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Interactive INFERNO

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 **Newton**
Fund

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Overview

1. Why is fire important
2. Introduction to INFERNO
3. Modifications
4. Results





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Why is fire modelling so important?

1. Fire effects vegetation dynamics, atmospheric chemistry, carbon cycle, hydrological cycle
2. Increased risk of fire with hotter, drier conditions
3. Continued pressure of land-use change, using fire
4. Fire modelling is in it's infancy ->
Low agreement and high uncertainty around future fire frequency

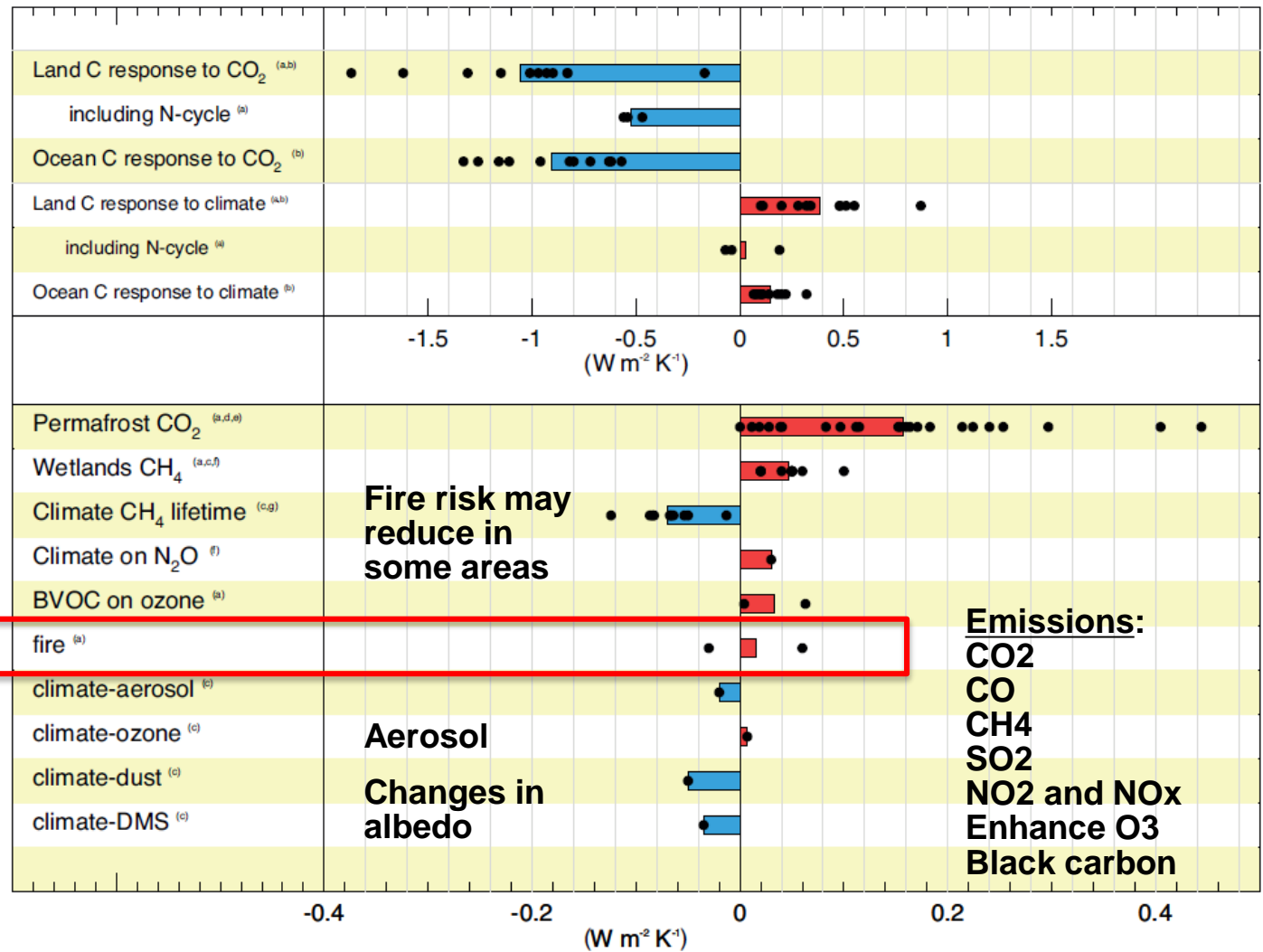
Worldwide, annual burned area reaches approximately 350 million hectares per year, and resultant CO₂ emissions can exceed 50% of fossil fuel emissions (Jolly et al, 2015)



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IPCC biogeochemical feedbacks on climate



Currently fire is represented as a constant disturbance in most ESMs



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Interactive Fire and Emission
algoRithm for Natural envirOnments

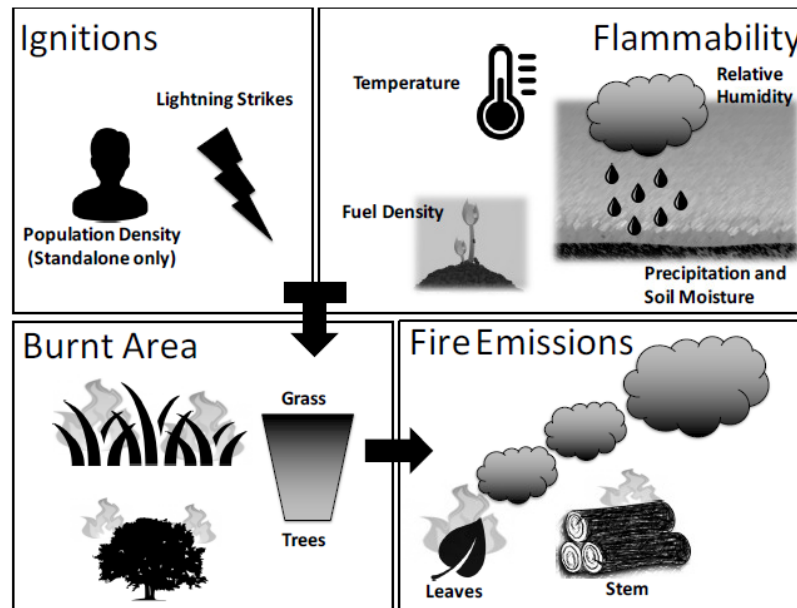


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INFERNO (INteractive Fire and Emission algoRithm for Natural enviroNments)

Fire model implemented into JULES Vn4.5 as a diagnostic of burnt area



INFERNO

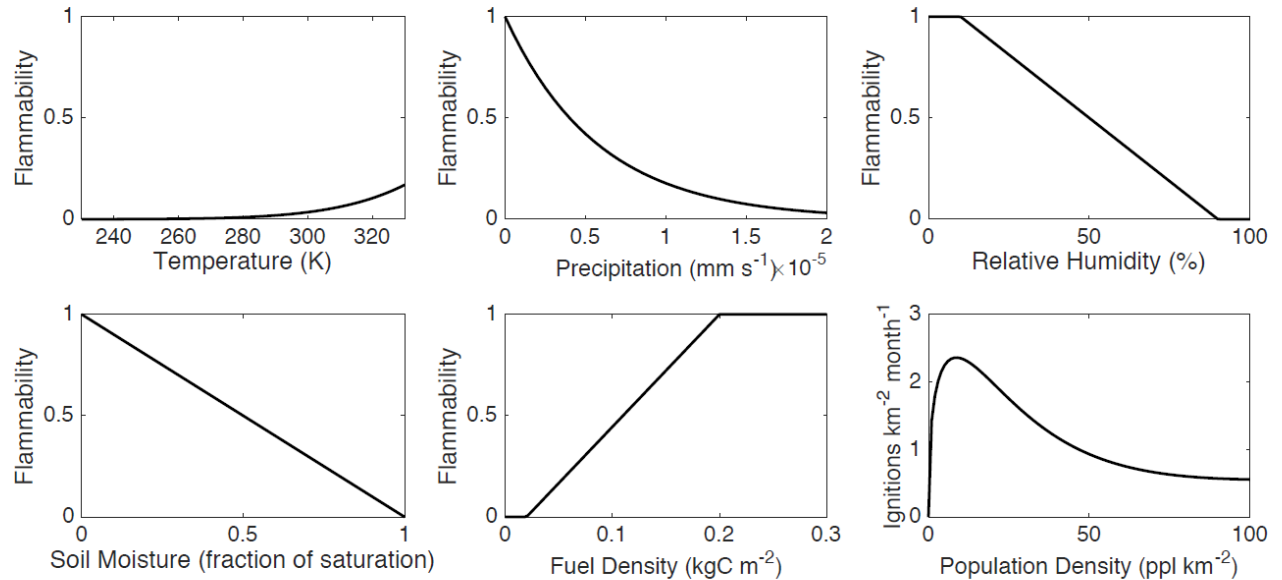


JULES
Joint UK Land
Environment Simulator



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Functional dependencies

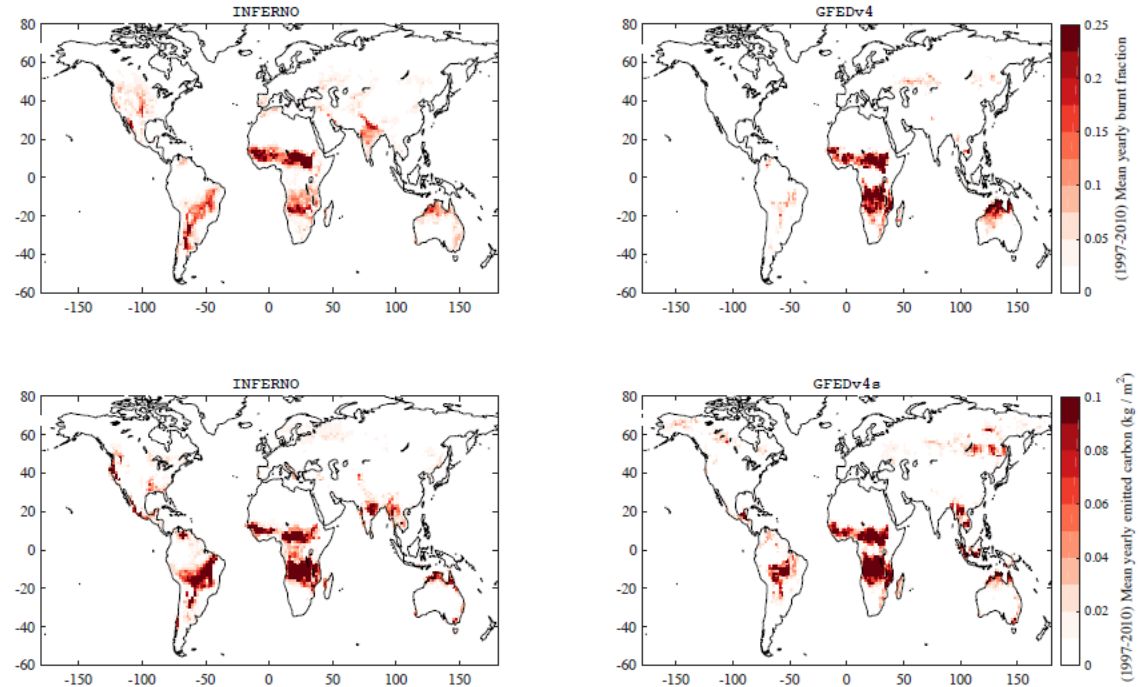




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INFERNO (INteractive Fire and Emission algoRithm for Natural enviroNments)



Mangeon et al, 2016

Fig. 2. 1997-2010 mean yearly burnt fraction (above) and emitted carbon (below, in kg m⁻²). Shown for INFERNO on the left (with CRUNCEP meteorology and interactive ignitions: mode 3) and for GFED on the right.

INFERNO



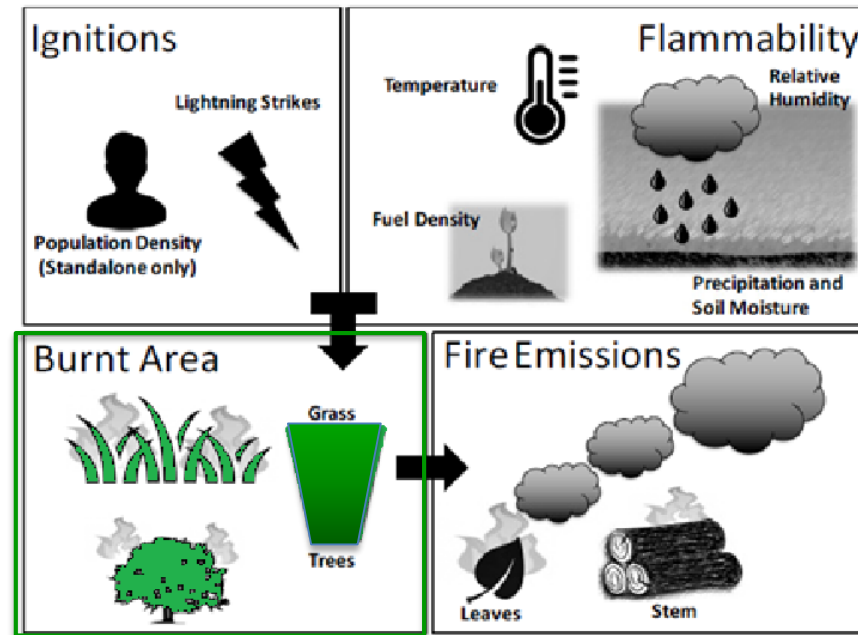


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INFERNO (INteractive Fire and Emission algoRithm for Natural enviroNments)

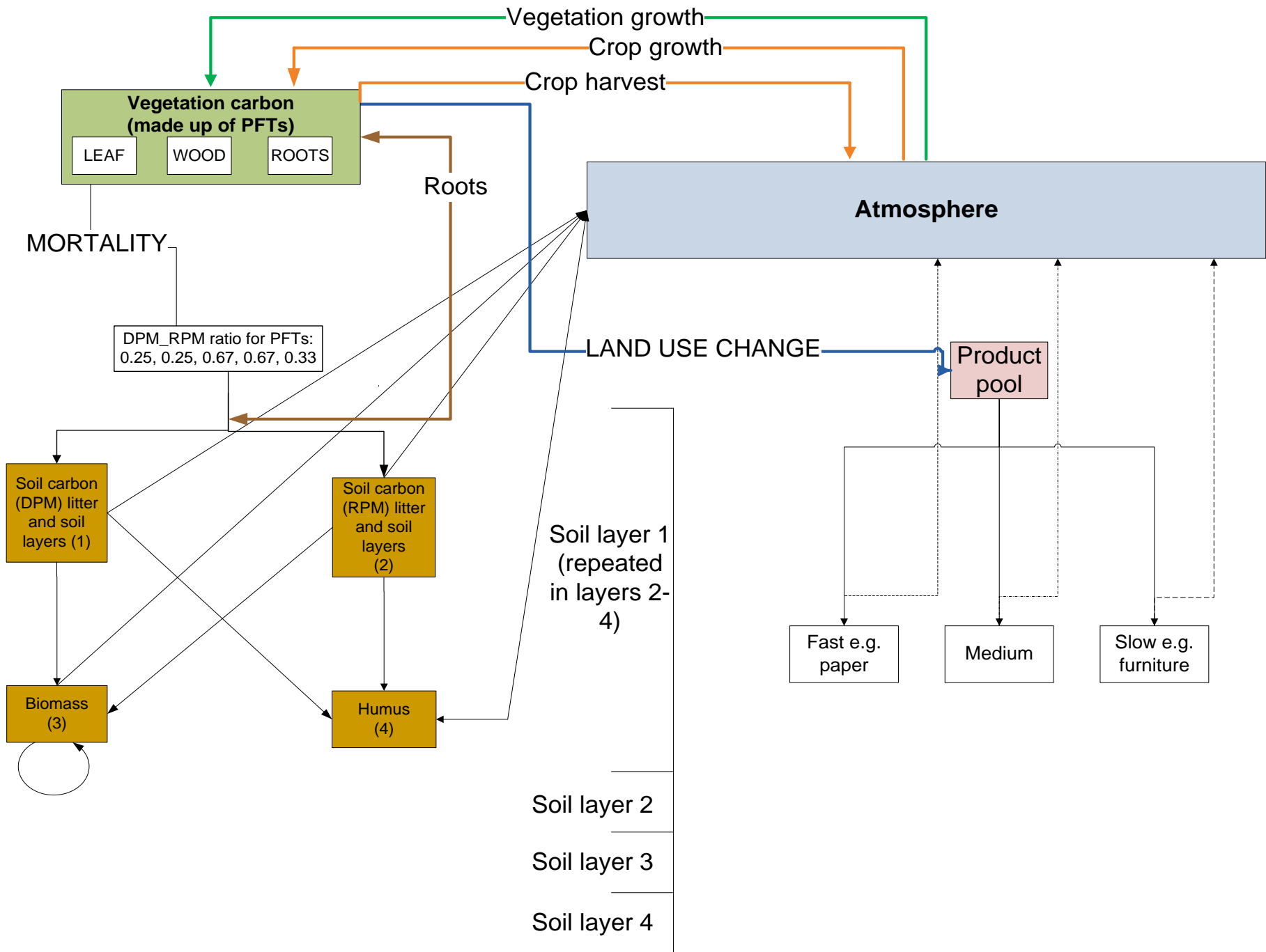
- Vn 4.8 now includes interactive fire, with dynamic vegetation

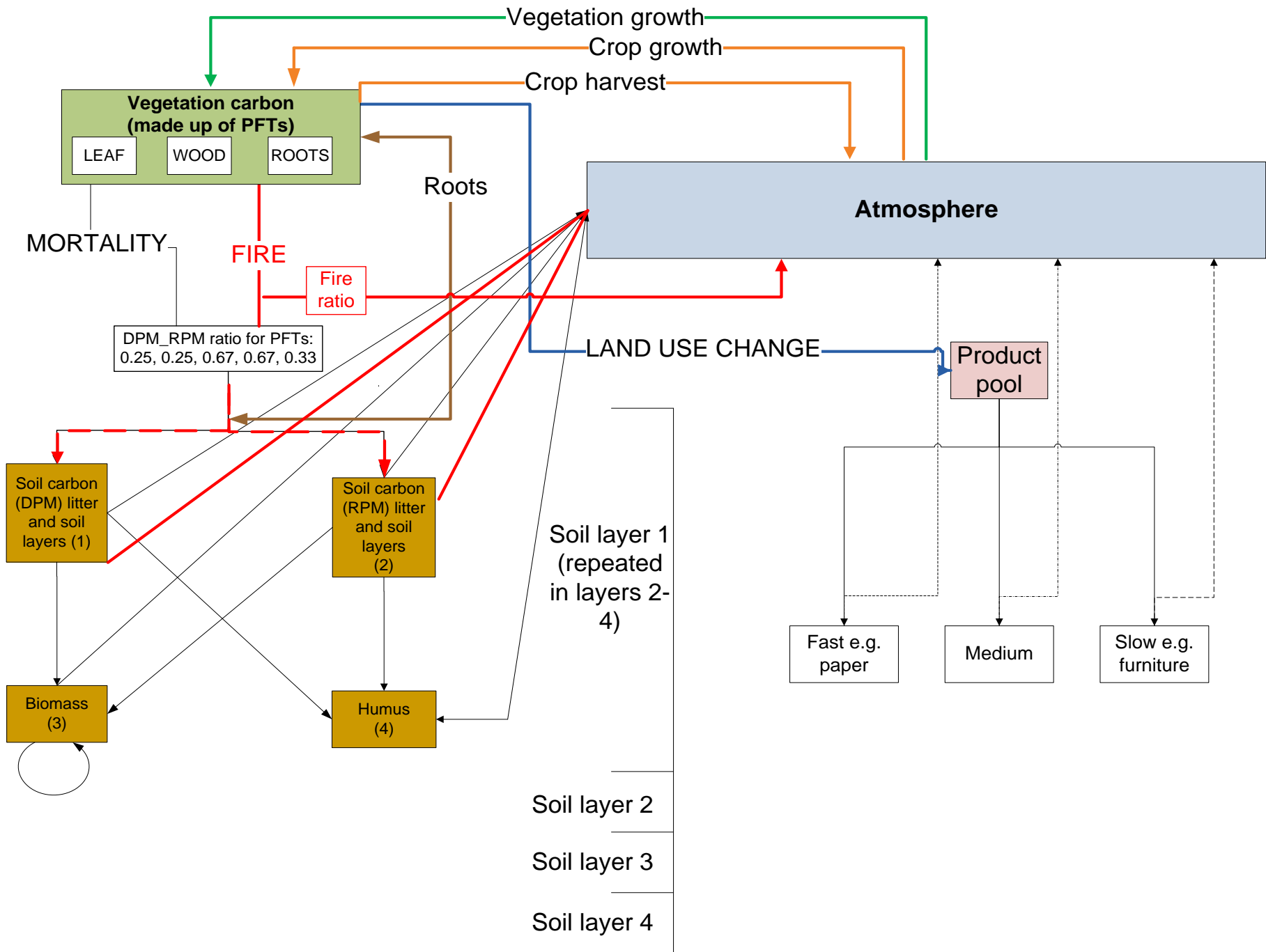


INFERNO



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Output from INFERNO

Diagnostics

- Flammability
- Burnt area (fraction of gridbox)
- Emitted Carbon (KgC/m²/s)
- Carbon Dioxide (KgC/m²/s)
- Carbon Monoxide (KgC/m²/s)
- Methane (KgC/m²/s)
- Nitrogen Oxides (KgC/m²/s)
- Sulphur Dioxide (KgC/m²/s)
- Organic Carbon (KgC/m²/s)
- Black Carbon (KgC/m²/s)

For:

- PFTs
- GB aggregate
- DPM
- RPM

Interactive

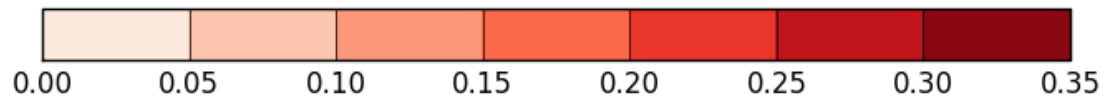
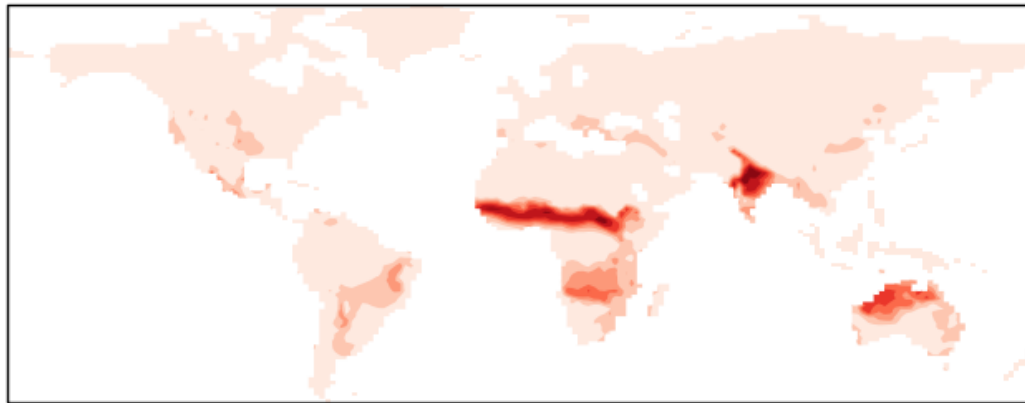
- Fire disturbance (fraction of gridbox)
- Fire disturbance (per pft)
- Burnt carbon DPM
- Burnt carbon RPM
- Fire emissions from vegetation (fraction of gridbox)
- Fire emissions from vegetation (per pft)
- Burnt vegetation carbon



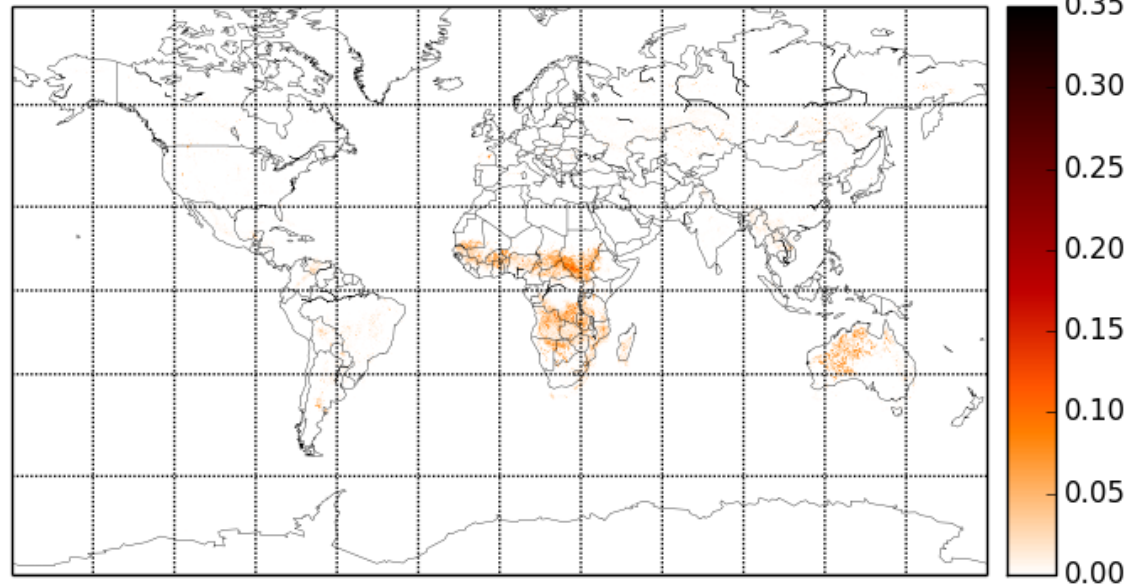
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Fire disturbance, 2000



GFED Observations of burned area 2000



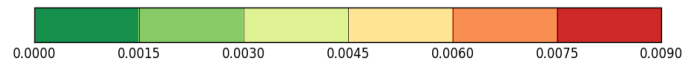
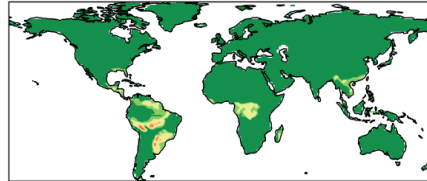


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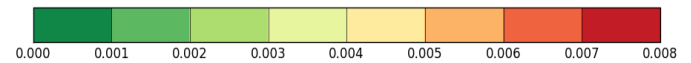
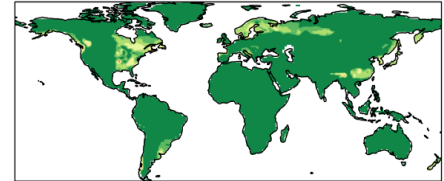
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Fire disturbance

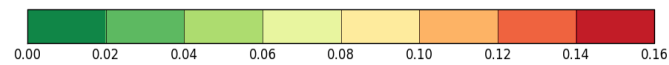
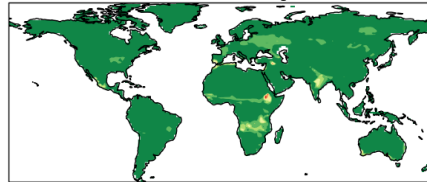
Fire disturbance, broadleaf



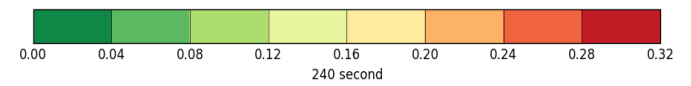
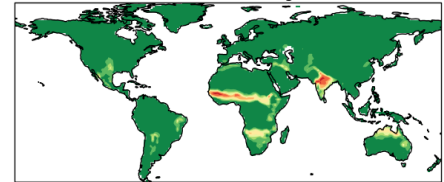
Fire disturbance, needleleaf



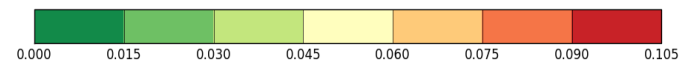
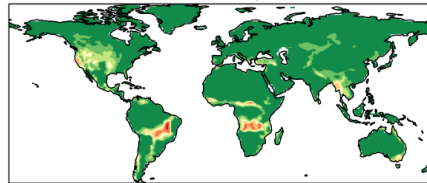
240 second
Fire disturbance, C3 grass



240 second
Fire disturbance, C4 grass



240 second
Fire disturbance, Shrub

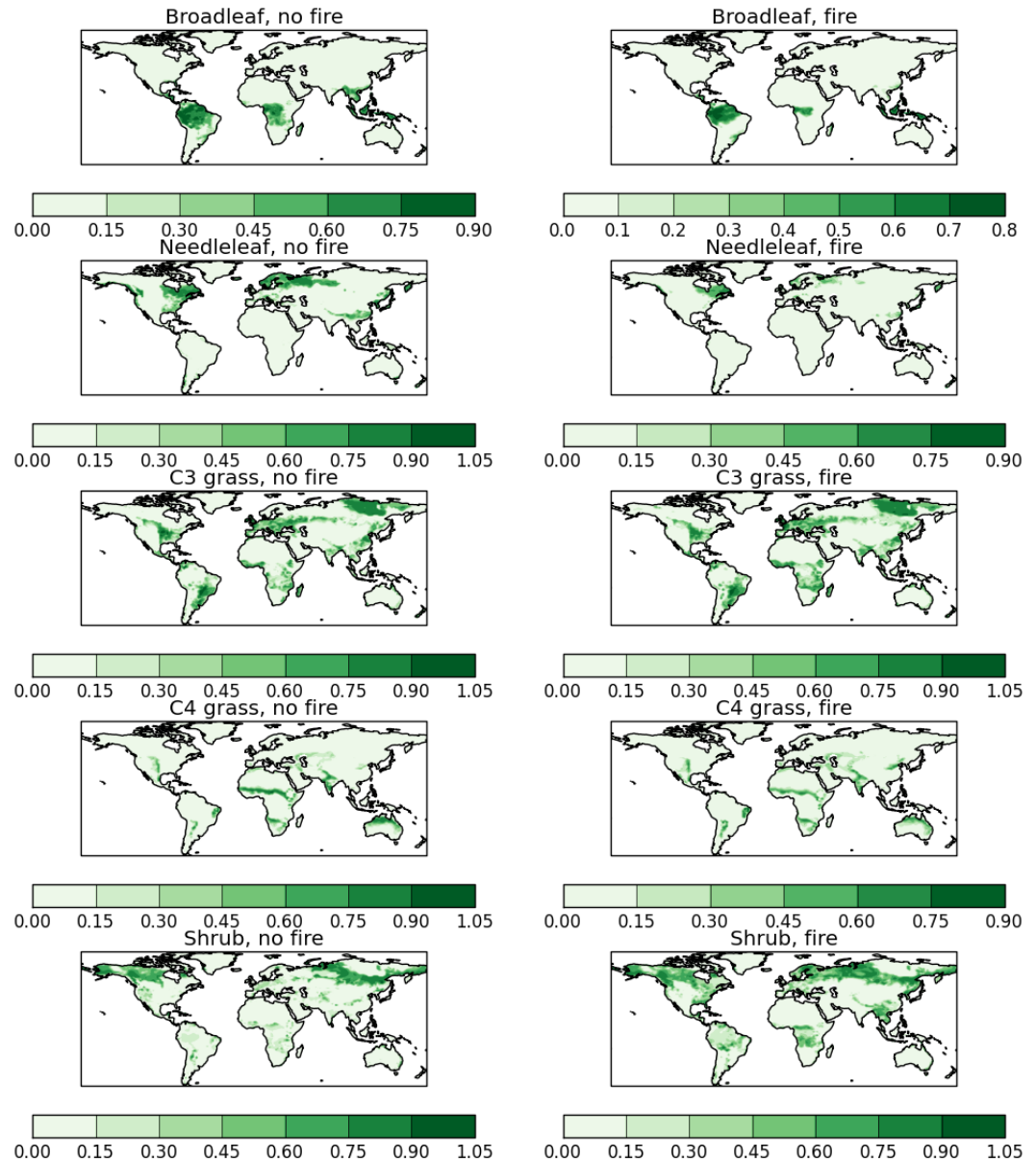




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Vegetation fractions without fire and with fire, 2009

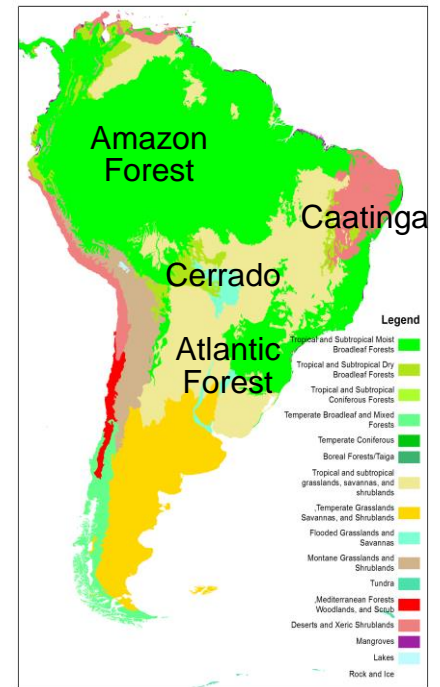
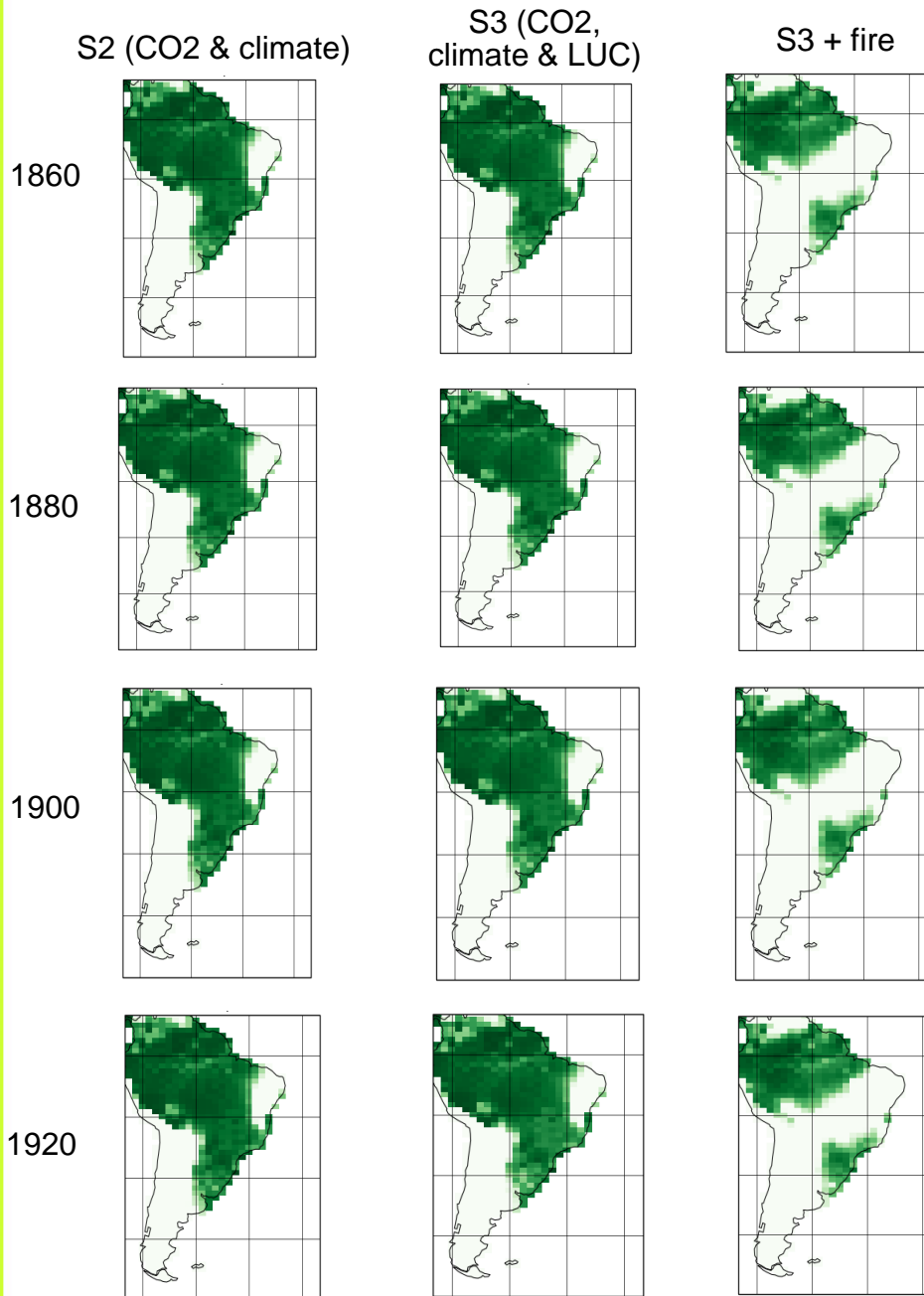




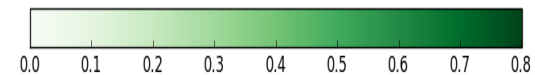
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TRENDY runs, fraction of broadleaf tree



WWF Biome and ecoregions



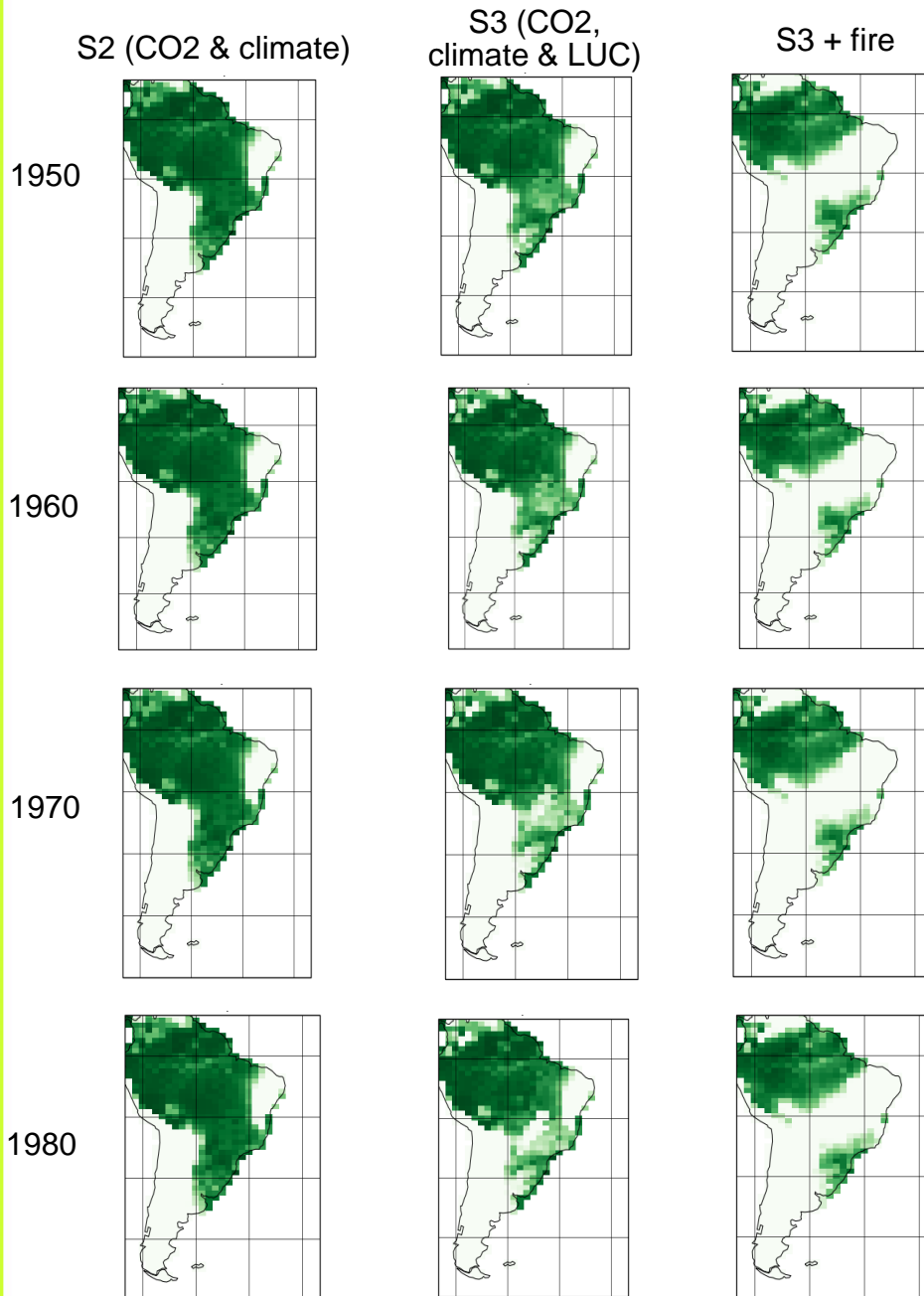
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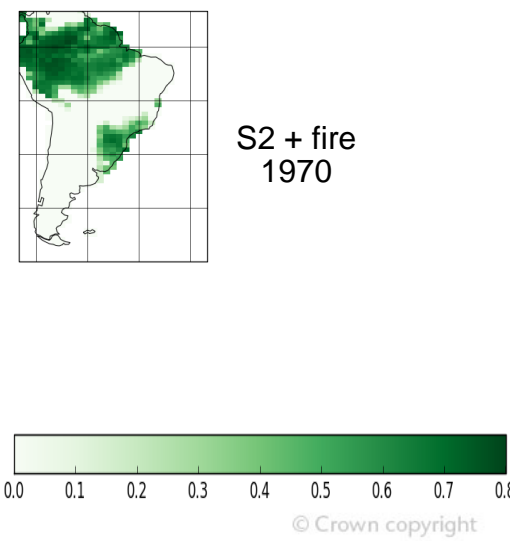
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TRENDY runs, fraction of broadleaf tree



WWF Biome and ecoregions

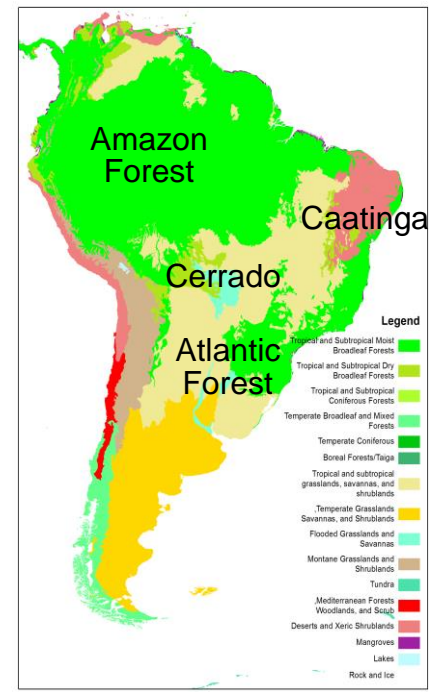
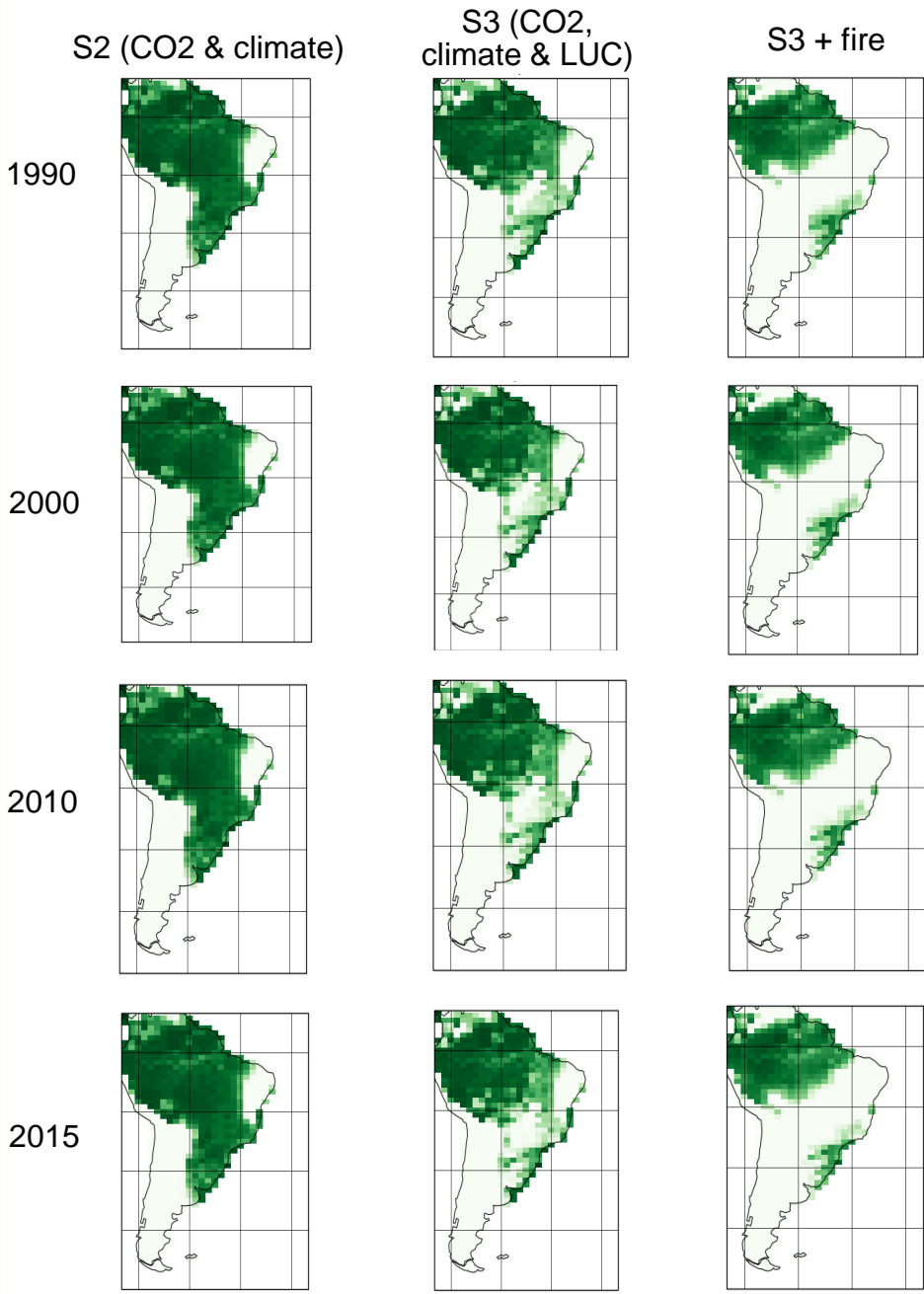




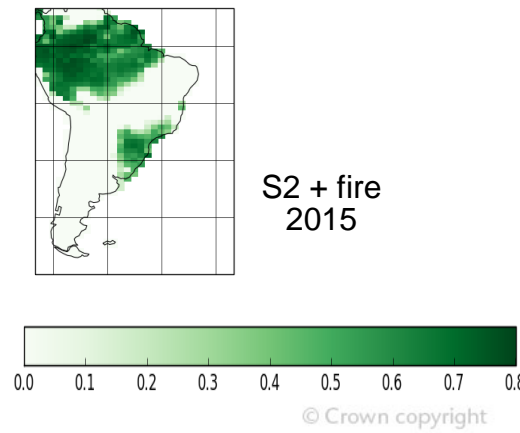
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TRENDY runs, fraction of broadleaf tree



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Summary



- Fire impacts many parts of the Earth system
- INFERNO now coupled to vegetation
- Needs tuning
- Good in some areas, too high in others
- More work to understand processes & response in PFTs





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