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The role of climatic and oceanic forcing in Arctic tidewater outlet glacier behaviour

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Arctic ice masses have rapidly lost mass from the mid-1990s, through a combination of negative surface mass balance and accelerated ice discharge from tidewater outlet glaciers. Consequently, identifying the primary drivers of tidewater outlet glacier dynamics is crucial for accurate sea level rise prediction. To date, oceanic and climatic forcing have been identified as potential drivers, with research primarily focusing on the role of air temperatures, ocean temperatures and sea ice concentrations, yet considerable uncertainty remains over the relative importance of each forcing factor.

In this paper, we present monthly frontal position data for selected major tidewater outlet glaciers on Greenland, Svalbard and the Russian High Arctic. Frontal position data were digitised from ESA SAR Image Mode data at an approximately monthly temporal resolution and we analyse frontal position variations in relation to oceanic and climatic forcing for the period 1990 to 2010. Specifically, surface and sub-surface ocean temperatures, surface air temperatures and sea ice data were assembled from a variety of remotely sensed and directly measured data sources (e.g. MODIS and AVHRR SST products, Hadley Centre EN3 data, meteorological stations and NIC sea ice charts). Furthermore, we assess the spatial variation in the relative importance of each forcing factor across the Atlantic sector of the Arctic and use statistical analysis to investigate the relationships between these parameters. Preliminary results suggest sea ice plays a key role in determining tidewater glacier behaviour across the region. We also identify spatial patterns in tidewater glacier retreat rates and regional variability in the relative importance of climatic and oceanic forcing factors.