temperature data set, which provides monthly temperature anomalies (with respect to 1961–90) for 5° × 5° grid boxes based on land and ship reports[2]. A spatially weighted average of the HadCRUT grid boxes that have data from 1958 to 2000 gives a warming of 0.176 °C per decade, which is significant at the 95% level.

Doran *et al.* calculated spatially smoothed trends using a technique that allowed grid boxes (there are only 16 of these south of 65° S) to have a radius of influence of roughly 25% of the maximum width of the image, which we believe is too large, considering the highly localized nature of the factors that influence the climate at many of the stations. We suggest that the interpolation has given too much weight to grid boxes in data-sparse regions, resulting in a misleading representation of cooling over the continent, which is not supported by *in situ* or remote-sensing data.

Doran and colleagues' Fig. 2 shows annual and seasonal temperature trends for 1966–2000, with the largest cooling occurring in autumn over an area from the southern Weddell Sea to the South Pole. There is also pronounced cooling in spring and in annual trends. However, their Fig. 2 does not show the marked warming on the western side of the Antarctic Peninsula, which is greatest during winter[3]. It is unclear why the authors chose 1966–2000 for their analysis, as most of the temperature series in the HadCRUT data set begin in the late 1950s.

Although the spacing of stations around the coast is reasonable in the eastern hemisphere, there are large gaps in the data for the coast of west Antarctica, and only two stations in the interior have long records: those at the South Pole and Vostok (78.5° S, 106.9° E). The area in which Doran *et al.* report the greatest cooling is devoid of stations with long records, and HadCRUT includes no data for this region.

The warming on the western side of the Antarctic Peninsula is of limited spatial extent and is greatest close to Faraday Station (65.3° S, 64.3° W), where the trend for 1951–2000 is an increase of 1.09 °C per decade during winter and 0.56 °C per decade annually (both values are significant at the 95% level). However, at Halley Station (75.5° S, 26.4° W), where there is a continuous record dating back to 1957, there is an indication of a slight cooling over this period during autumn, but a small warming during other seasons, although none of these trends is statistically significant. The South Pole shows limited cooling in each season, although only the annual trend of 0.20 °C of cooling per decade is statistically significant at the 90% level. Data from Vostok for 1957–2000 do not show any statistically significant trend in any season or in the annual data.

Trends in the ice-skin temperature based on remote-sensing data have been examined[4] for 1979–98. The greatest cooling was found over the high plateau of east Antarctica, with some cooling over west Antarctica, but with warming over the area from the southern Weddell Sea towards the South Pole. Another study[5] examined temperature trends across west Antarctica using automatic weather-station observations and satellite passive microwave measurements: the only statistically significant trend found at the 95% level was an increase of 2 °C at Siple (75.9° S, 84.2° W) over the period 1979–97.

Attempting to derive a temperature trend for the entire Antarctic continent is almost meaningless, as huge areas are devoid of long-term, *in situ* climate measurements. At present, the trends from the various stations present a spatially complex picture of change across the continent during recent decades and do not indicate any consistent warming or cooling.

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Doran et al. *reply* —Turner *et al.* do not find fault with our main focus — the rapid ecological response to recent cooling in the McMurdo Dry Valleys. The essence of their comment is that the spatial interpolation of the Antarctic continental data set (our Fig. 2) does not provide a meaningful picture of recent temperature trends. Although any interpolation is open to question, we note the following points.

First, weighting by inverse-fourth-power of separation distance in our analysis effectively eliminates contributions near to the 2,284-km radius of influence if other stations are closer. Only between the Antarctic Peninsula and the Ross Sea does the gap between points approach the radius of influence. Second, the trend maps in our Fig. 2 have features that are finer than the quarter-image radius of influence, indicating that that local data prevail in our analysis. Third, the interpolated fields are consistent with the summaries for 1976–2000 in Fig. 2.10 of the recent IPCC WG-I report[1] and with trends based on a different data set[2] for 1965–1999, an interval that was chosen because it was one of global warming. A recent depiction[3] of combined summer and autumn Antarctic surface-temperature trends from 1969 to 2000 is similar to ours, although our data suggest that cooling is more pronounced during autumn periods than in summer.

The key question that arises is this: is our interpolation better than arithmetic averaging? We contend that, although the interpolations involve uncertainty, they highlight the fact that a full assessment of Antarctic temperature trends requires more than the averaging schemes that have so far been used to imply that Antarctica has been warming at a rate that is faster than the global average[4,5].

In estimates of hemispheric anomalies or trends (for example, see the IPCC's Figure 2.7; ref. 1), regions that are devoid of data are effectively assigned anomalies (or trends) that are equal to the hemispheric means of anomalies (or trends) for areas for which data exist. This type of assignment ignores information from even nearest-neighbour grid cells. We maintain that our approach represents an improvement over arithmetic means of station values or grid cells, provided that the nature of the interpolation procedure is clearly stated.

Only by interpolation can one hope to determine the area fraction and spatial pattern of continental warming or cooling, regardless of the magnitudes of such trends — which are irrelevant to our conclusions. As Antarctic trends obviously vary spatially, seasonally and interdecadally, interpolation will ultimately be required to optimize the information contained in historical data.

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