20 ANS MRN au service de la connaissance et de la prévention des risques naturels

Jordis TRADOWSKY
Scientist
Deutscher Wetterdienst

Inondations extrêmes en Allemagne et en Europe de l'Ouest de juillet 2021

Evaluation de l'impact du changement climatique sur les fortes précipitations au cours de cet événement

Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD

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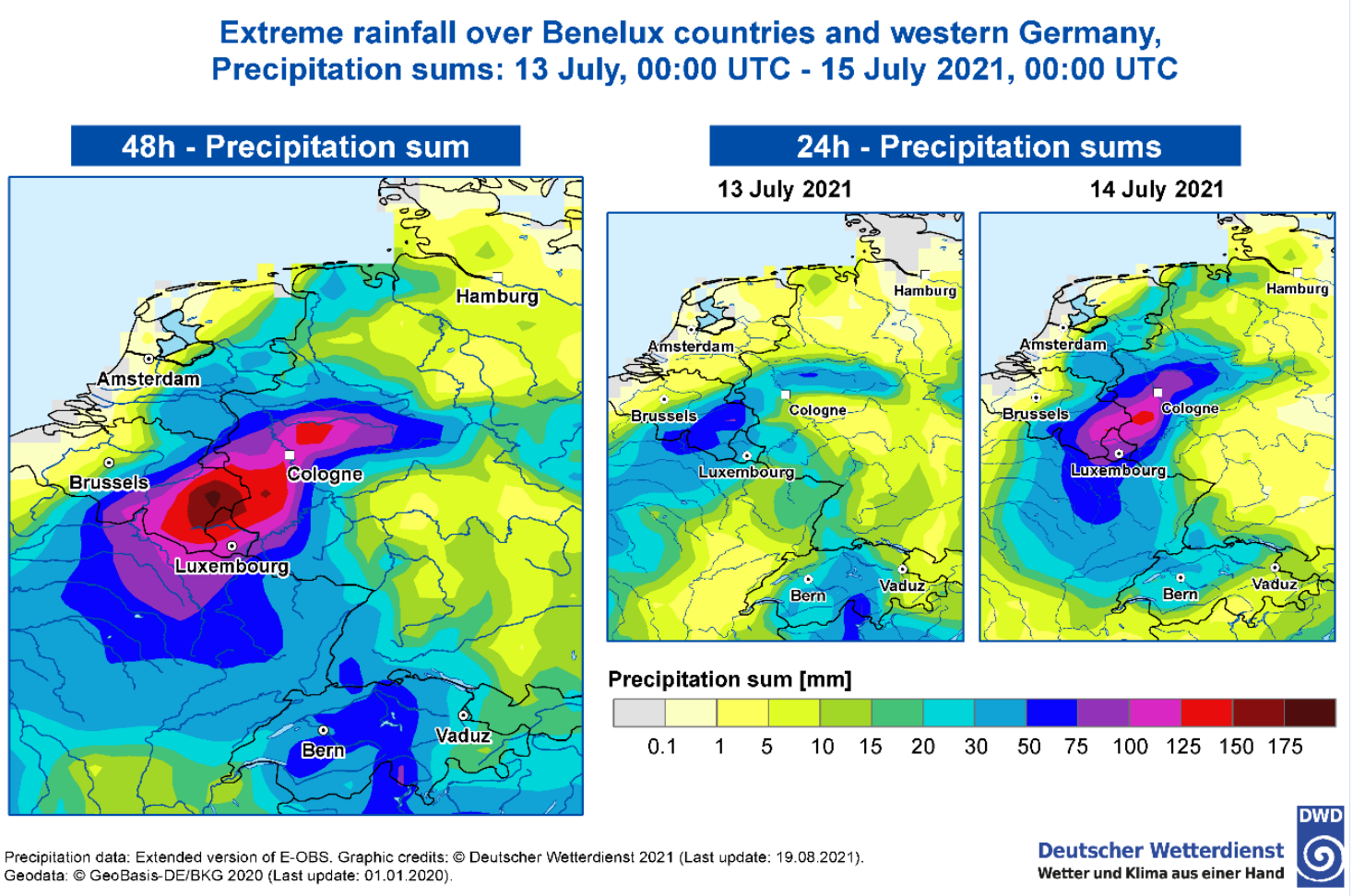
Severe flooding in Germany and Western Europe during July 2021 - Evaluating the impact of human-caused climate change on the heavy rainfall event

Jordis Tradowsky[1,2], Frank Kreienkamp[1] and Philip Lorenz[1]
[1]Deutscher Wetterdienst, [2]Bodeker Scientific

Motivation

- In July 2021 severe flooding occurred in Germany and the Benelux countries.
- The event led to strong impacts with more than 200 fatalities and severe infrastructure damage leading to an estimate of €4.5 to €5.5 billion insured damages.
- Following the event World Weather Attribution initiated an attribution study (Kreienkamp et al., 2021).

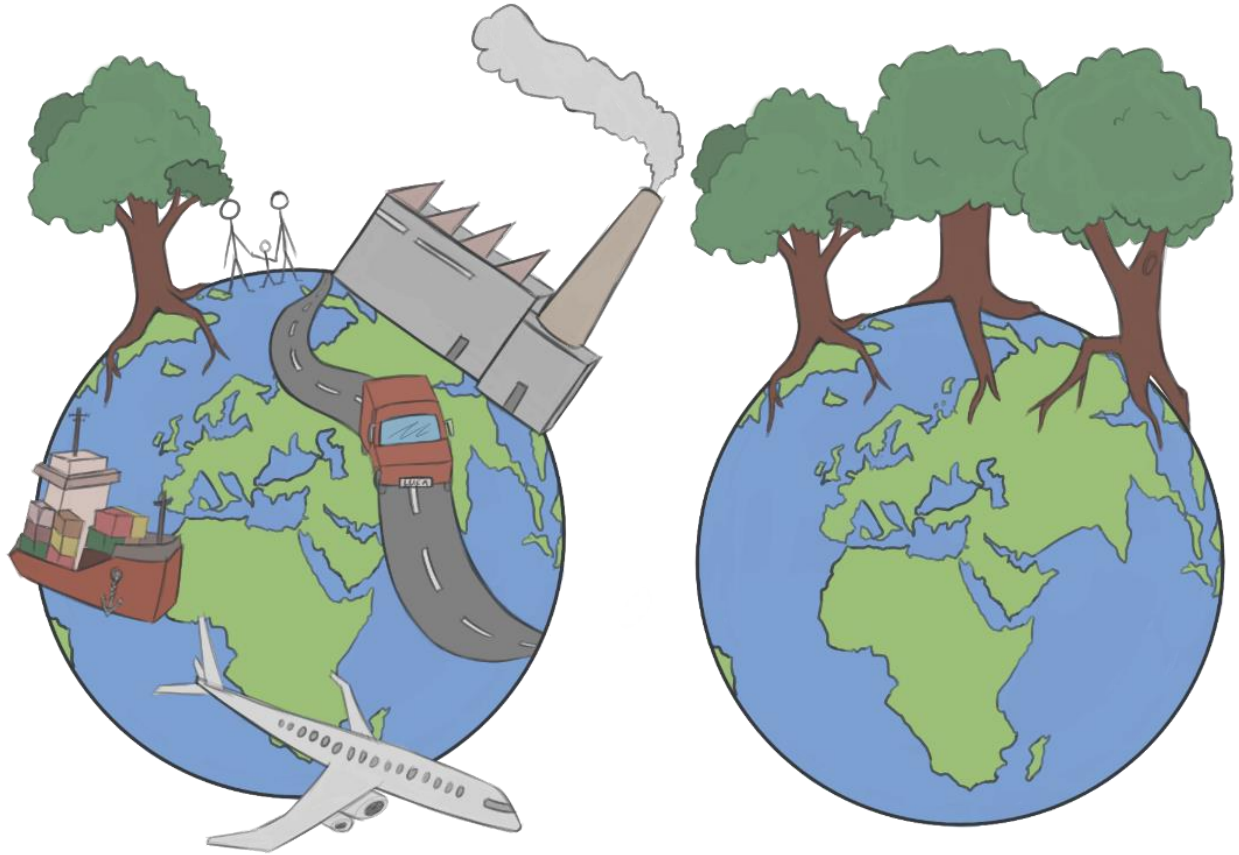


Introduction World Weather Attribution (WWA)

- The *World Weather Attribution* initiative was established in 2015 to
  - evaluate influence of climate change on specific extreme events.
  - inform media, public and decision makers within weeks following the event.
- The studies are based on peer-reviewed methods (Philip et al., 2020, and van Oldenborgh et al., 2021) and are published on https://www.worldweatherattribution.org/.

Extreme event attribution

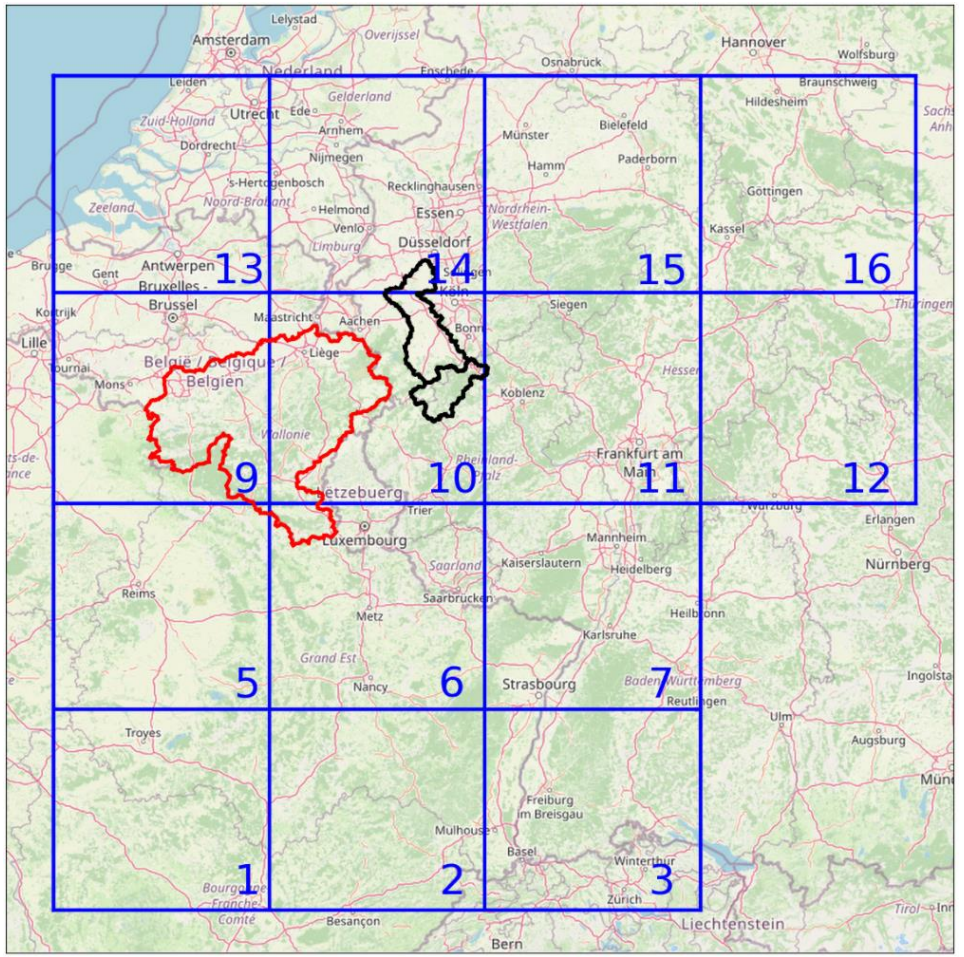
- Answers questions such as:
  - Has climate change increased the likelihood of such an event?
  - Has climate change made this event more severe/stronger?
- Compares extreme events in the current climate and in a climate with no/little human impact.



The world with human influence (left), world without human influence (right). © Hanna Luca

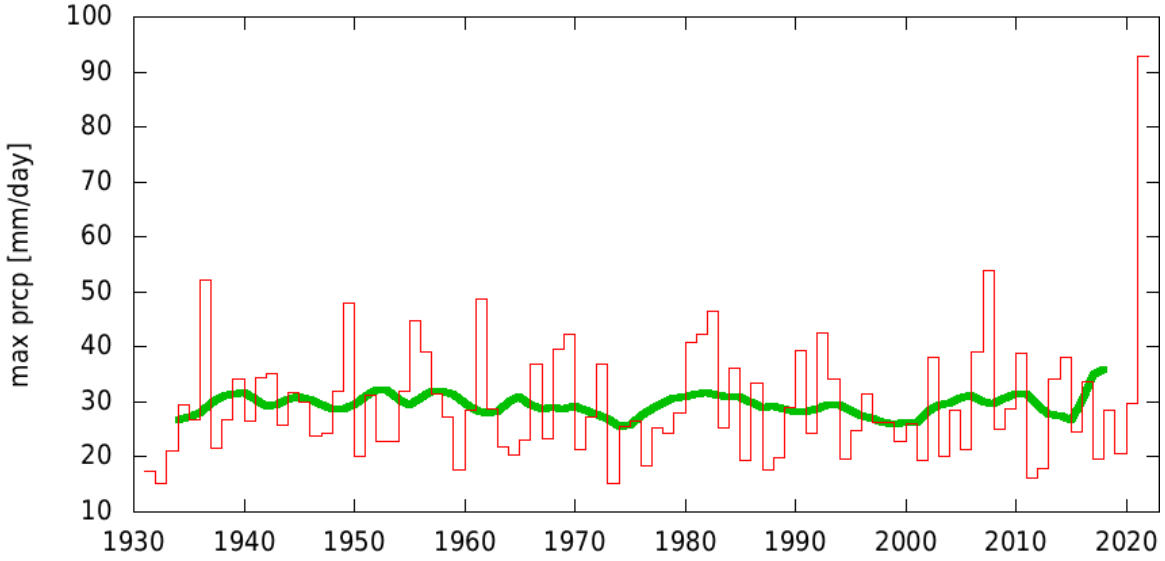
Event definition and method

- Based on the impact, the Ahr/Erft and Meuse catchments were selected.
- As these areas are small for an attribution study, extend analysis using ‘pooling approach’ to 14 sub-regions of Europe.
- Data from individual tiles of pooling region are combined into one long time series to increase the availability of data.
- Analysed are the differences **past-to-present** and **present-to future**.



Areas analysed in Kreienkamp et al., 2021.

Observational analysis Ahr/Erft



Blockmaxima 1-day rainfall Ahr/Erft catchments.

- The analysed rainfall event exceeded any events observed to date.

  → This makes it challenging to estimate return periods.

  → Use of the pooling approach to get robust attribution results.

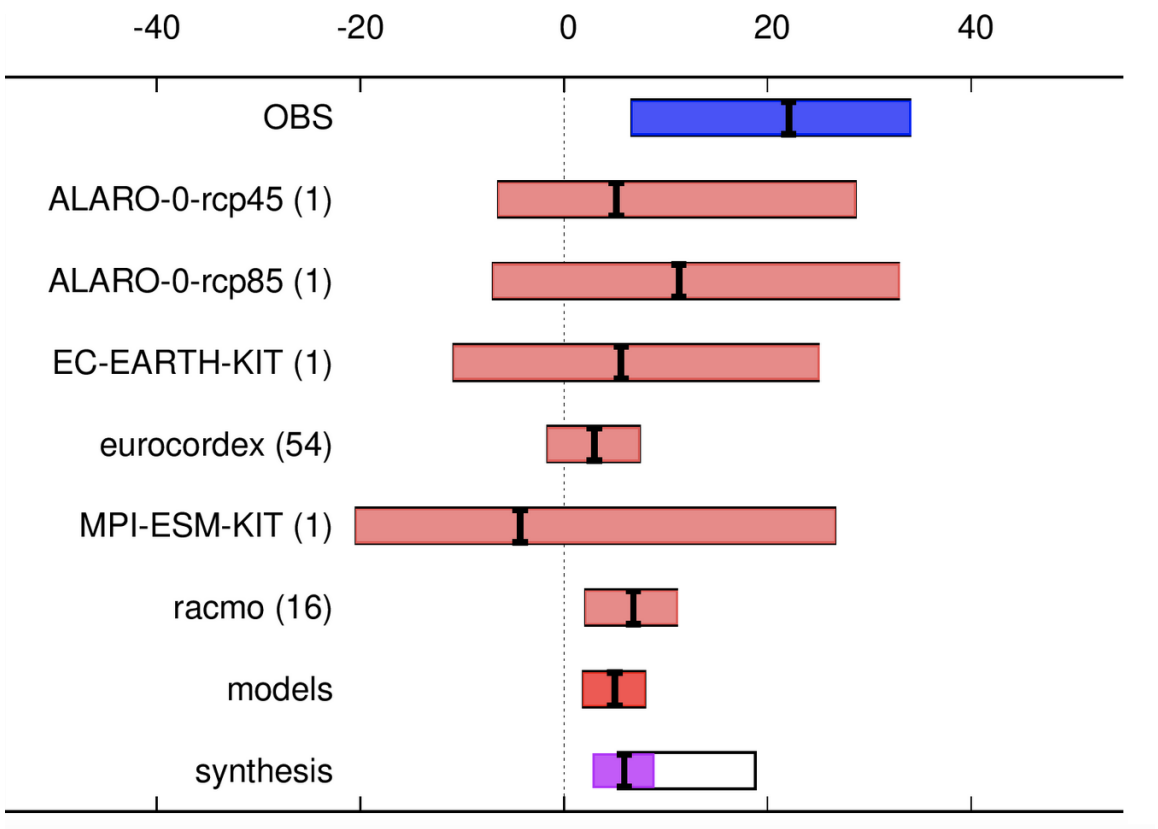
Results return periods of the extreme rainfall event

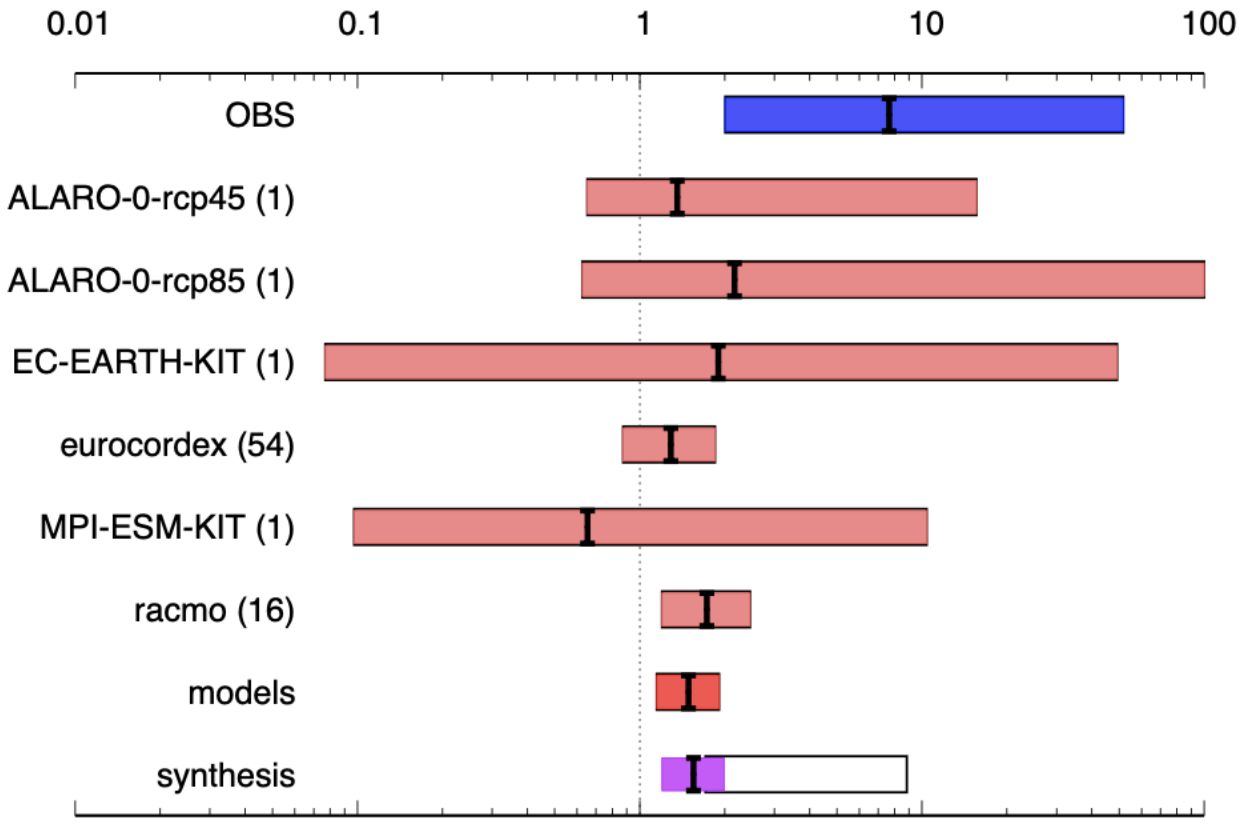
- For the current climate, within the larger Western-European region, we can on average expect one such event every 400 years for a given location.

  → We expect **more than one such events to occur within 400** years in the entire larger Western European region.

- Flooding at the Ahr only comparable to most severe historical events (pre-observational record), i.e. summer 1804.
- “This means that, for a brief moment, a volume of water flowed through the Ahr valley that corresponds to the mean discharge of the Upper Rhine” (Dr. Enno Nilson, BfG).

Results pooled region 1-day event





Changes in **intensity** in percent (left) and **probability ratios** (right).

Summary of the results

- The results show a **robust signal towards an increased likelihood and severity**.
- The observed rainfall in the Ahr/Erft and the Belgian Meuse catchment broke observed records. Estimation of return values and attribution challenging in such small regions.
- Therefore, we broadened the analysis through the pooling approach and found that climate change:
  - increased the intensity by about **3 - 19%**.
  - Increased the likelihood of such an event by a factor between **1.2 and 9**.

Literature

Kreienkamp, F., Philip, S. Y. Tradowsky, J. S., Kew, S. F., Lorenz, P., Arrighi, J., Belleflamme, A., Bettmann, T., Caluwaerts, S., Chan, S. C., Ciavarella, A., De Cruz, L., de Vries, H., Demuth, N., Ferrone, A., Fischer, E. M., Fowler, H. J., Goergen, K., Heinrich, D., Henrichs, Y., Lenderink, G., Kaspar, F., Nilson, E., Otto, F. E. L., Ragone, F., Seneviratne, S. I., Singh, R. K., Skålevåg, A., Termonia, P., Thalheimer, L., van Aalst, M., Van den Bergh, J., Van de Vyver, H., Vannitsem, S., van Oldenborgh, G. J., Van Schaeybroeck, B., Vautard, R., Vonk, D., Wanders, N., (2021): Rapid attribution of heavy rainfall events leading to the severe flooding in Western Europe during July 2021, World Weather Attribution, published online at https://www.worldweatherattribution.org/wp-content/uploads/Scientific-report-Western-Europe-floods-2021-attribution.pdf

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Thank you very much for your attention!

Please get in contact with any comments or questions!

klima.attribution@dwd.de

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