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Amazon forest responses to drought: scaling from individuals to ecosystems.

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Scaling from individuals or species to ecosystems is a fundamental challenge of modern ecology and understanding tropical forest response to drought is a key challenge of predicting responses to global climate change. We here synthesize our developing understanding of these twin challenges by examining individual and ecosystem responses to the 2015 El Niño drought at two sites in the central Amazon of Brazil, near Manaus and Santarem, which span a precipitation gradient from moderate (Manaus) to long (Santarem) dry seasons. We will focus on how ecosystem water and carbon cycling, measured by eddy flux towers, emerges from individual trait-based responses, including photosynthetic responses of individual leaves, and water cycle responses in terms of stomatal conductance and hydraulic xylem embolism resistance. We found the Santarem forest (with long dry seasons) responded strongly to drought: sensible heat values significantly increased and evapotranspiration decreased. Consistent with this, we also observed reductions in photosynthetic activity and ecosystem respiration, showing levels of stress not seen in the nearly two decades since measurements started at this site. Forests at the Manaus site showed significant, however, less consistent reductions in water and carbon exchange and a more pronounced water deficit. We report an apparent community level forest composition selecting for assemblies of traits and taxa manifest of higher drought tolerance at Santarem, compared to

the Manaus forest (short dry seasons) and other forest sites across Amazonia. These results suggest that we may be able to use community trait compositions (as selected by past climate conditions) and environmental threshold values (e.g. cumulative rainfall, atmospheric moisture and radiation) as to help forecast ecosystem responses to future climate change.