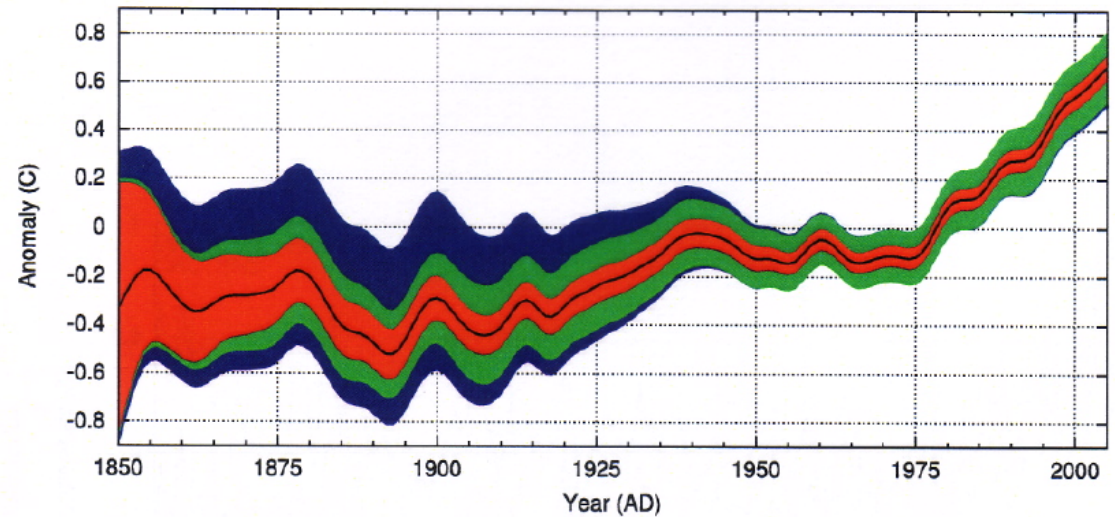


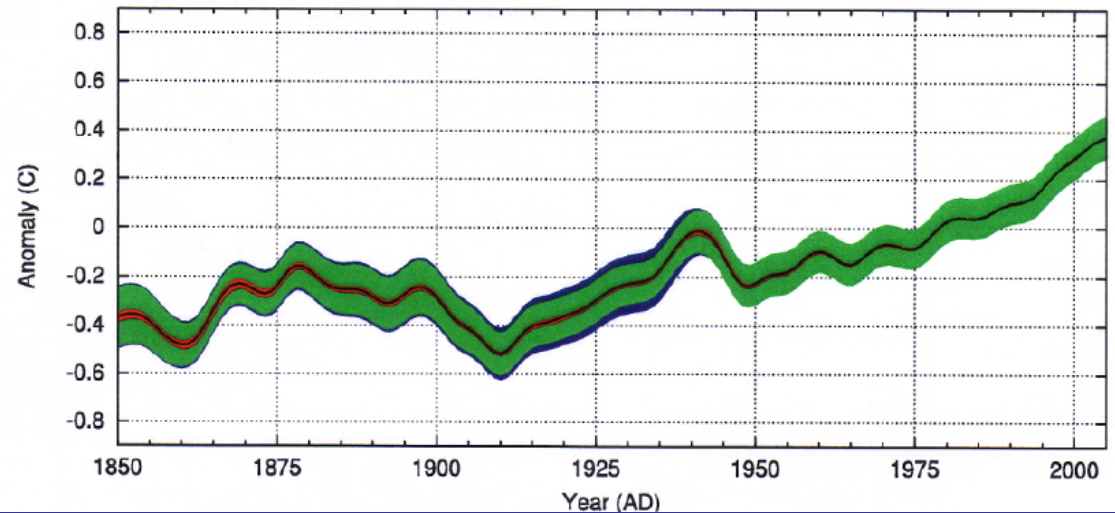
- Observations  
(temperatures, **global**, 150 years)

# Global temperature anomaly (HadCRUT3, °C)

Continents



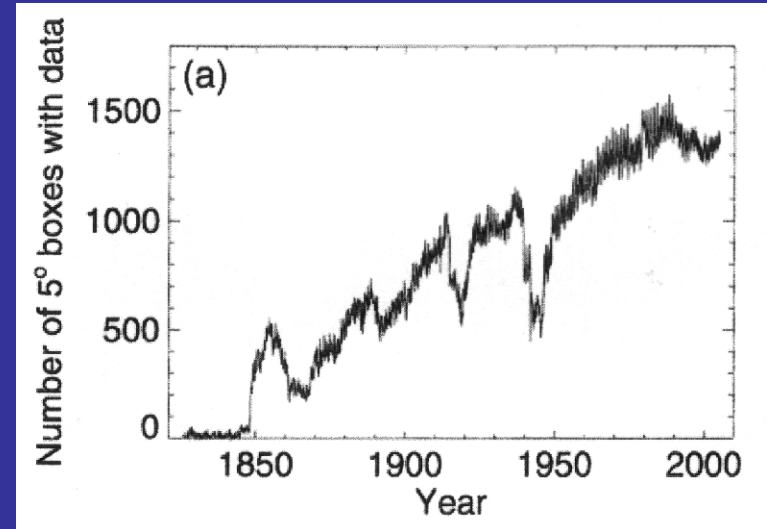
Oceans



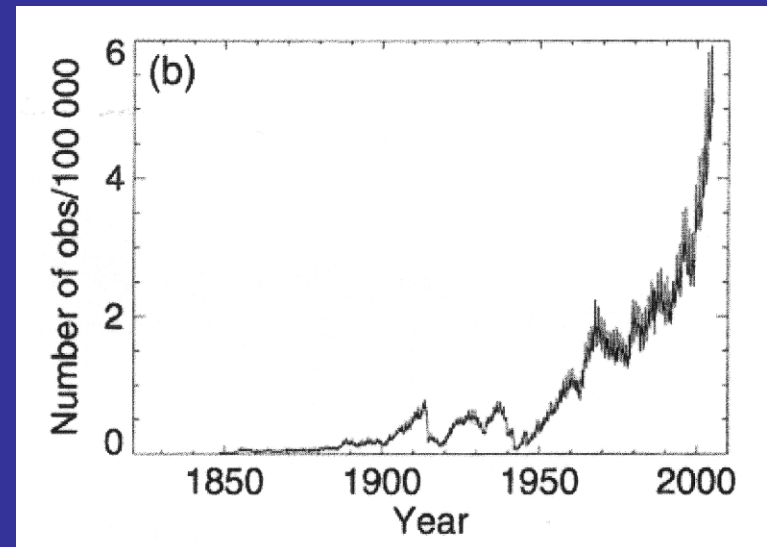
Brohan et al, 2006

# Monthly means of sea-surface temperature anomalies available from 1826 to 2004

Number of 5° cells in the grid with at least one observation in a month

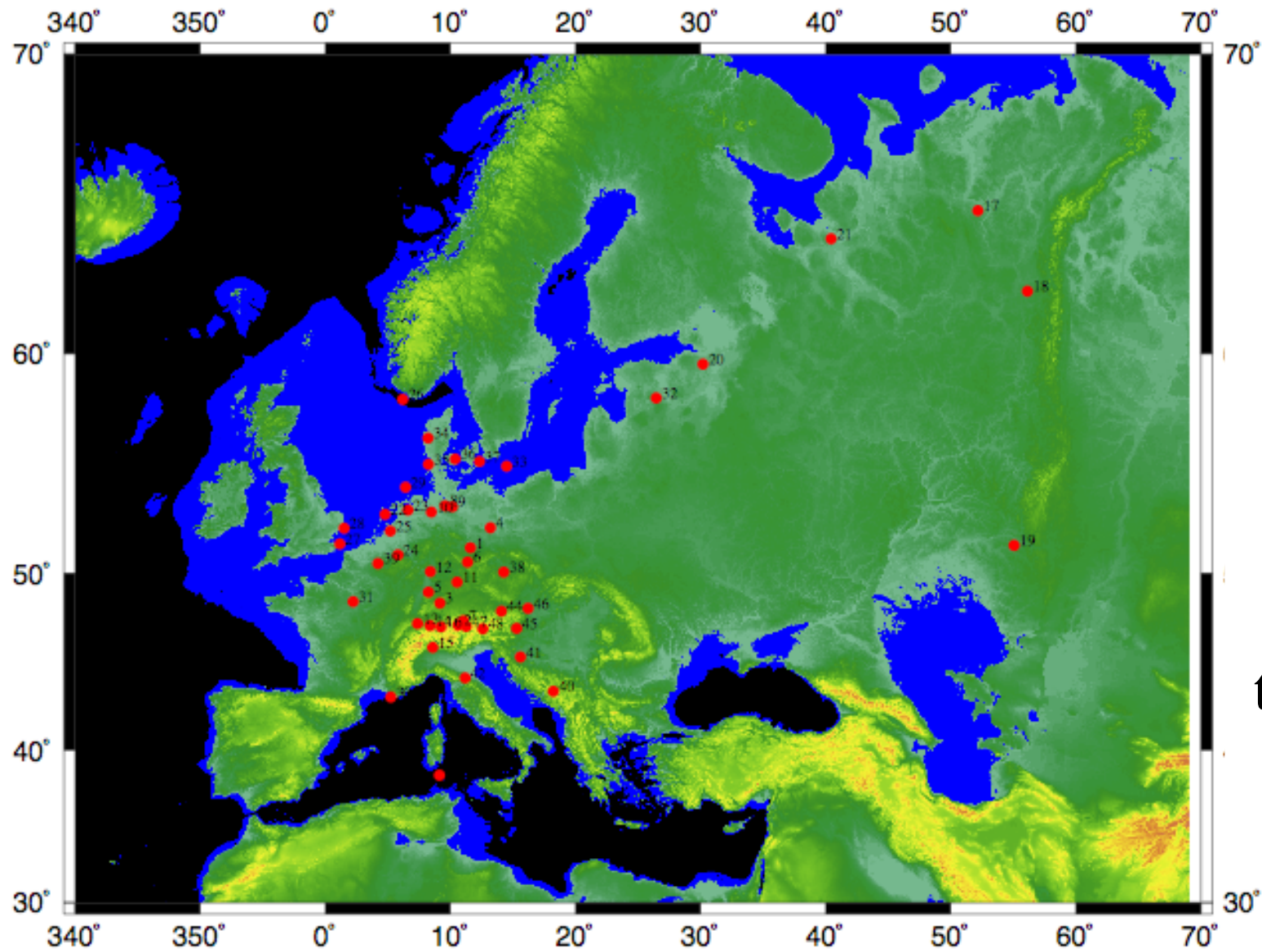


Number of observations



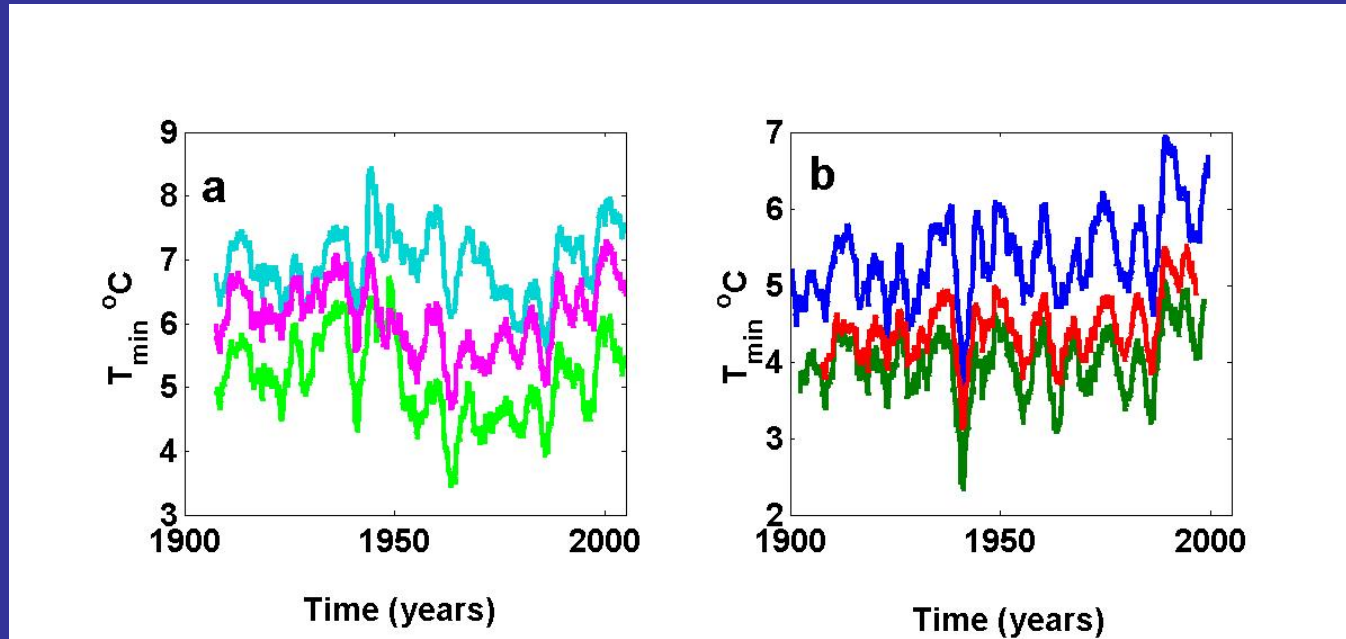
- Observations  
(temperatures, **Europe**, 150 years)





Map of 48  
European  
stations  
with 100  
years of  
daily  
temperature  
data

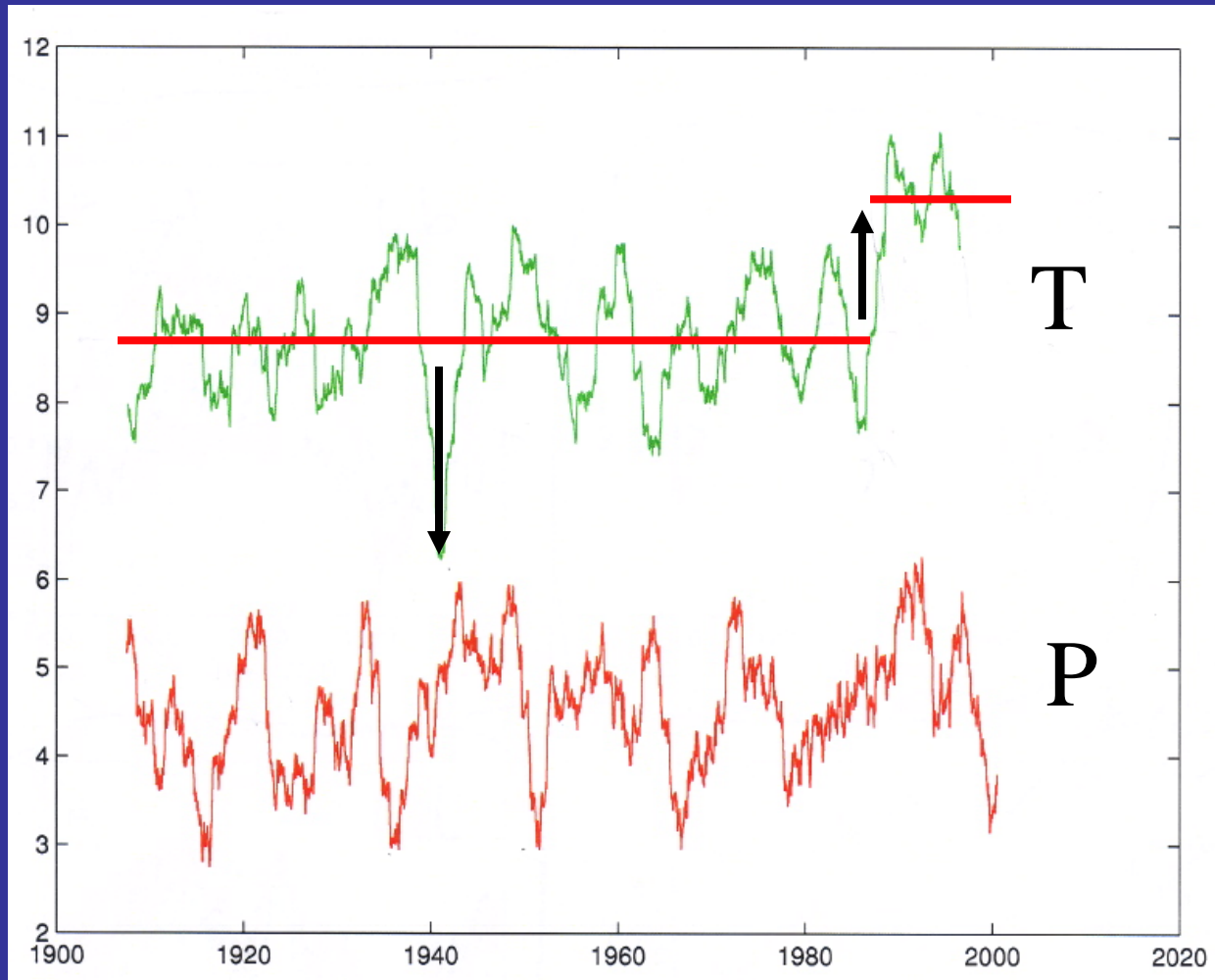
# European temperature series (3-yr running means)



Den Helder de Kooy (cyan),  
Maastricht (magenta),  
Eelde (green)

Denmark (blue),  
Europe (red),  
Switzerland (green)

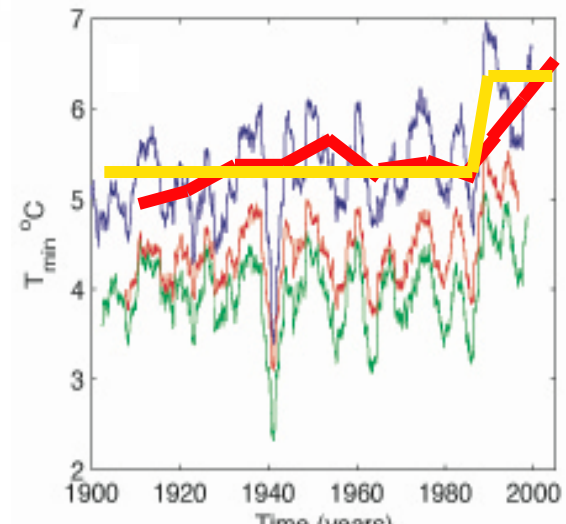
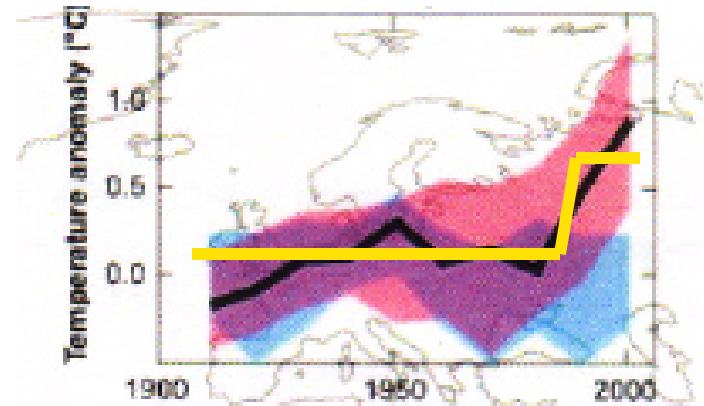
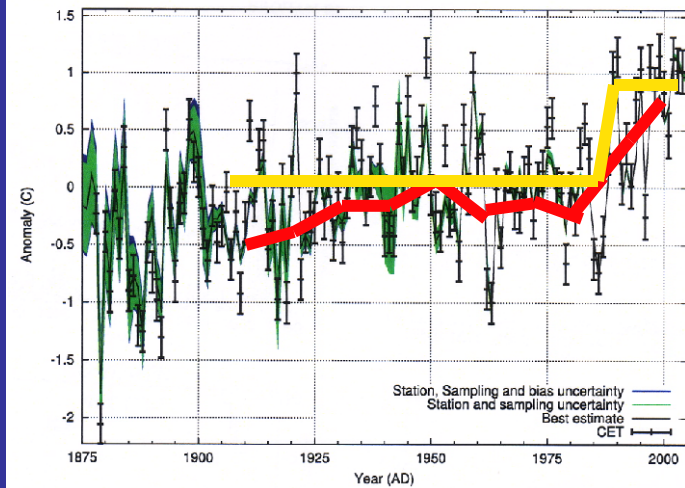
# Overall mean European temperature (green) and pressure (red)



# Central England temperature series

## Mean European temperature (IPCC)

## Mean European temperature (our work)

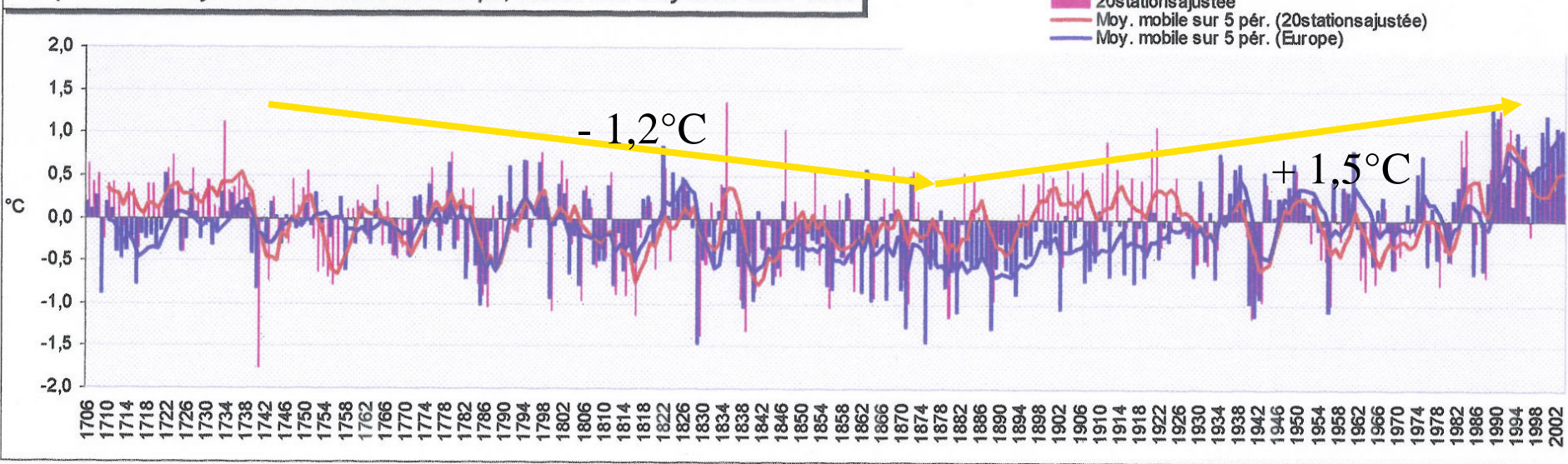


- Observations  
(temperatures, Europe, 300 years)



Overall mean temperature for 20 European stations with 300 years of data (Flageollet, 2007, in red) compared to mixed data (J. Luterbacher, in blue) :

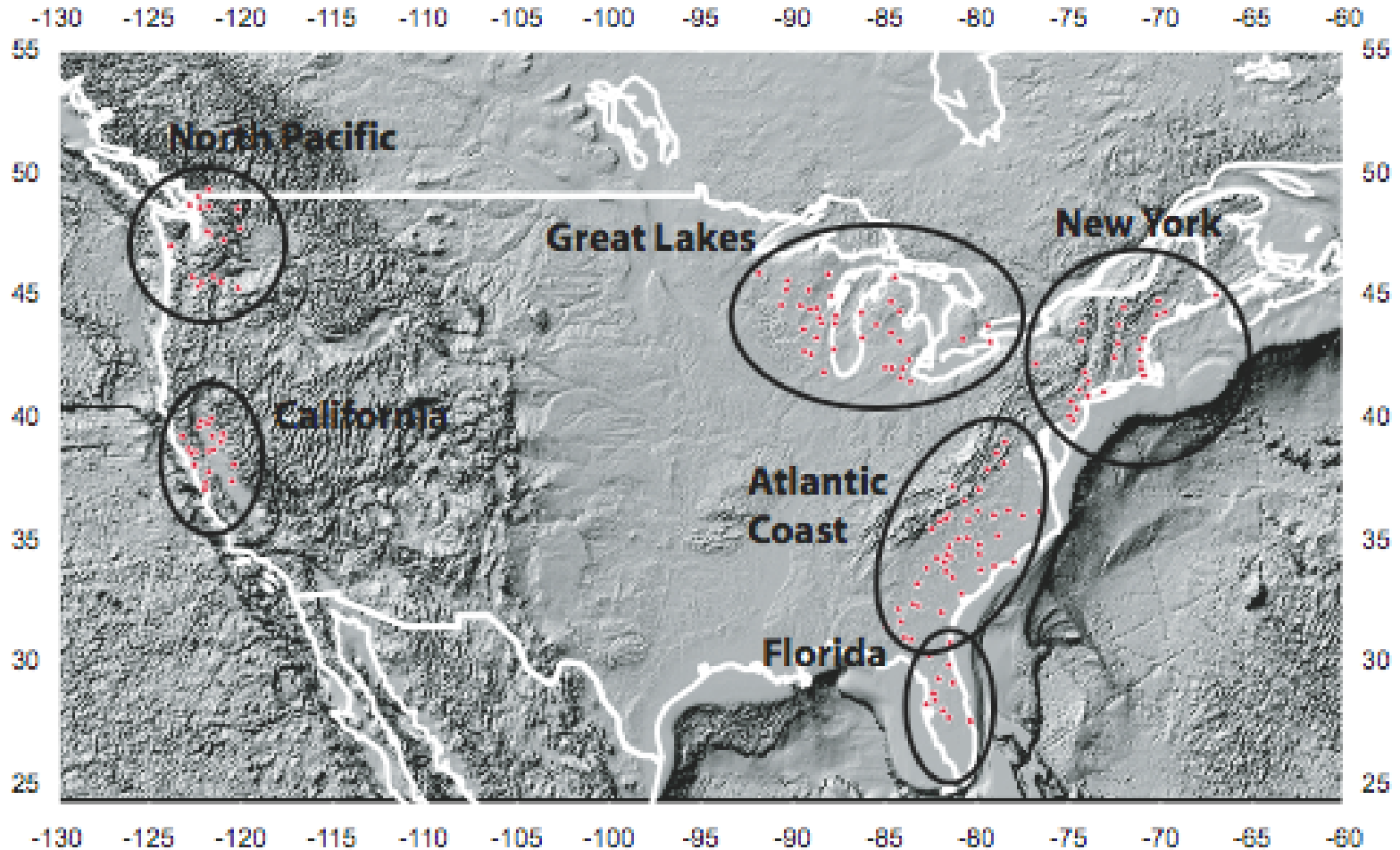
Températures moyennes annuelles en Europe, écarts à la moyenne 1901-1990



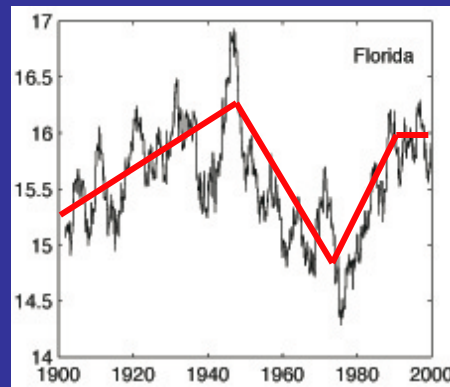
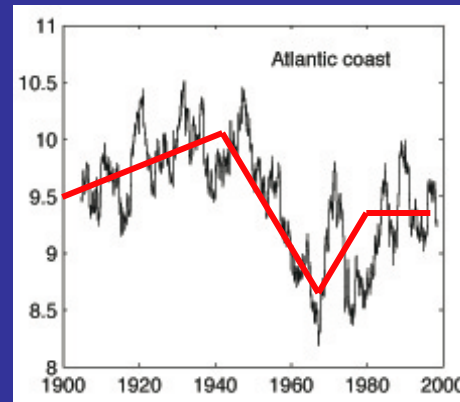
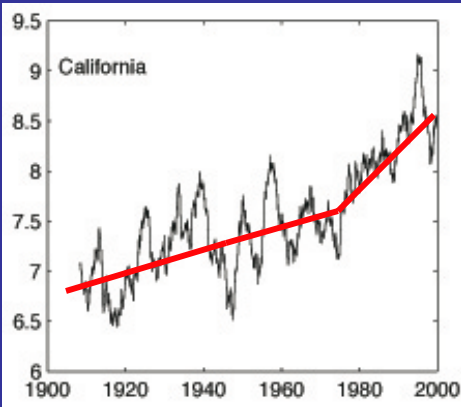
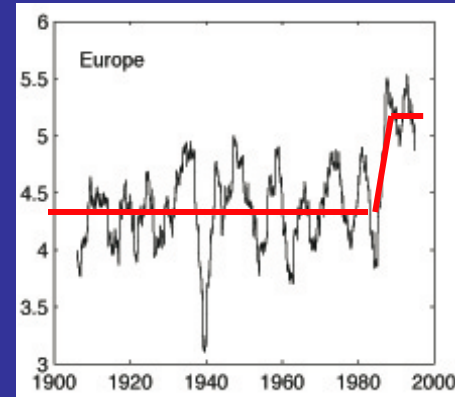
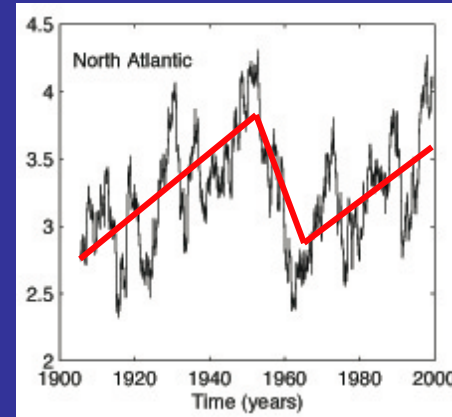
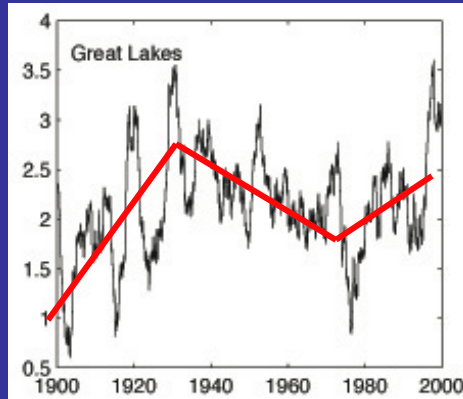
Central England, De Bilt, Basel, Berlin, Le Bourget, Budapest, Copenhagen, Edinburgh, Frankfurt, Genève, Hohenpeissen, Milano, Moscow, Munich, Prague, Saint-Petersburg, Stuttgart, Trondheim, Warsaw, Vienna

- Observations  
(temperatures, **North America**, 100 years)

# Map of 153 US stations with (almost) 100 years of daily temperature data

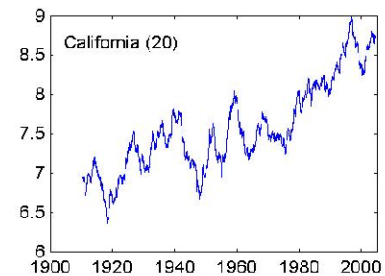
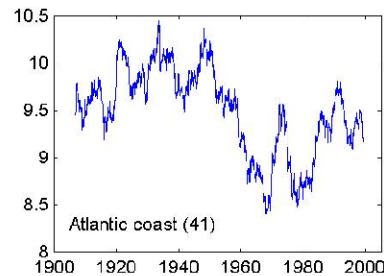
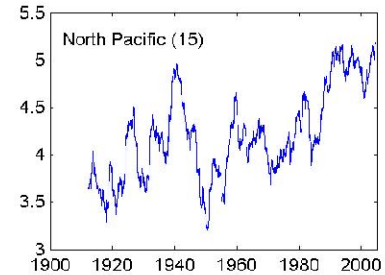
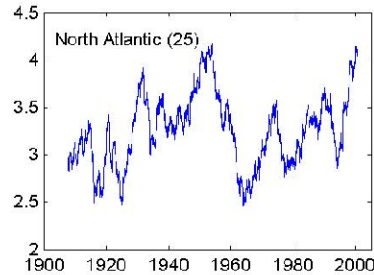
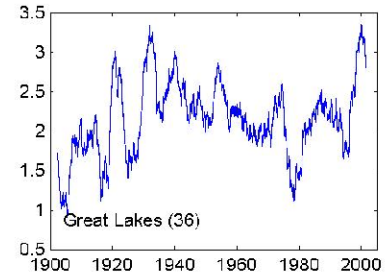
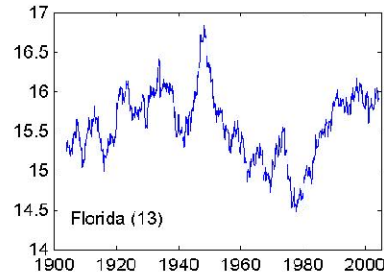
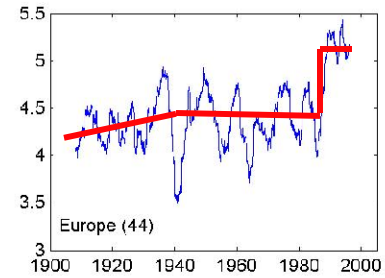
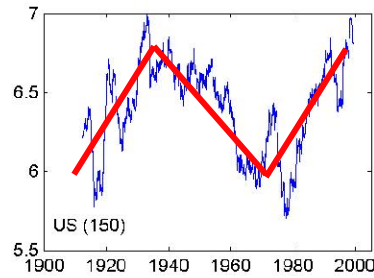






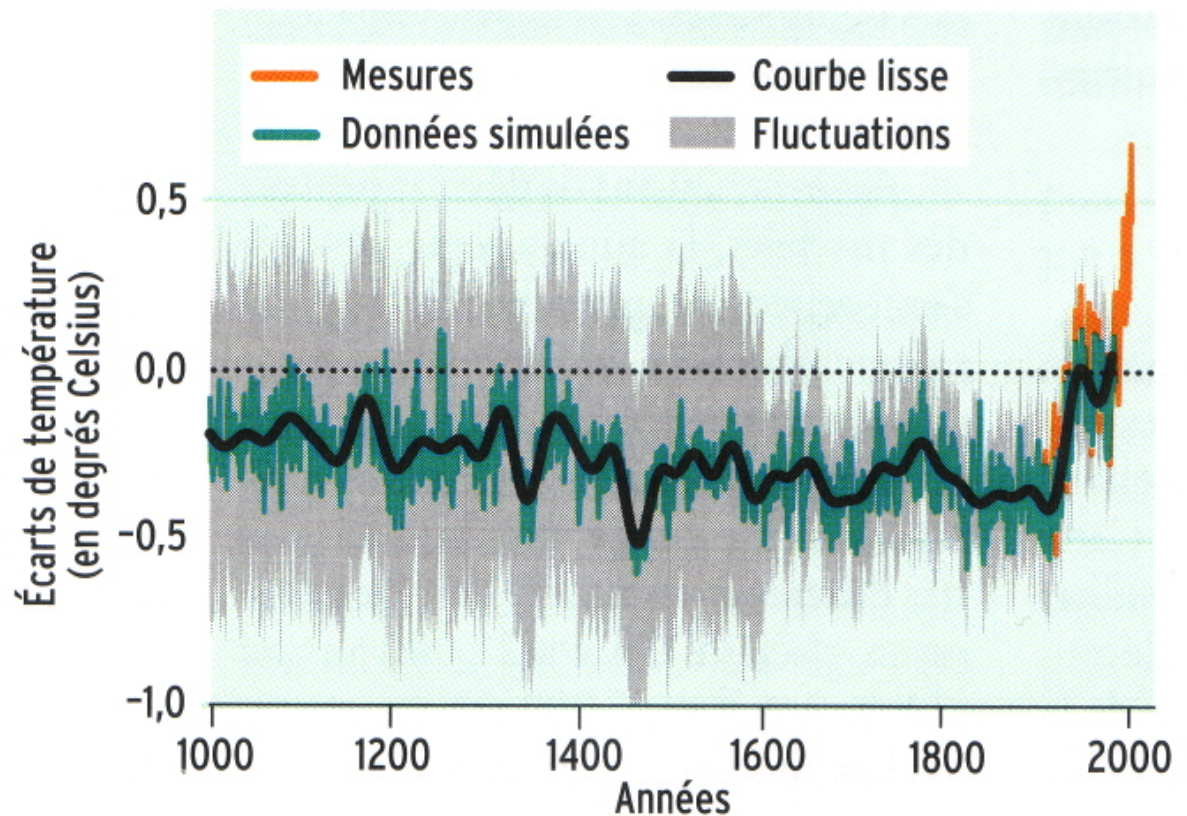
Regional variability  
of long-term trends  
in regional mean  
temperatures (scale  
~2000km; 3-yr  
running means)

Regional variability of  
long-term trends in  
regional mean  
temperatures  
(scale ~2000km;  
3-yr running means)



- Observations  
(temperatures, **global, 2000 years**)

# The Mann et al. « hockey stick curve »



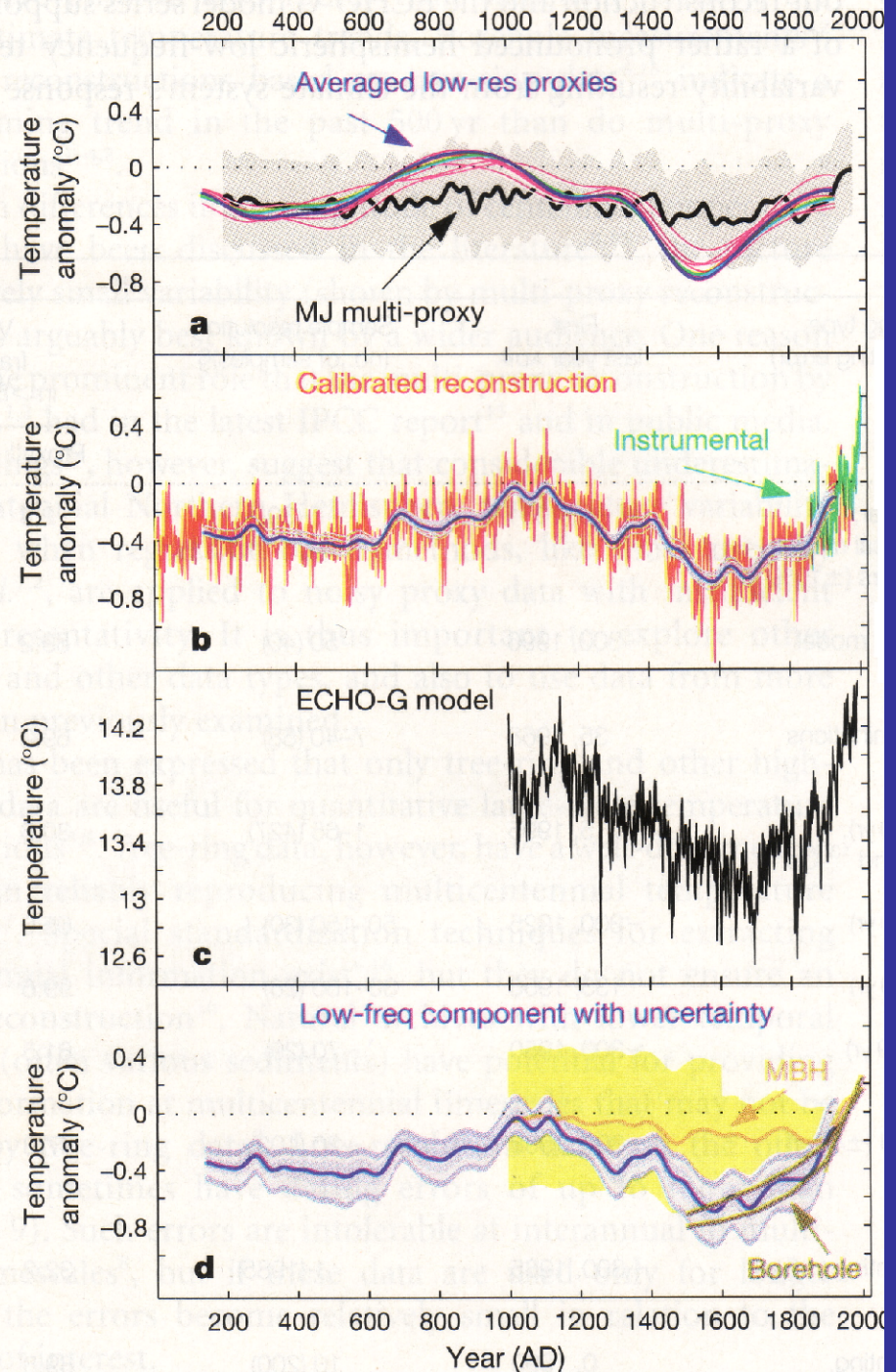
**4. LA CROSSE DE HOCKEY, POINT DE DISCORDE.** Les écarts de température par rapport à la moyenne calculée entre 1961 et 1990 tendent à augmenter. En 2001, la courbe restait en deçà des fluctuations, si bien qu'il était difficile de conclure à un réchauffement. Depuis, la courbe poursuit son ascension.

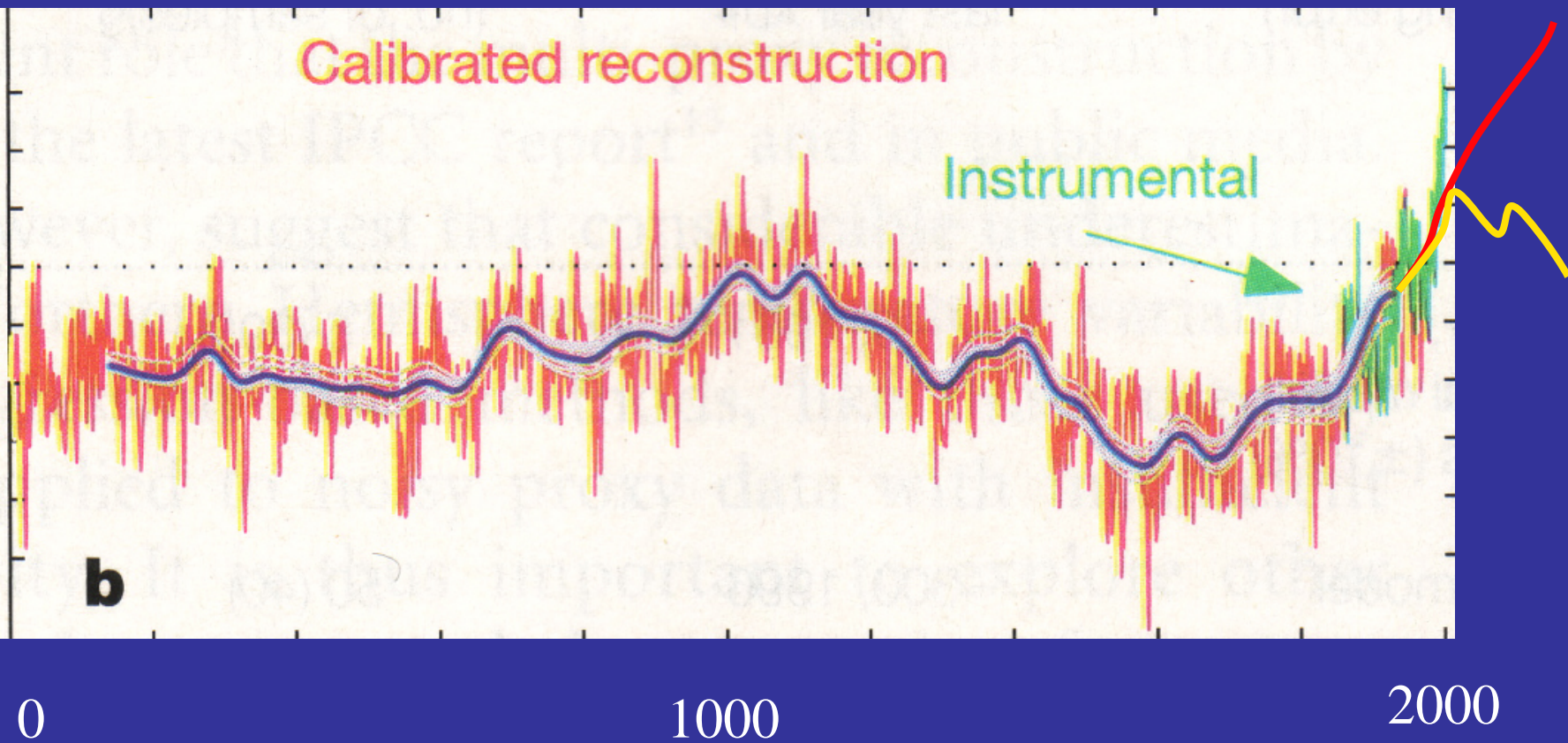


# Reconstruction of mean temperatures from the northern hemisphere based on combined lower (ocean and lake sediments) and higher (tree rings) resolution data

- 2000 years -

Moberg et al, 2005





- **Back to Europe :**  
**introducing “lifetimes”**  
**and uncovering evidence**  
**of some form of solar forcing**

# Lifetimes

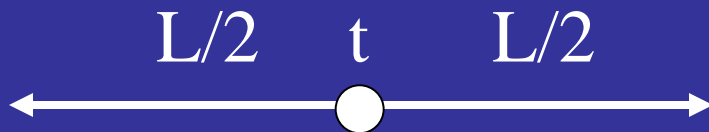
$$F(t) = A (\sin \omega t + c) \cdot \eta(t) \quad \omega = 2\pi/a, \quad a = 1 \text{ an}$$

$$\text{AR1: } \eta(t) = \alpha \cdot \eta(t-1) + \xi(t) \quad \xi(t) \text{ R.V. } (0,1)$$

$\alpha$  slowly varying with time

Estimate:

$$D(t) = \langle [F(t+a) - F(t)]^2 \rangle_{L,t}$$



$$L = 2 \text{ yr} = 730 \text{ days}$$

$$L = 22 \text{ yr} \sim 8000 \text{ days}$$

$$\text{Lifetime : } \Theta(t) \sim 1/(1 - \alpha) \sim D(t)$$



Lifetimes for  
(minimum and mean)  
temperature series  
with  $L = 2$  yr:  
Europe (red),  
Germany (green)

Wolf Number (sunspots)

Lifetimes :  
 $180^\circ$  phase shift between  
primary and secondary  
maxima

