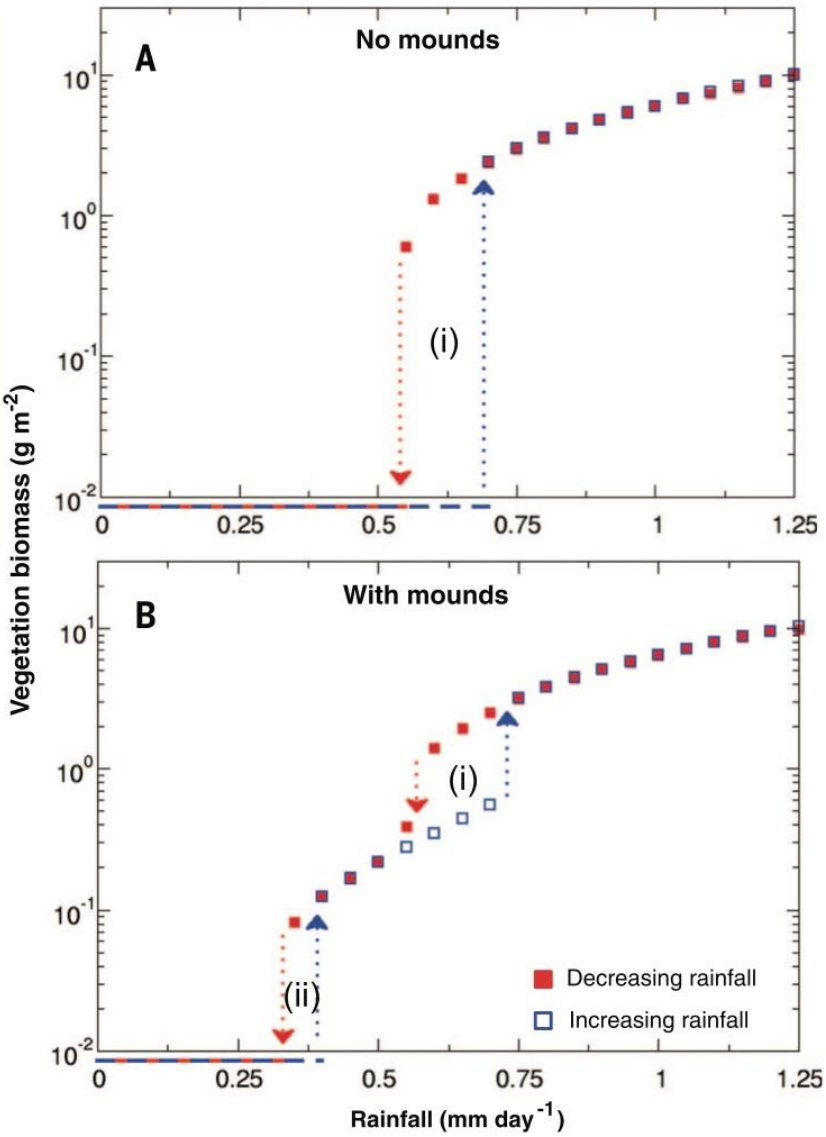

Caption: Diagrams showing how models predict the response of vegetation to increasing (blue squares) and decreasing (red squares) rainfall in ecosystems where termite mounds are not present (A) and are present (B). Each data point indicates the vegetation biomass in an area of land for a particular amount of rainfall. Figure A shows one cycle (i) of desertification (down red arrow) and revegetation (up blue arrow) in the absence of mounds. Figure B shows two cycles representing (i) loss and recovery of vegetation in the landscape between the mounds and (ii) desertification and revegetation of the entire system, including vegetation on the mounds.

BACKGROUND INFORMATION

In arid and semiarid savanna and grassland ecosystems (i.e., dryland ecosystems), a decrease in rainfall typically results in increasingly sparse vegetation, leading to uniformly spaced spots of vegetation (or vegetation patterns), and eventually complete loss of vegetation. The complete loss of vegetation, or desertification, is catastrophic to an ecosystem, and its effects can last for many years. More than 38% of the human population

lives in dryland environments, which cover more than 40% of Earth's surface. The risk of desertification is predicted to increase as drought intensity increases in response to global warming. Scientists have proposed using vegetation patterns as an early warning system to predict desertification.

In ecosystems with termites, vegetation tends to be concentrated on termite mounds, which are spread out across the landscape. Dr. Corina Tarnita and colleagues found that the pattern of vegetated termite mounds across a landscape resembles the spotty vegetation that occurs when a system is near desertification. But despite the similarities in these patterns, the fates of these two ecosystems may be very different. The presence of termite mounds in a landscape may actually provide resistance to desertification and a faster recovery of vegetation if desertification does occur. Termite mounds promote vegetation growth because the termites enrich the soil with nutrients found in their waste and they dig tunnels that help to increase water infiltration to plant roots.

The researchers incorporated the positive effects of termite mounds on vegetation growth into an existing mathematical model used to predict how changes in the annual average rainfall alter vegetation patterns in a savanna ecosystem. Panel A in the figure above shows a diagram of the modeled vegetation change as rainfall decreases (red) and increases (blue) in an ecosystem without termite mounds. Panel B shows a model of the vegetation change as rainfall decreases (red) and increases (blue) in an ecosystem with termite mounds. From these models, the researchers were able to predict the system's "robustness," measured by how well the vegetation resisted and then recovered from desertification. They then compared the modeled vegetation patterns against aerial photographs and data collected at their field site in Kenya, confirming that the vegetation patterns predicted by the models closely matched the actual data.