Towards More Efficient and Effective Global Sensitivity Analysis

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Sensitivity analysis (SA) is an important paradigm in the context of model development and application. There are a variety of approaches towards sensitivity analysis that formally describe different "intuitive" understandings of the sensitivity of a single or multiple model responses to different factors such as model parameters or forcings. These approaches are based on different philosophies and theoretical definitions of sensitivity and range from simple local derivatives to rigorous Sobol-type analysis-of-variance approaches. In general, different SA methods focus and identify different properties of the model response and may lead to different, sometimes even conflicting conclusions about the underlying sensitivities. This presentation revisits the theoretical basis for sensitivity analysis, critically evaluates the existing approaches in the literature, and demonstrates their shortcomings through simple examples. Important properties of response surfaces that are associated with the understanding and interpretation of sensitivities are outlined. A new approach towards global sensitivity analysis is developed that attempts to encompass the important, sensitivity-related properties of response surfaces. Preliminary results show that the new approach is superior to the standard approaches in the literature in terms of effectiveness and efficiency.