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Carbon sequestration and storage in Arctic coastal wetlands: impacts of sea level rise

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Coastal wetlands, including salt marshes, mangroves and seagrasses, contain some of the largest stores of the pedologic and biotic carbon pools and climate change is likely to influence the ability of these ecosystems to sequester carbon. Recent studies have attempted to provide data on carbon sequestration in both temperate and tropical coastal wetlands. However, there has been little attempt to assess carbon sequestration or stocks within Arctic coastal wetlands. The impacts of climate change have been predicted to be greatest within the Arctic region. Alteration of Arctic wetland carbon sequestration rates is also likely where coastal forcing mechanisms interact directly with these coastal systems. At present there are no data available to provide a detailed understanding of present day and historical carbon sequestration rates within Arctic coastal wetlands. Such data are essential for making any assessment of carbon storage within these ecosystems and of future trends in response to the continued warming of the Arctic region.

In order to address these questions rates of carbon sequestration were assessed within five Arctic coastal wetland sites in Norway using radiometric dating techniques (210Pb and 137Cs) to establish a geochronology for recent wetland development and soil carbon stocks were estimated from cores.

Arctic Norway has an uplifting coastline ∼1mm/yr similar to rates occurring in Scotland, where it has been suggested that recent sea level rise may now be outpacing combined coastal wetland sediment accretion and uplift. Arctic coastal wetlands in Norway are typically located at the head of deep fjords with small estuaries which drain from the surrounding mountain catchments and glaciers. The size of the wetlands is typically dependent on available sediment deposition, which provides a shallow platform to the typically deep and steep coastline within the fjords. The greater the volume of the fluvial sediment supply the larger the wetland area.

The five study sites were selected to take into account the variability in Fennoscandian Arctic coastal wetlands including the two largest coastal wetlands in the region (Alta within Altafjord and Stabbursnes within Porsangerfjord) and the smaller fjordhead coastal wetlands, similar to those of Scotland, that are typical of the region (Birtvarre, Storfjord and Storslett).

Carbon sequestration rates were found to be enormously varied both between sites and over time, ranging between 4 and 1220 g C m2 y-1, although in most sites these exceeded the global average for saltmarshes (210 g C m2 y-1). Stocks ranged between 3.67-13.79 Mg C ha-1, very low compared with global average estimations for similar coastal systems e.g. 250 Mg C ha-1 for temperate salt marshes, 280 Mg C ha-1 for mangroves, and 140 Mg C ha-1 for seagrasses. This is most likely due to isostatic uplift and sediment accretion historically outpacing sea level rise, which results in wetland progradation and thus a continuous formation of new marsh with thin organic soil horizons. However, with increasing rates of sea level rise it is uncertain whether this trend is set to continue or be reversed.