KTH Land and Water Resources Engineering

Impact Of Cold Climate On Boreal Ecosystem Processes

- Exploring Data And Model Uncertainties

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ABSTRACT

The impact of cold climate on physical and biological processes, especially the role of air and soil temperature in recovering photosynthesis and transpiration in boreal forests, was investigated in a series of studies. A process-based ecosystem model (CoupModel) considering atmospheric, soil and plant components was evaluated and developed using Generalized Likelihood Uncertainty Estimation (*GLUE*) and detailed measurements from three different sites. The model accurately described the variability in measurements within days, within years and between years. The forcing environmental conditions were shown to govern both aboveground and belowground processes and regulating carbon, water and heat fluxes. However, the various feedback mechanisms between vegetation and environmental conditions are still unclear, since simulations with one model assumption could not be rejected when compared with another.

The strong interactions between soil temperature and moisture processes were indicated by the few behavioural models obtained when constrained by combined temperature and moisture criteria. Model performance on sensible and latent heat fluxes and net ecosystem exchange (*NEE*) also indicated the coupled processes within the system. Diurnal and seasonal courses of eddy flux data in boreal conifer ecosystems were reproduced successfully within defined ranges of parameter values. Air temperature was the major limiting factor for photosynthesis in early spring, autumn and winter, but soil temperature was a rather important limiting factor in late spring. Soil moisture and nitrogen showed indications of being more important for regulating photosynthesis in the summer period. The need for systematic monitoring of the entire system, covering both soil and plant components, was identified as a subject for future studies. The results from this modelling work could be applied to suggest improvements in management of forest and agriculture ecosystems in order to reduce greenhouse gas emissions and to find adaptations to future climate conditions.

Key words: net ecosystem exchange; sensible and latent heat fluxes; soil temperature; soil moisture; CoupModel; *GLUE*

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