AI-based model that predicts extreme wildfire danger

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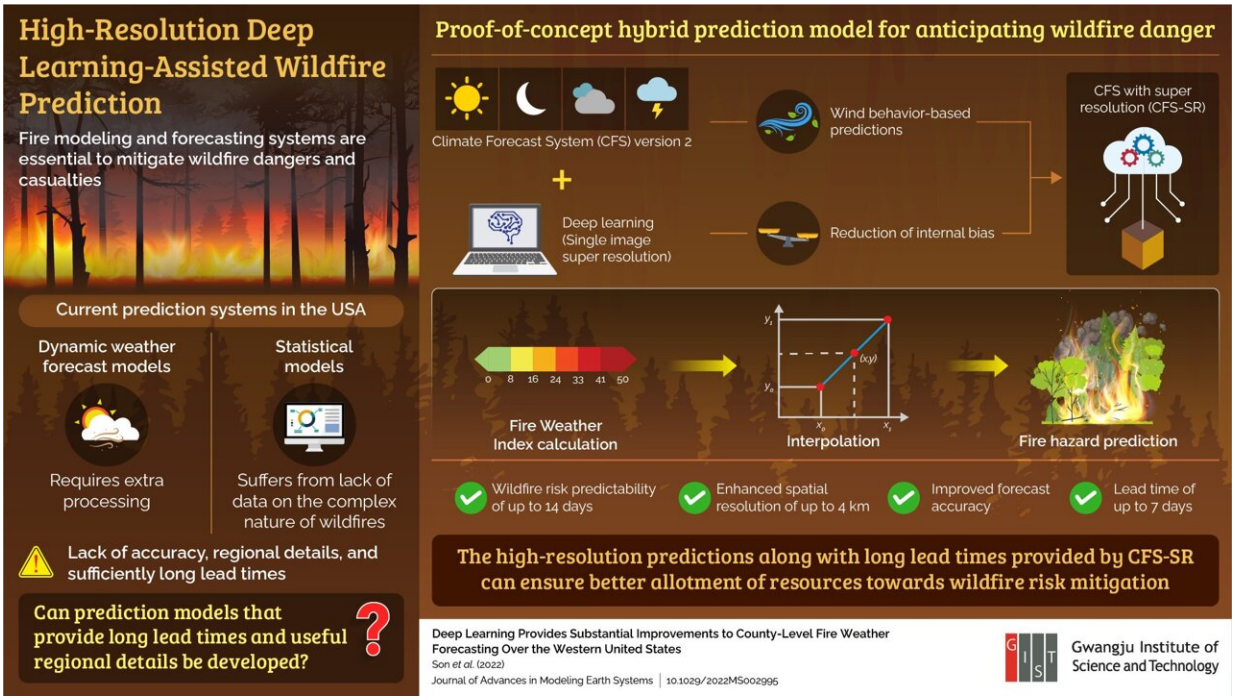

Wildfire forecast systems can be made more accurate by integrating AI with weather forecast models, finds a new study by an international research team. Their new model provides improved forecast accuracy with a lead time of up to 7 days, enabling early preparation and better allotment of resources towards wildfire risk mitigation. Credit: Jin Ho-Yoon from GIST, Korea.

Raging wildfires occurring worldwide have caused tremendous economic damage and loss of life. Knowing when and where a

widespread fire could happen in advance can improve fire prevention and resource allocation. However, available forecast systems only provide limited information. Moreover, they do not provide lead times long enough to gain useful regional details.

Scientists have now applied a deep learning algorithm to enhance the prediction of wildfire danger in the Western United States. Researchers from South Korea and the United States developed a hybrid method that combines AI techniques and weather forecasts to produce improved predictions of extreme fire danger out to one week at finer scales (4km x 4km resolution), increasing its utility for fire suppression and management.

"We tried numerous approaches to integrate machine learning with traditional weather forecast models to improve forecasts of wildfire risks. This study is a big step forward as it demonstrates the potential of such an effort for enhancing fire danger prediction without the need for extra computing power," says lead author Dr. Rackhun Son, a recent Ph.D. from the Gwangju Institute of Science and Technology (GIST) in South Korea, who currently works at The Max Planck Institute for Biogeochemistry in Germany. "The fire danger forecasts could be improved further using constant development in both Earth System Models and recent AI developments."

While data-driven AI methods have shown excellent capabilities for inferring things, explaining why and how the inferences are arrived at still remains a challenge. This has led to AI being labeled a black box. "But when AI was combined with computer models based on physical principles, we could diagnose what was going on inside this black box," says co-author Prof. Simon Wang of Utah State University. "The AI-based predictions associated with extreme levels of fire danger are well grounded to strong winds and specific geographical characteristics, including high mountains and canyons in the Western United States that

have been traditionally difficult to resolve with coarser models."

Computational efficiency is another major advantage of this method. Conventional methods of predicting fire risks at finer spatial resolutions, a process called "regional downscaling," are often computationally demanding, expensive, and time-consuming.

"Although comparable computational resources were required at the developing stage, once the training task for the AI was complete, i.e., performed once initially, it only took few seconds to use that component with the weather forecast model to produce forecasts for the rest of the season," says co-author Prof. Kyo-Sun Lim at Kyungpook National University, Korea.

Therefore, the newly developed AI-based method with the ability to make accurate high-resolution forecasts in a shorter time was much more cost-effective compared to conventional forecast systems.

"In this study, the AI is only tested for fire danger forecasting in the Western United States. In the future, it could be applied to other types of weather extremes or to other parts of the world," said co-author Dr. Philip J. Rasch of the Pacific Northwest National Laboratory and the University of Washington. "The flexibility of our AI method can help forecast any weather-related feature."

The research has been published in the *Journal of Advances in Modeling Earth Systems* on September 22, 2022.

More information: Rackhun Son et al, Deep Learning Provides Substantial Improvements to County-Level Fire Weather Forecasting Over the Western United States, *Journal of Advances in Modeling Earth Systems* (2022). DOI: 10.1029/2022MS002995

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