Extended Abstract

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# Land loss and sea transgression due to glacial recession under climate warming in the Arctic

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**Abstract:**

It is a common but incorrect opinion that a significant land loss and especially an appearance of new islands, due to a sea transgression under climate warming necessitates an appropriate sea level rising, predicted in future, e.g. by the end of our century. However, such a transgression has occurred without any significant sea level rising in many places. If the bottom of a frontal part of a tidewater glacier lies on bedrock below sea level this bedrock has to be inundated by sea during this glacier recession. Numerous descriptions of such a process were published by Pelto (2009–2018, 2017) and Sharov (2014). 34 new straits and islands (each from 0.5 to 59 $km^2$) have appeared due to recession of Arctic glaciers under climate warming in 1963-2017, as described by Ziaja and Ostafin (2019). Sea level rising was estimated at only 2-3 mm per year in that time. Next straits and islands are in the course of forming, e.g. an unnamed peninsula (ca. 200$km^2$) which is very close to separation from the Eastern Greenland mainland at Dove Bay, and the Sørkapp Land peninsula (ca. 1200 $km^2$) which may be separated from Spitsbergen in the of 21st century (Ziaja and Ostafin 2015). Apart from that, hundreds of new big bays, including fjords, appeared in the $20^{th}$ and $21^{st}$ centuries due to glacial recession. The newest of them have not been described yet, e.g. in the Eastern Spitsbergen coast. The new straits and bays, together with releasing of old islands and fjords from land-fastened sea ice, make the Arctic much more available than before and shorten some sea routes. Hence, this kind of transgression (due to glacial recession) influences both natural ecosystems and human economic activities, changing considerably physical and human Arctic geography. In result, both biodiversity and environmental threats are and will be increasing in the Arctic.

Sea-level rise is a major effect of climate change. It has drawn international attention, because higher sea levels in the future would cause serious impacts in various parts of the world. There are questions associated with sea-level rise which science needs to answer. To what extent did climate change contribute to sea-level rise in the past? How much will global mean sea level increase in the future? How serious are the impacts of the anticipated sea-level rise likely to be, and can human society respond to them? This paper aims to answer these questions through a comprehensive review of the relevant literature. First, the present status of observed sea-level rise, analyses of its causes, and future projections are summarized. Then the impacts are examined along with other consequences of climate change, from both global and Japanese perspectives. Finally, responses to adverse impacts will be discussed in order to clarify the implications of the sea-level rise issue for human society. Several large-scale cryosphere elements such as the Arctic summer sea ice, the mountain glaciers, the Greenland and West Antarctic Ice Sheet have changed substantially during the last century due to anthropogenic global warming. However, the impacts of their possible future disintegration on global mean temperature (GMT) and climate feedbacks have not yet been comprehensively evaluated. Here, we quantify this response using an Earth system model of intermediate complexity. Overall, we find a median additional global warming of 0.43 °C (interquartile range: 0.39−0.46 °C) at a $CO_2$ concentration of 400 ppm. Most of this response (55%) is caused by albedo changes, but lapse rate together with water vapour (30%) and cloud feedbacks (15%) also contribute significantly. While a decay of the ice sheets would occur on centennial to millennial time scales, the Arctic might become ice-free during summer within the 21st century. Our findings imply an additional increase of the GMT on intermediate to long time scales.

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