Bioregional primary productivity and community-level niche width

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Aim

Conserving different spatio-temporal dimensions of biological diversity may help maintain ecosystem functions such as primary productivity under global change. The range of environmental conditions that plant species occupy - their environmental niche widths - approximate the degree of ecological specialisation in a community, potentially influencing current primary productivity (**Fig. 1**).

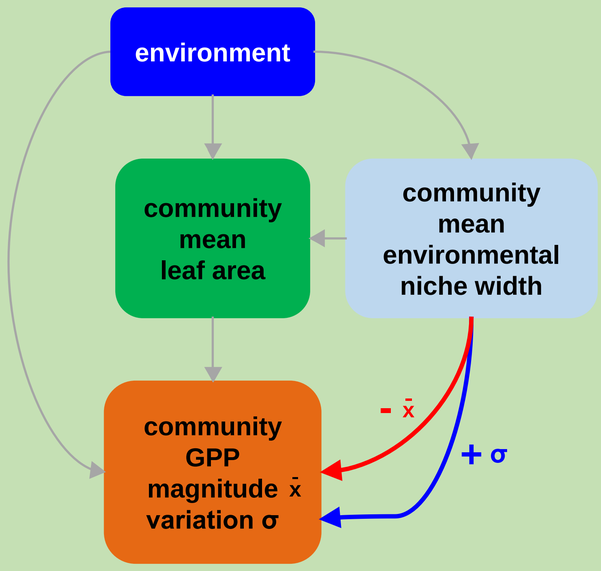

Fig. 1). Conceptual equation predicting wider community mean niche widths drive lower magnitude and greater variation of community primary productivity.

We use structural equation models to test whether mean community niche width influences the magnitude and variation of community primary productivity in the Australian Wet Tropics, above and beyond community mean traits values (e.g. leaf area) and *current* environmental conditions.

Niche width

Species niche width (NW, **Fig. 2**) is defined as the middle 90% of rainfall (mm) and temperature (°C) values for all geographic records of Wet Tropics tree species across Australia. Trees with niches *centred* beyond the middle 90% of temperature values OR the driest 5% of rainfall values for the Wet Tropics - based on their geographic records - were excluded from analysis. Community niche width is defined as the average niche width of all tree species occurring at each of 492 Wet Tropics sites.

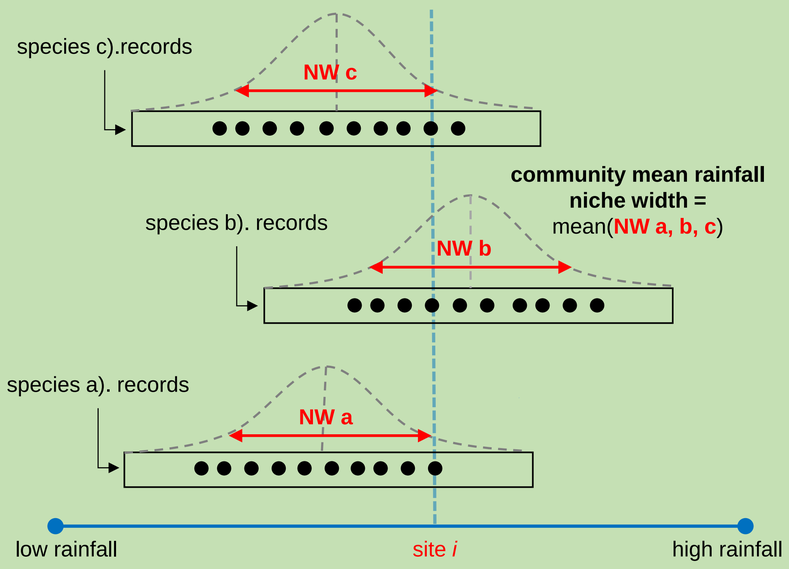

Fig. 2). Quantifying community mean rainfall niche width for a hypothetical site.

Bivariate regressions

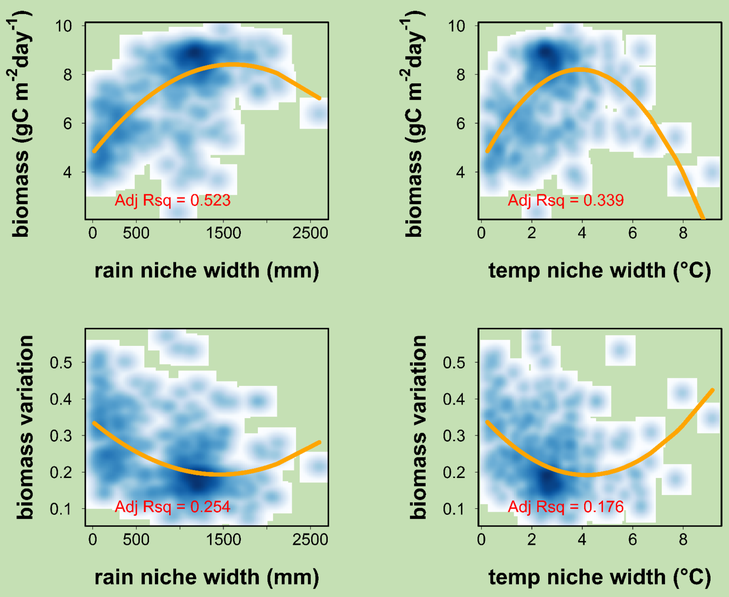

Fig. 3). Scatterplots of primary productivity magnitude (average daily gross primary productivity in grams of carbon from 01/2001-12/2012) and variation (ratio of the standard deviation in primary productivity to the mean) for 492 Wet tropics tree communities. Second order polynomial regression lines are plotted in orange.

Structural equations

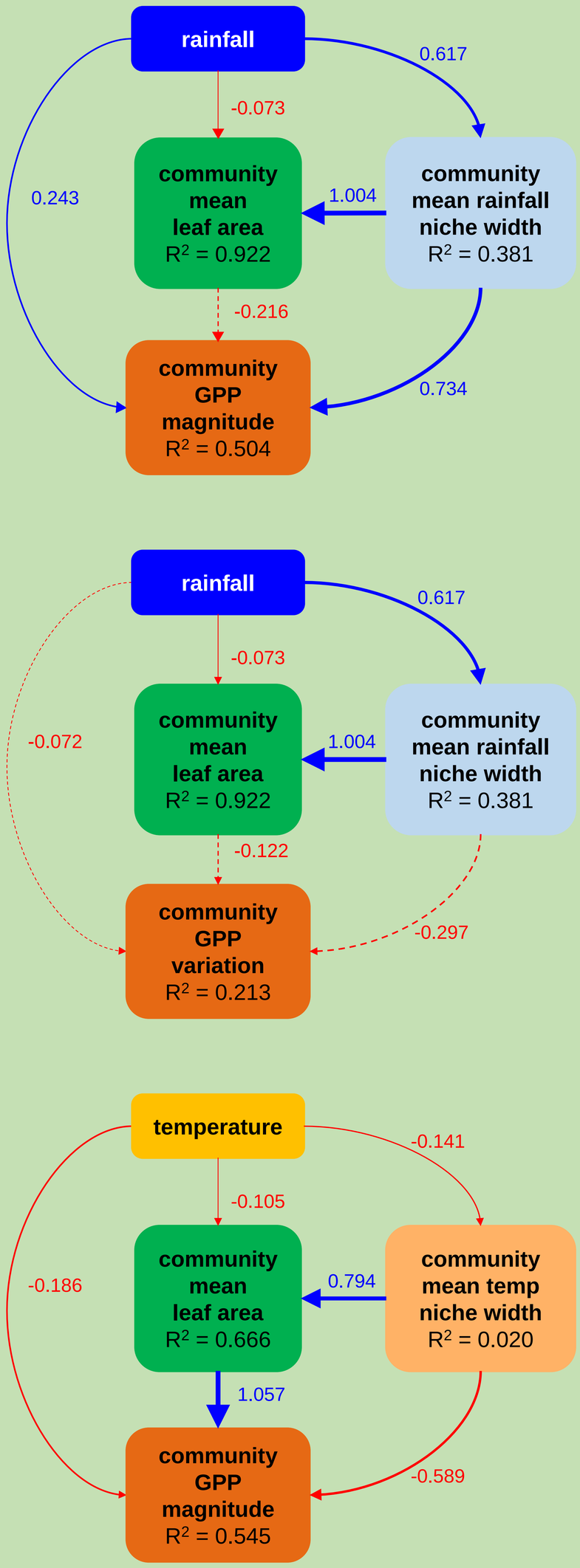

Fig. 4). *Observed variable* structural equation models, assuming all variables are measured directly. Single headed arrows represent hypothesised causal paths. Positive standardised path coefficients are in blue, negative in red and non-significant paths are dashed (α = 0.05). Arrow width is proportional to strength of path coefficients,.

Future directions

Preliminary models suggest the influence of community mean niche width on primary productivity is greater than either rainfall or temperature themselves. However, community mean leaf area is a stronger influence on primary productivity than temperature niche width. Communities with *wider* mean rainfall niches have greater magnitude and lower variation of primary productivity. Conversely, communities with *narrower* mean temperature niches have greater primary productivity magnitude and lower variation.

Further modelling could incorporate the effects of spatial non-stationarity and phylogenetic relationships between species on ecosystem functions such as primary productivity.

Data sources

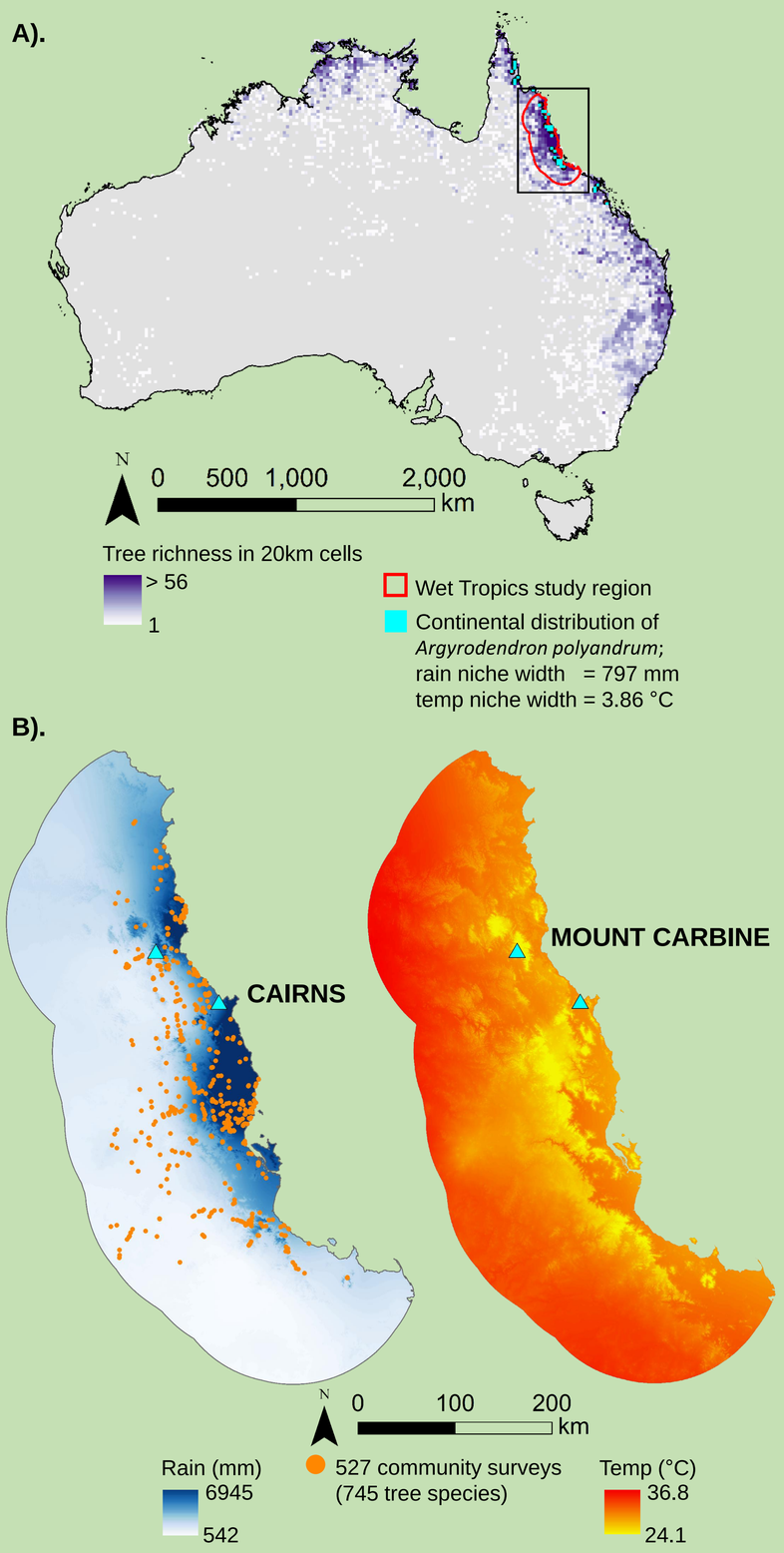

Fig. 5). **A).** 100,00 continental geographic records for 745 trees from the Atlas of Living Australia (http://www.ala.org.au/). **B).** 527 10m × 50m vascular plant community surveys, with 745 trees recorded at the sites that were within the Wet Tropics environmental extremes. Sites are overlain with interpolated 250m surfaces (1976-2005) of annual rainfall (mm, blue) and maximum temperature of the warmest period (°C, orange) **C).** Example vegetation communities of north Queensland, Australia, near Cairns, top, and Mount Carbine, bottom.