



## **Externally forced transitions in vegetated biogeomorphic ecosystems**

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The shift between bare sediment and dense vegetation cover in biogeomorphic ecosystems is often referred to as a critical transition. This means that once vegetation is present, it stabilises the sediment and creates positive feedbacks to the system, making a shift to the bare state less likely. However, new vegetation establishment or vegetation recovery is often inhibited due to lacking stabilising feedbacks in the bare state.

Exposure to fluid motion by water or wind and sediment erosion or burial can hamper seed germination at otherwise suitable locations or lead to failure during subsequent seedling anchorage. However, during calm conditions such physical disturbance is absent or minimal so that temporal 'Windows of Opportunity' for seedling establishment may arise in which seedlings can gain stability against average forcing.

Based on time series analyses of external forcing in a range of biogeomorphic ecosystems, we show how 'Windows of Opportunity' may explain sudden establishment/recovery of vegetation. We discuss their importance for initiating a biogeomorphic succession and for the wider critical transition theory.