Temperature Reconstructions & The “Mann”

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1/30/2006
Overview:

1. Methods
2. Results
3. Attribution
4. Proxy Pathologies
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Methods
Problem: Climate is complicated

http://www.3dnworld.com/users/1/images/UltimateEarth.jpg
Solution: Reduce degrees of freedom

Pattern 1
Pattern 2
Pattern 3
Pattern 4
Pattern 5
Principal Component Analysis

Patterns in space (EOFs)

Pattern strength (% of variance)

Behavior in time (PCs)
Proxy EOFs

Inverse Problem

Temp. EOFs

Climate Field

Proxy

EOFs
The Data:

- Ice Core
- Instrumental
+ Tree
- Tree PCA
C Coral
Assumptions:

1) Linear relationship
2) Few degrees of freedom
3) Stationarity
Reality:

1) Proxies may have non-linear responses to climate

2) Climate may be non-stationary in time & space
Results
Results

Positive

Negative

RPC no. 1

1400  1500  1600  1700  1800  1900  2000
Is there decadal variability?
Attribution
Criterion for attribution:

1.) Consistent with forcing

2.) Inconsistent with other types of forcing
MBH98/99: 20th century is the warmest in last 1ka

Solar + Volcanic forcing drove preindustrial changes

GHG caused 20th century warming (correlation analysis)
“[Conclusions of M98/99]… have subsequently been supported by an array of evidence that includes both additional large-scale surface temperature reconstructions and pronounced changes in a variety of local proxy indicators, such as melting on ice caps and the retreat of glaciers around the world, which in many cases appear to be unprecedented during at least the last 2,000 years.”
1.) Unprecedented warming
2.) Unprecedented rise in CO$_2$
3.) Lower tropospheric warming
4.) Stratospheric cooling
5.) Consistent with climate models
6.) Warming is less than CO$_2$ potential
But what about **decadal variability**?
Does the IPCC criterion of **attribution** apply?
Proxy Pathologies
I) Temporal Integration:

Ring-width Image from Scott St. George
I) Temporal Integration:

Will this affect DecVar?
II) Age model uncertainty:
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PCA applied to a synthetic dataset

20 records
Each with 3yr, 7yr, & 10yr $\sigma^2$
Age model uncertainty
Noise $\sigma^2$
Is the decadal signal affected?
What about the relative strength of DecVar?
I) Temporal Integration
II) Age model uncertainty

**Good** for signal identification
**Bad** for assessing signal strength
Do these problems effect all proxies?

How might they impact reconstructions?

What do they mean for attribution?

What is the value of multiple proxies?