EMS Annual Meeting Abstracts
Vol. 10, EMS2013-58, 2013
13th EMS / 11th ECAM

Diagnostic Study of Global Energy Cycle in the Mixed Space-Time Domain for GRAPES Model

B Zhao
National Meteorological Center, Beijing, China,100081 (zhaob@cma.gov.cn)

Some important diagnostic characteristics are reflected in energy cycle reservoirs and conversions for model's physical background. The atmospheric energy cycle diagnosis is a suitable way towards understanding and improvement of numerical models. The framework of the classical energy cycle is well known as so-called "Mixed Space-Time Domain" energy cycle. Among this energy cycle, stationary (time mean) and transient (departure from time mean) atmospheric waves are the main characteristic feature of the general circulation. Stationary waves are generally attributed to diabatic and orographic forcing and transient waves are the results of baroclinic instability of the zonal mean flow.

In this paper, the formulation of energy cycle are computed and the role of stationary and transient waves within the atmospheric energy cycle from Global-Regional Assimilation and Prediction System (GRAPES) is firstly diagnosed and compared with NCEP Final Operational Global Analysis (FNL) for 2011.Only 31 days (July) are considered. The zonal mean contributions to the energy cycle reservoirs and conversions are investigated to explain the ameliorations and deteriorations of numerical integral values. The results of different time forecast (24hrs, 72hrs, 120hrs, 168hrs) are selected to diagnose the effects of changes in global energy cycle.

It is confirmed that GRAPES model has capability to reproduce the similar main features of global energy cycle with NCEP analysis. Zonal available potential energy (AZ) is converted into stationary eddy available potential energy (ASE) and transient eddy available potential energy (ATE), the reservoirs of ASE and ATE have about the same energy content. The nonlinear conversion between the two eddy reservoirs of available potential energy (CATE-ASE) is playing an important role within the global energy cycle and it is directed from the stationary to the transient reservoir. With forecast time increasing, AZ becomes larger which reflects the meridional temperature gradient between high and low latitude grows larger. It increases zonal baroclinic and makes conversion from AZ to eddy potential energy larger, especially CAT. The reservoir of zonal kinetic energy (KZ) is just similar value to the sum of the reservoirs of stationary eddy and transient eddy kinetic energy (KSE and KTE), while there is almost no global net conversion between the two eddy kinetic energy reservoirs. Barotropic conversions (CKS and CKT) are directed from eddy kinetic energy to zonal kinetic energy. The zonal conversion CZ (from AZ to KZ) in GRAPES is about 1.5 times larger than NCEP analysis.

The analysis of zonal mean cross sections of energy cycle reservoirs and conversions shows that all the energy and conversions has similar features with analysis at 24hrs. With forecast time increasing, transient eddy available potential energy (ATE) decreases at 60N that reduce the meridional transports of sensible heat which makes meridional temperature gradient increase. Conversion from transient eddy potential energy to kinetic energy (CET) is observed with the same structure of CAT, poleward value near surface grows, KTE value associated with the southern hemisphere subtropical jet and conversion CKT over tropopause near 30S reduces. The nonlinear barotropic conversion CKTE-KSE is reduced predominantly by the weaker KTE with forecast time increasing.