EGU23-8249, updated on 22 Feb 2024
https://doi.org/10.5194/egusphere-egu23-8249
EGU General Assembly 2023

Towards species-level forecasts of drought-induced tree mortality risk

Martin De Kauwe[1], Manon Sabot[2], Belinda Medlyn[3], Andy Pitman[2], Patrick Meir[4], Lucas Cernusak[5], Anna Ukkola[2], Sami Rifai[2], and Brendan Choat[3]

[1]University of Bristol, School of Biological Sciences, Bristol, United Kingdom of Great Britain – England, Scotland, Wales (mdekauwe@gmail.com)

[2]Climate Change Research Centre, University of New South Wales, Sydney, NSW 2052, Australia

[3]Hawkesbury Institute for the Environment, Western Sydney University, NSW 2751, Australia

[4]School of Geosciences, The University of Edinburgh, Edinburgh, EH9 3FF, UK

[5]College of Science and Engineering, James Cook University, Cairns, Qld 4878, Australia

Australia is the driest inhabited continent. Annual rainfall is low and is accompanied by marked inter-annual variability, leading to multi-year droughts. n particular, South-East Australia has recently experienced two of the worst droughts in the historical record (2000–2009 and 2017–2020). Predicting species-level responses to drought at the landscape scale is critical to reducing uncertainty in future terrestrial carbon and water cycle projections. We embedded a stomatal optimisation model in the Community Atmosphere Biosphere Land Exchange (CABLE) land surface model and parameterised the model for 15 canopy-dominant eucalypt tree species across South-Eastern Australia (mean annual precipitation range: 344–1424 mm yr^{-1}). We carried out three experiments: applying CABLE to the recent drought; a theoretical future drier drought (20% reduction in rainfall); and a future drier drought (20% reduction in rainfall) with a doubling of atmospheric carbon dioxide (CO_2). The drought's severity was highlighted as at least 25% of their distribution ranges, and 60% of species experienced leaf water potentials beyond the water potential at which 50% of hydraulic conductivity is lost due to embolism. We identified areas of severe hydraulic stress within species' ranges, but we also pinpointed resilience in species found in predominantly semiarid regions. The importance of the role of CO_2 in ameliorating drought stress was consistent across species. Our results represent an important advance in our capacity to forecast the resilience of individual tree species, providing an evidence base for decision-making around the resilience of restoration plantings or net-zero emission strategies.