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Impact of climate change on UK estuaries: A review of past trends and potential projections

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ABSTRACT

UK estuarine environments are regulated by inter-acting physical processes, including tidal, wave, surge, river discharge and sediment supply. They regulate the fluxes of nutrients, pollutants, pathogens and viruses that determine whether coastlines achieve the Good Environmental Status (GEnS) required by the EU's Marine Strategy Directive. We review 20th century trends and 21st century projections of changes to climatic drivers, and their potential for altering estuarine bio-physical processes. Sea-level rise will cause some marine habitats to expand, and others diminish in area extent. The overall consequences of estuarine morphodynamics to these habitat shifts, and vice-versa, are unknown. Increased temperatures could intensify microbial pathogen concentrations and increase public health risk. The patterns of change of other climatic drivers are difficult to predict (e.g., river flows and storm surges). Projected increased winter river flows throughout UK catchments will enhance the risks of coastal eutrophication, harmful algal blooms and hypoxia in some contexts, although there are spatial variabilities in river flow projections. The reproductive success of estuarine biota is sensitive to saline intrusion and corresponding turbidity maxima, which are projected to gradually shift landwards as a result of sea-level rise. Although more-frequent flushing events in winter and longer periods of drought in summer are predicted, whereby the subsequent estuarine mixing and recovery rates are poorly understood. With rising estuarine salinities, subtidal species can penetrate deeper into estuaries, although this will depend on the resilience/adaptation of the species. Many climate and impact predictions lack resolution and spatial cover. Long-term monitoring and increased research, which considers the catchment-river-estuary-coast system as a whole, is needed to support risk predicting and mitigatory strategies.

Contents

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1. Introduction

Estuaries are process centres for coastal hydrological, biogeochemical and biological cycles and their biological productivity rivals those of tropical rainforests and coral reefs (Cai, 2011). The high productivity combines with the provisioning of important ecosystem services, such as flood protection and providing recreational space, to maintain a Good Environmental Status (GEnS) so

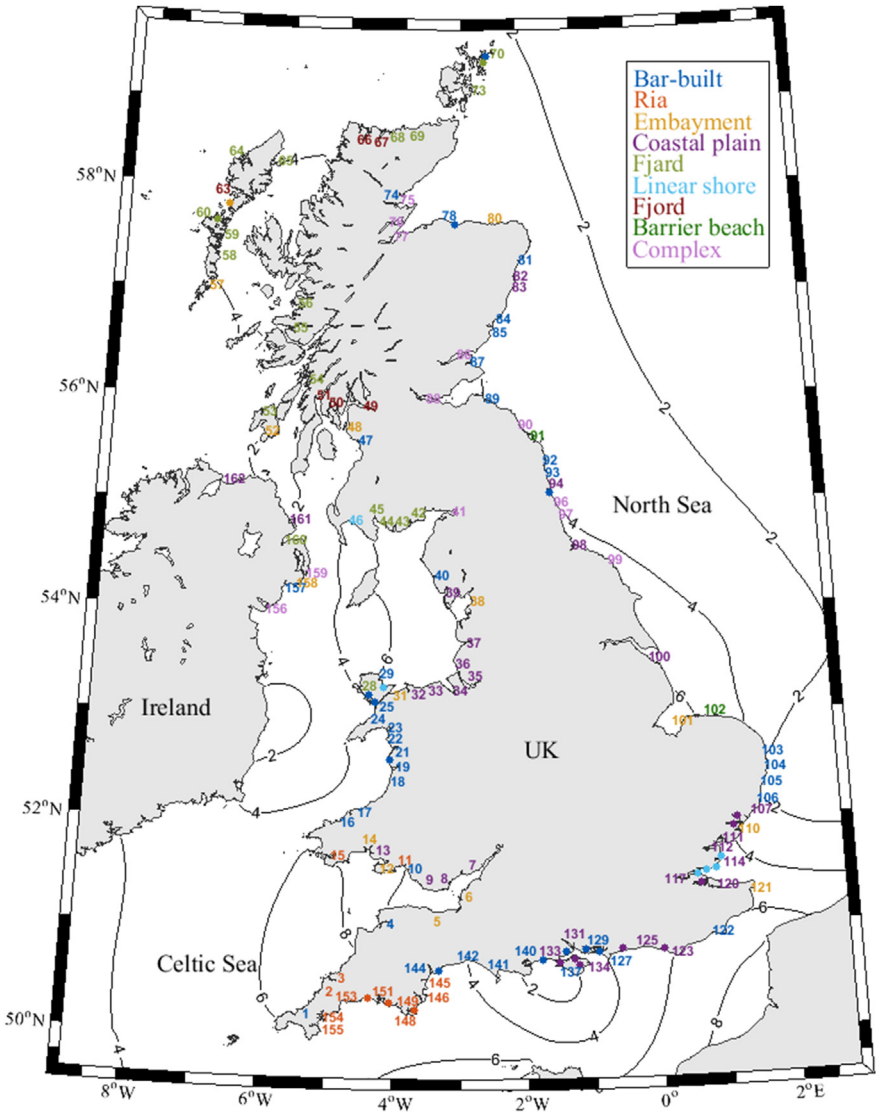

Fig. 1. Location and geomorphological classification of 162 UK estuaries, as defined by Davidson et al. (1991), who did not include estuaries in Northern Ireland. Tidal type can be inferred from tidal range (m) contours (calculated from a 3D ocean model, simulated and validated by Lewis et al., 2014), classified by Davies (1964) as: microtidal (tidal range < 2 m), mesotidal (2 m–4 m), macrotidal (4 m–6 m), and hypertidal (>6 m).