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A tracking algorithm to identify slab and weak layer combinations for assessing snow instability and avalanche problem type

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Snow cover models have mostly been developed to support avalanche forecasting. Recently developed snow instability metrics can help interpreting modeled snow cover data. However, presently snow cover models cannot forecast the relevant avalanche problem types – an essential element to describe avalanche danger. We present an approach to detect, track and assess weak layers in snow cover model output data to eventually assess the related avalanche problem type. We demonstrate the applicability of this approach with both, SNOWPACK and CROCUS snow cover model output for one winter season at Weissfluhjoch. We introduced a classification scheme for four commonly used avalanche problem types including new snow, wind slabs, persistent weak layers and wet snow, so different avalanche situations during a winter season can be classified based on weak layer type and meteorological conditions. According to the modeled avalanche problem types and snow instability metrics both models produced weaknesses in the modeled stratigraphy during similar periods. For instance, in late December 2014 the models picked up a non-persistent as well as a persistent weak layer that were both observed in the field and caused widespread instability in the area. Times when avalanches released naturally were recorded with two seismic avalanche detection systems, and coincided reasonably well with periods of low modeled stability. Moreover, the presented approach provides the avalanche problem types that relate to the observed natural instability which makes the interpretation of modeled snow instability metrics easier. As the presented approach is process-based, it is applicable to any model in any snow avalanche climate. It could be used to anticipate changes in avalanche problem type due to changing climate. Moreover, the presented approach is suited to support the interpretation of snow stratigraphy data for operational forecasting.