**Same but different: Rethinking the common understanding of ENSO and its impact on biodiversity**

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# Abstract

The El Niño Southern Oscillation (ENSO) is a recurrent global phenomenon causing climate anomalies with major consequences for all affected ecosystems. We studied the spatio-temporal effects of different ENSO episodes on biodiversity in the terrestrial core region of ENSO in NW Peru. We sampled 50 permanent vegetation plots along a climatic gradient in four years representing different ENSO episodes: dry La Niña (LN; 2011), humid LN (2012), moderate El Niño (EN; 2016) and a very humid neutral year (coastal EN; 2017). To visually represent the spatio-temporal changes in floristic composition, we use an innovative approach by modeling the scores of a DCA using a GAM and spatial cross-validation. Additionally, we applied variation partitioning to test if topographic or edaphic variables gained in importance as soon as water was no longer the limiting factor. Plant species richness increased under humid conditions during the humid LN (2012) and moderate EN (2016) year, and slightly decreased under the very humid conditions of the coastal EN year (2017). Vegetation composition changed also under more humid conditions. Vegetation cover was manifold higher in 2017 compared to all previous years. Edaphic and topographic variables gained in importance with increased water availability in 2012 and 2016, but not in 2017. As nutrients can be equally important for primary production as water, we additionally executed an irrigation-nutrient experiment. The experiment showed that biomass production under wet Super Niño conditions was three times higher when a fertilizer treatment was added. Overall, our results can help to 1) protect local human populations from devastating ENSO effects through informed conservation management and the restoration of degraded ecosystems; 2) equip farmers with information regarding sustainable agrarian management. We conclude that given the large variability of ENSO episodes, it is time to challenge our partly overly simplistic understanding of ENSO’s impact on biodiversity.

**Keywords**: tropical dry forest, Peru, ecosystem diversity, ordination, statistical learning, predictive mapping, irrigation-fertilization experiment, productivity

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