



IDRISI[®] Selva

GIS and Image Processing Software

An integrated feature-rich GIS and Image Processing software system
for the analysis and display of spatial data

- GIS Analysis
- Image Processing
- Surface Analysis
- Change & Time Series Analysis
- Modeling
- Decision Support
- And more...



Application LAND COVER MAPPING

The IDRISI software includes a comprehensive suite of image processing tools, making it an excellent choice for land cover mapping applications with remotely-sensed data. Tools are provided for image restoration, enhancement, classification and transformation. Special techniques are included for soft classification and hyperspectral image analysis. IDRISI also provides a host of machine learning tools, including artificial neural network classifiers and classification tree analysis. A segment-based classification is also included.

Types of analysis available with IDRISI:

- Inventory and baseline land resource mapping
- Land change and time series analysis
- Agricultural monitoring
- Natural resource monitoring
- Satellite image processing



Unsupervised land cover classification is available in IDRISI through a group of modules, including Neural Networks. CLUSTER, a histogram peak clustering procedure, is one of the fastest routines available and uses raw imagery to produce an output image of spectral classes.

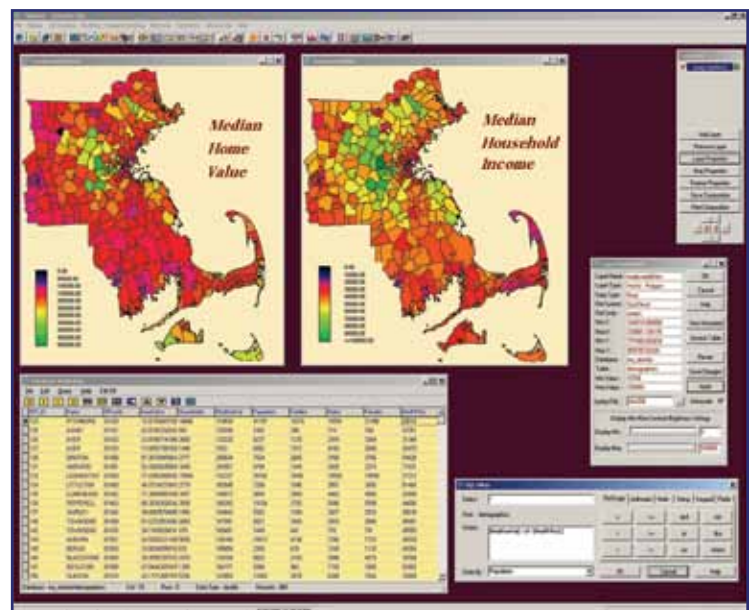
Researchers and professionals across industries in over 180 countries worldwide use IDRISI to monitor and manage complex environmental issues. Our users include environmental scientists and managers from a wide range of fields—landuse planning, ecology, forestry, development, vulnerability assessment—who require research-grade tools at an affordable cost.

GIS Analysis

At the very heart of GIS is the ability to perform analyses based on geographic location. IDRISI provides a range of powerful tools for the exploration of our rapidly changing world--traditional tools for the day-to-day needs of the GIS professional as well as advanced procedures for complex modeling and analysis.

For the most fundamental of GIS operations, database query, IDRISI supports the ability to query features in map layers and also provides a wide range of tools for analyzing a spatial database of raster and vector data. For raster data, facilities exist to query irregular subregions of images and report basic statistics as well as profiles over space and time, histograms, and tabulations of area and perimeter. Queries can also be constructed as relational statements using the basic overlay and reclassification routines provided. For vector databases, an integrated relational database management tool called Database Workshop can be used to enter attribute data, calculate new field values as a function of existing fields, and construct database queries. Database Workshop allows for the full integration and linking of vector data with ancillary tabular database files employing full SQL capabilities.

Derivative mapping is one of the most dramatic features of a GIS--the ability to construct new data layers as a function of existing layers (such as developing



The towns that meet the query criterion (median home value > 4 * median income) are shown in red. A toggle button also allows the query result to be shown with a quantitative color scheme.

With IDRISI, all analytical features come standard. There is no need to buy costly add-ons to extend your research capabilities. A wide range of tools—nearly 300 modules—is included for GIS analysis, image processing, surface analysis, change & time series analysis, modeling, and decision support & uncertainty management. The Selva Edition, released in January 2012, is the 17th version of the IDRISI software since 1987.

a map of soil erosion as a mathematical function of layers indicating slope, rainfall intensity, soil K factor, etc.). IDRISI provides a full suite of mathematical and relational modeling tools for this activity, allowing models to be entered as equations, with map layers as variables.

With respect to distance and geographic context, important factors in the analysis of interactions over space, IDRISI provides an especially rich set of operations, including Euclidian and cost distance functions (the latter incorporating the concept of frictions), procedures for the aggregation and disaggregation of directional forces and frictions, a least-cost path procedure, and spatial allocation routines. IDRISI also includes facilities for the analysis of patterns and textures in the local vicinity of features, and the analysis of local context through filtering and aggregation of contiguous groups.

Further, an entire suite of tools exists for employing statistics, primarily aimed at the description of spatial characteristics. These include point distribution measures, simple and multiple image regression, logistical and multinomial logistical regression, autocorrelation procedures, pattern and texture measures, polynomial trend surface analysis and spatial sampling, and random generation procedures for support of Monte Carlo Simulation.

Image Processing

Of major significance are the tools that IDRISI provides for the processing of remotely-sensed images. IDRISI accommodates all major imagery formats, including satellite-borne multispectral imagery and hyperspectral data.

IDRISI includes restoration procedures that allow for both the radiometric and geometric correction of images, permitting the integration of high quality images with other georeferenced data. Tools are also provided for atmospheric correction, destriping and mosaicing. Image enhancement techniques in IDRISI include contrast adjustment, panchromatic merging, noise removal (using both convolutional filters and Fourier analysis) and various filtering operations (such as edge enhancement).

An extensive set of transformation procedures is provided, including principal components analysis, canonical correlation analysis, color space transformations and procedures for the calculation of vegetation indices.

For image classification, the IDRISI software is unsurpassed, offering the widest range of classifiers in the industry. IDRISI includes unsupervised classifiers which employ clustering techniques to find characteristic land cover reflectance patterns, as well as supervised classifiers, which use examples of land cover types provided by the analyst to search for statistically similar characteristics in the imagery.

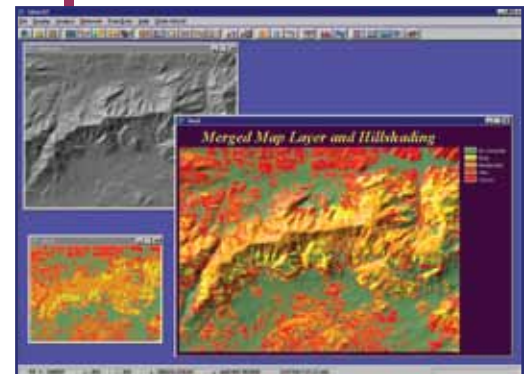


Application LAND USE PLANNING

IDRISI offers a set of support tools that are particularly well-suited for landuse planning and resource allocation decisions. Innovative multi-criteria and multi-objective evaluation techniques as well as tools for uncertainty management provide decision makers unprecedented power and control over their choices.

Types of analysis available with IDRISI:

- Smart growth planning
- Land change analysis and prediction
- Natural resource evaluation
- Landuse decision support
- REDD project planning
- Impact analysis



Results of a fire danger study. An elevation model was used to calculate a hillshaded relief image for the area (upper-left image), which was then enhanced and merged with the classified image to produce the final relief-shaded fire danger image.



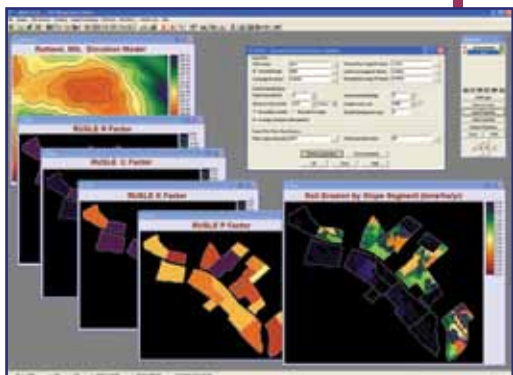
Application

NATURAL RESOURCE MANAGEMENT

IDRISI includes an unparalleled set of tools to facilitate the management and protection of our natural resources. IDRISI is the ideal software for complex analytical challenges, whether it be modeling erosion potential or fire risk or demarcating watershed boundaries.

Types of analysis available with IDRISI:

- Watershed and rainfall runoff analysis
- Erosion potential modeling with RUSLE
- Fire risk assessment
- Flood modeling and prediction
- Forest mapping



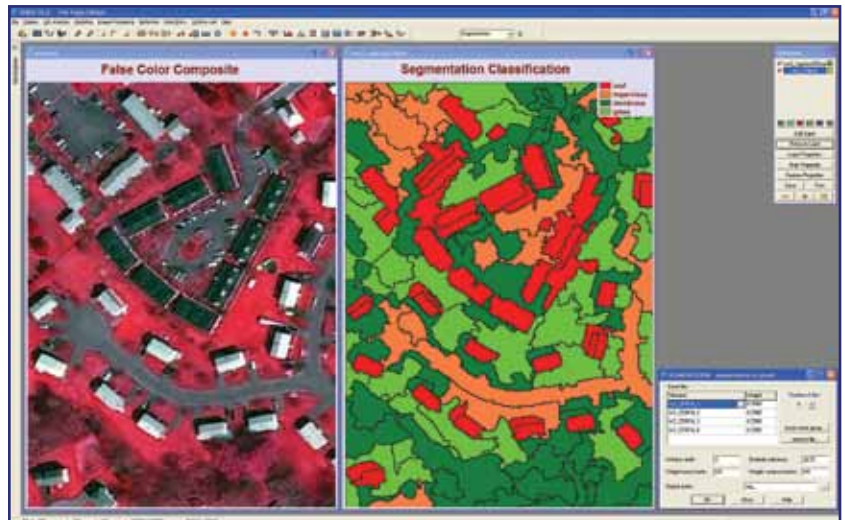
A soil erosion modeling tool, utilizing the Revised Universal Soil Loss equation (RUSLE), computes average soil loss on field units of relative homogeneity.

Developed by researchers for researchers, IDRISI is designed to support the analytical demands of the most challenging problems confronted in our stewardship of the environment as well as provide day-to-day support for the common tasks of the GIS and Image Processing community.

IDRISI provides the traditional hard classifiers as well as innovative soft classifiers. Where hard classifiers identify the most likely land cover class using procedures such as a Bayesian Maximum Likelihood evaluation of evidence, soft classifiers expose the inherent uncertainties in the classification process. The reasons for this vary but include the determination of proportions of various land covers in mixed pixels. These are often called fuzzy classification techniques, but in IDRISI, they incorporate mathematical bases in Bayesian and Dempster-Shafer weight-of-evidence procedures as well as Fuzzy Sets.

Recent classifiers in the IDRISI tool set are geared towards advanced exploration and include Machine Learning, Neural Network and Classification Tree analyses. Specifically provided are the Multi-Layer Perceptron, Kohonen's Self-Organizing Feature Map, Radial Basis Function and Fuzzy ARTMAP neural network classifiers; Classification Tree Analysis; K-Means; and k-Nearest Neighbor.

IDRISI also includes a suite of tools to support segment-based classification. Segmentation is a process by which pixels are grouped into segments that share a homogenous spectral similarity. Segment-based classification is an approach that classifies a remotely-sensed image based on these image segments.



The SEGMENTATION module creates an image of segments that have spectral similarity across many input bands. The module SEGTRAIN assigns these segments to specific land cover types for the development of training site data. The user interactively selects segments and assigns class IDs and class names. The module SEGCLASS classifies the imagery using a majority rule algorithm to assign each segment to a class, based on class majority within each segment as well as the segments of a previously classified image. SEGCLASS can improve the accuracy of a pixel-based classification and produce a smoother map-like classification result while preserving the boundaries between the segments.

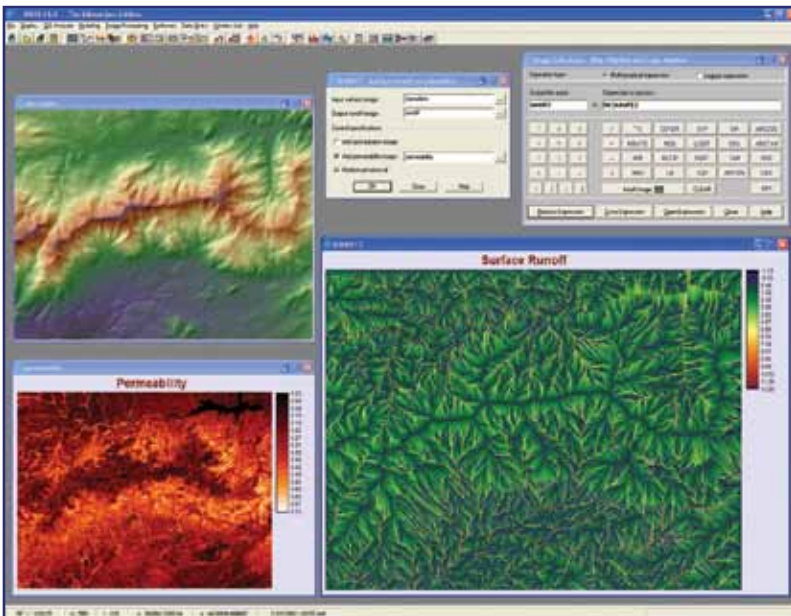
Each license of IDRISI includes a comprehensive User's Guide as well as a set of Tutorial Exercises to assist you in your exploration of the tools and techniques. The Help System provides detailed information and guidance on the use of each analytical module. Each full license also comes with 30 days of free Technical Support.

Surface Analysis

A distinctive component of IDRISI is its wide range of surface analysis tools. These tools support the manipulation of imagery over continuous space to identify patterns, trends, and topological features.

IDRISI provides a variety of surface generation, interpolation and analysis routines. Given a developed digital elevation model, surface characteristics such as slope gradient, aspect (slope orientation), illumination (hillshading), and curvature can easily be calculated. Interpolation procedures include inverse distance weighting, triangulated irregular network (TIN) modeling, Thiessen polygons, trend surface mapping and geostatistics.

IDRISI also allows you to delineate watersheds and viewsheds, determine surface runoff and flow patterns, evaluate sedimentation and model soil erosion. Traditional distance and buffer analysis tools include cost distance and pathway analyses. Surface analysis modeling tools are provided for random image generation, image sampling, and image filtering.



In addition to determining the flow pattern over an elevation model, the RUNOFF module includes the capability to allow for precipitation, infiltration, and duration to model surface runoff.

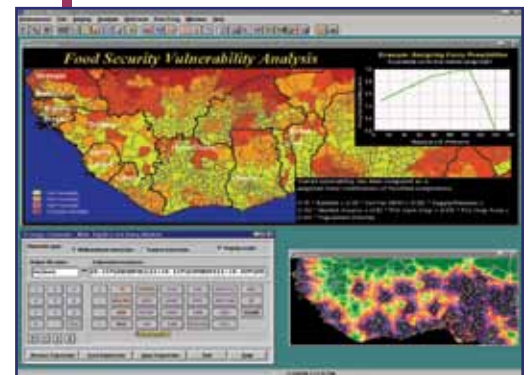


Application ENVIRONMENTAL MODELING

Investigating and modeling the complexities of our environment requires a breadth of innovative and flexible tools. IDRISI provides a variety of spatial modeling environments that permit access to a wide range of analytical functions. Modeling tools are also provided for DEM interpolation, 3-D visualization, data assessment and quality control.

Some of the environmental modeling tools available in IDRISI:

- Macro Modeler
- Image Calculator
- COM compliancy for developers
- Prediction tools such as Cellular Automata and Artificial Neural Networks
- Trend surface analysis



A vulnerability analysis was performed using IDRISI's modeling tools, specifically Image Calculator, an interactive expression-building facility that supports mathematical and logical expressions.



Application LAND CHANGE MODELER

It is imperative that we clearly understand our coupled human-environment system and the consequences of our actions on global ecosystems if we are to plan for a sustainable future.

The Land Change Modeler provides a range of tools for modeling land cover change and its impacts on biodiversity. Along with a wealth of change analysis tools, Land Change Modeler includes tools for modeling the potential for change, grouping transitions into a set of sub-models and exploring the potential power of explanatory variables. One can also predict the course of change into the future through a dynamic land cover change prediction process.

Tools are included to assess the implications of that change for biodiversity, including species-specific habitat assessment, detection of changes in habitat status and gap analysis, land cover pattern and change process analysis, biodiversity assessment, species distribution modeling, and species range polygon refinement. Interfaces are included to both Marxan and MaxEnt.

Land Change Modeller provides tools to evaluate planning interventions. There is a REDD (Reducing Emissions from Deforestation and Forest Degradation) modeling facility to estimate and monitor GHG emission reductions due to REDD forest project interventions.



A set of tools allows the understanding the nature and extent of landcover change, and includes graphs of gains and losses, net changes and contributions experienced by any category.

Clark Labs, developer of the IDRISI software, is based within the world-renowned Graduate School of Geography at Clark University, and is dedicated to the research and development of geospatial technologies for responsible and effective environmental management.

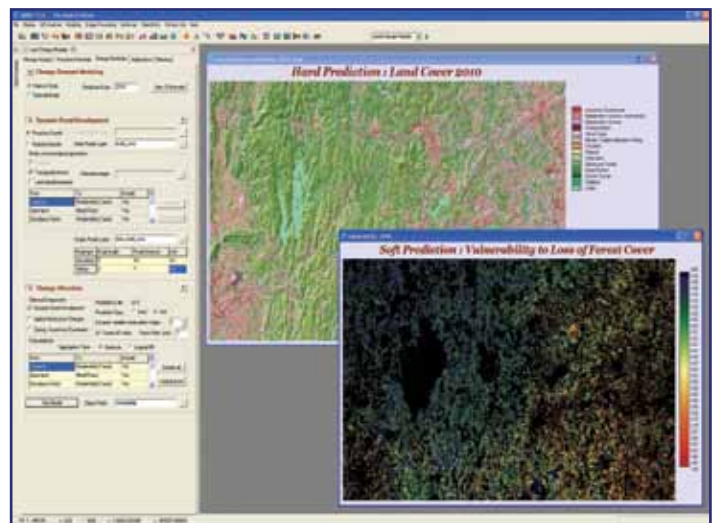
Change and Time Series Analysis

Change and Time Series analysis identifies and quantifies change and its impacts. IDRISI includes an extensive set of tools for measuring change at both local and global scales, including tools for pairwise image comparison, multiple image comparison, and predictive modeling and assessment.

IDRISI's distinctive image comparison tools include image differencing, image ratioing, regression differencing, change vector analysis, and qualitative data analysis. Multiple image comparison techniques look at trends and anomalies across multiple images (time series) and include tools for time series analysis using Principal Components analysis, time series Fourier analysis, spatial/temporal correlation and image profiling over time.

A suite of tools is provided for predictive land cover change modeling as well as the assessment of those predictions, utilizing knowledge of past changes. These tools include Markov Chain Analysis, Cellular Automata, logistical regression and multinomial logistical regression, GEOMOD, and Artificial Neural Networks.

IDRISI includes two vertical applications for the analysis of change and time series as well. The Land Change Modeler provides tools for the assessment of land cover change, the identification of driving forces of change, and the use of that information to predict future scenarios. The Earth Trends Modeler provides tools for the observation, exploration and analysis of image time series data and is particularly relevant for climate change work.



The Land Change Modeler provides the capability for both hard and soft projection of change into the future. Both modes accommodate the recalculation of dynamic variables and dynamic road growth. Hard prediction models a single realization while soft prediction maps the spatial pattern and potential for change.

Partnering with such organizations as the Gordon & Betty Moore Foundation, Google.org, USDA, the United Nations, and Conservation International, Clark Labs leverages its academic base to develop innovative and customized research tools, provide software solutions to organizations in need and apply geospatial expertise to a range of real-world problems.

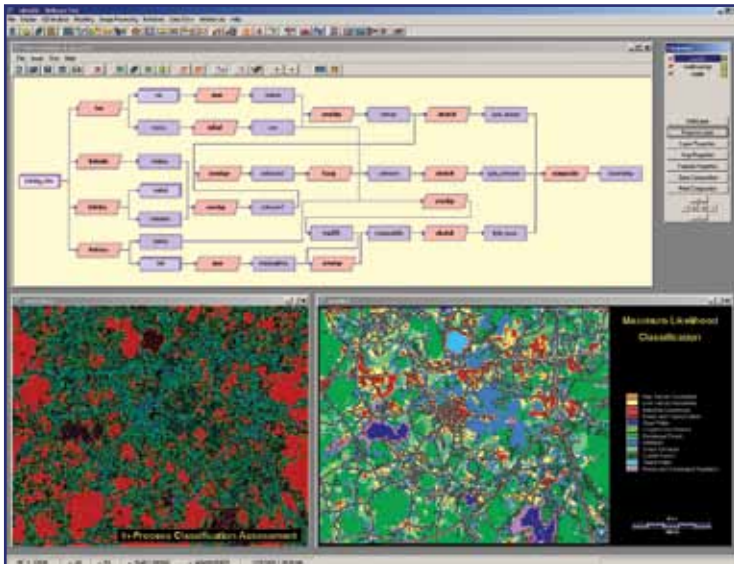
Modeling

IDRISI's modeling tools unleash the power of raster analysis by allowing users to easily develop their own models through existing functionality or to create their own tools and procedures to work within the IDRISI environment.

The Image Calculator, an interactive mathematical modeling tool, provides a simple calculator-like interface for constructing algebraic and logical formulas with map layers as variables. The Macro Modeler, another graphical modeling tool, exposes all of IDRISI's GIS modules as objects that can be linked, dynamically and with feedbacks, with map layers in an algorithmic chain.

For the most demanding of algorithmic modeling applications, or for the development of stand-alone modules as add-ons to IDRISI, a scripting language such as Python or a full programming language such as C++, Delphi or Visual Basic can be used to access IDRISI through the industry-standard COM object model interface.

IDRISI also includes two vertical applications for modeling. The Earth Trends Modeler provides a coordinated suite of data mining tools for the extraction of trends and underlying determinants of variability from image time series data. The Land Change Modeler provides a range of tools for modeling land cover change and its impacts on biodiversity.



With the Macro Modeler, you can develop models by constructing graphical flow diagrams using over 100 analytical functions. Dynamic and batch modeling are also supported.



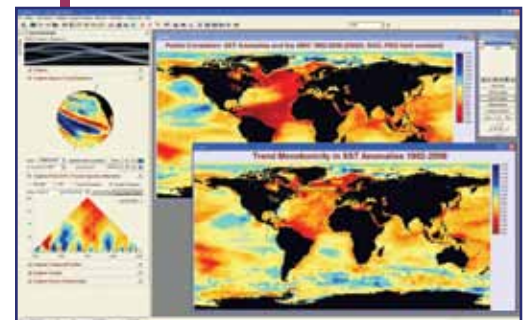
Application

EARTH TRENDS MODELER

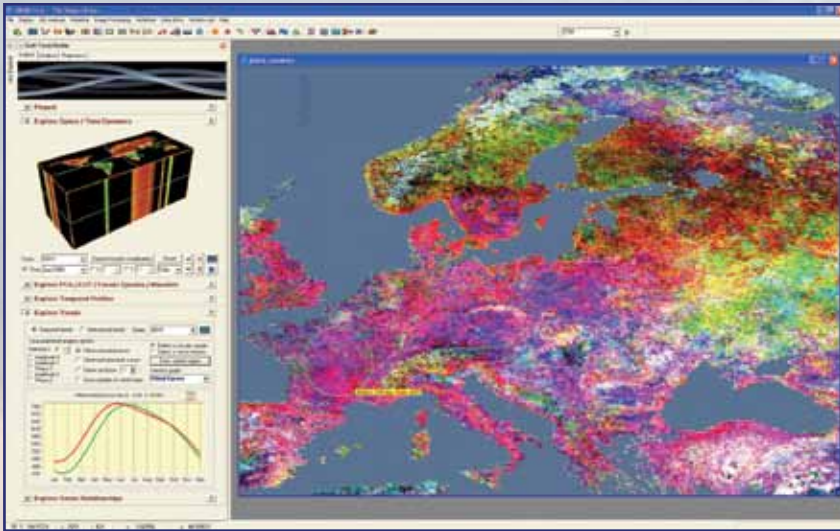
Earth Trends Modeler is a vertical application focused on the analysis of trends and the dynamic characteristics of these phenomena as evident in earth observation image time series. No other software technology provides such a coordinated suite of data mining tools needed by the earth system science community of climate change analysis and impact assessment.

Earth Trends Modeler allows you to view animations of series, analyze variability across varying temporal scales, extract profiles of values over time, and analyze long-term environmental trends with a variety of techniques, for example, a procedure to examine trends in seasonality, such as phenological change in plant species, or to examine relationships between series using linear modeling (multiple regression) tool.

Earth Trends Modeler provides tools for spectral decomposition, in particular those for the analysis of coupled systems over time. These tools include principal components analysis in both T-mode and S-mode, amongst others, for analyzing patterns that evolve in space and time, and many others for the decomposition of a series into its underlying constituents.



Earth Trends Modeler allows you to analyze long-term trends with a variety of techniques for trend analysis, including measures of linearity, monotonicity, and trend rate. Several visualization techniques are provided.



Seasonal trend analysis is a revolutionary new analytical procedure developed by Clark Labs. Traditional multi-year trend analysis procedures consider seasonality to be a contaminant and thus intentionally reject it. ETM specifically seeks trends in seasonality and displays them in a dramatic manner. This procedure combines the logic of Windowed Fourier Analysis with non-parametric trend analysis. This screenshot shows a seasonal trend analysis of vegetation conditions in Europe for the period 1982-2003 based on an analysis of vegetation index imagery from the AVHRR instrument on the NOAA Polar Orbiter satellites (shown in the space-time visualization cube). The colors represent different types of trends in the seasonal curve of vegetation photosynthesis. The graph shows vegetation photosynthetic activity (Y-axis) for each of the 12 months (X-axis) of 1982 (in green) and 2003 (in red) for the area circled in France. As can be seen, the red color that is found over most of Europe relates to increased photosynthetic activity through the winter and spring. By looking at the graph, one can see that spring came about a month earlier in 2003 than it did in 1982.

Decision Support and Uncertainty Management

IDRISI is widely known for the character of its decision support tools for effective resource allocation, including cutting-edge techniques for multi-criteria evaluation, multi-objective land allocation modeling, and suitability mapping. IDRISI also provides a consensus-seeking procedure for weighting criteria, fuzzy standardization, and an extensive set of criteria aggregation procedures based on Weighted Linear Combination and Ordered Weighted Averaging.

IDRISI has the most extensive set of tools for uncertainty management in the industry. These include error propagation through Monte Carlo Simulation, the evaluation of decision risk as a result of propagated error, calculation and aggregation of Fuzzy Sets, and the aggregation of indirect evidence to support a weight-of-evidence conclusion using both Bayesian and Dempster-Shafer approaches. IDRISI includes a soft reclassification procedure that allows one to map the probability of a location being above or below a threshold (such as sea level rise) as well as an implementation of spatial prior probabilities for Maximum Likelihood classification.

Learn more about IDRISI: Visit www.clarklabs.org

Display, Map Composition and 3-D Fly Through

IDRISI provides a variety of display and map composition utilities for visualization and enhancement. There are facilities for multiple image pan, zoom and spatial query, control over image transparency, and interactive 24-bit RGB compositing and contrast controls, among others.

IDRISI also includes a Fly Through module, an interactive 3-D viewer that allows you to simulate movement through space over existing IDRISI images. The user has control over altitude, orientation, and movement. Flight paths can be saved and redisplayed.

System Requirements

IDRISI Selva is a 32-bit, object-oriented system designed for professional-level use on platforms employing the Microsoft® Windows operating environment.

- Intel Pentium IV or higher running on a 32-bit or 64-bit platform
- Windows XP, Vista and Windows 7 (32- or 64-bit)
- If utilizing a server, Windows Server 2003 and above
- Minimum display of 1024 x 768 with 64,000 colors
- 2 GB RAM or greater
- 1.3 GB hard disk space for installation
- CD-ROM for installation

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