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Supplementary appendix

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Online-only Supplements

Title: Estimating the reduced heat-related mortality burden due to greenness: a global modelling study

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1. eMethods

1.1 Mortality and temperature data

We obtained mortality and temperature data from the Multi-City Multi-Country (MCC) database (https://mccstudy.lshtm.ac.uk/). The detailed information of the database has been described elsewhere.[1] Briefly, the MCC is a global consortium established to investigate the health impacts of environmental stressors, particularly temperature, on mortality.[1-7] The primary data types collected, including Mortality Data (daily counts of all-cause or non-external cause deaths) and meteorological Data (daily measurements of temperature and other relevant weather variables). By integrating these datasets, the MCC facilitates robust analyses of the relationships between environmental exposures and health outcomes across diverse global settings. The MCC database collects and continues to collect daily series on mortality and weather data from locations around the globe. The most recent version of the MCC database includes 852 locations in 53 countries with different study periods. For this analysis, we excluded locations with a missing rate of mortality greater than 20% and years with non-random missing data. In total, 830 locations in 53 countries contributed to the analysis, including Argentina (3 cities, 2005-2015), Australia (5 cities, 2010-2017), Brazil (17 cities, 1997-2018), Bulgaria (5 cities, 2000-2020), Canada (26 cities, 1986-2015), Chile (4 cities, 2004-2014), China (15 cities, 1996-2015), Colombia (5 cities, 1998-2013), Costa Rica (1 city, 2000-2017), Cyprus (5 cities, 2004-2019), Czech Republic (4 cities, 1994-2020), Ecuador (2 cities, 2014-2018), Estonia (5 cities, 1997-2020), Finland (1 city, 1994-2014), France (20 cities, 2000-2017), French Guiana (1 city, 2000-2015), Germany (15 cities, 1993-2020), Greece (1 city, 2001-2010), Guadeloupe (1 city, 2000-2015), Guatemala (1 city, 2009-2016), Iceland (1 city, 2000-2018), Iran (2 cities, 2002-2015), Ireland (6 cities, 1984-2007), Israel (4 cities, 1985-2020), Italy (18 cities, 2006-2015), Japan (47 cities, 1972-2020), Kuwait (1 city, 2000-2016), Malta (1 city, 1995-2019), Martinique (1 city, 2000-2015), Mexico (11 cities, 1998-2021),

Moldova (4 cities, 2001-2010), Netherland (5 cities, 1995-2016), Norway (1 city, 1969-2018), Panama (1 city, 2013-2016), Paraguay (1 city, 2004-2019), Peru (17 cities, 2008-2014), Philippines (13 cities, 2006-2019), Portugal (6 cities, 1980-2018), Puerto Rico (1 city, 2009-2016), Reunion (1 city, 2000-2015), Romania (8 cities, 1994-2016), Serbia (1 city, 1995-2021), South Africa (52 cities, 1997-2013), South Korea (36 cities, 1997-2018), Spain (52 cities, 1990-2014), Sweden (3 cities, 1990-2016), Switzerland (8 cities, 1969-2018), Taiwan (3 cities, 1994-2014), Thailand (62 cities, 1999-2008), UK (112 cities, 1990-2020), USA (211 cities, 1973-2006), Uruguay (1 city, 2012-2016), and Vietnam (2 cities, 2009-2013). The median area of 830 locations was 1705.55 km^2 (25th to 75th centiles: 345.46 to 5652.69), and the median population density was 330 people per km^2 (25th to 75th centiles: 116 to 1313).

Our analysis included 44.79 million deaths for all or non-external causes in the warm season, covering the study period 1969 to 2021. Only 0.01% of all-cause deaths data were missing (**eTable 1**). The median warm-season mean temperature across 830 locations was 22.3°C (25th to 75th centiles: 18.2 to 25.5); and the median EVI value was 0.44 (25th to 75th centiles: 0.35 to 0.52). **eFigure 1** shows the warm-season mean temperature and EVI for each location. Higher warm-season mean temperatures were observed in tropical regions, whereas areas with higher EVI values were primarily located in the Northern Hemisphere.

1.2 Details on the random forest model

To estimate counterfactual daily temperatures under different EVI scenarios, we trained a random forest model to correlate factual daily temperatures with factual EVI at the urban level. The random forest approach was selected for its superior predictive accuracy compared to other machine learning models in estimating EVI.[8] The model incorporated multiple meteorological, geographical, and temporal variables, including daily mean eastward and northward

components of 10m wind, daily total precipitation, daily mean surface air pressure, daily mean downward solar radiation at the surface, longitude, latitude, region, year, and month.

Parameter selection

To reduce the computational burden, we divided the data into three subsets, using stratified random sampling by country to ensure that each country was proportionally represented. For each subset, we randomly split the data into training (80%) and testing (20%) partitions. We considered a range of number of trees and number of variables to possibly split at in each node. For each combination of parameters, we then trained a random forest model on each training partition and evaluated its performance on the corresponding test partition, using R-squared and root mean squared error (RMSE) to select the best combination of parameters.

Temperature prediction

We trained random forest model in each of the three subsets described above and used them to predict daily mean temperature for all urban areas under four counterfactual EVI scenarios: EVI deceased to 0, EVI increased by 10%, 20%, and 30%. If the EVI value exceeded 1, we set it to the maximum value of 1. All three trained models achieved high accuracy in estimating daily temperature (average R^2=0.93~0.94, average RMSE=1.35~1.38°C, **eTable 2**). We calibrated the three projected temperature series using the factual temperature series and assembled them into a single temperature series at the urban level by averaging the three projected temperature series.

1.3 Details on the exposure-response curve between heat and mortality

In the first stage, a generalized linear regression model with a quasi-Poisson family was applied in each of 830 locations to estimate location-specific heat-mortality associations. We used

distributed-lag nonlinear models (DLNMs) to model the nonlinear and lagged effects of daily mean temperature during warm season. The equation was as follows:

$$Y_{it} \sim Poisson(\mu; \theta)$$

$$\mathrm{E}(Y_{it}) = \exp(\alpha_i + cb(Heat_{it}, lag = 10) + year \times ns(yday_{it}, df = 4) + ns(date, df = 1/10\ years) + \gamma_i DOW_{it}), \quad (1)$$

$$VAR(Y_{it}) = \theta\mu, \quad (2)$$

where Y_{it} denotes daily deaths in location i on day t; α_i is the intercept in location i. $cb(Heat_{it}, lag = 10)$, is a 2-dimensional cross-basis function of daily mean temperature modelled by the DLNM, with one dimension featuring the nonlinear effect of temperature and the other dimension for lag. The temperature dimension includes a natural spline function with two internal knots placed at the 50^{th,} and 90th percentile of the location-specific warm-season temperature distribution. The lag dimension is modelled with a natural spline function with two internal knots at equally spaced values in the log scale over 10 days of lag. $yday_{it}$, denotes the day of the year, is used to model seasonality with a natural spline with 4 degrees of freedom (df). We also included an interaction between the seasonality spline and year to allow for different seasonal trends across the study period. Additionally, we included a natural spline function of time with approximately one knot every 10 years to control for long-term trends. The model also included a categorical variable for day of the week (DOW_{it}). $VAR(Y_{it})$ and μ denote the variance and expectation of Y_{it}, and θ is an overdispersion parameter. These parameters were chosen based on related studies.[9,10]

1.4 Details on the calculation of the heat-related deaths and attributable fractions

To estimate the heat-related deaths and attributable fractions of mortality due to heat for each day, urban area, and scenario, we used the forward method with the following equations:[11]

$$AF_{x,t,s} = 1 - \exp\left(-\sum_{l=0}^{L} \beta_{x_t,l,s}\right) \quad (3)$$

$$AD_{x,t,s} = AF_{x,t,s} \times \sum_{l=0}^{L} \frac{n_{t+l}}{L+1} \quad (4)$$

where $AD_{x,t,s}$ and $AF_{x,t,s}$ are the heat-related deaths and the related fraction of deaths experiences in the next L days, with L as the maximum lag period of 10 days in the current analysis. $\sum_{l=0}^{L} \beta_{x_t,l,s}$ is the cumulative log-relative risk with contributions from the temperature x_t on day t under scenario s to the temperatures experienced at next L days under scenario s. n_{t+l} is the number of deaths on day $t+l, (l = 0, \dots, \mathrm{L})$. For each urban area and scenario, the total heat-related deaths are calculated by summing all $AD_{x,t,s}$ for the days when the temperature was higher than the urban-specific MMTs, and its ratio with the total number of numbers provides the total attributable fraction. We used Monte Carlo simulations to generate 1,000 samples of the coefficients to quantify the uncertainty of the estimates. The 2.5th and 97.5th percentiles of these distributions are interpreted as 95% empirical confidence intervals (eCIs). Heat-related deaths and attributable fractions were aggregated at the country, region, continent, and global levels. Finally, we calculated the change in heat-related deaths and attributable fraction by increasing EVI as the difference compared to the factual EVI scenario.

1.5 Details of stratification analyses

To assess the potential modification effects of urban characteristics, we performed several stratified analyses based on climate type (Köppen–Geiger climate classification), greenness level (EVI), socioeconomic status (GDP per capita and human development index), and demographic characteristics (proportion of children under 5 years or population ages 65 and above). Human development index (HDI) was obtained from a global gridded database at 5 arc-min resolution in 2015.[12] The mean HDI value for each urban area was calculated as the average of values of all grid cells covering the boundary of the urban area. The HDI ranges from 0 to 1, and we classified all urban areas into four groups according to the cut-off values

set by the United Nations Development Programme. The age-specific population data were obtained from the WorldPop project, which provides the global gridded age structure at a resolution of 1km in 2010.[13] We first calculated the total population counts and the population counts for children under 5 years or population ages 65 by aggregating the values of all grid cells covering the boundary of the urban area. Next, we calculated the proportions of these age groups for each urban area. We classified the urban areas into four groups based on the quantiles of the distributions of these two age indicators.

2. eResults

eTable 1. Descriptive statistics of warm-season mean temperature and enhanced vegetation index in 830 locations of 53 countries/regions.

Country/ Region	No. of locations	Study period	Number of deaths	Median (P_{25}-P_{75})		Missing rate of all-cause deaths (%)
				Temperature (℃)	EVI	
Argentina	3	2005-2015	205,651	23.6 (23.6, 23.8)	0.47 (0.33, 0.48)	0.91
Australia	5	2010-2017	206,981	22.8 (21.2, 24.0)	0.36 (0.34, 0.36)	0.00
Brazil	17	1997-2018	1,213,988	25.1 (24.3, 27.3)	0.44 (0.33, 0.51)	0.09
Bulgaria	5	2000-2020	164,432	22.6 (22.4, 22.7)	0.49 (0.48, 0.52)	0.00
Canada	26	1986-2015	1,171,055	17.4 (16.0, 19.1)	0.42 (0.35, 0.46)	0.00
Chile	4	2004-2014	98,028	18.1 (17.0, 19.3)	0.35 (0.24, 0.42)	0.13
China	15	1996-2015	369,782	25.1 (23.0, 27.3)	0.40 (0.33, 0.46)	0.00
Colombia	5	1998-2013	322,750	24.8 (23.2, 28.2)	0.50 (0.45, 0.51)	0.00
Costa Rica	1	2000-2017	10,093	23.3 (23.3, 23.3)	0.55 (0.55, 0.55)	0.00
Cyprus	5	2004-2019	24,043	27.3 (27.1, 27.7)	0.33 (0.33, 0.39)	0.00
Czech Republic	4	1994-2020	277,077	17.5 (17.1, 17.9)	0.47 (0.44, 0.48)	0.00
Ecuador	2	2014-2018	38,357	21.4 (18.5, 24.3)	0.46 (0.45, 0.48)	0.00
Estonia	5	1997-2020	57,288	15.4 (15.0, 15.7)	0.49 (0.40, 0.50)	0.00
Finland	1	1994-2014	48,810	15.7 (15.7, 15.7)	0.34 (0.34, 0.34)	0.00
France	20	2000-2017	639,246	18.9 (18.1, 20.5)	0.51 (0.43, 0.56)	0.01
French Guiana	1	2000-2015	2,261	27.4 (27.4, 27.4)	0.55 (0.55, 0.55)	0.00
Germany	15	1993-2020	1,375,388	17.5 (17.1, 17.8)	0.41 (0.39, 0.43)	0.00
Greece	1	2001-2010	90,845	27.1 (27.1, 27.1)	0.17 (0.17, 0.17)	0.00
Guadeloupe	1	2000-2015	9,039	27.9 (27.9, 27.9)	0.55 (0.55, 0.55)	0.00
Guatemala	1	2009-2016	20,826	20.5 (20.5, 20.5)	0.47 (0.47, 0.47)	0.00
Iceland	1	2000-2018	7,991	10.5 (10.5, 10.5)	0.32 (0.32, 0.32)	0.00
Iran	2	2002-2015	266,270	27.0 (26.4, 27.5)	0.12 (0.11, 0.12)	0.00
Ireland	6	1984-2007	316,652	14.3 (13.9, 14.4)	0.59 (0.56, 0.63)	0.00
Israel	4	1985-2020	182,789	26.6 (25.7, 27.2)	0.32 (0.27, 0.33)	0.00
Italy	18	2006-2015	247,381	23.8 (23.3, 24.5)	0.46 (0.41, 0.50)	0.01
Japan	47	1972-2020	14,111,801	24.8 (23.9, 25.5)	0.51 (0.47, 0.53)	0.00
Kuwait	1	2000-2016	22,347	37.8 (37.8, 37.8)	0.07 (0.07, 0.07)	0.00
Malta	1	1995-2019	23,511	25.7 (25.7, 25.7)	0.37 (0.37, 0.37)	0.00
Martinique	1	2000-2015	7,017	28.0 (28.0, 28.0)	0.58 (0.58, 0.58)	0.00
Mexico	11	1998-2021	1,428,174	21.9 (19.8, 24.9)	0.31 (0.26, 0.37)	0.00
Moldova	4	2001-2010	18,828	20.6 (20.3, 20.9)	0.45 (0.43, 0.45)	0.00
Netherland	5	1995-2016	141,526	16.8 (16.7, 16.8)	0.43 (0.37, 0.48)	0.00
Norway	1	1969-2018	85,904	13.4 (13.4, 13.4)	0.36 (0.36, 0.36)	0.00
Panama	1	2013-2016	3,895	28.6 (28.6, 28.6)	0.51 (0.51, 0.51)	0.00
Paraguay	1	2004-2019	15,239	27.3 (27.3, 27.3)	0.31 (0.31, 0.31)	0.00
Peru	17	2008-2014	206,317	21.0 (14.3, 23.6)	0.30 (0.18, 0.39)	0.23
Philippines	13	2006-2019	268,064	29.3 (29.0, 29.3)	0.26 (0.20, 0.35)	0.00
Portugal	6	1980-2018	568,710	22.3 (20.5, 23.1)	0.35 (0.33, 0.37)	0.08
Puerto Rico	1	2009-2016	8,823	28.2 (28.2, 28.2)	0.15 (0.15, 0.15)	0.00
Reunion	1	2000-2015	4,731	26.7 (26.7, 26.7)	0.48 (0.48, 0.48)	0.00

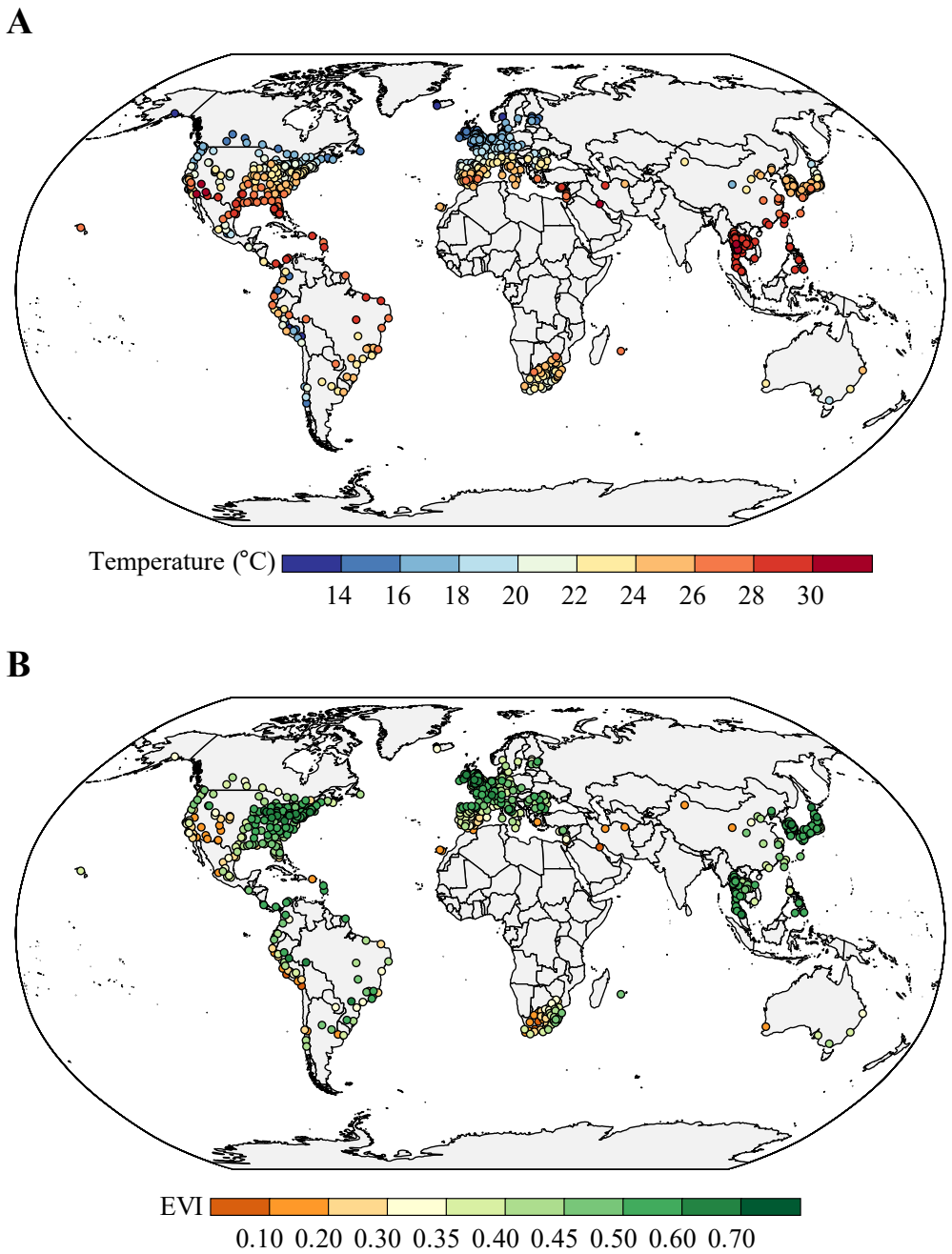
Romania	8	1994-2016	300,031	20.7 (19.9, 21.4)	0.44 (0.42, 0.51)	0.00
Serbia	1	1995-2021	171,692	22.0 (22.0, 22.0)	0.46 (0.46, 0.46)	0.00
South Africa	52	1997-2013	2,684,104	22.1 (20.8, 24.0)	0.34 (0.24, 0.40)	0.00
South Korea	36	1997-2018	967,465	23.5 (23.0, 23.9)	0.52 (0.48, 0.54)	0.00
Spain	52	1990-2014	918,069	23.1 (19.8, 24.6)	0.34 (0.28, 0.40)	0.00
Sweden	3	1990-2016	224,021	16.3 (16.3, 16.3)	0.39 (0.37, 0.41)	0.00
Switzerland	8	1969-2018	212,904	17.5 (16.7, 18.2)	0.43 (0.35, 0.52)	0.00
Taiwan	3	1994-2014	385,617	28.6 (28.4, 28.6)	0.45 (0.42, 0.47)	0.03
Thailand	62	1999-2008	619,747	29.0 (28.6, 29.5)	0.47 (0.42, 0.52)	0.00
UK	112	1990-2020	2,101,705	16.0 (15.4, 16.4)	0.47 (0.40, 0.53)	0.00
USA	211	1973-2006	11,842,735	22.4 (20.6, 25.2)	0.47 (0.36, 0.54)	0.00
Uruguay	1	2012-2016	45,487	24.1 (24.1, 24.1)	0.39 (0.39, 0.39)	0.00
Vietnam	2	2009-2013	37,677	29.4 (29.4, 29.4)	0.44 (0.41, 0.48)	0.00
Overall	830	1969-2021	44,793,164	22.3 (18.2, 25.2)	0.44 (0.35, 0.52)	0.01

186 Abbreviation: P_{25}, 25th percentile; P_{75}, 75th percentile. EVI, Enhanced Vegetation Index.

eTable 2. Model performance of each subset.

Subset	Random forest model	
	R-square	RMSE
Subset 1	0.93	1.38
Subset 2	0.93	1.38
Subset 3	0.94	1.35
Average	0.93	1.37

RMSE: root mean squared error.

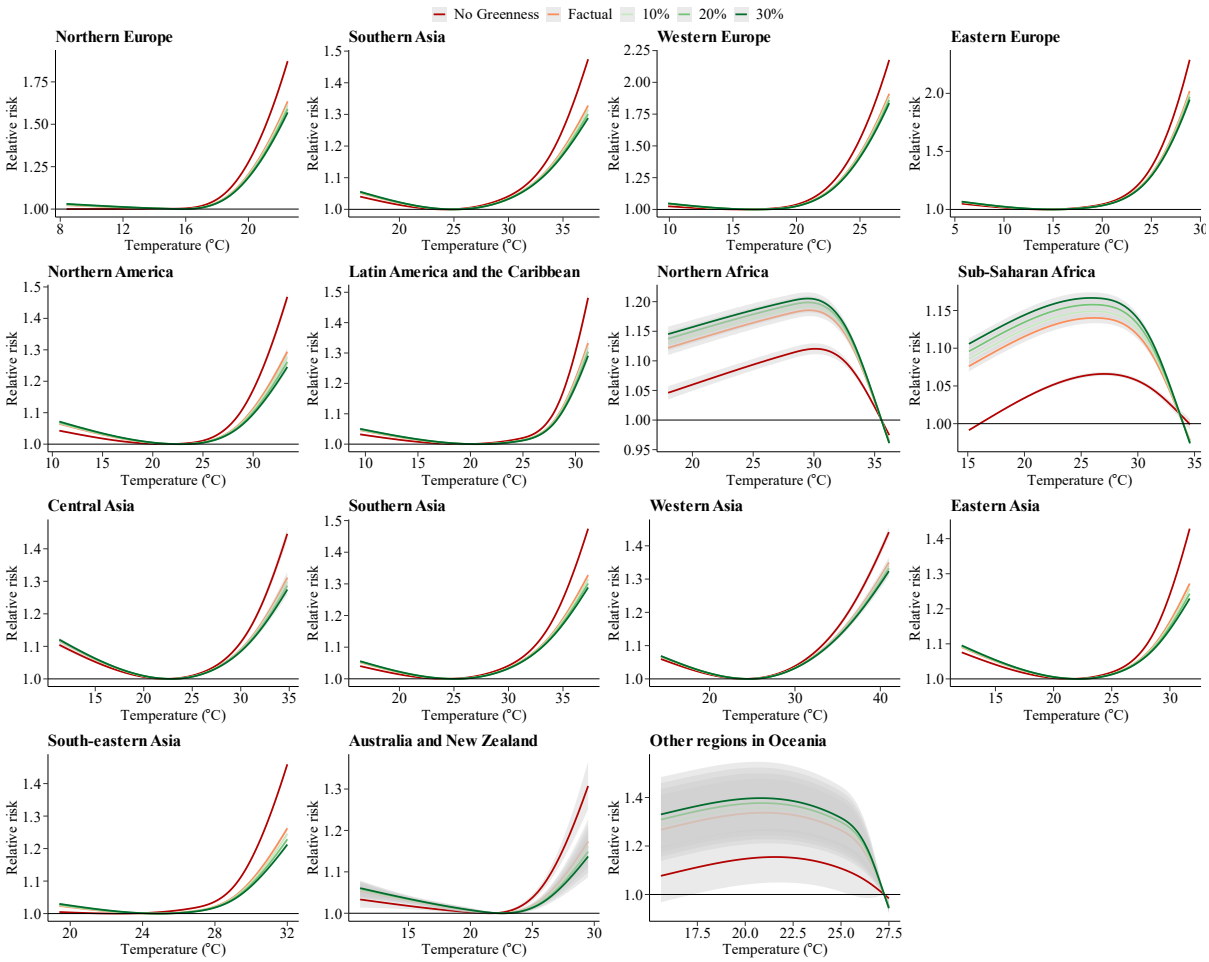


eFigure 1. Warm-season mean temperature (A) and enhanced vegetation index (EVI) (B) in 830 locations from 53 countries during the study period.

eTable 3. Modelled reduction in warm-season mean temperature under different enhanced vegetation index (EVI) scenarios compared to the factual scenario during 2000 and 2019 by region and continent.

Region	Reduction in warm-season temperature (°C）			
	Decrease to zero	Increase by 10%	Increase by 20%	Increase by 30%
Global	-0.23	0.08	0.14	0.19
Northern Europe	-0.18	0.08	0.14	0.18
Southern Europe	-0.51	0.13	0.24	0.33
Western Europe	-0.43	0.17	0.30	0.39
Eastern Europe	0.13	0.09	0.17	0.23
Northern America	-0.22	0.15	0.26	0.33
Latin America and the Caribbean	0.23	0.04	0.08	0.11
Northern Africa	-0.03	0.02	0.02	0.03
Sub-Saharan Africa	-0.37	0.05	0.09	0.14
Central Asia	-0.23	0.12	0.22	0.30
Southern Asia	-0.42	0.07	0.13	0.18
Western Asia	-0.47	0.05	0.10	0.15
Eastern Asia	-0.01	0.01	0.01	0.02
South-eastern Asia	-0.41	0.04	0.07	0.09
Australia and New Zealand	-0.34	0.12	0.23	0.30
Other regions in Oceania	-0.22	0.01	0.01	0.02

Abbreviation: EVI, Enhanced Vegetation Index.



eFigure 2. Exposure-response associations between heat exposure and mortality by EVI scenarios in 15 regions during 2000 and 2019.

eTable 4. Modelled reduction in heat-related deaths under different enhanced vegetation index (EVI) scenarios compared to the factual scenario between 2000 and 2019 by country/region.

Country/Region	Reduction in heat-related deaths (95% eCI)			
	EVI decreased to zero	EVI increased by 10%	EVI increased by 20%	EVI increased by 30%
Afghanistan	-571 (-2608, 1629)	3978 (2254, 5687)	4435 (3058, 5882)	4770 (3337, 6314)
Albania	-387 (-646, -100)	783 (709, 855)	915 (817, 1009)	1036 (934, 1137)
Algeria	-1553 (-2560, -433)	86 (-343, 497)	84 (-354, 498)	81 (-353, 500)
Angola	712 (-4498, 6185)	9741 (1789, 17391)	9746 (1804, 17395)	9757 (1817, 17407)
Argentina	32535 (28417, 36491)	20991 (16883, 24862)	22585 (19658, 25417)	24366 (21139, 27459)
Armenia	-1158 (-1666, -594)	783 (569, 1007)	896 (552, 1223)	973 (714, 1236)
Australia	-77 (-2395, 2591)	2316 (-159, 4551)	2527 (443, 4324)	2662 (461, 4557)
Austria	-1510 (-2169, -712)	2692 (2562, 2826)	3393 (3173, 3620)	3940 (3652, 4221)
Azerbaijan	-891 (-1436, -303)	793 (453, 1160)	914 (563, 1286)	1025 (658, 1403)
Bangladesh	-45322 (-87254, -2595)	5083 (-871, 10629)	7181 (2106, 11741)	9070 (4041, 13532)
Belarus	1769 (540, 3127)	5321 (4830, 5847)	6142 (5553, 6751)	6795 (6158, 7449)
Belgium	-271 (-1312, 877)	1869 (1694, 2031)	2225 (1978, 2450)	2572 (2272, 2848)
Benin	-2381 (-4473, -16)	-9 (-115, 95)	-6 (-123, 102)	-3 (-123, 119)
Bhutan	-93 (-137, -41)	3 (-2, 7)	3 (1, 6)	4 (1, 6)
Bolivia	2193 (19, 4198)	2110 (299, 3668)	2414 (514, 4122)	2668 (734, 4435)
Bosnia and Herzegovina	-1066 (-1385, -718)	935 (867, 1002)	1069 (997, 1141)	1140 (1060, 1217)
Botswana	-236 (-401, -54)	232 (165, 296)	280 (204, 352)	319 (239, 392)
Brazil	48395 (37016, 58456)	42822 (35486, 49804)	51465 (43089, 60090)	57693 (47683, 67596)
Brunei	-62 (-177, 51)	27 (-73, 116)	36 (-66, 124)	43 (-59, 133)
Bulgaria	-2115 (-3390, -624)	4125 (3855, 4413)	4996 (4667, 5333)	5636 (5215, 6032)
Burkina Faso	-2105 (-4585, 265)	-179 (-2386, 1854)	-147 (-3055, 2938)	154 (-2226, 2387)
Burundi	360 (-69, 819)	-20 (-35, -4)	-26 (-55, 5)	-27 (-48, -6)
Cabo Verde	-15 (-36, 8)	-5 (-40, 29)	-4 (-39, 31)	-3 (-39, 32)
Cambodia	-189 (-726, 378)	732 (548, 921)	821 (623, 1015)	936 (733, 1149)
Cameroon	-872 (-2290, 628)	-360 (-1391, 640)	-292 (-1674, 1161)	-51 (-675, 611)
Canada	2251 (-603, 5254)	5972 (4824, 7027)	6480 (5166, 7702)	6801 (5348, 8115)
Central African Republic	-4829 (-9039, -376)	-43 (-92, 4)	-43 (-92, 4)	-43 (-92, 4)
Chad	-3408 (-4546, -2274)	44 (-991, 1075)	2270 (-39, 4528)	4396 (1218, 7151)
Chile	4729 (3737, 5745)	4965 (4057, 5870)	4589 (3765, 5443)	4205 (3470, 4977)
China	-8260 (-70561, 63251)	86617 (63445, 110953)	99618 (75600, 124456)	111752 (86316, 137756)
Colombia	957 (-2609, 4289)	2001 (305, 3625)	2371 (1730, 2926)	2688 (950, 4280)
Comoros	176 (-503, 912)	-6 (-22, 10)	-5 (-18, 8)	-4 (-20, 12)
Costa Rica	-229 (-394, -62)	132 (-35, 305)	136 (-40, 317)	138 (-46, 325)
Croatia	-1075 (-1599, -454)	1750 (1634, 1872)	2025 (1894, 2163)	2203 (2056, 2356)
Cuba	-2038 (-3924, -363)	566 (-67, 1169)	996 (360, 1632)	1398 (529, 2298)
Cyprus	-91 (-194, 28)	221 (192, 245)	273 (217, 323)	317 (241, 384)
Czechia	-278 (-983, 540)	2526 (2356, 2704)	2980 (2766, 3181)	3258 (3009, 3492)

Democratic Republic of the Congo	-39326 (-78324, 1361)	-338 (-1666, 922)	-233 (-1679, 1173)	-142 (-1685, 1362)
Denmark	-56 (-563, 501)	834 (757, 911)	956 (866, 1041)	1043 (927, 1157)
Djibouti	-519 (-1423, 527)	-121 (-1234, 994)	-66 (-435, 337)	-5 (-263, 248)
Dominican Republic	-2738 (-4212, -1094)	479 (149, 759)	727 (228, 1187)	960 (397, 1464)
Ecuador	431 (-277, 1186)	703 (112, 1281)	781 (198, 1372)	858 (293, 1448)
Egypt	-6276 (-9595, -2980)	-1660 (-2864, -489)	-1600 (-2769, -467)	-1531 (-2665, -428)
El Salvador	-215 (-1249, 893)	531 (-54, 1113)	599 (-189, 1326)	641 (-343, 1493)
Equatorial Guinea	-1041 (-1925, -108)	-12 (-27, 4)	-12 (-27, 4)	-12 (-27, 4)
Eritrea	11 (-10, 30)	8 (-32, 48)	8 (-33, 48)	8 (-33, 48)
Estonia	73 (-85, 238)	414 (365, 465)	458 (403, 516)	485 (430, 541)
Ethiopia	160 (-381, 719)	-431 (-806, -37)	-431 (-806, -37)	-431 (-806, -37)
Fiji	-56 (-154, 52)	-7 (-18, 3)	-7 (-18, 3)	-7 (-18, 3)
Finland	8 (-649, 714)	1148 (1028, 1272)	1243 (1118, 1379)	1323 (1176, 1479)
France	-19146 (-34910, -2557)	16815 (15456, 18012)	19857 (17587, 21887)	22376 (19517, 24888)
Gabon	-1804 (-3316, -249)	-34 (-69, 0)	-34 (-69, 0)	-34 (-69, 0)
Gambia	-90 (-132, -47)	-48 (-84, -14)	-48 (-84, -14)	-48 (-84, -14)
Georgia	-821 (-1242, -368)	515 (300, 732)	594 (356, 846)	660 (394, 936)
Germany	-16405 (-28879, -3169)	23367 (21835, 24821)	27310 (25326, 29149)	29545 (27119, 31733)
Ghana	-1274 (-1955, -515)	-379 (-792, 46)	840 (-342, 1925)	875 (-309, 1969)
Greece	-700 (-2217, 976)	5646 (5217, 6073)	6840 (6367, 7288)	7767 (7152, 8333)
Guatemala	-151 (-417, 138)	290 (-115, 722)	313 (-51, 719)	327 (-100, 791)
Guinea	-481 (-1178, 317)	-144 (-294, 12)	106 (-213, 398)	105 (-213, 396)
Guinea-Bissau	-235 (-408, -41)	-28 (-55, -3)	-28 (-55, -3)	-28 (-55, -3)
Guyana	-55 (-141, 21)	43 (25, 60)	72 (48, 94)	97 (70, 123)
Haiti	-1082 (-2311, 75)	525 (52, 1012)	814 (301, 1337)	1134 (453, 1729)
Honduras	-361 (-792, 98)	327 (180, 456)	357 (-94, 783)	395 (-54, 810)
Hong Kong S.A.R.	-1595 (-2578, -457)	542 (405, 670)	783 (574, 974)	931 (675, 1166)
Hungary	-837 (-1996, 540)	4395 (4149, 4646)	5370 (5009, 5712)	6054 (5617, 6450)
India	-230398 (-314855, -133602)	108694 (85341, 133412)	142705 (113443, 172416)	172581 (139528, 206453)
Indonesia	-106222 (-149774, -54207)	34883 (26108, 43994)	40655 (30309, 50923)	45281 (33910, 55887)
Iran	2114 (-3268, 7803)	12915 (9205, 16707)	15018 (10877, 19190)	17143 (12984, 21510)
Iraq	5142 (3245, 7167)	5399 (3885, 7006)	5732 (4326, 7236)	6673 (5125, 8340)
Ireland	-785 (-2246, 721)	501 (417, 584)	531 (442, 617)	554 (460, 644)
Israel	-1479 (-2529, -260)	612 (454, 764)	724 (513, 916)	750 (527, 949)
Italy	-11559 (-19163, -2873)	28865 (27188, 30658)	33340 (31317, 35426)	37616 (35256, 39958)
Ivory Coast	-1275 (-2066, -376)	-370 (-657, -87)	-373 (-662, -87)	-375 (-665, -88)
Jamaica	-880 (-1732, 57)	151 (16, 280)	239 (-233, 732)	347 (-952, 1707)
Japan	17307 (-1259, 37264)	29238 (22007, 36562)	30609 (23024, 38478)	32575 (24308, 41138)
Jordan	-94 (-472, 340)	739 (544, 925)	742 (548, 928)	750 (557, 935)
Kazakhstan	1353 (-170, 2951)	3507 (2425, 4645)	3919 (2779, 5100)	4258 (3046, 5468)
Kenya	-3099 (-5547, -488)	-315 (-551, -85)	-315 (-551, -85)	-316 (-551, -85)
Kosovo	-161 (-246, -64)	266 (245, 288)	327 (301, 356)	378 (348, 410)
Kuwait	369 (260, 481)	277 (-76, 659)	165 (47, 291)	155 (38, 283)
Kyrgyzstan	-131 (-456, 222)	489 (333, 646)	564 (405, 731)	608 (434, 784)

Laos	-304 (-499, -73)	238 (183, 293)	282 (220, 344)	326 (258, 395)
Latvia	419 (153, 710)	929 (830, 1033)	1038 (922, 1155)	1109 (984, 1237)
Lebanon	-636 (-1143, -45)	405 (268, 538)	444 (295, 580)	487 (302, 663)
Liberia	-78 (-138, -20)	-79 (-145, -15)	-84 (-152, -17)	-85 (-154, -17)
Libya	-87 (-168, -6)	68 (-67, 198)	68 (-68, 199)	68 (-68, 199)
Lithuania	500 (130, 923)	1365 (1232, 1501)	1507 (1380, 1627)	1620 (1462, 1780)
Macedonia	-189 (-440, 101)	1110 (1044, 1183)	1390 (1301, 1485)	1585 (1478, 1692)
Madagascar	-1591 (-5424, 2272)	-5 (-91, 83)	40 (-66, 146)	76 (-41, 193)
Malawi	-2381 (-4254, -198)	318 (-130, 737)	321 (-107, 697)	324 (-132, 749)
Malaysia	-16186 (-23649, -7847)	3329 (2734, 3889)	4155 (2779, 5519)	4929 (1779, 8056)
Mali	-2103 (-3085, -1040)	-312 (-1423, 694)	59 (-1364, 1390)	1338 (-380, 2895)
Mauritania	-61 (-97, -26)	-36 (-72, -2)	-27 (-63, 7)	-15 (-51, 21)
Mexico	8000 (2497, 13523)	12480 (7977, 16477)	13894 (9010, 18243)	15181 (10129, 19943)
Moldova	-1184 (-1670, -619)	1578 (1446, 1717)	1913 (1757, 2070)	2069 (1898, 2236)
Mongolia	118 (-15, 252)	191 (32, 349)	201 (34, 364)	207 (29, 378)
Montenegro	-79 (-142, -5)	249 (234, 264)	297 (279, 313)	328 (308, 348)
Morocco	-460 (-769, -153)	-415 (-735, -111)	-417 (-738, -111)	-418 (-745, -105)
Mozambique	-2830 (-3729, -1917)	440 (-389, 1199)	828 (-280, 1884)	1245 (150, 2277)
Myanmar	-7110 (-10306, -3428)	3892 (3010, 4828)	5357 (4176, 6588)	6596 (5170, 8111)
Namibia	22 (-90, 140)	179 (87, 274)	197 (102, 293)	213 (117, 309)
Nepal	-5701 (-8882, -2461)	232 (75, 391)	303 (86, 526)	366 (132, 606)
Netherlands	-4163 (-9014, 819)	2767 (2435, 3056)	3453 (2952, 3907)	3857 (3275, 4372)
New Zealand	-514 (-1232, 241)	91 (-542, 664)	97 (-442, 595)	97 (-495, 639)
Nicaragua	76 (-337, 495)	330 (179, 475)	411 (221, 614)	517 (280, 769)
Niger	-3877 (-5428, -2143)	-117 (-642, 428)	315 (-252, 859)	1873 (699, 2859)
Nigeria	-83492 (-153484, -5232)	-1490 (-12674, 9720)	1778 (-10132, 13748)	8379 (-5247, 22579)
North Korea	112 (-2134, 2597)	2617 (1941, 3232)	2813 (1918, 3761)	3029 (1975, 4123)
Norway	-440 (-961, 117)	879 (742, 1002)	982 (845, 1108)	1066 (924, 1193)
Oman	82 (32, 132)	185 (147, 222)	198 (165, 229)	208 (166, 248)
Pakistan	-13049 (-24144, -400)	22677 (17767, 27791)	27993 (22811, 33466)	33499 (27295, 39706)
Palestine	-752 (-1229, -208)	448 (322, 569)	542 (384, 686)	610 (412, 792)
Panama	-225 (-606, 130)	224 (92, 350)	317 (64, 595)	397 (209, 572)
Papua New Guinea	202 (-68, 719)	-30 (-64, 1)	-30 (-65, 1)	-30 (-65, 1)
Paraguay	2755 (2456, 3038)	1038 (914, 1167)	1220 (1078, 1369)	1338 (1193, 1485)
Peru	6221 (3558, 8810)	3539 (1328, 5676)	2912 (958, 4879)	1693 (-308, 3806)
Philippines	-35798 (-55466, -13805)	7131 (4792, 9571)	8635 (5841, 11286)	10031 (6122, 13721)
Poland	-1410 (-4536, 2182)	10213 (9526, 10920)	11951 (11098, 12749)	12963 (11899, 13930)
Portugal	-3248 (-6859, 512)	3052 (1923, 4035)	3353 (2274, 4314)	3592 (2559, 4514)
Puerto Rico	-866 (-1244, -441)	143 (83, 195)	220 (38, 399)	296 (110, 483)
Qatar	40 (-514, 528)	86 (-443, 557)	92 (59, 126)	97 (-446, 582)
Republic of Serbia	-1314 (-2347, -101)	3983 (3695, 4281)	4961 (4649, 5285)	5567 (5178, 5971)
Republic of the Congo	-1185 (-2043, -428)	-34 (-70, 3)	-34 (-70, 3)	-34 (-70, 3)
Romania	-2316 (-4732, 467)	8360 (7763, 8996)	10130 (9411, 10880)	11529 (10638, 12372)

Russia	34020 (14938, 55121)	91010 (83255, 99267)	105115 (96809, 113339)	117272 (107082, 127775)
Rwanda	142 (-143, 453)	-54 (-98, -10)	-55 (-99, -11)	-55 (-100, -11)
Saudi Arabia	1908 (582, 3200)	4053 (2951, 5116)	4408 (3331, 5457)	4924 (3785, 6020)
Senegal	-562 (-857, -262)	-221 (-392, -52)	-202 (-369, -37)	115 (-137, 359)
Sierra Leone	-289 (-639, 105)	-133 (-245, -25)	-132 (-243, -25)	-128 (-235, -24)
Slovakia	-211 (-473, 90)	1017 (951, 1089)	1195 (1125, 1264)	1303 (1215, 1390)
Slovenia	-189 (-313, -48)	400 (375, 426)	449 (424, 474)	483 (451, 515)
Somalia	-1185 (-1959, -313)	223 (-122, 556)	223 (-122, 556)	224 (-121, 556)
South Africa	-16472 (-26620, -4652)	5746 (3069, 8315)	6572 (3719, 9270)	7242 (3771, 10346)
South Korea	2396 (-2135, 7178)	6996 (5532, 8583)	7620 (4860, 10229)	8176 (6555, 9780)
South Sudan	-1257 (-2358, -198)	-70 (-626, 458)	131 (-322, 597)	318 (-1661, 2381)
Spain	3502 (-1950, 9246)	23318 (21298, 25376)	26039 (24300, 27817)	28014 (25876, 30111)
Sri Lanka	-21956 (-29541, -13781)	2145 (1505, 2753)	2484 (1681, 3219)	2765 (1826, 3600)
Sudan	-9802 (-19729, 1249)	-122 (-1992, 1667)	580 (-1528, 2752)	1472 (-558, 3493)
Sweden	508 (-193, 1323)	1788 (1639, 1934)	1973 (1803, 2138)	2065 (1881, 2245)
Switzerland	-2516 (-3261, -1679)	2653 (2496, 2821)	3034 (2770, 3296)	3292 (3071, 3521)
Syria	-300 (-1465, 1001)	2429 (1863, 3021)	2734 (2087, 3392)	3058 (2364, 3715)
Tajikistan	-18 (-432, 424)	519 (345, 701)	615 (419, 822)	693 (500, 902)
Thailand	-4188 (-8036, 144)	4485 (3511, 5482)	6311 (5111, 7558)	8092 (6584, 9666)
Togo	-1039 (-1781, -202)	-104 (-443, 240)	16 (-150, 185)	25 (-152, 199)
Trinidad and Tobago	-735 (-939, -492)	135 (85, 183)	192 (139, 243)	247 (187, 301)
Tunisia	-102 (-188, -17)	-101 (-187, -17)	-102 (-188, -17)	-103 (-191, -17)
Turkey	-7568 (-13661, -525)	8833 (6339, 11488)	9998 (7146, 12936)	10910 (7866, 13794)
Turkmenistan	100 (-102, 323)	705 (554, 858)	876 (716, 1044)	996 (819, 1171)
Uganda	306 (-2439, 3166)	-187 (-326, -51)	-188 (-326, -51)	-188 (-326, -51)
Ukraine	-10526 (-17769, -1784)	29418 (26783, 32095)	36602 (33481, 39868)	41408 (37925, 44971)
United Arab Emirates	273 (-36, 583)	618 (468, 757)	751 (-89, 1575)	858 (729, 980)
United Kingdom	-10444 (-38349, 18206)	20946 (11322, 30236)	22576 (12940, 31829)	23735 (14142, 32900)
United Republic of Tanzania	-11332 (-20930, -1364)	-195 (-389, -4)	-196 (-390, -5)	-196 (-390, -5)
United States of America	Í	52044 (40575, 63389)	58298 (45060, 71088)	62505 (48249, 76289)
Uruguay	2431 (2049, 2792)	1599 (1347, 1861)	1732 (1466, 2000)	1869 (1583, 2161)
Uzbekistan	359 (-1376, 2208)	3127 (2312, 3981)	3545 (2675, 4440)	3918 (3032, 4875)
Venezuela	-1764 (-7846, 4494)	2252 (1257, 3174)	2806 (399, 5063)	3358 (47, 6615)
Vietnam	-11478 (-19268, -2738)	5601 (4354, 6828)	6677 (5145, 8257)	7635 (5887, 9348)
Yemen	-1039 (-1561, -442)	1768 (1184, 2384)	2089 (1391, 2767)	2372 (1621, 3089)
Zambia	-4401 (-8869, 717)	308 (-78, 708)	510 (17, 1012)	660 (78, 1155)
Zimbabwe	-3686 (-6842, -227)	471 (-72, 1046)	693 (-239, 1538)	734 (-227, 1610)

207 Abbreviation: EVI, Enhanced Vegetation Index.

eTable 5. Modelled reduction in attributable fraction of mortality due to heat under different enhanced vegetation index (EVI) scenarios compared to the factual scenario during 2000 and 2019.

Region	Factual scenario	Reduction in attributable fraction (percentage change, 95% eCI)							
		EVI decrease to zero		EVI increased by 10%		EVI increased by 20%		EVI increased by 30%	
		Absolute	Percentage	Absolute	Percentage	Absolute	Percentage	Absolute	Percentage
Global	2.48 (1.79, 3.08)	-0.51 (-1.04, 0.08)	-20.42 (-33.46, 0.09)	0.67 (0.53, 0.82)	27.16 (21.79, 35.53)	0.80 (0.63, 0.97)	32.22 (26.89, 40.44)	0.91 (0.72, 1.10)	36.66 (31.32, 44.80)
Northern Europe	1.69 (1.23, 2.11)	-0.35 (-1.44, 0.78)	-20.94 (-69.54, 59.55)	1.00 (0.66, 1.32)	58.95 (49.38, 67.48)	1.08 (0.75, 1.41)	63.98 (55.90, 71.45)	1.14 (0.80, 1.47)	67.53 (60.34, 74.58)
Southern Europe	5.52 (4.76, 6.17)	-0.46 (-1.00, 0.12)	-8.33 (-16.28, 2.56)	1.94 (1.79, 2.10)	35.14 (30.82, 41.20)	2.23 (2.08, 2.40)	40.45 (36.11, 46.37)	2.47 (2.30, 2.66)	44.80 (40.69, 50.57)
Western Europe	2.64 (2.25, 2.98)	-1.05 (-1.84, -0.22)	-39.58 (-65.62, -9.17)	1.19 (1.11, 1.26)	45.03 (41.79, 50.07)	1.41 (1.29, 1.51)	53.20 (50.17, 57.80)	1.56 (1.41, 1.68)	58.86 (55.95, 63.17)
Eastern Europe	5.05 (4.29, 5.73)	0.16 (-0.20, 0.57)	3.24 (-3.41, 13.31)	1.53 (1.40, 1.66)	30.26 (26.52, 35.58)	1.80 (1.66, 1.94)	35.71 (31.94, 41.10)	2.02 (1.85, 2.19)	39.91 (35.95, 45.55)
Northern America	1.40 (0.95, 1.80)	0.34 (0.06, 0.65)	24.33 (3.68, 64.81)	0.74 (0.59, 0.89)	52.65 (43.91, 69.00)	0.82 (0.65, 1.00)	58.78 (50.01, 75.02)	0.88 (0.69, 1.07)	62.89 (54.10, 79.02)
Latin America and the Caribbean	2.21 (1.33, 2.94)	0.78 (0.49, 1.07)	35.52 (19.29, 66.78)	0.80 (0.58, 0.99)	36.06 (25.70, 57.74)	0.91 (0.72, 1.10)	41.14 (32.06, 60.47)	1.00 (0.77, 1.23)	45.06 (35.49, 65.23)
Northern Africa	0.64 (0.22, 1.02)	-0.48 (-0.81, -0.12)	-74.73 (-247.11, -20.72)	-0.06 (-0.15, 0.04)	-8.76 (-51.63, 5.93)	-0.04 (-0.14, 0.07)	-5.67 (-48.21, 9.75)	-0.01 (-0.11, 0.09)	-1.76 (-32.34, 11.84)
Sub-Saharan Africa	0.75 (0.18, 1.26)	-1.25 (-2.23, -0.17)	-165.38 (-229.11, -60.04)	0.07 (-0.09, 0.25)	9.77 (-34.94, 29.35)	0.14 (-0.06, 0.34)	18.15 (-23.35, 38.85)	0.23 (-0.01, 0.46)	29.89 (-1.51, 51.54)
Central Asia	2.53 (1.75, 3.25)	0.18 (-0.27, 0.65)	7.06 (-9.35, 34.30)	0.90 (0.63, 1.16)	35.42 (25.58, 50.09)	1.02 (0.76, 1.31)	40.39 (30.90, 54.46)	1.13 (0.84, 1.42)	44.44 (35.40, 57.92)
Southern Asia	3.24 (2.43, 3.94)	-1.28 (-1.83, -0.66)	-39.63 (-50.13, -25.40)	0.63 (0.51, 0.76)	19.59 (15.56, 25.78)	0.81 (0.66, 0.97)	25.18 (20.84, 31.77)	0.98 (0.80, 1.16)	30.22 (25.72, 37.05)
Western Asia	3.40 (2.56, 4.12)	-0.19 (-0.55, 0.22)	-5.56 (-13.89, 8.27)	0.76 (0.55, 0.97)	22.34 (16.47, 30.16)	0.84 (0.62, 1.08)	24.82 (18.94, 32.59)	0.94 (0.70, 1.18)	27.62 (21.75, 35.05)
Eastern Asia	2.28 (1.63, 2.88)	0.04 (-0.30, 0.42)	1.66 (-11.14, 23.63)	0.47 (0.35, 0.60)	20.74 (15.60, 28.42)	0.53 (0.40, 0.66)	23.27 (18.55, 30.18)	0.59 (0.45, 0.73)	25.74 (21.50, 31.87)
South-eastern Asia	1.97 (1.21, 2.63)	-1.97 (-2.89, -0.92)	-99.98 (-120.49, -71.21)	0.66 (0.51, 0.82)	33.45 (25.75, 49.48)	0.80 (0.61, 0.99)	40.48 (32.63, 56.94)	0.92 (0.69, 1.15)	46.58 (38.29, 63.55)
Australia and New Zealand	0.52 (-0.18, 1.12)	-0.09 (-0.51, 0.34)	-17.77 (-78.10, 366.47)	0.38 (0.02, 0.69)	72.41 (10.58, 429.50)	0.41 (0.07, 0.70)	78.93 (43.11, 447.60)	0.43 (0.09, 0.72)	82.98 (41.46, 503.34)
Other regions in Oceania	-0.08 (-0.30, 0.12)	0.44 (-0.24, 1.78)	562.93 (-711.17, 4625.83)	-0.08 (-0.28, 0.11)	-97.04 (-131.72, 91.08)	-0.08 (-0.29, 0.12)	-95.96 (-107.15, 119.80)	-0.07 (-0.29, 0.11)	-94.93 (-97.91, 97.65)

Abbreviation: EVI, Enhanced Vegetation Index.

eTable 6. Modelled reduction in attributable fraction of mortality due to heat under different enhanced vegetation index (EVI) scenarios compared to the factual scenario during 2000 and 2019, by country/region.

Country/Region	Reduction in attributable fraction (percentage point, 95% eCI)			
	EVI decreased to zero	EVI increased by 10%	EVI increased by 20%	EVI increased by 30%
Afghanistan	-0.15 (-0.68, 0.42)	1.04 (0.59, 1.48)	1.16 (0.80, 1.53)	1.24 (0.87, 1.65)
Albania	-0.91 (-1.51, -0.23)	1.83 (1.66, 2.00)	2.14 (1.91, 2.36)	2.43 (2.19, 2.66)
Algeria	-0.35 (-0.58, -0.10)	0.02 (-0.08, 0.11)	0.02 (-0.08, 0.11)	0.02 (-0.08, 0.11)
Angola	0.13 (-0.80, 1.09)	1.72 (0.32, 3.07)	1.72 (0.32, 3.08)	1.72 (0.32, 3.08)
Argentina	2.57 (2.24, 2.88)	1.66 (1.33, 1.96)	1.78 (1.55, 2.01)	1.92 (1.67, 2.17)
Armenia	-1.41 (-2.03, -0.72)	0.95 (0.69, 1.23)	1.09 (0.67, 1.49)	1.19 (0.87, 1.50)
Australia	-0.01 (-0.45, 0.48)	0.43 (-0.03, 0.85)	0.47 (0.08, 0.81)	0.50 (0.09, 0.85)
Austria	-0.94 (-1.35, -0.44)	1.67 (1.59, 1.75)	2.11 (1.97, 2.25)	2.45 (2.27, 2.62)
Azerbaijan	-0.64 (-1.04, -0.22)	0.57 (0.33, 0.84)	0.66 (0.41, 0.93)	0.74 (0.47, 1.01)
Bangladesh	-2.17 (-4.18, -0.12)	0.24 (-0.04, 0.51)	0.34 (0.10, 0.56)	0.43 (0.19, 0.65)
Belarus	0.44 (0.13, 0.78)	1.33 (1.21, 1.46)	1.53 (1.39, 1.69)	1.70 (1.54, 1.86)
Belgium	-0.12 (-0.57, 0.38)	0.81 (0.73, 0.88)	0.96 (0.85, 1.06)	1.11 (0.98, 1.23)
Benin	-1.14 (-2.14, -0.01)	-0.00 (-0.06, 0.05)	-0.00 (-0.06, 0.05)	-0.00 (-0.06, 0.06)
Bhutan	-4.22 (-6.19, -1.85)	0.12 (-0.10, 0.33)	0.15 (0.03, 0.26)	0.17 (0.05, 0.28)
Bolivia	0.78 (0.01, 1.50)	0.75 (0.11, 1.31)	0.86 (0.18, 1.47)	0.95 (0.26, 1.58)
Bosnia and Herzegovina	-2.21 (-2.88, -1.49)	1.94 (1.80, 2.08)	2.22 (2.07, 2.37)	2.37 (2.20, 2.53)
Botswana	-0.75 (-1.28, -0.17)	0.74 (0.53, 0.94)	0.89 (0.65, 1.12)	1.02 (0.76, 1.25)
Brazil	1.18 (0.90, 1.42)	1.04 (0.86, 1.21)	1.25 (1.05, 1.46)	1.40 (1.16, 1.64)
Brunei	-1.56 (-4.46, 1.29)	0.69 (-1.84, 2.92)	0.90 (-1.67, 3.14)	1.08 (-1.49, 3.36)
Bulgaria	-0.96 (-1.54, -0.28)	1.88 (1.76, 2.01)	2.28 (2.13, 2.43)	2.57 (2.38, 2.75)
Burkina Faso	-1.21 (-2.64, 0.15)	-0.10 (-1.37, 1.07)	-0.08 (-1.76, 1.69)	0.09 (-1.28, 1.37)
Burundi	0.74 (-0.14, 1.68)	-0.04 (-0.07, -0.01)	-0.05 (-0.11, 0.01)	-0.06 (-0.10, -0.01)
Cabo Verde	-0.48 (-1.16, 0.26)	-0.17 (-1.27, 0.92)	-0.13 (-1.25, 0.98)	-0.09 (-1.25, 1.04)
Cambodia	-0.23 (-0.90, 0.47)	0.91 (0.68, 1.14)	1.02 (0.77, 1.26)	1.16 (0.91, 1.43)
Cameroon	-0.19 (-0.50, 0.14)	-0.08 (-0.30, 0.14)	-0.06 (-0.36, 0.25)	-0.01 (-0.15, 0.13)
Canada	0.26 (-0.07, 0.62)	0.70 (0.57, 0.83)	0.76 (0.61, 0.91)	0.80 (0.63, 0.95)
Central African Republic	-5.09 (-9.53, -0.40)	-0.05 (-0.10, 0.00)	-0.05 (-0.10, 0.00)	-0.05 (-0.10, 0.00)
Chad	-1.36 (-1.82, -0.91)	0.02 (-0.40, 0.43)	0.91 (-0.02, 1.81)	1.76 (0.49, 2.86)
Chile	1.13 (0.89, 1.38)	1.19 (0.97, 1.40)	1.10 (0.90, 1.30)	1.01 (0.83, 1.19)
China	-0.04 (-0.37, 0.33)	0.45 (0.33, 0.58)	0.52 (0.40, 0.65)	0.58 (0.45, 0.72)
Colombia	0.12 (-0.31, 0.52)	0.24 (0.04, 0.44)	0.28 (0.21, 0.35)	0.32 (0.11, 0.51)
Comoros	2.32 (-6.60, 11.98)	-0.08 (-0.29, 0.13)	-0.07 (-0.24, 0.10)	-0.06 (-0.27, 0.15)
Costa Rica	-0.33 (-0.56, -0.09)	0.19 (-0.05, 0.43)	0.19 (-0.06, 0.45)	0.20 (-0.06, 0.46)
Croatia	-1.25 (-1.87, -0.53)	2.04 (1.91, 2.19)	2.36 (2.21, 2.52)	2.57 (2.40, 2.75)
Cuba	-0.84 (-1.61, -0.15)	0.23 (-0.03, 0.48)	0.41 (0.15, 0.67)	0.57 (0.22, 0.94)
Cyprus	-0.36 (-0.76, 0.11)	0.87 (0.75, 0.96)	1.07 (0.85, 1.27)	1.25 (0.95, 1.51)
Czechia	-0.17 (-0.59, 0.32)	1.51 (1.41, 1.61)	1.78 (1.65, 1.90)	1.94 (1.79, 2.08)
Democratic Republic of the Congo	-2.67 (-5.31, 0.09)	-0.02 (-0.11, 0.06)	-0.02 (-0.11, 0.08)	-0.01 (-0.11, 0.09)
Denmark	-0.06 (-0.58, 0.52)	0.86 (0.78, 0.94)	0.99 (0.89, 1.08)	1.08 (0.96, 1.20)
Djibouti	-1.69 (-4.64, 1.72)	-0.40 (-4.03, 3.24)	-0.22 (-1.42, 1.10)	-0.02 (-0.86, 0.81)
Dominican Republic	-1.27 (-1.95, -0.51)	0.22 (0.07, 0.35)	0.34 (0.11, 0.55)	0.44 (0.18, 0.68)
Ecuador	0.19 (-0.12, 0.52)	0.31 (0.05, 0.56)	0.34 (0.09, 0.60)	0.37 (0.13, 0.63)
Egypt	-0.31 (-0.47, -0.15)	-0.08 (-0.14, -0.02)	-0.08 (-0.14, -0.02)	-0.08 (-0.13, -0.02)
El Salvador	-0.19 (-1.10, 0.78)	0.47 (-0.05, 0.98)	0.53 (-0.17, 1.16)	0.56 (-0.30, 1.31)
Equatorial Guinea	-4.91 (-9.09, -0.51)	-0.05 (-0.13, 0.02)	-0.05 (-0.13, 0.02)	-0.05 (-0.13, 0.02)
Eritrea	0.04 (-0.03, 0.10)	0.03 (-0.11, 0.16)	0.03 (-0.11, 0.16)	0.03 (-0.11, 0.16)
Estonia	0.20 (-0.24, 0.66)	1.15 (1.02, 1.29)	1.27 (1.12, 1.43)	1.35 (1.20, 1.50)
Ethiopia	0.03 (-0.06, 0.12)	-0.07 (-0.13, -0.01)	-0.07 (-0.13, -0.01)	-0.07 (-0.13, -0.01)
Fiji	-0.96 (-2.62, 0.89)	-0.12 (-0.30, 0.05)	-0.12 (-0.30, 0.05)	-0.12 (-0.30, 0.05)
Finland	0.01 (-0.78, 0.86)	1.37 (1.23, 1.52)	1.49 (1.34, 1.65)	1.58 (1.41, 1.77)
France	-1.48 (-2.69, -0.20)	1.30 (1.19, 1.39)	1.53 (1.36, 1.69)	1.73 (1.51, 1.92)
Gabon	-3.54 (-6.50, -0.49)	-0.07 (-0.13, 0.00)	-0.07 (-0.14, 0.00)	-0.07 (-0.14, 0.00)
Gambia	-0.19 (-0.27, -0.10)	-0.10 (-0.17, -0.03)	-0.10 (-0.17, -0.03)	-0.10 (-0.17, -0.03)
Georgia	-0.90 (-1.37, -0.40)	0.57 (0.33, 0.80)	0.65 (0.39, 0.93)	0.73 (0.43, 1.03)
Germany	-0.86 (-1.51, -0.17)	1.22 (1.14, 1.29)	1.42 (1.32, 1.52)	1.54 (1.41, 1.66)

Ghana	-0.28 (-0.43, -0.11)	-0.08 (-0.18, 0.01)	0.19 (-0.08, 0.43)	0.19 (-0.07, 0.44)
Greece	-0.21 (-0.66, 0.29)	1.69 (1.56, 1.82)	2.05 (1.91, 2.19)	2.33 (2.14, 2.50)
Guatemala	-0.10 (-0.28, 0.09)	0.19 (-0.08, 0.48)	0.21 (-0.03, 0.47)	0.22 (-0.07, 0.52)
Guinea	-0.28 (-0.69, 0.19)	-0.08 (-0.17, 0.01)	0.06 (-0.12, 0.23)	0.06 (-0.12, 0.23)
Guinea-Bissau	-0.74 (-1.27, -0.13)	-0.09 (-0.17, -0.01)	-0.09 (-0.17, -0.01)	-0.09 (-0.17, -0.01)
Guyana	-0.42 (-1.08, 0.16)	0.33 (0.19, 0.46)	0.55 (0.37, 0.73)	0.75 (0.54, 0.95)
Haiti	-0.56 (-1.19, 0.04)	0.27 (0.03, 0.52)	0.42 (0.16, 0.69)	0.59 (0.23, 0.89)
Honduras	-0.41 (-0.90, 0.11)	0.37 (0.20, 0.52)	0.41 (-0.11, 0.89)	0.45 (-0.06, 0.92)
Hong Kong S.A.R.	-0.65 (-1.04, -0.18)	0.22 (0.16, 0.27)	0.32 (0.23, 0.39)	0.38 (0.27, 0.47)
Hungary	-0.34 (-0.80, 0.22)	1.77 (1.67, 1.87)	2.16 (2.02, 2.30)	2.44 (2.26, 2.60)
India	-1.38 (-1.89, -0.80)	0.65 (0.51, 0.80)	0.86 (0.68, 1.03)	1.03 (0.84, 1.24)
Indonesia	-2.22 (-3.13, -1.13)	0.73 (0.55, 0.92)	0.85 (0.63, 1.07)	0.95 (0.71, 1.17)
Iran	0.15 (-0.24, 0.57)	0.94 (0.67, 1.21)	1.09 (0.79, 1.39)	1.24 (0.94, 1.56)
Iraq	0.66 (0.42, 0.93)	0.70 (0.50, 0.90)	0.74 (0.56, 0.93)	0.86 (0.66, 1.08)
Ireland	-1.35 (-3.85, 1.24)	0.86 (0.72, 1.00)	0.91 (0.76, 1.06)	0.95 (0.79, 1.10)
Israel	-0.97 (-1.66, -0.17)	0.40 (0.30, 0.50)	0.47 (0.34, 0.60)	0.49 (0.35, 0.62)
Italy	-0.82 (-1.37, -0.20)	2.06 (1.94, 2.18)	2.38 (2.23, 2.52)	2.68 (2.51, 2.85)
Ivory Coast	-0.29 (-0.47, -0.09)	-0.08 (-0.15, -0.02)	-0.08 (-0.15, -0.02)	-0.09 (-0.15, -0.02)
Jamaica	-1.48 (-2.91, 0.10)	0.25 (0.03, 0.47)	0.40 (-0.39, 1.23)	0.58 (-1.60, 2.86)
Japan	0.32 (-0.02, 0.68)	0.54 (0.40, 0.67)	0.56 (0.42, 0.71)	0.60 (0.45, 0.76)
Jordan	-0.08 (-0.42, 0.30)	0.66 (0.48, 0.82)	0.66 (0.49, 0.82)	0.67 (0.49, 0.83)
Kazakhstan	0.35 (-0.04, 0.77)	0.91 (0.63, 1.21)	1.02 (0.72, 1.32)	1.11 (0.79, 1.42)
Kenya	-0.77 (-1.39, -0.12)	-0.08 (-0.14, -0.02)	-0.08 (-0.14, -0.02)	-0.08 (-0.14, -0.02)
Kosovo	-1.07 (-1.64, -0.43)	1.77 (1.63, 1.91)	2.18 (2.00, 2.37)	2.52 (2.31, 2.73)
Kuwait	1.10 (0.77, 1.43)	0.82 (-0.22, 1.96)	0.49 (0.14, 0.87)	0.46 (0.11, 0.84)
Kyrgyzstan	-0.22 (-0.77, 0.38)	0.83 (0.57, 1.10)	0.96 (0.69, 1.24)	1.03 (0.74, 1.33)
Laos	-1.07 (-1.77, -0.26)	0.84 (0.65, 1.04)	1.00 (0.78, 1.22)	1.15 (0.91, 1.40)
Latvia	0.59 (0.22, 1.00)	1.31 (1.17, 1.46)	1.47 (1.30, 1.63)	1.57 (1.39, 1.75)
Lebanon	-0.95 (-1.71, -0.07)	0.60 (0.40, 0.80)	0.66 (0.44, 0.87)	0.73 (0.45, 0.99)
Liberia	-0.11 (-0.19, -0.03)	-0.11 (-0.19, -0.02)	-0.11 (-0.21, -0.02)	-0.11 (-0.21, -0.02)
Libya	-0.08 (-0.16, -0.01)	0.06 (-0.06, 0.19)	0.06 (-0.06, 0.19)	0.06 (-0.06, 0.19)
Lithuania	0.52 (0.14, 0.96)	1.42 (1.28, 1.56)	1.57 (1.43, 1.69)	1.68 (1.52, 1.85)
Macedonia	-0.39 (-0.90, 0.21)	2.27 (2.14, 2.42)	2.85 (2.66, 3.04)	3.25 (3.03, 3.47)
Madagascar	-1.23 (-4.18, 1.75)	-0.00 (-0.07, 0.06)	0.03 (-0.05, 0.11)	0.06 (-0.03, 0.15)
Malawi	-2.04 (-3.64, -0.17)	0.27 (-0.11, 0.63)	0.28 (-0.09, 0.60)	0.28 (-0.11, 0.64)
Malaysia	-3.30 (-4.82, -1.60)	0.68 (0.56, 0.79)	0.85 (0.57, 1.12)	1.00 (0.36, 1.64)
Mali	-0.84 (-1.23, -0.42)	-0.12 (-0.57, 0.28)	0.02 (-0.55, 0.56)	0.53 (-0.15, 1.16)
Mauritania	-0.12 (-0.18, -0.05)	-0.07 (-0.14, -0.00)	-0.05 (-0.12, 0.01)	-0.03 (-0.10, 0.04)
Mexico	0.35 (0.11, 0.58)	0.54 (0.34, 0.71)	0.60 (0.39, 0.79)	0.66 (0.44, 0.86)
Moldova	-1.41 (-1.99, -0.74)	1.88 (1.72, 2.05)	2.28 (2.10, 2.47)	2.47 (2.26, 2.67)
Mongolia	0.29 (-0.04, 0.61)	0.46 (0.08, 0.84)	0.48 (0.08, 0.88)	0.50 (0.07, 0.91)
Montenegro	-0.70 (-1.26, -0.04)	2.20 (2.07, 2.33)	2.62 (2.47, 2.77)	2.90 (2.72, 3.08)
Morocco	-0.08 (-0.14, -0.03)	-0.08 (-0.14, -0.02)	-0.08 (-0.14, -0.02)	-0.08 (-0.14, -0.02)
Mozambique	-0.85 (-1.13, -0.58)	0.13 (-0.12, 0.36)	0.25 (-0.08, 0.57)	0.38 (0.05, 0.69)
Myanmar	-1.08 (-1.56, -0.52)	0.59 (0.46, 0.73)	0.81 (0.63, 1.00)	1.00 (0.78, 1.23)
Namibia	0.09 (-0.37, 0.58)	0.75 (0.36, 1.14)	0.82 (0.43, 1.22)	0.89 (0.49, 1.29)
Nepal	-3.32 (-5.18, -1.44)	0.14 (0.04, 0.23)	0.18 (0.05, 0.31)	0.21 (0.08, 0.35)
Netherlands	-0.90 (-1.96, 0.18)	0.60 (0.53, 0.66)	0.75 (0.64, 0.85)	0.84 (0.71, 0.95)
New Zealand	-0.51 (-1.21, 0.24)	0.09 (-0.53, 0.65)	0.10 (-0.43, 0.59)	0.10 (-0.49, 0.63)
Nicaragua	0.11 (-0.50, 0.74)	0.49 (0.27, 0.71)	0.61 (0.33, 0.91)	0.77 (0.42, 1.14)
Niger	-2.06 (-2.88, -1.14)	-0.06 (-0.34, 0.23)	0.17 (-0.13, 0.46)	0.99 (0.37, 1.52)
Nigeria	-1.52 (-2.80, -0.10)	-0.03 (-0.23, 0.18)	0.03 (-0.19, 0.25)	0.15 (-0.10, 0.41)
North Korea	0.02 (-0.36, 0.44)	0.44 (0.33, 0.54)	0.47 (0.32, 0.63)	0.51 (0.33, 0.69)
Norway	-0.66 (-1.45, 0.18)	1.32 (1.12, 1.51)	1.48 (1.27, 1.67)	1.60 (1.39, 1.80)
Oman	0.50 (0.20, 0.81)	1.13 (0.90, 1.36)	1.21 (1.01, 1.40)	1.27 (1.01, 1.52)
Pakistan	-0.37 (-0.69, -0.01)	0.64 (0.50, 0.79)	0.79 (0.65, 0.95)	0.95 (0.77, 1.13)
Palestine	-1.16 (-1.90, -0.32)	0.69 (0.50, 0.88)	0.84 (0.59, 1.06)	0.94 (0.64, 1.22)
Panama	-0.41 (-1.11, 0.24)	0.41 (0.17, 0.64)	0.58 (0.12, 1.09)	0.73 (0.38, 1.04)
Papua New Guinea	0.85 (-0.29, 3.04)	-0.13 (-0.27, 0.01)	-0.13 (-0.27, 0.01)	-0.13 (-0.27, 0.01)
Paraguay	2.90 (2.59, 3.20)	1.09 (0.96, 1.23)	1.29 (1.14, 1.44)	1.41 (1.26, 1.56)
Peru	0.95 (0.54, 1.35)	0.54 (0.20, 0.87)	0.45 (0.15, 0.75)	0.26 (-0.05, 0.58)
Philippines	-2.50 (-3.87, -0.96)	0.50 (0.33, 0.67)	0.60 (0.41, 0.79)	0.70 (0.43, 0.96)
Poland	-0.18 (-0.58, 0.28)	1.31 (1.22, 1.40)	1.53 (1.42, 1.64)	1.66 (1.53, 1.79)
Portugal	-1.36 (-2.87, 0.21)	1.28 (0.81, 1.69)	1.41 (0.95, 1.81)	1.51 (1.07, 1.89)
Puerto Rico	-1.40 (-2.02, -0.71)	0.23 (0.13, 0.32)	0.36 (0.06, 0.65)	0.48 (0.18, 0.78)
Qatar	0.34 (-4.40, 4.52)	0.74 (-3.79, 4.77)	0.78 (0.51, 1.08)	0.83 (-3.81, 4.98)
Republic of Serbia	-0.70 (-1.26, -0.05)	2.13 (1.98, 2.29)	2.65 (2.49, 2.83)	2.98 (2.77, 3.19)

Republic of the Congo	-2.31 (-3.99, -0.84)	-0.07 (-0.14, 0.01)	-0.07 (-0.14, 0.01)	-0.07 (-0.14, 0.01)
Romania	-0.48 (-0.99, 0.10)	1.74 (1.62, 1.88)	2.11 (1.96, 2.27)	2.41 (2.22, 2.58)
Russia	0.55 (0.24, 0.89)	1.47 (1.34, 1.60)	1.69 (1.56, 1.83)	1.89 (1.73, 2.06)
Rwanda	0.18 (-0.18, 0.57)	-0.07 (-0.12, -0.01)	-0.07 (-0.12, -0.01)	-0.07 (-0.12, -0.01)
Saudi Arabia	0.53 (0.16, 0.89)	1.13 (0.82, 1.43)	1.23 (0.93, 1.52)	1.37 (1.05, 1.68)
Senegal	-0.23 (-0.35, -0.11)	-0.09 (-0.16, -0.02)	-0.08 (-0.15, -0.02)	0.05 (-0.06, 0.15)
Sierra Leone	-0.19 (-0.42, 0.07)	-0.09 (-0.16, -0.02)	-0.09 (-0.16, -0.02)	-0.08 (-0.16, -0.02)
Slovakia	-0.38 (-0.86, 0.16)	1.85 (1.73, 1.98)	2.18 (2.05, 2.30)	2.37 (2.21, 2.53)
Slovenia	-0.90 (-1.49, -0.23)	1.90 (1.78, 2.03)	2.13 (2.01, 2.25)	2.30 (2.14, 2.45)
Somalia	-0.37 (-0.60, -0.10)	0.07 (-0.04, 0.17)	0.07 (-0.04, 0.17)	0.07 (-0.04, 0.17)
South Africa	-1.10 (-1.78, -0.31)	0.38 (0.20, 0.56)	0.44 (0.25, 0.62)	0.48 (0.25, 0.69)
South Korea	0.18 (-0.16, 0.55)	0.54 (0.43, 0.66)	0.59 (0.38, 0.79)	0.63 (0.51, 0.75)
South Sudan	-2.01 (-3.78, -0.32)	-0.11 (-1.00, 0.73)	0.21 (-0.52, 0.96)	0.51 (-2.66, 3.81)
Spain	0.30 (-0.17, 0.78)	1.97 (1.80, 2.15)	2.20 (2.06, 2.35)	2.37 (2.19, 2.55)
Sri Lanka	-6.59 (-8.86, -4.13)	0.64 (0.45, 0.83)	0.75 (0.50, 0.97)	0.83 (0.55, 1.08)
Sudan	-1.89 (-3.80, 0.24)	-0.02 (-0.38, 0.32)	0.11 (-0.29, 0.53)	0.28 (-0.11, 0.67)
Sweden	0.30 (-0.11, 0.77)	1.04 (0.96, 1.13)	1.15 (1.05, 1.25)	1.21 (1.10, 1.31)
Switzerland	-1.70 (-2.21, -1.14)	1.79 (1.69, 1.91)	2.05 (1.87, 2.23)	2.23 (2.08, 2.38)
Syria	-0.11 (-0.52, 0.36)	0.86 (0.66, 1.07)	0.97 (0.74, 1.21)	1.09 (0.84, 1.32)
Tajikistan	-0.02 (-0.59, 0.58)	0.71 (0.47, 0.96)	0.84 (0.57, 1.13)	0.95 (0.68, 1.23)
Thailand	-0.59 (-1.13, 0.02)	0.63 (0.49, 0.77)	0.89 (0.72, 1.06)	1.13 (0.92, 1.36)
Togo	-0.74 (-1.27, -0.14)	-0.07 (-0.32, 0.17)	0.01 (-0.11, 0.13)	0.02 (-0.11, 0.14)
Trinidad and Tobago	-2.15 (-2.75, -1.44)	0.39 (0.25, 0.53)	0.56 (0.41, 0.71)	0.72 (0.55, 0.88)
Tunisia	-0.07 (-0.12, -0.01)	-0.07 (-0.12, -0.01)	-0.07 (-0.12, -0.01)	-0.07 (-0.12, -0.01)
Turkey	-0.61 (-1.09, -0.04)	0.71 (0.51, 0.92)	0.80 (0.57, 1.04)	0.87 (0.63, 1.10)
Turkmenistan	0.17 (-0.17, 0.54)	1.19 (0.93, 1.45)	1.48 (1.21, 1.76)	1.68 (1.38, 1.97)
Uganda	0.12 (-0.99, 1.28)	-0.08 (-0.13, -0.02)	-0.08 (-0.13, -0.02)	-0.08 (-0.13, -0.02)
Ukraine	-0.62 (-1.05, -0.11)	1.73 (1.58, 1.89)	2.16 (1.97, 2.35)	2.44 (2.23, 2.65)
United Arab Emirates	0.62 (-0.08, 1.33)	1.41 (1.07, 1.73)	1.71 (-0.20, 3.59)	1.96 (1.66, 2.24)
United Kingdom	-0.47 (-1.74, 0.82)	0.95 (0.51, 1.37)	1.02 (0.59, 1.44)	1.07 (0.64, 1.49)
United Republic of Tanzania	-2.66 (-4.91, -0.32)	-0.05 (-0.09, -0.00)	-0.05 (-0.09, -0.00)	-0.05 (-0.09, -0.00)
United States of America	0.35 (0.07, 0.65)	0.74 (0.58, 0.90)	0.83 (0.64, 1.01)	0.89 (0.69, 1.09)
Uruguay	2.16 (1.82, 2.48)	1.42 (1.20, 1.65)	1.54 (1.30, 1.78)	1.66 (1.41, 1.92)
Uzbekistan	0.10 (-0.39, 0.62)	0.88 (0.65, 1.12)	1.00 (0.76, 1.25)	1.11 (0.86, 1.38)
Venezuela	-0.27 (-1.22, 0.70)	0.35 (0.19, 0.49)	0.43 (0.06, 0.78)	0.52 (0.01, 1.02)
Vietnam	-1.14 (-1.92, -0.27)	0.56 (0.43, 0.68)	0.67 (0.51, 0.82)	0.76 (0.59, 0.93)
Yemen	-0.49 (-0.73, -0.21)	0.83 (0.56, 1.12)	0.98 (0.65, 1.30)	1.11 (0.76, 1.45)
Zambia	-1.65 (-3.32, 0.27)	0.11 (-0.03, 0.26)	0.19 (0.01, 0.38)	0.25 (0.03, 0.43)
Zimbabwe	-1.31 (-2.42, -0.08)	0.17 (-0.03, 0.37)	0.25 (-0.08, 0.54)	0.26 (-0.08, 0.57)

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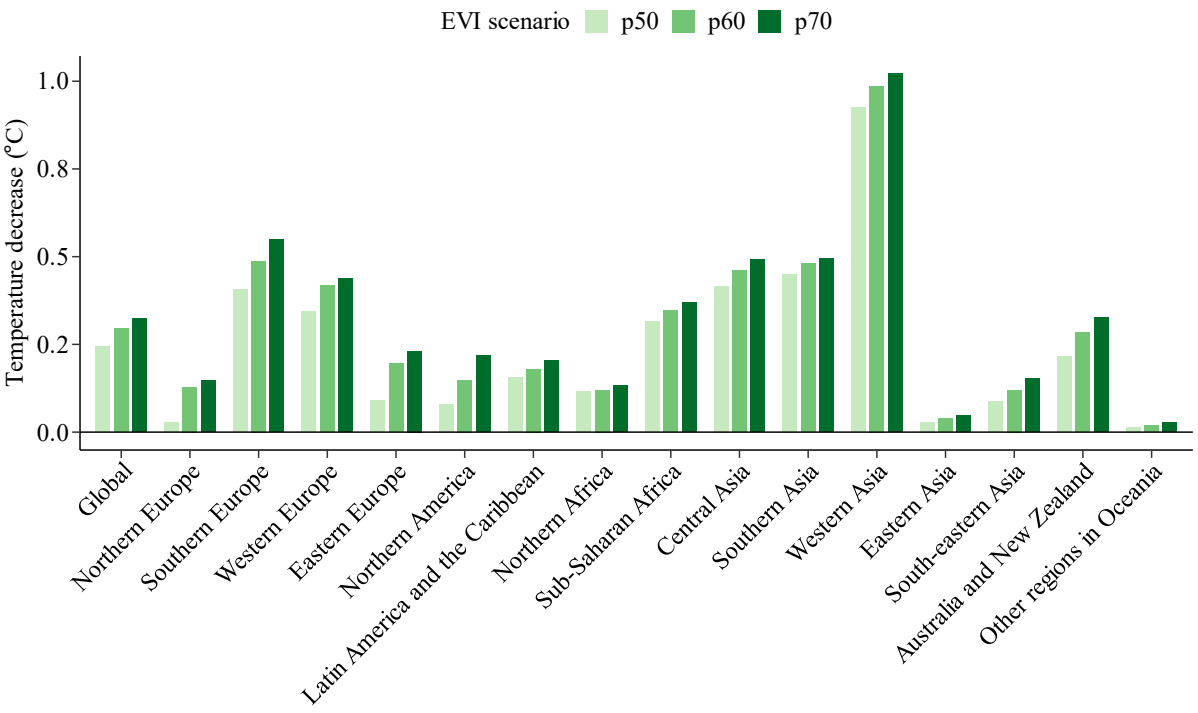
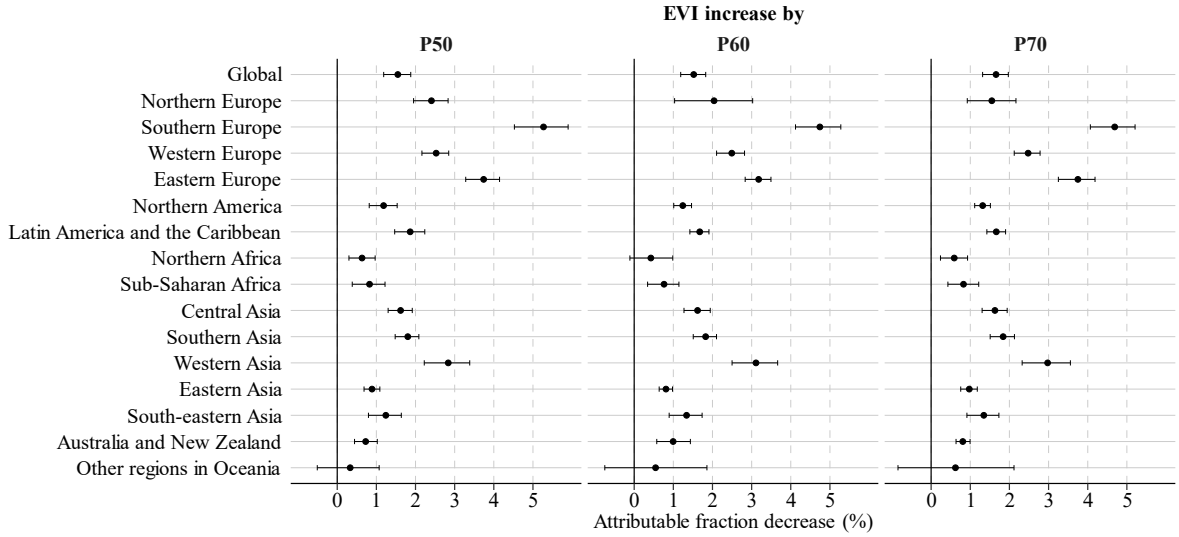
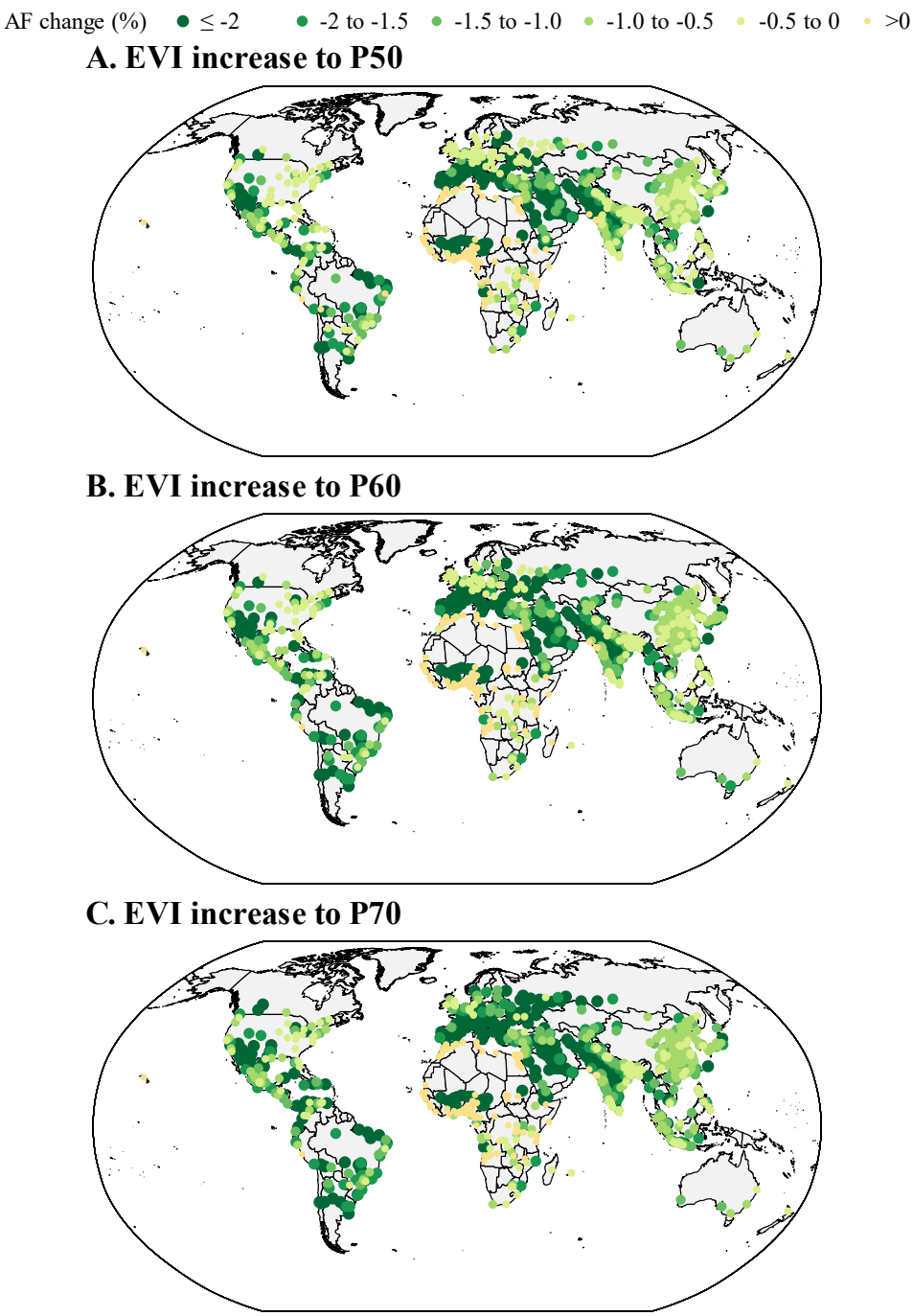


eFigure 3. Modelled decrease in population-weighted warm-season mean temperature under different enhanced vegetation index (EVI) scenarios (increasing to 50th, 60th, and 70th percentiles of the global urban EVI distribution) compared to the factual scenario during 2000 and 2019 by region and continent. EVI, Enhanced Vegetation Index.



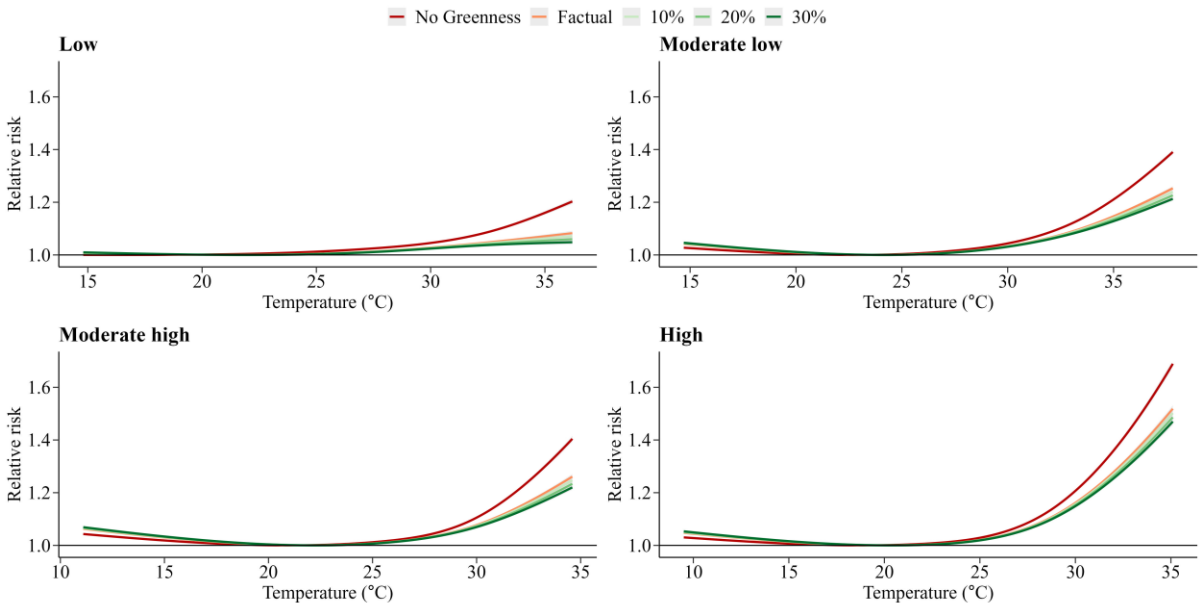
eFigure 4. Modelled reduction in attributable fraction of mortality due to heat under different enhanced vegetation index (EVI) scenarios (increasing to 50th, 60th, and 70th percentiles of the global urban EVI distribution) compared to the factual scenario during 2000 and 2019. EVI, Enhanced Vegetation Index.



eFigure 5. Modelled change in attributable fraction of mortality due to heat under different enhanced vegetation index (EVI) scenarios (increasing to 50th, 60th, and 70th percentiles of the global urban EVI distribution) during 2000 and 2019 for top 1000 most populated urban areas. Abbreviations: EVI, Enhanced Vegetation Index; AF, attributable fraction.

eTable 7. The baseline enhanced vegetation index (EVI) across urban areas with different socio-economic status.

GDP per capita (US$)	EVI
Low (≤ 1950)	0.243
Moderate low (1950 to 4375)	0.251
Moderate high (4375 to 9216)	0.260
High (> 9216)	0.260



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237 **eFigure 6. Exposure-response associations between heat exposure and mortality by EVI**

238 **scenarios during 2000 and 2019, stratified by socio-economic status of urban areas.**

eTable 8. The proportion of population aged above 65 years old across urban areas with different socio-economic statuses.

GDP per capita (US$)	Proportion (%)
Low (≤ 1950)	4.1
Moderate low (1950 to 4375)	5.5
Moderate high (4375 to 9216)	7.5
High (> 9216)	11.7

3. Full list of MCC collaborators

Ala Overcenco[1], Aleš Urban[2,3], Alexandra Schneider[4], Alireza Entezari[5], Ana Maria Vicedo-Cabrera[6,7,8], Antonella Zanobetti[9], Antonis Analitis[10], Aurelio Tobias[11,12], Baltazar Nunes[13,14], Barrak Alahmad[15], Bertil Forsberg[16], Carmen Íñiguez[17,18], Caroline Ameling[19], César De la Cruz Valencia[20], Christofer Åström[16], Danny Houthuijs[19], Do Van Dung[21], Ene Indermitte[22], Fatemeh Mayvaneh[5], Fiorella Acquaotta[23], Gabriel Carrasco-Escobar[24,25], Haidong Kan[26], Hanne Krage Carlsen[27], Hans Orru[22], Ho Kim[28], Iulian-Horia Holobaca[29], Jan Kyselý[2,3], Jouni J.K. Jaakkola[30,31], Klea Katsouyanni[10,32], Magali Hurtado Diaz[20], Martina S. Ragettli[33,34], Masahiro Hashizume[35], Micheline de Sousa Zanotti Stagliorio Coelho[36], Nicolás Valdés Ortega[37], Noah Scovronick[38], Paola Michelozzi[39], Patricia Matus Correa[37], Patrick Goodman[40], Paulo Hilario Nascimento Saldiva[41], Raanan Raz[42], Rosana Abrutzky[43], Samuel Osorio[44], Shih-Chun Pan[45], Shilpa Rao[46], Tran Ngoc Dang[47], Valentina Colistro[48], Veronika Huber[49,50], Whanhee Lee[51,52], Xerxes Seposo[12], Yasushi Honda[53], Yoonhee Kim[54], Yue Leon Guo[55,45,56]

[1]National Agency for Public Health of the Ministry of Health, Labour and Social Protection of the Republic of Moldova
[2]Institute of Atmospheric Physics, Czech Academy of Sciences, Prague 141 00, Czech Republic
[3]Faculty of Environmental Sciences, Czech University of Life Sciences, Prague, Czech Republic.
[4]Institute of Epidemiology, Helmholtz Zentrum München – German Research Center for Environmental Health (GmbH), Neuherberg, Germany
[5]Faculty of Geography and Environmental Sciences, Hakim Sabzevari University, Sabzevar 9617916487 Khorasan Razavi, Iran
[6]Institute of Social and Preventive Medicine, University of Bern, Bern, Switzerland
[7]Oeschger Center for Climate Change Research, University of Bern, Bern, Switzerland
[8]Department of Public Health Environments and Society, London School of Hygiene and Tropical Medicine, London, United Kingdom
[9]Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, MA, USA
[10]Department of Hygiene, Epidemiology and Medical Statistics, National and Kapodistrian University of Athens, Greece
[11]Institute of Environmental Assessment and Water Research (IDAEA), Spanish Council for Scientific Research (CSIC), Barcelona, Spain
[12]School of Tropical Medicine and Global Health, Nagasaki University, Nagasaki, Japan
[13]Department of Epidemiology, Instituto Nacional de Saúde Dr Ricardo Jorge
[14]Centro de Investigação em Saúde Pública, Escola Nacional de Saúde Pública, Universidade NOVA de Lisboa, Lisboa, Portugal
[15]Department of Environmental Health, Harvard T.H. Chan School of Public Health, Harvard University, Boston, MA, USA
[16]Department of Public Health and Clinical Medicine, Umeå University, Sweden
[17]Department of Statistics and Computational Research. Universitat de València, València, Spain
[18]Ciberesp, Madrid. Spain
[19]National Institute for Public Health and the Environment (RIVM), Centre for Sustainability and Environmental Health, Bilthoven, Netherlands
[20]Department of Environmental Health, National Institute of Public Health, Cuernavaca, Morelos, Mexico

[21]Department of Environmetal Health, Faculty of Public Health, University of Medicine and Pharmacy at Ho Chi Minh City, Ho Chi Minh City, VietNam
[22]Department of Family Medicine and Public Health, University of Tartu, Tartu, Estonia
[23]Department of Earth Sciences, University of Torino, Italy
[24]Health Innovation Laboratory, Institute of Tropical Medicine "Alexander von Humboldt", Universidad Peruana Cayetano Heredia, Lima, Peru
[25]Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA, USA
[26]Department of Environmental Health, School of Public Health, Fudan University, Shanghai, China
[27]School of Public Health and Community Medicine, University of Gothenburg, Gothenburg, Sweden
[28]Graduate School of Public Health, Seoul National University, Seoul, Republic of Korea
[29]Faculty of Geography, Babes-Bolay University, Cluj-Napoca, Romania
[30]Center for Environmental and Respiratory Health Research (CERH), University of Oulu, Oulu, Finland
[31]Medical Research Center Oulu (MRC Oulu), Oulu University Hospital and University of Oulu, Oulu, Finland
[32]School of Population Health and Environmental Sciences, King's College, London, UK
[33]Swiss Tropical and Public Health Institute, Basel, Switzerland
[34]University of Basel, Basel
[35]Department of Global Health Policy, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan
[36]Department of Pathology, Faculty of Medicine, University of São Paulo, São Paulo, Brazil
[37]Department of Public Health, Universidad de los Andes, Santiago, Chile
[38]Gangarosa Department of Environmental Health. Rollins School of Public Health, Emory University, Atlanta, USA
[39]Department of Epidemiology, Lazio Regional Health Service, Rome, Italy
[40]Technological University Dublin, Ireland
[41]INSPER, São Paulo, Brazil
[42]Braun School of Public Health and Community Medicine, The Hebrew University of Jerusalem, Israel
[43]Universidad de Buenos Aires, Facultad de Ciencias Sociales, Instituto de Investigaciones Gino Germani
[44]Department of Environmental Health, University of São Paulo, São Paulo, Brazil
[45]National Institute of Environmental Health Science, National Health Research Institutes, Zhunan, Taiwan
[46]Norwegian institute of Public Health, Oslo, Norway
[47]Department of Environmetal Health, Faculty of Public Health, Department of Environmetal Health, University of Medicine and Pharmacy at Ho Chi Minh City, Ho Chi Minh City, Vietnam
[48]Department of Quantitative Methods, School of Medicine, University of the Republic, Montevideo, Uruguay
[49]IBE-Chair of Epidemiology, LMU Munich, Munich, Germany
[50]Department of Physical, Chemical and Natural Systems, Universidad Pablo de Olavide, Sevilla, Spain
[51]School of the Environment, Yale University, New Haven CT, USA
[52]Department of Occupational and Environmental Medicine, School of Medicine, Ewha Womans University, Seoul, South Korea
[53]Center for Climate Change Adaptation, National Institute for Environmental Studies,

Tsukuba, Japan
[54]Department of Global Environmental Health, Graduate School of Medicine, University of Tokyo, Tokyo, Japan
[55]Environmental and Occupational Medicine, National Taiwan University (NTU) College of Medicine and NTU Hospital, Taipei, Taiwan
[56]Graduate Institute of Environmental and Occupational Health Sciences, NTU College of Public Health, Taipei, Taiwan

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