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Spatio-temporal trends in antecedent soil moisture conditions and instability of ash-covered slopes in New Zealand

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The ash-covered slopes of New Zealand are particularly prone to landsliding due to the combination of relatively shallow, permeable soils overlying impervious bedrock and incidental, high-intensity rainstorms. Landslide occurrence has particularly increased after the widespread clearing of native scrub and forest in the wake of the European settlement in the 19th century, which suggests that with the conversion an essential stabilising influence of vegetation has been lost. Reduced actual evapotranspiration is one of the possible vegetation effects that, through elevated antecedent moisture conditions, may result in a higher incidence of critical pore pressures. This paper aims to assess the influence of evapotranspiration on landslide activity by means of a physically-based model at the catchment scale (Waikopiro catchment) over a 100-year period. The spatial and temporal effects of evapotranspiration on the antecedent moisture conditions have been evaluated by establishing rainfall-duration thresholds from the simulated slope instability as a proxy for landslide activity. In order to isolate the influence of vegetation from spatial trends in evapotranspiration that arise from exposition and topography, both uniform and distributed potential evapotranspiration estimates (Penman) have been applied. Distributed potential evapotranspiration includes spatial differences in incoming radiation whereas the uniform values are based on the spatial average. Given the vegetation cover, i.e. native vegetation or rangeland, the actual evapotranspiration is calculated by means of crop factors and the available soil moisture content. The results show that slopes become more prone to instability induced by high-frequency low-magnitude rainstorms due to the decreased evapotran-

spiration under rangeland. For low-frequency high-magnitude events, the difference between vegetation types is less marked as antecedent moisture conditions are less important. Distributed evapotranspiration results in a difference in simulated slope stability within the catchment that is of the same order of magnitude as that between vegetation types.