We describe advances on our formulation and numerical solution of stochastic inverse problems for determining parameters in differential equations from stochastic data on output quantities. The new approach involves approximating the generalized contour maps representing set-valued inverse solutions, using the approximate contour maps to define a geometric structure on events in the sigma-algebra for the probability space on the parameter domain, and exploiting the structure to define and approximate probability distributions in the space. We will present various examples, including high-dimensional problems involving spatially varying parameter fields in storm surge models. We conclude with recent work on defining a notion of condition for stochastic inverse problems and the use in choosing observable quantities.