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| **Detecting Drivers of Forest Canopy Mortality following Drought** |
| **Introduction/Aim:** Why do some trees die during droughts while others seem to be doing just fine? Many studies have explored the influence of site characteristics on forest mortality at local monitoring sites, but few have used a detailed mortality dataset at a large spatial scale, yet. **Methods:** Here we created a new, large dataset of canopy mortality acquired over the years 2017-2020 for the country of Luxembourg (~2500 km²) within Europe, using a deep learning image segmentation and classification algorithm. The dataset contains all dead standing tree canopies throughout Luxembourg at a resolution of 20 cm and differentiates between conifer and broadleaf trees. We explored why canopy mortality during the drought summers 2018-2020 was higher on certain sites throughout the country, while trees seemed to be less effected in other areas. To this end, we tested the influence and interaction of different site characteristics pertaining to topography, stand structure and soil using a generalized additive model.**Results:** Canopy mortality was ten times higher in 2020 compared to 2017, increasing from 0.64 km² in 2017 to 7.49 km² of canopy area in 2020. Additionally, canopy mortality in conifers was much higher and highly clustered. We found that the distance to previously dead trees played an important role in explaining mortality patterns in conifers, and this effect was most pronounced for the year 2019. This is likely linked to the spread of bark beetles (*Ips typographus*) in the drought-prone and extensively managed forests. In broadleaf trees in which mortality appeared scattered throughout the forests, we found tree height as a driver of mortality with trees above 20 m having a higher mortality rate. Canopy mortality was generally more pronounced on soils with little water storage capacity, while topographic variation played only a minor role in explaining the observed mortality patterns.**Conclusion:** The patterns of tree mortality following three consecutive dry years were not explained by a single factor, but were clearly affected by a multitude of environmental and stand characteristics intertwined at the landscape-scale, which might be easily missed by discreet monitoring sites. This highlights the importance of developing tools to study tree mortality at larger scales in order to develop management strategies that promote tree resilience to future drought events.  |