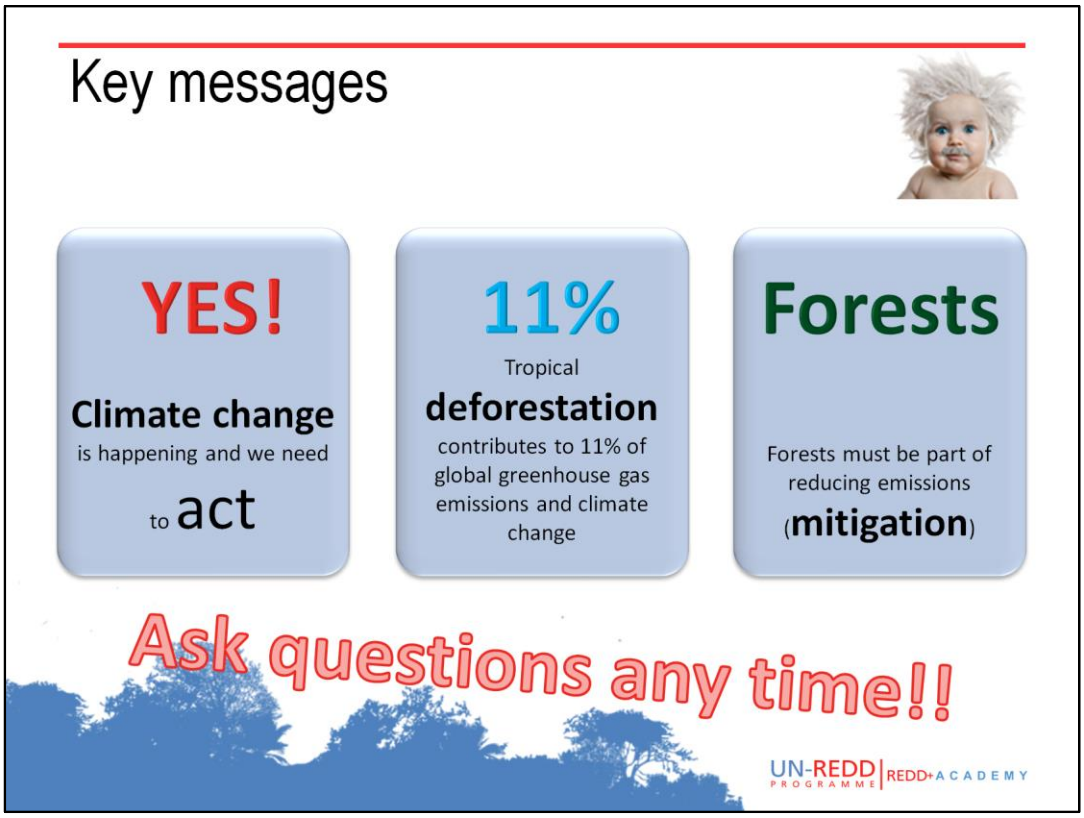
UN-REDD PROGRAMME

Forests, Carbon Sequestration & Climate Change

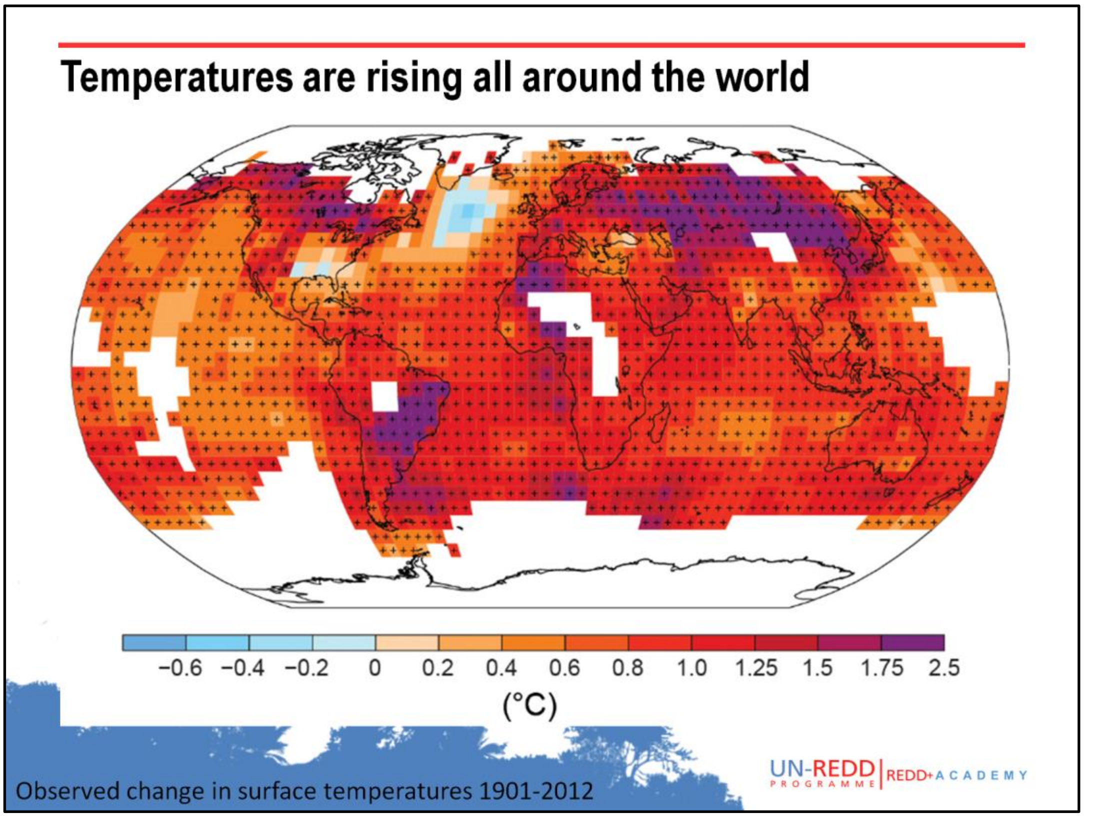
REDD+ Academy Session 2

Day 1 (afternoon)

UN-REDD PROGRAMME | REDD+ ACADEMY

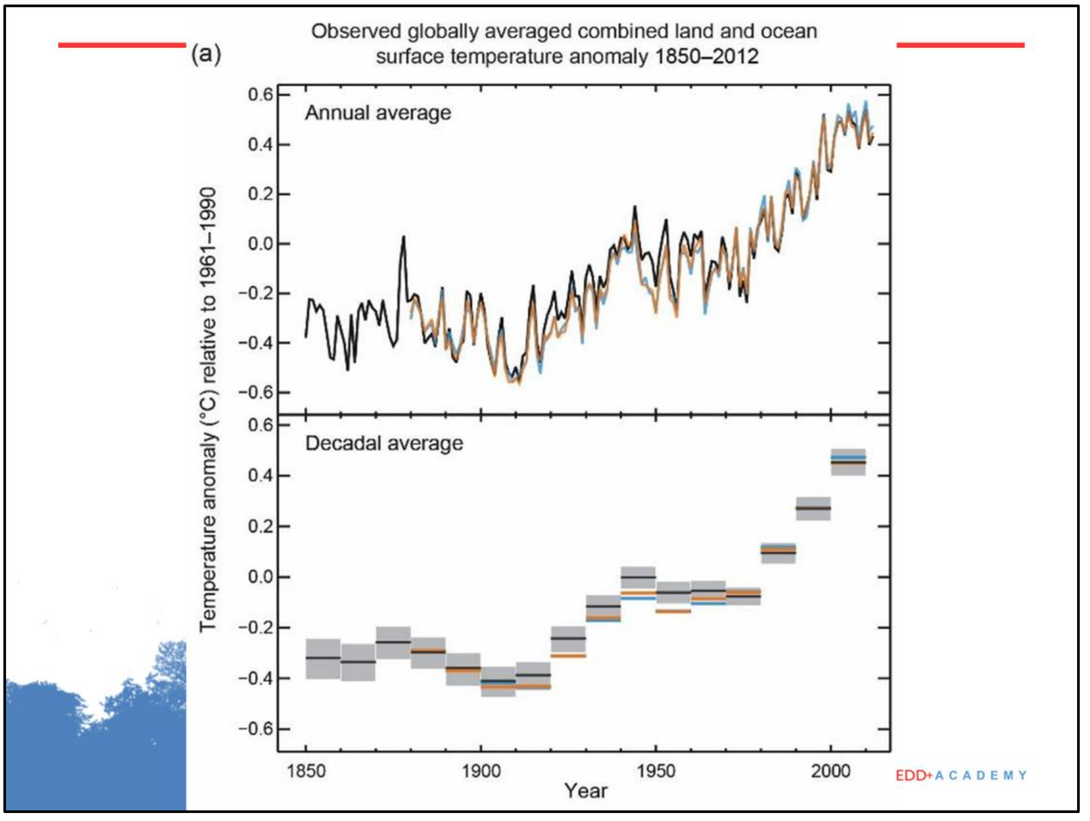


This presentation has about 40 slides. You should remember at least 3 key messages from this presentation.



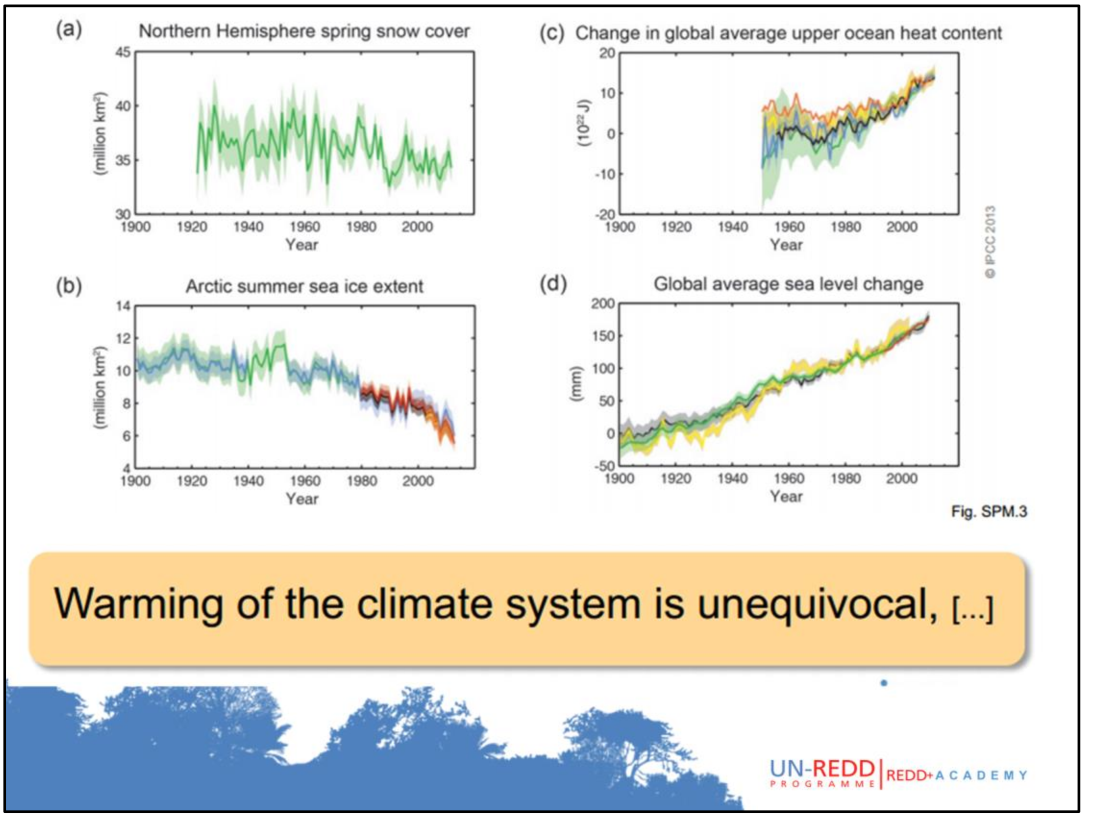
Narrative: Temperatures are rising all around the world. A few places only have seen temperature decrease over the last 110 years, and these are in the Atlantic South of Greenland (maybe a place here melting icewater accumulates) and an area in SE USA. All other places see temperature increases of at least 0.4°C, and many continental areas of 1.75°C. The global average temperature increase over that period is 0.85°C over the period 1880 to 2012.

Source:
http://www.climatechange2013.org/report/reports-graphic/report-graphics/
Figure SPM.1 | (a) (b) Map of the observed surface temperature change from 1901 to 2012 derived from temperature trends determined by linear regression from one dataset (orange line in panel a). Trends have been calculated where data availability permits a robust estimate (i.e., only for grid boxes with greater than 70% complete records and more than 20% data availability in the first and last 10% of the time period). Other areas are white. Grid boxes where the trend is significant at the 10% level are indicated by a + sign. For a listing of the datasets and further technical details see the Technical Summary Supplementary Material. {Figures 2.19–2.21; Figure TS.2}



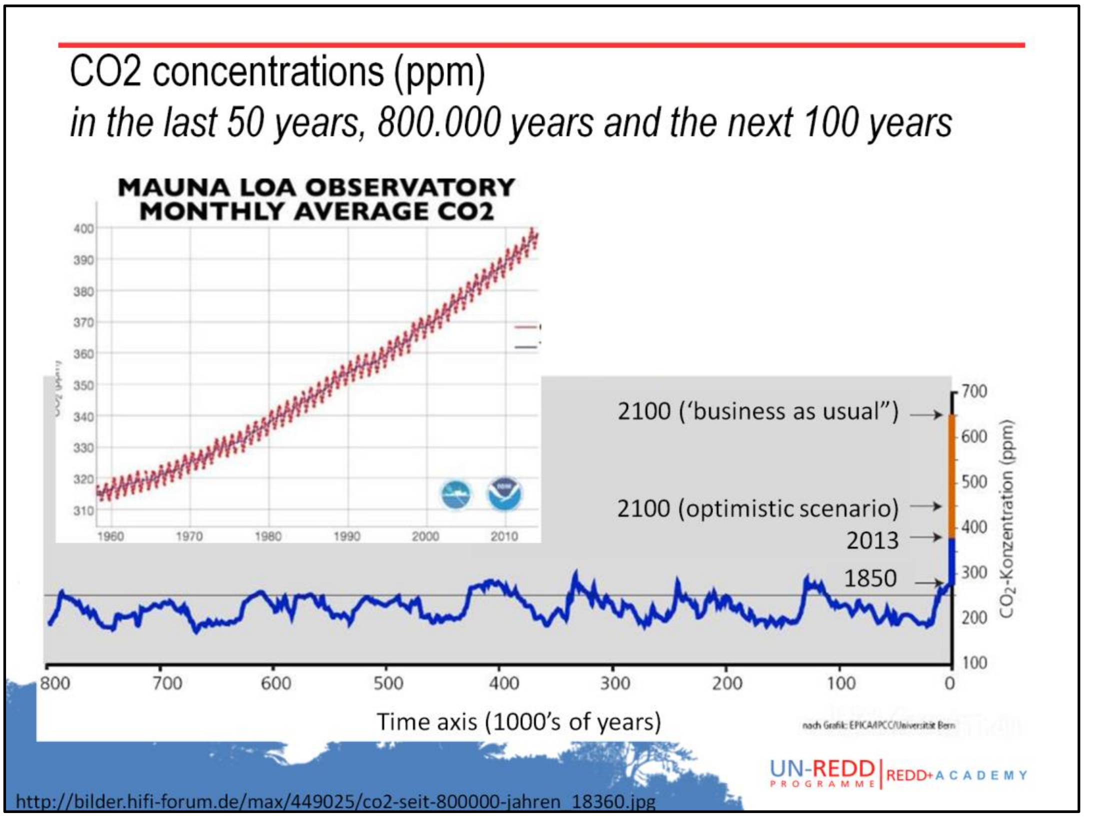
Narrative:
The global average temperature data for a longer period (1850-2010 = 160 years) as annual data (above) and decadal averages below. The last 3 decades have been the hottest in this period; Each of them successively warmer at the Earth's surface than any preceding decade since 1850.
Explain different colors

Source:
http://www.climatechange2013.org/report/reports-graphic/report-graphics/
Figure SPM.1 | (a) Observed global mean combined land and ocean surface temperature anomalies, from 1850 to 2012 from three data sets. Top panel: annual mean values. Bottom panel: decadal mean values including the estimate of uncertainty for one dataset (black). Anomalies are relative to the mean of 1961−1990.



Narrative: Not only the temperature record but also a few other data sets confirm the trend (independently). Northern hemisphere snow cover and Arctic summer ice are falling particularly after 1960. The melting snow and ice ends up in the oceans, and this leads to s millimetric but steady ocean level increase (15 cm already over the observed period). In spite of the melting ice water, global upper water layers are heating up since 1950, when the measurements started. The warming of the climate system is thus unequivocal, and the largest contribution comes from the increase in the atmospheric concentration of CO2 since 1750, which is man-made.

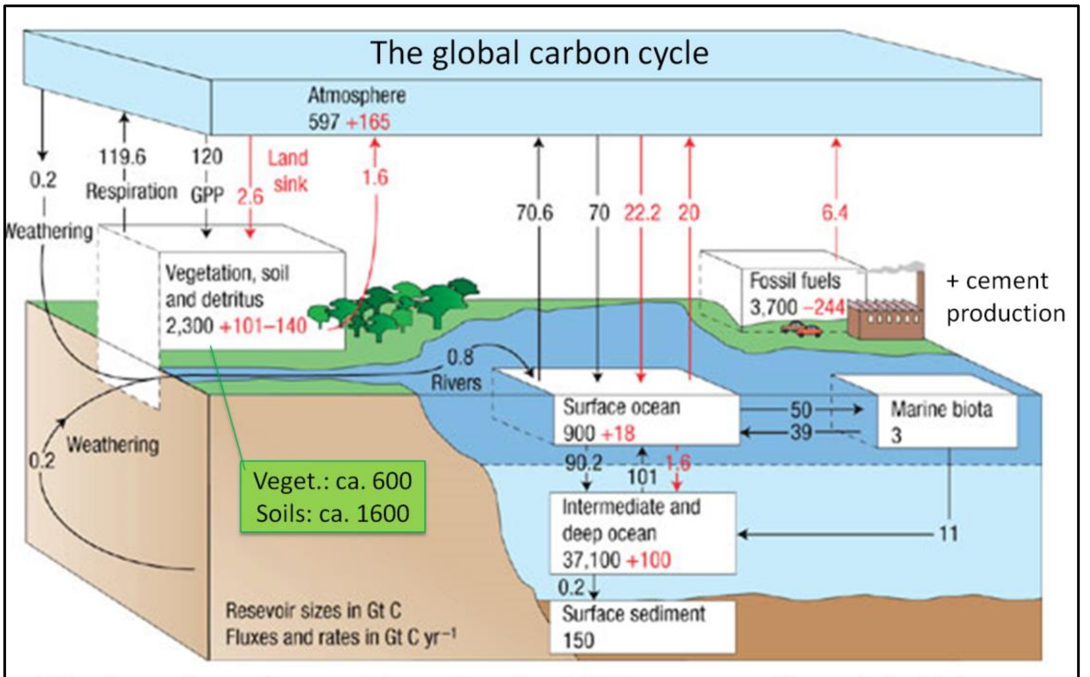
Source:
http://www.climatechange2013.org/report/reports-graphic/report-graphics/
Figure SPM.3 | Multiple observed indicators of a changing global climate: (a) Extent of Northern Hemisphere March-April (spring) average snow cover; (b) Extent of Arctic July-August-September (summer) average sea ice; © change in global mean upper ocean (0–700 m) heat content aligned to 2006−2010,
And relative to the mean of all datasets for 1970; (d) global mean sea level relative to the 1900–1905 mean of the longest running dataset, and with all datasets aligned to have the same value in 1993, the first year of satellite altimetry data. All time-series (coloured lines indicating different data sets) show annual values, and where assessed, uncertainties are indicated by coloured shading.



The global atmospheric CO2 concentrations have been steadily increasing over the last 60 years, as observed in the famous Keeling curve from Hawaii, Mauna Loa observatory. While thousands of years below 300 ppm (the pre-industrial value was about 280 ppm), we have reached for the first time 400 ppm in April and May 2014. As the global CO2 concentrations oscillate annually (caused by seasonal variations in carbon dioxide uptake by land plants), the CO2 curve fell back to under 400 in September/October 2014. But they can be expected to rise to 650 ppm until 2100 if nothing is done (business as usual) and to at least 450, in the best of the scenarios.

Mauna Loa Graph: http://d35brb9zkkbdsd.cloudfront.net/wp-content/uploads/2014/04/402-ppm-638x501.png
(from http://thinkprogress.org/climate/2014/04/09/3424704/carbon-dioxide-highest-level/)

800.000 year graph: http://bilder.hifi-forum.de/max/449025/co2-seit-800000-jahren_18360.jpg, re-touched for English legends



This shows the main annual fluxes in units of Gt C per year, with pre-industrial 'natural' fluxes in black and 'anthropogenic' fluxes in red. Gross fluxes generally have uncertainties greater than 20%. Atmospheric carbon content and all cumulative fluxes since 1750 are as of the end of 1994. Copyright (2007) IPCC.

This graph shows the global carbon cycle with its stocks and flows (all units in GTC = billion tons of carbon (per year in case of fluxes)). Stocks and flows are shown in two ways: how they were before large human intervention (roughly before 1850 – black figures and arrows), and how they were changed with human intervention over the last 160 years (red figures and arrows). The large stocks are in the atmosphere (597 + 165), vegetation and soils (2300), and the various layers of the oceans (surface waters and deep waters). While the 'historical' fluxes were in equilibrium (respiration vs. GPP – Global Primary Production: 119.6 vs. 120; ocean outflux vs. influx: 70.6 vs. 70; etc.), some of the 'modern' fluxes are creating a disequilibrium (emissions from fossil fuels and industrial processes (mainly cement production): +6.4; emissions from land use change: +1.6). These bigger fluxes from 'sources' (stocks producing carbon (C) output such as vegetation, fossil fuels and ocean) to the atmosphere are compensated partly by bigger fluxes from the atmosphere into 'sinks' (the same 'stocks' receiving C input): particularly the ocean sink and the land sink.

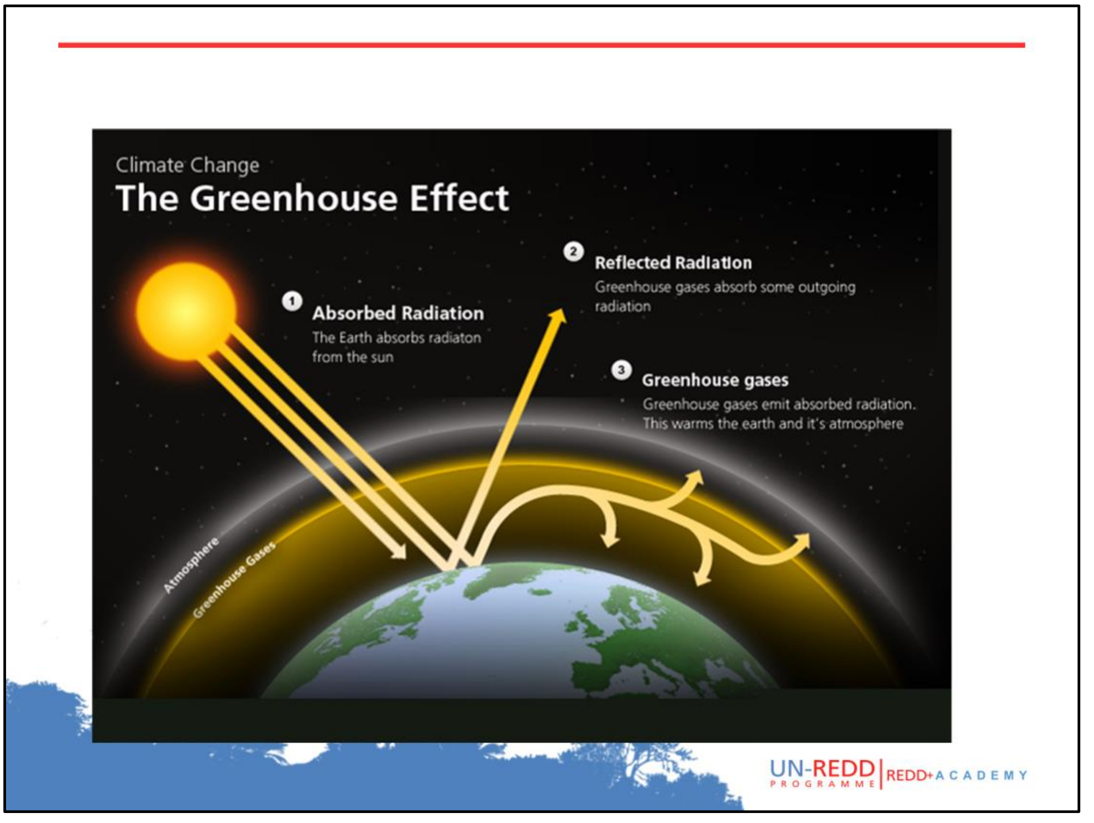
In summary, additional inflows to the atmosphere from fossil fuel & cement plus land use change have created an increase in the carbon dioxide concentration in the atmosphere from 597 to 762 (adding 165).

http://www.nature.com/ngeo/journal/v1/n7/fig_tab/ngeo230_F1.html
http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch7s7-3.html

(same figure used in both sources)

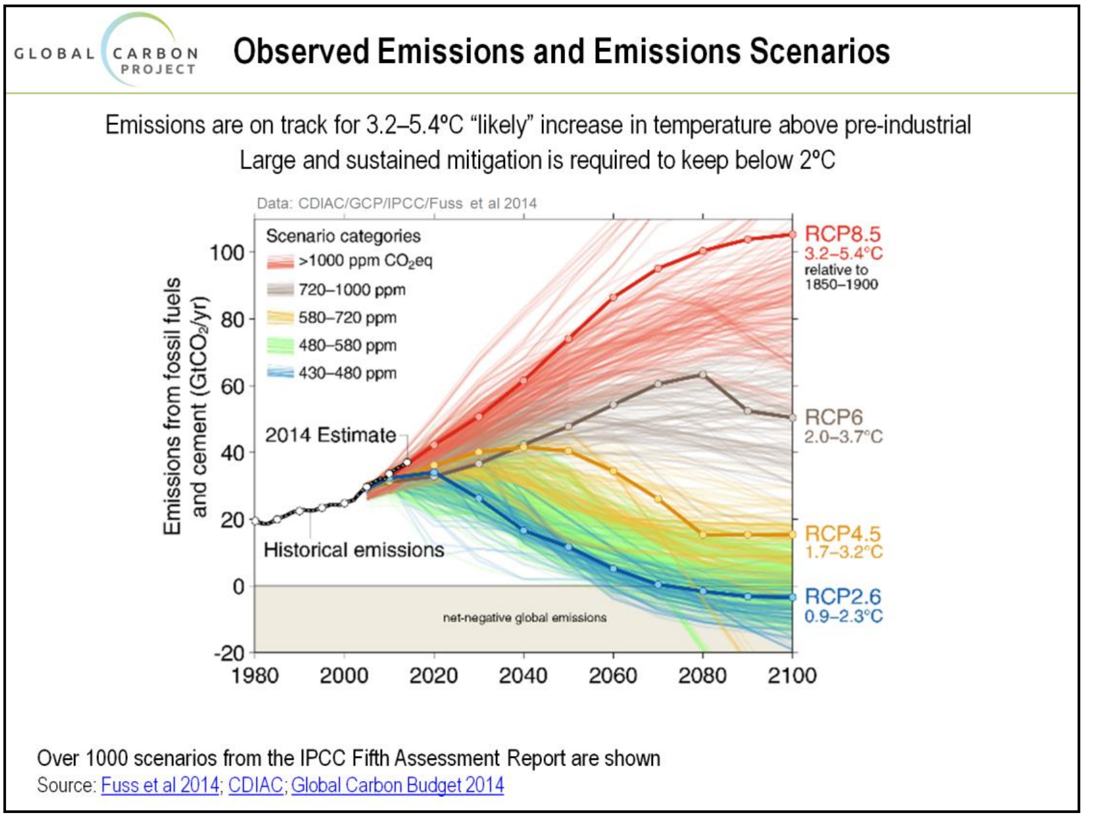
The net terrestrial loss is inferred from cumulative fossil fuel emissions minus atmospheric increase minus ocean storage.

(slightly modified to add cement, and disaggregate soil and vegetation)



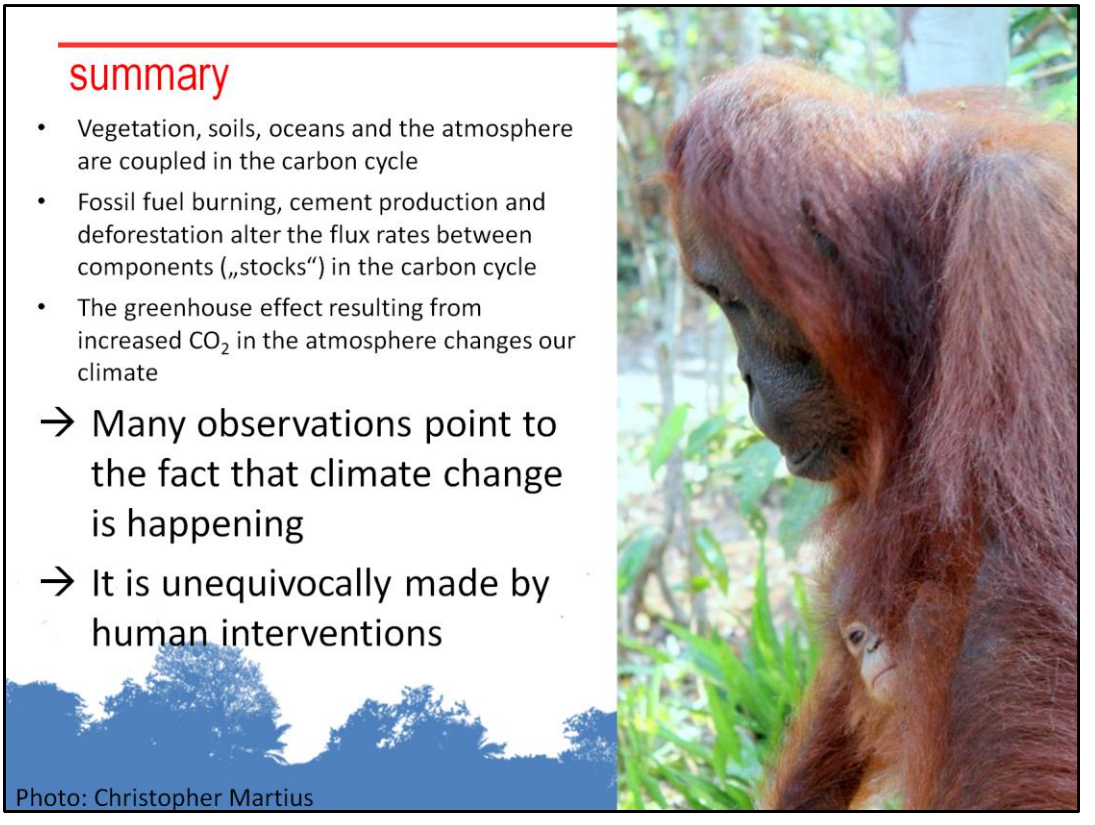
This has created the now famous greenhouse effect. Carbon dioxide in the atmosphere (and a few other gases) keep the solar rays that hit the earth surface from reflecting back into the outer space, thus heating the planet. In principle this is a good thing, as otherwise the planet would be too cold for us to survive. But the increase in greenhouse gases has led to an increase in this "warming potential" of the atmosphere, and this is related to the increase of the global average temperature we are observing.

Picture source:
http://www.edfenergy.com/energyfuture/energy-gap-climate-change/greenhouse-effect



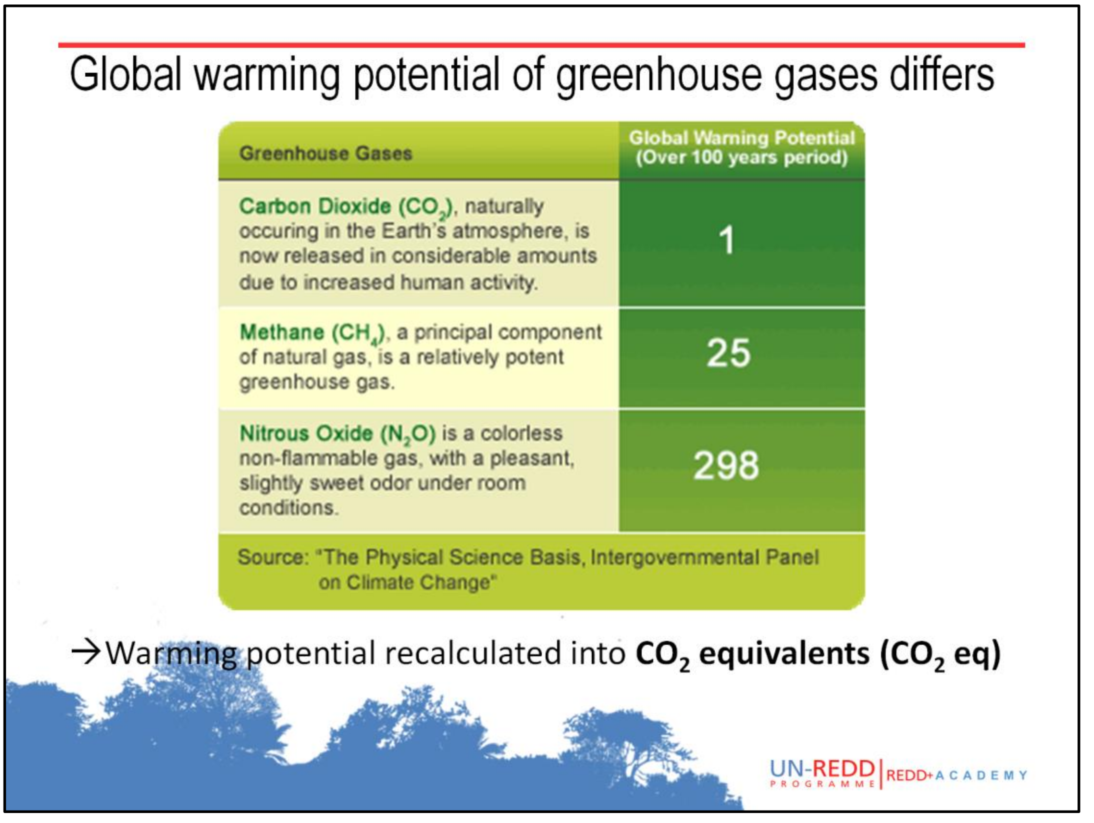
The graph shows emissions from fossil fuel and cement production only. The emissions under 'business as usual' are on track for a 3.2–5.4°C "likely" increase in temperature above pre-industrial levels (red scenario called RCP8.5; roughly using the year 1850 as a reference).
If we want to keep global temperature increase up to the year 2100 to 2°C (referring to the 1850 baseline temperature), then we need to make large and sustained mitigation efforts (the other scenarios). Note that the outcomes are subject to wide variation, so that even with the best scenario (blue lines) the chances are to end up with a 0.9-2.3°C degree increase, i.e. slightly above target. Note further that the 2°C degree goal is just a political convention. There is no scientific knowledge suggesting that this is a 'safe' level of temperature increase. We just know that we hardly can stay below that even if massive mitigation efforts would kick in immediately, because the climate system is slow to react (inert).
Note how the scenarios are linked to ranges of carbon dioxide levels in the atmosphere (inset legend on top left side).

Slide from
http://www.globalcarbonproject.org/carbonbudget/14/presentation.htm
PowerPoint (13.5mb)



Vegetation, soils, oceans and the atmosphere are coupled in the carbon cycle
Fossil fuel burning, cement production and deforestation alter the flux rates between components („stocks“) in the carbon cycle
The greenhouse effect resulting from increased CO_2 in the atmosphere changes our climate
→ Many observations point to the fact that climate change is happening
→ It is unequivocally made by human interventions

Foto: Christopher Martius
(The picture of the Orang Utan female with kid is taken from Tanjung Putin in South Kalimantan, more precisely Camp Leakey, a 40-year old effort in Orang Utan research and preservation). Orang Utans are strongly threatened by deforestation in Kalimantan.)

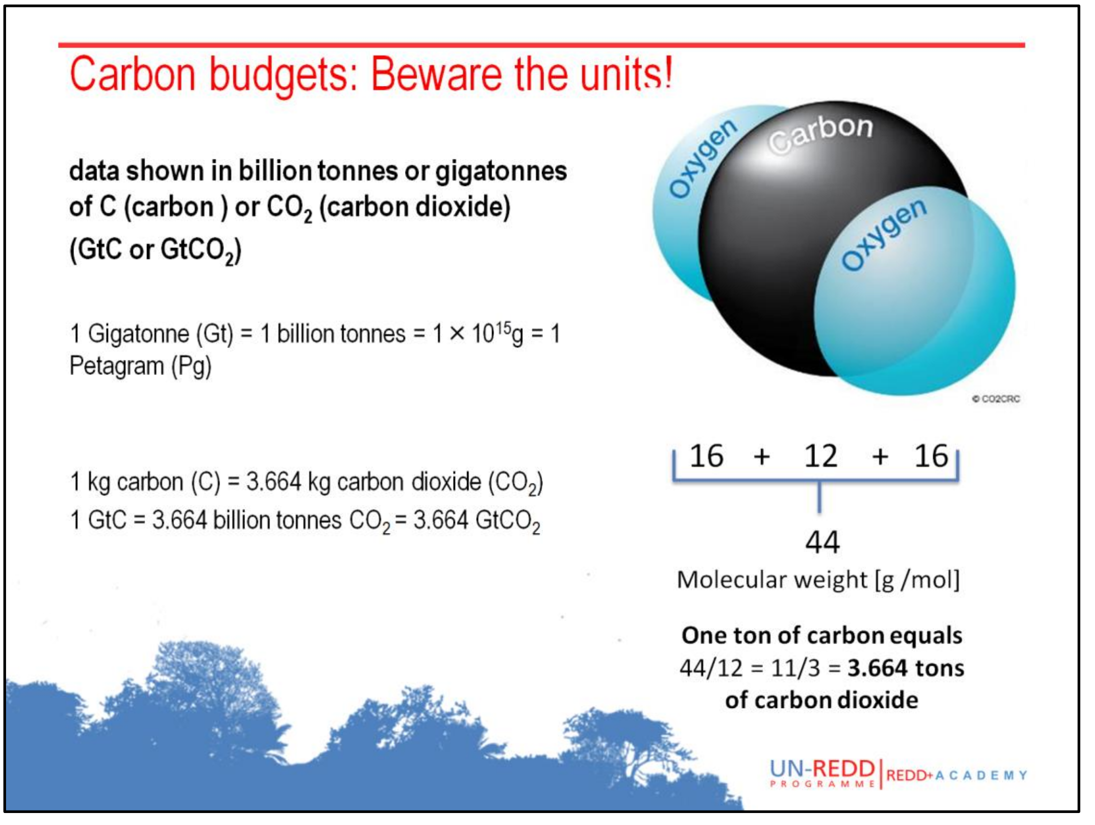


Greenhouse Gases	Global Warming Potential (Over 100 years period)
Carbon Dioxide (CO_2), naturally occuring in the Earth's atmosphere, is now released in considerable amounts due to increased human activity.	1
Methane (CH_4), a principal component of natural gas, is a relatively potent greenhouse gas.	25
Nitrous Oxide (N_2O) is a colorless non-flammable gas, with a pleasant, slightly sweet odor under room conditions.	298
Source: "The Physical Science Basis, Intergovernmental Panel on Climate Change"	

[Technical aside I] Two aspects are important to know when dealing with carbon budgets. (I) We are talking here about carbon dioxide because that is the most important greenhouse gas with regards to emissions of forests. But there are other gases that occur in smaller quantities but have a much higher atmospheric warming potential than carbon dioxide. Some of them are the fluorinated gases responsible for the 'ozone hole' and quite successfully taken care of by the Montreal protocol. They are not mentioned here. Here we list also methane and nitrous oxide. Their warming potential is 25 times and 298 times, respectively, that of CO2. That means one molecule of methane warms the atmosphere as much as 28 molecules of CO2. One molecule of nitrous oxide warms the atmosphere as much as 298 molecules of CO2. These gases are therefore much more potential than CO2.

Dealing with these many gases, their varying concentrations and different warming potential is cumbersome. That is why the warming potential of all these greenhouse gases together is often recalculated into CO_2 equivalents (CO_2 eq), as it is easier to deal with just one unit. But it is important to know that there is actually a mixture of gases responsible for the greenhouse effect.

https://www.clpgroup.com/poweru/eng/climate_change/cause_climateChange2.aspx



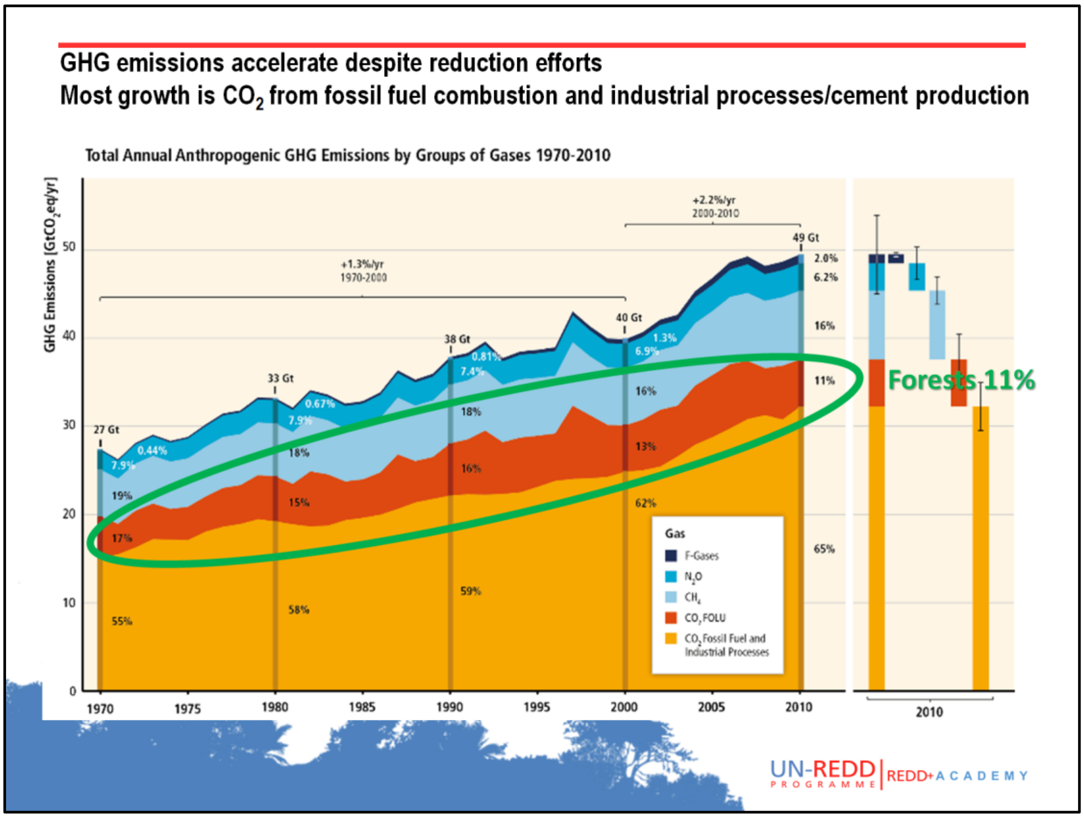
[Technical aside II] The second aspect has to deal with how carbon data are presented. First, the units typically used are billion tonnes or gigatonnes or sometimes Petagram. One Gigatonne (Gt) corresponds to 1 billion tonnes. This is the same as 1×10^{15}g and the same as 1 Petagram (Pg).

Second, carbon is rarely occurring alone. In biomass, it is attached to plant and animal tissues, hence to organic molecules of all sorts. Typically, a mass unit of biomass has on average 50% of carbon (say, 1 kg of biomass has 500 g of carbon). But in the atmosphere, carbon occurs mostly as carbon dioxide, CO2. In this molecule, one atom of carbon is associated to two atoms of oxygen. Due to the molecular weights of carbon (12) and oxygen (16), the total weight of a molecule of CO2 is 44 [the unit is g/mol; but let us not worry about this here]. The ratio of the molecular weights of carbon to carbon dioxide is 12:44, or 3.664. You will find carbon budgets ‘normalized’ to one of these two units, either C or CO2. The only difference is that in the second case, all fluxes and stocks will be 3.664 times higher than in the first (because also real (in the atmosphere) or hypothetical (in the tissues) O2 is calculated). This can be quite confusing, so it is good practice to pay attention to the units displayed in carbon budget data, tables and graphs.

1 kg carbon (C) = 3.664 kg carbon dioxide (CO_2)
1 GtC = 3.664 billion tonnes CO_2 = 3.664 $GtCO_2$

[From:

http://www.fcmcglobal.org/documents/AGRC_Competencies_Framework.pdf, at 21]



Here is a graph of the annual GHG emissions over the last 40 years, using the unit of CO2 eq. It shows emissions from fossil fuels and cement production (yellow; bottom), forests*) (red, middle) and emissions from other greenhouse gases (F-gases, nitrous oxide and methane; blue hues; top part).

You can see several things in this graph:

1) In spite of all efforts, the rate global greenhouse gas emissions has been rising from an average increase of 1.3%/year over the first 30 years to an average increase of 2.2%/year over the last 10 years.

2) this increase is mostly due to fossil fuels and cement; while emissions from forests oscillate some, they mostly remain stable in absolute terms

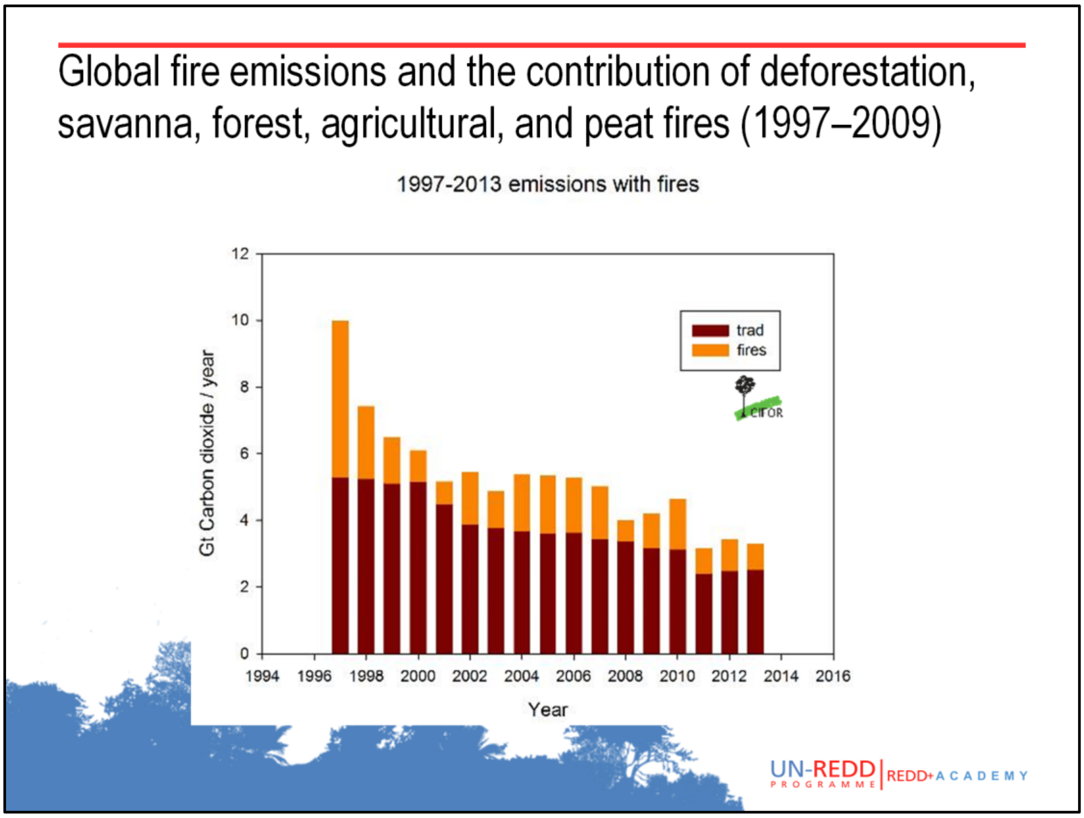
3) as the emissions from fossil fuel burning rise and the emissions from forests remain stable, the relative emission rate from forests has been decreasing from 17% in 1970 to 11% in 2010 (the last year that data are available in this graph). This does not mean that emissions from forests decreased (they remained stable), but that the emissions from other sources increased.

4) there is a notable peak of emissions from forests in 1997. Let us dissect this peak in the next graph.

http://mitigation2014.org/report/figures/summary-for-policymakers-figures

Figure SPM.1 | Total annual anthropogenic GHG emissions (GtCO2eq / yr) by groups of gases 1970 – 2010: CO2 from fossil fuel combustion and industrial processes; CO2 from Forestry and Other Land Use (FOLU); methane (CH4);

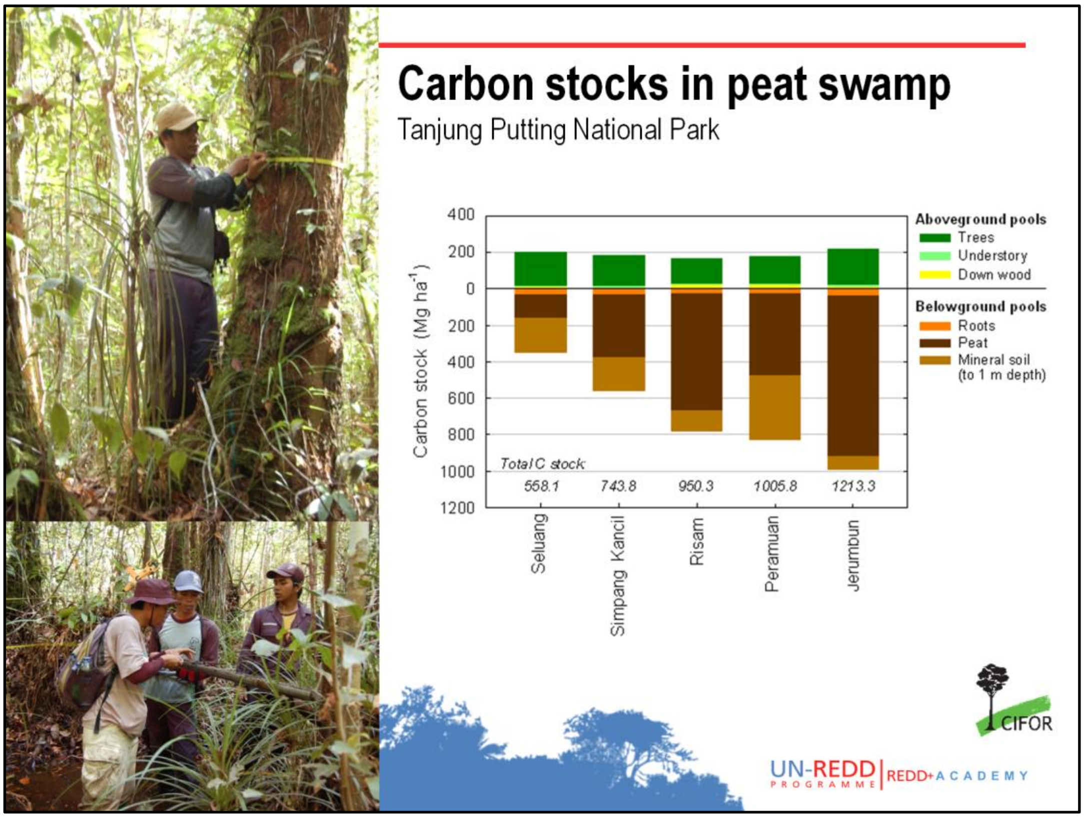
nitrous oxide (N_2O); fluorinated gases8 covered under the Kyoto Protocol (F-gases). At the right side of the figure GHG emissions in 2010 are shown again broken down into these components with the associated uncertainties (90 % confidence interval) indicated by the error bars. Total anthropogenic GHG emissions uncertainties are derived from the individual gas estimates as described in Chapter 5 [5.2.3.6]. Global CO_2 emissions from fossil fuel combustion are known within 8 % uncertainty (90 % confidence interval). CO_2 emissions from FOLU have very large uncertainties attached in the order of ± 50 %. Uncertainty for global emissions of CH_4, N_2O and the F-gases has been estimated as 20 %, 60 % and 20 %, respectively. 2010 was the most recent year for which emission statistics on all gases as well as assessment of uncertainties were essentially complete at the time of data cut-off for this report. Emissions are converted into CO_2-equivalents based on GWP100 from the IPCC Second Assessment Report. The emission data from FOLU represents land-based CO_2 emissions from forest fi res, peat fi res and peat decay that approximate to net CO_2 flux from the FOLU as described in chapter 11 of this report. Average annual growth rate over different periods is highlighted with the brackets.



Global fire emissions and the contribution of deforestation, savanna, forest, agricultural, and peat fires (1997–2009)
This graph shows disaggregated data for forest emissions from 1997-2013 (the same as the red data in the previous slide, 1997-2010). The dark red bars show the emissions from rain forest deforestation, and the orange data the emissions from peatlands. It becomes clear that the high peak of emissions in 1997 was predominantly due to emissions from peatlands. This single year peak of emissions was high enough to drive the overall global emissions visibly up (Note: There should be a peak in 2013, which this data set does not show).

Based on Global Carbon Project data set (http://www.globalcarbonproject.org/carbonbudget/14/data.htm) which is the source of the data in the previous slide, too

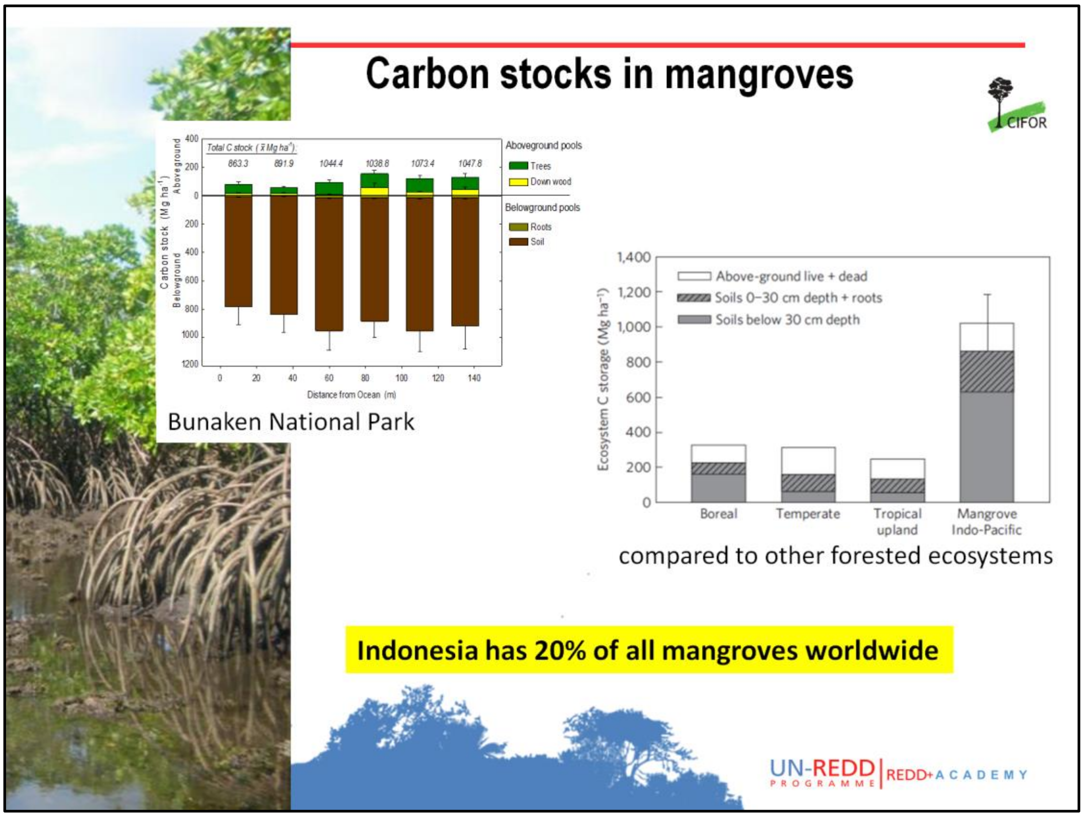
Here we use data in van der Werf, G. R., Randerson, J. T., Giglio, L., Collatz, G. J., Mu, M., Kasibhatla, P., Morton, D. C., DeFries, R. S., Jin, Y., and van Leeuwen, T. T.: Global fire emissions and the contribution of deforestation, savanna, forest, agricultural, and peat fires (1997–2009), Atmospheric Chemistry and Physics, 10, 11707-11735, 2010.



Why are peatlands so important? This graph shows the carbon stock data for several field sites of peatlands in South Kalimantan. While above ground carbon is about 200 tons (Mg = megagrams) of carbon per hectare, below ground carbon is between 300 and 1000 tons (roughly) per hectare. This is in roots, but mostly in peat soil and the mineral soil below it. Thus, 1-5 times as much carbon is stored in the soil of these sites than is stored in the biomass of trees above ground.

CIFOR's SWAMP Project
http://www1.cifor.org/swamp

Donato, D.C., Kauffman, J.B., Murdiyarso, D., Kurnianto, S., Stidham, M., Kanninen, M., 2011. Mangroves among the most carbon-rich forests in the tropics. Nature Geosci 4, 293–297. doi:10.1038/ngeo1123



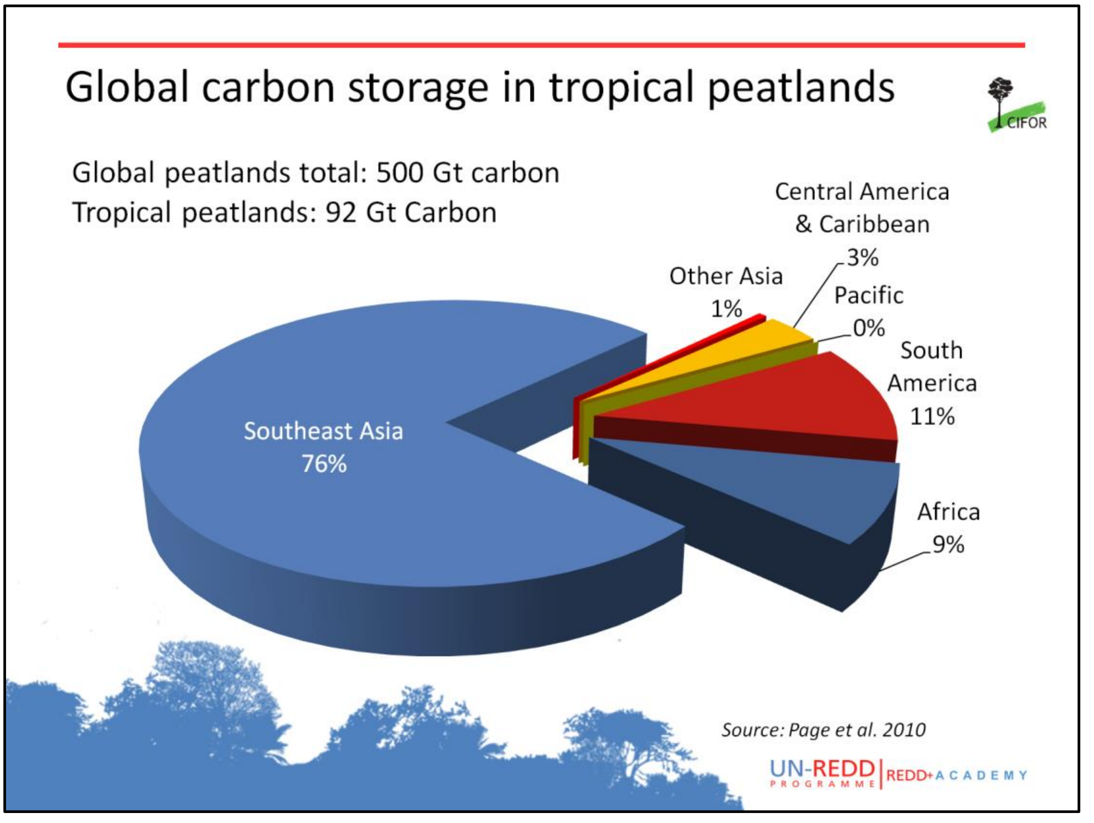
Similarly to the previous slide, we see here the above- and below ground carbon stocks in mangroves (left part). There is at least 5 times as much carbon in mangrove soil and roots as there is in aboveground biomass parts of the mangrove vegetation.

We also see (right part) that the carbon stored in mangrove biomass, particularly belowground, is ca. 3x higher than in other forested ecosystems in northern (boreal), temperate and tropical environments

Mangroves are globally distributed in the tropics, but Indonesia with its long coastline has 20% of all mangrove area worldwide.

CIFOR's SWAMP Project
http://www1.cifor.org/swamp

Donato, D.C., Kauffman, J.B., Murdiyarso, D., Kurnianto, S., Stidham, M., Kanninen, M., 2011. Mangroves among the most carbon-rich forests in the tropics. Nature Geosci 4, 293–297. doi:10.1038/ngeo1123

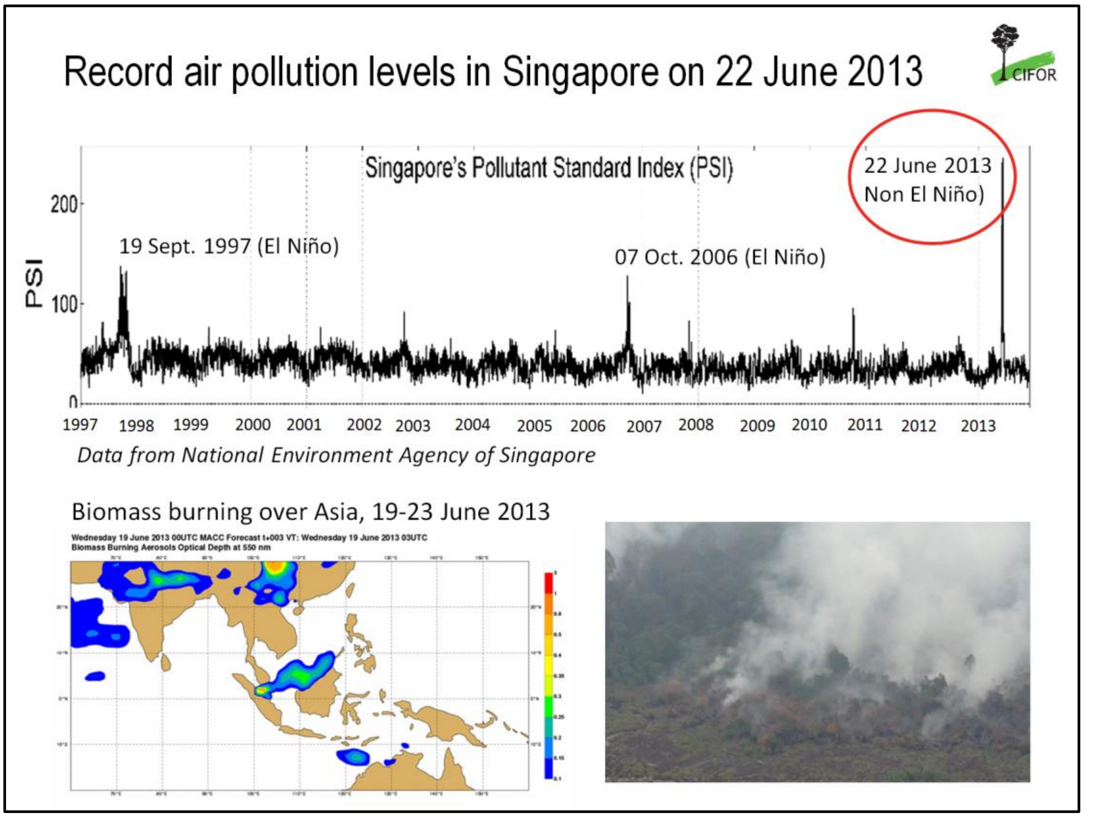


Globally, some 500 billion tons of carbon are stored in peatlands. Tropical peatlands are about 1/5 of this, 92 billion tons of carbon. Most of this is located in SE Asia (and most of this, in Indonesia)

CIFOR's SWAMP Project
http://www1.cifor.org/swamp

Donato, D.C., Kauffman, J.B., Murdiyarso, D., Kurnianto, S., Stidham, M., Kanninen, M., 2011. Mangroves among the most carbon-rich forests in the tropics. Nature Geosci 4, 293–297. doi:10.1038/ngeo1123

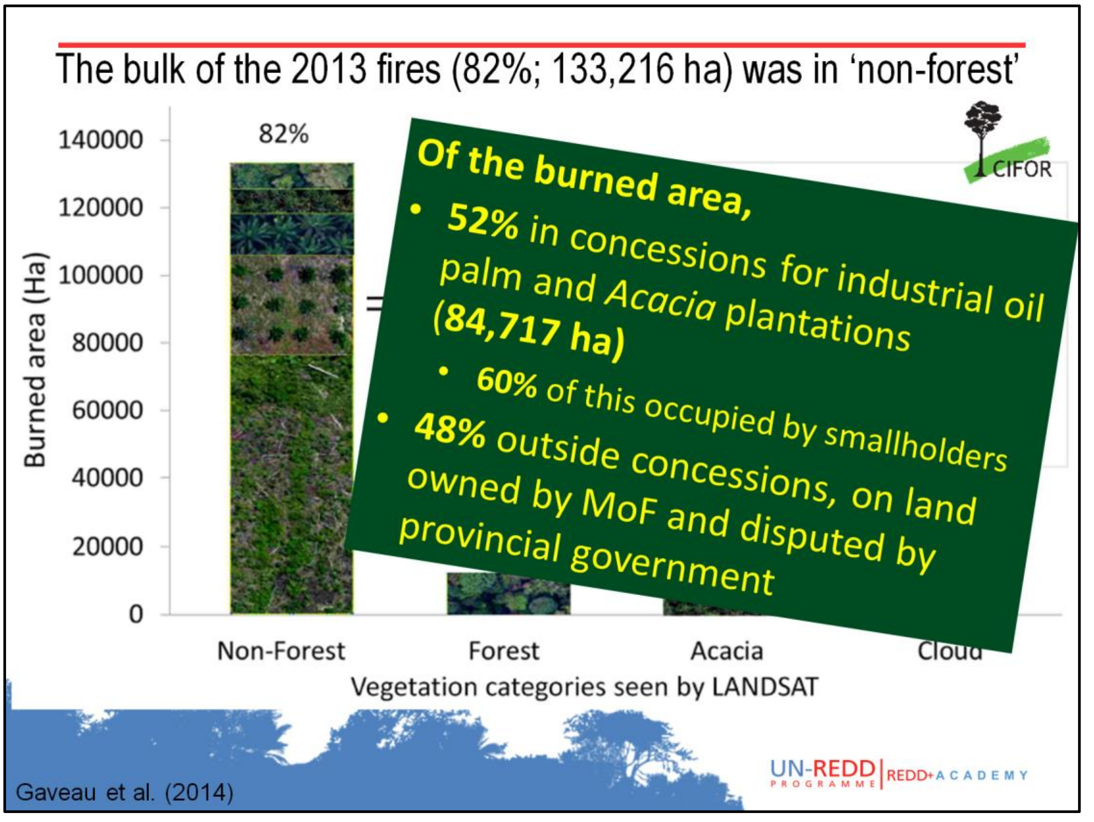
Globally peatlands store around 500 Bt C and one-fifth of it is in the tropics
Calculated from peat volume (area x depth), multiplied by bulk density of 0.09 g cm3 and carbon concentration of 0.56



This slide shows the Pollutant Standard Index that Singapore measures every day based on the sum of 6 pollutants. It shows peaks in 1997, 2006 and the largest peak ever, in 2013. The 1997 and 2006 peaks were related to El Nino years (very dry years in Indonesia). The 2013 peak is not related to El Nino. The 1997 peak corresponds to the emission 1997 peak visible at global levels (cf. slide 13 above; "GHG emissions accelerate despite reduction efforts"). The 2013 is not visible (but the data for 2013 in slide 14 may be incomplete).
The slide also shows the biomass burning over Asia in the week 19-23 June 2013, and that much from the biomass burning in Sumatra moved to the Singapore area. Hence, the pollution in Singapore in these three incidents at least was linked to the peatland fires in Sumatra.

The PSI is a number representing the highest sub-index of five common pollutants computed based on the concentrations averaged over a 24-hour period: particulate matter (PM_{10}), sulphur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), and nitrogen dioxide (NO_2)

Source: Gaveau, D.L.A., Salim, M.A., Hergoualc'h, K., Locatelli, B., Sloan, S., Wooster, M., Marlier, M.E., Molidena, E., Yaen, H., DeFries, R., Verchot, L., Murdiyarso, D., Nasi, R., Holmgren, P., Sheil, D., 2014. Major atmospheric emissions from peat fires in Southeast Asia during non-drought years: evidence from the 2013 Sumatran fires. Scientific Reports 4, 6112. doi:10.1038/srep06112



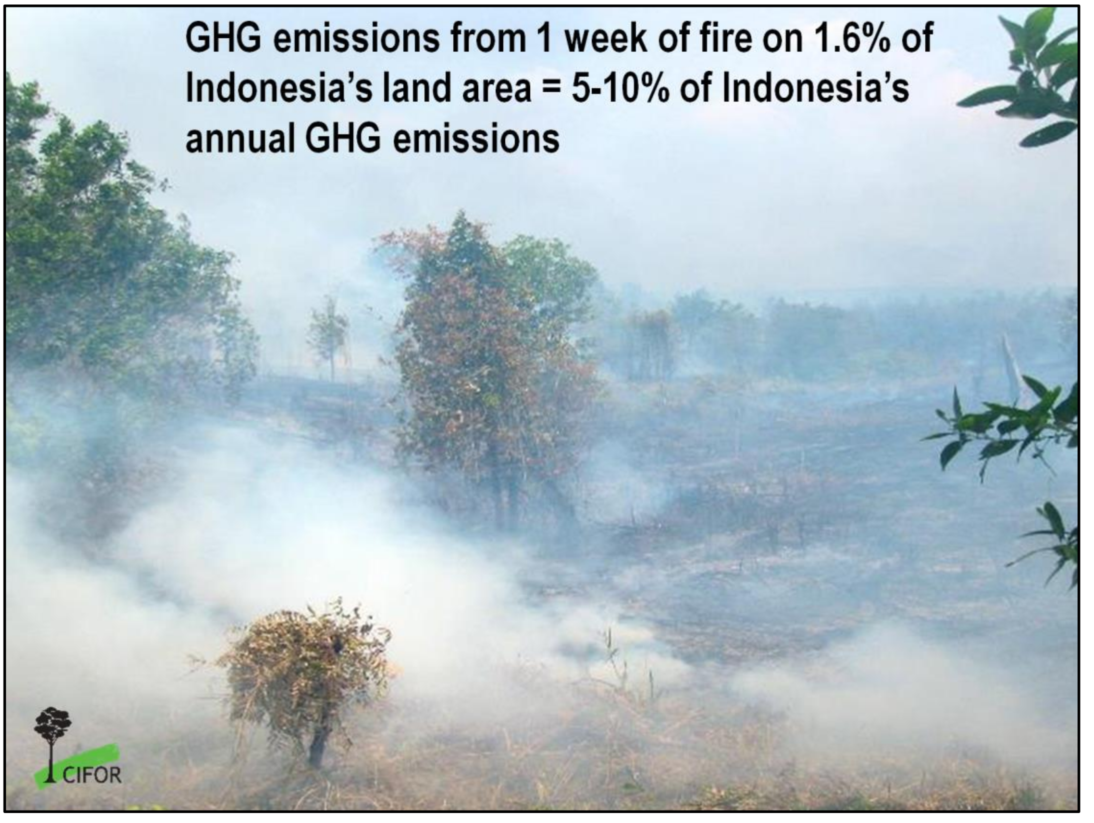
GHG emissions from 1 week of fire on 1.6% of Indonesia's land area = 5-10% of Indonesia's annual GHG emissions
… but the GHG emissions from just one week of fire (and that happened on just 1.6% of Indonesia's land area) corresponded to 5-10% of Indonesia's annual GHG emissions

Source: Gaveau, D.L.A., Salim, M.A., Hergoualc'h, K., Locatelli, B., Sloan, S., Wooster, M., Marlier, M.E., Molidena, E., Yaen, H., DeFries, R., Verchot, L., Murdiyarso, D., Nasi, R., Holmgren, P., Sheil, D., 2014. Major atmospheric emissions from peat fires in Southeast Asia during non-drought years: evidence from the 2013 Sumatran fires. Scientific Reports 4, 6112. doi:10.1038/srep06112

Our satellite analysis shows that the bulk of the 2013 fires came from non-forest areas (82% _ scrub, oil palm, acacia etc.). Of the burned area, about half (52%) was in concessions for industrial oil palm and Acacia plantations (84,717 ha), 60% of which are occupied by smallholders, and the other half (48%) came from outside concessions, on land owned by MoF and disputed by provincial government. This shows that land disputes may have been responsible for the 2013 fires.

Why such a large area was set to fire in just one week nevertheless remains still unclear…

Source: Gaveau, D.L.A., Salim, M.A., Hergoualc'h, K., Locatelli, B., Sloan, S., Wooster, M., Marlier, M.E., Molidena, E., Yaen, H., DeFries, R., Verchot, L., Murdiyarso, D., Nasi, R., Holmgren, P., Sheil, D., 2014. Major atmospheric emissions from peat fires in Southeast Asia during non-drought years: evidence from the 2013 Sumatran fires. Scientific Reports 4, 6112. doi:10.1038/srep06112



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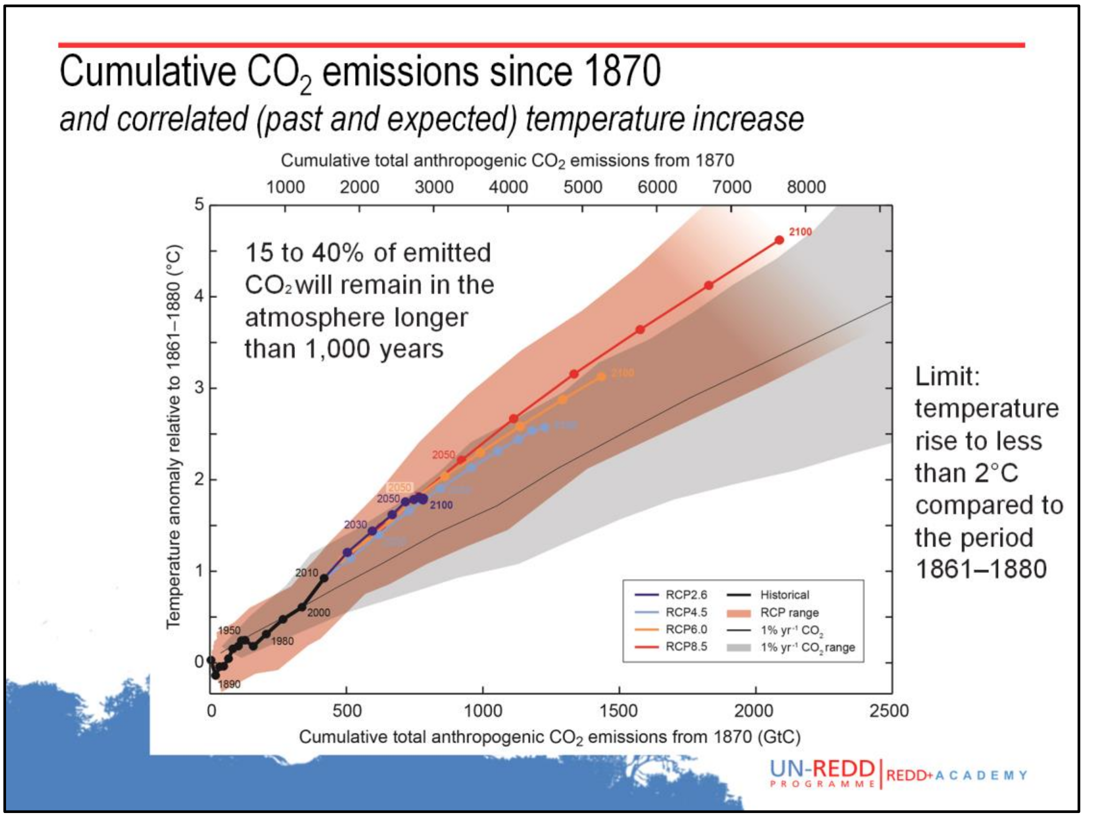
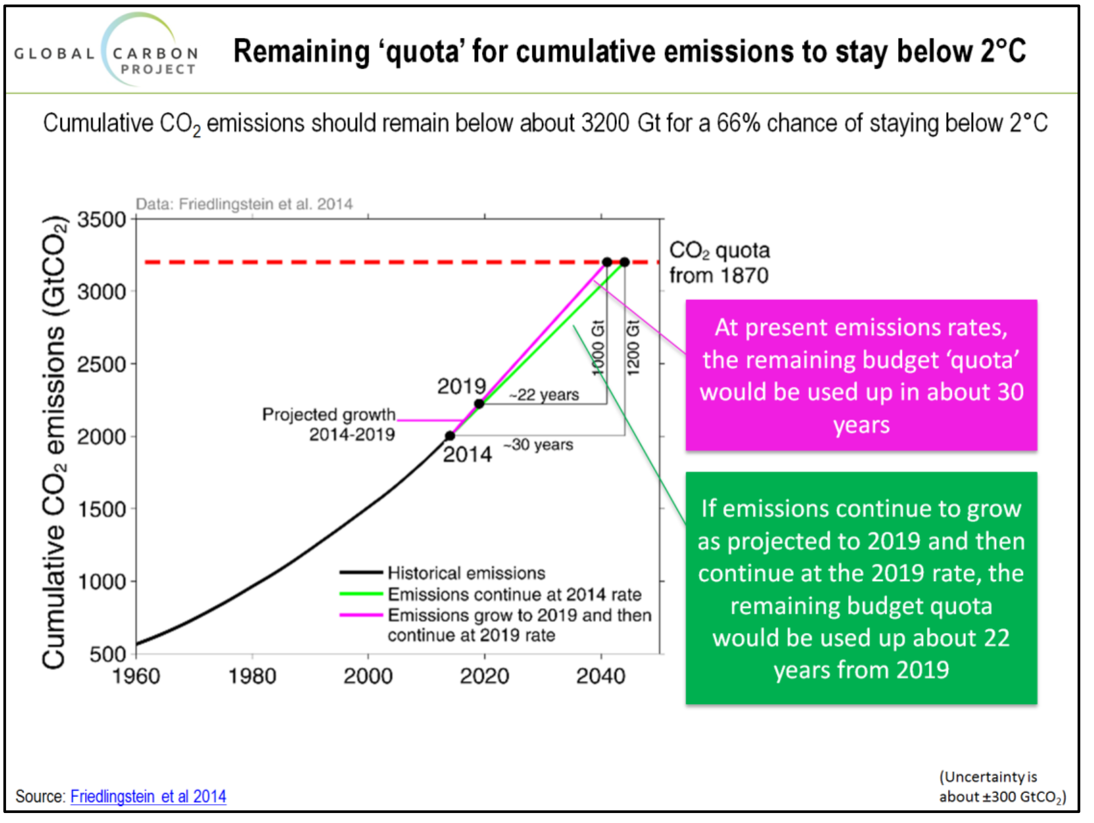


Let us go back to the global emissions. Now we look not at annual emissions such as in slide 13, but (on the bottom or x-axis) at the accumulated emissions of greenhouse gases since 1870 (i.e. the annual emissions stocked on each other). This graph also shows a forecast of emissions for the next 85 years (until 2100). The cumulative emissions are put in relation to the expected global average temperature increase (left-side or y-axis) corresponding to each level of cumulative emissions. Historic data (black dots and lines) and forecasts (colored lines) are shown together with the associated range of possibilities based on uncertainties in the forecasts (grey and reddish colored areas).

We often see a goal set to limiting the global temperature increase compared to preindustrial times (i.e. the period 1961-1880), This is nothing more than a political convention. It is believed that this increase would allow for still manageable climate change. In fact, as a previous slide (13) has shown, we are already heading to a goal much higher than 2°C. This graph also shows that most scenarios point to a 3-4° increase by 2100. Even if drastic measures are taken today to curb emissions, a large part of the CO2 emitted today will remain in the atmosphere for more than 1000 years.

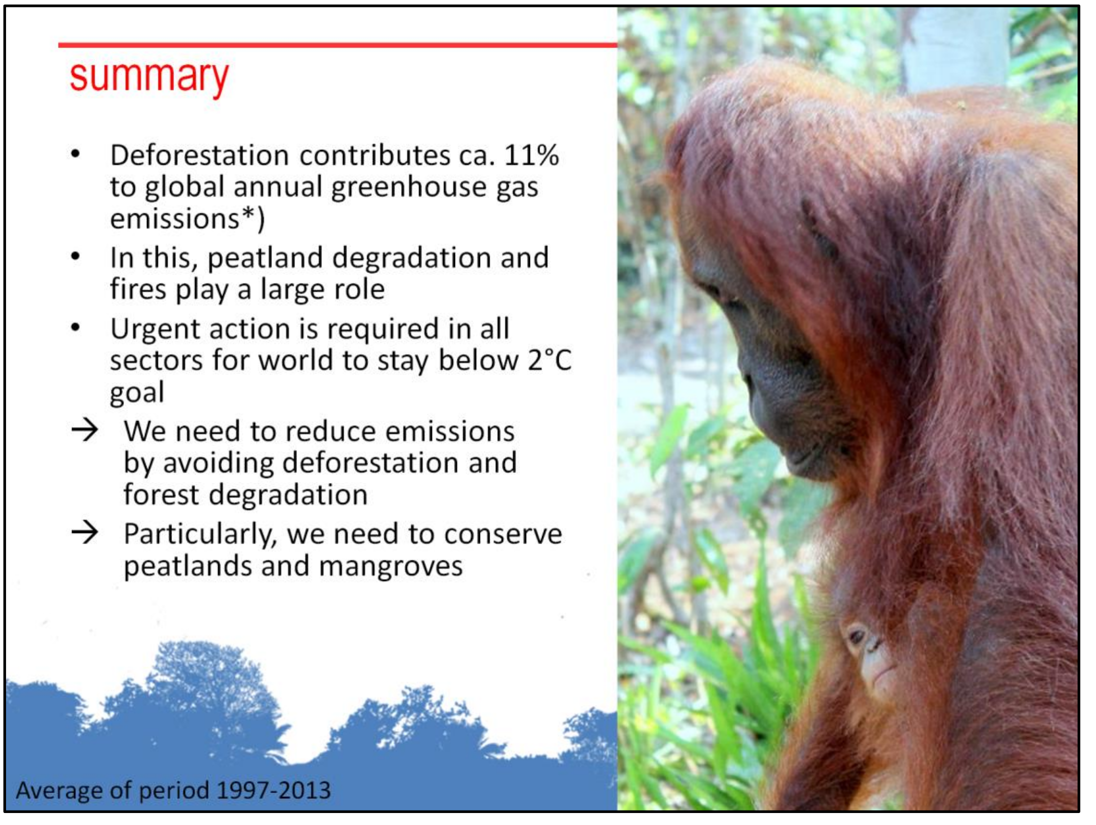
http://www.climatechange2013.org/report/reports-graphic/report-graphics/

Figure SPM.10 | Global mean surface temperature increase as a function of cumulative total global CO_2 emissions from various lines of evidence. Multimodel results from a hierarchy of climate-carbon cycle models for each RCP until 2100 are shown with coloured lines and decadal means (dots). Some decadal means are labeled for clarity (e.g., 2050 indicating the decade 2040−2049). Model results over the historical period (1860 to 2010) are indicated in black. The coloured plume illustrates the multi-model spread over the four RCP scenarios and fades with the decreasing number of available models in RCP8.5. The multi-model mean and range simulated by CMIP5 models, forced by a CO_2 increase of 1% per year (1% yr^{-1} CO_2 simulations), is given by the thin black line and grey area. For a specific amount of cumulative CO_2 emissions, the 1% per year CO_2 simulations exhibit lower warming than those driven by RCPs, which include additional non-CO_2 forcings. Temperature values are given relative to the 1861−1880 base period, emissions relative to 1870. Decadal averages are connected by straight lines.

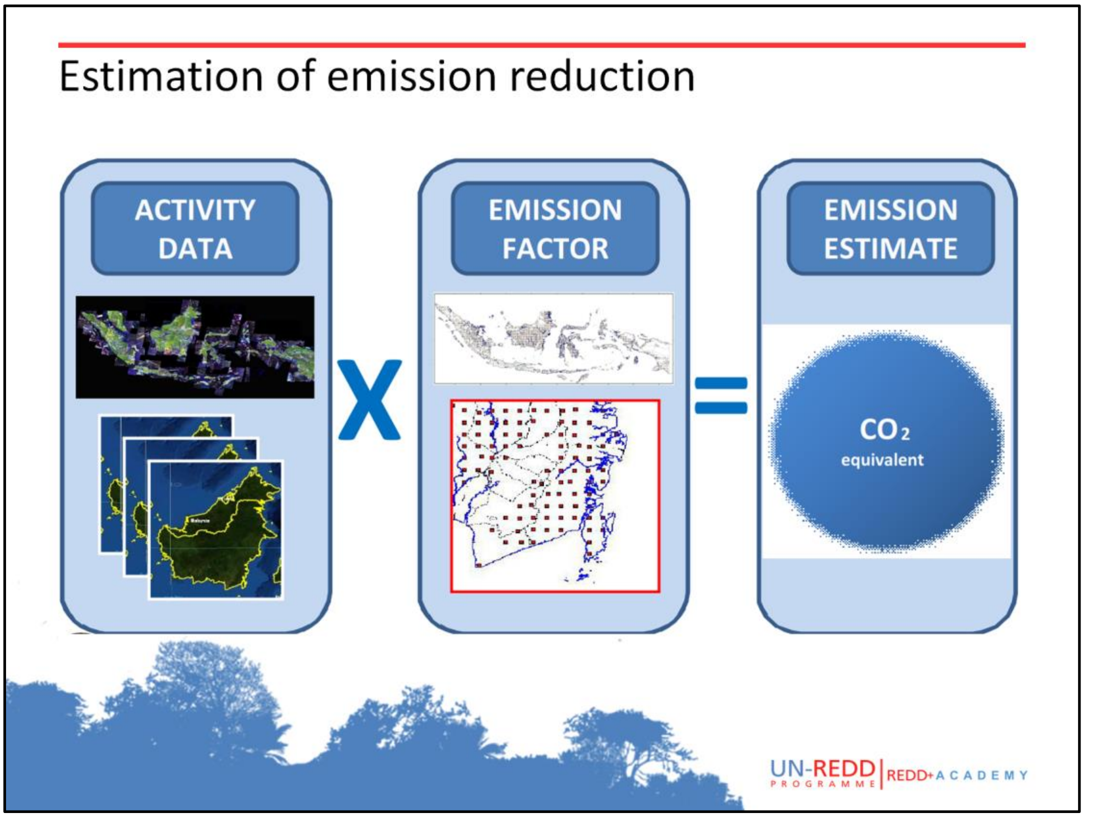


The link between cumulative emissions since the 1850ies and temperature increase means that we have to cap emissions at a certain level of cumulative emissions (the level that corresponds to the 21°C increase). This graph from Global Carbon project shows that if emission rates stay at the current levels, the remaining budget 'quota' would be used up in about 30 years (pink lines).
If emissions continue to grow as projected to 2019 and then continue at the 2019 rate, the remaining budget quota would be used up about 22 years from 2019.

Slide based on
http://www.globalcarbonproject.org/carbonbudget/14/presentation.htm
PowerPoint (13.5mb)

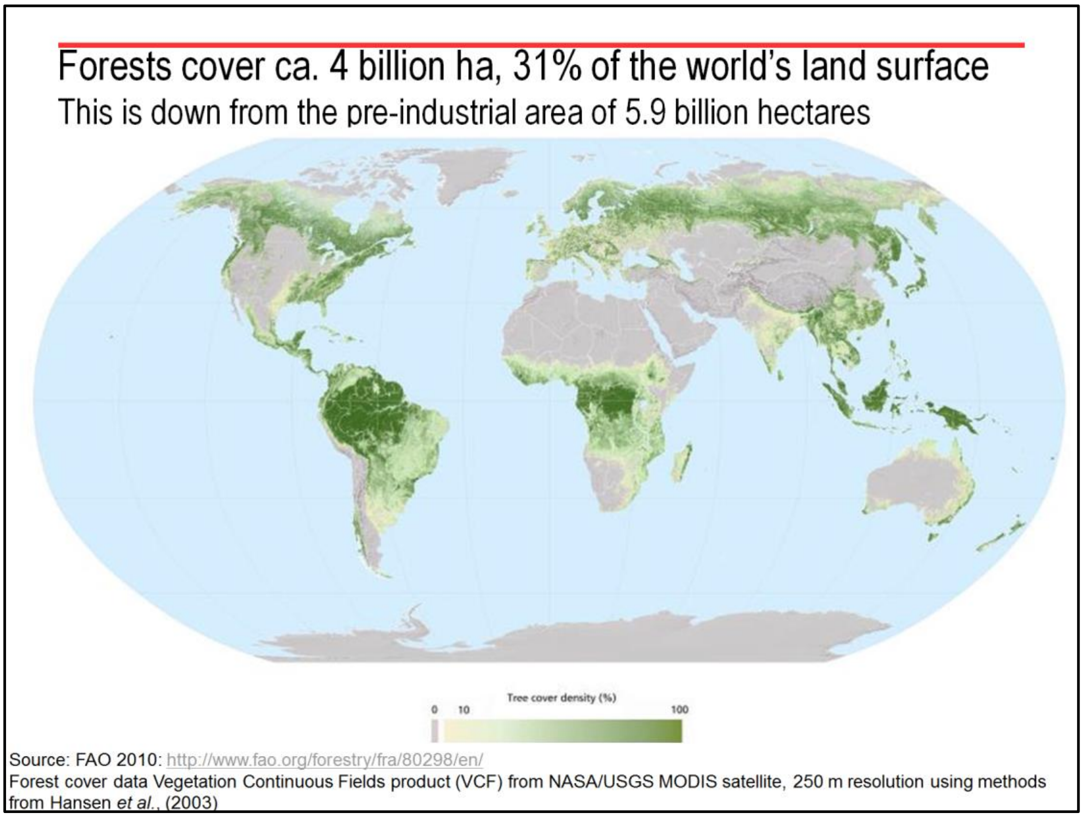


Deforestation contributes ca. 11% to global annual greenhouse gas emissions*)
In this, peatland degradation and fires play a large role
Urgent action is required in all sectors for world to stay below 2°C goal
→ We need to reduce emissions by avoiding deforestation and forest degradation
→ Particularly, we need to conserve peatlands and mangroves



This slide explains why in the following we will be talking about forest areas. If we want to reduce emissions from deforestation, we need to understand how forest area relates to $CO2$. Basically we need data on forest area and deforestation area (so-called activity data) and multiply them with the corresponding carbon contents and carbon dioxide emissions (the emission factor), to get to a carbon dioxide emission estimate per forest area.

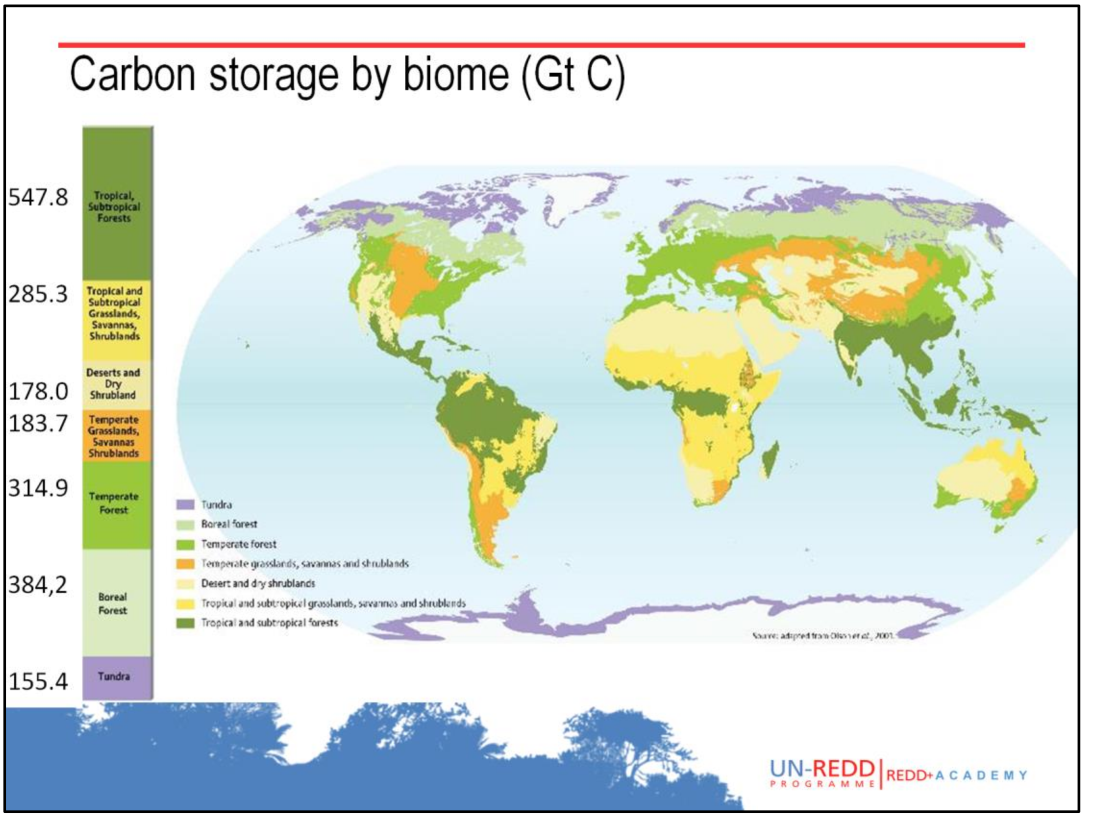
Source of slide: Indonesia’s Ministry of Forestry (slide provided by Shijo Joseph)



Globally, forests cover ca. 4 billion ha, 31% of the world's land surface. This is down from the pre-industrial area of 5.9 billion hectares of forests. You can see that most forests occur in the tropics, and in large areas of the Northern hemisphere in Canada, the US, Europe, Siberia and China.
This is the year 2010 map of the world's forests. FAO has worked with partners using data from the USGS and NASA MODIS satellite and processed by the South Dakota State University using the methods of Professor Matthew Hansen and his colleagues.

They have developed a Vegetation Continuous Fields product (VCF) with a 250 m spatial resolution (many times better than the year 2000 product and the data is much higher resolution so they should NOT be directly compared and definitely NOT subtracted to get differences or change.

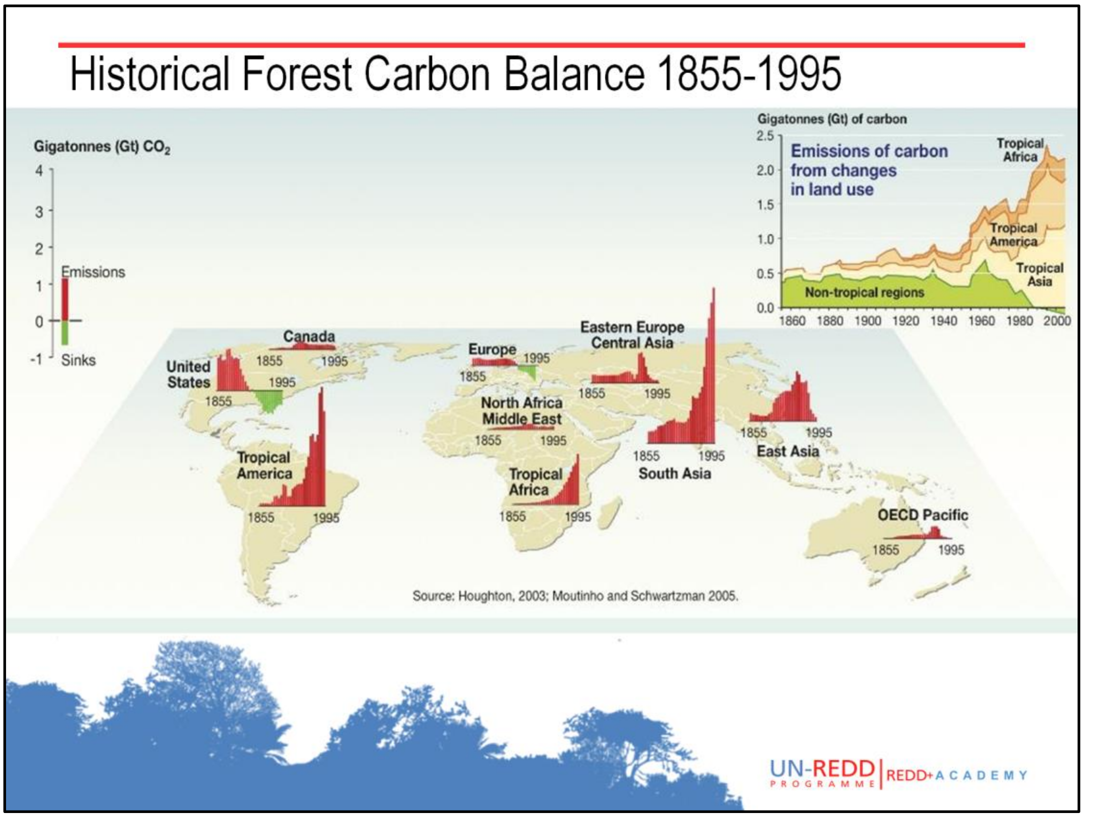
Source: FAO 2010: http://www.fao.org/forestry/fra/80298/en/
Forest cover data Vegetation Continuous Fields product (VCF) from NASA/USGS MODIS satellite, 250 m resolution using methods from Hansen *et al.*, (2003)



So, why concentrate the efforts (of REDD+) on tropical forest areas?

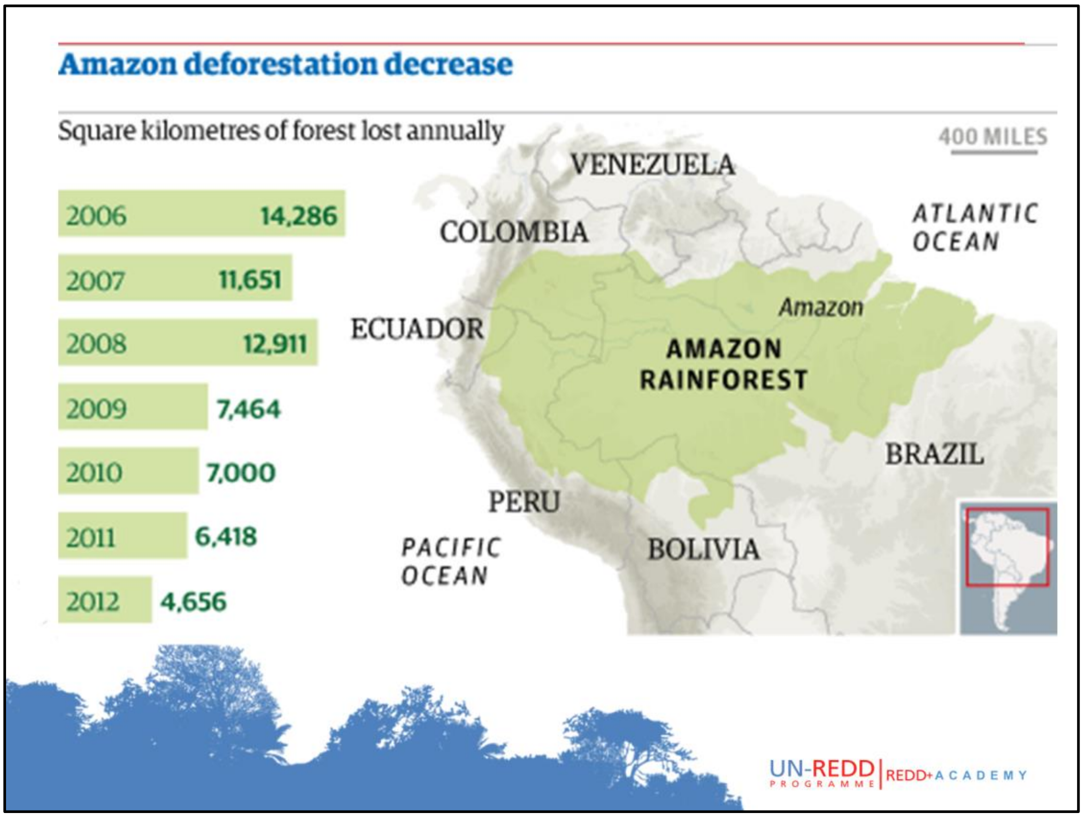
This graph shows that the tropical areas are where the largest carbon stocks are, globally (547.8 million tonnes C in tropical and subtropical forests). Followed by boreal (Northern) and temperate forests, and so on. So, it's not only worth conserving these large forests stocks, but probably also a relatively cheap option, because we know that conserving vegetation is much cheaper than restoring it once it is destroyed or degraded.

http://www.carbon-biodiversity.net/Issues/CarbonStorage
(UNEP, WCMC, and German BMU, and the German Federal Agency for Nature Conservation (BfN))



Furthermore, the historical Forest Carbon Balance over 140 years shows that, while historically deforestation was large in the US, Europe and Eastern Europe, the largest deforestation rates are observed nowadays, in tropical rain forest regions. By the way, only the USA and Europe have reverted the trend are their forests have turned into sinks of atmospheric carbon.

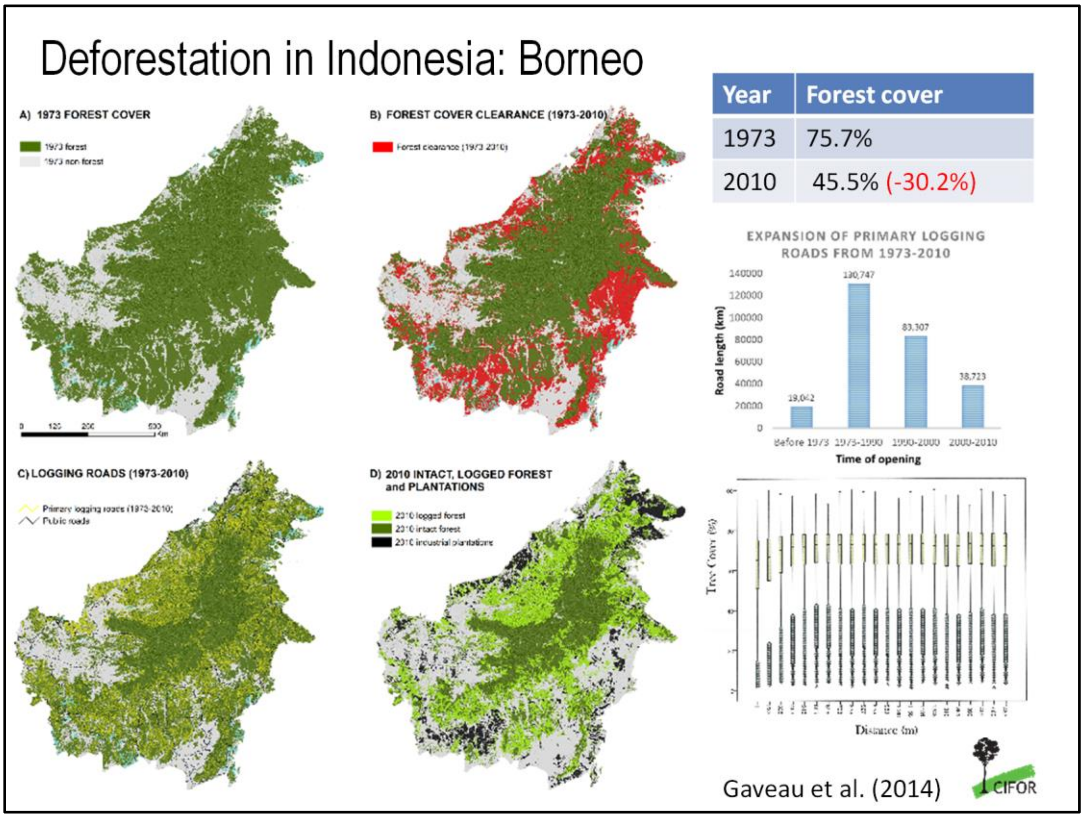
http://www.grida.no/graphicslib/detail/historical-forest-carbon-balance-1855-1995_1148



Let us have a look at the regional trends. In Amazonia, Brazil has managed to reduce its deforestation rates drastically since 2006. Unfortunately, in all other Amazonian countries, deforestation rates continue to raise. Brazil achieved this through a mix of policies, incentives and rigorous satellite monitoring.

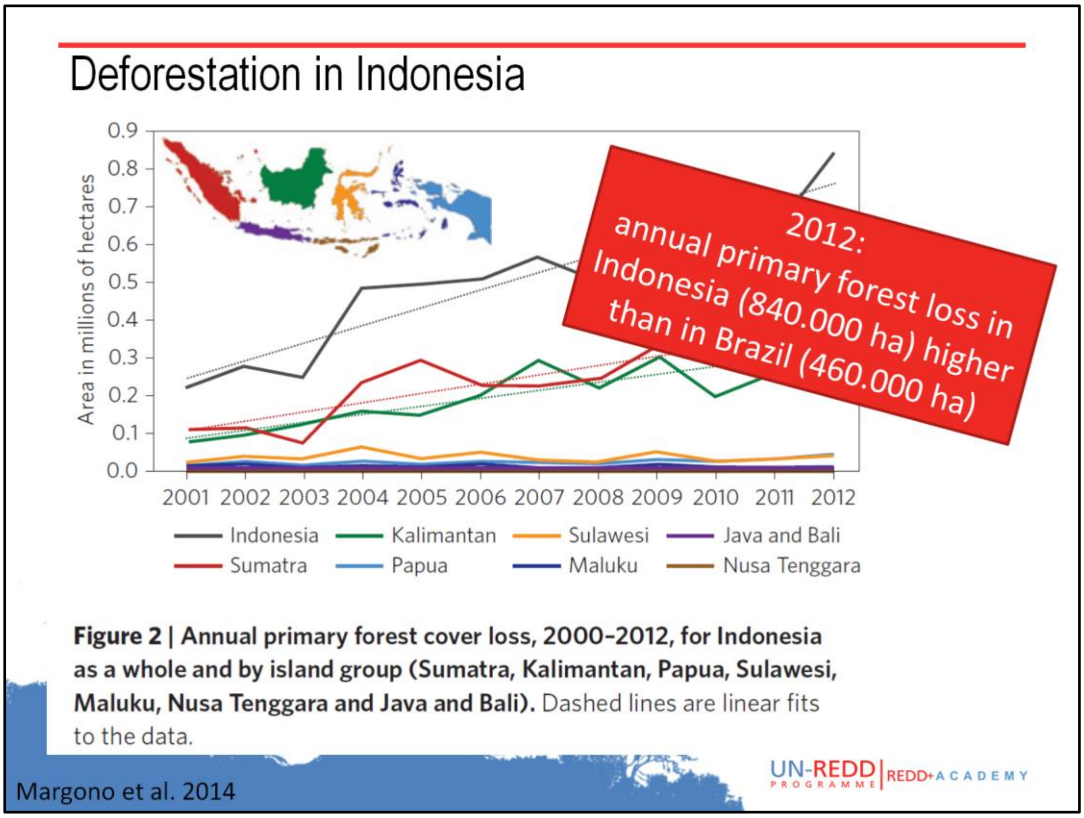
The Guardian 2012

http://www.theguardian.com/environment/2012/nov/28/amazon-deforestation-record-low



In contrast, a recently published study on deforestation in Kalimantan shows that deforestation has reduced the once large forest cover on Kalimantan (75.7%) by one third. Most of this related to logging (the forest cover decreases with shorter distance to logging roads, lower right inset graph). (a more recent study, not shown, shows furthermore that 30% of this deforestation was due to severe degradation from forest fires).

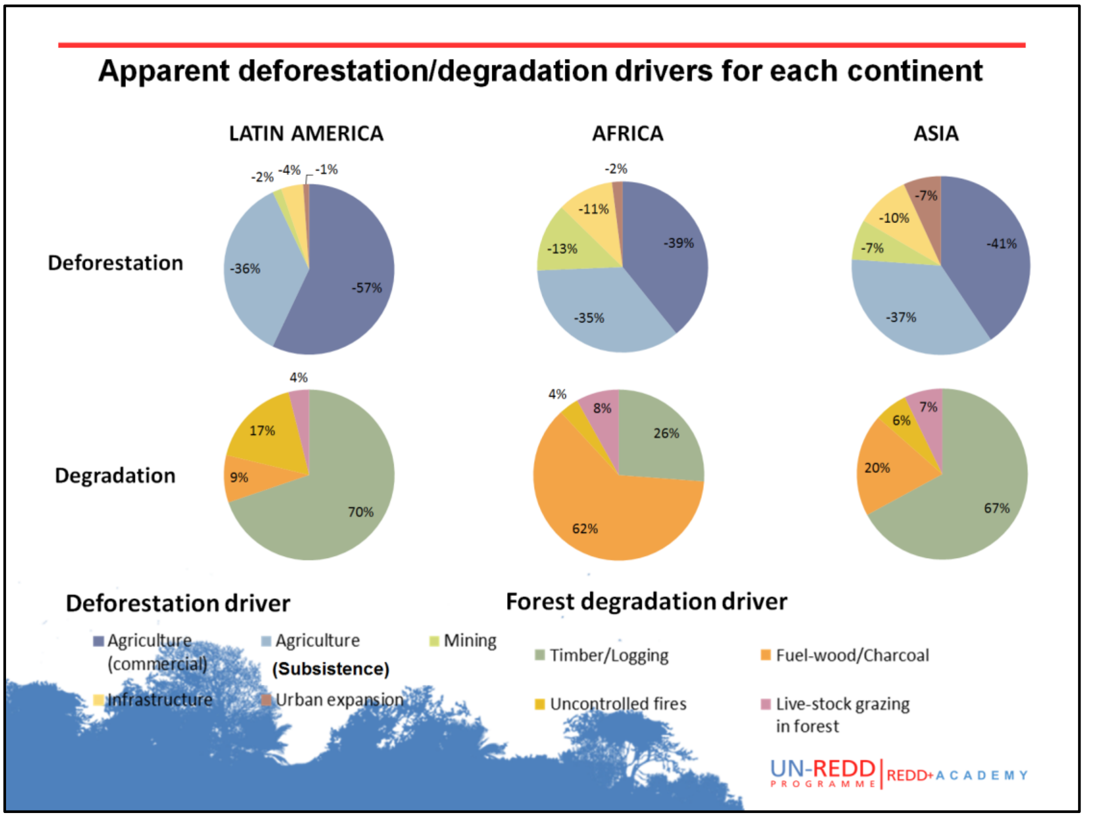
Gaveau, D.L.A., Sloan, S., Molidena, E., Yaen, H., Sheil, D., Abram, N.K., Ancrenaz, M., Nasi, R., Quinones, M., Wielaard, N., Meijaard, E., 2014. Four Decades of Forest Persistence, Clearance and Logging on Borneo. PLoS ONE 9, e101654. doi:10.1371/journal.pone.0101654



The latest figures on deforestation in Indonesia show a steady increase of deforestation rates (overall and for most of the islands) between 2001 and 2012. In 2012, the annual loss of primary rain forest in Indonesia (840.000 ha) was much higher than in Brazil (460.000 ha).

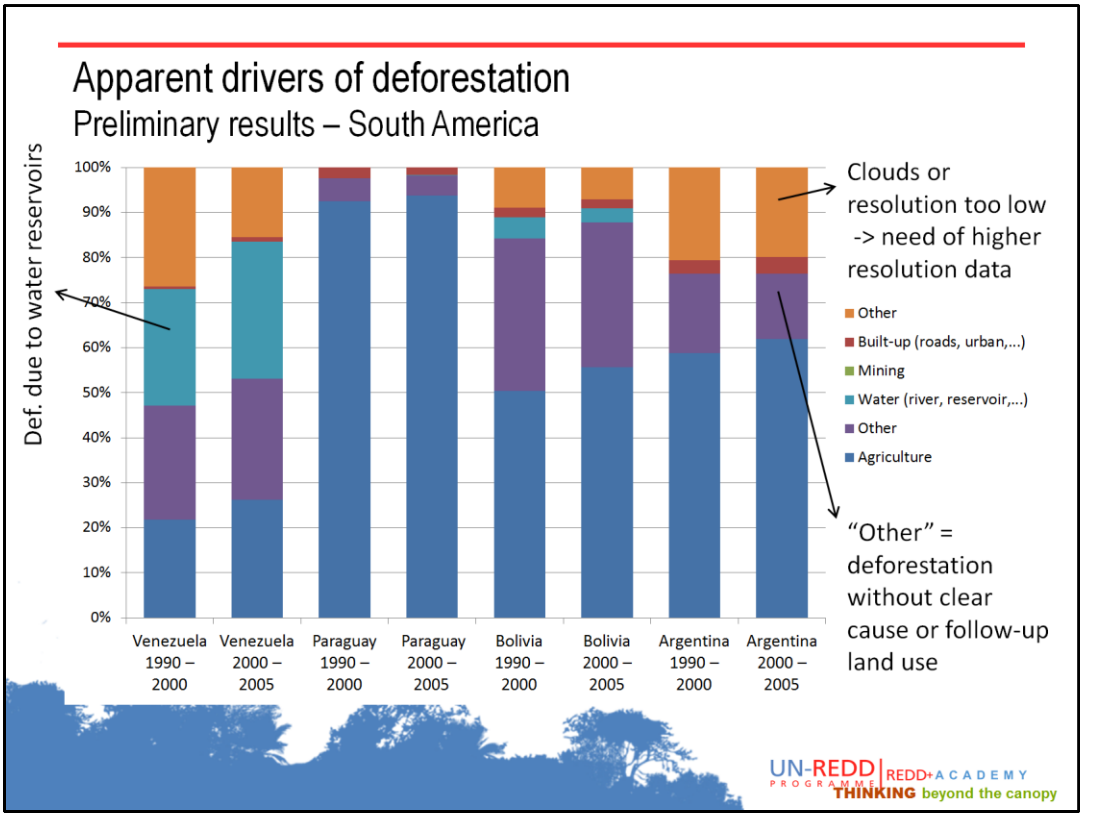
Margono, B.A., Potapov, P.V., Turubanova, S., Stolle, F., Hansen, M.C., 2014. Primary forest cover loss in Indonesia over 2000-2012. Nature Clim. Change 4, 730–735. doi:10.1038/nclimate2277

This paper is using a revised data set based on the original Hansen/Google data.



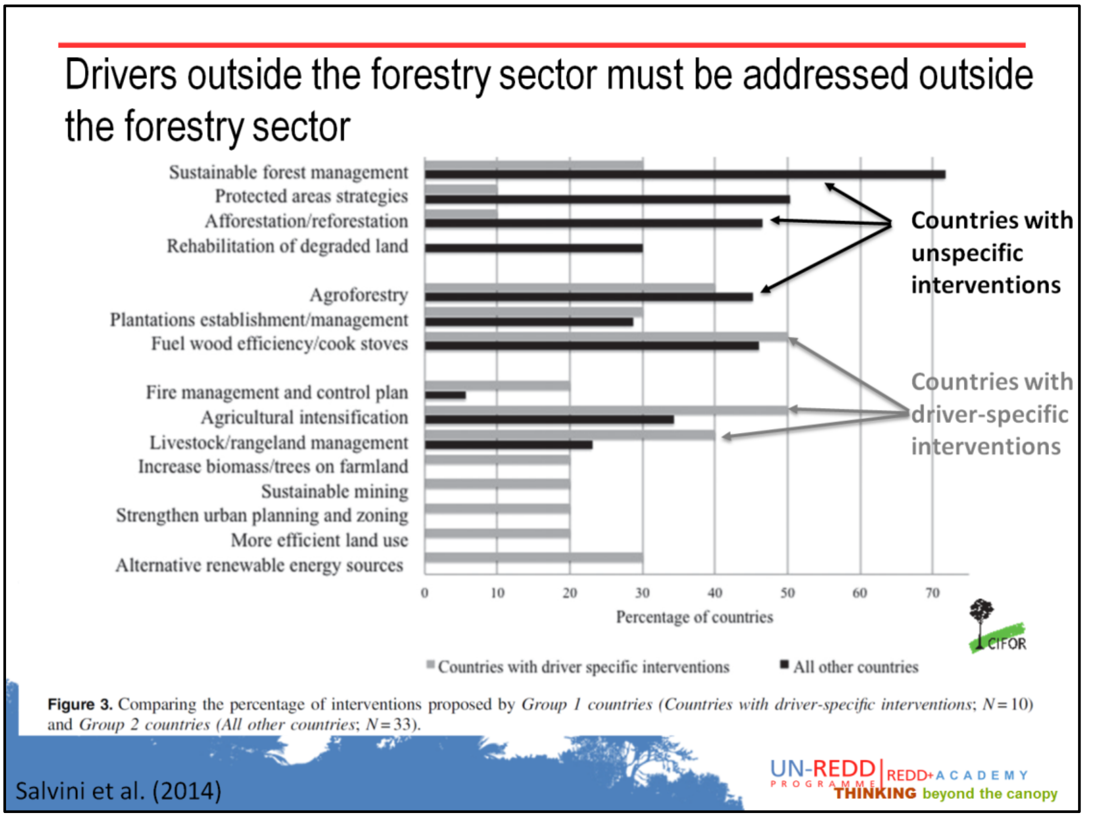
It is important to look at the 'drivers' (causal factors) of deforestation and degradation. Deforestation is the total removal of the forest cover; degradation the partly removal and loss of ecosystem function. They are often in logging and fires, as the data in the slide on Borneo showed, but not always. Here we see the drivers of deforestation, disaggregated by continents. We see that mostly agriculture (both commercial and subsistence farming) is responsible for deforestation (slightly more so in Latin America, while infrastructure growth is a bit more important relatively in Africa and Asia).
As for degradation drivers, they are mostly timber (logging) and fires.

CIFOR unpublished



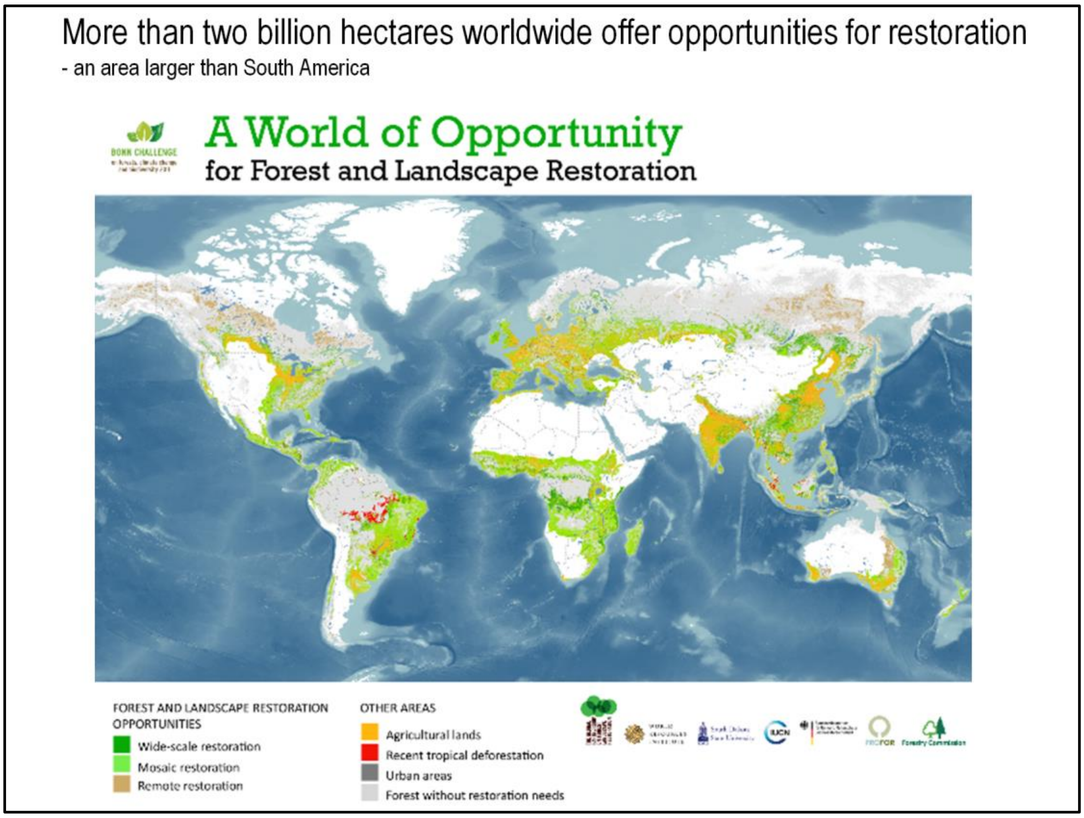
A more detailed analysis shows that agriculture drives most of the deforestation in 4 South American countries and that this role of agriculture was increasing between the periods 1990-2000 and 2000-2005. [Orange areas are parts of the satellite images covered in clouds, which could not be used in the analysis]. These are unpublished data from a recent study.

CIFOR unpublished



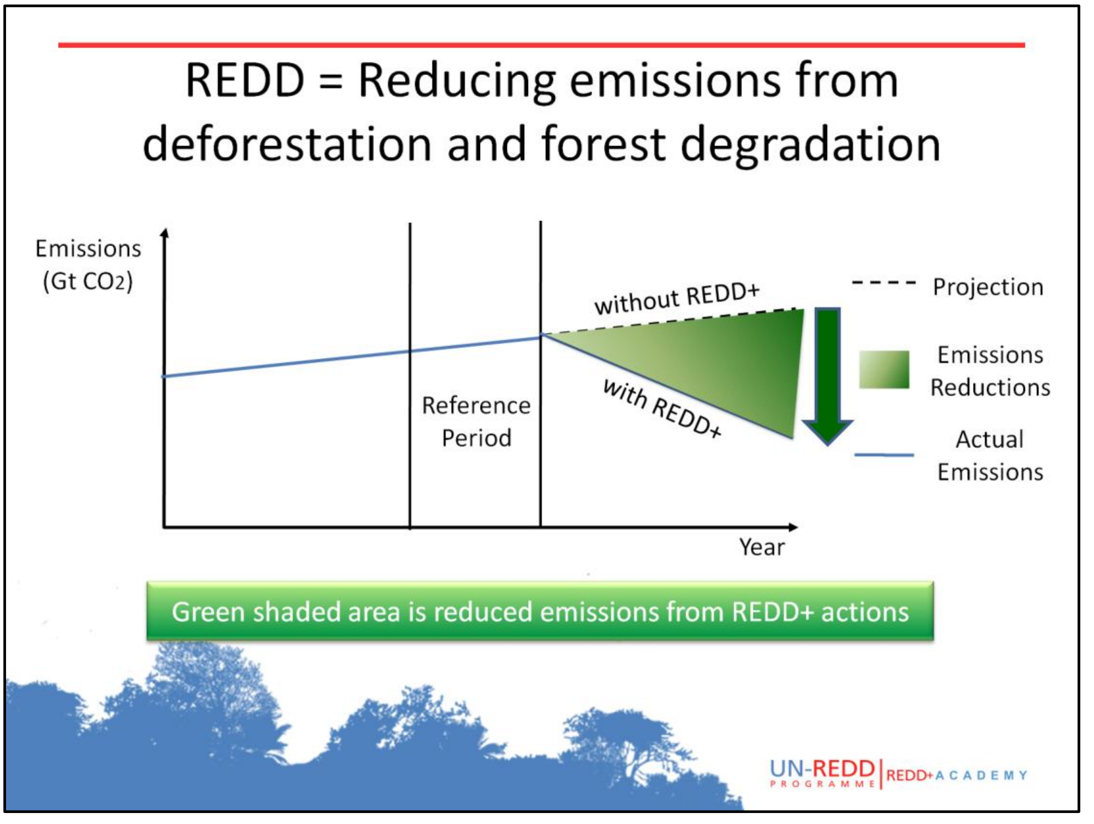
This graphic is the result from a recent study that shows how countries address drivers in different ways. Countries with a driver-specific approach have a much broader array of interventions at their disposal (gray bars) than countries with a narrow view of deforestation being caused only in the forestry sector (black bars). It is important to address the drivers where they occur.

Salvini, G., Herold, M., Sy, V.D., Kissinger, G., Brockhaus, M., Skutsch, M., 2014. How countries link REDD+ interventions to drivers in their readiness plans: implications for monitoring systems. Environ. Res. Lett. 9, 074004. Doi:10.1088/1748-9326/9/7/074004



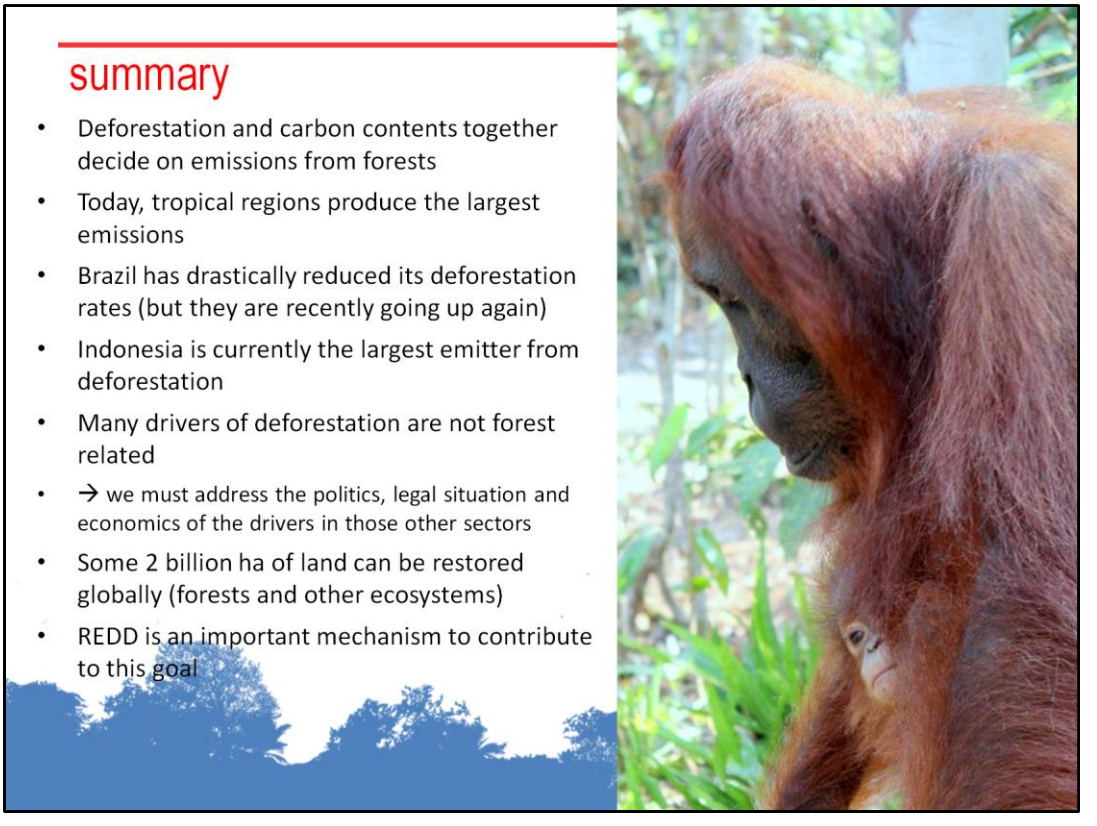
It follows out of the historic analysis of past forest cover (slide 25; "Forests cover ca. 4 billion ha…) that about 2 billion hectares can be restored in one way or the other. Thus, in addition to preserving standing forests we can also act on the lost carbon stocks and recuperate some of them through judicious reforestation and ecosystem restoration.

http://www.wri.org/resources/maps/global-map-forest-landscape-restoration-opportunities

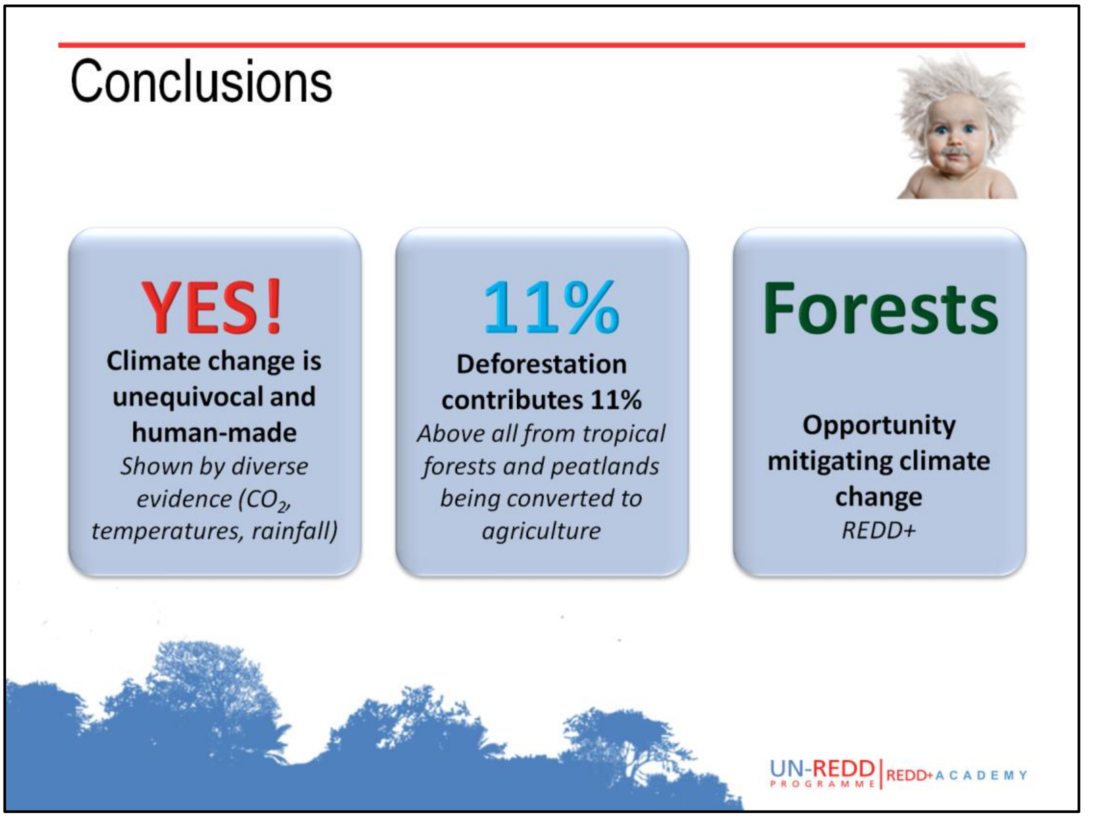


It is therefore important to pursue efforts such as REDD+ = Reducing emissions from deforestation and forest degradation and restoring carbon stocks, as they can sensibly reduce emissions

Source for this slide: UN-REDD



- Deforestation and carbon contents together decide on emissions from forests
- Today, tropical regions produce the largest emissions
- Brazil has drastically reduced its deforestation rates (but they are recently going up again)
- Indonesia is currently the largest emitter from deforestation
- Many drivers of deforestation are not forest related
- → we must address the politics, legal situation and economics of the drivers in those other sectors
- Some 2 billion ha of land can be restored globally (forests and other ecosystems)
- REDD is an important mechanism to contribute to this goal



Conclusions:
Our three messages from the beginning revisited. We conclude:
Climate change is unequivocal and human-made (shown by diverse evidence (CO2, temperatures, rainfall)
Deforestation contributes 11% (Above all from tropical forests and peatlands being converted to agriculture)
Forests offer an opportunity for the mitigation of climate change (particularly through REDD+)

UN-REDD PROGRAMME

Further information

www.un-redd.org

http://www.ipcc.ch/

www.unfccc.int

www.fao.org

http://www1.cifor.org/gcs/global-comparative-study-on-redd.html

http://www.cifor.org/fctoolbox/

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