

## Recent past, present and future temperatures for calving area in Gabna community: cross-checking datasets and first results<sup>12</sup>

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Global warming and its effects on regional and local scales are more prevailing in arctic and subarctic socio-ecosystems (IPCC, 2013; Tyler, Turi et al., 2007). In northern Scandinavia, (semi-) domesticated reindeer and associated pastoralism are part of the tundra-taiga ecotone, dealing now with spectacular changes. Reindeer pastoralism strongly contributes to land-use, landscapes history and ecological traits. Dealing with the hard trend of climate change, landscape fragmentation and land use utilization, grazing history of vegetal formations is likely to form an interesting carbon sink (Väisänen, Ylänne et al., 2014). Moreover, large herbivores such as reindeer “promote the expansion and productivity of graminoids while constraining biomass of deciduous shrubs such as dwarf birch (*Betula nana*) and willow (*Salix glauca*)” (Post & Pedersen, 2008). Finally, reindeer calving areas are classified as “strategic areas” by the Skogsstyrelsen, late spring (May-July) being a crucial part for herders’ calendar and reindeer’ reproductive costs/success (Tunón, Håkan et al., 2012; Bianchet, Gaillard et al., 1998). Here, we studied in particular the Gabna community calving area, dealing with a lot of seasonal issues, such as growing winter and summer tourism disturbances, increasing maximum temperatures in summer and amplifying thawing-freezing processes in winter. We wanted to know better the biogeographical features of the calving area, in particular how much the raise of temperatures is expected in May and June for the near future with the worst green-house gas concentration scenario (RCP8.5; CMIP5). For different temporal scales (recent past: 1970-2000; present: 2000-2016; near future: 2041-2050) we tried to describe averaged temperature evolution. A large part of the study is focused on the reliability of used databases by cross-checking. The first part deals with verifications between past climatological reanalysis (Worldclim, CMIP5), MODIS Land Surface Temperatures (MODIS 11A2) and meteorological records along the Gabna community (Abisko, Kiruna, Vittangi). Then, we drawn the recent past and near future averages temperatures of the Corine Land Cover ecological habitats which compose the calving area.

For past temperatures (1970-2000), absolute bias (°C) between WorldClim maps and recorded temperatures (min,max, averaged) describe higher total error for minimal temperatures (total error: 2°C) and lower for averaged ones (0,9°C). For meteorological stations (Abisko, Kiruna, Vittangi), total error between reanalysis and measured temperature is weaker for Vittangi (1,1°C), stronger for Abisko (2,3°C). This results suggests the relatively good reliance of Worldclim reanalysis, in particular for averaged temperatures. As mentioned by Hijmans, Cameron et al. (2005), topo-climatological effects increase uncertainty, in particular in mountainous and poorly sampled areas. Increasing the amount of meteorological records and correcting climatological interpolations may improve results, in particular in Torneträsk lake area. Moreover, a cross-checking should be made between the fine mesh Worldclim (~30 sec of arc) dataset and ERA-Interim (*European Reanalysis Interim – European Centre for Medium Range Weather Forecasts*) ones. For present temperatures (2000-2016), variance analysis between MODIS11A2 daily land surface temperatures (variance: 4,93, standard deviation: 2,2) and Abisko Meteorological Station mean temperatures (variance: 1,36; SD: 1,16) reveal significantly different distributions all along the time series. For this first attempt, reliability of daily land surface temperatures as proxy of 2000-2016 air temperature appears to be quite poor, and are more likely to be used to better understand links between snow melt and annual plant onset with high pastoral value. As suggested by Pepin, Maeda et al. (2016), nighttime LST might be a better predictor for air temperature, in particular for high altitudes areas.

For past averaged temperatures (1970-2000) of May and June, overall mean is about 4,46 °C. Concerning near future (2041-2050, ICP = 8.5) projected increase is +5,23°C (overall mean: 9,69°C). In particular, low altitudinal ecological habitats such as peat bogs, broadleaved forests and moors/heathlands are likely to rise over 10°C as mean value for May-June in 2050. At higher elevations, natural grasslands and sparsely vegetated areas might exceed 8°C as mean value (respectively: 9,41°C and 8,74°C). Comparisons between averaged T°C boxplots (fig 1) show high variability among ecological habitats, revealing the wide range of distribution of vegetal formations, in particular for moors and heathlands and natural grasslands (SD for 1970-2000 temperatures respectively of 0,76 and 0,56). When looking at past and future temperatures features, medians and boxplot position for mid- and high altitudes ecological habitats are higher in the future compared to past temperatures. Boxplots presenting relatively low-altitudes habitats (broadleaved forests, peat bogs) show lower medians and lower Q1 and Q3 positions. These results suggest a more pronounced warming for moors and heathlands, natural grasslands and sparsely vegetated areas, as mapped in figure 2a and 2b. Future temperatures, here based on downscaled Global Climate Models (GCM) will be later cross-checked with CORDEX-WRCP scenarios.

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**Figures :**

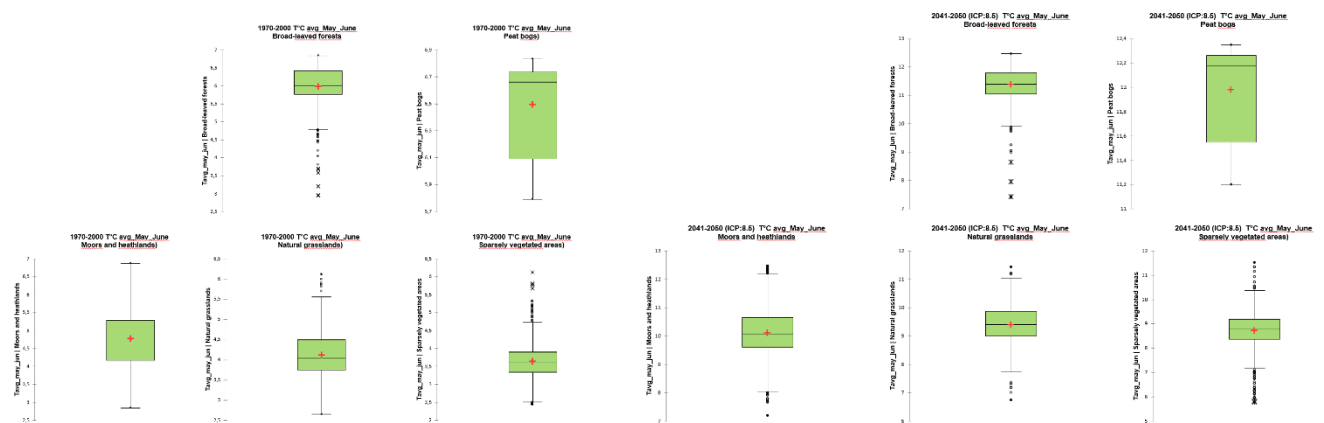


Figure 1a and 1b: 1970-2000 and 2041-2050 boxplots comparison of averaged temperatures (°C) for vegetation dominated ecological habitats (Corine Land Cover, Worldclim)

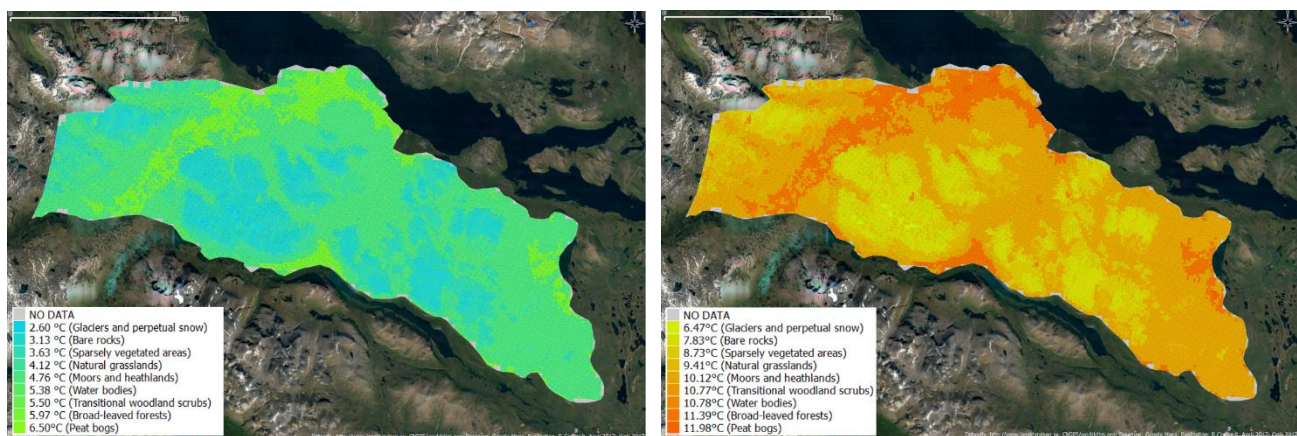


Figure 2a and 2b: 1970-2000 and 2041-2050 map of averaged temperatures for every ecological habitats composing the Gabna 'community calving area (Corine Land Cover, Worldclim)