HEAT & COLD ILLNESSES

ESTIMATES GLOBAL CLIMATE IMPACT

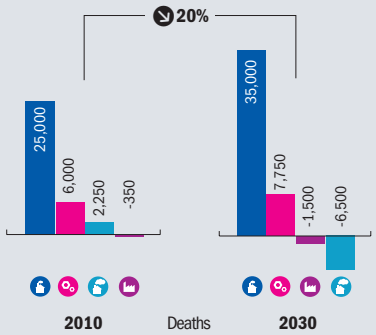
2010 EFFECT TODAY

DEATHS PER YEAR **35,000**

2030 EFFECT TOMORROW

DEATHS PER YEAR **35,000**

MORTALITY IMPACT

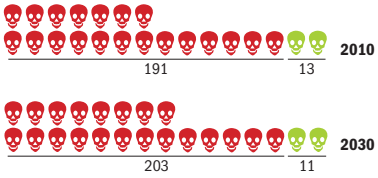


CONFIDENCE **INDICATIVE**

SEVERITY
AFFECTED
INJUSTICE
PRIORITY
MDG EFFECT

- Extreme heat is dangerous, entails high risks for the elderly, sufferers of chronic cardiovascular and respiratory diseases, and may increase skin cancer rates
- Shorter and less harsh winters alleviate dangers for the same risk groups and reduce the incidence of flu-like illnesses
- Some developed countries are estimated to experience modest health gains, as winters become less severe on average
- Effective responses to heat and cold illnesses benefit from a restricted high-risk group, concentrated on the elderly and chronic disease sufferers, while skin cancer risk is more diffuse in the population

RELATIVE IMPACT



HOTSPOTS

2010 2030

10,000 **INDIA** 10,000

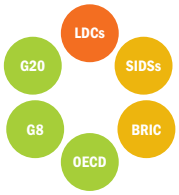
3,000 **NIGERIA** 4,250

2,250 **RUSSIA** 3,000

2,000 **UKRAINE** 2,250

1,750 **BANGLADESH** 2,000

GEOPOLITICAL VULNERABILITY



Deaths
Developing Country Low Emitters
Developing Country High Emitters
Developed
Other Industrialized

= Deaths per 10 million

Change in relation to overall global population and/or GDP

= Millions of USD (2010 PPP non-discounted)

Changes in the average levels and the extremities of heat and cold affect health. Increases in hospitalization and mortality rates are particularly evident for those suffering from chronic disease during heat waves (Michelozzi et al., 2009). Vulnerabilities to extreme hot and cold exist both in developed and developing countries and involve cardiovascular and respiratory diseases, skin cancer, and influenza-like illnesses, with both positive and negative effects. In tropical developing countries, exposure to heat is higher, especially since air conditioning, being linked to income, is less prevalent (Isaac and van Vuuren, 2009). Nor do tropical countries reap any of the potential benefits of shorter, warmer winters. While cooler, wealthy countries are likely to see improved health outcomes, experts have argued that even in developed countries, heat-related deaths may be greater than any gains from milder winters (McMichael et al., 2006). In Europe for example, 2003 was the hottest summer in some 500 years and left an estimated death toll of approximately 35,000–70,000 additional deaths (Patz et al., 2005; Robine et al., 2008). Scientists have argued the extent to which such extreme heat waves would be unlikely without climate change (Hansen et al., 2012). Reponses to the challenge benefit from clearly delineated groups among chronic disease sufferers. Skin cancer risk is much more generalized and presents a growing challenging for the promotion of safe behavioural adjustments for communities at risk (Bharath and Turner, 2009).

CLIMATE MECHANISM

Warm spells and heat waves have become more common and extreme, cold spells less so (IPCC, 2007). Because heat causes sweating, which removes water from the blood, high temperatures "thicken" blood, causing heart attacks or strokes (Solonin and Katsyuba, 2003). Sufferers of chronic respiratory illnesses, such as chronic obstructive pulmonary disease are also under additional stress during periods of high heat, but reduced stress in cold extremes. The elderly are another major risk group, due in part to impaired body temperature regulation (Lin et al., 2009; Gosling et al., 2009). Populations are thought to gradually acclimatize to increasing heat up to a point, a process for which the elderly are poorly equipped to handle; however, the speed of heat increase is outstripping the capacity to acclimatize (Kennedy and Munce, 2003; Kjellstrom, 2009b). Skin cancer rates are expected to be affected by behavioural change—as people in colder climates spend more time outdoors as the planet warms, increasing the carcinogenicity of UV radiation—and by the delay or speed of recovery of the ozone layer, due to temperature effects in the upper atmosphere (Bharath and Turner, 2009; Gilchrest et al., 1999; Waugh et al., 2009). In some regions, ozone recovery is speeded up through climate change; in others, the recovery is slowed. Finally, influenza-like illnesses, in particular pneumonia, respond in complex ways to weather, but are generally more prevalent at lower temperatures, i.e., during winter, with climate change reducing the risks (van Noort et al., 2012).

IMPACTS

The global impact of climate change on heat and cold-related illnesses is estimated at 35,000 additional deaths a year in 2010, with one million more people affected than would have been the case without climate change. The net figure includes approximately 45,000 deaths, mainly in developing countries, and close to 10,000 deaths avoided in developed countries, which are expected to see a net positive effect.

The worst affected countries are mainly developing countries of Africa and Asia, but include Russia and several Commonwealth of Independent States countries where chronic disease burdens are very high. The largest total effects occur in India, with over 10,000 deaths per year. Very high total impacts are also seen in countries such as Nigeria, Russia, the Ukraine, Bangladesh, and DR Congo.

The death toll is expected to remain relatively stable through to 2030, with mortality increasing to 55,000 people, but with avoided deaths also doubling from 10,000 to 20,000 over the same time period.

THE BROADER CONTEXT

The types of illnesses, particularly non-communicable illnesses, that are most affected by extreme heat and cold fluctuations are widely prevalent in both developed and developing countries. The incidence of cardiovascular and chronic respiratory diseases as well as skin cancer have increased in the last decade, while respiratory, including influenza-like diseases have declined (WHO BDD, 2000 and 2011).

BIGGER PICTURE

N/A

SURGE

OCCURRENCE

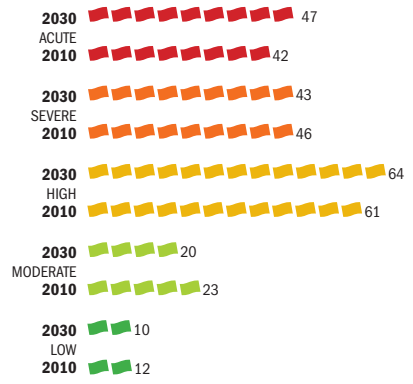
N/A

PEAK IMPACT

N/A

GENDER BIAS

VULNERABILITY SHIFT



= 5 countries (rounded)

Acute Severe High Moderate Low

INDICATOR INFORMATION

MODEL: Curriero et al., 2002; Knutti et al., 2008; Toulemon and Barbieri, 2006; Van Noort et al., 2012

EMISSION SCENARIO: SRES A1B (IPCC, 2000)

BASE DATA: CIA World Factbook, 2012; WHO BDD, 2011

VULNERABILITIES AND WIDER OUTCOMES

Elderly populations are at the greatest risk by far, with two-thirds of all mortality in persons of 70 years of age, and over 80% of all mortality in persons over 60.

Countries with higher relative burdens of cardiovascular risk and chronic respiratory diseases have higher levels of vulnerability. Those same sufferers are less at risk of disease aggravation during milder winters; so geography is key: those in cold countries will benefit, while those in warmer countries will suffer more. Heat stress effects are deemed also to be stronger in tropical regions where temperatures are already elevated, air conditioning and insulation less prevalent, and outdoor work more common (Kovats and Hajat, 2008; Kjellstrom, 2009b). Since most developing countries fall in this category, there are negative implications for poverty reduction and development. Cities are more vulnerable, because they exaggerate extreme heat through the well-known heat island effect (Campbell-Lendrum and Corvalán, 2007).

More frequent and severe hot periods with sudden impacts will contribute to temporary capacity overloads on the health systems of affected areas, which may lead to further degradations in health services, with still additional negative health outcomes (Frumkin et al., 2007; Gosling et al., 2009). The well-being and health of outdoor workers especially in hot countries is also seriously jeopardized (Kjellstrom et al., 2009b).

RESPONSES

Responses include a variety of measures from preventative (pre-summer) health assessments, early-warning procedures for heat spells, and behaviour adjustments, such as increasing fluid intake, adjusting medication, and avoiding midday heat, as well as increasing climate-controlled indoor cooling or heightened vigilance of high risk patients. Longer-term measures might include changes to building design and housing, improved institutional care for the elderly, and stricter controls on urban air pollution, which seriously exacerbates the heat effects of the summer hot spells (Kovats and Hajat, 2008; Ayres et al., 2009).

THE INDICATOR

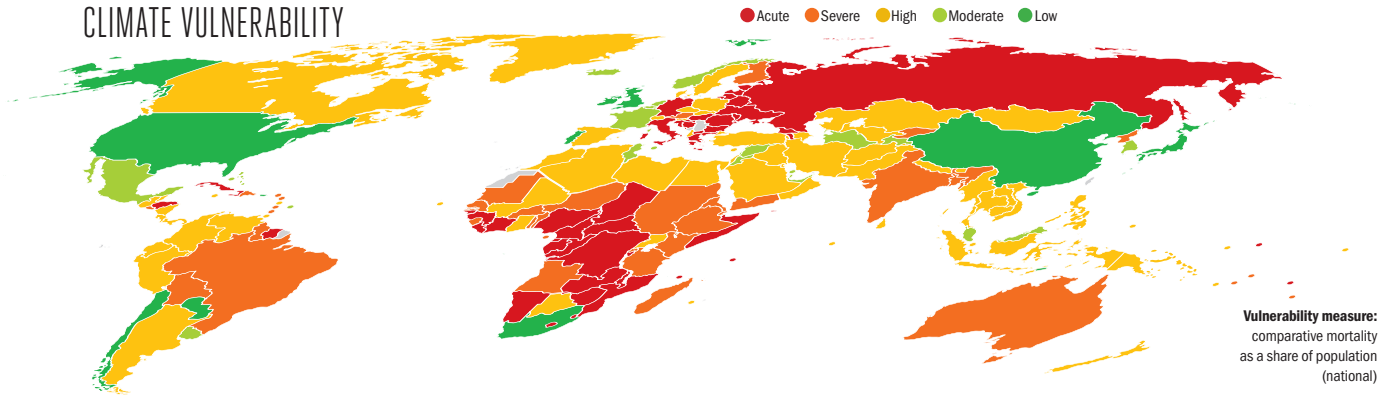
The indicator measures the impact of new heat or cold patterns on cardiovascular and respiratory diseases, skin cancer, and influenza-like illnesses (Curriero et al., 2002; Bharath and Turner, 2009; Hill et al., 2010; van Noort et al., 2012). Baseline mortality is drawn from World Health Organization disease data (WHO BDD, 2011). The indicator has corrected for the so-called "harvesting effect"— i.e., climate change merely shifts the timing of mortality, as opposed to triggering it, given the high share of morality in already high-risk groups. Baseline research from a wider set of countries studies would help improve the analysis, although the basic mechanisms of heat stress are understood to be broadly similar from country to country (Suchday et al., 2006). While the temperature effect is highly certain, other weather effects, such as humidity, which plays a key role, are more unpredictable. The complex interplay of disease and climate parameters for influenza-like illnesses is particularly difficult to map.

ESTIMATES COUNTRY-LEVEL IMPACT

COUNTRY	2010	2030	2010	2030
ACUTE				
Armenia	75	85	400	-1,250
Belarus	250	300	6,000	6,750
Bosnia and Herzegovina	50	85	1,000	1,500
Bulgaria	200	200	2,000	-250
Burundi	150	200	6,250	9,250
Cameroon	350	450	15,000	20,000
Central African Republic	95	150	4,000	5,500
Chad	250	400	10,000	15,000
Comoros	10	15	450	700
Congo	70	100	3,000	5,000
Cote d'Ivoire	350	450	15,000	20,000
Croatia	55	75	650	-300
Cuba	150	150	5,000	4,750
DR Congo	1,250	2,000	50,000	85,000
Equatorial Guinea	15	20	550	850
Estonia	20	25	700	750
Gabon	25	40	1,250	1,750
Georgia	65	100	1,750	3,000
Germany	700	1,250	80,000	150,000
Greece	150	200	15,000	20,000
Guinea	150	250	6,750	10,000
Guinea-Bissau	25	40	1,250	1,750
Haiti	200	250	8,750	10,000
Honduras	150	150	3,750	4,750
Hungary	100	200	4,000	5,250
Italy	600	850	60,000	95,000
Latvia	45	60	1,500	1,750
Lesotho	40	35	1,750	1,500
Liberia	75	150	3,250	5,750
Lithuania	10	55	-600	300
Macedonia	45	60	950	1,250
Malawi	250	400	10,000	15,000
Marshall Islands	1	1	40	50
Moldova	55	75	1,500	950
Mozambique	400	550	15,000	20,000
Namibia	40	55	1,250	1,500
Nigeria	3,000	4,250	100,000	150,000
Romania	300	400	150	-6,000
Russia	2,250	3,000	75,000	90,000
Seychelles	1	1	65	95
Somalia	150	250	5,750	10,000
Suriname	10	10	350	350
Swaziland	25	30	800	900
Tuvalu			5	5
Ukraine	2,000	2,250	55,000	60,000
Zambia	250	400	10,000	15,000
Zimbabwe	200	250	8,250	10,000
SEVERE				
Angola	200	300	5,250	9,000
Antigua and Barbuda	1	1	40	40
Australia	100	250	8,000	20,000
Austria	30	85	3,000	8,750
Bangladesh	1,750	2,000	70,000	85,000
Barbados	5	1	150	100
Benin	90	150	3,750	5,750
Bolivia	100	150	3,250	4,250
Brazil	1,750	2,000	50,000	55,000
Burkina Faso	150	250	6,000	10,000
Djibouti	10	10	300	350
Dominica	1	1	35	35
Dominican Republic	150	150	4,000	4,250
El Salvador	55	65	1,500	2,000
Eritrea	45	65	1,750	2,750
Ethiopia	750	1,250	30,000	50,000
Fiji	10	10	250	250
Finland	30	70	3,000	6,750
Gambia	20	25	750	1,000
Grenada	1	1	50	50
Guyana	10	5	250	200
India	10,000	10,000	500,000	500,000
Kenya	350	450	15,000	20,000
Kyrgyzstan	60	75	1,000	-600
Madagascar	200	350	9,000	15,000
Mauritania	30	45	1,250	2,000
Myanmar	600	650	25,000	30,000
New Zealand	20	50	1,500	3,750
Niger	150	250	5,500	9,750
North Korea	150	300	7,250	10,000
Poland	250	350	-3,000	-15,000
Rwanda	100	150	5,250	7,250
Saint Vincent	1	1	55	55
Samoa	1	1	55	65
Sao Tome and Principe	1	5	85	150
Senegal	100	150	4,500	6,500
Sierra Leone	75	100	3,000	4,750
Sudan/South Sudan	600	850	25,000	35,000
Sweden	45	90	5,500	10,000
Tanzania	350	550	15,000	20,000
Togo	55	80	2,250	3,250
Tonga	1	1	30	35
Yemen	200	450	8,250	20,000
HIGH				
Afghanistan	250	400	10,000	15,000
Albania	5	20	-1,500	-3,250
Algeria	150	200	4,750	5,750

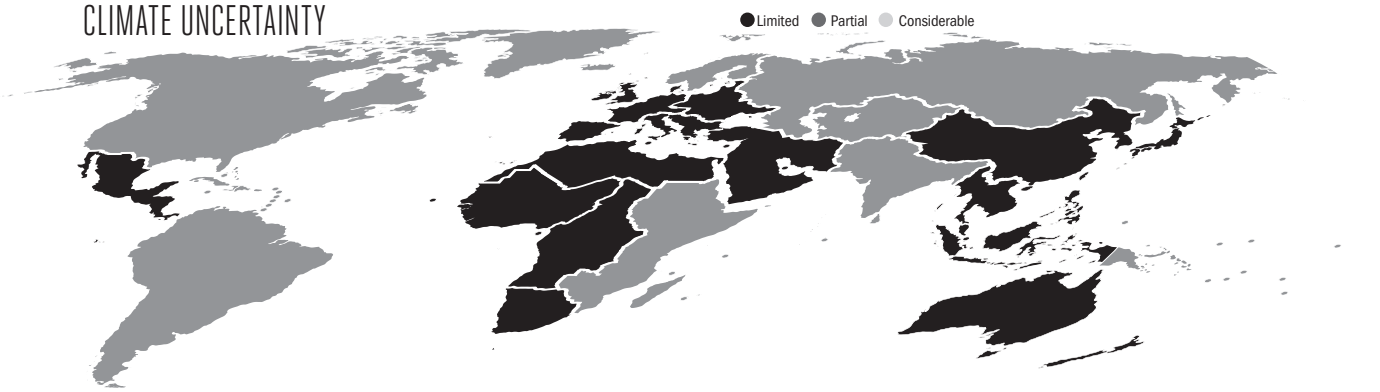
Additional mortality due to climate change - yearly average

CLIMATE VULNERABILITY



Vulnerability measure: comparative mortality as a share of population (national)

CLIMATE UNCERTAINTY



COUNTRY	2010	2030	2010	2030
Argentina	300	250	-9,750	-45,000
Azerbaijan	25	65	-2,250	-5,000
Belize	1	1	85	100
Bhutan	5	10	250	400
Botswana	15	15	650	700
Brunei	1	1	100	150
Cambodia	100	150	5,000	5,500
Canada	75	200	10,000	25,000
Cape Verde	5	5	95	100
Colombia	300	350	8,750	10,000
Costa Rica	20	25	850	1,000
Cyprus	5	10	600	900
Czech Republic	30	70	-3,000	-5,250
Denmark	15	30	2,500	5,250
Ecuador	60	70	1,750	2,000
Egypt	450	500	10,000	15,000
Ghana	200	250	8,250	10,000
Guatemala	90	100	2,500	3,500
Indonesia	1,250	1,250	35,000	35,000
Iran	250	300	7,250	8,750
Iraq	100	150	3,500	4,750
Israel	30	35	2,750	3,000
Jamaica	15	15	400	400
Kazakhstan	15	85	-8,000	-15,000
Kiribati	1	1	20	25
Laos	45	50	2,000	2,000
Lebanon	35	40	1,500	1,750
Libya	20	30	1,000	1,250
Luxembourg	1	1	100	400
Maldives	1	1	25	40
Mali	80	150	3,500	5,500
Mauritius	5	5	200	300
Micronesia	1	1	30	35
Mongolia	15	10	100	-700
Morocco	100	150	3,500	4,000
Nepal	250	300	9,500	15,000
Nicaragua	40	55	1,750	2,250
Oman	10	15	350	650
Pakistan	1,250	1,750	55,000	75,000
Palau			10	10
Panama	15	20	750	800
Papua New Guinea	60	80	2,500	3,500
Peru	100	150	3,500	4,000
Philippines	700	800	20,000	25,000
Saint Lucia	1	1	70	65
Saudi Arabia	75	150	7,250	10,000
Singapore	25	25	2,250	2,500
Slovakia	40	40	-1,000	-3,500
Slovenia	5	10	900	1,500
Solomon Islands	5	5	150	200
Spain	250	300	30,000	45,000
Sri Lanka	90	150	2,750	3,750
Switzerland	15	40	2,000	5,250
Thailand	200	350	5,250	9,750
Trinidad and Tobago	5	5	300	250
Turkey	250	500	10,000	20,000
Uganda	250	500	10,000	20,000
Uzbekistan	200	300	2,500	-1,500
Vanuatu	1	1	50	70
Venezuela	150	150	6,250	7,250
Vietnam	450	350	20,000	15,000
MODERATE				
Bahamas	1	1	40	70
Bahrain	1	1	150	150
Belgium	20	20	5,500	9,250
France	20	150	10,000	30,000
Iceland		1	50	150
Jordan	10	10	200	300
Kuwait	5	5	350	450
Malaysia	1	65	40	3,000
Malta			200	350
Mexico	150	95	5,500	4,250
Netherlands	-10	1	3,000	8,500
Norway	5	10	1,250	2,750
Qatar	1	1	70	70
South Korea	-1	30	5,000	15,000
Syria	10	10	300	300
Tajikistan	45	20	-1,000	-7,250
Tunisia	1	30	75	900
Turkmenistan	25	5	-4,500	-15,000
United Arab Emirates	5	1	300	250
Uruguay	20	10	-1,750	-5,000
LOW				
Chile	-20	-70	-9,250	-25,000
China	-5,500	-15,000	-500,000	-1,000,000
Ireland	-15	-15	-250	900
Japan	-850	-1,750	20,000	50,000
Paraguay	-5	-25	-3,000	-9,000
Portugal	-15	-60	5,250	7,750
South Africa	-300	-1,250	-100,000	-200,000
Timor-Leste				
United Kingdom	-55	-200	25,000	40,000
United States	-1,500	-3,250	-100,000	-250,000

Additional persons affected due to climate change - yearly average