



## **Experimental evidence and modelling of drought induced alternative stable soil moisture states**

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The theory of alternative stable states in ecosystems is well established in ecology; however, evidence from manipulation experiments supporting the theory is limited. Developing the evidence base is important because it has profound implications for ecosystem management. Here we show evidence of the existence of alternative stable soil moisture states induced by drought in an upland wet heath. We used a long-term (15 yrs) climate change manipulation experiment with moderate sustained drought, which reduced the ability of the soil to retain soil moisture by degrading the soil structure, reducing moisture retention. Moreover, natural intense droughts superimposed themselves on the experiment, causing an unexpected additional alternative soil moisture state to develop, both for the drought manipulation and control plots; this impaired the soil from rewetting in winter. Our results show the coexistence of three stable states. Using modelling with the Hydrus 1D software package we are able to show the circumstances under which shifts in soil moisture states are likely to occur. Given the new understanding it presents a challenge of how to incorporate feedbacks, particularly related to soil structure, into soil flow and transport models?