Extreme weather: How to improve forecasts with Artificial Intelligence

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Extreme weather events such as heavy rain and hurricanes can be better predicted in the future with the help of artificial intelligence (AI). Particularly energy-efficient and powerful methods were presented by computer scientist Dr. Haojin Yang of Potsdam's Hasso Plattner Institute (HPI) on Monday, February 27. Together with researchers from the Technical University of Munich and the German Research Centre for Geosciences in Potsdam, Yang is analyzing image data from around 900 measuring stations in Europe that satellites have provided over the past 22 years. "Deep learning" technologies are used in the process.

"The analyzed image data comes from the troposphere, i.e. the lowest layer of the Earth's atmosphere, where most of the weather takes place," the HPI scientist reported during the monthly "openXchange" video conference on Monday evening. The public event was held as part of the Hasso Plattner Institute's Clean IT Forum for more sustainability in digital technologies.

Yang explained that the researchers are also incorporating weather data that Germany's National Meteorological Service Deutscher Wetterdienst (DWD) provides regularly and at short intervals from its measuring stations on the Earth's surface. "We have now succeeded in using novel deep learning to develop an algorithm that significantly speeds up the calculation of the huge amounts of data compared to previous weather models, while also saving an enormous amount of power," said Yang, who heads the Multimedia and Machine Learning (MML) research group in HPI's Internet Technologies and Systems department. Especially in the case of extremely strong winds or rain, he said, the population in affected areas can be asked earlier and more precisely to take protective measures.

According to the scientist from the team of HPI managing director Prof. Christoph Meinel, he uses so-called binary neural networks for deep learning. These work with data in 1-bit format (0 and 1) instead of 32 bits. This ensures a thousand times lower energy consumption of the corresponding

hardware. Yang recalled that in machine learning, the training of Deep Learning models has so far required the use of a lot of power. For example, the energy used for artificial intelligence is currently doubling every three and a half months, the HPI scientist said.

Yang acknowledged that the use of energy-efficient algorithms still leads to a loss of accuracy in the results. "However, our technology, BNext, with its binary neural network, has proven to achieve more than 80 percent accuracy in initial deployments. It is superior to all competing approaches, including Google's PokeBNN," the Potsdam scientist said.

In the further research work of the "EKAPEx" project, the focus is now on "customized optimization" of the novel weather forecasting technology, according to the computer scientist. For example, a good balance is to be found between accuracy and energy consumption. The aim is to fully exploit the potential of low-bit networks for publicly accessible weather forecasts.

The EKAPEx research project, which is funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUV), involves the German Research Centre for Geosciences (GFZ) and the Hasso Plattner Institute (HPI), both located in Potsdam, as well as the Technical University of Munich (TUM). The goal of the project is to use new energy-efficient AI algorithms for innovative forecasting methods of severe weather events in Germany.

Background to the openHPI education platform

The Hasso Plattner Institute launched its interactive course offerings as a pioneer among European scientific institutions on September 5, 2012 - on the Internet platform https://open.hpi.de. Since then, it has offered free access to the latest university knowledge from the rapidly changing fields of information technology and innovation. So far, this has mainly been done in German and English. In the fall of 2017, however, openHPI also offered online translation and subtitling of a course in eleven world languages for the first time. In the meantime, almost 1.2 million course enrollments have been registered on openHPI. Around 322,000 people from 180 countries currently belong to the platform's permanent user base. It is growing daily. For particularly successful participants in its "Massive Open Online Courses," or MOOCs for short, the institute has issued nearly 131,000 certificates to date. The openHPI annual program includes numerous offerings for IT beginners and experts. The 100 or so courses offered in the past can still be used for self-study - also free of charge. Students can now also receive credit at their university for completing openHPI courses. Those who want to watch video lessons from the courses while on the move, even if no Internet connection is guaranteed (for example, on an airplane), can also use the openHPI app for Android mobile devices, iPhones or iPads. Partner platforms that work with the same learning technology include KI-Campus, eGov-Campus and Kommunalcampus, in addition to openSAP and OpenWHO, for example.