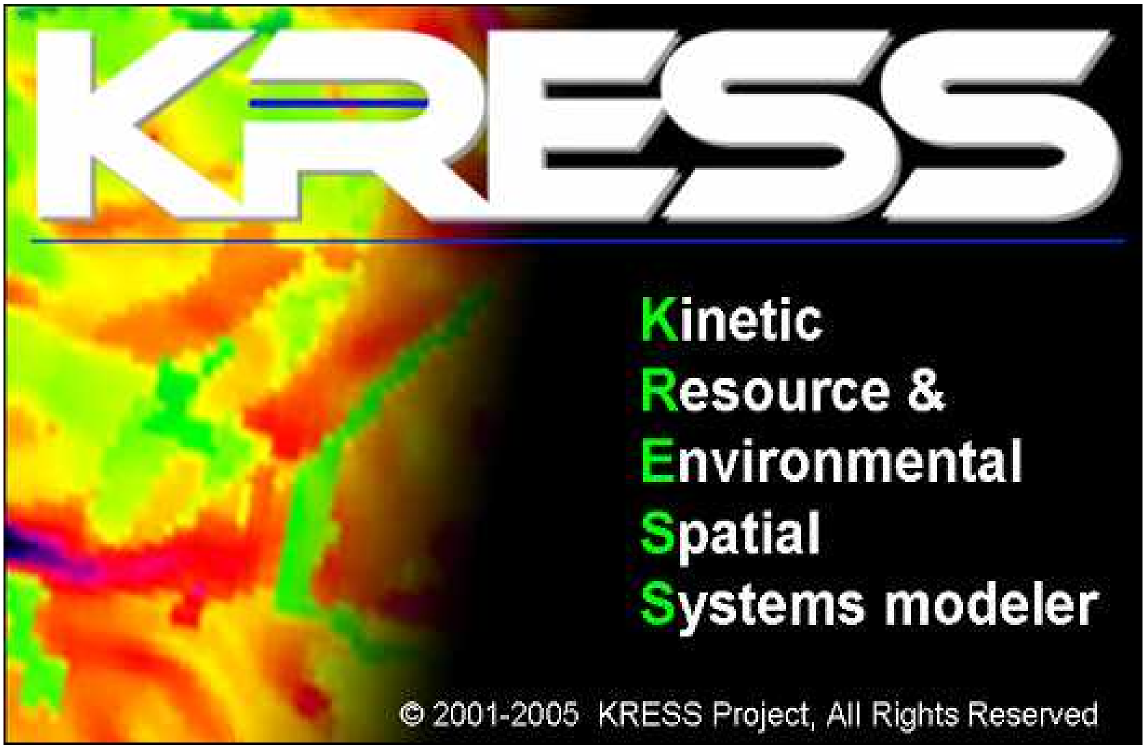
KRESS
Kinetic
Resource &
Environmental
Spatial
Systems modeler
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KRESS Modeler Version 2.0.1 User's Manual

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 The project and the software are part of an ongoing program designed to speed the modeling of spatial variables and apply linear and non-linear, static and time-series multicriteria decision making technology to natural resource and ecological analyses. Comments and suggestions about the program should be directed to:

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Introduction

The KRESS Modeler is computerized multifactor decision making tool. It is the outgrowth of work that was done on a series of projects by the Department of Rangeland Ecology and Management and the Department of Agronomy and Range Science to evaluate the suitability of various locations across a landscape for use by domestic livestock and wildlife. A software package was needed that was capable of implementing GIS data layers for subsequent visual analysis by experts knowledgeable in the field. This program must incorporate landscape parameters to determine the suitability of each site on the landscape in terms of animal usage. Working it pre-existing information about how animals use the landscape, this project is an attempt to construct models for predicting current and future use. These models and maps can also be assessed for their accuracy based on actual observations of animals.

Animal location and movement is affected by landscape factors. The general suitability of a specific location for an animal is dependent upon what the animal is doing and how well the site supplies the animal's needs. During feeding periods, animals are expected to be in areas with the highest amounts of palatable forage. If temperatures are extreme, it is expected that grazing animals are located in thermally neutral areas with greater standing forage, gentler slopes and closer proximity to water. In the KRESS Modeler, the relationship between suitability and the landscape is mediated via mathematical models created by researchers or managers who have extensive knowledge about a landscape.

In addition to the initial uses of the modeler, it can be broadly applied to many types of systems. Since the systems studied have been primarily resource-based and involve lands used for domestic animals, water, and wildlife, natural resource applications are the primary focus. Due to active involvement in landscape design and monitoring type work, the model reflects this natural resource/spatial perspective.

The KRESS modeler software system is a tool that facilitates the evaluation and analysis of multiple factors to determine the suitability of sites on a landscape for a purpose. At its broadest, it is a multi-criteria decision aid (MCDA) and uses classification techniques to rank alternative solutions to problems. The MCDA process is used in a variety of fields as diverse as environmental and landscape management, medicine and finance.

The modeling process used consists of the following steps:

1. Define the decision or decisions that are to be made by the animal or decision maker
2. Identify the factors of importance
3. Build GIS layers – ASCII Raster maps – of factors
4. Scale of each of the factors so that they can be treated similarly

5. Determine or estimate of the “importance” or weight of each of these factors for mathematical analysis
6. Determine the spatial and temporal relationship of the factors.
7. Build the model
8. Process the weighted factors mathematically using a Weighted Sum Algorithm
9. View the spatial pattern of the model
10. Evaluate the model using GPS generated positions in the study area.

The KRESS multiple factor analysis is used to simultaneously take into account a series of factors that affect the preference of animals for a particular position on the landscape, based on a deterministic applications of rules.

The program was built to be flexible. It is as close to an open “blackboard” format as possible. Thus a scientist or resource manager should be able to conceptualize linear, non-linear, or mixed models and, if spatial data exists for the parameters chosen, rapidly apply them to a landscape. The user can use information about the system to build a model that seems reasonable and generate the suitability for each cell on the landscape.

Generating models is easy; it is far more difficult to evaluate them. Therefore, an evaluation routine that uses GPS data gathered in a standard format has been incorporated into the program. The GPS information is ordered and a random selection is taken from it. The frequency and distribution is then determined and compared to a random distribution model.

Data Volume and the KRESS Modeler

As the dimensions of a landscape being analyzed increase, the data volume increases exponentially. The KRESS Modeler was designed to operate most efficiently with raster data sets up to 1000 by 1000 cells. Larger data sets can be used, but processing time increases and the program slows. This is especially true for time series operations and insolation algorithms. Faster computers and faster data movement to and from hard drives improve the size/processing time balance, so better and faster machines tend to compensate for larger data sets.

KRESS Modeler and Other GIS Programs

The KRESS modeler is designed to be used in conjunction with a full-fledged GIS program such as ArcView, ArcGIS, IDRISI Kilimanjaro, etc. These programs are required to develop the data layers that the modeler uses. For example, a manager could use soils/vegetation data from the Natural Resource

Conservation Service to estimate forage production on each ecological sites across a landscape. This layer would be saved in an ASCII raster format for use in the KRESS modeler.

Themes that can be generated in the KRESS Modeler include slope and aspect, which are generated from digital elevation models (DEM) produced by the US Geological Service. Other data layers found to be useful in animal studies are Direct Solar Radiation (DirSR), Diffuse Solar Radiation (DifSR), and Global Solar Radiation (GSR); routines were built in the KRESS Modeler to calculate these parameters using an ASCII digital elevation model. The algorithms generate DirSR, DifSR and GSR estimates for each cell in the DEM for both a single date and time and for time intervals. This routine requires ASCII raster data for elevation, slope, and aspect. As one would expect, this produces enormous amounts of output if short time intervals and large landscapes are modeled.