PROJECT SUMMARY

We propose to extend a promising statistical method and to develop software that will aid scholars across disciplines to make more accurate forecasts. This project builds on work in the fields of meteorology and statistics to (1) extend the method for application to a wider array of outcomes (e.g., binary data), (2) provide freely available software that implements both maximum likelihood and Bayesian estimation techniques, and (3) publish papers that provide accessible explanations of the method and social science applications.

The method – ensemble Bayesian model averaging (EBMA) – improves prediction by pooling information from multiple forecast models to generate ensemble predictions similar to a weighted average of component forecasts. The weight assigned to each forecast is calibrated via its performance in some training period. The aim is not to choose some "best" model, but rather to incorporate the insights and knowledge implicit in various forecasting efforts via statistical post-processing. These component models can be diverse and need not share covariates, functional forms, or error structures. Indeed, the components may not even be statistical models, but may be predictions generated by agent-based models or subject-matter experts. In practice, the method provides superior predictive power relative to any single component and reduces the likelihood of dramatic miss-predictions as it is not reliant on any one data source or methodology.

Intellectual merit: This project will address several substantive questions in political science, with a focus on the field of international relations, where policymakers have a particular demand for improved forecasting. In addition, the proposed project will include research on the utility of various forecast comparison metrics for applied analysts in the social sciences. It also includes basic research into prior structures that penalize model complexity and ensure that ensemble forecasts reflect uncertainty in component forecasts, data vintage, and missingness. EBMA has received considerable attention in the fields of statistics, meteorology, and (to a lesser extent) economics. Yet, it has not been advanced in the methodological directions we are proposing here.

Broader impacts: Testing systematic predictions about future events against observed outcomes is generally seen as the most stringent validity check of statistical and theoretical models. Yet, political scientists rarely make predictions about the future; instead, they typically focus on developing and validating theories that explain past events. However, research in political science could gain immensely in its policy relevance if predictions were more common and more accurate. Improved forecasting of important political events would make research more germane to policymakers and the general public who may be less interested in explaining the past than anticipating and altering the future. From a scientific standpoint, greater attention to forecasting would facilitate stringent validation of theoretical and statistical models since truly causal models should perform better in out-of-sample forecasting.

This project will further develop statistical techniques that will improve the capabilities of researchers across disciplines to produce more accurate forecasts of future events. The methodological advancement made in this project will be available to the larger scholarly community and influence research agendas in multiple fields. This is particularly important as existing research projects and software packages are narrowly tailored to the needs of weather forecasting.

Finally, the principal investigators are active members of the research community at the intersection of statistics and the social sciences. Their work is widely read in political science and other disciplines. Further, at least two graduate students in political science will be included in the research and will gain experience in large-scale research projects.