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In this supplementary document, we show the derivation of Eqn. 6 which expresses the KI selection criterion assuming a generalized Gaussian distribution model for wet and dry snow.

In the KI criterion function (Kittler & Illingworth 1986), the cost function is given by:

$$c(X_l,T)=\begin{cases}-2\ln P(\omega_{dry}|X_l,T), if, X_l \le T\\ -2\ln P(\omega_{wet}|X_l,T), if, X_l > T\end{cases}, \tag{12}$$

in which $P(\omega_i|X_l,T)=\left[P(\omega_i)P(X_l|\omega_i,T)\right]\Big/\left[\sum_{j\in\{wet,dry\}}P(\omega_j)P(X_l|\omega_j,T)\right], i=wet,dry$ are the posterior probabilities of wet snow and dry snow, respectively, given the melt signal X_l and a specific value of the threshold T. Under the assumption that the class-conditional distributions follows generalized Gaussian statistical behaviour (Bazi et al. 2005), the cost function $c(X_l,T)$ defined by the KI algorithm is given (Bazi et al. 2005) by:

$$c(X_l,T)=\begin{cases}-2\ln[P_{dry}(T)a_{dry}(T)\times e^{\left[b_{dry}(T)\left|X_l-m_{dry}(T)\right|\right]^{\beta_{dry}(T)}}], if, X_l \le T\\ -2\ln[P_{wet}(T)a_{wet}(T)\times e^{\left[b_{wet}(T)\left|X_l-m_{wet}(T)\right|\right]^{\beta_{wet}(T)}}], if, X_l > T\end{cases} \tag{13}$$

Then, by substituting Eqn. 13 in Eqn. 2, the cost function to be optimized under the generalized Gaussian model distribution assumption can be obtained (Bazi et al. 2005).

References

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Kittler J. & Illingworth J. 1986. Minimum error thresholding. *Pattern Recognition 19*, 41-47.