

# Running Out of Cool Days

How climate change is decreasing the odds of optimal marathon conditions

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## KEY FINDINGS

Researchers have found there is a “[sweet spot](#)” for marathon temperatures where runners perform their best. But as the planet warms, those optimal race-day conditions are becoming less likely. This report explores which races are projected to remain record-breaking contenders — and which risk losing their competitive edge if fossil fuel pollution remains unchecked.

- Of 221 global races analyzed, 190 of them (86%) will see a decline in odds of optimal running marathons for either recreational or elite runners by 2045, including all seven [Abbott World Marathon Majors](#).
- For elite male runners, the Tokyo Marathon offers the highest likelihood of ideal conditions — there was a 69% chance of optimal temperatures in Tokyo on March 2, 2025 — among the seven Abbott World Marathon Majors. But it’s also expected to see the largest decline in odds by 2045 (dropping by 12 percentage points) for this group of runners.
- Elite female runners are uniquely resilient, maintaining optimal performance at higher temperatures than elite men and other runner types — though their odds of experiencing ideal race-day conditions are still projected to decline over the next two decades.
- The exceptional heat experienced at the 2025 Berlin and Tokyo Marathons was well above peak performance conditions and was made two and three times more likely, respectively, by human-caused climate change.
- Earlier race start times (closer to sunrise rather than late morning) would increase the chances of optimal running temperatures. However, the most effective way to preserve ideal race-day conditions is by taking meaningful action to curb fossil fuel pollution.

## DATA

- [Explore our data interactive](#) to see the data for specific marathons and the top marathons for each runner type
- [Download the data](#)

## INTRODUCTION

Running a successful marathon involves training, mental resilience, and good shoes — and the right weather. Researchers have found there is a “sweet spot” for marathon temperatures where runners perform their best, and performance declines in temperatures above and below the optimum. But as the planet warms, those ideal race-day conditions are becoming less likely.

Scientists have studied how temperature impacts the speed of marathon runners and found that for runners at the elite level, men run best in cooler conditions (on average, about 4°C or 39°F) and women do better at warmer temperatures (10°C or 50°F) (Table 1). For recreational runners, men run best at 6°C (43°F), and women run best at 7°C (44°F). Their results are consistent with studies from other marathons that use different methods.

Table 1. *Optimal temperatures for running performance in marathons*

Gender	Skill level	Lower temperature	Optimal temperature	Upper temperature
Men	Elite	30°F (-1°C)	39°F (4°C)	48°F (9°C)
Men	Recreational	37°F (3°C)	43°F (6°C)	51°F (11°C)
Women	Elite	41°F (5°C)	50°F (10°C)	59°F (15°C)
Women	Recreational	37°F (3°C)	44°F (7°C)	51°F (11°C)

*Note: Temperatures are rounded to the nearest integer. The optimal temperature is from El Helou et al., 2012, and the lower and upper temperatures represent the lower and upper bounds of ranges derived from a statistical fit to the paper's data.*

Human-caused climate change is shifting temperatures upward across the globe, shrinking the window for ideal marathon conditions. This report explores which races are projected to maintain optimal conditions — and which are losing their competitive edge — as global temperatures continue to rise.

## ABOUT THE ANALYSIS

We analyzed temperature conditions on the days of 221 marathons worldwide in 2025: all seven Abbott World Marathon Majors, all 158 races sanctioned by World Athletics, and a representative set of other major races across Europe, Canada, and the United States.

Using our [Climate Shift Index \(CSI\) system](#), we calculated the probability of each race day reaching temperatures at optimal running conditions — in other words, what the chances are that a runner will experience the ideal temperature for their skill level and gender on the day of their marathon. We calculated those probabilities for 2025, 2035, and 2045, using climate projections from the SSP3-7.0 scenario for the future years.

The two skill levels analyzed are referred to as “elite” runners and “recreational” runners. Elite refers to the top 1% of runners, and recreational refers to the median runner, whose marathon times fall at the middle of the pack.

We analyzed the probabilities using the daily average temperature (average of the day’s high and low temperatures), which is representative of the conditions encountered by most runners in most races. We also calculated the probabilities based on daily low temperatures, which typically occur near sunrise. This represents one adaptation option — switching to an earlier start time.

See **Methodology** below for more details.

## RESULTS

### → **The Tokyo Marathon leads the World Majors in optimal temperature probabilities, but not for long**

The seven Abbott World Marathon Majors represent the pinnacle of global marathon racing; joining the “seven star hall of fame” is a coveted achievement for elite runners. However, for elite athletes chasing records, rising temperatures are decreasing the odds of record-breaking runs (Table 2).

Note: the statistics in this section all represent probabilities, not actual conditions. See the section below for an exploration of how actual temperatures from 2025 races compare to their expected likelihood.

- Of the seven Abbott World Marathon Majors, the 2025 Tokyo Marathon had the highest likelihood of ideal conditions, with an 80% chance for recreational runners (averaged for men and women) and a 69% chance for elite men. Probabilities for Tokyo were also favorable for elite women (78%), but London had the highest likelihood of ideal conditions for them, with an 87% chance.
- At the 2025 Sydney Marathon, only elite women — with their higher temperature tolerances — had any chance for peak conditions (31%). For other runners, the warm early spring conditions that tend to come in August make peak conditions highly unlikely. On Aug. 31, 2025, the day of the race, elite

female runners experienced ideal conditions with an average temperature of 13.8°C (56.8°F), a temperature beyond optimal conditions for other runner types.

- From 2025 to 2045, the largest projected decline in ideal race conditions among the Abbott World Marathon Major races is for elite men at the Tokyo Marathon, dropping from 69% to 57%. So while the probability of ideal conditions at the Tokyo Marathon is best now, it's going to see a significant drop in 20 years, if carbon pollution is not curbed.
- Elite women are expected to experience the largest drop in odds between 2025 and 2045 at the Berlin Marathon, dropping from 40% to 29%. However, warming could slightly improve race-day conditions for elite women at the Boston Marathon (79% to 82%) and Tokyo Marathon (78% to 85%) over the same period.

### → **Climate change drove the unusual heat during the Tokyo and Berlin Marathons in 2025**

- While the 2025 Tokyo Marathon had the highest probability of ideal conditions for most runners, the race day did not deliver those conditions.
- On March 2, 2025, the day of the Tokyo Marathon, runners experienced an average temperature of 15.2°C (59.4°F) — about 8.2°C (14.7°F) warmer than normal. The temperature reached a [CSI level 3](#), meaning the unusual warmth was made three times more likely because of human-caused climate change. This indicates a very strong climate change influence.
- For a race like the 2025 Berlin Marathon, the chances of optimal temperatures were very low for most runners — 5% for recreational women, 4% for recreational men, and 1% for elite men.
- The 2025 Berlin Marathon [made headlines](#) for being exceptionally warm. On Sept. 21, 2025, runners experienced an average temperature of 20.7°C (69.3°F) — about 6.7°C (12.1°F) warmer than normal. The temperature reached a [CSI level 2](#), meaning the unusual warmth was two times more likely because of human-caused climate change. This indicates a strong climate change influence.

Table 2. Probability of optimal temperatures on race days for Abbott World Marathon Majors

Marathon	Elite men - 2025	Elite men - 2045	Elite women - 2025	Elite women - 2045
Tokyo Marathon	69%	57%	78%	85%
Boston Marathon	61%	53%	79%	82%
London Marathon	22%	17%	87%	81%
New York City Marathon	19%	17%	71%	66%
Chicago Marathon	14%	14%	57%	54%
Berlin Marathon	1%	0%	40%	29%
Sydney Marathon	0%	0%	31%	21%

Note: The table shows probabilities of optimal temperatures for 2025 and 2045 for elite runners.

→ **To adapt to a warmer future, earlier race start times would increase the odds of optimal temperatures**

One way to reduce the impact of climate change-driven warming on race performance is to start races earlier in the day. The probabilities below, showing the likelihood of experiencing optimal race conditions, are based on daily low temperatures, which typically occur near sunrise.

- Racing in the coolest part of the day would provide the greatest benefit to elite men, boosting the chances of peak conditions in 2045 by 44 percentage points in London (from 17% to 61%), 31 percentage points in Tokyo (from 57% to 88%), and 27 percentage points in Boston (from 53% to 80%).
- For recreational runners (men and women averaged), the races that would see the greatest benefits to racing early in the day in 2045 would be in London (up 40 percentage points), Berlin (up 29 points), and New York (up 22 points).
- Because elite women perform better in warmer temperatures, an earlier start would decrease their chances of optimal conditions in 2045 in Tokyo (down 41 percentage points) and Boston (down 18 points). The greatest benefits to racing early in the day in 2045 for elite women would occur in Berlin (up 51 percentage points) and Sydney (up 37 points).

## CONCLUSION

Around 1.1 million people finish a marathon each year, but as the planet warms due to climate change, the cool, comfortable race-day conditions that help runners perform their best are becoming harder to find. For most recreational runners, the odds of racing in perfect conditions are already slim for some races. For elite athletes chasing records, they're facing some races where optimal temperatures are nearly impossible. A different future will require significant and lasting emissions cuts to minimize carbon pollution.

## METHODOLOGY

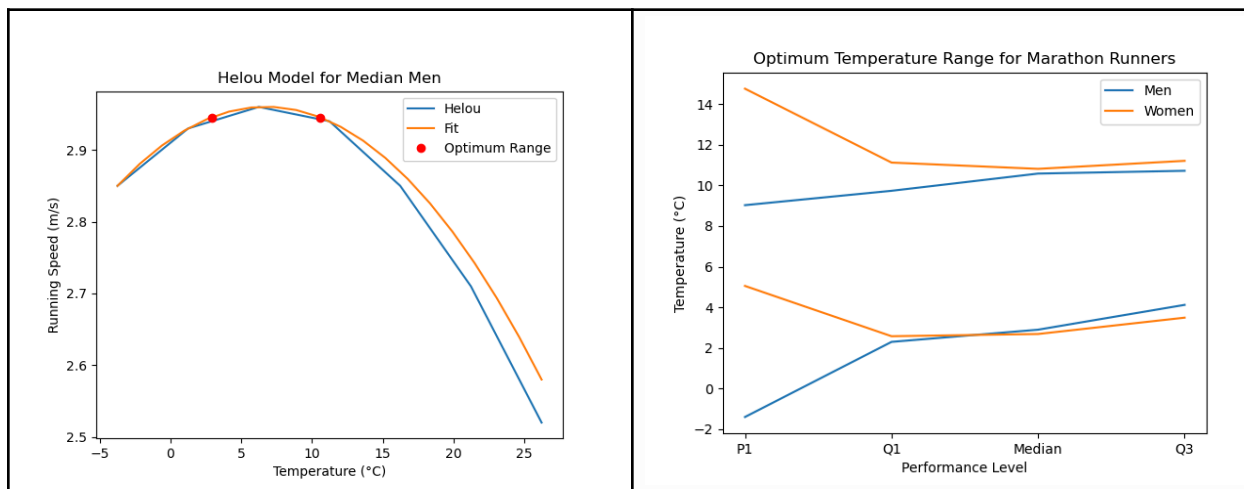
We identified the optimal temperature range for elite and recreational runners (men and women) by fitting a quadratic function to data on running speed at different temperatures reported by [El Helou et al., \(2012\)](#). We then found the temperature range over which the speed is within 99.5% of the maximum for those runners (Figure 1 and Table 1).

We used data from Climate Central's Climate Shift Index system to find the probability of encountering optimal running conditions for 221 races. This set includes:

- All seven Abbott World Marathon Majors.
- All races sanctioned by World Athletics.
- Representative races on all continents except Antarctica.
- At least one race in each European country, Canadian province, and U.S. state.

For each race, we found the nearest location and race date in the CSI system (0.25° by 0.25° grid cell based on ERA5). The system combines observational data and climate model data to assess how the frequency distribution of local temperatures changes as the global climate warms from 0.4°C above the pre-industrial average (mean climate of 1970) through 2.0°C (expected climate in 2050 based on SSP3-7.0). To account for biases between observations and climate models, before averaging the data together, we calculated each model's temperature probability bias relative to the observational data for a reference climate period, then adjusted the model data by that difference such that all methods give the same probability for this climate.

We analyzed the probabilities using the daily average temperature, which typically aligns with late-morning temperatures, when most runners are running most races. We also considered the probabilities based on daily low temperatures, which typically occur near sunrise. This represents one adaptation option — switching to an earlier start time.



**Figure 1.** Left: Running speed as a function of temperature for recreational men. The blue line is from El Helou et al. 2012. The orange curve is the quadratic fit to their data. The red dots indicate the optimal temperature range. Right: Optimal temperature range for men (blue) and women (orange) across four skill levels: P1 = top 1% of runners (referred to as “elite” runners in the analysis), Q1 = top 25%, Median (referred to as “recreational” runners in the analysis), Q3 = top 75% runners.

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