**Spatial and temporal analysis of extreme sea level and storm surge events around the coastline of the UK**

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**Abstract**

Coastal floods are a major global hazard leading to long-lasting and wide-ranging social, economic and environmental consequences. Over the winter of 2013/14 the UK experienced a remarkable sequence of extreme storms and coastal floods. These events caused an estimated £2.5 billion in damages, but much greater destruction was prevented due to the effectiveness of defences. What appears noteworthy about this period is: (1) the large spatial ‘footprint’ of some of the events (i.e. simultaneous flooding along extended coastline stretches during the same storm); and (2) the temporal ‘clustering’ of the flooding events (i.e. events occurring one after another in close succession). These two issues have important financial and practical implications for the risk management sector, such as flood management, re-insurance, infrastructure reliability and emergency response; as impact and losses may be spatially and temporally correlated. For example, if multiple ports were damaged during the same storm this would affect national and even international supply chains. Temporal clustering of extreme sea levels could lead to amplified flood damages due to attritional effects on defences and inadequate recovery/repair time of natural (e.g. beaches) and human elements within the flood protection system. Recognition and analysis of spatial and temporal extreme sea level characteristics and associated coastal flooding is, however, lacking. Spatial footprints and temporal clustering have started to be examined for other natural hazards but there has been limited assessment with regard to extreme sea levels.

In this paper we analyse the spatial footprint and temporal clustering of extreme sea level and skew surge events around the UK coast over the last 100 years (1915-2014). The vast majority of the extreme sea level events are generated by moderate, rather than extreme skew surges, combined with spring astronomical high tides. We distinguish four broad categories of spatial footprints of events and the distinct storm tracks that generated them. There have been rare events when extreme levels have occurred along two unconnected coastal regions during the same storm. The events that occur in closest succession (< 4 days) typically impact different stretches of coastline. The spring/neap tidal cycle prevents successive extreme sea level events from happening within 4-8 days. Finally, the 2013/14 season was highly unusual in the context of the last 100 years from an extreme sea level perspective.