Reply

ROGER A. PIELKE, M. SEGAL, R. T. MCNIDER, AND Y. MAHRER
Department of Atmospheric Science, Colorado State University, Fort Collins, Colorado

19 May 1992

Professor Louis Berkofsky is correct (Berkofsky 1993, hereafter referred to as B) that there was an error in Eq. (21) of Pielke et al. (1985, hereafter referred to as PSMM). The term in Eq. (19) of that paper, $\partial x^3/\partial \tilde{x}^1$, is equal to $\partial z/\partial \tilde{x}^1 = \partial z_G/\partial x = \tan\gamma$, as evident from the functional form of the coordinate transformation I, given on page 1103 of PSMM. This idealized model was introduced in order to illustrate the application of a generalized vertical coordinate system to a set of meteorological equations, as contrasted with a Cartesian coodinate system. Professor Berkofsky's corrected analysis accurately illustrates the differences for the slope flow equations we discussed in our paper.

For small slopes ($|\partial z_G|\partial x| \ll 1$) this error does not have a significant influence on the results since $\sin\gamma \approx \gamma - \gamma^3/3$ and $\tan\gamma \approx \gamma + \gamma^3/3$ for small γ. For large slopes, however, the error is more important, since

$$\hat{u}^1 = \frac{\overline{L_c}}{\beta \sin\gamma}(1 - \cos\tau t) \quad \text{(for transformation II)},$$

and

$$\tilde{u}^1 = \frac{\overline{L_c}}{\beta \tan\gamma}(1 - \cos\tau t) \quad \text{(for transformation I)}.$$

Relative values of $\hat{u}^1$ and $\tilde{u}^1$, for both transformations, are tabulated for several slope angles in Table 1. The terrain-following formulation (transformation I) should be more realistic since nonhydrostatic accelerations along the terrain slope can be represented. Slopes greater than about 20° would be required before the difference in the two velocities would become greater than 6%.

We appreciate the reevaluation of our 1985 paper since we feel that use of terrain-following coordinates offers several advantages to Cartesian representations as also discussed in Pielke and Cram (1987, 1989) and Cram and Pielke (1989).

TABLE 1. Comparison of values of tan γ and sin γ for several different slope angles.

γ	sin γ	tan γ
5°	0.09	0.09
10°	0.17	0.18
15°	0.26	0.27
20°	0.34	0.36
25°	0.42	0.47
30°	0.50	0.58
35°	0.57	0.70
40°	0.64	0.84
45°	0.71	1.00

REFERENCES

Berkofsky, L., 1993: Comment on "Derivation of slope flow equations using two different coordinate representations. *J. Atmos. Sci.*, **50**, 1444–1445.
Cram, J. M., and R. A. Pielke, 1989: Further comparison of two synoptic surface wind and pressure analysis methods. *Mon. Wea. Rev.*, **117**, 696–706.
Pielke, R. A., and J. M. Cram, 1987: An alternate procedure for analyzing surface geostrophic winds and pressure over elevated terrain. *Wea. Forecasting*, **2**, 229–236.
——, and ——, 1989: A terrain-following coordinate system—Derivation of diagnostic relationships. *Meteor. Atmos. Phys.*, **40**, 189–193.
——, M. Segal, R. T. McNider, and Y. Mahrer, 1985: Derivation of slope flow equations using two different coordinate representations. *J. Atmos. Sci.*, **42**, 1102–1106.

Corresponding author address: Dr. Roger A. Pielke, Colorado State University, Department of Atmospheric Science, Fort Collins, CO 80523.