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機械学習によるタービダイト逆解析手法の実験的検証

Experimental Verification of Inverse Analysis of Turbidity Current from Their Deposit by Machine Learning Technique

*Zhirong Cai[1]、Naruse Hajime[1]、Yao Qifeng[1]
*Cai Zhirong[1], Hajime Naruse[1], Qifeng Yao[1]

1. 京都大学
1. Kyoto University

In this study, inverse analysis of turbidite deposited in flume experiments will be performed using a new machine learning method. The results of inverse analysis will serve to verify the accuracy of the machine learning method when applied to flume experiment data.

Turbidity current is an important process of sediment transport into subaqueous environments such as deep lakes and ocean. Ancient deposits of turbidite form hydrocarbon reservoirs. However, understanding of the hydraulic conditions of turbidity current remains limited due to its destructive nature and its unpredictable occurrences. Thus, the inverse analysis of turbidity currents from ancient deposits of submarine fans is required for estimating the conditions of flows in the natural environments.

In the past, inverse modeling of turbidity currents was done in a trial and error fashion by adjusting initial conditions of numerical models, which is high in calculation load, making such technique very expensive and highly impractical. Naruse (2017 AGU Fall Meeting) developed a completely new method for inverse analysis of turbidity currents using a deep learning neural network. In this method, training data is generated by a numerical model, and a neural network for reconstructing hydraulic conditions of turbidity currents from turbidite is produced by machine learning of the training dataset.

This study aims to verify the new inversion methodology by flume experiments. The flume used in this study is 4 meters in length and 8.4 centimeters in width. Plastic particle with specific gravity of 1.45 and blue sand with specific gravity of 2.65 were chosen as the sediment materials simulating that in a turbidity current. The flow velocity was measured with acoustic Doppler velocity profiler during each experiment. The resulting sediment deposits were sampled at a 10 centimeters interval after each experiment and grain size analysis was performed using a settling tube analyzer. The deposits from the three runs of flume experiment conducted showed a fining downstream trend, in which blue sand increases toward the upstream direction and an increasing amount of plastic particle toward the downstream direction. The streamwise grain size distribution of deposits and the flow velocity data will be fed into the trained deep learning neural network, which would output the initial conditions of the experiment. The initial conditions predicted by the neural network will be verified with the initial setting for the experiment conducted.

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