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Evidence of climatic effects on soil, vegetation and landform in temperate forests of south-eastern Australia

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Water and radiation are unevenly distributed across the landscape due to variations in topography, which in turn causes water availability differences on the terrain according to elevation and aspect orientation. These differences in water availability can cause differential distribution of vegetation types and indirectly influence the development of soil and even landform, as expressed in hillslope asymmetry. While most of the research on the effects of climate on the vegetation and soil development and landscape evolution has been concentrated in drier semi-arid areas, temperate forested areas has been poorly studied, particularly in South Eastern Australia. This study uses soil profile descriptions and data on soil depth and landform across climatic gradients to explore the degrees to which coevolution of vegetation, soils and landform are controlled by radiative forcing and rainfall. Soil depth measurements were made on polar and equatorial facing hillslopes located at 3 sites along a climatic gradient (mean annual rainfall between 700 – 1800 mm yr-1) in the Victorian Highlands, where forest types range from dry open woodland to closed temperate rainforest. Profile descriptions were taken from soil pits dag on planar hillslopes (50 m from ridge), and samples were taken from each horizon for physical and chemical properties analysis. Hillslope asymmetry in different precipitation regimes of the study region was quantified from Digital Elevation Models (DEMs). Significant vegetation differences between aspects were noted in lower and intermediate rainfall sites, where polar facing aspects expressed higher overall biomass than the drier equatorial slope. Within the study domain, soil depth was strongly correlated with forest type and above ground biomass. Soil depths and chemical properties varied between topographic aspects and along the precipitation gradient, where wetter conditions facilitate deeper and more weathered soils. Furthermore, soil depths showed different patterns as a function of contributing area. While soils on the polar facing slope became deeper, soils on the equatorial facing slope kept a uniform depth with increasing contributing area, pointing to different governing geomorphic processes at work. Using slope-area relationships analysis, polar facing slopes were found to be generally steeper and with longer distance to channel initiation point (if existent) than that of the equatorial facing slopes, strengthening the evidence of climate-affected differential geomorphic processes shaping the hillslope form. The results point out to the effect of climate on the development and coevolution of soil, vegetation and landform in the temperate part of Australia.