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Controls of air temperature variability over an Alpine Glacier

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Near surface air temperature (Ta) is one of the most important controls on energy exchange between a glacier surface and the overlying atmosphere. However, not enough detail is known about the controls on Ta across a glacier due to sparse data availability. Recent work has provided insights into variability of Ta along glacier centre-lines in different parts of the world, yet there is still a limited understanding of off-centreline variability in Ta and how best to estimate it from distant off-glacier locations.
We present a new dataset of distributed 2m Ta records for the Tsanteleina Glacier in Northwest Italy from July-September, 2015. Data provide detailed information of lateral (across-glacier) and centre-line variations in Ta, with ~20,000 hourly observations from 17 locations. The suitability of different vertical temperature gradients (VTGs) in estimating air temperature is considered under a range of meteorological conditions and from different forcing locations. A key finding is that local VTGs account for a lot of Ta variability under a broad range of climatic conditions. However, across-glacier variability is found to be significant, particularly for high ambient temperatures and for localised topographic depressions. The relationship of spatial Ta patterns with regional-scale reanalysis data and alternative Ta estimation methodologies are also presented. This work improves the knowledge of local scale Ta variations and their importance to melt modelling.