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Turbulence closure modeling with machine-learning methods: Influence of choice of neural network and training procedure SALAR TAGHIZADEH, YASSIN HASSAN, FREDDIE WITHERDEN, SHARATH GIRIMAJI, Texas AM University — Generalizability of machine-learning (ML) assisted turbulence closure models to unseen flows remains an important challenge. It is well known from the computer vision community that the architecture of a neural network and the manner of training have a profound influence on the performance of the resulting model [Goodfellow et al. Deep learning. MIT press, 2016]. The objective of the present work is to characterize the relationship among the choice of network (in terms of the number of nodes and layers), the type of these layers (fully connected or convolutional), the set of training flows and the domain of generalizability. We will also examine the impact of the training procedure and the impact of techniques such as dropout. For a given set of training data (of different flows), it is reasonable to expect that most networks would perform reasonably in predictive computations of similar classes of flows. However, it is unclear how the closure model network will perform in a class of flows different from training flows. In our study, two sets of training and prediction flows are considered: (i) training in simple rectilinear shear flows and predictions of separated flows; and (ii) training in one type of separated flow and predictions of a different type of separated flow. It is expected that this line of investigation will lead to a formal procedure for selecting the optimal neural network for turbulence closure modeling contingent upon training data sets and targeted prediction flow classes.

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