

A model independent technique based on the ensemble Kalman Filter to estimate unresolved gravity wave drag: Evaluation in the Lorenz 96 model

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The forcing by small-scale gravity waves has important effects on the general circulation of the middle atmosphere. General circulation models (GCM) can not resolve these small-scale waves so that GCMs have a systematic bias if the effects of these unresolved waves are not parameterized. In this work, we develop a technique based on data assimilation principles that estimates objectively the systematic bias of a model. The assimilation technique is based on the ensemble Kalman filter and estimates objectively the forcing terms in the momentum equations, apart from the model state, using an augmented state space. As a first evaluation to the potential of the developed technique, we applied it to the Lorenz 96 equations using twin experiments (observations are generated synthetically with the model). We show that the technique is able to localize spatially and temporally sources of model errors, so that it has the potential to constrain gravity wave parameterizations from observations. An important aspect of this new proposed technique is that it is model independent, i.e. it could be applied in any general circulation model to estimate missing gravity wave drag without substantial modifications.