

Presseinformation

RiverMamba: New AI architecture improves flood forecasting

Research from Bonn combines modeling and Machine Learning – NeurIPS paper shows potential for climate adaptation and disaster control

Bonn, November 5, 2025. Extreme weather events such as heavy rain and flooding pose growing challenges for early warning systems worldwide. Researchers at the **Rheinische Friedrich-Wilhelms-University Bonn**, the **Forschungszentrum Jülich (FZJ)**, and the **Lamarr Institute for Machine Learning and Artificial Intelligence** have developed **RiverMamba**, a new AI model that can **predict river discharges and flood risks more accurately than previous methods**. The research paper has been accepted for NeurIPS 2025 – a sign of scientific excellence in Bonn-based research. RiverMamba thus makes an important contribution to climate adaptation and risk prevention – topics that are receiving special attention worldwide, particularly around **UN World Tsunami Awareness Day on November 5th**.

AI learns from environmental and climate data

RiverMamba is based on the so-called **Mamba architecture**, a new generation of deep learning models that can handle **temporal and spatial environmental and climate data** particularly efficiently. The system continuously evaluates data on precipitation, temperature, soil moisture, and flow velocity and **recognizes patterns that are decisive for the development of floods**.

RiverMamba combines the strengths of classic, physics-based models such as the Global Flood Awareness System (GloFAS), which makes global predictions but does not fully model local characteristics and is very computationally intensive, with local, learning-based models such as Google's Flood Hub, which is very efficient but can only predict river flows at existing measuring stations. **RiverMamba learns both from data from physics-based models and directly from extensive environmental and observational data**. This enables it to make **reliable predictions even when measurement series are incomplete or missing**—for example, in smaller catchment areas or regions with limited data availability.

This ability to **independently model complex interactions between weather, topography, and runoff behavior** opens up new perspectives for more accurate flood forecasts worldwide.

Bonn AI research receives international acclaim

The development was led by **Prof. Dr. Jürgen Gall**, Principal Investigator at the Lamarr Institute, in close collaboration with the **Transdisciplinary Research Area “Modeling” (TRA Modeling)**, the **Integrated Research Training Group at the DFG Collaborative Research Centre “DETECT – Regional Climate Change: Disentangling the Role of Land Use and Water Management” (SFB 1502 DETECT)** at the University of Bonn, and the project **„Foundation Model for Weather Forecasting“ (RAINA)**, a joint project of the University of Bonn, the **Deutscher Wetterdienst (DWD)**, and the **Forschungszentrum Jülich (FZJ)**. The interdisciplinary project combines AI research with climate modeling, hydrology, and weather forecasting – and shows how **excellent research from North Rhine-Westphalia contributes to overcoming global challenges**. *“With RiverMamba, we are showing how AI can be used in a targeted manner to model environmental processes more realistically and efficiently,”* says Prof. Dr. Jürgen Gall. *“Such data-based approaches can usefully complement existing early warning systems – an important step toward more reliable forecasts in the face of increasing extreme weather events.”*

The research team will present its findings on December 4 at this year's **NeurIPS conference** in San Diego – one of the world's most prestigious conferences for machine learning and artificial intelligence, where only a fraction of the submissions are accepted each year. The acceptance of the paper underscores the **international visibility and scientific excellence of Bonn-based research**: cutting-edge research from North Rhine-Westphalia is making a significant contribution to the further development of data-based environmental and climate models.

Publication: Mohamad Hakam Shams Eddin, Yikui Zhang, Stefan Kollet, Juergen Gall: „RiverMamba: A State Space Model for Global River Discharge and Flood Forecasting“, Preprint via [arxiv](#)

[Project Website RiverMamba](#)

[Further Information on the NeurIPS 2025 conference](#)

Press Contact:

Caroline Winter

Lamarr Institute for Machine Learning and Artificial Intelligence

c/o Rheinische Friedrich-Wilhelms-Universität Bonn

Friedrich-Hirzebruch-Allee 6, 53115 Bonn

Phone: +49 228 73 69342

Mail: caroline.winter@uni-bonn.de

Web: www.lamarr-institute.org ML Blog: www.lamarr-institute.org/blog

Lamarr Institute for Machine Learning and Artificial Intelligence

The Lamarr Institute is shaping a new generation of Artificial Intelligence (AI) that is high performing, sustainable, trustworthy and secure to contribute to solving fundamental challenges in business and society. As one of Germany's major AI competence centers, the Lamarr Institute stands for value-based, internationally competitive and application-oriented excellent research and is engaged in science, education and technology transfer on a regional, national as well as international level.

The research institute is constituted by the TU Dortmund University, the Rheinische Friedrich-Wilhelms-Universität Bonn and the Fraunhofer Institutes for Intelligent Analysis and Information Systems IAIS in Sankt Augustin and for Material Flow and Logistics IML in Dortmund. As outlined in the federal government's AI strategy, the Lamarr Institute receives permanent funding from the German Federal Ministry of Research, Technology and Space (BMFTR) and the state of North Rhine-Westphalia.

Bildzeilen:

Illustration 1: Artificial intelligence in river modeling: The RiverMamba project uses deep learning methods to study flood patterns. © **Lamarr Institute / University of Bonn (AI-generated)**

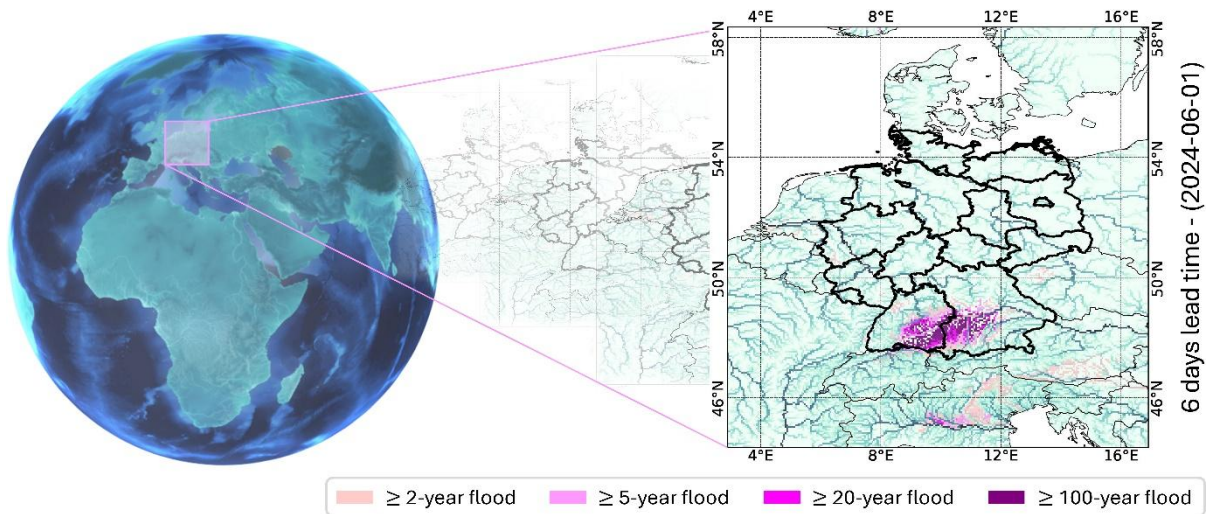


Illustration 2: Flood forecast using the AI model “RiverMamba”: At the beginning of June 2024, southern Germany experienced once-in-a-century flooding. RiverMamba can predict such extreme events six days in advance. © **Mohamad Hakam Shams Eddin, Yikui Zhang, Stefan Kollet, Jürgen Gall.** © Sea texture NASA