ConFire: An uncertainy method for fire attribution

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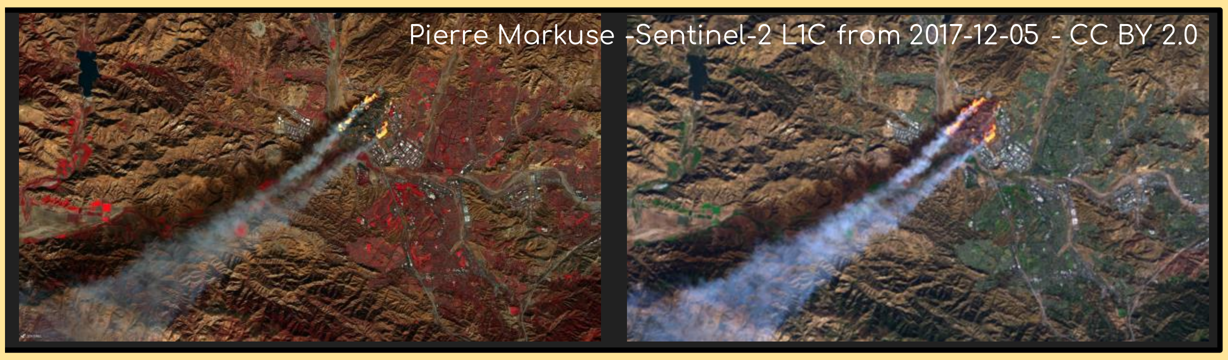
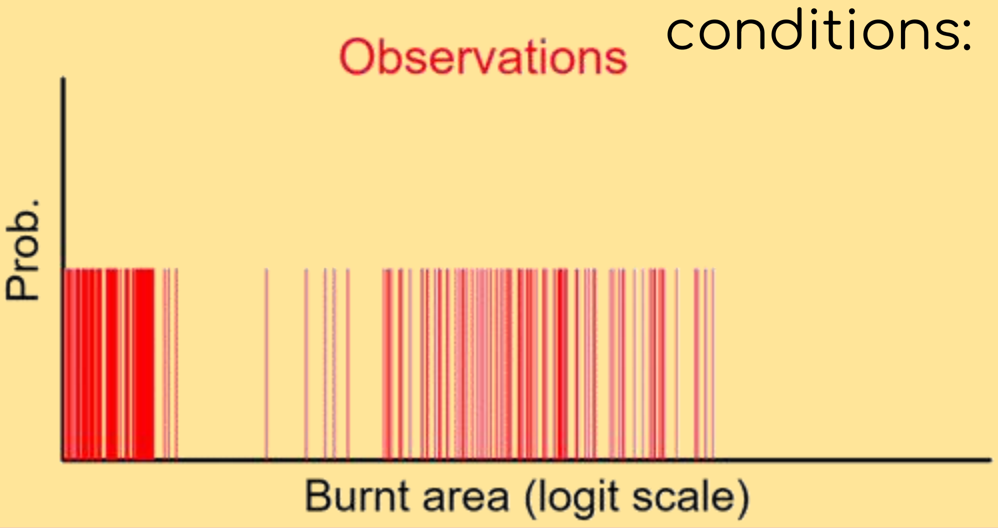


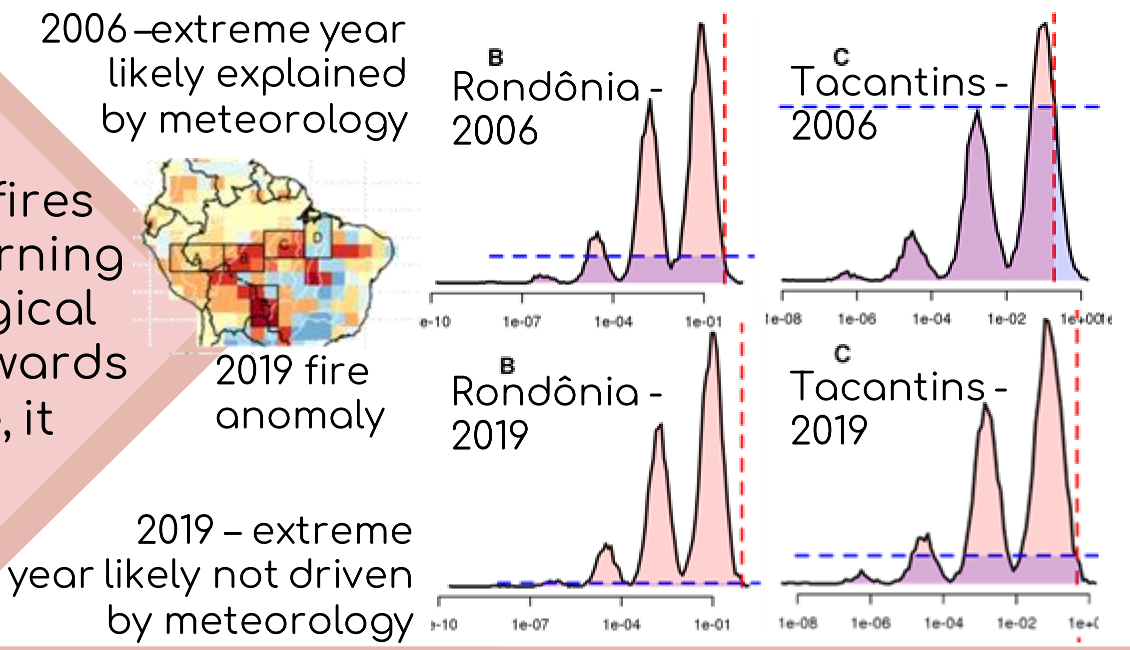
Under the same meteorological conditions:



Global fire models struggle to simulate many aspects of burnt area[1]. That is because similar large scale metrological conditions can cause a variety of burnt areas (red, left)[2]. With ConFire[2,3], we use Bayesian Inference (see QR for info) to optimise a model to satellite observations of fire & represent outputs as probability densities (blue+green). We can determine what aspects of fire regimes we are confident in & which are uncertain.

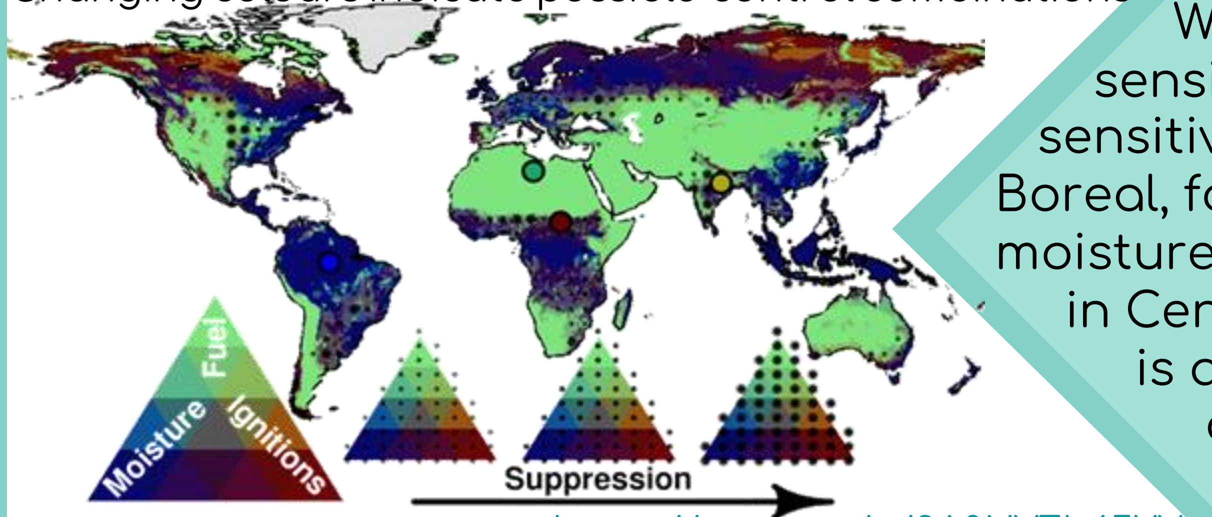
Extreme fire events[2]

Attributing fire event causes is difficult using standard modelling. However, probability densities let us assess a potential drivers likely influence. For the 2019 Amazonia fires over the arc of deforestation, we show that observed burning (red dashed line) was more extreme than the meteorological conditions and historic land use/land cover suggest (towards the model output distributions tail). Therefore, it is very likely (93% - blue line) that the burning levels were caused by sudden changes in human management or land cover, which the model did not consider.



Sensitivity of burnt area to controls

Changing colours indicate possible control combinations



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Historical fire regime change[3]

We find burning in tropical forests is limited by and sensitive to moisture (blue), and arid regions are sensitive to fuel. Elsewhere, exact drivers are uncertain. Boreal, for example, could be sensitive to ignition changes, moisture or both. While the impact of human suppression in Central USA and Northern African Savanna is also uncertain. Despite this, we can be confident in the large scale drivers of much of the world's changing fire regimes (see QR code)

Future changes in Wildfire[4]

We can look at the change in the "tail" of our model output to project change in extreme fires. We sample uncertainty in socioeconomic pathways with multiple future emissions scenarios (see QR code), and Earth system response uncertainty to forcing with a multi-model climate ensemble. Changes in burnt areas are very uncertain in the future (changing colours, left globe). However, we can find significant increases in wildfire (defined as a 1-in-100 likelihood event, 2010-2020) in Siberian peatland and forest, Amazonia and Indonesia by 2100 (right) – all carbon-rich ecosystems.

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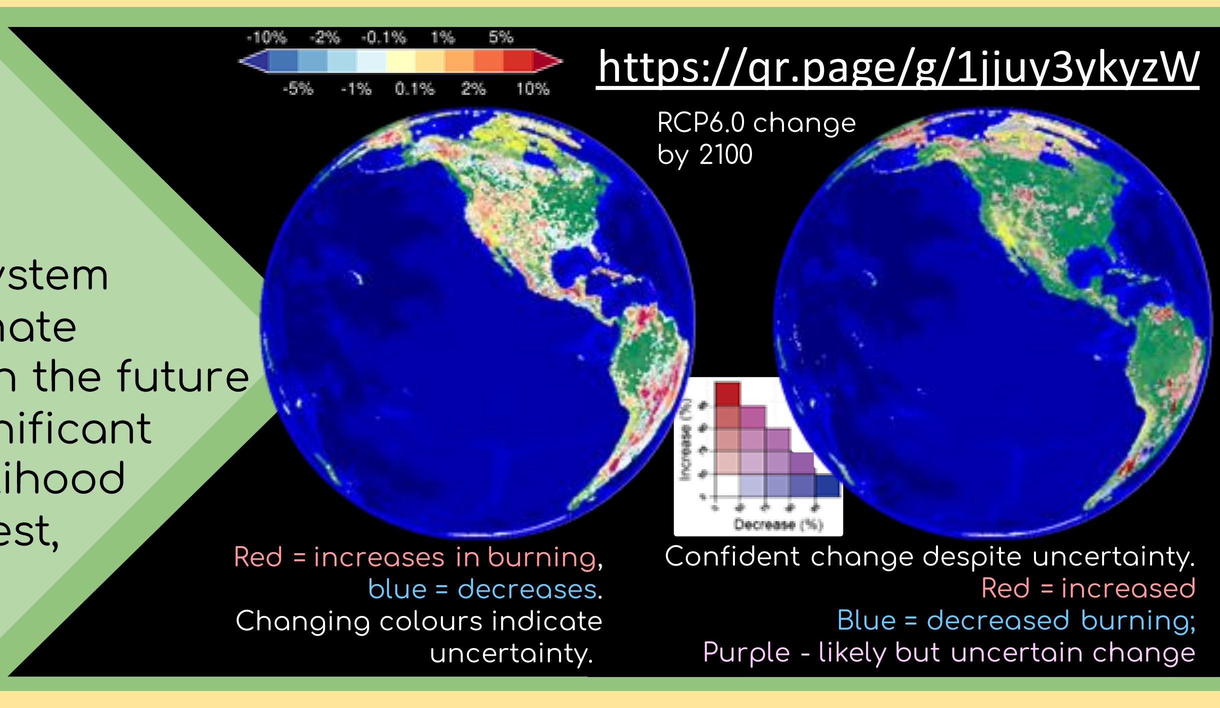

Red = increases in burning, blue = decreases. Changing colours indicate uncertainty.

Confident change despite uncertainty. Red = increased Blue = decreased burning; Purple - likely but uncertain change

1. Hantson et al. 2016 https://doi.org/10.5194/bg-13-3359-2016 , 2020 https://doi.org/10.5194/gmd-13-3299-2020. 2. Kelley et al. 2021 https://doi.org/10.5194/bg-18-787-2021
3. Kelley et al. 2019 https://doi.org/10.1038/s41558-019-0540-7. 4. UNEP 2022 https://wedocs.unep.org/20.500.11822/38372