# Prediction, Projection, and Probability: Quantifying Uncertain Scientific Insights Regarding the Far Future

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## Abstract

Physical simulations models are often employed to gain useful insight, and at times quantitative prediction, of the world. Weather forecasts are perhaps the highest profile example, long the domain of statistically based forecasting, since the 1960's simulations modelling have provided superior, steadily improving predictive information. It is not clear, however, even in this paradigm example that actionable probabilities are produced, where an "actionable probability" can be rationally interpreted as "probability" in a risk management sense. The extension of the mechanisms of modern numerical weather prediction to the climate problem is discussed. While it is clear that physical simulation can teach us a great deal about the climate system, and equally clear that we hold a great deal of longstanding understanding of the system without modern simulations, delimiting the boundaries between where quantitative interpretation of model simulations shift from high fidelity insights to biased but suggestive plausibility to systematically misleading and maladaptive misinformation, these boundaries are not well described. Given the central role simulation models play in policy and planning, an outline in how these boundaries might be sketched is given, including proposals for necessary if not sufficient conditions for rationally interpreting simulation information quantitatively

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