**Envision – A Quick Summary**

Envision is a framework for constructing **alternative future scenario applications**. It consists of:

1. A **dynamic spatial engine** for representing polygonal, network, point, and grid-based landscape characterizations.
2. A **multi-agent modeling framework** for representing values and behaviors of decision-makers on the landscape.
3. An **extensible plug-in architecture** for including:
   1. any number of conformant autonomous **process models** describing landscape change dynamics;
   2. any number or “**evaluative models**” reporting landscape production metrics, typically measured in terms of scarcity along biophysical, ecological, social or economic dimensions;
   3. Any number of “visualizers” for **visual representation** of spatial and aspatial data and inputs;
   4. Any number of “analysis modules” for **processing data or generating models.**
4. A rich representation of **policies** guiding and constraining actor decision-making, and **scenarios** describing alternative strategies for landscape management.

*Figure 1. Envision’s Conceptual Framework.*

Technically, Envision consists of several hundred thousand lines of C++ code. It runs as a 32-bit or 64-bit Windows application. Plug-ins are DLLs that are conformant with Envision architectural interface. Envision is currently being modified to run as a parallel application on HPC clusters.

***Envision* – Rational and Approach**

In the past several decades there has been a dramatic increase in the use of scientific, quantitative methods for informing landscape change and decision-making in the presence of deep uncertainty. This increase has occurred in both the public and private sectors. The predominant approach in such assessments has been characterized as a predict-then-act paradigm, which pairs models of rational decision-making with methods for treating uncertainty derived largely from the sciences and engineering. The preferred course of action in predict-then-act assessments is the one that performs ‘‘best’’ given some (typically small) set of assumptions about the likelihood of various futures and the landscape processes that will be sustained if these assumptions prove true. Such assessments are strongly tied to the validity of these assumptions.

A second paradigm is emerging that differs from predict-then-act in important ways. Rather than seeking strategies and policies that are optimal against some small set of scenarios for the future, this **explore-then-test** approach seeks near-term actions that are shown to perform well across a large ensemble of plausible future scenarios. These approaches offer the promise (but less so the proof) of policies and patterns that are sufficiently robust against future surprise that they can seize unexpected opportunities, adapt when things go wrong and provide new avenues in forging consensus regarding the facts and values that steer landscape change.

Envision was created to allow examination of the nature and properties of coupled human and natural environmental systems. We employ scenarios, data and evaluative models produced by past research, and utilize prior work in agent-based modeling and biocomplexity theory. Central to Envision, are the three-way interactions of actors, who have decision making authority over parcels of land, the landscape which is changed as these decisions are made, and the policies that guide and constrain decisions. In Envision, actors are entities that make decisions about the management of particular portions of the landscape for which they have management authority, based on balancing a set of objectives reflecting their particular values, mandates and the policy sets in force on the parcels they manage. They do this within the scope of policy sets that are consistent with the assumptions and intentions of a chosen future scenario. These policies are operative on particular landscape elements over which they have decision-making control.

Fundamentally, actors are characterized by the values they express through their behaviors, which in turn, alter landscape characteristics. Policies in Envision provide a fundamental construct guiding and constraining agent decisionmaking. As used in this context, policies are decisions or plans of action for accomplishing a desired outcome (Lackey 2006). They make scenario intentions operational and in so doing must integrate the facts of a situation with the values that motivate people to manage lands they control in the ways they do. Policies capture rules, regulations, incentives and other strategies promulgated by public agencies in response to demands for ecological and social goods, as well as considerations used by private landowners/land managers to make land and water use decisions. They contain information such as site attributes defining the spatial domain of application of the policy, whether the policy is mandatory or voluntary, goals the policy is intended to accomplish, and the duration the policy, once applied, will be active at a particular site. Defining and specifying a scenario-compliant set of policies is a key step in configuring Envision to model alternative futures.

As actors assess alternative management options, they weigh the relative utility of potentially relevant policies against their own values, landscape scarcities expressed as feedbacks, and global policy preferences, to determine what policies, if any, they will select to apply at any point in time/space. Once applied, a policy outcome is triggered that modifies one or more site attributes, resulting in landscape change. These changes are accumulated through space and time to provide a set of landscape trajectories.

Envision represents a landscape as a set of polygon-based geographic information system maps and associated information containing spatially explicit depictions of landscape attributes and patterns. Taken as a modeling approach, Envision employs a spatially explicit multi-agent construct that models relationships of agent’s values and behaviors, policy intentions and landscape metrics of production, as the actors attempt to avoid scarcity.