Agriculture Used Area and world population increase: present and future situation

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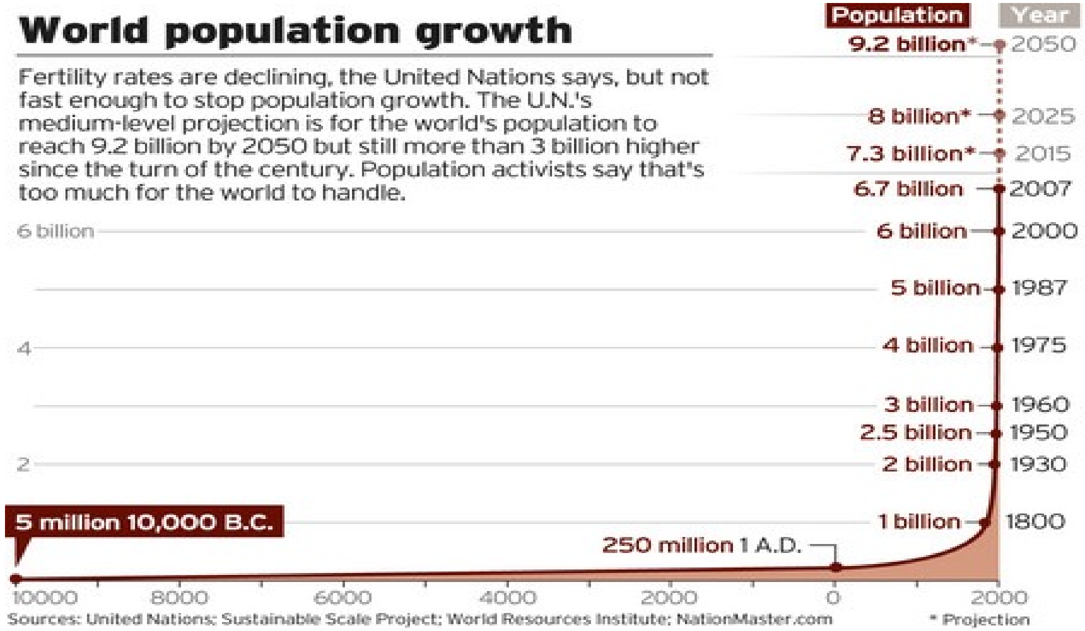
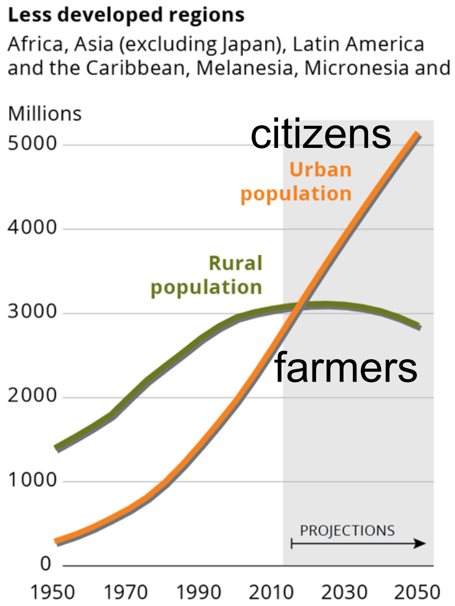
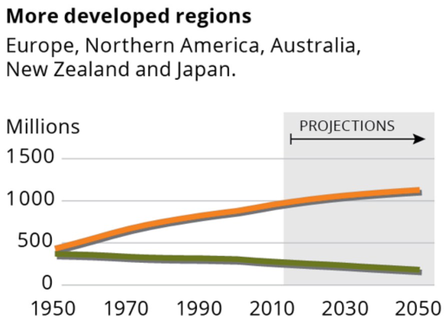
CMCC Foundation, Lecce, Italy

Human Transition 1/4



CIBO IN CITTA'
(Homo Urbanus)

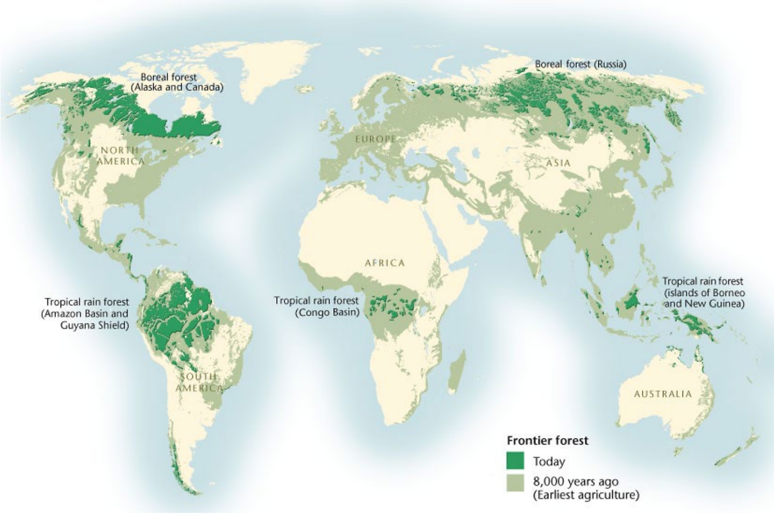




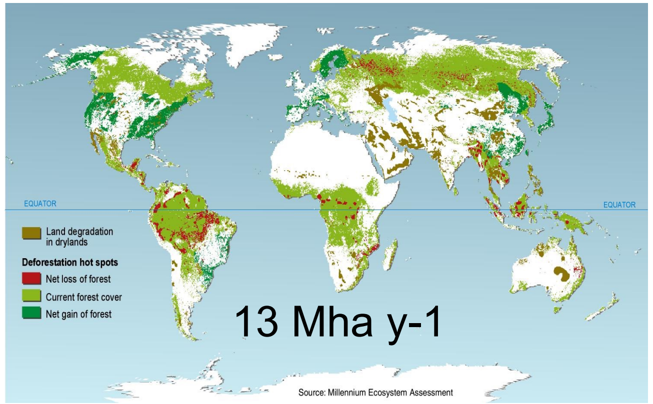
1. The need of higher production with less labour requirements
2. Food processing and transformation for feeding urban humans
3. Changes in cultural lifestyles and food consumption patterns
4. Food and packaging waste
5. Energy consumption
6. Volatility of prices
7. Climate change impacts on food production

Human Transition 2/4

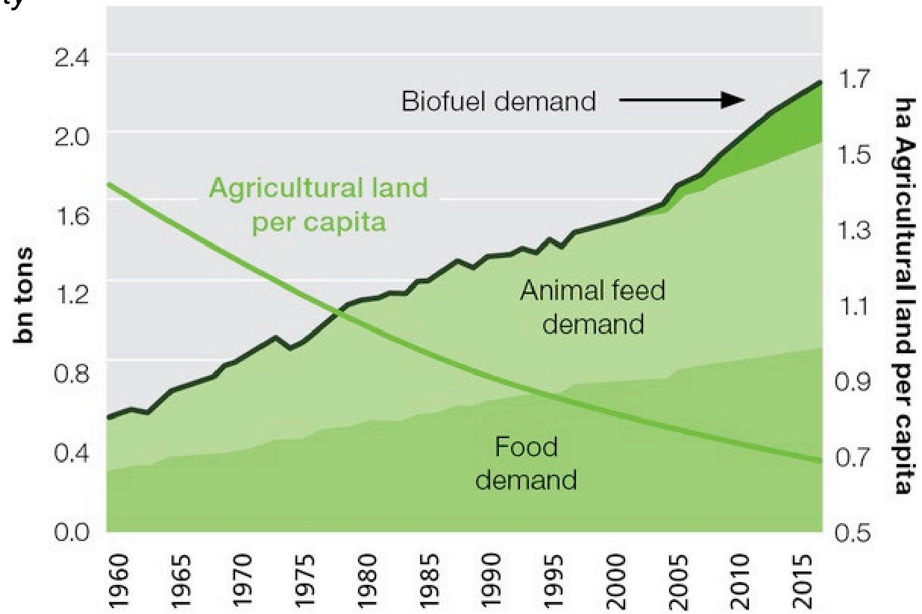
Natural Forests

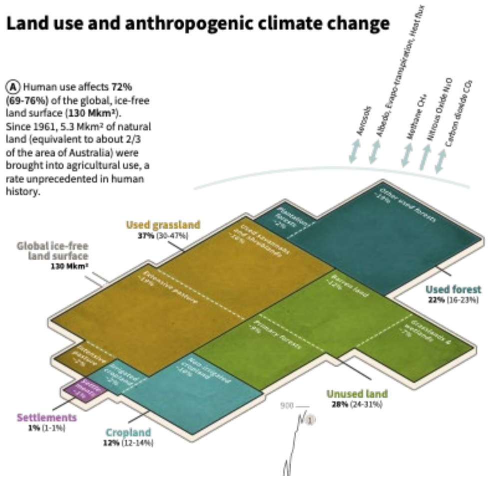


Tropica Deforestation



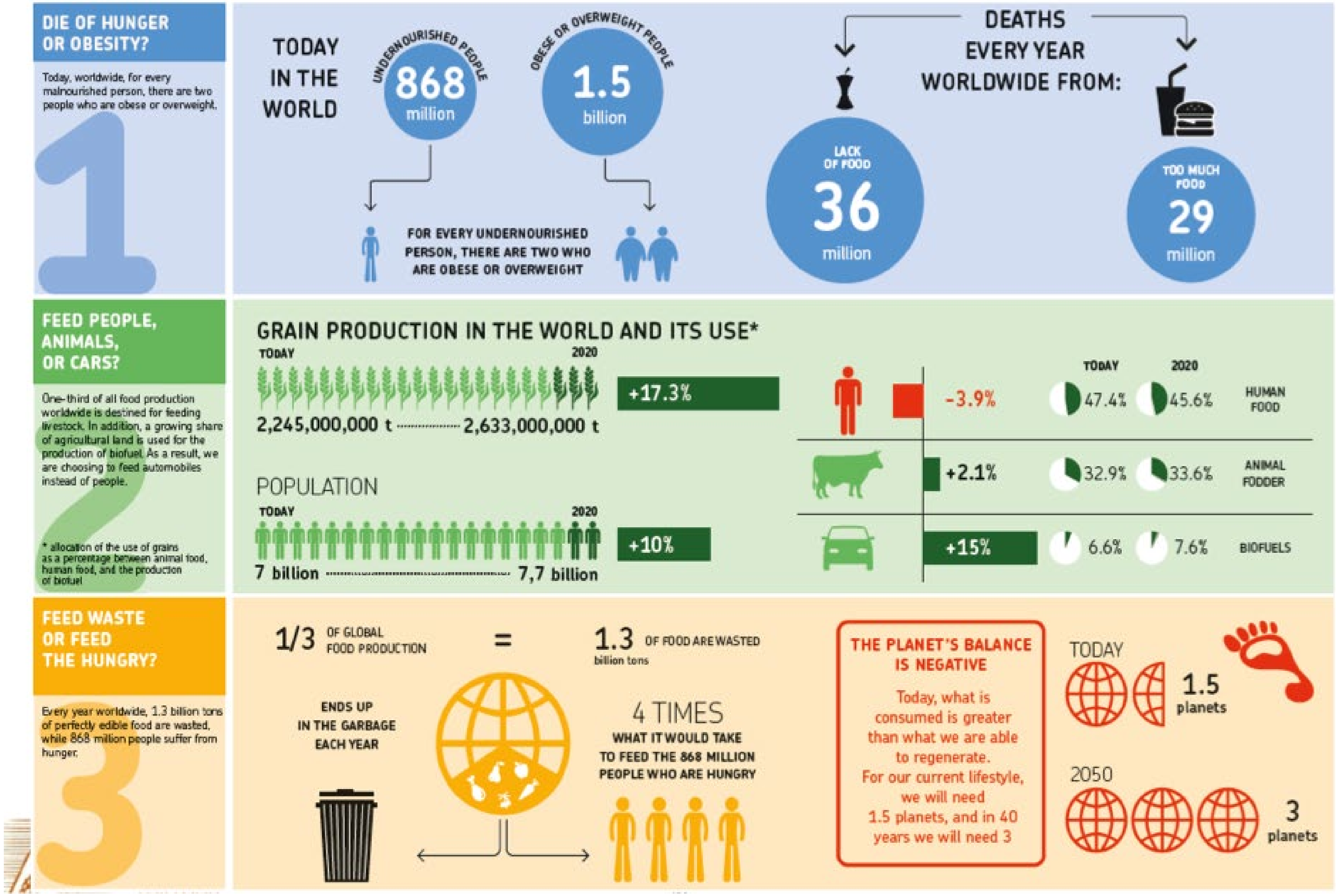
Land availability





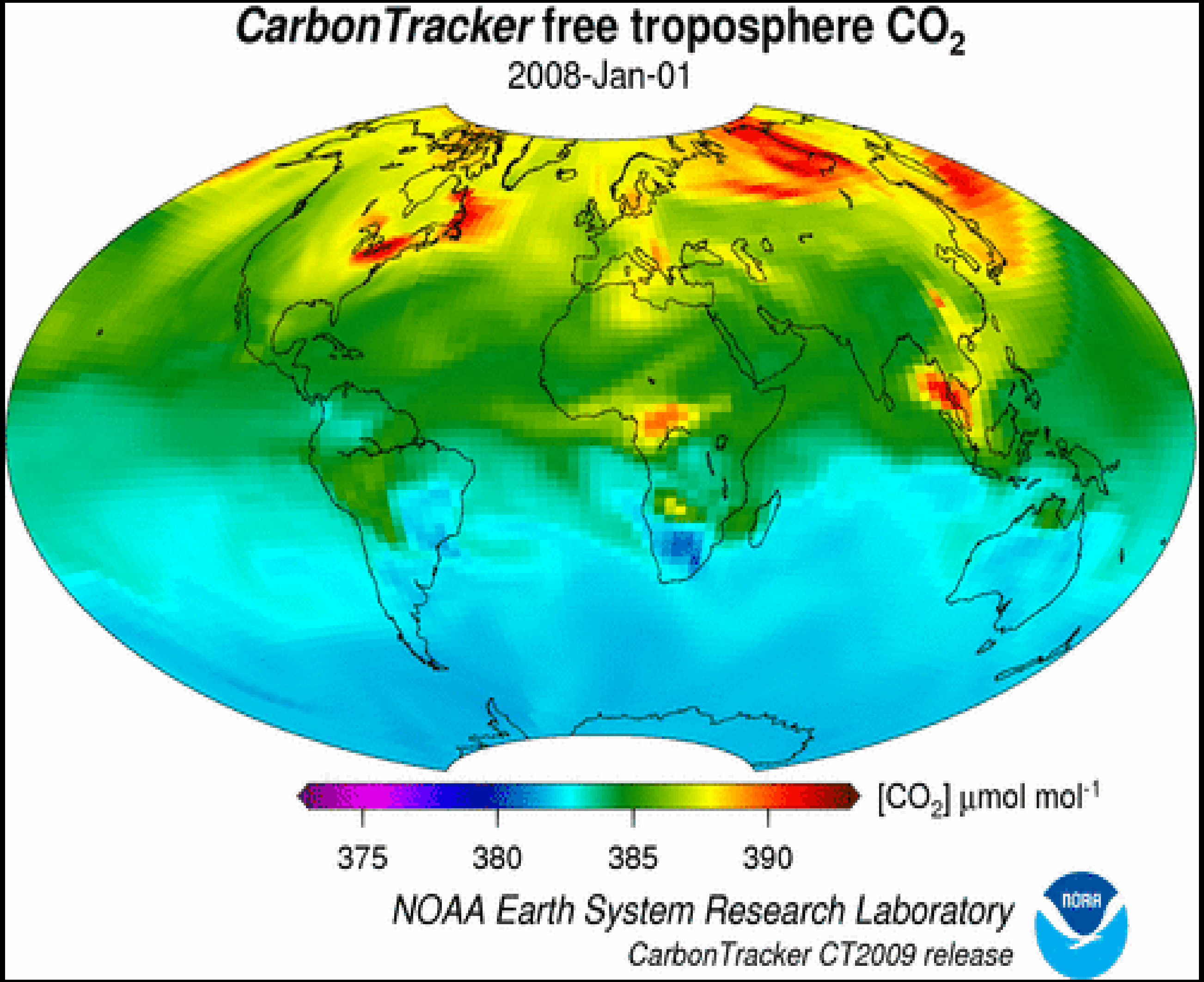
73% of Earth surface (excluding ice) is used by humans

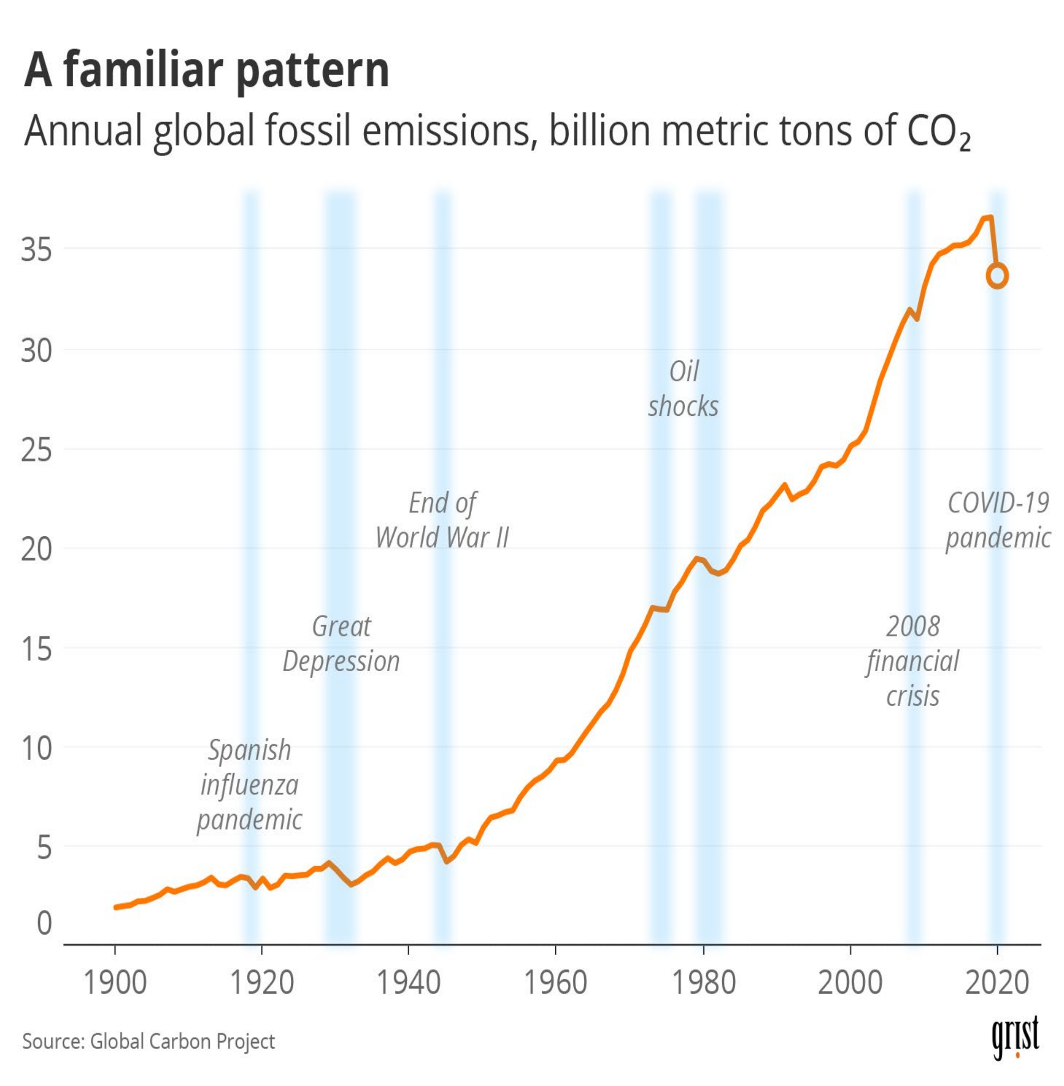
Human Transition 3/4



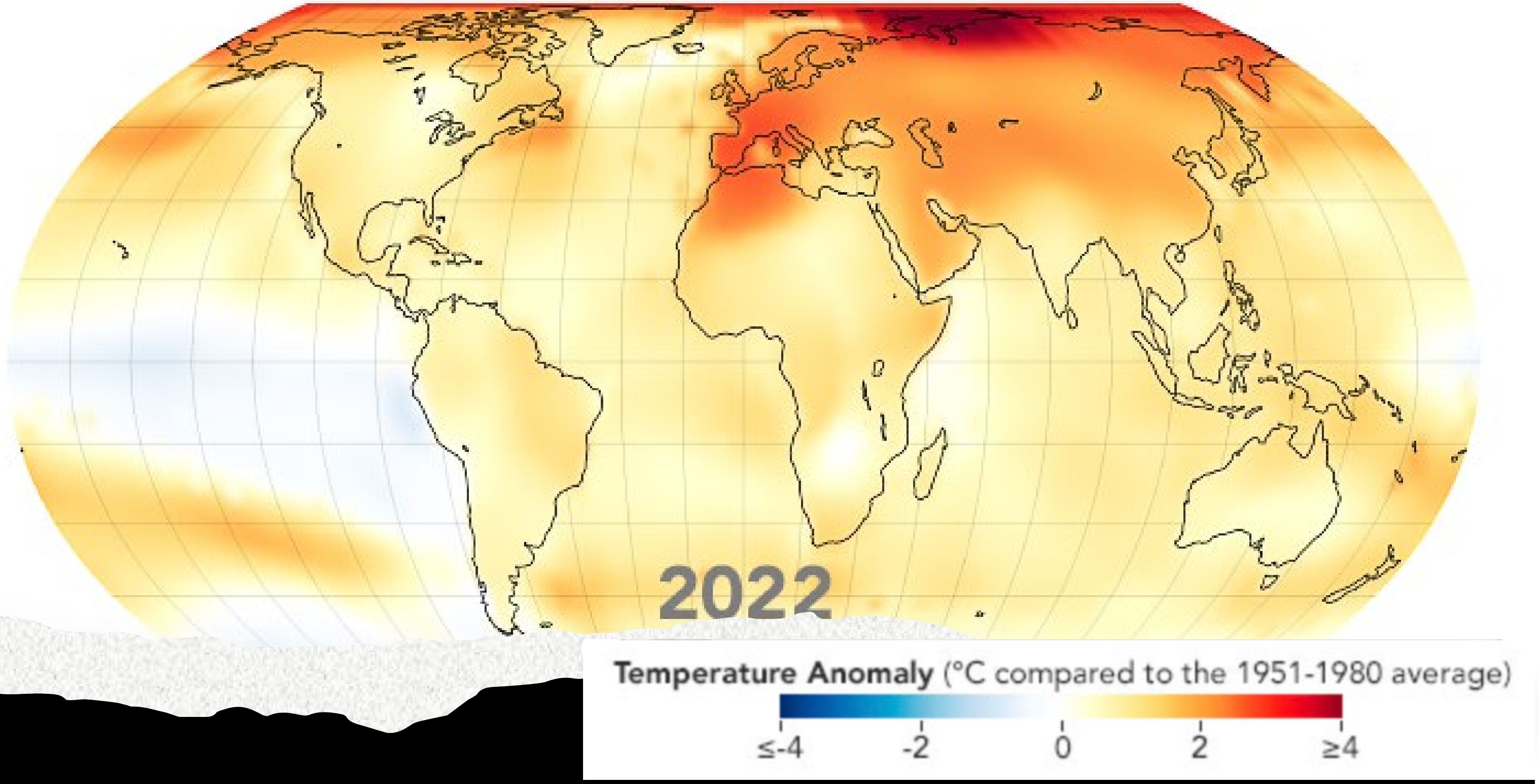
CO2 is rising !

Human Transition 4/4





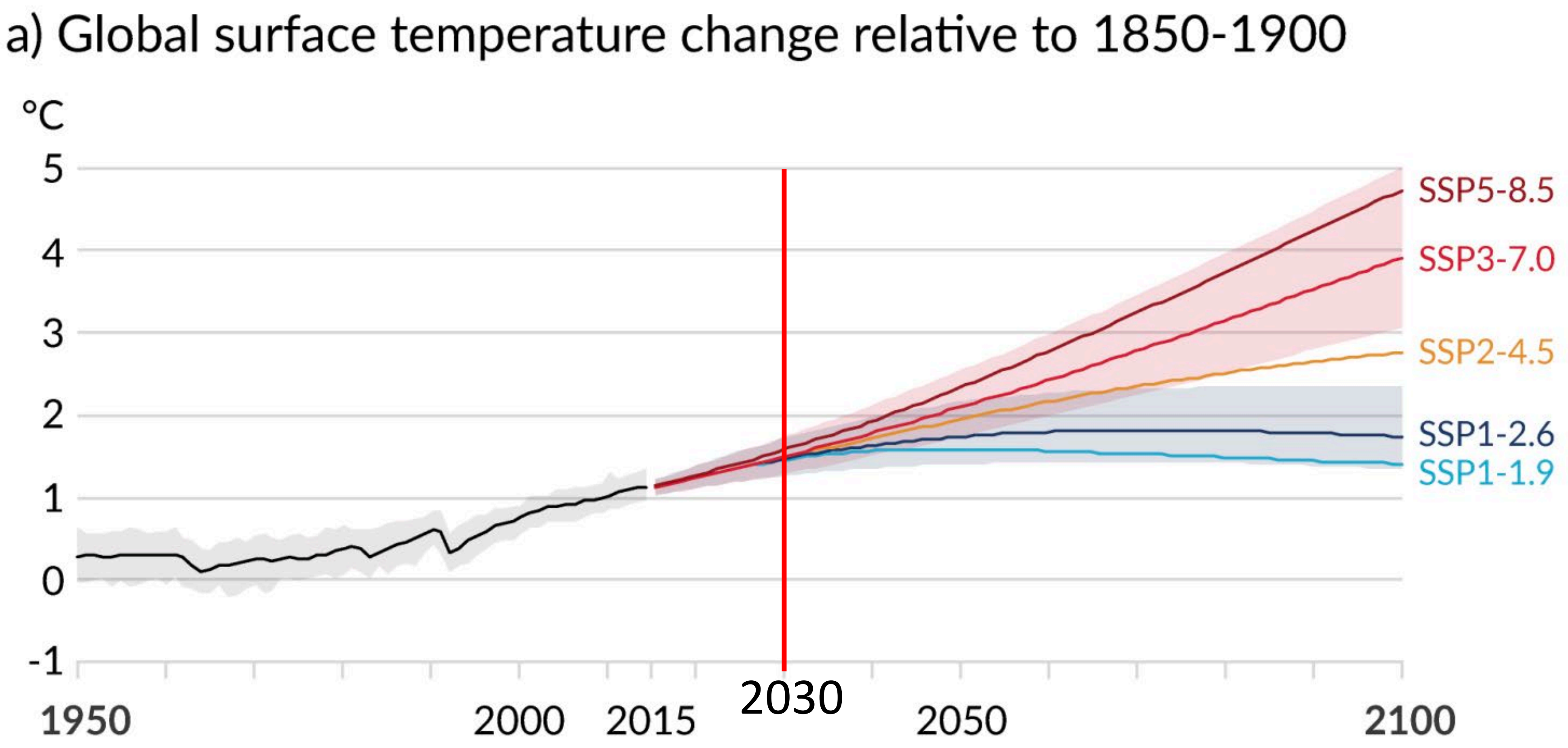
Nov 10, 2023 = 419.44 ppm
Nov 10, 2022 = 416.92 ppm

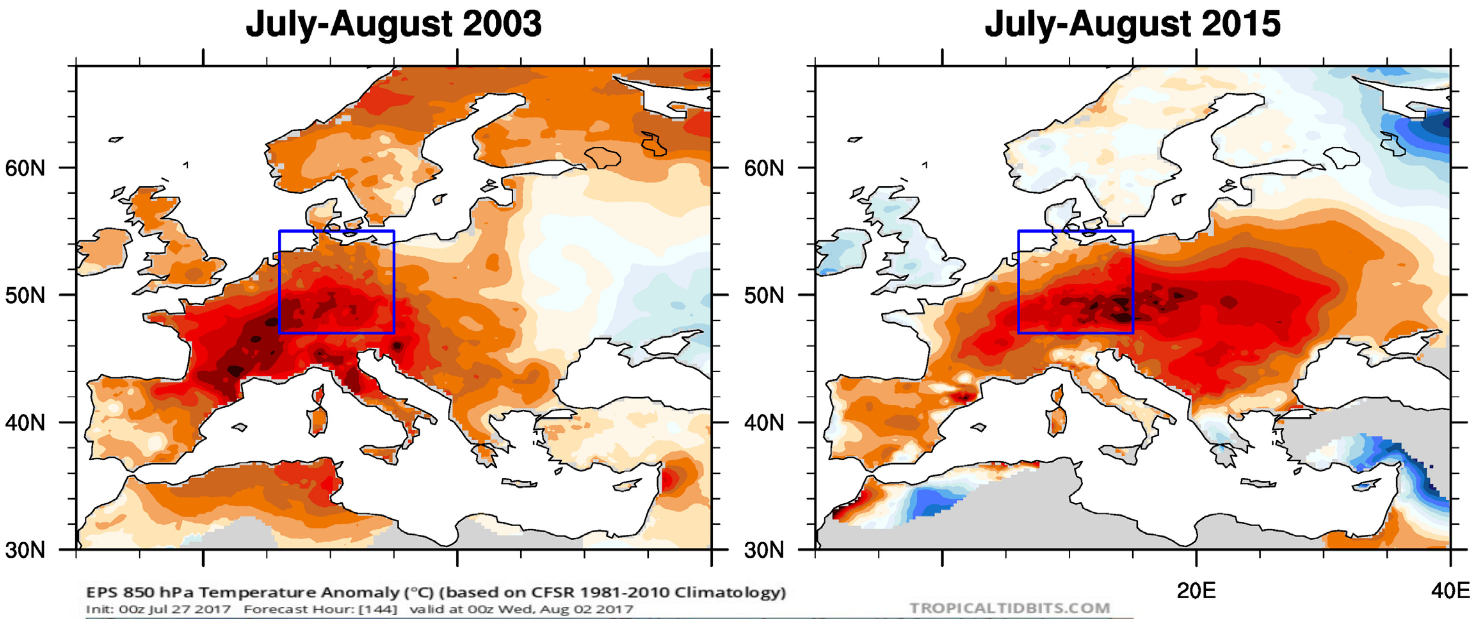


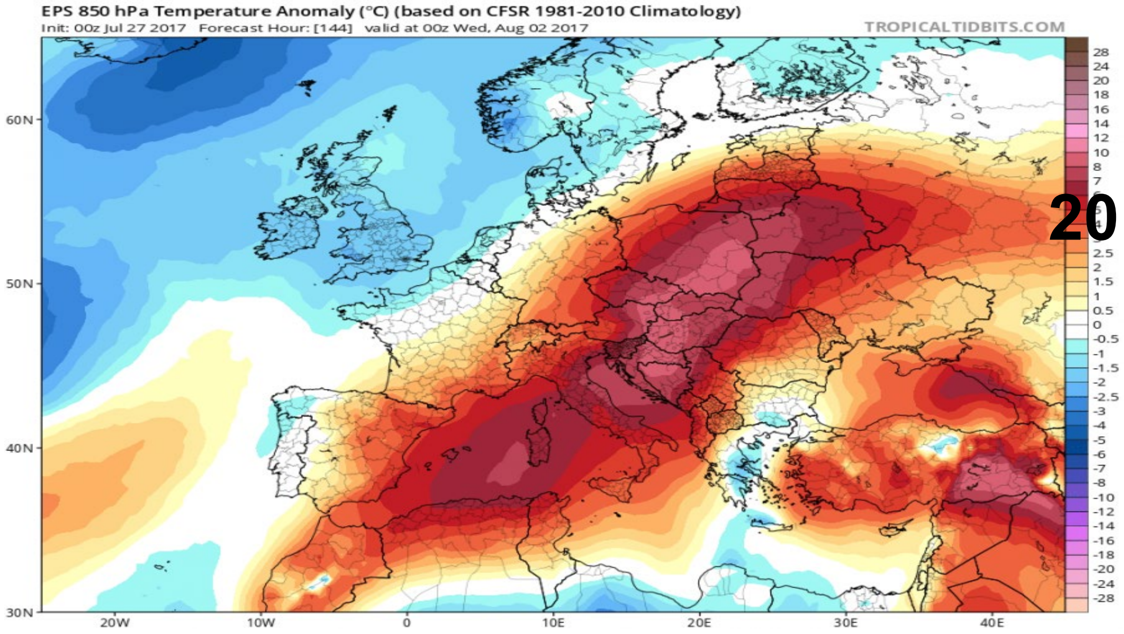
Warming is up !

Human activities affect all the major climate system components, with some responding over decades and others over centuries

Figure SPM.8



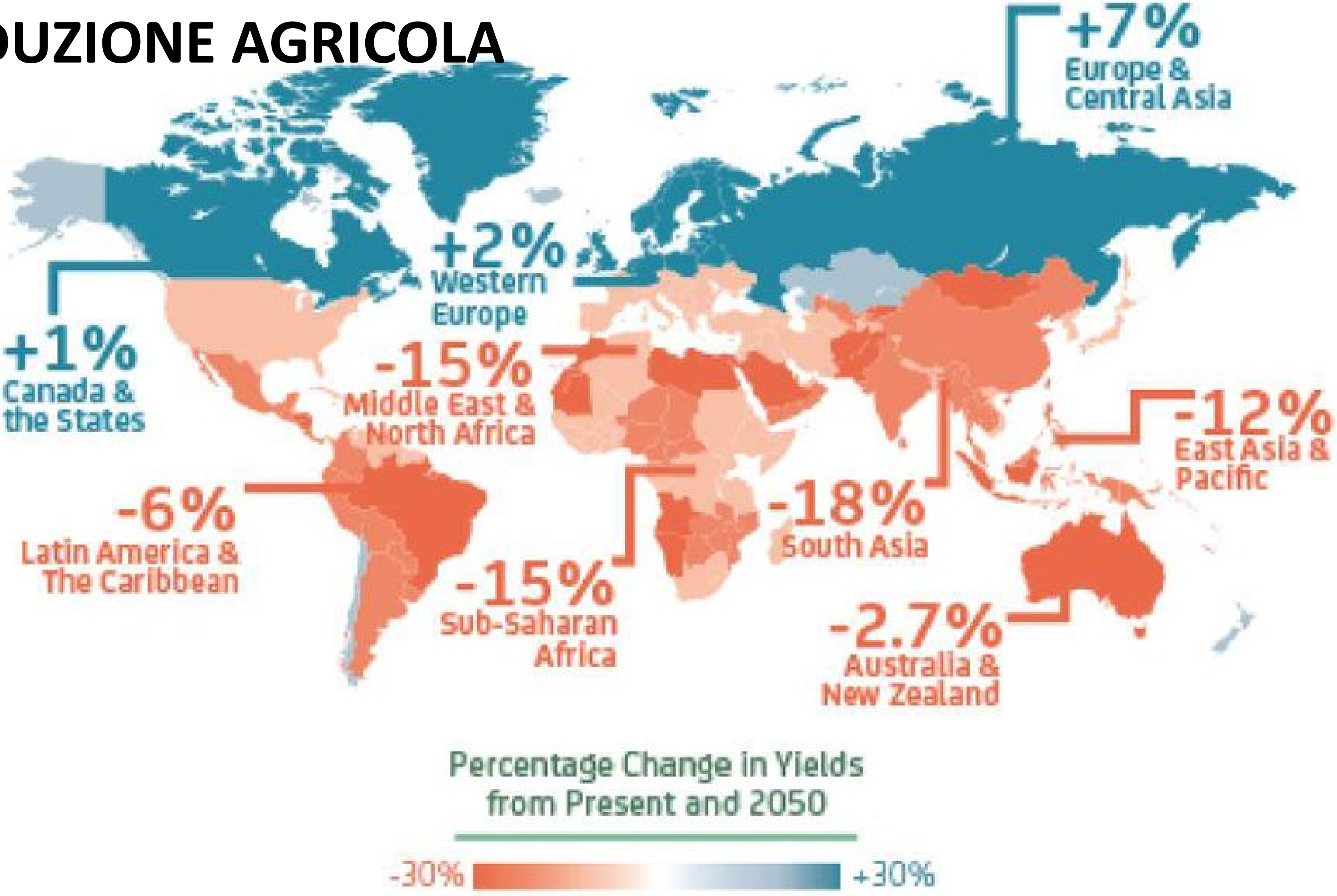




2017 July -August

ONDATE DI CALORE

PRODUZIONE AGRICOLA



Water

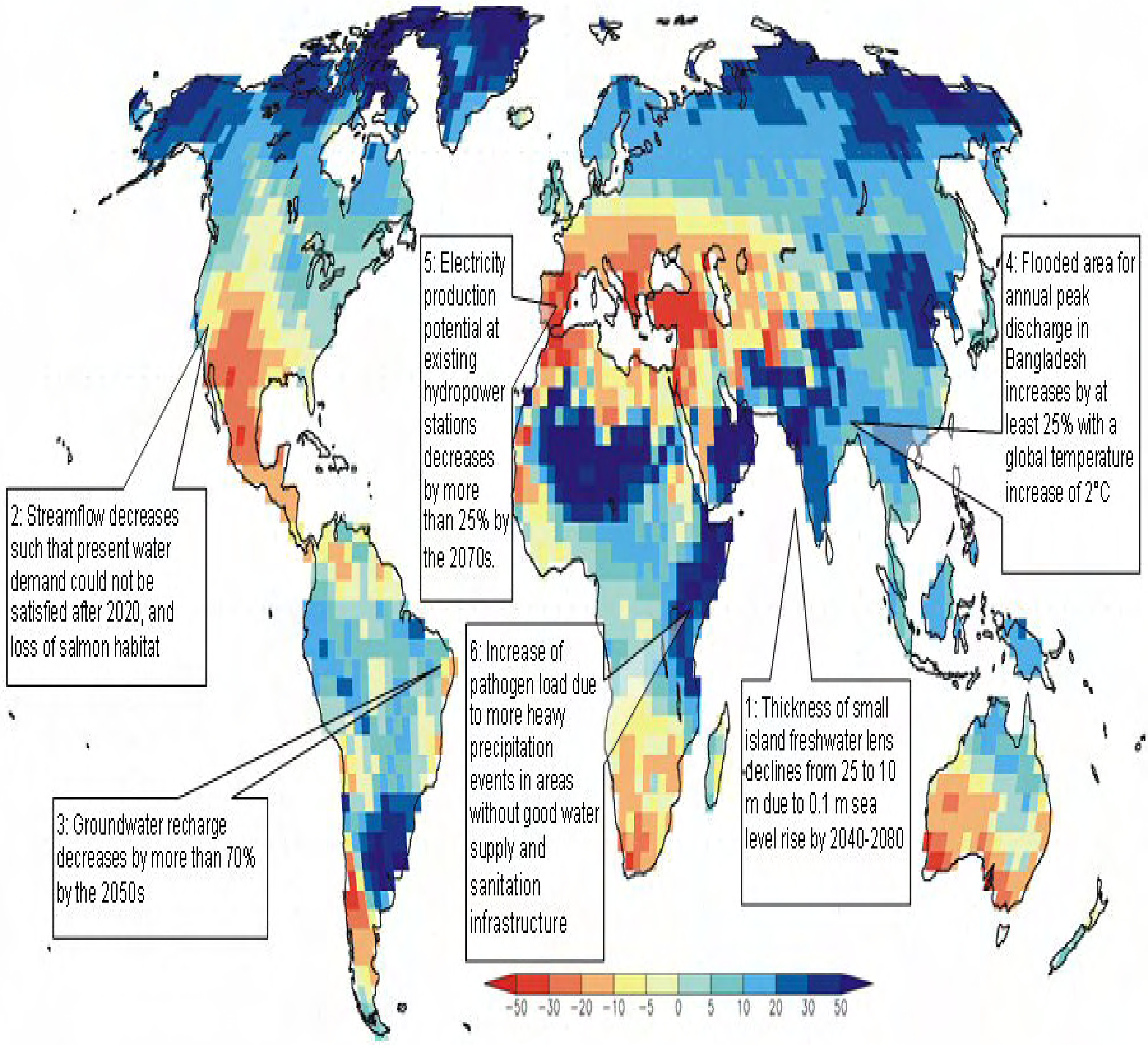
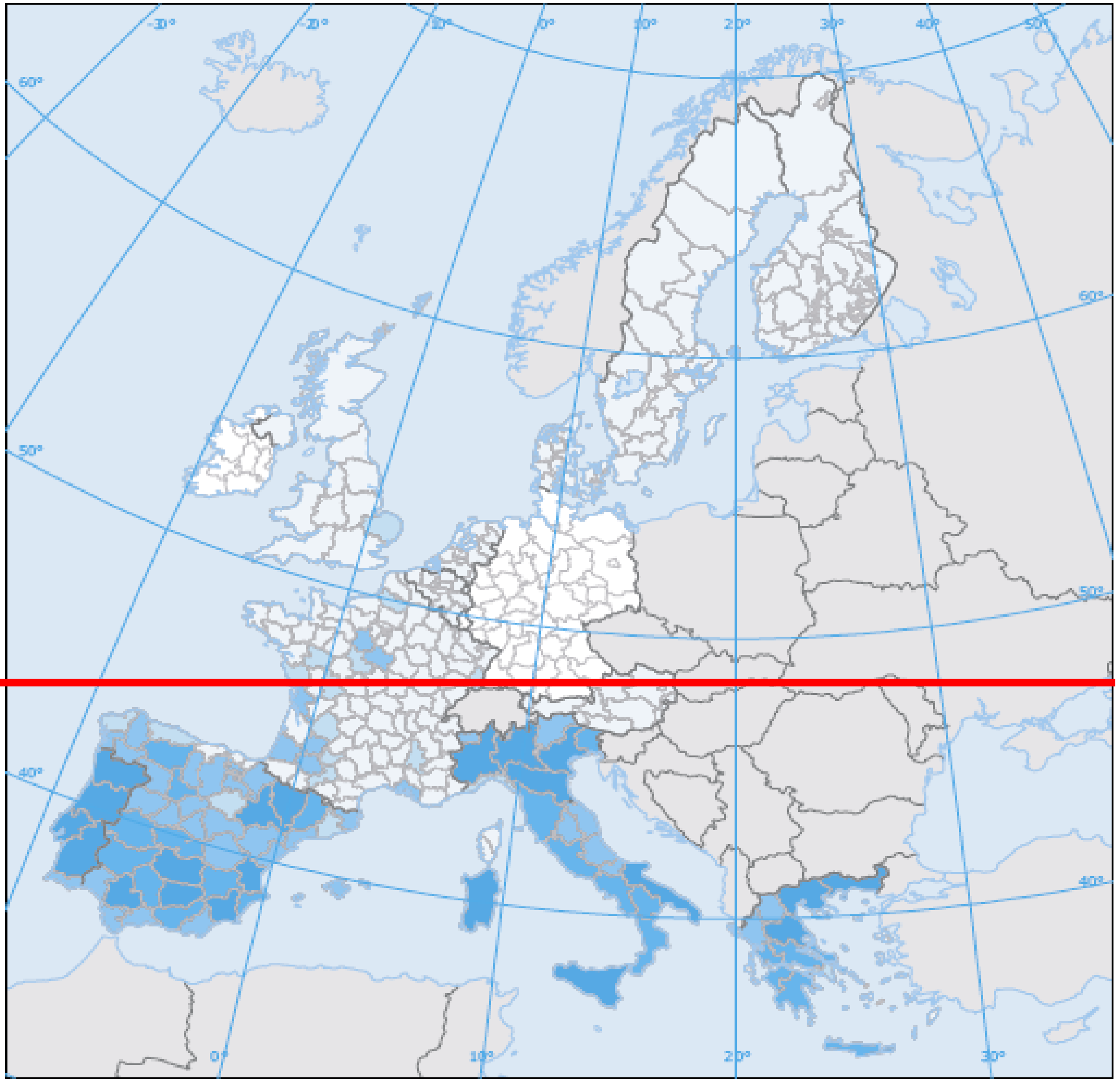

2: Streamflow decreases such that present water demand could not be satisfied after 2020, and loss of salmon habitat
3: Groundwater recharge decreases by more than 70% by the 2050s
5: Electricity production potential at existing hydropower stations decreases by more than 25% by the 2070s.
6: Increase of pathogen load due to more heavy precipitation events in areas without good water supply and sanitation infrastructure
1: Thickness of small island freshwater lens declines from 25 to 10 m due to 0.1 m sea level rise by 2040-2080
4: Flooded area for annual peak discharge in Bangladesh increases by at least 25% with a global temperature increase of 2°C
-50 -30 -20 -10 -5 0 5 10 20 30 50

Figure 4.2 **Regional water abstraction rates for agriculture (million m³/year) during 2000 (³¹)**

LOW

HIGH



Regional water abstraction

(million m³/year)

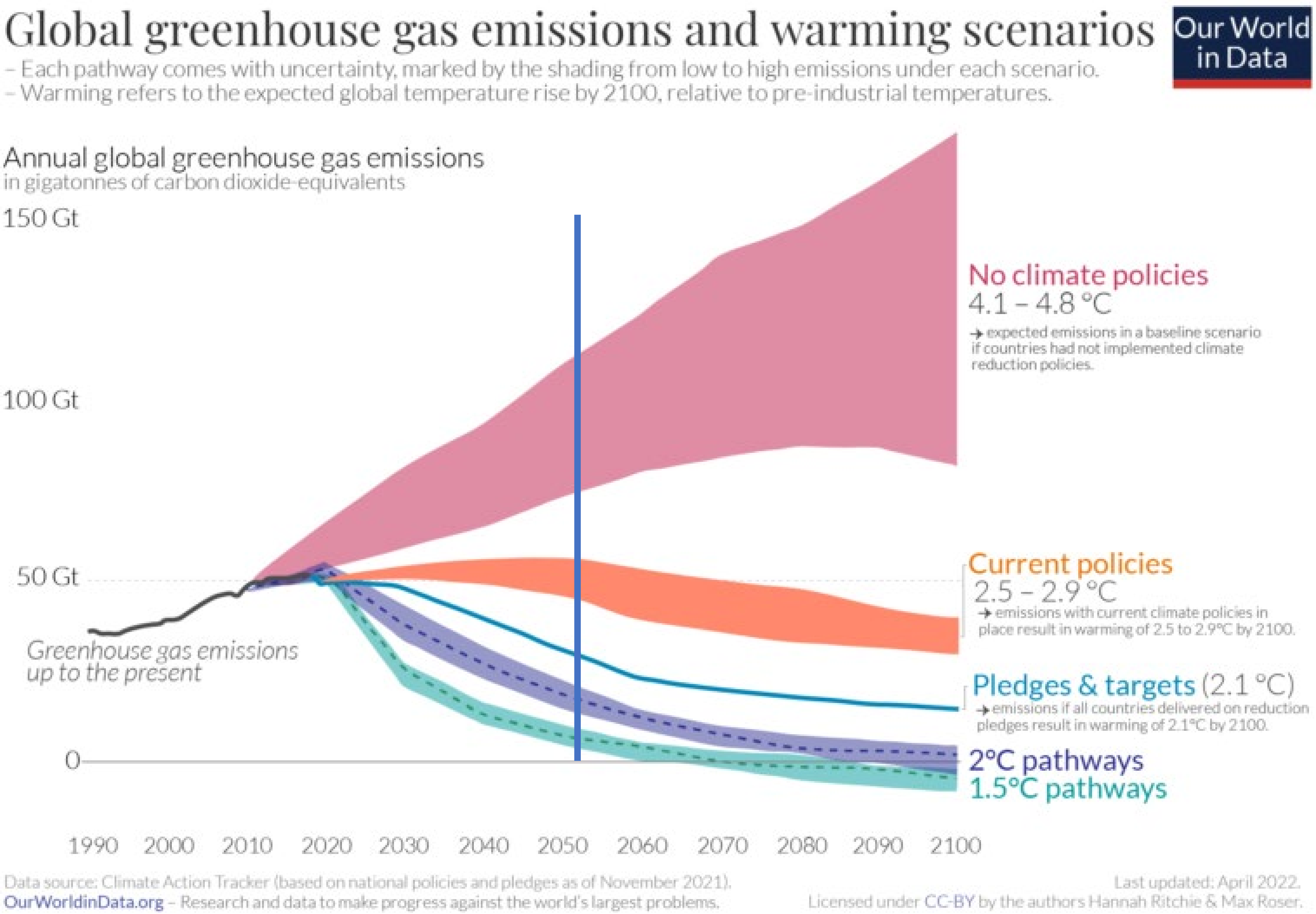
- 0–50
- 50–100
- 100–500
- 500–1 000
- > 1 000
- No data
- Non EU-15
- NUTS region (*)

(*) NUTS 1: the United Kingdom.
NUTS 2: Austria, Belgium, Germany, Greece, Italy, Luxembourg, the Netherlands and Portugal.
NUTS 3: Denmark, Finland, France, Ireland, Spain and Sweden.

NUTS = Nomenclature of territorial units for statistics.

Source: Community survey on the structure of agricultural holdings (FSS), Eurostat combined with information from OECD/Eurostat questionnaire.

From EEA Report, 2005



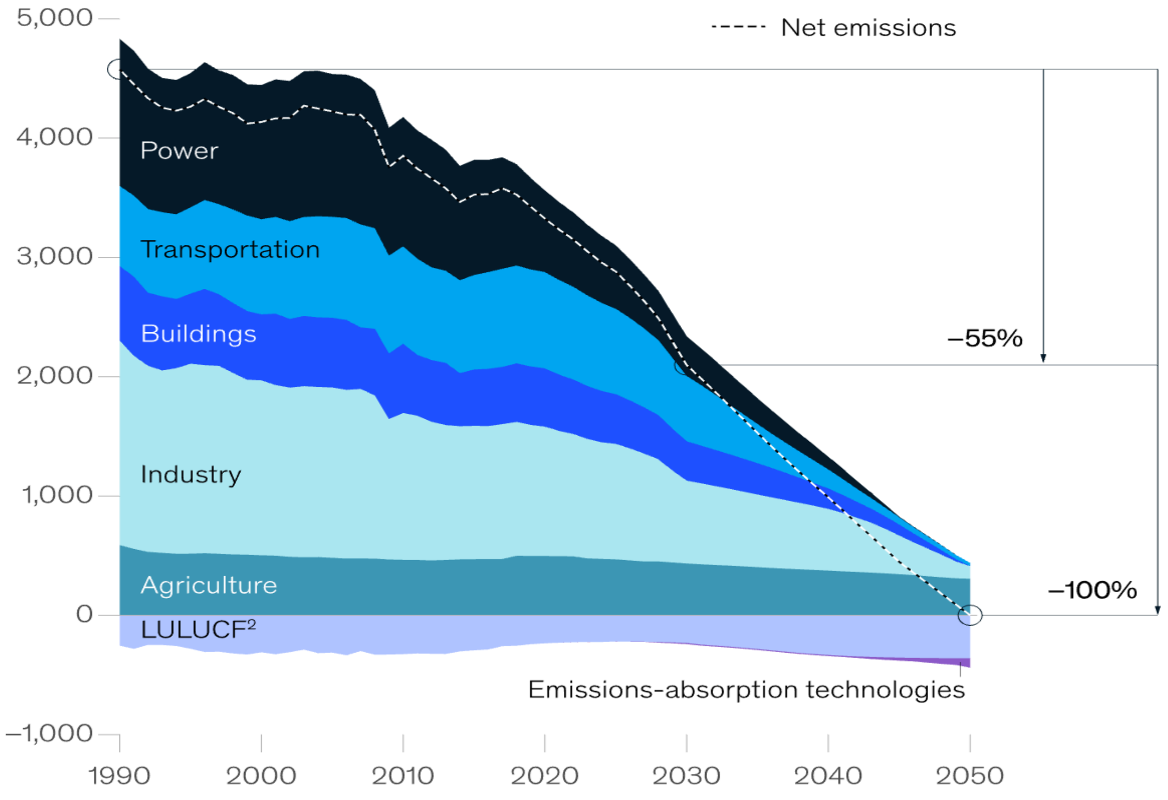
Global greenhouse gas emissions and warming scenarios
Our World in Data
– Each pathway comes with uncertainty, marked by the shading from low to high emissions under each scenario.
– Warming refers to the expected global temperature rise by 2100, relative to pre-industrial temperatures.
Annual global greenhouse gas emissions
in gigatonnes of carbon dioxide-equivalents
150 Gt
100 Gt
50 Gt
0
No climate policies
4.1 – 4.8 °C
→ expected emissions in a baseline scenario if countries had not implemented climate reduction policies.
Current policies
2.5 – 2.9 °C
→ emissions with current climate policies in place result in warming of 2.5 to 2.9°C by 2100.
Pledges & targets (2.1 °C)
→ emissions if all countries delivered on reduction pledges result in warming of 2.1°C by 2100.
2°C pathways
1.5°C pathways
Greenhouse gas emissions up to the present
1990 2000 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100
Data source: Climate Action Tracker (based on national policies and pledges as of November 2021).
OurWorldinData.org – Research and data to make progress against the world's largest problems.
Last updated: April 2022.
Licensed under CC-BY by the authors Hannah Ritchie & Max Roser.

The «resistent» Agricultural sector

Exhibit 3

The power sector would reach net-zero emissions before the others.

Total emissions per sector in cost-optimal pathway for EU-27,[1] megatons of carbon dioxide equivalent



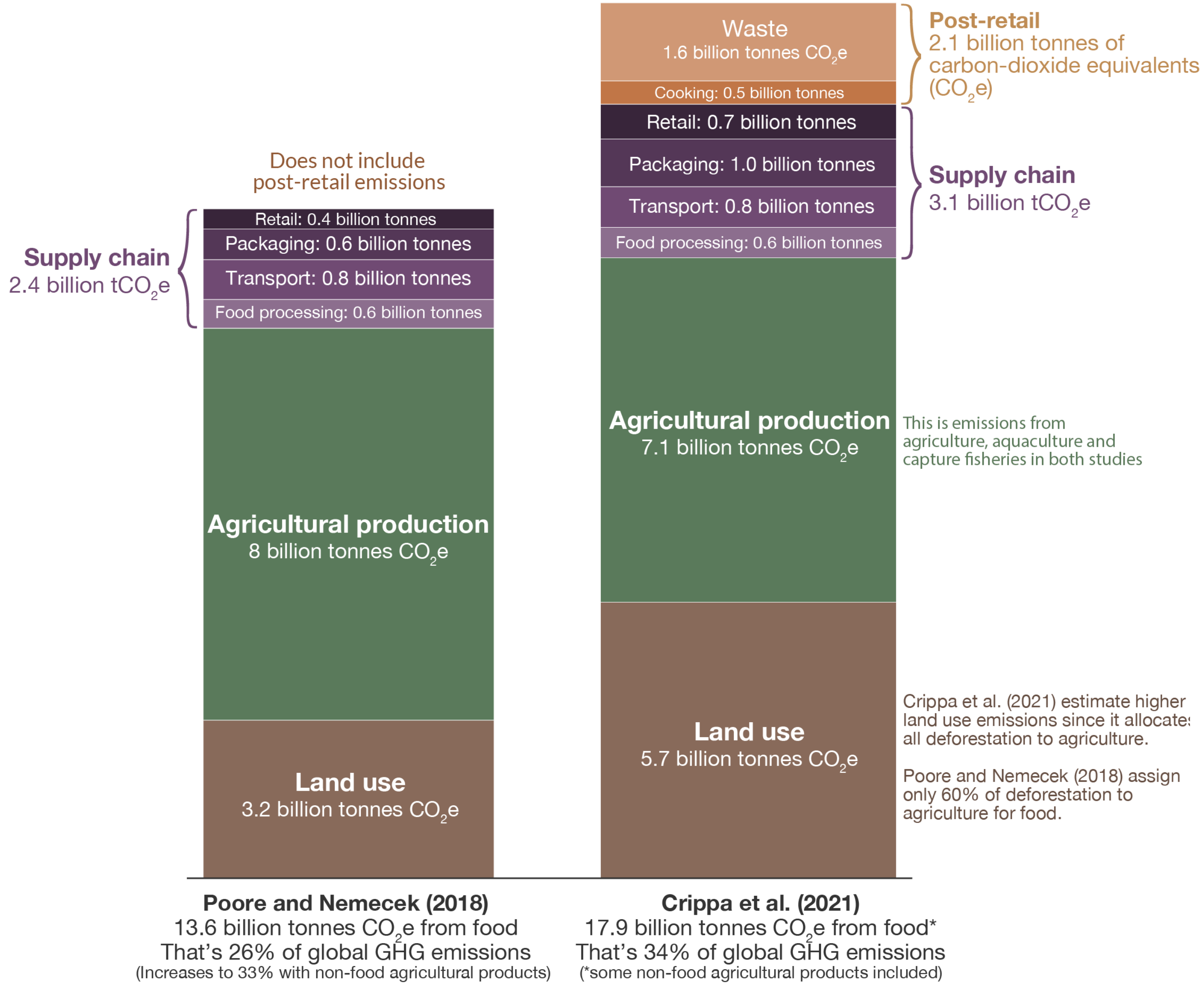
Residual: 65-85 MtCO2eq

[1]Excluding international aviation and shipping.
[2]Land use, land-use change, and forestry entails all forms in which atmospheric CO_2 can be captured or released as carbon in vegetation and soils in terrestrial ecosystems.
Source: UNFCCC; McKinsey analysis

McKinsey & Company

How much of global greenhouse gas emissions come from the food system?

Shown is the comparison of two leading estimates of global greenhouse gas emissions from the food system.
Most studies estimate that food and agriculture is responsible for 25% to 35% of global greenhouse gas emissions.



*Crippa et al. (2021) include emissions from a number of non-food agricultural products, including wool, leather, rubber, textiles and some biofuels.
Poore and Nemecek (2018) do not include non-food products in their estimate of 13.6 billion tonnes CO_2e. This may explain some of the difference.

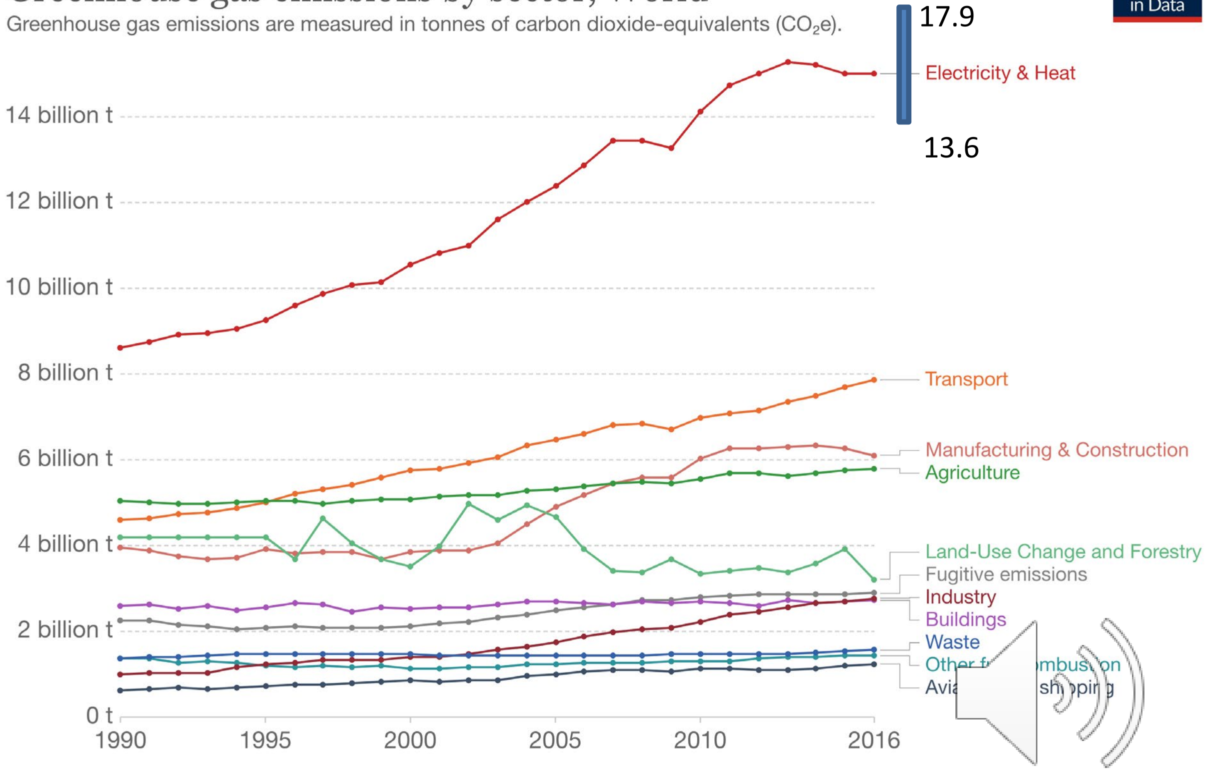
Data sources: Joseph Poore & Thomas Nemecek (2018). Reducing food's environmental impacts through producers and consumers. *Science*.
Crippa, M., et al. (2021) Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food*.

Total 55.3 billions tons CO_2eq

FOOD

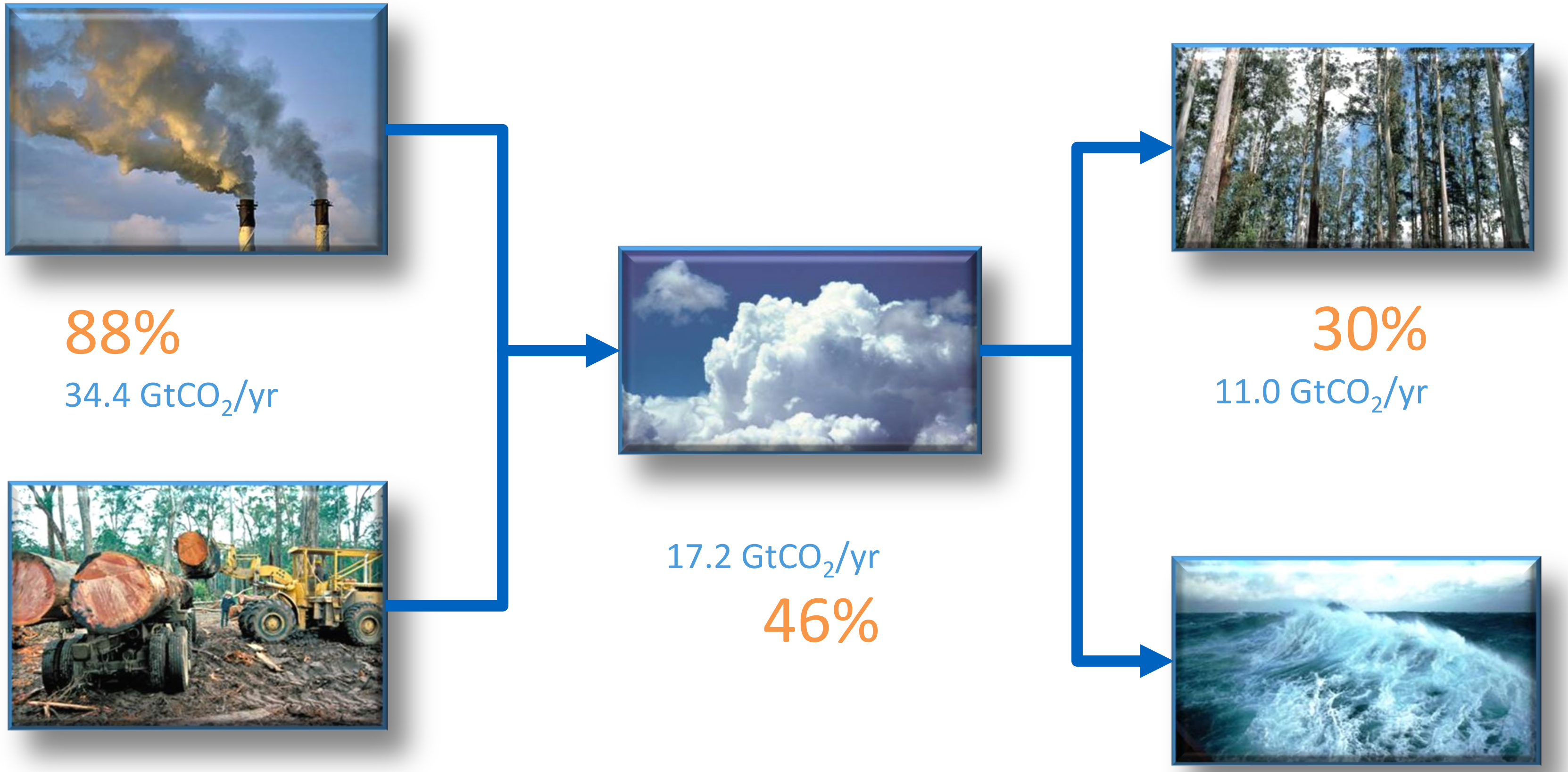
Greenhouse gas emissions by sector, World

Greenhouse gas emissions are measured in tonnes of carbon dioxide-equivalents (CO_2e).



Source: CAIT Climate Data Explorer via. Climate Watch

Fate of anthropogenic CO_2 emissions (2007–2016)



88%
34.4 $GtCO_2$/yr

12%
4.8 $GtCO_2$/yr

17.2 $GtCO_2$/yr
46%

30%
11.0 $GtCO_2$/yr

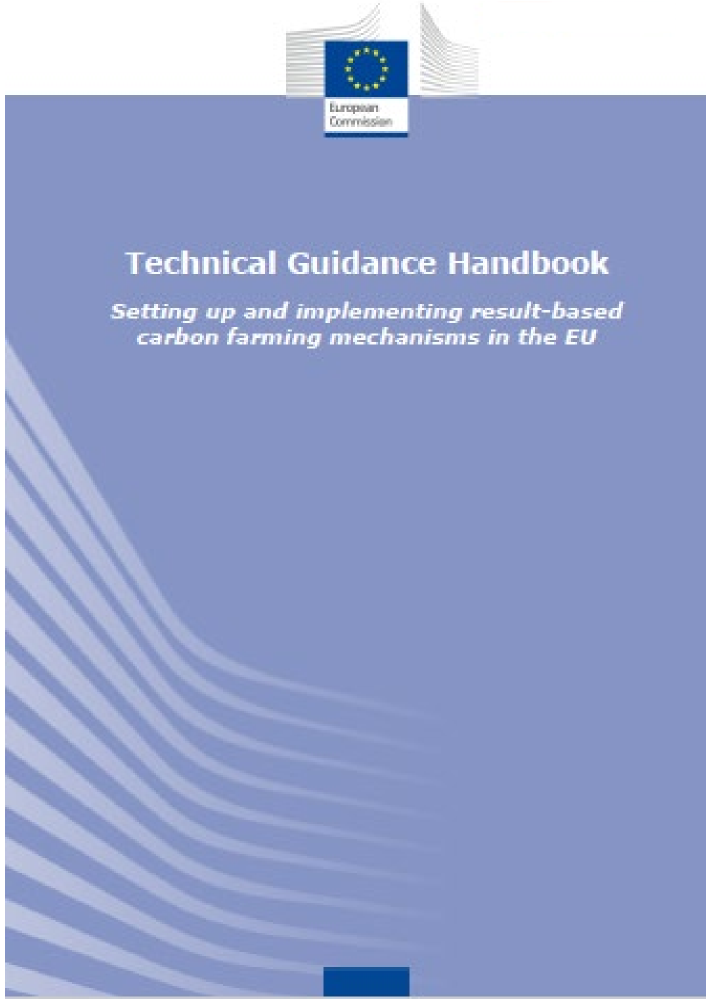
24%
8.8 $GtCO_2$/yr

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

6%
2.2 $GtCO_2$/yr

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

The carbon farming handbook



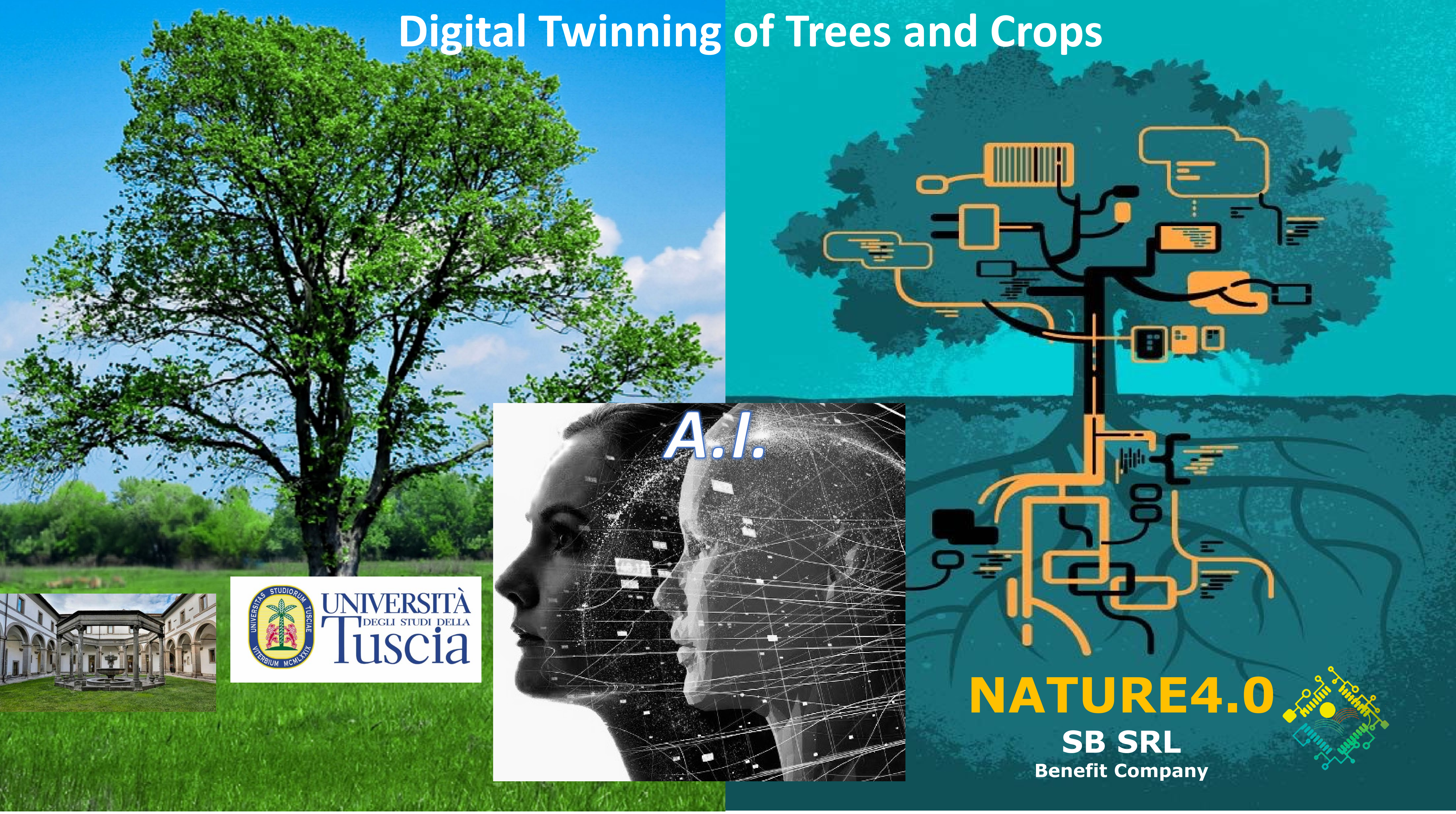
- Considering only carbon sink or avoided emissions?
- Action-based o result-based incentives?
- Mitigation targets measured or estimated?
- Scale of application: local/regional/national/EU
- Cost efficiency ?
- Other co-benefits?

Double Payments are allowed in CAP…….. !

EU lawmakers insist on monetisation of carbon farming

By Julia Dahm | EURACTIV.com Est. 4min 31 Aug 2023 (updated: 14 Sept 2023)

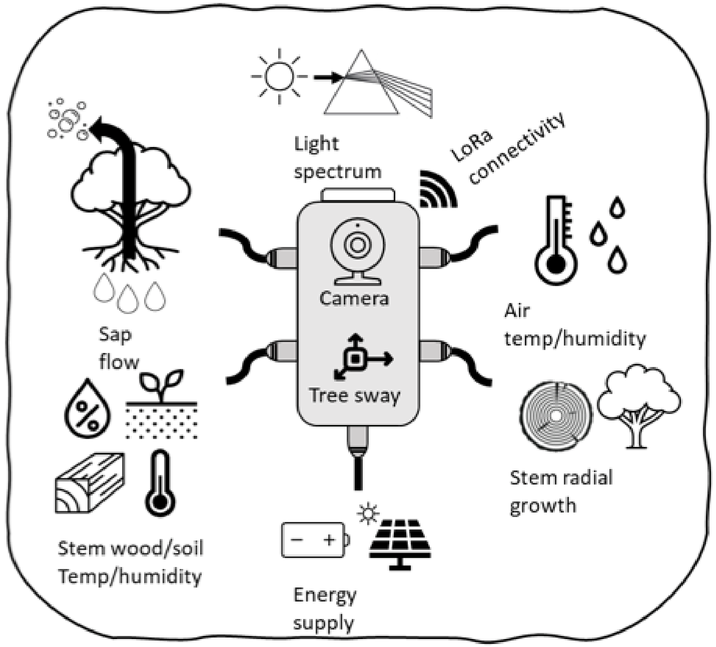
Content-Type: News



Digital Twinning of Trees and Crops
A.I.
UNIVERSITÀ DEGLI STUDI DELLA Tuscia
STUDIORUM UNIVERSITAS TUSCIAE VITERBIUM MCMLXXIX
NATURE4.0
SB SRL
Benefit Company

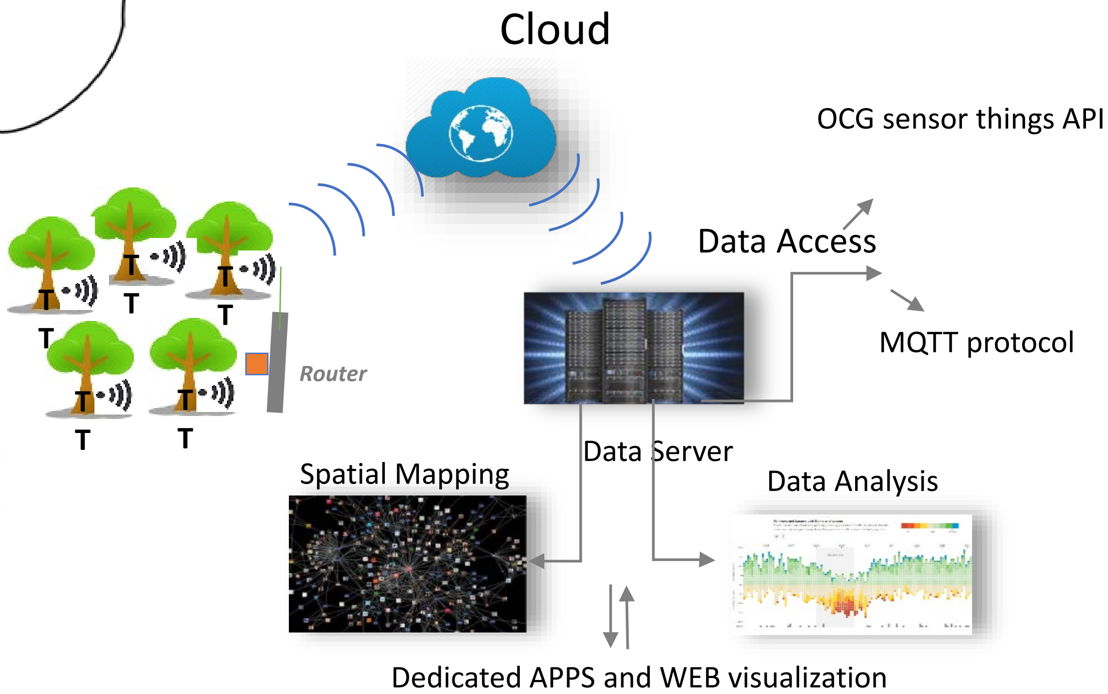
Nature 4.0 SRL
'Inspire to invent change'

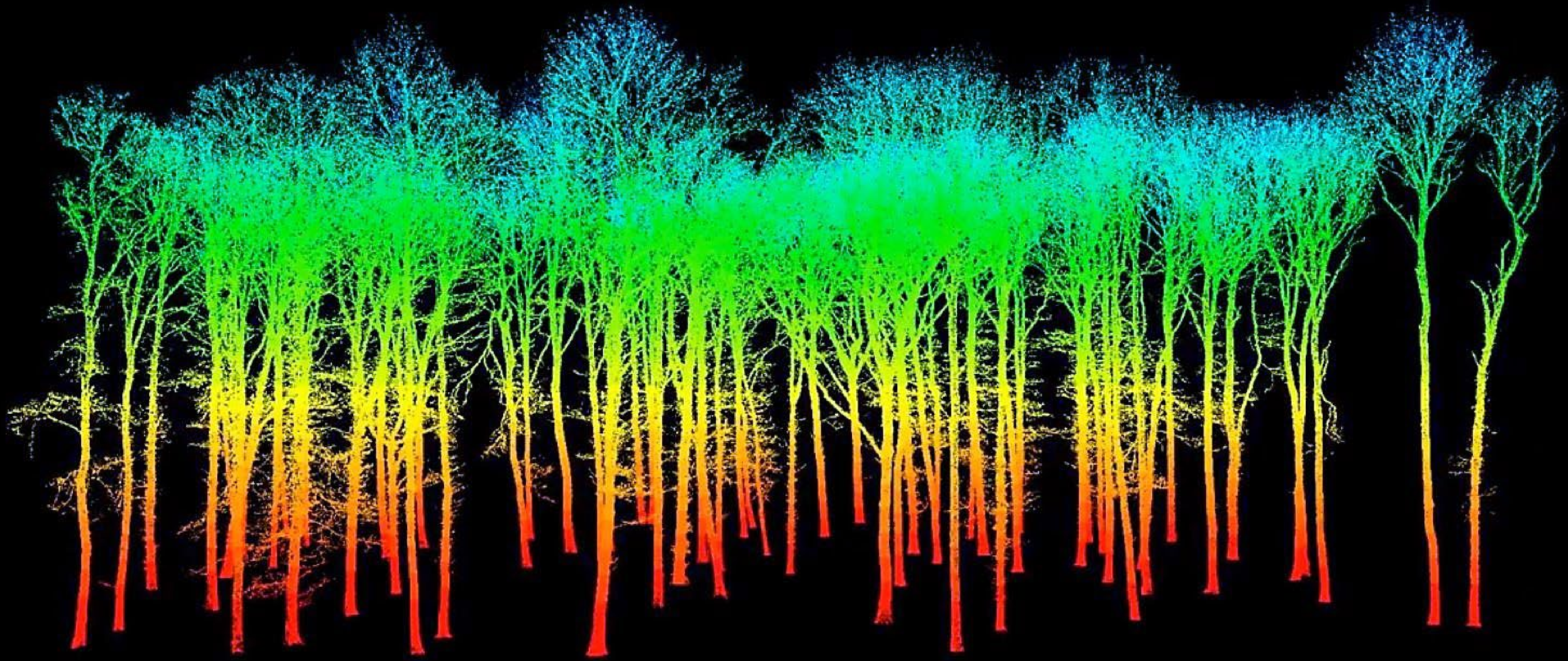
1. **Tree water consumption**
2. **Leaves development and health status**
3. **Diameter Growth**
4. **Tree stability**

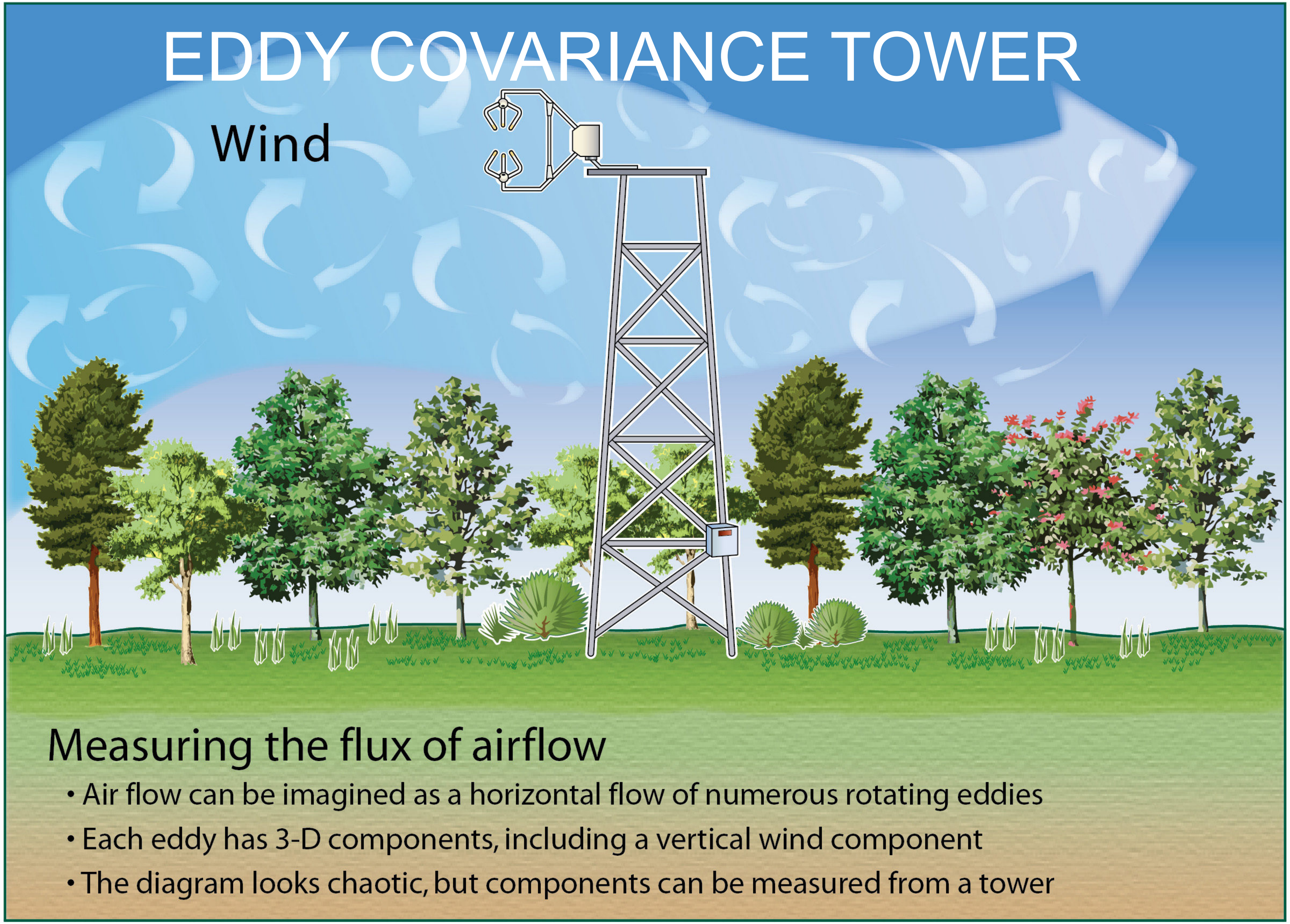


TreeTalker

(www.nature4.org)







Eddy Flux Formulas

1. Instant Vertical Flux

$$F_i = \rho_i w_i s_i$$

2. Initial Mean Flux

$$F = \frac{1}{N}\sum_{i}^{n}\rho_i w_i s_i = \overline{\rho w s}$$

3. Flux Equation

$$F = \overline{\rho}\,\overline{w's'}$$

ρ - dry air density

w - vertical wind speed

s - gas mixing ratio (gas mass/dry air mass)

From Reynolds Decomposition:

$\rho = \overline{\rho} + \rho'$

$w = \overline{w} + w'$

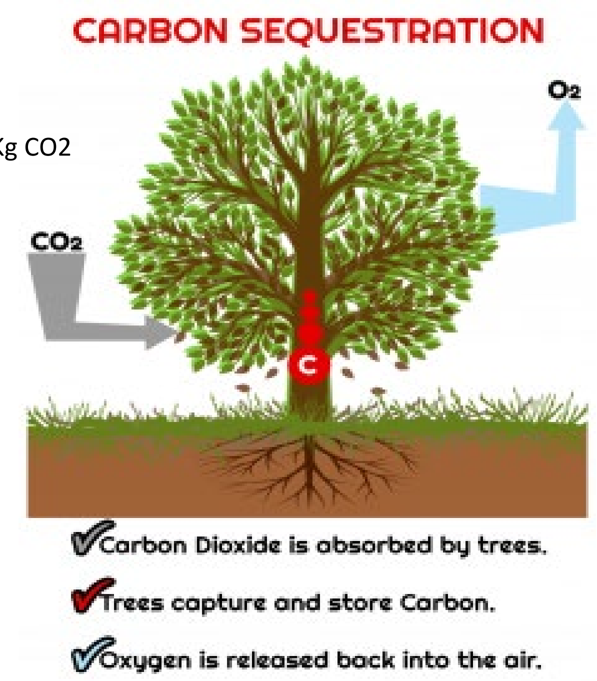
$s = \overline{s} + s'$

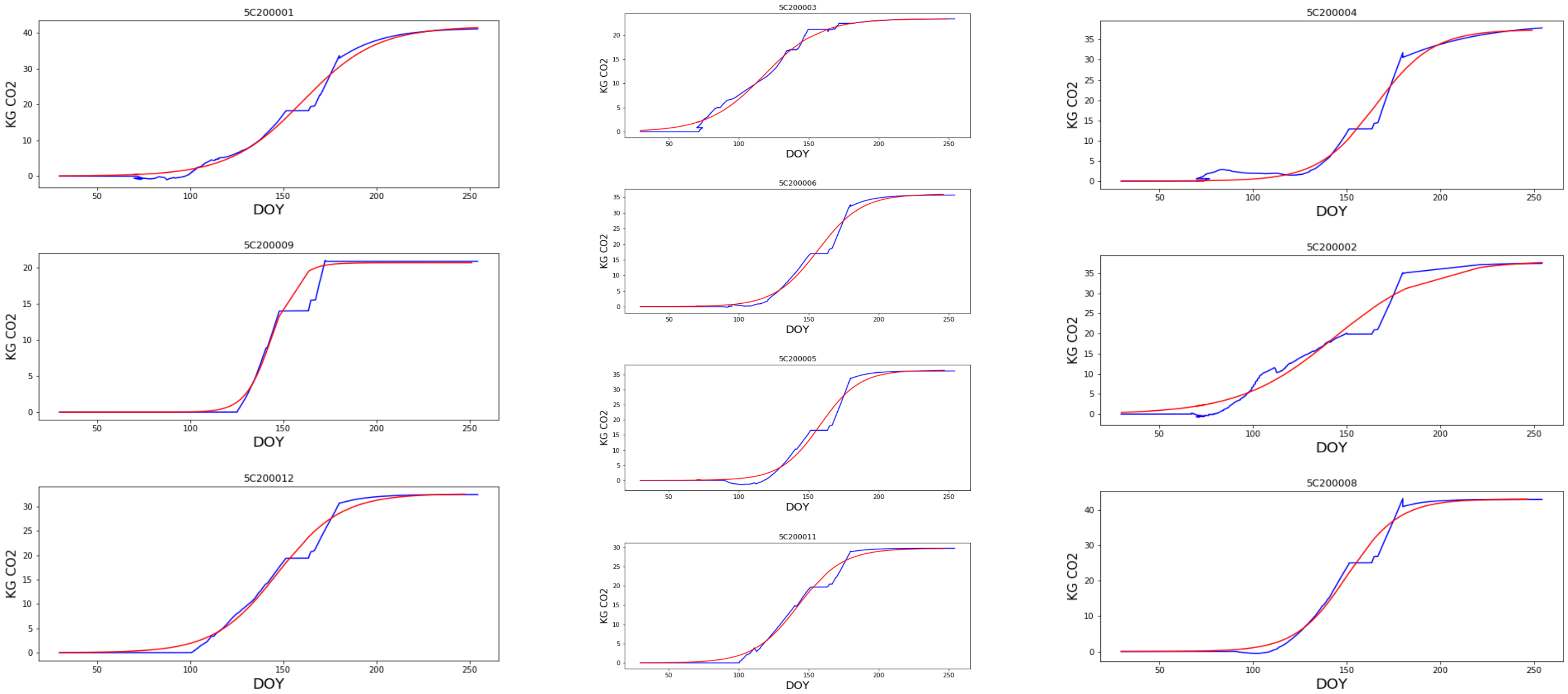
ESD14-039

The MonteRe Plum Tree

24.86 Kg O2

34.19 Kg CO2

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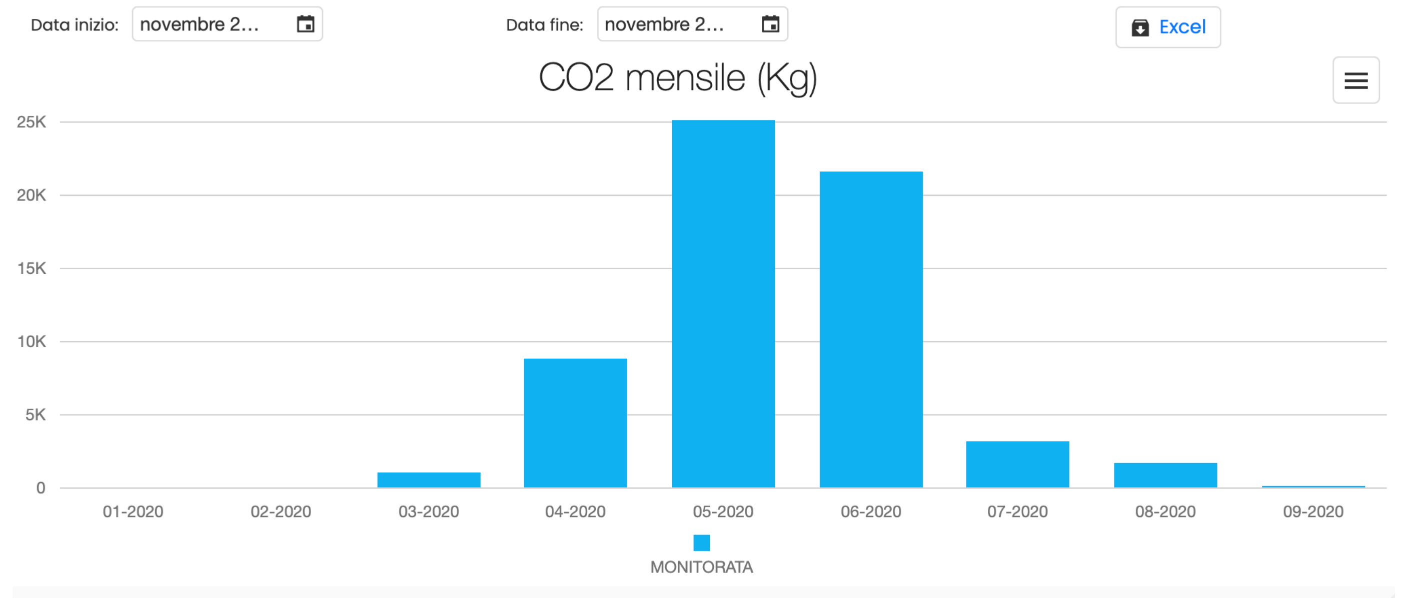
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CO2 mensile (Kg)
25K
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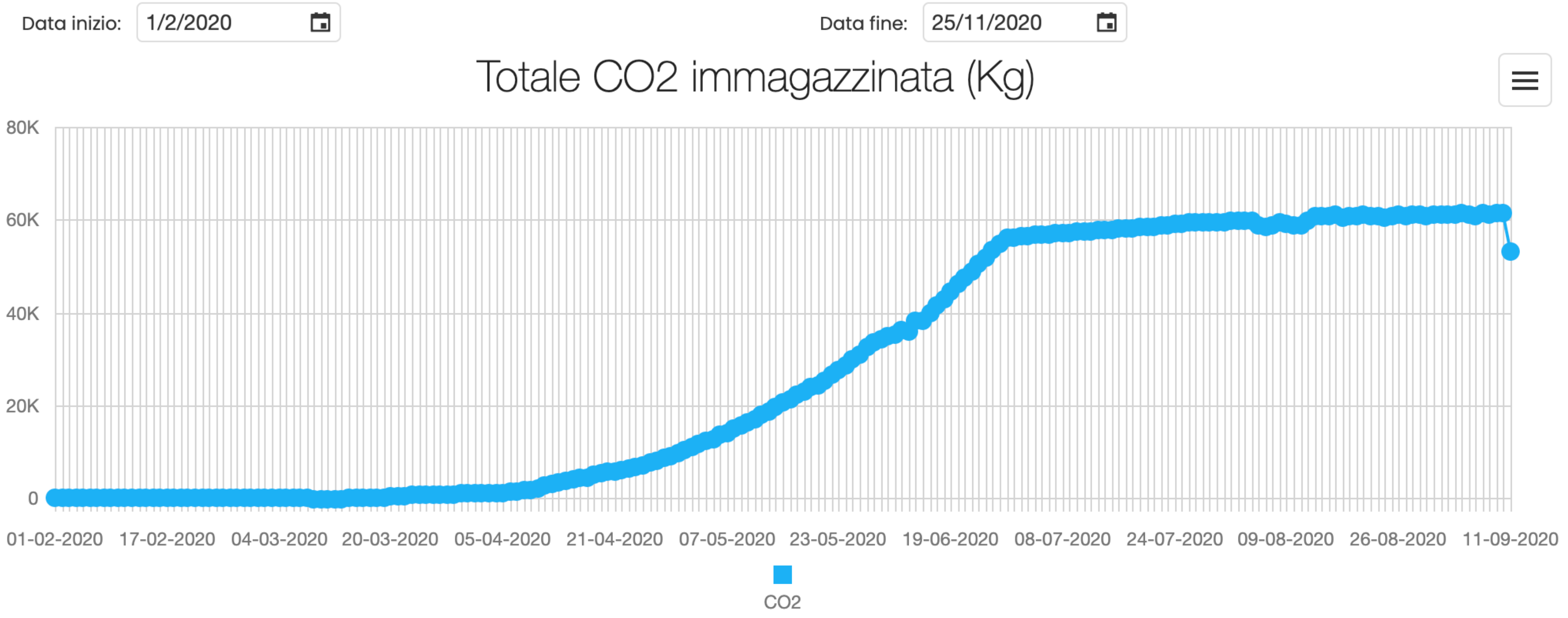
MONITORATA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23-05-2020
19-06-2020
08-07-2020
24-07-2020
09-08-2020
26-08-2020
11-09-2020
CO2

Carbon monitoring Technologies analysis

Technology	PROS	CONS	COST	CERTICATIONC COMPLIANCE
Eddy covariance	• Direct estimation of carbon sequestration (biomass+soil) • High temporal frequency (1hr) • Integration on area of about 10 Ha	• Not always applicable (complex terrain) • Uncertainty on night fluxes • Difficulkt to separate soil contribution • Energy consumption	HIGH (30000-50000 US$**)**	NO
TreeTalkers	• Very accurate measurement of biomass growth • High temporal frequency (1hr) • Other functional parameters measured • Soil and biomass are separated	• Requires many sensors for representativeness	LOW (100-200 US$ per sensor)	YES
Laser Scanner	• Accurate measurement of biomass (not necessary growth) • Integration on large areas	• Soil is not considered • Manual and operator work	HIGH (50000-100000 US$)	YES

CONCLUSIONS