What are the rates and drivers of tree mortality globally?

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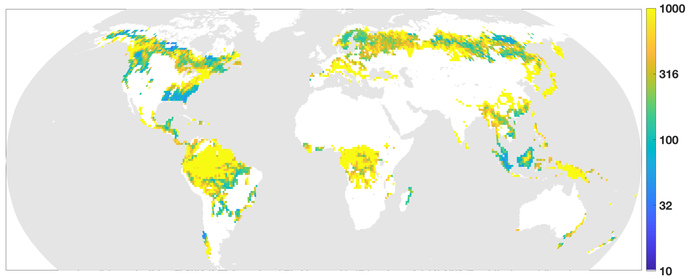
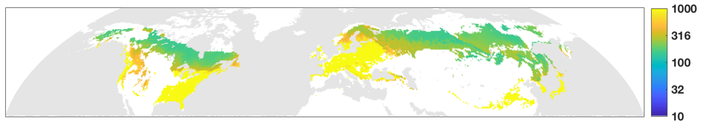
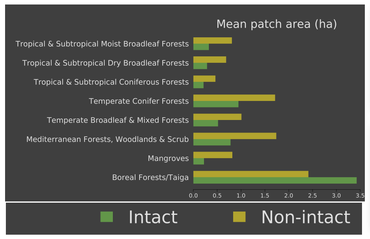
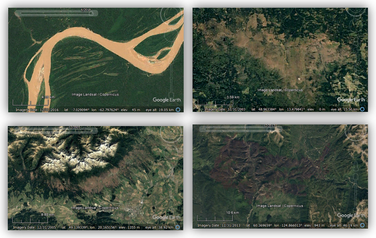


3 **Stand-replacing disturbance rotation periods 2001-2014.** Average number of years between repeat stand-replacing disturbances, of any kind, of 0.1 ha or larger. Derived from Landsat[1,2]. Units are years.

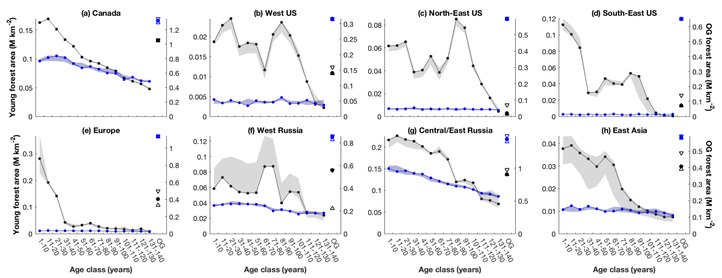


4 **Disturbance rotation periods in the absence of human disturbances.** Based on combining Landsat observations in protected areas[3] with modelling of potential vegetation using LPJ-GUESS.

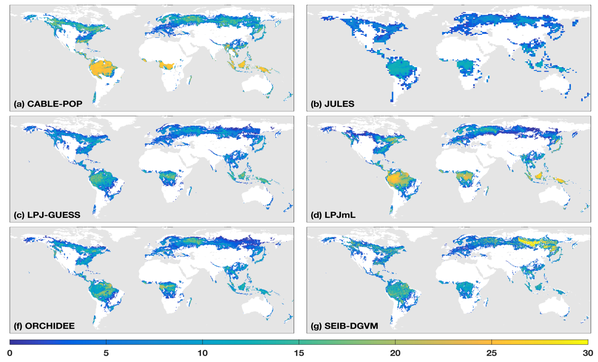




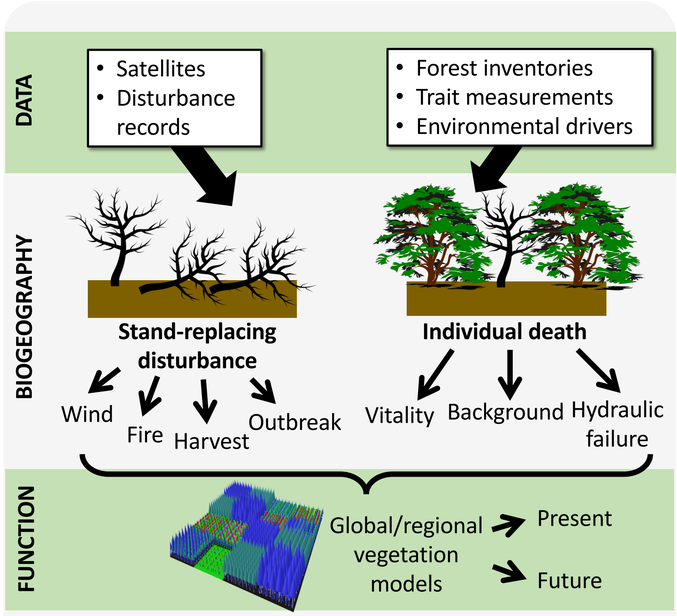
5 **The size of forest disturbances varies with size and with the influence of humans**[1]. The characteristic spatial signatures of different disturbances agents provide a route to identify their importance.



6 **Mortality rates are strongly influenced by stand age. Stand age datasets are therefore required for models and upscaling.** Here, estimates of stand age distribution in 2014 assuming only natural processes (blue) and including human land-use (black)[5].



1 **Problem: Baseline patterns of tree mortality and carbon turnover (τ) are poorly quantified at the global scale.** Here **τ** = C_{veg}/NPP is shown for 6 global vegetation models in the 1981-2010 mean.



2 **Project: Build and analyse pan-global datasets describing tree mortality at tree and stand scales, and integrate with modelling.**

10 **Next steps: Tree mortality regimes are rapidly changing. We need integrated pan-global observations of mortality trends, blending observation types, along with attribution of cause.**

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an initiative of the IUFRO task force on tree mortality

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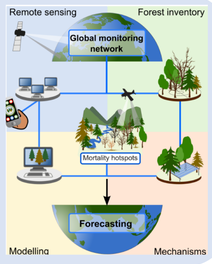
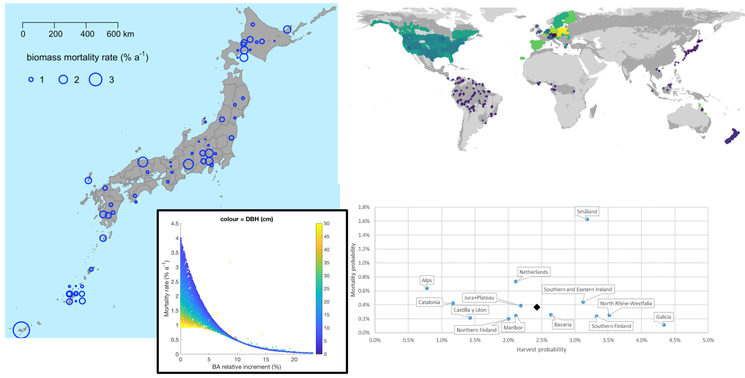
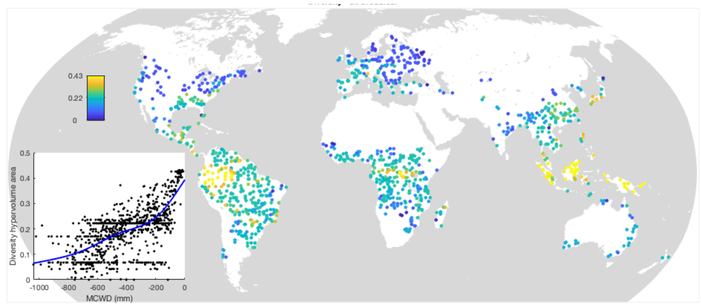
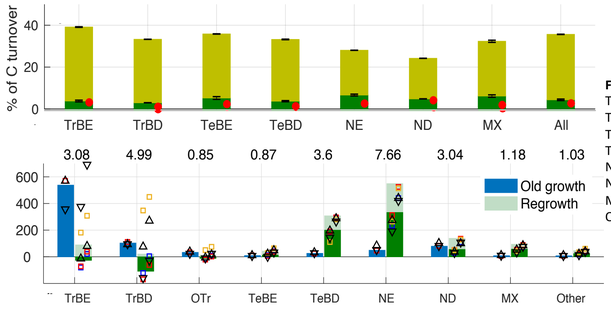




7 **Variation in mortality rates of individual trees across global forests** is being assessed using forest inventories and research plots[6]. Questions: (1) What are the baseline rates? (2) How do these link to drivers?



8 **Hydraulic failure under physiological drought appears to be prevalent**, but is hard to attribute directly in observations. Modelling can provide quantitative assessment, but requires tree strategies to be identified. Here, we simulate the diversity in successful broadleaf tree hydraulic strategies.



Forest types:
TrBE: Trop. Broadl. Ever.
TrBD: Trop. Broadl. Dec.
TeBE: Temp. Broadl. Ever.
TeBD: Temp. Broadl. Dec.
NE: Needlel. Ever.
ND: Needlel. Dec.
MX: Needlel. Broadl. Mix
Otr: Other trop.

9 **Assimilating these datasets in models allows assessment of how tree mortality interacts with forest functioning and the global carbon sink.** (top) Estimates of the fraction of carbon turnover due to mortality (whole bars) and stand-replacing disturbances (dark green)[2]. (bottom) C uptake in old-growth versus regrowth forests (dark green, demography-driven sink)[4].

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References: [1] Hansen et al. (2013) Science 342, 850-853. [2] Pugh et al. (2019) Nat. Geosci. 12, 730-735. [3] Sommerfeld et al. (2018) Nat. Commun. 9, 4355. [4] Pugh et al. (2019) PNAS 116, 4382-4387. [5] Hurtt et al. (2020) Geosci. Model Devel., [6] Schelhaas et al. (2018) PLoS ONE 13(11) e0207151.