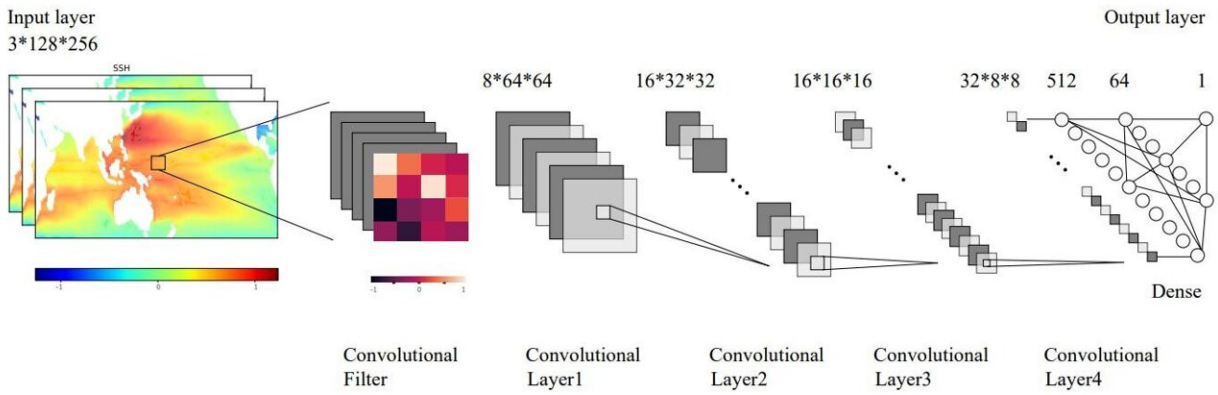
Deep learning-based AI system helps infer and predict Indonesian throughflow

January 19 2023, by Zhang Nannan



Architecture diagram of deep-learning. Credit: IOCAS

Scientists from the Institute of Oceanology of the Chinese Academy of Sciences (IOCAS) and Nanjing University of Information Science and Technology have successfully constructed an inference and prediction system of the Indonesian Throughflow (ITF) by using a deep-learning method and realized the valid prediction of the ITF transport.

The study was published in *Frontiers in Marine Science* on Jan. 16.

The Indonesian seas are the only ocean channel connecting the tropical ocean basins, and the ITF is a key ocean dynamic factor for the inter-

basin exchange between the Indian Ocean basin and the Pacific Ocean basin. The ITF has a strong material and energy transport and hence plays a significant role in the material and energy balance of the Indo-Pacific Ocean and regional and global climate change. However, prediction of ITF mainly relies on numerical simulation systems, which often have significant model biases and great uncertainty.

In view of this, the researchers led by Prof. Hu Shijian put forward the idea of combining satellite observations with artificial intelligence methods to construct the inference and prediction system of ITF and conducted experiments with various deep-learning models.

The Indo-Pacific pressure gradient is the main driving factor of ITF, so researchers used sea surface heights between the Indian and Pacific Ocean basins to infer and predict the transport of ITF. They trained the convolutional neural network (CNN) using the massive data provided by the Coupled Model Intercomparison Project Phase 6 model and Simple Ocean Data Assimilation data sets and reconstructed a time series of ITF transport.

The training results showed that the system based on the CNN model reproduces about 90% of the total variance of ITF transport, indicating that the system is able to achieve valid inference of ITF transport.

The researchers further combined the system with the satellite data from 1993 to 2021 to infer and construct the time series of ITF, and found that the time series was in good agreement with the internationally renowned field observation data of ITF. They explored the possibility of predicting ITF with this AI system, and the results show that the system can make a valid prediction with a leading time of seven months.

"The ITF AI inference and prediction system provides an important tool for conducting research on ocean circulation and climate change in the

Indo-Pacific Ocean, which may alleviate the pressure of field ocean observation to some extent," said Prof. Hu.

Provided by Chinese Academy of Sciences