Auxiliary Material for Paper 2011GL050610

Long tails in regional surface temperature probability distributions with implications for extremes under global warming

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Introduction

Table S1 provides a list of 29 total stations for which temperature distributions were analyzed, including 21 not explicitly shown in the paper, summarizing occurrences of longer- or shorter-than Gaussian tails (denoted by subscript L or S, respectively) for the low (L) or high (H) side of the distribution for each of daily minimum, average or maximum temperature (T_{min}, T_{ave}, T_{max}), for each season (JJA and DJF). Candidates for departure from Gaussian had to meet the following criterion: For long tails, at least 90% of the points beyond 2σ (with σ the standard deviation of the core) exceeded the 95th percentile error bar generated for each bin from the AR(1) process described in the main text. For short tails, at least 90% of the points beyond 1.5σ fell below the corresponding 5th percentile error bar. The distributions meeting these criteria were then examined, further applying a subjective criterion of eliminating candidates that did not appear as clear-cut as those shown on the main text. Specifically, 1 long and 6 short tail candidates were dropped for which the tail points were modestly above the 95% or below the 5% error bounds but for which it could be conceivable that an alteration of the procedure, for instance a asymmetric fit of the core, could put these within the error bars. This was done to provide a conservative count of non-Gaussian tails that includes only convincing cases. The subjectively excluded cases were all from stations having other non-Gaussian tails, so these do not affect the summary counts below except for the count of short tails.

Out of the 3 variables, 2 seasons and 29 stations, i.e. 174 entries in Table S1, 81 of the entries qualify as having non-Gaussian tails on at least one side by this criterion, i.e. 47% (49% in JJA, 44% in DJF). Out of the 29 stations, the number having at least one long tail among the three temperature variables is 18 in JJA and 15 in DJF. The number of stations having at least one short tail is 11 in JJA and 13 in DJF. Of the 29 stations, 22, i.e. 76%, had at least one variable qualifying as non-Gaussian in each of JJA and DJF. Only 2 stations qualified as close to Gaussian for all variables in both seasons.

Figure S1 shows the information from Table S1 but in graphical format, focusing (for graphical clarity) on the continental United States where 17 of the 29 stations occur. In addition to providing a visual sense of the prevalence of non-Gaussian tails, this format helps to illustrate the strong dependence of the tail characteristics on region discussed in the main text, underlining the need to better understand the physical mechanisms that produce the departures from Gaussianity, including the asymmetry and the sources of regional dependence. It is conjectured that a fairly high spatial resolution will be required to address this, suggesting that a suitable procedure may involve validating high resolution reanalysis and/or regional models against station data for these properties, and then investigating spatial dependence in the reanalysis or model data set with full spatial coverage.

Table S1. Occurrences of non-Gaussian tails at additional stations. For each of the three variables (T_{min}, T_{ave}, T_{max}), L_L and H_L represent low-side and high-side longer-than-Gaussian tails, respectively, and L_S and H_S represent low-side and high-side shorter-than-Gaussian tails, respectively; 0 represents no tail meeting the criteria.

Station	**JJA**			**DJF**		
	T_{min}	T_{ave}	T_{max}	T_{min}	T_{ave}	T_{max}
Baltimore-Washington Intl. AP, Baltimore, MD	H_S	0	0	0	0	0
Beijing Capital Intl. AP, China	0	0	L_L	0	0	0
Capetown Intl. AP, South Africa	0	0	H_L	L_L	H_L	0
Changi AP, Singapore	L_S,H_S	L_L	L_L	0	H_S	L_L
Chitose Air Base, Sapporo, Japan	0	0	0	0	0	0
Ciampino AP, Rome, Italy	0	0	0	L_S	H_S	H_L
Dallas-Fort Worth Intl. AP, TX	L_L	H_S	L_L	0	0	H_S
Dubai Intl. AP, United Arab Emirates	0	0	0	0	0	H_L
Ellington AFB, Houston, TX	L_L	L_L,H_S	L_L	L_S	0	H_S
Fiumicino AP, Rome, Italy	0	0	H_L	L_s	0	0
Johannesburg Intl. AP, South Africa	0	L_L	L_L	L_L	0	L_L
La Guardia AP, New York City, NY	0	0	0	0	0	0
Lakeland Linder Reg. AP, FL	L_L,H_L	0	L_L	H_S	H_S	H_S
Long Beach AP, CA	0	L_S,H_L	H_L	0	H_L	L_S,H_L
Los Angeles Intl. AP (LAX), Los Angeles, CA	0	H_L	H_L	0	H_L	L_S,H_L
March AFB, Riverside, CA	0	0	0	0	0	L_S
Modesto City-County AP, CA	0	0	0	L_S	0	0
Ocean pier, Santa Monica, CA	0	H_L	H_L	0	H_L	L_S,H_L
O'Hare Intl. AP, Chicago, IL	0	0	0	H_S	0	L_L
Orly AP, Paris, France	0	L_S	L_S	0	H_S	0
Philip Billard Muni. AP, Topeka, KS	0	0	0	0	0	0
Phoenix Sky Harbor Intl. AP, AZ	0	L_L,H_S	L_L	0	0	0
Ruzyne AP, Prague, Czech Republic	0	0	L_S	L_L,H_S	L_L	0
San Juan Intl./Martin AP, Puerto Rico	0	L_L	L_L,H_L	L_L	0	L_L,H_L
Seattle-Tacoma AP, WA	H_L	L_S,H_L	H_S	0	L_L	0
Stockton Met. AP, CA	L_S,H_L	L_S	0	L_S	0	L_L
Travis AFB, Fairfield, CA	H_L	L_S,H_L	L_S	0	0	0
Walker Field AP, Grand Junction, CO	0	L_L	L_L	L_L	L_L	0
Wiley Post-Will Rogers AP, Barrow, AK	H_L	H_L	L_s	0	0	H_L

Figure S1. Occurrences of non-Gaussian tails at stations in the continental US. Information from Table S1 is displayed in graphical form for the 17 stations examined in the continental US. For each of the three variables (T_{min}, T_{ave}, T_{max}), L_L and H_L represent low-side and high-side longer-than-Gaussian tails, respectively, and L_S and H_S represent low-side and high-side shorter-than-Gaussian tails, respectively. A dot marking a station with no accompanying letter indicates a case with no tail meeting the criteria.