Towards downscaling of precipitation phase from high resolution meteorological forecast model output over complex terrain

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Nowadays, limited area non-hydrostatic Numerical Weather Prediction (NWP) models run at kilometer scale resolution in operational settings. While those models can provide useful and physically coherent short-range weather forecasts at the scale of a few kilometers, they still need to be downscaled in order to be used as forcing datasets for hectometric scales snow cover modelling in high mountain areas.

The French NWP model AROME (1.3 km resolution) and its ensemble forecast version PEAROME (2.5 km resolution, 16 members), are planned to be used to provide surface meteorological variables in a future gridded snow cover forecast system planned to be operated by 2026 at 250 m horizontal resolution. To this end, a downscaling step to this target resolution of 250m is needed, with a specific focus on the precipitation phase. Indeed, this variable is crucial for snowpack modelling and highly dependent on altitude and atmospheric conditions. Over complex terrain, the altitude difference between pixels at different resolutions can be substantial.

We present a methodology for this purpose, which re-calculates the precipitation phase at the high resolution pixel heights given the forecasted, and potentially extrapolated, local wet-bulb temperature profile and the forecasted total precipitation rate. First tests are conducted over the Grandes Rousses mountain range in the French Alps where various evaluation datasets are availabe.