and Ukrainian scientists have also gathered health data that should provide grist for international studies.

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Many Citations Support Global Warming Trend

ARGUING AGAINST CONCLUSIONS ABOUT global warming reached by Donald Kennedy in his Editorial "An unfortunate U-turn on carbon" (30 Mar., p. 2515), S. Fred Singer says, "...the overwhelming balance of evidence shows no appreciable warming trend in the past 60 years; hence, it is unlikely to be significant in the future" (Letters, "Global warming: an insignificant trend?" 11 May, p. 1063). He is wrong on both counts.

The evidence for warming over the last 60 years is unequivocal, even if the direct instrumental record is ignored. The change in temperature has led to a major reduction in the mass of alpine glaciers in almost all parts of the world (*1*), an increase in permafrost thawing at high latitudes (*2*) and at high altitudes (*3*), a reduction in the extent and thickness of Arctic sea-ice (*4*), later

> "...regardless of arguments over instrumental versus satellite-based estimates of [global] warming... there are multiple indicators of warming in the 20th century..."

freeze-up and earlier break-up dates of ice on rivers and lakes (*5*), and an increase in the calving rate of Antarctic ice shelves (*6*). There is no evidence or reason to think that these systems have a lag response to warming of 50 years or more [e.g., (*7*)]. There have also been shifts in the distribution of plant and animal species, both latitudinally and altitudinally (*8*), changes in the phenology of plant leafing and flowering (*9*), and the storage of significant quantities of heat in the near-surface ocean (*10*), as well as an overall rise in sea-level driven by both continental ice melting and a steric change due to the increase in overall ocean temperature (*11*). In addition, there have been remarkable increases in ground temperatures over the last millennium (*12*).

Thus, regardless of arguments over instrumental versus satellite-based estimates of warming in recent decades (*13*), there are multiple indicators of warming in the 20th century that paint a vivid picture of the global-scale environmental consequences of the temperature increase. Going forward in time, the accelerating rate of fossil fuel consumption will drive global temperatures to levels not seen in at least a millennium, and probably higher than for many thousands of years. This scenario will play out in a world whose population will increase by 50% over the next century.

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The Scope of Medieval Warming

HEMISPHERIC MEAN TEMPERATURES THAT have been reconstructed with a wide range of climate proxies indicate that temperatures were warmer in Medieval times than during the subsequent "Little Ice Age" (~1550 to 1850) (*1*). However, all studies of large-scale climate variations reveal some regions that do not follow the global or hemispheric trend [for example, (*2*)], so selecting a few data points, as W. S. Broecker does in his Perspective (*Science*'s Compass, 23 Feb., p. 1497), adds little to resolving the title question he poses: "Was the Medieval Warm Period global?"

Furthermore, Broecker's statement that only borehole temperatures and snowlines can reconstruct temperatures to within 0.5°C is not supported in the literature. Reconstructing global temperature re-