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Mechanical stability indicators derived from detailed snow cover simulations

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The use of numerical modeling of the snow cover in support of avalanche hazard forecasting has been increasing in the last decade. Besides field observations and numerical weather forecasting, these numerical tools provide information otherwise unavailable on the present and future state of the snow cover. In order to provide useful input for avalanche hazard assessment, different mechanical stability indicators are typically computed from simulated snow stratigraphy. Such indicators condense the wealth of information produced by snow cover models, especially when dealing with large data (e.g., large domains, high spatial resolution, ensemble forecasting). Here, we provide an overview of such indicators. Mechanical stability indicators can be classified in two types i.e., whether they are solely based on mechanical rules or whether they include additional expert rules. These indicators span different mechanical processes involved in avalanche release: failure initiation and crack propagation, for instance. The indicators rely on mechanical properties of each layer. We discuss parameterizations of mechanical properties and the associated technical implementation details. We show simplified examples of snow stratigraphy to illustrate the benefit of different stability indicators in typical situations. There is no perfect indicator to describe the instability for any situation. All indicators are sensitive to the snow cover modeling assumptions and the computation of mechanical properties and hence, require some tuning before operational use. In practice, a combination of indicators should be considered to capture the variety of avalanche situations.