Geophysical Research Abstracts,
Vol. 10, EGU2008-A-02332, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-02332
EGU General Assembly 2008

A Study on the Applicability of Conditional Nonlinear Optimal Perturbations to the Adaptive Observations of Tropical Cyclones

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This study is concerned with the applicability of conditional nonlinear optimal perturbations (CNOPs) to the identification of sensitive area in the adaptive observations of tropical cyclones. The 5^{th} generation Pen-State University/National Center for Atmosphere Research mesoscale Model (MM5) and its adjoint system are used.

Two tropical cyclones Matsa and Meari are investigated, under the metrics of dynamic, dry and moist energies. The first singular vector (FSV) is also calculated, of which the results are compared with those of CNOP. It is found that when the initial constraint condition is small, CNOPs resemble as FSVs. As the initial constraint condition becomes larger, the structures of CNOPs deviate from those of FSVs. Meanwhile, the nonlinear evolutions of the CNOPs are larger than those of FSVs. As far as wind is concerned, the pattern of CNOP obtained from the metric of dynamic energy is similar to those from the dry and the moist energy metrics. It is the same when comparing the temperatures (surface pressures) obtained by dry and moist energy metrics respectively.

The authors also investigated the cases of optimal times of 12 and 24 hours, which indicate that the results may differ much. As the forecasts are more sensitive to the CNOP-type initial errors than the FSV-type ones from sensitivity experiments, it is feasible to use CNOP to identify the sensitive region in adaptive observations.