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Recent landscape changes assessed by remotely sensed data in Pechora Region

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Pechora Region, located in North-East European Russia, is a unique natural environment with high biodiversity and wilderness areas, such as coastal habitats, the Arctic tundra or the Ural Mountains. The area lies on different permafrost zones and faces considerable challenges such as the over-exploitation of natural resources or climate change related. Our objective is to analyze landscape changes in the last 30 years using free available satellite data and identify possible influences on the degradation of permafrost in the study area. We used Surface Reflectance images from Landsat archive between 1985 and 2019. For each year, normalized indices were derived, illustrating consistency of green vegetation, as Normalized Difference Vegetation Index (NDVI), and vegetation moisture, Normalized Difference Moisture Index (NDMI). From MODIS data archive we used land surface temperature (LST), between 2000 and 2019. Moreover, the Global Surface Water dataset which contains maps with the spatial and temporal distribution of permanent and seasonal surface water from 1984 to 2018 was used. These data were aggregated to yearly mean (i.e. NDVI, NDMI, LST) or yearly sum (surface water), for the entire Pechora region. The results reveal a significant increase in NDVI mean. This "greening" of the tundra landscape, especially the southern tundra, between 1985 and 2019 has also been highlighted in other studies in the Arctic. Similarly, NDMI shows a slight increase of vegetation moisture in this area in the last three decades. Vegetation dynamics in the last 20 years is in accordance with LST evolution, showing an increase especially in the August mean temperature, more significant after 2011. From the analysis of the spatio-temporal changes of the water surfaces, a significant increase in seasonal water can be observed after 1997, and a relatively stable trend of permanent waters, with minimum values in 1999, 2003 and 2012. In the same time, an increase in the active layer thickness in the last 20 years of measurements in a site located in the study area has been documented. We conclude that Pechora Region experienced significant landscape changes in the last 30 years, our results showed mostly positive changes on vegetation consistency and moisture, and a high spatial variability of surface water.

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