Institute of Fluid Mechanics
and Environmental Physics
in Civil Engineering

Master Thesis Topic - Snow surface energy balance modelling in permafrost dominated regions

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Introduction

Qinghai-Tibet Plateau (also known as the 'Water tower of Asia') is threatened by climate warming. Due to its high elevation (average 4000 m.a.s.l), it experiences temperature twice the global average. The high temperatures results in permafrost degradation. The subsurface thermal and hydrological environment in cold regions is influenced by the change in permafrost distribution.

The permafrost thaws and freezes seasonally due to the influx of heat energy from the ground surface. The groundwater flow increases as the hydraulic conductivity in the active layer increases. The pore water phase change from liquid to ice causes variation in the thermal parameters of the soil. Snow deposition on the surface also influence the characteristics of the subsurface. Several models exist that can implement these cryohydrogeological processes.

ATS (Advanced Terrestrial Simulator) simulates cryohydrogeological processes: thermal and hydraulic subsurface processes with freezing/thawing, surface energy balance, overland flow with ice and snow deposition/melting processes. Deposition/melting of snow and energy balance at the surface serves as the upper boundary condition for the model.

The Master thesis main goal is to use the ATS model to simulate snow surface energy balance and interpret it's influences on subsurface processes.

Research Questions

- What are the thermal and hydraulic processes that occur at the surface?
- What are the parameters that are considered to simulate snow surface energy balance in ATS?
- How does the snow surface energy balance model influence the subsurface processes?

Monthly Milestone Plan

- Literature review
- ATS model learning
- ATS model implementation 1 - Surface energy balance
- ATS model implementation 2 - Snow surface energy balance
- Quantify influences of snow surface energy balance on subsurface processes
- Thesis preparation - writing and presentation

Beneficial Skills

- Background knowledge - Hydrogeology and Numerical methods in fluid mechanics
- Basic programming knowledge

Contact Information

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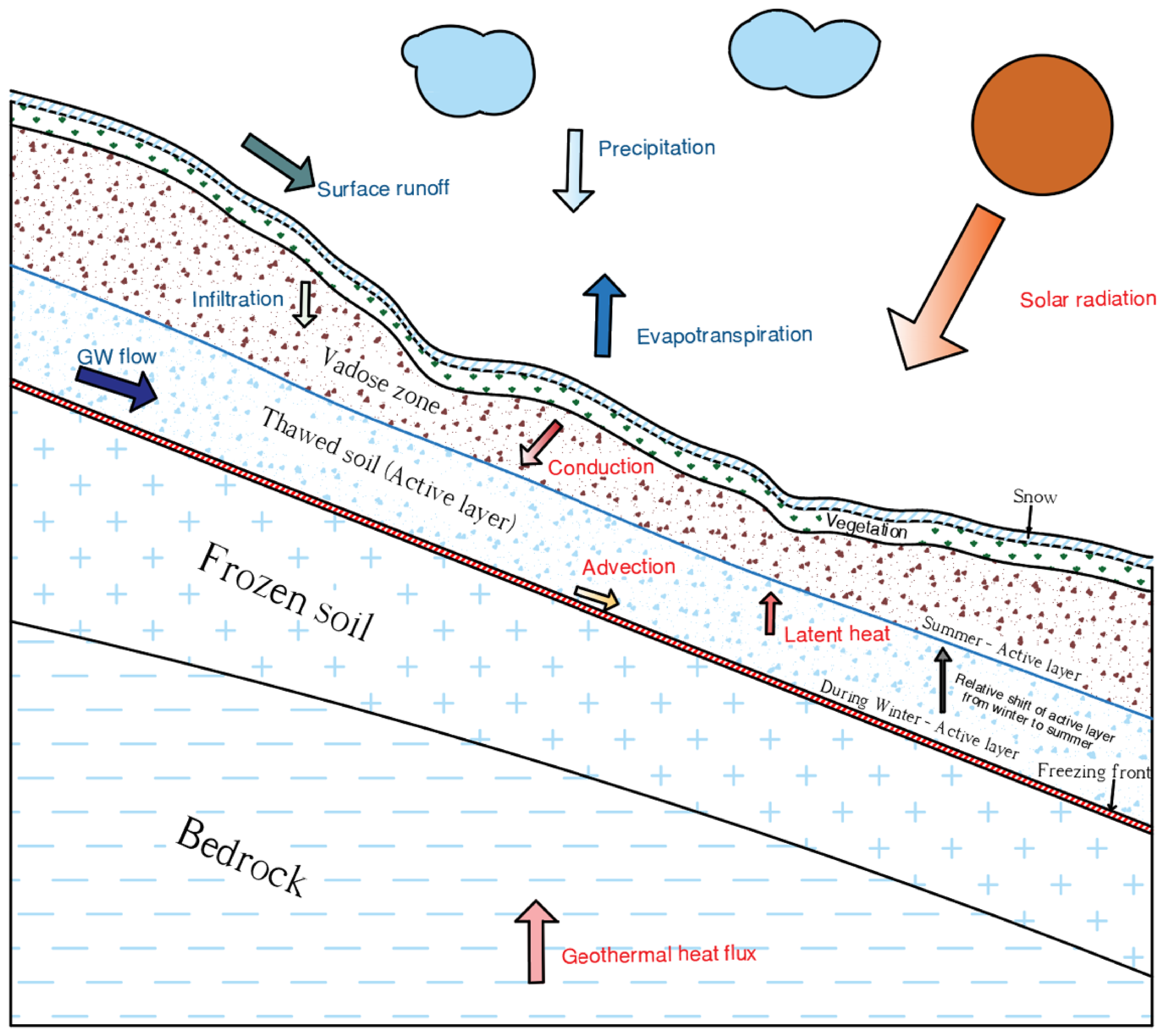
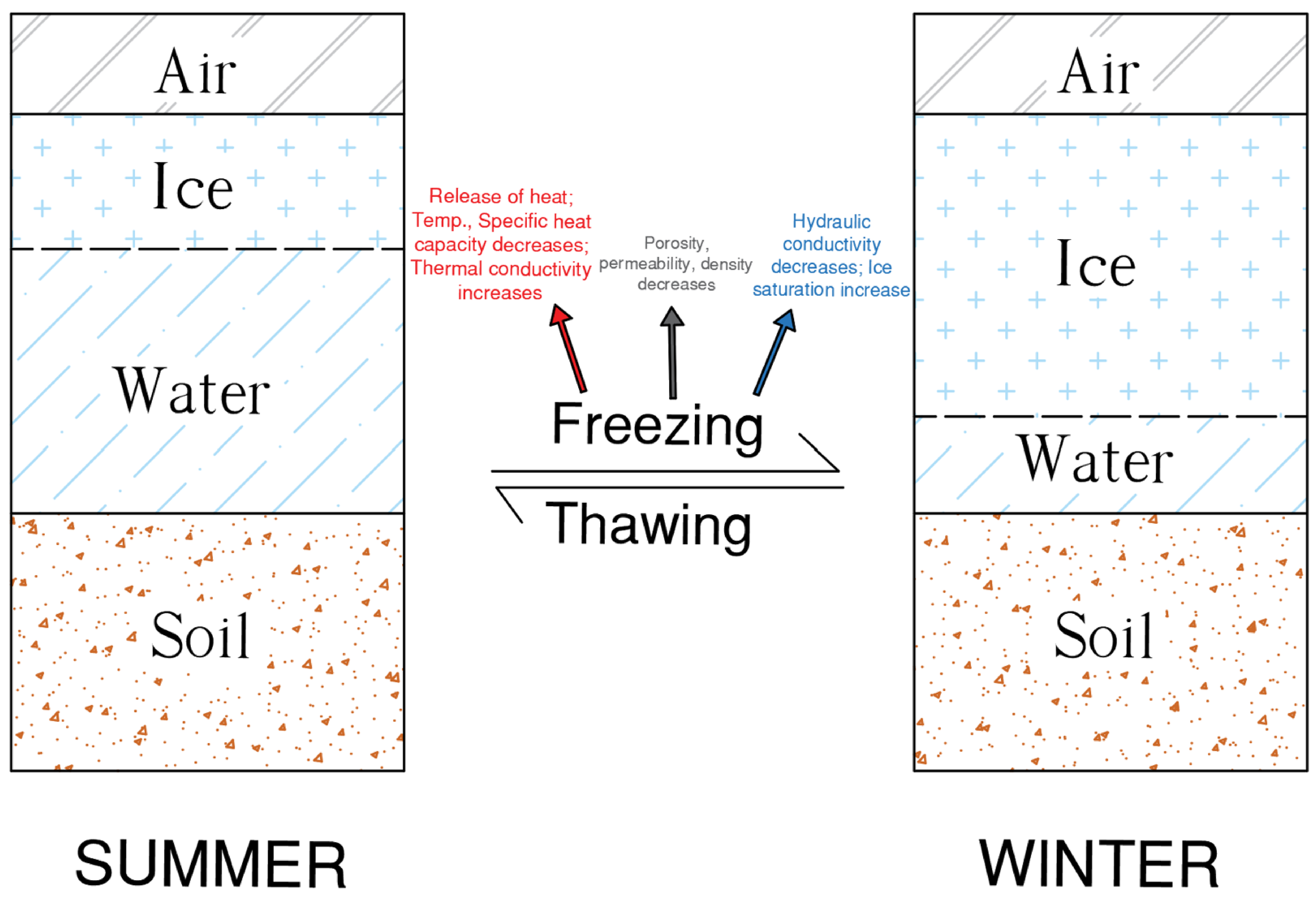
TransTiP Project

The IRTG "Geoecosystems in transition on the Tibetan Plateau" (TransTiP) is an international research training program which grants German and foreign students an international education within the cooperative environments of Technische Universität Braunschweig, Leibniz Universität Hannover and Friedrich Schiller University Jena. TransTiP project main research interests are on Sediment fluxes, Carbon fluxes, Water fluxes and water quality. Our project focuses on water fluxes on different scales in alpine catchments.





References

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