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Multivariate Ensemble Sensitivity Analysis for Super Typhoon Haiyan(2013)

Abstract

Ensemble sensitivity analysis is commonly computed using a diagonal approximation of the covariance matrix, resulting in a univariate formulation that neglects cross-variable correlations. In this study, univariate and multivariate ensemble sensitivity analyses are compared using a high-resolution ensemble forecast of Super Typhoon Haiyan (2013). Sensitivities are evaluated with respect to minimum sea level pressure error near peak intensity.

Results show that the univariate ensemble sensitivity systematically overestimates forecast response, with the discrepancy increasing with height, while the multivariate sensitivity produces more physically consistent perturbation structures associated with storm intensification. Perturbation experiments using hypothetical observations demonstrate that multivariate ensemble sensitivity provides substantially more accurate predictions of forecast response than the univariate approach at 24–48 h lead times, whereas both methods lose skill at longer lead times. These results highlight the importance of accounting for cross-variable covariance in ensemble-based sensitivity analysis of tropical cyclones.

Keywords:
Univariate ensemble sensitivity analysis、Multivariate ensemble sensitivity analysis

Reference:

SIJING REN, LILI LEI, ZHE-MIN TAN, AND YI ZHANG: Multivariate Ensemble Sensitivity Analysis for Super Typhoon Haiyan(2013),AMS,MWR,147,3467-3480.
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