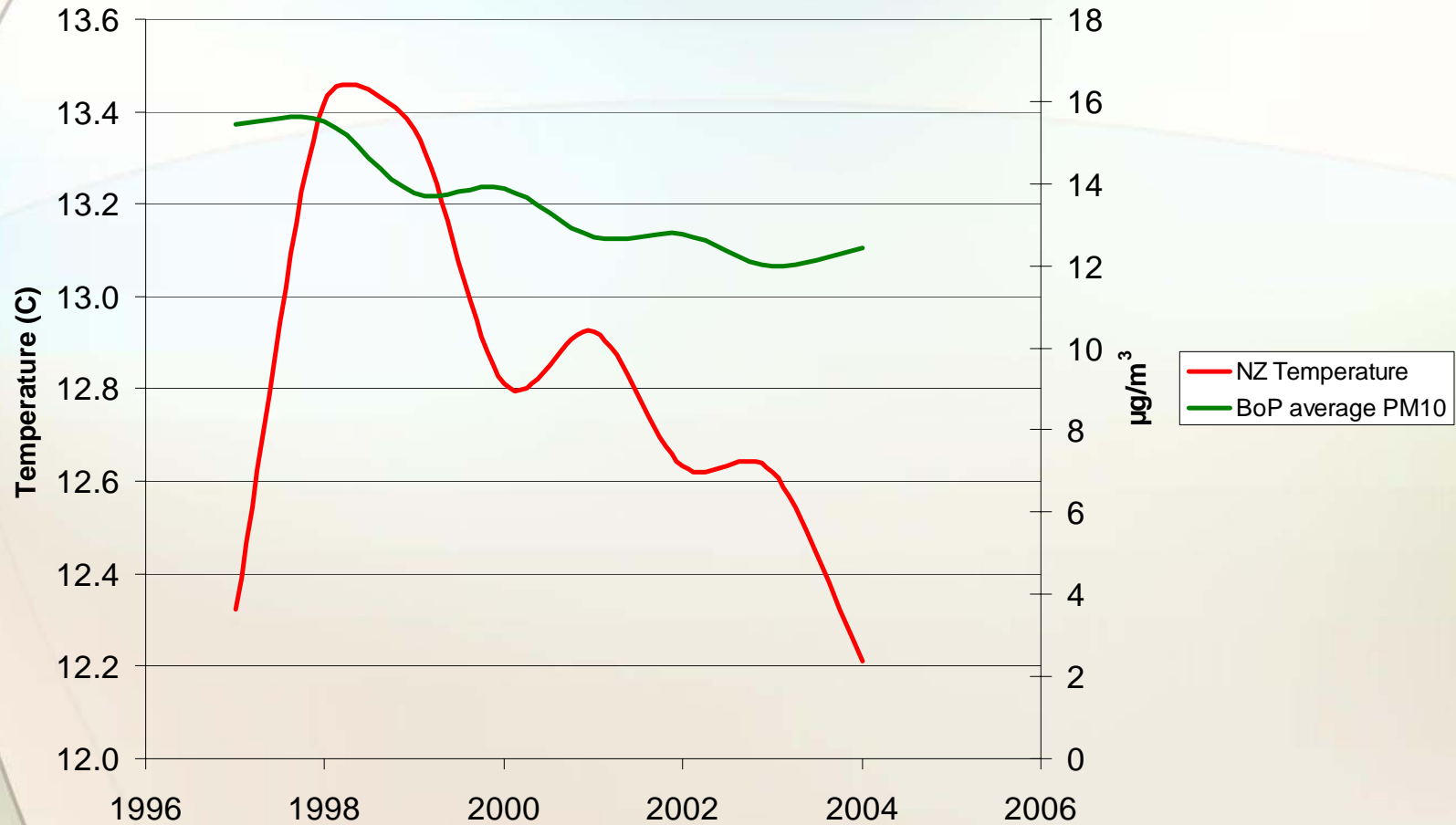
Just using Christchurch, Nelson, and Blenheim



Notice this is not 'normal' – concentrations go up when temperature goes up!

Different local effects

Just using Rotorua, Tauranga, and Whakatane



Notice this is 'normal' – concentrations go down when temperature goes up!

Hot off the press!

Next bit!

- All very well examining annual values, but that's not what people see and feel, and its not what the Standards are about.
- We need how much and how often - “*peak concentrations*” and “*frequency of exceedence*”.
- These are also very weather related. Can we get at some relationships?

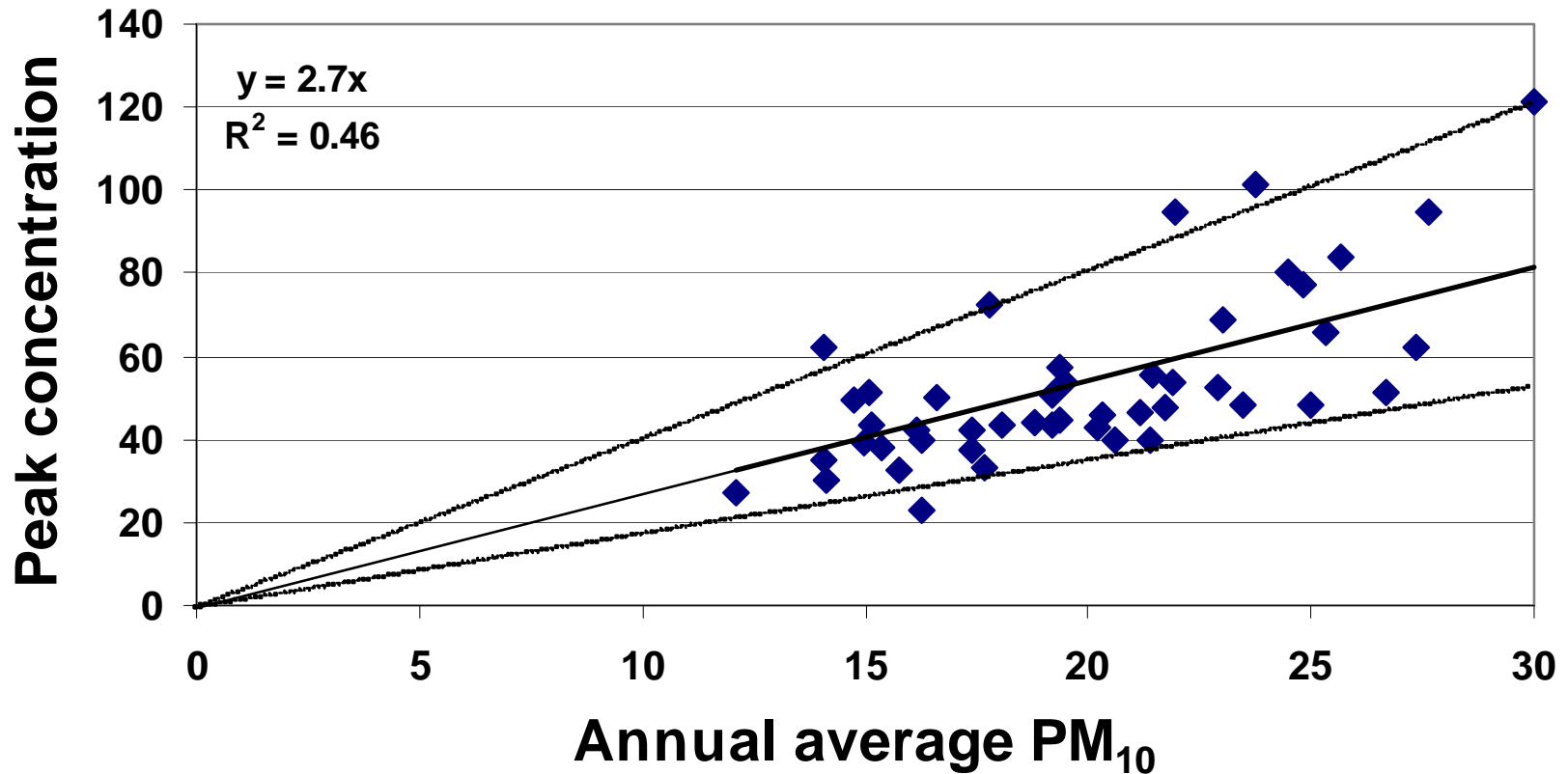
YES!

- **Plot value of the peak vs. average.**
- **And no. of exceedences vs. average.**
- **For places with 5+ years data.**

Get.....

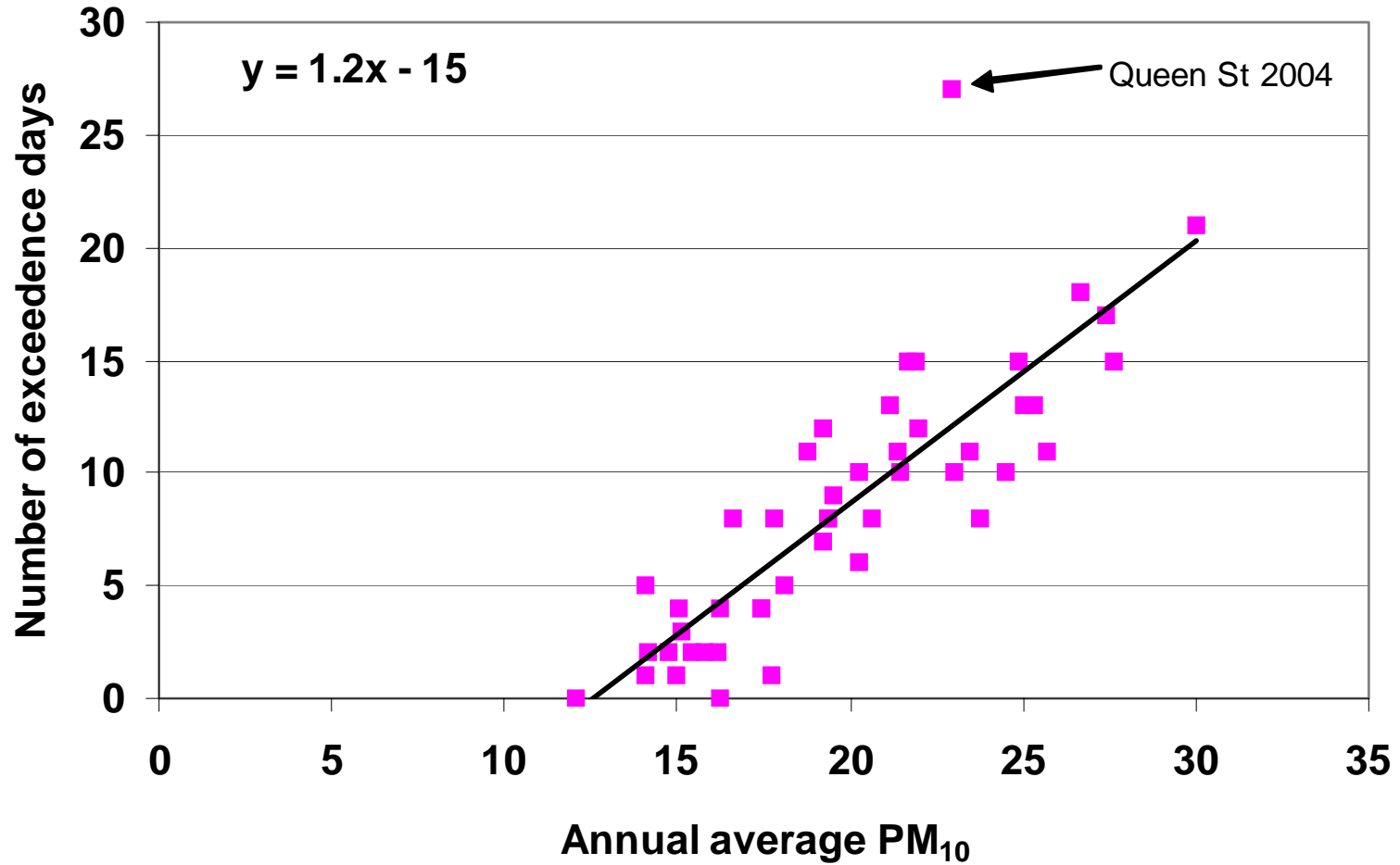
Annual averages and peaks

Auckland, peaks - micrograms m⁻³ (all sites)



Annual averages and exceedences

Auckland, exceeding 30 micrograms m⁻³ (all sites)



The "Model"

There is definitely some sort of fairly linear relationship...

Peak Conc = Average Conc x $fn(\text{city})$

where $fn(\text{city})$ seems to be a climate factor

Exceedences = Average Conc x $fn(\text{city})$ - Offset

where $fn(\text{city})$ is a climate/geography factor

Average Conc = $fn(\text{Climate Indices})$ x $fn(\text{region})$

where $fn(\text{region})$ is another climate/geography factor

The fns look linear – and they are clearly latitude (ie temperature) related

Once we have figured out these functions – we've got a pretty good, cheap and simple model for air pollution outlooks – if we can believe the climate outlooks that is!

And so....

- This is just a start – work in progress
- Obviously going to be differences between places (e.g. winter home heating vs. vehicle sources) – account for South Island vs. Auckland different effects?
- **Next...**
 - **Want to do it monthly**
 - **Want to analyse statistics closely**
 - **Want to take account of emissions trends**
 - **Want more data! Roll on 2005 results!**

If we were really brave/foolish/rash we'd make a 'prediction' for 2006!