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Increased winter warm events in Iceland drive enhanced glacier velocity and melting

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A key element in the comprehension of the response of glaciers to climate change is an understanding of the bed conditions, and these are a vital component of ice sheet models. The West Antarctic ice streams are potentially highly unstable, with implications for rapid sea level rise. These are underlain by unconsolidated sediments (soft-bed), which have a distinct but rarely studied subglacial hydrology. We present a detailed data set from Skálafellsjökull, a soft-bedded glacier in Iceland, as an analogue for other soft-bedded glaciers. These data include wireless in situ till water pressure, meteorological, surface melt, discharge and glacier surface velocity from GPS as well as remote sensing imagery. We show how short-term warm events during winter can effect annual velocity, and how the number of warm events has increased over the last 10 years. We argue this was because water was stored in a soft-bed subglacial reservoir where it could be rapidly released during winter, with the resultant storage levels effecting the following summer dynamics. To test whether warm winter events are unique to Iceland, we analyzed the daily air temperatures record of 18 World Glacier Monitoring Service 'reference' glaciers (1979-2018). We were able to show that periods of warm temperatures during winter were present in maritime locations, and the number of these events had increased in locations where winter temperatures had also increased. We propose that winter events are an important component of glacier retreat and sea level rise that have hitherto not been examined in detail.