WEEG NEWSLETTER July-Sept 2021

The newsletter is published monthly by the University of Southampton's Water and Environmental Engineering Group WEEG, and reports things of interest in this field worldwide, as well as ongoing undergraduate student and research work in WEEG itself.

We believe that water and energy are the most important topics worldwide for the next decades. Our work covers river and coastal engineering, water and wastewater and energy related to water.

Editorial: a longer than usual pause, caused by COVID-19 and holidays, but now we are in business again. The recent flood events in Germany, where 153 people lost their lives, have again highlighted the danger of flooding and the impossibility of predicting extreme events. Or have they really?

Hydraulic Engineering International: *Flood event on the Ahr, July 2021*

The Ahr in the West of Germany is a small river, with a total length of 85 km and a maximum flow of 8 m^3/s at its confluence with the River Rhine. On 19 July 2021 a localised extreme rainfall event occurred, with 150 mm of precipitation per square meter in 15 hours. There had been plenty of rain before that, so the ground was saturated and could not absorb much more water. Subsequently, a massive flood wave developed which occurred at night. Warning systems were dysfunctional, and in the event 133 people died. More than 70% of the 4,200 buildings in the Ahr valley were destroyed or damaged. The damage to houses and buildings amounts to more than 6.5 Bn Euros, and to infrastructure possibly twice as much.

Fig. 1: Flooding on the River Ahr

The question of course arises, how could this happen? Is modern hydrological knowledge not capable of predicting such events, and hydraulic engineering capable of defending against them? Is it climate change which causes new, unheard-of extremes? And the warning system - what happened there?

Let's answer the last question first. Part of the answer is simple: the cold war ended and warning systems were more or less discontinued. The possibility of extreme events was considered remote, and more important things than sirens were on the agenda.

The first question requires a bit more digging. Fortunately, the Karlsruhe Institute of Technology has published a study which unravels the situation, at least partially. The actual 100-year event was determined statistically. For the determination of the design event, only homogenous – i.e. continuous - data were used which however were only available from 1947 onwards. This resulted in a 100-year design flow of 241 m3/s. In 2016, a flood event with a flow volume of 236 m3/s was recorded, very close to the 100-year event. The 2021 flood volume was estimated as 400 to 700 m^3/s.

In 1910, however, a massive flood had occurred, with widespread destruction. Based on the recorded rainfall data, the KIT study estimated the flow at 586 m^3/s. Another big event was reported in 1804. Using water level marks, this flood was estimated as 1,100 m^3/s. Fig. 2 shows the recorded and estimated flood flows. The values for 2021 are estimated based on recorded flood levels and rainfall data.

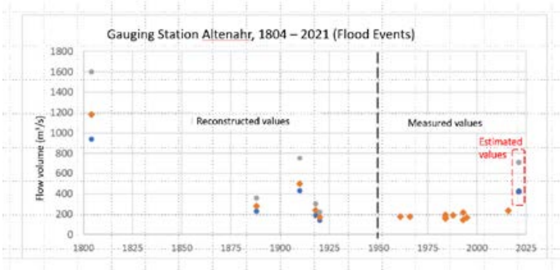

Fig. 2: Flood flows 1804 - 2021

In other words, there were at least two flood events on record within a 200-year period which were significantly higher than the 100-year event derived from the statistical analysis.

Fig. 3: The army installed a temporary bridge

In addition, there were of course several other developments which enhanced the flood wave.

Sealing of surfaces has increased massively since 1910. 10 out of 12 weirs in the river, which had been built for hydropower but of course also slowed down flood waves, were removed within a river re-naturalisation programme in the early 2000s; and land use has changed. A good example is the vineyards, which used to be terraced on the steep slopes. The terraces were replaced with downhill rows of plants, as shown in Fig. 4. This arrangement is easier to work with machines, but just think about rainfall... the water rushes down, of course, and takes a lot of the soil with it.

Fig. 4: Modern vineyard

So, reasons for the high and fast flood wave are manifold. And perhaps we do not need to blame climate change for this flood: other human activities may have been sufficient...

New Chilworth Labs: *Progress*

Our new Laboratory building in Chilworth is progressing nicely:

Fig. 6: New lab building, 15 Sept 2021

We hope to move in next March. Part of the new lab will be able to house a 32 m long, 1.8 m wide tilting flume with wave-current generation, positive and negative tilting angle, and sediment transport capability. This will be possibly the most advanced flume facility in the world. We have applied for funding, so let's hope we get it... The new building will also house a 12 m long small flume and a 20 m long and 0.4 m wide wave tank, as well as our new Environmental labs on another floor. This facility will provide excellent opportunities for state-of-the-art research and teaching.

COVID-19: *Lab class at home*

Teaching during the pandemic had to be flexible, with recorded lectures online, live seminars, and not least the big question of how best to conduct assessments and examinations Within WEEG, we started to look at the possiblity of designing lab experiments which students can do at home. This is an interesting option since, in particular for larger groups and for final year students with lots of elective modules, lab classes can be difficult to timetable. So, we are creating experiments where students can measure and interpret data off site. This is challenging but seems possible, and for our Coastal Engineering module a set of experiments is being developed which we hope to introduce in practice in the next academic year.

Contact: Dr Gerald Muller g.muller@soton.ac.uk

Individual Projects: *Biotechnology*

This year saw topics across all aspects of the circular bioeconomy, from nutrient and resource recovery to bioenergy production. There were IPs on farm-based aquaponics, AD and microbial electrochemical biomethanation, and VFA and PHA production, with forward osmosis as an enabling technology. Instead of the usual poster day our Year 3 students made short video presentations: now the degree results are out we will add these to our sites.

Contact: Dr Yue Zhang, Y.Zhang@soton.ac.uk

Jobs in water engineering:

This section gives you ideas of the type of work you can do when working in industry

Civil and Environmental Engineering at Southampton University:

WEEG: our modules offer the chance to deepen your knowledge in water-related areas, and give better preparation for environmental engineering projects

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Further information:

We have two Facebook pages, which provide a logbook of our laboratory activities:

www.facebook.com/Hydraulicslaboratory/

www.facebook.com/environmental.lab.university.of.southampton

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