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The influence of tropical cyclones targeted singular vectors on ensemble forecasts

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Though northern and southern hemisphere targeted extratropical singular vectors (NSSVs) have been applied to generate initial perturbations for the Global/Regional Assimilation and Prediction System (GRAPES) global ensemble prediction system, there is no initial perturbations for the tropical zone. To remedy this defect, tropical cyclones targeted singular vectors (TCSVs) are computed and applied to generate initial perturbations for ensemble forecasts, especially for the tropical cyclone track ensemble forecasts. The results show that TCSVs are located locally with the large amplitude distributed around the targeted zone, which leads to that when there exist two or more tropical cyclones, the initial perturbations with TCSVs only for one tropical cyclone could not well describe the initial uncertainty of all tropical cyclones, and the tropical cyclone track ensemble spread could be greatly increased and the initial uncertainty of all the tropical cyclones could be better described when TCSVs for all tropical cyclones are used to generate initial perturbations. Further studies show that the tropical cyclones track ensemble spread is seriously small when TCSVs are not used and the ensemble mean track has the nearly same forecast skill as the control forecast, but the tropical cyclones track ensemble spread is greatly increased and the ensemble mean track forecast error is decreased when TCSVs are used. In addition, the 24h-accumulated precipitation probability forecast skill for China zone is increased when TCSVs are used. All the results show that TCSVs are effective and important for improving the tropical cyclones track ensemble forecasts, and they should be used to generate initial perturbations when there exists at least one tropical cyclone.