# Impacts of Wildfire on Future Forest Carbon Sink

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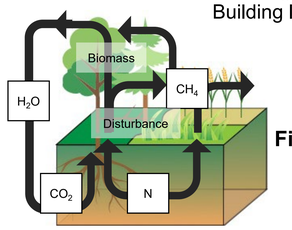
## Introduction

- Terrestrial ecosystems absorb 112–169 PgC ($10^{15}$ g carbon) annually.
- Fire is a major disturbance to ecosystems, influenced by both climate and socioeconomic factors.
- When disturbance occurs faster than recovery, ecosystems lose their carbon uptake potential.
- Future SSP-RCP scenarios will influence the extent of fire impacts on ecosystem carbon uptake.
- Estimating fire impacts under various SSP-RCPs is essential for designing effective nature-based climate strategies.
- Need for Global Fire Model Updates
  - The latest version of the Global Fire Emissions Database (GFED v5) estimates burned area at 787 Mha/year—significantly higher than the previous version (451 Mha/year)—based on high-resolution satellite imagery.

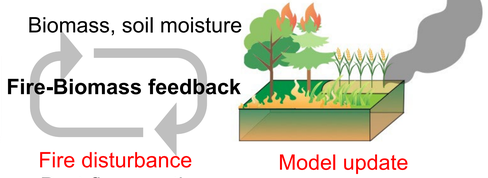
## Methods

**Fire model update & incorporate to VISIT**

Optimizing PFT-based parameters based on GFED5
(new satellite-based data)
including coefficient of combustion completeness
Building long-term spatial socioeconomic data (1650-2100)



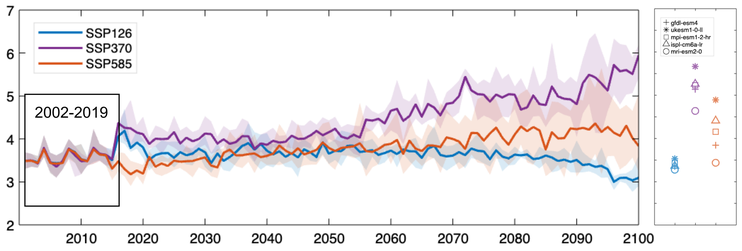

Terrestrial Ecosystem Model
(VISIT, Ito-san)





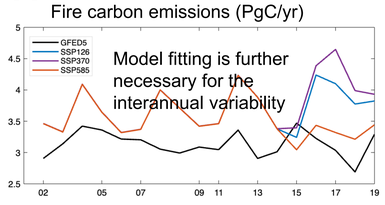

Model update
Land use Change Fire model
(LCFire)

## Results

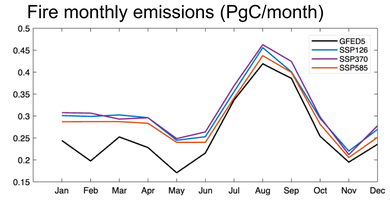



**[2] 2002-2019: Comparison to GFED (reference)**

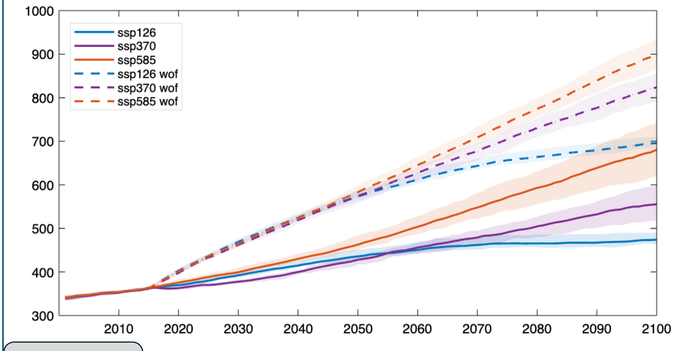
Fire carbon emissions (PgC/yr)



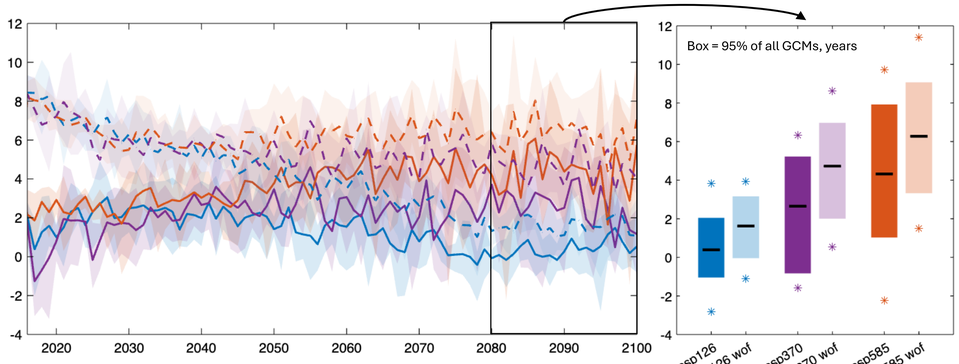

Fire monthly emissions (PgC/month)




**[3] Changes in Aboveground Biomass (AGB)**

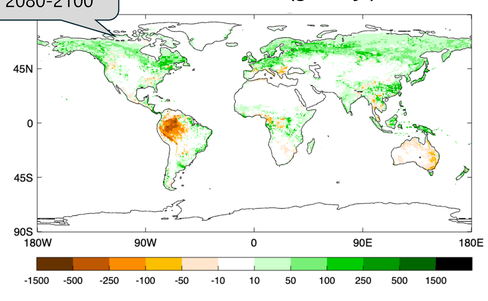



**[4] Changes in Aboveground Biomass Increment (y+1 - y)**

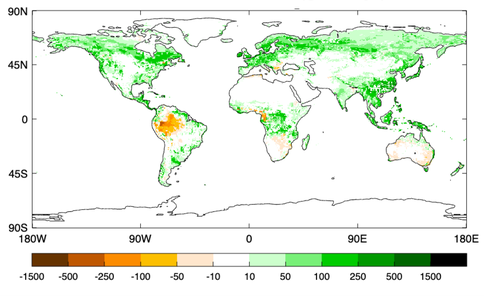



SSP3-7.0
2080-2100

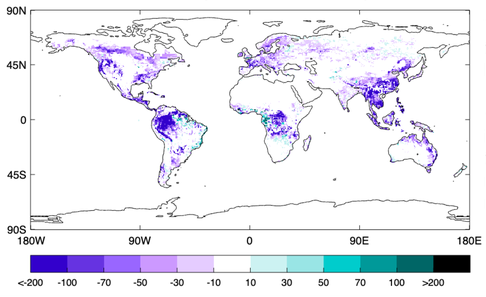
AGB Increment (gC/m²/yr)



AGB Increment wof (gC/m²/yr)



Differences (with – without fire)



Tropical forests, temperate forests, boreal forests

→ Fire disturbances increasingly exceed the frequency and magnitude of forest recovery.

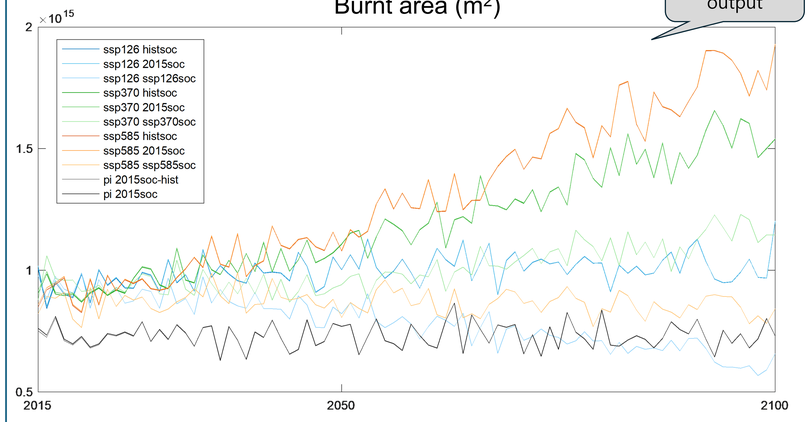
## Results

**[1] Future fire changes under various SSP-RCP forcing**

- **ISIMIP3b preliminary output**
  (The Inter-Sectoral Impact Model Intercomparison Project Phase 3b)
- SSP5-8.5 GHG levels resulted in the highest fire emissions.
- However, SSP5 also projects a large increase in GDP, which may help limit fire spread.
- For further analysis, the **SSP-SSPsoc scenarios** are selected:
  SSP3-7.0 > SSP5-8.5 > SSP1-2.6
  → Compare biomass with and without fire disturbance.

ISIMIP3b output

Burnt area ($m^2$)




## Key message

- Terrestrial ecosystes play a key role in climate change mitigation. But fire risk has been increased by climate change
- To develop effective mitigation policies, it's essential to understand the impact of fire on terrestrial carbon.
  - Ignoring fire disturbances can lead to overly optimistic estimates of nature-based solutions.

**ISIMIP (The Inter-Sectoral Impact Model Intercomparison Project)**
**- VISIT-LCFire is participating in ISIMIP3b**

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