Soil freezing in a SVAT

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ABSTRACT

Soil moisture changes are generally due to external forcing (precipitation, evaporation, etc.) as well as internal forcing (gravitational force, capillarity, transpiration, etc.). Freezing/thawing effects must be taken into account, especially in those regions where air temperature falls below 0°C for several consecutive days. A wrong or imperfect soil temperature and moisture estimation leads to errors in the boundary layer estimation (temperature, convection, etc.). Moreover soil properties (hydraulic conductivity, thermal capacity, etc.) may change during the freezing/thawing transient stage, leading to variations in the hydrological balance. Comparisons with observations highlight the importance of the correct soil freezing/thawing parameterisation to correctly estimate the energetic and hydrological balances in the surface layer.

PURPOSE

- numerical modelling of the freezing/thawing processes in the soil
- better estimation of the soil water content in cold regions
- better estimation of the PBL

RESULTS

1) Brookings campaign
2) Falkenberg campaign

Conclusions and future developments

In this work we implemented and tested some freezing parameterizations in the LSPM SVAT scheme. Our analysis on synthetic data, as well as on campaign experimental data, do not show exactly which is the best parameterization. The reason lies mainly in the rough precipitation data used as LSPM boundary conditions, especially regarding the snowfall. Nevertheless, all the three parameterizations are able to catch the freezing and thawing period observed in the two campaigns.

A guided campaign with forced and artificially created boundary conditions could help in finding out the best parameterization and to give other suggestions for the numerical implementation of the thawing/freezing physical mechanism. Another future improvement may be the inclusion of the soil properties change induced by the freezing/thawing process.

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References