



Towards a rain-dominated Arctic

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Current climate models project a strong increase in Arctic precipitation over the coming century, which has been attributed primarily to enhanced surface evaporation associated with sea-ice retreat. Since the Arctic is still quite cold, especially in winter, it is often (implicitly) assumed that the additional precipitation will fall mostly as snow. However, very little is known about future changes in rain/snow distribution in the Arctic, notwithstanding the importance for hydrology and biology. Here we use 37 state-of-the-art climate models in standardised twenty-first-century (2006–2100) simulations to show that 70° – 90°N average annual Arctic snowfall will actually decrease, despite the strong increase in precipitation, and that most of the additional precipitation in the future (2091–2100) will fall as rain. In fact, rain is even projected to become the dominant form of precipitation in the Arctic region. This is because Arctic atmospheric warming causes a greater fraction of snowfall to melt before it reaches the surface, in particular over the North Atlantic and the Barents Sea. The reduction in Arctic snowfall is most pronounced during summer and autumn when temperatures are close to the melting point, but also winter rainfall is found to intensify considerably. Projected (seasonal) trends in rain/snowfall will heavily impact Arctic hydrology (e.g. river discharge, permafrost melt), climatology (e.g. snow, sea ice albedo and melt) and ecology (e.g. water and food availability).