Mythscapes in the watery realm: a tale of two floods

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Funding: ARC, Boliden Apirsa S.L., CADW, CCW, DEFRA, EA, EPSRC, EU, HEFCW, Leverhulme Trust, National Geographic Society, NATO, NERC, NSF, The Royal Society, WWF
Since 2000 a series of major floods in the UK have lead many environmental protection agencies, politicians and members of the general public to believe that floods are becoming more frequent and larger.

Recent floods are viewed as “unprecedented” and are attributed to Anthropogenic Climate Change.

Is this true?
Topics:

(i) December 2010 - January 2011 Southeast Queensland and June 2012 Mid-Wales Floods: modern flood myths

(ii) Stormy geomorphology: lessons from the past

(iii) Building hydrologically resilient and informed communities: the role of the arts
A combination of low pressure systems and a La Niña event.
900,000 people were affected over an area of 500,000 km² (24 times the size of Wales!).
47 deaths.
Damage $2.38 billion.
The city of Toowoomba was hit by flash flooding after more than 160 millimetres of rain fell in 36 hours to 10 January 2011; this event caused four deaths.
Data presented in Wohl et al. (1994). Genoa R. floods (Erskine, 1993) 100y ARI floods for study sites.

Costa’s envelope curve for maximum rainfall-runoff floods.
Mid-Wales floods – 8\textsuperscript{th} & 9\textsuperscript{th} June 2012

Figure 1. West Wales river catchments affected by flooding on 8\textsuperscript{th} and 9\textsuperscript{th} June 2012.
June 2012 wettest in England and Wales in a record stretching back to 1766.

The depression which crossed England and Wales overnight 7\textsuperscript{th}/8\textsuperscript{th} June (980 mbar) is believed to have been the deepest in June since before 1900.

June 2012 amongst the most cyclonic Junes in a record extending back 140 years.

June 2012 mean temperatures were typically 1-2.5 degC below the 1981-2010 mean.
<table>
<thead>
<tr>
<th>Station</th>
<th>Catchment</th>
<th>Elevation (m AOD)</th>
<th>3 hour (mm)</th>
<th>6 hour (mm)</th>
<th>12 hour (mm)</th>
<th>24 hour (mm)</th>
<th>36 hour (mm)</th>
<th>48 hour (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dinas</td>
<td>Rheidol</td>
<td>280</td>
<td>25.4</td>
<td>46.2</td>
<td>81.6</td>
<td>146.4</td>
<td>183.4</td>
<td>186.2</td>
</tr>
<tr>
<td>Bontgoch</td>
<td>Leri</td>
<td>185</td>
<td>28.6</td>
<td>49.2</td>
<td>71.0</td>
<td>119.6</td>
<td>143.4</td>
<td>145.8</td>
</tr>
<tr>
<td>Pwllpeiran</td>
<td>Ystwyth</td>
<td>330</td>
<td>21.2</td>
<td>37.4</td>
<td>73.0</td>
<td>102.4</td>
<td>147.8</td>
<td>154.0</td>
</tr>
<tr>
<td>Cwm Rheidol</td>
<td>Rheidol</td>
<td>53</td>
<td>17.4</td>
<td>30.6</td>
<td>52.8</td>
<td>91.4</td>
<td>117.2</td>
<td>120.6</td>
</tr>
<tr>
<td>Tal-y-bont</td>
<td>Ceulan</td>
<td>65</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>73.0</td>
<td>-</td>
<td>97.0</td>
</tr>
<tr>
<td>Trawsgoed</td>
<td>Ystwyth</td>
<td>63</td>
<td>17.8</td>
<td>30.6</td>
<td>54.2</td>
<td>70.2</td>
<td>99.2</td>
<td>102.0</td>
</tr>
<tr>
<td>Gogerddan</td>
<td>Clarach</td>
<td>31</td>
<td>9.4</td>
<td>18.0</td>
<td>31.2</td>
<td>48.6</td>
<td>63.0</td>
<td>65.2</td>
</tr>
<tr>
<td>Bow Street</td>
<td>Clarach</td>
<td>15</td>
<td>8.4</td>
<td>15.2</td>
<td>26.2</td>
<td>39.0</td>
<td>51.6</td>
<td>53.8</td>
</tr>
<tr>
<td>Frongoch</td>
<td>Clarach</td>
<td>140</td>
<td>7.8</td>
<td>13.2</td>
<td>23.4</td>
<td>34.0</td>
<td>46.6</td>
<td>49.0</td>
</tr>
</tbody>
</table>
## Historical context - Wales

<table>
<thead>
<tr>
<th>County</th>
<th>24 hour rainfall (9am-9am)</th>
<th>Location</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid Glamorgan</td>
<td>211.1</td>
<td>Lluest Wen Reservoir</td>
<td>11(^{th}) Nov 1929</td>
</tr>
<tr>
<td>Gwynedd</td>
<td>197.4</td>
<td>Oakeley Quarry</td>
<td>28(^{th}) June 1928</td>
</tr>
<tr>
<td>Powys</td>
<td>184.1</td>
<td>Blaenau Ryofer</td>
<td>3(^{rd}) Nov 1931</td>
</tr>
<tr>
<td>Dyfed</td>
<td>165.6</td>
<td>Llynynfan Fach</td>
<td>3(^{rd}) Nov 1931</td>
</tr>
<tr>
<td>Gwent</td>
<td>147.3</td>
<td>Abertillery</td>
<td>3(^{rd}) Nov 1931</td>
</tr>
<tr>
<td><strong>Ceredigion</strong></td>
<td><strong>146.4</strong></td>
<td><strong>Dinas</strong></td>
<td>8(^{th}) June 2012</td>
</tr>
<tr>
<td>Anglesey</td>
<td>136.7</td>
<td>Llansadwryn</td>
<td>10(^{th}) Aug 1957</td>
</tr>
<tr>
<td>Clwyd</td>
<td>134.9</td>
<td>Hangmer</td>
<td>31(^{st}) May 1924</td>
</tr>
<tr>
<td>South Glamorgan</td>
<td>122.9</td>
<td>Lisvane</td>
<td>14(^{th}) Jul 1875</td>
</tr>
<tr>
<td>West Glamorgan</td>
<td>102.4</td>
<td>Cimla Reservoir</td>
<td>2(^{nd}) Aug 1948</td>
</tr>
</tbody>
</table>
## Historical context – UK (the ‘200 club’)  

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
<th>Rainfall (24 hr total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seathwaite, Cumbria</td>
<td>November 2009</td>
<td>316 mm</td>
</tr>
<tr>
<td>Martinstown, Dorset</td>
<td>July 1955</td>
<td>279 mm</td>
</tr>
<tr>
<td>Loch Quoich, Highland</td>
<td>December 1954</td>
<td>256 mm</td>
</tr>
<tr>
<td>Bruton, Somerset</td>
<td>June 1917</td>
<td>243 mm</td>
</tr>
<tr>
<td>Cannington, Somerset</td>
<td>August 1924</td>
<td>239 mm</td>
</tr>
<tr>
<td>Sloy, Highland</td>
<td>January 1974</td>
<td>238 mm</td>
</tr>
<tr>
<td>Lynmouth, Devon</td>
<td>August 1952</td>
<td>229 mm</td>
</tr>
<tr>
<td>Rhondda Valley, Wales</td>
<td>November 1929</td>
<td>211 mm</td>
</tr>
<tr>
<td>Kinlochquioich, Highland</td>
<td>October 1916</td>
<td>208 mm</td>
</tr>
<tr>
<td>Brundall, Norwich</td>
<td>August 1912</td>
<td>205 mm</td>
</tr>
<tr>
<td>Seathwaite, Cumbria</td>
<td>November 1897</td>
<td>204 mm</td>
</tr>
<tr>
<td>Camelford, Cornwall</td>
<td>June 1957</td>
<td>203 mm</td>
</tr>
<tr>
<td>Boscastle, Cornwall</td>
<td>August 2004</td>
<td>200 mm</td>
</tr>
</tbody>
</table>
Figure 8. Specific discharge estimates for rivers in west Wales and other large upland floods. The normal maximum flood curve was updated by the Institute of Civil Engineers at the same time that the catastrophic curve was introduced (1960). Although the latter is based on statistical theory, it is not used for design purposes. Locations with upper and lower specific discharge estimates (see Table 9) are plotted using mean values.

Larger events in: (i) October 1886: Trefechan Bridge destroyed (ii) July/August 1846 South Ceredigion floods: “A water spout broke amongst the mountains, filling the streams which enter the sea at Llanon, Llanrhystud and Aberaeron”.

Return periods on the Leri less than 50 years at Borth and 50-80 years at Dol-y-bont (river flow gauge opened 1971).
They thought it couldn’t get any worse .... it did!
Winter of 2013-14

The Aberystwyth storms of January 3rd-5th 2014
UK winter of 2013-14 was characterised by an exceptional run of storms, culminating in serious coastal damage and widespread, persistent flooding.

For England and Wales this was one of, if not the most, exceptional periods of winter rainfall in at least 248 years.

The two-month total of 372.2mm for the southeast and central southern England region is the wettest any 2-month period in the series from 1910.

Naturalised daily flows (m$^3$ s$^{-1}$; black) for the Thames at Kingston (1883-2014), compared against peak flow in December 2013 / January 2014 (red line)
Are the UK floods Cameron’s Katrina?
Development of floodplains is continuing below the UK Government’s radar.
Stormy Geomorphology: Lessons from the past

“The longer you can look back, the further you can look forward”. W.S.Churchill (1944), cited in Guldi and Armitage (2014, p.14)


It is argued that short-termism in history (as well in economics and politics – geomorphology!?) has recently been all-pervasive using documentary sources covering but a few decades.

Such ‘short pasts’ may be just too short to learn from, as they miss many long-term trajectories and pivotal events.

Foreseeing thresholds, often of complex and unexpected origin, is less readily achieved than the linear modelling of, and extrapolating from, current trends (cf. Taleb 2007. The Black Swan: The Impact of the Highly Improbable.)
....there is limited to medium evidence available to assess climate-driven observed changes in the magnitude and frequency of floods at a regional scale because the available instrumental records of floods at gauge stations are limited in space and time, and because of confounding effects of changes in land use and engineering.

Furthermore, there is low agreement in this evidence, and thus overall low confidence at the global scale regarding even the sign of these changes.
average recurrence interval > 100 yrs

average recurrence interval ~ 20-100 yrs

Extending the flood record using the fluvial geological archive
Floods and Droughts

Hydrologic variability in Australia
Flood- and drought-dominated regimes

Climate controls on variability
El Niño/Southern Oscillation (ENSO)
Inter-decadal Pacific Oscillation (IPO)

water depth in Lake George, SE Australia

Finlayson 2010
Rustomji et al. 2009
Extreme floods in UK uplands

(a) Thinhope Burn, North Pennines
- July 2007 flood

(b) Cambrian Mountains, Mid-Wales
- June 2012 flood

(c) Brecon Beacons, South Wales
- September 2008 flood

(d) Dartmoor, Southwest England

(e) Yorkshire Dales, Northern England

Graphs showing b-axis anomaly (%)

- Active channel
- Low terrace and 1930s boulder berm
- Floodplain and 2012 boulder berm

Regression analysis:
- y = 0.762x
- R² = 0.7471
2012 hydrologically the UK’s annus horribilis! A harbinger of anthropogenic climate change?

Arctic Amplification, Rossby Waves and the Jet Stream: warming in the Arctic reduces the temperature difference between the Arctic mid-latitudes. As temperature differentials are a main driver of air flow, this promotes slower circulation patterns.
2012 hydrologically the UK’s annus horribilis! A harbinger of anthropogenic climate change?

**Arctic Amplification, Rossby Waves and the Jet Stream:** warming in the Arctic reduces the temperature difference between the Arctic mid-latitudes. As temperature differentials are a main driver of air flow, this promotes slower circulation patterns.
Reconstructed centennial variability of Late Holocene storminess from Cors Fochno, Wales, UK

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Received 24 October 2014; Revised 29 April 2015; Accepted 3 June 2015

Figure 1. Left: location of Cors Fochno in the UK inset and map of the Dyfi estuary and Cors Fochno bog with the two coring locations. Right: map of Europe showing the approximate locations of the NAO pressure centres (Hurrell and Deser, 2010) and sites of storminess reconstructions discussed in this research (letters corresponding to these in Fig. 6).

Figure 6. Latitudinal differences of European storminess records. Sites (from top): A, Greenland (Meeke and Mawson, 2002); B, Iceland (basalt/plagioclase ratio) (Andersen et al., 2005); C, Iceland (Jackson et al., 2005); D, Scotland (Hansom and Hall, 2009); E, Northern Ireland (Wilson et al., 2004); F, Cors Fochno, Wales (this study); G, Skagerrak Sea (Hass, 1996); H, Halland Coast, Sweden (De Jong et al., 2006); I, Denmark (Clemmensen et al., 2009); J, Seine Estuary, France (Sorrel et al., 2009); K, Mont-Saint-Michel Bay, France (Billeaud et al., 2009); L, Aquitaine coast, France (Clarke et al., 2002); M, Portugal (Clarke and Rendell, 2006); N, French Mediterranean coast (Saltati et al., 2012). Dotted lines show periods of enhanced storminess identified in the Cors Fochno reconstruction.

These floods had catastrophic impacts on both communities and are reflected in the exhibition.
Ruth Jên Evans (Cymru/Wales)

I was first told the story of the drowning of Cantrė Gwaelod (The Lowland Hundred) by my grandfather when I was about four years old. Later, when at primary school, I was taught to recite and sing the poem Cychau Cantrė Gwaelod (The Bells of Cantrė Gwaelod) by J.J. Williams.

According to legend Cantrė Gwaelod or Maes Gwyddno (The Plain of Gwyddno) was an area of land located about 20 miles west of the present shoreline of Cardigan Bay. There are many versions of the myth, but the poem refers to the drunken watchman called Seithemmin who falls asleep and forgets to shut the sluice gates allowing the seawater to rush in and flood the land.

These prints are a response to the surrounding landscape of my childhood and the folktales and myths that feature the loss of lands due to coastal flooding and sea level rises.

Ochenaid Gwyddno Garanhir
Pan droes y don dros ei dir

Like the groans of Gwyddno Garanhir
As the waves washed over his land

The old Welsh saying known to the fishermen of Cardigan Bay, was used when someone found himself in an awkward or impossible situation.

Ben Partridge (Cymru/Wales)

My practice explores our complex and often contradictory relationship with technology. I find printmaking, particularly its alliance with both obsolete and emerging technologies, the perfect vehicle to explore the role of technology in both utopian and dystopian views of past, present and future. I am especially interested in examining the role of cultural concepts such as obsolescence and the rhetoric of progress play in our increasingly fragile relationship with the environment.

Following the large scale flooding to the seafront in Aberystwyth and accompanying media coverage caused by storms in early 2014, this body of work explores how our perception of an event is inevitably warped by the lens through which we experience it.

Increasingly the plight of communities affected by flooding and environmental change is experienced in a digital space. The physical event often echoed by a second, digital, flood of information, as articles, images, opinions and hyperbole are distributed, shared and retweeted globally. Do these insights, popping up on newsfeeds between adverts and cat photos, make us more environmentally conscientious global citizens, or do they form part of the accumulated visual detritus of the internet?

Combining nineteenth and twentieth century archival images of Aberystwyth with contemporary responses to the storms sourced from social media this work aims to highlight the tenuous link between image and meaning and how this can be warped through appropriation and decontextualisation.
John Doyle (Australia/Australia)

I witnessed the bewilderingly heavy rain which resulted in chaos and tragedy in Toowoomba and the Lockyer Valley in January 2011.

Over hundreds of millions of years, vast quantities of greenhouse gases have been buried in the earth. In the past 300 years we have returned vast quantities to the atmosphere. The science is in - we are changing the world’s climate and chaotic weather events will increase unless we stop greenhouse pollution.

But in this country, vested interests, media barons and the willfully ignorant seem to rule the climate change debate – we still have a lot of coal to sell, it’s economically too difficult, the science is wrong etc. And too many politicians are compromised by corporate donations to show any independent leadership.

But the science just won’t go away.
Hydrocitizen funded arts project with Borth and Tal-y-bont Schools, Ceredigion.

‘The Water Cycle – Past and Present’ lead by Judy Macklin
Building hydrologically resilient and informed communities: the role of the arts

(i) Art-science collaboration can play a central role in exploring societal-water environment interactions, community risk and in myth busting.

(ii) Modern watery myths, centre on the notion that recent floods or droughts, are “unprecedented”, the largest or worst ever and that the primary cause is anthropogenic global warming\(^1\).

(iii) Artists and scientists working together in the community can address these problems in a more ‘joined up’ and holistic way, emphasising their complexity and encouraging individuals and communities to engage with these issues in an informed way.

(iv) We need to move away from environmental rhetoric to environmental realism in decision making. Increased empathy and connection to the watery realm, including human and ecosystem health, can only be achieved by a partnership between the arts and sciences.

(v) The challenge is how successful we can be in identifying ‘communities’ that can develop new evidence-based approaches to solving our most complex challenges (cf. Zaid Hassan [2014]. *The Social Labs Revolution*). My own experience is that we are very poor indeed at doing this.

\(^1\)For the record, I’ve worked on the impacts of floods and droughts for more than 35 years and I am NOT a climate sceptic. Climate change has affected the frequency of extreme hydrological events in the past and it will in the future. But it is only in the last few years that evidence, in the form of a change in the frequency and magnitude of floods and droughts, is beginning to emerge to suggest that anthropogenic climate change is beginning to affect river hydrology. Once the world’s oceans catch up with the warming of continental areas, unfortunately the worst is yet to come.