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Soil-atmosphere interaction during two strikingly different winters at an alpine valley site

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This investigation is based on data that were collected in the Unterinntal valley (Austria) during two winter periods in 2005/2006 and 2007/2008. Compared to climatology the winter 2005/2006 was outstanding due to a permanent snow cover (max. 0.54m) from the beginning of December until mid of March. The mean air temperature was 1.5°C lower than the 30- year climatological mean. Further, the atmospheric conditions were characterized by long- lasting high- pressure periods with persistent inversions and dominant down-valley winds. During winter 2007/2008 on the other hand, the valley remained mostly free of snow (max 0.07m) which was associated with abnormally high temperatures (+1.8°C compared to long term average).

We employ a one dimensional SVAT model (SHAW, G. Flerchinger 1989) in order to investigate the influence of thus distinct atmospheric winter regimes on the underlying soil with particular emphasis on the inherent snow/soil mass and energy balances. The model simulates soil freeze and thaw cycles as well as heat and water transfer within a 1d profile including effects of plant cover, residue and snow. The simulations are driven by consistent data that were collected during the two winters at the same site. This comprises air temperature, relative humidity, wind speed, as well as the short wave and long wave radiation components and initialising profiles of the physical snow/soil parameters. During the first winter period the turbulent fluxes were directly measured as well as soil temperatures at 3 depths and snow depth and density (episodically). This data are used for calibration and validation of the model results and inherent measurement uncertainties are addressed by sensitivity studies.

The results are mainly discussed in terms of energy and mass balance components, as well as vertical profiles of the relevant parameters (snow and soil temperatures, density and liquid water content). Comparison of the two winters reveal outstanding features regarding the surface and subsurface thermal regime in response to the different atmospheric forcing due to the different extend of snow in particular. Moreover, the model results may be valuable for improvement of the model and studies of the climate sensitivity of soil-atmosphere interactions.