Vegetation Distribution JPEG

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Vegetation ~~Distribution~~ JPEG

Dynamics

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natural Vegetation Distribution JPEG

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Vegetation Distribution JPEGs

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Vegetation Distribution JPEGs

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Started May 2018

Douglas Kelley, Chantelle Burton, France Gerard, Eddy Robertson, Rich Ellis, Graham Weedon, Rhys Whitley, Karina Williams, Alistair Sellar, Stephanie Woodward, Rachel Turton, Andy Wiltshire, Chris Jones, Eleanor Burke, Andrew Hartley, Debbie Hemming, Sarah Chadburn, Edward Comyn-Platt

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Sub-JPEGS

Observations JPEG

- Veg frac with uncertainty estimates to help JULES evaluation/calibration
- Collate LAI datasets
- Reduce uncertainty with CCI based on high resolution original data

"Mortality" JPEG

- Productive vegetation competition and distribution
- Representation and magnitude of disturbance
- Post-disturbance recovery rate

Arid-veg JPEG

- Too high bare soil in arid regions
- Vegetation can be over-sensitive to moisture availability
- Test response to variability at different timescales (seasonal, annual, decadale etc)

Phenology JPEG

- Lack of cold deciduousness in grasses
- Drought phenology untested
- Assessment of veg-frac "shrinkage" from seasonal carbon starvation

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Arid-veg SJPEG

- Andy W/Eddy R/Spencer/Chantelle etc: JULES-ES veg frac comparisons vs IGBP.
- Rich E/Eddy R/Chantelle: vegetated fraction in climate space (MAP, MAT, seasonality etc)
- Karina: Soil moisture suite and JPEG crossover

Vegetation Dynamics JPEGS

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JULES runs

- JULES-"RH" from Burton et al. 2018 GMDD
  - SF3: "Control" inc. Land use & Fire disturbance
  - SF2: No land use, just fire
  - S 3: No fire, just land use
  - S 2: No fire or land use.
- Upgrade to JULES-ES when fire biogeochemical feedbacks are included

Disturbance / Land Use	None	Fire	Drought	High temperatures	People	All
None	S2	SF2				*SF2?*
Crop						
Pasture						
All	S3	SF3				*SF3?*

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Seasonal Rainfall Distribution!

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Model benchmarking

Null Models	Perfect	Simple & optimized	Median	Mean	Randomly Resampled	Worse
NME/NMSE Spatial, Inter-annual, trends Site	0	~ 0.4 - 0.7*	~ 0.7*	1	~1.2 - 1.4*	∞
Season length	0	*	~ 0.7*	1	~1.2 - 1.4*	∞
MM/SCD Fractional cover	0	~ 0.1 - 0.3*	~ 0.7*	~1*	~ 1*	2
MPD Season timing, Inter-annual oscillations	0	*	*	*	*	1
DNME Spatial gradients	0	~ 0.4 - 0.7*	~ 0.7*	1	~1.2 - 1.4*	∞
DMM/SDMM Biome/item comparisons	0		~ 0.5*	~1	~1.2 - 1.4*	2

Kelley et al. Comprehensive benchmarking, BG 2013; Rabbin et al. fireMIP phase 1, GMD, 2017

**dataset dependant*

Model benchmarking

Comparison	Dataset	Time period	-	LU	Fire	LU + Fire
	VCF	2002-2012	0.78	0.6	0.54	0.51
Life form			0.72	0.6	0.64	0.63
Tree Cover	CCI	2010	0.35	0.28	0.3	0.3
	VCF	2002-2012	0.64	0.43	0.33	0.29
Wood Cover	CCI	2010	0.45	0.31	0.35	0.36
	VCF	2002-2012	0.64	0.48	0.43	0.42
Herb cover	CCI	2010	0.43	0.33	0.4	0.42
	VCF	1992-1993	0.56	0.55	0.5	0.53
Leaf type			0.56	0.56	0.51	0.54
BL			0.18	0.15	0.17	0.17
NL			0.25	0.22	0.18	0.17
C3			0.34	0.36	0.38	0.43
C4			0.2	0.21	0.21	0.21
Shrub	CCI	2010	0.36	0.28	0.26	0.23

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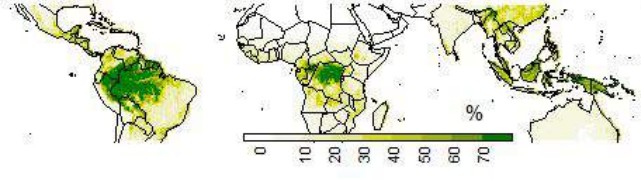
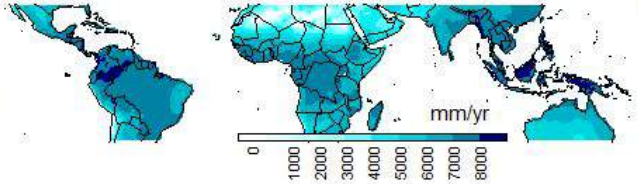
Tree cover controls assessment

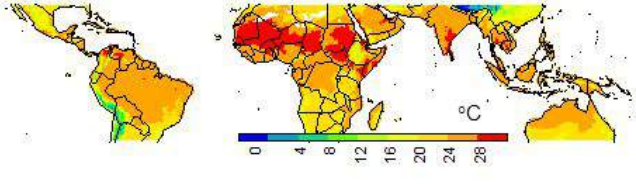
Tree Cover (VCF)



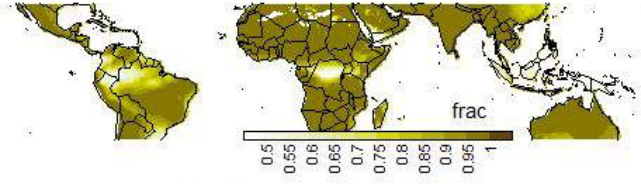
Mean Annual Precip (MAP; CRUTS3.22)



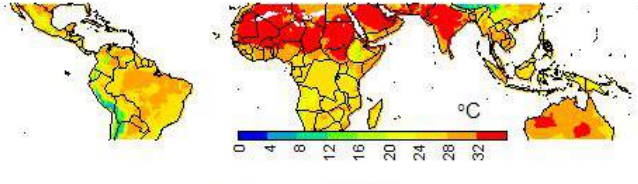
Mean Annual Temp. (MAT; CRUTS3.22)



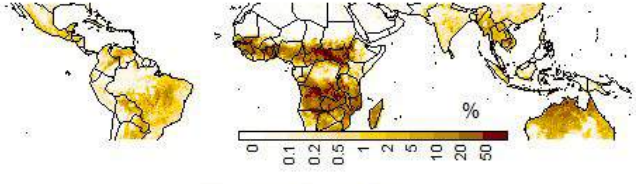
Drought



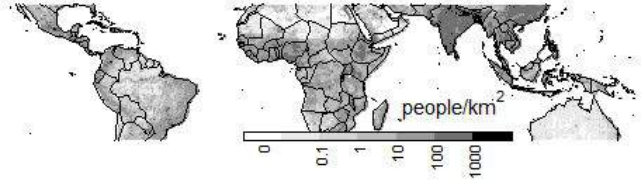
Mean Max. Temp Warmest Month (MTWM; CRUTS3.2)



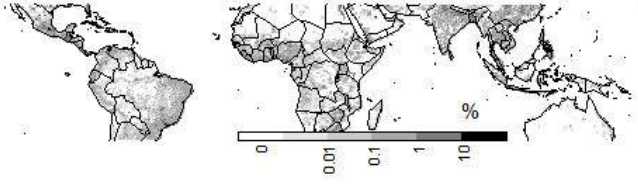
Burnt Area (GFED4s)



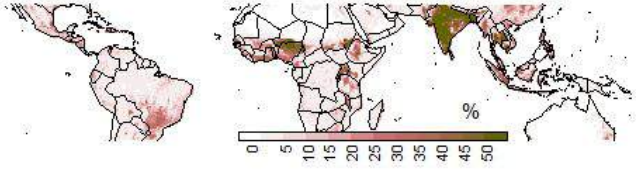
Population Density (HYDE)



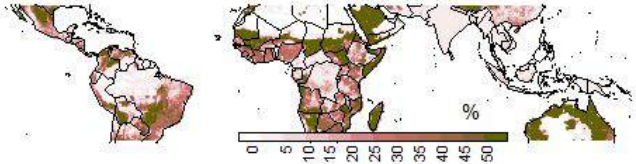
Urban area (HYDE)



Cropland Area (HYDE)

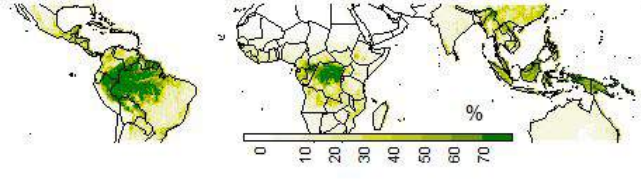


Pasture Area (HYDE)



Tree cover controls assessment

Tree Cover (VCF)



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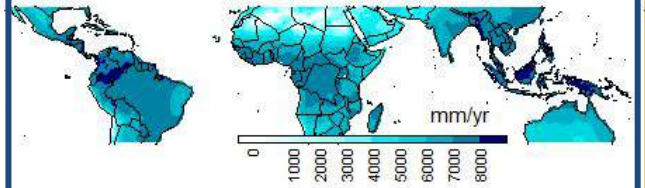
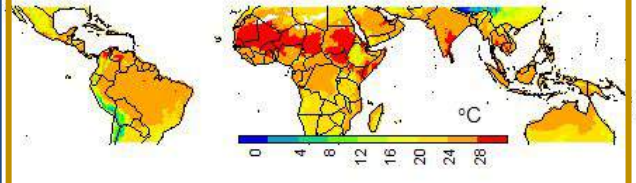
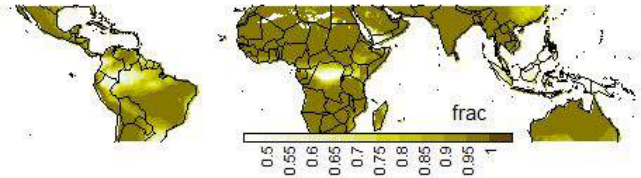


Mean Annual Temp. (MAT; CRUTS3.22)



Drought



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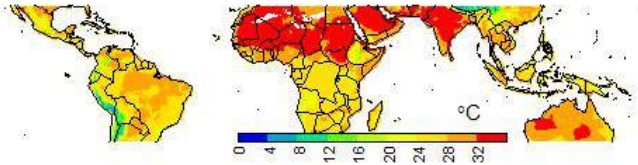

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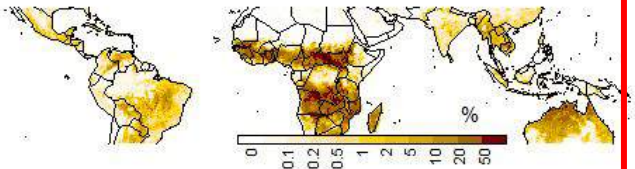

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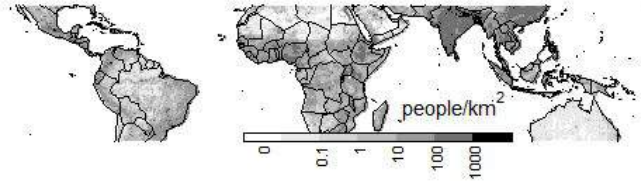

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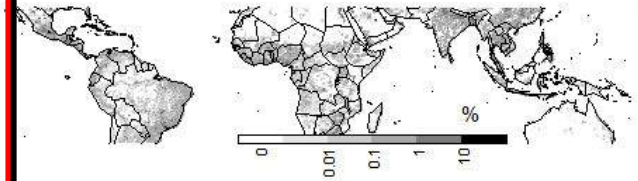
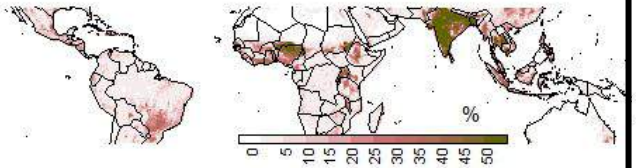
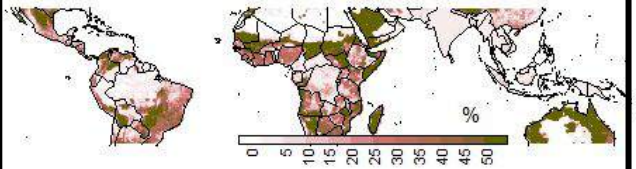


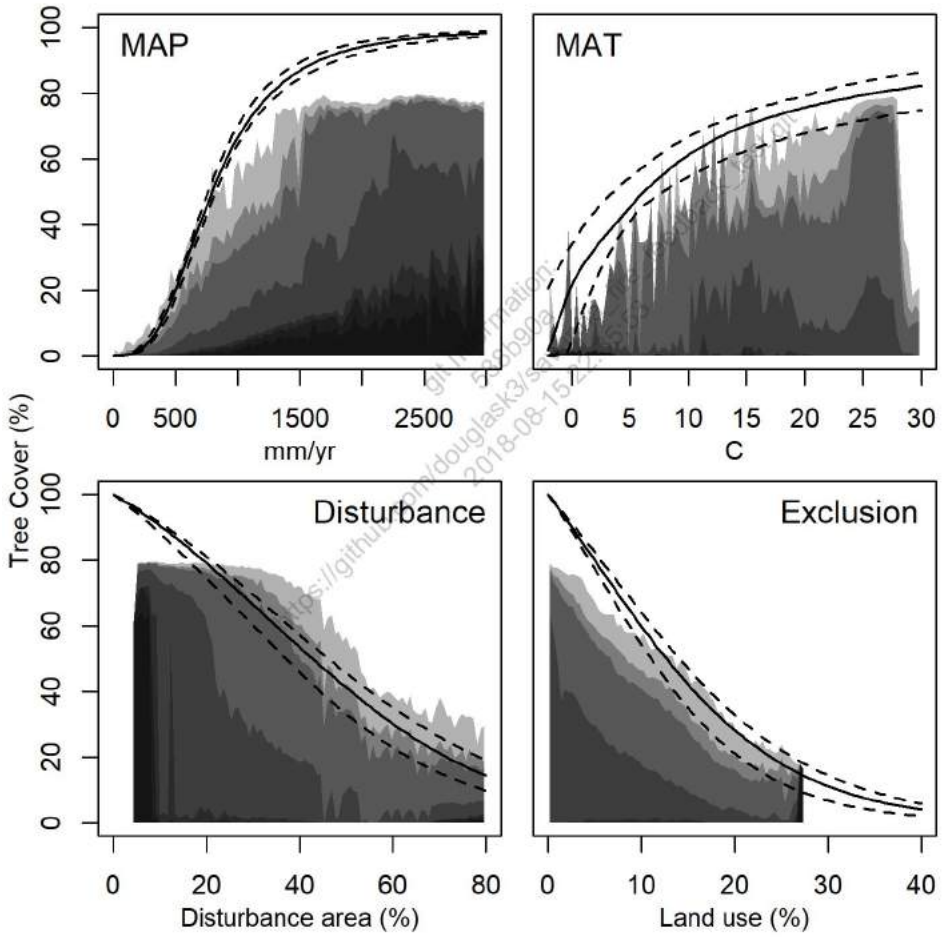
Cropland Area (HYDE)



Pasture Area (HYDE)



Tree cover controls assessment



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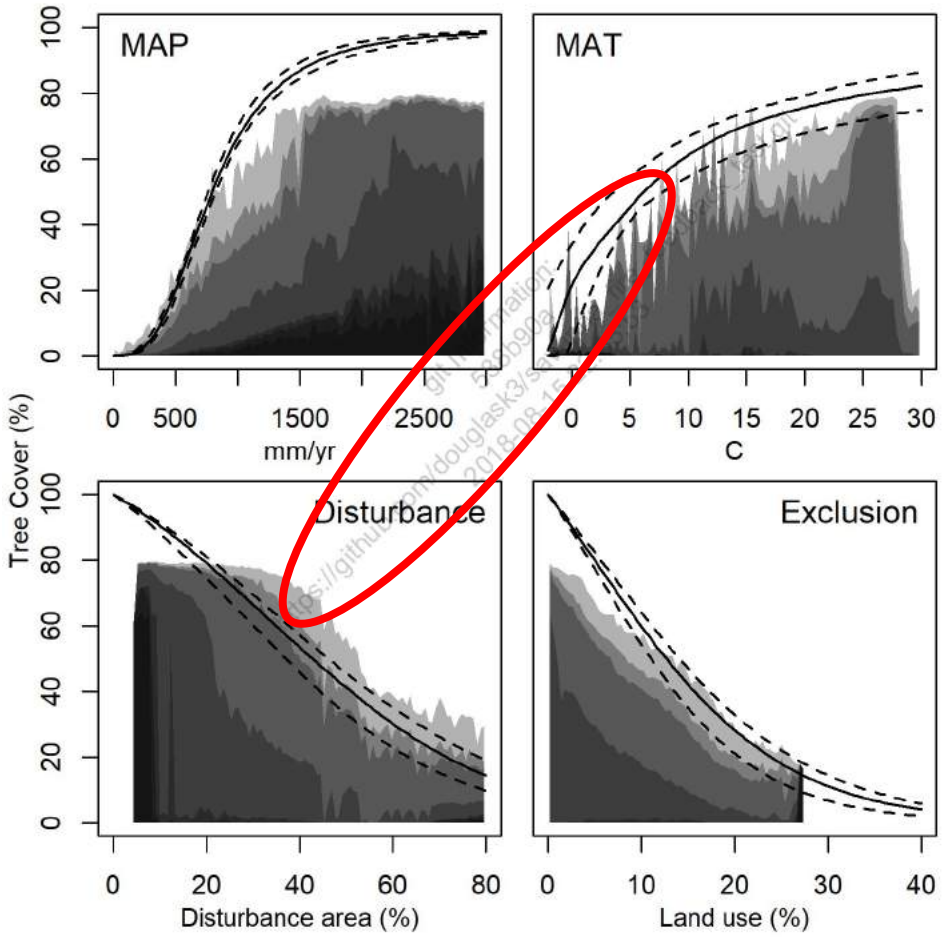

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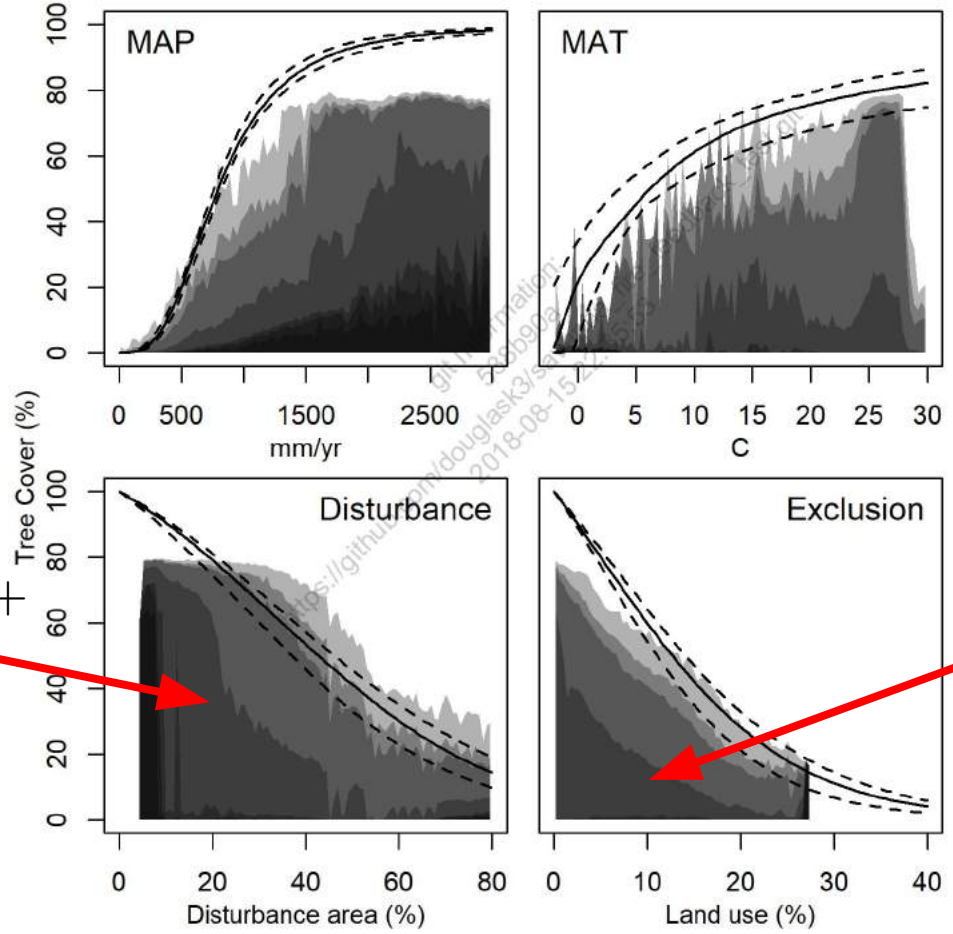
Tree cover controls assessment

$$Background + v_{fire} \cdot BurntArea + v_{drought} \cdot Drought + v_{temp} \cdot MxTWM + v_{pop} \cdot population$$



$$Urban + v_{crop} \cdot crop + v_{pas} \cdot pasture$$

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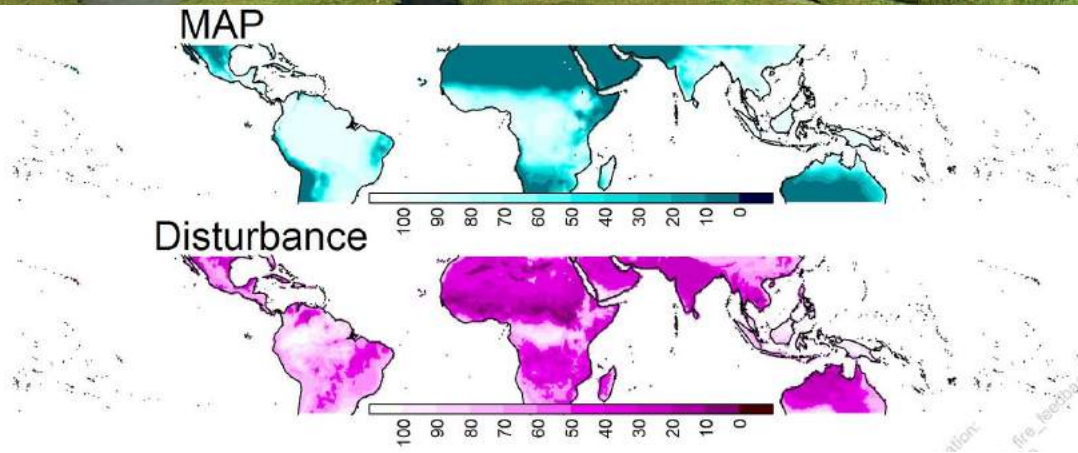

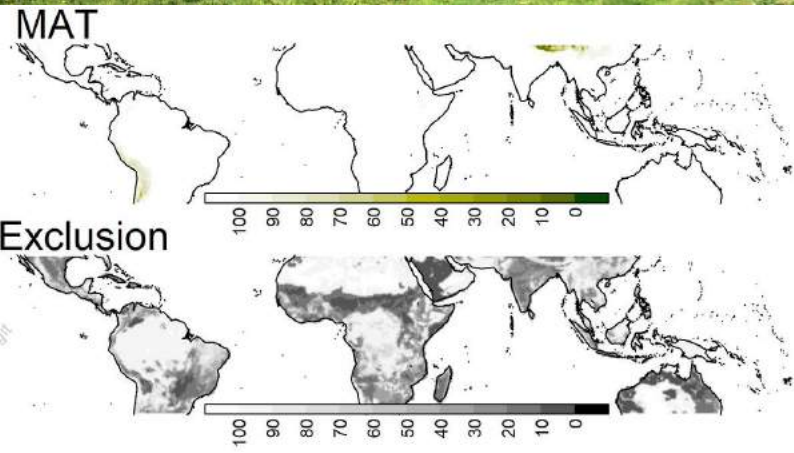

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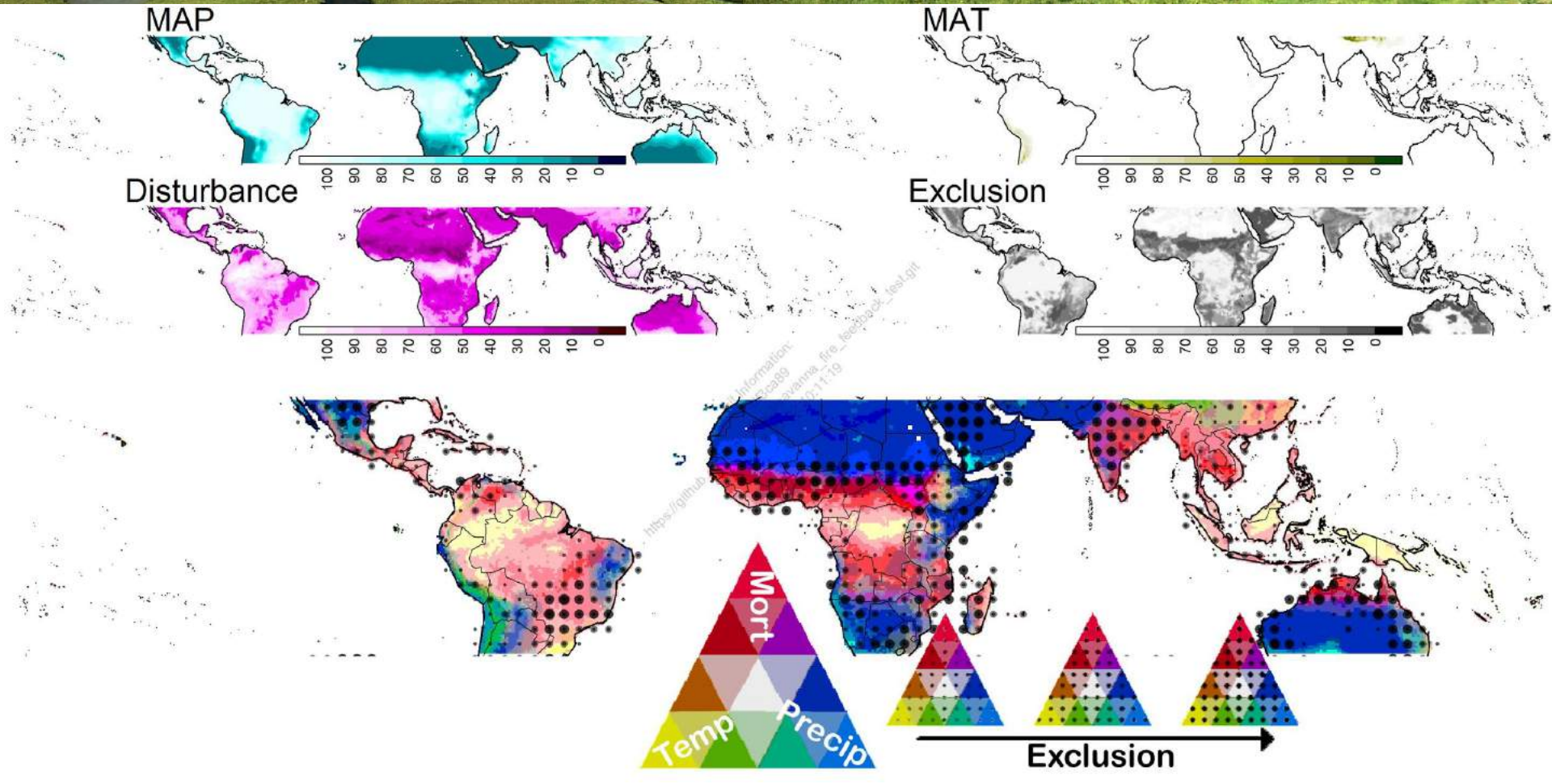
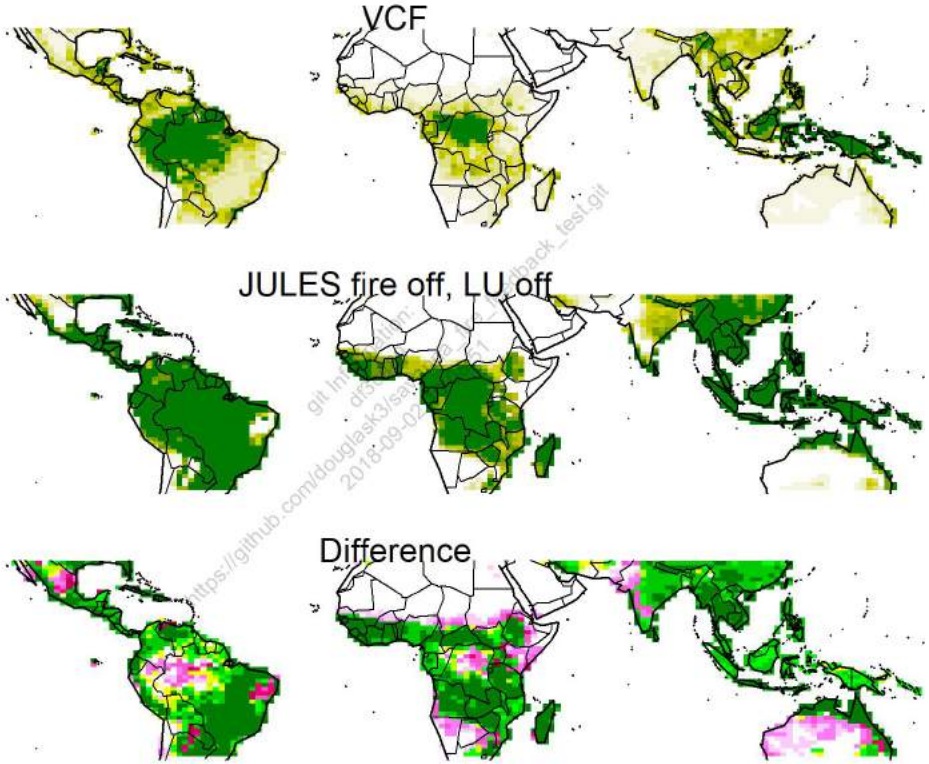


Jules Comparison - S2



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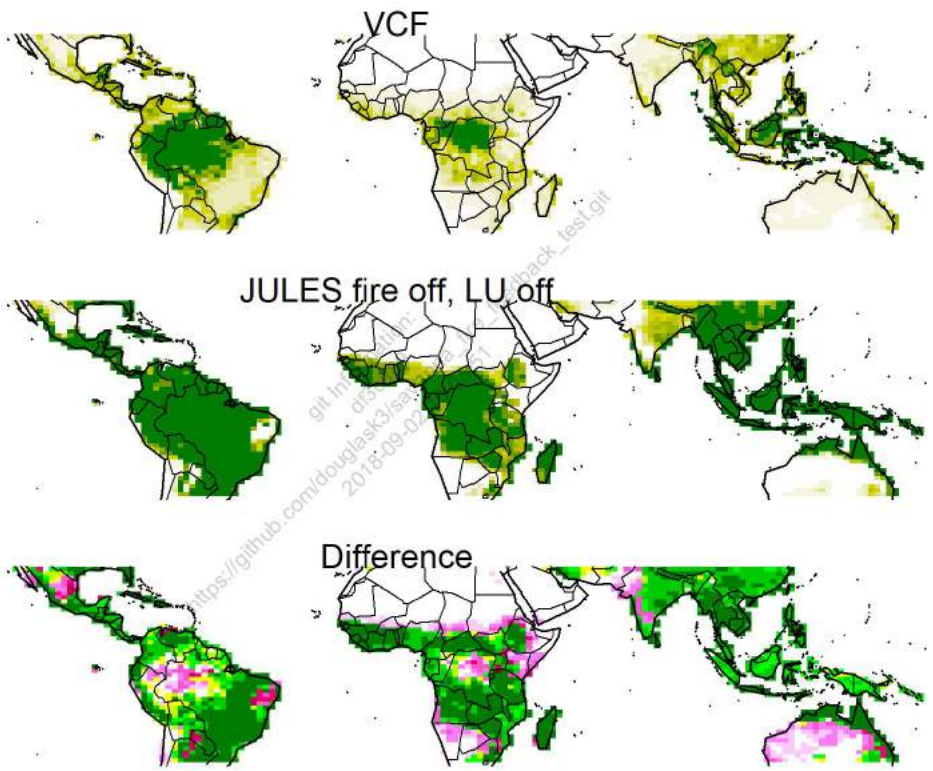

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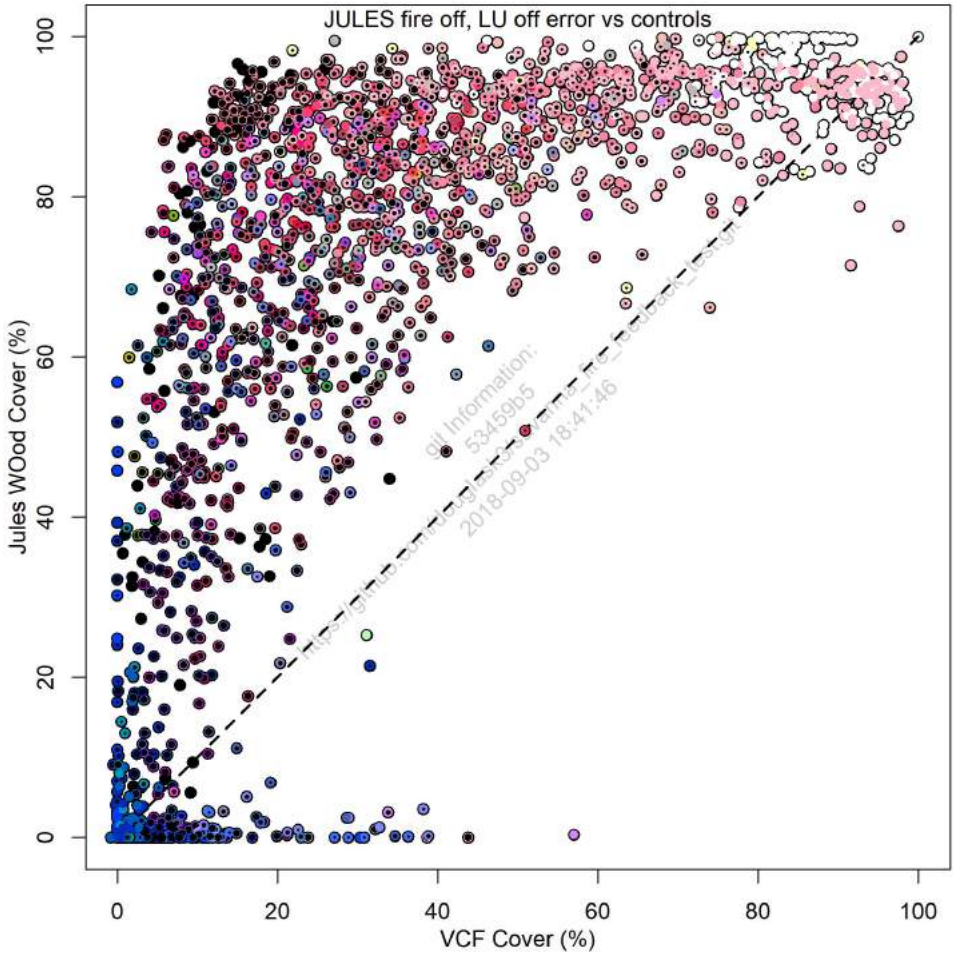

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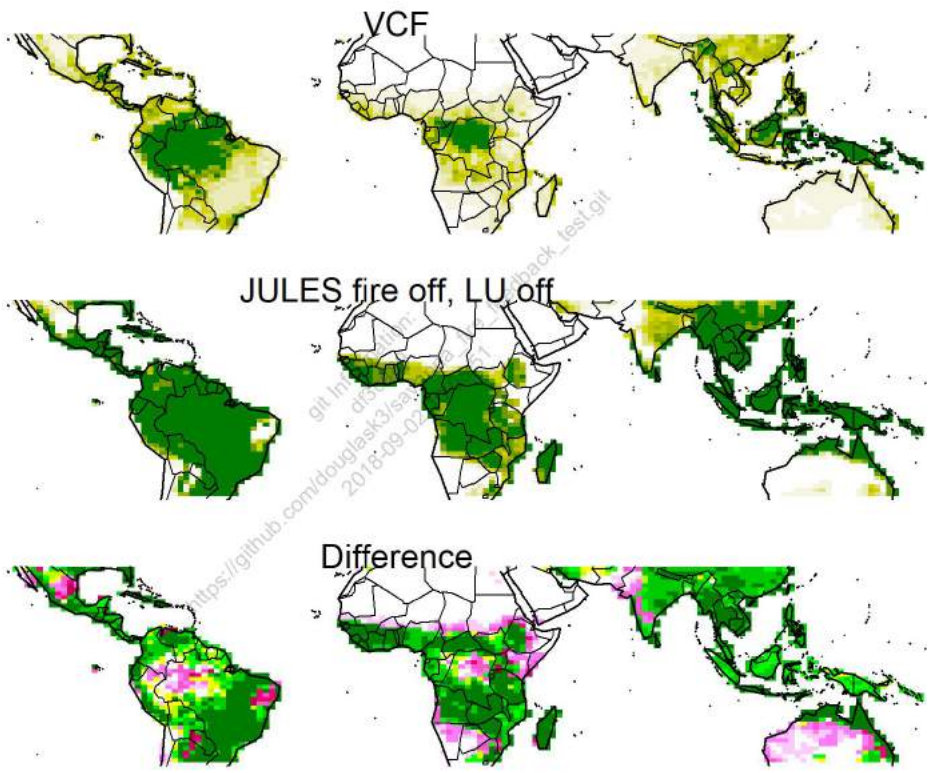

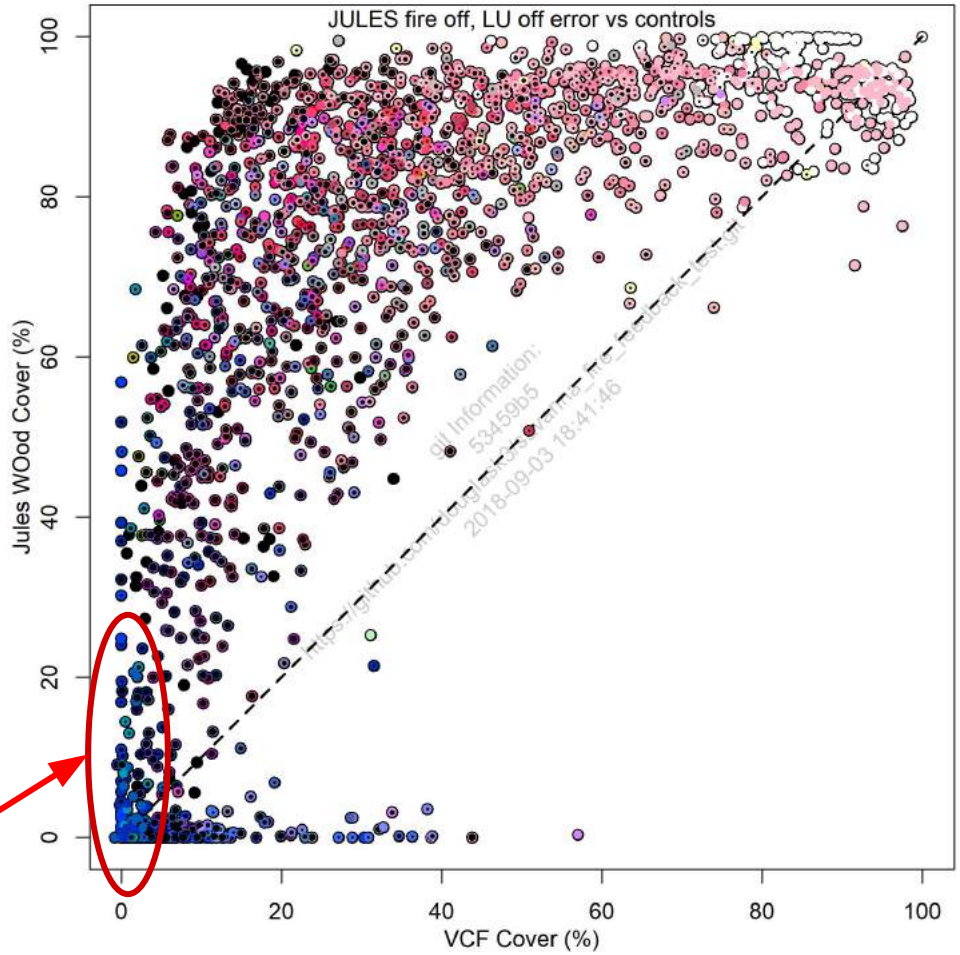

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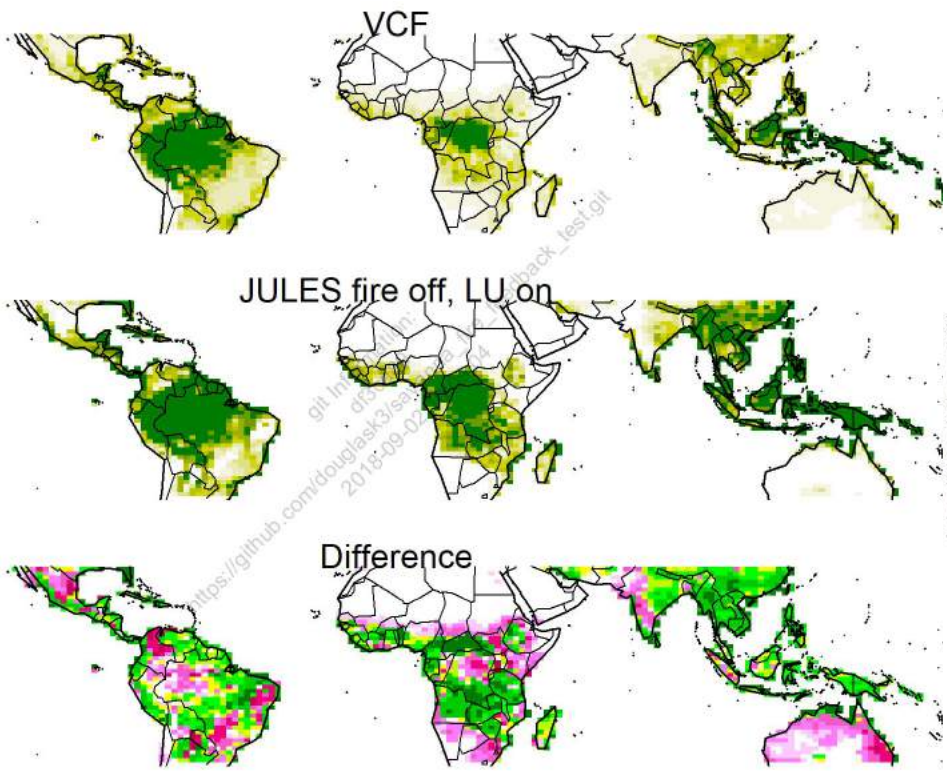
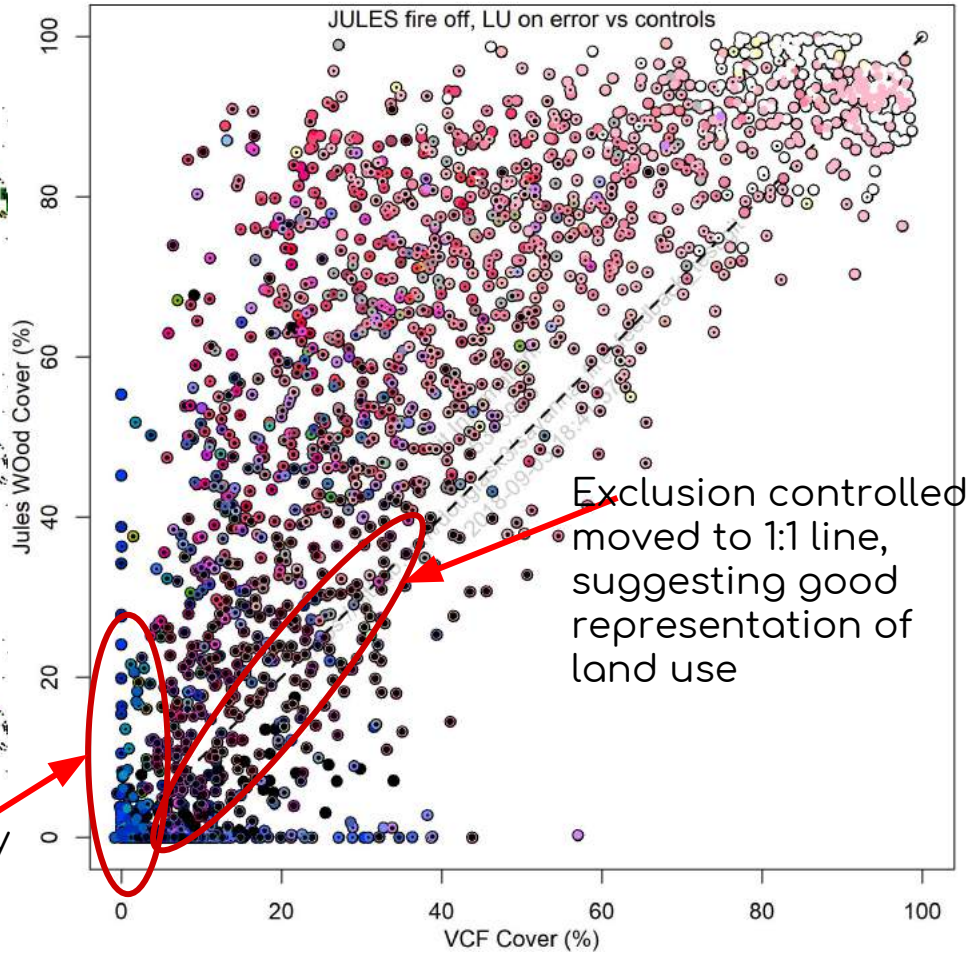
Simulates tree cover when should be limited by MAP

Jules Comparison - S3





Exclusion controlled moved to 1:1 line, suggesting good representation of land use

should be limited by MAP

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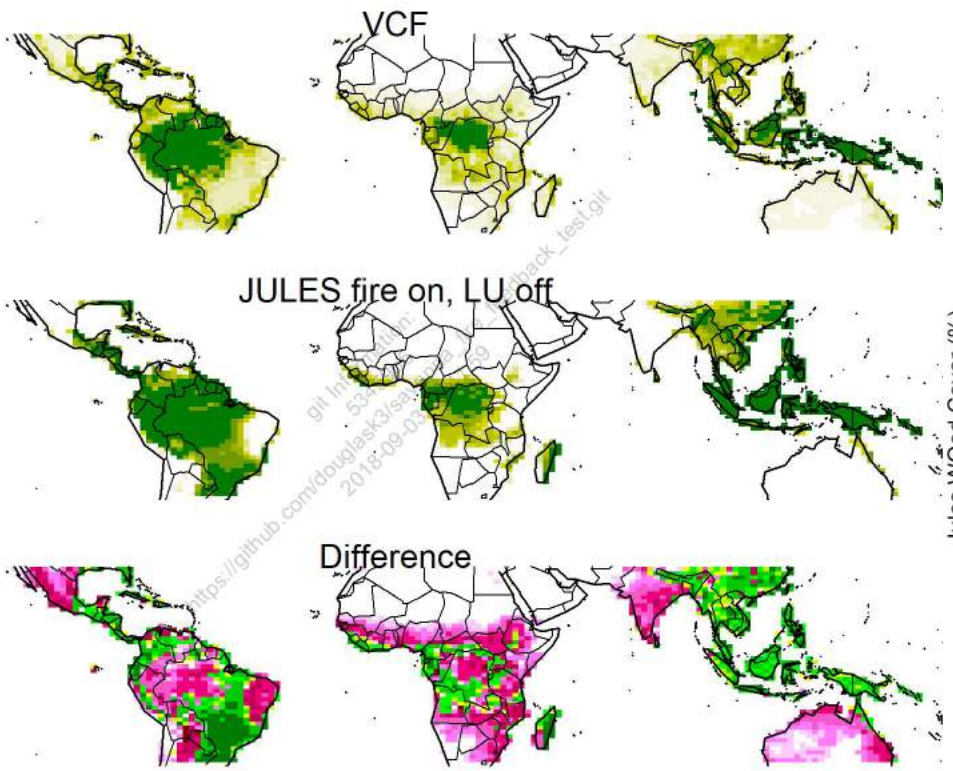
Jules Comparison - SF2



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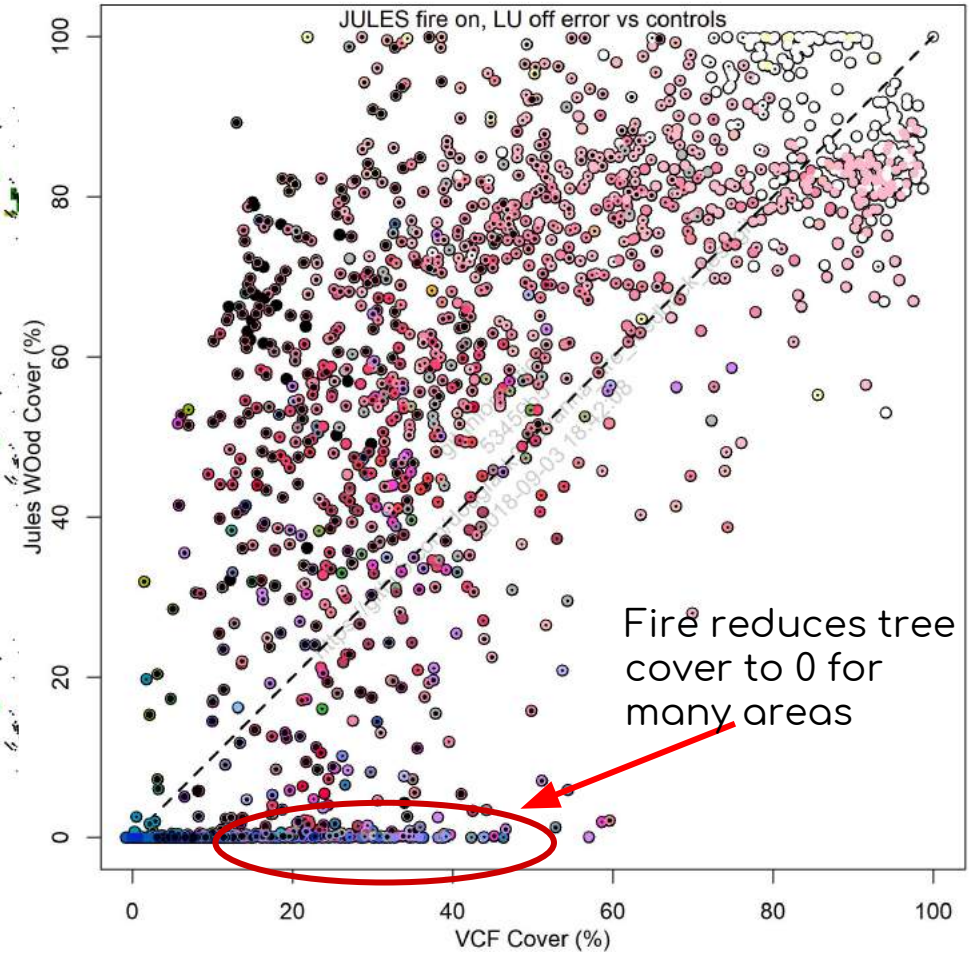
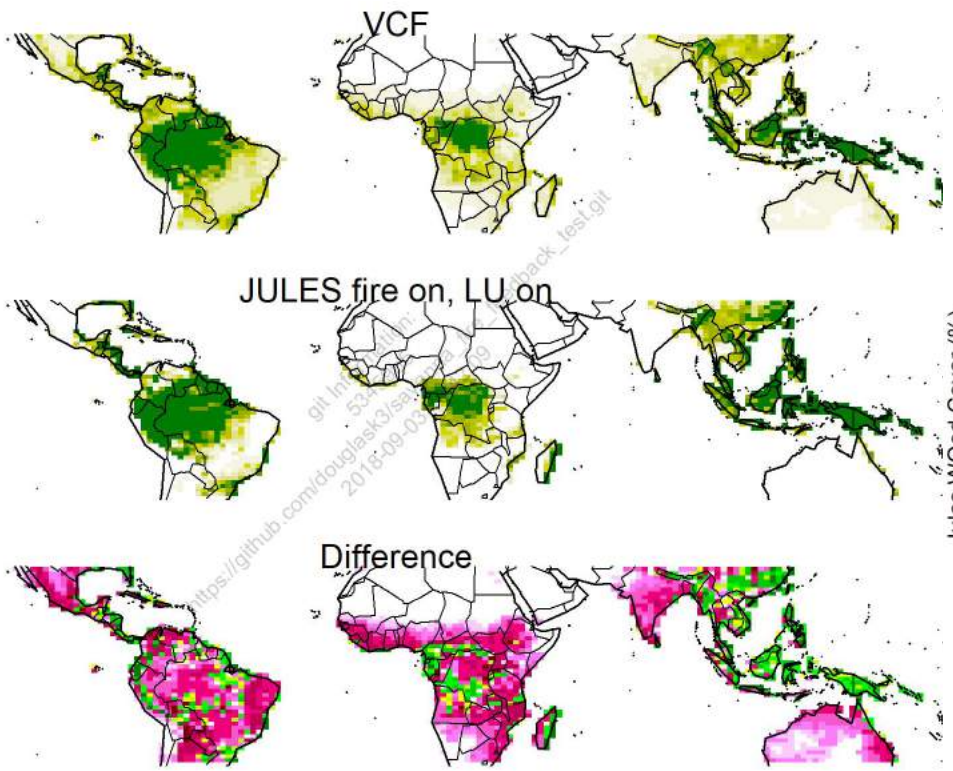


Jules Comparison - SF3



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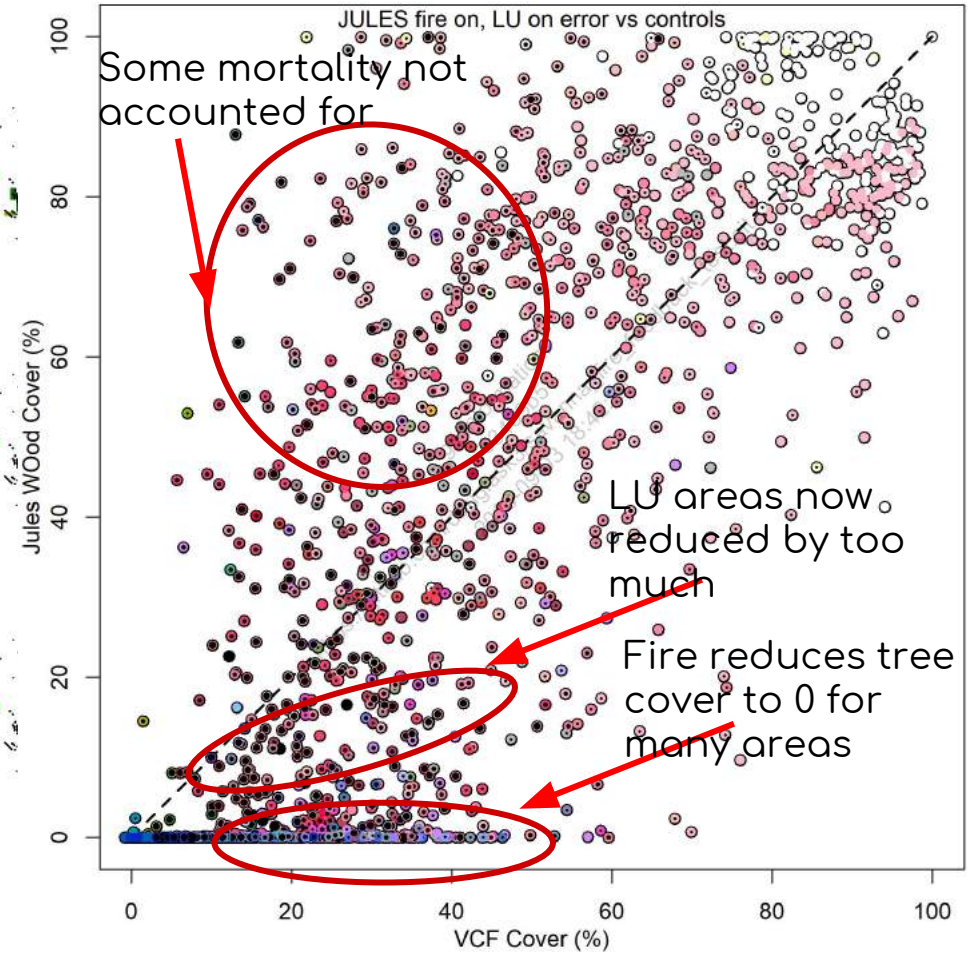
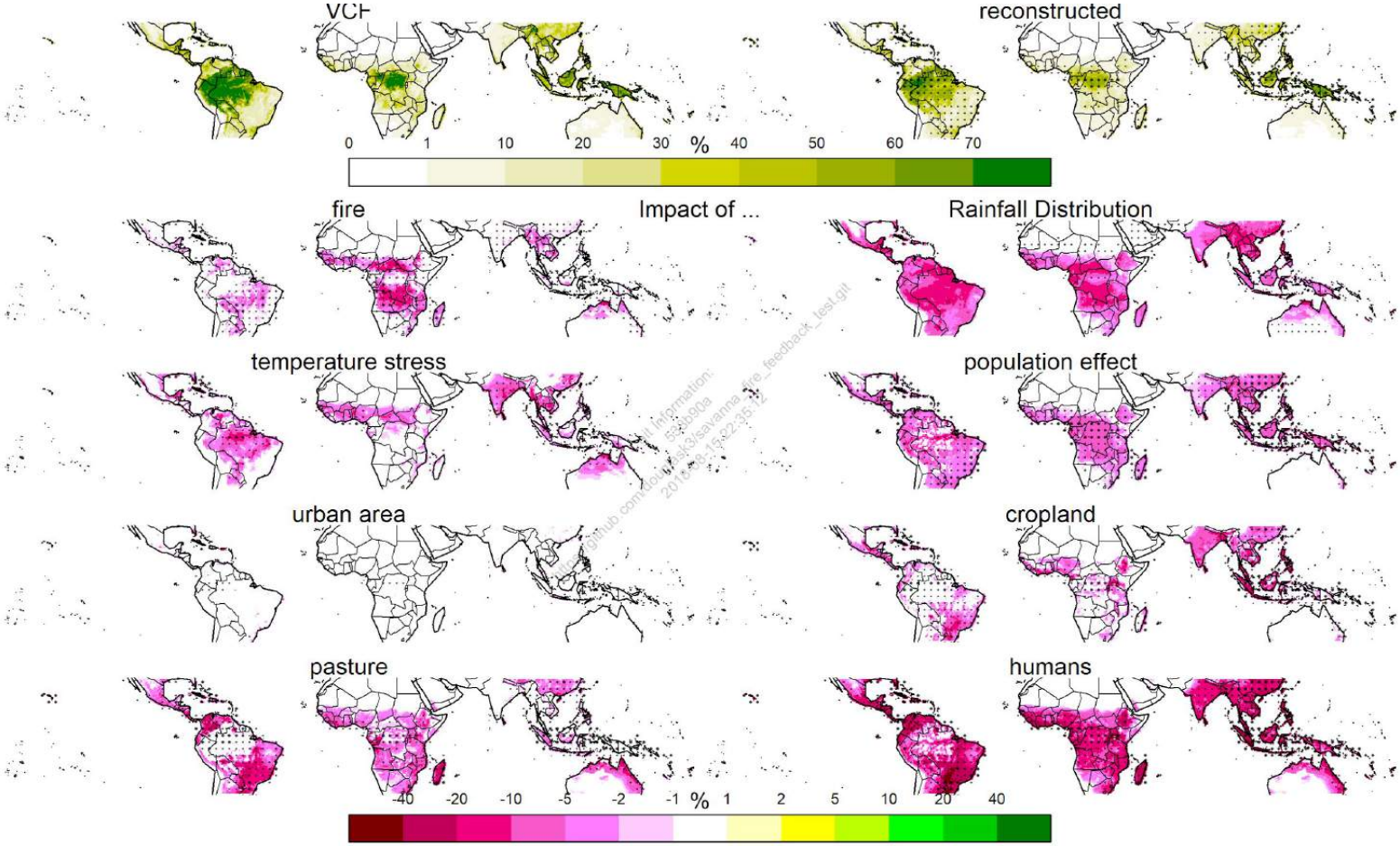
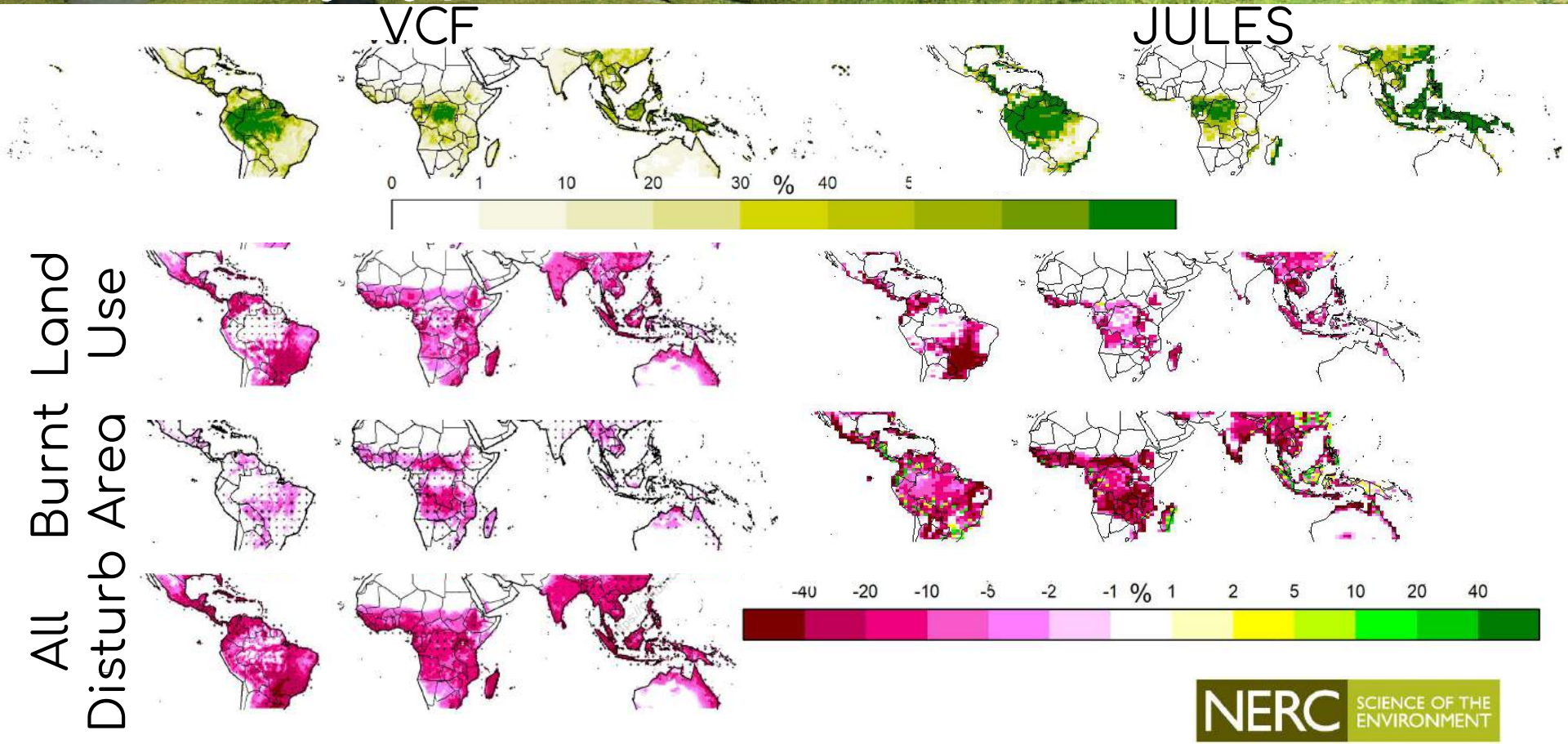


Mortality types

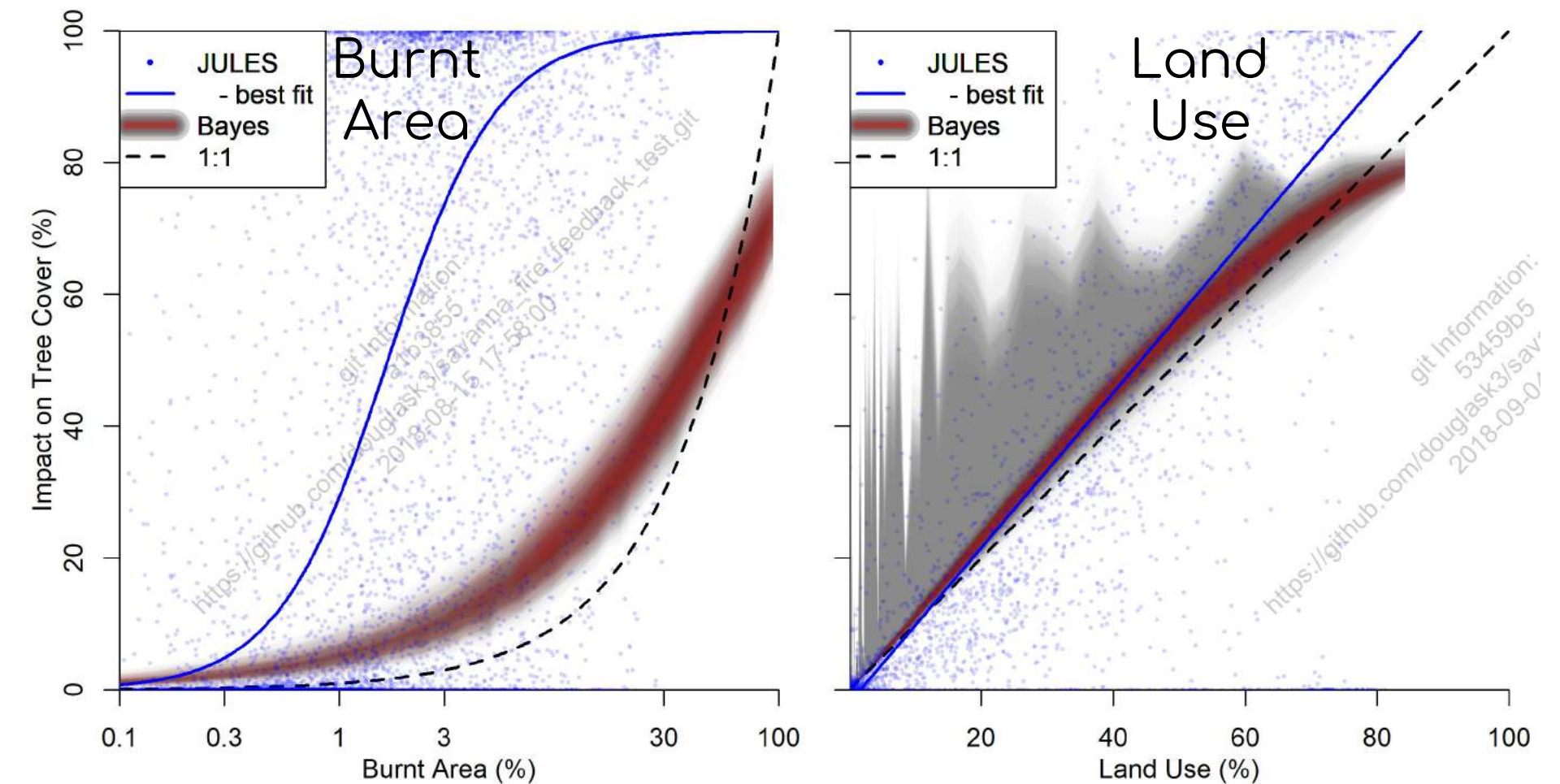


Mortality types



NERC SCIENCE OF THE ENVIRONMENT

Mortality types



Summary of biases

- Too much tree cover at low MAP
- Reasonable land use impact
- Fire “overkill”
- Fire double-counts land use impact (untested in other LSMs?)
- Some mortality types not represented (although extent for some unknown)

Mortality or Recovery?

- Impact on tree cover an (unknown) combination of mortality and recovery
- Test and compare different veg recovery techniques:
  1. Fiddle with minimum LAI before vegetation spreads
  2. Reduce carbon density for low veg fracs
  3. Introduce simple build of seedbank.
  4. **Add in a non-structural carbohydrate pool for disturbed veg to draw on**

Optimised TRIFFID

TRIFFID:

$$\frac{dv_i}{dt} = \frac{\lambda_i \Pi_i}{C_{v_i}} v_{i,*} \cdot (1 - \Sigma_j (c_{i,j} \cdot v_j + \alpha \cdot a_i)) - (\gamma_i + \beta_i) v_{i,*}$$

(Burton et al. 2018, GMD)

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$$\Delta VegFrac = SomeNPP \cdot (1 - (Comp + Exclusion)) - Mortality \cdot VegFrac$$

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From JULES-ES output

Initialized from JULES-ES Output or obs?

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Optimise against obs

From JULES-ES output

Optimize

Optimize

Initialized from JULES-ES Output or obs?

Optimised TRIFFID

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(Burton et al. 2018, GMD)

$$\Delta VegFrac = SomeNPP \cdot (1 - (Comp + Exclusion)) - Mortality \cdot VegFrac$$

Optimise against obs

From JULES-ES output

+ NSC/recovery carbon

Optimize

Optimize

+ Drought, Max. temp people

Initialized from JULES-ES Output or obs?

The "OTHER" JPEGs

- More help with "other" JPEGs please
  - Someone to organize observations/phonology JPEG
  - More help with bare soil, particularly outside of UKESM
- Vegetation mortality JPEG is doing alright.

Number of JULES talks with dinos in...