



Quantification of seasonal to annual mass balances from glacier surface albedo derived from optical satellite images, application on 30 glaciers in the French Alps for the period 2000-2015.

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Increasing the number of glaciers monitored for surface mass balance is very challenging, especially using laborious methods based on in situ data. Complementary methods are therefore required to quantify the surface mass balance of unmonitored glaciers. The current study relies on the so-called albedo method, based on the analysis of albedo maps retrieved from optical satellite imagery acquired since 2000 by the MODIS sensor, onboard of TERRA satellite. Recent studies performed on single glaciers in the French Alps, the Himalayas or the Southern Alps of New Zealand revealed substantial relationships between summer minimum glacier-wide surface albedo and annual mass balance, because this minimum surface albedo is directly related to accumulation-area ratio and the equilibrium-line altitude.

On the basis of 30 glaciers located in the French Alps where annual surface mass balance are available, our study conducted on the period 2000-2015 confirms the robustness and reliability of the relationship between the summer minimum surface albedo and the annual surface mass balance. At the seasonal scale, the integrated summer surface albedo is significantly correlated with the summer mass balance of the six glaciers seasonally surveyed. For the winter season, four of the six glaciers showed a significant correlation when linking the winter surface mass balance and the integrated winter surface albedo, using glacier-dependent thresholds to filter the albedo signal. Sensitivity study on the computed cloud detection algorithm revealed high confidence in retrieved albedo maps. These results are promising to monitor both annual and seasonal glacier-wide surface mass balances of individual glaciers at a regional scale using optical satellite images.