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## Measuring model improvement using surface energy budget process relationships: the impact of a new snow model

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Energy exchange at the snow-atmosphere interface in winter governs the evolution of temperature at the surface and within the snow, preconditioning the snowpack for melt during spring. This study illustrates a set of diagnostic tools that are useful for evaluating the energy exchange at the Earth surface in a numerical weather prediction model from a process-based perspective using in-situ observations. In particular, a new way to measure model improvement using relationships between different terms in the surface energy budget (SEB) is presented. These process-oriented diagnostics provide a holistic view the realism of the balance of terms in the SEB, ensuring that improvements in headline skill scores, such as 2m temperature, are happening for the right reasons. Correctly capturing such process relationships is a necessary step to achieve reliable weather forecasts.

These diagnostic techniques are applied to assess the impact of a new multi-layer snow scheme in the ECMWF-Integrated Forecast System at two high-Arctic sites (Summit, Greenland and Sodankylä, Finland). The multi-layer scheme is expected to replace a single layer snow scheme enhancing the 2m temperature forecast accuracy and reliability across the northern hemisphere in boreal winter.