

# Minutes

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Date: Oktober 4th 2021

Subject: 4th Dutch-German workshop 'From flood forecasts to effective emergency response measures'

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## Summary

A two-day workshop was held at Magdeburg/Germany with the subject of the translation of flood forecasts to emergency response measures, organized by Deltares on behalf of the working group "Wiki Noodmaatregelen" and the University of Applied Sciences of Magdeburg-Stendal (HS-M). A delegation of Dutch water professionals and scientists were welcomed warmly at the Agency for Flood Protection and Water Management of Saxony-Anhalt (LHW) in Magdeburg. The visit consisted of a field trip to the levees at the by-pass river for the Elbe as well as many presentations were given divided in several sessions such as flood forecasting and extreme precipitation events as well as crisis management and much more. An excursion to the historic Pretzien Weir was part of the visit. During the workshop many interesting views and discussions arose between German and Dutch parties about e.g. the surveying and maintenance of levees. Hopefully this visit will be followed up with further cooperation.



Figure 1 Opening of workshop at LHW headquarters.

Day before (Tuesday 27<sup>th</sup> of September)

Several workshop participants arrived early in the evening on Tuesday. For this evening a get-together was organized to start the coming workshop in an informal matter.

Day 1 (Wednesday 28<sup>th</sup> of September)

On Wednesday morning the Dutch group was greeted with a warm welcome at the headquarters of the Landesbetrieb für Hochwasserschutz und Wasserwirtschaft (LHW) in Magdeburg / Saxony-Anhalt. The LHW is an agency of the Ministry for Science, Energy, Climate Protection and Environment. Because the bus to the levee inspection was running late due to delays, there was time to introduce each of the workshop participants inside the venue. The Dutch delegation was welcomed by Mr. Burkhard Henning, executive director of LHW and Mr. Sven Schulz, head of division Flood Protection and Maintenance of Watercourses and Facilities of the Ministry of Environment of Saxony-Anhalt. After a short while the bus had arrived at the LHW and the group could leave for the Magdeburg levee inspection.



*Figure 2 Round of introductions.*

The German hosts showed the flood protection measures along the Elbe by-pass river (Old Elbe). This by-pass is used when high water levels will occur to reduce the water levels in the main Elbe river. During this visit there was time to share first thoughts, ideas and problems. For example, Mr. Ronald Günther from the LHW spoke about having difficulties with having sufficient and well-trained staff available to inspect the levees and other flood protection measures (short-handed for the amount of km's of levees). Additionally, the inspections are done by trained inhabitants of the area which is different compared to the Netherlands where regional water authorities are responsible. Also, the levee inspectors use written instructions and also report with pen and paper. Furthermore, discussions about problems with animal burrows, making levees weaker, being familiar to both the Germans and the Dutch. Lastly, also discussions about the knowledge concerning a grass cover of good quality.



Figure 3 Impressions of visit to levees of the Old Elbe (by-pass of the Elbe River).

After the bus ride back to the LHW headquarters, a delicious lunch was waiting for the group. Along with soup, sandwiches and desserts. After lunch, the workshop was officially opened by prof. dr. Daniel Bachmann of the University of Applied Sciences Magdeburg-Stendal. Wout de Vries (Rijkswaterstaat) looked back at the history of our cooperation and introduced the background and the necessity of this workshop. In addition, he presented an observer's perspective of the 2021 floods in Limburg (NL), by means of some pictures. The floods in July 2021 at the Meuse showed that it was difficult to come up timely with correct predictions of water levels and river discharges respectively for such an exceptional situation in summer, as well as concerning the relations between the forecasts and warning levels with the first responders and crisis management.

The common objective is to write a handbook on flood emergency response. There is no funding so far, but the plan by RWS is to give it a go. The German colleagues are invited to join in this process.



Figure 4 Wout de Vries (RWS) setting the scene.



The next presentation of Janine Oelze (*Central Forecasting Office Elbe*) fitted the daily subject of the workshop: Flood Forecasting. Janine Oelze presented how they had built up the model to be able to forecast (up to 8 days before) the water levels and discharges along the Elbe river. WSA and LHW work with a set of coupled models, rainfall-runoff and hydrodynamic models, to forecast water levels in the Elbe River. WSA Magdeburg provides water level forecasts and LHW checks them and anticipates on these forecasts. The Elbe has three controllable weirs and 14 flood protection systems, which are steered based on the forecasts for the Elbe.

Two different hydrodynamic models are used, namely WAVOS-1D and since 2018 SOBEK-1D, because of need for higher quality flood forecasts. WAVOS will be out of use soon, but the LHW wants to have a flood event first to test and improve the SOBEK-1D setup before they do so. Boundary condition water levels and also forecast water levels are present for a set of locations along the main course of the Elbe. Recently, improvements were made to the model, such as the inflow of the Elbe from the Czech Republic as well as the influence of the tide at the downstream end. A large set of rainfall-runoff models, with for almost every tributary of the Elbe a different model has been added. For instance, HWVOR for Saale and Schwarze Elster, Hydpy for the Mulde, etc.

There is no automatic model calculation present. The hydrologist on duty manually runs the models once a day. Hence, forecasts are present once a day or twice a day during flood situations. The system that is used for this, is called Calypso.



Figure 5 Janine Oelze (LHW).

Following up the forecasting subject of the day, Ruben Imhoff (Deltares) presented the subject of nowcasting of rainfall. Nowcasting precipitation is the forecasting of rainfall from now to +6 hours. It combines radar data together with wind data to estimate the route and lifetime of storms. The difficulty lies in the estimation of heavy, short-lived and small storms, as they can alter quickly. This way of modelling can be used to provide warnings for flood crisis management. These predictions can change after each model run (model takes ~3 hours to run). Therefore, Ruben proposed a warning with a corresponding measure of likelihood. The nowcasting model performance can be improved by using other models, which are used to model weather changes over longer time periods.

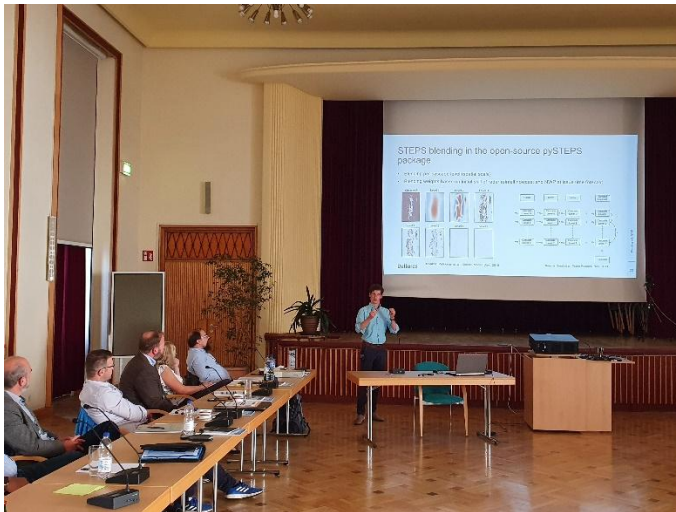


Figure 6 Ruben Imhoff (Deltares).

The last presentation of Wednesday was by Wijnand Evers (water authority Drents Overijsselse Delta) to demonstrate the digital application the water authority uses to inspect levees. Within this digital application levee inspectors can map the outcomes of their inspections. The water authority can also keep track of earlier inspections and monitor whether difficulties with the levee have been getting worse. This small demonstration was added to the program on request of the German delegation. Wijnand Evers offered to come back to Magdeburg to give a short course for the local levee inspectors!



Figure 7 Wijnand Evers (Drents Overijsselse Delta) demonstrating the digital app for levee inspectors.

After this session the workshop participants were asked to enter the bus once again. After a short stop at a hotel in the floodplain, which was rebuilt on piles for protection against flood, the party travelled further to the last stop of the day: the historic Pretzien Weir. At the location a film was shown introducing the functioning of the weir as well as the recent restoration performed on the weir. During the film a barbeque had been prepared, so after the film a delicious meal has been waiting for the group. After dinner the weir supervisor and a colleague showed the Dutch delegation the workings of the weir and its opening. To open the weir, single smaller panels have to be removed from the middle outwards.



Figure 8 In the floodplain and at the historic Pretzien Weir.

#### Day 2 (Thursday 29<sup>th</sup> of September)

The second session started with a presentation about the crisis management during the floods of 2002 and 2013 of the Elbe at Magdeburg by Thilo Weichel (LHW). In 2002, the flood protection systems of the Elbe River were not up to today's standards. Although most of the regions was protected by dikes, there were no dikes everywhere and many were not up to the standards we have now. This resulted in 310 dike failures. During this flood, the area experienced a total of 17 levee breaches and the estimated damage was approximately 2 billion euros.

Flood documentation was not part of the process before 2002, but a first documentation effort was made using satellite imagery and aerial photography for flood extent, and hand measurements of maximum water levels. This documentation also gave an impression of the needs for real-time documentation (DTM<sup>1</sup>, levee documentation and register, flood protection plans and the surveying of levees). during flood occurrences, which was later used during the 2013 floods. Since 2002, a documentation including datasets of the state of the system started.

Important lesson for LHW was that most of the dike damages and/or breaches took places there where trees were growing on or right next to the dikes. The rooting system of the trees heavily impacts the dikes and may weaken the structure during flood situations. Clear decision, based on these findings, not to plant trees at and to remove trees near new dikes.

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<sup>1</sup> Digital Terrain Model



2010, a flood protection concept for the period until 2020 was drafted, including the following plans:

- Different and new flood protection measures for the Elbe system.
- Application of retention basins to smoothen and lower flood peaks.
- Application of polder areas to smoothen and lower flood peaks.
- Setup of flood risk management plans, including the communication of those plans. It should also be clear to citizens that they will never be 100% safe from floods.

The new flood protections plans based on flood risk management instead of flood protections and were supposed to be active till 2020.

The flood of 2013 followed, testing the system with the highest water levels on record for the Magdeburg area and surrounding regions. Diike breaches did happen again, e.g. in between the Elbe and Havel, and in between the Elbe and Saale (near Breitenhagen). Both breaches were later on modelled in 2D flood maps to assess the impact. However, the new dikes and protection measures that followed from the 2002 floods did last and resulted in no damages. The Havel polder was successfully used to lower the flood peak, but total damage was still around 2.7 billion euros.

It was obvious that the previous plans weren't relevant anymore and needed another revision. Several valuable experiences arose from this almost 20-year recent history, namely the need for proper communication between parties, more trust in the own flood forecasting capabilities, the usefulness of GIS & model data to estimate inundation areas, pragmatic solutions for closing breaches and the need for better use of social media to reach a wider audience and update them. However, new data, plans and concepts are needed for the future. Also, more staff members and knowledge are needed to manage these floods. Since then almost all levees have been strengthened with a total investment of 1.2 billion euros.



Figure 9 Thilo Weichel (LHW)



Figure 10 Stephan Rikkert (TU Delft)

Stephan Rikkert (TU Delft) then took the floor to present work package 1 of the EU-funded Polder2Cs project (<https://polder2cs.eu/>). Within the Hedwige-Prosperpolder levee experiments can be conducted under multiple destructive conditions. Within this project solutions for many failure mechanisms can be developed. This dike can breach without impact, because it will be removed for nature restoration in due time. Hence, it gives an ideal playground for levee tests.

Some scenarios that are tested in order to see how they impact the dike during overflowing events:

- Presence of a tree at the dike
- A brick wall and stairs on the dike
- Animal burrows in the dike (tested with visual inspection, smoke tests to see how they are connected, ground penetrating radar and electrical resistivity tomography)
- Different dike soil compositions
- Wave impacts on the dike

Later on, two breach experiments will be conducted to test the advantage a foreshore can have on lowering the impact of a breach.

WP2 was explained in the presentation of Wout de Vries later on. WP3 of this project focusses on knowledge infrastructure and transfer. Main goal here is to turn results into useful tools and education of the next generation of water managers, hydrologists, etc.

The project is mainly about the understanding of levee behavior under varying conditions and to share and document findings. This is a European funded project with partners from Belgium, France and the UK. Additionally, there are programs such as the Winter School and Levee Challenges for students to learn about levee inspections and repairs.

Stephan Rikkert, in name of the Polders2C's consortium, invites the German attendees to join to and their students are welcome for the experiments and winter schools that are organized.

Responding to a question from Thilo Weichel, whether there is any knowledge transfer, as part of WP3, to the normal citizen or to school children: This is not the case, but it will be taken into consideration.



Then a presentation was given by Daniel Bachmann (HS-M) about the 2021 flood of small and medium size rivers with origin in medium range mountains like the Eifel, from a German observer's perspective. The flood situation was a combination of flash floods and pluvial floods, the latter being harder to forecast.

Bachmann's group performed a rapid retrospective modelling exercise to assess the flood, purely based on the available open data at that point. They used a coupled 1D-2D model to forecast river discharges and translate this into inundation maps. Only the tools ProMalDes and QGIS were used for this. With this model calculations could be done regarding water flows and the resulting damages. One of the tributaries of the Rur, the Vicht creek, gave a  $130 \text{ m}^3/\text{s}$  discharge, which is 130 times the normal discharge. As a result of that, a secondary river channel formed in the main street of the nearby city causing a lot of damage.

Based on open-source news information and pictures, the simulated inundations were validated. Landsat imagery was also used for this. Results are promising, especially considering the quick assessment that it was. However, the rough estimation of the damages (part of the impact) was still highly underestimated, mostly because infrastructural damages were not well enough modelled and taken into account.

With this model he would like to emphasize the need for a holistic, catchment-based approach for flood risk analyses. With this approach different solutions against flooding can be analyzed and better choices can be made. Daniel Bachmann proposes to state the profit as flood risk reduction per euro, because in that way different measures can be compared per location.

In line with Thilo Weichel's statement, there is a clear need for better communication of our results to the general citizens and between different organizations (for instance forecasters, emergency response coordinators and teams on site during a flood crisis).

The question is what information is necessary for a chain from forecasting to emergency measures and are our current discharge and water level forecasts sufficient or should we move to impact-based forecasts.

Bachmann proposes to use 1D-2D coupled models for inundation forecasts and visualizations, which will make it possible to communicate where and when streets will be closed, the electricity will be shut down and so on.

Questions and notes from the audience:

- How do we go from research to practice when resources are limited? (question remained open during the discussion)
- We should be careful with the expectation we raise and the information we give to the general public.
- Flood hazard maps should be informative and indicate the needed scenarios. An example given was during the 2021 floods where a municipality flooded. The mayor had decided not to evacuate the town, because the flood maps presented to him (based on return periods that were lower than what occurred) indicated that a flood of the town would not be likely.



Figure 11 Presentation of prof. Daniel Bachmann (HS-MS) and Wout de Vries on behalf of Bart Vonk.

And lastly, Wout de Vries presented, on behalf of Bart Vonk (Rijkswaterstaat), the Dutch activities on emergency response by means of the work in Work Package 2 of the Polders2C's project and the need for international cooperation regarding the emergency measures during floods.

Main point during this presentation is that the Netherlands is already for a long time quite well protected against flooding and as a result of that, the Dutch actually have a lack of expertise on flood crisis situations. Therefore, the Netherlands seeks, through Rijkswaterstaat, for active collaboration with other agencies abroad to learn from each other and get a community of practice. This way countries can learn from each other by exchanging knowledge. One way is to do this via a handbook for describing emergency response principles.

In WP11 of Polders2C's emergency responses are practiced and tested in the living lab of the Hedwigepolder in a consortium of Dutch, British, Belgian and French agencies. Goal is to learn from it and write a handbook about best practices. Once again, all participants are invited to join in this collaborative effort.

The session was closed with another delicious lunch, followed up by a short final discussion session.

The following points followed from the discussion:

- Drents Overijsselse Delta may organize the workshop next year. Another idea is to join in the final stage of Polders2C's, which would allow to do an experiment together. The possibilities of that depend on the agenda of the project and will be explored.
- Handbook on flood risk response: it is still not sure if any funding will be present (or come) for this. However, LHW has decided to team up with Rijkswaterstaat here to make this happen and to contribute practical experiences.
- Announcement: all presentations, minutes and additional information about the current and past Dutch-German workshops can be found on the Dutch website [www.wiki-noodmaatregelen.nl](http://www.wiki-noodmaatregelen.nl).
- Polders2C's: Stephan Rikkert invites students to join in upcoming workshops, winter schools and challenges.
- From the German side:
  - Request to work together on the handbook (see above).
  - No other concrete plans yet.
- Impact-based forecasting:

- Daniel Bachmann invites everyone to team up for EU grants on this topic. The HS-M is not big enough to lead this but invites TU Delft and Deltares to do so.
- It is decided to invite the French partners again. Question to all current participants to let the organizers know which parties to invite to make sure there is a good attendance.
- Wijnand Evers (Dents Overijsselse Delta) invites the German attendants to inspect a levee together, either in Germany or in the Netherlands.

Finally, the workshop was formally closed at the LHW headquarters in Magdeburg.



Figure 12 Group picture of the attendees at the LHW headquarters.

