The 27th AIM International Workshop



Impact of future climate and socioeconomic change on fire carbon emissions

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Recent megafires



unprecedented, unexpected





There are more indirect impacts on biodiversity, food, etc. ...



Fire emissions

Yearly trend: regionally different





In United States,











5 sub-burned area model **> Partitioning into 6 fire types** for simulating emissions

Climate, land use, and socioeconomic factors affects differently

Fire mechanism by type (1) land transition fire (2) non-peat fires





90E

- model - GFED4.1s



180W

90S 90E 90W 180E 180W 90W



g C/m²/yr

90E

180E

- model

- GFED4.1s



Fire mechanism by type (3) Agricultural fire



Increase in population density and GDP pc decrease fires





Fire mechanism by type (4) Peat fire



Future prediction – protocol

Six scenarios

	Climate change		
	RCP 2.6	RCP 6.0	
SSP 1	SSP1-2.6	SSP1-6.0	
SSP 2	SSP2-2.6	SSP2-6.0	
SSP 3	SSP3-2.6	SSP3-6.0	

Data

1. Climate (climate, soil properties) / Biomass

RCP 2.6/6.0

- CMIP5 (from ISIMIP2a, 2b)
- Four GCMs (GFDL_ESM2M, HadGEM2-ES, IPSL-CM5A-LR, MIROC5)
- 2. Socioeconomic (population, GDP)



- From Yamagata and Murakami (2016)
- 3. Land use



- From Fujimori et al. (2018)



- Future fire carbon emission will increase under only SSP3-RCP6.0 scenario
- Large decrease in RCP 2.6

Temporal Trends by fire type



- Boreal and temperate fire C emissions increase at a higher rate under RCP6.0
- Agricultural fire C emissions decrease due to cropland reduction
- Savanna/grassland fire C emissions decrease under RCP2.6 scenario

Proportion of forest fires (tropic, boreal, temp)→ increased under RCP6.0



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Factors' contribution to global fire C emissions



- Increase in GDP per capita :↓
- Increase in Biomass (under RCP 6.0):



Factor's contribution in increased fire C emissions area

- (blue) Most area are affected by climate factor (decreasing humidity)
- (green) Grasslands are affected by biomass
- (orange) Some areas in South America, Africa, land use change fires will increase
- (red)Population increase in Australia can increase future fires

the most influenced factor in increased grid (SSP3-6.0)





Factor's contribution in decreased fire C emissions area

- (pink) Most area are affected by GDP per capita
- (blue) South Asia and Central Africa are affected by climate factor (increase rainfall, humidity)
- (orange) Some areas in South America, Africa, land use change fires will increase
- (red) Population increase in Australia can increase future fires

the most influenced factor in decreased grid (SSP3-6.0)





- Conclusion
 - Current fires emit 2 Pg C/yr
 - In the future, SSP3-RCP6.0 scenario increase total fire C emissions (high climate change + unequal development)
 - Forest fires will increase more than savanna fires
 - Five factors' change increase or decrease future fire and its emissions.
 - Future change in GDP per capita will decrease fires
 - Climate change will increase fires in Amazon and temperate forests even under RCP2.6 !
 - We need adaptation plans for reducing fire impacts

(e.g., fire real time monitoring, predict better fire brigade allocation)

Thank you for listening

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(Fire model information) <u>https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2020EF001786</u>