Abstract:
With so many spatial planning and decision support tools available today, all of which claim to solve a multitude of problems, why introduce another tool? Virtually all spatial planning and analysis tools today are built around the power of Geographic Information System (GIS) software applications. These systems exist, are in wide use, and adapting them for planning tasks seems an attractive and straightforward path. Despite their ease of use and spatial intelligence, GIS systems alone fall short for decision support. They (1) do not explicitly account for or propagate uncertainties in the underlying data or models, (2) do not handle temporal and multidimensional data well or at all, and finally (3) they do not really help the user make a decision or find common ground among the stakeholders. Bayesian analysis methods, however, provide a way to incorporate uncertainties (model or measurement), disparate and patchy data, or even missing data into a robust analysis system. This type of system not only provides an outcome but also reports the certainty of the outcome as well as the sensitivity of the outcome to any particular piece of data. The BASS system also explicitly integrates real-time interaction with stakeholders and their subjective views of the issues involved at a joint science/social solution. The Bayesian decision support system allows the user to discover which data are important, which can be ignored, and which are needed to make an optimal decision. The system treats all data probabilistically, combining probabilities in conceptually the same way a GIS combines layers, but Bayes Theorem replaces the ad-hoc map algebra methods used in typical GIS analysis. The Bayesian system can also be used in the final stage of decision-making, allowing users to engage in “what if” scenarios by permitting them to input their subjective values into the decision process. For non-subjective values, the system calculates an initial and final suitability value as a means of evaluating change or impact to a given environmental measure. Lastly, since the problems addressed here are spatial and the analysis has been applied to spatial datasets, the output can be visualized in a GIS system so that the users can view the outcomes, the underlying data, and the analysis results in an intuitive way. By having all cards on the table, with a robust science based foundation, consensus building is simplified.

Stakeholder Input Continued:

The Belief Map, developed by Robust Decisions, provides a mechanism for stakeholder input regarding specific subjective measures. In this example a user is asked to evaluate their belief of how a wave park installation at each location would affect their value structure around the wave park at those locations. Movement along the x-axis indicates a level of satisfaction and movement along the y-axis indicates a level of certainty. This allows subjective values to be combined with more objective model estimates of suitability and uncertainty.

Bayesian Belief Networks:

Some impacts of a decision are scientific by nature and can be modeled to provide input to the decision. The BASS tool uses Bayesian Belief Networks (BBNs) constructed around expert opinion, in combination with observed environmental data (contained in GIS datasets), to predict both an initial suitability as well as an impacted suitability for selected environmental support functions.

Tool Output:

The BASS tool has a webviewport in which users can explore model output. This feature allows users to visualize layers that may be helpful in initial site selection by showing areas within a region that may or may not be suitable for tech installation. Through an ancillary tool, users may submit requests for raster of custom extents which are returned as geo-referenced images which can be used in GIS.

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