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The changing Arctic fresh water export in the 21st century

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Coupled IPCC experiments with the Max-Planck-Institute climate model ECHAM5/MPI-OM are used to analyse the changes in the fresh water export out of the Arctic. Furthermore, the impacts of these changes on climate are investigated. In the 20th century, the largest Arctic export takes place through Fram Strait. The variability of the total Arctic export is mainly governed by the Fram Strait ice export, which is highly affected by the atmospheric circulation. Large ice exports provoke a dramatic reduction in Labrador Sea surface salinity. Oceanic convection is decreased and ice cover is increased. The heat flux from ocean to atmosphere is below normal, which leads to significant negative air temperature anomalies in the Labrador Sea. In the 21st century, our model results show a reduction of sea ice and an increase of precipitation and river runoff. The total Arctic fresh water export is only slightly changing but a redistribution of the export occurs: The solid part becomes much smaller and is almost zero in the year 2100 while the fluid part strongly increases. The export through the Canadian Archipelago rises and the export over the Barents Shelf is reduced. The fresh water export through Fram Strait stays constant but its interannual variability is decreased by 25%. Thus, its impact on Labrador Sea climate is reduced. Although the total Arctic fresh water export does not show strong changes in the 21st century, the convection is reduced by about 40% in the Greenland Sea and 50% in the Labrador Sea. The reduction in the Labrador Sea can be explained by increased fresh water export through the Canadian Archipelago and increased P-E. In the Greenland Sea higher air and sea temperatures are the main reason for the decrease. The meridional overturning circulation (MOC) at 30 N declines from about 22 Sv in the 20th century to 16 Sv at the end of the 21st century.