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Younger Dryas cirque glaciers in the Wicklow Mountains, Ireland, and the significance of local topo-climatic factors

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The Wicklow Mountains are a key region for understanding the extent of glaciation in the east of Ireland during the Younger Dryas (YD; 12.9 – 11.7 ka BP). The area offers important insight into the understanding of both local and regional palaeoclimate due to its location between the mountains of western Ireland and mainland Britain, where YD climate has been inferred from glacier reconstructions. Traditionally, the Wicklow Mountains have been considered marginal for YD glaciation, characterised by small cirque glaciers in limited upland locations. However, the only existing investigation of YD glacier extent is at the Irish type-site, Lough Nahanagan, where a series of moraines within the cirque lake have been radiocarbon dated to 11.5 ka BP. Here, we present the first detailed examination of YD glaciation extent and style in the Wicklow Mountains. The limits of six viable YD glaciers have been identified through a combination of geomorphological mapping, morphostratigraphy, and radiation and snowblow modelling. A total glacierised area of 2.33 km^2 has been reconstructed, with an average glacier area of 0.39 km^2. Reconstructed ELAs (AABR 1.9 $\pm$ 0.81) range from 467 $\pm$ 9 to 739 $\pm$ 8 m, with a regional average of 621 $\pm$ 9 m. We also demonstrate that not all cirques in the Wicklow Mountains were occupied during the YD. Geomorphological evidence supportive of YD glaciation is absent in cirques with southern and south-eastern aspects which received the highest levels of solar insolation, up to 7000 Wh/m^2. By contrast, all proposed YD sites identified through the use of morphostratigraphy received lower levels of solar insolation (up to 5000 Wh/m^2) than surrounding areas due to a combination of aspect and topographic shading. A glacier-derived sea-level equivalent precipitation range of 1648 $\pm$ 569 to 2476 $\pm$ 273 $mm^{\alpha-1}$ suggest wetter conditions than at present in the Wicklow Mountains, contradicting assertions of a more arid YD climate. We suggest that calculated precipitation estimates reflect the influence of topographically enhanced snow accumulation. Snowblow modelling suggests that glacier mass balance was augmented by the redistribution of snow by wind, lowering glacier ELAs from 'true' climatic ELAs. Our research adds to the growing evidence for cirque glaciation in upland areas of Ireland during the YD.