The following supplement accompanies the article

A MODIS-derived snow climatology (2000–2014) for the Australian Alps

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Study area supplement

Because the study area is comprised of a dissected plateau, it is characterised by low elevations relative to other mountain ranges (Barry 2008, Costin 1989). This limited elevation range (with Mt. Kosciuszko representing the highest peak at 2,228 m ASL) impact Australia's snow-climatology. Fig. S1 shows the distribution of elevation within the study area, when data are aggregated to 500-meter resolution.

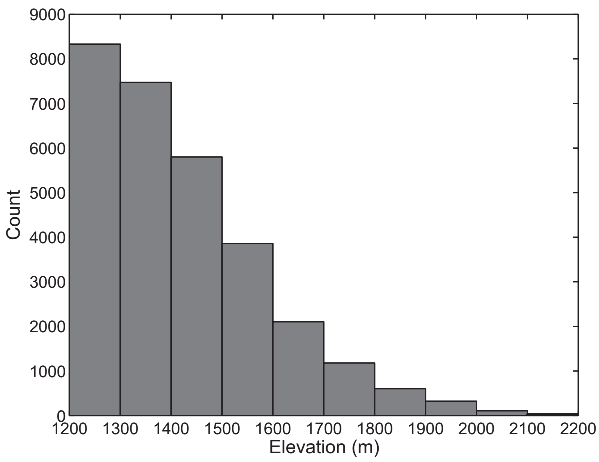

Fig. S1. Elevation distribution in the Australian Alps for pixels above 1200 metres.

Methods supplements

Snow seasonality descriptors

Because cloud-cover often obscures the view of underlying snow throughout the winter months, the algorithm of Thompson and Lees (2014) employs an object-based temporal interpolation that is functionally similar to other temporal gap filling methods reported in the literature (e.g. Foppa and Seiz 2012; Hall et al. 2010; Parajka and Blöschl 2008; Wang et al. 2008). Once snow was identified within a pixel it was presumed to exist underneath cloud-cover until a clear sky, snow-free view of the pixel indicated otherwise. Because the detection of snow-cover is influenced by solar azimuth in relation to sensor view-angles (Dozier et al. 2008) observations with view-angles ≤35° were used to calculate the snow-seasonality descriptors. Although this view-angle threshold was not used in the original algorithm discussed by Thompson and Lees (2014), analysis undertaken in this study (not presented) indicated that results obtained using the view-angle threshold were comparable to those reported previously.

Gap-filling the time-series

Snow-covered area (SCA) is a descriptor frequently used to characterise snow cover in mountainous environments (Gao et al. 2012; Husler et al. 2014). As noted in the main text, the method of Thompson and Lees (2014) explicitly assumes the presence of snow underneath obscuring cloud-cove until a clear sky view of the surface is obtained. This assumption can also be used to gap-fill a time-series thereby enabling the creation of a snow-covered area time-series. More complicated interpolation techniques have been used in other snow-cover studies. These methods include the regional snow-line method proposed by Parajka et al. (2010) or they incorporate both MODIS Terra and Aqua imagery (e.g. Gafurov and Bardossy 2009). Unlike other snow-covered areas, Australia lacks a dense network of ground-based sites where *in situ* observations of snow are collected. While it would have been possible to implement a more complicated method for gap-filling the time-series, there were insufficient data available for validation, particularly those methods that employ a form of spatial interpolation like regional snow-lines (e.g. Gafurov and Bardossy 2009; Parajka et al. 2010). While simple, seasonality descriptors derived using the method of Thompson and Lees (2014) correlated well with seasonality descriptors derived from on-ground observations. It should be noted that this method tends to identify an earlier end to the snow-covered period than is observed with *in situ* observations, though these discrepancies may be a result of scale related differences in the point-based and areal observations. Nevertheless, it was felt that the method of Thompson and Lees (2014) would provide a conservative estimate of snow-covered area during the study period.

Fig. S2 presents the results of the gap-filling method for May 1 – October 31, 2000. Fig. S2a represents the percentage of snow-covered area in the study area before interpolating the presence of snow underneath cloud-cover and Fig. S2b depicts the SCA after interpolation.

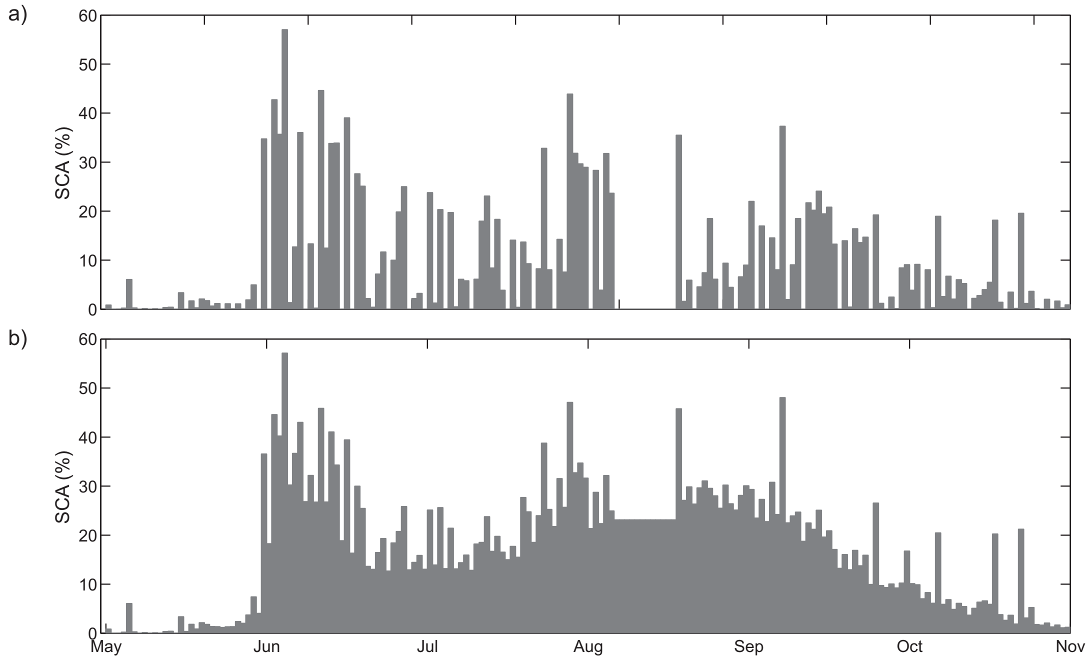

Fig. S2. Results of the snow-covered area observed in 2000, where a) is the amount of area where snow was detected using the algorithm of Thompson and Lees (2014) and b) is the snow-covered area after gap-filling by interpolating the presence of snow under cloud-cover

Results supplement

Snow seasonality descriptor supplement

For lower elevations (below 1500 metres) the results for the three descriptors (SCOD, SCMD, SCD) were relatively homogenous (Fig. S3). The figures indicate that snow-cover tended to arrive earlier (Fig. S3a), persist longer (Fig. S3b), resulting in an overall longer duration of the snow-covered period (Fig. S3c). Interestingly, the results for the SCD descriptor exhibited an increase in variability about the mean as elevation increased, which could either be a result of latitudinal differences, or the fact that there were relatively few high elevation pixels in the study area.

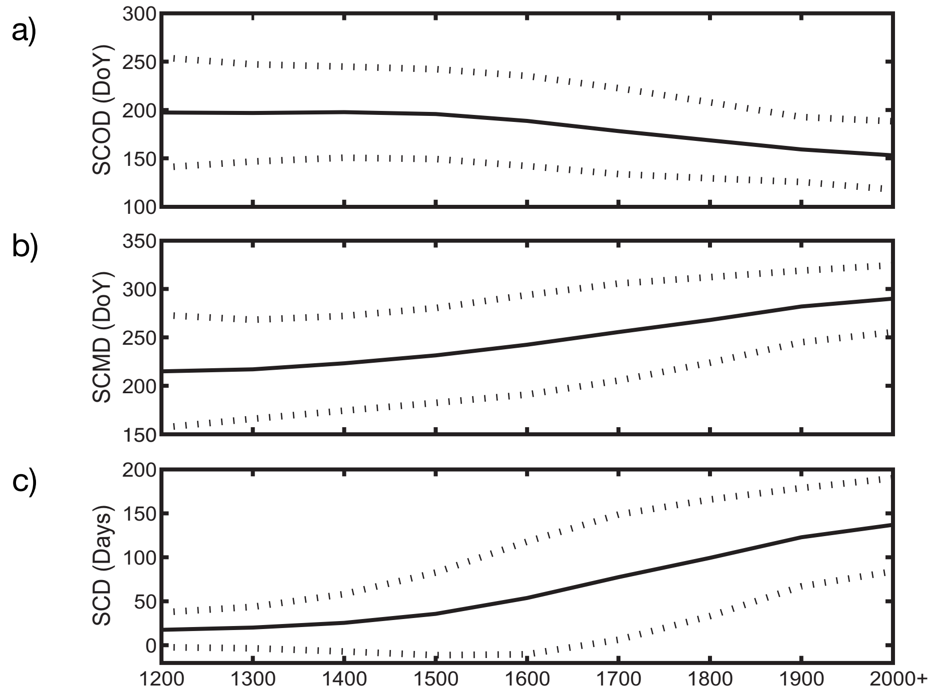

Fig. S3. Results for the mean snow seasonality descriptors as a function of elevation, solid lines represent the mean value and the dotted lines represent two standard deviations from the mean (2σ). Data were aggregated into 100 meter intervals, with elevations ≥2000 meters analysed together

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