

Reconstructing How Wildfires Spread with Satellite Images

Wildfires are an important feature of the natural world's dynamics, but the modern scientific understanding of how wildfires spread is limited because it is difficult to map. Satellite images are the best way to map fires, but, depending on what satellite is used, the images either have too little detail (grainy) or take images too infrequently to actually track the spread of wildfires. My study uses a satellite mission, Sentinel-2, which takes images rather infrequently (every 5 days) but whose images are very detailed and can be used to detect active fires confidently. With images from Sentinel-2, I detect actively burning areas and areas that have already burned. Then, I try to figure out what happened in between two successive images, separated by about 5 days, to get from one burned area to the next. I do this with two different methods, which both work by estimating "paths" along which the fire might have spread. Then I compare what I estimated to what has been captured from other satellite missions that take images more frequently. What I found is that my estimates consistently underestimated how fast a wildfire expands in between two images. While in reality fires tend to expand faster at first and slow down, my estimation assumed that the fire would expand at a fixed speed. What is surprising about this result is that it is very one-directional: the estimate is consistently too slow, and almost never too fast. I think this means that the speed of fire spread slows down as they grow bigger. However, other researchers have not acknowledged this, while estimating the speed of a fire as an average speed over a time interval. If the speed of a fire decreases over time, consistently, then the average speed over a time interval will actually underestimate how fast the fire has really expanded. Furthermore, there will be different amounts of underestimation when measured over different time intervals, meaning that the measure of a fire's speed depends on how frequently the fire is measured. Moving forward, researchers should look into how estimating fire speed from satellite imagery depends on how often images are captured, and how much this might bias measurements of speed.