Climate Change Mitigation in Land Use Planning

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Vegetationsökologie

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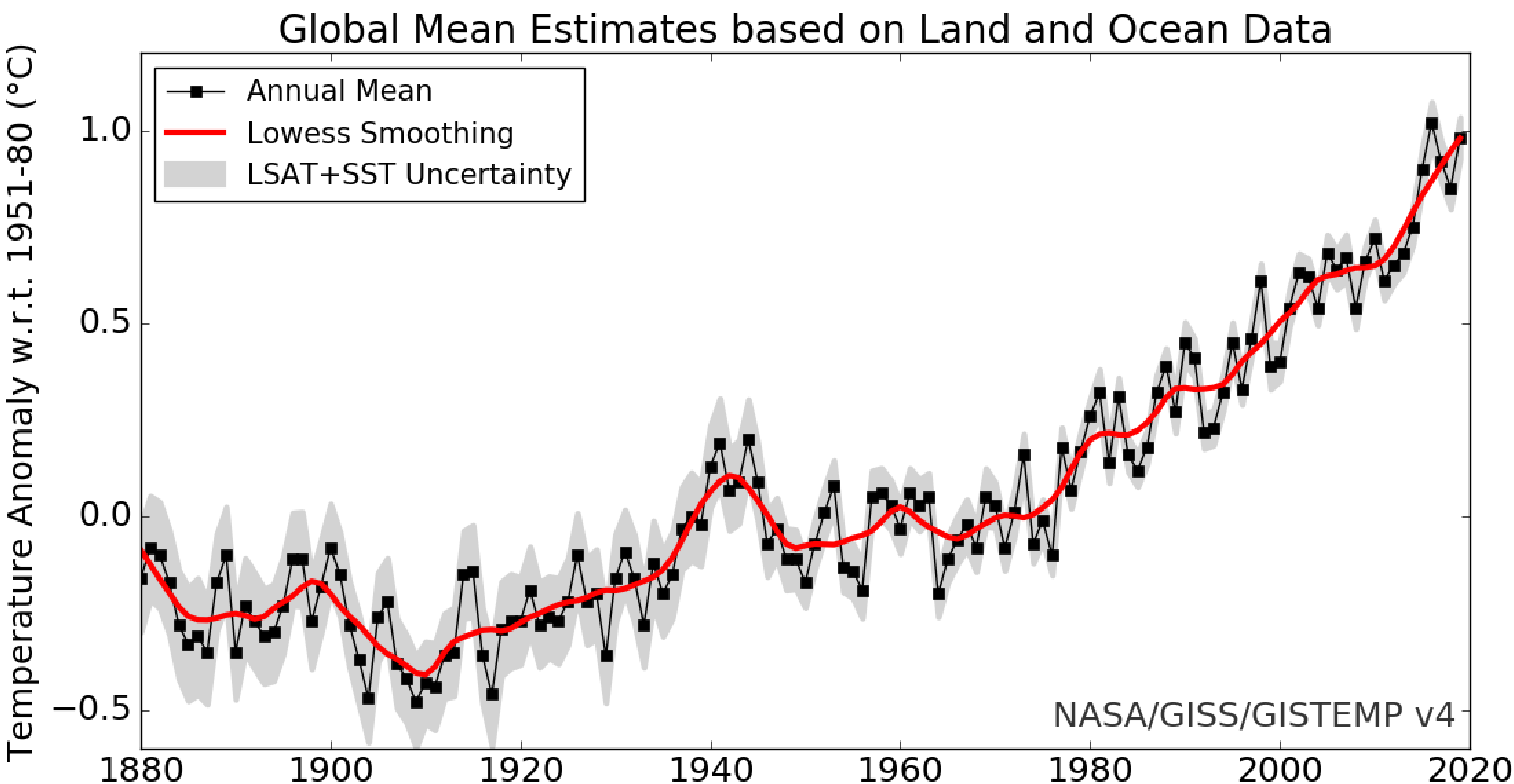
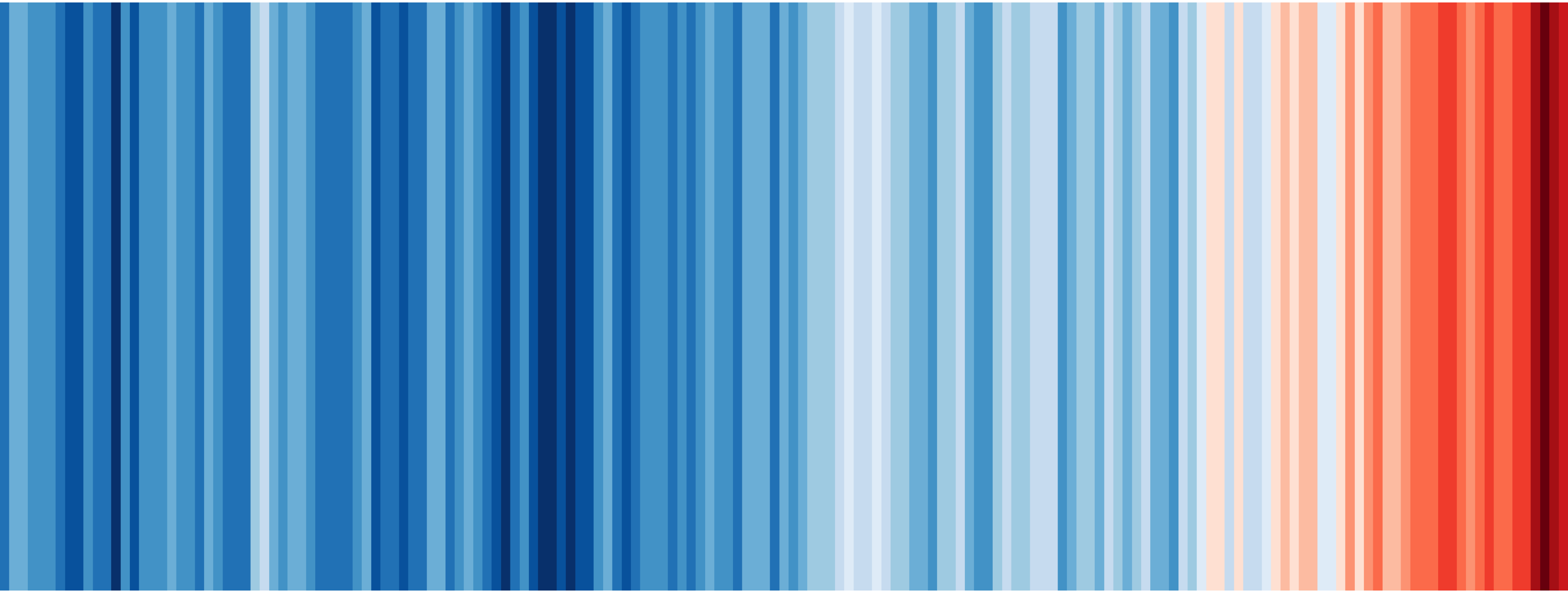
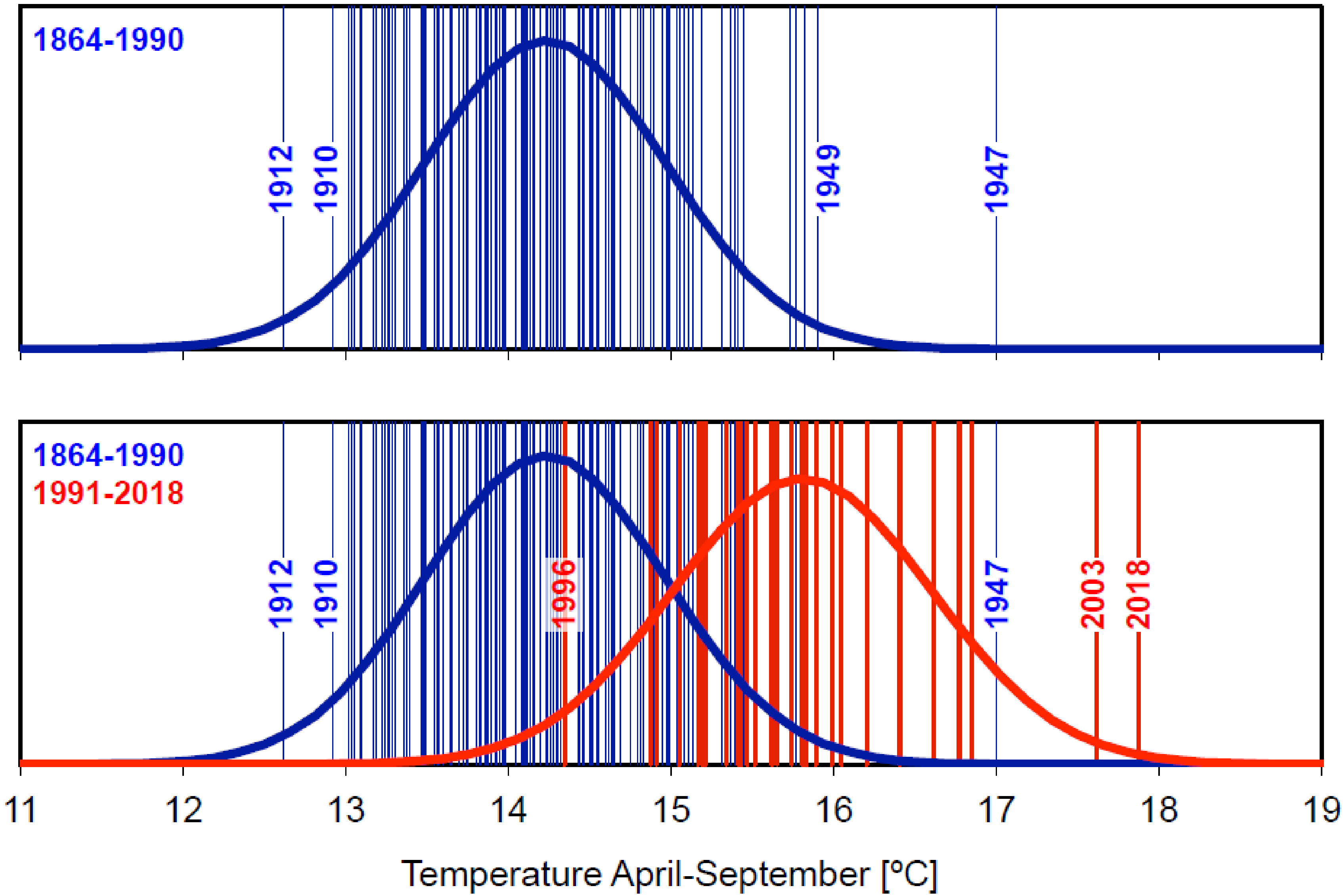

Global Mean Estimates based on Land and Ocean Data
Annual Mean
Lowess Smoothing
LSAT+SST Uncertainty
Temperature Anomaly w.r.t. 1951-80 (°C)
1.0
0.5
0.0
−0.5
1880
1900
1920
1940
1960
1980
2000
2020
NASA/GISS/GISTEMP v4

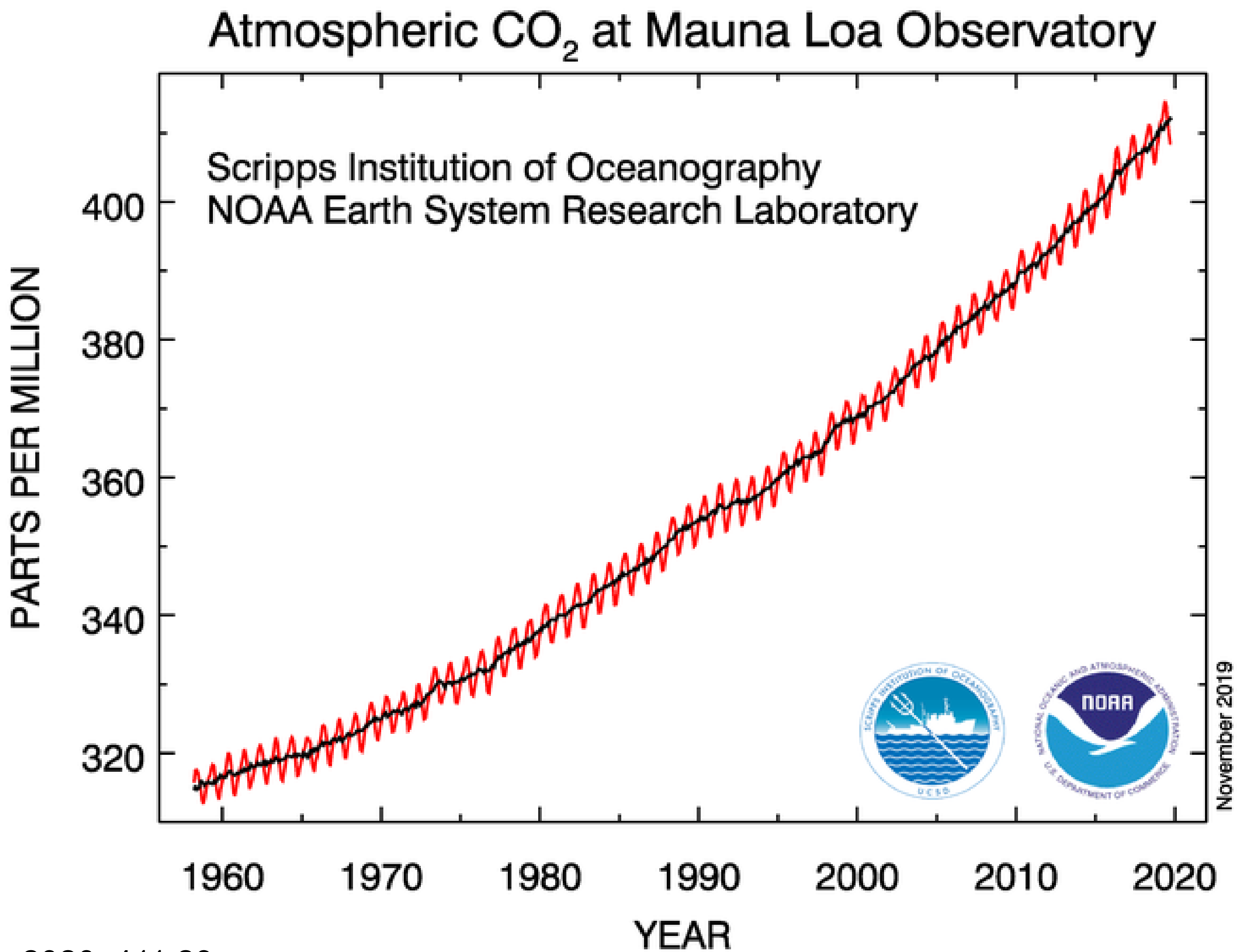
Warming stripes



Annual global temperatures from 1850-2017: The colour scale represents the change in global temperatures covering 1.35°C
(Ed Hawkins 2018)



Schär, ETH Zürich (updated from Schär et al. 2004, *Nature*, **427**, 332-336); Station observations from MeteoSwiss



September 2020: 411.29 ppm
October 2019: 408.53 ppm
October 2018: 406.00 ppm

https://www.esrl.noaa.gov/gmd/webdata/ccgg/trends/co2_trends/mlo.html

Fate of anthropogenic CO_2 emissions (2009–2018)

Sources = Sinks

34.7 $GtCO_2$/yr
86%

14%
5.5 $GtCO_2$/yr

17.9 $GtCO_2$/yr
44%

29%
11.5 $GtCO_2$/yr

23%
9.2 $GtCO_2$/yr

Budget Imbalance:
(the difference between estimated sources & sinks)

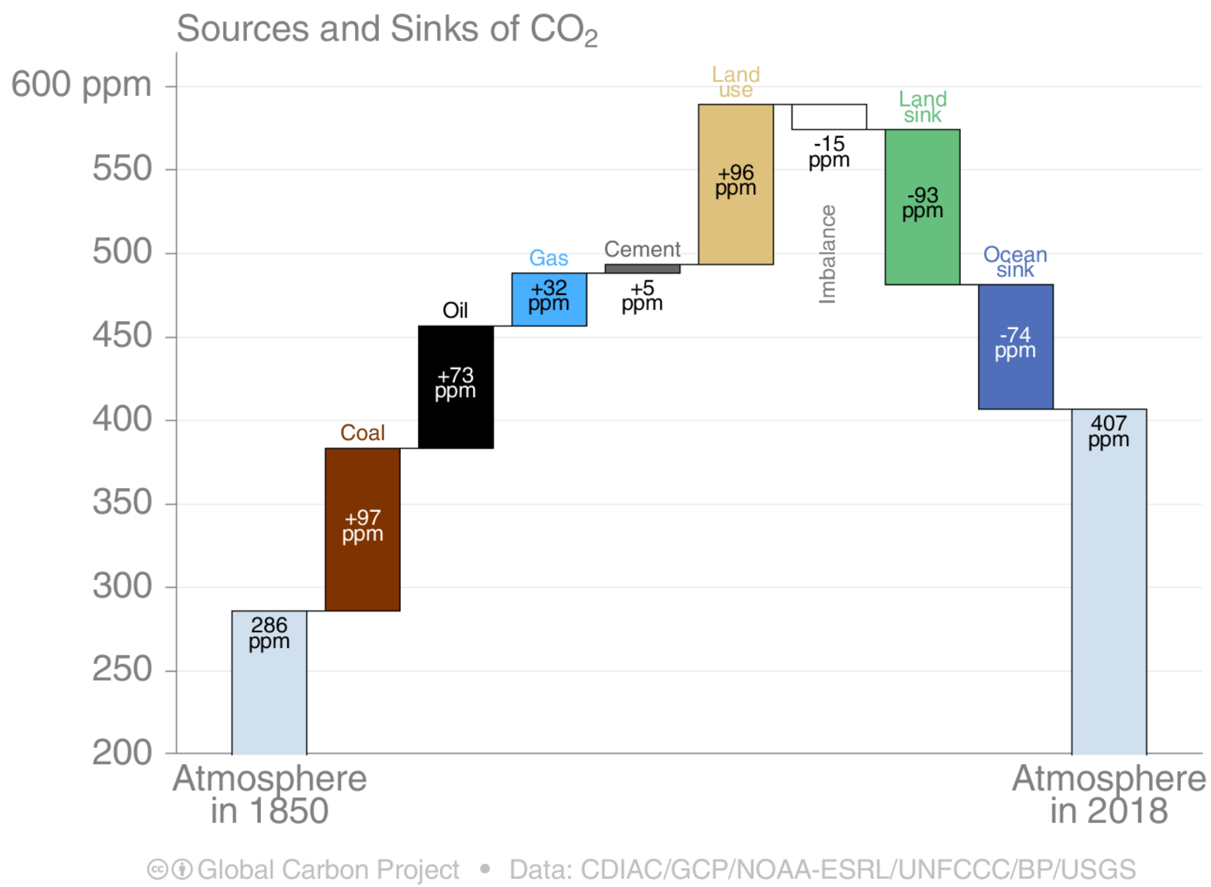
4%
1.6 $GtCO_2$/yr

Source: CDIAC; NOAA-ESRL; Houghton and Nassikas 2017; Hansis et al 2015; Friedlingstein et al 2019; Global Carbon Budget 2019

Global carbon budget

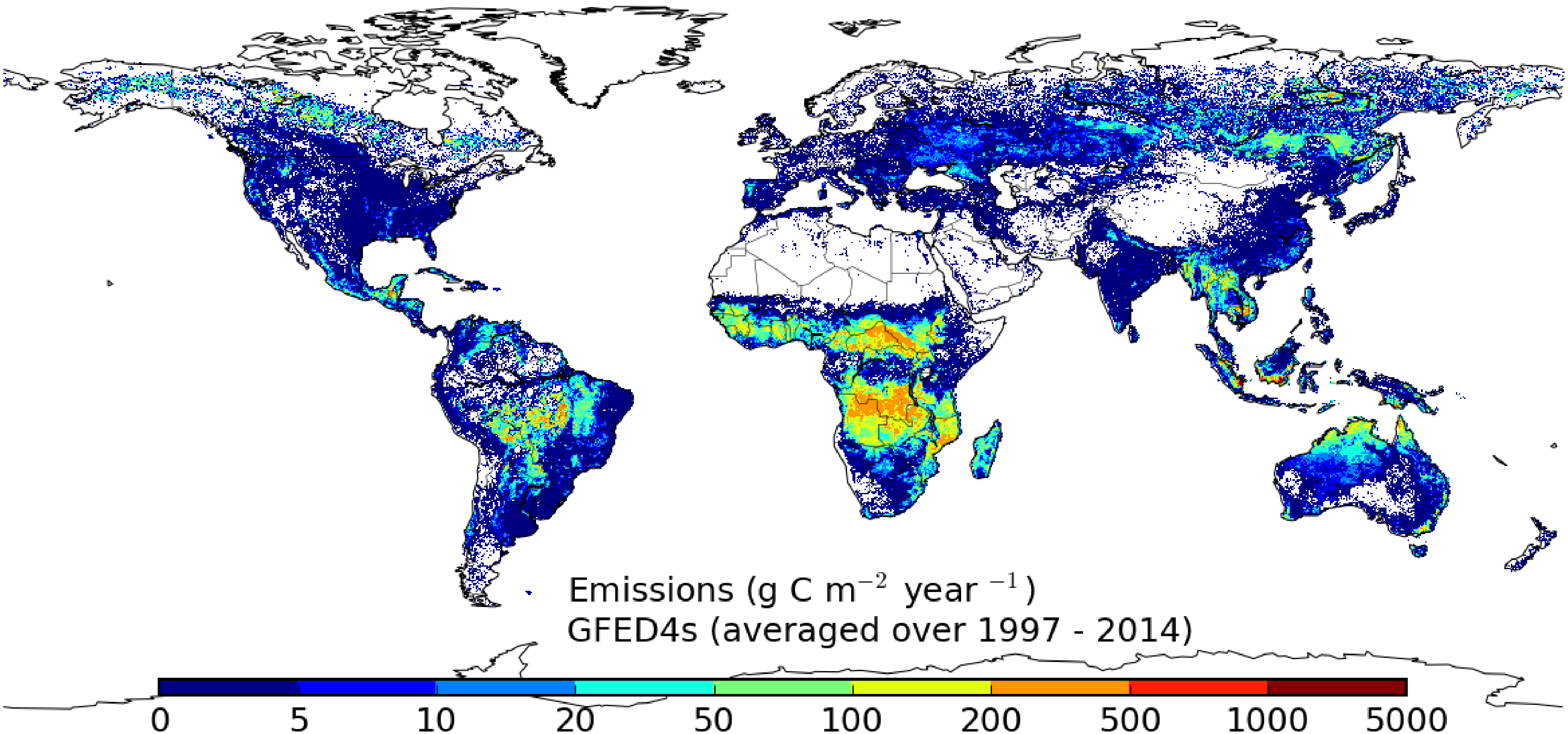
The cumulative contributions to the global carbon budget from 1850

The carbon imbalance represents the gap in our current understanding of sources & sinks



Source: CDIAC; NOAA-ESRL; Houghton and Nassikas 2017; Hansis et al 2015; Joos et al 2013; Khatiwala et al. 2013; DeVries 2014; Friedlingstein et al 2019; Global Carbon Budget 2019

emissions in g C m^{-2} a^{-1}



http://www.globalfiredata.org/_plots/map_emissions.png

Temperature

In response to increasing greenhouse gas (GHG) concentrations, **air temperature over Ethiopia is projected to rise by 1.6 to 3.7 °C (very likely range) by 2080** relative to the year 1876, depending on the future GHG emissions scenario (Figure 2). Compared to pre-industrial levels, median climate model temperature increases over Ethiopia amount to approximately 1.5 °C in 2030 and 1.8 °C in 2050 as well as 2080 under the low emissions scenario RCP2.6. Under the medium/high emissions scenario RCP6.0, median climate model temperature increases amount to 1.5 °C in 2030, 1.8 °C in 2050 and 2.4 °C in 2080.

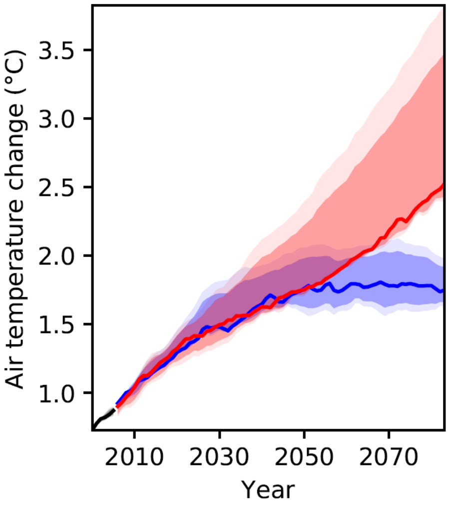


Figure 2: Air temperature projections for Ethiopia for different GHG emissions scenarios.[5]

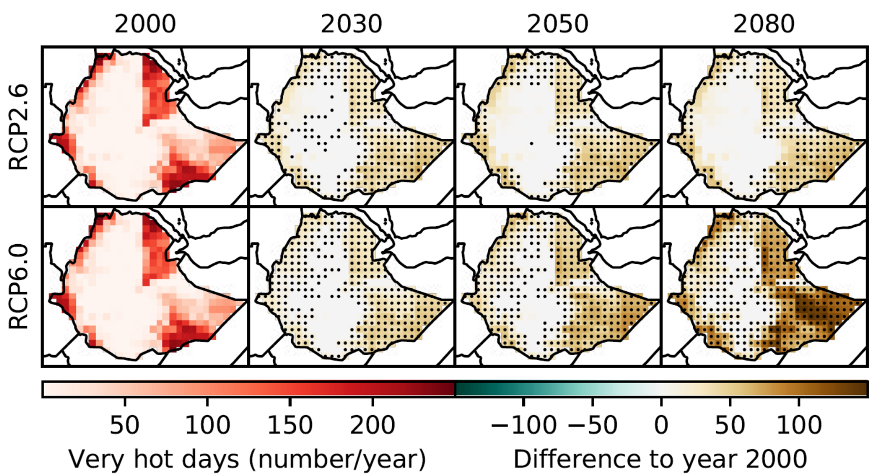


Figure 3: Projections of the annual number of very hot days (daily maximum temperature above 35 °C) for Ethiopia for different GHG emissions scenarios.

Very hot days

In line with rising mean annual temperatures, the annual number of very hot days (days with daily maximum temperature above 35 °C) is projected to rise substantially and with high certainty, in particular over eastern Ethiopia (Figure 3). Under the medium/high emissions scenario RCP6.0, the multi-model median, averaged over the whole country, projects 18 more very hot days per year in 2030 than in 2000, 26 more in 2050 and 50 more in 2080. In some parts, especially in eastern Ethiopia, this amounts to about 200 days per year by 2080.

Climate Risk Profile: BMZ, PIK, GIZ, KfW, 2019

Precipitation

Future projections of precipitation are less certain than projections of temperature change due to high natural year-to-year variability (Figure 4). Out of the three climate models underlying this analysis, one model projects almost no change in mean annual precipitation over Ethiopia, while the other two models project an increase. Median model projections for RCP2.6 show **almost no change in total precipitation per year until 2080**, while median model projections for RCP6.0 show a **precipitation increase of 85 mm per year by 2080** compared to year 2000.

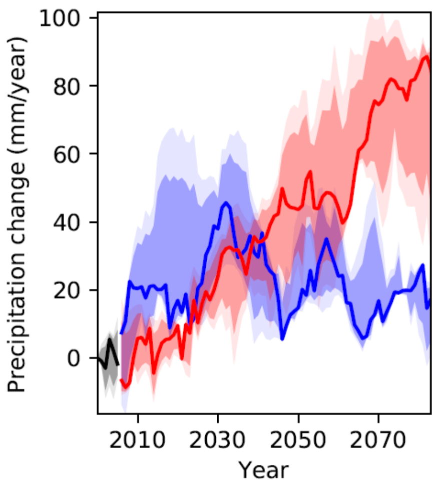


Figure 4: Annual mean precipitation projections for Ethiopia for different GHG emissions scenarios, relative to the year 2000.

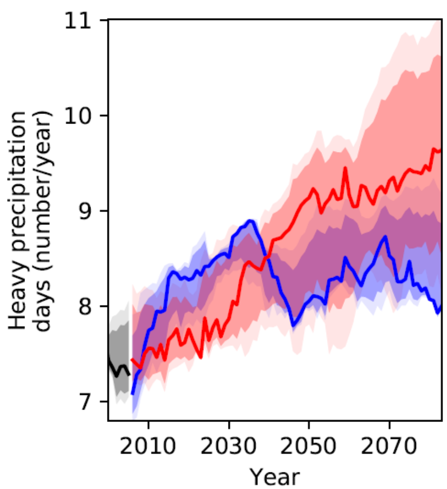


Figure 5: Projections of the number of days with heavy precipitation over Ethiopia for different GHG emissions scenarios.

Heavy precipitation events

In response to global warming, heavy **precipitation events are expected to become more intense** in many parts of the world due to the increased water vapour holding capacity of a warmer atmosphere. At the same time, the number of days with heavy precipitation events is expected to increase. This tendency is also found in climate projections for Ethiopia (Figure 5), with climate models projecting **a slight increase in the number of days with heavy precipitation events**, from 7 days per year in 2000 to 8 days per year in 2080 under RCP2.6 and 9 days per year under RCP6.0 by 2080.

Climate Risk Profile: BMZ, PIK, GIZ, KfW, 2019

b. Agriculture

Agriculture is amongst the sectors most exposed to climate change. Smallholder farmers in Ethiopia are increasingly challenged by the uncertainty and variability of weather that climate change causes. Since crops are predominantly rainfed (only 5 % of the national crop area is irrigated), crop yields depend on water availability and are prone to drought [4]. **Climate change will have a negative impact on maize, which is the most important staple crop** in terms of caloric intake, number of farmers growing it and production volume in Ethiopia [21]. **Millet will also suffer from climate change impacts** (Figure 11). **However, actual yields for both crops will depend on the site and year as well as aggregate, regional and local drivers of crop production.** Non-

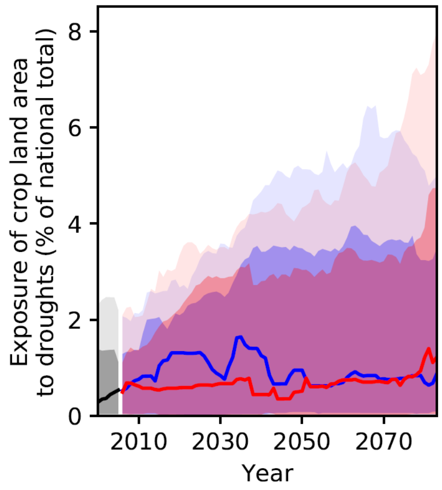


Figure 10: Projections of crop land area exposed to drought at least once a year for Ethiopia for different GHG emissions scenarios.

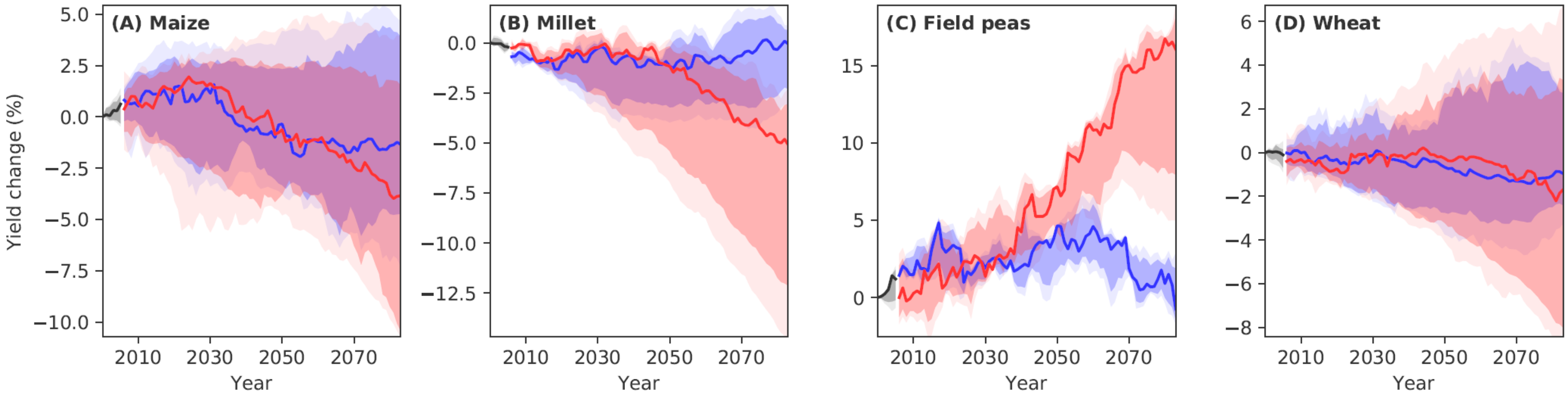


Figure 11: Projections of crop yield changes for major staple crops in Ethiopia for different GHG emissions scenarios assuming constant land use and agricultural management, relative to the year 2000.

Climate Risk Profile: BMZ, PIK, GIZ, KfW, 2019

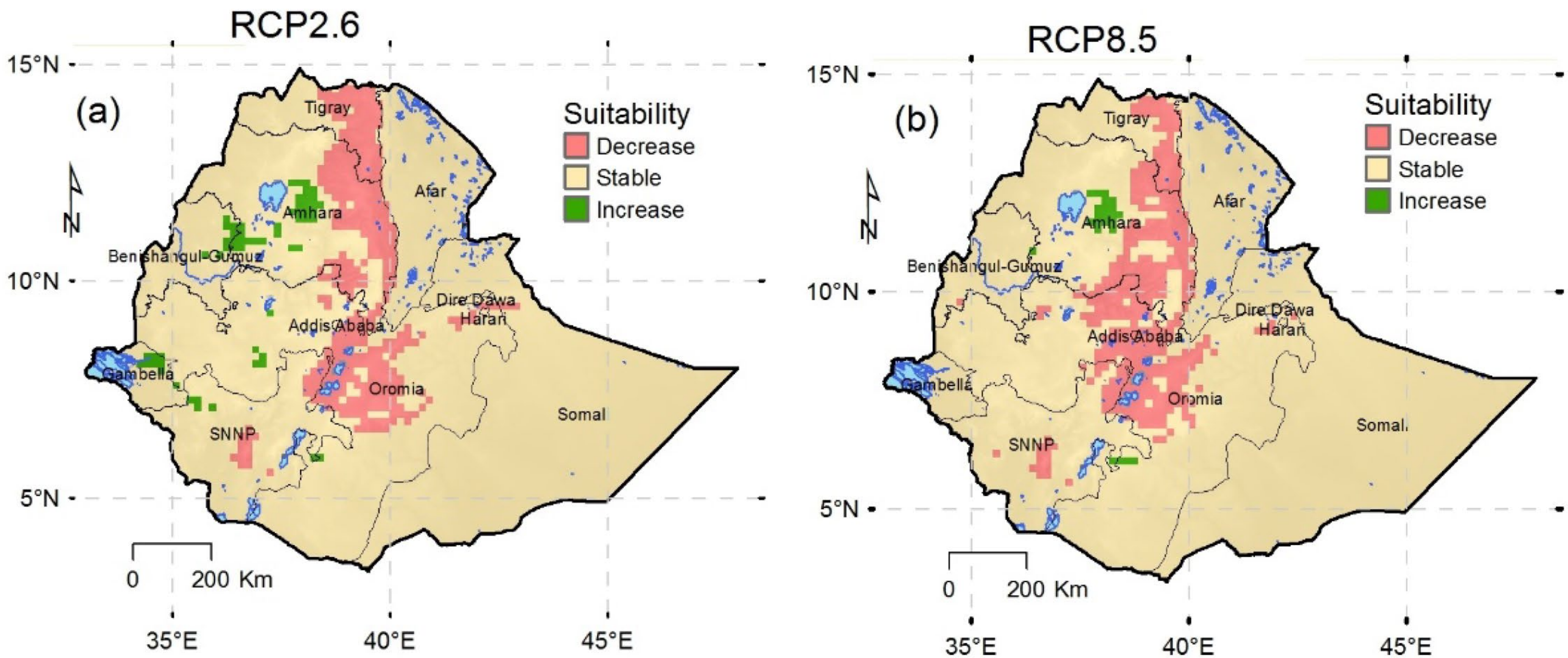


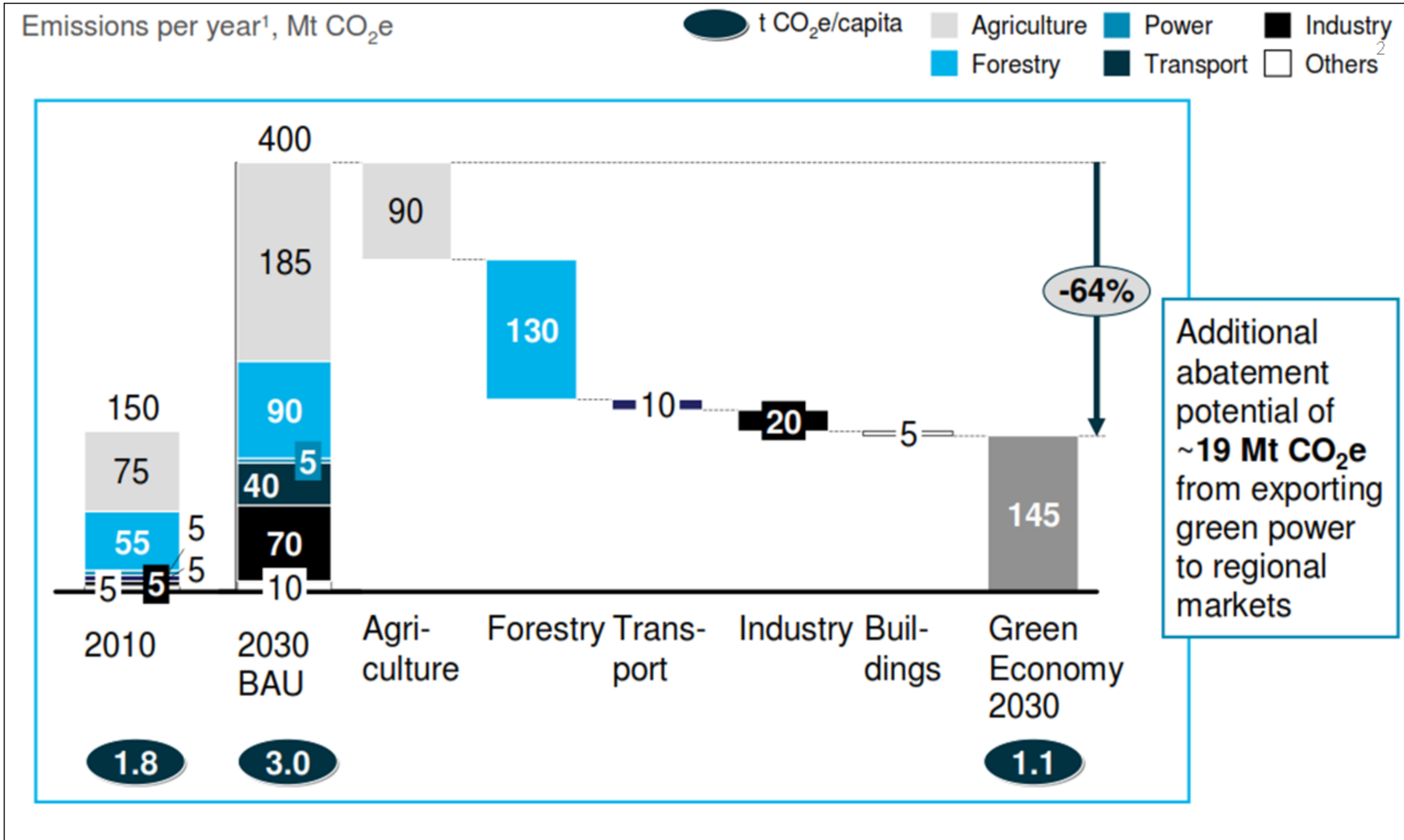
Figure 27: Projected impact of climate change on suitability of wheat under (a) RCP2.6 and (b) RCP8.5 scenarios in Ethiopia by 2050.

Murken, Gornott et al 2019

Goals of Ethiopia - NDC:

- Development of a Climate Resilient Green Economic strategy to address the adverse effects of climate change by building a greener and more resilient economy.
- Contribution to the Paris Agreement through its Nationally Determined Contribution (NDC), which is currently being updated to integrate new realities and renewed ambition.
- Development of a National Adaptation Plan (NAP) to address climate change in the country’s development policy frameworks.
- In 2019, the country launched the Green Legacy for a greener and cleaner Ethiopia, an ambitious undertaking to become a green society by planting various types of eco-friendly trees to combat environmental degradation, with the goal of planting 20 billion trees over five years and restoring about 15 million hectares of forest.

Intended Nationally Determined Contribution (INDC) of the Federal Democratic Republic of Ethiopia



1 Rounded numbers
2 Currently estimated emissions form buildings and waste

Intended Nationally Determined Contribution (INDC) of the Federal Democratic Republic of Ethiopia

Sectors included are Agriculture (livestock and soil), Forestry, Transport, Electric Power, Industry (including mining) and Buildings (including Waste and Green Cities).

The plan to mitigate GHG emissions is built on the following four pillars:

1) Improving crop and livestock production practices for greater food security and higher farmer incomes while reducing emissions;
2) Protecting and re-establishing forests for their economic and ecosystem services, while sequestering significant amounts of carbon dioxide and increasing the carbon stocks in landscapes;
3) Expanding electric power generation from renewable energy;
4) Leapfrogging to modern and energy efficient technologies in transport, industry and building sectors.

Intended Nationally Determined Contribution (INDC) of the Federal Democratic Republic of Ethiopia

The total GHG emissions of Ethiopia in 2010 were 150 Mt CO_2 e. The sectoral GHG emission sources and their quantities were the following:

a. Livestock emitted methane and nitrous oxide totalling 65 Mt CO_2e, i.e. 42% of the total;
b. Crop cultivation emitted nitrous oxide totalling 12 Mt CO_2e, i.e. 9% of the total;
c. Deforestation and forest degradation due to cutting and burning fuel wood and due to logging totalling 55 Mt CO_2e, i.e. 37% of the total;
d. Electric power generation totalling 5 Mt CO_2e, i.e.3% of the total;
e. Transport sector emissions totalling 5 MtCO_2e, i.e. 3% of the total;
f. Industrial sector emissions totalling 4 Mt CO_2e, i.e. 3% of the total;
g. Building sector emissions totalling 5 Mt CO_2e, i.e. 3% of the total.

Intended Nationally Determined Contribution (INDC) of the Federal Democratic Republic of Ethiopia

The emissions reduction, which constitutes a reduction of 255 MtCO_2e or 64% compared to 'business-as-usual' (BAU) emissions in 2030, includes 90 Mt CO_2e from agriculture; 130 Mt CO_2e from forestry; 20 Mt CO_2e from industry; 10 Mt CO_2e from transport; and 5 Mt CO_2e from buildings. This does not include the reduction of 19 Mt CO_2e in neighbouring countries due to the export of electric power to them from Ethiopia.

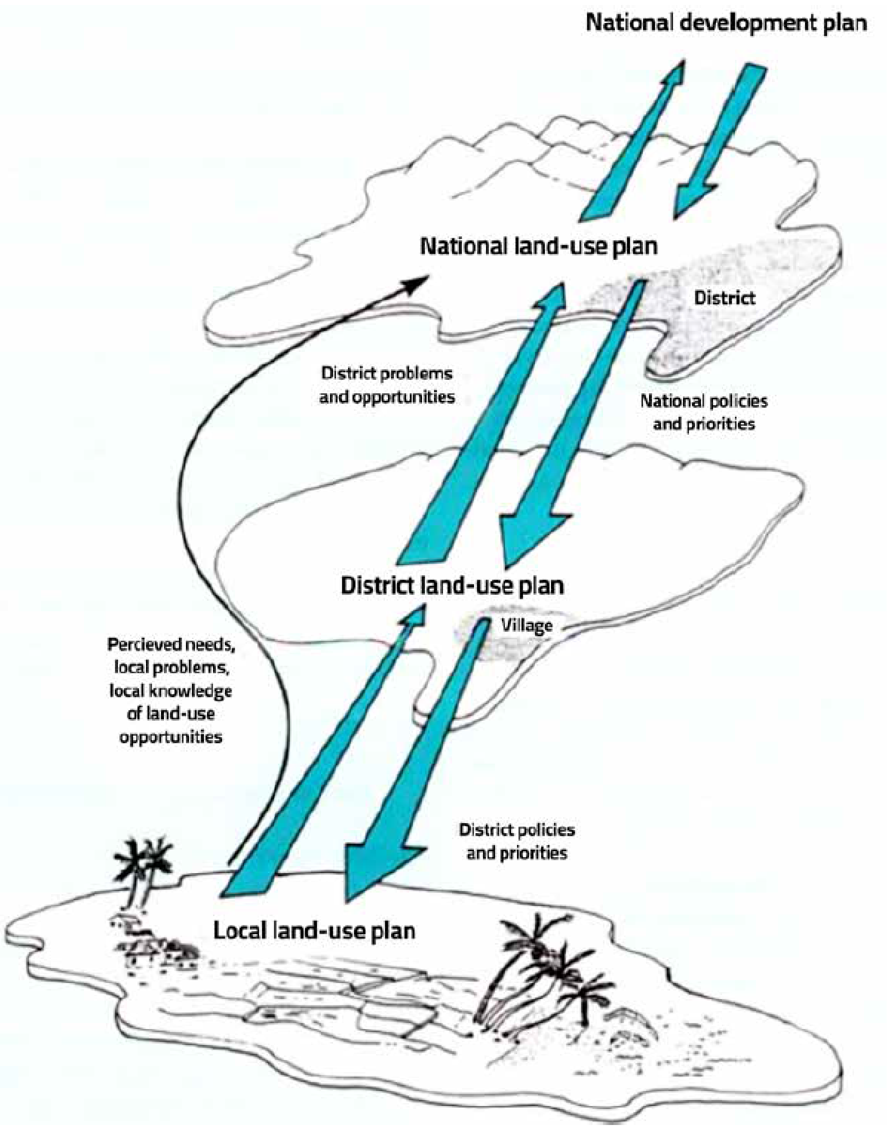
- Measures – what can we do to reduce the emissions

CC-mitigation measures in landuse - planning

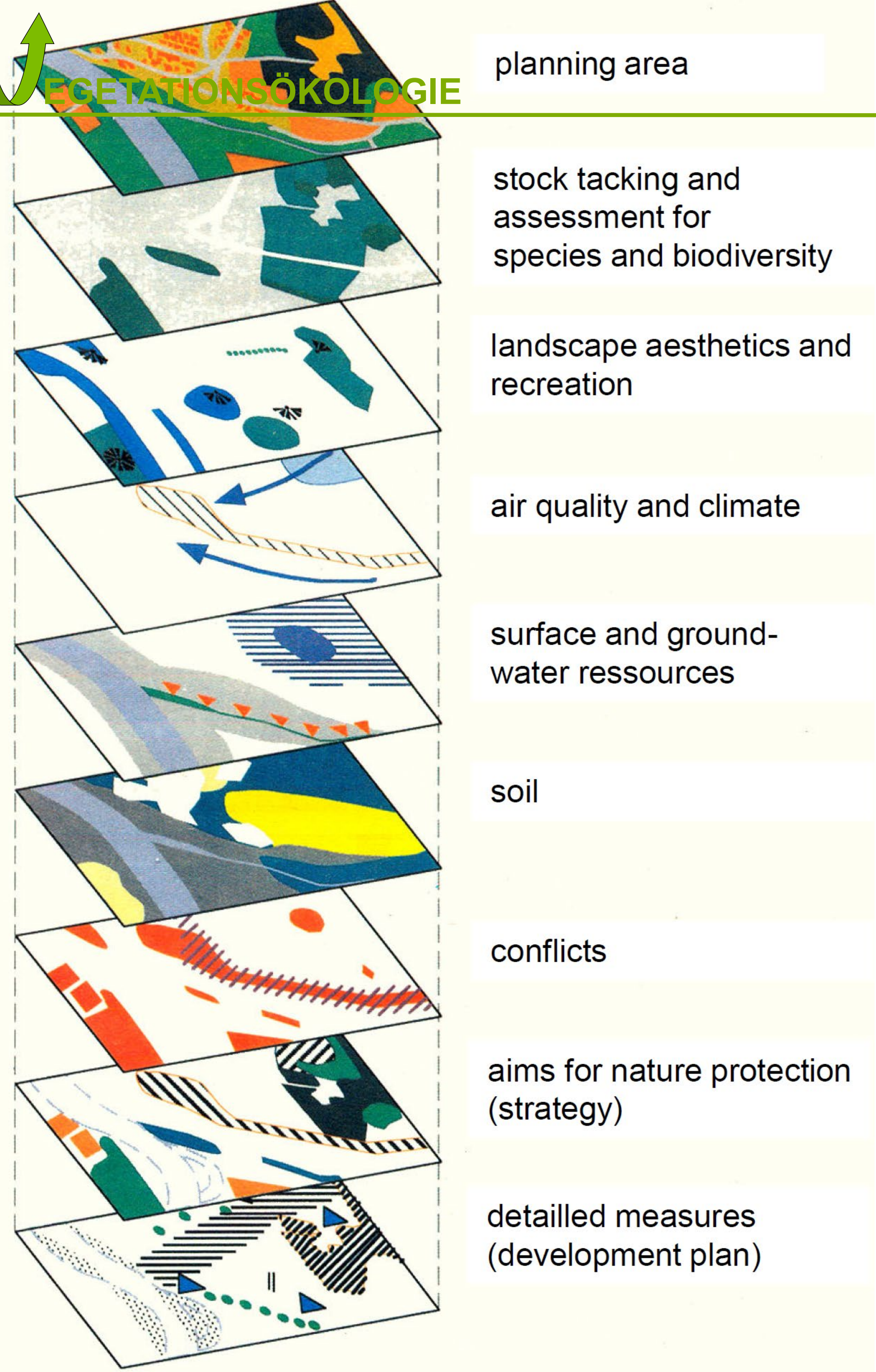
- Mitigation
  - carbon sequestration in soils
  - emission reduction in peatlands
  - reforestation and agroforesty
  - technical solutions

FIGURE 5

Land-use planning at three scales



Source: FAO, 1993



- Landscape planning
  - structural approach
  - Scale 1:10.000

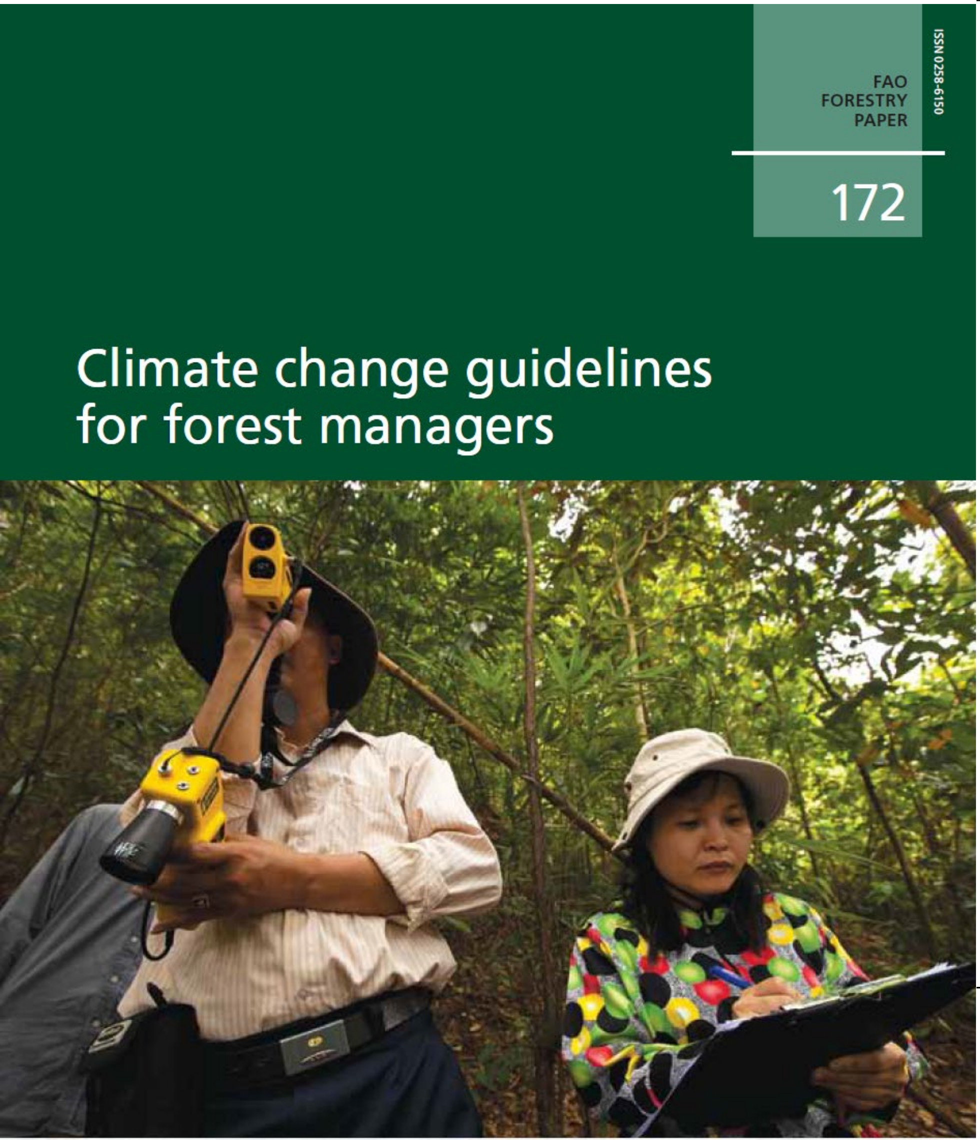
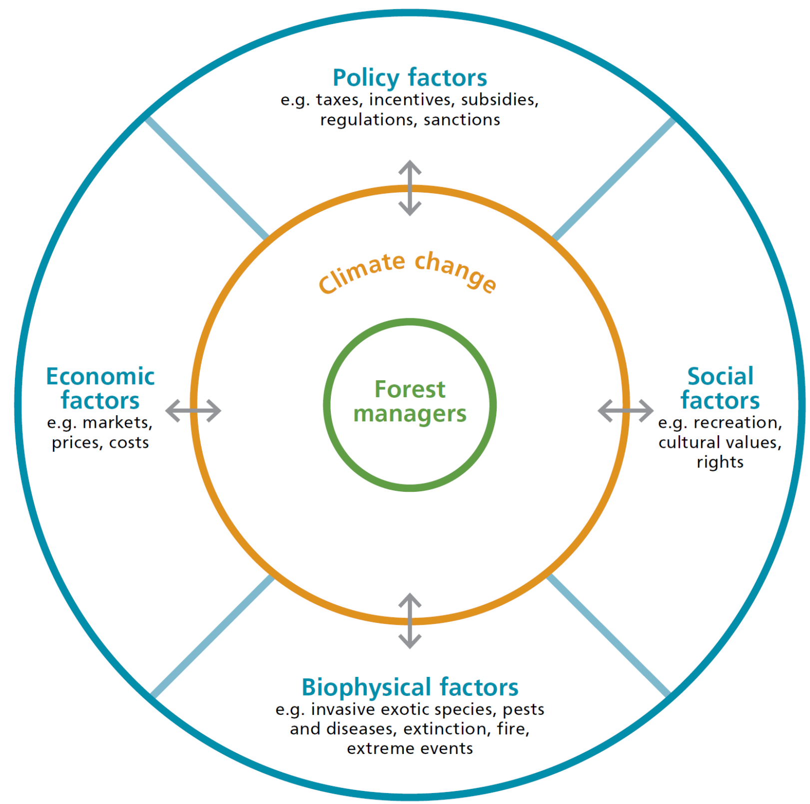


FIGURE 1
Forest managers need to respond to a wide range of factors, all of which may be influenced by climate change



Assessment of Carbon (CO_2) emissions avoidance potential from the Nile Basin peatlands

Despite of peatlands importance in the Nile Basin region, it was only very rarely the target of wetland research (also soil and ecological research) and thus, available data is very rough and partly contradictory. This project aimed at filling in the knowledge gaps of peatlands distribution and degradation status, identify main land-use types associated with peatlands in the region and quantify the CO_2 emissions avoidance potential.

Elshehawi, S. et al 2020

CC-mitigation measures in landuse – planning – efficieny of measures

- Mitigation
  - carbon sequestration in soils:
    - max 1-2 t CO_2-eq /ha*a
  - reforestation and agroforesty
    - About 10 t CO_2-eq /ha*a
  - emission reduction in peatlands
    - Up to 20 t CO_2-eq /ha*a
  - technical solutions
    - Dependig on the topic

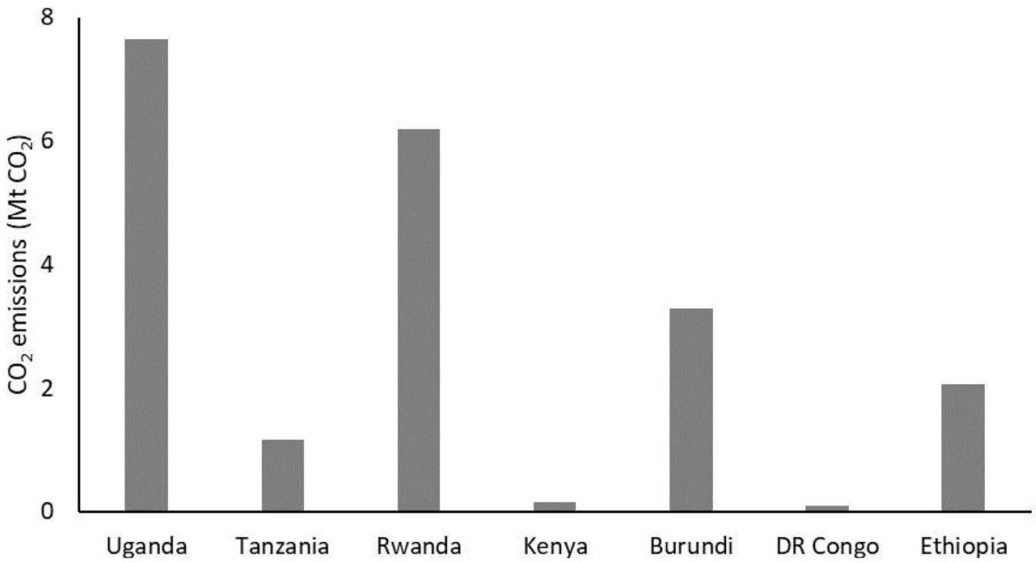


Figure 1. Average annual CO_2 emissions from drained peatlands within the various Nile Basin countries in a business-as-usual scenario for the period 2015-2050 (cf. Technical Report). Note that national emissions from drained peatlands outside the Nile Basin are not included and that information for S. Sudan, Sudan and Egypt is currently unavailable.

CC-mitigation measures in landuse - planning

- Scenarios of landscape development
- Planning of spatially explicit measures for Adaptation and Mitigation
- Application of MRV*-criteria for the
- Evaluation of the measures in comparison to a baseline scenario

- Thanks for your attention!