# How to preserve carbon in a changing climate

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# context

- What ecosystems we consider:
  - Forests
  - Permanent grasslands
  - Natural areas
  - Wetlands
- Current stock and fluxes in France:

| Type | Surface (ha*1000) | Stock (tCO2/ha) | Sink (tCO2/ha/y) |
|---|---|---|---|
| Crops | 24 004 | 224 | -0.06 |
| Grasslands | 8 565 | 320 | 0.37 |
| Forest (metropolitan) | 17 158 | 598 | 5.06 |
| Forest (Guyane) | 8 130 | 1110 | 0 |
| Others natural ecosystems | 2724 | 443 | 0.42 |

# Challenges

- It is important to create new carbon sinks, but it is mandatory to avoid new carbon sources that could jeopardize any effort to reach carbon neutrality !
- First challenge:
  - Protect natural carbon rich ecosystems

  **but also**
  - Full evaluation of carbon grain from sequestration or fuel substitution projects considering current stocks and fluxes!
- Second challenge: Climate change will affect ecosystems and then modify the carbon cycle ➔ *It is not sufficient to avoid exploitation of carbon rich ecosystems, we should also improve their resilience.*

# How climate change will impact ecosystems carbon sequestration

- Direct impact:
  - Increasing temperature and drought will increase mortality
  - Increasing temperature could enhance soil carbon decomposition

- Indirect impact:
  - Increasing risk of fire

  - Increasing risks related to others extremes events (windthrow, flooding, landslides) (but impact of climate change not well established)

  - Increasing pests damage because of degraded health and new species

# The difficult tradeoff between carbon mitigation and carbon storage preservation

E.g: use of wood biomass for fossil fuel substitution (Valade et al 2020)

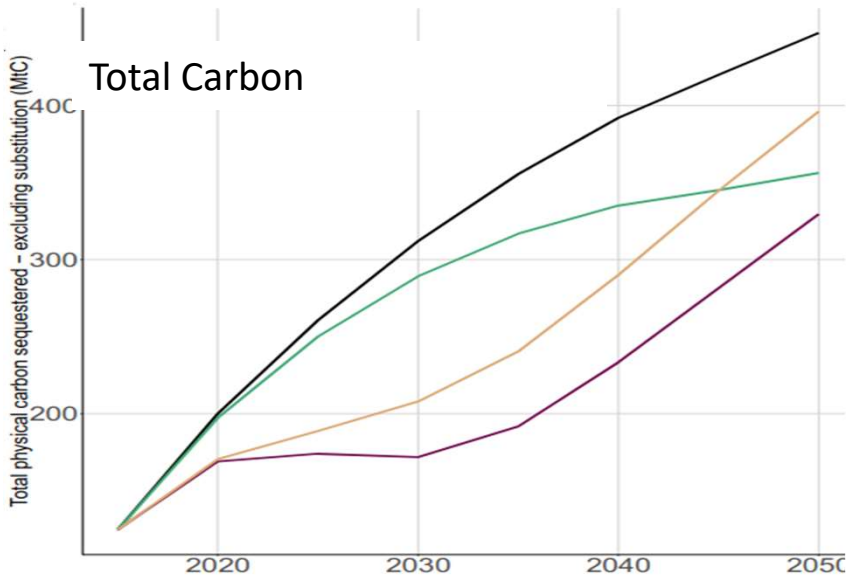
Theoretically 50% of biomass can be used ➔ substitution coefficient= 0.5

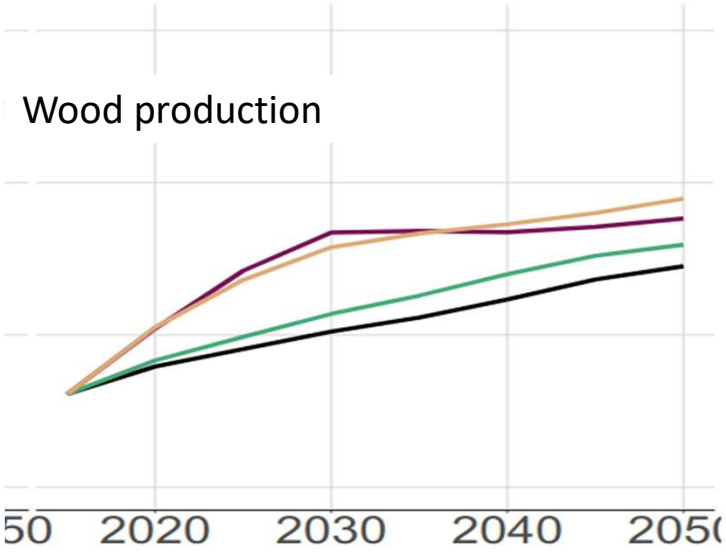
➔ 3 scenarios of increasing wood harvest:

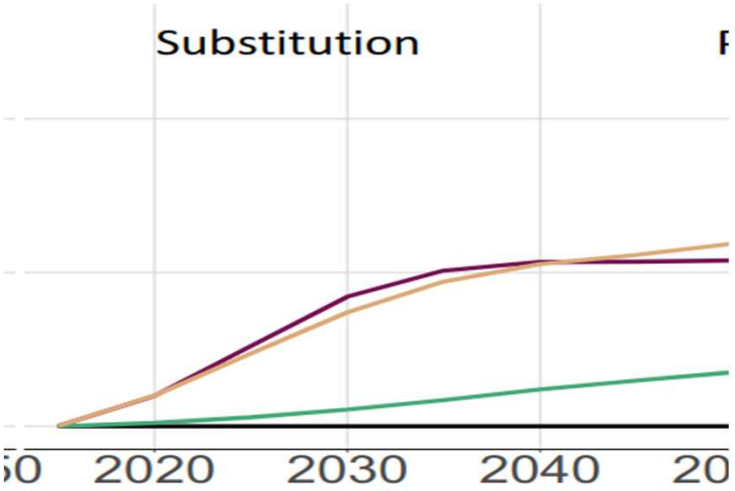
1/ Increasing harvest in over-dense forests

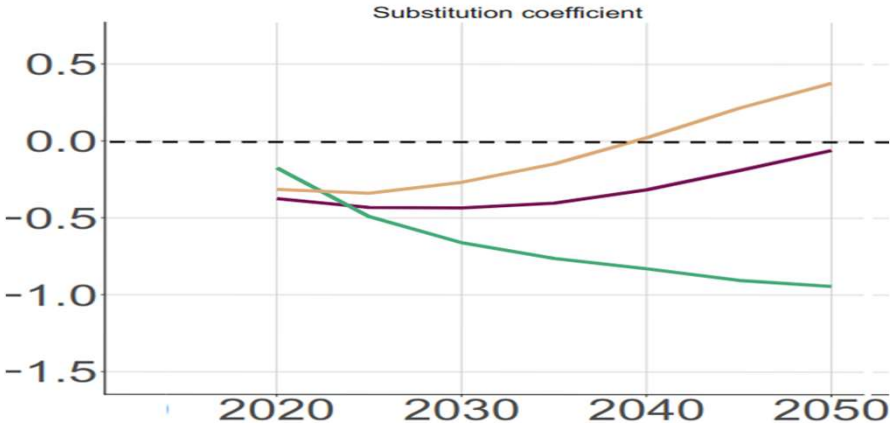
2/ Harvest in abandoned forests

3/ Decreasing rotation time in intensively managed forests


Total Carbon
Total physical carbon sequestered – excluding substitution (MtC)
400
300
200
2020
2030
2040
2050


Wood production
50
2020
2030
2040
205(


Substitution
50
2020
2030
2040
20


Substitution coefficient
0.5
0.0
-0.5
-1.0
-1.5
2020
2030
2040
2050

# Barriers

- Lack of data on current stocks and fluxes and long term monitoring
- Lack of understanding of climate change effects on ecosystems (and then on carbon stocks)
- Lack of systemic evaluation of practices
- Little insight on long term effects of changing practices on stocks
- Land use conflicts between food, carbon mitigation, stocks conservation and all others ecosystems services

# Research actions

- Improve database and long term monitoring of carbon rich ecosystems (natural areas, forests, wetlands…)
- Improve knowledge on ecosystem response to climate change
- Improve modeling of climate change scenarios and their impacts on carbon stock and fluxes
- Development of systemic evaluation of scenarios for carbon sequestration to assess: impact of carbon stocks, ecosystems services taking into account for climate change

# Implementation recommendations

- Develop and maintain long term monitoring of C,N,P cycles
- Protection of rich carbon ecosystems
- Full estimation of effective gain of projects for carbon sequestration or substitution in term preserving existing stocks
- Identify the full range of ecosystem services
- Develop projects that enable resilience and adaptation of ecosystems to climate change