



A century of volume changes of Glacier Blanc (Ecrins Range, French Alps) from historical maps and aerial photogrammetry

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Surface area, elevation and volume changes of the largest glacier of the French Southern Alps (Glacier Blanc, Ecrins range) have been calculated from historical maps (1904, 1925-29, 1967) and photogrammetric restitutions of aerial images (1952, 1981, 2002, 2014) integrated in a single GIS. On average, the elevation of the glacier surface has dropped by 29.9 m between 1904 and 2014, reaching a maximum of thickness loss of 170 m in the glacier tongue area while the upper regions above 3400 m have encountered mostly no change in ice thicknesses. Over 110 years, the mean annual rate in thickness change is -0.24 m/year. Except a 15-year period of mass gain (+0.3 m/yr) from 1967 to 1981, the volume change is negative and has mostly occurred along the last 33 years, with increased and highest thickness change rates up to -0.61 m of ice per year. In 2014, the glacier has lost 28% (-1.9 km²) of its initial 1904 surface area (6.69 km²). The rate in this surface area loss is almost constant over 110 years as the mass gain between 1967 and 1981 is mainly a gain in thickness and not in the glacier surface extent. This large glacier has lost a total ice volume of 171 Mm³ between 1904 and 2014 but remains the largest glacier in the French Southern Alps (4.79 km²) with estimated ice thicknesses up to 310 m in the accumulation area.