take care to specify the context of the model; and (iv) use model acceptability and performance indices rather than simple declarations of validation to describe the results of model testing.

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2. R. G. Sargent, in *Proceedings of the 1984 Winter Simulation Conference*, S. Sheppard, U. Pooch, D. Pegden, Eds. (IEEE 84CH2098-2, Institute of Electrical and Electronics Engineers, Piscataway, NJ, 1984), pp. 115–121.
3. *Webster's New Collegiate Dictionary* (Merriam, Springfield, MA, 1975).

Response: We fully agree with Sterman that the points raised in our article are limited neither to computer models nor to the earth sciences. We focused on numerical models in the earth sciences because the more general point about underdetermination of scientific theories has been made eloquently elsewhere, because earth science is the area of our own experience and expertise, and because the issues of verification and validation are active topics of discussion among earth scientists.

Rykiel sees little semantic difference between "verify," "validate," and "confirm." While acknowledging overlap in the many meanings of these terms, we disagree that they are synonyms in common usage. For example, one can *verify* that a parking permit has been *validated*. Nuances of meaning do matter, particularly when terms are shared in scientific and lay discourse. Our discussion of the terms "verify" and "validate" is an accurate representation of the way many earth scientists use these terms (*1*), and our use of the term "confirm" follows decades of scholarship in logic and in philosophy of science (*2*). Nevertheless, the primary objective of our article was substantive, not semantic. If modelers were to change only language and not practice, then our article would not have achieved its objective. Current usage *is* misleading and can create a false sense of truth, particularly in practical policy applications.

Rykiel says we slay a straw man, but the "straw people" in this case include the International Atomic Energy Agency and the U.S. Department of Energy. The terminology that we critique comes directly from the scientific guidelines of these agencies and from published scientific literature (*3*). The syllogism that Rykiel puts forward as the correct logical construct for evaluating models begs the fundamental questions at stake: Who decides what the specified criteria are? What are the limits of the problem domain? and Can they change with time?

Rykiel concludes that "modelers themselves should take the lead in asserting the restrictions and limitations of models." Insofar as two of us are modelers (*4*), and all three of us routinely use and evaluate models (*5*), this is precisely what we tried to do.

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References and Notes

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3. "Radioactive waste management glossary" (IAEA-TECDOC-264, International Atomic Energy Agency, Vienna, 1982); *Environmental Assessment: Yucca Mountain Site, Nevada Research and Development Area, Nevada*, vol. 2, *DOE/RW-0073* (Office of Civilian Radioactive Waste Management, U.S. Department of Energy, Washington, DC, 1986). Also see *U.S. Nuclear Regulatory Commission Radioactive Waste Management Program (NUREG-0865)* (U.S. Nuclear Regulatory Commission, Washington, DC, 1990); P. A. Davis, N. E. Olague, M. T. Goodrich, "Approaches for the validation of models used for performance assessment of high-level nuclear waste repositories" (SAND90-0575/NUREG CR-5537) (Sandia National Laboratories, Albuquerque, NM, 1991); J. L. Younker *et al.* (*1*); *Adv. Wat. Resour.* **15** (1992).
4. K. Belitz, J. M. Gronberg, S. P. Phillips, *U.S. Geological Survey Water Supply Paper 2396* (1993); K. Belitz and J. D. Bredehoeft, in *Hydrogeology of Low-Permeability Environments Hydrogeology, Selected Papers*, vol. 2, S. P. Neuman and I. Neretnieks, Eds. (Verlag-Heinz Heise, Hannover, Germany, 1990) pp. 7–17; K. Belitz and J. D. Bredehoeft, *Am. Assoc. Petrol. Geol. Bull.* **72**, 1334 (1988); N. Oreskes, *Proceedings of the Eighth International Association on the Genesis of Ore Deposits*, p. A137 (July 1990).
5. K. S. Shrader-Frechette, *Burying Uncertainty: Risk and the Case Against Geological Disposal of Nuclear Waste* (Univ. of California Press, Berkeley and Los Angeles, CA, 1993).

Corrections and Clarifications

In the Random Sample "Venuses reappear" (18 Feb., p. 923), Patricia Rice of West Virginia University is incorrectly identified as "Patricia White." Randall White of New York University is the source of quotes attributed to "White."