

Alternatives to Experiments

Alternatives to Experiments

- Real Experiments
 - Within subjects
 - Between subjects (random assignment)
- Quasi Experiments
 - Field studies, lack of subject assignment
- Correlational/Observational
- Longitudinal designs
- N=1 studies

Minimum requirements for any study

At least two levels of one variable (otherwise it is not a variable) to assess the effect of that variable on another

At least two replications of a level

(as way of estimating amount of variance associated with error)

Result = Effect/(error of effect) or Effect \pm error

Quasi Experimental Designs

- Post Test Only
- Post Test only with non-equivalent groups
- One Group - Pre Test- Post Test
- Untreated control group pretest-posttest
- Multiple Levels pretest - post test

One Group Post Test only

X O

Post test only with non equivalent groups

$$\begin{array}{r} X \quad O \\ \hline O \end{array}$$

One Group pretest post test

O1

X

O2

Untreated Control Group

pretest posttest

O1

X

O2



O1

O2

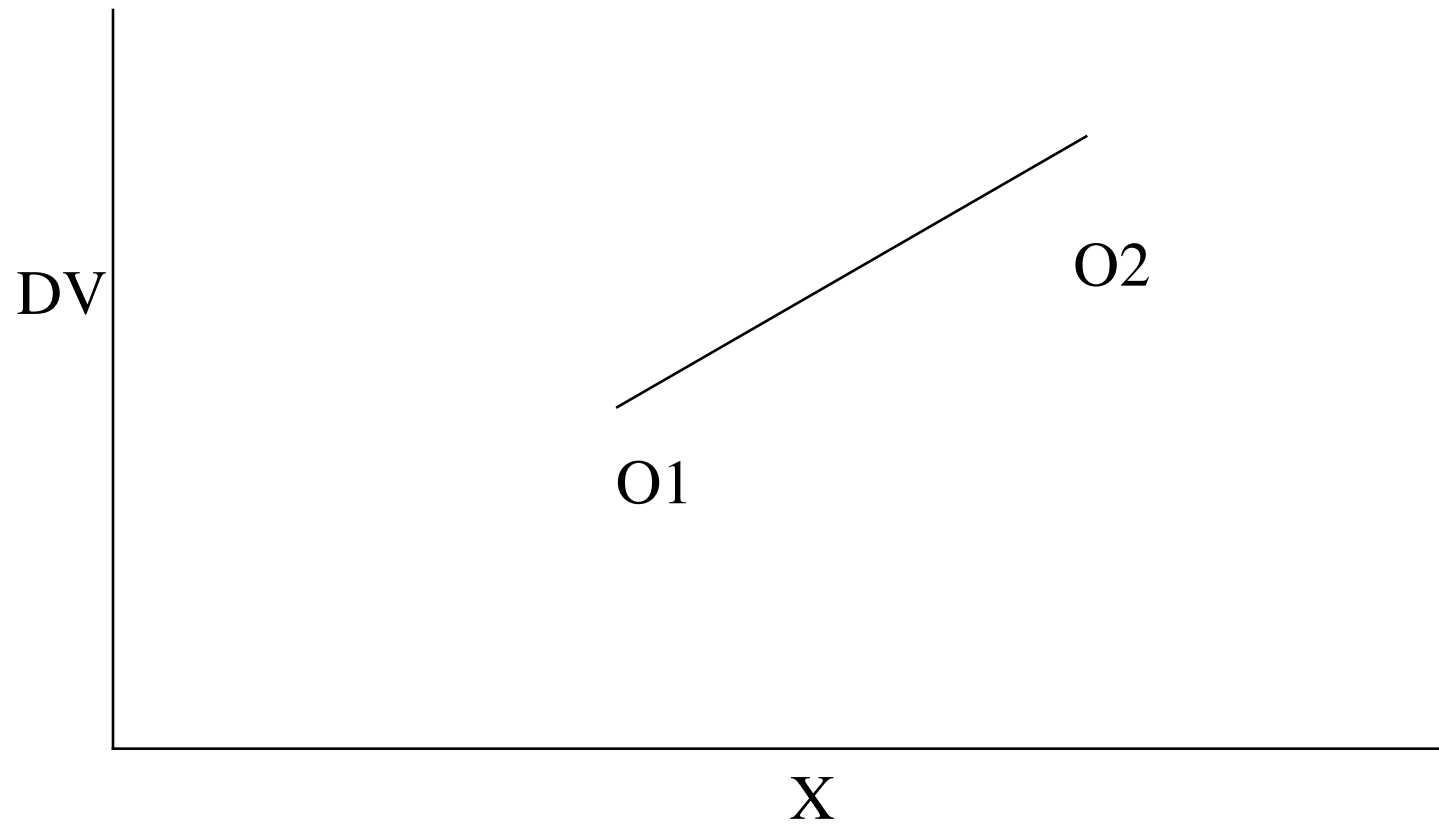
Multiple levels pretest-posttest

O1	X1	O2
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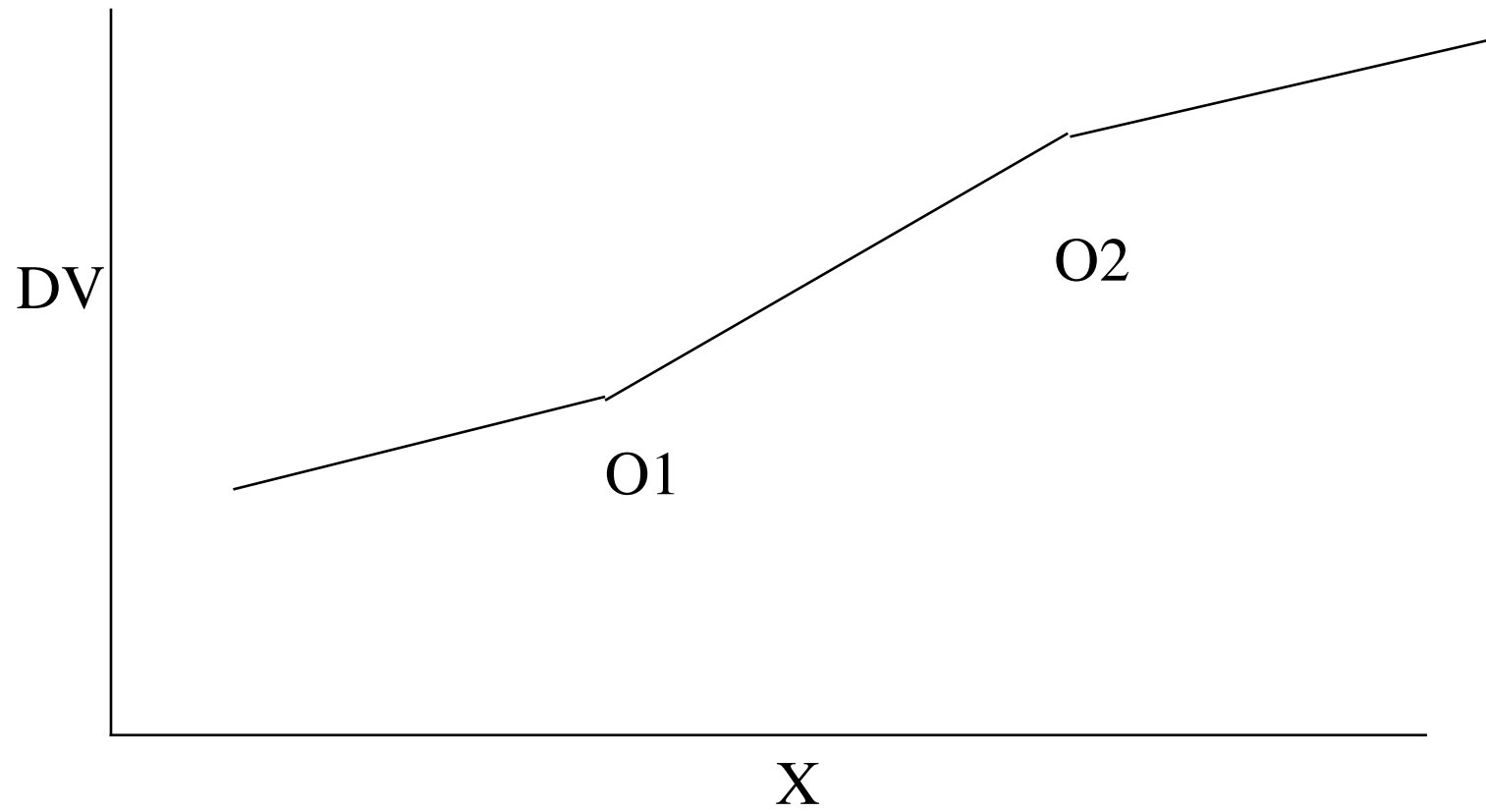
O1	X2	O2
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O1	X3	O2
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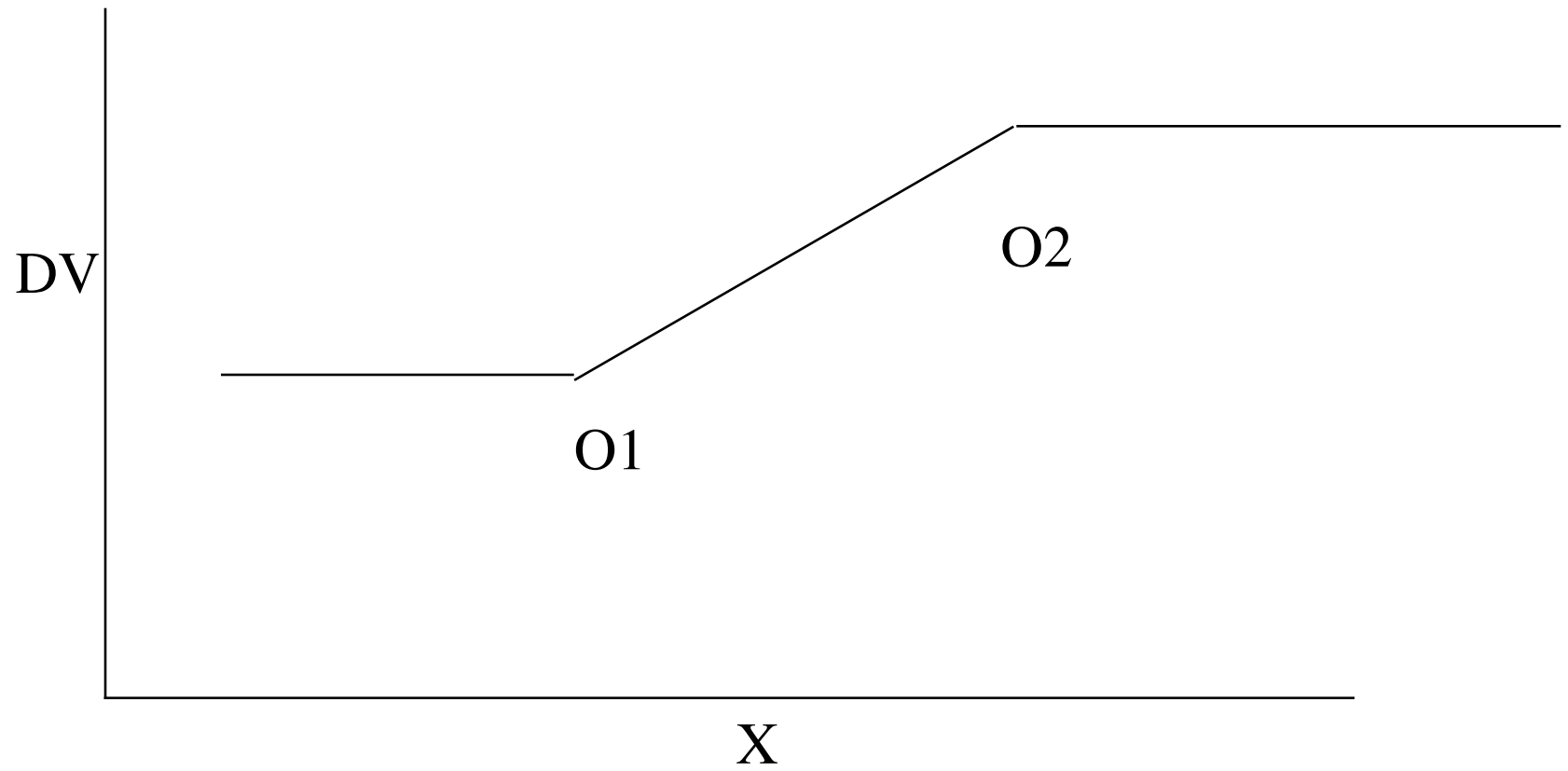
Time series variations



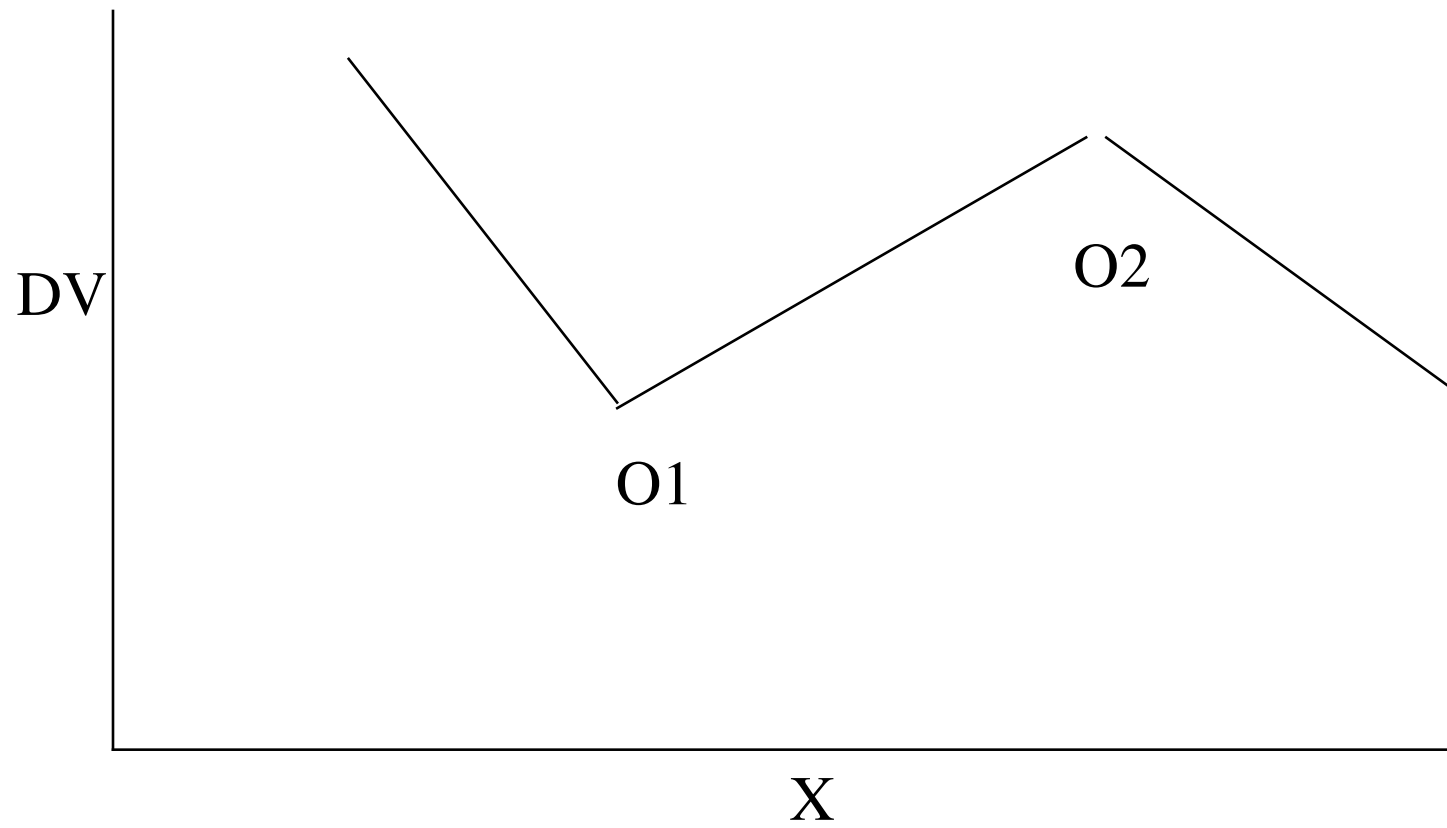
Time series variations



Time series variations



Time series variations



Types of Measures

- Direct
 - Self report
 - Peer rating
- Indirect
 - Reaction time
 - implicit attitudes
 - cognitive availability

Unobtrusive

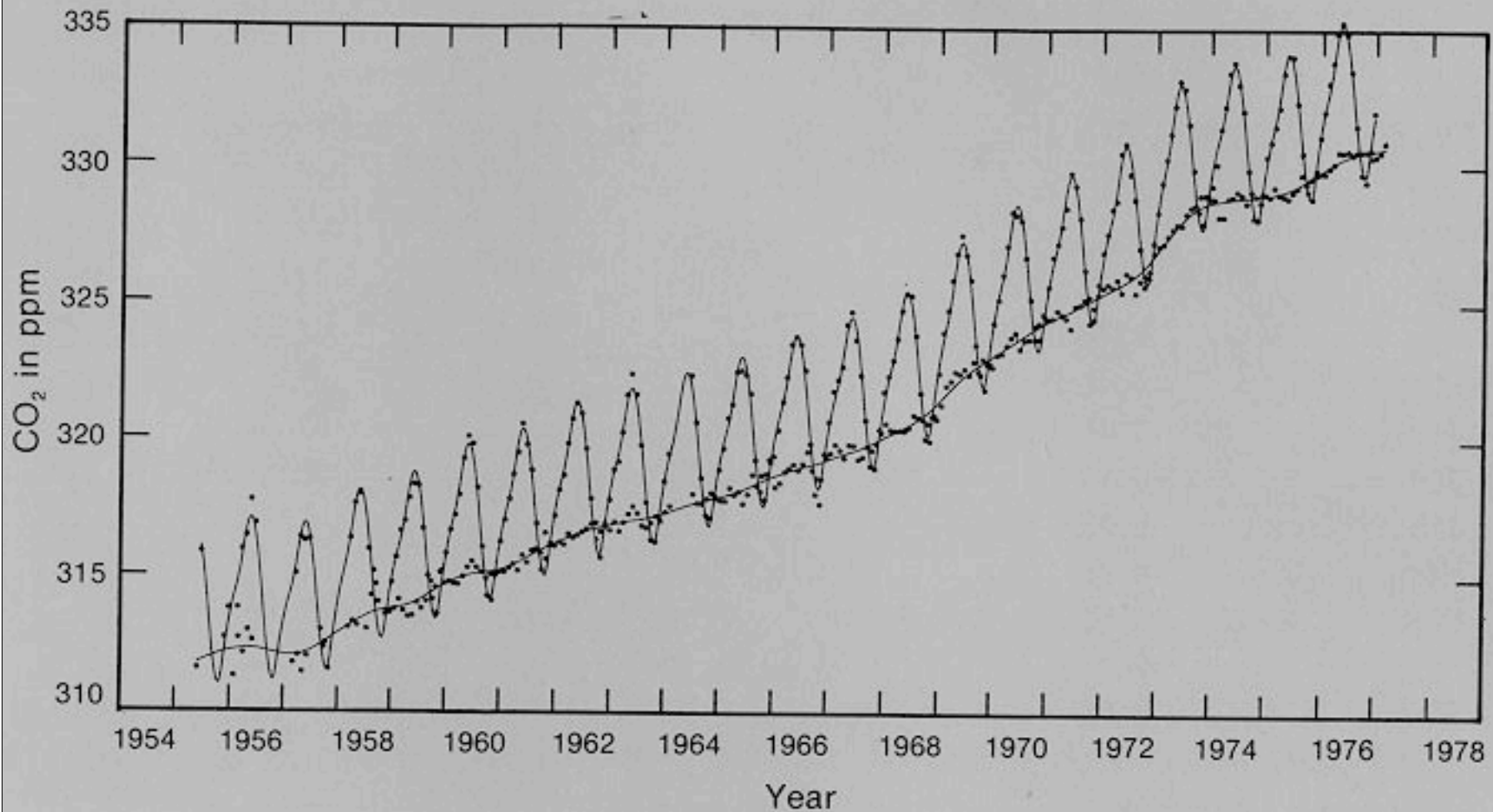
Archival

Observational

CO₂ and global warming - a field experiment

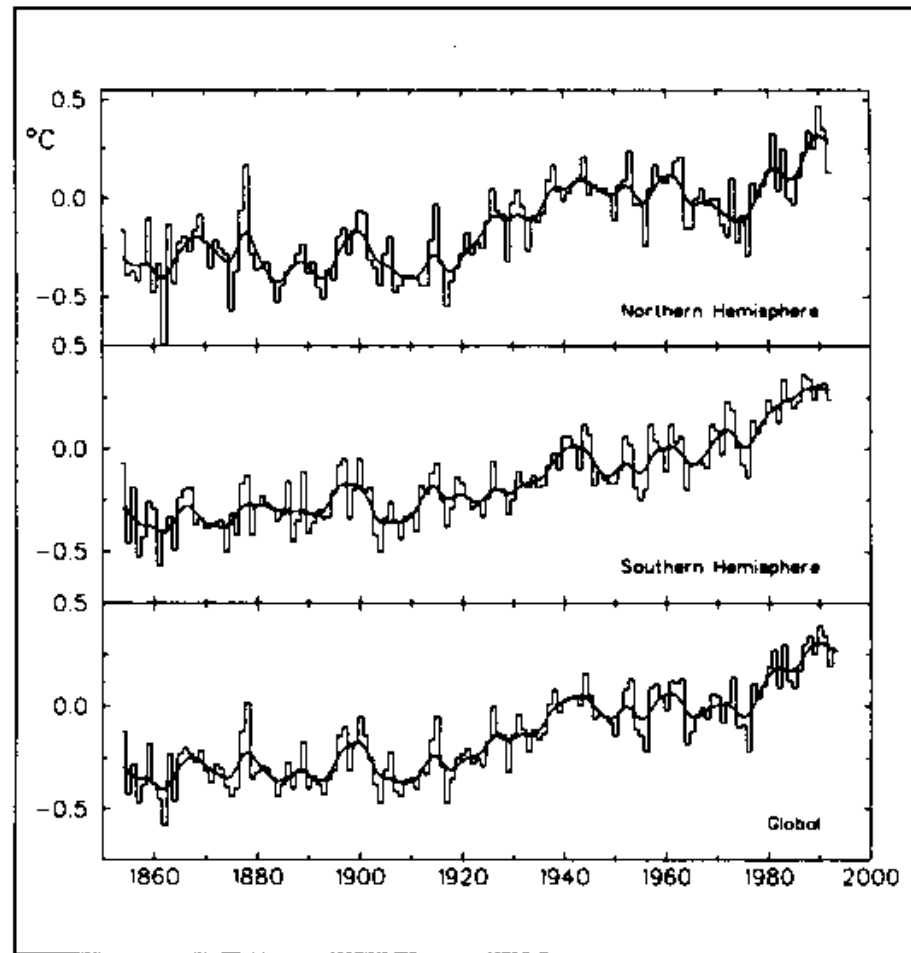
- Ninety-seven percent of the energy demand of the industrial world is met today by burning fossil fuels. Even if the industrialized world were to decide to shift to other energy sources as rapidly as possible, the annual consumption of fossil fuels would double before the shift was complete. Without such a shift, a peak annual rate ten or even twenty times today's rate may occur before fuel reserves, especially coal reserves, are exhausted. Thus a large additional increase in atmospheric CO₂ is likely in the next few decades. ... "Through his worldwide industrialized civilization, man is unwittingly **conducting a vast geophysical experiment**. Within a few generations he is burning the fossil fuels that slowly accumulated in the earth over the past 500 million years."
- The idea that CO₂ from fossil fuel burning might accumulate in air and cause a warming of the lower atmosphere was speculated upon as early as the latter half of the nineteenth century (Arrhenius, 1903). At that time the use of fossil fuel was too slight to expect a rise in atmospheric CO₂ to be detectable. The idea was again convincingly expressed by Callendar (1938, 1940) but still without solid evidence of a rise in CO₂.
- (From Keeling, <http://www.mlo.noaa.gov/HISTORY/PUBLISH/20th%20anniv/co2.htm>)

The Mona Loa CO2 data set as an example of the need for extended time series



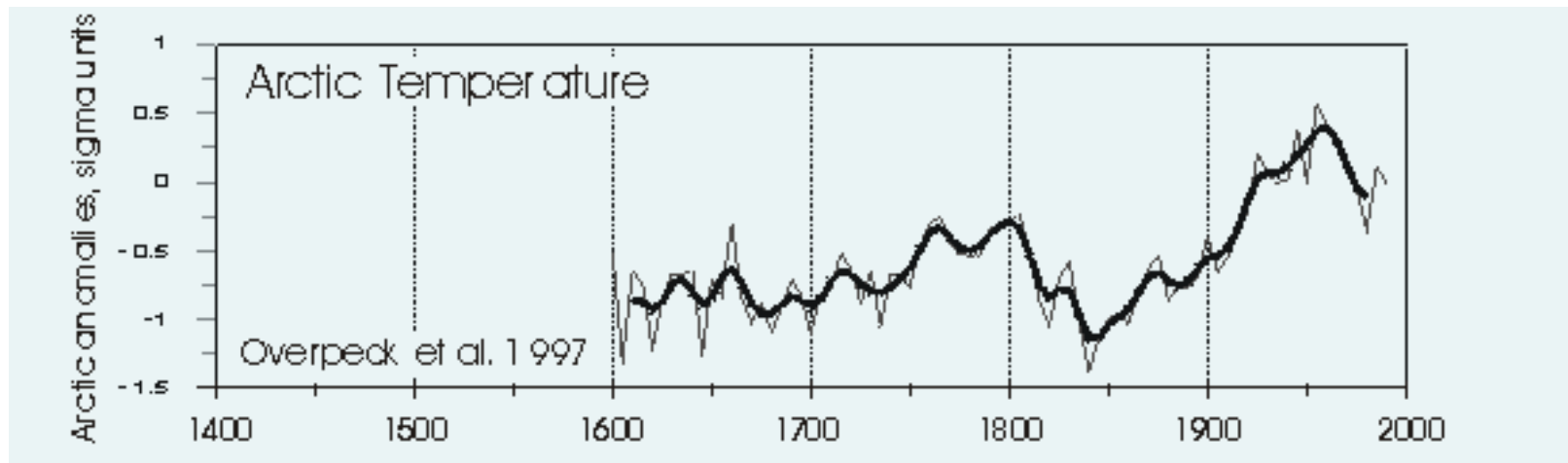
Trend in atmospheric CO₂ concentrations at MLO. The dots indicate the monthly average concentration.

Temperature trends - time series

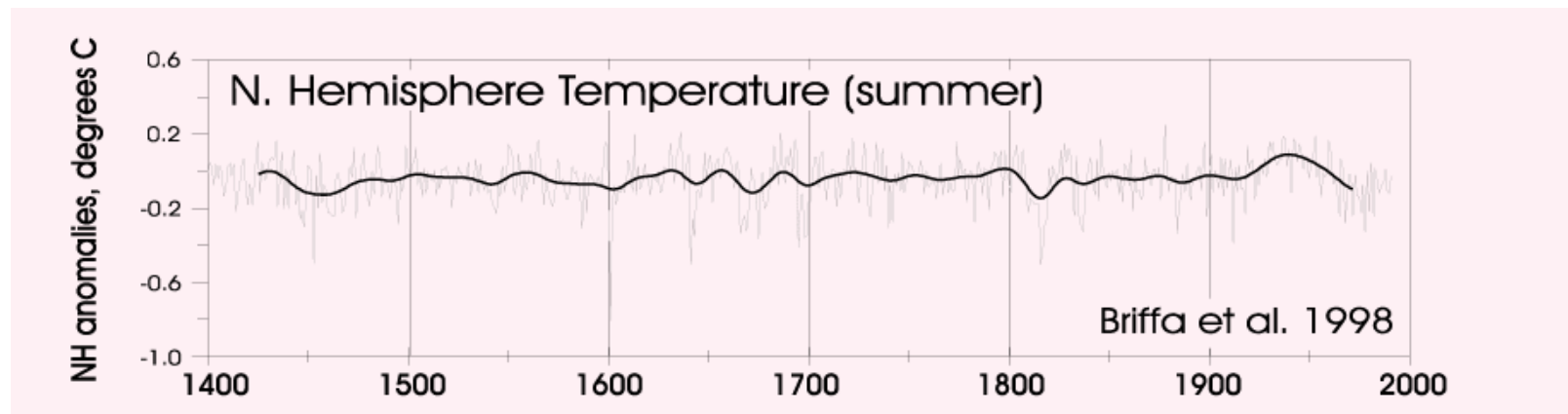


*Hemispheric and mean global
temperature trends, 1854 to the present*

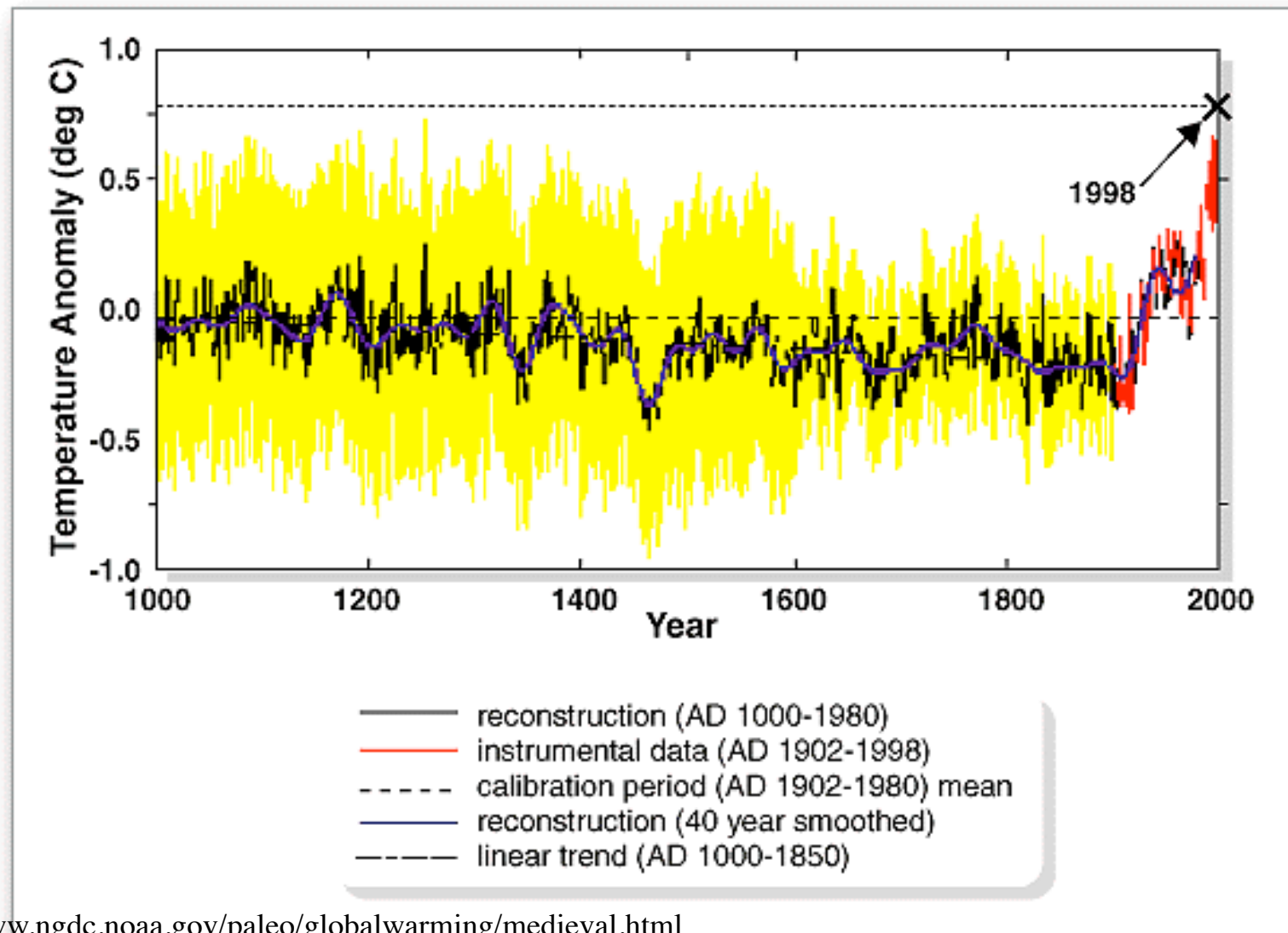
4 centuries of Arctic Temperatures



600 years of tree ring data



1000 years of temperature (from ice cores + tree rings)



Longitudinal designs

- Multiple observations within subject over multiple occasions
 - Time interval can be minutes, hours, days, years
- Confounding effects
 - Cohorts
 - Age
 - Testing

Examples

- Terman study of exceptional children
- Berkeley growth study
- National Longitudinal Study of Youth
- Scottish study of ability
- Dunedin longitudinal study
- Women's Health Initiative

Terman study of exceptional youth

- \approx 1200 very high performance (as judged by teacher ratings and IQ tests) Californian school children
- Personality measures at age \approx 10
- Measures of achievement throughout life
- Reanalyses have shown many other effects
 - Effects of military disruption on career
 - Relationship of childhood personality to life span and health

Berkeley growth and guidance studies

- Berkeley Growth study
 - 61 healthy, full term infants born between Sept. 15, 1928 to May 15, 1929
- Guidance study
 - 248 subjects: every 3rd birth from Jan, 1928-June 1929
 - problems of pre-school children
- Oakland Growth Study
 - 212 adolescents from 5 elementary schools in Oakland

Followups to BGS/OGS

- Followup studies were conducted when the children were 30 (GS), 36-37 (BGS) in 1959-1960
- 1965-67
- 1981-1983 286 subjects from all studies were interviewed and given cognitive assessments about occupational careers, marriage, relations with parents, siblings and off spring.

Further followups

- parents of original sample were interviewed in 1969-1971 when they average 70 years (N=142) and in 1981-1983 (N=94)
- Spouses of subjects
- Children of subjects

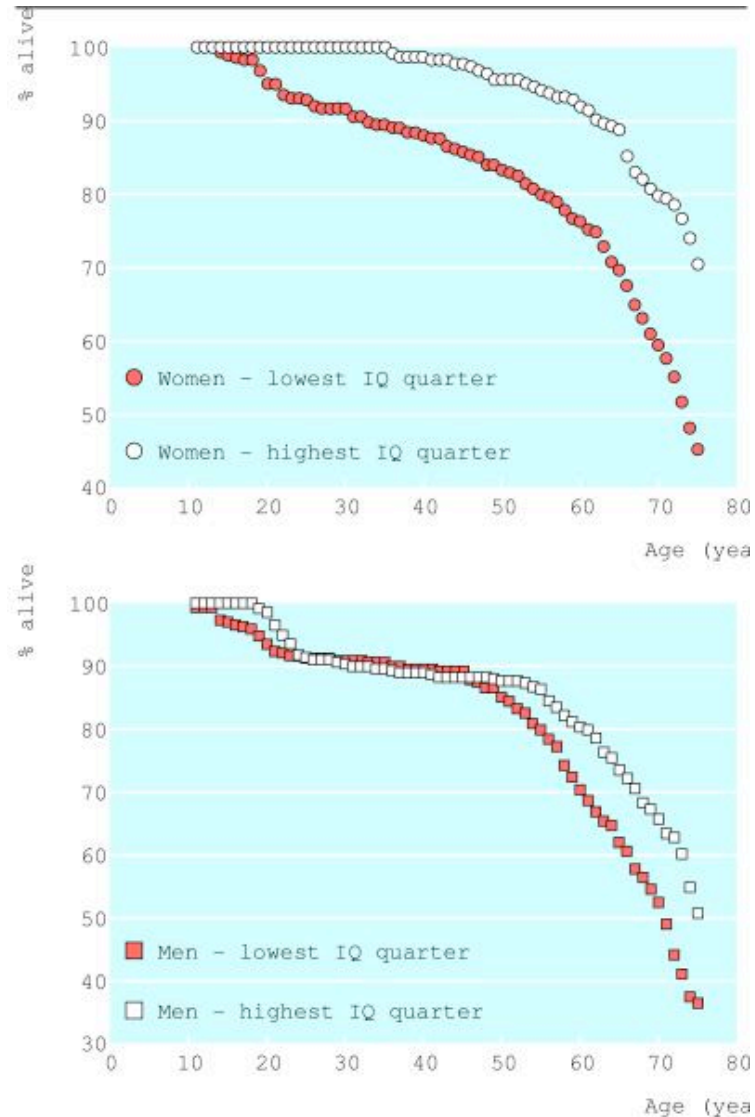
NLSY - U.S. Department of Labor- Bureau of Labor statistics

- **National Longitudinal Survey of Youth 1997 (NLSY97)**-- *Survey of young men and women born in the years 1980-84; respondents were ages 12-17 when first interviewed in 1997.*
- **National Longitudinal Survey of Youth 1979 (NLSY79)**-- *Survey of men and women born in the years 1957-64; respondents were ages 14-22 when first interviewed in 1979.*
- **NLSY79 Children and Young Adults**-- *Survey of the biological children of women in the NLSY79.*
- **National Longitudinal Surveys of Young Women and Mature Women (NLSW)**-- *The Young Women's survey includes women who were ages 14-24 when first interviewed in 1968. The Mature Women's survey includes women who were ages 30-44 when first interviewed in 1967. These surveys are now conducted simultaneously in odd-numbered years.*
- **National Longitudinal Surveys of Young Men and Older Men**-- *The Young Men's survey, which was discontinued in 1981, includes men who were ages 14-24 when first interviewed in 1966. The Older Men's survey, which was discontinued in 1990, includes men who were ages 45-59 when first interviewed in 1966.*

Scottish school children Ability over the life span

- Entire Scottish 11 year old population tested for ability in 1932
- Retested in late 1990s and early 2000s
 - Early correlates of intellectual growth and stability
 - long term measures of life satisfaction

Edinburgh longitudinal study of IQ -- hazard function



Dunedin Multidisciplinary Health and Development Study

- birth cohort, April 1, 1972-March 31, 1973 in Dunedin, NZ
- 1037 assessed at age 3
- whose members were questioned regularly throughout growth
 - at ages 5, 7, 9, 11, 13, 15, 18, 21, 26 years
 - Physical abuse
 - Psychological abuse
 - delinquency
 - child rearing effect
 - Gene-environment interactions (resiliency)
 - Low MAO

Womens' Health Initiative

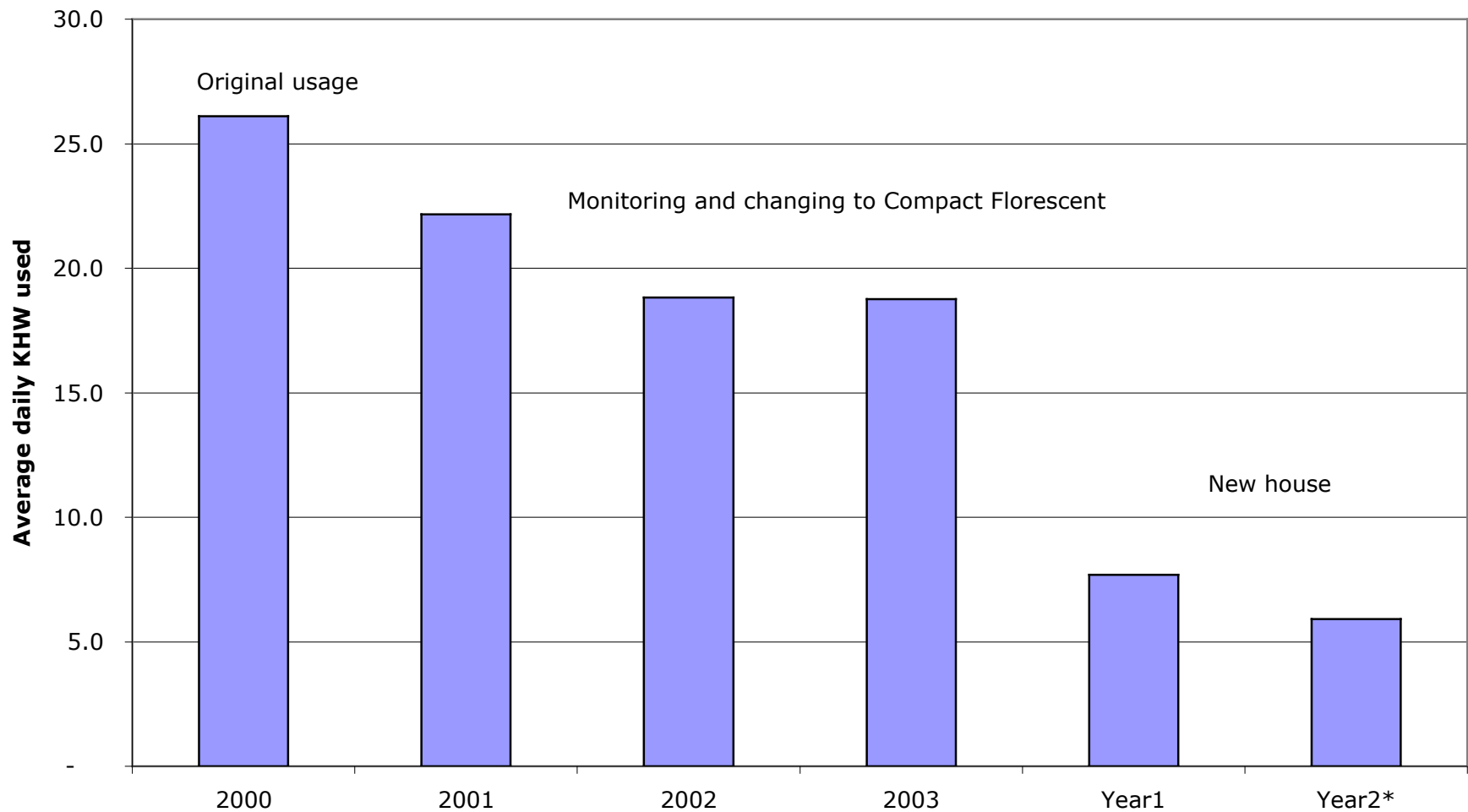
- 15 year study
- 161,000 women aged 50-79 at start
- Randomized controlled clinical trials (68,000)
 - Hormone Replacement Therapy
 - Dietary Modification
 - Calcium/Vitamin D
- Observational study (93,000)

Research Methods as general skill set

- What is the influence of X upon Y
- Does changing X influence Y
- How large is the effect compared to what I would expect by chance variation
- Is there some other variable Z that is mediating or moderating the effect

Longitudinal Experimental

The effect of monitoring and PV
average daily electrical load



Does a new charge controller work better than the prior one

