Soil erosion rejuvenates vegetation community composition

A. EGER[1*], O.R. BURGE[1], P.C. ALMOND[2]

[1]Manaaki Whenua-Landcare Research, Lincoln 7608, New Zealand (*egera@landcareresearch.co.nz)
[2]Lincoln University, Lincoln 7647, New Zealand

Terrestrial plant community composition is linked to edaphic conditions since soil provides essential nutrients, and physical habitat. With increasing soil age, soils become more weathered leading ultimately to a decline of primary production and biomass, changing vegetation traits, and strong effects on species and functional diversity. Soil erosion counteracts this 'aging'-trajectory and facilitates natural fertilisation of ecosystems through the feedback between soil erosion and production.

While the ecological effects of declining fertility across gradients of soil age are well studied under the premise of minimal erosion, little evidence exists for soil erosion as a modulator of fertility decline for vegetation community composition. We quantified the rejuvenating effect of soil erosion on vegetation composition, using a matrix of landform ages (MIS2,3,4,6), and slope angles (0-<50°) as proxies for weathering and erosional rejuvenation, respectively. We hypothesised that increasing rates of soil erosion on steeper slopes would counteract the effect of loss of soil fertility as landforms age, rejuvenating vegetation community composition.

We analysed the community composition of >250 vegetation plots across our age-slope matrix. Using unconstrained ordination, we calculated a 'baseline' of vegetation composition in ecological space using the 95% confidence interval for plots on the youngest surface (MIS2). We then calculated the ecological distance of all plots from the baseline, and tested if distance varied with plot slope, surface age, and an interaction between the two.

We found that the effect of age on composition depended on slope, and vice versa. As landform ages increased, compositional distance to the MIS2-baseline increased for vegetation communities on low-angled, low-erosion surfaces. Increasing slope gradually reversed this relationship, an effect strongest on the MIS6 surfaces. However, while >35° slopes could fully rejuvenate the plant communities on MIS4 surfaces to the MIS2 baseline, such full rejuvenation was never achieved for MIS6 plots. We conclude soil erosion counteracts changes of vegetation community composition imposed by increasing landform age at our sites. This has likely consequences for biogeochemical fluxes, and primary productivity and diversity of vegetation communities.