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Impact of realistic future ice sheet discharge on the Atlantic ocean

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A high-end scenario of polar ice loss from the Greenland and Antarctic ice sheet is presented with separate projections for different mass-loss sites up to the year 2100. The resultant freshwater forcing is applied to a global climate model and the effects on sea-level rise are discussed. The simulations show strong sea level rise on the Antarctic continental shelves. To separate the effects of atmospheric warming and melt water we then ran four simulations. One without either forcing, one with both and two with one of each separately.

Melt water leads to a slight additional depression of the Atlantic overturning circulation, but a strong decrease remains absent. The bulk of the strength reduction is due to higher atmospheric temperatures which inhibits deep water formation in the North Atlantic. The melt water freshens the upper layers of the ocean, but does not strongly impact buoyancy. The balance between North Atlantic Deep Water and Antarctic Bottom Water must then remain relatively unaffected. Only applying the melt water forcing to the Northern Hemisphere does not lead to a stronger effect. We conclude that the meltwater scenario only impacts the overturning circulation superficially because the deeper ocean is not affected.

Transport through Bering Strait and across the zonal section at the latitude of Cape Agulhas is increased by increased atmospheric temperatures and adds some inertia to these transports. Reversing the atmospheric forcing bears this out when the transport then further increases. The freshwater, however, mitigates this inertia somewhat.