Global Temperature and Europe's Frigid Air

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Figure 1(a) shows January-November 2010 surface temperature anomalies (relative to 1951-80) in the preliminary GISS analysis. This is the warmest January-November in the GISS analysis, which covers 131 years. However, it is only a few hundredths of a degree warmer than 2005, so it is possible that the final GISS results for the full year will find 2010 and 2005 to have the same temperature within the margin of error.

As described in an in-press paper (link provided below) that defines the GISS analysis method, we estimate a two-standard-deviation uncertainty (95 percent confidence interval) of 0.05°C for comparison of global temperatures in nearby recent years. The magnitude of this uncertainty and the small temperature differences among different years is one reason that alternative analyses yield different rankings for the warmest years. However, results for overall global temperature change of the past century are in good agreement among the alternative analyses (by GISS, NOAA National Climate Data Center, and the joint analysis of the UK Met Office Hadley Centre and the University of East Anglia Climatic Research Unit).

Figure 1(b) shows November 2010 surface temperature anomalies based only on surface air measurements at meteorological stations and Antarctic research stations. In producing this map the radius of influence of a given station is limited to 250 km to allow extreme temperature anomalies to be apparent. Northern Europe had negative anomalies of more than 4°C, while the Hudson Bay region of Canada had monthly mean anomalies greater than +10°C.

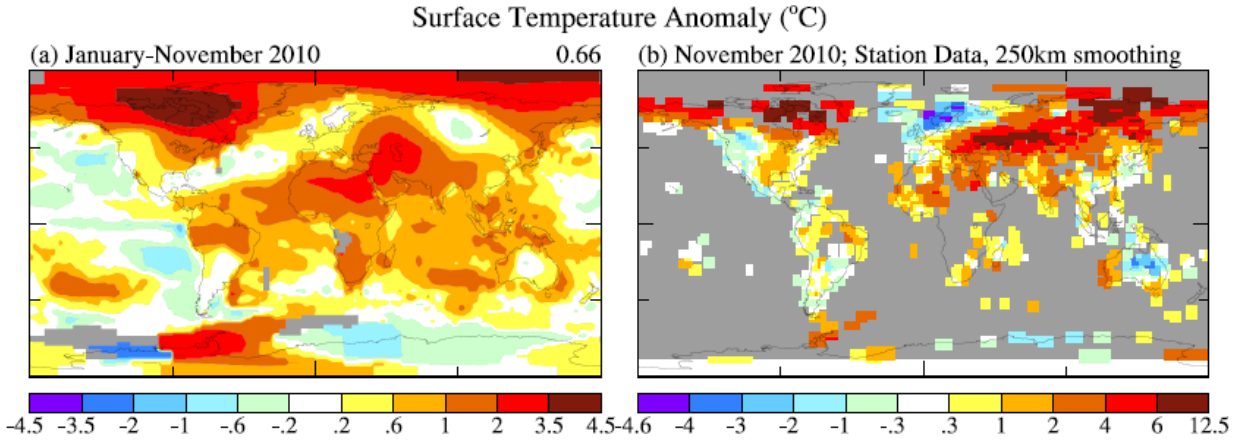

Fig. 1. (a) January-November surface air temperature anomaly in GISS analysis, (b) November 2010 anomaly using only data from meteorological stations and Antarctic research stations, with the radius of influence of a station limited to 250 km to better reveal maximum anomalies.

The extreme warmth in Northeast Canada is undoubtedly related to the fact that Hudson Bay was practically ice free. In the past, including the GISS base period 1951-1980, Hudson Bay was largely ice-covered in November. The contrast of temperatures at coastal stations in years with and without sea ice cover on the neighboring water body is useful for illustrating the dramatic effect of sea ice on surface air temperature. Sea ice insulates the atmosphere from ocean water warmth, allowing surface air to achieve temperatures much lower than that of the ocean. It is for this reason that some of the largest positive temperature anomalies on the planet occur in the Arctic Ocean as sea ice area has decreased in recent years.

The cold anomaly in Northern Europe in November has continued and strengthened in the first half of December. Combined with the unusual cold winter of 2009-2010 in Northern Hemisphere mid-latitudes, this regional cold spell has caused widespread commentary that global warming has ended. That is hardly the case. On the contrary, globally November 2010 is the warmest November in the GISS record.

Figure 2(a) illustrates that there is a good chance that 2010 as a whole will be the warmest year in the GISS analysis. Even if the December global temperature anomaly is unusually cool, 2010 will at least be in a statistical tie with 2005 for the warmest year.

Figure 2(b) shows the 60-month (5-year) and 132-month (11-year) running-mean surface air temperature in the GISS analysis. Contrary to frequent assertions that global warming slowed in the past decade, as discussed in our paper in press, global warming has proceeded in the current decade just as fast as in the prior two decades. The warmth of 2010 is especially noteworthy, given the strong La Nina that developed in the second half of 2010. The La Nina, caused by unusually strong easterly equatorial winds, produces the cool anomalies in the tropical Pacific Ocean as cold upwelling deep water along the Peruvian coast is blown westward along the equator.

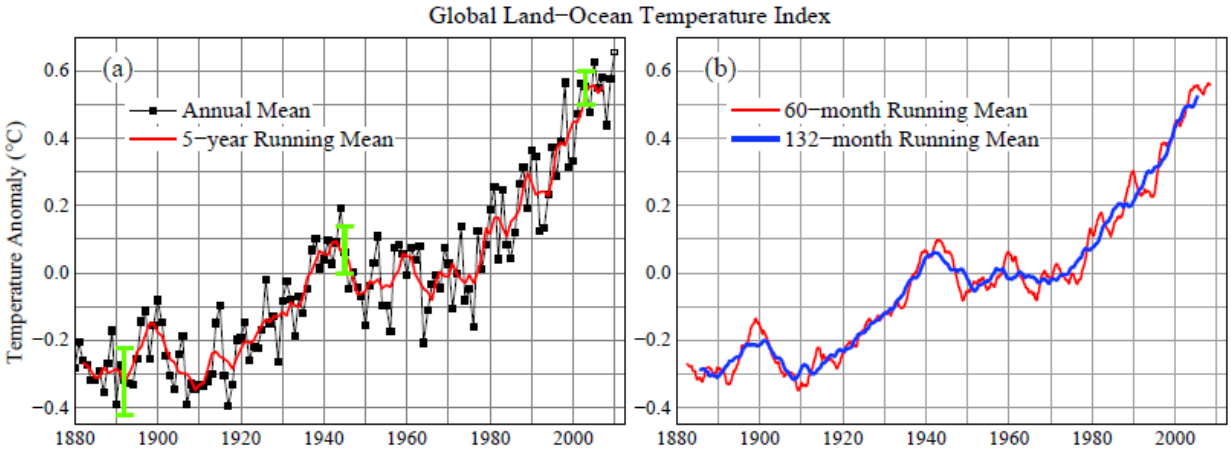

Fig. 2. Global surface air temperature anomalies relative to 1951-1980 mean for (a) annual and 5-year running means, and (b) 60-month and 132-month running means. In (a) the 2010 point is a preliminary 11-month anomaly. Green vertical bars are two-standard-deviation error estimates, as discussed in our Rev. Geophys. paper.

Back to the cold air in Europe: is it possible that reduced Arctic sea ice is affecting weather patterns? Because Hudson Bay (and Baffin Bay, west of Greenland) are at significantly lower latitudes than most of the Arctic Ocean, global warming may cause them to remain ice free into early winter after the Arctic Ocean has become frozen insulating the atmosphere from the ocean. The fixed location of the Hudson-Baffin heat source could plausibly affect weather patterns, in a deterministic way – Europe being half a Rossby wavelength downstream, thus producing a cold European anomaly in the trans-Atlantic seesaw. Several ideas about possible effects of the loss of Arctic sea ice on weather patterns are discussed in papers referenced by Overland, Wang and Walsh (http://www.arctic.noaa.gov/reportcard/atmosphere.html).

However, we note in our Reviews of Geophysics paper in press that the few years just prior to 2009-2010, with low Arctic sea ice, did not produce cold winters in Europe. The cold winter of 2009-2010 was associated with the most extreme Arctic Oscillation in the period of record. Figure 3, from our paper in press, shows that 7 of the last 10 European winters were warmer than the 1951-1980 average winter, and 10 of the past 10 summers were warmer than climatology. The average warming of European winters is at least as large as the average warming of summers, but it is less noticeable because of the much greater variability in winter.

Finally, we point out in Figure 3 the anomalous summer warmth in 2003 and 2010, summers that were associated with extreme events centered in France and Moscow. If the warming trend that is obvious in that figure continues, as is expected if greenhouse gases continue to increase, such extremes will become common within a few decades.

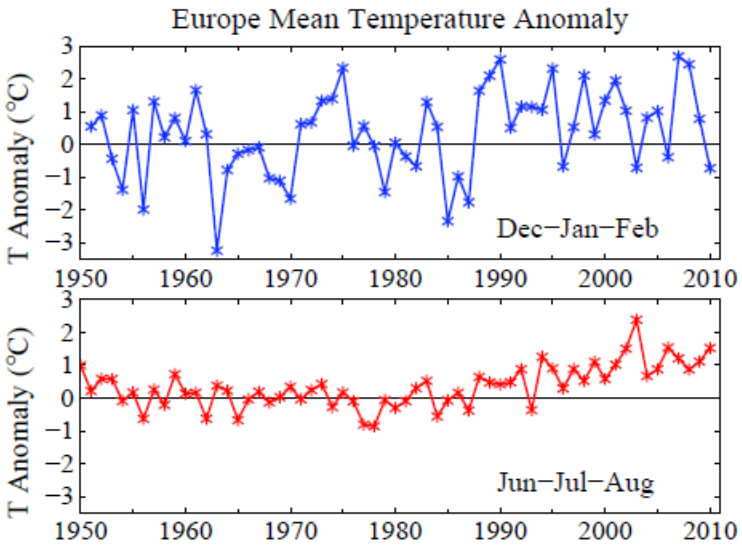

Fig. 3. Temperature anomalies relative to 1951-1980 for the European region defined by 36°N-70°N and 10°W-30°E.

The summary section of our Rev. Geophys. paper is available here and the entire paper here.

A copy of this webpage text is also available as a PDF document.

Reference

Hansen, J., R. Ruedy, M. Sato, and K. Lo, 2010: Global surface temperature change, *Rev. Geophys.*, in press. (PDF)

Contacts

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