Programme INTERREG IIIB

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MOONRISES

INTEGRATED MONITORING SYSTEM FOR DESERTIFICATION RISK ASSESSMENT

COFINANCED BY THE EUROPEAN REGIONAL DEVELOPMENT FUND

INTEGRATED MONITORING SYSTEM FOR DESERTIFICATION RISK ASSESSMENT

MOONRISES

ΟΛΟΚΛΗΡΩΜΕΝΟ ΣΥΣΤΗΜΑ ΠΑΡΑΚΟΛΟΥΘΗΣΗΣ ΓΙΑ ΤΗΝ ΕΚΤΙΜΗΣΗ ΤΟΥ ΚΙΝΔΥΝΟΥ ΕΡΗΜΟΠΟΙΗΣΗΣ

Description of the MOONRISES Geodatabase-WP 4.1 REGION OF NORTH AEGEAN-LESVOS ISLAND

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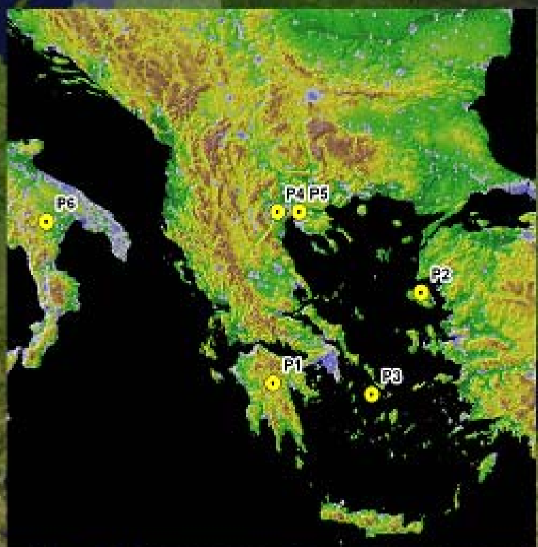

INTERREG III

MOONRISES

INTEGRATED MONITORING SYSTEM FOR DESERTIFICATION RISK ASSESSMENT

Description of the MOONRISES Geodatabase

FOR THE REGION OF NORTH AEGEAN LESVOS ISLAND

WP 4.1/4.2

Programme INTERREG IIIB ARCHIMED

MOONRISES

INTEGRATED MONITORING SYSTEM
FOR DESERTIFICATION RISK ASSESSMENT

MOONRISES PROJECT

INTEGRATED MONITORING SYSTEM FOR DESERTIFICATION RISK ASSESSMENT

WP 4.1/4.2

GEODATABASE

Program	**Interreg III B - Archimed**
Measure	**3.3 - Management, prevention and reduction of natural risks**
Call for Proposals	**1st Call – June 2005**
Project Acronym	**Moonrises**
Project Title	**Integrated Monitoring System For Desertification Risk Assessment**
Date of Approval	**May 2006**
Agreement ref. No	**A.1.083/3.3**

CONTENTS

CHAPTER 1: IDENTIFICATION SHEET

Identification Sheet

Work Package	WP 4: Data collection, data pre-processing and data processing
Action	**4.2: Data assembling, normalization and Pre-processing**
Deliverable	GEODATABASE
Type	RTD
Version	FINAL
Responsible Partner	P1
Involved Partners	P5
Authors	ARISTOTLE UNIVERSITY
Date of completion	06/2006 - 12/2007
Distributed to Partners	Lead partner

Deliverable	**GEODATABASE**
Abstract	
This action's objective is to produce collections of pre-processed data ready to give input to the GIS developed during the next action. This action will start with the development of software tools that will facilitate the assembling, pre-processing and normalization of the collected desertification Data and indices.	
Keywords	
GEODATABASE	

1. Brief introduction to geodatabases

1.1. What is a geodatabase?

A geodatabase, short for geographic database, is the common data storage and management framework for ArcGIS. It consists in a collection of geographic datasets of various types held in a common file system folder, a Microsoft Access database, or a multiuser relational database (Oracle, Microsoft SQL Server, IBM DB2, etc…).

The geodatabase helps storing and organizing the different types of data that are supported by ArcGIS: attribute tables, geographic features, satellite and aerial imagery, surface modeling data and survey measurements. Moreover, a geodatabase can also implement complex business logic such as: modeling of spatial relationships between data (e.g., topologies, networks, and terrains), data validation (e.g., subtypes and domains) and long transactions (e.g., versioning).

The geodatabase is more particularly able to:

- Store a rich collection of data types in a centralized location.
- Apply sophisticated rules and relationships to the data.
- Define advanced geometric relational models (e.g., topologies, networks).
- Maintain integrity of spatial data.
- Work within a multiuser access and editing environment.
- Integrate spatial data with other IT databases.
- Easily scale your storage solution.
- Support custom features and behavior.

1.2. Types of geodatabases

Table 1 presents the two types of geodatabase architectures available: personal geodatabases and multiuser geodatabases.

Table 1- Different types of geodatabases

Geodatabase type	DBMS	Notes
Personal geodatabase	• Microsoft Jet Engine (Access)	• Single-user editing • 2 GB size limit • No versioning support
Multiuser, versioned geodatabase	• Oracle • Oracle with Spatial or Locator • IBM DB2 • IBM Informix • Microsoft SQL Server	• Requires ArcSDE • Multiuser editing • Version-based work flows • Database size and number of users up to RDBMS limits

1.2.1. Personal geodatabases

Personal geodatabases are available to all ArcGIS users (i.e., users of ArcView, ArcEditor, and ArcInfo) and use the Microsoft Jet Engine database file structure to persist GIS data in smaller databases. Personal geodatabases are ideal for working with smaller datasets for GIS projects and in small workgroups. In fact, these geodatabases are limited in size (maximum 2 GB), they are designed to be edited by a single user and do not support versioning. All the contents of a personal geodatabase are held in a single Microsoft Access file (.mdb).

1.2.2. Multiuser geodatabases

Multiuser geodatabase require the use of ArcSDE and work with a variety of DBMS storage models (IBM DB2, Informix, Oracle and SQL Server). Multiuser geodatabases can be extremely large since the size limits are set by the DBMS owns limits. They support many simultaneous users (Many readers and many writers), long transactions and versioned workflows.

2. Components of a geodatabase

ArcGIS provides a set of components that help storing, managing and editing the geospatial data into the geodatabase. These components are presented in Table 2.

Table 2- Geodatabase components

GEODATABASE COMPONENTS	DESCRIPTION
Annotation	A specialized feature class that stores text or graphics that provide information about features or general areas of a map. An annotation feature class may be linked to another feature class so that edits to the features are reflected in the corresponding annotation (i.e., feature-linked annotation).
Dimension	A special type of geodatabase annotation that shows specific lengths or distances on a map. A dimension feature may indicate the length of a side of a building or land parcel, or it may indicate the distance between two features such as a fire hydrant and the corner of a building.
Feature Class	A collection of geographic features with the same geometry type (i.e., point, line, or polygon), the same attributes, and the same spatial reference. They allow homogeneous features to be grouped into a single unit for data storage purposes; for example, a feature class of city streets.
Feature Dataset	A collection of feature classes stored together that share the same spatial reference. Feature classes in a feature dataset share a coordinate system, and their features fall within a common geographic area. Feature datasets are used to help model spatial relationships between feature classes.
Geometric Network	Edge and junction features that represent a directed-flow system network, such as a utility or hydrologic system, in which the connectivity of features is based on their geometric coincidence.
Network Dataset	A collection of topologically connected network elements (e.g., edges, junctions, and turns) that are derived from network sources, typically used to represent an undirected-flow system

	network such as a road or subway system.
Raster Catalog	A collection of raster datasets defined in a table of any format, in which the records define the individual raster datasets that are included in the catalog. Raster catalogs can be used to display adjacent or overlapping raster datasets without having to mosaic them together in one large file.
Raster Dataset	Any valid raster format organized into one or more bands. Each band consists of an array of pixels (cells), and each pixel has a value (e.g., a Landsat satellite image).
Relationship Class	A class similar to relationships that exist within an RDBMS. Relationship classes manage the associations between objects in one class (e.g., table or feature class) and objects in another. Objects at either end of the relationship can be features with geometry or records in a table.
Schematic Dataset	A dataset used for graphically representing network connectivity and sets of relationships.
Survey Dataset	An integrated collection of specialized survey feature classes and associated survey measurements.
Table	A set of data elements arranged in rows and columns. Each row represents a single record. Each column represents a field of the record. Tables typically store stand-alone attribute information or information associated with a spatial location such as addresses.
Terrain	A triangulated irregular network (TIN)-based dataset that uses feature classes as data sources to model multiple resolution surfaces using z-values.
Toolbox	A collection of dataflow and workflow processes for performing data management, analysis, and modeling.
Topology	The arrangement that constrains how point, line, and polygon features share geometry within a geodatabase. For example, street centerlines and census blocks share geometry, and adjacent soil polygons share geometry. Topology defines and enforces data integrity rules, topological relationship queries and navigation, and sophisticated editing tools. It also allows feature construction from unstructured geometry.

3. Construction of a geodatabase

The careful planning of the geodatabase is necessary to ensure the long-term storage and the easy and fast editing of the geospatial data. Therefore, before designing the geodatabase a decision must be taken concerning numerous topics such as: the kind of data to be stored in the database, the kind of projection to be used, the most appropriate objects for storing the data, the rules needed for the data modifications, the potential relationships between objects. To assist the user in this geodatabase design task, data model templates are proposed by ESRI for various industrial domains.

Once the geodatabase design ready, new database items can be created with ArcCatalog and the existing data imported (shapefiles, coverages, tables,etc…).

4. The MOONRISES Geodatabase

The MOONRISES project undertook the assessment of desertification risks in five target areas: Peloponnese, North and South Aegean, central Macedonia (Greece) and the area of Basilicata (Italy).
Various data were collected on each study site and then processed to generate several thematic maps and desertification risk layers for each study area.
The collected and newly produced data constitute valuable geospatial dataset that need to be stored for future retrieval and analysis by stakeholders or for further processing by research groups. The decision was taken to use geodatabases to efficiently archive the geodata.

4.1. The MOONRISES data

The data for MOONRISES project consists in various thematic feature layers (polygons, lines, points) and thematic raster layers. For a detailed description of these data refer to Figure 1, Table 3 and Table 4. Not all the layers were used for the generation of the final desertification sensitivity map. Nevertheless data such as (rivers, swamps, villages) are very helpful for the interpretation of the results obtained.

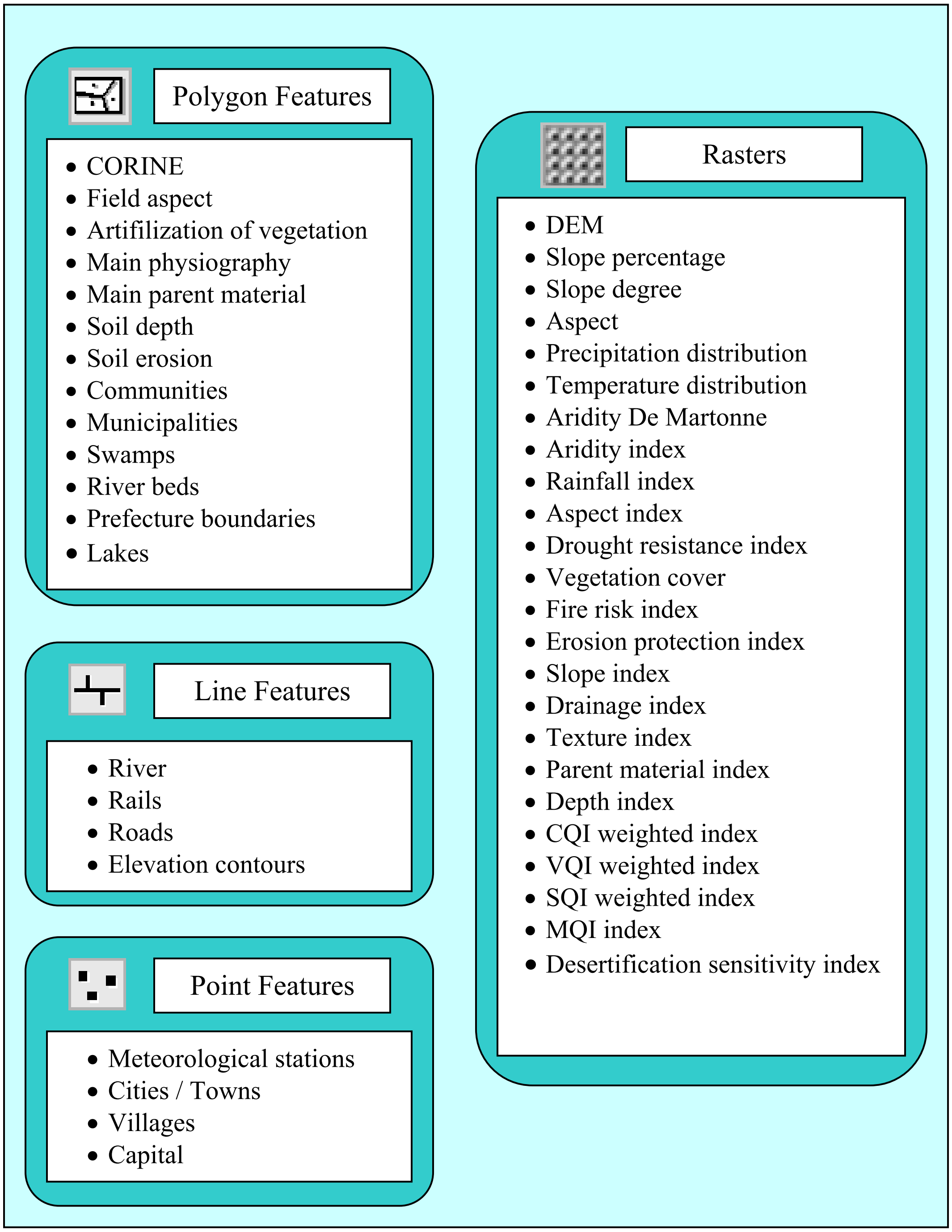

Figure 1- Grouping of the collected and generated data by type

Table 3- Description of the collected data

	Thematic layers	Description	Used for the generation of the desertification risk index
POLYGON	CORINE	Polygon layer of land uses according to the CORINE nomenclature.	YES
	Field aspect	Polygon layer with the orientation of each parcel (SW; S; SE; E; NE; N; NW; W).	NO
	Artificilization of vegetation	Polygon feature layer.	NO
	Main physiography	Polygon feature layer with a physiographic classification (Open valleys, Cliffs, upper slopes, etc….).	YES
	Main parent material	Polygon feature layer with the main parent material (Alluvium, Granite, Schist, etc…).	YES
	Soil depth	Polygon feature layer with 9 categories of soil depth. A dominant and minor depth level is provided for each polygon as follows: Deep; deep and shallow; deep and bare; shallow and deep; shallow; shallow and bare; bare and deep; bare and shallow and bare.	YES
	Soil erosion	Polygon feature layer with 8 categories of erosion. A dominant and minor erosion level is provided for each polygon as follows: None; none and moderate; none and severe; moderate and none; moderate and severe; severe and none; severe and moderate and severe.	YES
	Communities	Polygon feature layer indicating the communities.	NO
	Municipalities	Polygon feature layer indicating the municipalities.	NO
	Swamps	Polygon feature layer locating the swamps.	NO
	River beds	Polygon feature layer locating the river beds.	NO
	Prefecture boundaries	Polygon feature layer with the borders of the study area.	YES
	Lake	Polygon feature layer locating the lakes.	NO
LINE	River	Line feature layer.	NO
	Rails	Line feature layer.	NO
	Roads	Line feature layer.	NO
	Contours	Line feature layer with the elevation contours.	NO
POINT	Meteorological stations	Point feature layer with the meteorological stations. The mean monthly temperature and mean annual precipitation is the minimum dataset to provide for each station.	YES
	Cities	Point feature layer locating the main cities.	NO
	Villages	Point feature layer locating the villages.	NO
	Capital	Point feature layer locating the prefecture's capital.	NO
RASTER	DEM	Raster layer corresponding to the Digital Elevation Model with a cell size of 20m.	YES

Table 4- Description of the generated data

	Thematic layers	Description
RASTER	Slope percent	Raster layer with the slope in percentage (Cell size: 20m).
	Slope degree	Raster layer with the slope in degree (Cell size: 20m).
	Aspect	Raster layer (Cell size: 20m) with the slope aspect (SW; S; SE; E; NE; N; NW; W).
	Precipitation distribution	Raster layer with the precipitation distribution deduced from the meteorological station data by linear regression (Cell size: 20m).
	Temperature distribution	Raster layer with the temperature distribution deduced from the meteorological station data by linear regression (Cell size: 20m).
	Aridity DeMartonne	Raster layer with the aridity values generated using the De Martonne formula (Cell size: 20m).
	Aridity index	Raster layer resulting from the classification of the above aridity layer (Cell size: 20m).
	Rainfall index	Raster layer resulting from the classification of the above precipitation layer (Cell size: 20m).
	Aspect index	Raster layer resulting from the classification of the aspect polygon feature layer (Cell size: 20m).
	Drought resistance index	Raster layer resulting from the interpretation of the CORINE layer using the CORINE to vegetation table (Cell size: 20m).
	Vegetation cover index	Raster layer resulting from the interpretation of the CORINE layer using the CORINE to vegetation table (Cell size: 20m).
	Fire risk index	Raster layer resulting from the interpretation of the CORINE layer using the CORINE to vegetation table (Cell size: 20m).
	Erosion protection	Raster layer resulting from the classification of the erosion polygon feature layer (Cell size: 20m).
	Slope index	Raster layer resulting from the classification of the slope percent polygon feature layer (Cell size: 20m).
	Drainage index	Raster layer resulting from the interpretation of the main parent material layer using the Soil table (Cell size: 20m).
	Texture index	Raster layer resulting from the interpretation of the main parent material layer using the Soil table (Cell size: 20m).
	Parent material index	Raster layer resulting from the classification of the main parent material layer using the Soil table (Cell size: 20m).
	Depth index	Raster layer resulting from the classification of the depth layer (Cell size: 20m).
	CQI weighted index	Raster layer representing the weighted climate quality index (Cell size: 20m). It combines the aridity index, rainfall and aspect layers using specific weights.
	SQI weighted index	Raster layer representing the soil quality index (Cell size: 20m). It combines the parent material, drainage, slope, depth and texture layers using specific weights.

	VQI weighted index	Raster layer representing the vegetation quality index (Cell size: 20m). It combines the vegetation cover, fire risk, drought and erosion protection layers using specific weights.
	MQI index	Raster layer representing the Management Quality Index (Cell size: 20m). It results from the interpretation of the CORINE.
	Desertification sensitivity index	Raster layer created by merging the weighted CQI, weighted SQI, MQI and weighted VQI layers using specific weights (Cell size: 20m).

4.2. A personal geodatabase for MOONRISES

The major advantage of building an enterprise geodatabase would have been the possibility of managing the simultaneous data editing by multiple users. This capability was not justified for the MOONRISES project since it would have required the acquisition of ArcSDE and a DBMS, plus much more implementation efforts. Therefore, a personal database was adopted to store and structure the project's data. Concerning the problem of size limitation (2GB), it has been overcome by the construction of multiple geodatabases.

4.3. Structure and construction of the MOONRISES personal geodatabase

The structure of the geodatabase is simple since relationships, topologies and networks were not required to manage the datasets and achieve the project targets. Even though various data models are proposed on the ESRI website, the MOONRISES geodatabase was designed from scratch. Its final structure is shown in Figure 2.
Once the skeleton of the geodatabase created, data was imported using a complete suite of tools proposed within ArcCatalog.

5. Access to the MOONRISES data

Together with the .mbd Microsoft Office Access file an .mxd file is provided. This ArcMap document presents all the collected and generated data layers by directly accessing the data stored in the personal geodatabase newly created. While the data is organized within the database following a data type classification, the ArcMap document offers a more convenient visualization of the data using a content-based classification (see Figure 3).

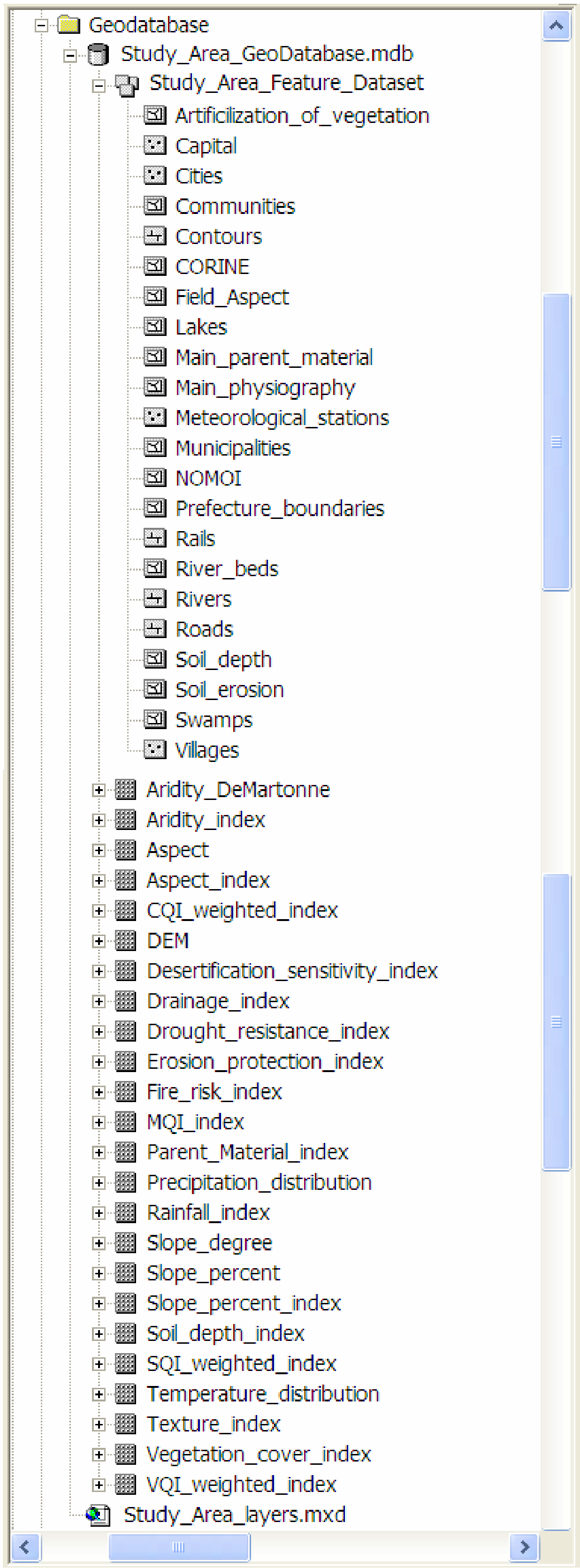

Figure 2- Structure of the MOONRISES geodatabase

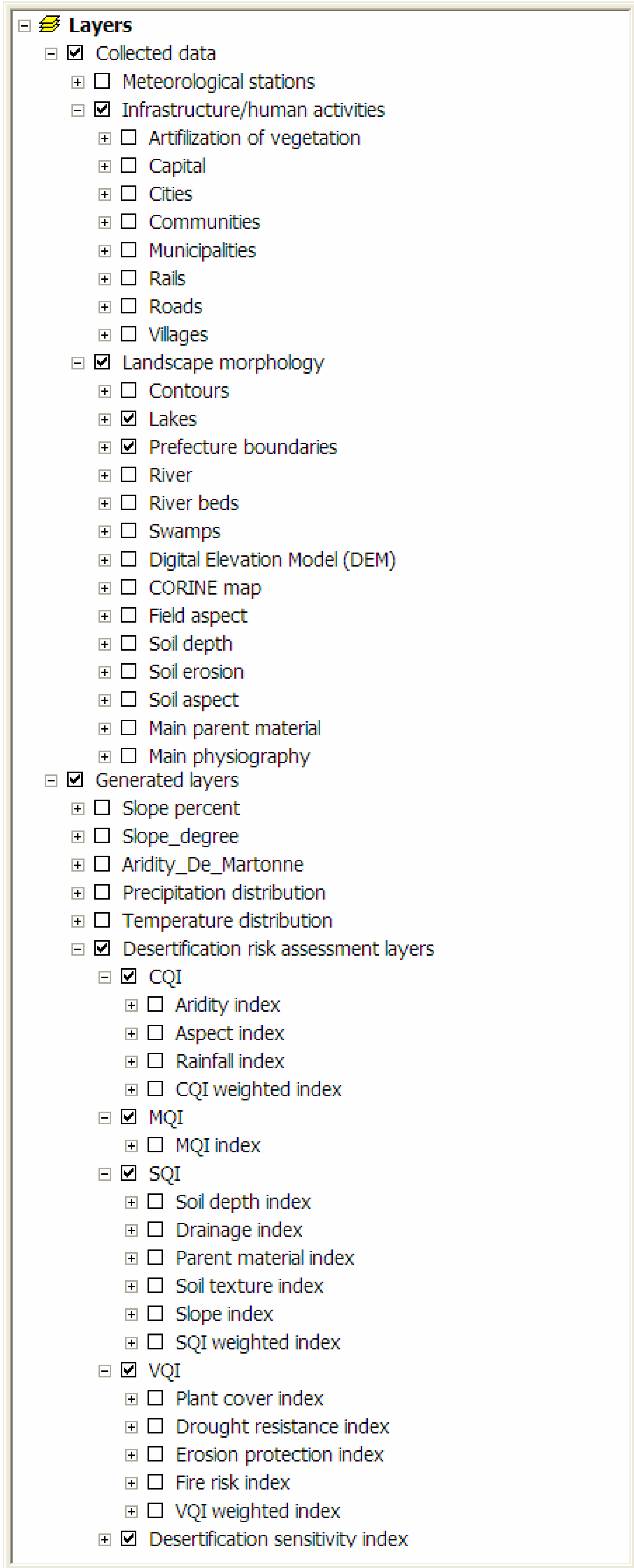

Figure 3- Structure of the data in the ArcMap document