AI model to forecast complicated large-scale tropical instability waves in Pacific Ocean

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Large-scale oceanic phenomena are complicated and often involve many natural processes. Tropical instability wave (TIW) is one of these phenomena.

Pacific TIW, a prominent prevailing oceanic event in the eastern equatorial Pacific Ocean, is featured with cusp-shaped waves propagating westward at both flanks of the tropical Pacific cold tongue.

The forecast of TIW has long been dependent on physical equation-based numerical models or statistical models. However, many natural processes need to be considered for understanding such complicated phenomena.

Recently, a research team led by Prof. LI Xiaofeng from the Institute of Oceanology of the Chinese Academy of Sciences (IOCAS) studied this type of complex oceanic phenomena through artificial intelligence (AI) technologies.

The team member includes ZHENG Gang from the Second Institute of Oceanology of Ministry of Natural Resources, ZHANG Ronghua from IOCAS, and LIU Bin from Shanghai Ocean University.

They used satellite data-driven deep learning model to forecast the complicated thousand-kilometer scale TIW for the first time in the world. Their study was published in *Science Advances* on July 15.

Basic rules governing the complicated oceanic phenomena are usually profoundly hidden in the fast-increasing satellite remote sensing big data itself. They need to be dug up by powerful information mining techniques such as deep learning in the AI field.

"AI technology may lead to a promising alternative for modeling complicated oceanic phenomena and circumventing the difficulties faced by traditional numerical models," said Prof. LI.

In this work, the researchers developed a deep learning model for forecasting sea surface temperature (SST) field associated with TIW based on current and previous satellite-derived SST data.

The long-term test of nine-year SST data showed that the model efficiently and accurately forecasted SST evolution and captured TIW

propagation's spatial and temporal variation.

The study demonstrates that a purely data-driven and AI-based information mining paradigm can be a robust and promising way to model and forecast complicated oceanic phenomena in the satellite remote sensing Big Data Era.

"AI-based models, statistical models, and traditional numerical models can complement each other and provide a novel perspective for studying complicated oceanic features," said Prof. LI.

A review article by Prof. LI's group was published in *National Science Review* on March 19, which systematically reviewed deep-learning-based information mining from ocean remote-sensing imagery.

More information: Purely satellite data–driven deep learning forecast of complicated tropical instability waves, *Science Advances* (2020). DOI: 10.1126/sciadv.aba1482

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