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Equatorial mass/wind balance relationship in global data assimilation

H. Körnich and E. Källén

Department of Meteorology, Stockholm University, Sweden (heiner@misu.su.se)

Multivariate data assimilation is achieved by introducing mass/wind balance relationships in the background term. Typically, geostrophy is used as a balance relationship of the midlatitudinal flow. However, this relationship is not valid in tropical latitudes. A new tropical balance relationship has been proposed which based on convectively coupled equatorial waves. The tropical analysis will benefit from this new approach, especially when applied with the future line-of-sight wind observations of the Earth Explorer Atmospheric Dynamics Mission (ADM-Aeolus).

The presented study combines the new equatorial background term with the standard midlatitudinal formulation in a new variational data assimilation scheme. A global shallow water model is used, where the balance relationships are formulated in terms of Hough modes of different equivalent depth. For the minimization of the cost function, a control variable is contructed by weighting the Hough modes ppropriately based on the background covariances. The covariance structures of the data assimilation scheme are examined with single observation experiments and the resulting increments are discussed with respect to the balance relationships. Finally, the new proposed assimilation scheme is tested in a simple observing system simulation experiment. It is shown that the correct balance relationships are vital for the correct interpretation of the observational information. Particularly, the tropical analysis depends on the new balance relationships in order to make optimal use of future spaceborne wind observations.