Abstract

The oceans can be visualized as a stratified fluid in turbulence around the rotating earth with several land-water-atmospheric interfaces, varying parameters of salinity, temperature, density, etc., as well as irregular bathymetry. The major external forces acting on the oceans can be classified into mechanical forcing, thermohaline forcing, and planetary forcings such as the winds, heat, freshwater fluxes, and tides, respectively. Ocean modelling is a necessary step for understanding and analyzing various processes within the earth's system. While the conventional ocean circulation models have a lot of limitations, it is necessary to develop a method, that is computationally easier and feasible. The ocean processes are dynamic and so complex that the usual models have to make assumptions and the situations are idealized to reach to the outcomes. In this thesis, we show, how the application of Artificial Neural Networks (ANNs) paves the way for advanced and improved predictions of current velocities and salinity without the basis of underlying equations and formulations. Artificial Neural Network is a data-driven approach, where the predictions are completely based on past data or the data fed into them. The continental shelf in the Northern Bay of Bengal is the area of study taken for this research purpose. Delft3D was able to model up to 50m water depth which is termed as the near shelf but failed to execute beyond 50m. Hence, another advanced and nascent method should be adapted for understanding the circulation pattern at depths beyond 50m which is termed the far shelf region. The predictions are validated against OSCAR data and have shown commendable accuracy in terms of correlation coefficients. The correlation coefficients obtained are above 0.9, which shows the precision of the architectures used in the ANNs. The ANNs are usually site-specific, and different architectures must be developed to address different cases. With the improved predictions, observational studies are also done to analyse the freshwater plume spread, upwelling and ocean acidification patterns.

Keywords: Ocean circulation, ANN, Deep Neural networks, Freshwater plume spread, Upwelling