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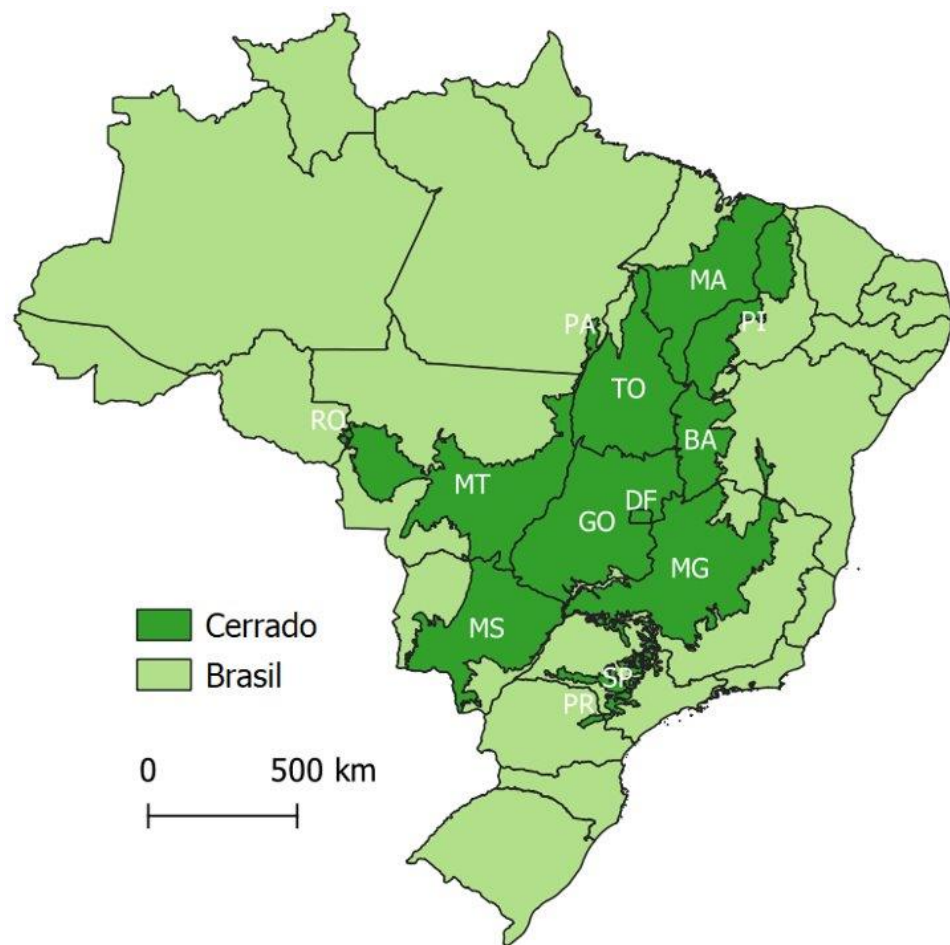
# Simulating prescribed burning to investigate its effect on fire emissions in Cerrado using JULES- INFERNO

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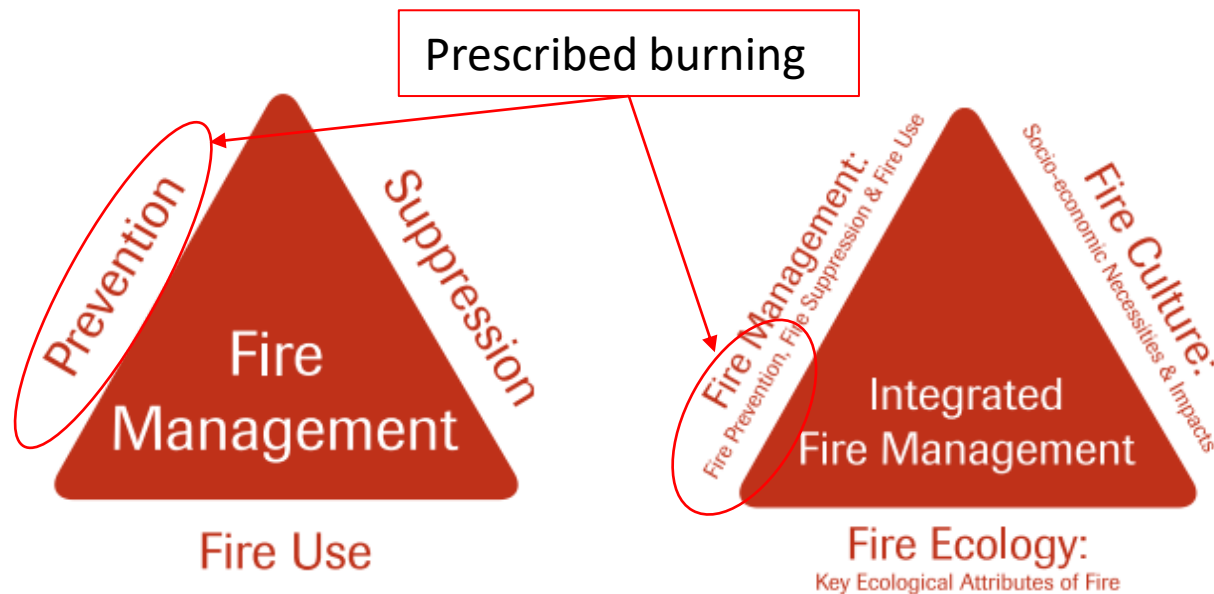
# Prescribed burning (PB) in the Cerrado



Mato Grosso (ICMBio, 2018)

# PB is a common activity under fire management

Set of technical decisions and actions to prevent, control, manipulate or use fire in a landscape for a specific goal  
**+ social, economic, cultural and ecological aspects of fire**



Myers, 2006

- Fire under controlled conditions to limit fuel load and avoid intense wildfires, while maintaining the ecosystem integrity

# Cerrado evolves with fire

- Fire shapes the structure of the Biome and maintains its integrity and biodiversity
- Fire exclusion policies led to fuel accumulation and more severe fires in Cerrado, as in other savannah ecosystems
- Anthropogenic activities + climate change altering the natural fire regime



# How does PB affect fire emissions in Cerrado?

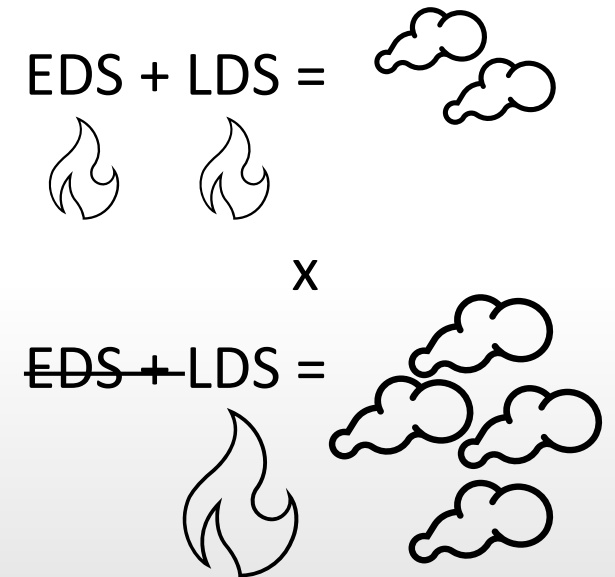
Compare emissions  
between PB and  
wildfires in natural  
vegetation in Cerrado  
with JULES-INFERNO



## Simulations in JULES-INFERNO:

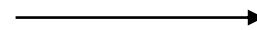
early-dry season  
(EDS) month  
represents PB

late-dry season (LDS)  
month represents  
wildfire



# Establish EDS and LDS based on JULES climatic variables and burnt area

- Precipitation rate
- Air temperature
- Relative humidity
- Moisture content of top soil layer

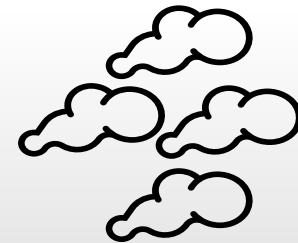


EDS = April, **May**, June  
LDS = August, **September**,  
October

May → fuel reduction → September =

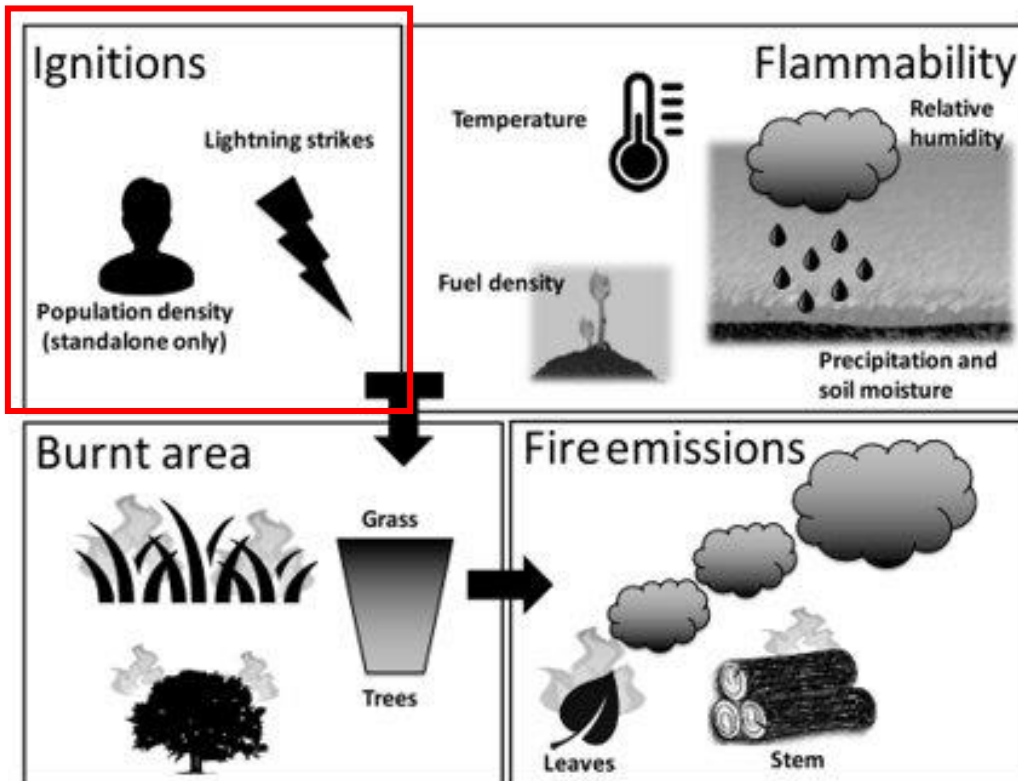


~~May~~ → fuel accumulation → September =



# How PB was simulated in JULES-INFERNO

- Added a PB component to ignition equation in **C4 grass during EDS**



$$\begin{aligned} \text{Ignition} &= \text{anthropogenic} + \text{natural} \\ &\downarrow \\ \text{Ignition} &= \text{anthropogenic} + \text{natural} + \text{prescribed burning} \end{aligned}$$

# Changes in JULES-INFERNNO to better represent Cerrado

## 1) Decreased litter accumulation

- Maximized combustion completeness (cc) of the DPM pool → more efficient burning
- Removed soil moisture → soil moisture not limiting the burning

## 2) Decreased regrowth rate of C4 grass

- Halved the efficiency in use of light (alpha algorithm)

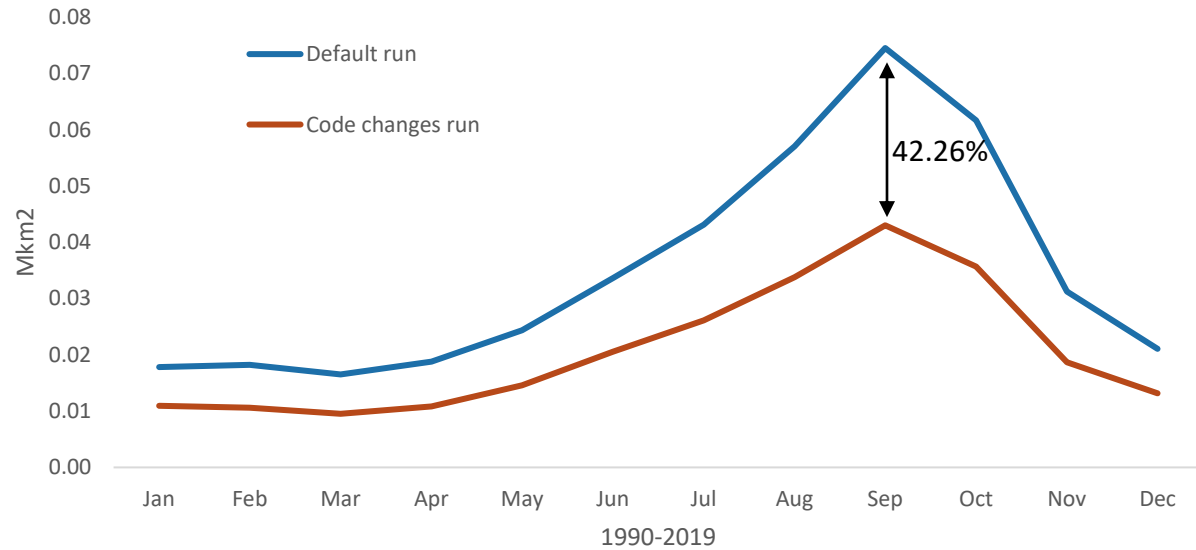
## 3) Made land uses constant

- Crop and pasture constant over the time series
- Enables to evaluate changes in C4 alone



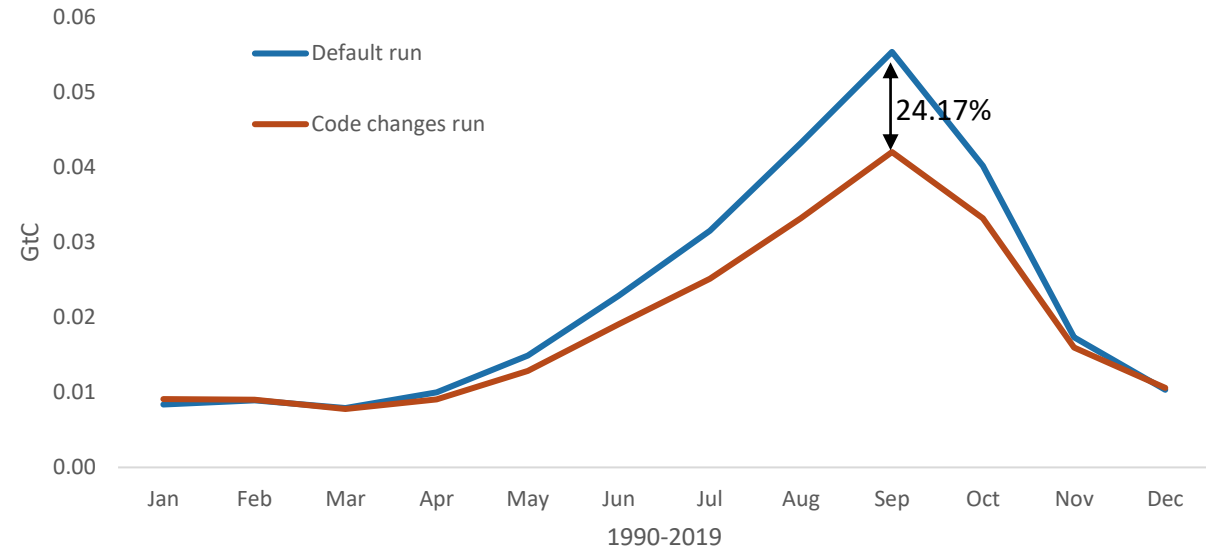
# With the changes in the code, burnt area and fire emissions reduced

Burnt area in Cerrado



Reduction over the time series = 41%

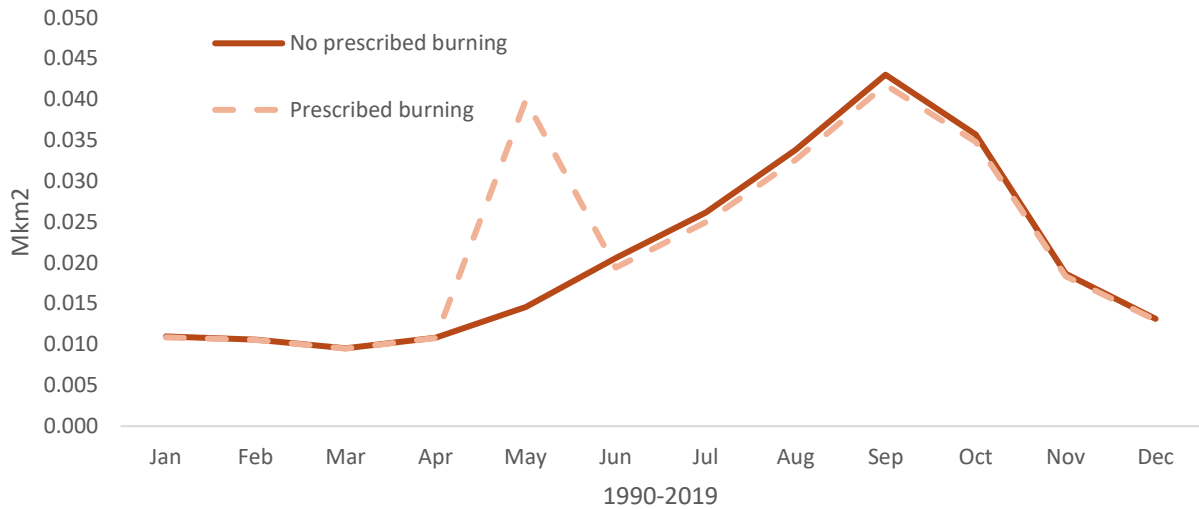
Fire emissions in Cerrado



Reduction over the time series = 16%

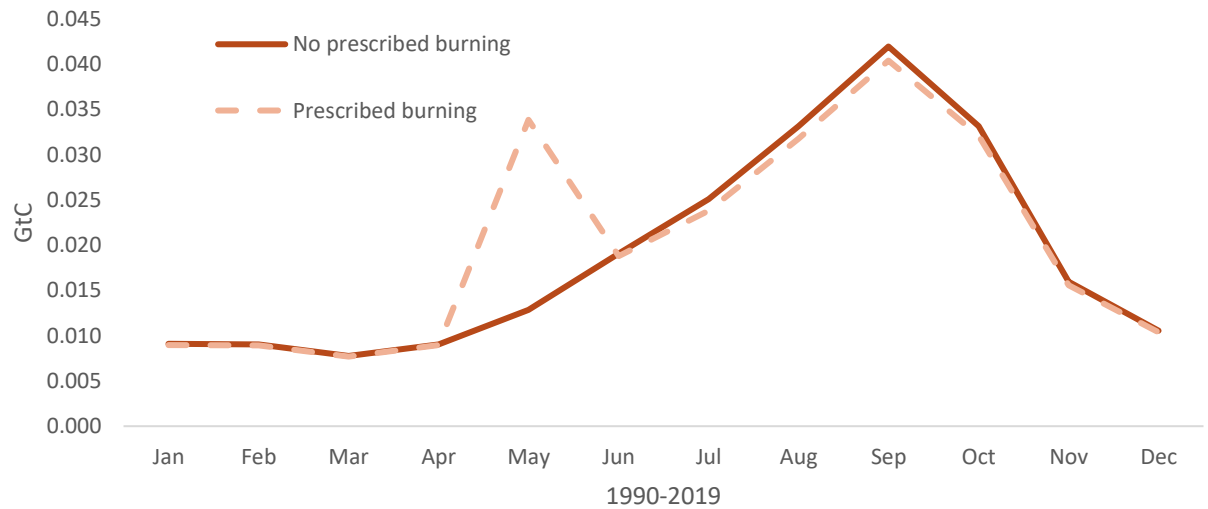
# When PB is applied to the changed code, burnt area and fire emissions reduce slightly in September

Burnt area in Cerrado



Average reduction in September = 2.94%

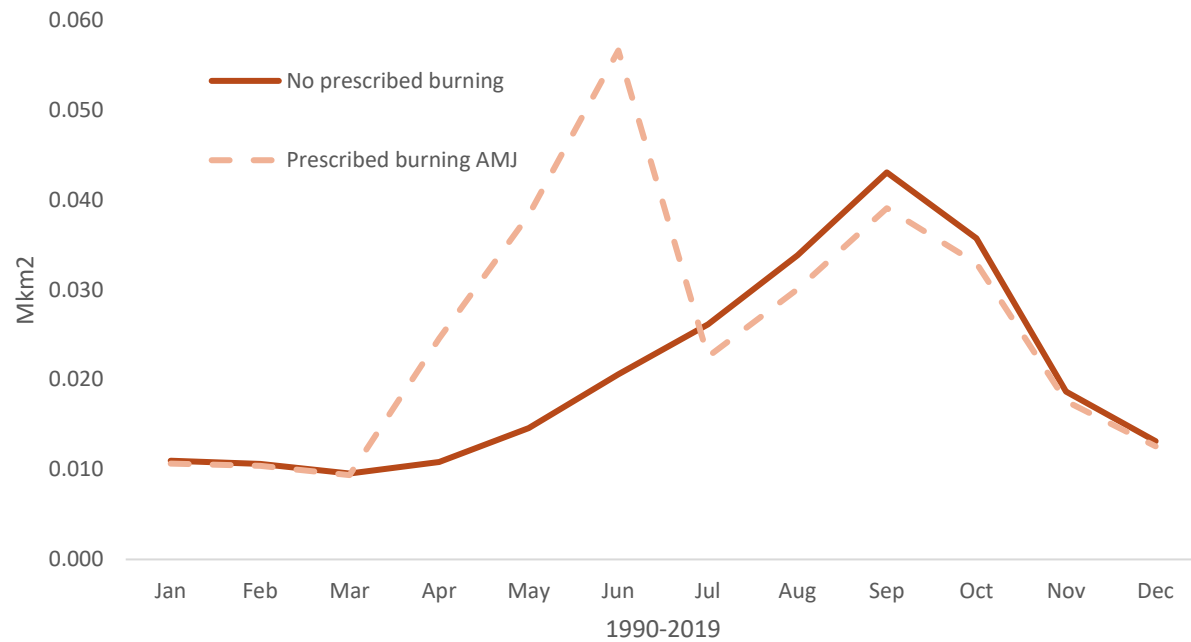
Fire emissions in Cerrado



Average reduction in September = 3.67%

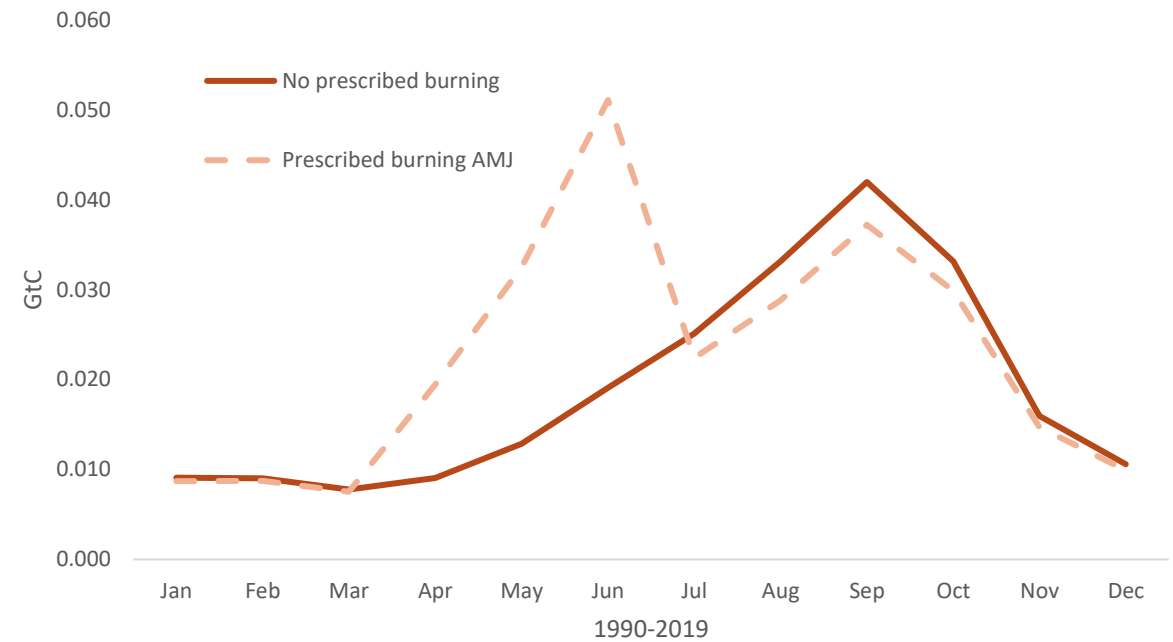
# If we apply PB to the whole EDS, the decrease in the LDS is larger

Burnt area in Cerrado



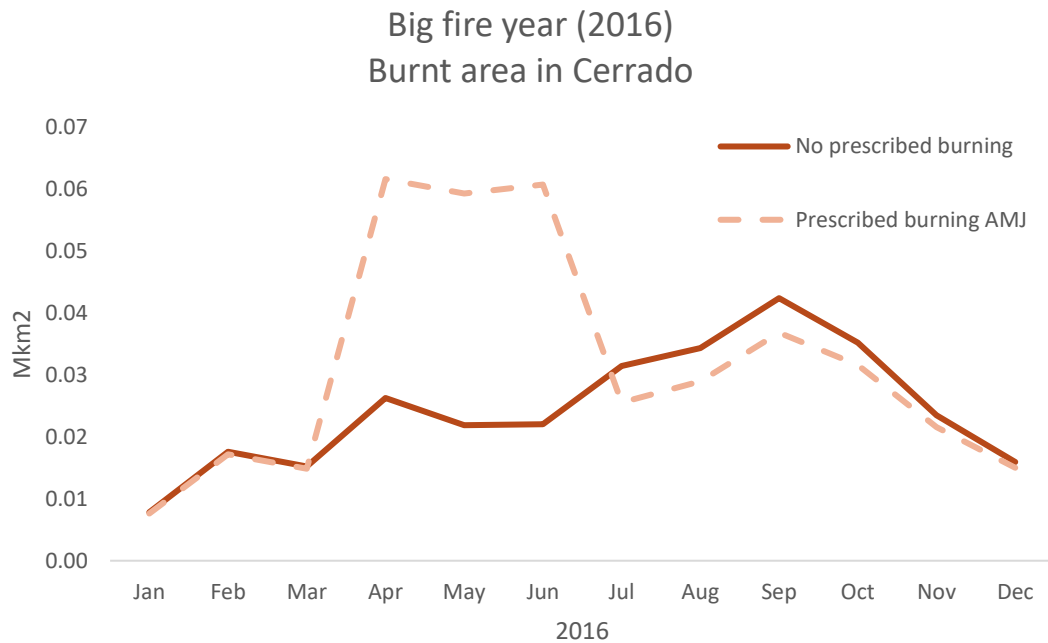
Average reduction in LDS (ASO) = 9.33%

Fire emissions in Cerrado

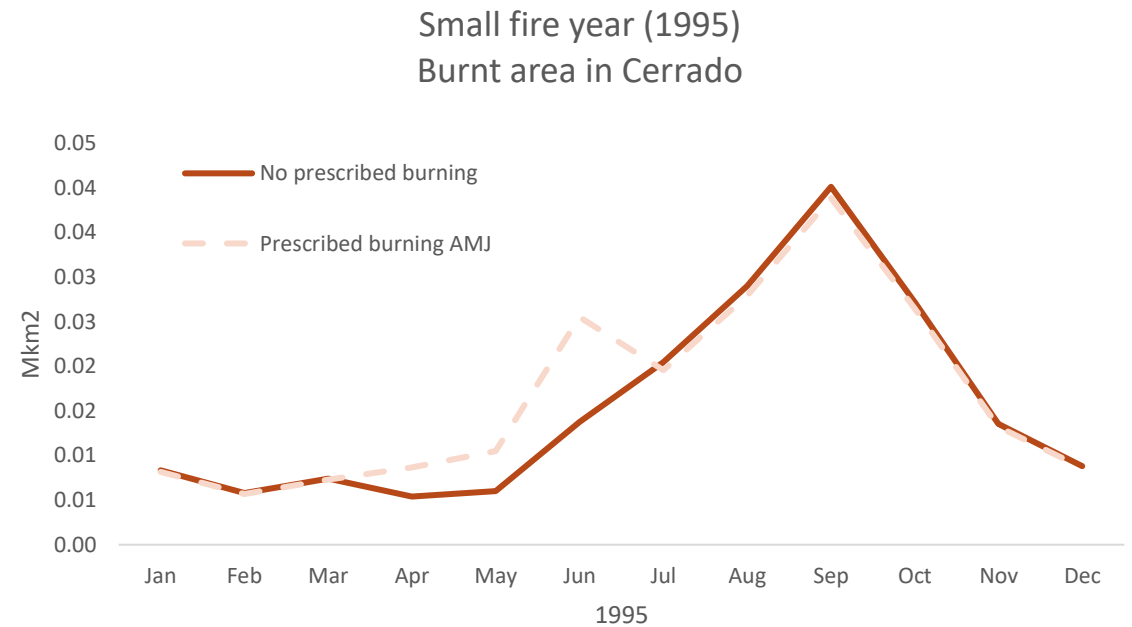


Average reduction in LDS (ASO) = 11.43%

# Example: burnt area in big fire year x small fire year



Average reduction in LDS (ASO) = 13.00%



Average reduction in LDS (ASO) = 3.13%

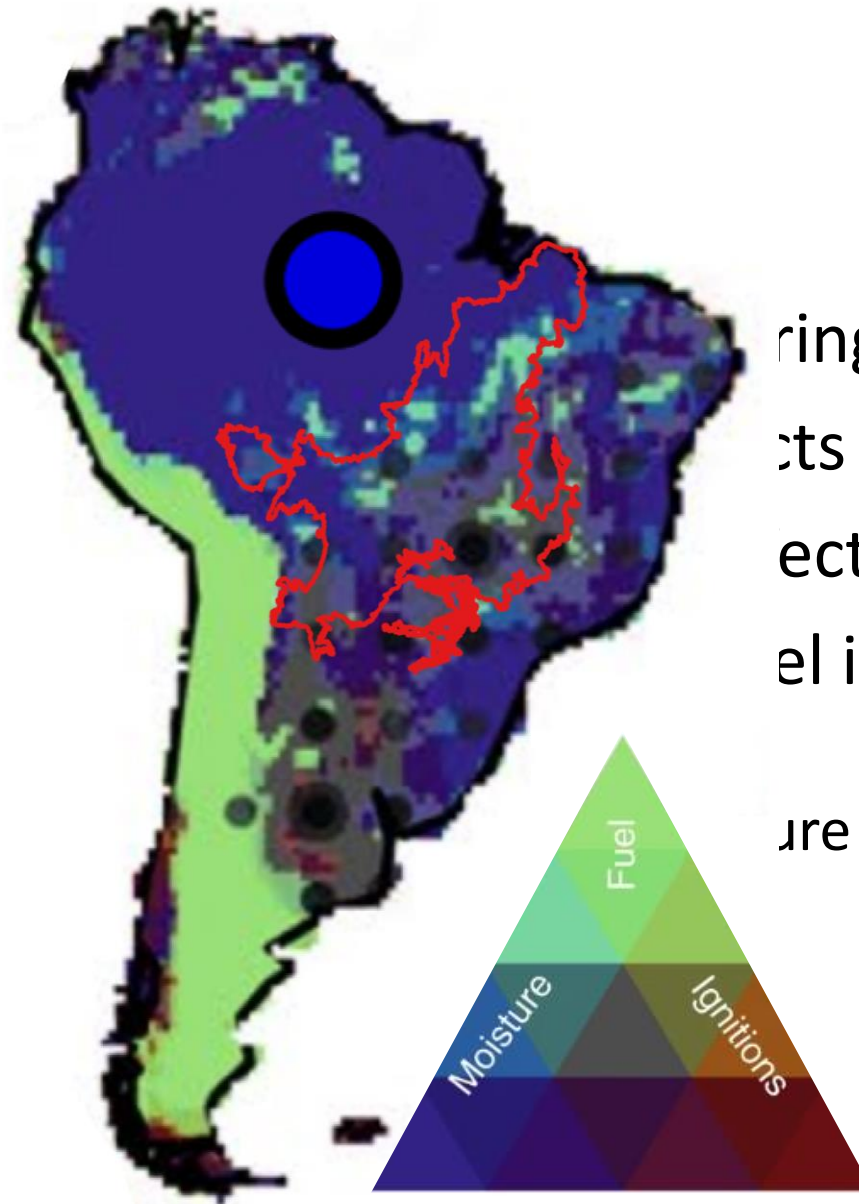
**In years where uncontrolled fires are more likely to happen (big fire years), PB is more effective**

# Final remarks

- PB reduces burnt area and fire emissions during LDS
- PB can be used as a tool to reduce the impacts of uncontrolled fires
- When analysing yearly changes, PB is not effective
- Climate might have a greater impact than fuel in JULES-INFERNO fire emission predictions
  - Cerrado has shown to be more limited by moisture than fuel (Kelley et al., 2019)

# Final remark

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Kelley et al. (2019)

<https://www.nature.com/articles/s41558-019-0540-7>

# Final remarks

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- PB can be used as a tool to reduce the impacts of uncontrolled fires
- When analysing yearly changes, PB is not effective
- Climate might have a greater impact than fuel in JULES-INFERNO fire emission predictions
  - Cerrado has shown to be more limited by moisture than fuel (Kelley et al., 2019)
- Potential JULES-INFERNO improvements: fire spread

# Next steps

- **Spatial analysis** to understand if there are areas of Cerrado that perform better than others
- **Model evaluation** to understand how JULES represents Cerrado when compared to observations
  - Burnt area
  - Fire emissions





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**Thank you!**  
**Obrigada!**

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