Mapping Standardized Terrestrial Ecosystems for Africa – The GEOSS Approach

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Why Are Ecosystems Important?

BENEFITS

•*Goods* (food, water, fiber, fuel, etc.)

•*Services* (climate regulation, water purification, soil formation, pollination, cultural benefits, etc.)

MANAGEMENT NEEDS

•*Mapping* ecosystem distributions

•*Monitoring* ecosystem conditions

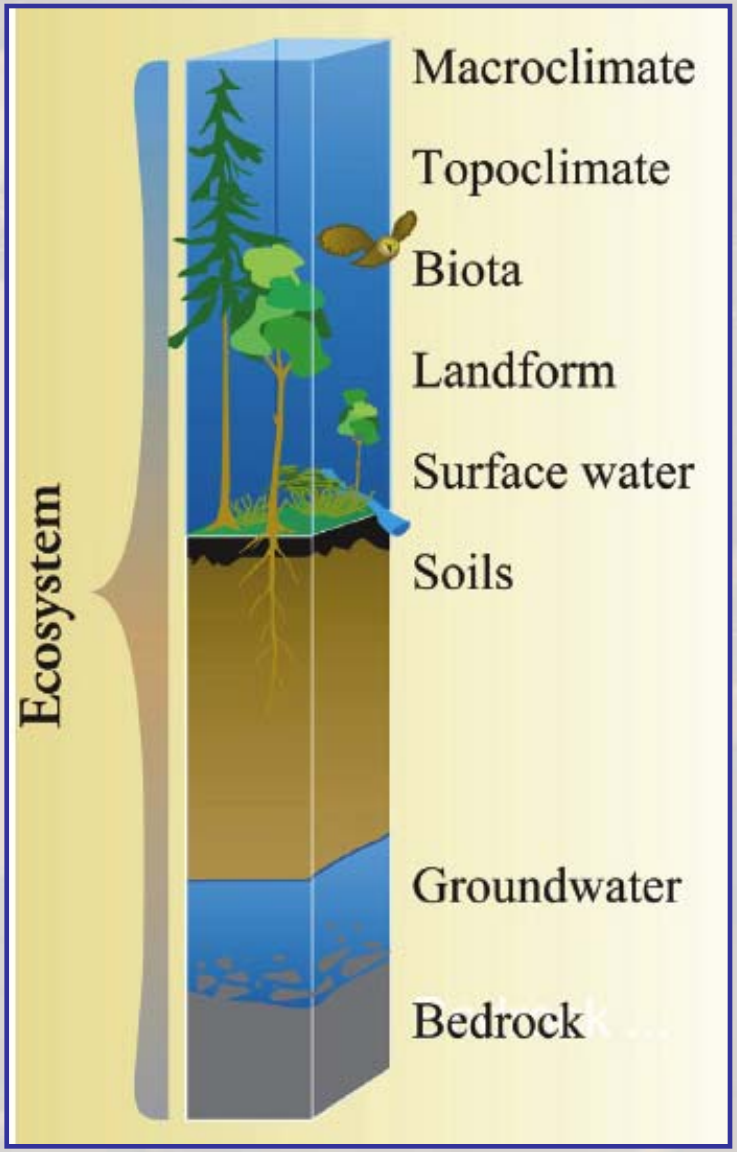
•*Forecasting* future ecosystem states

What are Ecosystems?

Ecosystems

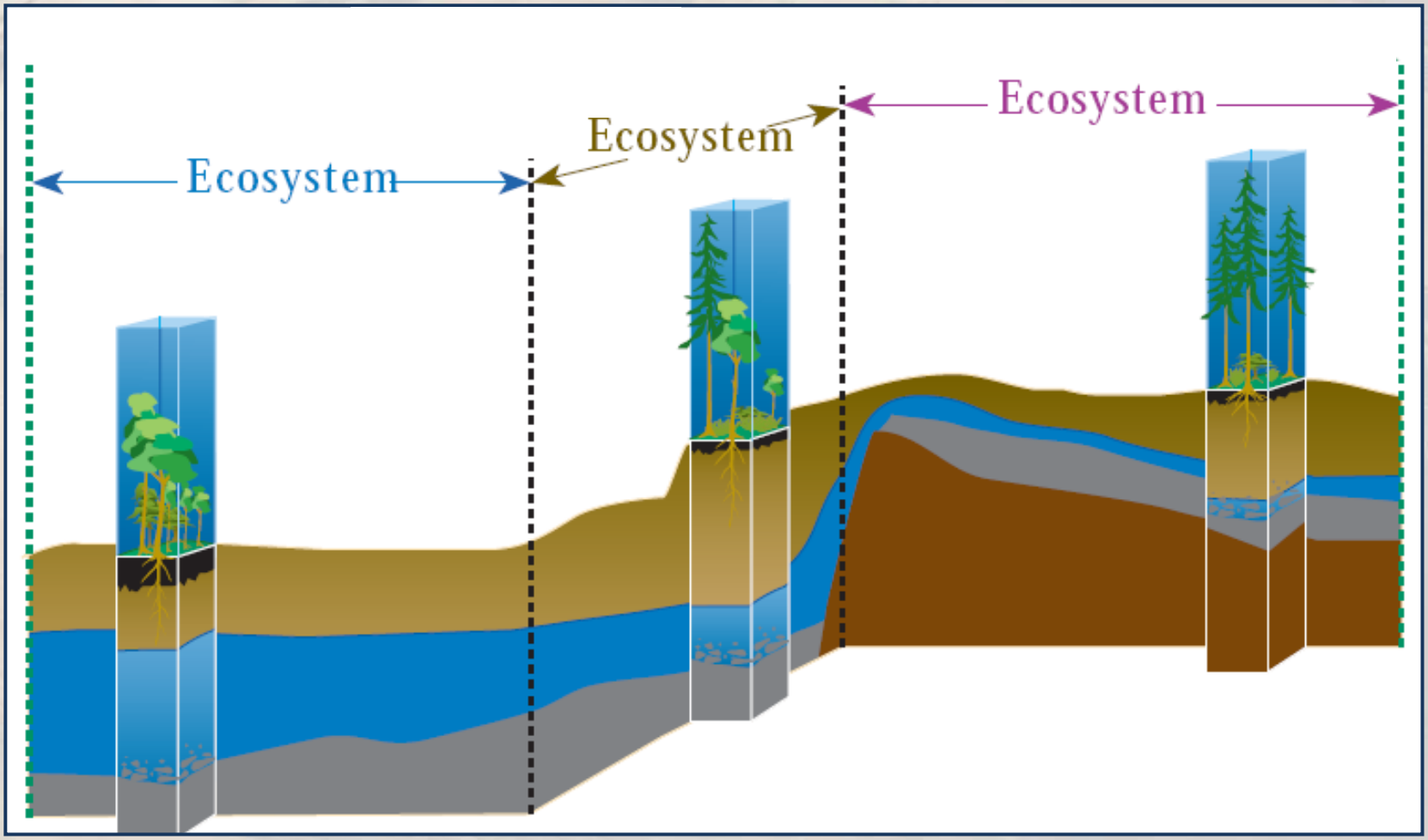
Odum, 1953

Systems of biotic communities interacting with their physical environment

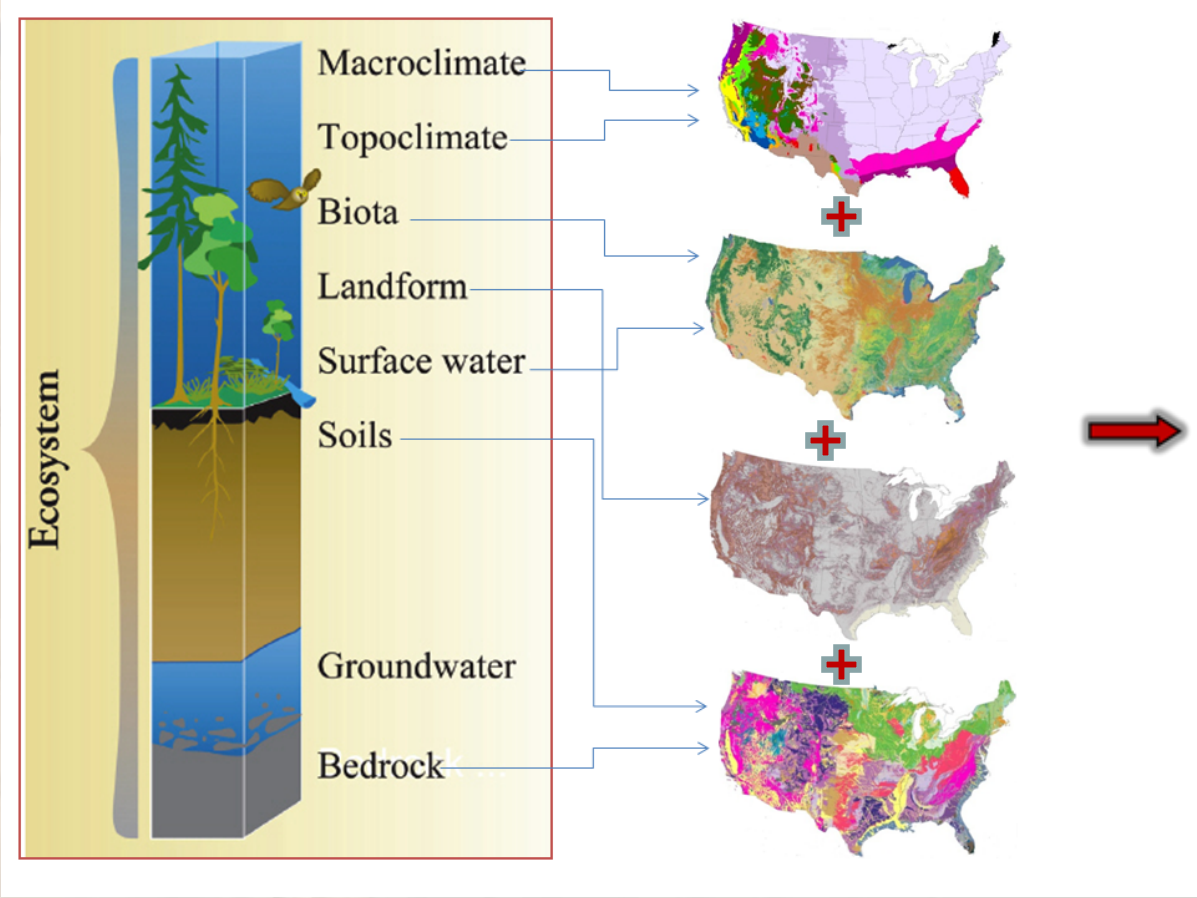


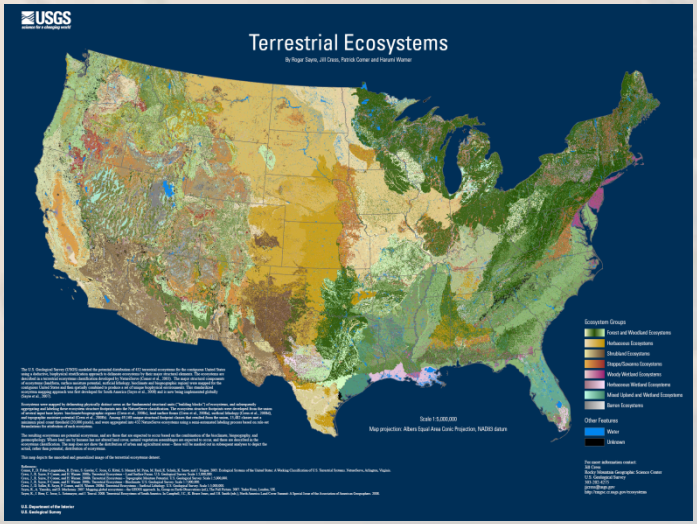
Ecosystem Structure Varies Geographically

(hence ecosystems vary geographically)



Ecosystem Structure Mapping

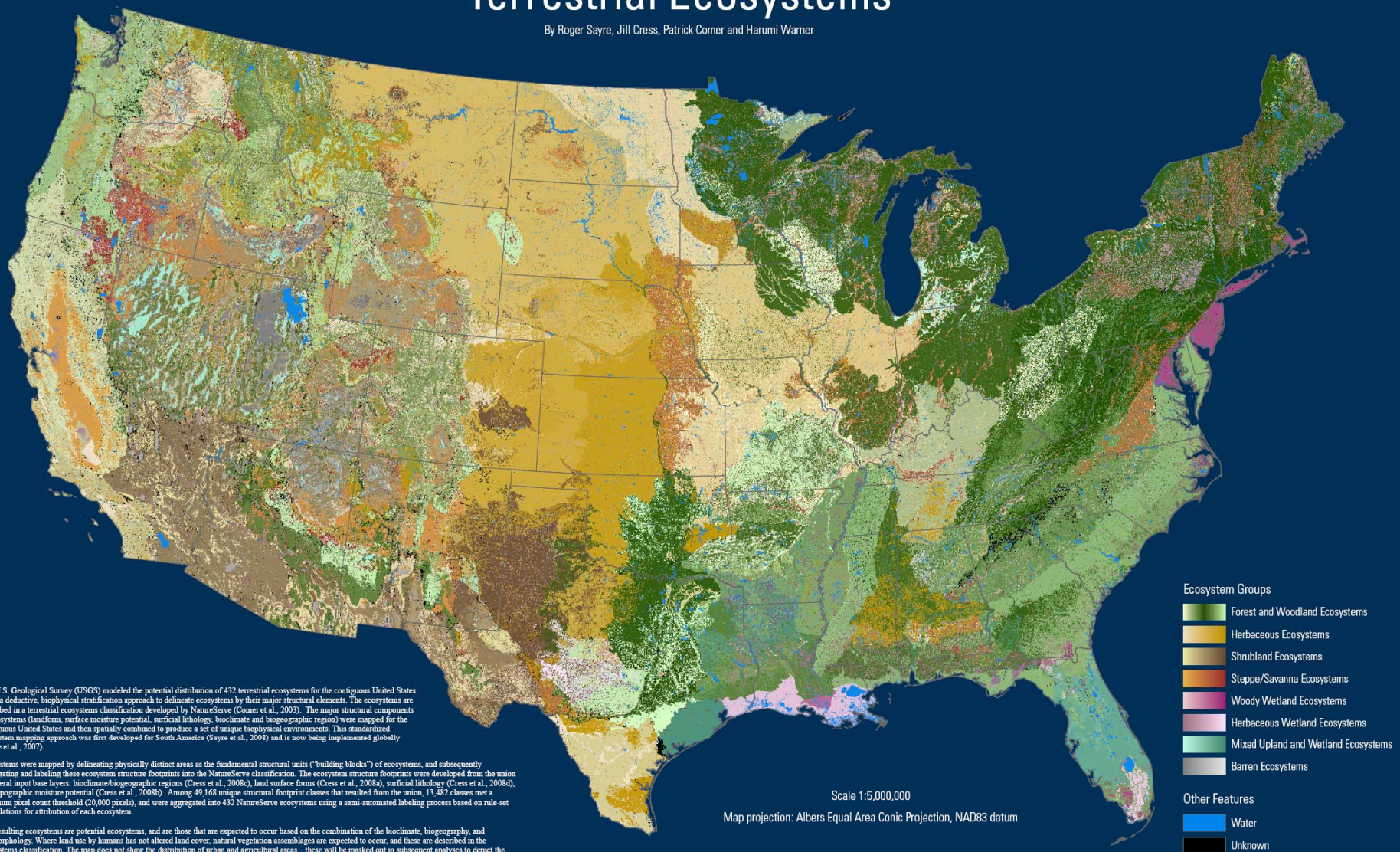




USGS
science for a changing world

Terrestrial Ecosystems

By Roger Sayre, Jill Cress, Patrick Comer and Harumi Warner



The U.S. Geological Survey (USGS) modeled the potential distribution of 432 terrestrial ecosystems for the contiguous United States using a deductive, biophysical stratification approach to delineate ecosystems by their major structural elements. The ecosystems are described in a terrestrial ecosystems classification developed by NatureServe (Comer et al., 2003). The major structural components of ecosystems (landform, surface moisture potential, surficial lithology, bioclimate and biogeographic region) were mapped for the contiguous United States and then spatially combined to produce a set of unique biophysical environments. This standardized ecosystem mapping approach was first developed for South America (Sayre et al., 2008) and is now being implemented globally (Sayre et al., 2007).

Ecosystems were mapped by delineating physically distinct areas as the fundamental structural units ("building blocks") of ecosystems, and subsequently aggregating and labeling these ecosystem structure footprints into the NatureServe classification. The ecosystem structure footprints were developed from the union of several input base layers: bioclimate/biogeographic regions (Cress et al., 2008c), land surface forms (Cress et al., 2008a), surficial lithology (Cress et al., 2008d), and topographic moisture potential (Cress et al., 2008b). Among 49,168 unique structural footprint classes that resulted from the union, 13,482 classes met a minimum pixel count threshold (20,000 pixels), and were aggregated into 432 NatureServe ecosystems using a semi-automated labeling process based on rule-set formulations for attribution of each ecosystem.

The resulting ecosystems are potential ecosystems, and are those that are expected to occur based on the combination of the bioclimate, biogeography, and geomorphology. Where land use by humans has not altered land cover, natural vegetation assemblages are expected to occur, and these are described in the ecosystems classification. The map does not show the distribution of urban and agricultural areas – these will be masked out in subsequent analyses to depict the actual, rather than potential, distribution of ecosystems.

This map depicts the smoothed and generalized image of the terrestrial ecosystems dataset.

References:

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, Virginia.
Cress, J., R. Sayre, P. Comer, and H. Warner. 2008a. Terrestrial Ecosystems – Land Surface Forms. U.S. Geological Survey. Scale 1:5,000,000.
Cress, J., R. Sayre, P. Comer, and H. Warner. 2008b. Terrestrial Ecosystems – Topographic Moisture Potential. U.S. Geological Survey. Scale 1:5,000,000.
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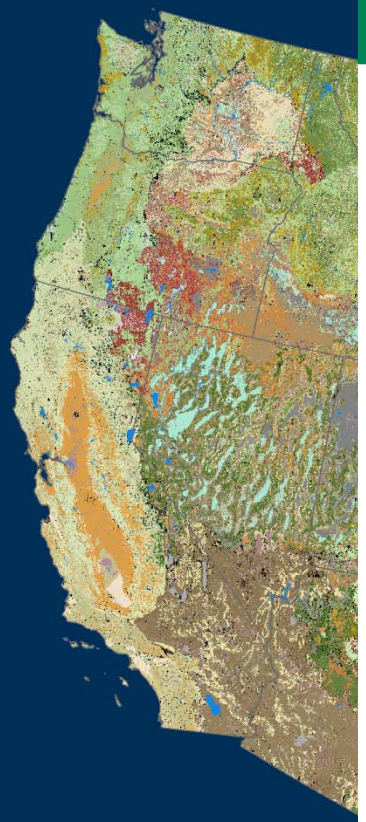

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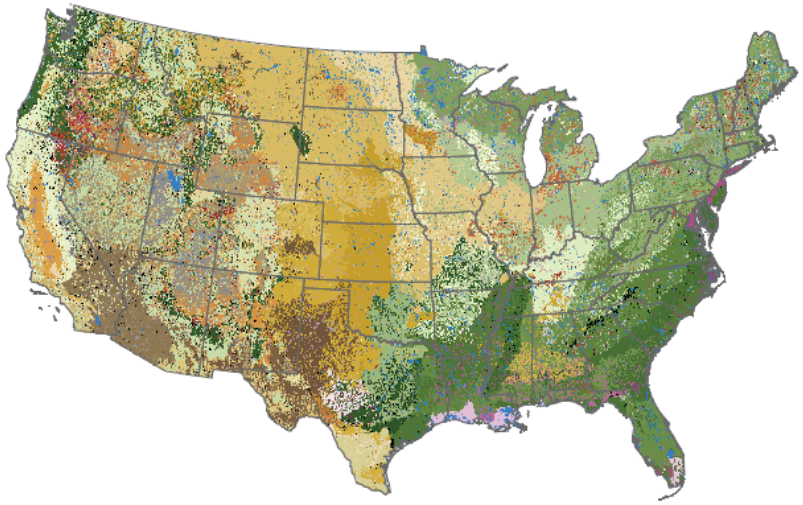
A New Map of Standardized Terrestrial Ecosystems of the Conterminous United States



Professional Paper 1768

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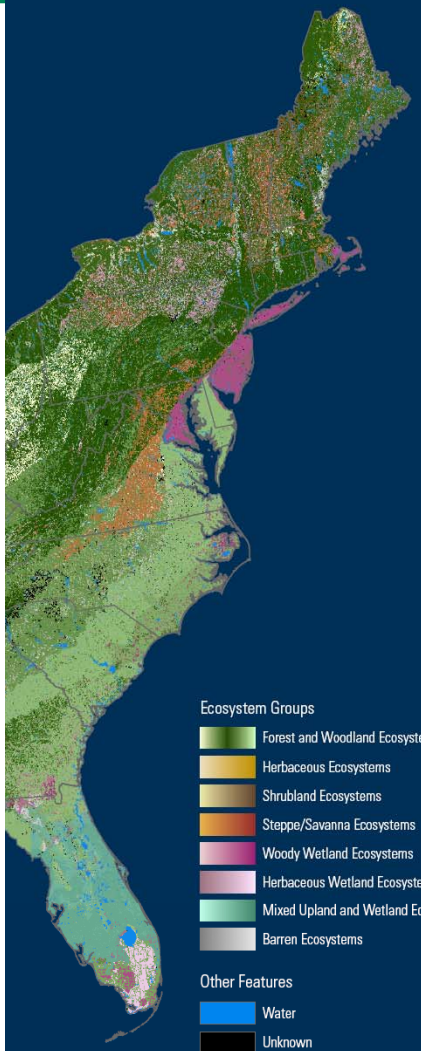

Ecosystem Groups
- Forest and Woodland Ecosystems
- Herbaceous Ecosystems
- Shrubland Ecosystems
- Steppe/Savanna Ecosystems
- Woody Wetland Ecosystems
- Herbaceous Wetland Ecosystems
- Mixed Upland and Wetland Ecosystems
- Barren Ecosystems

Other Features
- Water
- Unknown

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Cress, J., R. Sayre, P. Comer, and H. Warner. 2008c. Terrestrial Ecosystems – Bioclimate. U.S. Geolog
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U.S. Geological Survey

GEOSS Ecosystem Mapping Model

Step One

Biogeography

Bioclimate

Lithology

Landforms

Surface Moisture

Land Cover

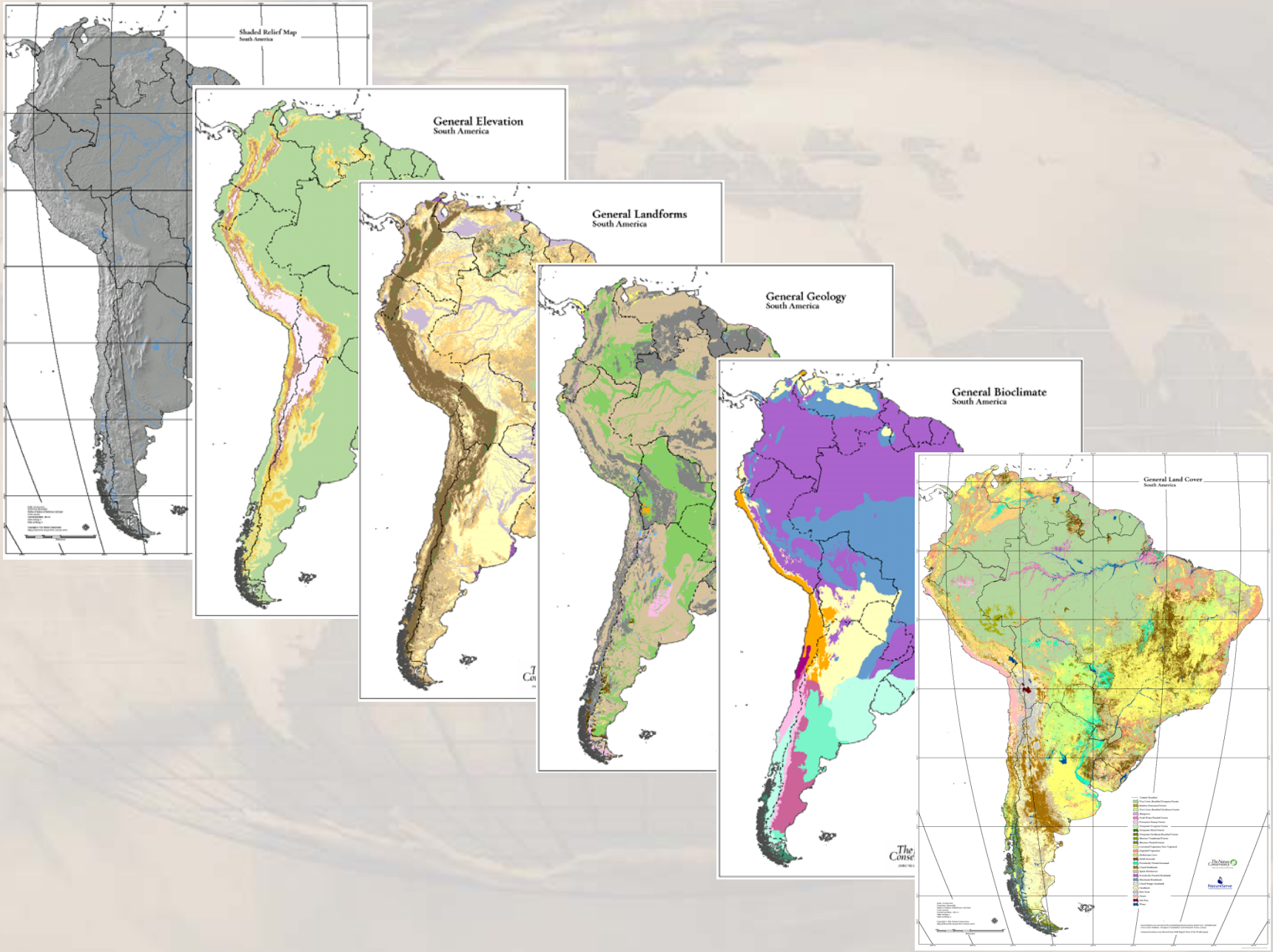
Ecosystem Footprints

Step Two

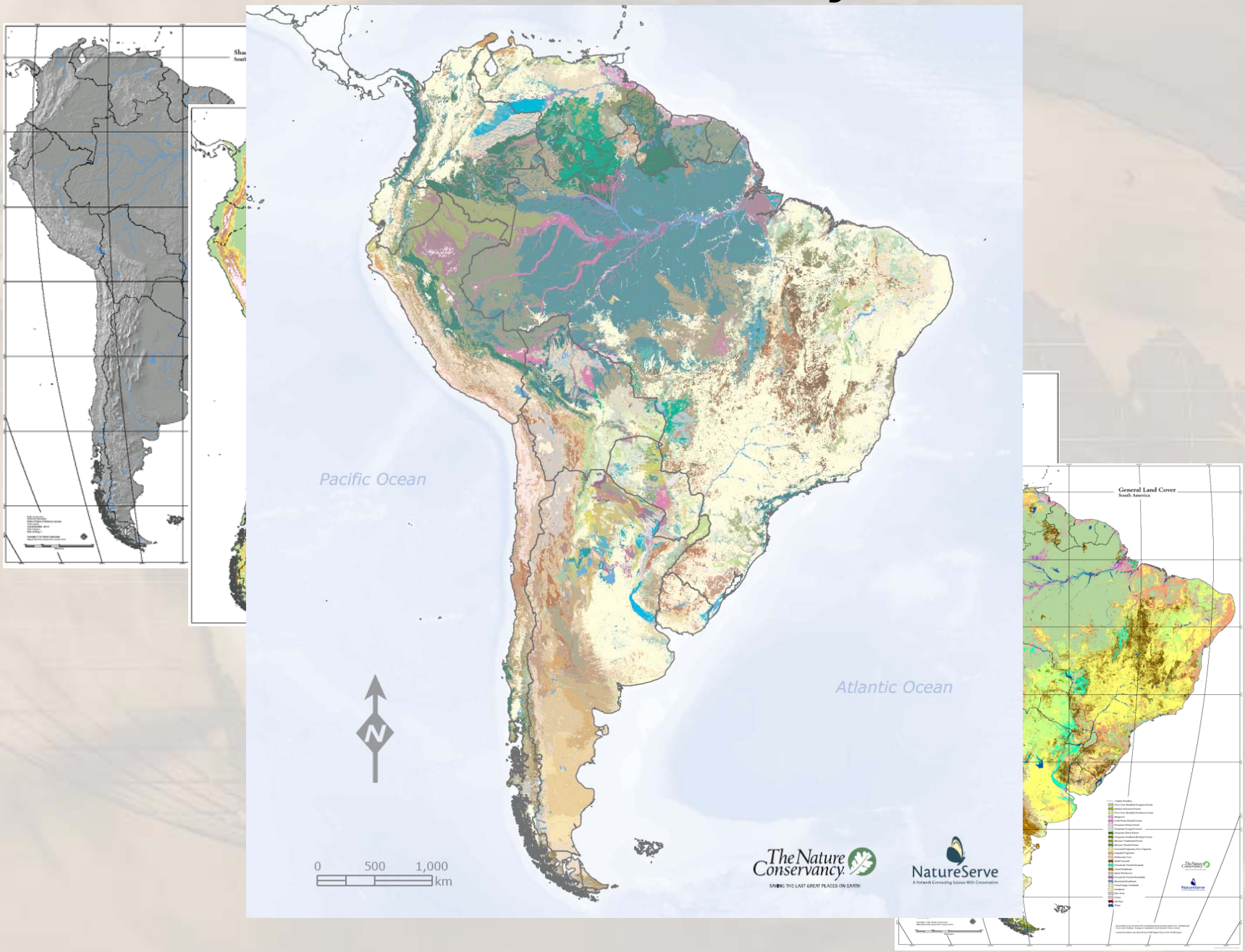
Ecosystems Classification

Labeled Ecosystems

South American Ecosystems



South American Ecosystems



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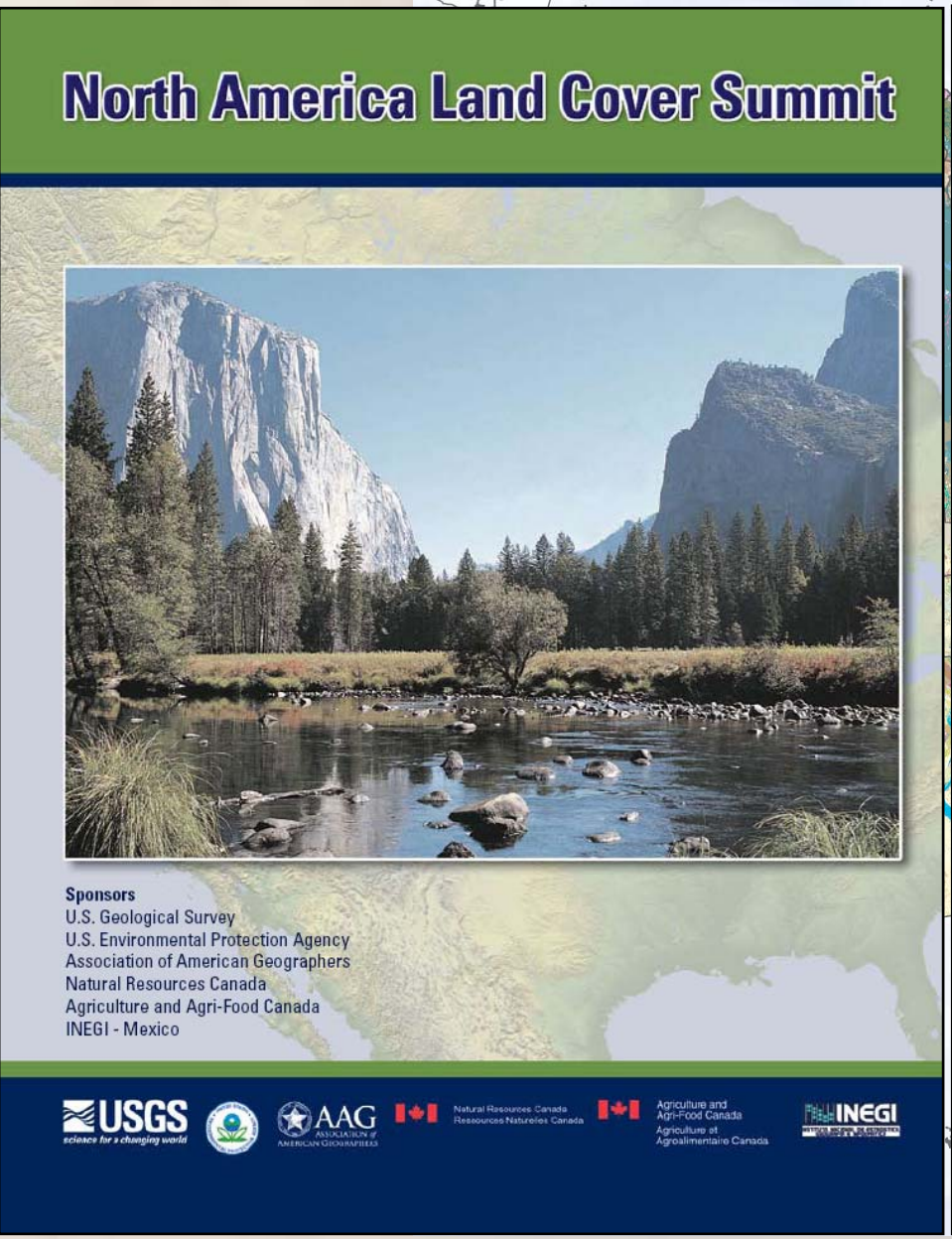

CHAPTER 9

Terrestrial Ecosystems of South America

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ABSTRACT

Standardized terrestrial ecosystems of South America were mapped using a biophysical stratification approach, and employing an ecological systems classification recently developed for Latin America and the Caribbean. The classification effort involved the development of diagnostic criteria and names for describing expert-derived ecological systems. The mapping/modeling effort stratified the continent into unique physical environments supporting a variety of land cover types. Ecosystem footprints were delineated by overlaying continental datalayers for elevation class, landform, lithology, bioclimate, and image-derived land cover. Polygonal occurrences of these ecosystem footprints were developed at a working pixel resolution of 450m (20 hectares). The ecosystem footprint polygons were subsequently labeled using the standardized ecosystems. 659 ecosystem types were identified and mapped across the South American continent; by comparison there are 110 World Wildlife Fund (Olson et al., 2001) terrestrial ecoregions. These standardized ecosystems, mapped for the entire continent at a relatively fine scale, are useful for a variety of biodiversity conservation and resource management applications. These data can be used to identify areas deserving of management attention due to their value for biodiversity conservation, as well as the production of ecosystem goods and services (e.g., food, water, fuel, fiber, forage, etc.).

Key words: *biodiversity conservation, biophysical stratification, ecosystems, ecosystem classification, ecosystem management, spatial analysis, spatial planning*

Africa Ecosystems – Geospatial Approach

Input Layers

Products

1a

Isobioclimate Regions (157 classes)

+

1b

Mesobiogeographic Region (16 classes)

Product 1
Mesobioclimate/mesobiogeographic regions
(585 classes)

+

+

2a

Landform Classes (7 classes)

+

2b

Surficial Materials (19 classes)

+

2c

Topographic Position (2 classes)

Product 2
Local Abiotic Environments (370 classes)

=

Product 3
Unique Physical Environments (32,844 classes)

+

=

3

Land Cover (21 classes)

Product 4
Physical Environment/Land Cover
(181,516 classes)

aggregation and labeling

4

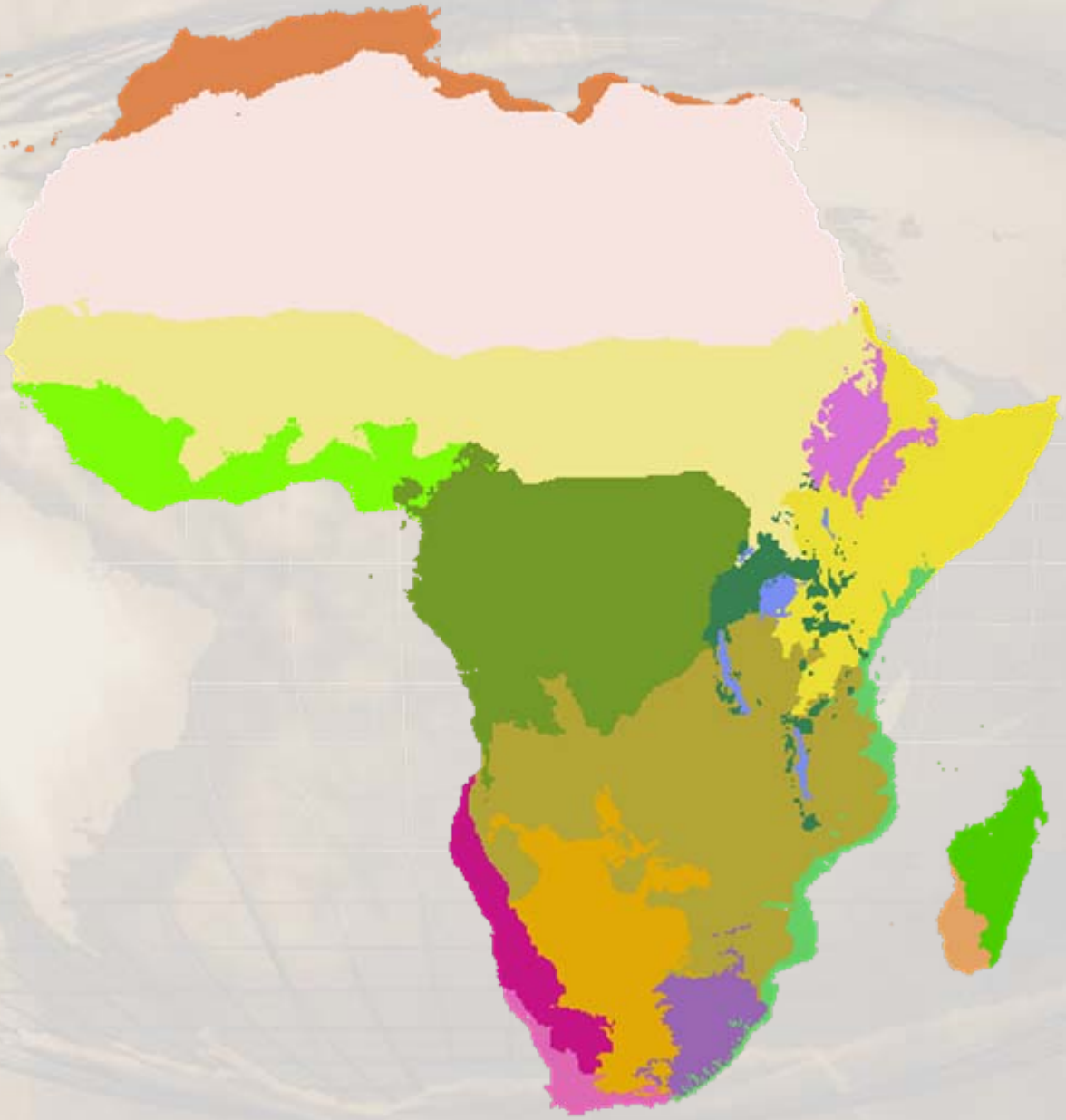
WWF Ecoregions (classes)
(not combined, used for aggregation and labeling support)

Product 5
NatureServe Ecosystem Groups (classes)

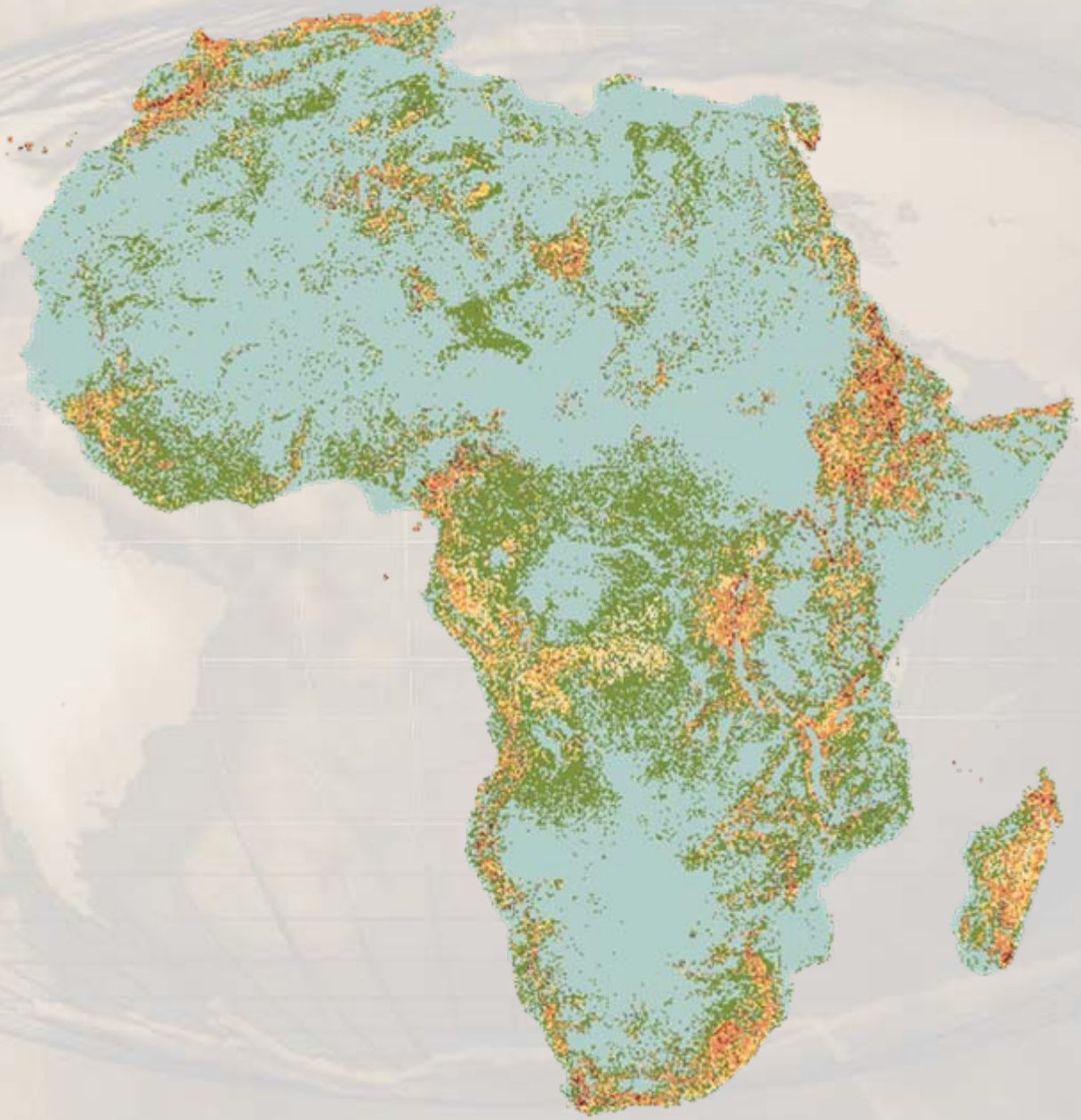
Africa Coastline (30 m spatial resolution)

Africa Isobioclimates (157)

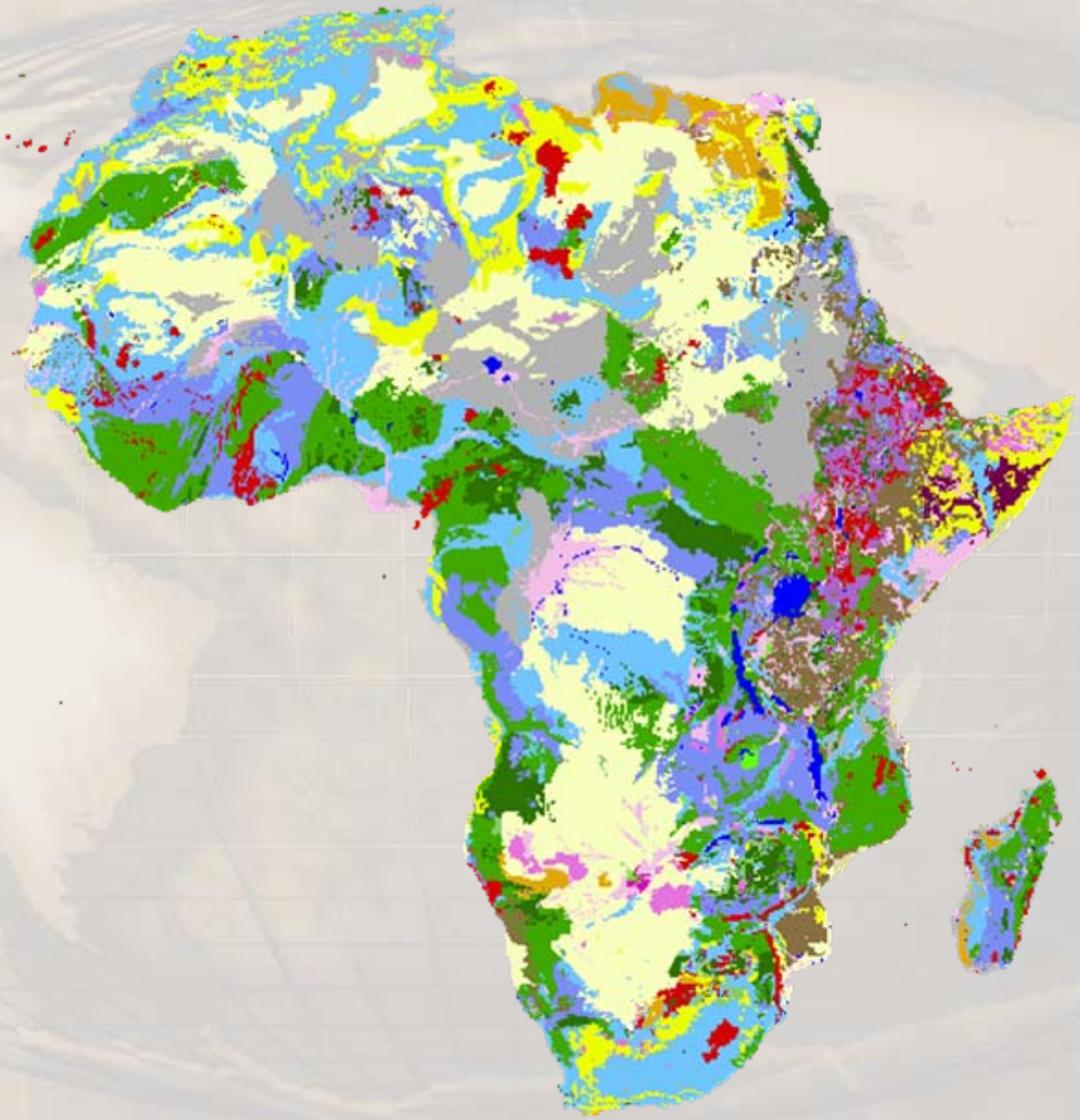
Africa Ecological Divisions (16)



Africa Landforms (7)

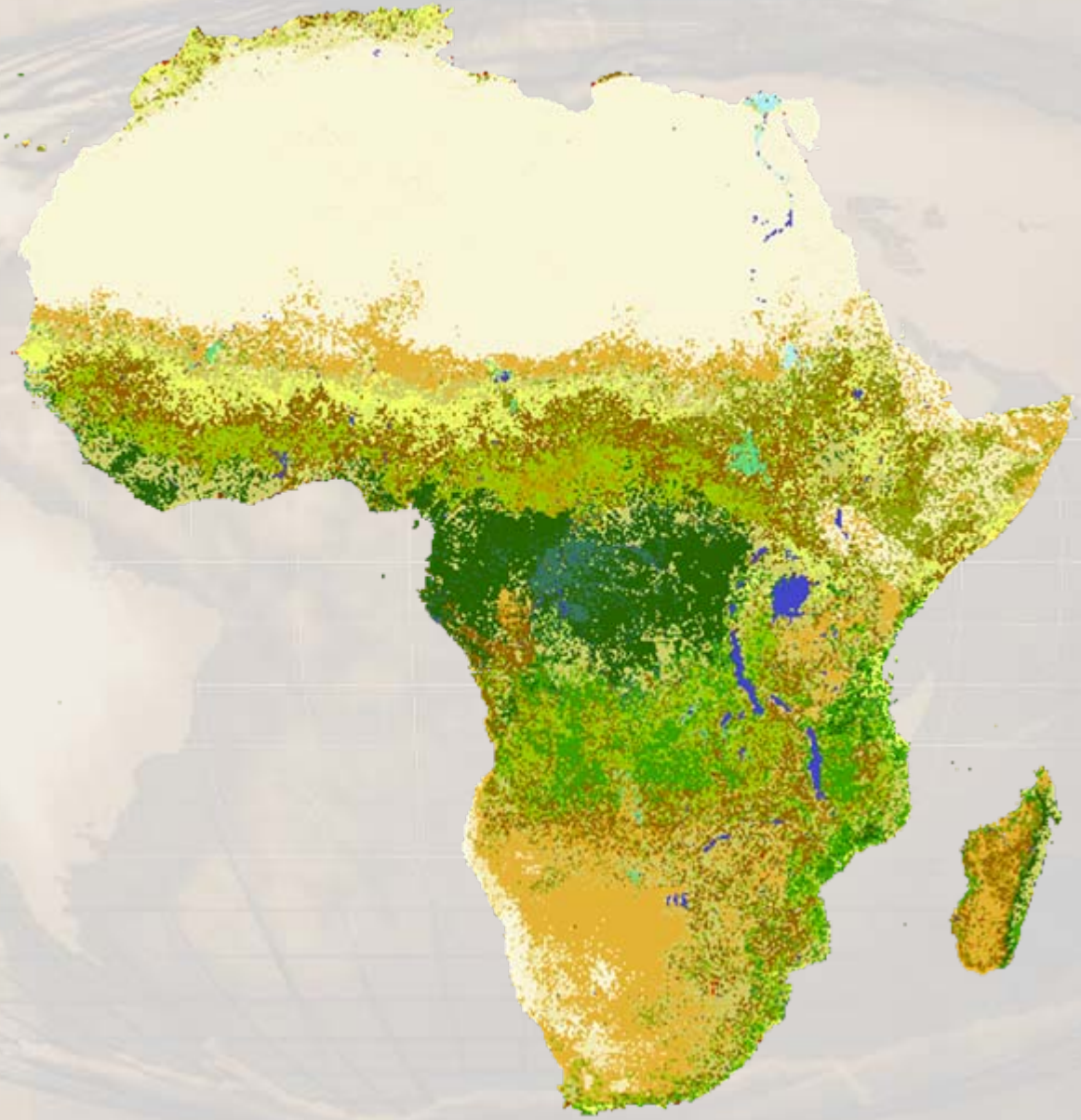


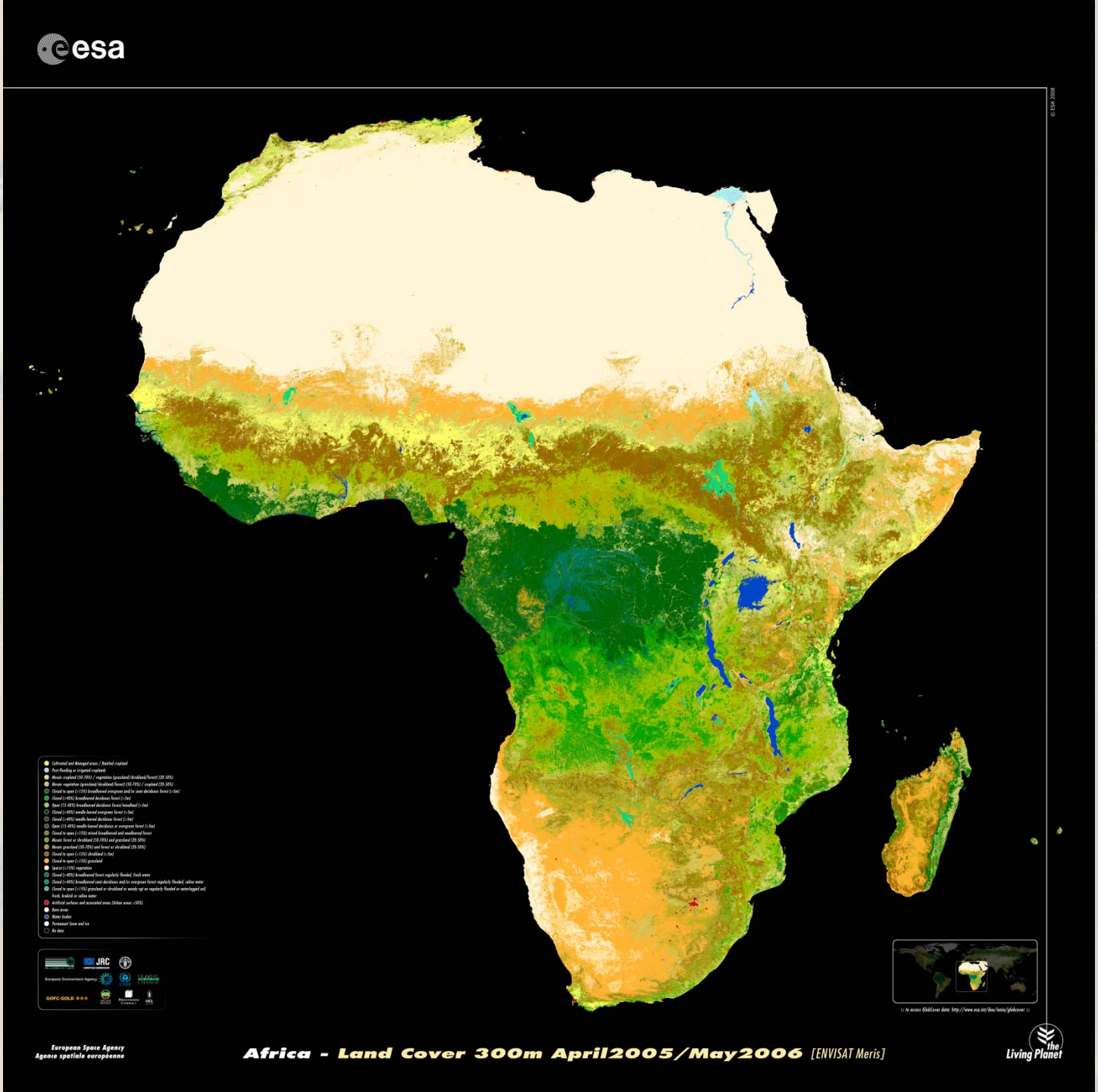
Africa Surficial Materials (19)



Africa Topographic Position (2)

Africa Land Cover (21)




esa
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Cultivated and Managed areas / Rainfed cropland
Post flooding or irrigated croplands
Mosaic cropland (50-70%) / vegetation (grassland/shrubland/forest) (20-50%)
Mosaic vegetation (grassland/shrubland/forest) (50-70%) / cropland (20-50%)
Closed to open (>15%) broadleaved evergreen and/or semi deciduous forest (>5m)
Closed (>40%) broadleaved deciduous forest (>5m)
Open (15-40%) broadleaved deciduous forest/woodland (>5m)
Closed (>40%) needle-leaved evergreen forest (>5m)
Closed (>40%) needle-leaved deciduous forest (>5m)
Open (15-40%) needle-leaved deciduous or evergreen forest (>5m)
Closed to open (>15%) mixed broadleaved and needleaved forest
Mosaic forest or shrubland (50-70%) and grassland (20-50%)
Mosaic grassland (50-70%) and forest or shrubland (20-50%)
Closed to open (<15%) shrubland (<5m)
Closed to open (<15%) grassland
Sparse (<15%) vegetation
Closed (>40%) broadleaved forest regularly flooded, fresh water
Closed (>40%) broadleaved semi deciduous and/or evergreen forest regularly flooded, saline water
Closed to open (>15%) grassland or shrubland or woody veg on regularly flooded or waterlogged soil, fresh, brackish or saline water
Artificial surfaces and associated areas (Urban areas >50%)
Bare areas
Water bodies
Permanent Snow and Ice
No data
JRC
European Environment Agency
GOFC-GOLD
European Space Agency
Agence spatiale européenne
Africa - Land Cover 300m April2005/May2006 [ENVISAT Meris]
the Living Planet

Group on Earth Observations

Lead and POC
Roger Sayre, PhD
U.S. Geological Survey

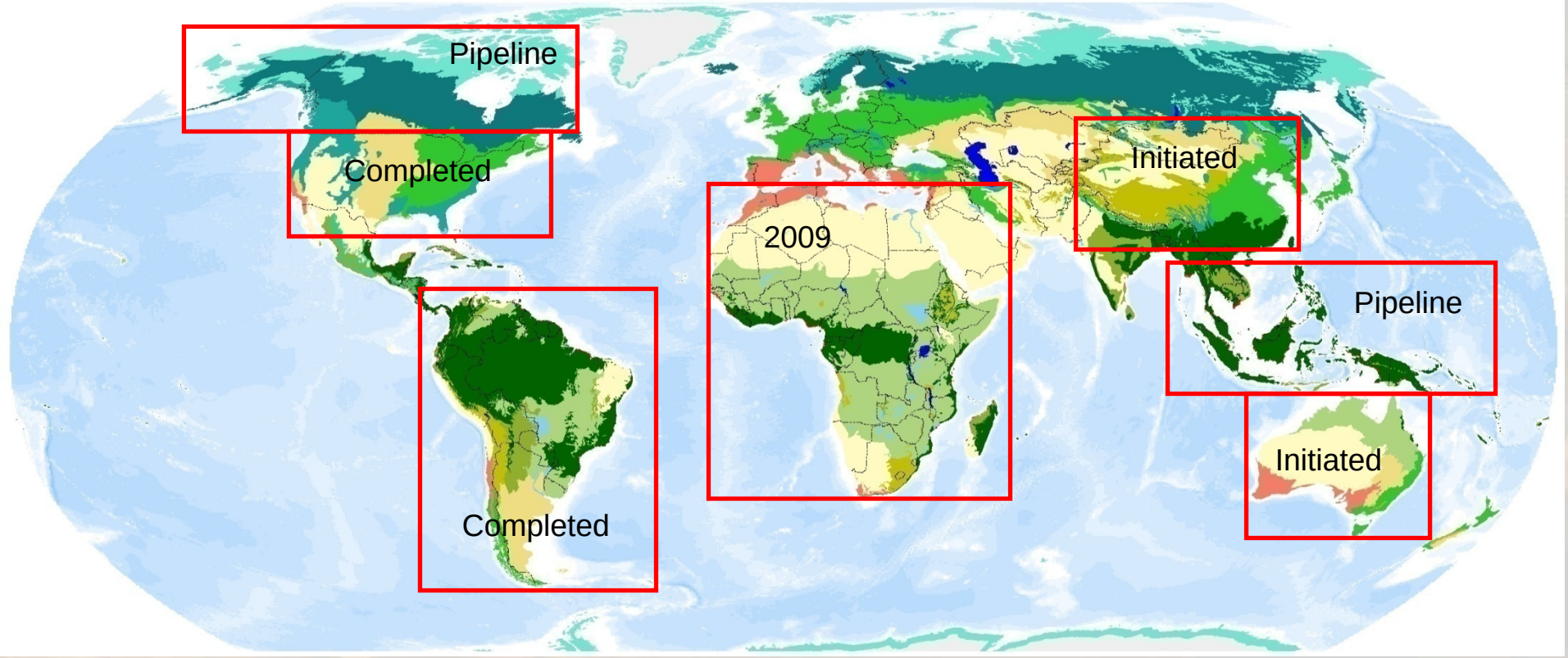
Global Ecosystems Classification and Mapping Initiative

Co-lead
Alberto Yanosky, PhD
Guyra Paraguay

EC-06-02: Ecosystem Classification and Mapping

Develop a standardized, robust, and practical global ecosystems classification and map for the planet's terrestrial, freshwater, and marine ecosystems.

GEOSS Global Terrestrial Ecosystem Mapping Efforts



Conclusions

- ***Standardized ecosystems can be mapped by their structural elements.***

- ***Standardized ecosystem mapping for Africa is at an advanced state; AfricaGIS 2009 is a target event for initial products distribution.***

http://rmgsc.cr.usgs.gov/ecosystems