ISIMIP
Inter-Sectoral Impact Model Intercomparison Project

ISIMIP update

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Met Office

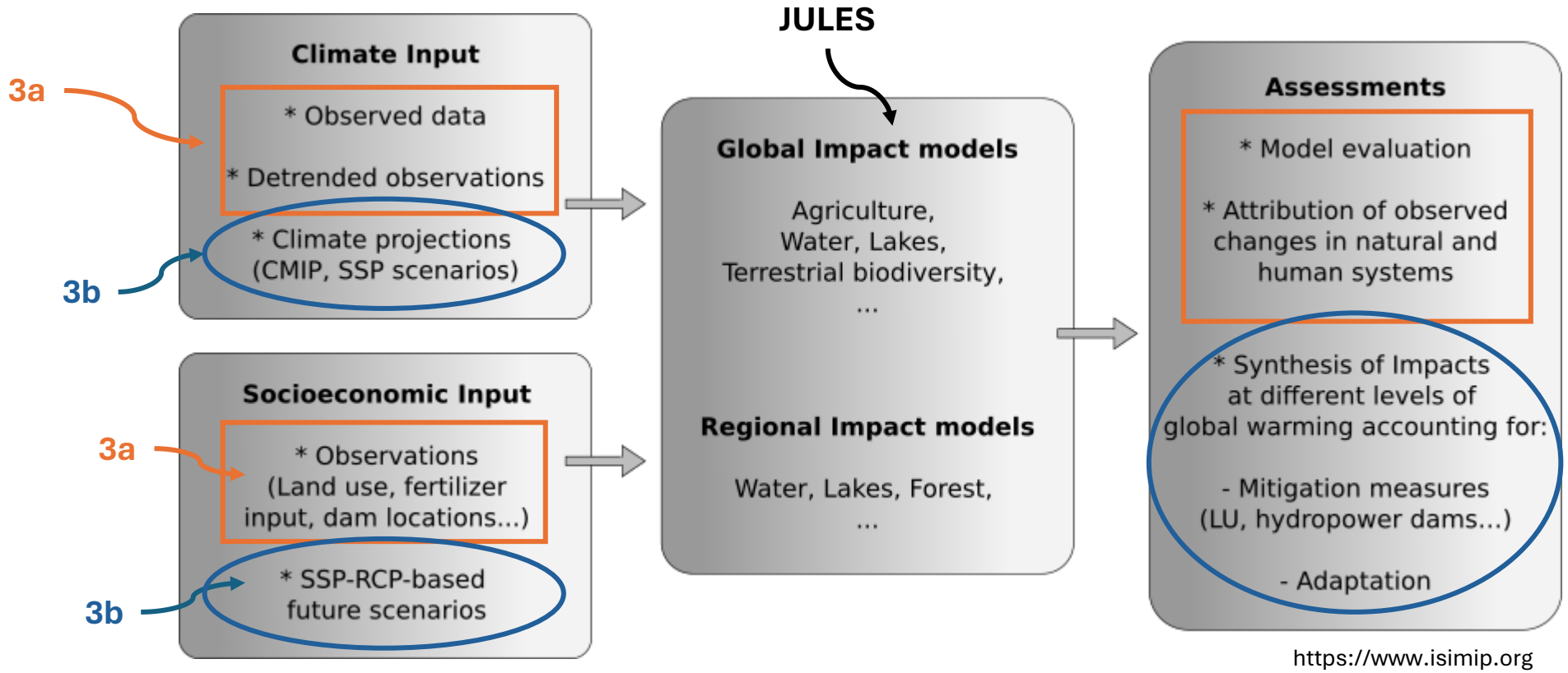
UK Centre for Ecology & Hydrology

What's ISIMIP

ISIMIP
Inter-Sectoral Impact Model Intercomparison Project

- Inter-Sectoral Impact Model Intercomparison Project
- Assess impacts of climate change on various sectors:
  - **Water (global)**, water (regional), water quality, groundwater, fisheries & marine ecosystems, energy, regional forests, **global biomes**, agriculture, agro-economic modelling, terrestrial biodiversity, **permafrost**, coastal systems, health, lakes, **fire**, **peat**, labour supply & productivity
- Impact models focusing on singular or multiple sectors
- Protocol ensures consistency across sectors and models
- Input data: bias-corrected climate, socio-economic, and other relevant data on human influences

Simulations

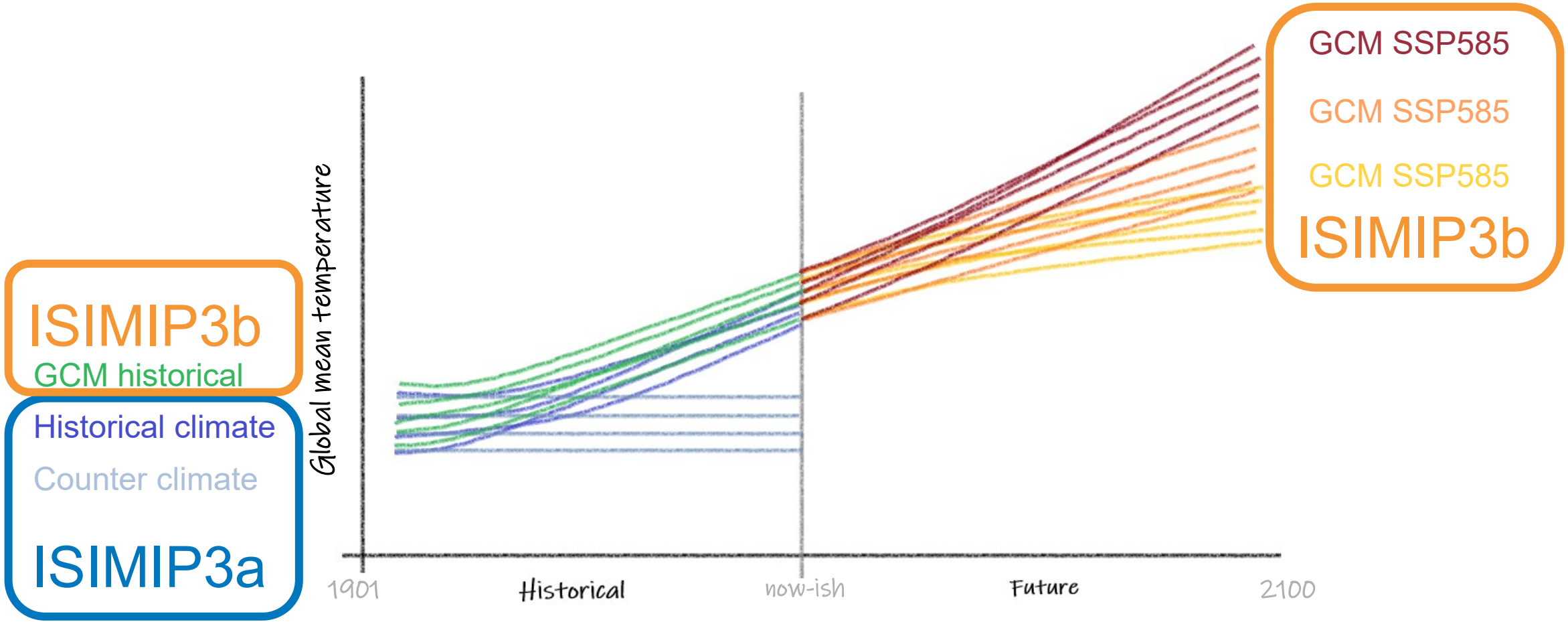


https://www.isimip.org

- ISIMIP2: CMIP5-based
- ISIMIP3: CMIP6-based
  - 3a: observed/detrended climate: 1901-2021
  - 3b: simulated climate: 1850-2014, 2015-2100 (SSP126/370/585)

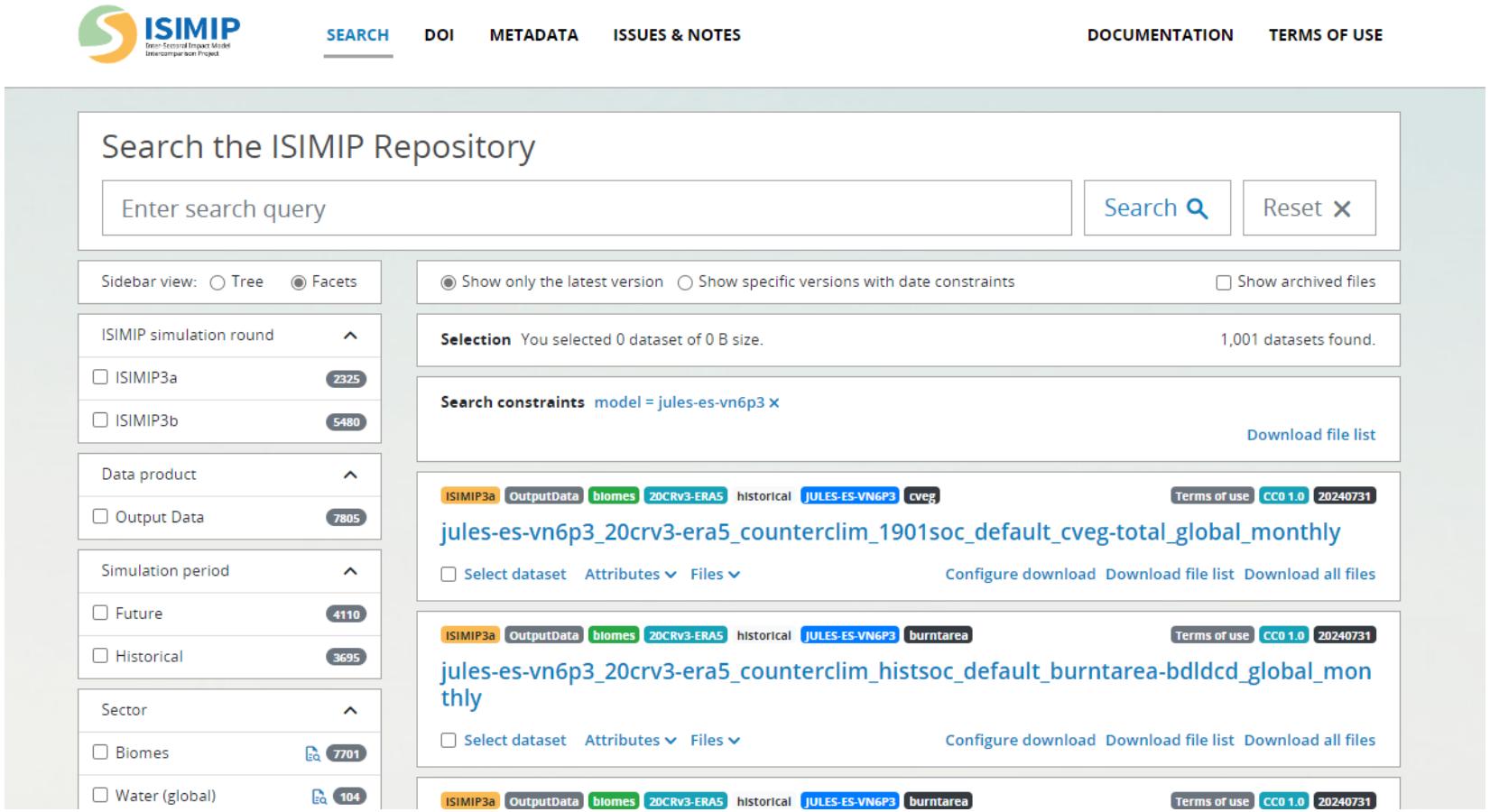
- Direct human forcing (e.g. land use, nitrogen)
  - Historical
  - Fixed to 1901
  - Fixed to 2015 (current 3b future experiments)
  - Projection (3b group iii experiments, upcoming)
  - Etc.

ISIMIP data


GCM SSP585
GCM SSP585
GCM SSP585
ISIMIP3b
ISIMIP3b
GCM historical
Historical climate
Counter climate
ISIMIP3a
Global mean temperature
1901
Historical
now-ish
Future
2100

JULES-ES outputs on the ISIMIP repository

- JULES-ES setup:
  - TRIFFID, TRIFFID-Crop, nitrogen limitation, river routing, land use change, fire (INFERNO only)
  - 0.5° x 0.5° resolution
- JULES-ES-VN6P3
  - ISIMIP3a: biomes, water (global)
  - ISIMIP3b: biomes, water (global)
- JULES-INFERNO-VN6P3
  - ISIMIP3a: fire
  - (ISIMIP3b: fire)*
- JULES-ES-55
  - ISIMIP2b: biomes, water (global)

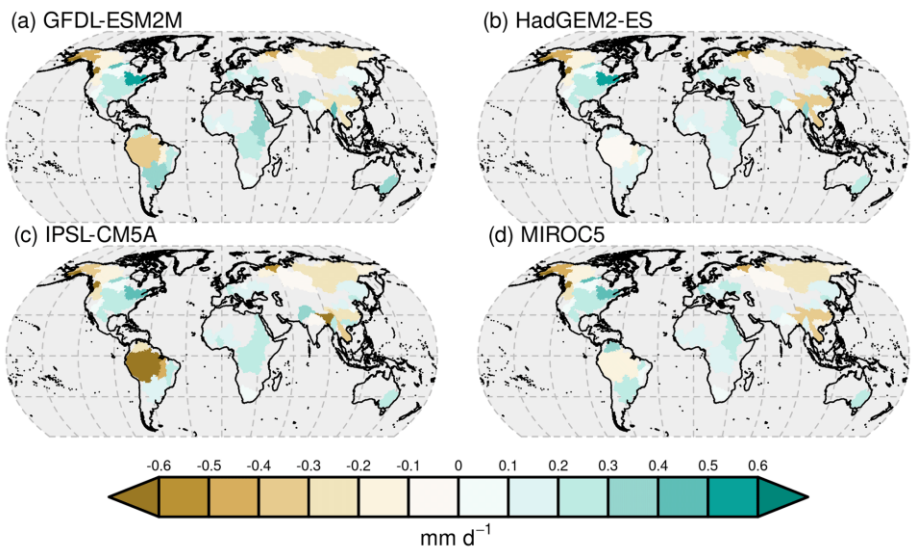


*not on repository but simulation available

https://data.isimip.org

Suite u-cc669 description paper (ISIMIP2b)

- Mathison et al. (2023) https://doi.org/10.5194/gmd-16-4249-2023
- Description of JULES-ES ISIMIP setup and evaluation with ISIMIP2b



Runoff bias

Geosci. Model Dev., 16, 4249–4264, 2023
https://doi.org/10.5194/gmd-16-4249-2023

Geoscientific Model Development
Open Access
EGU

Model experiment description paper

Description and evaluation of the JULES-ES set-up for ISIMIP2b

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Abstract. Global studies of climate change impacts that use future climate model projections also require projections of land surface changes. Simulated land surface performance in Earth system models is often affected by the atmospheric models' climate biases, leading to errors in land surface projections. Here we run the Joint UK Land Environment Simulator Earth System configuration (JULES-ES) land surface model with the Inter-Sectoral Impact Model Intercomparison Project second-phase future projections (ISIMIP2b) bias-corrected climate model data from four global climate models (GCMs). The bias correction reduces the impact of the climate biases present in individual models. We evaluate the performance of JULES-ES against present-day observations to demonstrate its usefulness for providing required information for impacts such as fire and river flow. We include a standard JULES-ES configuration without fire as a contribution to ISIMIP2b and JULES-ES with fire as a potential future development. Simulations for gross primary productivity (GPP), evapotranspiration (ET) and albedo compare well against observations. Including fire improves the simulations, especially for ET and albedo and vegetation distribution, with some degradation in shrub cover and river flow. This configuration represents some of the most current

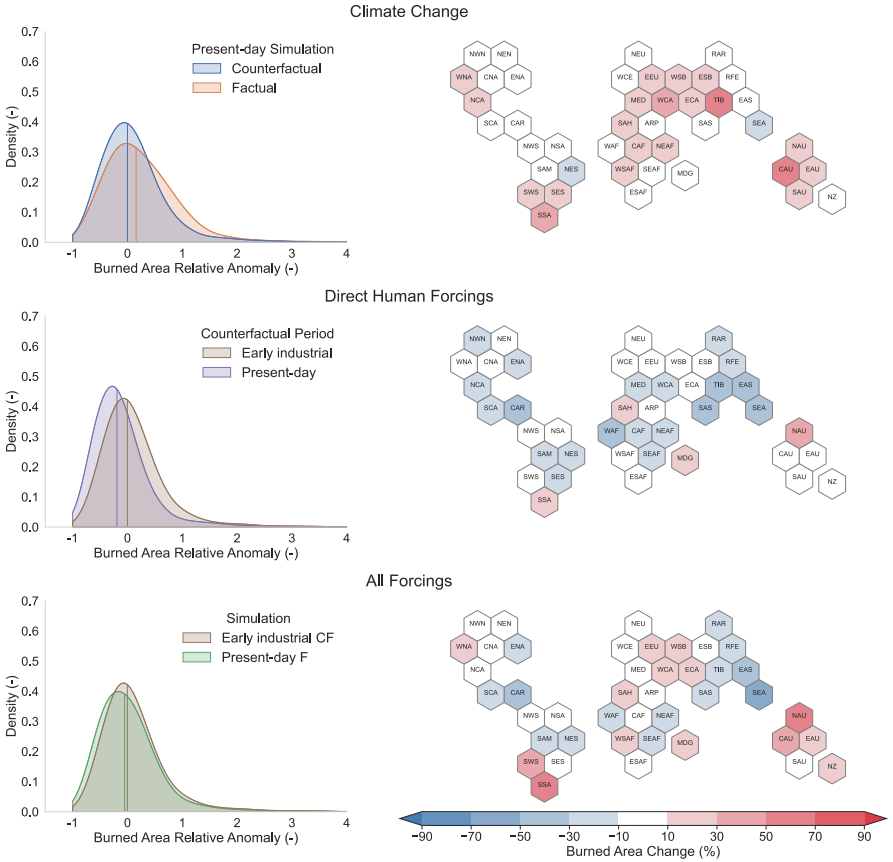
1 Introduction

The Joint UK Land Environment Simulator (JULES; Clark et al., 2011; Best et al., 2011) is a community-supported and developed land surface model used by land, hydrological, weather and climate communities. JULES is a configurable code base supporting weather, climate and Earth system science applications. Here, we describe and evaluate the JULES Earth System (JULES-ES) configuration and experimental set-up used in the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP; Frieler et al., 2017). JULES-ES builds on the JULES-GL7 configuration described in Wiltshire et al. (2020) by including additional biogeochemical

Wildfire impacts attribution papers (ISIMIP3a)

Global burned area increasingly explained by climate change

Chantelle Burton and Seppe Lampe et al., incl. Doug Kelley & Eleanor Burke,
Nature Climate Change, accepted



Attributing human mortality from fire PM2.5 to climate change

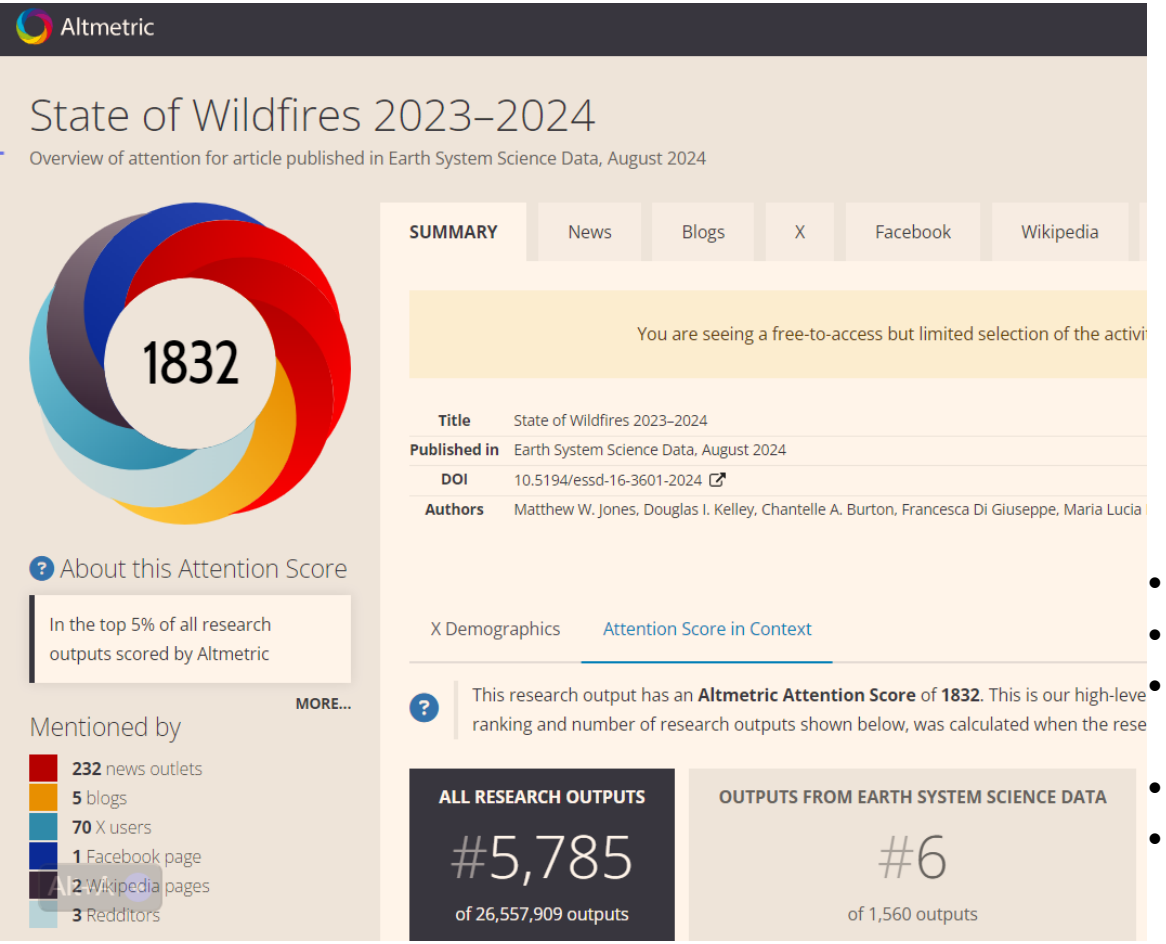
Park et al., incl. Chantelle Burton & Eleanor Burke
In review

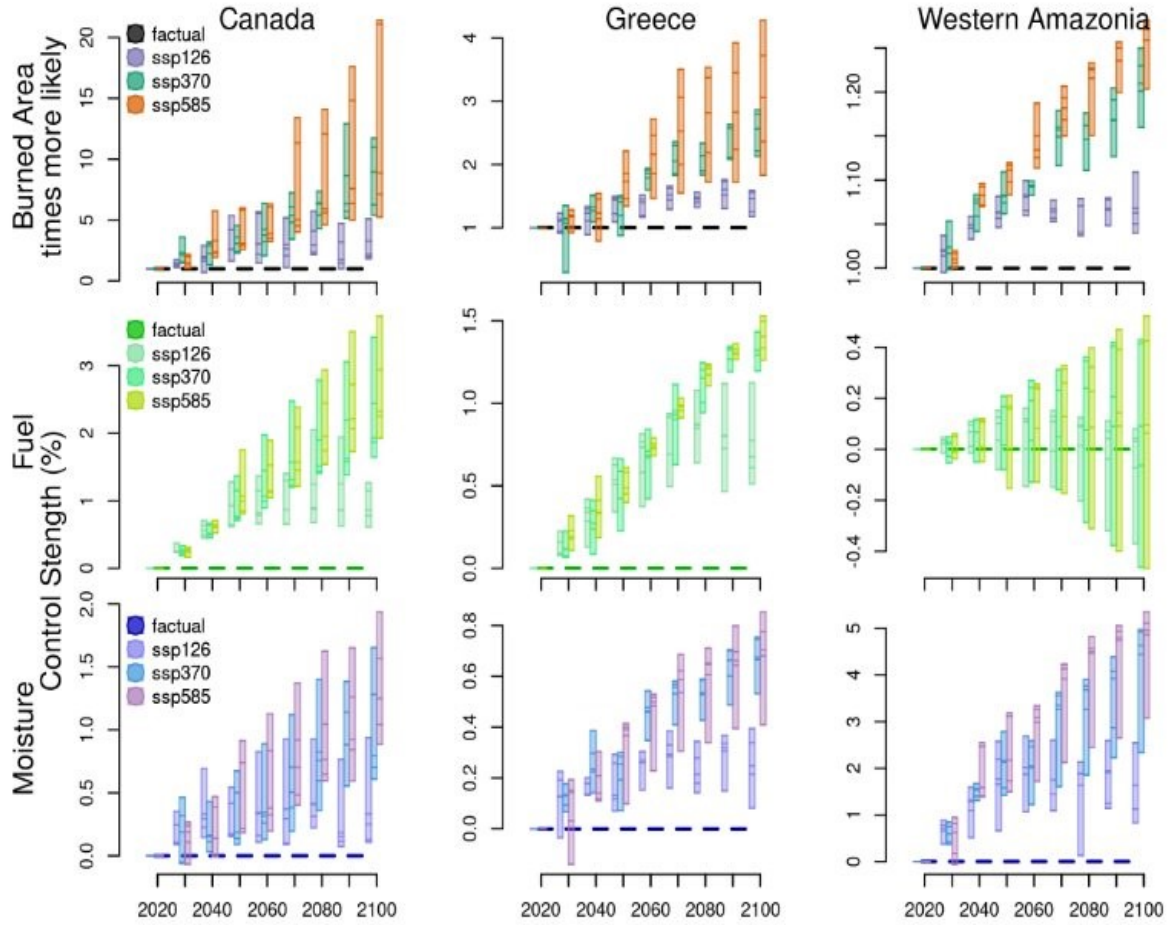
- 3 fire-vegetation models from ISIMIP (CLASSIC, SSiB4, and JULES) used to drive a chemical transport model
- Attribution of global human mortality to fire-related PM2.5 emissions
- Climate change has had a clear impact on fire mortality in some regions, such as South America, northern hemisphere Africa, and Europe. This helps inform policy aimed at reducing fire impact.

State of Wildfires report (ISIMIP3a/3b)

M. Jones, **D. Kelley, C. Burton**, F. Di Giuseppe et al, incl. Maria Lucia F. Barbosa, Eleanor Burke, Andy Hartley, Fiona Spuler, Jakob Wessel

https://essd.copernicus.org/articles/16/3601/2024/

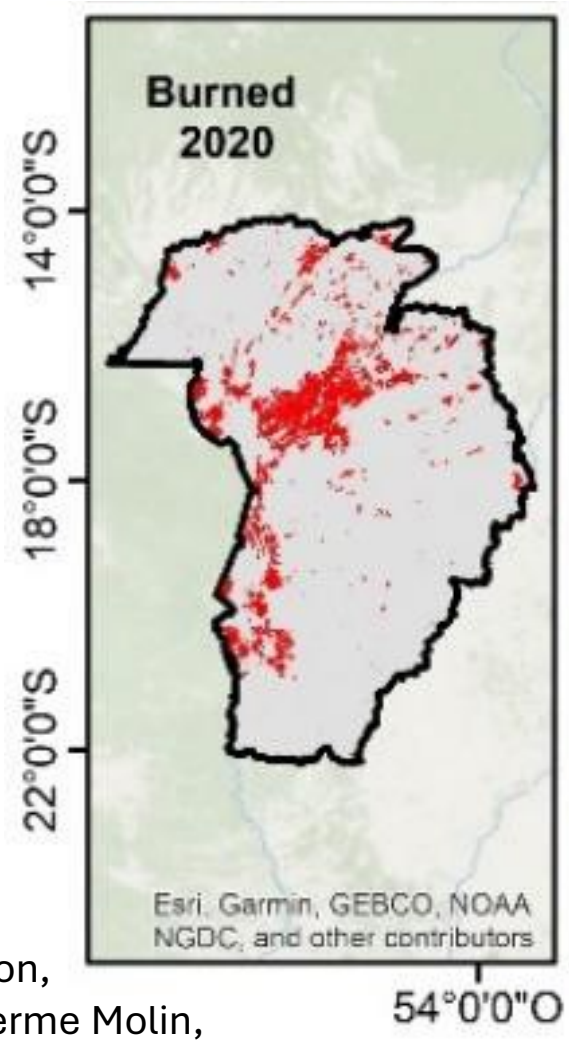


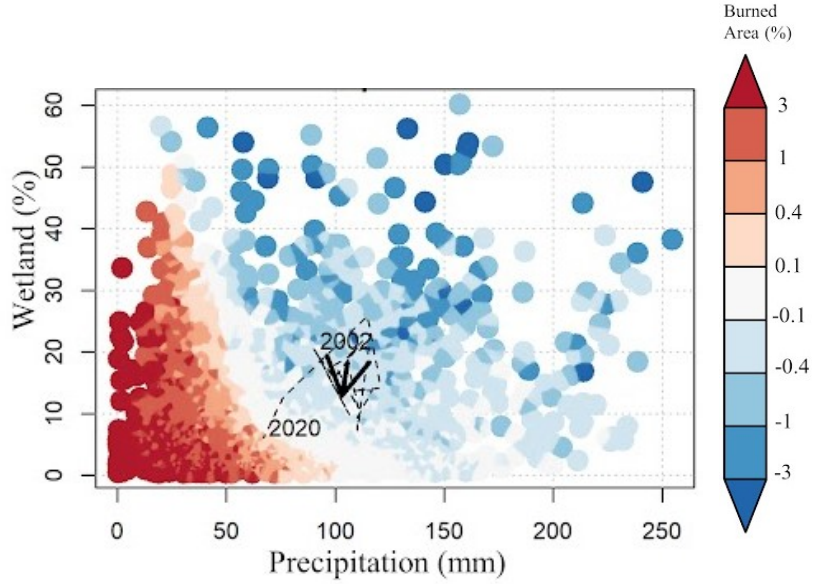


- Focus on Canada, Greece and Western Amazonia fires from 2023
- Included FireMIP attribution results from Burton & Lampe et al
- ConFire used for drivers, attribution and future projections, using JULES land cover and ISIMIP driving data
- Excellent engagement already (only published on 14th Aug)
- First of an annual report

Burning in Pantanal driven by wetland degradation and lower precipitation (ISIMIP3a)

- Much of the Pantanal wetland burnt in 2020 (map)
- Using ISIMIP3a simulations couple of a Bayesian Inference scheme, we show burnt areas get much higher at reduced wetland AND drier conditions, like those seen in 2020
- Shows that maintain/restoring wetlands might make regions less venerable to extreme climate driven fire's



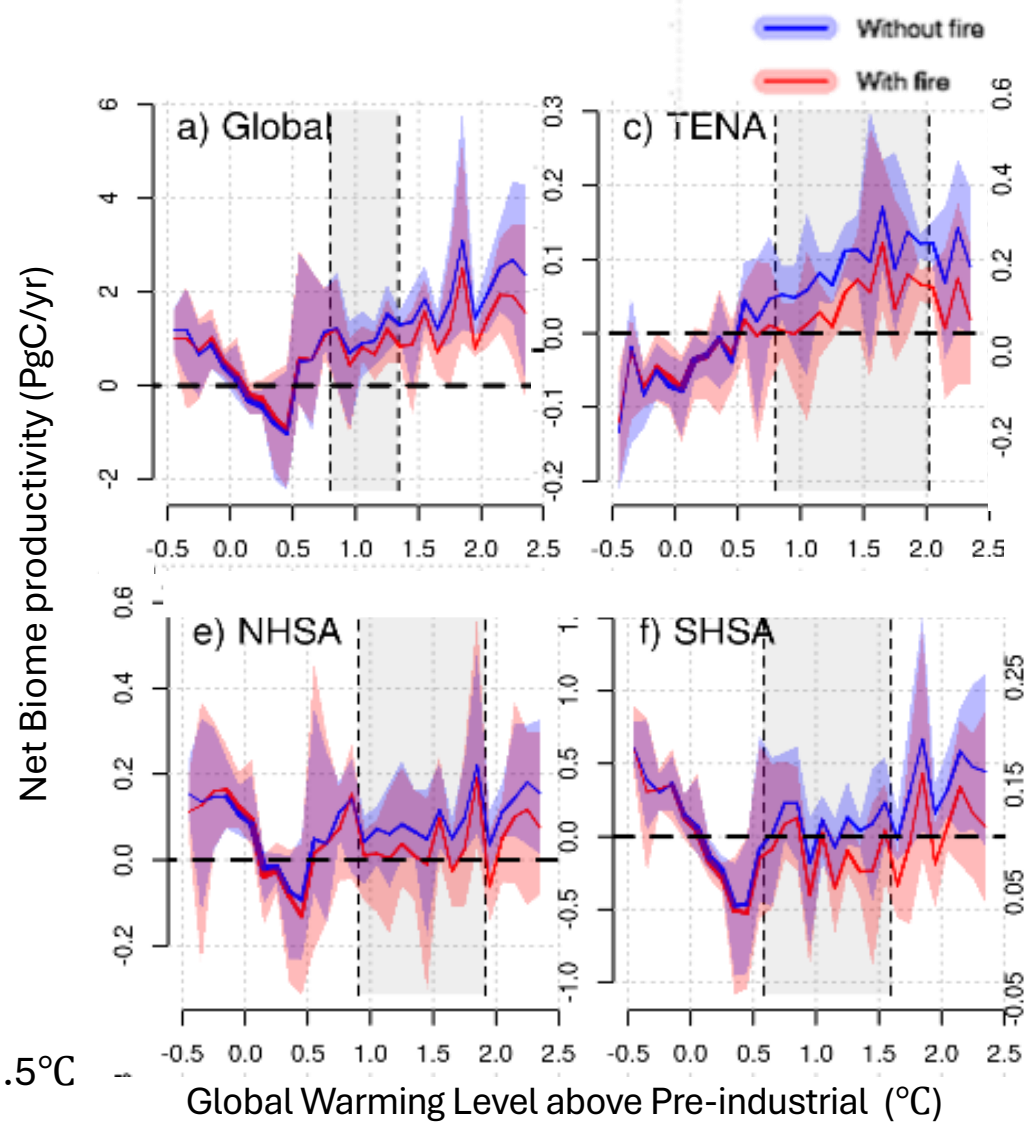


Alto Paraguay Basin
Unburned
Burned

Maria Lucia Ferreira Barbosa Doug Kelley, Chantelle Burton, Igor Ferreira, Renata da Veiga, Anna Bradley, Paulo Guilherme Molin, Liana O. Anderson. FLAME 1.0, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2024-1775, 2024.

Fire weakens land carbon sinks before 1.5°C (ISIMIP2b)

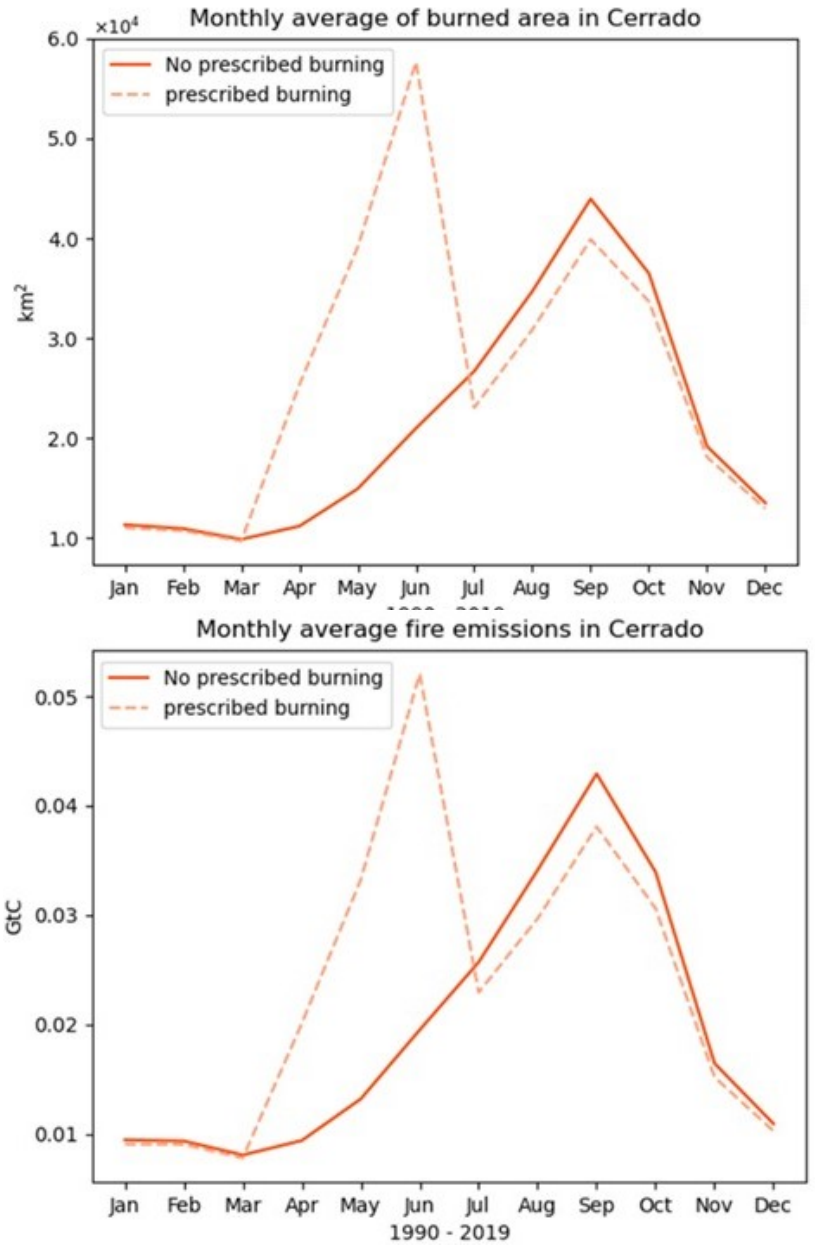
- JULES runs with and without fires impact on terrestrial carbon stores at different global warming levels
- Shows significant and substantial impacts on stores by 1.34°C globally, with many regions starting to switch from sink to source sometime between now and 2 °C.
- Shows a reduction in previous estimates of allowable carbon emissions by around 25%.



Chantelle Burton, Doug Kelley, Eleanor Burke, Camilla Mathison, Chris Jones, Richard Betts, Joao Teixeira, Manoel Cardoso, Liana Anderson, Eddy Robertson, Fire weakens land carbon sinks before 1.5°C Nature Geo, accepted

Prescribed burning in the Cerrado (ISIMIP3a)

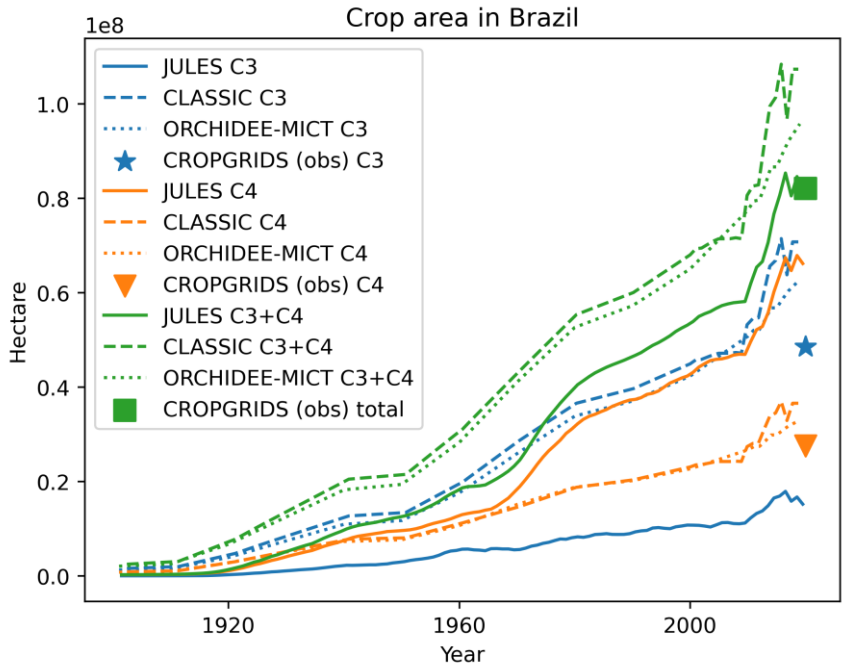
- Simulating early dry season control burns in the Cerrado
- Includes changes in C4 grass recovery rates
- Leads to an average 9.28% reduction in the burned area and fire emissions 11.34% during the late dry season (August, September, and October).

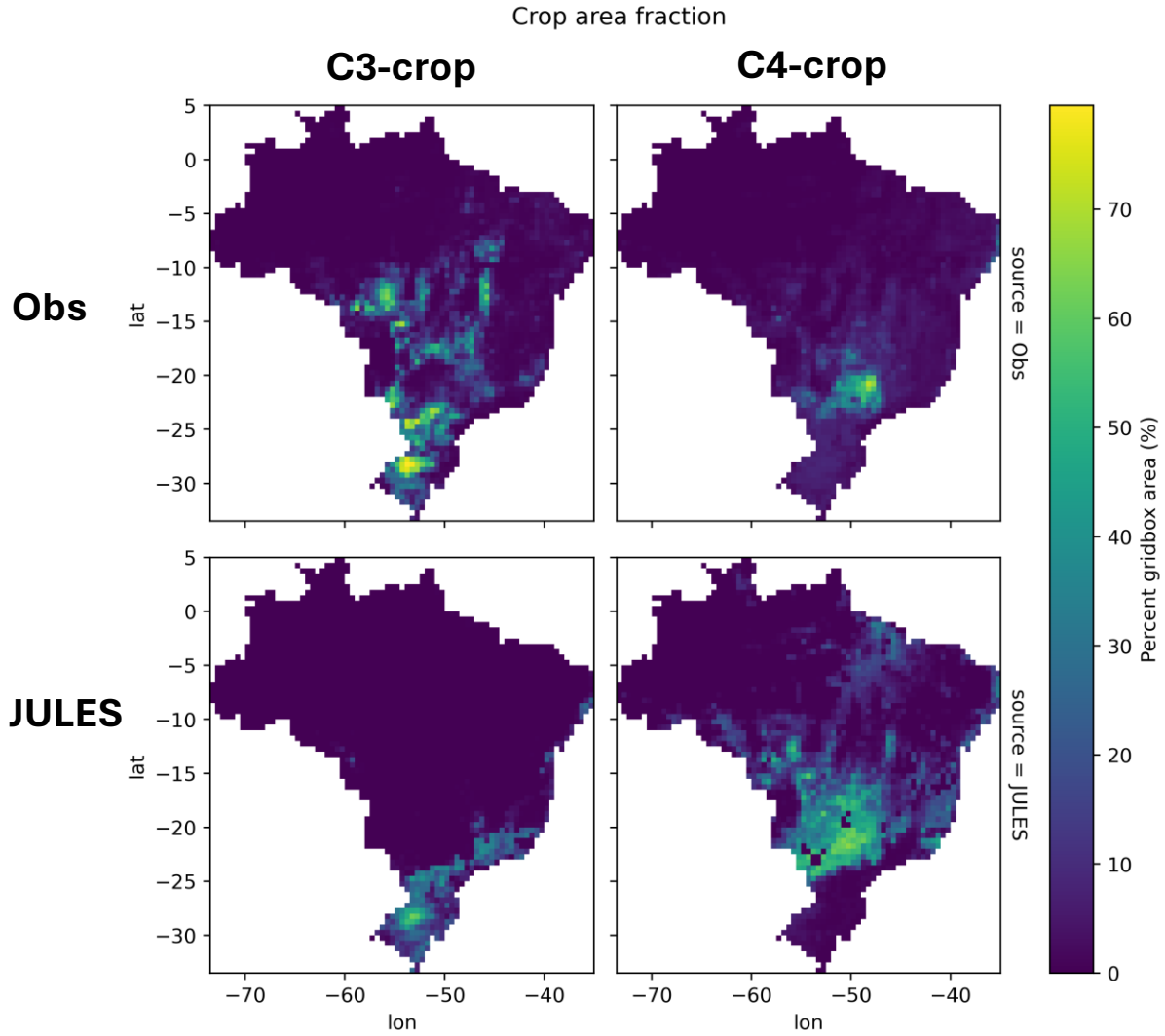


Renata Moura da Veiga, Chantelle Burton, Douglas Kelley, Eddy Robertson, Eleanor Burke, Manoel Cardoso, Maria Lucia Barbosa, Fabiano Morelli and Celso von Randow Including prescribed burning in fire modelling: a case study from the Brazilian Cerrado using JULES-INFERNO, in prep

Ongoing work:
Assessing suitability of TRIFFID-crop for agricultural impact (ISIMIP3a)

- Is TRIFFID-crop suitable for assessing food security?
- Elements of interest: spatial distribution, yield/vegetation health, response to shock events





What's next?

New & upcoming developments

- Pre-industrial control simulation
- Suite update to Cylc 8
- Participation in multi-model ensemble papers
  - Climate change impacts on vegetation biomass (Akihiko Ito, University of Tokyo)
  - Impacts of nitrogen cycling on terrestrial carbon sink (Sian Kou-Giesbrecht, Dalhousie University)
  - Patterns in extreme climate impacts (Karim Zantout, PIK)
- Permafrost & peat simulations
- ISIMIP3b (group III): with future land use change

Other potential applications

- Use the ISIMIP framework (input data and ISIMIP suite u-cc669) for
  - Model validation
  - Impact attribution
  - Assessing impacts under past and future climate conditions
  - Multi-model intercomparisons
  - Multi-sector impacts under one framework
- JULES developments of particular interest for the ISIMIP water sector
  - Irrigation, dams, CaMa-Flood, improved TRIP