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LOST IN SMOKE:

WILDLAND FIRE CLIMATE IMPACT CASE STUDIES OF BRAZIL, INDONESIA AND RUSSIA

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INTRODUCTION

Russia

IT'S COMMONLY ACCEPTED THAT CLIMATE CHANGE HAS LED TO BIGGER, MORE FREQUENT FIRES IN MANY PARTS OF THE WORLD. IT IS LESS WIDELY UNDERSTOOD THAT FIRES ARE MAKING A SIGNIFICANT CONTRIBUTION TO CLIMATE CHANGE. IF WE KEEP IGNORING THE CLIMATE IMPACTS OF FIRES, WE WILL STRUGGLE TO GET ON A VIABLE PATHWAY THAT LIMITS WARMING TO THE PARIS AGREEMENT TARGET OF 1.5°C.

This is a threat - but also an opportunity - because many fires are preventable. Preventing fires reduces carbon emissions and preserves the ability of vegetation to absorb carbon.

This report aims to lay out some of the mechanisms by which wildland fires can contribute to climate change and to put that contribution in the wider context of the totality of human caused carbon emissions. It will challenge the idea that most fires are natural or carbon neutral.

We will examine three case studies of Brazil, Indonesia and Russia to show how these countries are failing to adequately monitor fires or to report emissions from them. We'll set out ways in which IPCC guidance on fire emission accounting needs to be improved. Finally, this report will lay out the opportunities that exist for the focus regions to act to reduce the climate impacts of fires.

SCOPE

In this report, we focus on the climate impacts of fires which have been most discussed in published papers. Fires have additional impacts on climate that are out of the scope of this report. These include soil degradation and the emission of non-CO_2 gases like methane, which are never directly re-absorbed by vegetation.

The mechanisms by which fires contribute to climate change are global. However, this report focuses on the areas where fires play the most destructive role in ecosystems and where the greatest opportunities lie for reducing fires and related greenhouse gas emissions. In particular, we focus on Brazil, Indonesia and Russia.

There are fire-dependent ecosystems around the globe where fire serves an important ecological role and where natural fire regimes and their functions have been altered. This results in complexities specific to those ecosystems that render fires in these areas outside the scope of this present report.

WHAT DO WE MEAN BY "FIRES"?

In this report, we use the term "fires" to refer to "wildland fires", defined as any fire where vegetation burns.

Examples include forest fires, peat fires, grass fires and savannah fires. It includes fires started intentionally or unintentionally, whether under control or out of control.

It also, therefore, includes fires that are started to clear land for agriculture or to drive out local people in order to "grab" land.

This meaning for "fires" or "wildland fires" is distinct from "wildfires", a term often used to refer specifically to unintentional fires or wildland fires burning out of control.

SUMMARY

WILDLAND FIRES CONTRIBUTE TO CLIMATE CHANGE THROUGH THREE KEY MECHANISMS. FIRSTLY, CARBON DIOXIDE IS RELEASED WHEN BIOMASS BURNS. INCREASING CARBON DIOXIDE IN THE ATMOSPHERE LEADS TO INCREASING GLOBAL TEMPERATURES. ON AVERAGE, GROSS CARBON EMISSIONS FROM FIRES MAKE UP AN EQUIVALENT OF NEARLY 25% OF TOTAL GLOBAL EMISSIONS FROM FOSSIL FUELS EACH YEAR. A PROPORTION OF THESE WILL BE RE-ABSORBED BY FAST RE-GROWTH - LIKE IN GRASSLANDS - WITHIN A YEAR OR SO, BUT THE REST WILL CONTRIBUTE TO CLIMATE CHANGE.

Secondly, 'black carbon' or soot generated by fires is a serious threat to the climate when it ends up landing on Arctic ice. This is particularly a concern from fires that happen in the Russian boreal forests close to the Arctic. Heat convection from fires draws black carbon high up into the atmosphere where it can be carried long distances. Black carbon on ice or snow prevents it reflecting back the sun's heat as effectively as it otherwise would and speeds up melting. Science gives us a range for the impact of black carbon that makes it either the second or the third most important contributor to climate change.

Third, when fires destroy forests they not only release CO_2 immediately, they reduce its sink potential for a long period of time. CO_2 which a forest would have removed will instead stay in the atmosphere.

These climate impacts largely go unremarked and fires are often considered a natural phenomenon. This may have been true before widespread industrialisation, logging, agriculture and human-induced climate change have profoundly altered the conditions under which fires occur and spread.

Fires are often started as a result of human activity. Most of the places where fires happen today have been changed by human activity, be that forests fragmented by roads, plantations of oil-producing trees, or human settlements. These changes affect where fires start, how they spread and how intense they become.

In addition, fire risk is likely to increase around the globe. Increasing average global temperature may lead to more frequent and severe fires. If the time period between two fires shortens, there is less time between fires for the ecosystem and landscape to recover. This may lead to long term degradation as the landscape stores less carbon.

We also need to challenge the idea that forest fires can be considered CO_2 neutral because trees eventually re-grow after a fire, re-capturing carbon in the process. Even when burned forests are allowed to recover, rather than being converted to agriculture, the speed of re-growth is very slow. In short, destroyed forests cannot grow back fast enough to be considered CO_2 neutral in the context of seeking an urgent and successful path to the 1.5°C Paris Agreement target. The situation is worse still for peatlands, which release thousands of years worth of stored carbon when they are drained and burnt.

These questionable ideas - that most fires are natural and are carbon neutral - coupled with a lack of attention to the relevant climate science may explain why emissions from fires are greatly underestimated.

Case studies from Brazil, Indonesia and Russia raise significant concerns. These countries have vast areas of forest within the tropical and boreal zones, which are key areas of concern in relation to fire and climate change. Yet none of these countries provide accurate reporting of the emissions from fires within their borders.

In tropical regions, fire is used extensively to clear land for agriculture or pastures. It has played a big role in the shift towards tropical forests becoming a net source of carbon emissions. Now fires are more frequent due to human activity and human-induced climate change. Even when fires do not completely clear the land, they change the structure of the forest, affecting its ability to stockpile carbon for decades afterwards.

Russian boreal forests have evolved with fire. However, they are only tolerant to a fire regime that has held relatively constant over thousands of years. These forests are not adapted to the fire regime we are seeing now. The CO_2 and black carbon emissions from fires in Russia are significant, as are the climate impacts resulting from of the destruction of the carbon sink potential of these forests.

There is little incentive to take action while poor monitoring and accounting of emissions from wildland fires renders the climate impacts largely invisible. Focus countries show lack of ambition to tackle fires within their Intended Nationally Determined Contributions under the Paris Agreement, which is deeply concerning.

Greenpeace is calling for decision-makers at global and national levels to urgently address the growing effects of wildland fires as an important driver of climate change.

We cannot get on a pathway to the 1.5°C Paris Agreement target without facing the contributions fires are making to climate change.

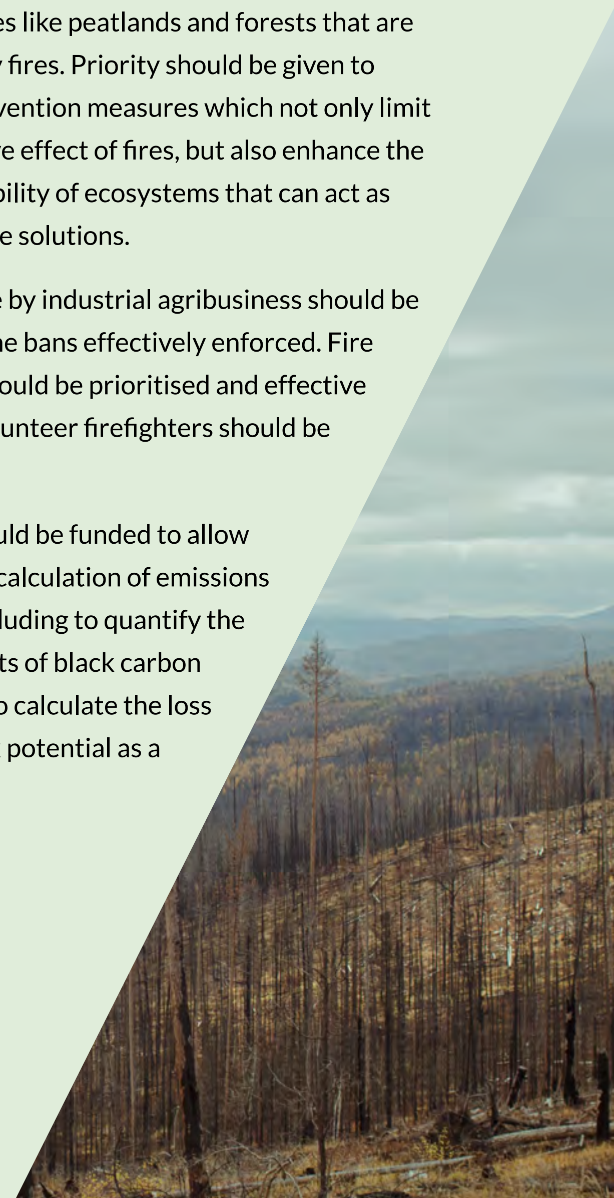
For the countries discussed in this report, Greenpeace recommends the following measures to be considered urgently, based on extensive research and literature review, consultation with experts and on practical experience.

As a first step we need accurate monitoring and reporting of fires, so it is possible to make informed decisions. Accordingly, there are a number of issues that need to be addressed by the International Panel on Climate Change (IPCC) as a matter of urgency. These include improving guidance on how to calculate burned area, closing loopholes that allow governments to exclude emissions from fires on loosely defined unmanaged lands, and requiring the inclusion of emissions of black carbon in national reports.

Accurate monitoring and reporting of fires must then lead to action: we need to protect carbon-rich landscapes like peatlands and forests that are threatened by fires. Priority should be given to those fire prevention measures which not only limit the destructive effect of fires, but also enhance the carbon sink ability of ecosystems that can act as natural climate solutions.

The use of fire by industrial agribusiness should be banned and the bans effectively enforced. Fire prevention should be prioritised and effective support to volunteer firefighters should be provided.

Research should be funded to allow more precise calculation of emissions from fires, including to quantify the precise impacts of black carbon emitted and to calculate the loss of carbon sink potential as a result of fires.



CHAPTER 01

3 WAYS IN WHICH FIRES AFFECT CLIMATE

Brazil
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FIRES RESULT IN THE RELEASE OF SIGNIFICANT AMOUNTS OF CARBON DIOXIDE FROM BURNING BIOMASS ABOVE AND BELOW GROUND. THEY ALSO CONTRIBUTE TO CLIMATE CHANGE BY CREATING BLACK CARBON THAT INCREASES THE MELTING OF SNOW AND ICE. THEY CAN SPEED UP CLIMATE CHANGE STILL FURTHER BY DAMAGING THE ABILITY OF ECOSYSTEMS TO ACT AS CARBON SINKS.

FIRES CAUSE CARBON EMISSIONS

All living - or once living - plant material contains carbon. When this biomass burns, carbon dioxide is released, whether it's grasses, shrubs, trees, leaf mould or dense peat that is consumed in the fire. Increasing carbon dioxide levels in the atmosphere lead to increasing global temperatures - which, in turn, leads to climate change.

Not all fires make the same contribution to climate change. It depends on what burns, for how long and how quickly it will - or won't - grow back.

When fires happen in forests and on peatland, the contribution to climate change is huge. Forests re-grow slowly when they are allowed to re-grow at all, meaning carbon cannot be re-captured quickly. This is even more true for peatlands, where the concentrated stores of carbon have built up over centuries or even millennia.[1] Carbon from peatlands once released by burning cannot be recaptured within a time span necessary to mitigate global warming.

The climate impacts of fires in grasslands, however, are different from those in forests and peatlands. Grasslands can regrow much more quickly than forest, reabsorbing carbon on a faster timescale. However burning grassland can be a direct cause of forest and/or peat fires that run out of control. They also contribute to land degradation and release black carbon as well as additional non-CO_2 greenhouse gases like methane.

Multiple studies using varied methodologies have all come to the same conclusion: the direct carbon dioxide emissions released by fires make a highly significant contribution to climate change. See Chapter 2 for more details.

But it's not just the carbon dioxide immediately released by a fire that causes concern. Fires create indirect carbon emissions from the slow rotting of trees that are damaged but not immediately destroyed. Postfire carbon emissions may be equal to or even greater than direct emissions from plant material consumed in fires, depending on the region in question.[2]

Fires also interact with other drivers of forest degradation in a mutually reinforcing cycle that further reduces the health and carbon sink capacity of the forest. For example, as well as increasing the frequency and intensity of fires, climate change can lead to increases in insect populations. This can result in the death of trees from infestations, leaving the trunks standing as dry, dead wood. This further increases the forest's vulnerability to fire. Conversely, fires damage the forest and can leave surviving trees more vulnerable to insect attack. Acting together these two forces destroy even more forests and, thus, more carbon is emitted indirectly.[3]

1 Hooijer, Aljosja, et al. "Current and future CO_2 emissions from drained peatlands in Southeast Asia." Biogeosciences 7.5 (2010): 1505-1514.
2 Auclair, Allan ND, and Thomas B. Carter. "Forest wildfires as a recent source of CO_2 at northern latitudes." Canadian Journal of Forest Research 23.8 (1993): 1528-1536.
3 Boucher, Dominique, et al. "Current and projected cumulative impacts of fire, drought, and insects on timber volumes across Canada." Ecological Applications (2018).

CO_2 EMISSIONS COMPARISONS

Based on Global Carbon Project data.

FIRES CREATE BLACK CARBON

Fires also contribute to climate change by creating 'black carbon'. Black carbon refers to soot from fires, biomass and fossil fuel combustion. It can be carried on the wind to settle on snow and ice, for example, in the Arctic, which plays a critical role in regulating global temperatures and counteracting climate change. Science gives us a range for the impact of black carbon that makes it either the second[4] or the third[5] most important contributor to climate change.

Black carbon is the second or the third most important human emission in terms of its climate forcing in the present-day atmosphere.

White snow and ice can reflect much of the sun's heat back into space. This is known as the albedo effect and it helps keep the planet cool. However, as a result of fires, vast areas of ice get covered in black carbon so they absorb heat instead. This speeds up how quickly snow and ice in Arctic is melting.

If black carbon helps melt snow and ice, that in turn further reduces the chilling and heat reflecting abilities of the Arctic. This then creates a damaging cycle of warming that will make it even harder to keep global temperature rises to below 1.5°C.

Black carbon has a particularly significant impact if it is transported by the atmosphere into the Arctic during springtime, the period of highest snow cover. The more snow there is on the ground, the more potential the Arctic has at that moment to reflect back heat and cool the earth. Black carbon landing on snow at this time and contributing to melting will do more to limit the cooling ability of the Arctic than at

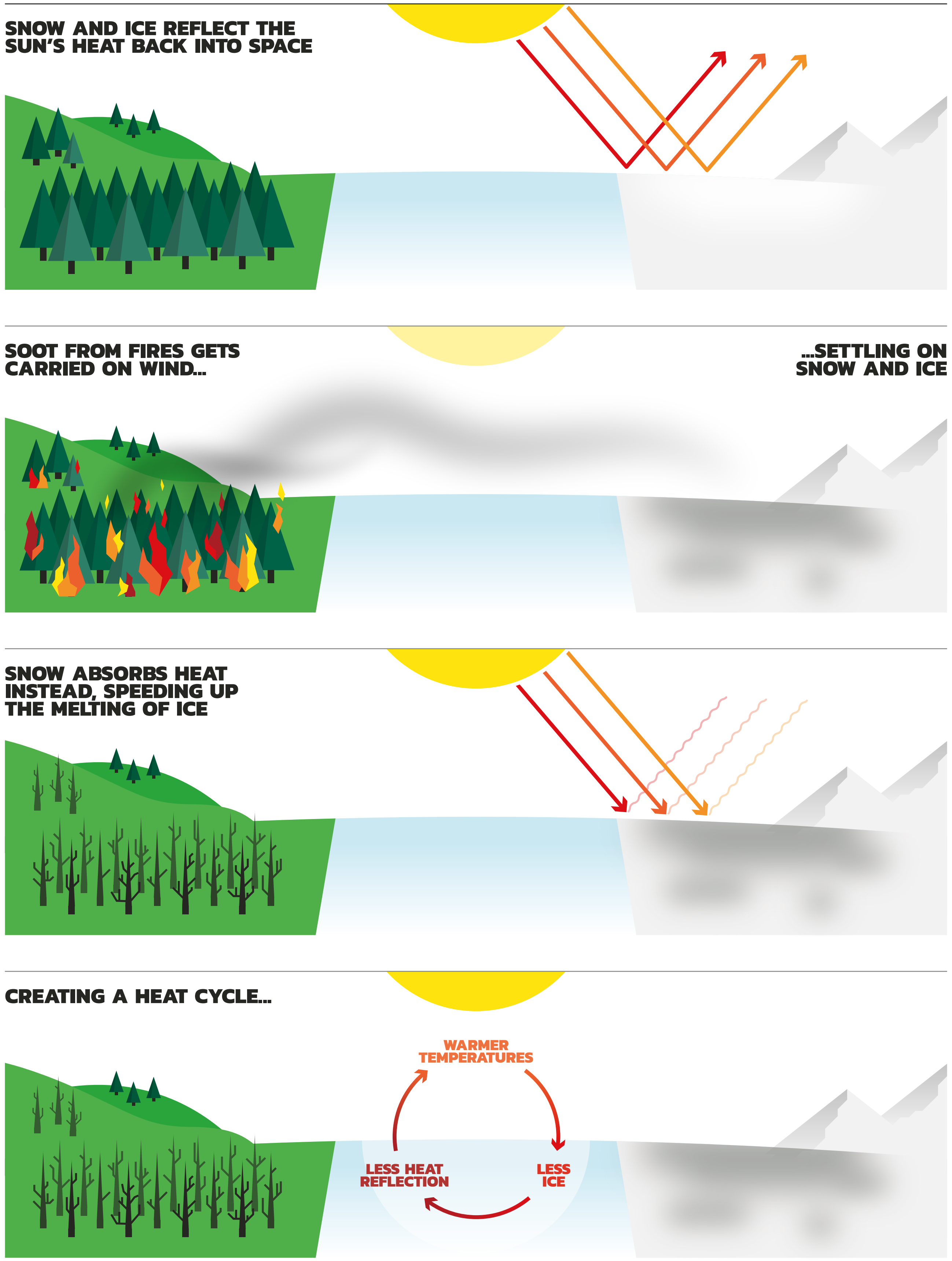
other times.[6] Springtime also coincides with the peak time for fires in nearby Russia. Given this and the high latitude of the country, it appears that the impact of these fires may be significant.

The black carbon originating from fires tends to have a greater impact than the black carbon originating from biomass burning in power plants or fossil fuel combustion. The high temperatures and consequent convection in fires can cause black carbon to be drawn high into the atmosphere as the heated air rises. Rising to high altitudes, black carbon can then be carried in the atmosphere great distances, to be deposited ultimately on remote snow and ice.

Added to this, proportionally more black carbon is created from fires than fossil fuel combustion in vehicles and power plants because wildland fires burn less efficiently than fuel consumed in an engine or generator. This results in comparatively greater quantities of soot being generated. Fires in the boreal zone contribute more black carbon to the Arctic than all other anthropogenic sources combined.[7]

4 *Bond, Tami C., et al. "Bounding the role of black carbon in the climate system: A scientific assessment." Journal of Geophysical Research: Atmospheres 118.11 (2013): 5380-5552.*
5 *Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change. 2014*
6 *Bond, Tami C., et al. "Bounding the role of black carbon in the climate system: A scientific assessment." Journal of Geophysical Research: Atmospheres 118.11 (2013): 5380-5552.*
7 *Liu, Yongqiang, et al. "Wildland fire emissions, carbon, and climate: Wildfire–climate interactions." Forest Ecology and Management 317 (2014): 80-96.*

HOW BLACK CARBON IMPACTS CLIMATE



FIRES PREVENT FORESTS FROM ACTING AS CARBON SINKS

To meet the Paris Agreement target of limiting global warming to below 1.5°C, IPCC scientists[8] estimate that we need to reduce fossil fuel emissions to zero while minimizing all other emissions by the second half of this century and remove a large amount of CO_2 from the atmosphere.

The world's forests are the single largest terrestrial carbon sink.[9] Carbon sinks continually remove carbon from the atmosphere. This means that not only do forests contain huge stores of carbon accumulated over decades, centuries and sometimes over millennia - they continue to actively capture carbon from the atmosphere as they grow.

Protecting and restoring forests is the main element of a range of identified natural climate solutions, that together could provide more than a third of the climate mitigation needed by 2030.[10] Continued destruction and degradation of forests globally compromises this potential by reducing their ability to act as carbon sinks.

Indeed, the continuing high rate of destruction of tropical forests means that their carbon capturing potential is already threatened. In some years, tropical forests are a net source of carbon emissions, rather than a sink that removes emissions.[11]

By contrast, boreal and temperate forests still appear to be consistently acting as net carbon sinks. But fires in these areas pose a significant threat. More tree cover loss in Russian boreal forests is attributed to fires than to logging.[12]

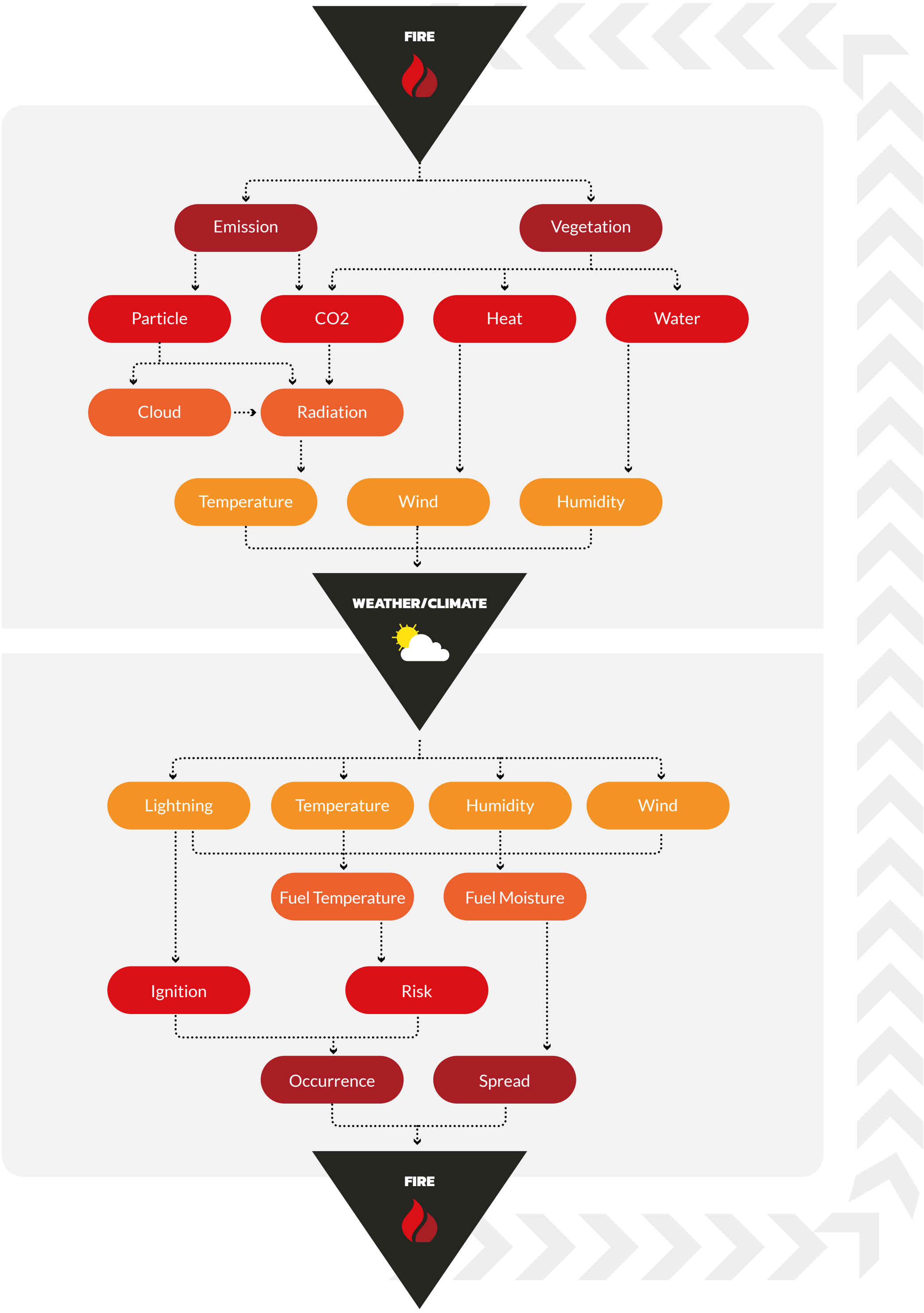
The threat from fires is likely to increase. With climate change, fires are happening more often and with greater intensity. Global mean fire weather season length has increased by 18.7% between 1979 and 2013.[13] Changes in global climate are likely to result in a widespread increase in global fire potential based on a projection of future soil moisture.[14]

More frequent fires implies less time for the land to recover. The average time between fires in a given area is known as the "fire return interval". If a fire return interval is lower than historical, the resulting reduced recovery time between fires may result in a degraded forest. This degradation can make the forest less capable of storing carbon and, therefore, less capable of acting as a sink.

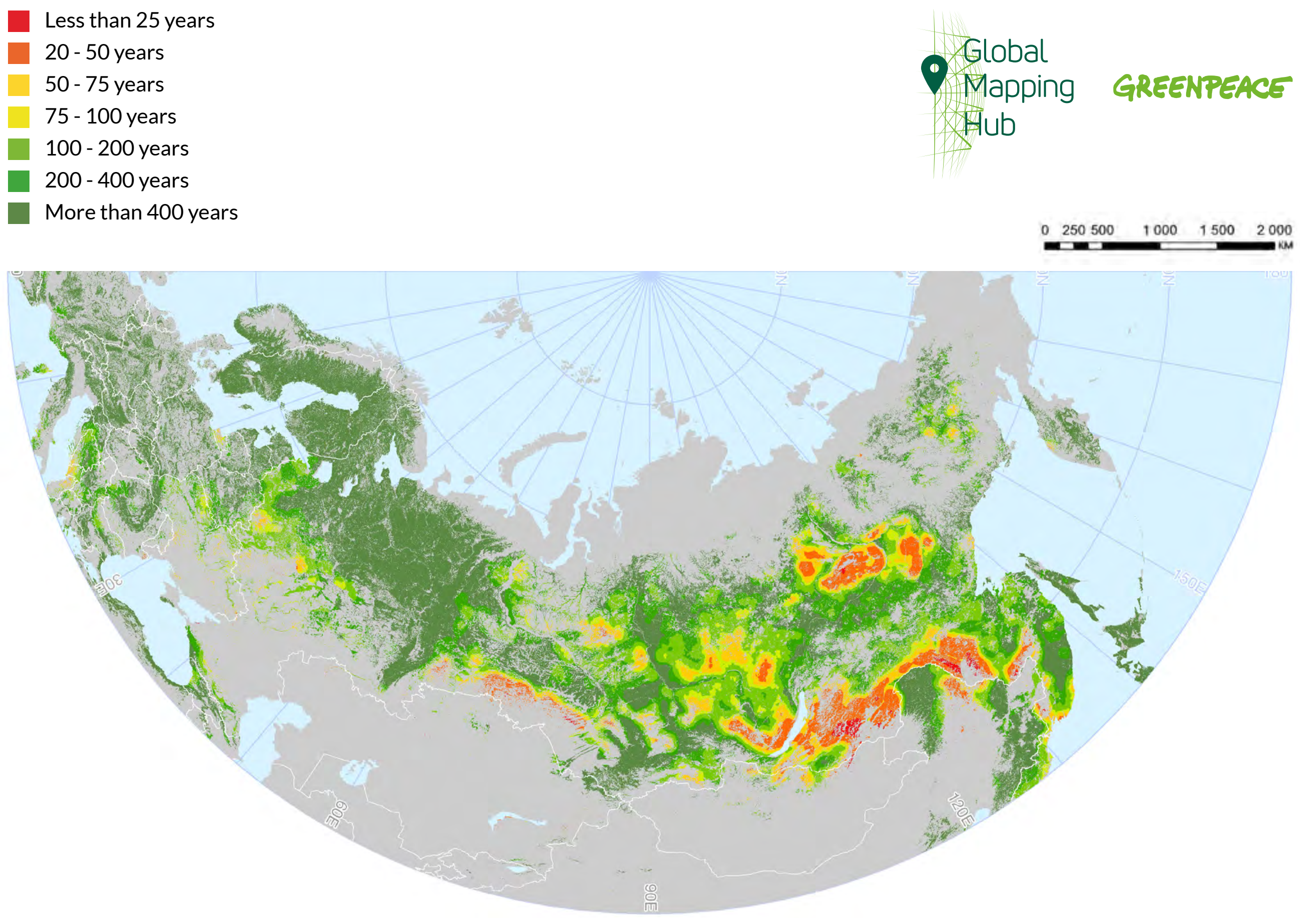
Decreasing fire return intervals can also lead to the long-term decline of forest landscapes until they simply no longer exist as forests. Repeated fires damage the land, remove soil nutrients and kill the microorganisms that are critical to the forest ecosystem.[15] With repeated fires, forests become savanna or tundra depending upon their location.[16] Savanna and shrublands burned too many times can ultimately become deserts.[17] Deserts have little or no carbon sink ability. This would represent the final destruction of a forest's ability to act as a natural climate solution.

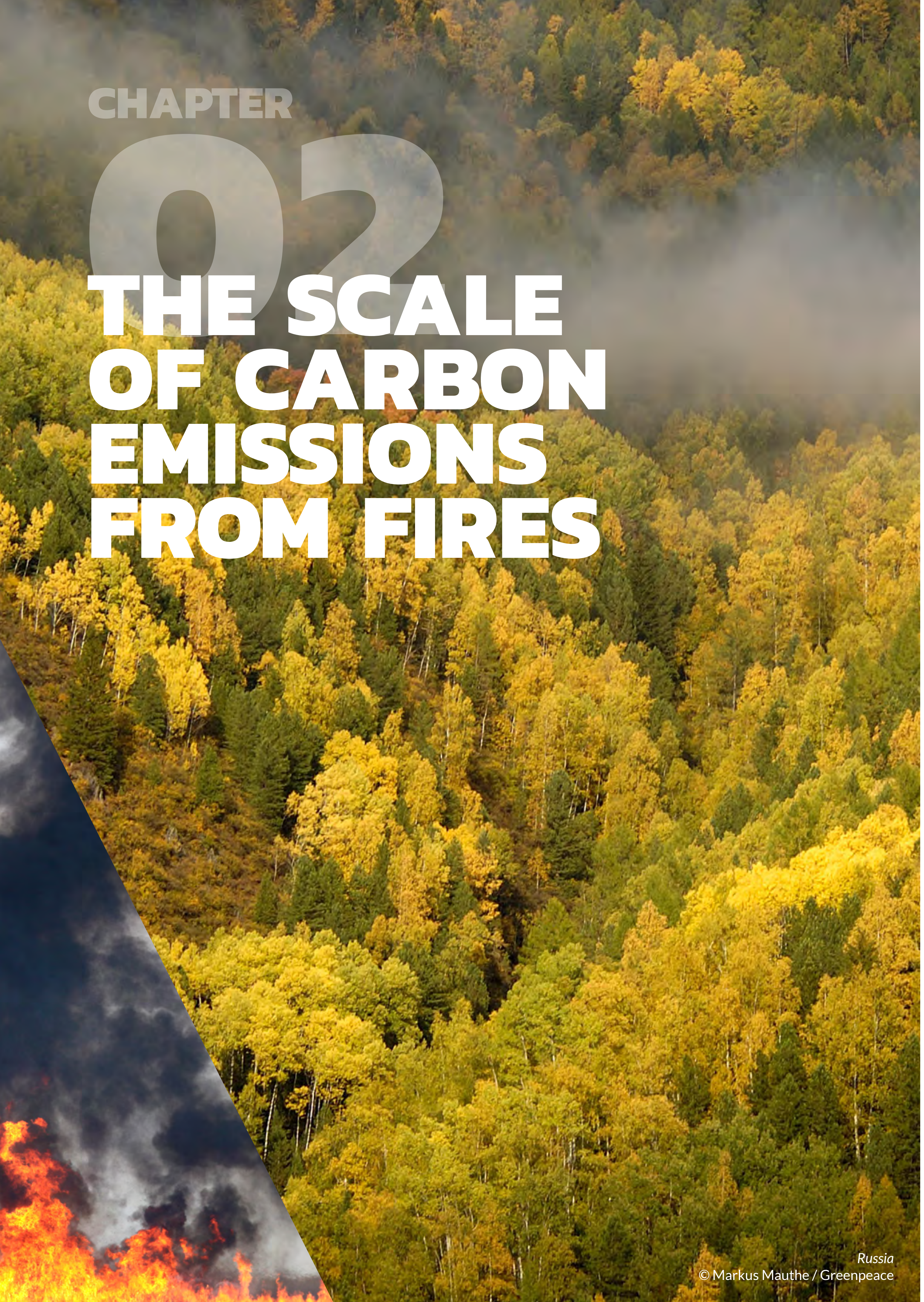
8 *Intergovernmental Panel on Climate Change, Special Report on Global Warming of 1.5°C (2018)*
9 *Pan, Yude, et al. "A large and persistent carbon sink in the world's forests." Science (2011): 1201609.*
10 *Griscom, Bronson W., et al. "Natural climate solutions." Proceedings of the National Academy of Sciences 114.44 (2017): 11645-11650.*
11 *Baccini, A., et al. "Tropical forests are a net carbon source based on aboveground measurements of gain and loss." Science 358.6360 (2017): 230-234.*
12 *Curtis, Philip G., et al. "Classifying drivers of global forest loss." Science 361.6407 (2018): 1108-1111.*
13 *Jolly, W. Matt, et al. "Climate-induced variations in global wildfire danger from 1979 to 2013." Nature communications 6 (2015): 7537.*
14 *Liu, Yongqiang, et al. "Trends in global wildfire potential in a changing climate." Forest ecology and management 259.4 (2010): 685-697.*
15 *Bobrovskii, M. V. "Effect of the historical land use on the structure of forest soils in European Russia." Eurasian Soil Science 43.13 (2010): 1458-1466.*
16 *Pierce, Jennifer L., et al. "Fire-induced erosion and millennial-scale climate change in northern ponderosa pine forests." Nature 432.7013 (2004): 87-90.*
17 *Ichoku, Charles, et al. "Biomass burning, land-cover change, and the hydrological cycle in Northern sub-Saharan Africa." Environmental Research Letters 11.9 (2016): 095005.*

FIRE-CLIMATE FEEDBACK LOOP



FIRE RETURN INTERVAL IN RUSSIAN FORESTS IN 2018





CHAPTER 02

THE SCALE OF CARBON EMISSIONS FROM FIRES

Russia

TO APPRECIATE THE SIGNIFICANCE OF CARBON EMISSIONS FROM FIRES IT'S IMPORTANT TO SET THEM WITHIN THE CONTEXT OF TOTAL EMISSIONS. IT'S ALSO IMPORTANT TO UNDERSTAND HOW CARBON EMISSIONS FROM FIRES ARE STUDIED AND WHERE THERE ARE UNKNOWNS OR UNCERTAINTIES. WHERE THERE ARE UNCERTAINTIES, THE BALANCE OF PROBABILITIES INDICATES THAT THE IMPACT OF FIRES ON THE CLIMATE IS ACTUALLY EVEN STRONGER THAN THE CURRENT DATA SUGGESTS.

WHAT ARE THE TOTAL GLOBAL EMISSIONS FROM FIRES?

As described in Chapter 1, the total climate impacts of fires include direct emissions from burning, indirect emissions from trees damaged by fire which slowly emit carbon as they die, the effects of black carbon, and the reduction of the ability of forests to remove carbon from the atmosphere.

Direct carbon dioxide emissions from fires have been the subject of the most research. So in this section these emissions will be considered and shown to be highly significant within the context of overall emissions from human activity.

A number of scientific studies have made efforts to estimate the average amount of gross global emissions from fires per year, over the last 40-50 years. Between 1980 and 2017 some 15 studies have been reported and/or reviewed as indicated in the table below.

FIRE EMISSIONS ESTIMATIONS[18]

PERIOD	EMISSIONS (MEAN GTC/YEAR)	SOURCE
1970s	1.8 1.9	Seiler and Crutzen, 1980 Schutz et al., 2008
1980s	2 2.1	Lobert et al., 1999 Schutz et al., 2008
1990s	2.8 2.3 2.2 2.4 2.5 0.8-2.2 2.5	Galanter et al., 2000 Andreae and Merlet, 2001 Houghton, 2003 Yevich and Logan, 2003 Bond et al., 2004 Houghton, 2005 Schultz et al., 2008
2000s	1.4 1.7 2 2.2	Ito and Penner, 2004 Hoelzemann et al., 2004 van der Werf, 2006 Schultz et al., 2008
97-2001	2	van der Werf et al., 2003
97-2004	2.5	van der Werf et al., 2006
60-2000	2.4	Lavoué et al., 2000
60-2000	2	Schultz et al.,2008
97-2009	2	van der Werf, 2010
97-2015	2.2	van der Werf et al., 2017

18 Schultz, Martin G., et al. "Global wildland fire emissions from 1960 to 2000." Global Biogeochemical Cycles 22.2 (2008).

There is broad scientific consensus about the approximate range of estimated figures for carbon emissions from fires. Studies examining emissions since the 1980s estimate average carbon emissions each year from fires to fall between 0.8 GtC per year to 2.5 GtC per year. Most recent estimations fall within the range of 2 GtC to 2.5 GtC per year. Studies look at slightly different time periods and use varied methodologies. This likely accounts for much of the variability in estimates made.

The most recent synthesis of available data has been used to generate the Global Fire Emissions Database (GFED)[19]. This looks at fire emissions from 1997 onwards and gives the average carbon emissions from fires (including small fires) per year up until 2017 as 2.1 GtC per year.

Weather conditions appear to play a major role in this variance. For example, 1997 and 2015 were both El Niño years, leading to droughts in tropical regions and consequently, more fires with nearly 3 GtC emitted. 2013 was at the other end of the scale, with around 1.7 GtC released. The overall trend is quite clear, however, - with climate change, we are likely to see more dry years and higher temperatures, extending the fire weather season in many places.[20]

What proportion of global carbon emissions result from fires?[20]

The latest GFED figures suggest average gross carbon emissions from fires of 2.1Gt each year from 1997 to 2017 which is equivalent to 7.7 Gt CO_2 annually.

7.7 Gt CO_2 is equivalent to nearly 25% of the total annual amount of CO_2 emissions from fossil fuel burning.[22]

Some proportion of these CO_2 emissions will be reabsorbed by regrowth within a year, for example emissions from fires on grasslands. Fires that are not balanced by regrowth are a net CO_2 source. These can be ***stand-replacing forest fires***, fires associated with deforestation or those that burn drained peatlands. Including non-CO_2 greenhouse gases, the contribution of fires to the greenhouse gas budget is 2.1 Gt CO_2 equivalent annually or 6% of global fossil fuel CO_2 emissions.[23]

> ***Stand-replacing forest fires***
> Fires which kill all or most of the living overstory trees in a forest and initiates forest succession or regrowth.

19 Global Fire Emissions Database www.globalfiredata.org
20 Flannigan, Mike, et al. "Impacts of climate change on fire activity and fire management in the circumboreal forest." Global Change Biology 15.3 (2009): 549-560.
21 Figures provided here are calculated via GFED Analysis Tool in September 2018.
22 Le Quéré, Corinne, et al. "Global carbon budget 2017." Earth System Science Data Discussions (2017): 1-79.
23 van der Werf, Guido R., et al. "Global fire emissions estimates during 1997-2016." (2017): 697-720.

Do these figures for carbon dioxide emissions cover the full climate impacts of fires?

No, they do not. The carbon emissions estimates produced by these scientific studies only look at carbon emissions resulting directly from fires. The studies attempt to estimate how much land area was burned, what material was consumed by fire and how much carbon dioxide would have been released in the fire.

The figures do not include the other climate impacts of fires: indirect emissions from trees damaged by fire which slowly emit carbon as they subsequently die and decompose, the effects of black carbon and the resulting reduction of the ability of forests to remove carbon from the atmosphere.

What methods are used to estimate emissions from fires?

The studies noted above provide estimates of how much land area was burned, what material was consumed by the fire, to what extent it was fully or partially consumed and how much carbon would have been released as a result, over a specified period. A variety of techniques have been used.

Some studies have used remote sensing to calculate burned areas while others have calculated emissions using fire radiative power, detecting the heat radiated by fires using satellite infrared sensors.

There are inherent uncertainties in estimating emissions. Each study must make choices and assumptions about which datasets to use and how to define parameters including: fire identification, land cover classifications, estimated burned area, fuel load and biomass consumption.

Accordingly, all studies have methodological strengths and weaknesses. Taken together, what is striking is that they produce a set of similar figures for global emissions from fires over similar time frames. These convergent values appear to confirm the global significance of carbon emissions from fires.

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CHAPTER 03

ALTERED FIRE REGIMES

Brazil
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FIRES ARE OFTEN CONSIDERED TO BE LARGELY NATURAL PHENOMENA. HOWEVER, OVER TIME, WIDESPREAD DEVELOPMENT OF INFRASTRUCTURE, AGRICULTURE AND HUMAN-INDUCED CLIMATE CHANGE HAVE CONSTANTLY ALTERED THE CONDITIONS UNDER WHICH FIRES OCCUR AND SPREAD. WITH GLOBAL TEMPERATURES INCREASING, FIRE REGIMES WILL CONTINUE TO CHANGE, SO THAT EVER FEWER REGIONS WILL HAVE NATURAL FIRE REGIMES.

NATURAL FIRE REGIMES	FIRE REGIMES TODAY
The fire starts as a result of a natural phenomenon: dry lightning, volcanic eruption or meteorite strike.	Fires often start as a result of human activity. It can happen intentionally, for example, in order to clear land, and unintentionally, for example, due to negligence.
The landscape where the fire starts is largely intact, unaltered by human infrastructure, agriculture or forest management.	In the countries discussed in this report most landscapes where fires happen have been significantly changed by human activity. These changes affect where fires start, how they spread and how intense they become. For example, roads are built through forest to support logging, mining, oil and gas projects, hydroelectric dams and more. Fires frequently start near roads due to carelessness before spreading along them.[24]
The amount of time passed since the last fire in the area would be in keeping with historical norms. That means the biodiversity, landscape and biosystem of the area do not experience long term or permanent changes as a result of the fire.	Fire risk is likely to increase around the globe. Increasing average global temperature may lead to more frequent and severe fires. On average around the world, the fire potential is increasing.[25] That means there is less time between fires for ecosystems to recover, resulting in long term alterations.

24 Potapov, Peter, et al. "The last frontiers of wilderness: Tracking loss of intact forest landscapes from 2000 to 2013." Science Advances 3.1 (2017): e1600821.
25 Liu, Yongqiang, et al. "Trends in global wildfire potential in a changing climate." Forest ecology and management 259.4 (2010): 685-697.

Natural fire regime

A 'natural fire regime' is a general pattern in which fires naturally occur in a particular ecosystem over an extended period of time. A natural fire regime is characterised by a combination of factors: frequency, intensity, size, pattern, season, and severity.

The idea that forest fires can be considered CO_2 neutral because trees eventually re-grow and re-capture carbon needs to be placed in a realistic context. Even when burned forests are allowed to recover rather than being converted to agricultural land the relatively slow speed of re-growth means that carbon recapture is much slower than the initial release. Simply, destroyed forests cannot grow back fast enough for fires to be considered entirely CO_2 neutral. In addition, the damage to land from repeated fires may inhibit full recovery in some areas all together.

According to IPCC, we need to maximise emission reductions before 2030[26], rather than in the 70 or 100 years that it takes forests in most regions to regain the majority of their original carbon content.

Where forests are growing on peatlands the situation is even worse. Peat is so rich in carbon and so slowly laid down through partial decomposition of plant matter that even if allowed to regenerate it could take thousands of years to re-capture the carbon released when it is destroyed by fire. Additionally, with permafrost increasingly becoming more vulnerable to thawing, carbon-rich peatlands in Russia are becoming increasingly susceptible to fire[27].

26 *Intergovernmental Panel on Climate Change, Special Report on Global Warming of 1.5°C (2018)*
27 *Comyn-Platt, Edward, et al. "Carbon budgets for 1.5 and 2 C targets lowered by natural wetland and permafrost feedbacks." Nature Geoscience 11.8 (2018): 568.*

Indonesia
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CHAPTER 04 FACING CLIMATE CHANGE

Russia
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TO MEET THE PARIS AGREEMENT TARGET OF 1.5˚C, IPCC SCIENTISTS ESTIMATE THAT WE NEED TO REDUCE HUMAN-CAUSED CO_2 EMISSIONS TO NET ZERO BY NO LATER THAN 2050[28].

As well as this reduction in emissions, the IPCC Special Report states that all 1.5°C-consistent scenarios or pathways will need us to actively remove CO_2 from the atmosphere. How much will depend on how fast we can reduce emissions to zero. The slower the reduction in global emissions, the more CO_2 we will have to attempt to remove later.

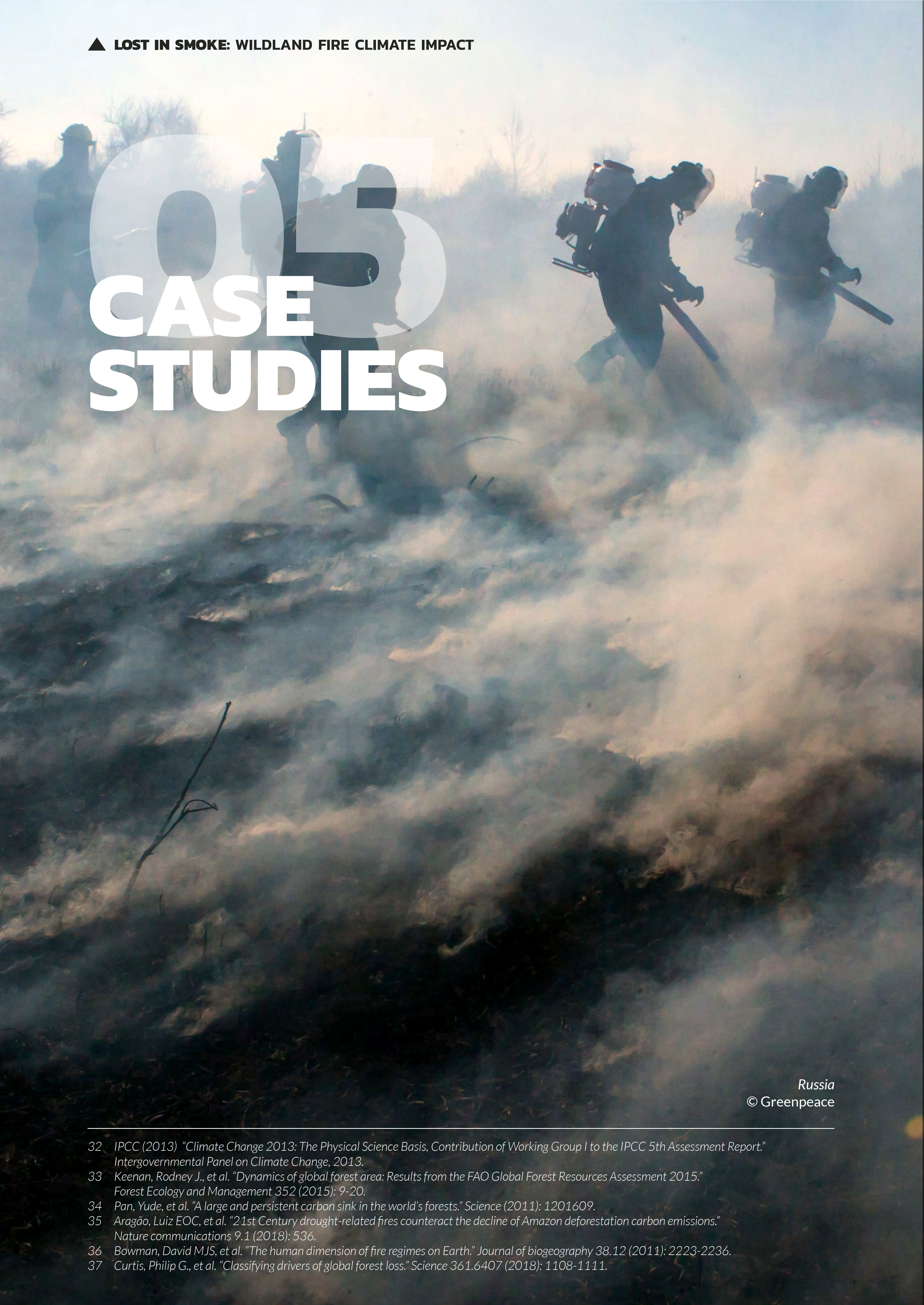
Speed is of the essence - and preventing fires can create *immediate* opportunities for reductions in greenhouse gas emissions. To take advantage of this opportunity we need to understand which fires are preventable, which should be prevented and how we should go about it.

In the focus countries of this report human activities are directly responsible for the vast majority of fires. For example, it is estimated that 90% of fires in Russia are caused by people.[29] In Indonesia[30] and Brazil[31] fires are started deliberately to clear land for agriculture and other purposes.

Given that more fires in the focus countries are caused by people rather than by natural phenomena, like lightning or volcanic eruption, accordingly there is enormous scope for effective action to prevent these. If emissions from fires are allowed to continue without constraint, then a very significant opportunity to reduce carbon emissions globally will be lost.

Given the urgency of mitigating climate change, we have to drastically reduce emissions where possible as well as to aim for the greatest maximum possible accumulation of organic matter in order to take up carbon from the atmosphere.

28 *Intergovernmental Panel on Climate Change, Special Report on Global Warming of 1.5°C (2018)*
29 *Alekseev, Genrih.V., et al. Vtoroj ocenochnyj doklad Rosgidrometa ob izmenenijah klimata i ih posledstvijah na territorii Rossijskoj Federacii [The second assessment report of Roshydromet on climate change and its consequences on the territory of the Russian Federation]. Gosudarstvennyj nauchnyj centr Rossijskoj Federacii "Arkticheskij i antarkticheskij nauchno-issledovatel'skij institut" Federal'noj sluzhby Rossii po gidrometeorologii i monitoringu okruzhajushhej sredy [State Scientific Center of the Russian Federation "Arctic and Antarctic Research Institute" of the Federal Service of Russia for Hydrometeorology and Environmental Monitoring], 2014. [In Russian]*
30 *Marlier, Miriam E., et al. "Fire emissions and regional air quality impacts from fires in oil palm, timber, and logging concessions in Indonesia." Environmental Research Letters 10.8 (2015): 085005.*
31 *Cochrane, Mark A., and William F. Laurance. "Synergisms among fire, land use, and climate change in the Amazon." AMBIO: A Journal of the Human Environment 37.7 (2008): 522-527.*



05 CASE STUDIES

Russia
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FORESTS STORE SUBSTANTIAL AMOUNTS OF CARBON: IN THE LIVING TREES AND OTHER PLANTS, IN LEAF LITTER AND DEAD VEGETATION AND IN THE SOIL ITSELF. GLOBALLY, THE WORLD'S FORESTS ARE ESTIMATED TO STORE CARBON EQUIVALENT TO SOME 90 YEARS OF GREENHOUSE GAS EMISSIONS FROM FOSSIL FUEL BURNING.[32]

Most of the world's forests lie within tropical (44%) and boreal (31%) regions[33]. That means tropical and boreal forests together make up the largest part of this carbon store. Every year, forests account for the majority of the carbon taken up by the land masses from the atmosphere, some 30% of total annual emissions.[34]

As a result of climate change, degraded forests may become increasingly dry and more susceptible to fires. In comparison with intact forests, human-modified forests are characterised by greater canopy opening, drier microclimate, and species with lower wood density. Such characteristics make these forests more flammable and act to increase fire intensity if they do burn.[35]

Fire is used extensively in tropical regions such as Indonesia and Brazil as a cheap tool to clear the land for agriculture and for the purposes of land grabbing. Intact tropical forests rarely burn naturally. Now fires are far more frequent due to human activity and climate change.[36]

In Russia, larger areas of forests are currently impacted by fires than by logging[37]. Their proximity to the Arctic means black carbon released by boreal forest fires is particularly likely to end up on Arctic snow and ice.

Finally, it's critical to remember that a large portion of Russian boreal and Indonesian tropical forests grow on peatlands. It is important to prevent fires in these peatland forests because of the enormous amount of carbon that peat emits when it burns after being allowed to dry.

Below we examine the national reporting of fire emissions, the attitude to fire prevention and the Intended Nationally Determined Contributions (*INDCs*) of three countries: Brazil, Indonesia and Russia.

> *INDCs:*
> Countries across the globe adopted an international climate agreement at the U.N. Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP21) in Paris in December 2015. In anticipation of this moment, countries publicly outlined what post-2020 climate actions they intended to take under the new international agreement, known as their Intended Nationally Determined Contributions (INDCs). The climate actions communicated in these INDCs largely determine whether the world achieves the long-term goals of the Paris Agreement: to hold the increase in global average temperature to well below 2°C, to pursue efforts to limit the increase to 1.5°C, and to achieve net zero emissions in the second half of this century.

32 IPCC (2013) "Climate Change 2013: The Physical Science Basis, Contribution of Working Group I to the IPCC 5th Assessment Report." Intergovernmental Panel on Climate Change, 2013.
33 Keenan, Rodney J., et al. "Dynamics of global forest area: Results from the FAO Global Forest Resources Assessment 2015." Forest Ecology and Management 352 (2015): 9-20.
34 Pan, Yude, et al. "A large and persistent carbon sink in the world's forests." Science (2011): 1201609.
35 Aragão, Luiz EOC, et al. "21st Century drought-related fires counteract the decline of Amazon deforestation carbon emissions." Nature communications 9.1 (2018): 536.
36 Bowman, David MJS, et al. "The human dimension of fire regimes on Earth." Journal of biogeography 38.12 (2011): 2223-2236.
37 Curtis, Philip G., et al. "Classifying drivers of global forest loss." Science 361.6407 (2018): 1108-1111.

CASE STUDY: BRAZIL

KEY CONCERNS

Brazil is the second most forested country in the world, with 12% of global forest cover.[38] Rainforests represent 55% of global forest carbon stock.[39] This vast rainforest is becoming a net source of CO_2 instead of acting as a net sink.[40] Fires are a key cause as tropical forests used to burn only every 400 to 1000 years[41] and are not adapted to fire.

Fire damages the forest in such a way that it becomes vulnerable to further fires, creating a feedback loop[42]. Fires fundamentally change the structure of tropical rainforest,[43] affecting its ability to stockpile carbon for decades after the event.

Deforestation, degradation, fragmentation and infrastructure have been linked to increased fire activity and repeated fires.[44]

Brazil
© Valdemir Cunha / Greenpeace

38 FAO (2015) "Global Forest Resources Assessment 2015. Food and Agriculture Organization of the United Nations, 2015
39 Pan, Yude, et al. "A large and persistent carbon sink in the world's forests." Science (2011): 1201609.
40 Baccini, A., et al. "Tropical forests are a net carbon source based on aboveground measurements of gain and loss." Science 358.6360 (2017): 230-234.
41 Alencar, Ane, et al. "Temporal variability of forest fires in eastern Amazonia." Ecological Applications 21.7 (2011): 2397-2412.
42 Brando, Paulo Monteiro, et al. "Abrupt increases in Amazonian tree mortality due to drought–fire interactions." Proceedings of the National Academy of Sciences (2014): 201305499.
43 Barlow, Jos, and Carlos A. Peres. "Fire-mediated dieback and compositional cascade in an Amazonian forest." Philosophical Transactions of the Royal Society of London B: Biological Sciences 363.1498 (2008): 1787-1794.
44 Armenteras, Dolors, et al. "Changing patterns of fire occurrence in proximity to forest edges, roads and rivers between NW Amazonian countries." Biogeosciences 14.11 (2017): 2755-2765.

NATIONAL REPORTING OF CARBON EMISSIONS FROM FIRES COMPARED TO GLOBAL FIRE EMISSIONS DATABASE ESTIMATES[45]

Year examined	Reported CO_2 emissions from fires included in total	Reported CO_2 emissions from fires NOT included in total	GFED estimate	Reported total CO_2 emissions	Hypothetical total if GFED estimate was used instead of nationally reported figure	Black carbon reported	Mentioning fires in INDC
2010	Not itemised	246Mt	855Mt	740Mt	1595Mt	None	No

For 2010, Brazil reported 246 Mt of CO_2 from "fires not associated with deforestation".[46] It noted that "emissions from fires associated with deforestation are incorporated in the inventory". These emissions were not itemised further.

The same report gave a figure for total CO_2 emissions for 2010 of 740 Mt.[47] The 246 Mt of CO_2 from "fires not associated with deforestation" were not included in this total.

If all fire emissions reported by Brazil for 2010 had been included in their total emissions for that year, the figure would have been 986 Mt CO_2, a third more than actually reported.

The Global Fire Emissions Database (GFED) estimated 855 Mt CO_2 of gross emissions from fires in Brazil for 2010.[48]

If Brazil used the GFED estimate which includes all fires, its total national CO_2 emissions for 2010 would leap from 740 Mt to 1595 Mt. Emissions from fires would make up 63% of this total.

Brazil's most recent report on national greenhouse gas emissions[49] does not itemise emissions from fire.

Brazil does not mention black carbon in its reporting.

45 Figures provided here and in other case studies are calculated via GFED Analysis Tool in September 2018.
46 Government of Brazil (2016) "Third National Communication of Brazil to the United Nations Framework Convention on Climate Change", Brazil, 2016. Volume 3, Appendix 2.
47 Government of Brazil (2016) "Third National Communication of Brazil to the United Nations Framework Convention on Climate Change", Brazil 2016. Volume 3 pp 317, 315.
48 Global Fire Emissions Database Analysis Tool www.globalfiredata.org/analysis.html
49 Government of Brazil (2017) 'Second Biennial Update Report to the United Nations Framework Convention on Climate Change', Brazil, 2017

Stated ambition

Brazil's INDC[50] does not mention fires.

Brazil's Second Biennial Update Report discusses various measures for reducing fires, including training and hiring large numbers of fire fighters and training farmers in agricultural practices which do not use burning. However it's not clear that this is yet having any effect on reducing the number of fires.

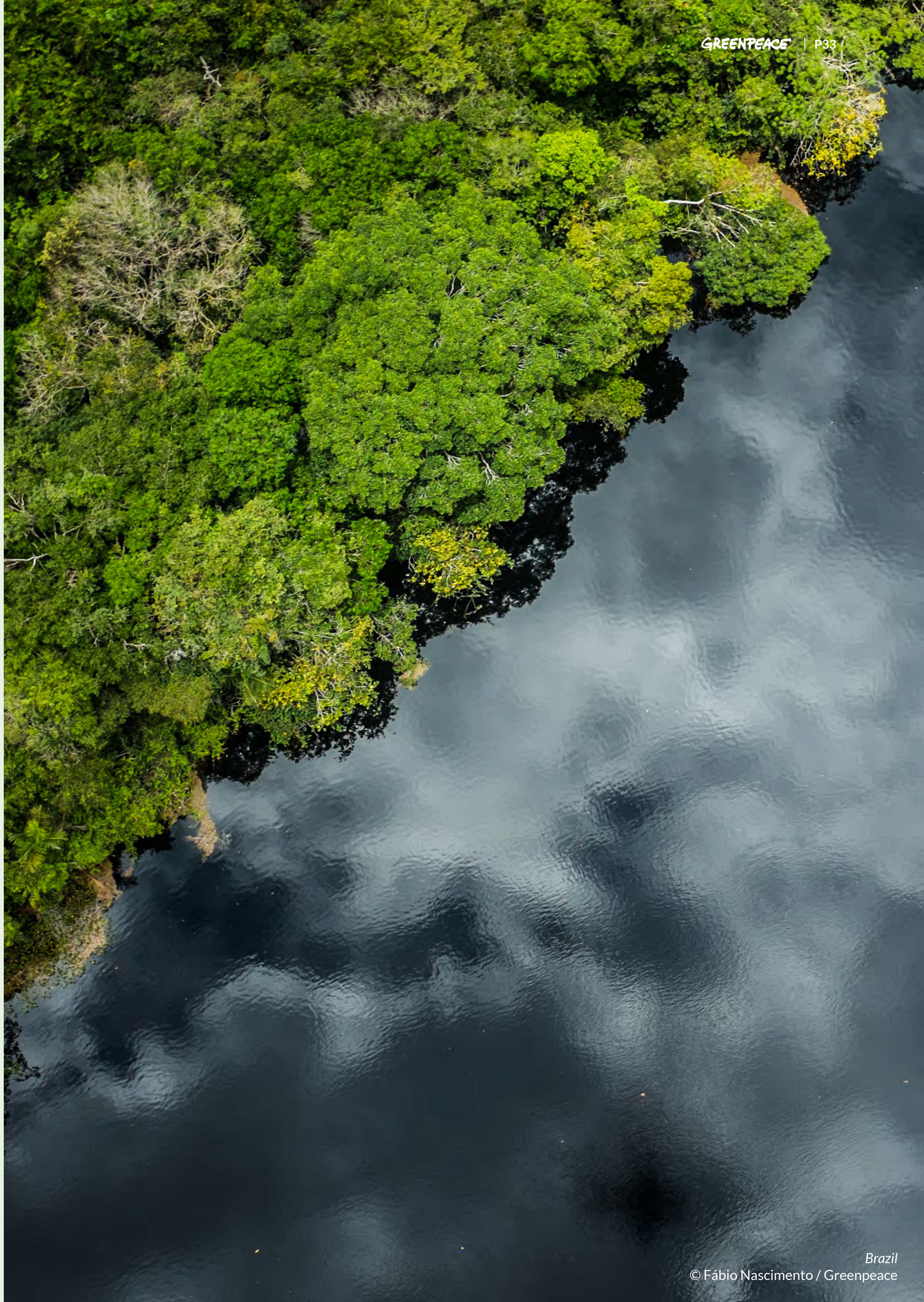
Causes of fire and opportunities for prevention

Fire is used actively in the region for a number of different purposes. Its primary use is in the clearing of land for agriculture, but may also be started intentionally in conflict areas in order to grab land. Unintended fires are likely to start alongside roads, so infrastructural development in the forest is a risk factor.[51]

Deforestation and degradation of the forest in themselves are important drivers of fire,[52] so the problem needs to be tackled also through forest protection and restoration. At the same time, an adequate level of funding for fire prevention and control is necessary, especially in those areas already subject to degradation.

Brazil could also improve its monitoring system to forecast the location and intensity of fires and expand the number of volunteer fire brigades to fight fires which occur on private farms, in protected areas and within indigenous lands.

Protected areas also appear to be effective not only in helping to reduce deforestation but also in reducing the numbers of fires. Fires were found to be between 4 and 9 times higher in number outside protected areas than inside.[53] Increasing the connectivity of forest patches, with more protected areas and the adoption of better land-use management practices might also help to reduce fires.



Brazil
© Fábio Nascimento / Greenpeace

50 Federative Republic of Brazil (2015) 'Intended nationally-determined contribution towards achieving the objective of the united nations framework convention on climate change', Brazil, 2015
51 Nepstad, Daniel, et al. "Road paving, fire regime feedbacks, and the future of Amazon forests." Forest ecology and management 154.3 (2001): 395-407.
52 Armenteras, Dolors, et al. "Changing patterns of fire occurrence in proximity to forest edges, roads and rivers between NW Amazonian countries." Biogeosciences 14.11 (2017): 2755-2765.
53 Nepstad, Daniel, et al. "Inhibition of Amazon deforestation and fire by parks and indigenous lands." Conservation biology 20.1 (2006): 65-73.

CASE STUDY: INDONESIA

KEY CONCERNS

Indonesia represents only 2% of global forest cover,[54] but fires here are of enormous concern because large areas of Indonesia's land mass consist of peatlands. The peatlands contain 74% of all the carbon captured within the country's forests[55] and contribute the bulk of CO_2 emissions from fires.[56]

Fire is frequently used to convert land for agriculture. Moreover, government moratoria on deforestation and other industrial activities that damage peatlands have not been enforced.[57] The Indonesian government has responded to pressure to act following devastating fires in 1997 and 2015. But little has changed in practice. Corporations have continued with business as usual and the number of fires continues to stay high.[58]

Indonesia reports high numbers for carbon emissions from fires, though these still appear to be underestimates based on comparison with GFED data. The Indonesian government has stated that they intend to begin excluding some emissions from fires from their reports. This would be a seriously backwards step in relation to bringing the situation under effective management and control.

Indonesia
© Ulet Ifansasti / Greenpeace

54 FAO (2015) "Global Forest Resources Assessment 2015. Food and Agriculture Organization of the United Nations, 2015
55 Hooijer, Aljosja, et al. "Current and future CO_2 emissions from drained peatlands in Southeast Asia." Biogeosciences 7.5 (2010): 1505-1514.
56 van der Werf, Guido R., et al. "Global fire emissions estimates during 1997-2016." (2017): 697-720.
57 Marlier, Miriam E., et al. "Fire emissions and regional air quality impacts from fires in oil palm, timber, and logging concessions in Indonesia." Environmental Research Letters 10.8 (2015): 085005.
58 Purnomo, Herry, et al. "Fire economy and actor network of forest and land fires in Indonesia." Forest Policy and Economics 78 (2017): 21-31.

NATIONAL REPORTING OF CARBON EMISSIONS FROM FIRES COMPARED TO GLOBAL FIRE EMISSIONS DATABASE ESTIMATES

Year examined	Reported CO_2 emissions from fires included in total	Reported CO_2 emissions from fires NOT included in total	GFED estimate	Reported total CO_2 emissions	Hypothetical total if GFED estimate was used instead of nationally reported figure	Black carbon reported	Mentioning fires in INDC
2014	499 Mt	Not reported	631 Mt	1608 Mt	1740 Mt	None	Little

In 2014, Indonesia reported 499 Mt of CO_2 emitted from peat fires.[59] 979 Mt CO_2 from Forest and Other Land Use was also reported. Emissions from forest fires are not itemised as such but it's likely that the 979 Mt includes emissions from deforestation and associated fires.

In theory, all known fire emissions should be included in these figures because Indonesia currently considers all forests to be managed and does not exclude any emissions from fires.[60] Indonesia's total reported emissions for 2014 were 1,608 Mt CO_2.

The GFED estimated 631 Mt CO_2 total emissions from forest and peat fires for 2014. If Indonesia used the GFED estimate which includes all fires, its total national CO_2 emissions for 2014 would increase from 1,608 Mt to 1,740 Mt. Emissions from fires would make up 36% of this total.

Indonesia does not mention black carbon in its reporting.

59 Government of Indonesia (2017) "Third National Communication under the United Nations Framework Convention on Climate Change", Republic of Indonesia, 2017
60 Government of Indonesia (2017) "Third National Communication under the United Nations Framework Convention on Climate Change", Republic of Indonesia, 2017. p142

Stated ambition

Indonesia's INDC mentions fire emissions but does not discuss any reduction in detail.

The Third National Communication suggests aiming for a 21.87 Mt annual reduction in emissions via forest fire control. This would constitute only a 4% reduction in the emissions reported by Indonesia from peatland fires in 2014.

The same Communication advises that Indonesia intends to begin excluding reporting emissions from some forest fires namely those on unmanaged lands.[61] This is a development that is difficult to justify since it would mean that many fires would fall outside the scope of the current reporting. This is despite the fact that few fires can be said to be natural in origin.

Causes of fire and opportunities for prevention

In Indonesia, the fragmentation of forests, mainly driven by the development of industrial activities such as agriculture, logging, pulpwood plantations and mining, as well as the related drainage of peatlands, is a key element in increasing fire risks in affected areas. With fires actively being used by humans for the purpose of land clearing, catastrophic fire seasons have here become an ever recurring reality. Deforestation in Indonesia amounted to 6 million hectares between 2000 to 2012.[62]

Also issues relating to land tenure seem to be an underlying cause of fires in Indonesia. Conflicts between communities and the large plantations have increased markedly since the late 1990s, and sometimes fire is used for the purposes of retaliation in these conflicts.[63] The lack of an appropriate legal system to address land claims, land 'ownership', and communal rights has led smallholders to burn plantations in order to reclaim land for agriculture. Fires set on their land can easily spread to neighboring areas.[64]

To prevent fires it will be necessary to implement a full moratorium on deforestation, to stop peatland drainage and the use of fire for the purpose of clearing land. Land rights must be restored to communities and full access to justice provided.

Indonesia
© Rendra Hernawan / Greenpeace

61 *Government of Indonesia (2017) "Third National Communication under the United Nations Framework Convention on Climate Change", Republic of Indonesia, 2017. p142*
62 *Marlier, Miriam E., et al. "Fire emissions and regional air quality impacts from fires in oil palm, timber, and logging concessions in Indonesia." Environmental Research Letters 10.8 (2015): 085005.*
63 *Aiken, S. Robert. "Runaway fires, smoke haze pollution, and unnatural disasters in Indonesia." Geographical Review 94.1 (2004): 55-79.*
64 *Suyanto, S. "Underlying cause of fire: different form of land tenure conflicts in Sumatra." Mitigation and adaptation strategies for global change 12.1 (2007): 67-74.*

CASE STUDY: RUSSIA

KEY CONCERNS

Russia is the world's most forested country, with 20% of global forest cover.[65] Forest fires are a massive problem within Russia, with more tree cover lost to fire than to logging.[66] Russia loses on average 3-4 million hectares of forest per year to fires[67] and the total burned area can reach up to 15 million hectares.[68]

There is no legal obligation to fight fires across nearly 49% of Russian forests unless settlements or infrastructure are threatened.[69] These areas the Russian government has categorised as "zones of control".

Geographical, political, legal and cultural factors in Russia have combined to make the country a global fires hotspot. People start around 90% of the fires which occur[70]. Causes of fires include prescribed burnings, grass burnings and also fires started to clear former agricultural land in order to avoid legal action and fines.

Russia
© Greenpeace

65 FAO (2015) "Global Forest Resources Assessment 2015. Food and Agriculture Organization of the United Nations, 2015
66 Curtis, Philip G., et al. "Classifying drivers of global forest loss." Science 361.6407 (2018): 1108-1111.
67 According to Greenpeace Russia estimations based on remote sensing
68 According to ISDM-Rosleskhoz (National Remote Monitoring Agency)
69 Ministry of Natural Resources and Ecology of the Russian Federation, Federal Agency of Forestry "State Forest Inventory 2013", Moscow, 2014. Table 12 p.465 [In Russian
70 Alekseev, Genrih.V., et al. Vtoroj ocenochnyj doklad Rosgidrometa ob izmenenijah klimata i ih posledstvijah na territorii Rossijskoj Federacii [The second assessment report of Roshydromet on climate change and its consequences on the territory of the Russian Federation]. Gosudarstvennyj nauchnyj centr Rossijskoj Federacii "Arkticheskij i antarkticheskij nauchno-issledovatel'skij institut" Federal'noj sluzhby Rossii po gidrometeorologii i monitoringu okruzhajushhej sredy [State Scientific Center of the Russian Federation "Arctic and Antarctic Research Institute" of the Federal Service of Russia for Hydrometeorology and Environmental Monitoring], 2014. [In Russian]

NATIONAL REPORTING OF CARBON EMISSIONS FROM FIRES COMPARED TO GLOBAL FIRE EMISSIONS DATABASE ESTIMATES

Year examined	Reported CO_2 emissions from fires included in total	Reported CO_2 emissions from fires NOT included in total	GFED estimate	Reported total CO_2 emissions	Hypothetical total if GFED estimate was used instead of nationally reported figure	Black carbon reported	Mentioning fires in INDC
2015	205 Mt	?	324 Mt	1031 Mt	1150 Mt	None	No

In 2015, Russia reported 205 Mt of CO_2 emitted from fires.[71] GFED looks at emissions from all fires and estimated 324 Mt CO_2 for the same period. If Russia used the GFED estimate which includes all fires, its total national CO_2 emissions for 2015 would increase from 1031 Mt to 1150 Mt. Emissions from fires would represent 28% of this total.

Russia does not report emissions from forest fires located on what it defines as unmanaged lands, which comprise 23% of the nation's forests.[72] As a result, emissions from fires in nearly a quarter of Russia's forests go unreported. The unmanaged lands include the areas of forest with the largest actual proportion of burned area, including Irkutsk region, Yakutia, The Republic of Buryatia and Krasnoyarsk region.[73]

Despite this omission, Russia's official documents claim that "Managed forests cover a large part of the country's forest land and, accordingly, determine the dynamics of emissions and absorption of greenhouse gases in the forest sector."[74]

It is even harder to justify this reasoning around managed and unmanaged lands when we consider that many fires in unmanaged lands start near human activity. For example, in the Irkutsk region 72% of fires in unmanaged lands start within 2 km of human activity.[75]

71 Russian Federation (2018) "National inventory report anthropogenic emissions from sources and removals by sinks of greenhouse gases not regulated by the Montreal Protocol for the years 1990 - 2016", Moscow, 2018 [in Russian]
72 Russian Federation (2018) "National inventory report anthropogenic emissions from sources and removals by sinks of greenhouse gases not regulated by the Montreal Protocol for the years 1990 - 2016", Moscow, 2018. p225 [in Russian]
73 Russian Federation (2018) "National inventory report anthropogenic emissions from sources and removals by sinks of greenhouse gases not regulated by the Montreal Protocol for the years 1990 - 2016", Moscow, 2018. p227 [in Russian]
74 Russian Federation (2018) "National inventory report anthropogenic emissions from sources and removals by sinks of greenhouse gases not regulated by the Montreal Protocol for the years 1990 - 2016", Moscow, 2018. p225 [in Russian]
75 According to Greenpeace Russia study published on: www.forestforum.ru/viewtopic.php?f=24&t=20248

The exclusion of emissions from fires in unmanaged lands is one of the reasons why Russia's reported emissions from fire are lower than GFED estimates. However, the method by which Russia calculates burned area also contributes to the problem.

CO_2 emissions from fires are calculated based on how much area is burned. Therefore it is critical to use an accurate figure for burned area. Greenpeace has demonstrated that official Russian figures for burned area consistently underestimate its true extent. In addition, a different set of figures for burned area is used for IPCC reporting. This adds to the confusion around reported CO_2 emissions and reinforces a picture of consistently under-estimated emissions using the official methods.

Stated ambition

Russia's INDC highlights the climate benefits for Russia as a heavily forested country but completely fails to acknowledge the threats posed by fire.

Causes of fire and opportunities for prevention

Forestry officials carry out prescribed burnings with the stated aim of preventing future fires. But these are extremely under-resourced. In some regions, the amount of money spent per hectare burned is just 15 rubles, less than the cost of a postage stamp. As a result, every year prescribed burnings run out of control, leading to forest and peat fires (see map).

As well as government agencies, individuals start fires. This happens most frequently in the approximately 100 million hectares of forest that is growing on abandoned agricultural land. As it is illegal to let forest grow in these places, landowners set fire to forest that has grown up to clear the land and thus avoid financial penalties. This, in turn, creates further emissions that go unreported. These fires also frequently spread to other forests and peatlands, emitting carbon and destroying carbon sink potential.

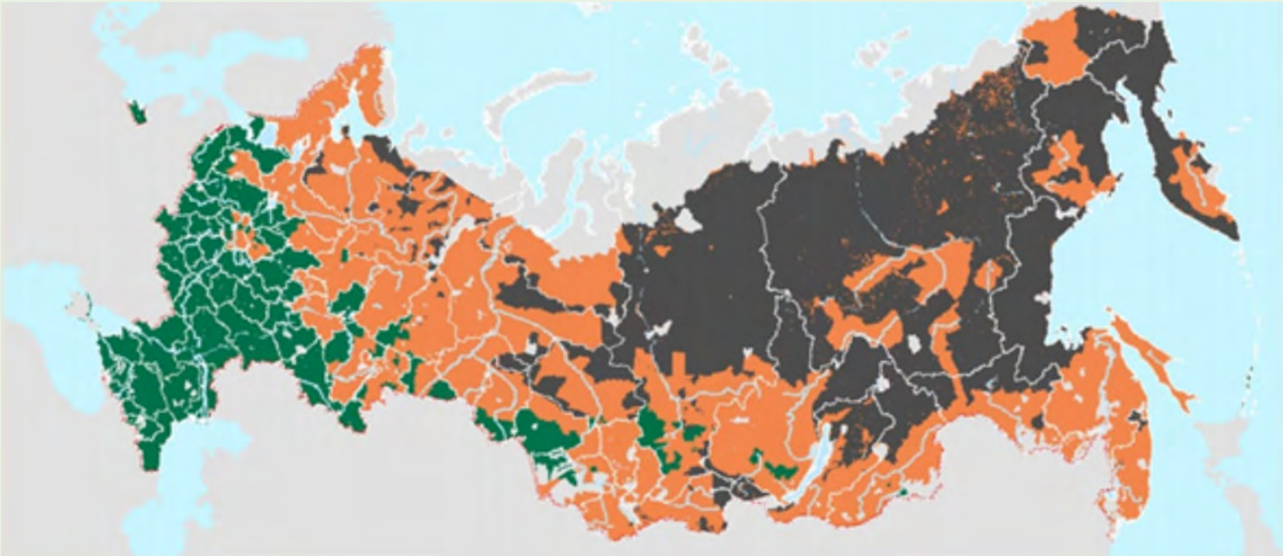
There is also a widespread practice of starting grass fires[76]. This is illegal[77] but the law is rarely enforced.

Russia has its own separate and additional system of classifying forest land that is not clearly aligned with the managed/unmanaged lands it reports on to the UNFCCC. Nearly half of all Russia's forest can legally be left to burn with no attempt to reduce the climate impacts by fighting the fire.[78] These areas are called "zones of control". The name is misleading as in these areas it is deemed unnecessary to control fire unless they are threatening settlements or infrastructure.

In the first 10 months of 2018, 39% of all burned land area lay within the "zones of control".[79] Around half of the area within the zones of control is too remote to make fire fighting possible. But the remaining half - 280 million hectares of forest, the size of Kazakhstan - should be reclassified to require fires to be fought there. The necessary funding should be put in place to make this possible.

Underestimating how much land burns year to year leads to under-resourcing of fire fighting and prevention. That makes it hard to effectively fight forest fires, leading to more carbon emissions.

CURRENT ZONING SCHEME



In the map, green areas have fire fighting protection available on the ground.
Orange areas are monitored from the air and fires should be fought there.
The grey areas are "zones of control". They are monitored but there is no requirement to fight fires.

76 McCarty, Jessica L., et al. "Agricultural Fires in European Russia, Belarus, and Lithuania and Their Impact on Air Quality, 2002–2012." Land-Cover and Land-Use Changes in Eastern Europe after the Collapse of the Soviet Union in 1991. Springer, Cham, 2017. 193-221.
77 Governmental Decree of November 10, 2015 No. 1213 "On Amendments to the Rules of the fire regime in the Russian Federation"
78 Ministry of Natural Resources and Ecology of the Russian Federation, Federal Agency of Forestry "State Forest Inventory 2013", Moscow, 2014. Table 12 p465 [in Russian]
79 According to data retrieved from ISDM-Rosleskhoz (National Remote Monitoring Agency), accessed on October 19th 2018. https://nffc.aviales.ru/main_pages/index.shtml

CONCLUSION FROM THE CASE STUDIES

COUNTRIES UNDER REVIEW HERE FACE SOME SHARED CHALLENGES INCLUDING THE HIGH FREQUENCY AND INTENSITY OF FIRES. THEY HAVE SHARED FAILINGS TOO. ALL OF THEM ARE CONSISTENTLY UNDER-REPORTING CO_2 EMISSIONS FROM FIRES. NONE OF THEM ARE REPORTING BLACK CARBON EMISSIONS. WE KNOW THIS FROM COMPARING THEIR NATIONAL REPORTS WITH ESTIMATES FROM THE GLOBAL FIRE EMISSIONS DATABASE. THE GFED IS BASED SOLELY ON REMOTE SENSING, SO IT IS LIKELY THAT EVEN GFED FIGURES ARE UNDERESTIMATES AND THE TRUE FIGURES FOR EMISSIONS FROM FIRES ARE EVEN HIGHER.

This theory is supported by comparing GFED estimates to reported figures from countries which have sophisticated on the ground fire monitoring and reporting systems. This shows GFED figures are lower than those reported when remote sensing is combined with locally reported information.[80]

All three countries have a great opportunity they can and should exploit. Greatly increased effort should be directed both at ensuring accurate reporting of emissions from fires, and then at taking action to prevent them. The IPCC should be encouraged to set up procedures to facilitate detailed and accurate reporting. If we want to limit temperature increases to 1.5°C, reducing fire emissions demands urgent attention.

Russia
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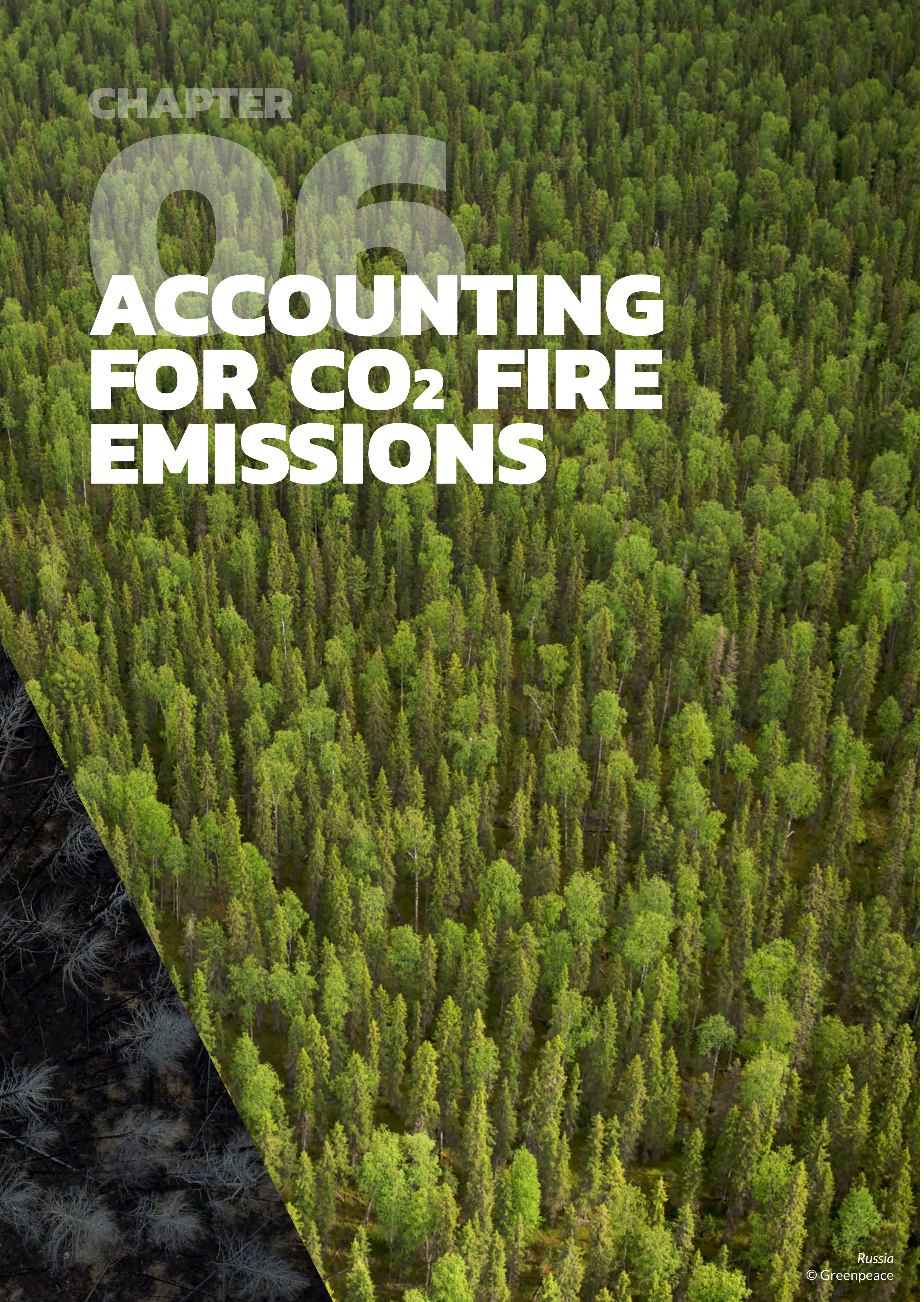
80 See Chapter 6

CHAPTER 06
ACCOUNTING FOR CO_2 FIRE EMISSIONS



Russia

NATIONAL REPORTS ARE SERIOUSLY UNDERESTIMATING CO_2 EMISSIONS FROM FIRES, THROUGH A COMBINATION OF INEFFECTIVE MONITORING AND INACCURATE REPORTING. THEY ARE IGNORING BLACK CARBON EMISSIONS AND THEY ARE NOT ACCOUNTING FOR THE IMPACTS OF THE LOSS OF CARBON SINK POTENTIAL DUE TO FIRE. THIS NEGLECT TO ACCOUNT FOR AND ACT ON THE CLIMATE IMPACTS OF FIRES POSES A CRITICAL THREAT TO OUR CHANCES OF LIMITING GLOBAL TEMPERATURE INCREASES TO 1.5°.

With respect to three countries with significant forest cover in tropical and boreal regions - Russia, Brazil and Indonesia - it is possible to take the most recently available official figures (see the box) for emissions from fires and compare these with figures from the Global Fire Emissions Database. When this is done, it becomes apparent that emissions from fires given in national figures are considerably underestimated. It's then important to ask why this is happening.

FOCUS ON: UNDERESTIMATING EMISSIONS FROM FIRES[81]

Brazil (2010):
reported 246 Mt CO_2 from fires, no black carbon mention[82]. GFED calculates 855 Mt CO_2 from forest fires and 404 kt black carbon from all fires.

Indonesia (2014):
reported 499 Mt CO_2 (from peat fires only), no black carbon mention.[83] GFED calculates 631 Mt CO_2 from forest and peat fires, 175 kt black carbon.

Russia (2015):
reported 205 Mt CO_2 from fires, no black carbon mention.[84] GFED calculates 324 Mt from forest fires and peat fires, 122 kt black carbon.

The answer to this question is that there is a lack of binding guidance on how to comprehensively and routinely collect and report detailed information on fire related emissions.

In ideal circumstances this should include data on land cover, burned area, combustion effectiveness, etc. As a result of failures to systematically collect primary data, globally we are unable to accurately calculate and report on the carbon emissions from fires. A number of common challenges that can contribute to this outcome are identified below.

81 GFED figures provided here are calculated via GFED Analysis Tool.
82 Government of Brazil (2016) "Third National Communication of Brazil to the United Nations Framework Convention on Climate Change", Brazil, 2016. Volume 3, Appendix 2
83 Government of Indonesia (2017) "Third National Communication under the United Nations Framework Convention on Climate Change", Republic of Indonesia, 2017
84 Russian Federation (2018) "National inventory report anthropogenic emissions from sources and removals by sinks of greenhouse gases not regulated by the Montreal Protocol for the years 1990 - 2016", Moscow, 2018 [in Russian]

EFFECTIVE MONITORING OF FIRES

In contrast to countries where data are not being systematically collected, countries effectively and routinely collecting data on fires within their borders, report significantly higher levels of emissions from fires than are estimated in the Global Fires Emissions Database. This is true, for example, for USA[85], Spain[86] and Portugal[87].

In these countries, the calculations are based on detailed local and national data, so it is likely that reported figures are more accurate because the GFED figures are based on less well resolved remote sensing data.

As noted above, for most countries studied by Greenpeace, the opposite is true: lower levels of emissions from fires are reported than those estimated by the GFED. In these cases, the remote sensing data are better resolved than the locally or regionally available information. True figures in these places, therefore, are likely to be higher than those estimated in the GFED. It follows that if data were being systematically collected, the true scale of the problem would be exposed.

Why aren't national governments effectively monitoring carbon emissions from fires? Two key challenges are set out below:

Developing countries have limited data collection and lack the resources to assess carbon emissions to meet IPCC reporting guidelines meaningfully. For example, many developing countries like the Democratic Republic of Congo appear to base fire emissions figures on rough or out-of-date estimates, like the UNEP data (such as the UNEP database of burned area in the year 2000 mentioned in the IPCC TFI guidelines)[88] rather than on systematically collecting current data.

Examples

Angola:
their Initial National Communication (2012) states that it follows UNFCCC guidelines but doesn't state which version, nor which tier of reporting was used.

DRC:
their Third National Communication (2015) is based on the 1996 version of the IPCC guidelines, and acknowledges a shortage of data for 2004-2009.

Mozambique:
their Initial National Communication (2006) is based on the 1996 version of the IPCC guidelines, and uses data for 1994.

Limited guidance exists on calculating burned area. To accurately calculate carbon emissions from fires requires accurate calculations of what areas of land have been burned.

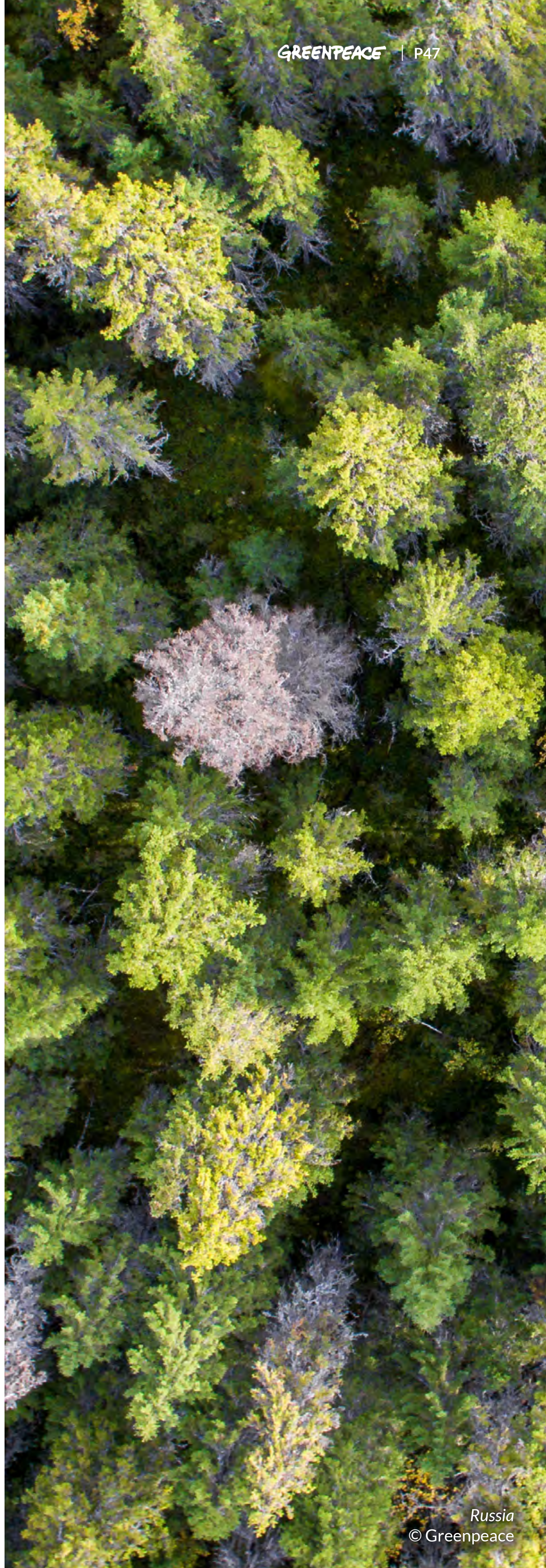
Unfortunately, the most recent IPCC guidance[89] does not provide sufficient information on how to do this effectively. It refers to a UN Environment Programme database on global burned area from 2000, while acknowledging that it will not provide a representative average due to inter-annual variation,[90] as well as any systematic climate driven fire regime changes.

Examples

Indonesia:
the only non-Annex 1 country examined by Greenpeace which explained the methodology it used to calculate how much land was burned[91]. There are clear problems with this cited methodology. For example, peat fires may burn underground and at lower surface temperatures than forest fires on mineral soil, meaning they are less likely to show up in satellite hotspot data with a high confidence threshold.

85 United States Environmental Protection Agency (2018) 'Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2016', USA, 2018
86 Government of Spain (2018) Comunicación al Secretariado de da Convención Marco de NNUU Sobre Cambio Climático. Inventario nacional de emisiones de gases de efecto invernadero 1990 - 2016', Spain 2018 [in Spanish]
87 Government of Portugal (2018) 'Portuguese national inventory report on greenhouse gases, 1990-2016. Submitted under the United Nations Framework Convention on Climate Change and the Kyoto Protocol', Amadora, May 8th 2018
88 IPCC Task Force on National Greenhouse Gas Inventories (2006) Volume 4 Chapter 4 p4.17

89 The main emissions reporting guidelines appear in the resource Guidelines on National Greenhouse Gas Inventories published in 2006, with supplements from 2013. This resource was produced by the Intergovernmental Panel on Climate Change Task Force on Greenhouse Gas Inventories (IPCC TFI). Existing guidelines can be found in Volume 4 "Agriculture, Forestry and Other Land Use" of Guidelines on National Greenhouse Gas Inventories. In addition, guidelines relating to emissions from burning organic soils like peat can be found in the separate Wetlands guidelines from 2013.
90 IPCC Task Force on National Greenhouse Gas Inventories (2006) Volume 4 Chapter 4 p4.17
91 Government of Indonesia (2015) 'First Biennial Update Report (BUR) under the United Nations Framework Convention on Climate Change, Republic of Indonesia, 2015. p2.62-2.63



Russia
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ACCURATELY ACCOUNTING FOR CLIMATE IMPACTS OF FIRES

Most countries fail to accurately monitor and calculate direct and indirect greenhouse gases emissions of fires. To compound this, almost all studied countries fail to accurately account for and report the results of any monitoring they actually do. Admittedly, there are both technical and political challenges involved in this. For example, a national government may consider it to be in their interest to obscure or inaccurately report emissions from fires.

Improved IPCC guidance on how emissions from fires should be reported could greatly improve transparency and accuracy and allow for meaningful comparisons of the data. Three shortcomings with the current guidance include:

Only emissions from 'managed lands' need to be reported

IPCC guidance reporting standards for land use and forestry, only cover emissions from "managed lands".[92] This is problematic because:

- The definition of "managed lands" is left open to interpretation, so can vary from country to country. This builds in inconsistencies in reporting across countries.
- Unmanaged lands are assumed to have constant carbon stock and so carbon emissions from these lands do not need to be reported unless there is a change in land classification.[93] This assumption is ever more questionable because of changing fire regimes, shorter fire return intervals and other effects of human-caused climate change.

Example

Russia considers 77% of its total forest land to be managed, so emissions from fires in nearly a quarter of Russia's vast forests go unreported.[94] The "unmanaged" lands have large proportions of burned area, so discounting emissions from fires in these areas has a distorting effect on those data that are reported.

92 IPCC Task Force on National Greenhouse Gas Inventories (2006) Volume 4 Chapter 4 p4.7

93 'Carbon stocks on unmanaged lands can be assumed to remain constant (thus, carbon stock changes would be zero) until the year in which land is classified as a managed use.' IPCC Task Force on National Greenhouse Gas Inventories (2006) Volume 4 Chapter 3 p3.9

94 Russian Federation (2018) "National inventory report anthropogenic emissions from sources and removals by sinks of greenhouse gases not regulated by the Montreal Protocol for the years 1990 - 2016", Moscow, 2018 [in Russian]

Fire is not itemised as a separate category of emissions

IPCC guidelines have carbon emissions categorised into the sectors of the economy in which they occurred, rather than by the mechanisms by which they occurred. There are advantages to this approach but it creates a serious problem when it comes to understanding emissions from fires.

Fire emissions are not considered as a separate category, for example, grassland fires are dealt with under the category 'grassland' and forest fires under category 'forest'. This means there is no itemised entry corresponding to 'fires' or 'wildfire' in national GHG inventories. Peat fires, where included, may be listed under 'other'.

This makes it difficult to know whether emissions from fires are included in any given country's report and if any included emissions represent the full picture.

Example

Brazil:

their Biennial Update Report 2 (2017) is based on the 1996 version of the IPCC guidelines and the 2003 land use emissions guidelines.[95] It does not itemise fire emissions from the agriculture or Land Use, Land-Use Change and Forestry (LULUCF)[96] sectors.

Black carbon emissions are not currently reported under UNFCCC

Unfortunately IPCC guidelines do not provide guidance on how to monitor or report on black carbon from fires. This can be considered a very serious omission given the significance of the impact black carbon has on the climate.[97]

No countries studied reported black carbon emissions.

CONCLUSION ON EMISSIONS REPORTING

There is little obvious incentive to take action while poor monitoring and accounting of emissions from fires renders a significant portion of them invisible. Few countries mention any intended action to address the issue of fires within their Intended Nationally Determined Contributions (INDCs). Where examples are found, they appear to lack any great level of ambition. The Democratic Republic of Congo's 2015 INDC attributed 0.2% of potential emissions reductions to improving efforts to fight brush fires.[98] Chile's 2015 INDC discusses "preventative forestry against wildfires and names fire as one of the main causes of forest degradation".[99] However no specific emissions target is attached to these narrative observations.

The lack of ambition to reduce carbon emissions from fires represents a missed opportunity. Accordingly, it is important that IPCC provides improved guidance to assist nation states in effectively monitoring and accurately accounting for the climate related emissions from fires.

95 Government of Brazil (2017) 'Second Biennial Update Report to the United Nations Framework Convention on Climate Change', Brazil, 2017

96 For more information on LULUCF see e.g. UNFCCC (undated) Land Use, Land-Use Change and Forestry (LULUCF) https://unfccc.int/topics/land-use/workstreams/land-use--land-use-change-and-forestry-lulucf

97 See Chapter 1

98 Government of Democratic Republic of Congo (2015) 'Soumission de la Contribution Nationale Prévue Déterminée Au Niveau National Au Titre De La Convention Des Nations Unies Sur Les Changements Climatiques', République Démocratique Du Congo, 2015 [in French]

99 Government of Chile (2015), 'Intended Nationally Determined Contribution of Chile towards the Climate Agreement Of Paris 2015', Santiago, Chile. September 2015.

CHAPTER 07

SOLUTIONS AND OPPORTUNITIES FOR CHANGE

Indonesia
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WE CANNOT GET ON A PATHWAY TO LIMIT WARMING TO 1.5˚C WITHOUT FACING THE CONTRIBUTIONS FIRES ARE MAKING TO CLIMATE CHANGE: DIRECT CO_2 EMISSIONS, BLACK CARBON AND DESTRUCTION OF CARBON SINKS. FOR THE COUNTRIES DISCUSSED IN THIS REPORT, GREENPEACE RECOMMENDS MEASURES THAT SHOULD BE CONSIDERED URGENTLY, BASED ON EXTENSIVE RESEARCH AND LITERATURE REVIEW, CONSULTATION WITH EXPERTS AND PRACTICAL EXPERIENCE.

1 **Decision-makers at a global level must address the accelerating effects of fires as a driver of climate change.**
International bodies, like the UNFCCC, should look critically at where climate regulations and agreements currently fail to take account of the climate impacts of fires and identify how and when they can be revised. The goal should be to ensure that the climate impacts of wildland fires are considered and acted upon quickly. Similarly, the IPCC must improve the guidance it provides on how emissions from fires should be reported.

2 **Protect and restore carbon-rich landscapes that are threatened by fires.**
To get on a viable pathway to limit warming to 1.5°C, we must use natural climate solutions that could provide more than a third of the climate mitigation needed by 2030. Where appropriate we must pursue forest protection and restoration, reforestation as well as the re-wetting of peatlands, in order to decrease the risk of fires starting and spreading while also increasing the potential of forests to act as carbon sinks.

3 **Ban the use of fire by industrial agribusiness.**
Effective bans on the use of fire as a tool of clearing land for industrial agribusiness must be put in place. This is urgent, especially in countries rich in forests and peatlands where fire is frequently linked to this sector. Steps must be taken to ensure bans are effectively enforced.

4 Use climate-friendly methods to manage fire risks

Priority should be given to those fire prevention measures which not only limit the destructive effects of fires, but that also enhance the carbon sink ability of ecosystems. These measures could include conservation and restoration of fire-resistant ecosystems and creating barriers consisting of local fire-resilient species.

Measures that decrease the amount of carbon stored in an ecosystem or damage its ability to act as carbon sink, should be minimized where possible and used under limited circumstances; this includes prescribed burnings and forest thinning.

5 Prioritize investments in fire prevention

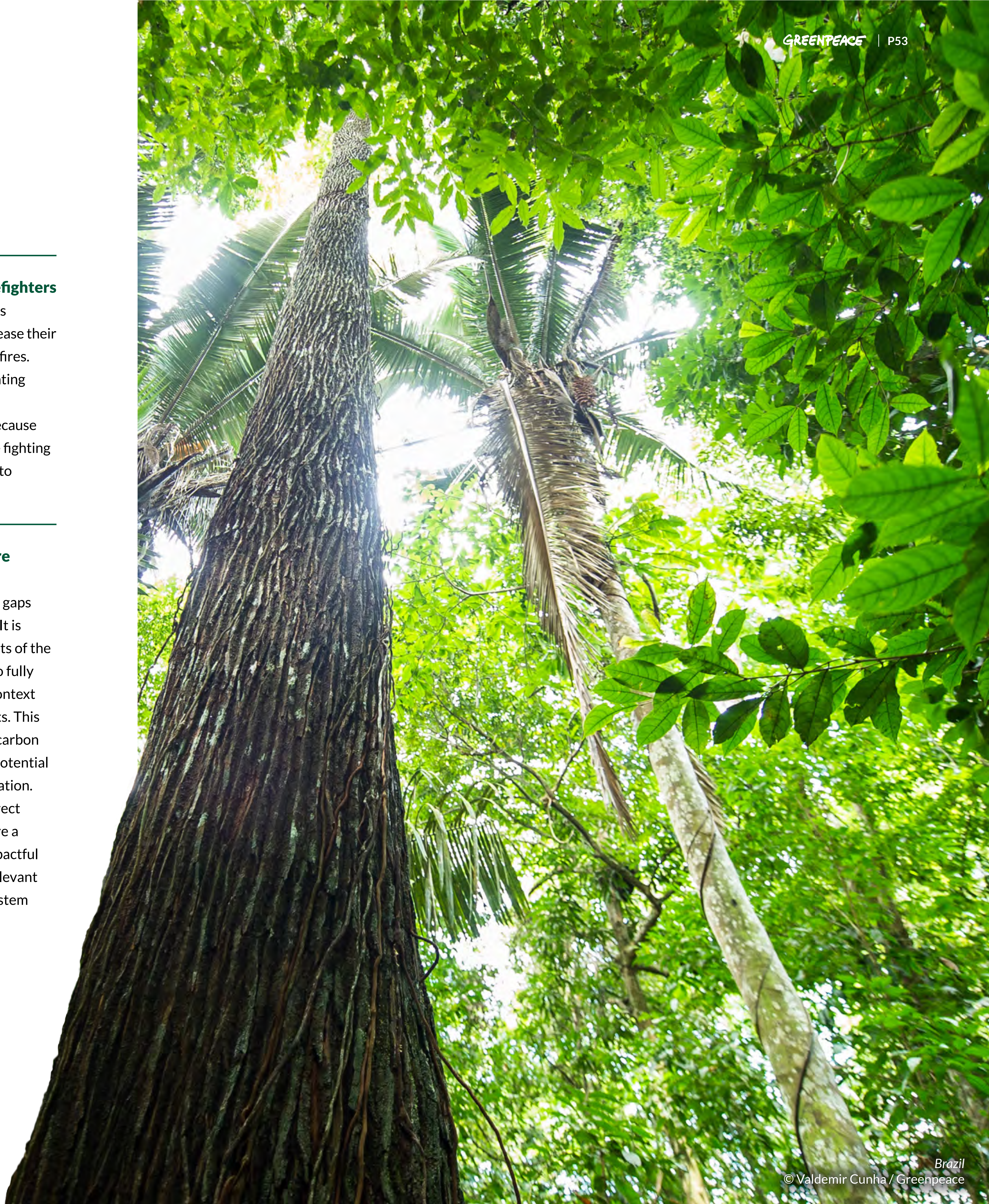
The majority of fires could be avoided because they are started and allowed to spread by human activities. Investments in prevention are key and should include measures like raising awareness of how fires can start by accident, and the consequences of wildland fires.

6 Provide support to volunteer firefighters

Provide support to affected Indigenous Peoples and local communities to increase their capacity to prevent and fight wildland fires. Support international wildland firefighting solidarity and empower international firefighting cooperation. It is crucial because the ability to increase professional fire fighting capacity is about to reach its limit due to financial and efficiency reasons.

7 Invest in research to provide more information where it is needed

Research is urgently needed to fill the gaps in our current knowledge about fires. It is critical that we further quantify aspects of the climate impacts of fires to enable us to fully understand their significance in the context of global carbon emissions and impacts. This includes the precise impacts of black carbon and the potential loss of carbon sink potential from deforestation and forest degradation. This enhanced knowledge is key to direct mitigation efforts to those areas where a reduction of fires is possible, most impactful and also desirable - according to all relevant criteria such as climate change, ecosystem processes and people.



Brazil
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Greenpeace International
Ottho Heldringstraat 5
1066 AZ Amsterdam
The Netherlands

enquiries@greenpeace.org
www.greenpeace.org

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