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Uncertainty and sensitivity analysis: new purposes, new users, new challenges

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Uncertainty and sensitivity analysis are becoming an integral part of mathematical modelling of earth and environmental systems. Uncertainty analysis aims at quantifying uncertainty in model outputs, which helps to avoid spurious precision and increase the trustworthiness of model-informed decisions. Sensitivity analysis aims at identifying the key sources of output uncertainty, which helps to set priorities for uncertainty reduction and model improvement.

In this presentation, we draw on a range of recent studies and projects to discuss the status of uncertainty and sensitivity analysis, focusing in particular on ‘global’ approaches, whereby uncertainties and sensitivities are quantified across the entire space of plausible variability of model inputs.

We highlight some of the challenges and untapped potential of these methodologies, including: (1) innovative ways to use global sensitivity analysis to test the ‘internal consistency’ of models and therefore support their diagnostic evaluation; (2) challenges and opportunities to promote the uptake of these methodologies to increasingly complex models, chains of models, and models used in industry; (3) the limits of uncertainty and sensitivity analysis when dealing with epistemic, poorly bounded or unquantifiable sources of uncertainties.