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Data Descriptor: An improved database of coastal flooding in the United Kingdom from 1915 to 2016

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Coastal flooding caused by extreme sea levels can produce devastating and wide-ranging consequences. The 'SurgeWatch' v1.0 database systematically documents and assesses the consequences of historical coastal flood events around the UK. The original database was inevitably biased due to the inconsistent spatial and temporal coverage of sea-level observations utilised. Therefore, we present an improved version integrating a variety of 'soft' data such as journal papers, newspapers, weather reports, and social media. SurgeWatch2.0 identifies 329 coastal flooding events from 1915 to 2016, a more than fivefold increase compared to the 59 events in v1.0. Moreover, each flood event is now ranked using a multi-level categorisation based on inundation, transport disruption, costs, and fatalities: from 1 (Nuisance) to 6 (Disaster). For the 53 most severe events ranked Category 3 and above, an accompanying event description based upon the Source-Pathway-Receptor-Consequence framework was produced. Thus, SurgeWatch v2.0 provides the most comprehensive and coherent historical record of UK coastal flooding. It is designed to be a resource for research, planning, management and education.

Design Type(s)	data integration objective • time series design • observation design
Measurement Type(s)	coastal flooding
Technology Type(s)	data collection method
Factor Type(s)	
Sample Characteristic(s)	North Sea • coast • South East Region • Scotland • United Kingdom • The Solent

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Background & Summary

Of all natural hazards, coastal flooding due to extreme sea levels has caused some of the worst human and financial losses worldwide[1]. Major events since 1900 include the Galveston, Texas hurricane in 1900 (ref. 2), Cyclone Bhola in the Bay of Bengal in 1970 (ref. 3), Hurricane Katrina in New Orleans in 2005 (ref. 4) and Typhoon Haiyan in the Philippines in 2013 (ref. 5). Chronologies compiled for flood-prone regions[6] indicate that storm surges continue to cause widespread devastation[7,8], despite advances in risk management and technology (e.g., flood defences, forecasting and warning). Coastal flooding is a growing threat due to climate-induced sea-level rise[8], land subsidence[9,10] and rapid population and economic growth in flood-exposed areas[11,12].

In the UK it has been estimated that 4 million people and £150 billion of assets are threatened by coastal flooding[13]. Coastal flooding is rated as the second highest risk of civil emergency in the UK, after pandemic influenza[14]. Coastal flooding, combined with fluvial flooding, is responsible for at least £0.25bn in annual economic damages[15]. The UK has a long history of severe coastal flooding. Historic accounts suggest that large numbers of people (of order 10^5 per event) were drowned on the east coast in 1099, 1421 and 1446, but with large uncertainty[16]. In 1607, floods around the Bristol Channel killed around 2,000 people[17], and coastal flooding caused by the 'Great Storm' of 1703 'completely washed away' the lower streets of Brighton on the south coast[18,19]. In the last century, major events include the 1928 flood which drowned 14 people in central London[20], and the 'Big Flood' of 31st January–1st February 1953 that devastated the east coast, with 307 deaths and 24,000 evacuees[21,22]. The 1953 event was pivotal in shaping the current state of UK flood risk management, and was a major incentive for scientific research and improved forecasts, warnings, and sea defences[23–26]. Recently, the winter of 2013–2014 saw severe storms and extreme sea levels, resulting in widespread and prolonged coastal flooding[27–32].

Motivated by the absence of a national framework for documenting coastal floods and their impacts, we[32] developed a coastal flood database and online tool called 'SurgeWatch' (v1.0; Data Citation 1) the first-step to provide a systematic record of coastal flood events around the UK from 1915 to present. We subsequently used it to improve understanding of the spatial and temporal characteristics of extreme sea-level events around the UK[31]. However, as we previously acknowledged[32], SurgeWatch1.0 had two key limitations: (1) historical events were omitted or under-represented due to the incomplete coverage of tide gauge records, which are sparse pre-1980s and especially prior to the mid-1960s; and (2) events were ranked using the maximum sea level return period, but the extent and severity of coastal flooding is more complex than this owing to other variables (e.g., waves and defences).

This paper presents SurgeWatch2.0, which encompasses significant updates to address these two issues. First, we systematically reviewed a wide range of 'soft' data sources which document instances of UK flooding and storms. This resulted in the identification of 329 coastal flood events from 1915 to the end of 2016, which is a fivefold increase on the 59 coastal flood events identified in the original database. Second, events were classified based on impacts using a multi-level categorisation: ranging from 1 (Nuisance) to 6 (Disasters). In addition, we replaced the existing template for event descriptions with an enhanced systematic commentary based on the Source-Pathway-Receptor-Consequence (SPRC) model—the most widely accepted conceptual model representing all interacting elements of the coastal floodplain system[33,34]. SurgeWatch2.0 continues to be available online in an enhanced user-friendly website (www.surgewatch.org).

The systematic assessment of the coastal flood events and their consequences is foundational for developing a thorough understanding of the flood system, and for making better decisions regarding the allocation of public resources for flood defences and management. Therefore, SurgeWatch2.0 will be useful for both scientific and practical applications, and of interest to a wide range of audiences. We hope that similar datasets will be compiled for other countries/regions, following the framework we have developed here.

Methods

Creating SurgeWatch2.0 involved three main stages, explained in detail below.

Stage 1: Review of 'soft' data sources

To create SurgeWatch1.0, we first used sea-level records from the National Tide Gauge Network (Data Citation 2) and extracted all extreme sea-level events that reached or exceeded the 1 in 5 year return level. Across the 40 tide gauge sites we analysed, 310 high waters reached or exceeded this threshold, resulting from 96 distinct storms. We used the dates of these 96 events as a chronological base from which to investigate whether historical documentation exists for a concurrent coastal flood. We found evidence of flooding for 59 out of the 96 storm events. Given that our initial focus was on dates extracted from sea-level records, it is almost inevitable the original database missed several events due to incomplete coverage of tide gauge records which are sparse pre-1980s and especially prior to the mid-1960s. This method was also inherently liable to omit flood events that arose from when sea levels were lower than the 1 in 5 year threshold chosen, and/or when coastal flooding was predominantly caused by factors other than storm surges, such as large waves and tide-locking of rivers. Therefore, to developed SurgeWatch2.0 we compiled a more comprehensive record of historical coastal flood events, by undertaking a detailed review of the known available 'soft' data sources that document instances of UK storms and floods.

We closely reviewed nine main sources, namely: Lamb[35], Davison et al.[36], Hickey[37], Zong and Tooley[38], Eden[39], Ruocco et al.[40], Kundewicz et al.[41], Stevens et al.[12], and Haigh et al.[32]. A brief description for each source, the periods they cover, and the sources they draw upon, is given in Table 1 (available online only). There is a variable number of coastal flood events documented in each source, in addition to disparities in the level of detail provided; some list only the date of the event, with no further detail. Three of the sources provide only local to regional scale flood histories (Davison et al.[36] —Hampshire and Isle of Wight; Hickey[37]—Scotland; Ruocco et al.[40]—the Solent), whilst all other sources provide a national perspective. These nine sources are not exclusively concerned with coastal flooding, and some focus on other aspects of extreme storms and other weather-related hazards such as hail and tornadoes (Lamb[35]; Davidson et al.[36]; Eden[39]), for which we recorded only the events where coastal flooding was explicitly mentioned. Stevens et al.[12] documented instances of both fluvial and coastal flooding mentioned in the monthly weather and hydrological reports provided by the Met Office (http://www.metoffice.gov.uk/learning/library/archive-hidden-treasures/monthly-weather-report) and Centre for Ecology and Hydrology (http://nrfa.ceh.ac.uk/monthly-hydrological-summary-uk). Kundewicz et al.[41] recorded large fluvial and coastal floods globally. In these instances, we recorded only the coastal flooding events. To our knowledge, these sources provide the most relevant and up-to-date chronologies available in the UK that are concerned with storms or coastal flooding, and collectively provide a sufficiently detailed overview of historic events. Although several of the nine sources recorded events pre-1915, we focus here on the 102-year period from 1915 onwards, as a first-step to make the task manageable. Most sources provide coverage since 1915.

The nine key sources cite many other documents, such as periodicals, newspaper articles, flood and extreme weather chronologies, monthly weather and hydrological reports, journal papers, professional reports, and other online sources (e.g., blogs, social media). Where possible, we verified these original sources and obtained further information. We also used focused analysis of contemporary (i.e., at the time of the event) newspaper articles in The Times Digital Archive (http://gale.cengage.co.uk/times.aspx/) and the National Library of Australia (http://trove.nla.gov.au/) to obtain additional information for individual events. However, we did not undertake extensive searches of these archives beyond the dates of events identified by the nine main sources.

For each event identified, we recorded the: date of the event; country or region affected; specific locations mentioned in the source; and the specific source(s) listing that event. We added additional events we were aware of from other sources. As discussed in more detail in the Technical Validation section, we then identified and combined duplicate events where: (1) different sources provide separate reports for an event each dated over different consecutive days; and (2) no specific day or month is reported and there were other events within the same month (year) which are likely to be the same event.

In total, we identified 329 distinct coastal flood events from the start of 1915 to the end of 2016 (Table 2 (available online only) and Fig. 1). These are defined as events with a period of high sea levels and/or waves arising from a distinct storm, which were associated with coastal flooding. For several events only the month or year in which they occurred are reported. In some cases, as discussed in more detail in the Technical Validation section, we were able to identify the day or month from other sources or through our own analysis of meteorological and sea-level data. However, 43 events remain where we know the month of occurrence only, and nine for which we only know the year. We have included these in the database as more detailed information may come to light in the future.

For each of the 329 coastal flood events identified, we documented (described in detail in Stage 3) all information we could find about the event using: (1) journal papers; (2) publically available reports and newsletters by interested professional parties such as the EA, Meteorological Office, local councils and coastal groups; (3) journalistic reports/news websites; and (4) other online sources (e.g., blogs, social media). The level of information available for each event varies greatly, but as an absolute minimum we identified a date and a location impacted.

Stage 2: Categorising events based on the severity of their consequences

In SurgeWatch1.0, we ranked coastal flooding events by the estimated maximum sea level return period for each event, using tide gauge data. As a result of poor coverage, several events were ranked lower than they should be in the original database. This is because, while we have tide gauge data at some sites for these events, tide gauges were not necessarily operational at the time along the stretches of the coastline where the sea levels were likely to have been most extreme. For example, the 31 January–1 February 1953 event was ranked 10th in the original database, but we know from examining the event in detail[30], and considering other information sources (Rossiter[42] in particular), that it should be ranked highest, both in terms of maximum sea level return period and impact. Only four of the 40 tide gauges were operational at that time and the gauge closest to the location of the peak storm surge failed during the event, just prior to high water, and the next closest (Newlyn) was located too far away. In addition, the severity of a coastal flood is not linearly related to the maximum sea level return period, due to other important variables such as waves, the presence and state of defences, and population density. Thus, the aim of the second stage was to rank all events using a multi-level categorisation based on reported impacts of the flooding, which is independent of the storm or water level characteristics, to more accurately represent the severity of the events in terms of impacts.

We used an iterative process to devise a simplified multi-level categorisation to classify flood events based on the severity of their consequences. All flood events were classified (with a higher score representing higher consequence), as either: (1) Nuisance; (2) Minor; (3) Moderate; (4) Major; (5) Severe or (6) Disaster. We refined the classification so that the number of events in each category roughly reduced exponentially, as would be expected in reality. Comparatively, the Richter scale, used to quantify the size of an earthquake, varies on base-10 logarithmic scale. The criteria to define these six categories, are listed in Table 3, and were based on the information yielded from Stage 1. They closely reflect our understanding of the key impacts that delineate the severity of coastal floods, but are also inevitably influenced by the style of reporting and availability of information.

Category 1 events (Nuisance) are those with localised flooding, where roads, parks or quayside areas were flooded. Events where we were only able to identify the location(s) flooded and no specific consequences were also ranked 1. For Category 2 events (Minor) the inundation was typically more extensive and in most cases properties were flooded and/or there was disruption to services. Category 3 (Moderate) events involved flooding of larger number of properties, wider disruption to services and/or flooding of agricultural land. Category 4 (Major) and 5 (Severe) events involved more extensive flooding with significant damage to infrastructure and large economic damage costs. For an event to be ranked Category 5 there needed to be either loss of life due to drowning, or reliable evidence that defences and/or flood warnings, and a substantial institutional response to the event, prevented multiple fatalities. Category 6 events (Disaster) were reserved for large consequence events that are associated with multiple fatalities due to drowning. Direct flood-related fatalities caused by immediate physical trauma (primarily drowning) are linked to only six UK floods since 1915. Of the 329 events in the database, 185 were ranked Category 1, 91 were ranked Category 2, 26 Category 3, 18 Category 4, 8 Category 5, and only 1 (the 31st January–1st February 1953 event) was ranked Category 6.

Stage 3: Improving event descriptions by incorporating the SPRC framework

In the third and final stage, we compiled a systematic commentary for each of the 329 events. As expected, there was often only limited information available for the lower ranked events. Hence, for each of the Category 1 events we provide a one or two-sentence summary of the reported consequences. The same was done for each of the Category 2 events, but with a longer paragraph describing the reported consequences. For the Category 3 events and higher, for which more information was available, we compiled a longer systematic commentary. Each of these includes, on the first page, the event date, a map indicating the approximate stretch of coast where flooding was reported, and a one sentence summary in the style of a news headline. This is followed by a color-coded graphic indicating the event ranking, with: Category 1 and 2 events in turquoise; Category 3 and 4 in orange; and Category 5 and 6 in dark red. A significant enhancement of the event commentaries in SurgeWatch2.0 is the addition of a table outlining 15 key parameters which highlight the types of consequence criteria associated with the events that were reported (3 social, 8 economic and 4 environmental). Examination of these parameters for the events was key to establishing and refining the criteria we used to define the six ranking categories, as described above. An example of the first page of a Category 3 or higher event commentary is shown in Fig. 2a. Each commentary includes on the second page a concise narrative of the event, an example of which is shown in Fig. 2b. In SurgeWatch1.0 this narrative contained, in three sections respectively, a description of: (1) the meteorological conditions; (2) the sea-level conditions experienced during the event; and (3) a succinct account of the recorded consequences to people and property. In hindsight, we reflect that it is more appropriate to reformat this narrative around the Source-Pathway-Receptor-Consequence (SPRC) model; and hence have done this for SurgeWatch2.0. Importantly, defining the SPRC elements of events in our database improves clarity and compatibility for integration of SurgeWatch2.0 with other flood analysis literature.

The Source describes the natural drivers of coastal flood events (i.e., tide, surge and waves, and the associated meteorological conditions). The Pathways component comprises descriptors (e.g., reporting or photos) of flood defence responses (e.g., erosion, breaching, overtopping, overflowing) and inundation (e.g., flood water surrounding or entering buildings). Receptors can be regarded as anything that can suffer damages from the event, and in our assessment, are regarded as people, property, infrastructure and the environment impacted by flooding. Finally, Consequences (defined as impacts upon people, property, the economy and the environment) is a key component of SurgeWatch2.0, as this is the most meaningful measure to determine the severity of a flood event in terms of affecting society (albeit one that is intrinsically linked with the sources, pathways and receptors).

In the revised narrative, the first section describes the source of the event (combining sections 1 and 2 in the SurgeWatch1.0 narrative). This is separated into three paragraphs: the first describing the meteorological conditions of the storm; the second outlines the still water level conditions; and the third the wave conditions observed during the event. These were characterised from information reported in the available sources and using the datasets and methods established for the original database. We provide only a brief overview of the datasets and methods that were used to characterize sources here; Haigh et al.[32] provide a comprehensive account. We used global reanalysis[43] data provided at 6-hourly intervals (Data Citation 3) to determine key meteorological features of the events (e.g., the storm track, atmospheric pressure and wind speeds and directions). We used records from the National Tide Gauge Network (Data Citation 2) to establish still water level conditions, including the astronomical tide and

skew surge[44] components, observed during each event. Sea level return periods were estimated using exceedance probabilities from an Environment Agency study[45,46]. Due to the limited spatial and temporal coverage provided by the tide gauge observations (which is most noticeable for the period pre-1960s), we could only document the peak sea-level height(s), astronomical tides and skew surge(s) for events which coincide with the data records available. For wave conditions, we referred to reported information where available.

In the revised narrative, the second section briefly describes the pathway of the flood, as reported in the available sources. For older events, information on pathways is often missing and we explicitly acknowledge this in the narrative. The third section briefly but systematically describes the receptor and consequences for the event, as reported in available sources. The first paragraph focuses on the consequences related specifically to the coastal flood. The second paragraph, where relevant, briefly describes impacts that relate to other aspects of the storm (i.e., wind damage) that are not directly relevant to coastal flooding. The third paragraph, if relevant, describes coastal flood impacts that occurred in neighbouring counties; which is only the case for the very large events.

Each commentary also includes (as in SurgeWatch1.0) a graphical representation of the storm track, mean sea level, pressure, and wind fields at the time of maximum high water. They also include figures of the return period and skew surge magnitudes at sites around the UK, and a table containing the available peak sea-level measurements for each event.

Data Records

SurgeWatch2.0 is available to the public through an unrestricted repository available at the British Oceanographic Data Centre (BODC) portal (Data Citation 4), and remains formatted according to their international standards. It includes data available up to the end of 2016. The first file is a spread sheet (XLSX) containing the list of all 329 coastal flood events in the database categorised according to the severity scale that we devised. The second and third files are PDF documents containing the short commentaries for all Category 1 and 2 events. There are an additional 53 PDF files containing the longer event commentaries for events ranked Category 3 and higher. Two final CSV files contain: the digitised storm tracks for the 53 Category 3 and higher events; and the peak sea-level height(s), astronomical tides and skew surge(s) for events which coincide with the data records available. Each of these files is self-describing and is accompanied by extensive metadata.

The database remains freely available at the SurgeWatch website (http://www.surgewatch.org), along with interactive graphical presentations of event-specific sea level return periods and skew surges, a glossary of key terms, educational videos, and news articles. We have enhanced the design of the website. The home page now includes a navigable time-line by which users can scroll through the events in reversed chronological order. Where we can, we have added photos taken at the time of the
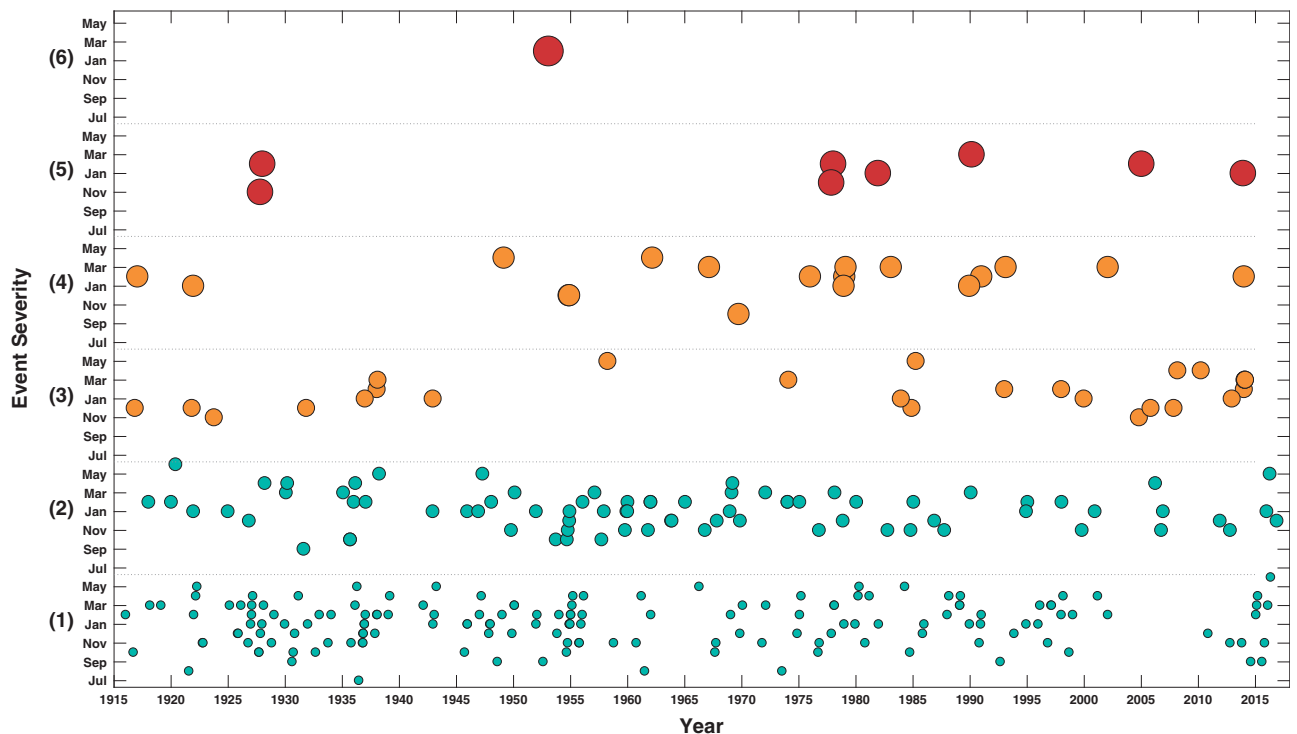

Figure 1. Ranking of each of the events in chronological order. .

Category	Description	Criteria
6	**Disastrous floods**	*Events must meet the following two criteria plus ≥2 criteria from Category 5*
		Multiple structural breaches of defences
		≥ 1 fatality caused by drowning in ≥1 locations
5	**Severe floods:** severely threatens life and/or results in considerable damage to infrastructure and property	*Events must: (1) meet ≥1 of the following criteria, or be associated with ≥1 fatality during the event or aftermath, and (2) meet ALL Category 2 criteria AND ≥1 criteria from Category 4*
		Substantial institutional response during or after the event (e.g., emergency Cabinet Office meeting, all-day media coverage)
		Reliable evidence that multiple fatalities were prevented by defences and/or flood warnings
4	**Major floods:** Impacts reported in monetary terms but no known loss of life	*Events must meet ALL of the Category 2 criteria, and 1 of the following*
		Descriptions of deep and/or fast-flowing water in ≥1 location, and/or statements to the effect of the 'worst flooding in [x number of] years', or the 'worst flooding since [reference event]'
		Serious damage to residential properties (e.g., loss of contents), and/or residential properties made uninhabitable due to coastal erosion
		Economic damages reported
		Damage to major infrastructure (e.g., port, key railway line, power station, motorway)
3	**Moderate floods:** Multiple impacts across affected areas (can be minor to quite severe)	*Events must meet ≥3 of Category 2 criteria*
2	**Minor floods:** Impacts known of, although full consequences may still be unclear	*Events must contain < 3 of these criteria, or otherwise reports of several properties flooded*
		Any reference to flooded property or agricultural land and livestock
		Disruption to services (e.g., branch railway line, power substation), including transport networks
		Descriptions of inundation including words such as 'extensive', 'deep', 'serious', 'widespread', 'cut off', 'severe'
		Damage to sea defences beyond limited overtopping
1	**Nuisance floods:** localised or unknown due to lack of information	Terms appear (with reference to flooding) in reports including: 'localised' or explicit statements that the impacts were limited e.g., few local roads, quayside areas
		No reports of flooded properties
		Insufficient information available to determine severity of consequences

Table 3. Categories and associated criteria used to rank the historical flood events based on the severity of their consequences.

event. The website has been designed to crowd source additional information. There is a facility for users to upload photos they may have of any event(s). Photos get moderated before showing up against that event.

Technical Validation

SurgeWatch2.0 was developed by undertaking an extensive search of documentation from a variety of readily available 'soft' data sources. In addition, it uses freely available and easily accessible meteorological and sea-level datasets, which have undergone rigorous quality control and validation. We have built on our previous experience of compiling the original dataset and addressed key issues to create a significantly enhanced record of coastal flooding for the UK for the last 102 years. We now outline a number of methodological issues encountered in the process of compiling the updated database.

The first issue relates to the fact that the quantity and quality of the reporting of coastal flooding varied significantly. Unsurprisingly, the amount of documentation available on coastal flooding improves with time, and more recent events are reported in greater detail. Several notable events in the earlier portion of the record (e.g., the 6th–7th January 1928 flooding in central London) are, however, also well documented. The most useful source for information on consequences of coastal floods was newspaper articles. Newspaper articles generally focus on human dimensions of flooding, while peer-reviewed journal papers are more dependable, but tend to focus more on analysis of the sources and pathways of events. Most sources are secondary or tertiary, and hence we were not able to identify the original source in many cases. We attempted to compare information about each event between multiple sources to verify the validity of the facts (e.g., date and time, main areas affected and impacts). However, this was not always possible as some sources (e.g., Lamb[35]; Eden[39]) are not fully independent and were compiled using common (primary) sources such as contemporary newspaper articles. Therefore, an event mentioned in more than one source, and reportedly involving considerable flooding, may be exaggerated if these are secondary or tertiary sources and all are based on the same primary source alone.

We overcame some of the key issues relating to ambiguous dates and duplicate events, by systematically (and independently) examining meteorological and sea-level data. In some cases, it
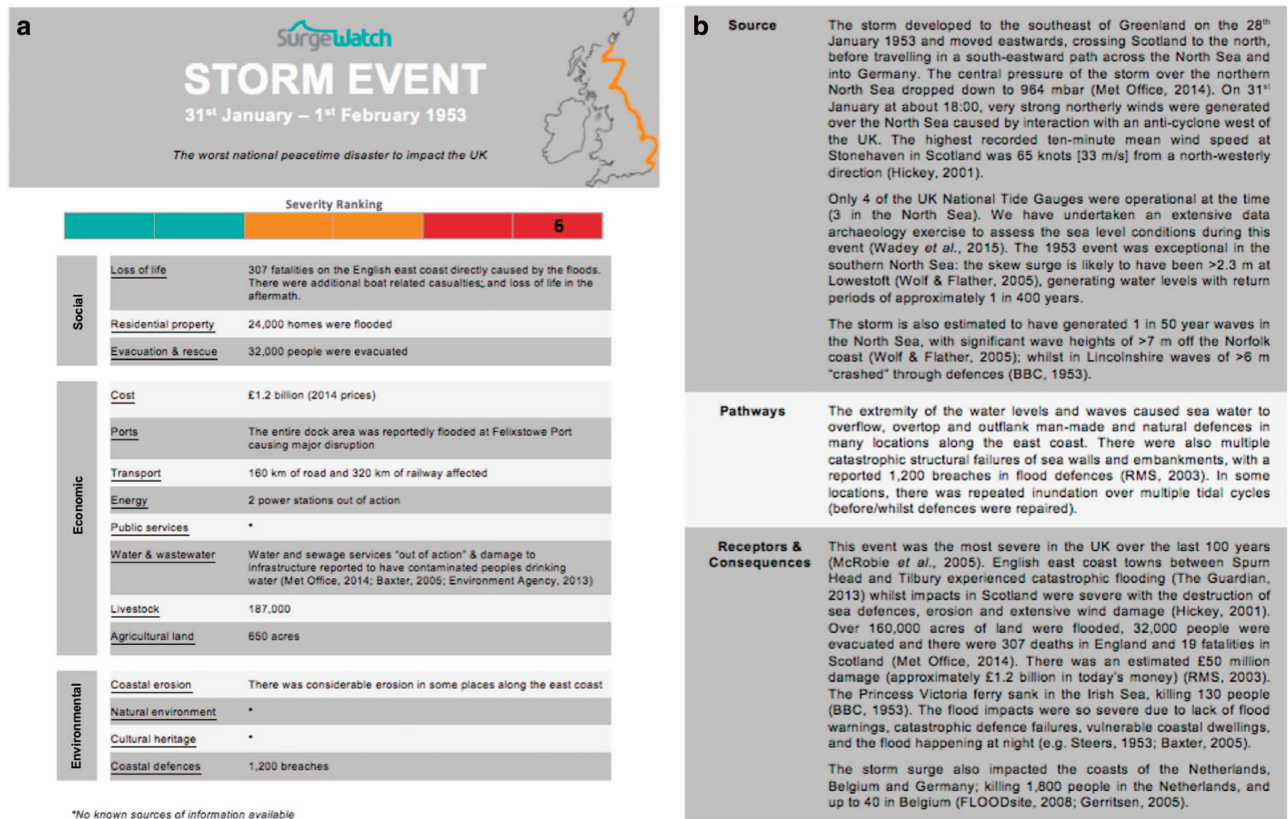
Figure 2. Example (31st January-1st February 1953) of the (a) first and **(b)** second pages of the commentaries for Category 3 and higher events.

appeared likely that the sources were referring to the same event, but on different days. For example, Zong & Tooley[38] reported flooding in Perth, Scotland and the wider region of Tayside on the 8th January 1920, whilst Hickey[37] reports flooding in Dundee also within Tayside, on the 9th January 1920. It was not immediately clear whether these were two distinct coastal flood events, caused by two different storm systems in close succession, or the same event caused by one storm. For each case when different sources reported events on consecutive days, we systematically examined the meteorological reanalysis and sea-level data (Data Citation 2 and Data Citation 3) available at the time to determine whether these were the same event, which impacted the coast over two days, or two distinct events, arising from different storm systems. For transparency, we explicitly record that we combined events in the commentaries where relevant.

An important component of producing this enhanced dataset was to illustrate the severity of flood events according to their consequences. This was achieved by devising a multi-level categorisation using criteria based on the pathways, receptors, and consequences of flood events. Although the scale represents a simplification of flood impacts, it does provide a meaningful classification that reveals the variety of flood types. Inevitably there is subjectivity in the ranking system. Ideally, these categories would be based entirely on more transparent, quantitative criteria (e.g., damage costs, recovery time). However, the information we identified from the sources was largely qualitative. Consequently, some events were not easily classified, e.g., such as those that had a large spatial footprint (i.e., affecting one or more coastal sectors), but simultaneously did not produce severe consequences. The broad definition of the categories however, did facilitate classification. We used an iterative process to refine the categories and number of events in each. We tried to ensure that ranking of each event was based on the consequences that arise due to the coastal flood directly, as opposed to other variables relating to the storm, such as high winds. In the case of loss of life, it was sometimes difficult to distinguish this. Despite the limitations, the classification provides a useful indication of the variety of flood types over the last 102 years. We deliberately designed the ranking system to increase numerically with severity, so we could add a larger category (i.e., Category 7), if a much more severe event occurred in the future.

We readily acknowledge that we might still be missing events. However, given the number and type of sources used (which favour national-scale and/or especially damaging events), we are confident we have documented the most severe events that have occurred in the UK since 1915, although the severity of some events may have been under-ranked due to the lack of detailed information available. For a large

number of Category 1 events, we were only able to identify the location(s) flooded and no specific consequences. These events are not likely to be Category 3 or higher, as from our experience the events of most extreme consequences were reported in more detail. Our approach is designed to allow improvement and if additional more detailed descriptions of flood impacts emerge, then we can re-rank these events accordingly.

We have not (due to time-constraints) directly considered wave data when compiling this database. In the event commentaries we referred to reported information on wave conditions, where available. In the future, we hope to add wave measurements from Centre for Environment, Fisheries and Aquaculture Science's (CEFAS) Wavenet (https://www.cefas.co.uk/cefas-data-hub/wavenet/) and Coastal Channel Observatory (http://www.channelcoast.org) wave buoy datasets, for events, where the data is available. A limitation of wave datasets is their short duration over the last decade or two. An alternative would be to use multi-decadal model wave hindcasts.

We plan to update the database forwards in real-time, including any new coastal flood events as they happen. Just prior to submitting this paper, minor flooding (Category 2) occurred in Swanage and Portsmouth on the 19th November 2016, and we have added this event to the database, and in Whitby on 13th January 2017 (we haven't added this event to the dataset as we wanted it to encompass complete years). In regard to the former event, we were able to visit both sites shortly after the event. We spoke to local coastal engineers and managers and obtained photos (and took our own) to build up an accurate picture of the extent and severity of the consequences that occurred, which helped to write the event commentary. We hope to be able to do this for future events. Also, we plan to continually update the database using new sources of information that reveal previously unidentified events, and expand upon the information available for events already within the updated record. By publishing this paper, making the dataset freely available via the SurgeWatch website and BODC portal, and regular publicity, we hope to promote and encourage identification of additional information regarding past events of which we are currently unaware. We actively encourage any interested parties such as coastal engineers, mangers or members of the public, to send us any information on flooding that is not yet featured in the database. All contributions that are included will be acknowledged.

Finally, we will shortly start to develop SurgeWatch3.0. We plan to repeat the tasks undertaken here, considering the same nine key sources, but for the pre-1915 events and go back in time as far as possible. In an initial assessment we have identified at least 400 events pre-1915, with the earliest event in 245 A.D. Going back pre-1915 we expect a large reduction in the amount of information available and increased uncertainty about the events. Extending the data back in time, we would also need to consider tsunamis.

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Author Contributions

I.D.H. and M.P.W. had the initial idea for the database. O.O., I.D.H. and M.P.W. created the event record and compiled the database based on SurgeWatch1.0 developed primarily by I.D.H. and M.P.W. All authors contributed to determining the final design of SurgeWatch2.0. I.D.H. and O.O. completed the storm track digitisation, data formatting and archiving the dataset with the BODC. All the authors shared ideas and contributed to this manuscript.

Additional Information

Tables 1 and 2 are only available in the online version of this paper.

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