# WILDFIRES

ESTIMATES GLOBAL CLIMATE IMPACT

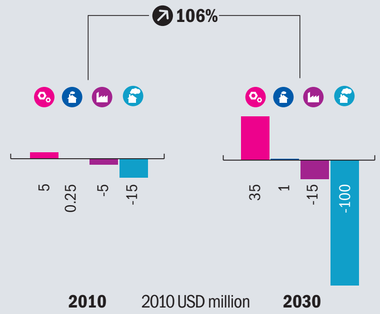
## 2010 EFFECT TODAY

USD **GAIN** PER YEAR **15** MILLION

## 2030 EFFECT TOMORROW

USD **GAIN** PER YEAR **90** MILLION

## ECONOMIC IMPACT




CONFIDENCE
**INDICATIVE**

SEVERITY

AFFECTED

INJUSTICE

PRIORITY

MDG EFFECT

- Global impact of climate change on wildfires may have a neutral effect as a warmer planet brings more rain, dampening fires
- Shifts in wildfire may occur where forested areas become drier and hotter, severely affecting populated parts of Russia, Mongolia, or Australia
- The marginal effect of climate change is difficult to predict because of wind and rain uncertainties and because good international data monitoring fire damages is lacking
- Wildfire occurrence has links to now more prevalent heat extremes and drought which increase the probability of fires

## RELATIVE IMPACT

2010: 2

2030: 2

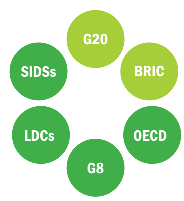
2010: 25 / 1

2030: 49 / 1

## HOTSPOTS

| 2010 | $ | 2030 |
|---|---|---|
| 5 | RUSSIA | 40 |
| 1 | MONGOLIA | 15 |
| 0 | NICARAGUA | 1 |
| 0 | SOUTH AFRICA | 1 |
| 1 | CANADA | 1 |

## GEOPOLITICAL VULNERABILITY




Economic Cost (2010 PPP non-discounted)
Developing Country Low Emitters
Developed
Developing Country High Emitters
Other Industrialized

= Deaths per 100 million
= Losses per 10 million USD of GDP
Change in relation to overall global population and/or GDP

= Millions of USD (2010 PPP non-discounted)

Wildfires—the uncontrolled burning of forests, grasslands or brush—will generally become more frequent and damaging for drought-prone parts of the world. But it is certain that climate change will reduce disturbances from wildfires in some areas where rainfall is significantly increasing. The 2010 wildfires in Russia, as well as the recent fires in Australia, Greece, and the US, are clearly linked to warm, dry temperatures, if not drought (UNISDR, 2011). However, the additional losses incurred by those worst affected are likely to be offset on a global scale by a reduction in wildfire activity in other parts of the world. It is expected that Vietnam may see increased rainfall in some seasons, but declining rain and rising heat during the dry periods would favour wildfire onset, even if more rain overall falls in a given year (Vietnam MONRE, 2010). Tackling an additional burden of wildfire in affected areas will be great, since suppressing fires is costly: the US Forest Service spent 1 billion dollars on fire suppression in the year 2000 alone, with costs growing significantly over time—2.5 million dollars in losses were reported for that year. But expenditures were undoubtedly warranted in most cases, since wildfires can be extremely deadly: in February 2009, one series of fires alone in Australia killed 180 people (WFLC, 2004; CRED/EM-DAT, 2012).

## CLIMATE MECHANISM

Wildfires are affected by three key factors: 1) availability of vegetation to burn; 2) environmental conditions, such as temperature, wind, and humidity or rainfall but also topography and ecosystem type—tropical forests for example are more humid and burn less than temperate forests; and 3) varying ignition sources of fires (Krawchuk et al., 2009). Climate change affects all of these elements: it influences vegetation growth and health along with the expanse of different ecosystem areas (Gonzalez et al., 2010). In regions with less rain and more heat, the declining vegetation will offer less available material for burning and will ultimately reduce disturbances from wildfires. Heat is increasing relatively uniformly around the world due to climate change. Less predictable rainfall and vegetation changes add considerable uncertainty to whether or not fires ultimately retreat or advance with global warming. Climate change has also been shown to potentially alter electrical activity in the atmosphere, giving rise to lightning, the principal initial trigger of wildfires (Reeve and Toumi, 1999).

## IMPACTS

Drawing on recent research, the Monitor estimates the global impact of climate change on wildfire to be close to zero in 2010 and in 2030 (Krawchuk et al., 2009). Estimates of impact include around 3 million dollars of additional losses a year in 2010, and some 15 million dollars of additional losses in 2030. “Gains” of 25 and 150 million dollars a year in 2010 and 2030, respectively, outweigh considerably any losses incurred elsewhere in the world, but overall totals are small. “Gains” represent avoided wildfires that would have taken place without climate change. The largest negative effects in absolute terms are estimated to occur in Russia, Mongolia, Canada, Australia, and South Africa, while the US and Indonesia are expected to reap the most benefits overall. Within large countries like the US, it is possible that increased fire activity may well be experienced in certain areas but will be counterbalanced with decreased activity in other parts of the country. In general, wildfires mainly concern industrialized or developed countries.

## THE BROADER CONTEXT

There has been a considerable increase in wildfire damage recorded in recent years (CRED/EM-DAT, 2012). However, improvements in the actual reporting systems themselves—advances in technology and information sharing—have allowed the reporting of increasing numbers of phenomena (UNISDR, 2009). However, satellite analysis has shown that the annual burned area has grown since the 1970s (UNEP, 2002). Several other factors, such as land usage change, could be contributing to increasing fire damage. As with other weather-related disasters, growing exposure to wildfires through economic development, population growth, and an expansion in infrastructure at risk should also increase damages.

## VULNERABILITIES AND WIDER OUTCOMES

Countries with large areas of non-tropical vegetation and a propensity to drought are particularly vulnerable to the effects of climate change

### BIGGER PICTURE

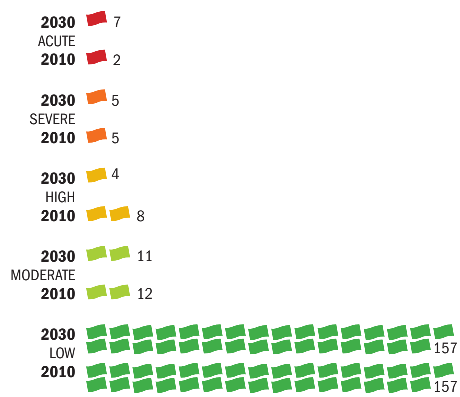
N/A

### SURGE

### OCCURRENCE

N/A

### VULNERABILITY SHIFT




### PEAK IMPACT

| Deaths | | Losses (Millions of USD) | |
|---|---|---|---|
| 2009 AUSTRALIA | 180 | 2003 UNITED STATES | 3,500 |
| 2007 GREECE | 70 | 2005 SPAIN | 2,050 |
| 2010 RUSSIA | 61 | 2010 RUSSIA | 1,800 |
| 2008 MOZAMBIQUE | 49 | 2007 GREECE | 1,750 |
| 2010 ISRAEL | 44 | 2003 PORTUGAL | 1,730 |

### GENDER BIAS

### INDICATOR INFORMATION

MODEL: Krawchuk et al., 2009

EMISSION SCENARIO: SRES A2 (IPCC, 2000)

BASE DATA: CRED EM-DAT, 2012

= Millions of USD (historic)

= 5 countries (rounded)

Acute Severe High Moderate Low

on wildfires. Coniferous forests are especially risky areas for fire outbreak during extended warm, dry periods (Cruz and Alexander, 2010).
The full extent of increased wildfires is difficult to estimate, but given the incredible potential for the rapid and uncontrolled spread of fires, growing fire dangers in some parts of the world could carry serious risks for public safety. The 2010 Russian wildfires, for example, burned some 4,000 hectares of land— contaminated, moreover, by radioactive material from the Chernobyl disaster—the full consequences of which are not yet known; the fires also threatened functioning nuclear power plants and research facilities (Munich Re, 2010).

## RESPONSES

Responding to wildfires is extremely costly requires highly sophisticated technology. Some early detection and warning systems are capable of identifying a fire within 5 minutes of its ignition (Bridge, 2010). Thus, such systems represent an investment that could significantly reduce overall expenditures on suppressing fires that would otherwise end up destroying thousands or millions of hectares. Fire safety and education programmes may reduce the potential for fires set by human hands by up to 80% (UNEP, 2002).
Of course, as is well known, not all wildfires are bad. Natural habitats have evolved to cope with wildfires over time and to support biodiversity and processes of regeneration (Parker et al., 2006). Therefore, many countries also practice what is called “prescribed burning,” effectively a “let-burn” policy, in which human settlements are not endangered. But while such practices may lower fire prevention costs and help support ecosystems, if fires subsequently reach a large-scale and deviate to threaten settlements, the costs of fire suppression can rapidly and counter-productively escalate (UNEP, 2002).

## THE INDICATOR

**The indicator relies on a high-resolution global pyrogeography model for the effect of climate change on fire disturbances, used to estimate impact for populated areas (Krawchuk et al., 2009). Limitations relate to uncertain future rainfall and the restricted socio-economic base data set, which may underestimate costs (CRED/EM-DAT, 2012). Regarding base data, the major wildfires that affected Russia in 2010 are recorded in the reference database at 1.8 billion dollars in losses and 61 deaths. The major reinsurer, Munich Re, on the other hand estimates the total cost of the fires at 3.3 billion dollars and over 50,000 indirect deaths from both extreme heat and the significantly higher than normal air particle loads and their effect on chronic respiratory and cardiovascular disease sufferers (Munich Re, 2010). Historical base data would also give a misleading trend if fires spread to areas where damage in the past was unusual, underestimating future losses.**

ESTIMATES COUNTRY-LEVEL IMPACT

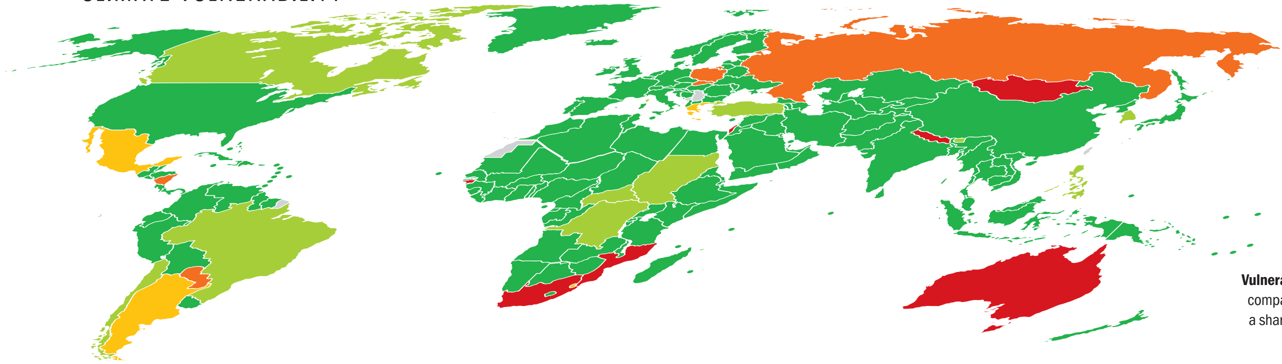
| COUNTRY | 2010 $ | 2030 $ |
|---|---|---|
| **ACUTE** | | |
| Australia | 0.25 | 0.50 |
| Guinea-Bissau | | |
| Israel | | |
| Mongolia | 1 | 15 |
| Mozambique | | |
| Nepal | | |
| South Africa | 0.25 | 1 |
| **SEVERE** | | |
| Nicaragua | 0.25 | 1 |
| Paraguay | | |
| Poland | | |
| Russia | 5 | 40 |
| Slovakia | | |
| **HIGH** | | |
| Argentina | | |
| Greece | | |
| Mexico | | |
| Swaziland | | |
| **MODERATE** | | |
| Bhutan | | |
| Brazil | | |
| Canada | 0.50 | 1 |
| Central African Republic | | |
| Chile | | |
| DR Congo | | |
| Lebanon | | |
| Philippines | | |
| South Korea | | |
| Sudan/South Sudan | | |
| Turkey | | |

| COUNTRY | 2010 $ | 2030 $ |
|---|---|---|
| **LOW** | | |
| Afghanistan | | |
| Albania | | |
| Algeria | | |
| Angola | | |
| Antigua and Barbuda | | |
| Armenia | | |
| Austria | | |
| Azerbaijan | | |
| Bahamas | | |
| Bahrain | | |
| Bangladesh | | |
| Barbados | | |
| Belarus | | |
| Belgium | | |
| Belize | | |
| Benin | | |
| Bolivia | | |
| Bosnia and Herzegovina | | |
| Botswana | | |
| Brunei | | |
| Bulgaria | -0.25 | -1 |
| Burkina Faso | | |
| Burundi | | |
| Cambodia | | |
| Cameroon | | |
| Cape Verde | | |
| Chad | | |
| China | | |
| Colombia | | |
| Comoros | | |
| Congo | | |

| COUNTRY | 2010 $ | 2030 $ |
|---|---|---|
| Costa Rica | | |
| Cote d'Ivoire | | |
| Croatia | | |
| Cuba | | |
| Cyprus | | |
| Czech Republic | | |
| Denmark | | |
| Djibouti | | |
| Dominica | | |
| Dominican Republic | | |
| Ecuador | | |
| Egypt | | |
| El Salvador | | |
| Equatorial Guinea | | |
| Eritrea | | |
| Estonia | | |
| Ethiopia | | |
| Fiji | | |
| Finland | | |
| France | | |
| Gabon | | |
| Gambia | | |
| Georgia | | |
| Germany | | |
| Ghana | | |
| Grenada | | |
| Guatemala | | |
| Guinea | | |
| Guyana | | |
| Haiti | | |
| Honduras | | |
| Hungary | | |

$ Additional economic costs due to climate change (million USD PPP) - yearly average

## CLIMATE VULNERABILITY




**Vulnerability measure:** comparative losses as a share of GDP in USD (national)

## CLIMATE UNCERTAINTY


| COUNTRY | 2010 | 2030 |
|---|---|---|
| Iceland | | |
| India | | |
| Indonesia | -20 | -150 |
| Iran | | |
| Iraq | | |
| Ireland | | |
| Italy | -1 | -1 |
| Jamaica | | |
| Japan | | |
| Jordan | | |
| Kazakhstan | | |
| Kenya | | |
| Kiribati | | |
| Kuwait | | |
| Kyrgyzstan | | |
| Laos | | |
| Latvia | | |
| Lesotho | | |
| Liberia | | |
| Libya | | |
| Lithuania | | |
| Luxembourg | | |
| Macedonia | | |
| Madagascar | | |
| Malawi | | |
| Malaysia | -0.25 | -1 |
| Maldives | | |
| Mali | | |
| Malta | | |
| Marshall Islands | | |
| Mauritania | | |
| Mauritius | | |

| COUNTRY | 2010 | 2030 |
|---|---|---|
| Micronesia | | |
| Moldova | | |
| Morocco | | |
| Myanmar | | |
| Namibia | | |
| Netherlands | | |
| New Zealand | | |
| Niger | | |
| Nigeria | | |
| North Korea | | |
| Norway | | |
| Oman | | |
| Pakistan | | |
| Palau | | |
| Panama | | |
| Papua New Guinea | | |
| Peru | | |
| Portugal | -0.25 | -1 |
| Qatar | | |
| Romania | | |
| Rwanda | | |
| Saint Lucia | | |
| Saint Vincent | | |
| Samoa | | |
| Sao Tome and Principe | | |
| Saudi Arabia | | |
| Senegal | | |
| Seychelles | | |
| Sierra Leone | | |
| Singapore | | |
| Slovenia | | |
| Solomon Islands | | |

| COUNTRY | 2010 | 2030 |
|---|---|---|
| Somalia | | |
| Spain | -0.25 | -1 |
| Sri Lanka | | |
| Suriname | | |
| Sweden | | |
| Switzerland | | |
| Syria | | |
| Tajikistan | | |
| Tanzania | | |
| Thailand | | |
| Timor-Leste | | |
| Togo | | |
| Tonga | | |
| Trinidad and Tobago | | |
| Tunisia | | |
| Turkmenistan | | |
| Tuvalu | | |
| Uganda | | |
| Ukraine | | |
| United Arab Emirates | | |
| United Kingdom | | |
| United States | -5 | -15 |
| Uruguay | | |
| Uzbekistan | | |
| Vanuatu | | |
| Venezuela | | |
| Vietnam | | |
| Yemen | | |
| Zambia | | |
| Zimbabwe | | |