

Steady Decline of East Asian Monsoon Winds, 1969 - 2000: *Direct Evidence of Ground Wind Speed*

Ming Xu, *Rutgers University*

Chih-Pei Chang, *Naval Postgraduate School*

Cngbin Fu, *Chinese Academy of Sciences*

Ye Qi, *Beijing Normal University*

Alan Robock, *Rutgers University*

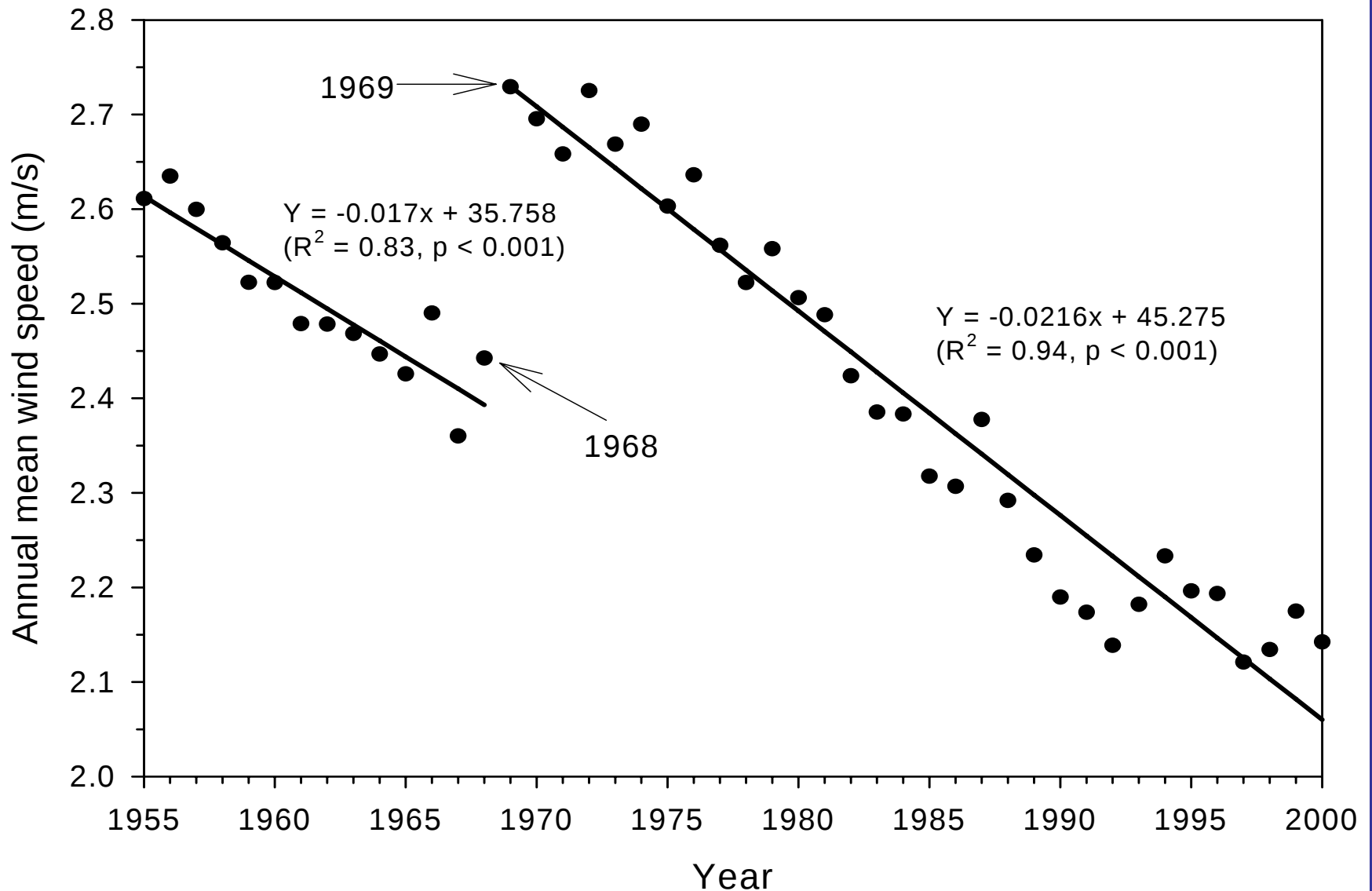
David Robinson, *Rutgers University*

Huai-min Zhang, *NOAA National Climatic Data Center*

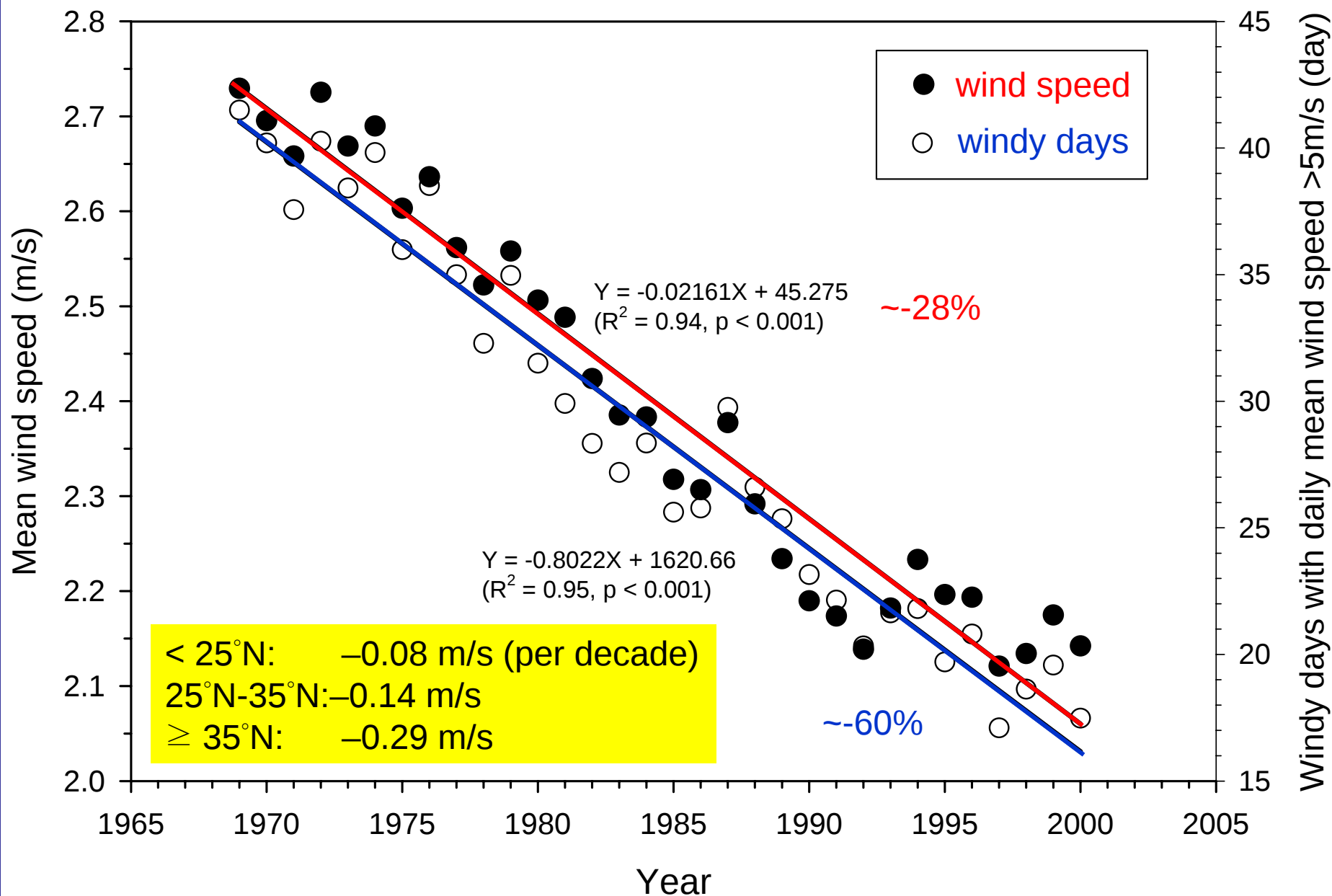
Data

- CMA surface station reports
 - 305 stations, most established in 1950s
 - V, T, precipitation, radiation (85/305)
 - Prior to 1969 deemed unreliable (Liu et al. 2004a)
 - China-mean = area-weighted average (GIS)
- NCEP Reanalysis $2.5^{\circ} \times 2.5^{\circ}$
 - China, South China Sea, Western North Pacific
 - V, T

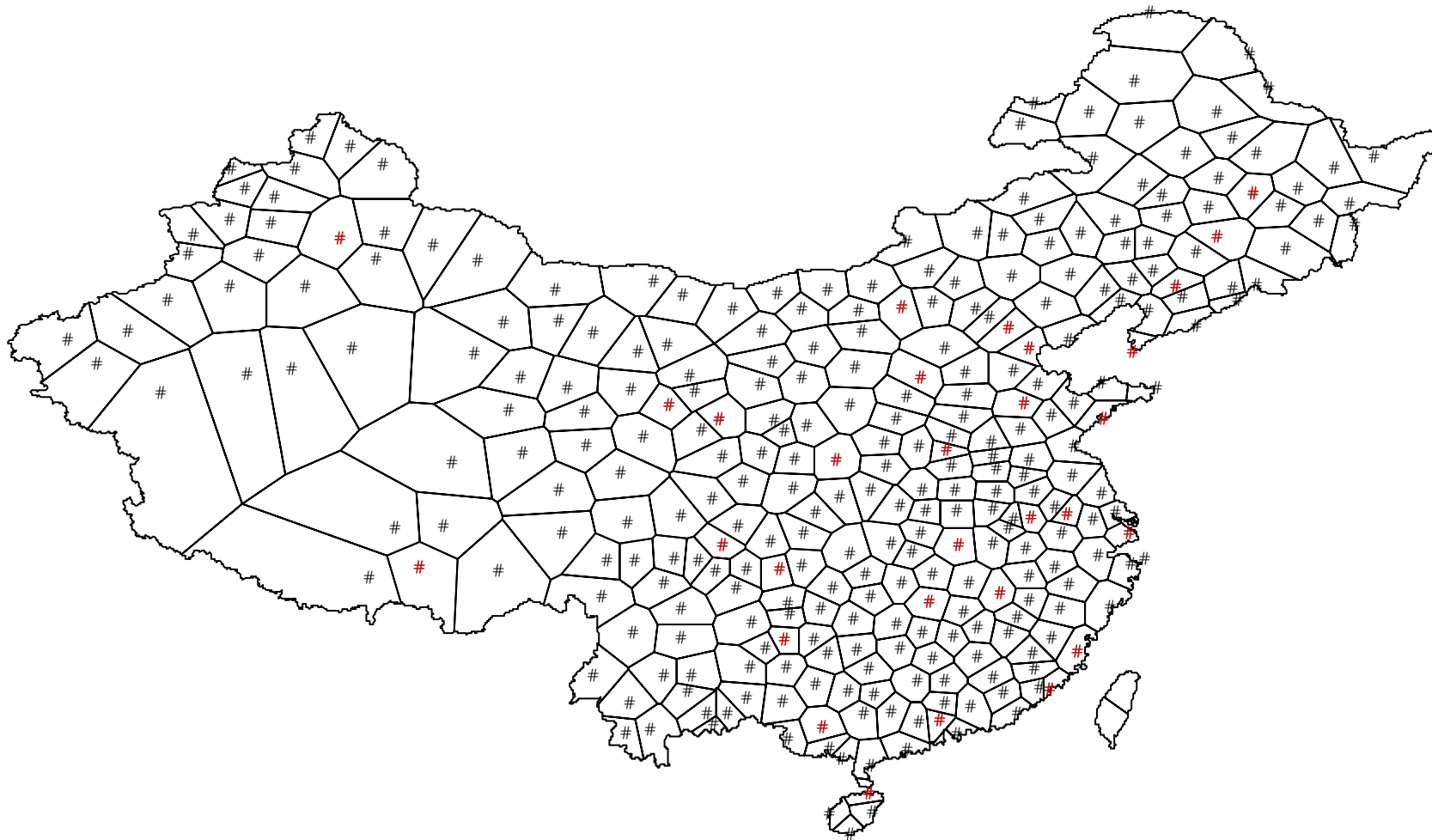
China mean sfc wind speed 1955-2000



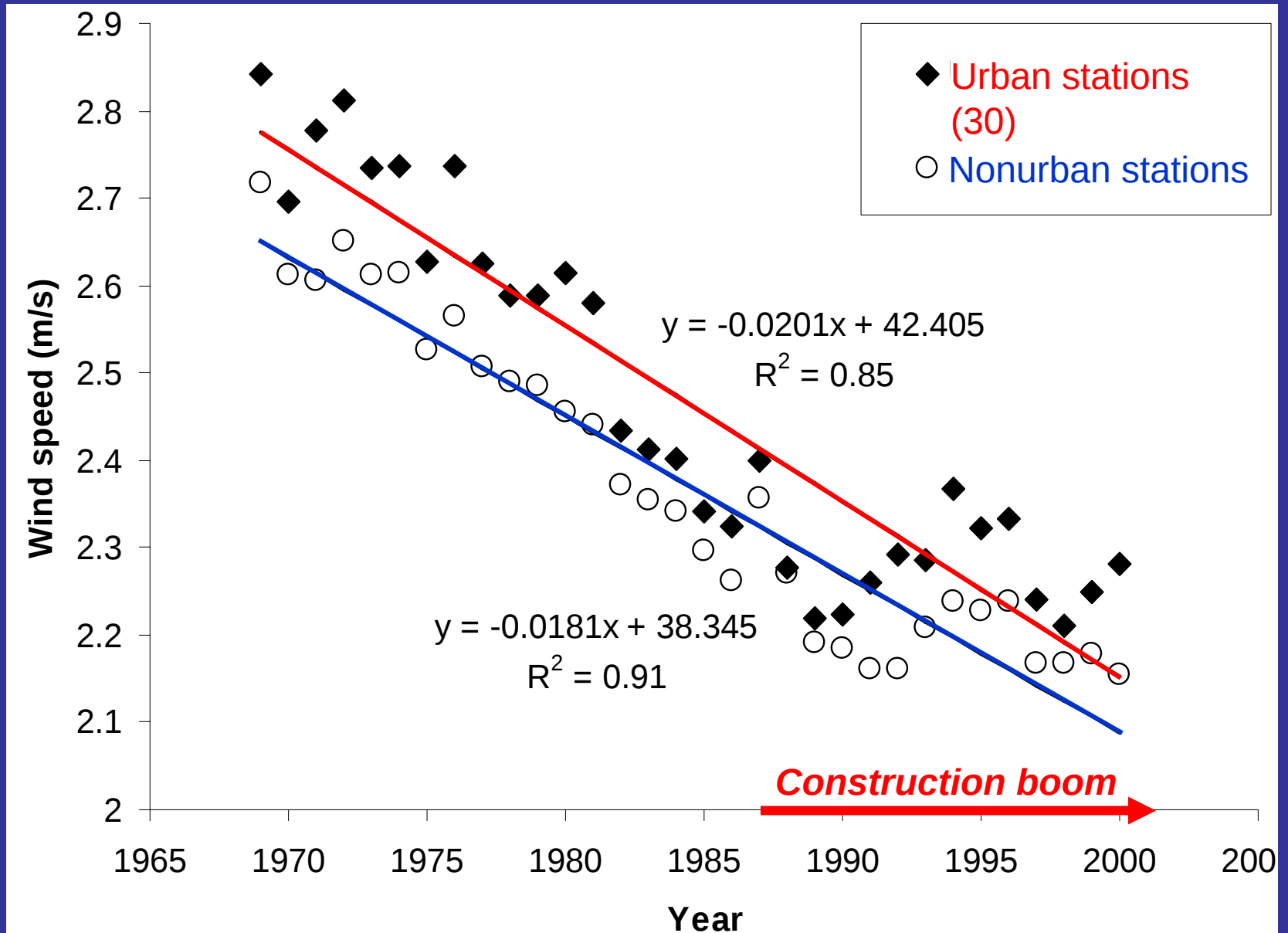
Mean sfc wind speed and windy days



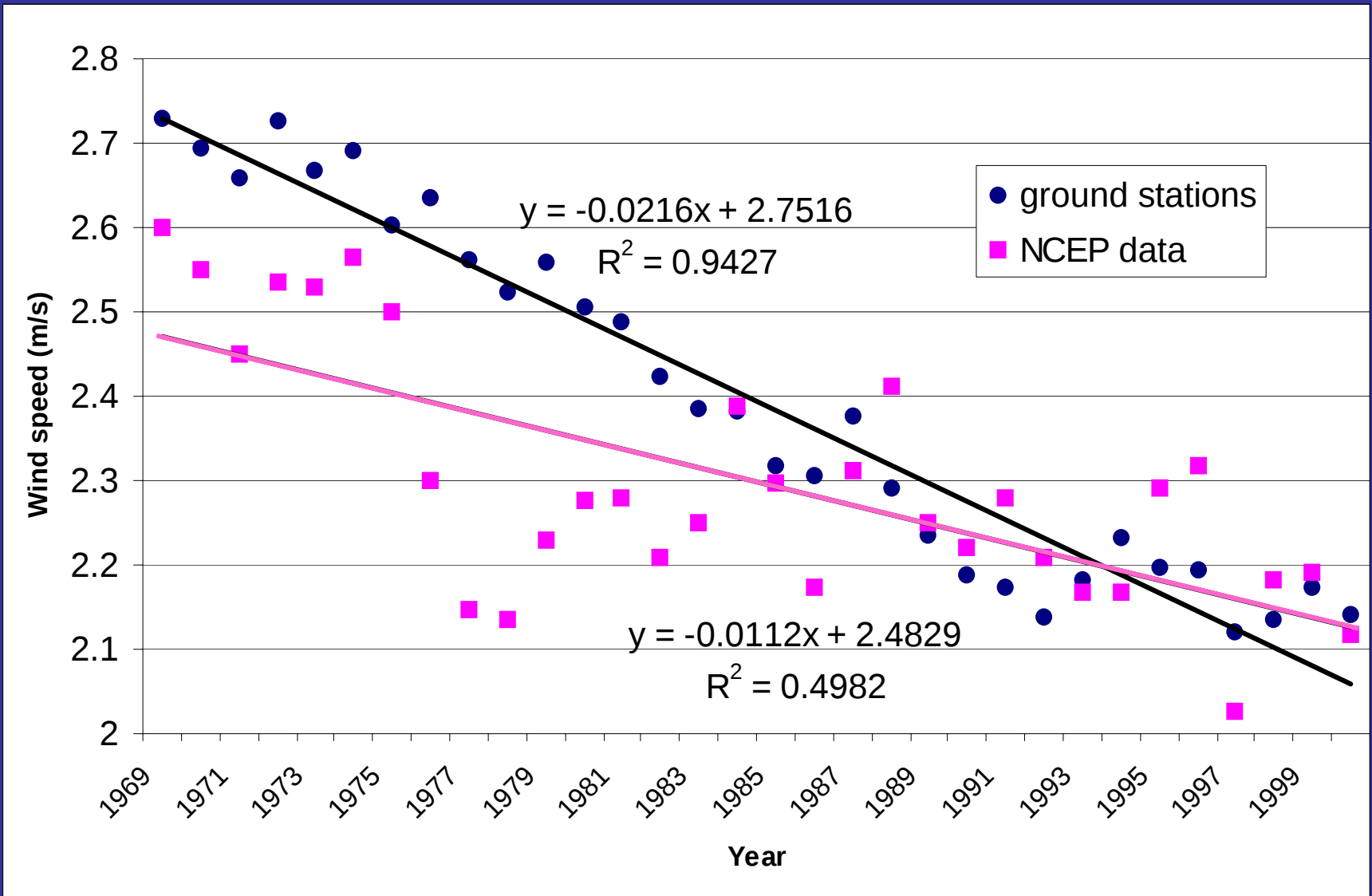
Urban vs. non-urban stations



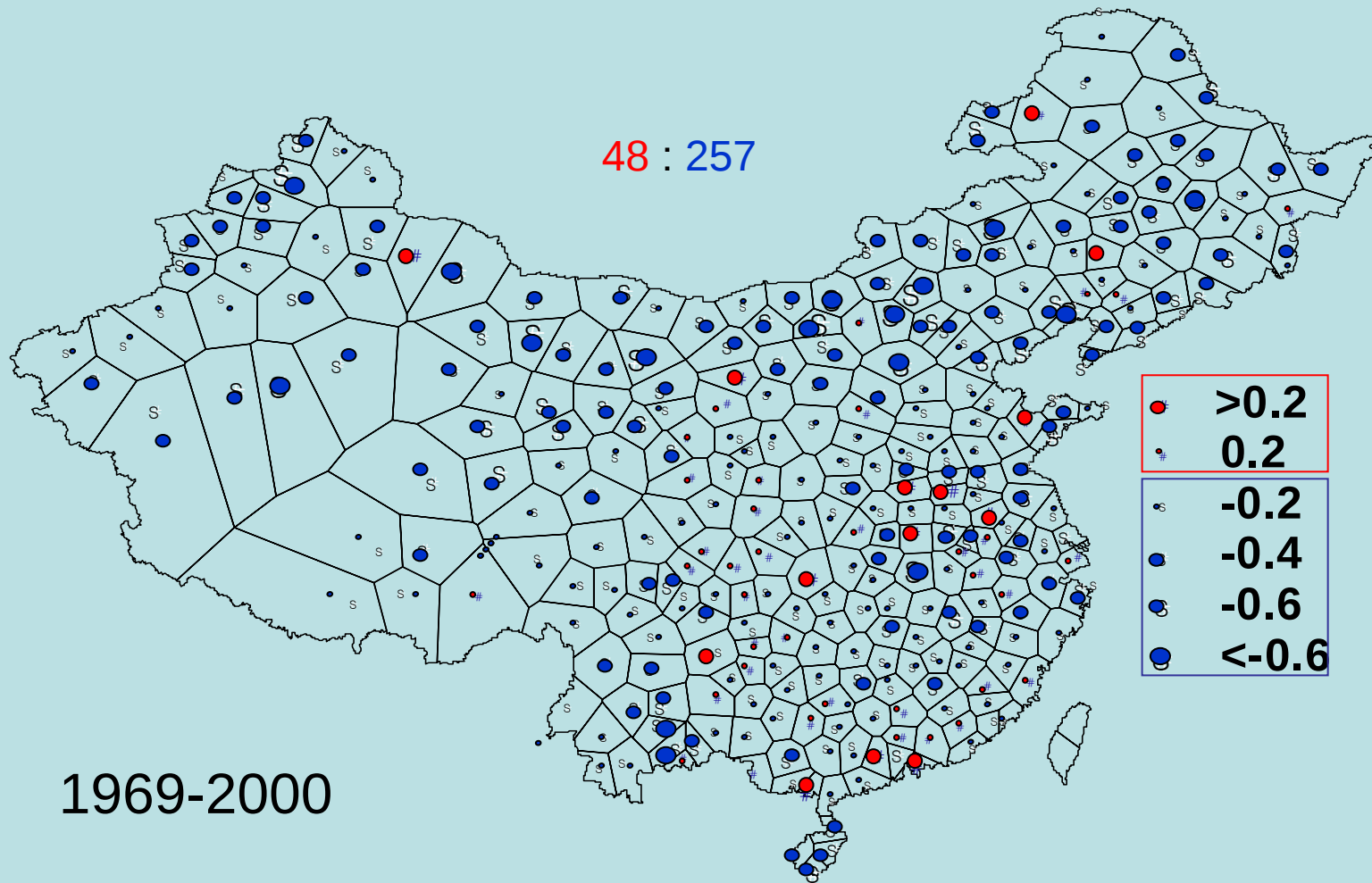
Urban vs. non-urban stations



Sfc (10m) wind speed: Station vs NCEP



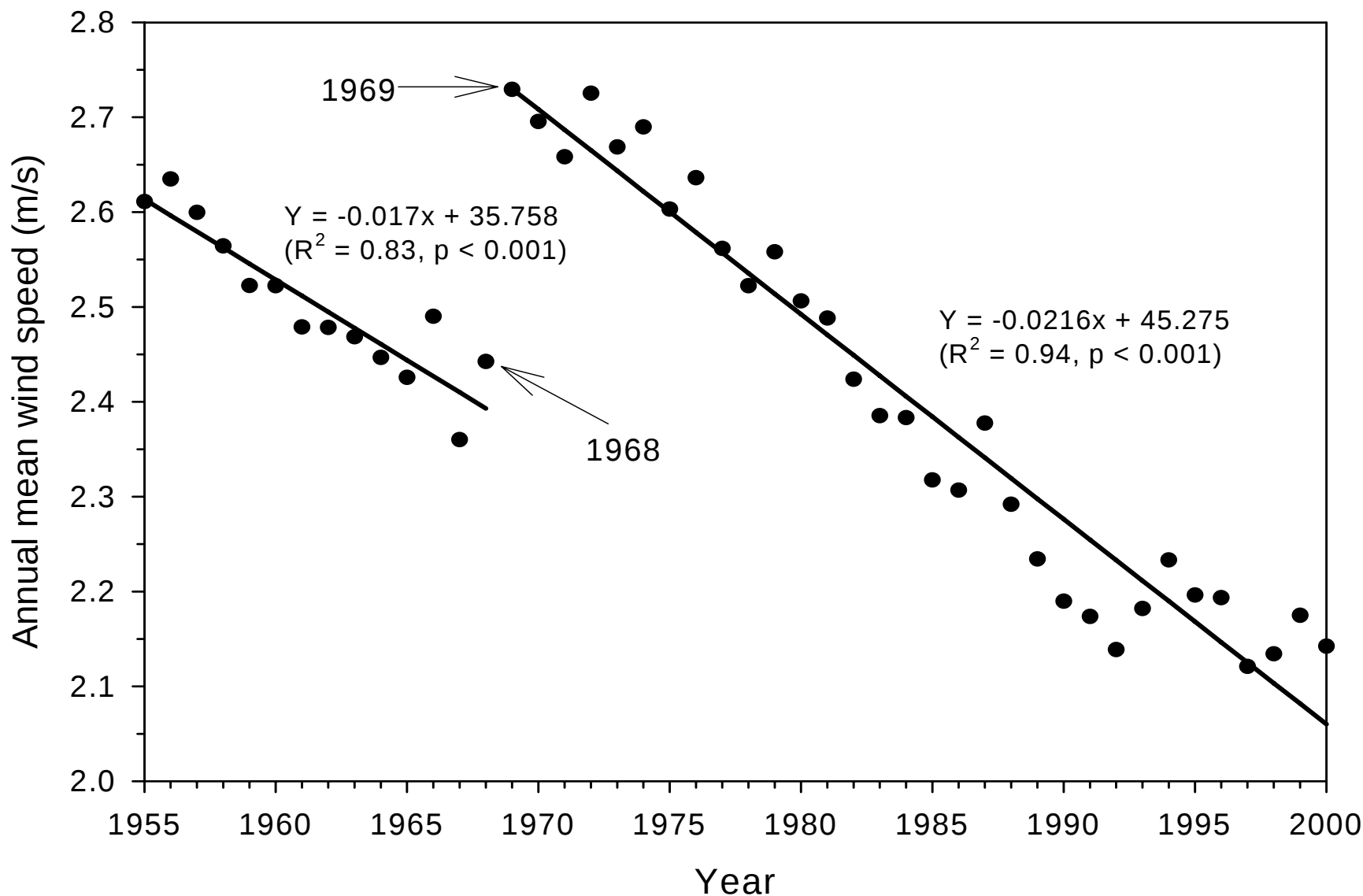
Wind speed change at each station



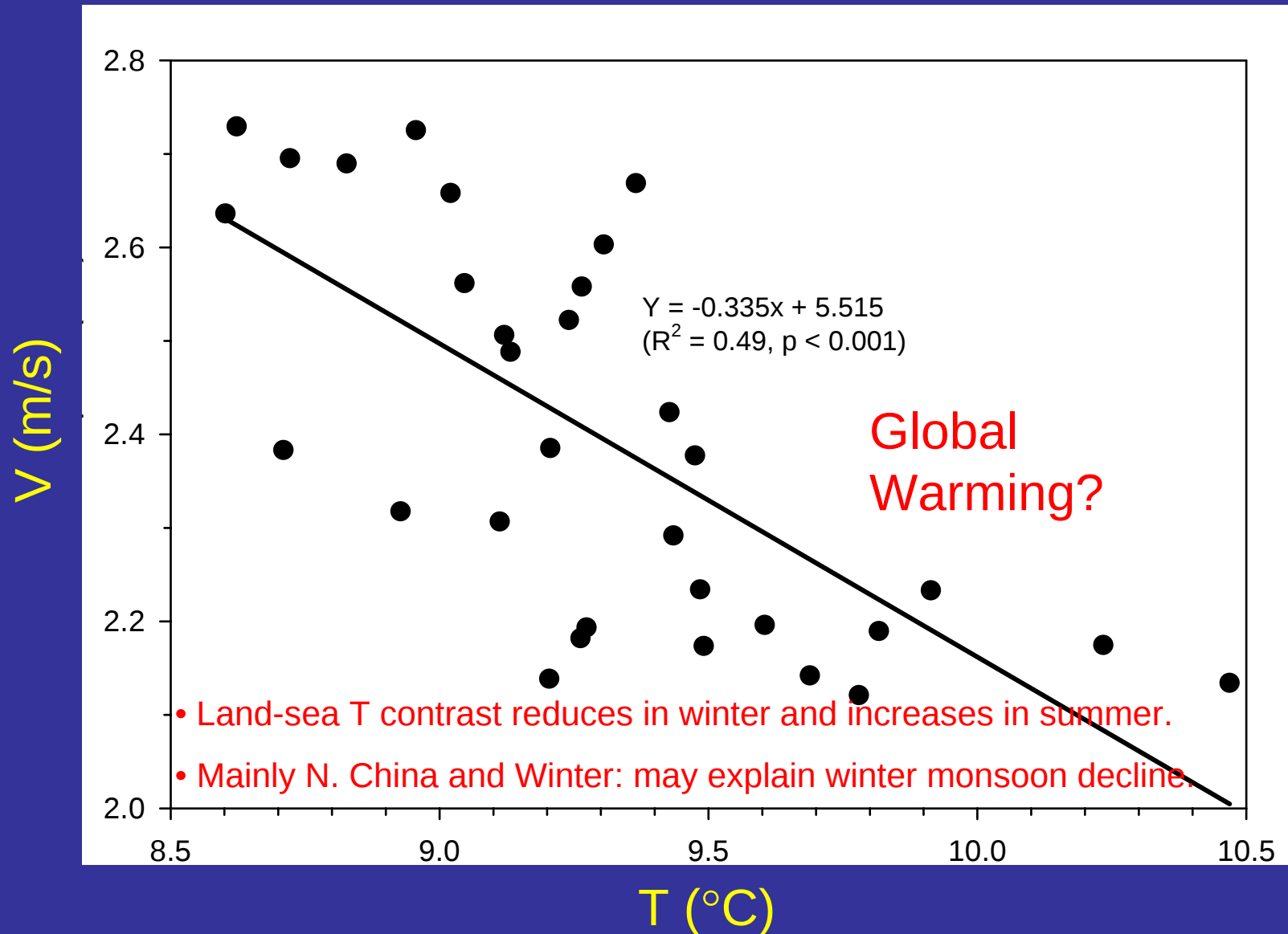
Possible Causes

- Global warming: thermal contrast reduced in winter and enhanced in summer
Hori and Ueda, 2006; Chen et al. 2004
- Decadal to longer-term atmospheric circulation change
- Other human factors (e.g., land use change, air pollution)

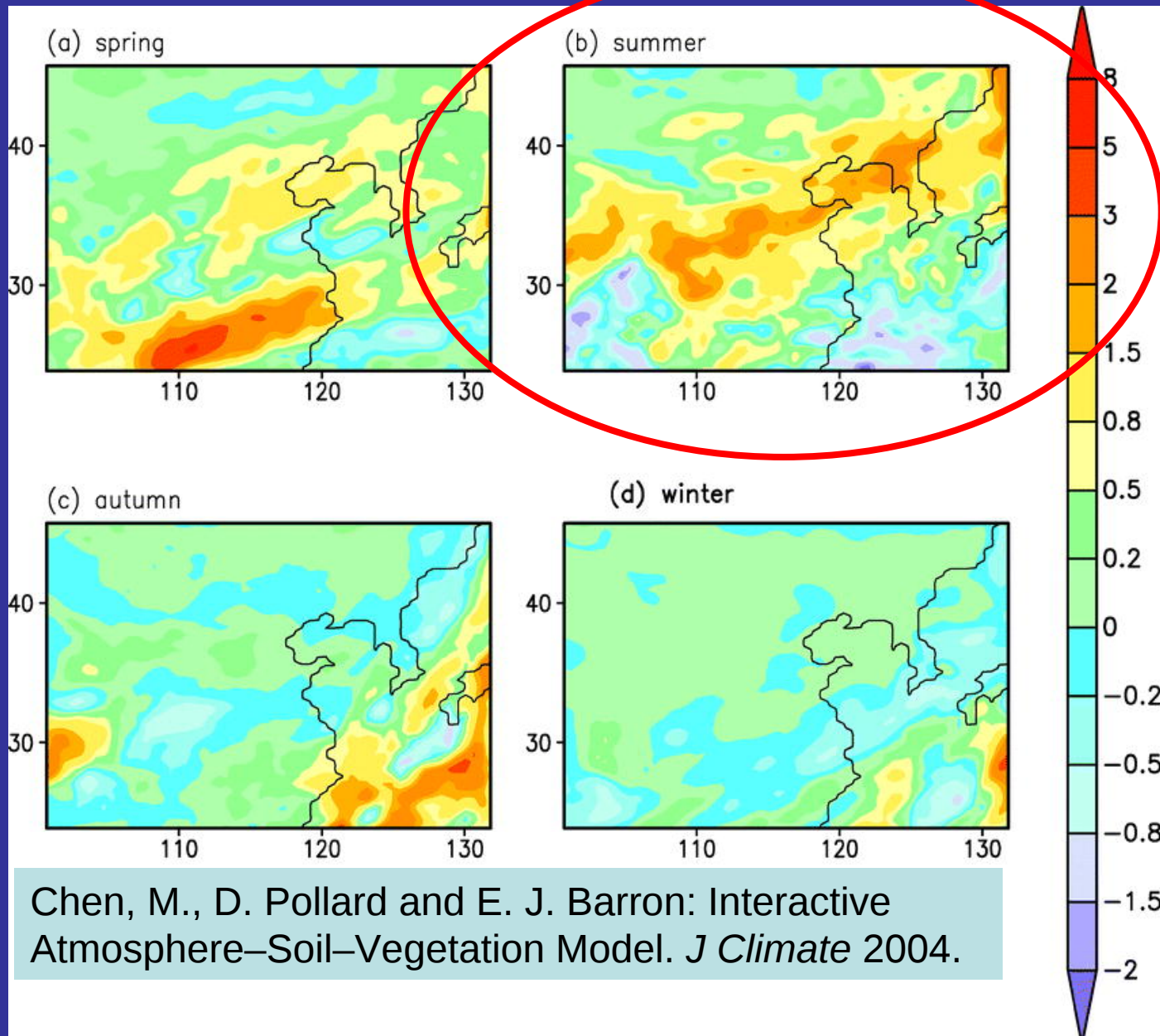
China mean sfc wind speed 1955-2000



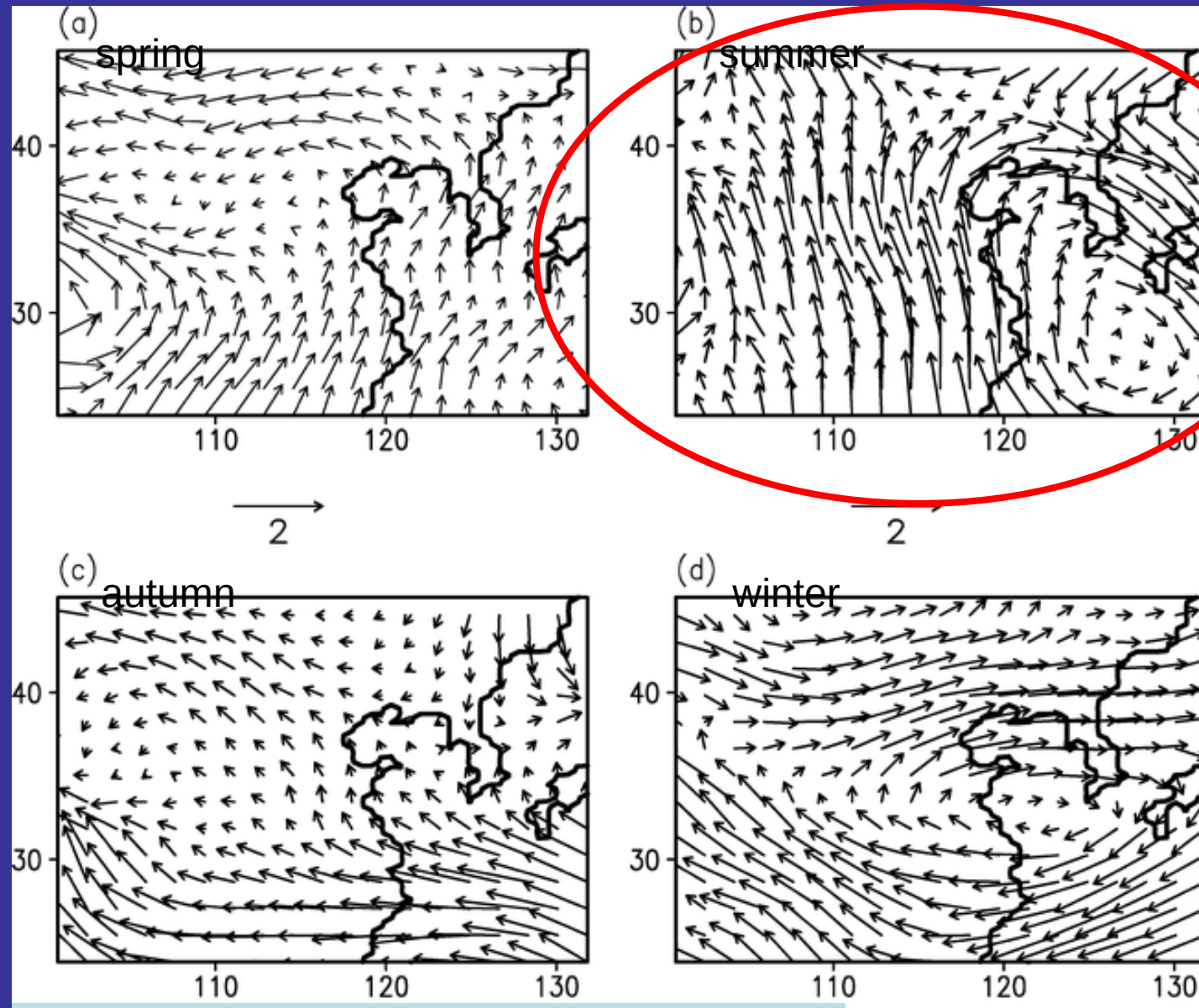
Mean surface V vs. temperature



RCM: EA Precipitation Change by Double-CO₂

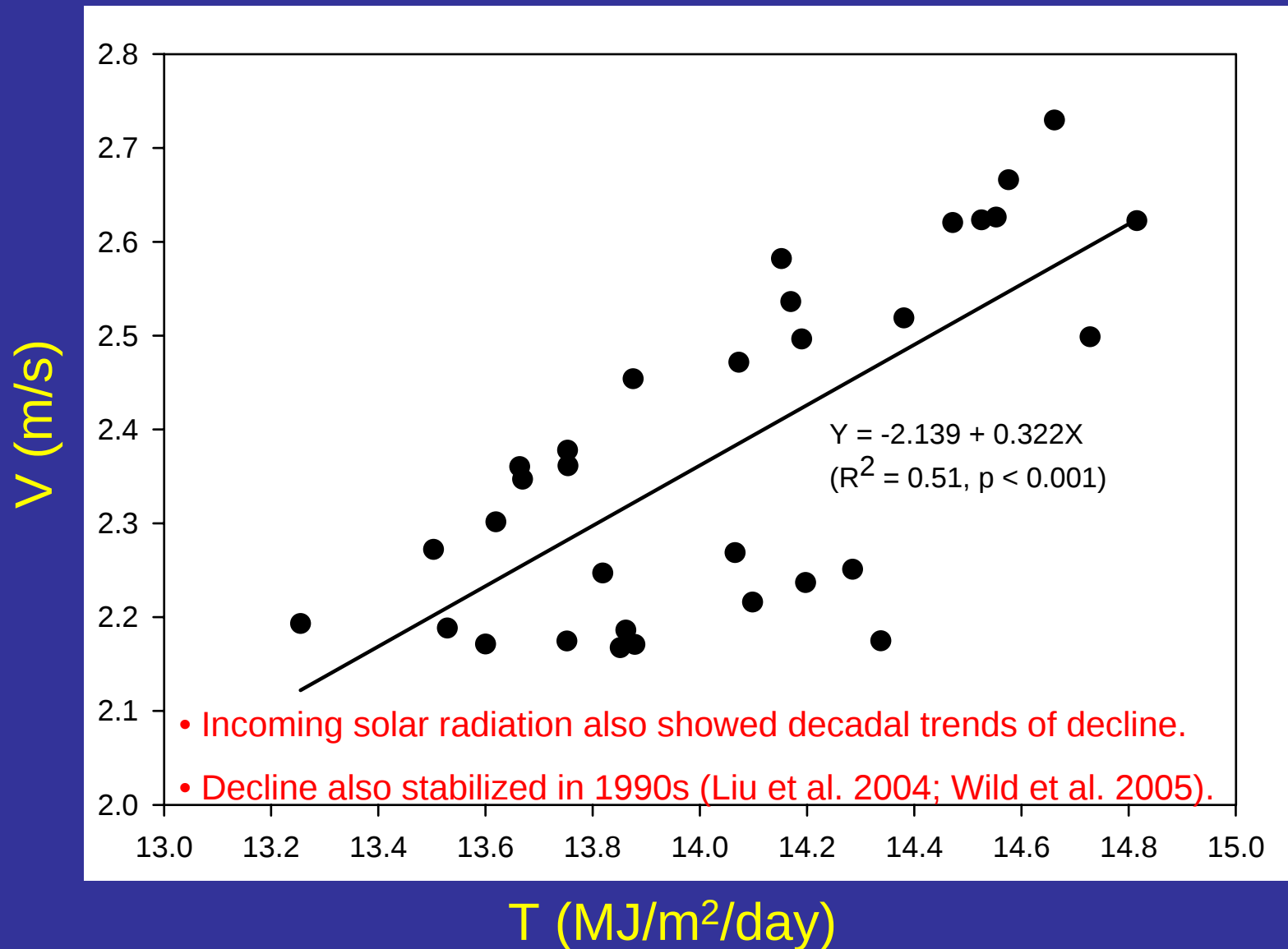


RCM: EA circulation change by Double-CO₂

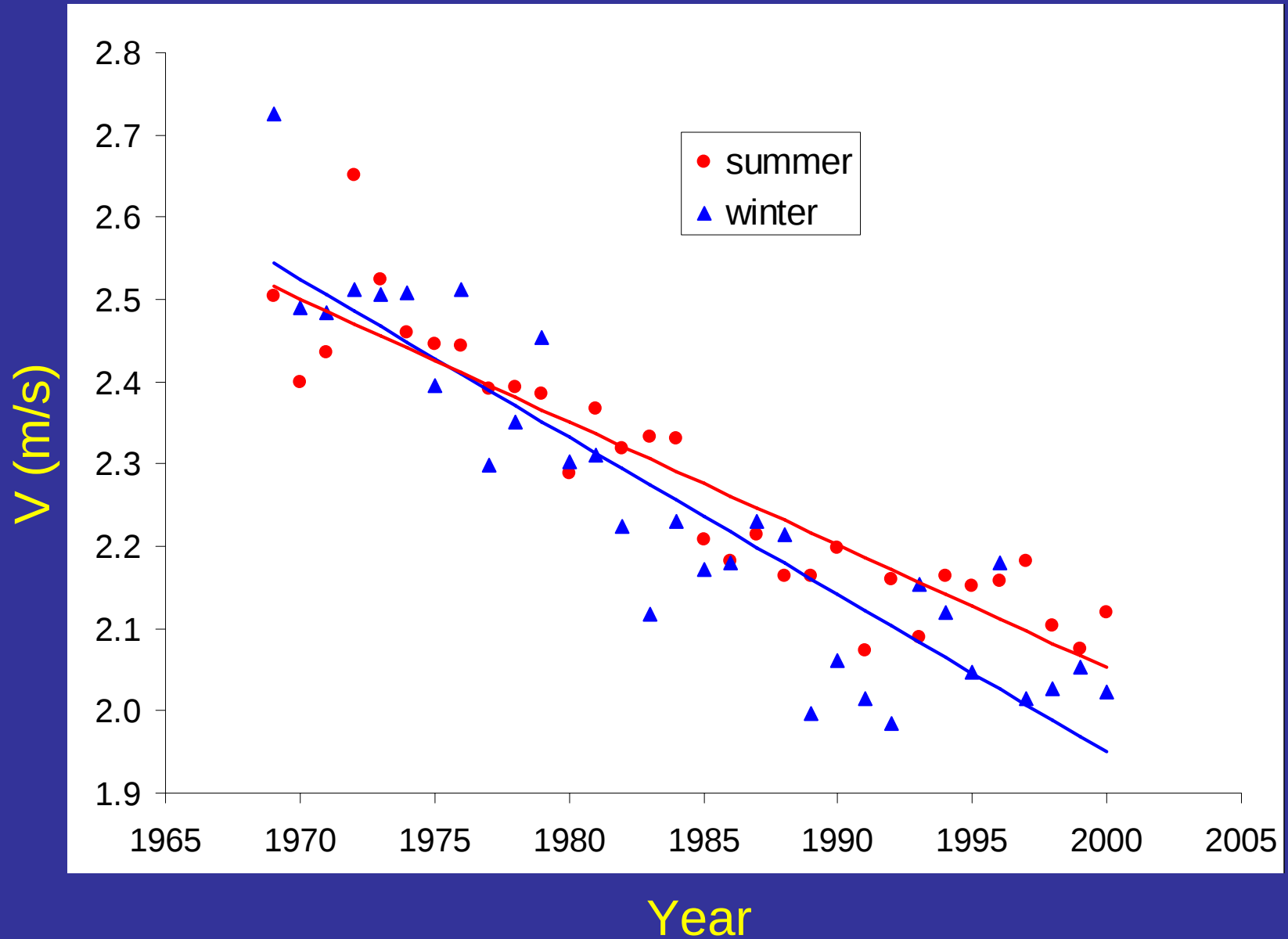


Chen, M., D. Pollard and E. J. Barron: 2004.

Mean surface V vs. incoming solar

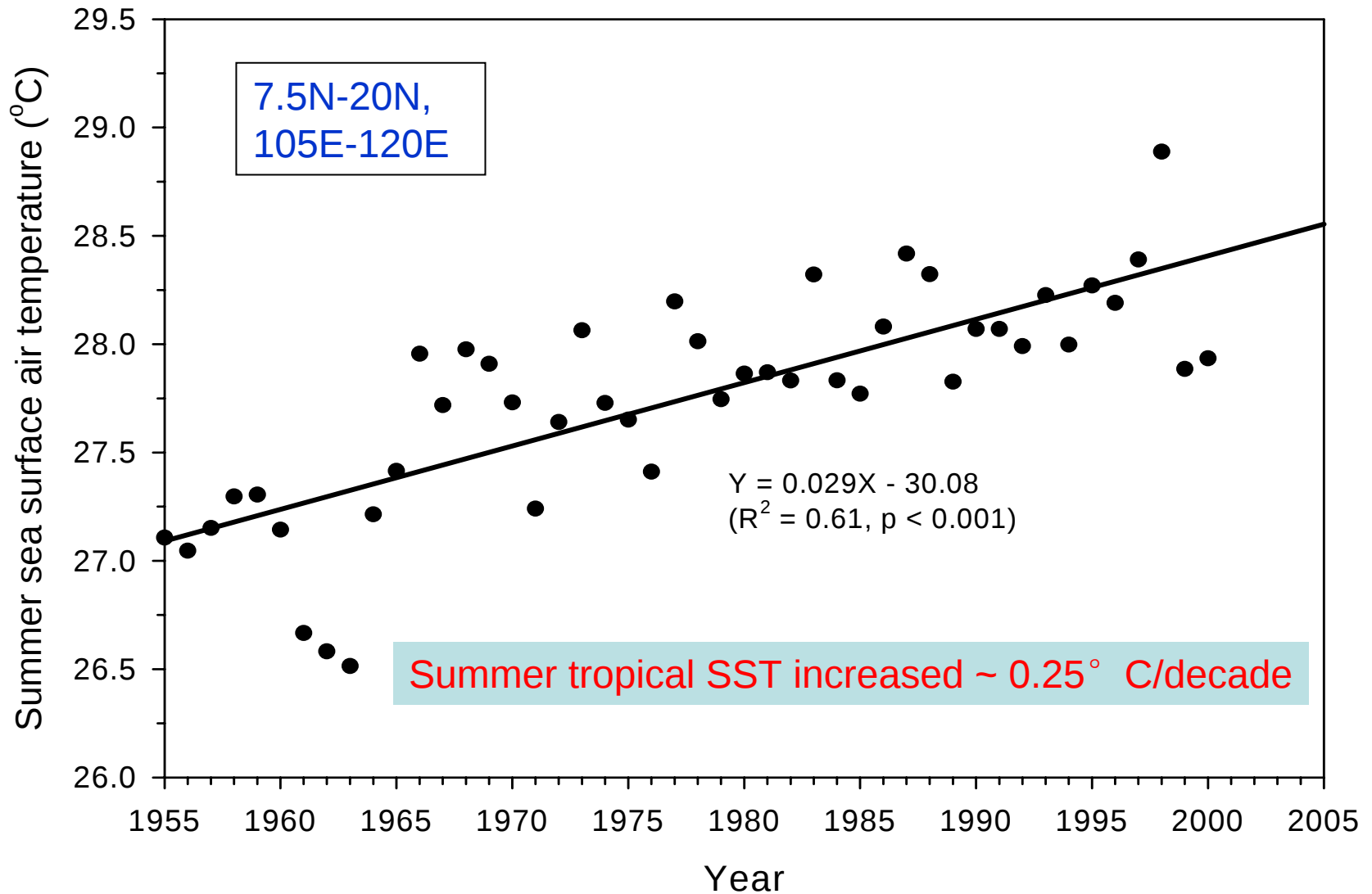


Summer vs. Winter

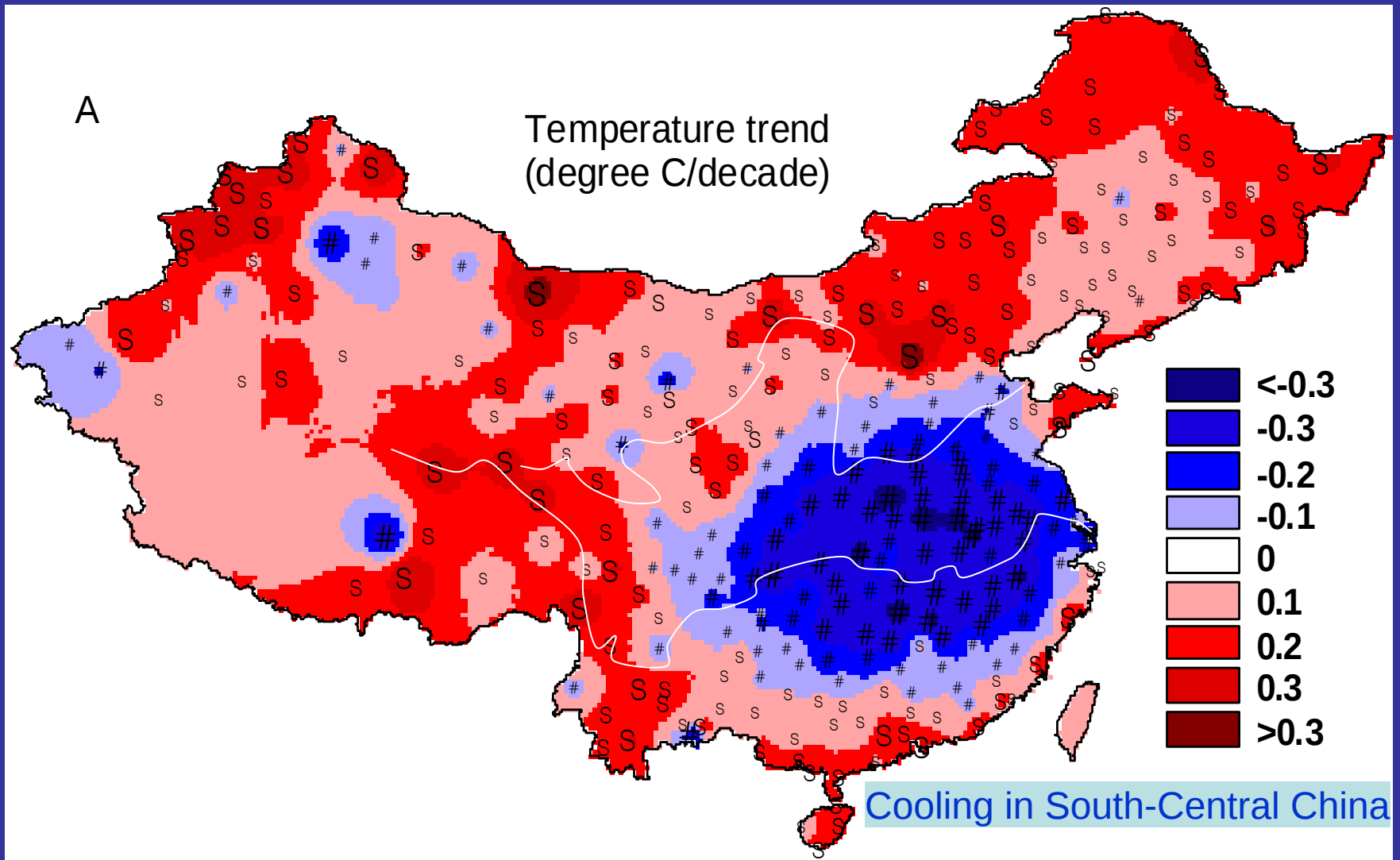


What about summer decline?

Summer SST over SCS & WNPac



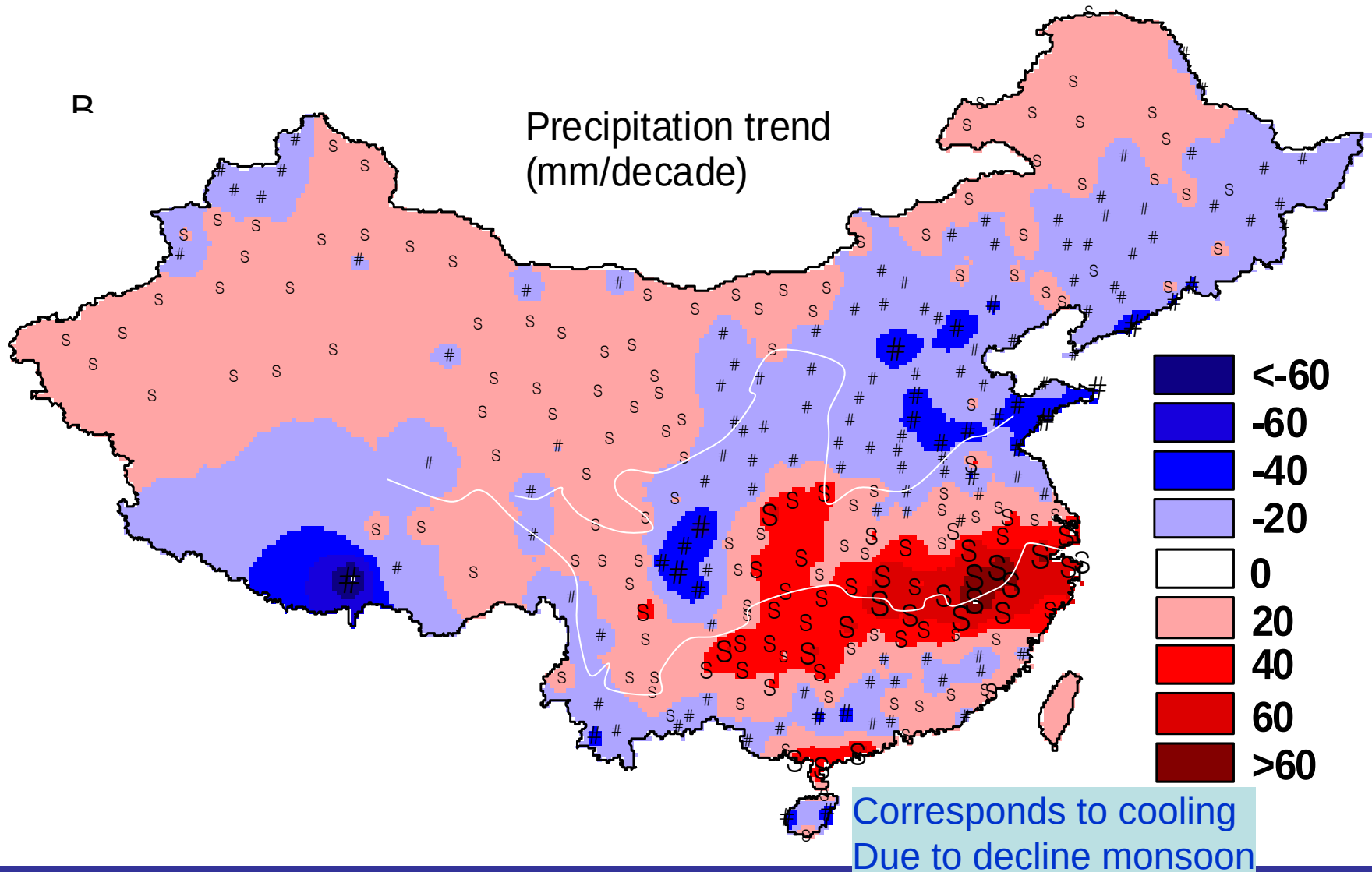
JJA daily max T trend, 1969-2000



What causes So/Cen. China cooling?

- Several climate model simulations suggest that air pollution, especially sulfate aerosols, caused cooling in South-Central China during the past decades of rapid economical growth [*IPCC*, 2001; *Xu*, 2001; *Menon et al.*, 2002].

JJA rainfall trend, 1969-2000



Summary

- EA surface wind speed declined significantly over China since late 1960s.
- Surface incoming solar radiation also highly correlated with the monsoon wind speed.
 - Slower winds → more hazy days?
- Winter monsoon decline correlated with stronger warming over North China than southern oceans.
 - Explainable by global warming.

Summary (cont.)

- Summer monsoon decline linked to cooling So/Cen China and warming SCS/WN Pacific.
 - Contrary to global warming effects in GCMs;
 - Related to local air pollution?
 - Positive feedback between wind decline and increased local pollution
 - Related to snow cover over Tibetan Plateau?
 - Positive feedback among summer wind decline, increased rainfall, and cooling?
- Why stabilized last decade?

N. China winter mean V vs. daily min- T

