XiHe: A Data-Driven Model for Global Ocean Eddy-Resolving Forecasting

Абстракт:

Наиболее популярными методами прогнозирования океана являются физические модели основанные на решении уравнений в частных производных. Основная проблема – вычислительная сложность решения большого количества уравнений и зависимость моделей от коэффициентов, определяемых экспертным путём. В статье приведена нейросетевая модель прогнозирования океана с разрешением 1/12 градуса. Данные взяты из Glorys12.

1 Введение:

1) We propose the first data-driven 1/12◦ resolution global ocean eddy-resolving forecasting model XiHe, which achieves stronger forecast performance in all testing variables than the compared leading operational physics-driven numerical GOFSs. Moreover, XiHe can make a forecast in only 0.35 seconds (1000x faster than the numerical GOFSs) averagely with one GPU.

2) We introduce an ocean-land masking mechanism to exclude the impact of land, thereby focusing exclusively on learning global ocean information. We also design a novel ocean-specific block containing local and global SIE modules to capture the inherent oceanic spatial information.

3) Extensive experiments on the authoritative IV-TT Class 4 evaluation framework verify that the accuracy of ocean current forecasting of XiHe out to 60 days is even better than that of PSY4 in 10 days.

4) Experimental evaluations based on satellite and in situ observations demonstrate that XiHe is able to forecast the large-scale circulation and the mesoscale eddies.

2 RELATED WORK:

Ocean forecasting aims to provide accurate and timely forecasts of the future ocean conditions based on current and historical ocean observations.

2.1 Physics-Driven Methods

Until now, numerical ocean forecasting methods have contributed overall the highest prediction accuracy, but they still face two major limitations. Firstly, they are usually computationally expensive and slow due to the high complexity of solving the physical partial differential equations [4]. Secondly, the improvement of the forecasting accuracy is exceedingly challenging due to their limitation of human cognitive abilities in understanding the physical laws of the ocean environment [3].

2.2 Data-Driven Methods

To sum up, recently there have been several data-driven models in global atmosphere weather forecasting, which achieved comparable or even better prediction performance than NWP methods. Furthermore, data-driven methods have also shown the potential in accelerating numerical ocean forecasting by orders of magnitude, but there is still a significant gap in the forecasting accuracy compared with the numerical operational GOFSs at 1/12◦ resolution.

3 DATASET

3.1 Training Dataset