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TITLE: Modeling dynamics of circum-arctic tundra plant communities in response to climate warming and grazing pressure

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CURRENT SECTION/FOCUS GROUP: Global Environmental Change (GC)

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ABSTRACT BODY: The Arctic is a complex system with strong interconnectedness among system components. Understanding the responses of the arctic tundra biome to a changing climate requires knowledge of the complex interactions among climate, soils, and the biological system. In this study, we investigate the individual and interactive effects of projected climate change and reindeer/caribou grazing across a variety of climate zones and soil nutrient levels on tundra plant community dynamics using an arctic vegetation model - ArcVeg. Our research questions include: 1) How does soil nutrient availability affect tundra vegetation responses to projected climate warming? 2) How does grazing affect tundra vegetation responses? 3) How do interactions of soil nutrients, climate warming and grazing affect tundra vegetation? We based our simulations on A1B scenario temperature data from the Intergovernmental Panel on Climate Change (IPCC), soil organic nitrogen data from Terrestrial Ecosystem Model (TEM) simulations and grazing pressure derived from reindeer/caribou population data from the CircumArctic Rangifer Monitoring and Assessment Network (CARMA). We found that in general tundra communities responded to warming with increased plant biomass, but the magnitude of the response is affected by the bioclimate zones, warming magnitude, available soil nutrients and grazing pressures. Regions with greater soil organic nitrogen responded to warming with greater biomass increase, Low Arctic tundra tended to have greater biomass increase than High Arctic tundra due to greater shrub abundance. However, such responses are mitigated by grazing. Regions with greater reindeer population and thus greater grazing intensity tended to have stronger negative effects on plant responses to warming than regions with less grazing. For example, in Subzone D, total biomass and NPP increases due to warming were about 71% and 43% in an Alaskan low grazing-intensity region, but 63% and 36% in a northwestern Canada high grazing-intensity region. In Subzone C, although with similar warming magnitude, Yamal and Taymyr region being intensely grazed by reindeer responded with smaller total biomass increase (~68%) than a northwestern Canada low grazing-intensity region (~93%). Plant responses to warming may be a factor that determines the size of reindeer population and understanding how tundra plants respond to warming, grazing and their interactions will contribute to reindeer management practices.

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INDEX TERMS: [0439] BIOGEOSCIENCES / Ecosystems, structure and dynamics, [0466] BIOGEOSCIENCES / Modeling, [0718] CRYOSPHERE / Tundra, [1630] GLOBAL CHANGE / Impacts of global change.
