



Exploring causality in interactions between climate shifts, land degradation and humans: 4000 years of sedimentary evidence from the Horn of Africa

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Drylands cover over 40 % of the Earth's land surface and accommodate about 38 % of the global population. Dryland degradation is often thought to result from rapid population growth, but evidence underpinning an association between climate changes and dryland degradation is scarce. This study presents records of dryland degradation dynamics over the past 4000 years in and around the Lake Ashenge basin (Ethiopia), a unique natural laboratory for comparing climate changes and environmental responses near the northern limit of the African monsoons. Our datasets are based on luminescence dating, pollen and short-lived isotope sediment records, and are complemented with climate model and hydrological simulation results. The sedimentary evidence provides paleoenvironmental benchmarks demonstrating that distinct Late-Holocene climatic shifts match with phases of increased alluvial sediment supply and grassland expansion. There are remarkable temporal associations between climatic changes and pastoral migrations that have influenced land cover and sediment mobilization in the basin (around 1500 BCE, 500 BCE, 500 CE, and 1700 CE). Overall, the data corroborate multi-model projections that climatic shifts can directly and indirectly lead to significant environmental changes in drought-prone regions on the longer term.