EGU2020-16276
https://doi.org/10.5194/egusphere-egu2020-16276
EGU General Assembly 2020

RED DGVM: simple approach to modelling vegetation with novel implications.

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The modelled global vegetation for the end of the 21st century is currently is insufficiently constrained
by climate models. A significant proportion of that uncertainty has been attributed to the limitations
of current Dynamic Global Vegetation Models (DGVMs), and the misrepresentation of mortality, dis-
turbance and regrowth within forests. Improving the simulation of the underlying processes of demographic change is of primary importance in the development of predictors of future climate.

Here we present the Robust Ecosystem Demography (RED), a new dynamical vegetation model which
simulates the size-structure of forests by partitioning the population of a Plant Functional Type (PFT)
into mass classes. Allometric scaling of mortality and growth across mass classes allows for a variety
of complex demographic processes to be captured, such as disturbances and regrowth. Competition
among PFTs is done purely through restricting the recruitment of new vegetation to unshaded space.
RED represents a reduction of complexity from more numerically unwieldy cohort DGVMs which
simulate both size and patch dimensions. The limited number of dimensions and simple competitive
regime allows the equilibrium state to be solved for analytically, providing two potential functions - (i)
Avoiding-spinning up by providing an equilibrium state for intilisation. (ii) Insights into the demography of vegetated areas, arising from parameter tuning to fit observation, such as coverage or carbon
mass. When paired with a rate of mortality or carbon assimilate rate gives, respectfully, required as-
similate or mortality rates.
We demonstrate the model functionality using offline UKESM PFT carbon assimilate rates, paired

with observed vegetation cover from the ESA LC_CCI datasets for the 9 different PFTs. From this dataset we calibrate a novel global equilibrium mortality map for each PFT and show the competitive
and successional behaviour of dynamical runs with convergence to the fitted equilibrium. Finally, we
explore underlying ecological questions that emerge from the equilibrium solutions.