Geophysical Research Abstracts, Vol. 7, 10217, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10217

Vertical coordinate, qpf, and resolution: sigma or eta, an update

F. Mesinger (1), D. Jovic (2)

(1) ESSIC, Univ. Maryland, College Park, MD, USA,

(2) SAIC and NCEP/EMC, Camp Springs, MD, USA

Choice of the vertical coordinate for NWP and climate models remains an unsettled issue. Following compelling results favoring the eta with step-topography discretization during the late eighties and the early to mid-nineties, difficulties the eta had with downslope windstorms became known. This, and Gallus and Klemp 2D experiments and arguments, led to a rather widespread view that the eta is "ill suited for high resolution prediction models". Thus, several recent development efforts, including four WRF (Weather Research and Forecasting Model) dynamical cores, are using sigma or sigma-like coordinates.

A number of results of the operational Eta at NCEP, as reviewed at the preceding EGU Assembly, suggested a reexamination of this view. Compared to its driver global model, GFS, the Eta showed perhaps a surprising skill at extended forecast times, of 2 to 3.5 days, in spite of the advection of the less accurate lateral boundary data. In addition, compared to a higher resolution sigma system model, the Eta showed similar QPF skill in the eastern United States, with no major topography; but in the mountainous west, where the higher resolution should have been of a particular advantage, the Eta had done better. GFS had performed better than the Eta in the east, but in the west the Eta was better.

These results are now updated by presenting additional statistics on the Eta vs GFS accuracy in placing major storms east of the Rockies, at 2.5 days forecast time, and on the three-model QPF skill during the recent catastrophic rains in California in December 2004 and January 2005.

Explanations of the leading sigma as well as eta step-topography problems are re-

called. It is pointed out that the sigma system problem, use of information that should not be used according to the continuous equations, and failure to use information which should be used, aggravates with increased resolution and/or steepness of topography; and that none of the many proposed PGF schemes are free from it. Continuation of the work on the refinement of the eta discretization, addressing the eta step-mountain downslope windstorm problem is reported upon. It is shown that the refined, “sloping-steps” eta discretization removes the problem as it is illustrated by the well-known Gallus-Klemp experiment. Discretization developed is an add-on to the traditional step-topography Eta code, and thus preserves the simplicity of the code. Thus, it may be an attractive alternative to shaved cells and/or partial step discretizations, in use in several other atmospheric models.