Geophysical Research Abstracts
Vol. 12, EGU2010-8367, 2010
EGU General Assembly 2010

Nudging and predictability in regional climate modelling: investigation in a nested quasi-geostrophic model

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In this work, we consider the effect of indiscriminate and spectral nudging on the large and small scales of an idealized model simulation. The model is a two layer quasi-geostrophic model on the beta-plane driven at its boundaries by the « global » version with periodic boundary condition. This setup mimics the configuration used for regional climate modelling.

The effect of large-scale nudging is studied by using the "perfect model" approach. Two sets of experiments are performed: (1) the effect of nudging is investigated with a « global » high resolution two layer quasi-geostrophic model driven by a low resolution two layer quasi-geostrophic model. (2) similar simulations are conducted with the two layer quasi-geostrophic Limited Area Model (LAM) where the size of the LAM domain comes into play in addition to the first set of simulations.

The study shows that the indiscriminate nudging time that minimizes the error at both the large and small scales is reached for a nudging time close to the predictability time, for spectral nudging, the optimum nudging time should tend to zero since the best large scale dynamics is supposed to be given by the driving large-scale fields are generally given at much lower frequency than the model time step(e,g, 6-hourly analysis) with a basic interpolation between the fields, the optimum nudging time differs from zero, however remaining smaller than the predictability time.