



Studies on initialization and simulation of a land falling Typhoon using 3-Dimensional variational bogus data assimilation of mapped observation

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Numerical weather prediction (NWP) is one of the most important tools to predict future states of atmosphere. It is produced by a numerical model starting from an initial condition (IC) that describes the current state of atmosphere. Prior to the prediction, however, the IC must be provided, which directly influences the accuracy of NWP. Four-dimensional variational data assimilation (4DVar) is one of the most efficient methods to provide optimal IC for NWP, but it requires huge computational resources, which greatly limits its wide applications. Here we propose a new fast initialization approach, called three-dimensional variational data assimilation of mapped observation (3DVM). Like the available 4DVar, 3DVM produces an optimal initial condition (IC) that is consistent with the prediction model due to the inclusion of dynamical and physical constraints of the model and is best fitting to the observations in the assimilation window through the model solution trajectory. Different from the 4DVar, the IC derived from 3DVM is not located at the beginning but the end of the assimilation window. It is the change of the IC time that makes the computing cost of the new approach greatly reduced. Especially, it is able to improve the assimilation accuracy because it does not need the tangent linear and adjoint approximations for calculating the gradient of cost function anymore. It produces better IC for 72-hour simulation of TY9914 (Dan) than 4DVar does, by assimilating bogus surface low data. And, The comparison tests show that the intensity and track forecasts are improved more significantly using 3DVM than 4DVar. Meanwhile, it takes only 1/7 of the computing costs the 4DVar requires for the same initialization with the same retrieved data. We anticipate our initialization and prediction test to be a starting point for wider application of 3DVM to many related field, and 3DVM will be also improved.

Key words: Mapped observation, Variational data assimilation, bogus, Timesaving.