

## The Ahr disaster 2021: Path to a scenario-based mission profile for HEMS with hoists using historical evidence and reconstructed peak discharges

### Author

Schiffarth M (1, 2, 3)

<sup>1</sup> ADAC Luftrettung gGmbH, Medical Operations, Germany

<sup>2</sup> Medical Officer in Charge, Local EMS authorities Ahrweiler, Germany

<sup>3</sup> German Red Cross, Rhineland-Palatinate, Germany

### Background

On the 14th/15th July 2021, the district of Ahrweiler (Germany) (**Fig. 1; A-D**) was hit by a flash flood (**Fig. 1; A-D**) of catastrophic and extreme proportions; 134 people died and more than 750 were injured [17]. Scenario-based knowledge in relation to the expected main areas of operation for HEMS with hoist, taking into account reconstructed peak discharges ( $Q_{mean}$ ) (**Fig. 1, D, Fig. 3-5**) and historical reports, are currently not available.

### Method

Comparative analysis of the 2016 Flood of the Century [1] (**Fig. 2**) and the Ahr disasters of 2021, 1910 and 1804 (**Fig. 1, 3-4**) in terms of discharge dimensions (**Fig. 1-4, D**) and the resulting damage pattern [2], with particular consideration of relevant mission profiles (**Fig. 1-4, E**) for HEMS with hoist in 2016/2021.

### Results

134 dead in 2021 (**Fig. 1**), 52 dead in 1910 (**Fig. 3**) and 63 dead in 1804 (**Fig. 4**). Centenary flood 2016 - Rescue and evacuation of campsites, no fatalities. In 2016, a total of 42 people were rescued from life-threatening situations (34 with a hoist), no fatalities. **Focus 2016:** Rescue and evacuation of campsites (**Fig. 2, E<sub>1</sub>**).

In 2021, hundreds of houses were destroyed (**Fig. 1**), hundreds of people were rescued with a hoist the day after the flash flood - discharge was 1120 [m<sup>3</sup>/s] and is most likely reflected in the Ahr disaster of 1804 (discharge: 1210 [m<sup>3</sup>/s]). In 1804, 129 houses disappeared and 469 were badly damaged. **Focus 2021:** Rescue from house roofs (**Fig. 1, E<sub>2</sub>**).

### Conclusion

In the context of reconstructed historical discharge, current and historical disaster reports offer an *initial basis for scenario development*, training and preliminary planning of priority tasks for emergency services and HEMS with hoist.

Whether an *impact forecast* (**Fig. 5a-b**) for heavy rain and flash floods with high spatial and temporal resolution allows a preemptive allocation (**Fig. 5b**) of HEMS with hoist requires further evaluation.

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- [1] Demuth N, Gerlach N, van der Heijden S, Johst M (2016) Bericht Starkregen und Hochwasser in Rheinland-Pfalz im Mai/Juni 2016, Landesamt für Umwelt Rheinland-Pfalz, Mainz
- [2] Bihani G L, Paystrate O, Gaume E, Moncoulon D et al. (2017) The challenge of forecasting impacts of flash floods: Test of a simplified hydraulic approach and validation based on insurance claim data. Hydrology and Earth System Sciences, 21 (11), 5911 – 5928. <https://doi.org/10.5194/hess-21-5911-2017>
- [3] Seel K A (1983) Die Ahr und ihre Hochwässer in alten Quellen, Heimatjahrbuch für den Kreis Ahrweiler 40, 91–102.
- [4] Roggenkamp T, Herget J (2014) Reconstructing peak discharges of historic floods of the river Ahr, Germany. Erdkunde, 68(1), 49–59. <https://doi.org/10.3112/erdkunde.2014.01.05>
- [5] Frick, H (1955) Das Hochwasser von 1804 im Kreise Ahrweiler. Heimatjahrbuch des Kreises Ahrweiler 1955. S. 43-51.
- [6] Schiffarth M, Link A, Lepping T et al. (2019) Heavy rain, flood, torrent & landslide. Use historical information! CRM-based operational analysis of the centenary flood in Ahr Valley 2016. Anästhesiologie & Intensivmedizin, Aktiv Druck & Verlag GmbH, Supplement (DINK 2019).
- [7] Postcard: Wetterkatastrophe im Ahratal 13. Juni 1910, Photographie: local history museum Adenau
- [8] Groß, P (1910) Zur Erinnerung an die Wetterkatastrophe bei Ahrweiler an der Ahr, Photographie, Elberfeld
- [9] Scherer, Königlicher Landrat (1911) Bericht über die Hochwasserkatastrophe im Kreise Adenau vom 12./13. Juni 1910, Beilage zum Verwaltungsbericht des Kreises Adenau für das Jahr 1910
- [10] Janta L, Poppelreuter H (2010) "... Das Elend übersteigt jeden Begriff..." - Ahr-Hochwasser am 12. /13. Juni 1910 forderte 52 Menschenleben, Heimatjahrbuch Kreis Ahrweiler 2010
- [12] Merz B, Kuhlick C, Kunz M et al. (2020) Impact Forecasting to Support Emergency Management of Natural Hazards. Reviews of Geophysics (Vol. 58, Issue 4). Blackwell Publishing Ltd. <https://doi.org/10.1002/2020RG000704>
- [13] Roggenkamp T, Herget J (2022) Projektbericht: Hochwasser der Ahr im Juli 2021 – Abflussabschätzung und Einordnung. Hydrologische Notizen Projektberichte – Workshops – Konferenzen, HW 66. 2022, H.1.
- [14] Landesamt für Umwelt Rheinland-Pfalz (LfU) (2022) (preliminary data based on reconstructed hydrographs)
- [15] DKKV Newsletter 09/2021. (2021) Flutkatastrophe Juli 2021 Vom Starkregen zur Katastrophe. <https://www.bbk.bund.de/SharedDocs/Downloads/DE/>
- [16] Neal R A, Boyle P, Grahame N et al. (2014) Ensemble based first guess support towards a risk-based severe weather warning service. Meteorological Applications, 21, 563–577. <https://doi.org/10.1002/met.1377>
- [17] DKKV Anfrage (2022) Informationen zur Flutkatastrophe im Ahratal. Opfer-und Schadensdaten der Flut 2021, DKKV Anfrage, Informationen zur Flutkatastrophe im Ahratal, 01.02.2022.
- [18] Schmid-Johannsen J, Lang U, Heiliger N (2021) SWR Datenanalyse zur Flutkatastrophe an der Ahr, Stand 24.11.2021, <https://www.swr.de/swraktuell/rheinland-pfalz/flut-in-ahrweiler-so-gross-ist-der-schaden-104.html>; Download am 18. Juni 2022

# THE AHR DISASTER 2021

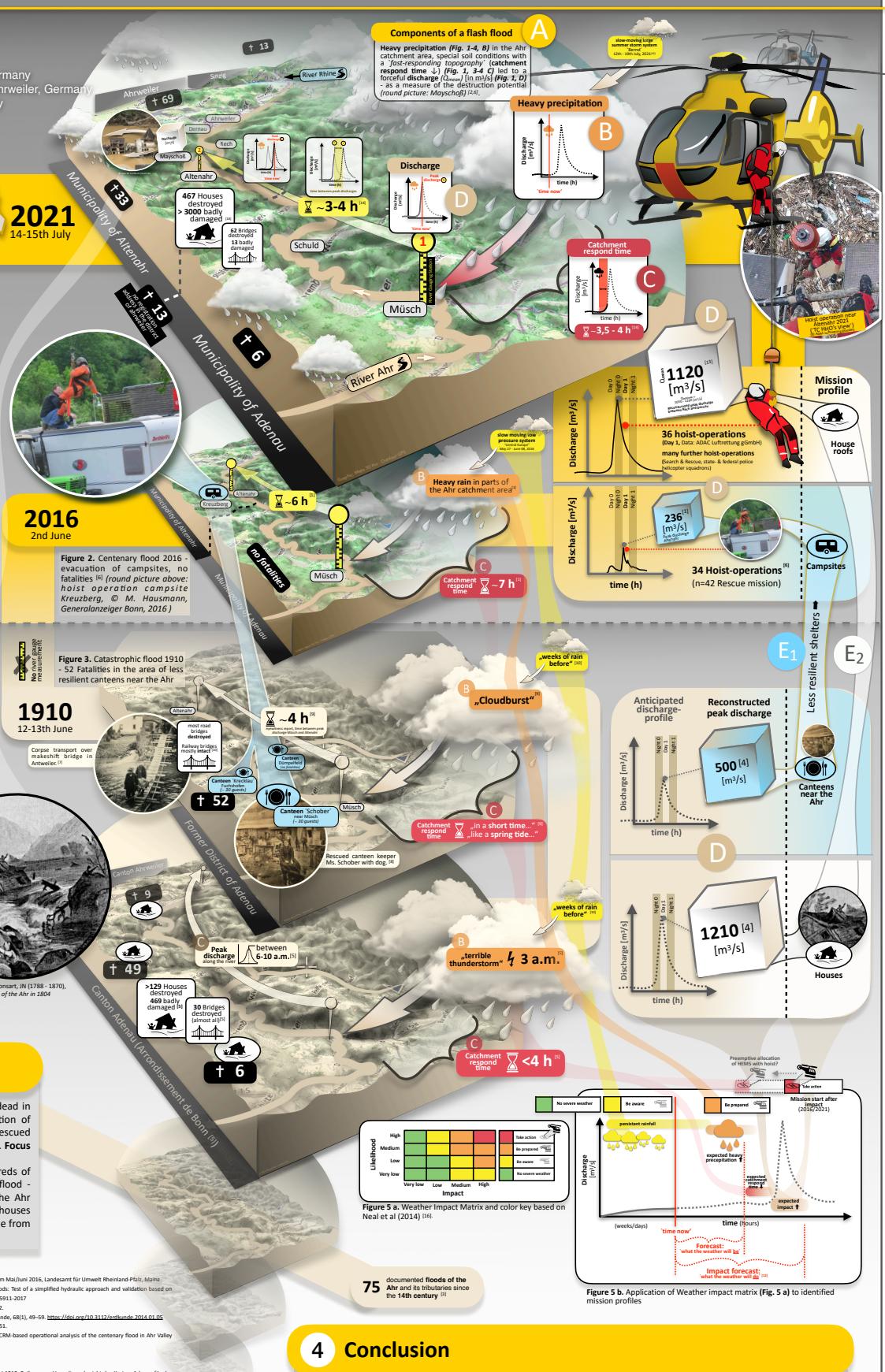
## PATH TO A SCENARIO-BASED MISSION PROFILE FOR HEMS WITH HOISTS USING HISTORICAL EVIDENCE AND RECONSTRUCTED PEAK DISCHARGES

### Schiffarth M 1, 2, 3

1 ADAC Luftrettung gGmbH, Medical Operations, Germany  
2 Medical Officer in Charge, Local EMS authorities Ahrweiler, Germany  
3 German Red Cross, Rhineland-Palatinate, Germany



Figure 1. Location of the Ahr Valley in the north-western part of Europe, mid-west of Germany



### 1 Background

On the 14th/15th July 2021, the district of Ahrweiler (Germany) (Fig. 1) was hit by a flash flood (Fig. 1, A-D) of catastrophic and extreme proportions; 134 people died and more than 750 were injured [17]. Scenario-based knowledge in relation to the expected main areas of operation for HEMS with hoist, taking into account reconstructed peak discharges ( $Q_{mean}$ ) (Fig. 1, D, Fig. 3-5) and historical reports, are currently not available.

### Experience-based knowledge

### Historical evidence

### 2 Methods

Comparative analysis of the 2016 Flood of the Century [1] (Fig. 2, A-D) and the Ahr disasters of 2021, 1910 and 1804 (Fig. 1, 3-4) in terms of discharge dimensions (Fig. 1-4, D) and the resulting damage pattern [2], with particular consideration of relevant mission profiles (Fig. 1-4, E) for HEMS with hoist in 2016/2021.

### 1804

2th Thermidor (heat month)

Figure 4. Catastrophic flood 1804 - Fatalities in the area of the upper to the middle Ahr

Lithography: Rennert, IN (1788 - 1870),  
The flood of the Ahr in 1804

### 3 Results

134 dead in 2021 (Fig. 1), 52 dead in 1910 (Fig. 3) and 64 dead in 1804 (Fig. 4). Centenary flood 2016 - Rescue and evacuation of campsites, no fatalities. In 2016, a total of 42 people were rescued from life-threatening situations (34 with a hoist), no fatalities. Focus 2016: Rescue and evacuation of campsites (Fig. 2, E).

In 2021, hundreds of houses were destroyed (Fig. 1), hundreds of people were rescued with a hoist the day after the flash flood - discharge was 1120 [ $m^3/s$ ] and is most likely reflected in the Ahr disaster of 1804 (discharge: 1210 [ $m^3/s$ ]). In 1804, 129 houses disappeared and 469 were badly damaged. Focus 2021: Rescue from house roofs (Fig. 1, E2)

### 4 Conclusion

In the context of reconstructed historical discharge, current and historical disaster reports offer an initial basis for scenario development, training and preliminary planning of priority tasks for emergency services and HEMS with hoist. Whether an impact forecast (Fig. 5-a) for heavy rain and flash floods with high spatial and temporal resolution allows a preemptive allocation (Fig. 5-b) of HEMS with hoist requires further evaluation.

**ADAC Luftrettung**

- [1] Demuth N, Gerlach N, van der Heijden S, Jost M (2016) Bericht Starkregen und Hochwasser in Rheinland-Pfalz im Mai/Juni 2016, Landesamt für Umwelt Rheinland-Pfalz, Mainz
- [2] Bilhan G L, Paynter O, Gaume E, Moncoulon O et al (2020) The challenge of forecasting impacts of flash floods: Test of a simplified hydraulic approach and validation based on insurance claim data. Hydrological Earth System Sciences, 21 (10), 3911–3928. <https://doi.org/10.5194/hess-21-3911-2017>
- [3] Seidl K A (1919) Das Hochwasser von 1804 in Kreis Ahrweiler. Meteorologische Beobachtungen des Kreises Ahrweiler, 68(1), 91–102
- [4] Roggendorf T, Hegel J (2014) Reconstructing peak discharges of historic floods of the river Ahr. Geomorphology, 204, 49–59. <https://doi.org/10.1016/j.geomorph.2014.01.005>
- [5] Fröhlke H (1953) Das Hochwasser von 1804 in Kreis Ahrweiler. Heimatbuch des Kreises Ahrweiler 1953, 5, 43–51.
- [6] Schiffarth M, Link A, Leppig T et al. (2019) Heavy rain, flood, torrent & landslide. Use historical information! CRM-based operational analysis of the centenary flood in Ahr Valley 2016. Anabiosis & Intensivmedizin, Aktiv Druck & Verlag GmbH, Supplement (DINX 2019).
- [7] Postcard: Wetterkatastrophe im Ahrtal 13. Juni 1910, Photographie: local history museum Adenau
- [8] Größl P (1910) Zur Erinnerung an die Wetterkatastrophe bei Ahrweiler. Photographic, Ellerstadt
- [9] Schäfer, Wetterkatastrophe im Ahrtal (1911) Bericht über die Wetterkatastrophe im Kreis Ahrweiler vom 12./13. Juni 1910, Beilage zum Verwaltungsbüro des Kreises Ahrweiler für das Jahr 1910
- [10] Janta C, Poppeler H (2010) „Das Elend übersteigt jeden Begriff.“ – Ahr-Hochwasser am 12./13. Juni 1910 forderte 52 Menschenleben, Heimatbuch Kreis Ahrweiler 2010
- [11] Merz B, Kuligk C, Kunz M et al. (2020) Impact Forecasting to Support Emergency Management of Natural Hazards. Reviews of Geophysics (Vol. 58, issue 4). Blackwell Publishing Ltd. <https://doi.org/10.1029/2019RG000200>
- [12] Reichenbach T, Hegel J (2022) Projektbericht: Hochwasser der Ahr im Juli 2021 – Abflussberechnung und Einordnung. Hydrologische Notizen Projektberichte – Workshops – Konferenzen – Berichte, 2022, 1, 1–10
- [13] Landesamt für Umwelt Rheinland-Pfalz (LUR) (2021) (preliminary data based on reconstructed hydrography)
- [14] DKV Anfrage (2022) Informationen zur Flutkatastrophe im Ahrtal. Opfer- und Schadensdaten der Flut 2021. DKV Anfrage, Informationen zur Flutkatastrophe im Ahrtal, 01.02.2022
- [15] Neal R A, Boyle P, Graham N et al. (2014) Ensemble based first guess support towards a risk-based severe weather warning service. Meteorological Applications, 21, 563–577. <https://doi.org/10.1002/met.1777>
- [16] DKV Anfrage (2022) Informationen zur Flutkatastrophe im Ahrtal. Opfer- und Schadensdaten der Flut 2021. DKV Anfrage, Informationen zur Flutkatastrophe im Ahrtal, 01.02.2022
- [17] Schmid-Johansen J, Lang U, Haugler N (2021) SWR Datenbasis zur Flutkatastrophe an der Ahr, Stand 24.11.2021, <https://www.swr.de/swraktuell/rheinland-pfalz/flut-in-schmid-joehansen-j-lang-u-haugler-n/2021>, Download am 18. June 2022