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Future fires in the Coupled Model Intercomparison Project phase 6 (CMIP6)

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Leibniz Association

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B3.17
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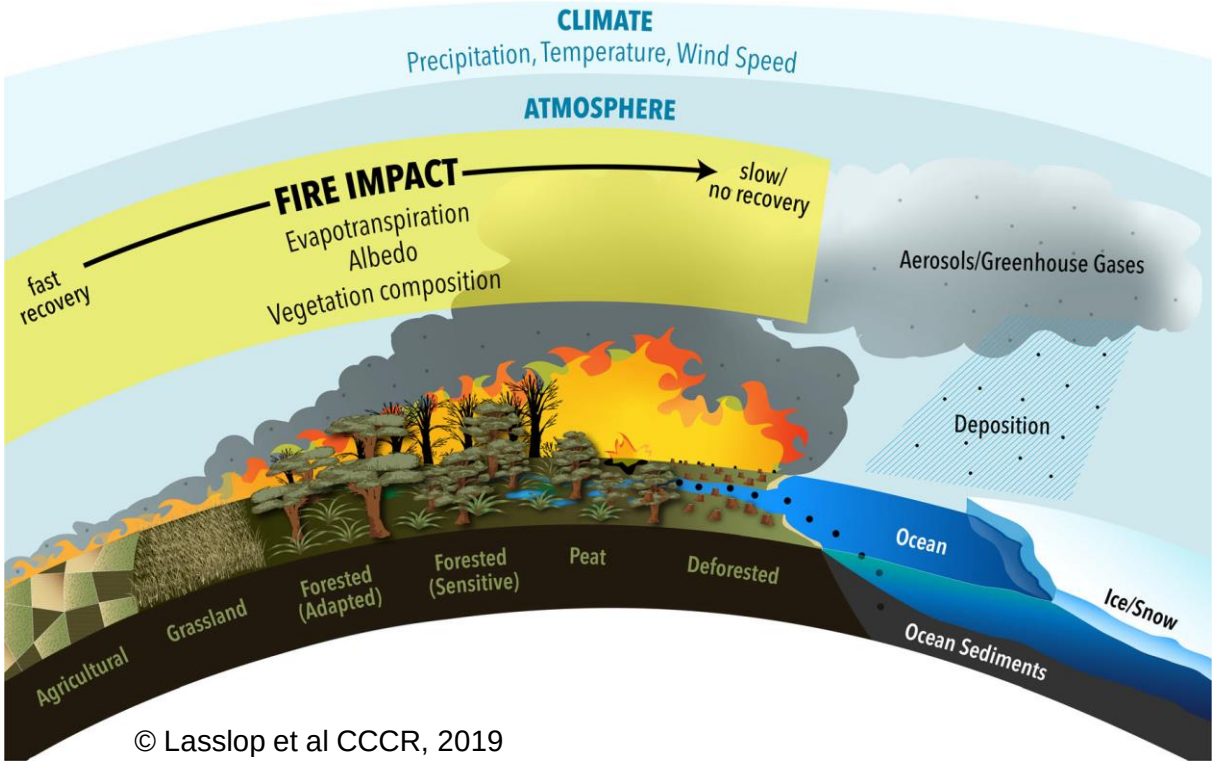
live chat session 17:48-17:51

Fire impacts on the Earth system

- Fire impacts all Earth system components including vegetation, atmosphere, ocean and cryosphere

→ Need to represent fire in global vegetation and Earth system models



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Availability of output related to fire in CMIP6

- Area burned: 3 models historical, 2 models with several future scenario
- Fire emissions: 12 models historical, 6 models with several future scenarios

→ As burned area is available for only few models we focus on fire emissions so far

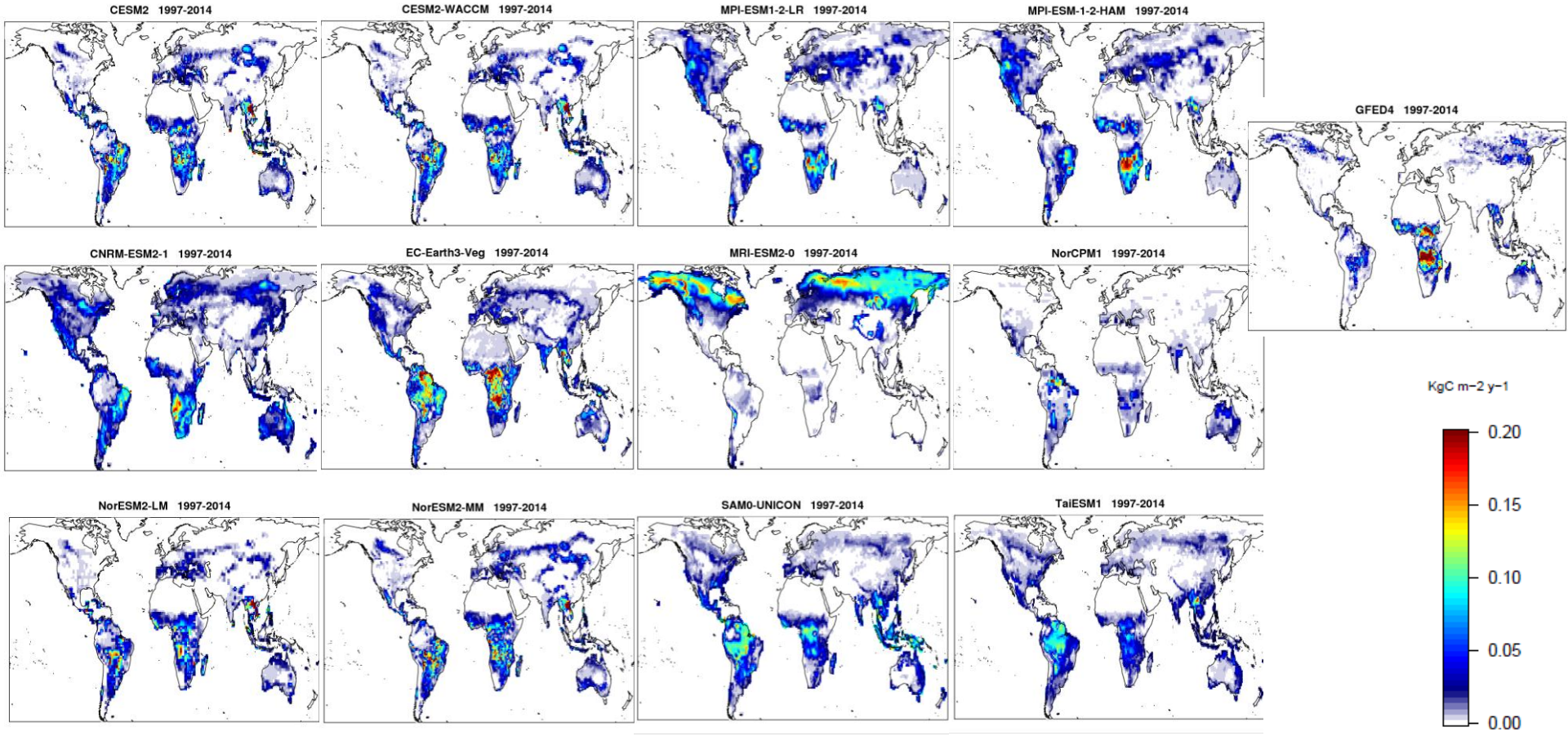
Changes in data availability are still expected in the next months

Information on models used

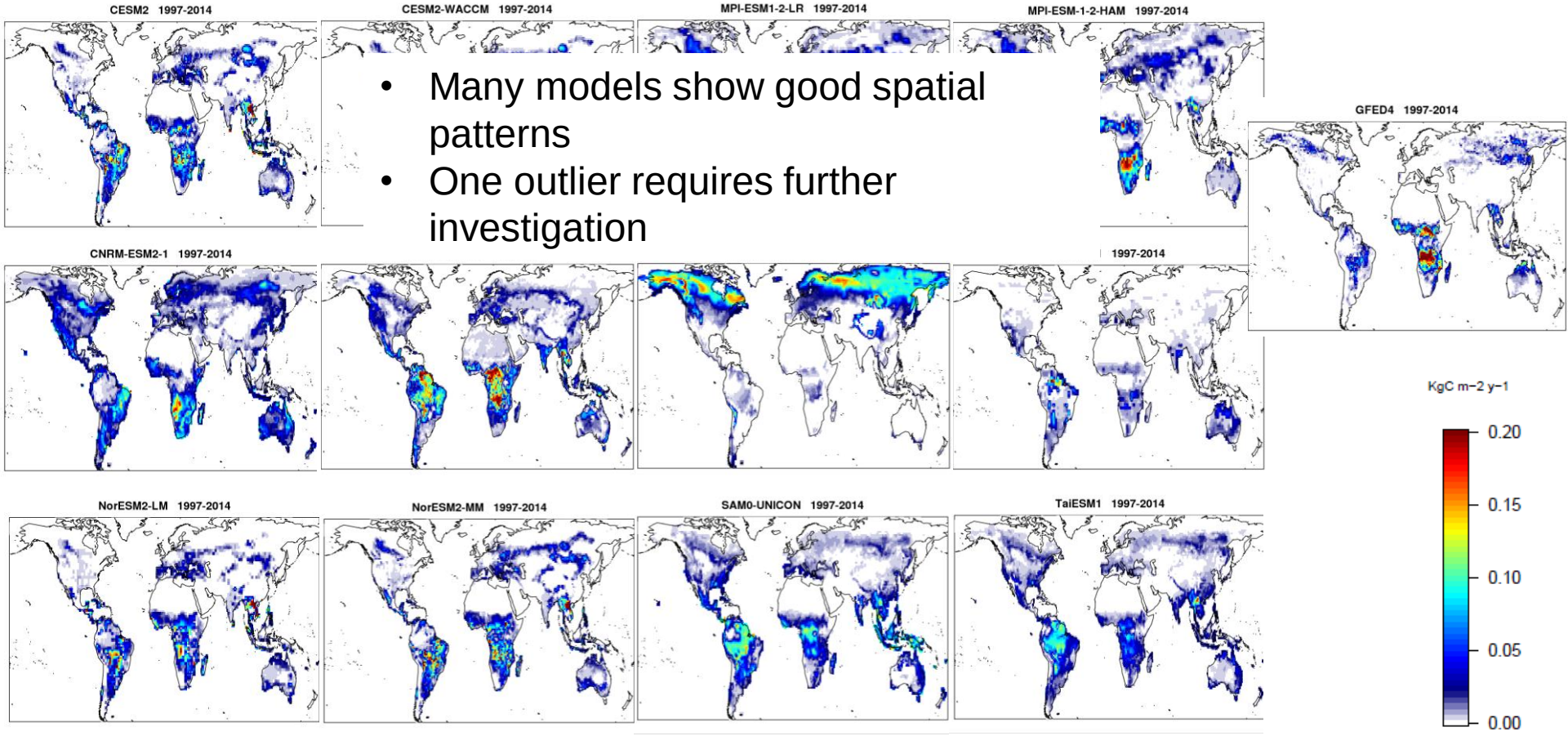
	Historical + SSP					
Coupled Model	**CESM2-WACCM**	**CNRM-ESM2-1**	**EC-Earth3-Veg**	**MPI-ESM1-2-LR**	**NorESM2-LM**	**NorESM2-MM**
Institution	NCAR	CNRM-CERFACS	C-Earth-Consortiu	MPI-M AWI	NCC	NCC
Land Model	CLM5	ISBA-CTRIP	LPJ-GUESS	JSBACH3.2	CLM5	CLM5
Fire emissions	yes	yes	yes	yes	Yes	Yes
Burned Area	yes	yes	no	no	no	No
Human fire ignition/suppression	Yes	Not allowed on crop and pasture	Suppression on crop and pasture	Yes/ no burning on croplands	Yes	Yes
SSP(126,245,370,585)	all	all	all	all	all	all

	Historical only					
Coupled Model	**MPI-ESM-1-2-HAM**	**TaiESM1**	**CESM2**	**SAM0-UNICON**	**NorCPM2**	**MRI-ESM**
Institution	AMMOZ-Consortiu	AS-RCEC	NCAR	SNU	NCC	MRI
Land Model	JSBACH3.2	CLM4	CLM5	CLM4	CLM4	HAL 1.0
Fire emissions	yes	yes	yes	yes	yes	yes
Burned Area	no	No	yes	no	no	no
Human fire ignition/suppression	Yes/ no burning on croplands	No	Yes	No	No	?
SSP(126,245,370,585)	ssp370	no	no	no	no	ssp585

Present day spatial patterns (1997-2014)



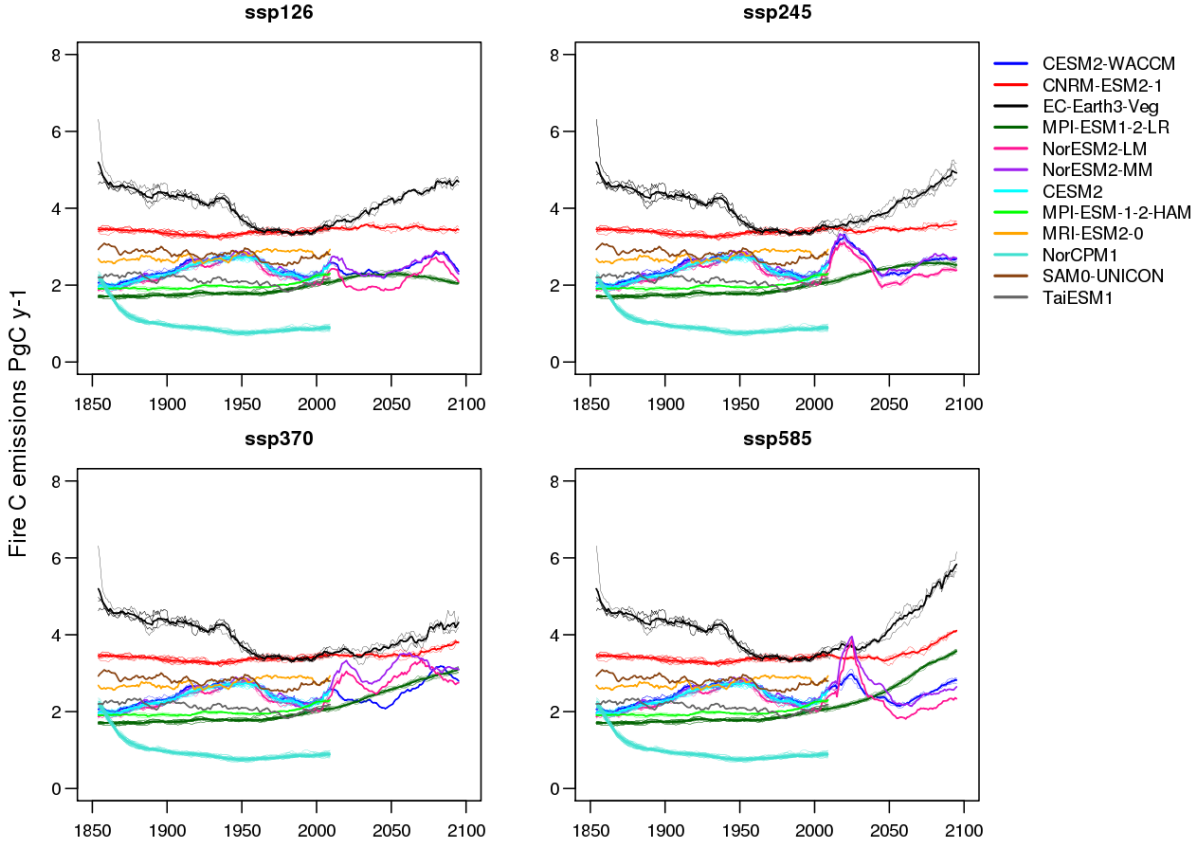
Present day spatial patterns (1997-2014)



- Many models show good spatial patterns
- One outlier requires further investigation

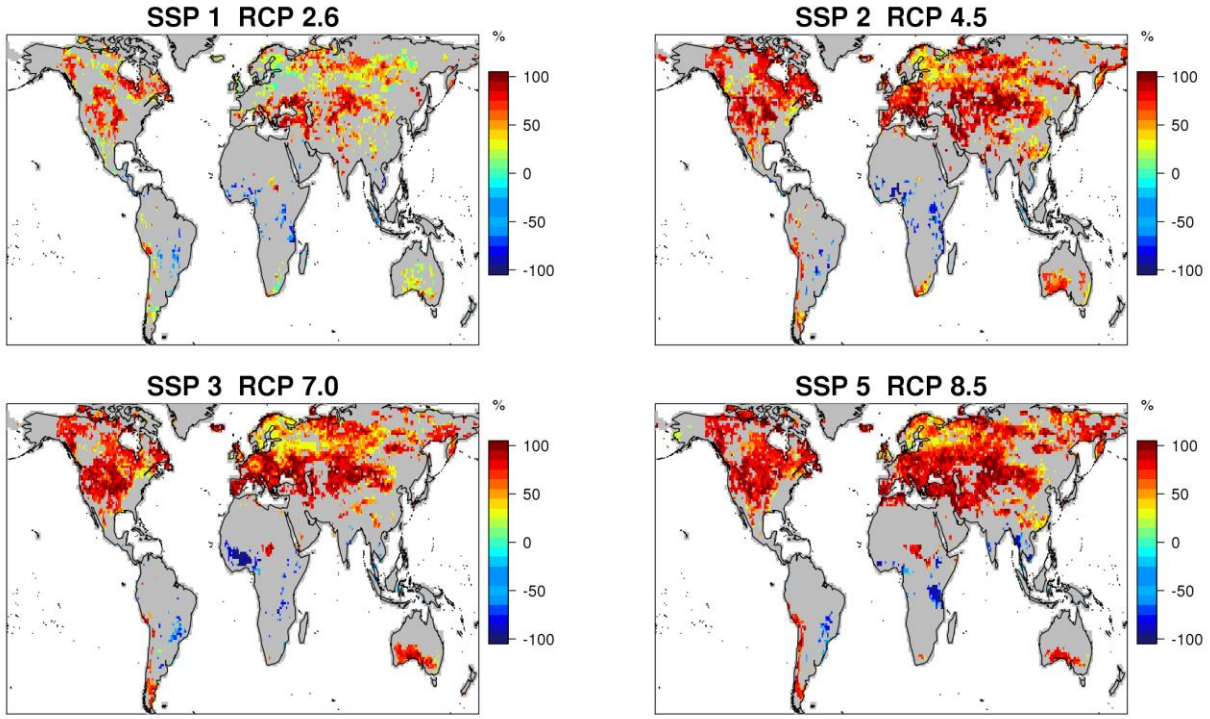
Global emissions from preindustrial to 2100

- Uncertainty is still big with respect to the global totals of fire emissions, but also the trends
- Slightly stronger convergence between models for future compared to the past
- Models with peaks use CLM5 as vegetation model

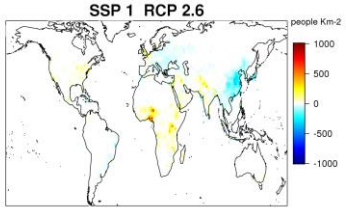


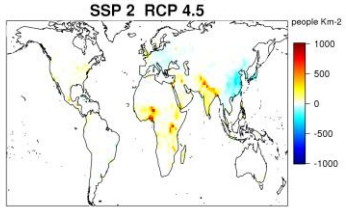
Spatial patterns of future changes

- In colored grid cells all models show the same direction of change
- Percentage indicates the models with significant change, sign indicates the direction of change
- For vast areas in the extra tropics all models indicate an increase in fire emissions
- In the tropics the model trends diverge, only for SSP3 a clear decrease in West Africa



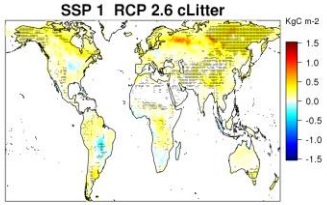
Changes of potential drivers of fire

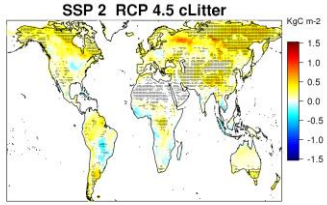


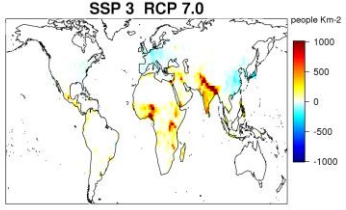


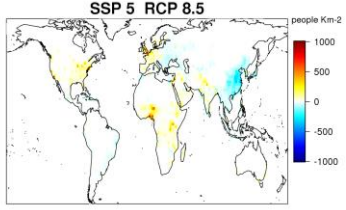
Population density

Contributes to decreases in West Africa in SSP3



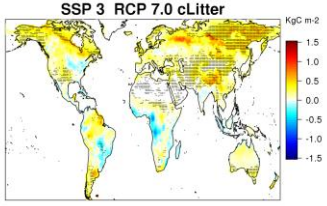


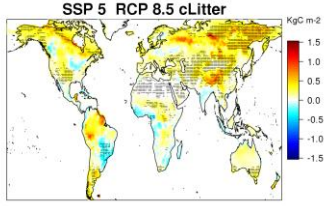


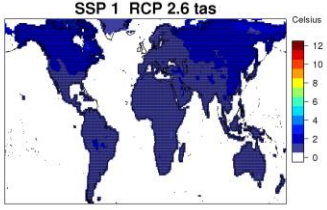


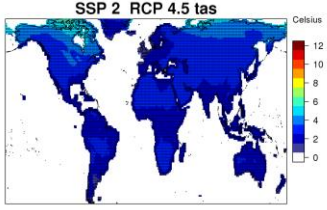
Litter pools

changes driven by climate and CO2 effects on vegetation



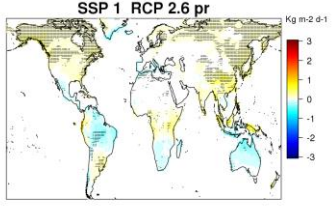


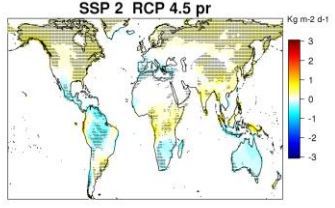


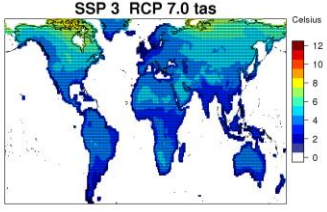


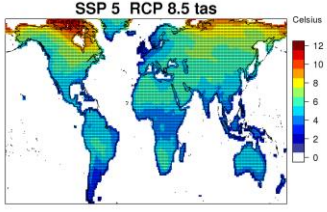
Temperature

increases everywhere



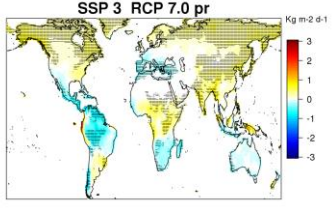


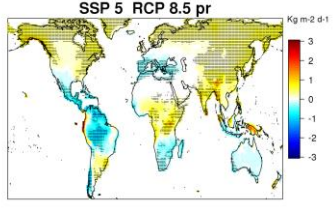




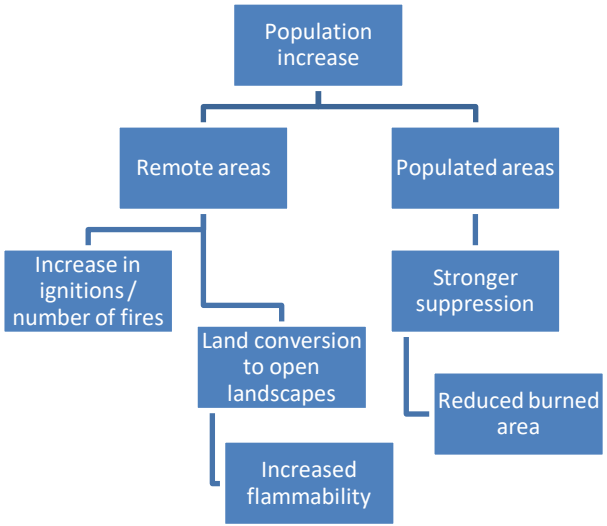
Precipitation

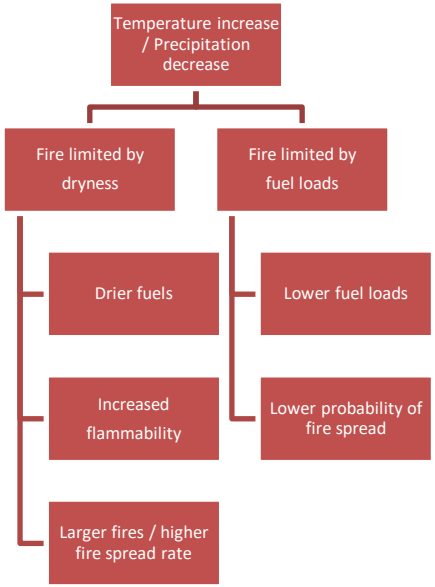
Increases can mitigate effects of increasing temperature

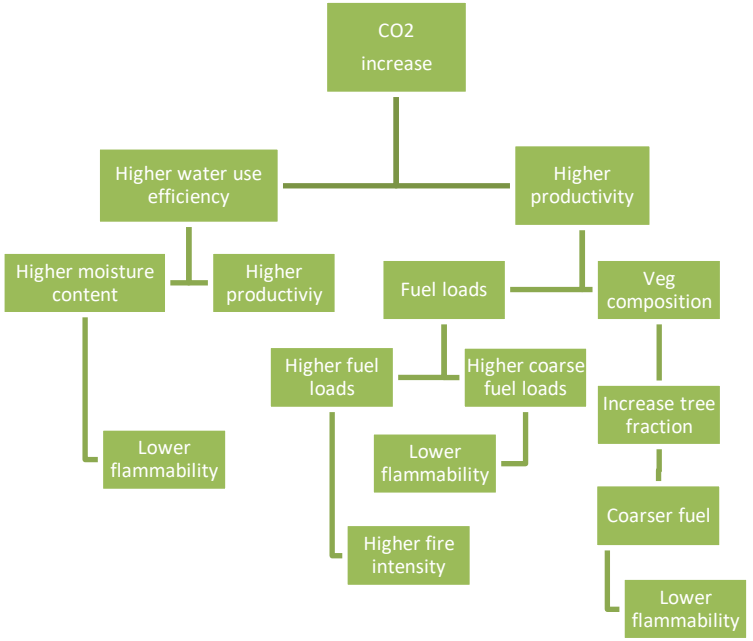




How do these drivers affect fire?







Conclusions

- Analysis is still in exploratory phase
- High uncertainty in global totals
- Increases in fire emissions in the extratropics are consistent across all model