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Tidal pumping - missing factor in glacial bays evolution?

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Most of the glaciers worldwide are subjected to rapid retreat. It is particularly well visible in Svalbard, where tidewater glaciers after the termination of the Little Ice Age often resulted in formation of new glacial bays. These bays are specific environments, characterised by high sediment accumulation rates, seasonal formation of sea-ice cover and common presence of icebergs. They are usually separated from the rest of the fjord by shallow (e.g. submerged moraine) or narrow passages. Although hostile, these bays also host unique ecosystems, with particular importance as feeding grounds for seals and sea birds. Among factors considered in development of such environments the role of tides is usually neglected or assumed as constant. Here we would like to stress the increasing role of tides in development of glacial bays ecosystems, as well as for import and burial of organic carbon in the bays. We present a model of tide development and results on present day conditions from Brepolen bay in Hornsund (southern Spitsbergen). On the basis of ADCP and CTD surveys we present the modern conditions and water exchange rates between the glacial bay and the fjord. Analysis of archival satellite images, aerial photographs and historical maps was used to map the change in glacial bay area. Finally simple modeling allow to identify a linear increase in tidal pumping magnitude (water exchange due to tides) with increasing glacial bay area due to glaciers retreat. We discuss it in context of potential consequences for bay oceanography, ecology and sedimentation. With fast glacier retreat and rapid grow of glacial bays one may expect the following effects of increasing tidal pumping: enhanced water exchange with the central part of the fjord, increasing salinity, facilitating colonisation by new species (e.g. import of juvenile forms of benthic species), increased input of marine organic carbon into setting suitable for its burial (high sediment accumulation rate in glacial bay), increased erosion and sediment transport due to increased tidal currents velocities.
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