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Subject: Response to doc: OST12, 02/05/03

OST reviews of Kevin Trenberth's recommendations to Jack Kelly 1/7/03.

To: Brigadier General Jack Kelly: Director National Weather Service.

Thank you for your letter of March 5, 2003. I met with Jiayu Zhou at NCAR on June, 19, 2003, and he briefed me on the response to my letter and provided me with the written comments in the above referenced document.

I am gratified that my letter has been taken seriously and that it has also found a responsive chord. It is encouraging to know about the move to one-second resolution upper air data from radiosondes and new BUFR formats that will enable users to take full advantage of the information measured. This exceeds my suggestions for increased vertical resolution. It is hoped that this is implemented in ways that make the data useful to the research community and not just operations. It is also very encouraging to know that a hybrid coordinate system model is to be implemented at NCEP, and is likely to become operational later in 2003 with 64 levels. This framework should enable more interactions with NCAR climate modeling efforts, hopefully producing mutual benefits. I am also pleased to see the general endorsement of a more complete systems oriented framework for observations that recognize climate needs, even if all aspects cannot be immediately implemented.

Don Johnson is of course correct in his remarks about the difficulties in computing some diagnostic quantities, a point we fully recognize. We are ambitiously planning to extend our diagnostic analysis of the atmosphere from the vertically averaged framework to the full three dimensional state and we will be using the NCAR Community Climate Model hybrid level coordinate framework to ensure that the numerics are fully consistent with identities that must be satisfied after discretization (such as mass continuity) and in energy conservation. By using flux formulations we will also be able to ensure that the vertical integral of local discretized computations matches the vertically-integrated quantities computed independently. As we pointed out, the problems arise not so much when one works in a consistent model coordinate framework, but when one moves to the more standard archive in pressure coordinates that many synopticians and researchers use. However, our analysis also revealed problems with standing gravity waves over topography through improper upper boundary conditions. These problems are certainly ameliorated when one moves to a hybrid coordinate system in which the stratospheric levels are pressure levels, although they do not vanish. The upper boundary condition problem is also ameliorated with more levels.

The reason for more attention to the need for increased numbers of p-levels and improved stratospheric values, is really because this archive is the most widely exploited one and most researchers will not use model coordinates. The use of 21 tropospheric levels, with increased resolution in the boundary layer and near the tropopause, is a marked improvement, and we will look forward to the further improvements with the next reanalysis.

I am also very pleased to note the support from Louis Uccellini, in the official NCEP response, for reanalysis activities as a continuing activity. I am one of the principle organizers of the August workshop

at NCAR in Boulder this summer to promote ongoing reanalyses and institutionalizing related analysis activities for climate purposes. One task that will be a topic for the workshop is the effects of the continually changing observing system, and one way of assessing these effects is through observing system experiments (OSEs). I believe these should be more routine than they currently are, and they can help design the observing system and make it more efficient. In fact, it appears that there may be problems with the current CDAS/reanalysis products beginning late 2000, perhaps in association with the introduction of ATOVS? These problems have been documented by Bill Randel of NCAR and confirmed by us, and I am aware of several email exchanges on this issue, but it still seems to be an outstanding issue. For me this highlights the need to do more.

Sincerely

Kevin E Trenberth
Head
Climate Analysis Section.