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Sea level response to Quaternary erosion and deposition in Scandinavia

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The landscape in western Scandinavia has undergone dramatic changes through numerous glaciations during the Quaternary. These changes in topography and in the volumes of offshore sediment deposition, have caused significant isostatic adjustments and local sea-level changes, owning to erosional unloading and de- positional loading of the lithosphere. This geomorphic mass redistribution also has the potential to perturb the geoid, resulting in additional sea-level changes. However, the combined sea-level response from these processes is yet to be investigated in detail for Scandinavia.

In this study we estimate the total sea-level change from i) late Pliocene- Quaternary onshore bedrock erosion and erosion of sediments on the coastal shelf and ii) the subsequent deposition in the Norwegian Sea, northern North Sea and the Danish region. We use a gravitationally self-consistent global sea- level model that includes the full viscoelastic response of the solid Earth to surface loading and unloading. In addition to total late Pliocene-Quaternary geomorphic mass redistribution, we also estimate transient sea-level changes related specifically to the two latest glacial cycles.

We utilize existing observations of offshore sediment thicknesses of glacial origin, and combine these with estimates of onshore glacial erosion and of erosion on the inner shelf. Based on these estimates, we define mass redistribution and construct a preglacial landscape setting as well as approximate a geomorphic history of the last two glacial cycles.

Our results show that erosion and deposition has caused a sea-level fall of □50-100 m along the southern coast of Norway during the last two glacial cycles reaching □120 m in the offshore Skagerak region. The total relative sea-level fall during the Quaternary reach as much as □350 m in Skagerak. This highlights the importance of accounting for geomorphic sediment redistribution in glacial isostatic-adjustment modelling when interpreting ice sheet histories and glacial rebound.