

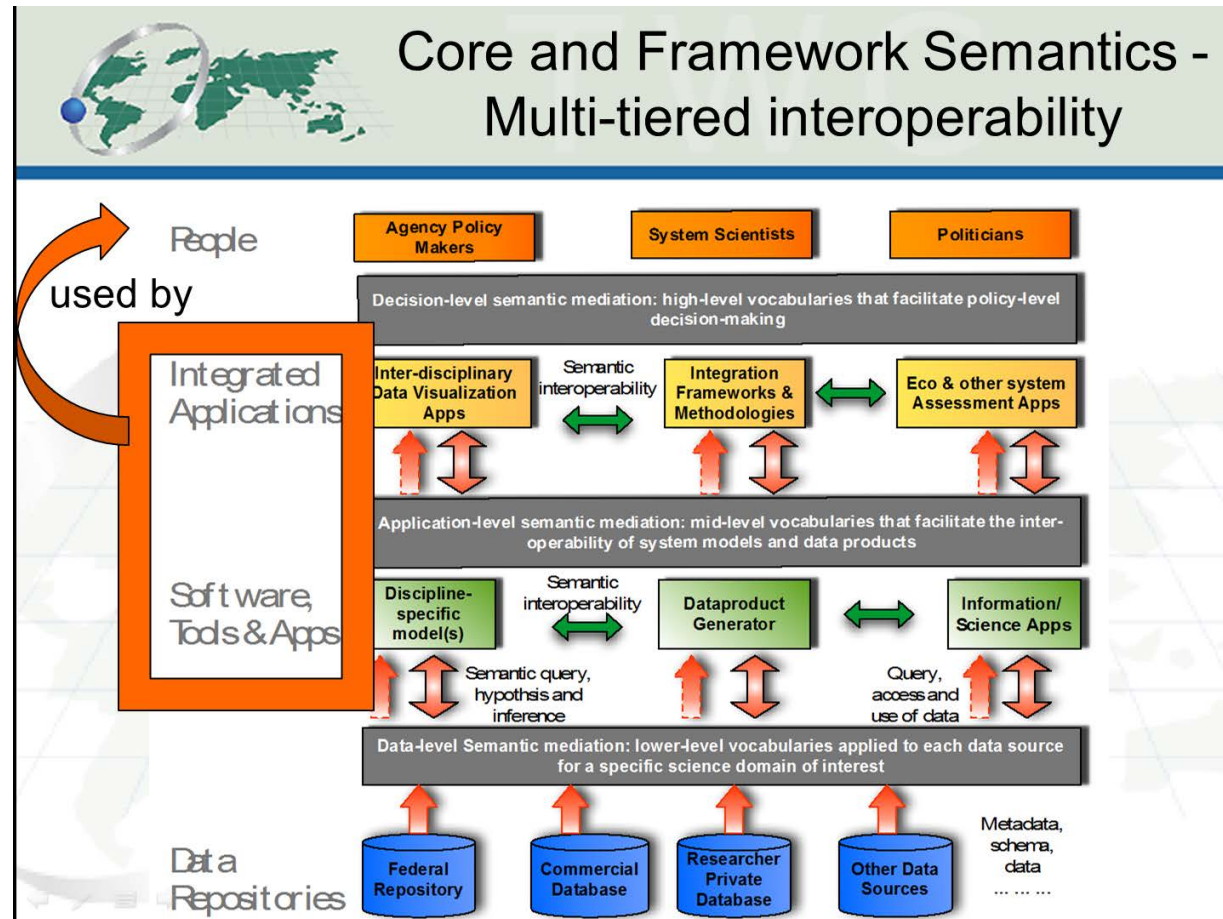
# Ontologies and Spatial Decision Support

Naicong Li, Philip Murphy, The Redlands Institute, University of Redlands  
Krzysztof Janowicz, University of California, Santa Barbara

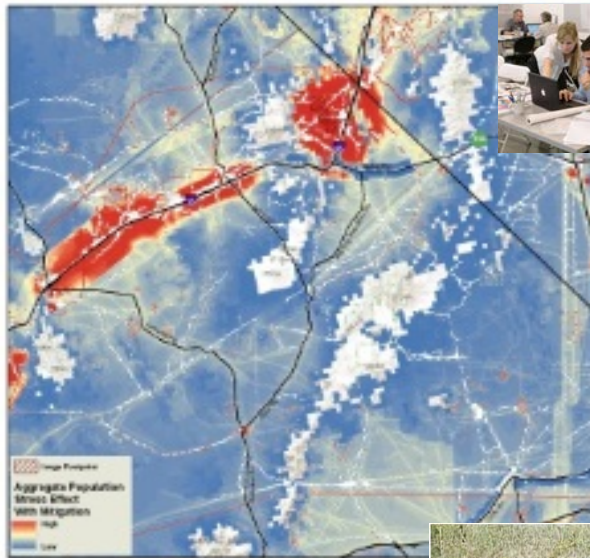
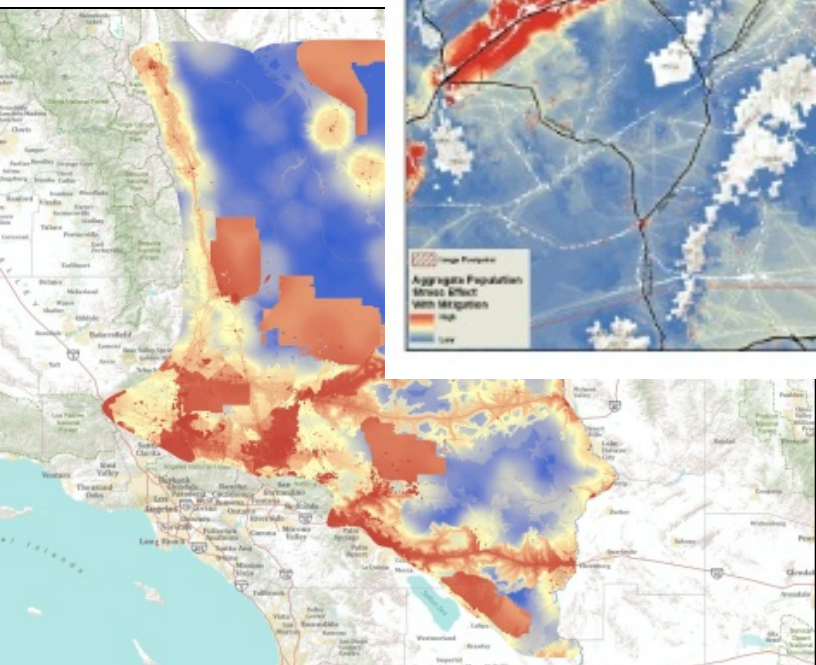
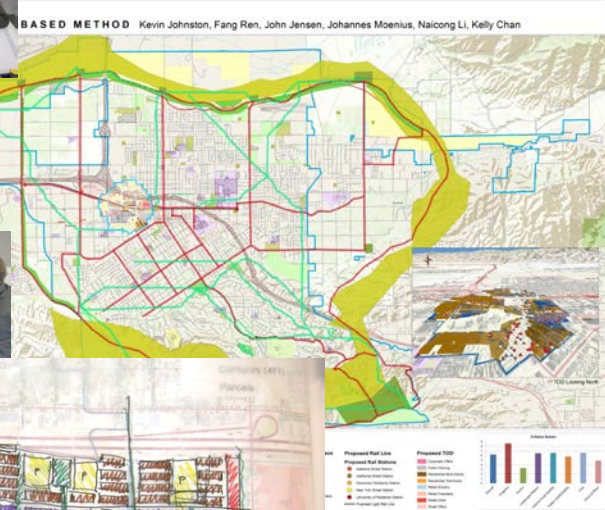
Earth Science-Ontolog mini series, Session 2  
September 6, 2012

# Earth sciences and decision making

- Down stream application for earth science data and models – informing decision making
- Data and models will have added value when easily discovered and accessed as useful resources for informing large-scale planning and decision making.
- Need for decision level semantics



Peter Fox, Earth science-Ontolog mini series, 2012



# Large-scale planning and decision problems


## Characteristics of large scale planning and spatial decision problems

- Complex
- Involving spatial and temporal dimensions
- Computationally demanding
- Inherently cross domain
- Involving interaction between natural and human systems
- Finding spatial decision support (SDS) resources often faces Big Data problem
  - Where are the good datasets, tools and models
  - Which ones are most appropriate for the problem at hand
- Interoperability problem among SDS resources

# Need for formalizing the knowledge in SDS

- Registration, automatic discovery and access of SDS resources (e.g. workflow templates, methods and algorithms, models and tools, data, cases studies)
- Encourage modular, reusable models and tools development
- Facilitate interoperability among models and tools
- Automatic workflow composition and orchestration
- Provide a common vocabulary for the user community
- Facilitate learning in SDS

# One solution – SDS ontology

Go to GeoDesign Portal 

Spatial Decision Support Knowledge Portal

Search

HOME CONCEPTS RESOURCES ABOUT CONTACT HELP LOGIN

Welcome to the Spatial Decision Support Knowledge Portal — your portal to knowledge, information and resources for your planning and spatial decision making needs.

**The SDS Knowledge Portal can help you:**

- gain a systematic understanding of planning and decision making **process**
- find relevant **methods, tools and models, data sources, literature**, and other useful resources for your specific planning/decision making **problem type** in your application domain
- learn about **case studies** with project needs similar to yours.

**Explore the Ontology**

- + Introduction
- + Spatial Planning And Decision Problem Types
- + Planning/Decision Context
- + Planning And Spatial Decision Process
- + Methods And Techniques
- + Technology
- + Data And Domain Knowledge
- + People And Participation
- + Resources

**What's New**

- New Portal architecture and user interface
- The Portal content is dynamically updated via ontology web services
- Concepts pages now have individual URLs
- Initial version of graphical browsing of concepts
- New interface for searching SDS resources
- Many content updates

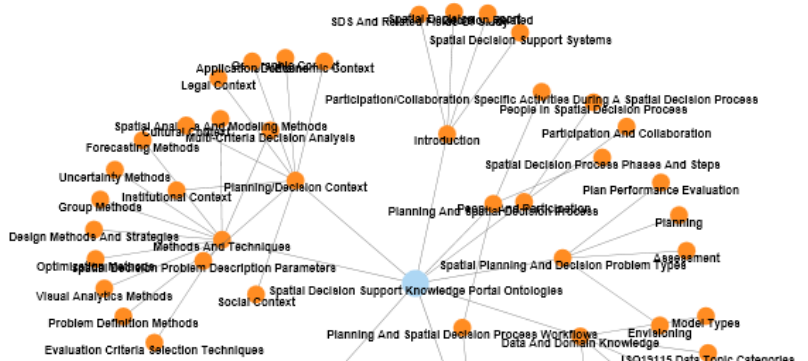
**SDS Consortium**

The SDS Consortium was formed in May 2008, and consists of researchers, experts and practitioners in the field of SDS. To learn more and see the complete list of members, [click here](#).

**Quick Tips for Getting Started**














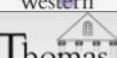




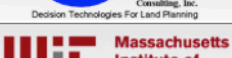









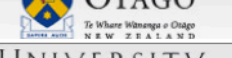

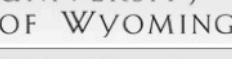

Browse the SDS Ontology graph on the left

- Click on a node to jump to the content of that node
- Pan to see the rest of the graph



... and the **SDS Knowledge Portal** driven by the SDS ontology

# The SDS Consortium

	<b>The Redlands Institute</b>	University of Redlands		<b>Krzysztof Janowicz</b>	University of California, Santa Barbara
	<b>Stephen Bathgate &amp; Duncan Ray</b>	Forest Research		<b>Karen Kemp</b>	The Kohala Center
	<b>Luc Boerboom</b>	University of Twente		<b>Richard E. Klosterman</b>	What if?, Inc.
	<b>Susan Crow</b>	University of Georgia		<b>Jason Lally &amp; Ken Snyder</b>	PlaceMatters
	<b>Catherine Darst</b>	US Fish & Wildlife Services		<b>Arika Ligmann-Zielinska</b>	Michigan State University
	<b>Hamid Ekbia</b>	Indiana University		<b>Jacek Malczewski</b>	University of Western Ontario
	<b>Ljusk Ola Eriksson</b>	Swedish University of Agricultural Sciences		<b>Andrew Miller</b>	Ecological Applications
	<b>Stephen M Ervin</b>	Harvard Graduate School of Design		<b>Philip Murphy</b>	InfoHarvest, Inc.
	<b>Brenda Faber</b>	Fore Site Consulting, Inc.		<b>Timothy L. Nyerges</b>	University of Washington
	<b>Mike Flaxman</b>	MIT		<b>Rob Raskin</b>	NASA / Jet Propulsion Laboratory
	<b>Stan Geertman</b>	Utrecht University		<b>Keith Reynolds</b>	USDA Forest Service
	<b>Michael Goodchild</b>	University of California, Santa Barbara		<b>Carl Steinitz</b>	Harvard University
	<b>Sean Gordon</b>	Interforest LLC		<b>Mingzhen Wei</b>	Missouri University of Science and Technology
	<b>Brent Hall</b>	University of Otago		<b>Dawn J. Wright</b>	Oregon State University
	<b>Jeffrey D. Hamerlinck</b>	University of Wyoming		<b>Xinyue Ye</b>	Bowling Green State University
	<b>Piotr Jankowski</b>	San Diego State University		<b>Paul Zwick</b>	University of Florida

# Content of the SDS ontology

- Planning/decision problem types
- Planning process workflows and steps
- Strategies, methods and techniques that are commonly associated with different workflow steps
- Models and tools supporting spatial planning
- Data sources supporting spatial planning
- Spatial planning/decision support case studies
- Related concepts supporting the descriptions of the above

# Spatial planning and decision problem types

## Suitability

Assessments of suitability and impact assessment. status or impact assessment

### Synonyms

land suitability; water res

### Related Planning

[Conservation Process W](#)  
[Urban Planning Process](#)

### Related Methods

[Multi-Criteria Decision A](#)  
[Uncertainty Methods](#)

### Related Tools

[AHP In Arcgis](#)  
[AHP-OWA In Arcgis](#)  
[Arcgis](#)  
[Coastal Landscape Anal](#)  
[Communityviz](#)  
[Conservation Assessme](#)

### Related Tools

[Ecosystem Assessment & Reporting Tool](#)  
[Ecosystem Management Decision Support](#)  
[EZ-IMPACT](#)  
[IDRISI](#)  
[Invest Toolbox](#)  
[Marine Reserve And Local Fisheries Inte](#)  
[NED](#)  
[Netweaver](#)  
[Program To Assist In Tracking Critical Ha](#)  
[Refuge GAP](#)  
[Remsoft Spatial Planning System](#)

[Land-Use Change And Analysis System \(LUCAS\)](#)

## Site Search Or Selection

Site selection involves identifying elements of biodiversity reserve or designation for timber. the two are sufficiently different to justify making assigning a set of alternative uses to all parcels in a general matrix of parcels that

### Synonyms

site search; site selection

### Related Tools

[C-Plan](#)  
[MARXAN / SPEXAN](#)  
[MARXAN V](#)  
[Resnet & S](#)  
[Sites/Site S](#)  
[Vista](#)  
[Zonae Cog](#)

### Related

[Global Ser](#)  
[Sandy Rive](#)

### Last Up

6/5/2008

## Location Allocation

Spatial allocation is primarily concerned with designating what kinds of activities can or will be done where on the landscape.

## Schedule

Scheduling in the context of GeoDesign problems can be thought of as a special case of selection and allocation problems in which temporal constraints also are important. A typical example of this type of problem is timber-harvest scheduling, in which there are constraints on both the types and timing of activities that can be implemented in neighboring units. These types of problems almost always are optimization problems.

## Network Design

Network design in the context of spatial decision problems is concerned with delineation of pathways through some spatial domain. Obvious examples in this realm include design of road and utility networks, which typically seek least-cost pathways that may involve both spatial and temporal considerations. The spatial computation for this class of problem is almost always global. In addition to the more conventional notion of networks in terms of roads and utilities, in conservation biology, there is also the notion of reserve networks. To the extent that an analysis for reserve design explicitly treats connectivity of patches through connecting corridors, this is an apt characterization.

### Related Planning/Decision Process Workflows

[Geodesign Process Workflow](#)

### Related Methods

[Agent Based Approach](#)  
[Anticipatory Approach](#)  
[Combinatorial Approach](#)  
[Connectivity Operations](#)  
[Constraining Approach](#)  
[Mixed Approach](#)  
[Optimizing Approach](#)  
[Rule Based Approach](#)  
[Sequential Approach](#)

### Subcategories

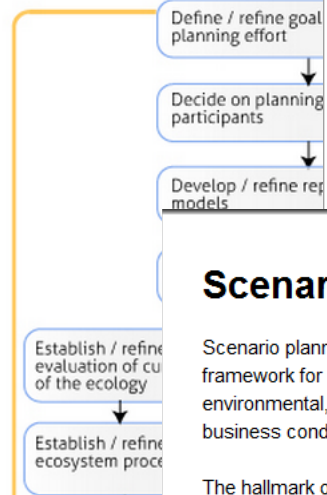
[Reserve System](#)  
[Transportation, Vehicle Routing And Scheduling](#)

# Spatial planning workflows

## Adaptive Natural Resource Plan

A prototypical process flow for adaptive natural resource management includes the post planning steps such as implementation, monitoring, and evaluation, and the process itself is iterative, with the result of the process being used to inform the next iteration. If the goal of managing the resource is to sustain that resource, the process is iterative.

### An iteration of a Natural Resource Management Process



## Scenario Planning

Scenario planning is a process for developing a set of alternative environmental, land use, etc. business conditions and better future.

The hallmark of scenario planning is that it might be considered developing possibilities for each variable in the future.

Scenario planning creates good future vision that provides a framework for discussing the scenarios and discussing the trade-offs, and making decisions.

Scenario planning is a flexible quality of life, urban form, transportation, geographic scales (including critical component in using the

## Urban Planning Process

Urban planning is a discipline of land use planning that explores a very wide range of aspects of the built and social environments of urbanized areas. It is a process that creates the urban environment based on the ideals based on the urban planning process.

Changes in the urban planning process. The urban planning process is a process of decisions made by grassroots planning.

### Process Phase 1 -

## Steinitz's Framework

Steinitz's framework is a conceptual framework proposed by Carl Steinitz (1990) to describe six levels of inquiry during a spatial decision-making process; each level is associated with a type (phase) of modeling with GIS to form a comprehensive expression of a decision support strategy for landscape planning and design:

Phase I: How should the state of the landscape be described in content, space, and time? This question is answered by REPRESENTATION MODELS, the data upon which the study relies.

Phase II: How does the landscape operate? What are the functional and structural relationships among its elements? This question is answered by PROCESS MODELS that provide information for the several assessments that are the content for the study.

Phase III: Is the current landscape working well? This question is answered by EVALUATION MODELS, which are dependent on the cultural knowledge of the decision-making stakeholders.

Phase IV: How might the landscape be altered, by what policies and actions, where and when? This question is answered by the CHANGE MODELS that will be tested in the research. They are also data, as assumed for the future.

Phase V: What difference might the changes cause? This question is answered by IMPACT MODELS, which are information produced by the process models under changed conditions.

Phase VI: How should the landscape be changed? This question is answered by DECISION MODELS, which, like the evaluation models, are dependent on the cultural knowledge of the stakeholders and responsible decision-makers.

As indicated in the following diagram, the decision process flow may go back to a previous phase if the conclusion for the current phase indicates the need:

## Conservation Process

The conservation process workflow is developed by The Trust for Public Land.

### Process Phases

CPW Phase 1 - Location Profiling

CPW Phase 2 - Stakeholder Engagement

RECOGNIZE CONTEXT

TIME -

PERFORM STUDY

REPRESENTATION MODELS

TIME +  
10

1. How should the geography be described?

# Steps in a spatial planning workflow

Spatial

Go to GeoDesign Portal

Search

## Condition Assessment

Condition assessment is a method where a decision maker assesses the current state of a multiattribute decision making phase. This phase is often referred to as the 'diagnostic' phase.

## Design

The design phase during a planning process involves creating and analyzing a set of possible solutions (alternative courses of action) to address the problem.

## Process

Process mapping is a tool for identifying who should be involved in the planning process and what their roles should be.

### Synonyms

intelligence;

### Sub Steps

Condition Assessment

## Impact Analysis

Impact analysis is the assessment of the pros and cons of pursuing a course of action in terms of possible intended or unintended consequences. It is the ability to anticipate the potential impacts of a decision or action.

## Rank Alternatives

Alternative ranking is a process during which a set of alternatives (for the solution of the decision problem) is ranked based on a set of evaluation criteria, with the alternative that best meets the criteria ranked on top. When alternative ranking is done with a multicriteria decision analysis approach, the ranking is achieved by selecting and applying an appropriate multiattribute or multiobjective decision rule.

### Synonyms

alternative ranking; prioritize options; decision rules application

### Input

Alternative

### Output

Ranked Alternatives

### Commonly Followed By

Recommend Alternative

### Commonly Used Methods And Techniques

Multi-Attribute Combination Methods  
Multi-Objective Combination Methods  
Optimization Methods  
Uncertainty Methods

### Participant Roles Involved

## Issue Analysis

The goal and problem are clarified, and the decision maker identifies the key issues and stakeholders.

### Synonyms

goal identification

### Sub Steps

Objective Definition  
Problem Definition  
Stakeholder Engagement  
Visualization

### Commonly Followed By

Condition Assessment  
Process Mapping

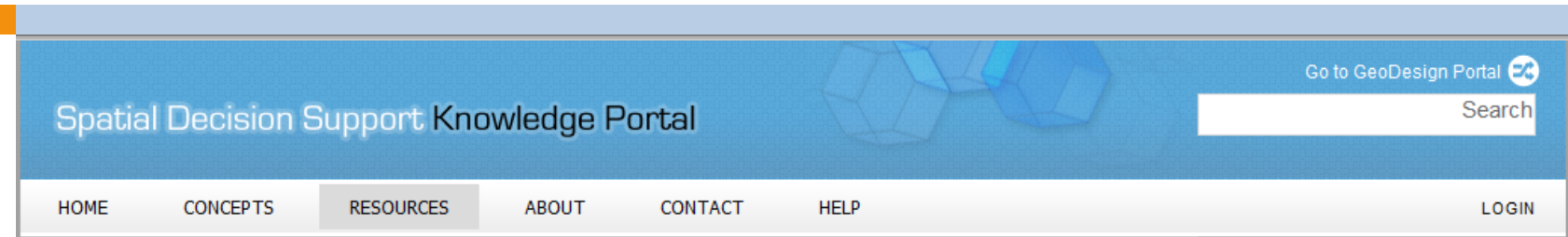
### Participant Roles Involved

Recommendation  
Stakeholder

### Participant Roles Involved

Business  
Community  
Decision Maker  
Government  
Interest Group  
Mediator  
Public

# Methods, techniques, algorithms



## Multi-Criteria Decision Analysis

Methods for making decisions (MCDM). It involves two broad categories: Both MCDM categories require the correct problem elements, uncertainty, decision assumptions, and criteria values.

**Abbreviation**  
MCDM

**Synonyms**  
multi-criteria

**For Decision Process Phases/Steps**  
Alternative Suitability

**Implemented For**  
Conservation Assessment, Environmental Impact

### Analytical Hierarchy Process

The Analytical Hierarchy Process (AHP) provides a structured approach to decision-making. It involves breaking down a complex problem into a hierarchy of sub-problems, which are then evaluated and ranked based on their relative importance. The process is iterative and involves the use of pairwise comparisons to estimate the relative importance of each element in the hierarchy.

**Abbreviation**  
AHP

**Used For**  
Condition Assessment, Environmental Impact

### Pairwise Comparison

The pairwise comparison involves comparing elements in a decision hierarchy. The comparison is based on the relative importance of each element, and the results are used to estimate the weights of each element.

**Used For**  
Specify Criteria

**Number**  
 $n(n-1)/2$

**Response**  
Ratio Scale

**Underlying**  
statistical/hierarchical

**Trustworthiness**  
High

**Precision**  
Quite Precise

### Value/Utility Function

The utility function is a mathematical representation of the decision maker's preferences. It is used to evaluate the relative importance of each element in the decision hierarchy. The utility function is typically derived from a set of pairwise comparisons.

**For Decision Process Phases/Steps**  
Balance Benefits, Maximize Benefits, Minimize Negative

**Implemented For**  
Conservation Assessment, Environmental Impact

### Criterion

Multicriteria Decision Analysis (MCDA) is a process for deriving weights for evaluation criteria. The criterion is the basis for the evaluation.

**Synonyms**  
weights assessment

**Used For Decision Process Phases/Steps**  
Specify Criteria

**Implemented For**  
Conservation Assessment, Environmental Impact

### Ratio

The ratio scale is a scale where the values are proportional to the actual values. It is used to evaluate the relative importance of each element in the decision hierarchy.

**Used For**  
Specify Criteria

**Number**  
n

**Response**  
Interval Scale

**Underlying**  
none

**Trustworthiness**  
High

### Genetic

A genetic algorithm is a search algorithm that mimics the process of natural selection. It is used to find the optimal solution to a problem. The algorithm starts with a population of random solutions and iteratively improves them through selection, crossover, and mutation.

**For Decision Process Phases/Steps**  
Balance Benefits, Maximize Benefits, Minimize Negative

**Used For Decision Process Phases/Steps**  
Alternative Generation, Alternative Screening, Rank Alternatives

### Heuristic

In computer science, a heuristic is a method for finding a solution to a problem. It is typically used when the problem is too complex to solve using a brute-force method.

**For Decision Process Phases/Steps**  
Balance Benefits, Maximize Benefits, Minimize Negative

**Used For Decision Process Phases/Steps**  
Alternative Generation, Alternative Screening, Rank Alternatives

**Subcategory**  
Metropolis Heuristic, Simulated Annealing

**Source Of**  
<http://en.wikipedia.org>

## Weighted Linear Combination

Weighted linear combination is the most often used technique for tackling spatial multicriteria decision analysis. It is a procedure based on the concept of a weighted average. The decision maker directly assigns a weight to each attribute. A total score is then obtained for each alternative by multiplying the importance value given to the alternative on that attribute, and summing the products over all attributes. The alternative with the highest overall score is chosen. The GIS-based method is as follows:

1. Define the set of evaluation criteria (map layers) and the set of feasible alternatives.
2. Standardize each criterion map layer.
3. Define the criterion weights; that is, a weight of relative importance is directly assigned to each criterion.
4. Construct the weighted standardized map layers; that is, multiply standardized map layers by their respective weights.
5. Generate the overall score for each alternative using the add overlay operation.
6. Rank the alternatives according to the overall performance scores; the alternative with the highest score is the best.

The weighted linear combination method can be operationalized using any GIS system. The method allows the evaluation criterion map layers (input maps) to be aggregated. The method can be implemented in both raster and vector GIS environments.

**Abbreviation**  
WLC

### Synonyms

weighted summation; boolean overlay; simple additive weighting method; SAW; scoring

### Used For Decision Process Phases/Steps

Condition Analysis And Assessment  
Impact Analysis  
Rank Alternatives

### Input

# Software models, tools, services

## Spatial Decision

HOME CONCEPTS

## Tools

See all the tools at a glance

### Filter By

decision problem type  
targeted

used for application domain

domain knowledge model  
area

decision process activity  
supported

methods and techniques

functional components

technical expertise required

ArcGIS



Home Industries

GIS helps Acc

### C-Plan

#### The C-Plan Conserva

You can download

C-Plan is a decision support system for conservation planning decisions. Reserve network design is based on the principle of maximization of species, vegetation type, or other features. It is compatible with the C-plan GIS.

### C-Whiz

#### KETRON Optimization

C-Whiz - Linear Programming

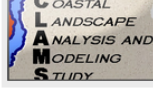
C-Whiz is a fast, reliable, accurate, efficient & easy to use general purpose linear solver for the C-Whiz mathematical programming system.

### AutoCAD



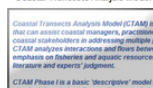
AutoCAD is a CAD (Computer Aided Design or Computer Aided Drafting) software application for 2D and 3D design and drafting.

### Coastal Landscape Analysis and Modeling System



Simulate and analyze the aggregate ecological, economic, and social consequences of general land use/cover changes and assess the impact of coastal zone development over a 100 year time span.

### Coastal Transacts Analysis Model



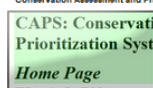
CTAM helps visualize and analyze interactions and flows between natural and human systems, with current emphasis on fisheries and aquatic resources, using information provided by users, literature, and expert judgment.

### Communityviz



Communityviz is an internet GIS application designed to help people visualize, analyze and communicate about important resource decisions.

### Conservation Assessment and Prioritization System



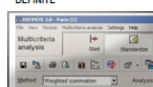
CAPS is a computer software program designed to assess the biodiversity value of any location based on natural community-specific models, and prioritize lands for conservation action based on their assessed biodiversity value in combination with other data relevant to their protection.

### Criterion Decision Plus



Criterion DecisionPlus (CDP) decision management system helps you structure and communicate complex decisions between alternatives. It is a very practical software tool for decision makers. CDP provides a structured approach to decision making. It helps and enhances decision makers' ability to structure the decision, it helps and enhances decision makers' ability to structure the decision, it helps and enhances decision makers' ability to structure the decision.

### DEFINITE



DEFINITE is an environmental planning analysis tool which uses judgement-based, online, and offline data to help users characterize the system at hand and explore hidden interactions and emergent properties.

### EZ-IMPACT



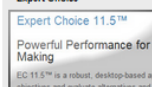
EZ-IMPACT is a planning analysis tool which uses judgement-based, online, and offline data to help users characterize the system at hand and explore hidden interactions and emergent properties.

### Ecosystem Management Decision Support



The Ecosystem Management Decision Support (EMDS) system provides decision support for integrated landscape evaluation and planning. The system provides decision support for integrated landscape evaluation and planning. The system provides decision support for integrated landscape evaluation and planning.

### Expert Choice



Expert Choice 11.5™ Powerful Performance for O Making EC 11.5™ is a robust, desktop-based app objectives and evaluate alternatives and achieve important organizational decisions.

### Forest Vegetation Simulator



The Forest Vegetation Simulator (FVS) is the USDA Forest Service's nationally supported framework for forest growth and yield modeling.

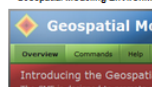
### G20



G20 is a PDF (Power to People) application for ArcGIS Desktop. The application allows you or your users to collaborate without any intermediate server. G20 (go to get) supports:

- 1) Test charting
- 2) Exchange of map content (georeferenced screenshots)
- 3) Use and graphics collaboration (shared editing)
- 4) Share navigation (one person can get the map display of other peers)

### Geospatial Modeling Environment



The Geospatial Modeling Environment (GME) is a platform designed to help to facilitate rigorous spatial analysis and modeling.

### Geographic Resources Analysis Support System



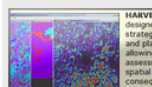
Commonly referred to as GRASS, this is a Geographic Information System (GIS) used for geospatial data management and analysis, image processing, processing, geospatial production, spatial modeling, and visualization. GRASS is currently used in academic and commercial settings around the world, as well as by many government agencies and environmental consulting companies. GRASS is an open source project of the Open Source Geospatial Foundation.

### TPL Greenprint



TPL Greenprint is a collaborative GIS application designed to help communities make informed decisions about conservation priorities. The Greenprint framework provides a systematic approach for identifying currently unprotected areas that offer the highest conservation benefits based on locally identified priorities. The Greenprint GIS application is coupled with a stakeholder-driven community process for identifying location-specific conservation goals and for establishing funding and acquisition strategies for land protection.

### HARVEST



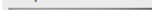
HARVEST is a land-use allocation model which can include common wildlife-related constraints (buffers and greenway periods) and can compute and display biodiversity-related metrics about patches, such as inter-patch habitat conditions.

### Ecosystem Functions Model



The Ecosystem Functions Model (HEC-EFM) is a planning tool that aids in analyzing ecosystem response to changes in flow regime. The Hydrologic Engineering Center (HEC) of the U.S. Army Corps of Engineers is developing HEC-EFM to enable project teams to visualize existing ecosystem conditions, project potential restoration sites, and assess and rank alternatives according to the relative change in ecosystem capacity.

### Habplan



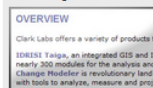
Habitplan is a program for forest harvest and habitat scheduling.

### Hearth Tools



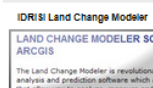
Hearth Tools is a FREE extension for ArcGIS (ArcInfo) that performs a number of spatial analyses and functions that cannot be conveniently accomplished with standard ArcGIS. Most of the tools are written with ArcGIS in mind, though many will be useful to any GIS user. HEC's HEC Tools has been formally discontinued as of December 2003. The new software releases and improve upon HEC Tools and a new Geospatial Modeling Environment (GME).

### IDRISI Taiga



IDRISI Taiga is an integrated GIS and Image Processing software solution providing nearly 300 modules for the analysis and display of digital spatial information. IDRISI offers the most extensive set of GIS and image processing tools in the industry in a single, affordable package. With IDRISI, all analysis features come standard—there is no need to buy costly add-ons to extend your research capabilities.

### IDRISI Land Change Modeler



An ArcGIS extension for analyzing and predicting land cover change and assessing the implications of the change for biodiversity. The Land Change Modeler is a revolutionary analysis and prediction software which also allows you to analyze, measure and predict habitat and biodiversity. Land Change Modeler includes tools that address the complex resource management and habitat assessment.

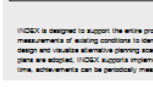
### INDEX



INDEX is an integrated suite of interactive GIS planning support tools for:

- Assessing community conditions
- Designing future scenarios in real time
- Measuring scenarios with performance indicators
- Ranking scenarios by goal achievement
- Optimizing implementation of adopted plans

### INVEST



INVEST is a family of tools to map and value goods and services from nature which are essential for sustaining and fulfilling human life.

### LANDIS



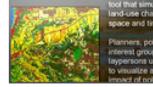
LANDIS is a spatially explicit landscape simulation model. It models natural processes, such as fire, wind, insect disturbance, succession, and seed dispersal, as well as forest management.

### LEAM



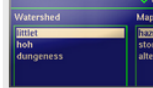
LEAM is a computer-based tool that simulates land-use change across space and time. It enables planners, policymakers, interest groups and legislators to visualize and test community decisions and their consequences. The LEAM environment enhances our understanding of the connection between urban, environmental, social, and economic systems.

### Land-Use Change and Analysis System



System designed to simulate and land use change in two geographic regions.

### Landscape Management System



LMS combines the flow of information among existing growth models, computer visualization software, and analysis tools to allow the user to simulate the growth

# Case studies

Go to GeoDesign Portal

Search

HOME

CONCEPTS

RESOURCES

ABOUT

CONTACT

HELP

LOGIN

## Case Studies

Filter By

show all

decision problem type	tools and models used
application domain	location
planning/decision process workflow adopted	start year
planning/decision process steps involved	end year

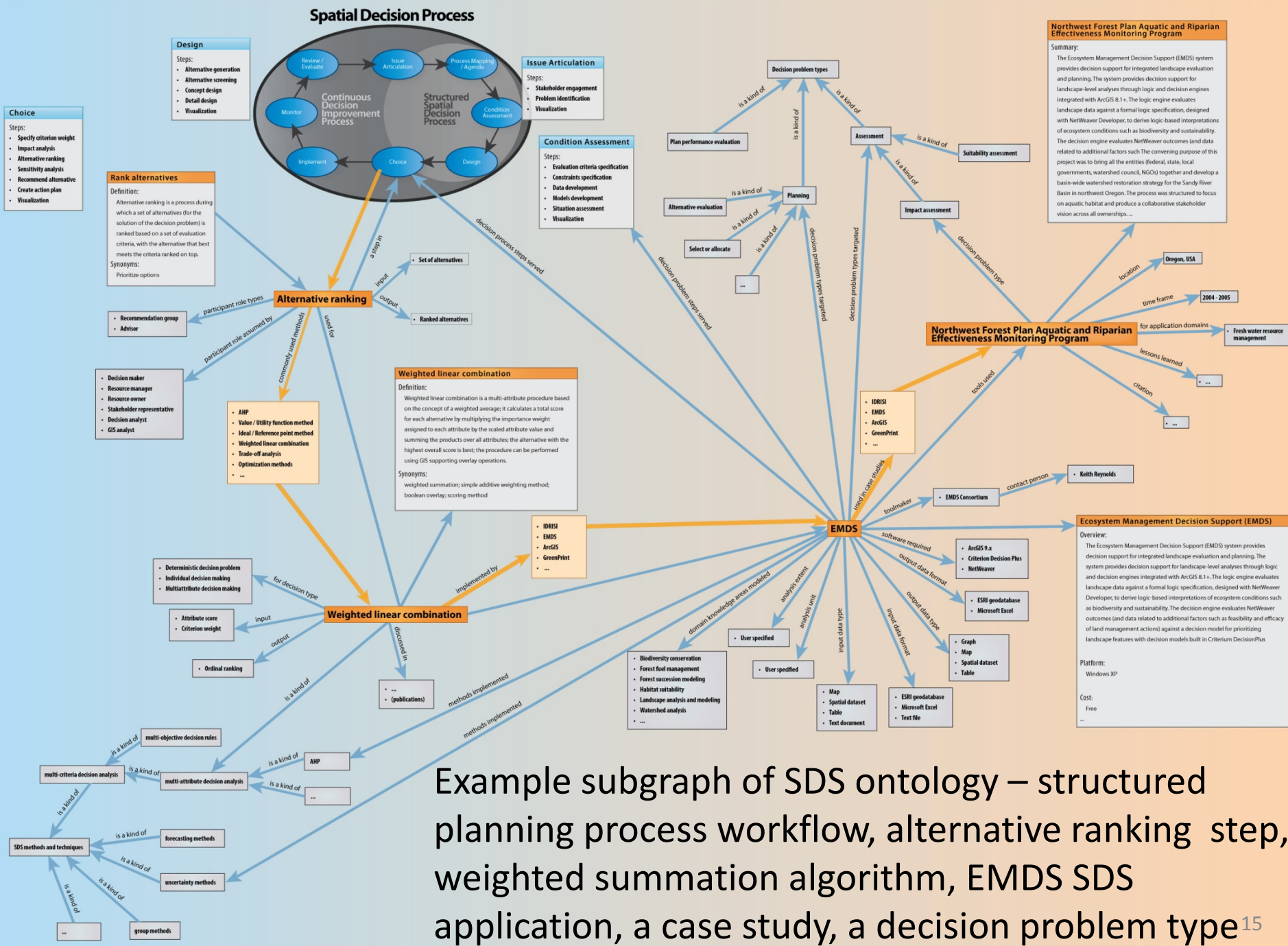
### Baltimore reservoirs forest conservation plan

The city of Baltimore, Maryland, used a combination of computer-based tools, primarily the ArcView geographic information system (GIS) and the NED-1 system, to analyze risks to the long-term sustainability of their reservoir lands and to develop and evaluate alternative scenarios for management of the lands. While maintaining water quality was the primary goal, the second and third goals were maintaining and enhancing the forest habitat as a contribution towards regional biodiversity. NED-1 inventories incorporated data needed to evaluate wildlife habitat composition and structure and the quality of habitat along first- and second-order streams. While providing a platform for the management and analysis of data on numerous key abiotic and biotic forest characteristics, the NED-1 decision support software did not provide a mechanism for evaluating the relationships of these landscape elements. The need to understand how landscape context and current ecological processes were shaping the forest required a synthesis of tools and often required stepping outside the decision support mechanism for critical answers to conservation problems.

### Boise-Payette-Sawtooth National Forest Plan

National forests are required to update their management plans every 10–15 years. The adjacent Boise, Payette, and Sawtooth National Forests in southern Idaho and northern Utah decided to update their plans together in order to better understand larger landscape issues and to address their many common concerns more efficiently. National forest plans do

Ontology Hierarchy



## Site Search Or Selection

Site selection involves identifying elements of the landscape that are best suited for some specific purpose such as designation as a biodiversity reserve or designation for timber harvest. Site selection is typically concerned with the two are sufficiently different to justify maintaining separate concepts, whereas spatial allocation is typically concerned with assigning a set of alternative uses to all parcels in a landscape. Site selection attempts to identify a relatively few parcels within the general matrix of parcels that are optimal for some specific purpose.

### Synonyms

site search; site selection

### Related Tools

C-Plan  
MARXAN / SPEXAN  
MARXAN With Zones  
Resnet & Surrogacy  
Sites/Site Selection Module (SSM)  
Vista  
Zonae Cogito

### Related Case Studies

Global Sensitivity Analysis, GIS And Multi-Criteria Evaluation For A Sustainable Planning Of A Hazardous Waste Disposal Site In Spain  
Sandy River Basin Anchor Habitats Project

### Last Updated

6/5/2008

### Contributor

Keith Reynolds

### Graphical Ontology Browser

Expand All Collapse All

filter hierarchy



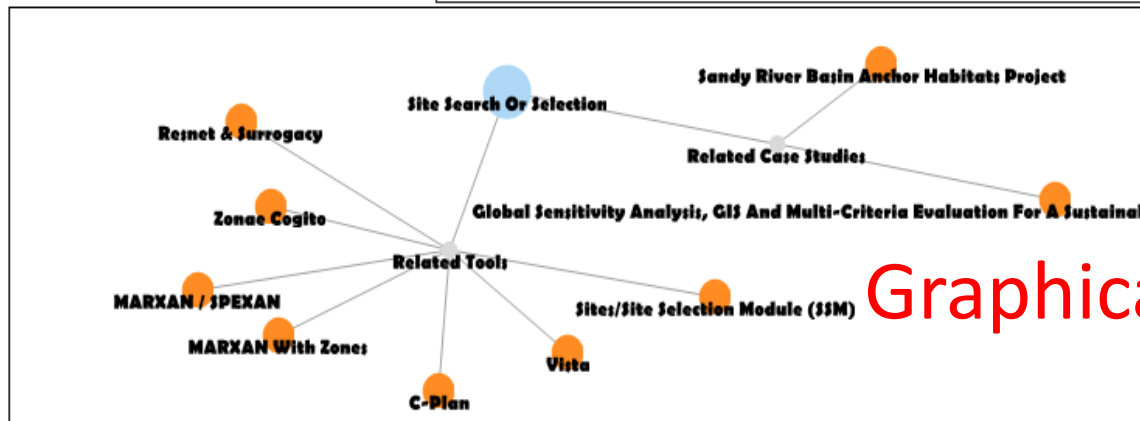
Ontology Hierarchy

- ☐ Introduction
- ☒ Spatial Planning And Decision Problem Types
  - Envisioning
  - ☒ Assessment
  - ☒ Planning
    - Alternative Evaluation
    - ☒ Network Design
    - Plan Evaluation
    - Schedule
    - ☒ Select Or Allocate
      - Location Allocation
      - Resources Allocation
      - Site Search Or Selection
    - Plan Performance Evaluation
  - ☒ Planning/Decision Context
  - ☒ Planning And Spatial Decision Process
  - ☒ Methods And Techniques
  - ☒ Technology
  - ☒ Data And Domain Knowledge
  - ☒ People And Participation
  - ☒ Resources

There are currently no assigned tags  
[add a tag](#)

Follow the ontology hierarchy

Follow the relation links from concept to concept



Graphical browsing

# Searching on SDS Knowledge Portal

# Search by filtering



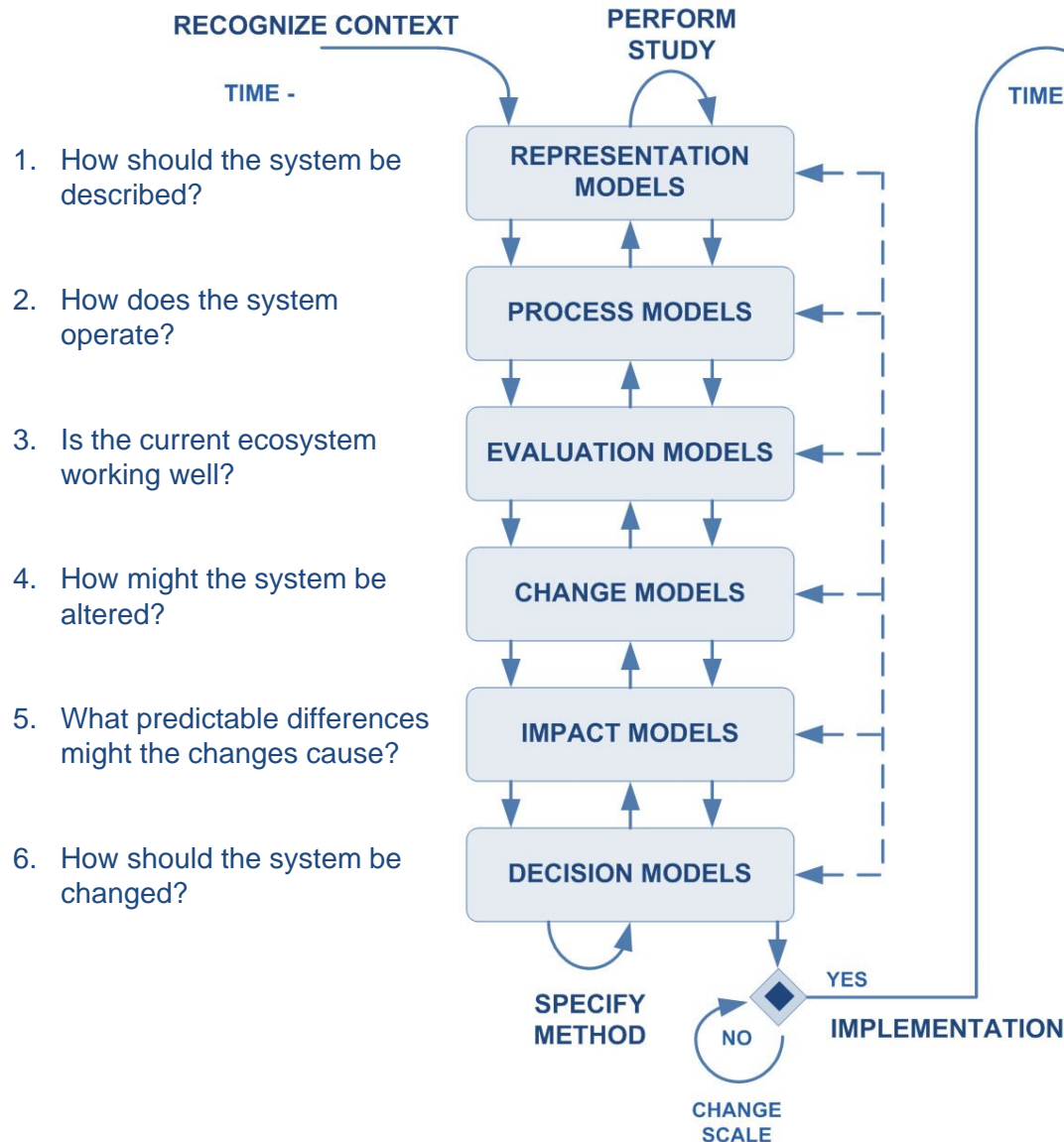
# Search the ontology hierarchy

# Advanced semantic search

# From Ontologies (directly) to Computational Workflows

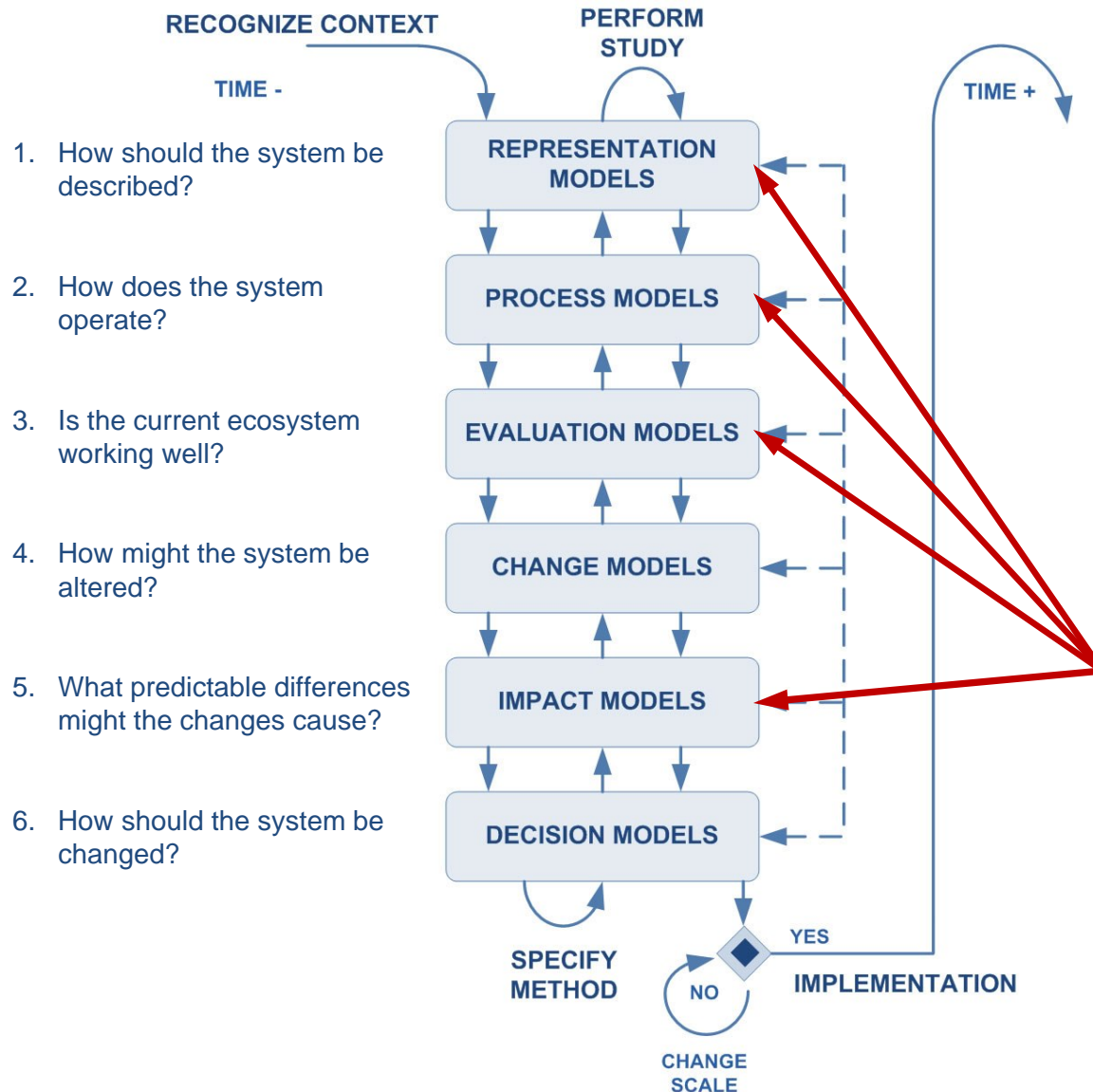
- Ontologies are not just for conceptual clarity (though we love that!) and for organizing things
- Decision support researchers and practitioners need them to create interoperable computational applications that deliver decision support for solving Grand Challenge planning and decision problems.

# A planning process workflow



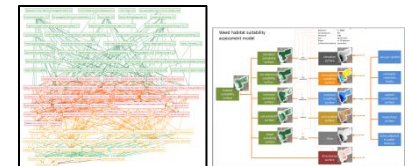
Steinitz's  
framework for  
planning workflow

# Earth sciences data and modes in planning workflow



Steinitz's  
framework for  
planning workflow

Earth science data,  
process models,  
assessment models



# Example of Earth Science models

-- Process model used in Desert Tortoise Recovery (DTRO) SDS, driving tortoise population change assessment calculation

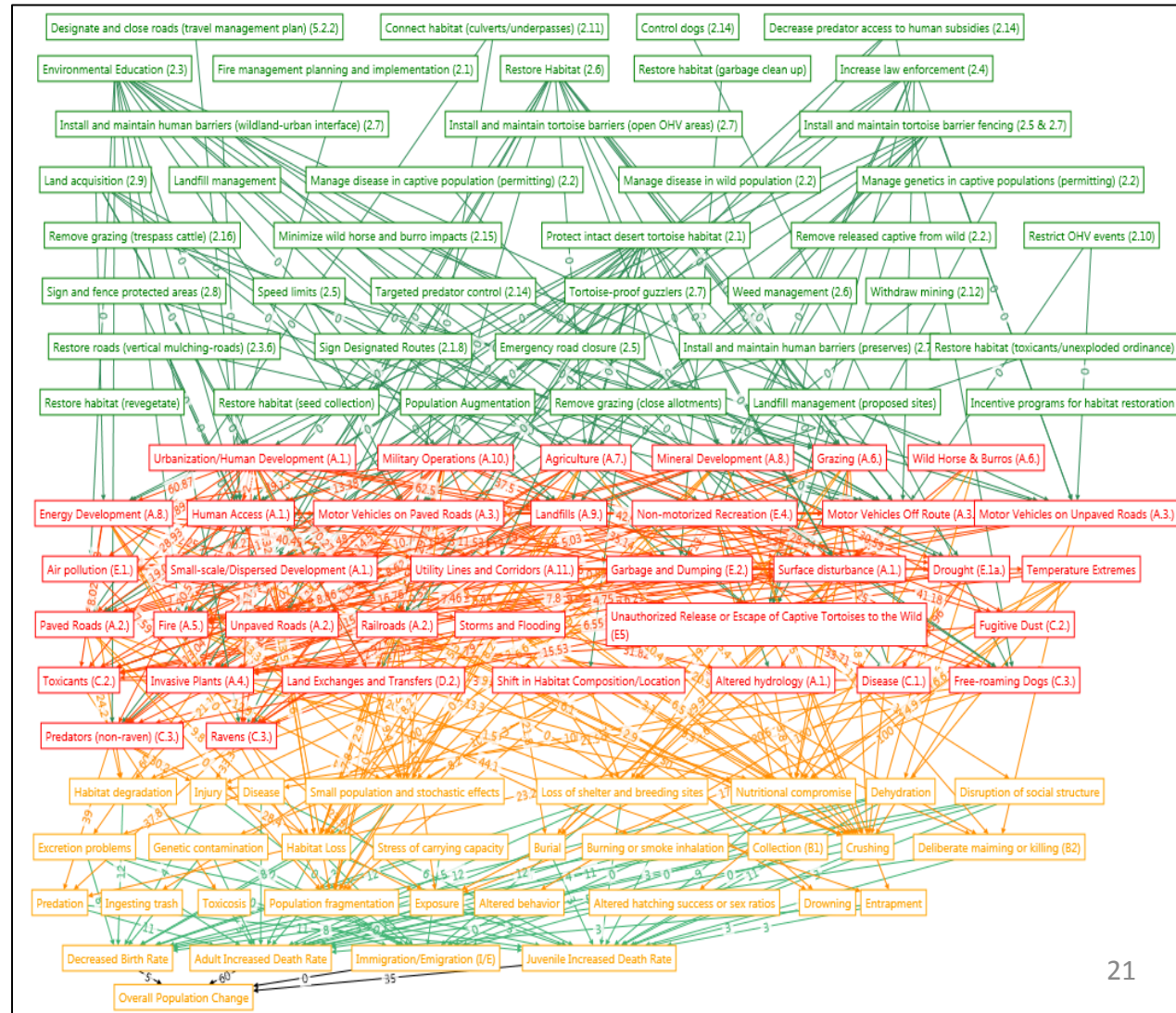
The Fish and Wildlife Service (FWS) DTRO office identified:

Which *Recovery Actions* can be introduced to abate the threat

The *threats* caused by each threat

The *stresses* caused by each threat

Which *factors* each stress causes to overall population change



# Example of Earth Science models

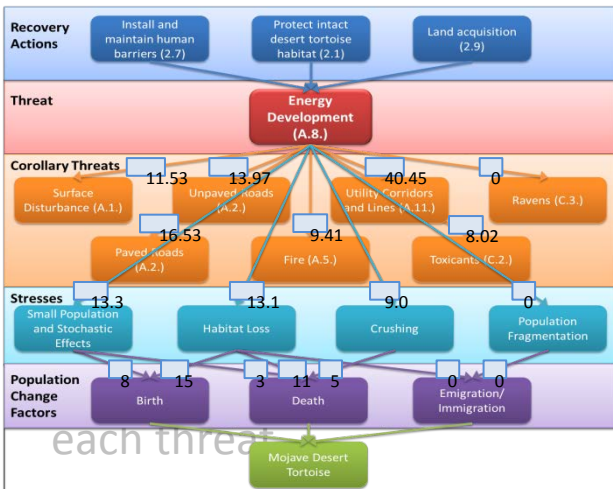
## -- Process model used in Desert Tortoise Recovery SDS

The FWS DTRO created this process model by creating Threat “tiles”

Which *Recovery Actions*

can be introduced to abate the threat

A threat description based on the Threat design pattern

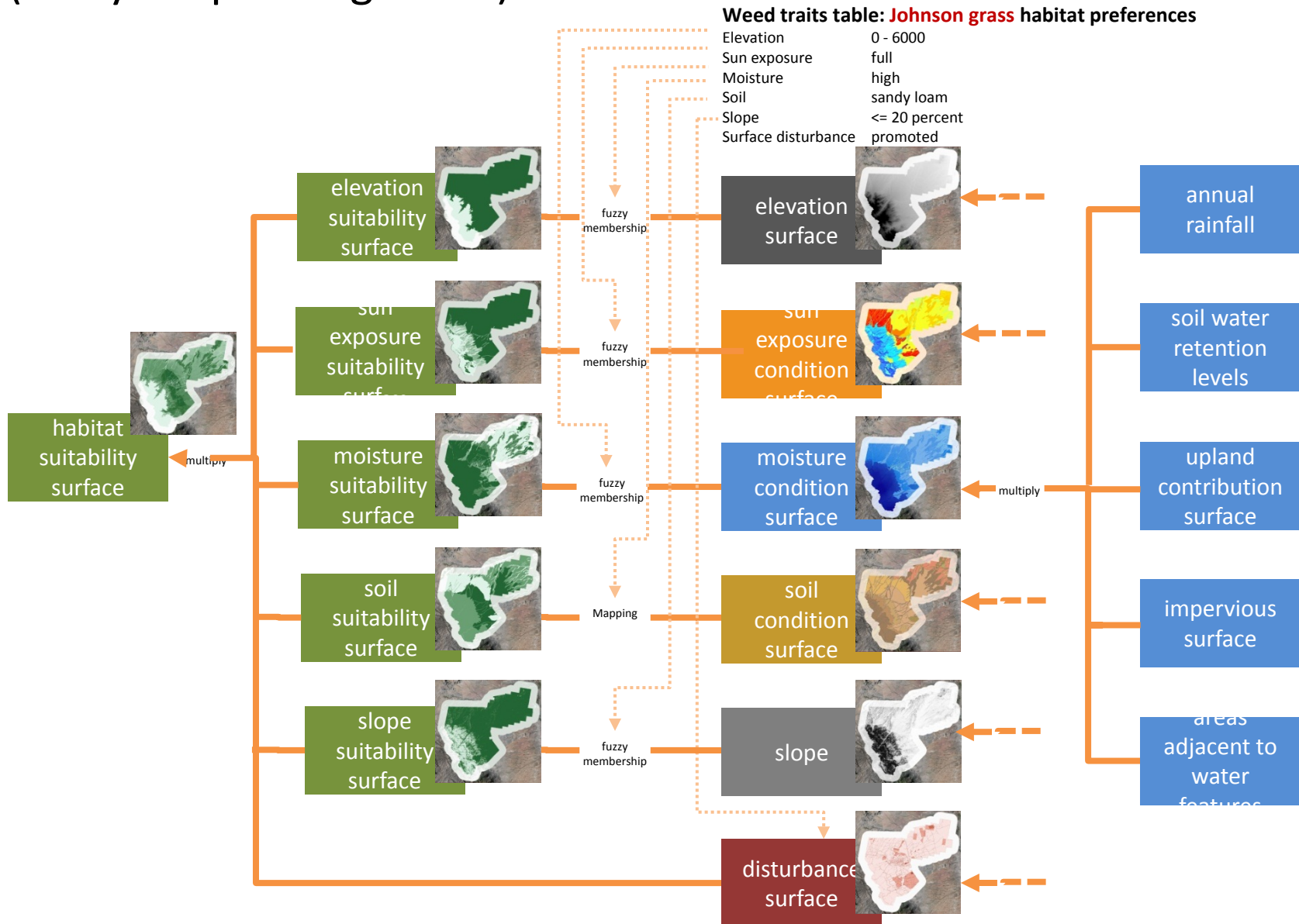


Which *factors* each stress causes to overall population change



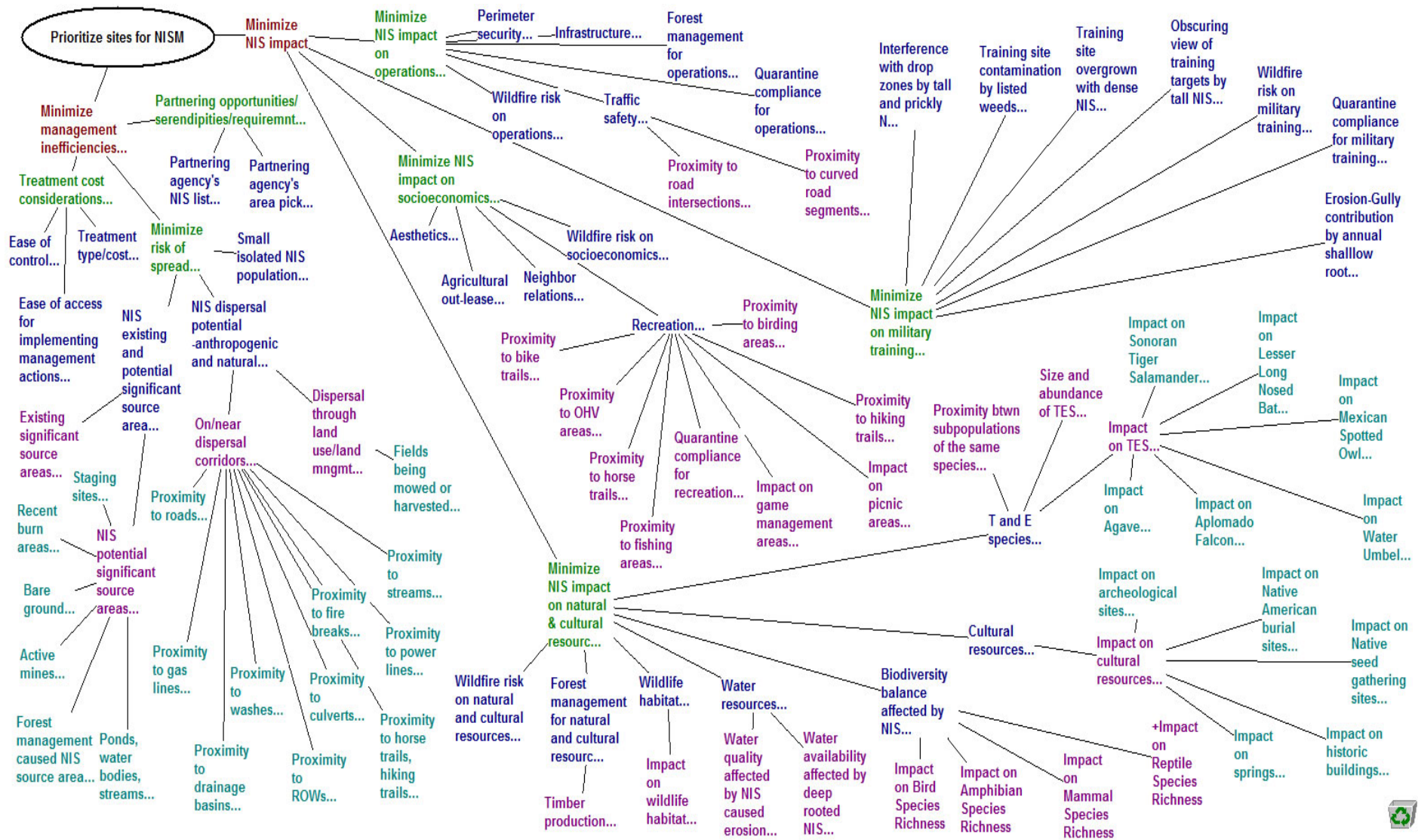
# Example of Earth Science models

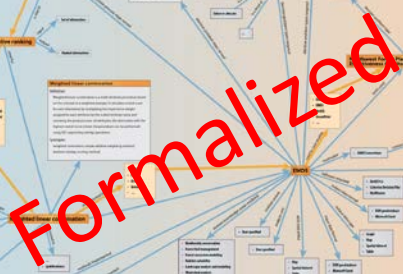
## -- Non-native invasive species habitat suitability assessment model (Army Corp of Engineers)



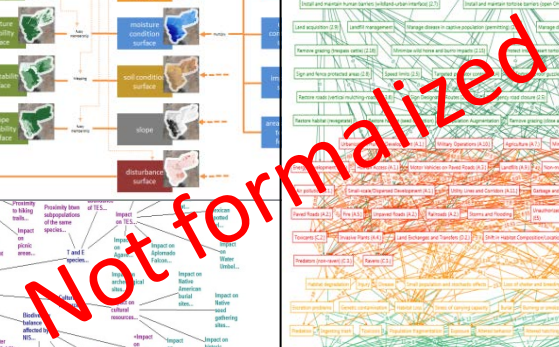
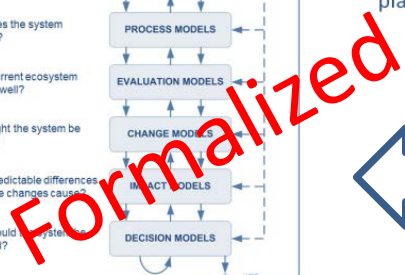
# Example of decision models

## -- Non-native invasive species management on military installations



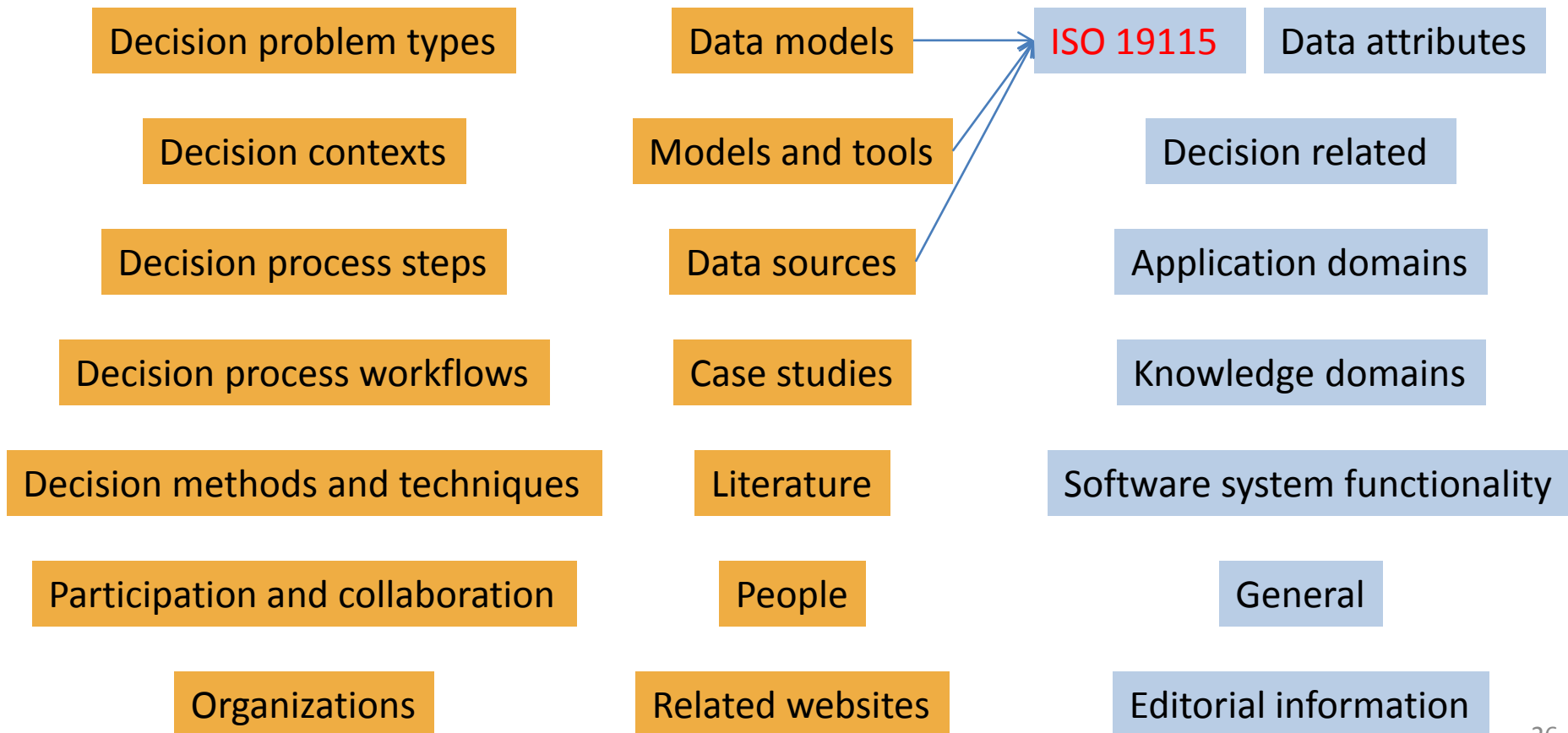


- appropriate for a specific decision problem
- Interoperable



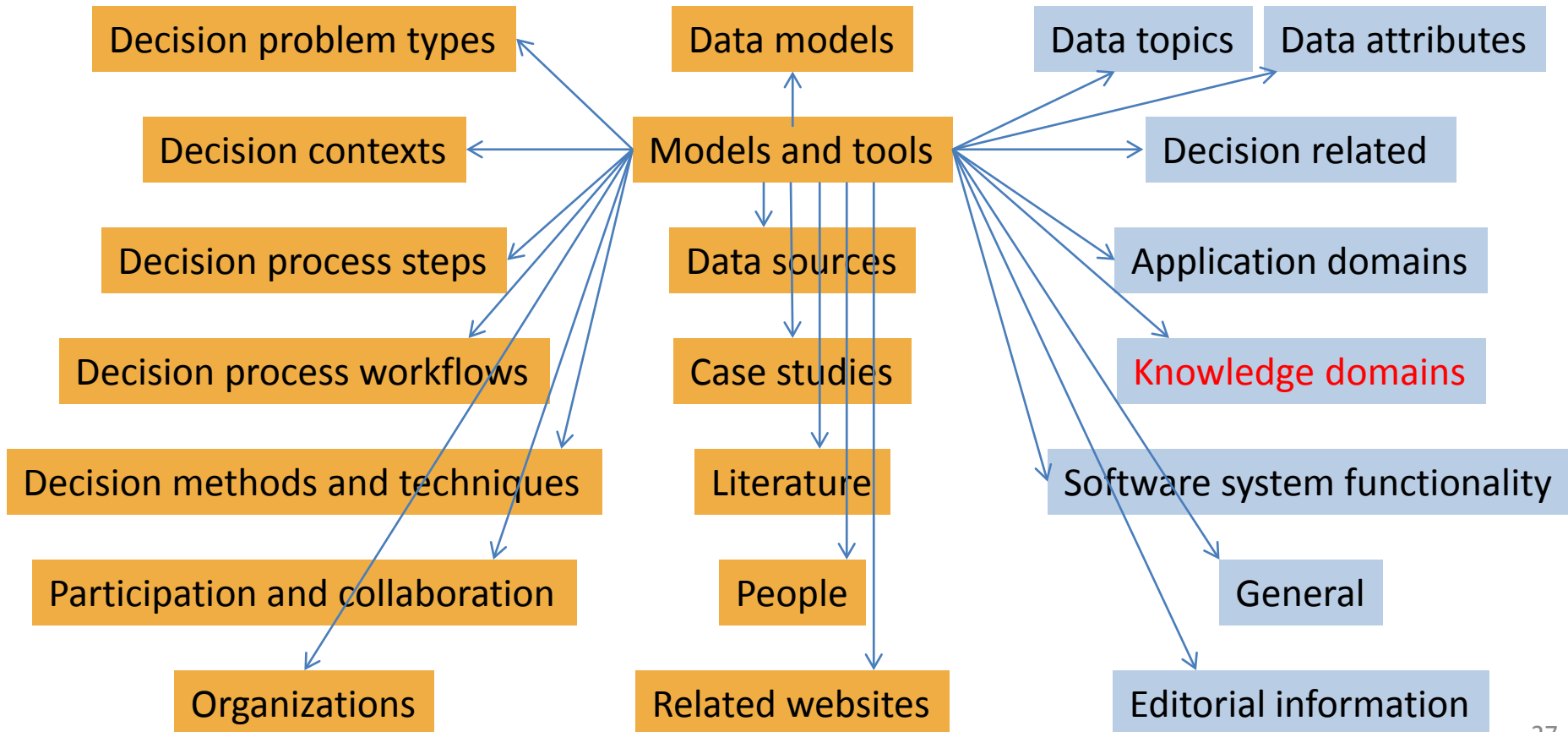
# Earth science ontologies and SDS ontology

The SDS ontology currently refers to ISO 19115 for data topic concepts (not granular enough)



# Earth science ontologies and SDS ontology

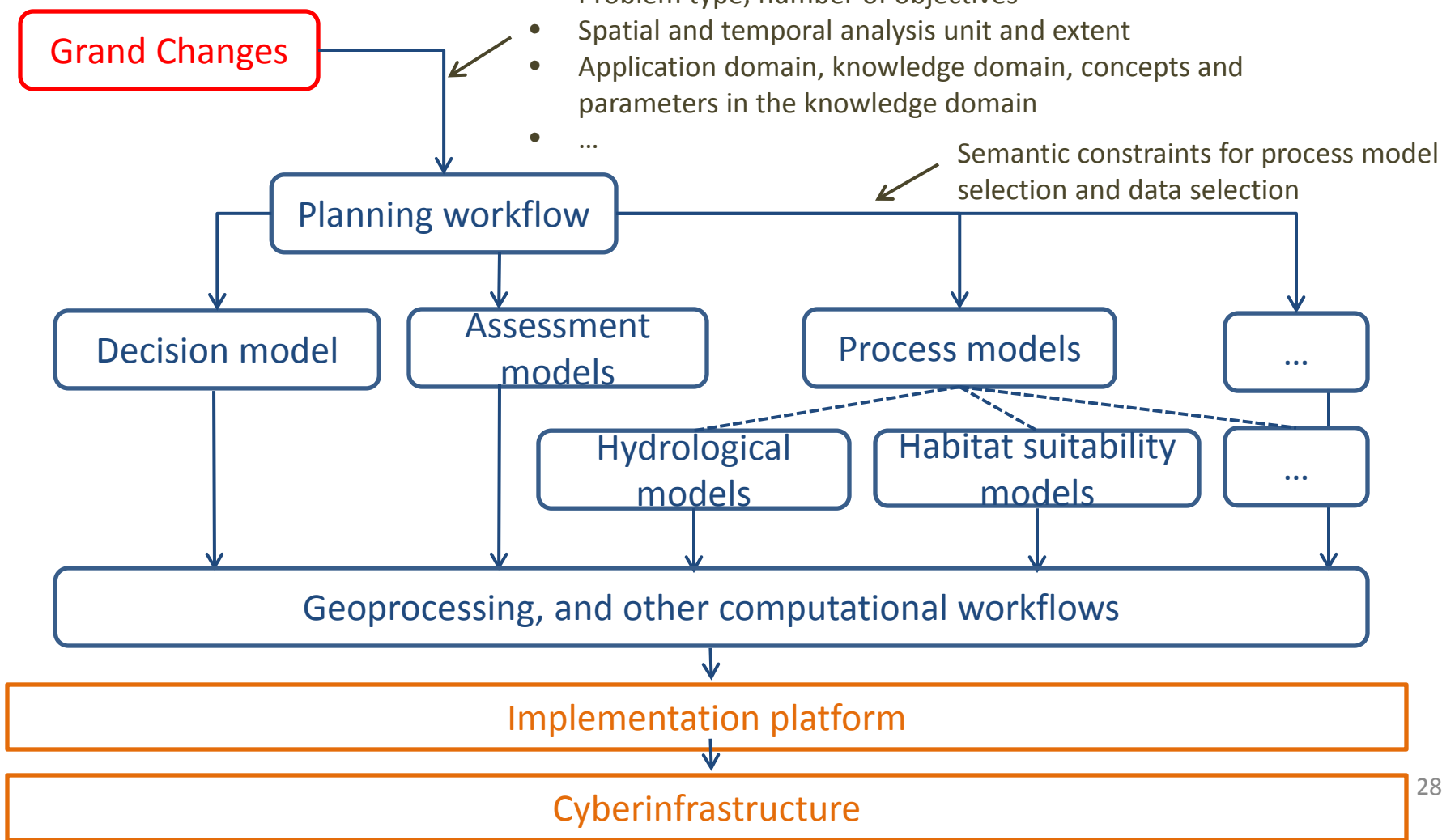
The models sub ontology in SDS ontology only refers to knowledge domains taxonomy, but not specific concepts within Earth science domains – **need to connect to earth science ontologies**



# Workflow composition guided by SDS ontology and Earth science ontologies

User's planning problem parameters providing semantic constraints for lower level workflow template selection in terms of

- Problem type, number of objectives
- Spatial and temporal analysis unit and extent
- Application domain, knowledge domain, concepts and parameters in the knowledge domain
- ...



# Contact

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- Krzysztof Janowicz, [jano@geog.ucsb.edu](mailto:jano@geog.ucsb.edu)

See also:

- [www.spatial.redlands.edu/sds](http://www.spatial.redlands.edu/sds)
- Li, N., Raskin, R., Goodchild, M. and Janowicz K. (2012)  
An Ontology-Driven Framework and Web Portal for  
Spatial Decision Support. *Transactions in GIS* 16(3): 313-  
329.