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the past millennium (2–4) is flawed. For this
and other important reasons, the previously
established conclusion (5) that late 20th
century warming appears to be unprecedented
over at least the past millennium still stands.

Esper et al., like previous studies (2–4),
conclude that peak warmth about 1000 years
ago was comparable to that of the mid-20th
century. However, unlike these previous studies,
they did not compare the peak medieval
warmth against that of the past few decades,
wherein hemispheric temperatures have risen
several tenths of a degree Celsius further
above mid-20th century levels. Their report is
thus not a refutation of the basic finding (5)
that late 20th century warmth is anomalous in
the context of at least the past millennium.

The Esper et al. reconstruction exhibits
greater century-scale variability than the
hemispheric reconstruction of, e.g., Mann
et al. (3), with the greatest differences seen
in the level of cooling during the so-called
Little Ice Age (17th to 19th centuries). As
they indicate, some of these differences
may have a geographic basis. Esper et al.
estimate extratropical (and primarily, warm-
season) temperature changes, using an entire-
extra tropical tree-ring data set. In
contrast, the Mann et al. reconstruction
estimates temperature trends over the full NH,
using both extratropical (tree ring, ice core,
and historical) and tropical (coral, tree ring,
and high-elevation ice core) proxy data and
targeting the full NH temperature. Half of
the surface area of the NH temperature
record estimated by Mann et al. lies at lati-
tudes below 30°N, whereas the Esper et al.
estimate is based entirely on latitudes above
30°N. Tropical surface temperatures are
typically less variable than extratropical
continental surface temperatures on almost
time scales. For example, Hendy et al.
(6) have shown that there is little if any
cooling in a substantial region of the tropi-
cal Pacific during the Little Ice Age, and
they argue that the main signature of the
Little Ice Age is an increase in the poleward
temperature gradient. Such inferences are
consistent with recently demonstrated
dynamical mechanisms for enhanced extrat-
ropical continental cooling in the Little Ice
Age (7). More moderate temperature varia-
tions at the scale of the full NH (2–4) are
consistent with model (5) simulations.

Esper et al. use the regional curve stan-
dardization (RCS) technique in their estima-
tion of temperatures between 800 and 1100
A.D. in spite of the cautions of Cook et al. (8)
and their own injunction that “Successful use
of the RCS method generally requires a large
number of ring-width series because the
method of detrending is not based on any
explicit curve-fitting to the individual series...”
(9, p. 225). Large numbers of samples were
used in their study, but not for the period
around 1000 A.D. Their supplemental Web
fig. 2 (9) shows that only 6 of the total of 14
sites cover this period and that the total num-
ber of samples used for any one year is be-
tween 50 and 70. Dendrochronologists usu-
ally take two samples per tree, so their estimate
of extratropical NH temperature 1000 years
ago is probably based on 25 to 35 trees
spread across six locations. They rightly point
to the need for more long, well-replicated
tree-ring collections covering the period 900
to 1300 A.D.

Rather than refuting past temperature
estimates, the Esper et al. record under-
scores the mounting evidence for substan-
tial differences between tropical and extra-
tropical temperature trends in past cen-
turies and the need for more records of
millennial length and for a better under-
standing of the situations under which
multicentennial climatic information may be
extracted from tree-ring data.

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8. E. Cook, K. Briffa, S. Shiyatov, V. Nazuga, in Method of Dendrochronology: Applications in the Environ-
9. Supplemental material for Esper et al. is available at Science Online at www.sciencemag.org/cgi/content
does/295/5563/2250/DC1

Tree-Ring Chronologies and Climate Variability

The recent report by Esper et al. (“Low-frequency signals in long tree-ring
chronologies for reconstructing past temperature variability,” 22 March, p. 2250) ad-
dresses important scientific questions on the spatial scale of past climate periods such as
the so-called “Little Ice Age” and “Medieval
Warm Period.” It also presents a valuable set
data and demonstrates a novel use of a
promising technique. As already indicated
(1), the basis used by Esper et al. for com-
parison with previous studies of Northern
Hemisphere (NH) temperature trends over

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