

Assessing vulnerability to climate-induced changes in ecosystem services of boreal croplands and forests

Croplands and forests of the boreal region supply a wide range of ecosystem services. The properties and processes of these ecosystems regulate water flow and climate, and retain nutrients and store carbon. The functioning of the ecosystem processes depends on ambient temperatures and precipitation patterns, which are likely to continue changing in the boreal zone. MONIMET (LIFE12 ENV/FI/000409, 9/2013 – 9/2017) is an EU Life funded project about Climate Change Indicators and Vulnerability of Boreal Zone Applying Innovative Observation and Modeling Techniques. In this project, we calculated future changes of carbon storage in soil, and nutrient loading from soil to surface waters and drinking water supplies.

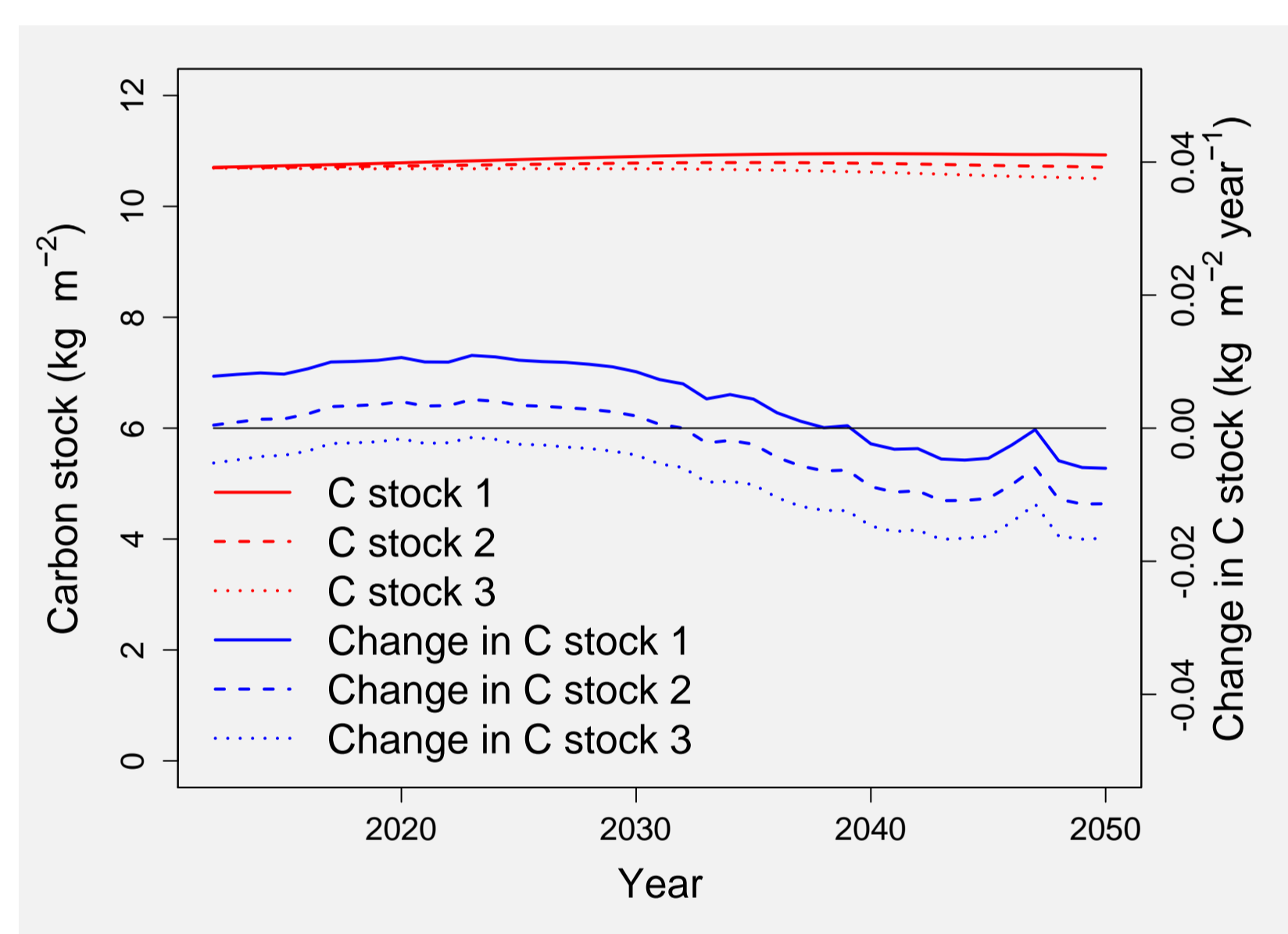


Figure 1. Carbon stock, and change of carbon stock, of litter and soil for three different forest management scenarios.

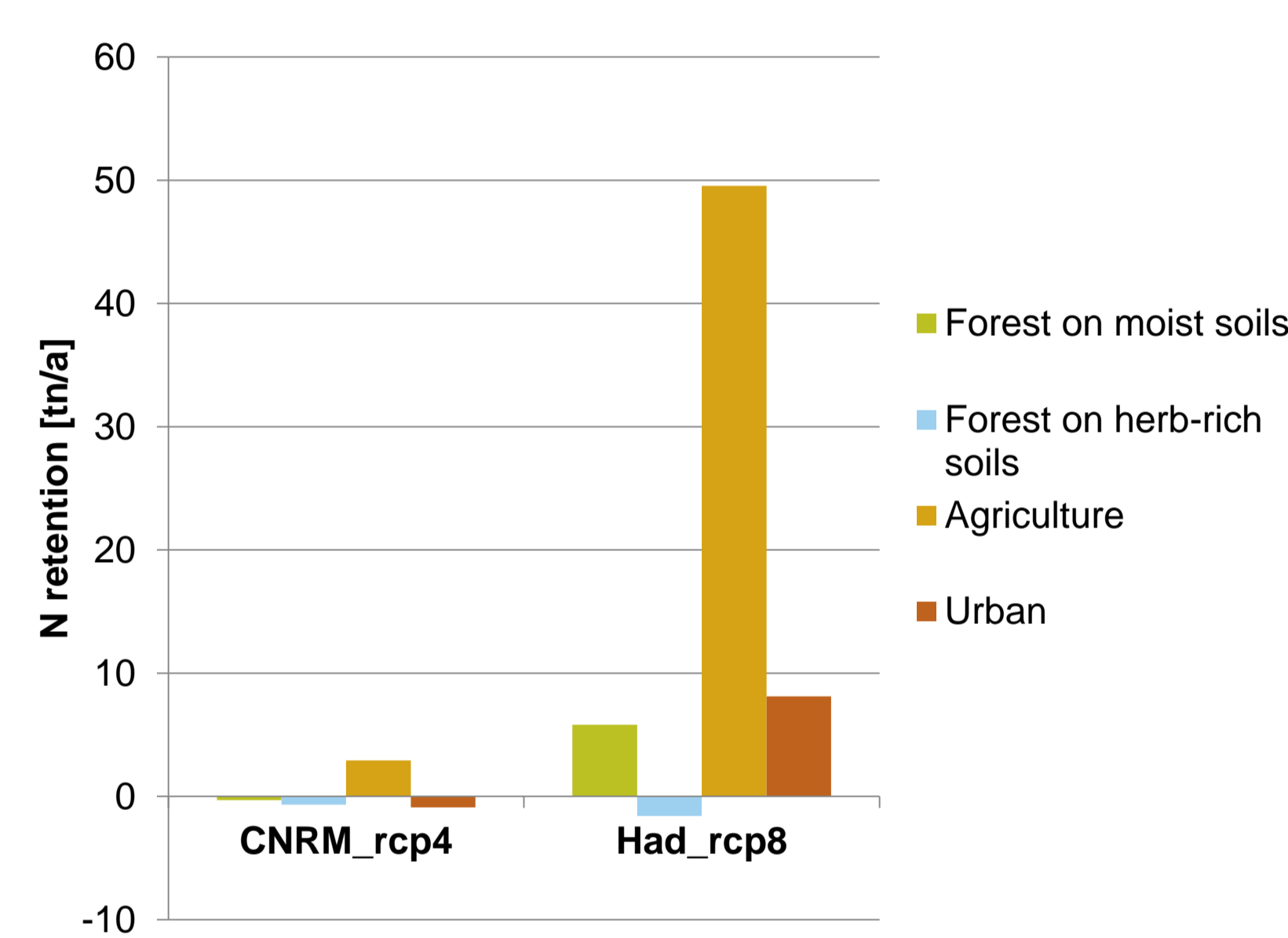
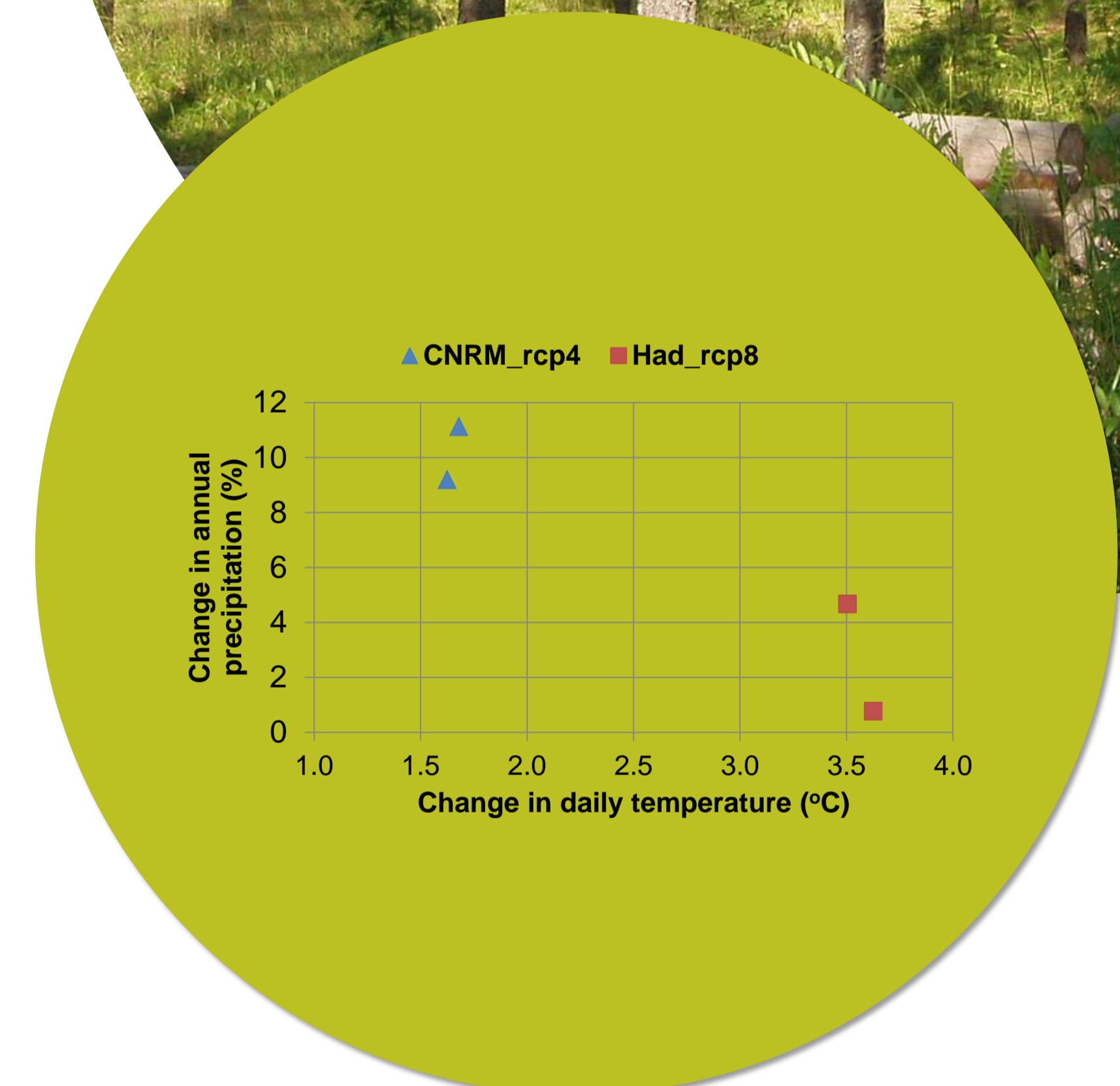


Figure 2. Nitrogen retention according to different climate change scenarios in Janakkala municipality by 2040-2069.



- We calculated the litter and soil carbon storage of forests using the dynamic YASSO model. The simulated carbon budget estimates were upscaled to the river basin by combining them with gridded data of land cover and forest characteristics.
- The temporal development of carbon stock of litter and soil, and the change in carbon stock, is presented for three different forest management scenarios (Fig. 1).
- The forest management scenarios consider different degrees of harvest residue removal.
- The methods of the mapping framework are described in Akujärvi et al. 2016.
- We simulated nutrient loading from two boreal catchments to the receiving waters using the dynamic, catchment scale model INCA.
- We calculated land use specific loading values for these two well monitored catchments that belong to the LTER (The Long Term Ecological Research) monitoring network.
- We upscaled these results to the larger river basin based on grid-scaled data of land cover.
- We present results also by municipality (Fig. 2).
- We present estimates of the spatial variation, temporal trends and trade-offs between these ecosystem service indicators at the landscape scale.
- The modelling framework developed can be applied to verify the integrated ecological effects of forest management scenarios across an actual landscape where land-use decisions take place.
- Mapping can also reveal the most sensitive and vulnerable areas for climate change.