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Snow cover and End of Summer Snowline statistics from a simple stochastic model

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One essential parameter characterizing snow cover statistics is the End Of Summer Snowline (EOSS), which is also a good indicator of actual climatic trends in mountain regions. EOSS is usually modelled by means of spatially distributed physically based models, and typically require heavy parameterization. In this paper we validate the simple stochastic model proposed by Perona et al. (2007), by showing that the snow cover statistics and the position of EOSS can in principle be explained by only four essential (meteorological) parameters.

Perona et al. (2007) proposed a model accounting for stochastic snow accumulation in the cold period, and deterministic melting dynamics in the warm period, and studied the statistical distribution of the snowdepth on the long term. By reworking the ensemble average of the steady state evolution equation we single out a relationship between the snowdepth statistics (including the position of EOSS) and the involved parameters.

The validation of the established relationship is done using 50 years of field data from 73 Swiss stations located above 2000 m a.s.l. First an estimation of the meteorological parameters is made. Snow height data are used as a precipitation proxy, using temperature data to estimate SWE during the precipitation event. Thresholds are used both to separate accumulation from actual precipitation and wind transport phenomena, and to better assess summer melting rate, considered to be constant over the melting period according to the simplified model. First results show that data for most of the weather stations actually scales with the proposed relationship. This indicates that, on the long term, the effect of spatial and temporal noise masks most of the process detail so that minimalist models suffice to obtain reliable statistics.

Future works will test the validity of this approach at different spatial scales, e.g., regional, continental and planetary.

Reference:
P. Perona, A. Porporato, and L. Ridolfi, "A stochastic process for the interannual snow storage and melting dynamics," Journal of Geophysical Research 112 (April 25, 2007): 10 PP.