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OCEAN MEAN TEMPERATURE CAN BETTER PREDICT INDIAN SUMMER MONSOON

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The sea surface temperature gives information only about the thin upper layer of the ocean and does not reflect the thermal energy available in the upper ocean, says Ali.

Sea surface temperature (SST) is routinely used for predicting whether the total amount of rainfall that India receives during the monsoon season will be less or more than the long-term mean of 887.5 mm. Now, scientists from Pune's Indian Institute of Tropical Meteorology (IITM) find that ocean mean temperature (OMT) that has better ability to predict this than the sea surface temperature. Compared with SST which has 60% success rate of predicting the Indian summer monsoon, OMT has 80% success rate.

In addition to better predictive success, the information on whether the amount of monsoon rainfall will be more or less than the long-term mean will be available by beginning of April, two months before the southwest monsoon can set in. This is because OMT is analysed by measuring the ocean thermal energy during the period from January to March. Southwest monsoon sets in around June 1 each year in Kerala .

"Sea surface temperature gives information only about the thin upper layer of the ocean and does not reflect the thermal energy available in the upper ocean. The variations in the upper ocean thermal energy conditions are mainly responsible for summer monsoon activity," says M.M. Ali, senior scientist at IITM and corresponding author of a paper published in *Scientific Reports.*

"The heat content of the upper ocean creates more impact on monsoon than sea surface temperature, which is restricted to the skin of the ocean," says M. Rajeevan, Secretary, Ministry of Earth Sciences and one of the authors of the paper.

The SST is restricted to a few millimetres of the top ocean layer and is largely influenced by strong winds, evaporation, or thick clouds. In contrast, OMT, which is measured up to a depth of 26 degree C isotherm, is more stable and consistent, and the spatial spread is also less. The 26 degree C isotherm is seen at depths varying from 50–100 metres. During January–March, the mean 26 degree C isotherm depth in the Southwestern Indian Ocean is 59 metres.

The researchers analysed 25-year OMT data from 1993 to 2017. They found that unlike SST, OMT was able to correctly predict 20 out of 25 years (80% success rate) whether the amount of rainfall during the summer monsoon was more or less than the long-term mean. The prediction based on sea surface temperature was correct only for 15 out of 25 years (60% success rate).

"Using OMT data collected during January-March 2018, we were able to predict with 80% probability that this year's monsoon will be below average during June–September," says Dr. Ali.

Similarly, OMT showed better success in predicting above or below-average rainfall years compared with SST. For instance, OMT was able to successfully predict 13 out of 16 below average rainfall years and seven out of nine above average rainfall years during the period 1993-2017.

In contrast, the prediction based on SST was correct only in 10 out of 16 below average rainfall years and five out of nine above average rainfall years.

The reason why OMT performs better than SST is because OMT better represents the upper ocean thermal energy conditions. And the variations in the upper ocean thermal energy conditions are mainly responsible for the summer monsoon. “When there is rapid heating or cooling, the temperature of the top ocean layer will be significantly different from the upper ocean thermal energy, resulting in misleading monsoon predictions,” says Dr. Ali.

In addition, SST also exhibits large temperature fluctuations compared with OMT of the upper layer, leading to more noise that causes lower correlations with summer monsoon rainfall. “The ocean mean temperature variations are more stable and consistent and have lower spatial and temporal spread. So OMT has better summer monsoon predictability than SST,” says Dr. Ali.

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