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A History of On-Road Emissions and Emissions Deterioration

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A HISTORY OF ON-ROAD EMISSIONS AND EMISSIONS DETERIORATION

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March 31, 2004

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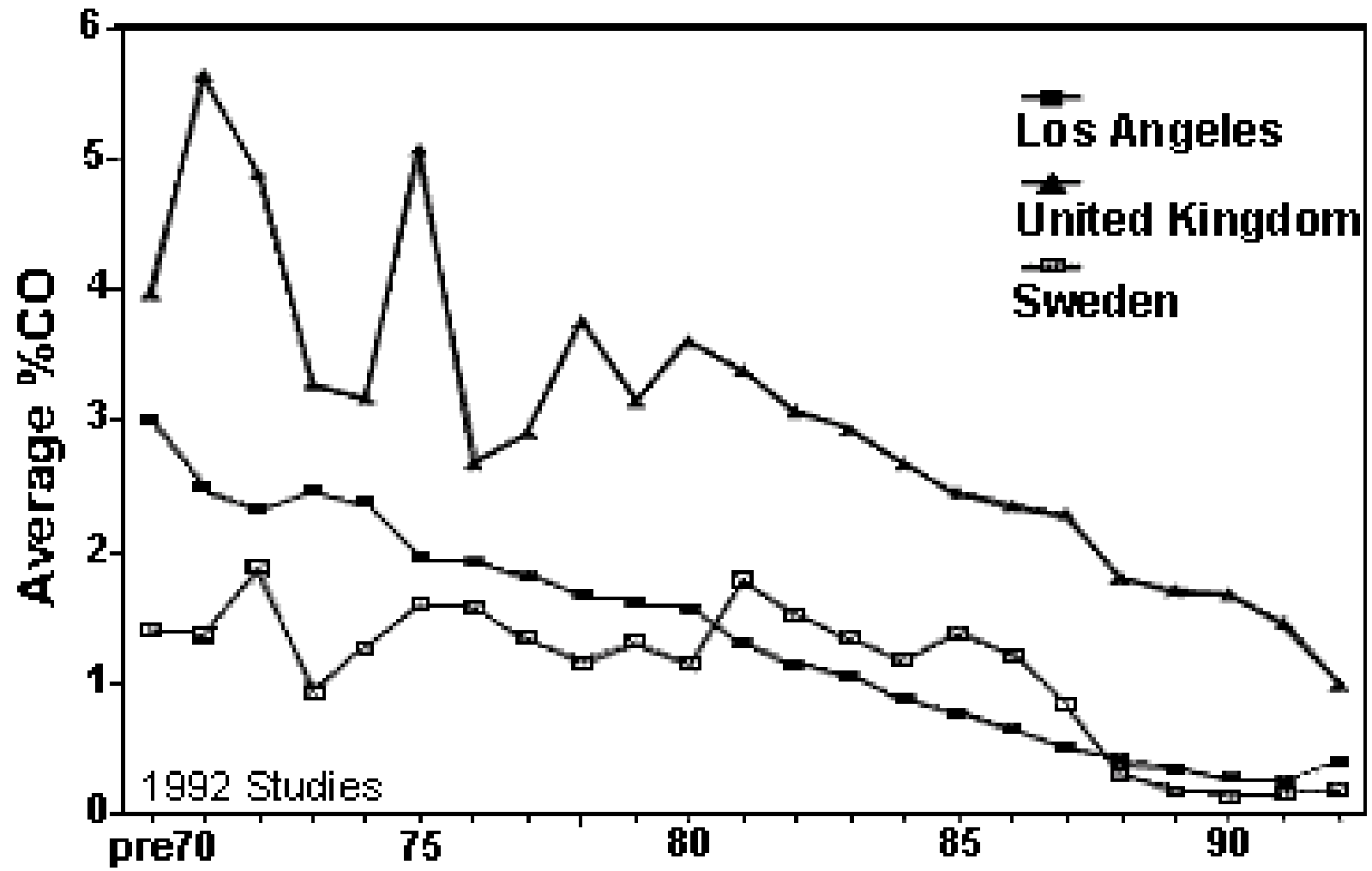
303 871-2580.. FAX 2587

dstedman@du.edu



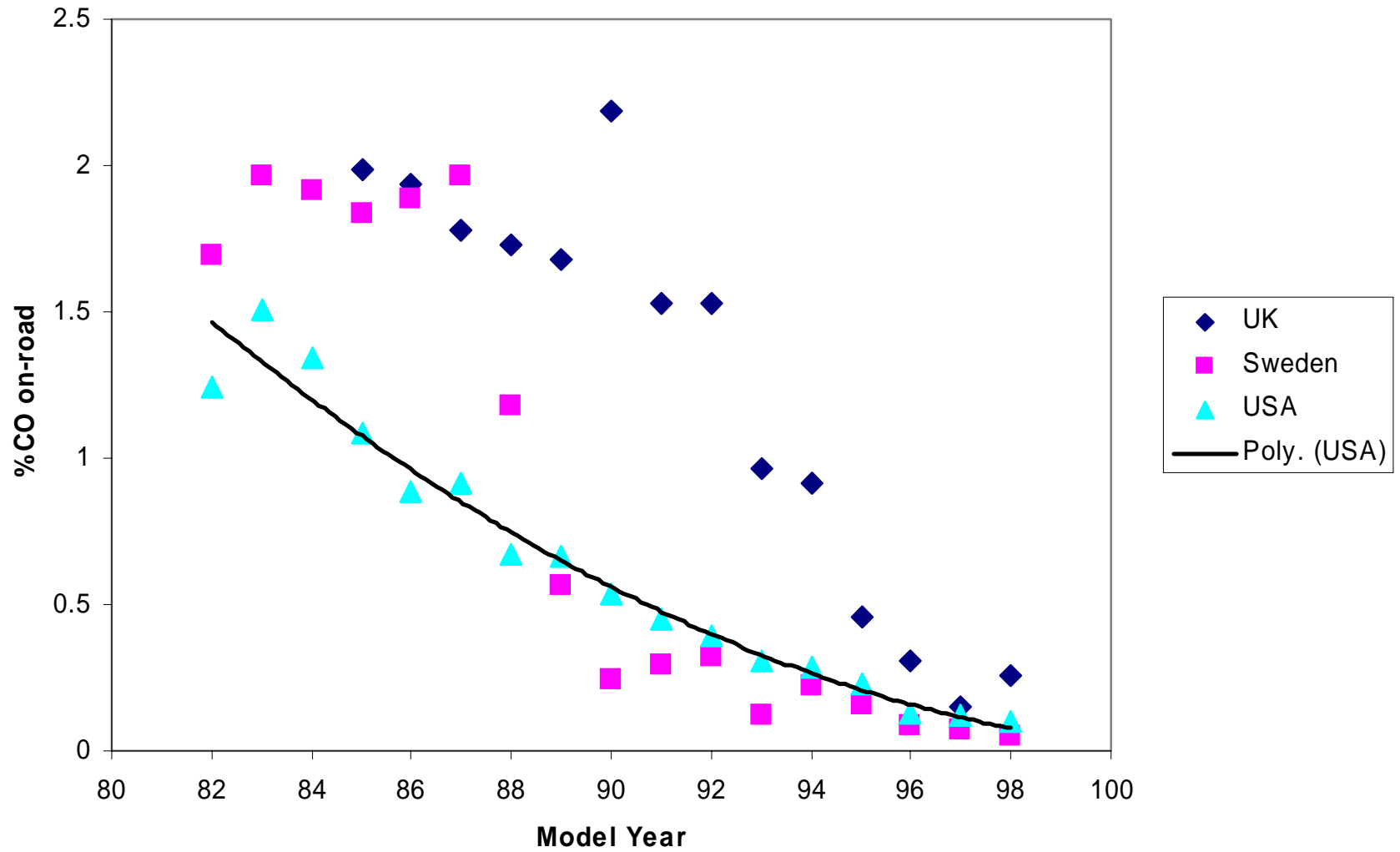
Emissions Deterioration

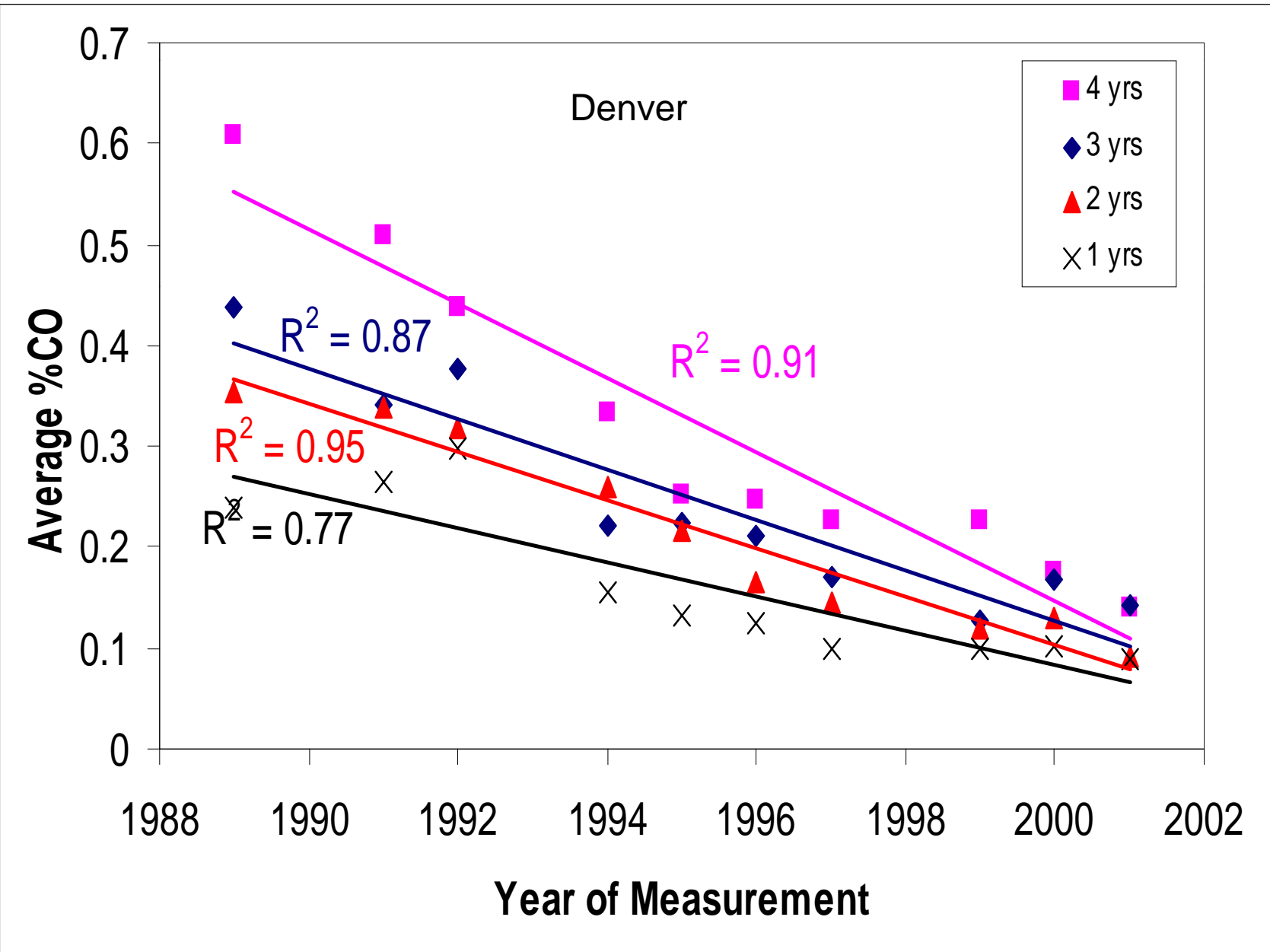
- depends both upon hardware
- and upon human behavior!



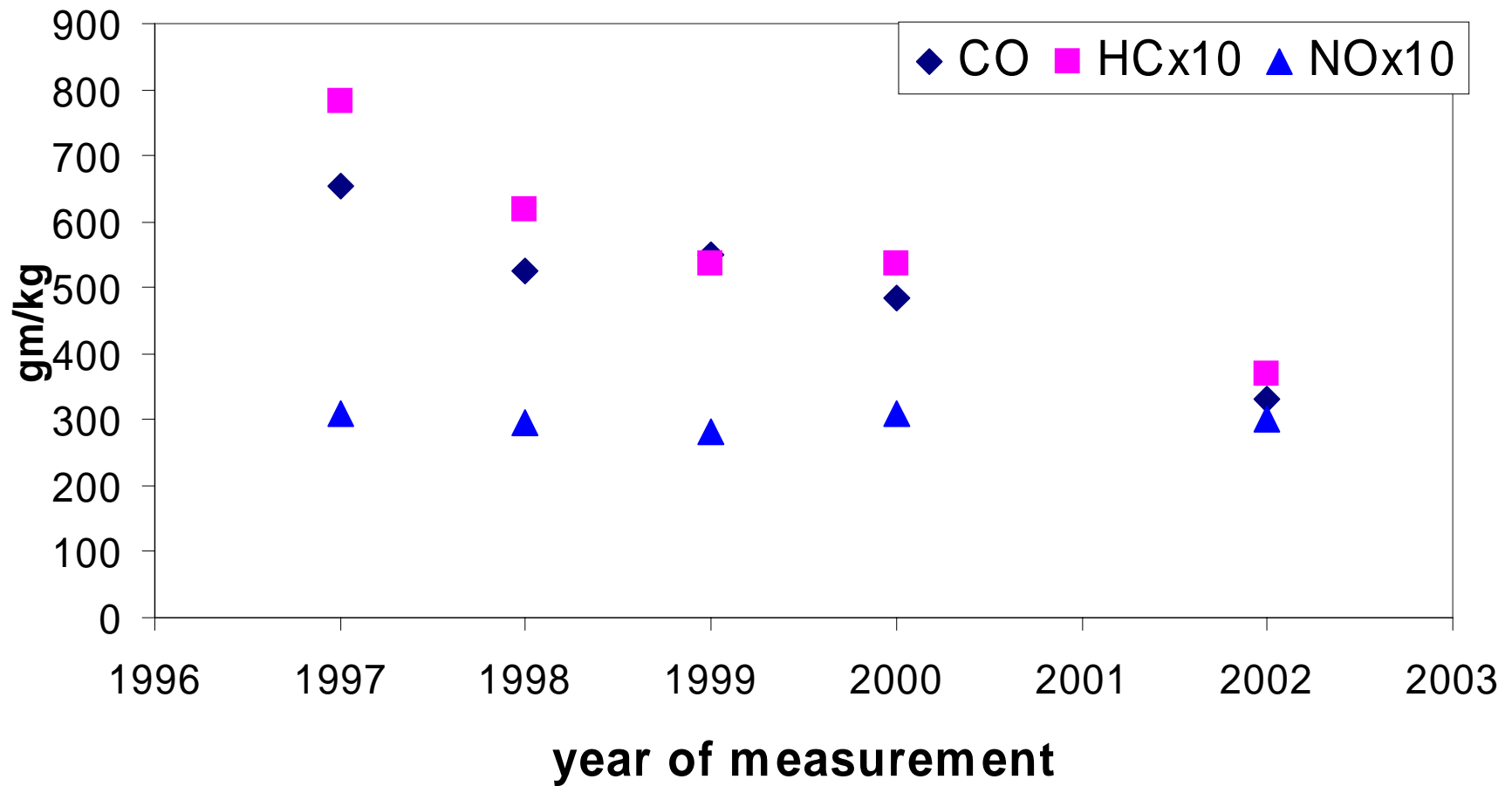
Non-US data from IVL (Ake Sjodin) and TRL (Ian McRae)

CO by Model Year



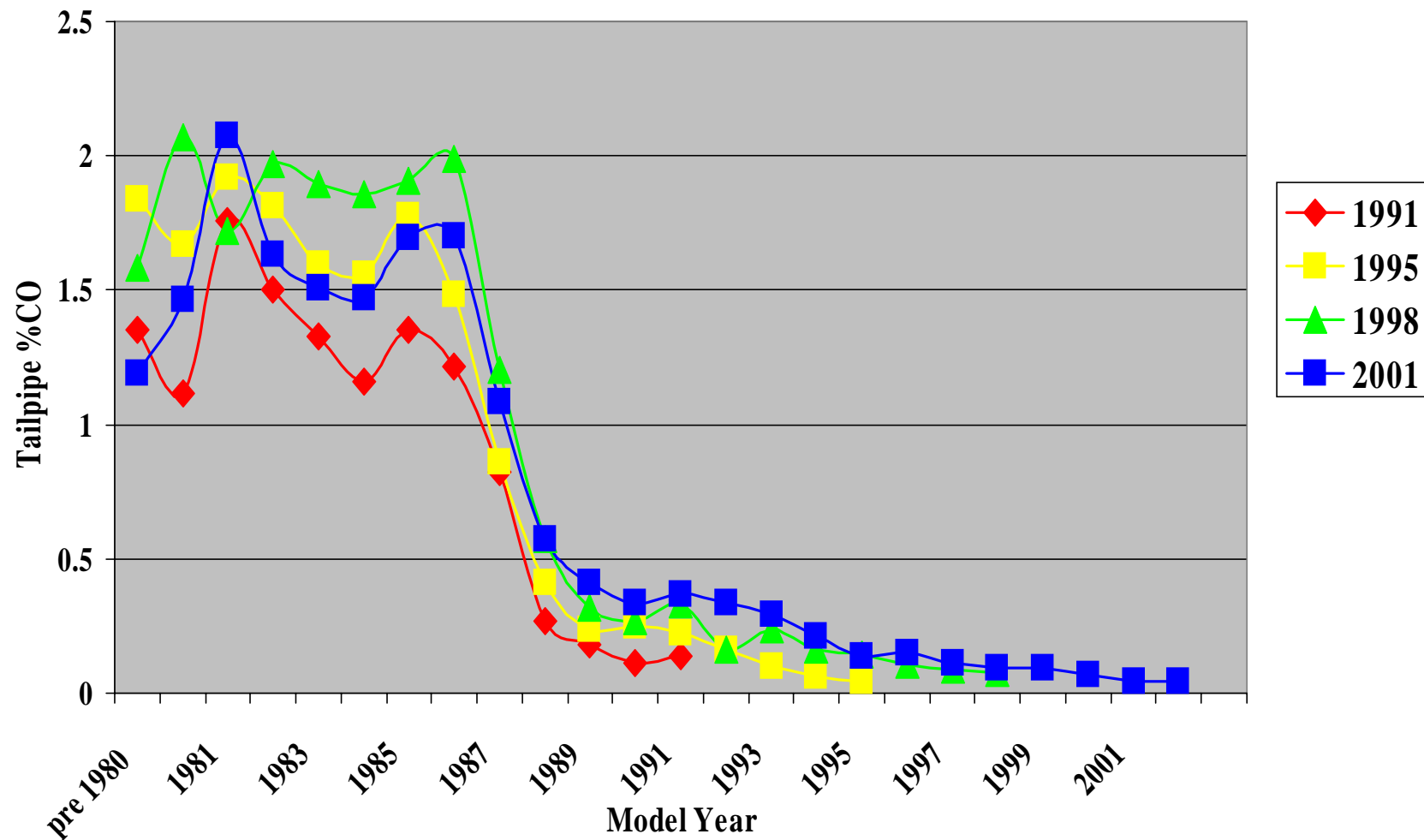


Highest emitting 20% of 15 yr old cars; Chicago

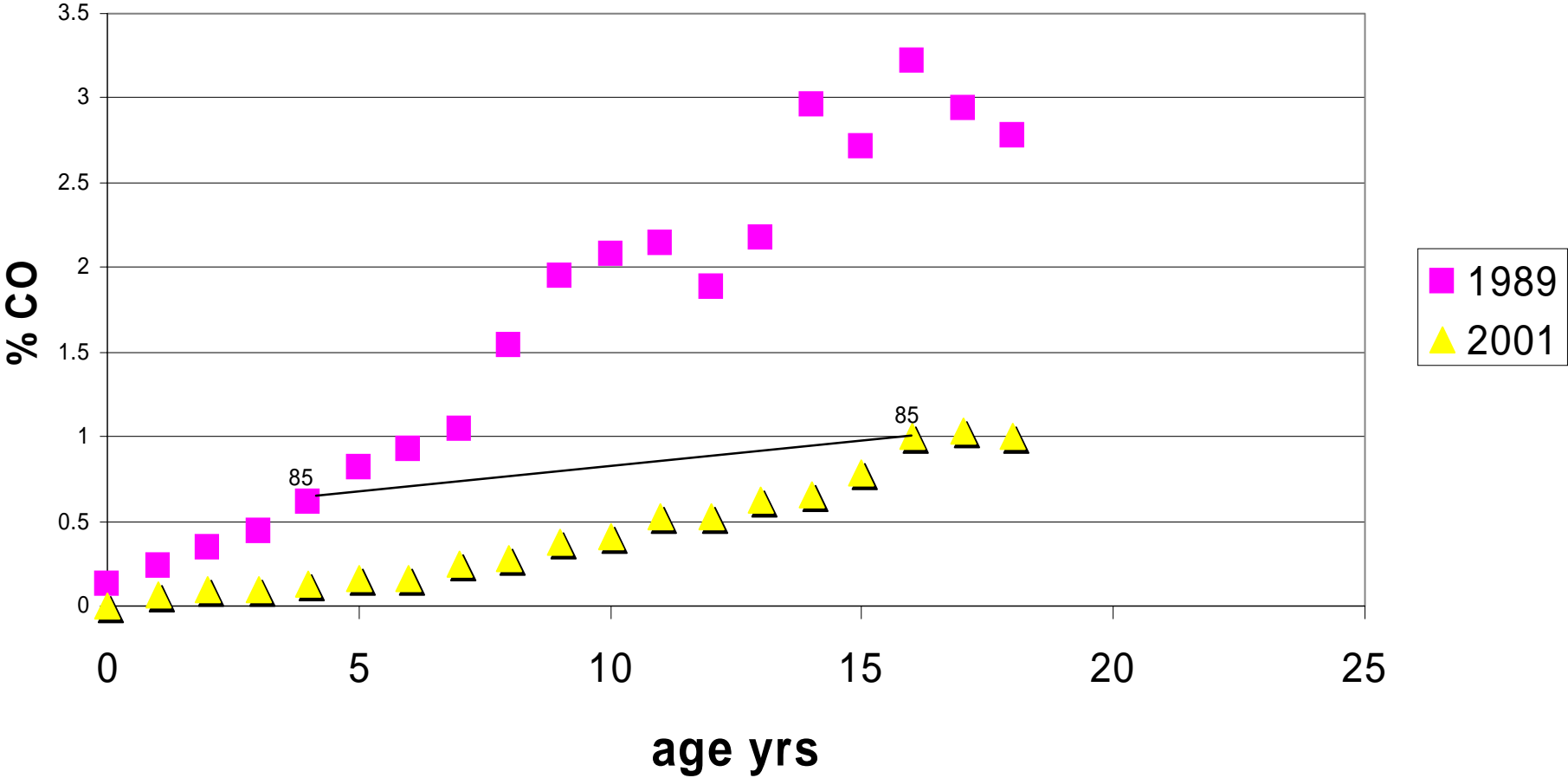


Average %CO by model year for gasoline LDVs in Gothenburg measured in 1991, 1995, 1998 and 2001

Ake Sjodin IVL 2004



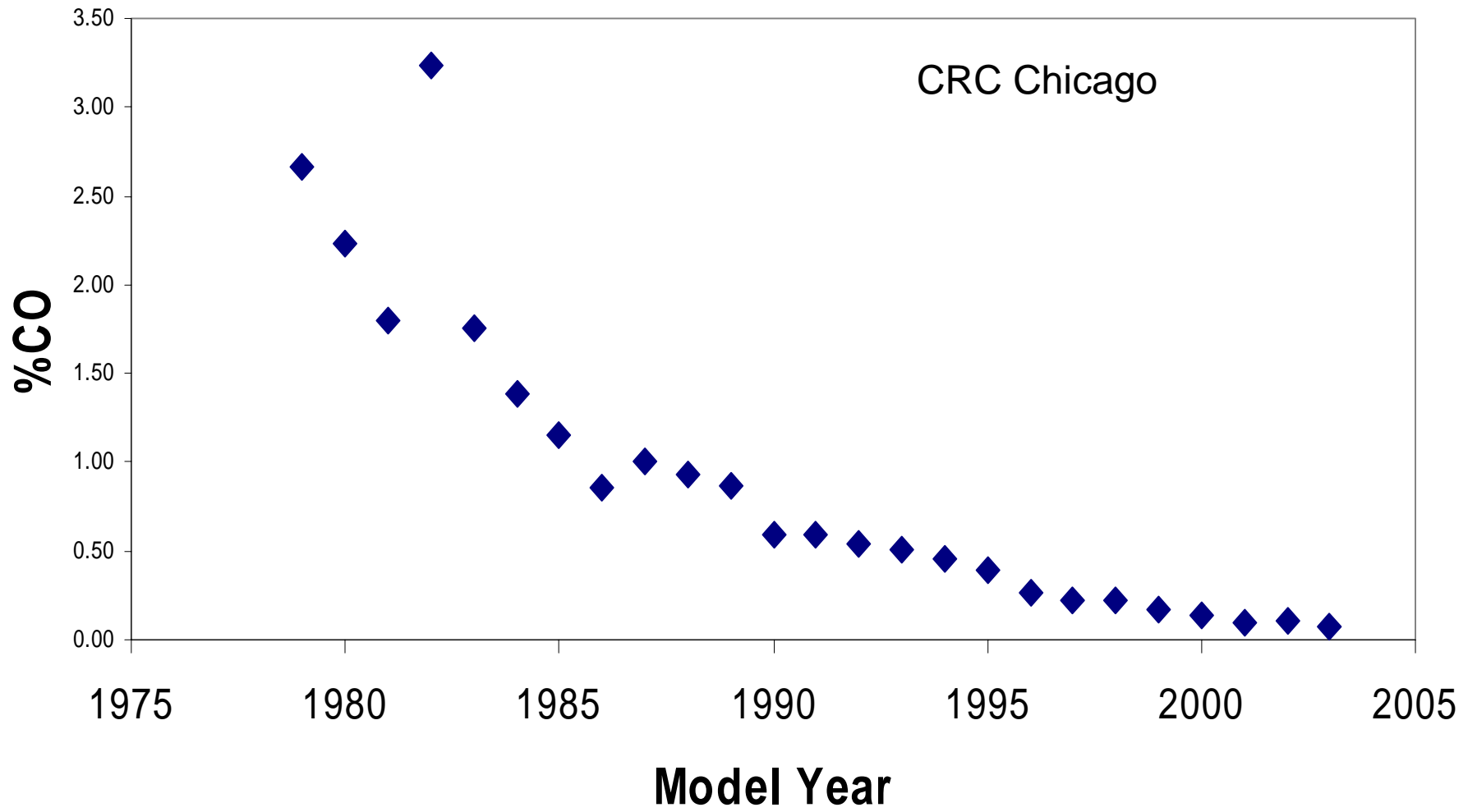
Denver CO Emissions versus Age



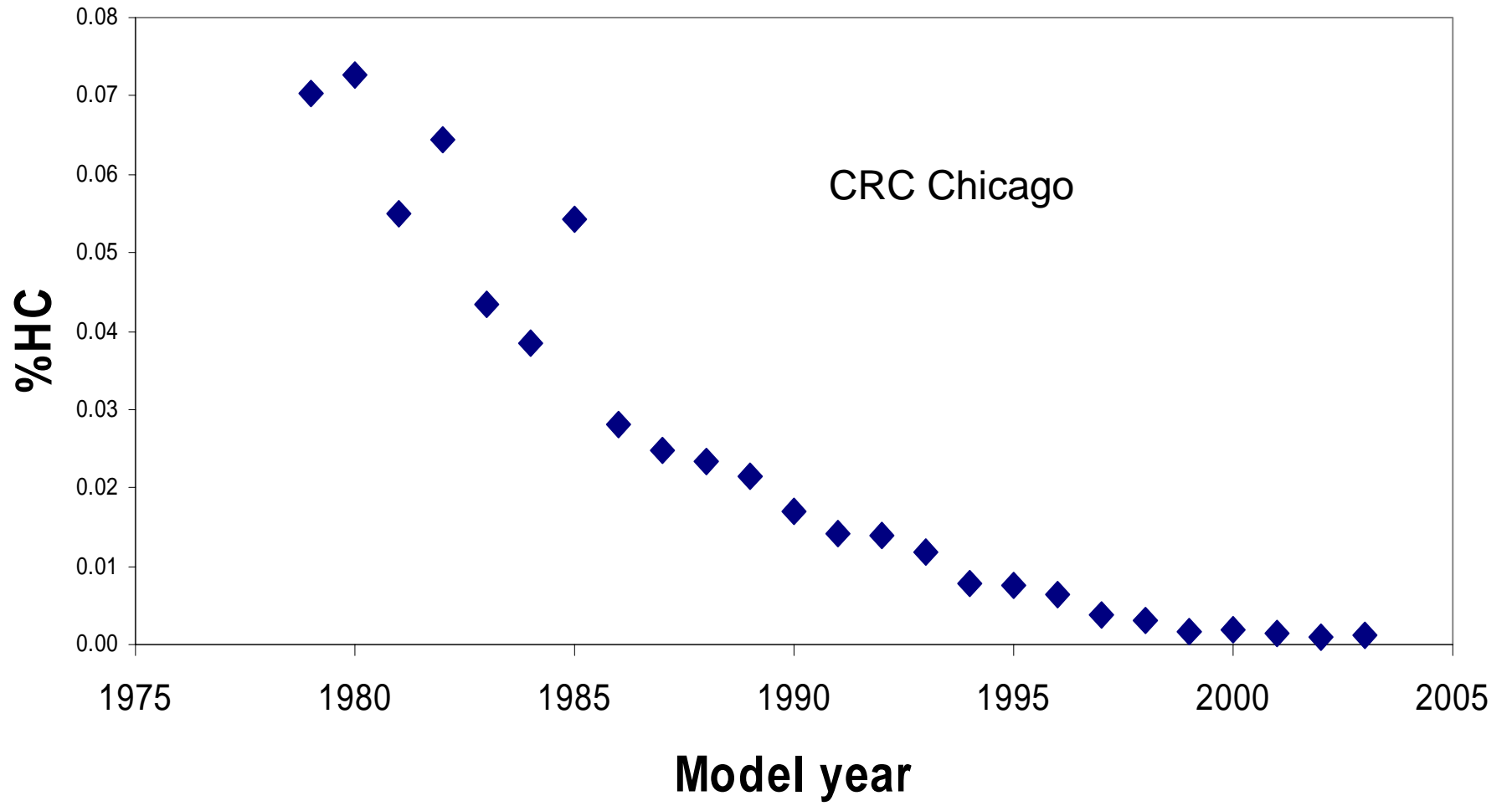
Three Measures of Emissions “Deterioration”

- **All gm/kg.yr**
- $-dE/ d(MY)$; **Wrong.**
- $dE(MY \text{ fleet})/ d(\text{age})$
 - **Right on-road but different from**
- $dE(\text{individual MY same vehicles})/ d(\text{age})$
 - **Also right. This is how MOBILE6 does it. The difference is caused because broken vehicles are preferentially removed with increasing age, an effect not in MOBILE6.**

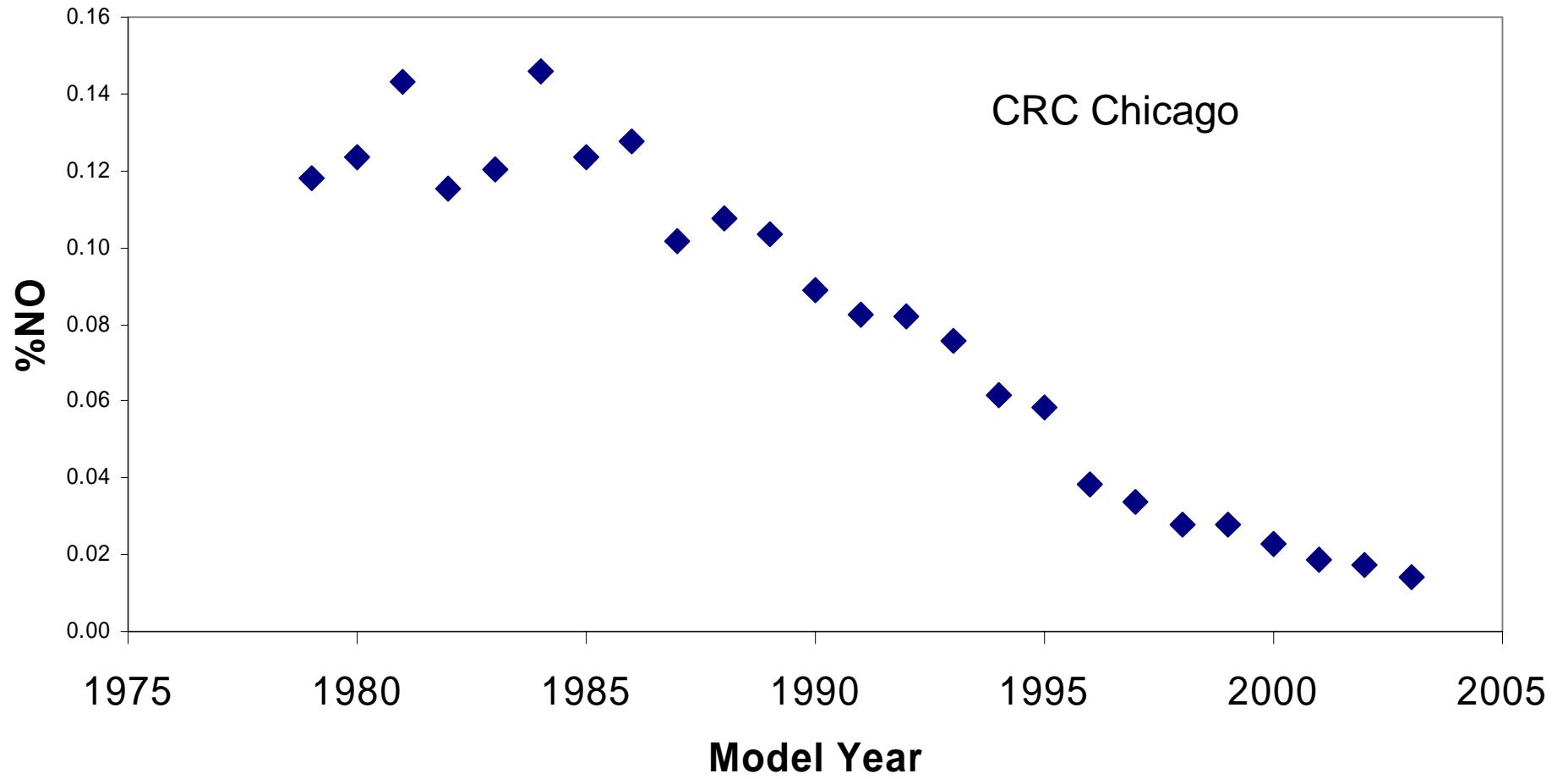
CO



HC

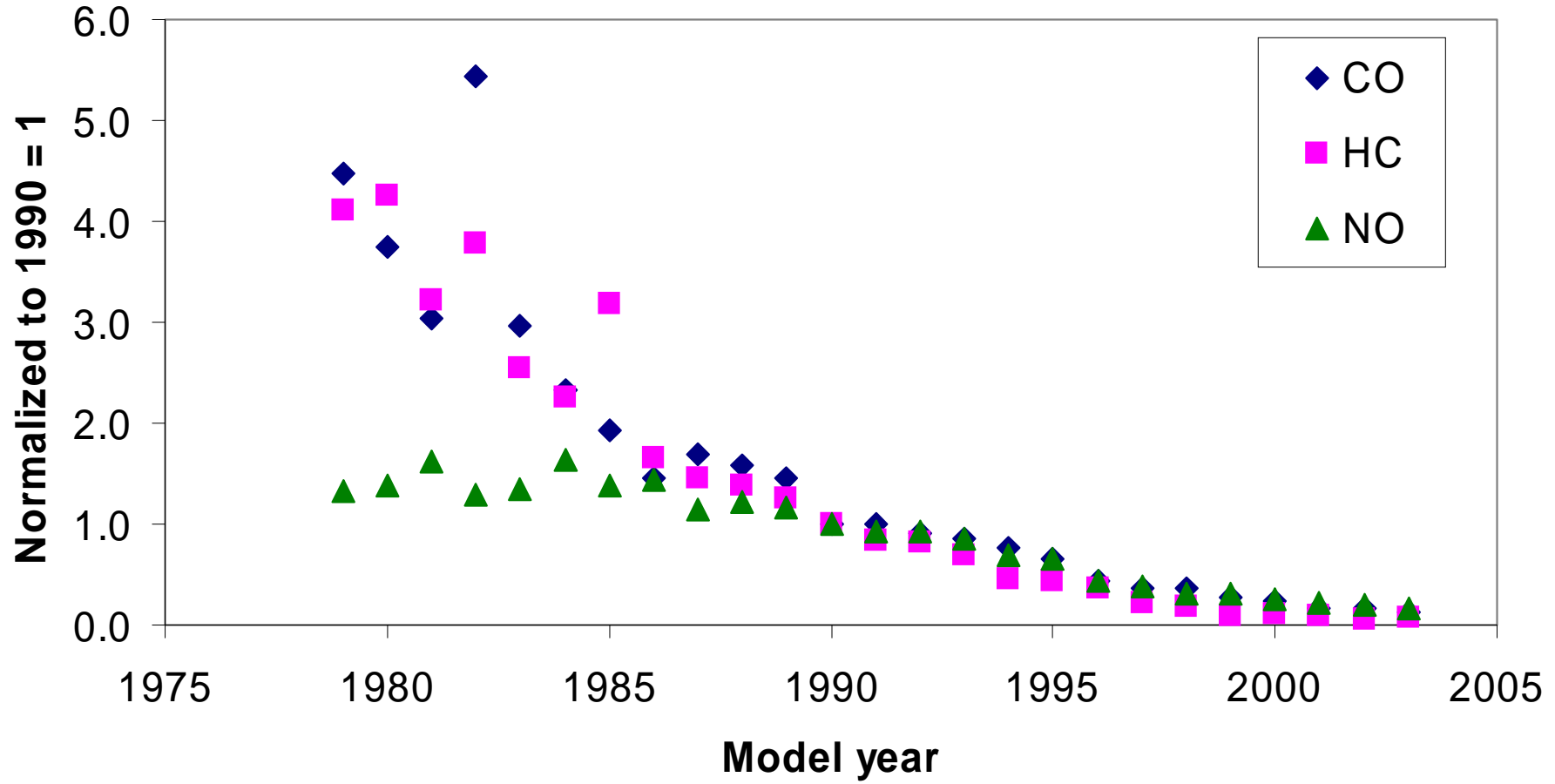


NO



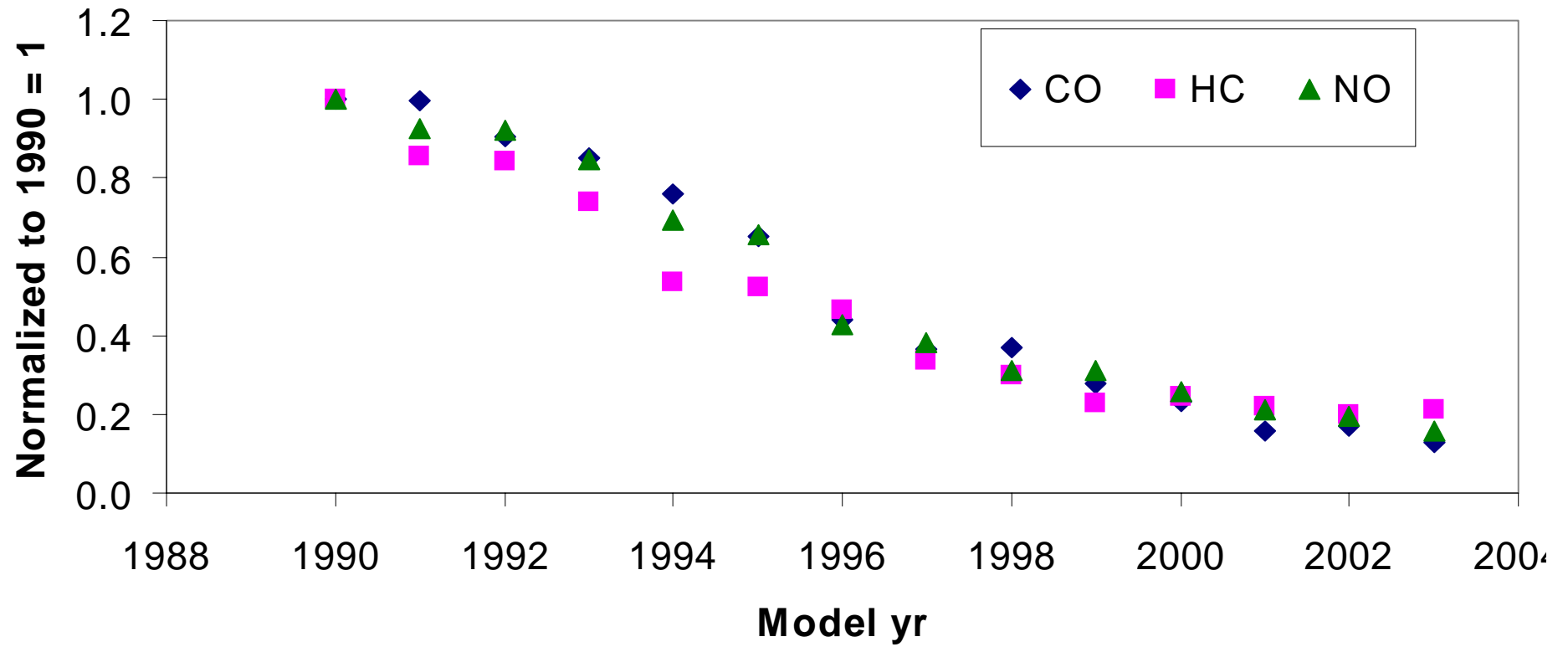
Normalized data

CRC Chicago

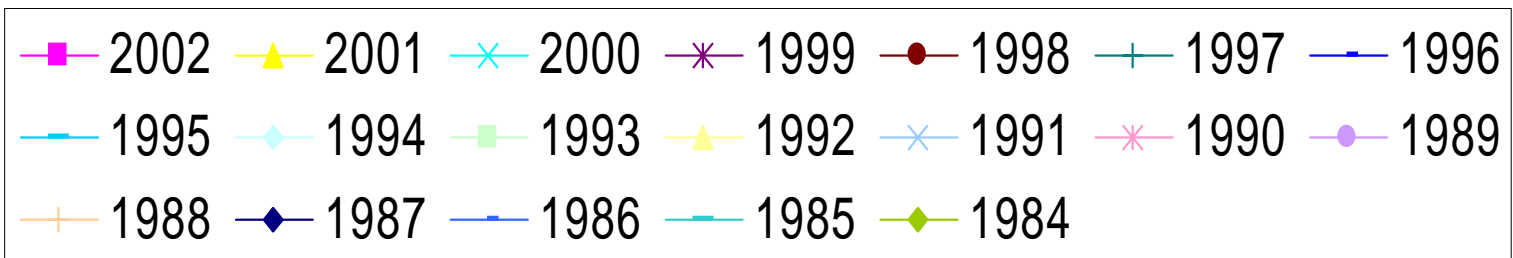
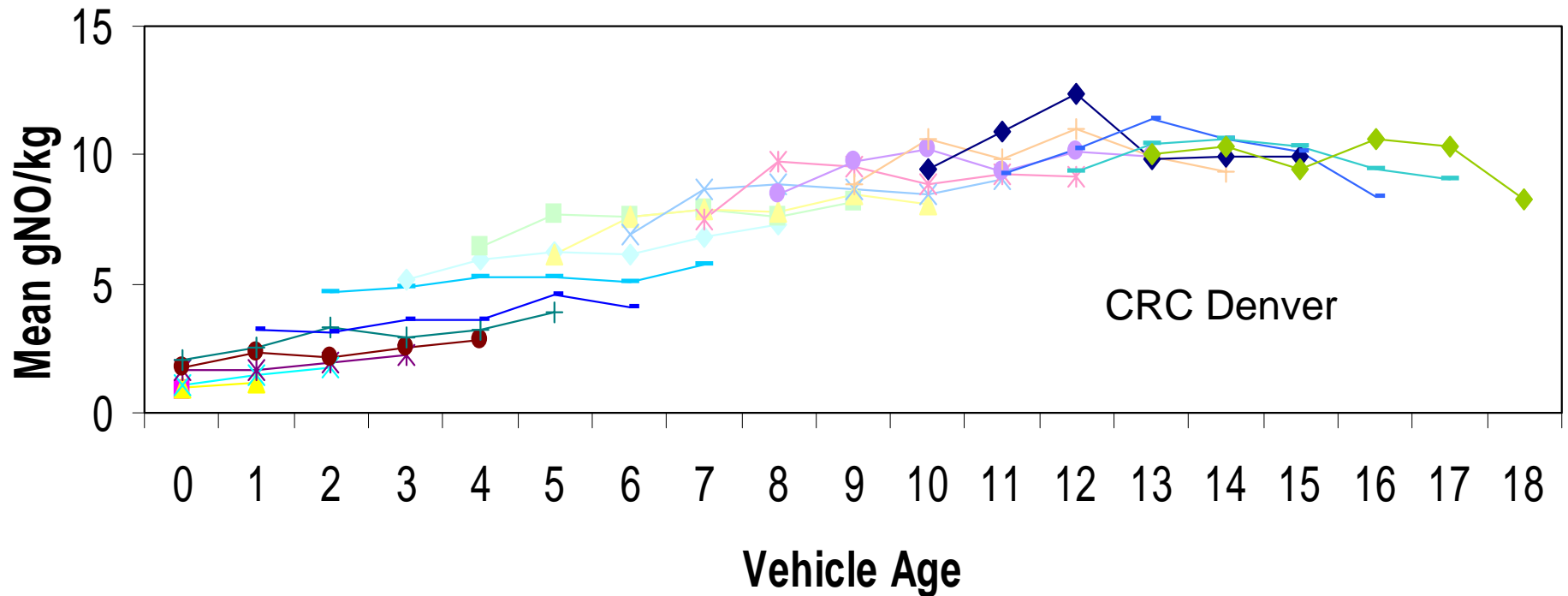


CRC Chicago

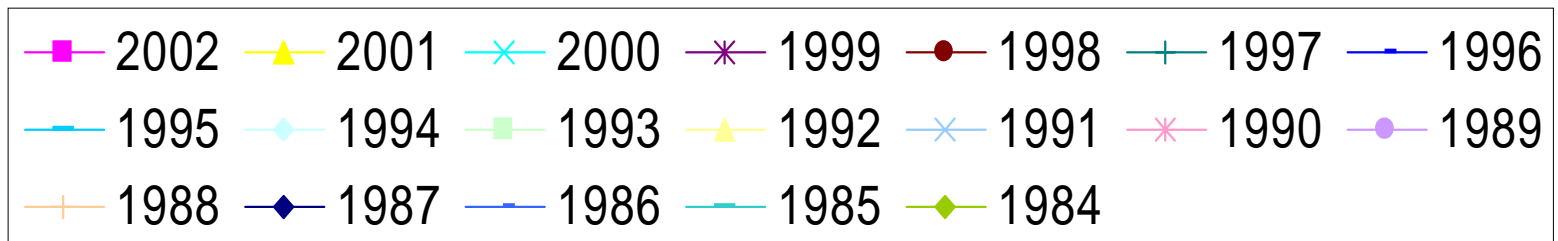
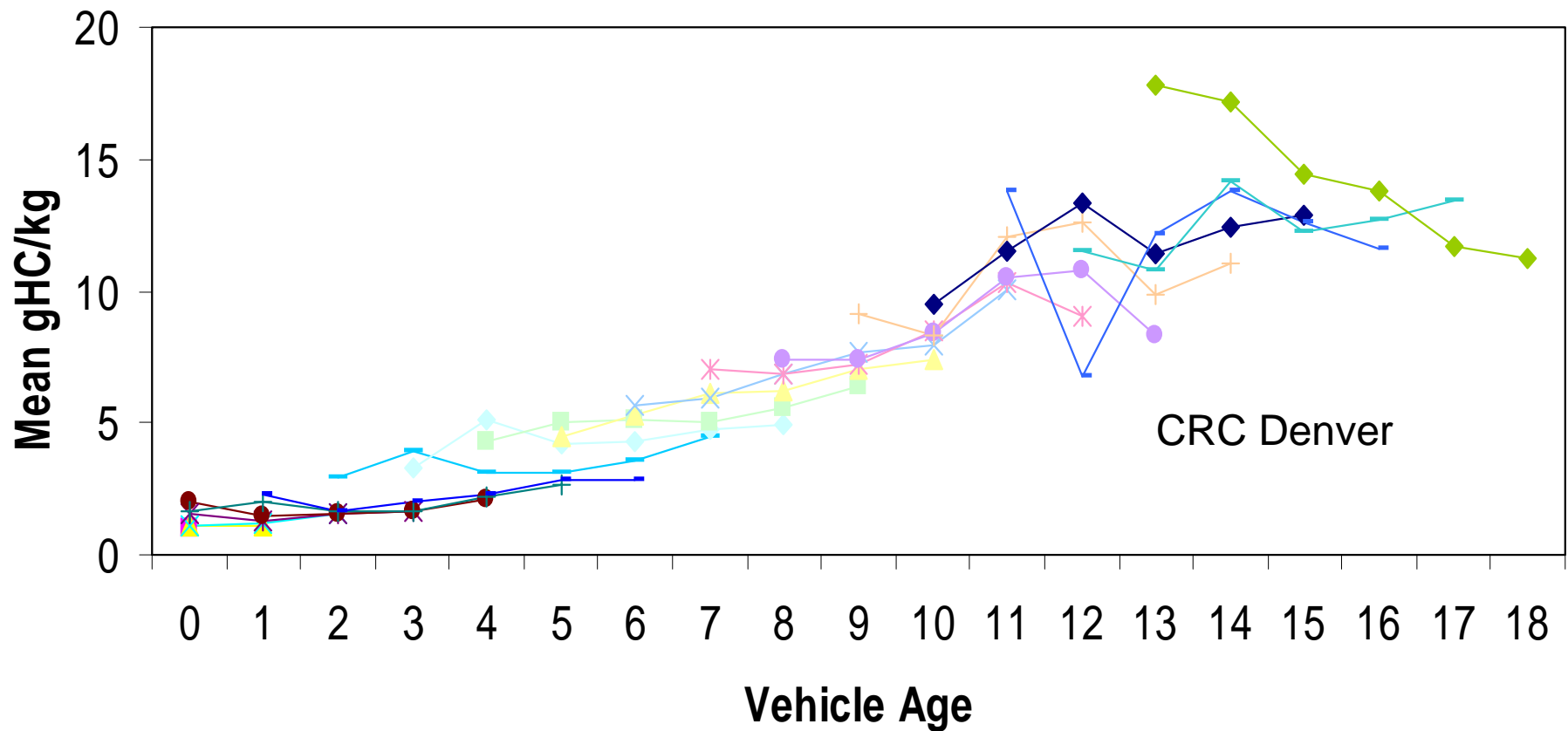
normalized data HC offset removed



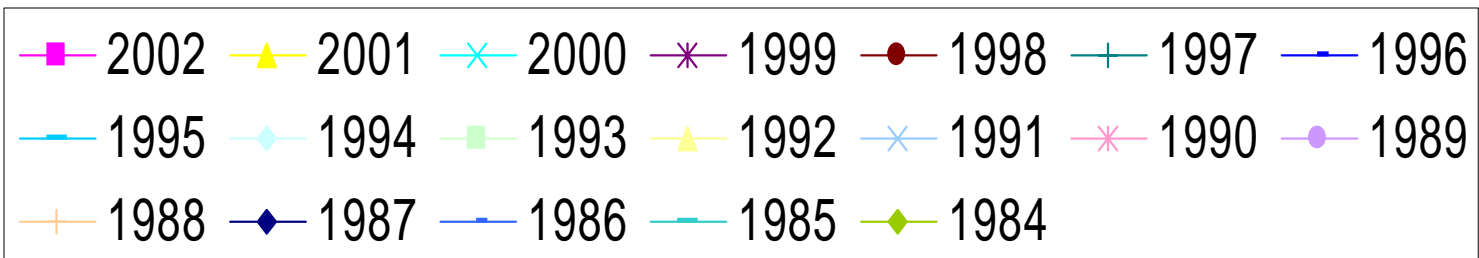
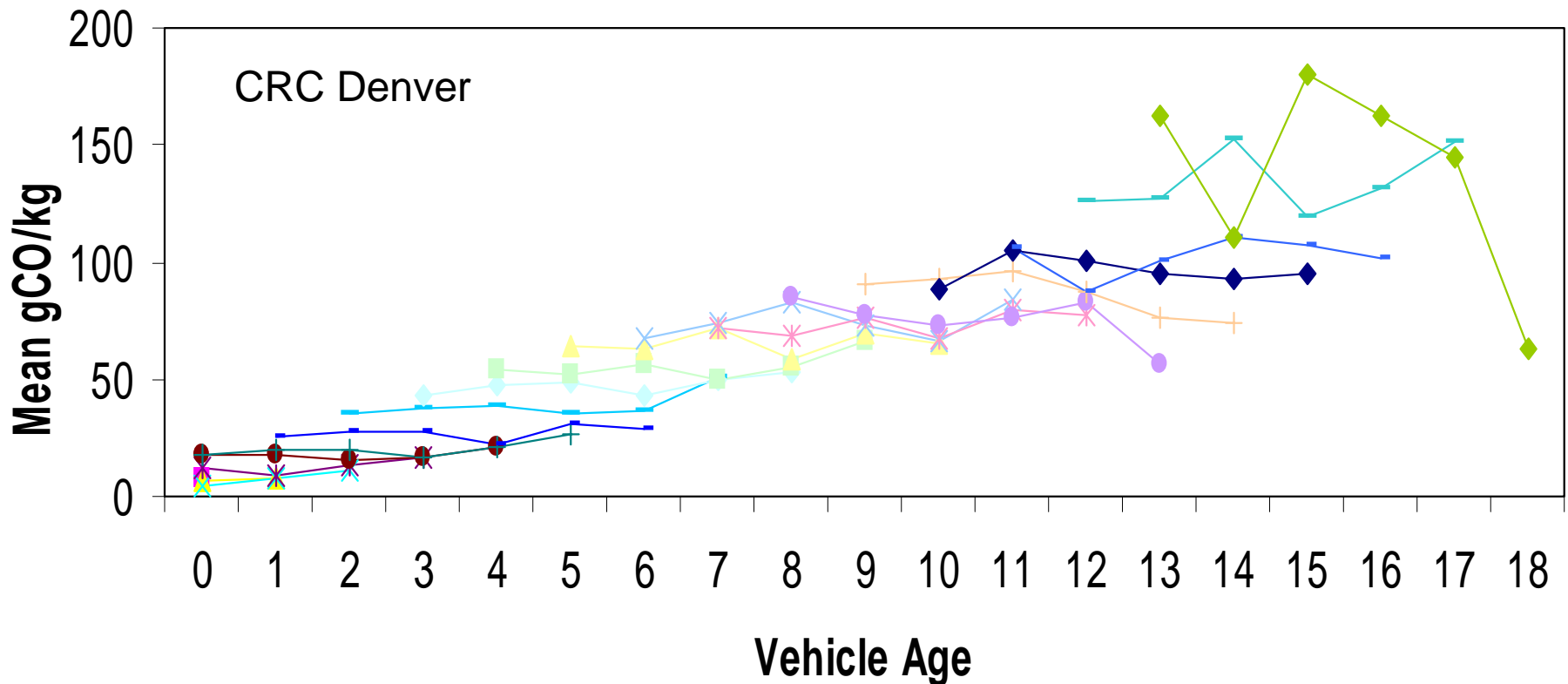
NO Emissions as Function of Age



HC Emissions as Function of Age



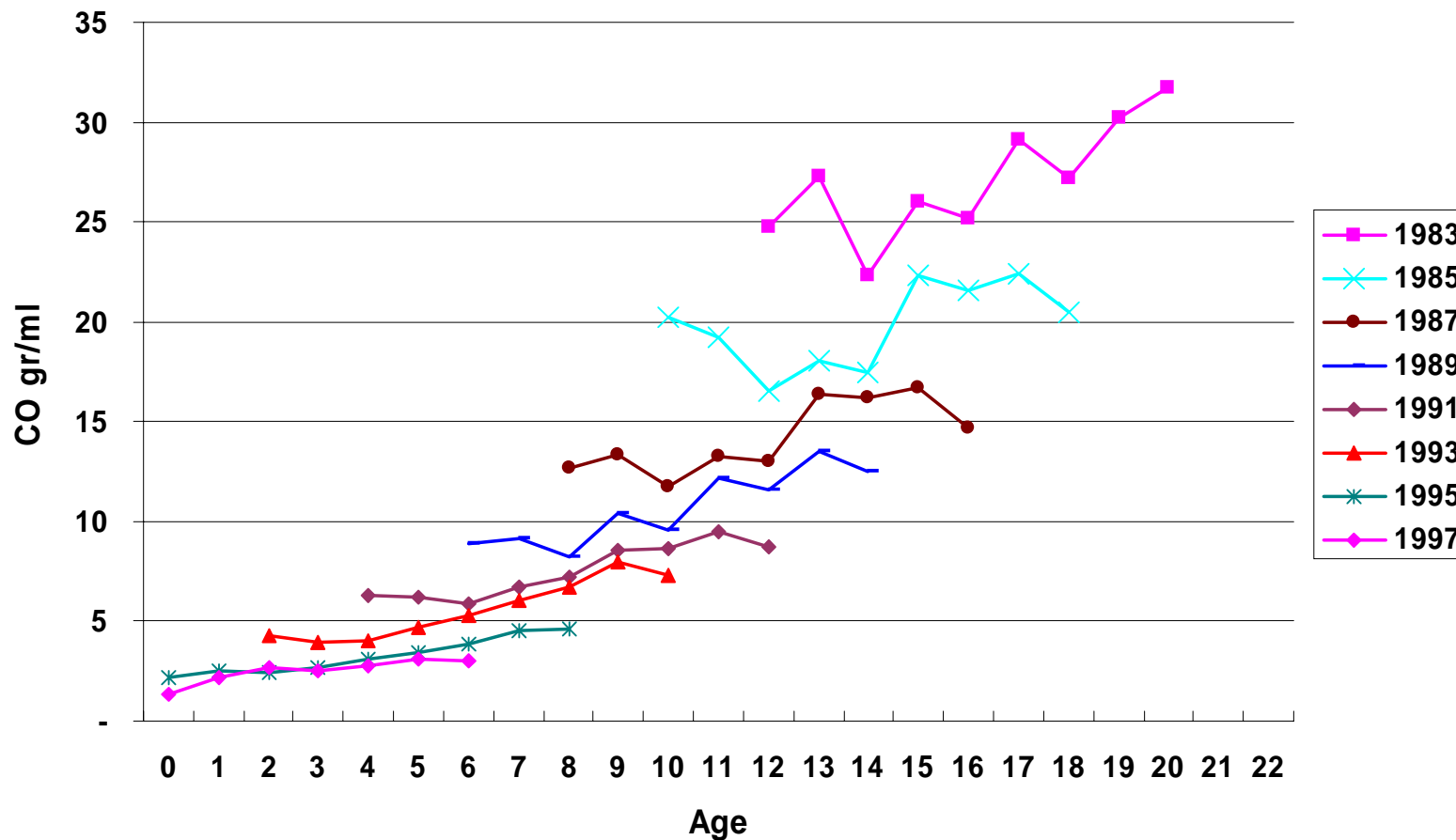
CO Emissions as Function of Age



Conclusions

- Emissions Deterioration is fascinating.
- I believe that MOBILE6 deterioration is subtly different from on-road because the preferential demise of broken (high emitting) vehicles from older fleets is not in the model.
- Emissions of 1996 model year and newer vehicles are amazingly low.
- The combination of Swedish technology and maintenance remains ahead of the USA and the UK.
- Acknowledge CRC, CARB and others.

Colorado I/M LDGV Odd Model Year CO 1995-2003 (1st Quarter Initials with Wait less than Five Minutes)



Communication from P McClintock, 2004

Are the on-road and IM240 data comparable?

- Yes the deterioration rates are slower than the effect of older model years.
- And no, the 1996 effect is not so obvious and the older fleet have much higher emissions relative to the newer.
- Why? IM240 is registration based, every old car is supposed to be tested. On-road studies are biased by the fact that the vehicles are being driven.

The 1996 Effect

- Galen Fisher of Delphi Automotive told me that the 1996 addition of oxygen sensors well downstream of the exhaust manifold has allowed 1996 and newer vehicles to recalibrate the otherwise unavoidable tendency of the exhaust manifold oxygen sensor to drift towards a rich calibration. I have failed so far to find a literature reference.

M6 prediction test (MY 92 &93) using Colorado IM240 data (97 and 02)

