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Adaptation of the Integrated Nitrogen Model for Catchments (INCA) to seasonally snow-covered catchments

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Abstract. Testing of the Integrated Nitrogen model for Catchments (INCA) in a wide range of ecosystem types across Europe has shown that the model underestimates N transformation processes to a large extent in northern catchments of Finland and Norway in winter and spring. It is found, and generally assumed, that microbial activity in soils proceeds at low rates at northern latitudes during winter, even at sub-zero temperatures. The INCA model was modified to improve the simulation of N transformation rates in northern catchments, characterised by cold climates and extensive snow accumulation and insulation in winter, by introducing an empirical function to simulate soil temperatures below the seasonal snow pack, and a degree-day model to calculate the depth of the snow pack. The proposed snow-correction factor improved the simulation of soil temperatures at Finnish and Norwegian field sites in winter, although soil temperature was still underestimated during periods with a thin snow cover. Finally, a comparison between the modified INCA version (v.1.7) and the former version (v.1.6) was made at the Simojoki river basin in northern Finland and at Dalelva Brook in northern Norway. The new modules did not imply any significant changes in simulated NO_3^- concentration levels in the streams but improved the timing of simulated higher concentrations. The inclusion of a modified temperature response function and an empirical snow-correction factor improved the flexibility and applicability of the model for climate effect studies.

Keywords: inorganic N leaching, degree-day snow model, snow pack, catchment scale model

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