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Session 7: Quantifying the uncertainty in Earth systems

Using computer models and uncertainty quantification to construct hazard maps

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The ultimate benefit of computer modeling of hazards arises in the ability to forecast the effect of a catastrophic event and to prepare maps of the probability of such hazard incorporating these predictions. The simplest way to use such a model to forecast hazard would be to use a Monte-Carlo like sampling strategy over the range of possible inputs and then compute the probability of different outcomes. However, in a setting where simulations can cost hours on modern supercomputers the use of such methodology is prohibitively expensive though occasionally still attempted. We present here an alternate approach using a systematically chosen set of simulations to construct a statistical model and then sampling to construct the hazard map. To overcome the cost of inverting the extremely large covariance matrices to assimilate data from new simulations we use a simple localization procedure which also enables the use of parallel computing. The computational time required is thus reduced from one that was estimated to take O(100) days to 1 day on 1024 processors.