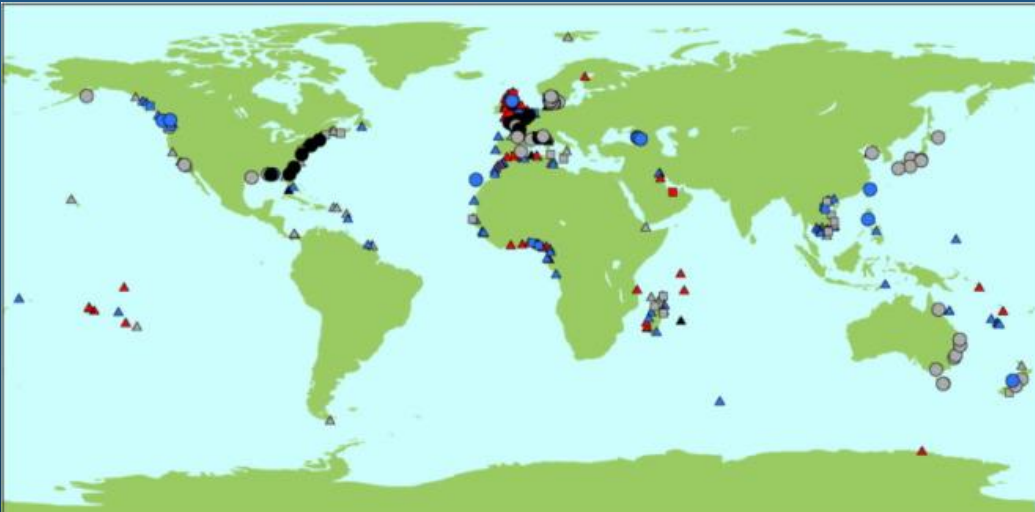


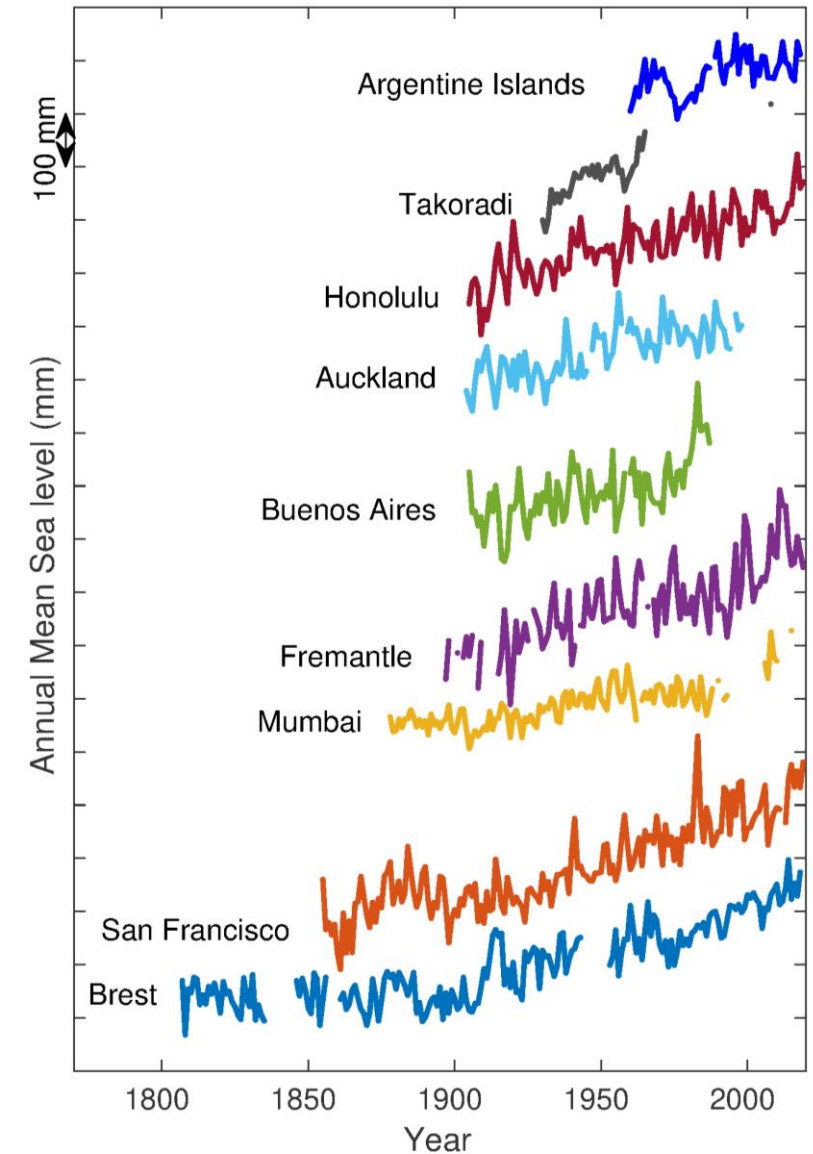
Rescuing historical sea level data using a citizen science platform

Andy Matthews, Liz Bradshaw, Jo Williams
and over 2,600 volunteers

Permanent Service for Mean Sea Level (PSMSL)
National Oceanography Centre, Liverpool, UK



Sea level records in
need of rescue:
Bradshaw et al
(2015)

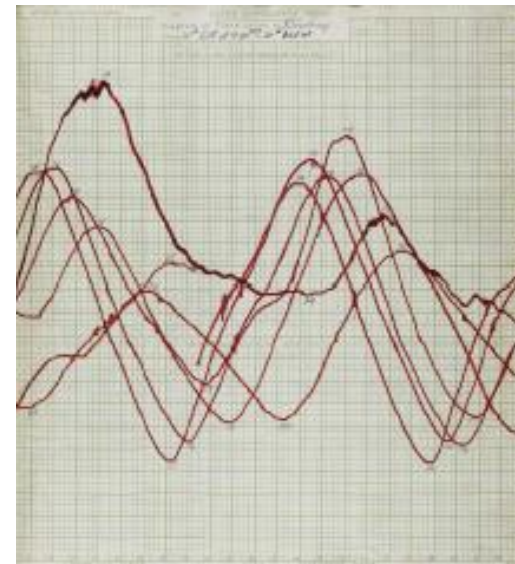


Data Under Threat

- Our knowledge of sea level rise, tides and extremes relies on data from tide gauges
- Large amounts of data remains inaccessible, existing as physical charts and ledgers
- Digitising these data is time consuming, expensive, and difficult to fund
- Most exists in the form of tidal charts and ledgers of tabulated values



LIVERPOOL DOCKS.											
REGISTER of TIDES observed at the Tide Gauge, <i>Georges Pierhead</i> for <i>March</i> 1867											
Date. <i>25th</i>						Date. <i>26th</i>					
Time.	Height.	Time.	Height.	Range of Tide.	Moon's Age.	Time.	Height.	Time.	Height.	Range of Tide.	Moon's Age.
P.M.	F. I.	A.M.	F. I.	F. I.		P.M.	F. I.	A.M.	F. I.	F. I.	
0.15	<i>11 2</i>	0.15	<i>9 11</i>		<i>D.H.</i>	0.15	<i>8 8</i>	0.15	<i>5 9</i>		<i>D.H.</i>
30	<i>12 4</i>	30	<i>11 2</i>		<i>20.2</i>	30	<i>9 11</i>	30	<i>6 11</i>		<i>21.2</i>
45	<i>13 6</i>	45	<i>12 3</i>		<i>AM</i>	45	<i>10 11</i>	45	<i>8 2</i>		<i>AM</i>
1. 0	<i>14 5</i>	1. 0	<i>13 4</i>		<i>Variable</i>	1. 0	<i>11 11</i>	1. 0	<i>9 3</i>		<i>Variable</i>
15	<i>15 3</i>	15	<i>14 3</i>		<i>P.M.</i>	15	<i>12 9</i>	15	<i>10 3</i>		<i>P.M.</i>
30	<i>16 0</i>	30	<i>15 2</i>		<i>W.S.H.</i>	30	<i>13 8</i>	30	<i>11 3</i>		<i>W</i>
45	<i>16 7</i>	45	<i>15 9</i>		<i>Mean Barometer</i>	45	<i>14 5</i>	45	<i>11 11</i>		<i>Mean Barow.</i>
2. 0	<i>16 11</i>	2. 0	<i>16 5</i>		<i>at 1 P.M.</i>	2. 0	<i>15 1</i>	2. 0	<i>12 6</i>		<i>at 1 P.M.</i>
15	<i>17 1</i>	15	<i>16 9</i>		<i>29.134</i>	15	<i>15 7</i>	15	<i>13 1</i>		<i>29.296</i>
30	<i>17 2</i>	30	<i>17 0</i>			30	<i>15 11</i>	30	<i>13 7</i>		
45	<i>16 11</i>	45	<i>17 2</i>			45	<i>16 1</i>	45	<i>14 0</i>		



How can the data be rescued?

- Ledgers contains many minor transcription errors and changes in format, making machine based methods difficult
- Crowd sourced approaches using platforms such as [Zooniverse](#) have been successful in other fields (such as meteorology)
- In particular, the [Rainfall Rescue](#) project transcribed over 5 million historical measurements of total monthly rainfall in the UK in about two weeks.

15	13	4	add 1 hour
30	14	5	
45	15	5	
10. 0	16	3	
15	16	11	
30	17	6	
45	17	11	

45	0 1+	45	0 9	} ? readings of Feb 27 th
10. 0	1 11	10. 0	1 2	
15	3 11	15	12 04	
30	5 9	30	18 68+	
45	7 7	45	30 03+	
11. 0	9 4	11. 0	5 3	
15	10 11	15	62 911	
30	12 6	30	85 510	
45	13 10	45	104 04	
12. 0	14 11	12. 0	118 9	
Noon.		Night.		

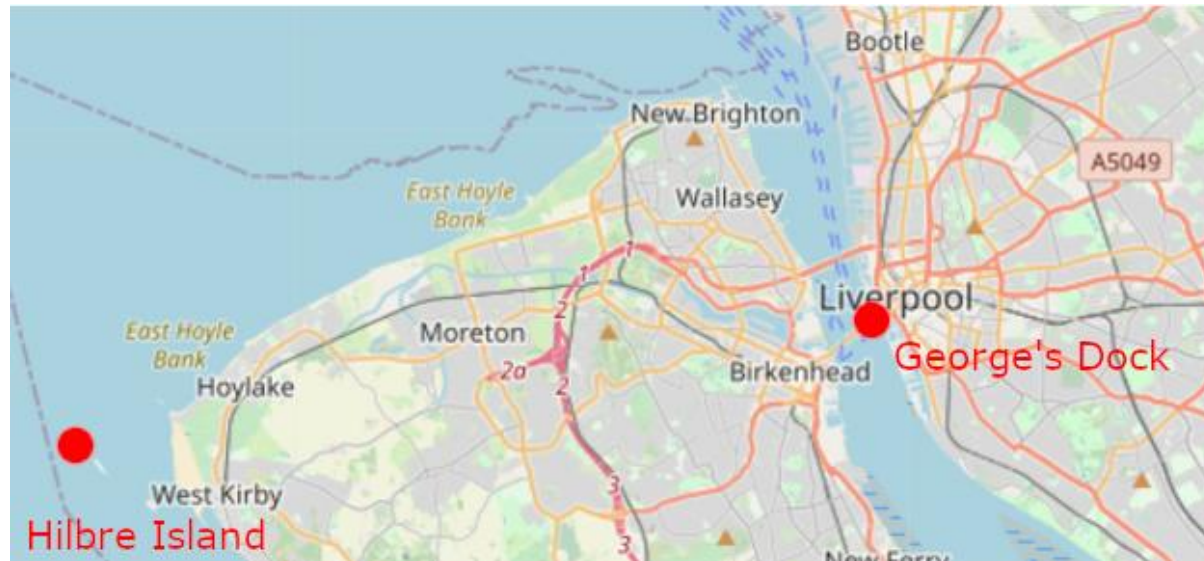
9. 0	2	3-	
15	0	8+	
30	3	0	
45	5	8	
10. 0	8	0	1
15	10	9	
30	13	6	
45	15	2	
11. 0	16	4	1
15	17	6	
30	18	5	
45	19	3	
12. 0			1
Noon.			N

2. 0	16	11	
15	16	6	
30	15	9	
45	15	6	4
3. 0	13	7	3
15	11	9	11
30	10	7	8
45	9	2	5
4. 0	7	9	1
15	6	8	10
30	5	4	5
45	4	6	3
5. 0	3	5	2
15	2	1	1
30	1	3	1

Some examples of ledgers with transcription problems

Our first pilot project – what data are we trying to rescue?

- 50 years of data (1853-1903) from two sites in North West England
- About 16 000 scanned images from Mersey Docks and Harbour Board
- Observations every 15 minutes, each image contains two days
- Although the data has never been fully digitised, summary statistics have been produced for some periods,

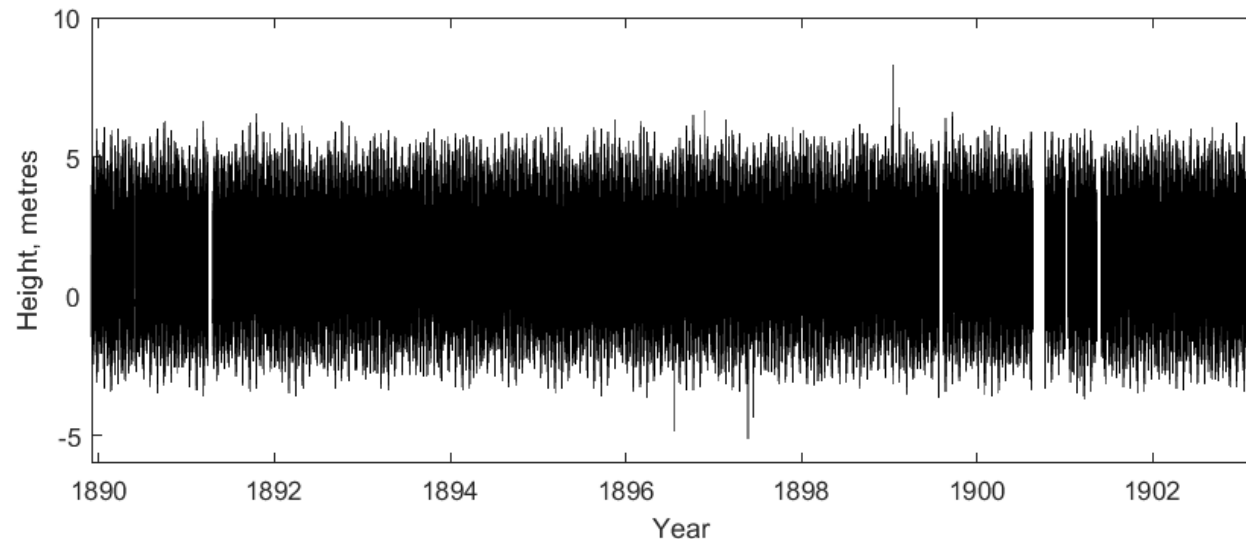


By Nilfanion - CC BY-SA 3.0
<https://commons.wikimedia.org/w/index.php?curid=12131901>

How does it work?

- Volunteers are asked to enter a column of data
- Each column is entered by five different volunteers
- Users can comment on talkboards on individual images and raise issues
- We collate and compare the results and produce complete time series
- So far, 14 years have been digitised by over 2600 volunteers
- Quality control continues, but results look very promising

*Preliminary
results from
Hilbre
1890-1903*



TASK

TUTORIAL

Please enter the data for the **first height column** in the page.

Enter the value for feet, followed by a space, then the value for inches, then a + or - (if present), for example:

6 2+

0:15

0:30

0:45

1:00

1:15

1:30

Some complications

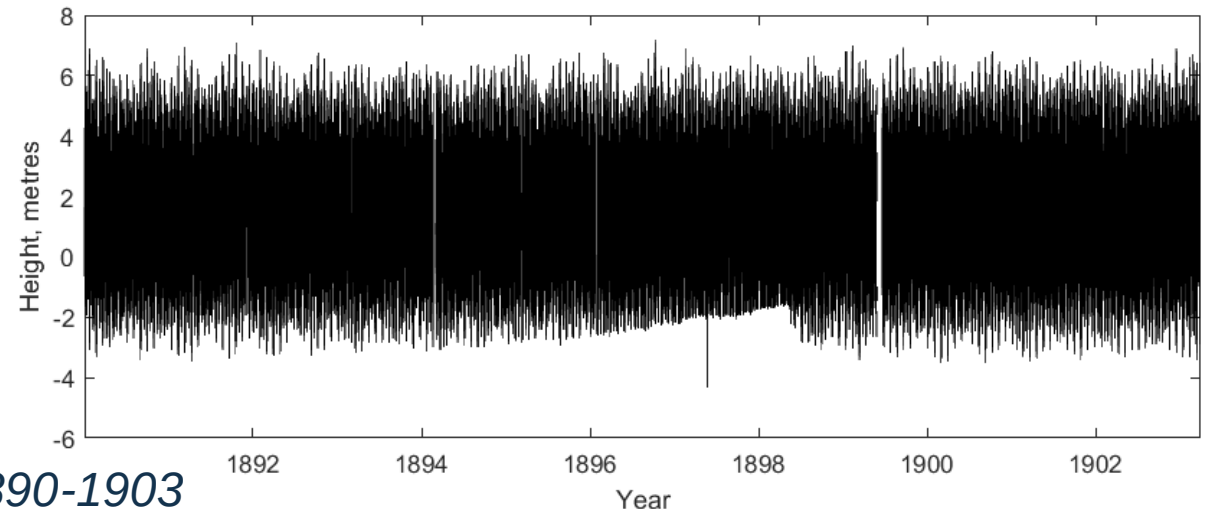
TIME.	HEIGHT.	
A.M.	Ft.	In.
0. 15	3	3
30	2	6
45	1	10
1. 0	1	1
15	0	5+
30	0	4-
45	0	11
2. 0	1	6
15	2	0
30	2	4
45	2	7
3. 0	2	8
15	2	9

positive

negative

- Heights are measured in feet and inches above the sill of the Old Dock in Liverpool – the working tidal datum at the time.
- Signs were only added when values moved between positive and negative (and vice versa), but were often omitted, or reversed and need to be corrected.
- At Liverpool, the measurements were taken at George's Pier, using the height of the floating landing stage itself which would occasionally ground during low waters, resulting in missing data.

- Sand would build up beneath the stage, but was regularly cleared.
- However, things deteriorated between 1894 and 1896 resulting in the stage grounding at higher levels.



Preliminary results from Liverpool, 1890-1903

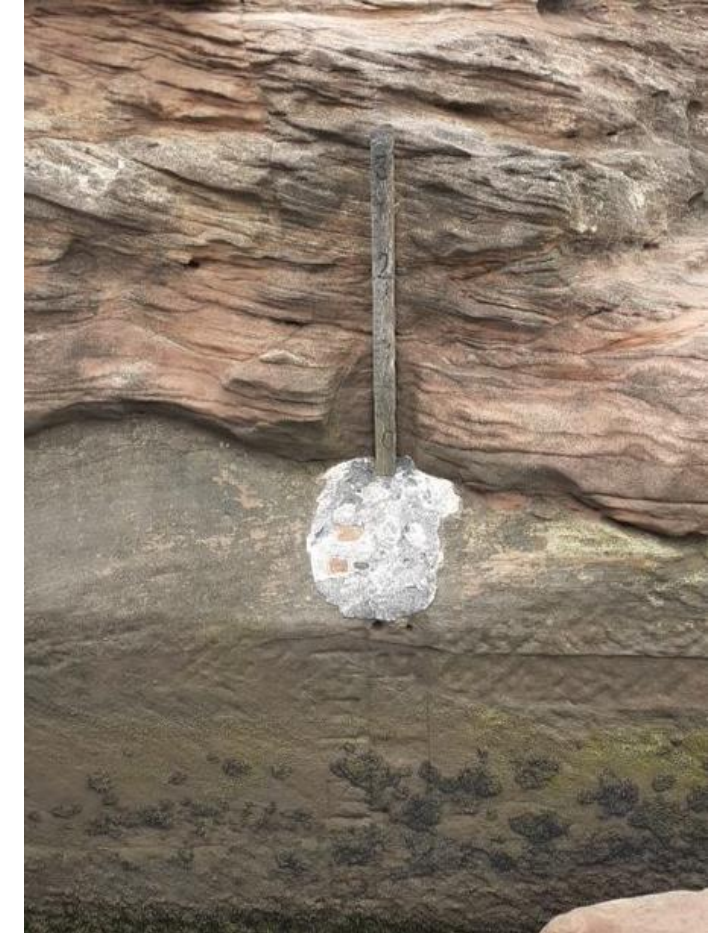
Lessons learnt

- The process is working well: outputs will be quality controlled and banked at bodc.ac.uk
- More problems have occurred due to errors with the original transcription than with the data entry
- Volunteers have reported many issues through the website's talk boards
- Running the project is more time consuming than setting it up
- It's a great way to tell the public about your data

Hilbre old lifeboat station

John S Turner, CC BY-SA 2.0

<https://commons.wikimedia.org/w/index.php?curid=8472334>



*Old tide staff at Hilbre
Jo Williams - NOC*

Try the project at <https://www.zooniverse.org/projects/psmsl/uk-tides>