

The Cryosphere Discuss., author comment AC2
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Reply on RC2

Johannes Oerlemans et al.

Author comment on "Brief communication: Growth and decay of an ice stupa in alpine conditions – a simple model driven by energy-flux observations over a glacier surface" by Johannes Oerlemans et al., The Cryosphere Discuss.,
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It is certainly true that taking the measured SW radiation for the glacier weather station underestimates the amount of SW intercepted by the stupa, especially for a low sun. It may therefore be better to use a correction factor to account for this. We propose to include the following text:

With respect to direct solar radiation, the solar beam can be considered to have a vertical component, impinging on the horizontal surface (base of the stupa), and a horizontal component impinging on the vertical cross section (a triangle). Measurements over a flat surface, like those from the glacier AWS, thus underestimate the solar radiation intercepted by a stupa. A correction factor f is therefore needed with which the direct radiation as measured by the AWS has to be multiplied. This factor may be large for low sun, but in alpine conditions where there is always significant shading by the surroundings this situation is rarely found. A simple analysis shows that, for a shape factor of $s=2$, f varies from 2.5 for a solar elevation of 20° to about 1.2 for a solar elevation of 60° .

Since we do not want to deal with solar elevation as a separate parameter, in a new calculation we use a standard value of $f = 1.5$. Compared to the earlier calculation without a correction factor, the maximum stupa height appears to be 5 to 7 % less.

With respect to the choice of the diffuse fraction of the SW radiation we will add two references showing that variations are large, but that 0.5 is a good choice for a characteristic value:

*Berrizbeitia, S. E., Cago, E. J. and Muneer, T.: Empirical models of the estimation of solar sky-diffusive radiation. A review and experimental analysis, *Energies*, 13, 701, doi:10.3390/en13030701, 2020*

*Li, D. H. W., Lou, S. W. and Lam, J. C.: An analysis of global, direct and diffuse solar radiation, *Energy Procedia*, 75, 388-393, <http://creativecommons.org/licenses/by-nc-nd/4.0/>, 2015*