

Large regional differences in industrial development across the Arctic

Increasing temperatures enable easier access to the Arctic where the anthropogenic effects on ecosystems might locally exceed the effects of climate change. Recent studies have documented the current state of infrastructure development in the Arctic or the historical development of human activities in selected regions such as the Bovanenkovo oil fields. However, there is no comprehensive pan-Arctic overview of industrial development and urbanization trends in the Arctic, which is crucial for the sustainable development of the region. In our study, we utilized artificial light at night (ALAN) to quantify the development of human activity across the Arctic from 1992 to 2013. We created a pan-Arctic ALAN map to assess hotspots of industrial development and the total area affected by human activity from 1992-2013. We analyzed 19.6 million km² and demonstrated that an area of 716'708 km² in the Arctic is affected by ALAN and corresponding human activity. The European Arctic and the oil and gas extraction regions are the hotspots of human activity, while the Canadian Arctic is least affected by ALAN. On average, the global human settlement data explains only 5.65% of the variation in ALAN in the Arctic in 2015, with large regional differences. We conclude that in most regions ALAN is related to industrial activity. The Arctic ALAN trend map shows that oil extraction regions, such as Khanty Mansi, have spatially dynamic ALAN trends, indicating that some oil wells are depleted and abandoned while new wells are developed. With this study, we provide a new, standardized pan-Arctic perspective on human industrial development and its use of the Arctic landscape that is crucial as a baseline for a sustainable development and conservation planning of this highly vulnerable region.