JULES-ES+fire

Chantelle Burton

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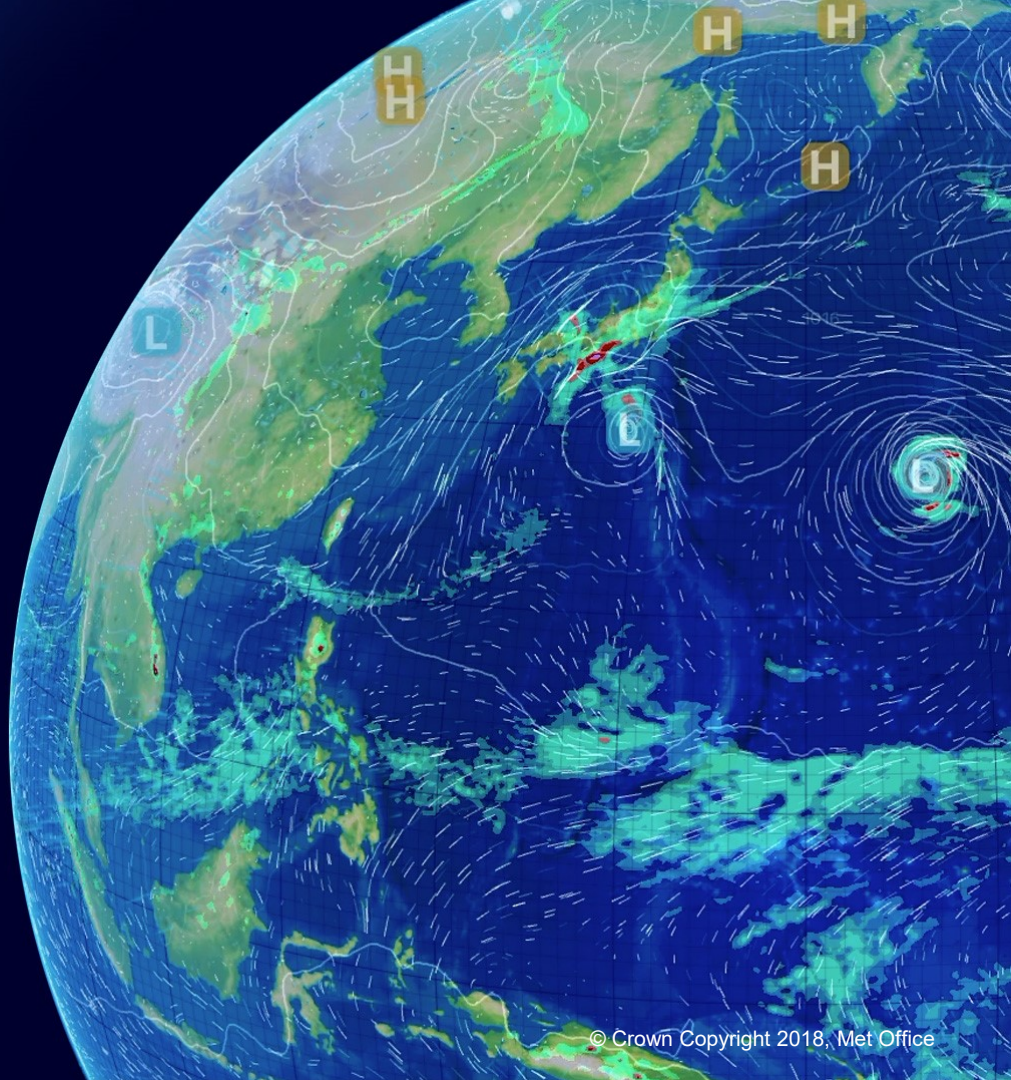
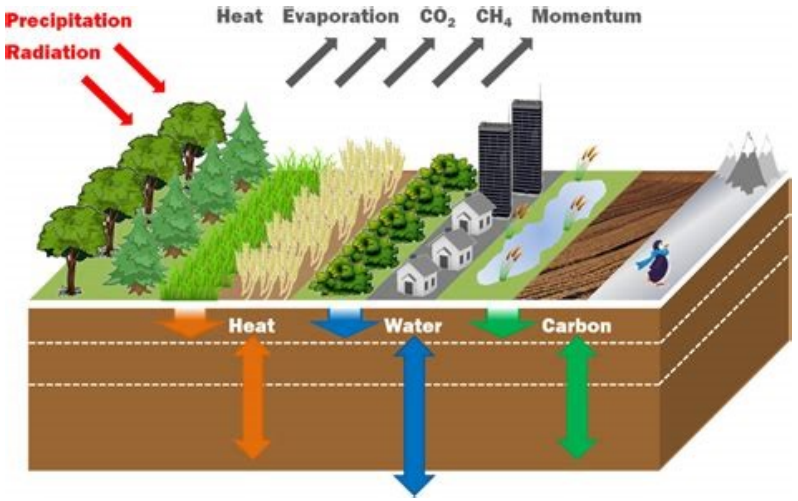


Overview

- JULES-ES configuration
  - 13 PFTs (crop and pasture separate)
  - Used for UKESM land surface
- TRENDY 2019
- Work on including fire (INFERNO)
- Early results (carbon)
- Other work in progress



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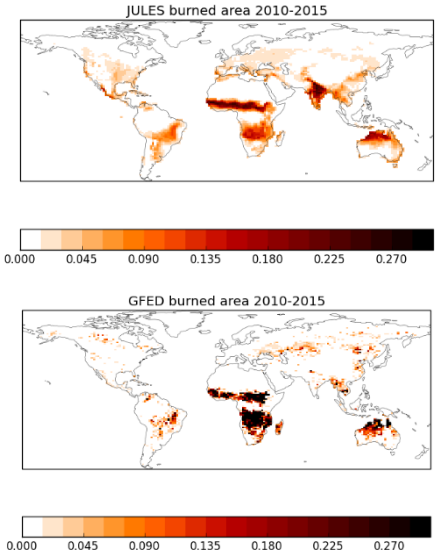
INFERNO



Fire weather conditions
Precipitation
Temperature
Relative Humidity

Fuel Density

Soil Moisture

Goff-Gratch saturation vapour pressure

Emissions

Burnt Area

Flammability

Ignition

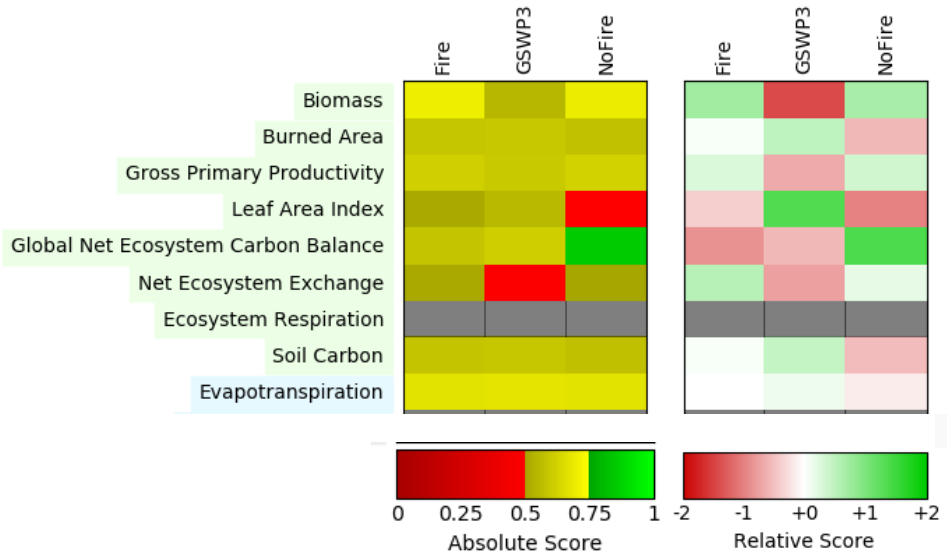
Ignition Mode

- Constant
- Lightning
- Population and lightning

Burton, C. et al Representation of fire, land-use change and vegetation dynamics in the Joint UK Land Environment Simulator vn4.9 (JULES), GMD 2019

INteractive Fire and Emission algoRithm for Natural envirOnments

Overview: ilamb



ILAMB Benchmark Results

Mean State | Relationship | Results Table

Mean State Scores

CRUJRA vs GSWP3

Columns

	Fire	GSWP3	NoFire
Biomass	0.70	0.55	0.70
Burned Area	0.59	0.60	0.57
Gross Primary Productivity	0.62	0.60	0.62
Leaf Area Index	0.51	0.55	0.49
Global Net Ecosystem Carbon Balance	0.58	0.62	0.85
Net Ecosystem Exchange	0.51	0.48	0.50
Ecosystem Respiration	~	~	~
Soil Carbon	0.58	0.59	0.57
Ecosystem and Carbon Cycle Summary	0.52	0.51	0.56
Evapotranspiration	0.67	0.67	0.67

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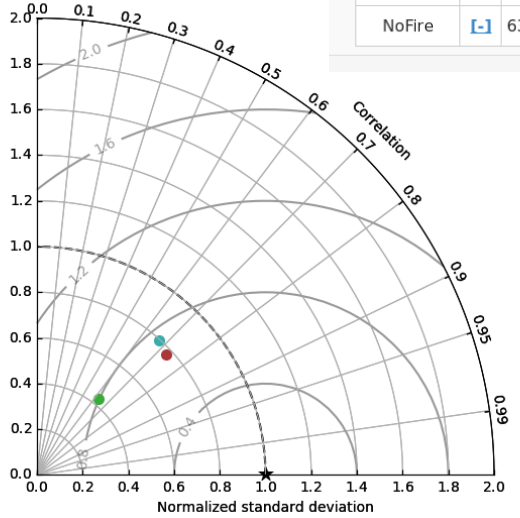
ILAMB

	Download Data	Period Mean (original grids) [Pg]	Model Period Mean (intersection) [Pg]	Model Period Mean (complement) [Pg]	Benchmark Period Mean (intersection) [Pg]	Benchmark Period Mean (complement) [Pg]	Bias [kg m-2]	Bias Score [1]	Spatial Distribution Score [1]	Overall Score [1]
Benchmark	[-]	455.								
Fire	[-]	485.	457.	28.2	452.	2.89	0.962	0.63	0.81	0.72
GSWP3	[-]	279.	259.	20.5	452.	2.89	-1.54	0.50	0.42	0.46
NoFire	[-]	635.	590.	44.9	452.	2.89	2.45	0.62	0.79	0.71

MODEL COLORS

- Benchmark
- Fire
- GSWP3
- NoFire

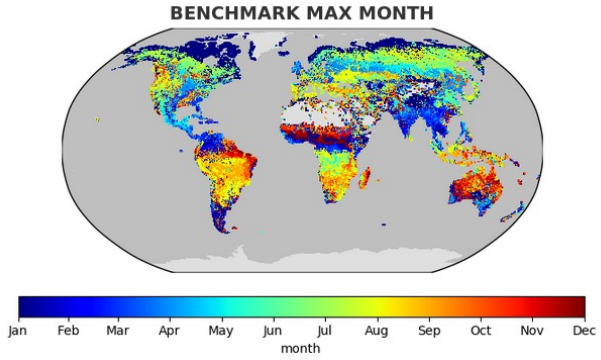
Spatial Taylor diagram



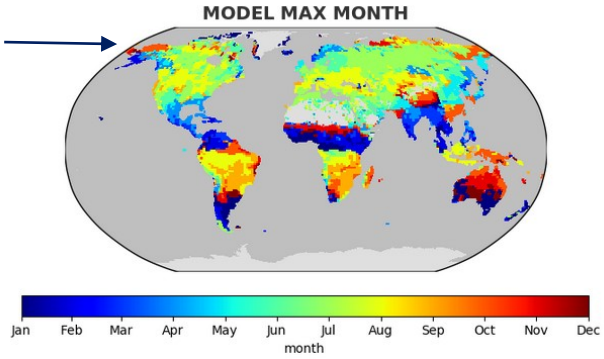
Biomass

Larger differences between forcing datasets

Month of max burned area

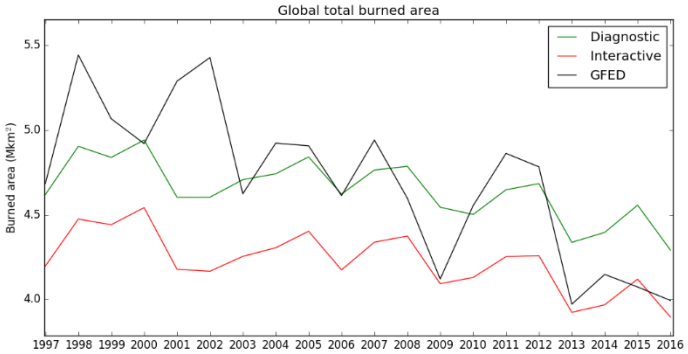


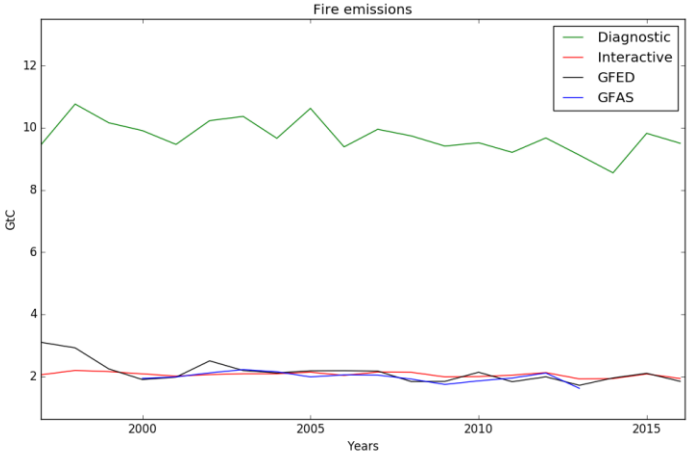
Burning too late

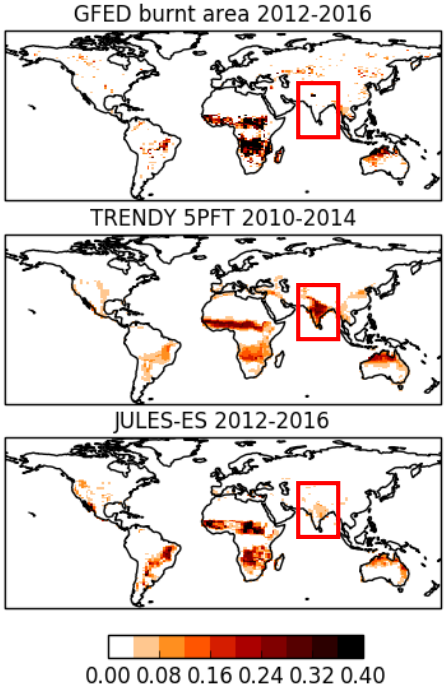


Fire variables

- Burned area and emissions compare with PD GFED4.1s observations
- Burned area and emissions are higher without vegetation mortality
- Reduce burning in crop areas

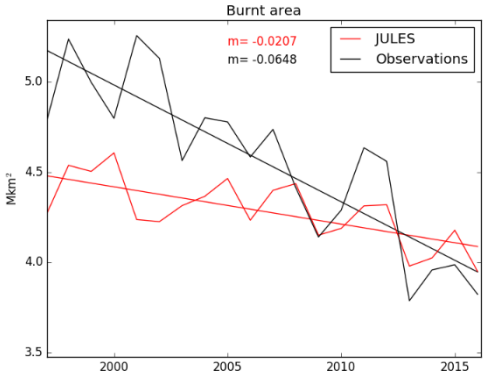


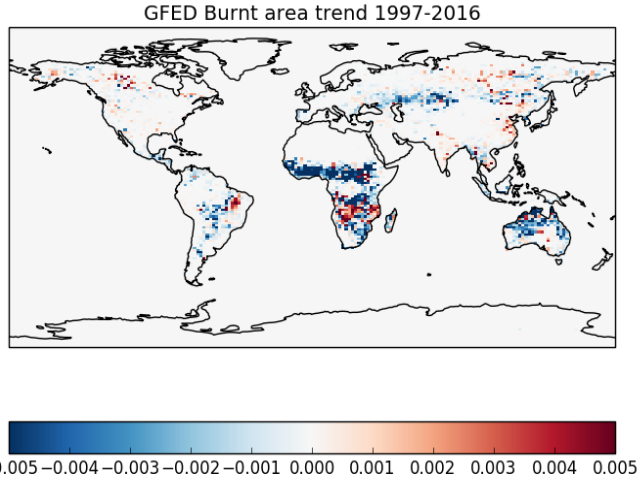


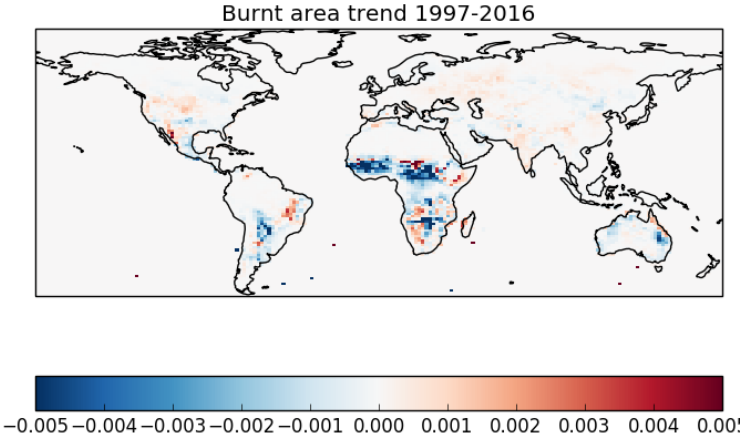


Burned area trend

- Slightly negative trend in time series, although not as strong as observations
- Negative trend in obs dominated by NH Africa -> likely driven reduction in agriculutral burning -> socio-economic trends in burning not included
- Otherwise spatial trend is fairly well captured

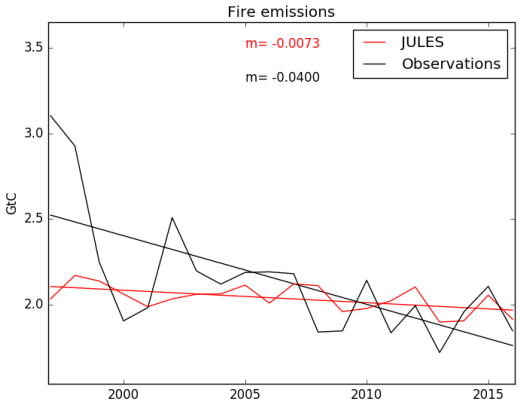


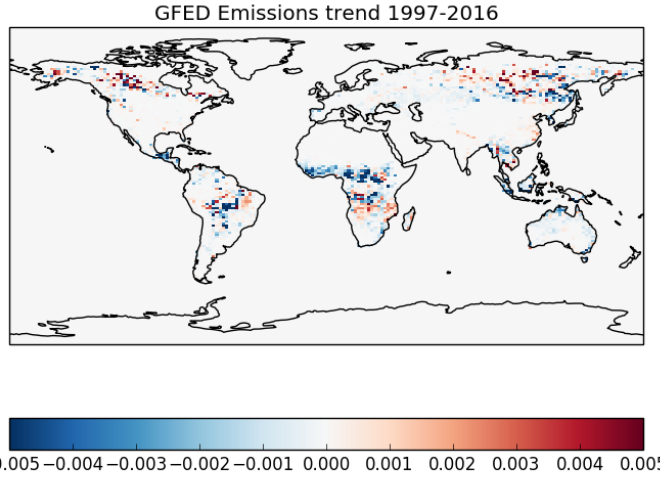


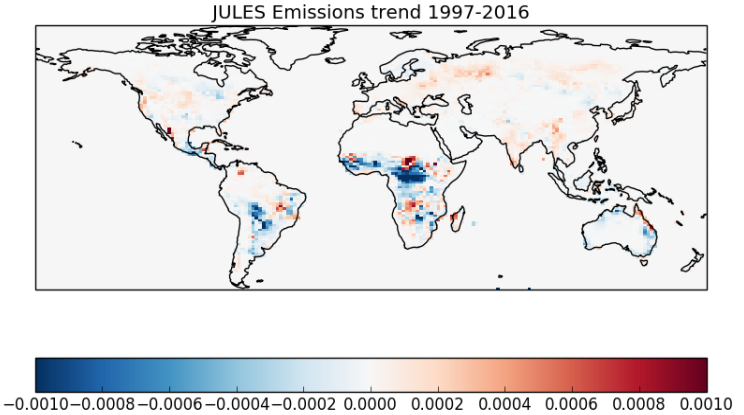


Emissions trend

- Slightly negative trend in time series, although not as strong as observations
- Negative trend in obs dominated by NH Africa -> likely driven by end of growing season burning -> socio-economic trends in burning are not included in the model
- Otherwise spatial trend is fairly well captured

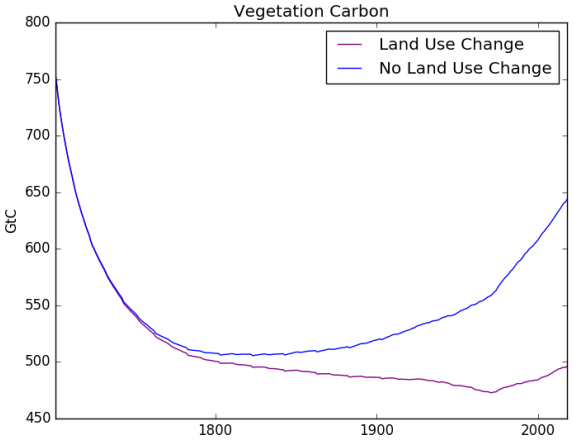


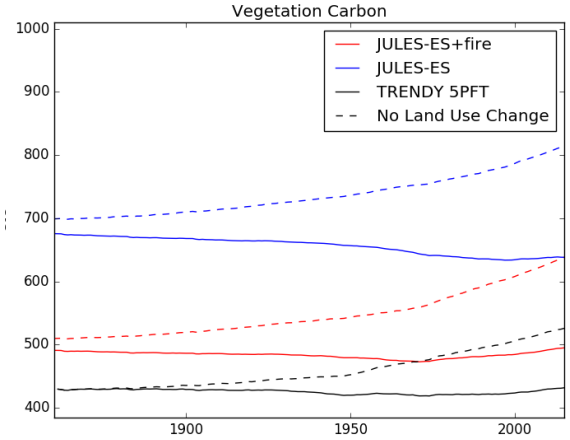


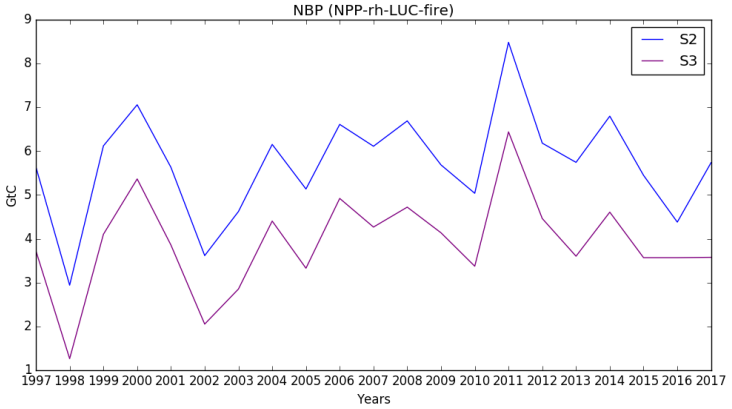


Vegetation carbon

- Observations: ~466GtC (IPCC AR5)
- JULES-ES+fire ~500GtC
- Increase in cveg around 1970 is replicated
- NBP is positive in present day







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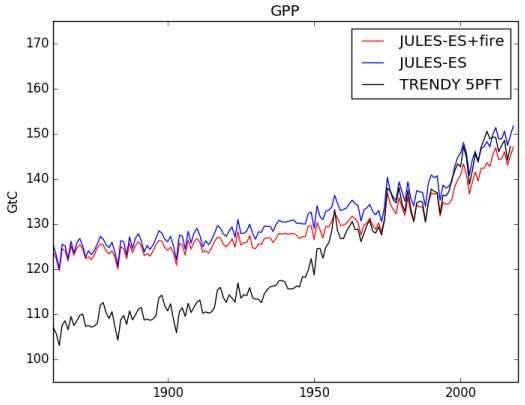
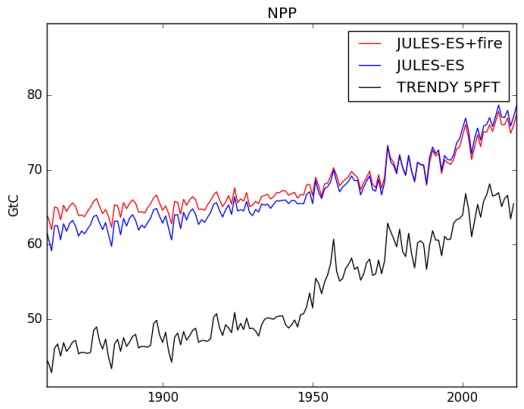
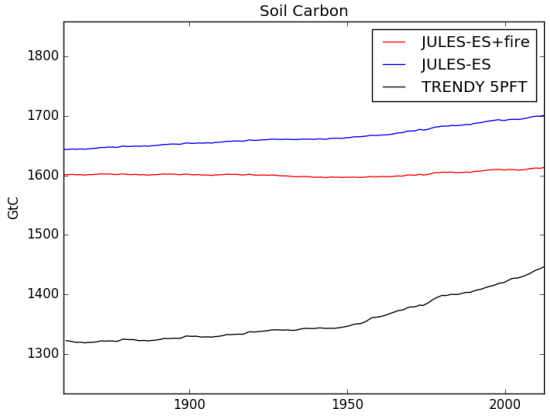
Productivity

- Observations:
  GPP ~100-130 GtC
  NPP ~55 GtC
  Soil Carbon ~1700GtC
- Soil carbon is lower with fire, but higher than previous configurations







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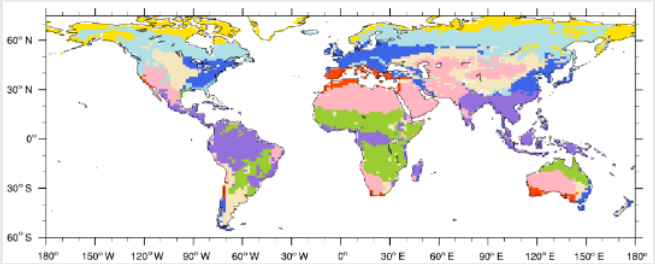
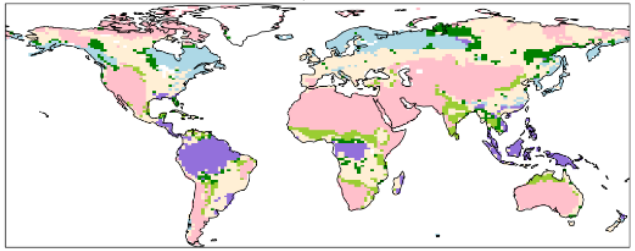
Vegetation cover

WWF biomes

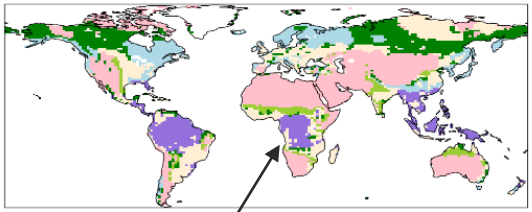


Tropical forest
Temperate forest
Boreal and coniferous
Tropical savannah
Grassland
Tundra
Mediterranean woodland
Desert

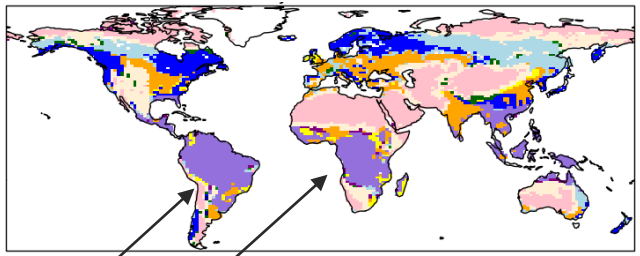
TRENDY 5 PFT + fire

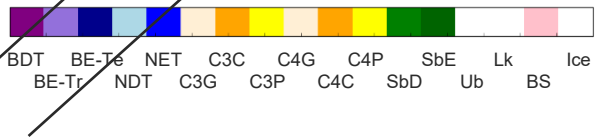


TRENDY 5 PFT

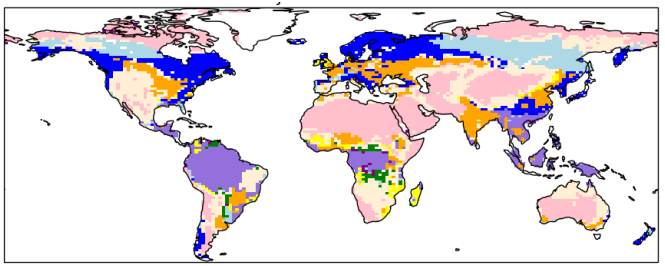


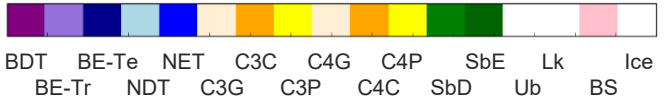
JULES-ES





JULES-ES+fire





High tropical tree cover without fire

Ongoing issues

- Still don’t capture strong negative trend (due to human influence in Africa?)
- Interannual variability: El Nino years not well captured (especially emissions – no peat burning)

Work in progress

- Crop fragmentation – Kelley et al (accepted)
- Mortality JPEG – identifying other causes of mortality, which may mean fire mortality reduces