Abrupt land change events alter biodiversity

Martin Jung[1], Pedram Rowhani[2], Jörn P.W. Scharlemann[1]

1 School of Life Sciences, University of Sussex, Brighton BN1 9QG, UK; 2 School of Global Studies, University of Sussex, Brighton BN1 9QJ, UK

✉ M.Jung@sussex.ac.uk
Martin_Ecology

Background

Natural events and human pressures continue to shape the Earth's surface. Abrupt land changes resulting from these processes can have lasting effects on ecosystems. Yet few studies have truly investigated the impacts of abrupt land changes on biodiversity.

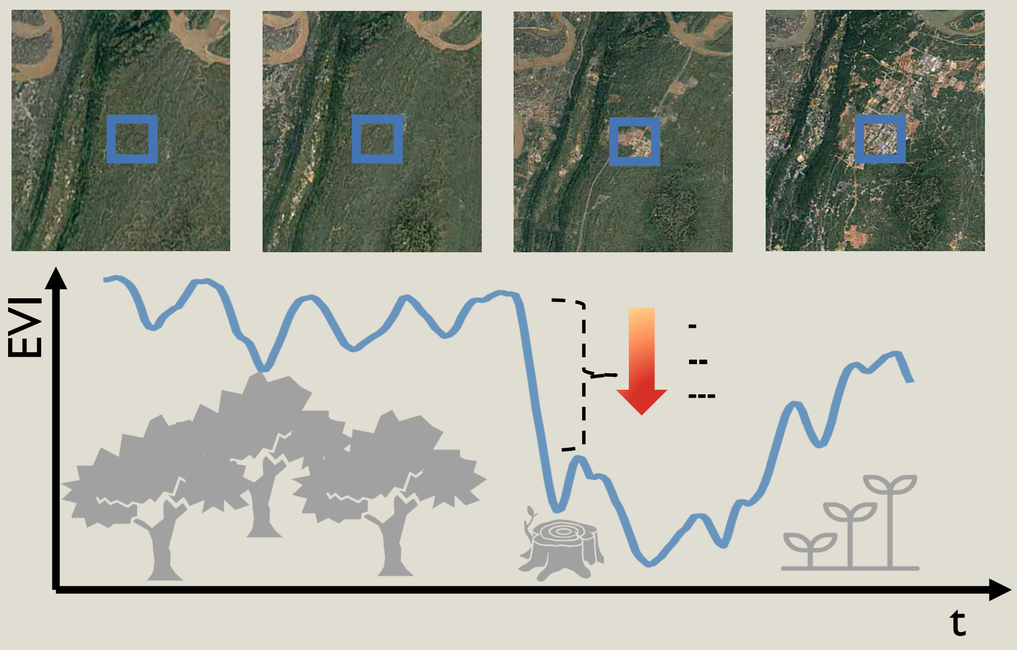
Aim

To use time series of satellite imagery to detect and quantify the timing and magnitude of past abrupt land changes and to assess how they affect local biodiversity.

Methods

We used a global database of local biodiversity records with information on sampling start and site location.

Satellite imagery from the Landsat missions were prepared covering 32 years at 30 m resolution.



Extracted time series of photosynthetic activity (EVI) as proxy for vegetation cover at each site.

A change-detection algorithm was used to detect and quantify the largest abrupt land change event and its magnitude as either loss (-) or gain (+).

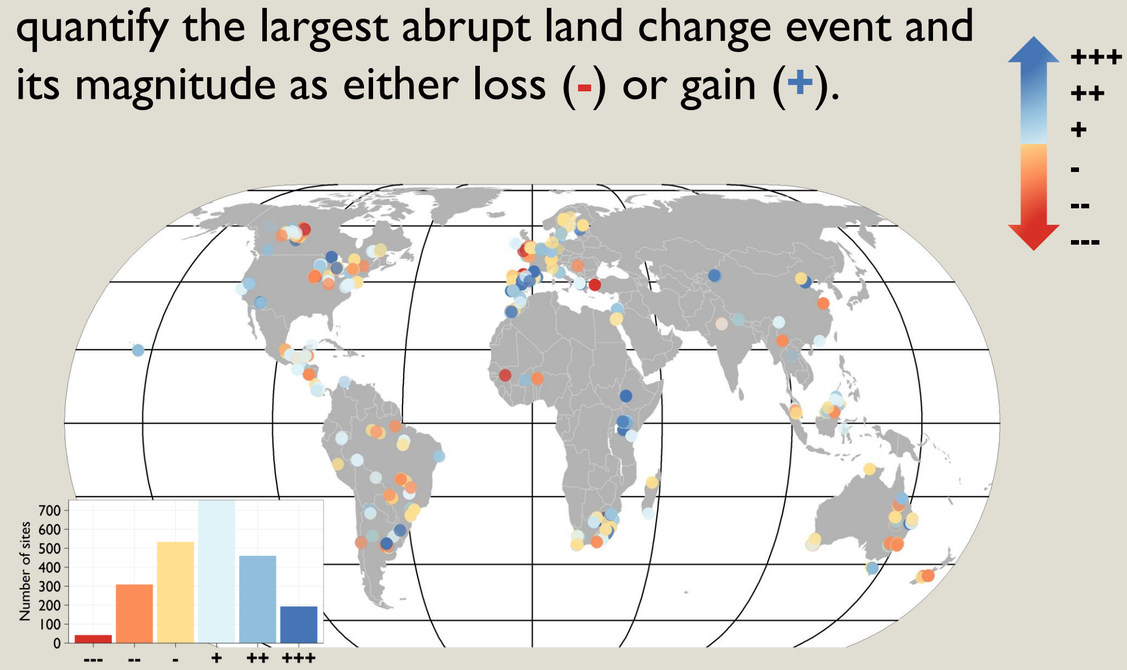


Fig 1. Sites with biodiversity records that experienced an abrupt change event in the past as detected in time series of the EVI. Colours display the relative magnitude change of each site, where symbols indicate either **---**, **--**, **-** for > 50 %, > 25 % and < 50 %, and < 25 % abrupt EVI loss and respectively **+**,**++** and **+++** for abrupt EVI gains.

General linear and additive mixed effects models to compare biodiversity between sites with no detected change event (0) and those with change events of varying magnitude.

Loss in species richness with abrupt change

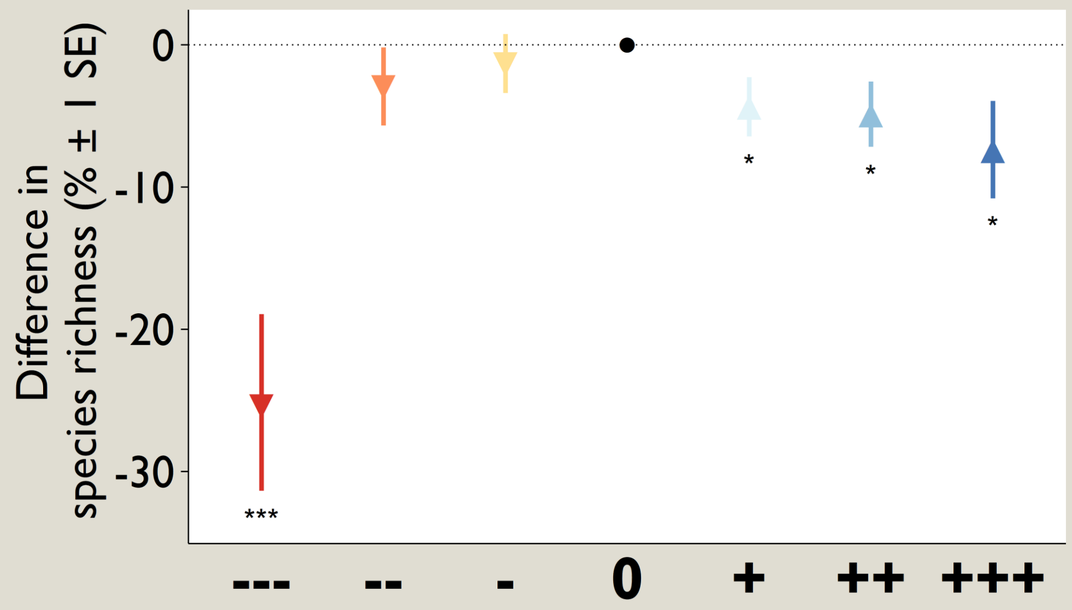


Fig 2. Average difference in local species richness across sites of varying relative magnitude change compared to sites without any change event (0). Symbols on the x-axis indicate either ---, --, - for > 50 %, > 25 % and < 50 %, and < 25 % abrupt EVI loss and respectively +,++ and +++ for abrupt EVI gains. Error bars show the predicted standard error and stars indicate statistically significant differences compared to sites without any detected change event.

Effect of change magnitude and time passed on local species richness

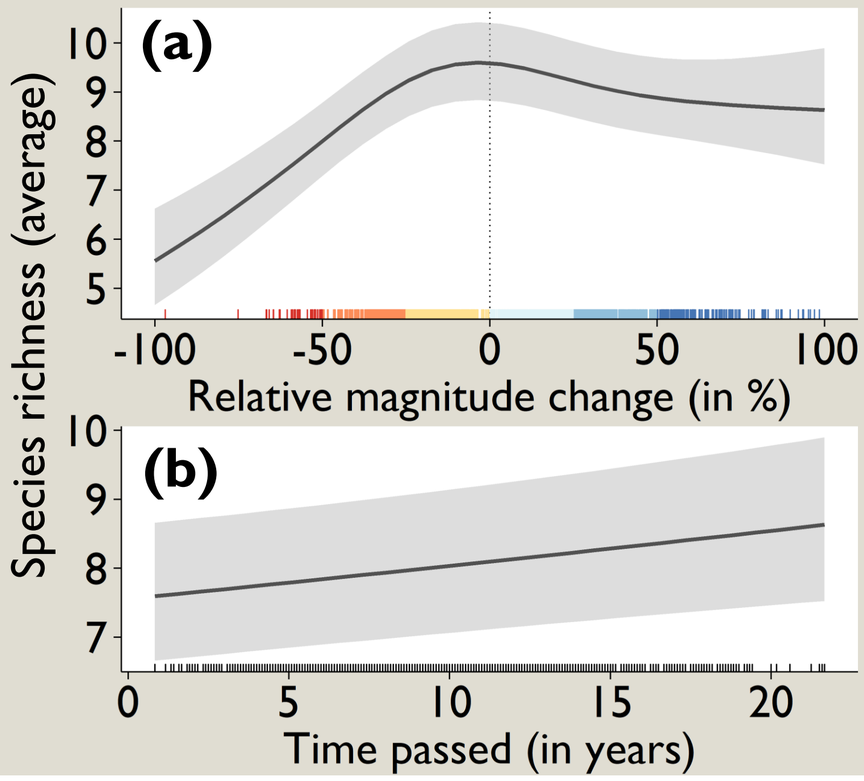


Fig 3. Predicted average species richness for relative change magnitude **(a)** and time passed **(b)**. Rugs are coloured per magnitude bin as shown in Figure 1 & 2. Shading shows the predicted standard error.

Key findings

Compared to sites without any abrupt change, sites with past abrupt losses of over 50 % in vegetation cover have lost 24 % species on average (Figure 2). Overall, sites with larger abrupt changes were found to possess fewer species (Figure 3a), although the time passed since the abrupt change occurred mediated this effect (Figure 3b).

Our study to investigate the impacts of past abrupt land change events on local biodiversity and demonstrates how remote sensing can be used to detect and quantify past land change globally.

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