Critical loads of acidity for lakes and ponds in the Canadian Arctic: Potential impacts of ship-source emissions

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Abstract: Increased accessibility of the northwest passage owning to climate change is expected to increase resource development and ship transportation within the Canadian Arctic. Increased ship-source emissions of sulphur dioxide (SO_2) may have potential acidification effects on Arctic lakes and ponds, especially those located on acid-sensitive geology, i.e., Baffin Island. The critical loads approach provides an estimate of the maximum amount of acidic deposition that will not pose a significant harmful effect on a specified indicator organism, e.g., Arctic Char (*Salvelinus alpinus*). The objective of this study was to assess the hydrochemical characteristics of lakes and ponds in the Canadian Arctic, and to determine their critical loads of acidity. Hydrochemical data for >1000 lakes and ponds from across the Canadian Arctic were gathered from the literature and compiled into a unified database. Furthermore, during summer 2015 and 2016 lakes and ponds (n = 80) were sampled on Southern Baffin owing to its acid-sensitive geology (Precambrian Shield) and proximity to major shipping routes (Hudson Strait and the Northwest Passage). In addition, lakes and ponds from eastern Northwest Territories (n= 9), Prince Charles Island (n=4), Coats Island (n=10) were also sampled to fill data gaps. Critical loads were estimated with the steady-state water chemistry model using observed water chemistry and a critical chemical limit for Arctic Char and Brown Trout. Modelled sulphur deposition scenarios with and without marine-source emissions were used to calculated exceedance (i.e., where acidic deposition is in excess of the critical load) and the risk of negative impacts.