Fire Ecology Chats: A Podcast Series by the Association for Fire Ecology

Transcript of Episode 21 - Multitemporal lidar captures heterogeneity in fuel loads and consumption on the Kaibab Plateau

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Bob Keane: Good morning everybody. My name is Bob Keane. I am the editor of Fire Ecology—the Association for Fire Ecology's journal that celebrates fire ecology and reports all things, science and management, on fire recalls. Today we are going to talk about a paper that is very exciting in my mind. The holy grail of fuel mapping is to get a sort of imagery that captures the heterogeneity of fuel load. Benjamin Bright, our speaker today is going to talk about that and the paper he's going to talk about is *Multitemporal lidar captures heterogeneity in fuel loads and consumption on the Kaibab Plateau*. Ben, would you like introduce yourself?

Benjamin Bright: Thanks, Bob. So yeah, I'm Benjamin Bright. I'm a geographer at the Rocky Mountain Research Station for the US Forest Service in Moscow, Idaho. I've been here for almost a decade. As far as my research, I often use remote sensing to map vegetation and fuels. And this paper is one of those papers.

Bob Keane: Well, it's a very exciting paper. I studied fuels for over 30 years, and I was very excited to read it. Ben, could you give us the quick summary of what the paper is all about?

Benjamin Bright: Sure. So we're using remote sensing from an airplane and a satellite, the Landsat satellite, which is in space. And in this case, we use that remote sensing data to map fuels on the Kaibab plateau. That's the plateau that sits above the Grand Canyon. It's a pretty large area. To make a map with remote sensing it's often only as good as the ground measurements where people have gone and actually measured in this case, fuels, and so you relate what you've measured on the ground to what you're seeing in the air. And that way you can create these models and use those models to map fuels across the large landscape. And so in this case, we used airborne lidar on an aircraft. And what's good about the lidar is it actively measures the underlying ground and vegetation, as opposed to lots of other remote sensing, that's imagery based. It's actively sensing that vegetation height and density. And with this, we're able to actually model as Bob said, the holy grail is to actually model some of that near surface fuel structure, heterogeneity in fuel structure across the plateau.

Bob Keane: You know, what I thought was really interesting about your paper, Ben, is that most people that try to map fuels with imagery only get one or two fuel components whereas you map the entire suite of fuel components, could you tell us what fuels you actually mapped?

Benjamin Bright: Right. So it's, I shouldn't say easy, but you know, canopy fuels, which is the fuel that's in trees, is often easier to map just because you get more of that signal from either a satellite or the airborne lidar. What we also did was measure the near ground surface fuel structures. So we mapped the canopy fuels, but we also measured the 1-1000 hour fuels, which is like, you know, sticks, logs. We didn't actually directly measure litter and duff with the airborne lidar, necessarily, but we were able to create models, you know, based on that overlying structure. There's a relationship between, of course, overlying structure and litter and duff, which is actually the fuel that is sitting on the forest floor and even below the surface of the forest floor, and we're able to create models that predicted that. So yeah, we're able to map you know, not only canopy fuels, but some of that fuel that is on the surface and just under the surface.

Bob Keane: Right. And the other exciting thing about this paper is that you're able to map fuels before and after a fire. Can you tell us about that?

Benjamin Bright: Yeah, that's something that's a little more novel because quite a few people have used remote sensing to map fuels and as well as airborne lidar to map fuels. But now airborne lidar is becoming more and more common. And more and more, we're being able to use multitemporal lidar. So this case, we had lidar in 2012 that was flown for a completely different purpose than this, but we had access to it. And then lidar in 2019 and then we had acquired lidar in 2020. So we actually had three different dates where we have this lidar that is a direct measure of vegetation structure. So when you have two different dates, you can of course, difference those and look at changes that have occurred. So yeah, in this case, there were fires. And we had that 2020 lidar that we had acquired over these fire extents. The Castle and Ikes fires that burned in 2019. And we're able to difference the fuel maps to see how the fire changed the fuel structure.

Bob Keane: Yeah, that's wicked cool. One other methodology question, you mentioned that use Landsat. What did you use landsat for when you had lidar?

Benjamin Bright: Right, so lidar, what it does well is it measures the structure and it's actively sending out laser pulses, they bounce off the ground and bounce back. And with that, you get what we call point cloud data. So millions, even sometimes billions, points in space. But what we didn't have from that was what you get from imagery, which is, you know, it's a picture basically from space, a satellite image. And so with that, you get a whole bunch of other information. In this case, we were mapping at a scale that was comparable to Landsat, and it's intuitive, you know, a fire is going to change fuel, a fire burns fuel. So we thought maybe using what we can get from Landsat, which has also a great temporal resolution. Landsat has been flown since Thematic Mapper since 1984. So you have this temporal record that goes way back, and we used a fire history database to assist. So, so long as I had that temporal record, that the lidar we only have these snapshots, we weren't actually sure if there would be a signal with fire history that I could tease out with modeling. But it turned out that the fire history of a pixel helps predict the amount of fuel at that pixel.

Bob Keane: Yeah. One other thing is that people don't realize that, you know, when you map all the fuel components like you did, you're able to then use programs like FOFEM or whatever or CONSUME to actually simulate the emissions and so on. So could you tell us what you see the future of this kind of mapping for fuels going to?

Benjamin Bright: Yes. So one of the big motivations for this paper, this was kind of the first step was to create first fuel maps and then by making fuel maps from different dates to estimate consumption, so differencing those fuel maps, and so that we hope to in future work, hopefully soon, currently working on it, to relate the consumption estimates that we get to information that we have from an aircraft, so another aircraft, this is different. One reason we pick these fires was first we had multitemporal lidar. The second reason is because an aircraft actually flew through the smoke plumes of the Castle and Ikes fire. And we have data from that aircraft that we'd like to relate to our consumption maps to see if there's, there's anything we can infer from the smoke claim from our consumption map. So we're hoping to take this one step further in our analysis.

Bob Keane: Well, Ben, I want to thank you very much for spending your time today to tell us about the paper. This is an incredibly important paper because it does use lidar imagery to get at actual fuel loadings and the models seem to be quite workable. So thank you again, Ben. Would you like to recognize any funding agencies that contributed to your work?

Benjamin Bright: Yes, so this was funded by a NASA project linking fire, fuels, and weather to atmospheric chemistry and it was also funded by the Joint Fire Science Program as well as the Smoke Model Evaluation Experiment or FASMEE.

Bob Keane: Again, thank you very much Benjamin Bright, and he is author along Andrew Hudak, Ryan McCarley, Alexander Spannuth, Nuria Sánchez-López, Roger Ottmar, and Amber Soja. So again, if anyone wants to know about how to map fuels with lidar and Landsat, please look at this paper. It's in Fire Ecology on the Fire Ecology website, free for all. Thank you very much, Ben. And this has been it for fire ecology chats.

Benjamin Bright: Thanks, Bob.