ENHANCED TRANSPARENCY AND REFUTABILITY IN MODELING ENVIRONMENTAL SYSTEMS

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This work proposes that environmental models would be made more transparent and refutable by establishing a base set of model fit, sensitivity, and uncertainty measures for which results are reported consistently, along with any other methods considered, and as innovations in model analysis continue. Indeed, there have been many innovations in model analysis in recent decades. While innovation is important, when every subfield within environmental modeling and almost every report uses different model analysis methods, the models are difficult to compare and the utility and limitations of the models are more often obscured than elucidated because few are familiar with the analysis method. Adoption of a base set of consistently used methods can be thought of as contributing to the "how" for achieving the model transparency and refutability encouraged by recent essays describing general goals and philosophies for environmental modeling. The base set of methods proposed here includes very computationally frugal methods that are most accurate when the model is sufficiently linear. Computationally frugal methods are advantageous when considering models with long execution times typical when considering environmental systems. Recent work indicates that many of the nonlinearities that have caused so much trouble in the past are numerical artifacts without validity to real world system dynamics. It appears that robust models absolved of such artifacts and still consistent with real system nonlinearities can often be fruitfully evaluated using linear methods. Also, situations in which the computationally frugal methods fail are generally apparent rather quickly, so little time is lost relative to the effort required by the computationally demanding methods. Comparisons of local methods to selected computationally expensive methods demonstrate the relative utility of both. Establishing a base set of linear and nonlinear methods provides a foundation that is expected to increase utility of environmental model results and interest in sensitivity analysis and uncertainty methods. The increased utility and interest would benefit all developers and users of environmental models, including scientists, modelers, policy makers and resource managers.