Technical and Financial Final Report

Data Digitization Grants Ecosystems Thematic Network

Standardization of the Terrestrial Ecosystems
in the Central America Pine-Oak Forests Ecoregion

Prepared By

Steven R. Schill, Ph.D.

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1. Executive Summary

The objective of IABIN is to promote sustainable development and the conservation and sustainable use of biological diversity in the Americas through better access to and management of biological information. The principal aim of this project was to enrich the IABIN Ecosystem Thematic Network (ETN) by a) developing and applying a crosswalk methodology for all 59 terrestrial ecosystems in the Central American Pine-Oak Forests ecoregion; b) filling out the terrestrial standard format for these ecosystems ; c) completing the metadata to IABIN standards; and d) ensuring that the standardized ecosystem data are made available to the public via public data portals and correspondingly linked to IABIN's portal. The ecosystem data used for this project were originally identified and mapped by combining biophysical factors such as climate, geology, land elevation and ocean depth, with existing land cover products. Satellite imagery was used to create and validate ecosystem maps that were reviewed by local experts (Vreugdenhil et al, 2002; World Bank and CCAD, 2000). Furthermore, the Nature Conservancy (TNC) used these ecosystems data to complete a comprehensive ecoregional assessment of biodiversity and threat status for Central America which is serving as a strategic plan for conservation action in the region (TNC, 2008). These ecosystems served as the basis for the development of a detailed crosswalk classification, created to match these terrestrial ecosystems with the ETN terrestrial standard format. Each of the 59 ecosystems within the Central American Pine-Oak Forests ecoregion was mapped to four levels of the standard format. The metadata and GIS files were posted to an internet map server and made publically available for conservation decision-makers. Locating relevant datasets required to fill out each of the details in the standard levels proved to be the most challenging part of the project. For example, in order to map the level 2 classification, the bioclimates and thermotypes (Rivas et al, 1999) did not exist in digital format and had to be digitized and integrated into the GIS database. These data will serve future efforts as the process to enrich the IABIN ETN database continues.

2. Results of the planned products and impact of the project

The products delivered for this project include

a) Application of the terrestrial standard format to 59 ecosystems found within the Central American Pine-Oak Forest ecoregion;
b) Publically available ecosystem data and corresponding metadata via an internet map service.

This project has been successful in standardizing all terrestrial ecosystems that have been mapped in the Central American Pine-Oak Forests Ecoregion to the IABIN ETN standard format. The Central American Pine-Oak Forests ecoregion is a very broad region, harboring 59 ecosystems that are found within the central Chiapas state of Mexico, southern Guatemala, most of Honduras and El

Salvador, and small areas of west central Nicaragua. These ecosystems have a wide range of complexity, encompassing the Sierra Madre de Chiapas with mountain ranges that run parallel to the Pacific Coast, and various mountain ranges with complex topography. The ecosystem data used in this project are part of the larger ecoregional assessment of terrestrial systems of Mesoamerica project that included over 30 ecoregions, of which 17 correspond to forest ecosystems, 12 correspond to swamps and mangroves ecosystems, and one desert and xeric scrub system. The Central American Pine-Oak Forests ecosystem standardization was completed for levels 1-4 which include a) macrobioclimates/biogeography, b) microbioclimates, c) physiographic land cover/hydrology conditions, and d) detailed ecosystem data derived from the ecoregional assessment. One major challenge for the project was the lack of bioclimates and thermotypes data (Rivas et al, 1999) required to complete the level two classifications (see Appendix A). In order to process the ecosystem data to level 2, the bioclimates and thermotypes were digitized and integrated into the GIS database.

The primary impacts of this project include

a) the expansion of the IABIN ETN database by including 59 additional terrestrial ecosystems that are now in the standard format;
b) the availability of standardized ecosystems that can be compared across boundaries and at multiple scales; and
c) publically available terrestrial ecosystem data that have been reviewed and validated by experts and are now readily available to conservationists/scientists for additional investigations aimed at decision-making and policy support. Users will be able to browse and download the data as well as link back to the IABIN catalog where more information will be available. The public internet map service for the ETN Central American Pine-Oak Forest ecosystems can be found at *http://gg.usm.edu/CA_Ecosystems*.

Since the central objective of the ETN is to address the need of creating a common language to which each of the existing national ecological classifications can relate, this project applied a standard reference classification so ecosystems can be compared across jurisdictional boundaries. By means of filling out the standard format with fields that describe the class according to a series of pre- determined attributes or criteria, each class in an each existing classification can be related to a class in the reference classification.

3. Methodology employed and activities carried out to achieve the planned products

The Standard Format is a template that is filled out for each class in an ecosystem classification, with fields that describe the class according to a series

of attributes, criteria or characteristics .These attributes include the ones associated with the Reference Classification structure. This project used ecosystems previously mapped for the Central American Pine-Oak Forests ecoregion (see Appendix B). Ecoregions are defined in biological terms as logical units for the conservation of the biodiversity. Separated from units defined politically or geographically, ecoregions are based on the limits of the nature and can be used to define the actions of conservation that better reflect the ecological and evolutionary processes that create and support the biological diversity (WWF, 2003). The original terrestrial ecosystem classification that was used was based on the following documents:

a. *Vreugdenhil, Daan., Jan Meerman, Alain Meyrat, Luis Diego Gómez, and Douglas J.Graham. 2002. Map of the Ecosystems of Central America: Final Report. World Bank, Washington, D.C.*
b. *World Bank and CCAD. 2000. "Ecosystems of Central America (ArcView regional mapFiles at: 1:250,000)." World Bank, Comisión Centroamericana de Ambiente y Desarrollo (CCAD), World Institute for Conservation and Environment (WICE), and the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Washington, D.C. (http://www.worldbank.org/ca-env)*

A crosswalk classification was developed so that each of the 59 terrestrial ecosystems could be matched to the IABIN ETN standard format (see Appendix C). Application of the standard format was applied to all terrestrial ecosystems in the Central America Pine-Oak ecoregion from levels 1-4 (see Appendix B). An example of the fields that were filled out for each of the levels in the standard format (IABIN) includes:

Level 1 - Macrobioclima, Macrobiogeogeografia
Level 2 - Mesobioclima (según la clasificación bioclimática de Rivas Martínez)
Level 3 - Fisiografía, Cobertura de la Tierra, Fenología de la vegetación, Condición hídrica superficial, Ciclo hidrológico
Level 4 - Clases de drenaje del suelo (USDA), Tipos de suelo según FAO, Suma de bases de cambio (Ca, Mg, Na, K) en meq/100g, Geomorfología, Cavernas, Hidrogeomorfología, Altura vegetación dominante, Densidad cobertura total, Tipo hoja dominante

In order to complete level 2 crosswalk, the bioclimates and thermotypes data (Rivas et al, 1999) had to be digitized since it was not already in a digital format. Once these features were in a GIS format, each of the terrestrial ecosystems could be attributed with the corresponding bioclimatic and thermotype information (see Appendix A).

Metadata was completed according to IABIN standards and submitted to the CASSIA system developed by Instituto Alexander von Humboldt. The completed terrestrial crosswalk information for the Central America Pine-Oak ecoregion was

organized and uploaded into the IABIN web-based Ecosystem Thematic Network standard format and a unique code is generated for each unique ecosystem. These unique codes correspond to the ecosystem polygons in the attribute table of the ecosystems shapefile. This code is used to link the ecosystems in the shapefile back to the IABIN web portal.

4. Lessons learned, problems and viable solutions

Key lessons learned from this project include:

a) Prior to applying the IABIN ETN standard format to terrestrial ecosystems, the ecosystem data to be used should be previously widely accepted, having been reviewed by ecosystem experts;
b) The development of crosswalk classification methodology should be transparent, reviewed and validated by ecosystems experts;
c) Coordination of efforts with web portals managers should happen in the early stages of the project to minimize technical problems that may occur during the linking of internet map services.

The major problem during this project was accessibility to data that was needed to complete the requirements outlined in the crosswalk classification. This problem was resolved by locating hard copies of the data and digitizing the features for inclusion in the GIS database. For hosting these data, TNC is providing the ecosystem map as an internet map service through our external data portal and hosting institution at *http://gg.usm.edu/CA_Ecosystems*. Since this project is part of a larger deliverable that includes the standardization of all Central American terrestrial ecosystems, this site will eventually be further enhanced to include the remaining standardized terrestrial ecosystems of Central America.

5. Brief description of how to make the database continues to grow after the completion of the project

As we know, terrestrial ecosystems are not static and change over time. The ecosystems that have been standardized for this project were mapped using remote sensor data (e.g. aerial photographs and satellite images) acquired around the year 2000. Consequently, the ecosystem that have been standardized, while they are the most accurate and widely accepted to date, are approximately ten years old and do not represent current conditions. One way to continue to grow and enhance the database is through additional remote sensing data collection to monitor changes of the ecosystem over time. However, when making updates, it is important to utilize the same methodology that was employed when creating the baseline data in order to avoid erroneous assumptions that may come from a mismatch in methods. In addition, the expansion of the database by including the standardization of new geographies

would represent an additional enhancement to users of these data, providing a more seamless resource.

6. Funds (attach a spending report counterpart Excel table)

7. Financial Report (attach a spending report in Excel table)

8. Appendices

Appendix A: Bioclimates and Thermotypes included in level two of the IABIN ETN Standard Classification for Terrestrial Systems.

Appendix B: Terrestrial Ecosystem Maps of the Central American Pine-Oak Forests Ecoregion.

Appendix C: Crosswalk classification for the four levels of the standard format (see attached Excel spreadsheet)

Appendix A. Bioclimates and Thermotypes included in level two of the IABIN ETN Standard Classification for Terrestrial Systems.

NIVEL 2
Bioclima: Los índices de Bioclima cuentan con mapas de consulta mediante enlaces en el Formato Estándar para facilitar su selección.
Los índices bioclimáticos tratan de expresar de forma sintética las interrelaciones entre los parámetros climáticos básicos como son temperatura y precipitación, ya que su acción sobre los seres vivos se efectúa de forma combinada y no por separado.

A este nivel proponemos utilizar los bioclimas de la clasificación bioclimática de Rivas Martínez (1999) [http://www.ucm.es/info/cif]que para el macrobioclima tropical, se basan en combinaciones del índice **ombrotérmico anual (Io) y el índice ombrotérmico de la época seca (Iod2)**, mientras que para los macroclimas extratropicales, además de los anteriores, se suma **el índice de continentalidad (Ic)**.

Io = P/12T, cociente entre la precipitación total anual media (P, en mm) y la temperatura media anual (T, en grados Celsius) multiplicada por 12. Si existe algún mes del año con temperatura media inferior a 0°C, no se computa, y la expresión se convierte en Io = (Pp/Tp)10, cociente multiplicado por 10 entre la sumatoria de las precipitaciones de los meses con temperatura promedio superior a 0°C y la sumatoria de las temperaturas (en décimas de grados Celsius) de los meses con temperatura promedio superior a 0°C .

Iod2 = P2/T2, índice ombrotérmico de los dos meses consecutivos más secos del año.

Ic = Tmax-Tmin, temperatura media del mes más cálido del año menos la temperatura media del mes más frío del año. Los índices de continentalidad tratan de expresar la amplitud de la oscilación anual de la temperatura. Así, el grado de continentalidad es directamente proporcional a la citada amplitud. En sentido contrario se utiliza el vocablo oceanidad; mares, lagos y océanos no helados tienden a amortiguar el contraste de la temperatura, mientras que con el alejamiento de las costas, tierra adentro, sucede lo contrario. Los índices más empleados para expresar la continentalidad/oceanidad se pueden agrupar en sencillos y compensados. Son sencillos aquellos que expresan únicamente la diferencia entre las temperaturas extremas, y compensados los que, a la amplitud u oscilación de la temperatura anual, se adiciona una cantidad en función de la altitud o de la latitud.

Bioclimas	Intervalos de Io	Intervalos de Iod2	Ombrotipos	Intervalos de Io
Tropical pluvial	≥ 3.6	> 2.5	Ultrahiperárido	< 0.2
Tropical pluviestacional	≥ 3.6	≤ 2.5	Hiperárido	0.2 – 0.4
Tropical xérico	1.0 – 3.6	-	Arido	0.4 – 1.0
Tropical desértico	0.1 – 1.0	-	Semiárido	1.0 – 2.0
Tropical hiperdesértico	< 0.1	-	Seco	2.0 – 3.6
			Subhúmedo	3.6 – 6.0

Húmedo	6.0 – 12.0
Hiperhúmedo	14.0 – 24.0
Ultrahiperhúmedo	> 24.0

El segundo índice a utilizar es el del piso bioclimático o termotipo que expresa la zonación de las variaciones térmicas altitudinales que ocurren en las montañas dentro de un macrobioclima determinado. Este índice de termicidad (It) se calcula:
It= (T+M+m)10, donde T= temperatura media anual, M= media de las temperaturas máximas del mes más frío del año, y m= media de las temperaturas mínimas del mes más frío del año.

Pisos bioclimáticos: termotipos

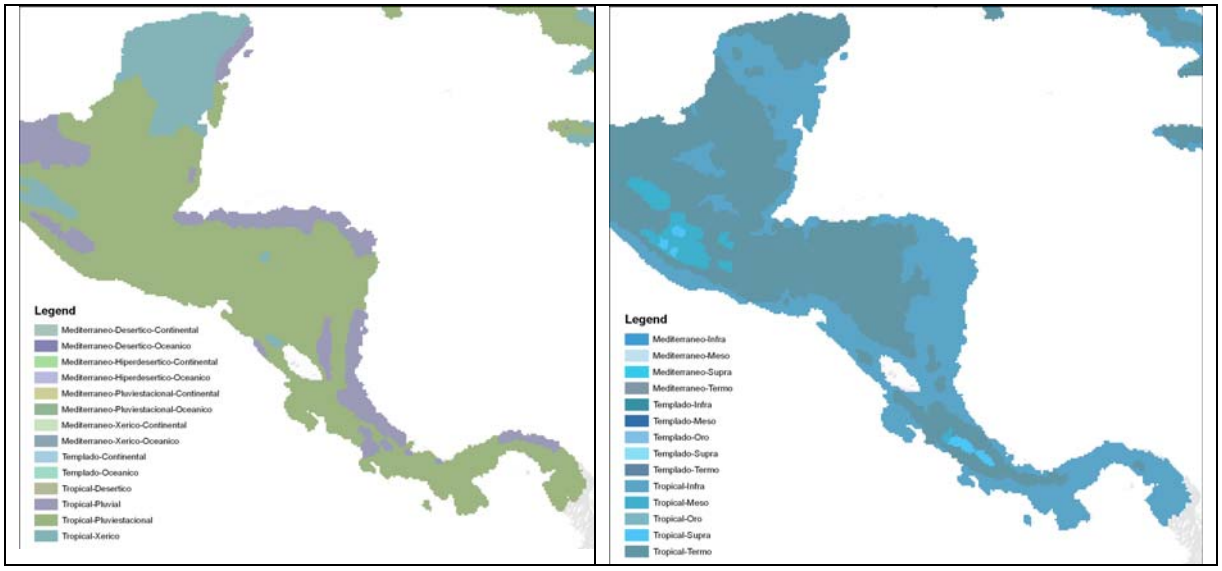
	It (Itc)	Tp(2)
1. Infratropical	710 - 890	> 2900
2. Termotropical	490 - 710	> 2300
3. Mesotropical	320 - 490	> 1700
4. Supratropical	160 - 320	> 950
5. Orotropical	< 160	450-950
6. Criorotropical	-	1-450
7. Gélido (3)	-	0

	It (Itc)	Tp(2)
1.	450 - 580	> 2400
Inframediterráneo	350 - 450	> 2100
2.	220 - 350	> 1500
Termomediterráneo	< 220	> 900
3.	-	450-900
Mesomediterráneo	-	1-450
4.	-	0
Supramediterráneo		
5. Oromediterráneo		
6.		
Crioromediterráneo		
7. Gélido (3)		

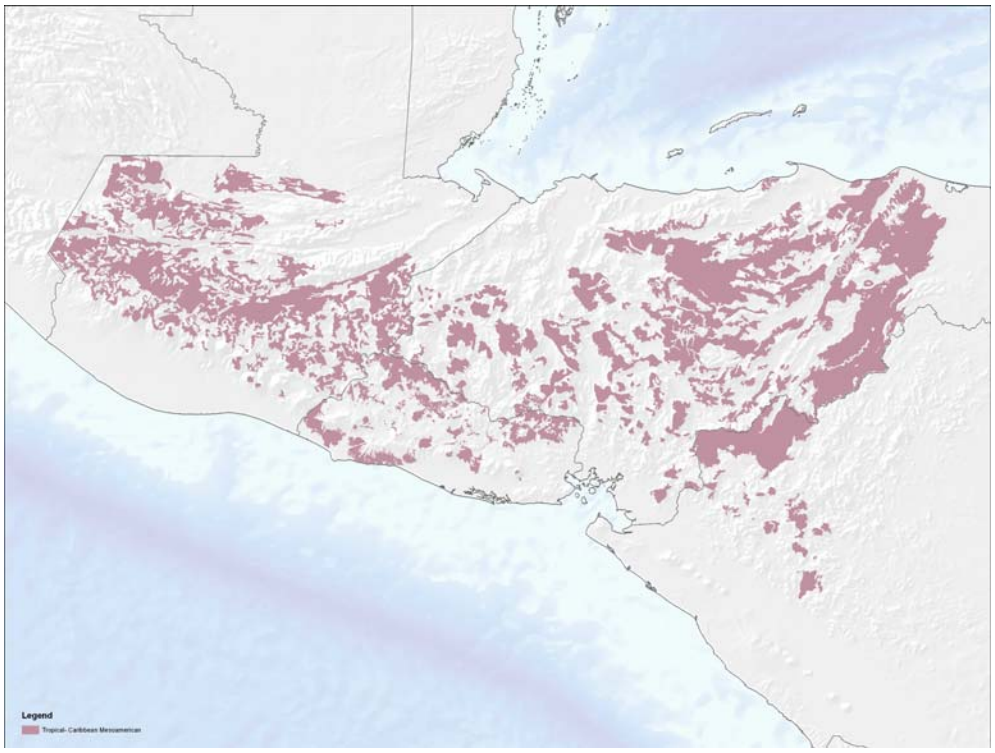
	It (Itc)	Tp (2)
	410	> 2350
1. Infratemplado	290 - 410	> 2000
2. Termotemplado	190 - 290	> 1400
3. Mesotemplado	< 190	> 800
4. Supratemplado	-	380-800
(4)	-	1-380

5. Orotemplado (4)	-	0
6. Criorotemplado		
7. Gélido (3)		
		Tp
1. Termoboreal	-	> 680
2. Mesoboreal	-	580-680
3. Supraboreal	-	480-580
4. Oroboreal	-	380-480
5. Crioroboreal	-	1-380
6. Gélido (3)	-	0
		Tp
1. Thermopolar	-	280-380
2. Mesopolar	-	100-280
3. Suprapolar	-	1-100
4. Gélido (3)	-	0

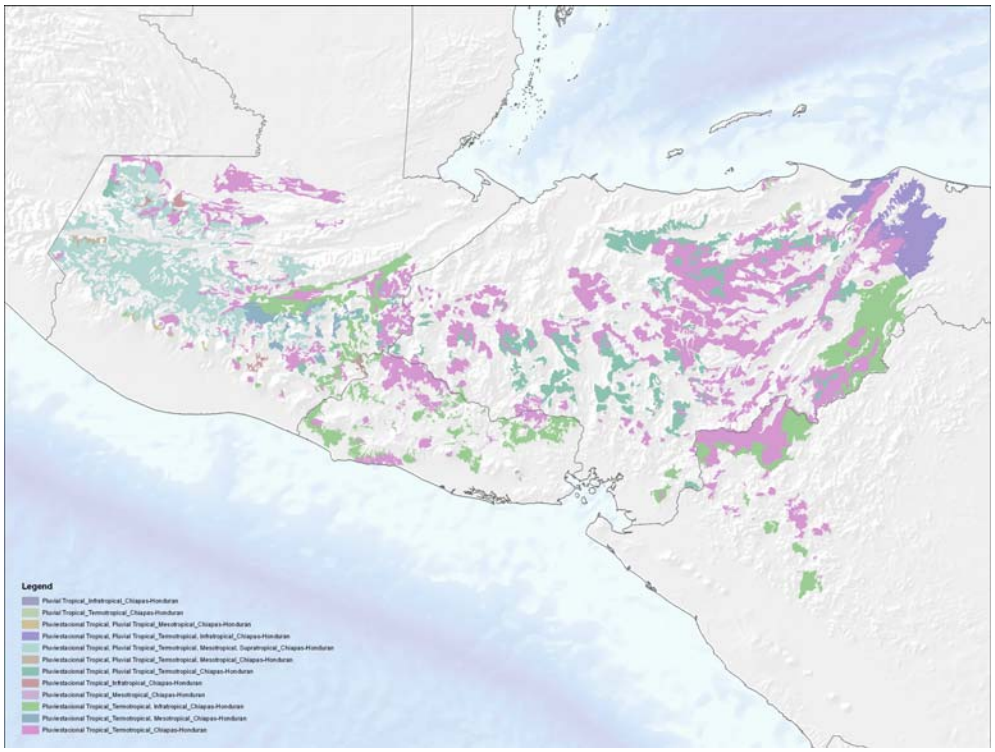
Rivas et al (1999) data (bioclimates and thermotypes) that were digitized for inclusion in the level 2 ETN terrestrial standard format for Central America.



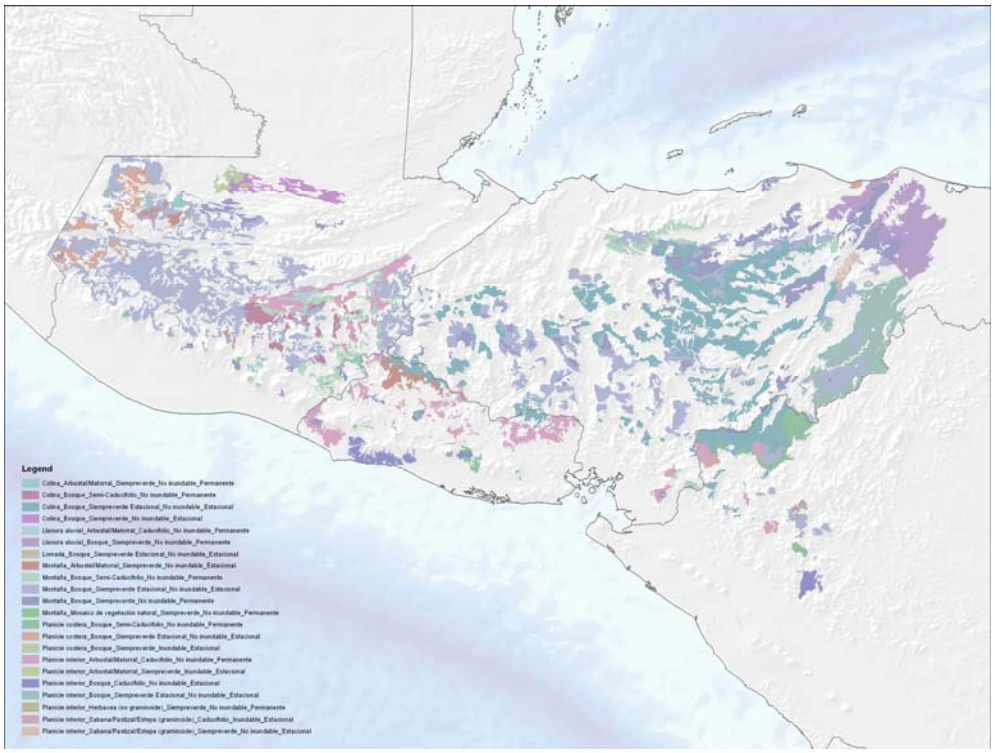
Appendix B: Terrestrial Ecosystem Maps of the Central American Pine-Oak Forests Ecoregion.



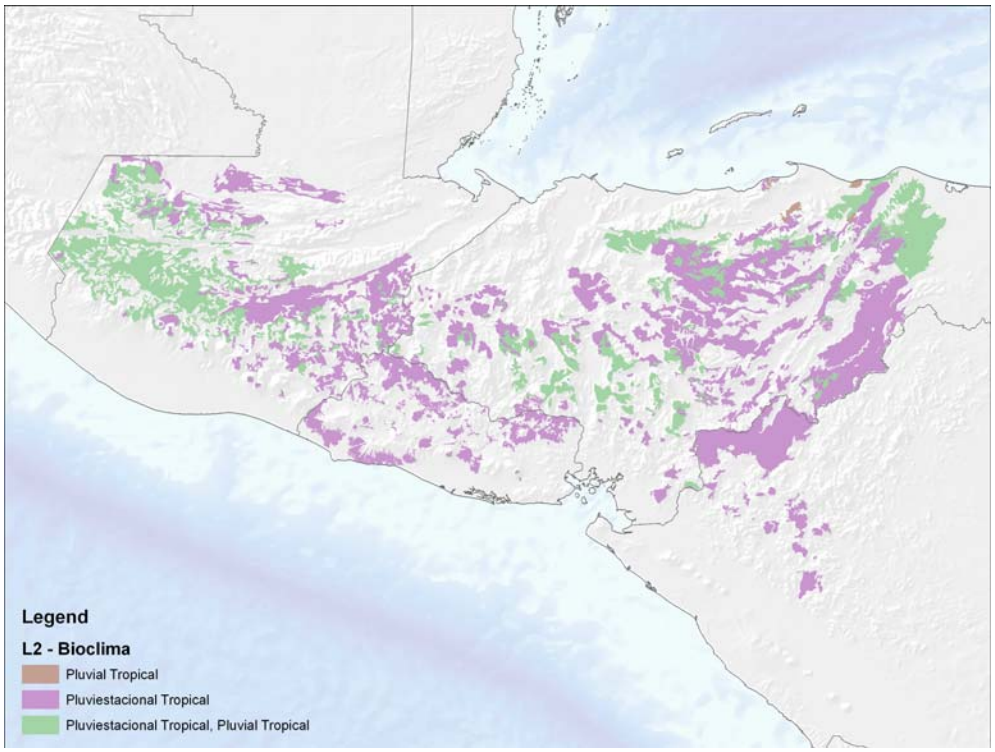
Level 1 of the ETN Terrestrial Standard Format



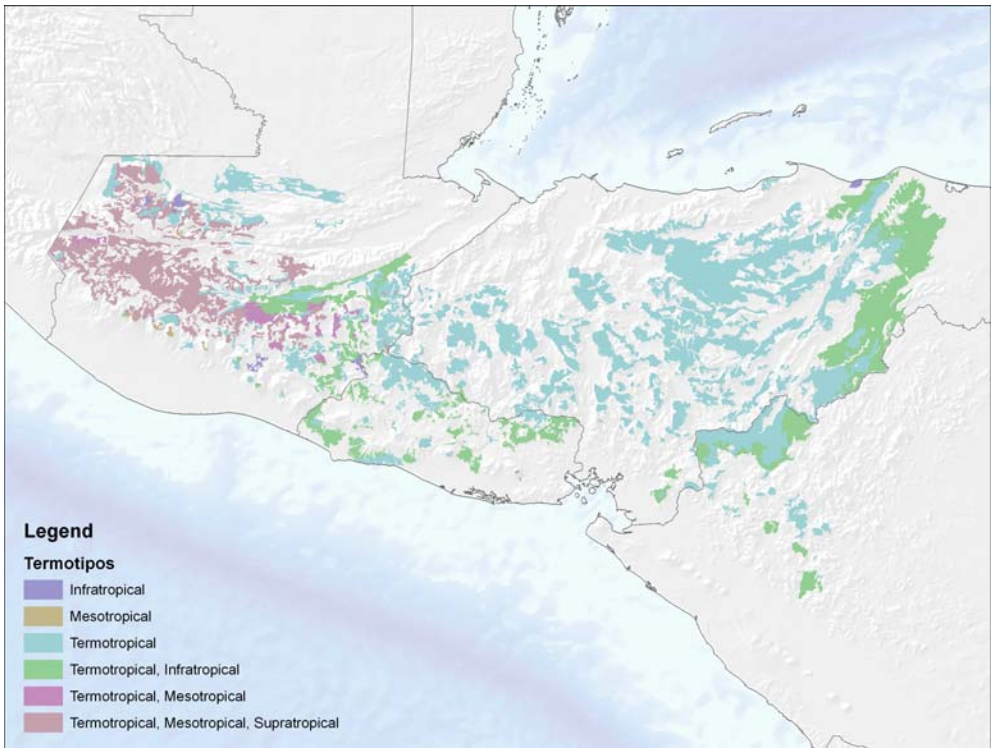
Level 2 of the ETN Terrestrial Standard Format



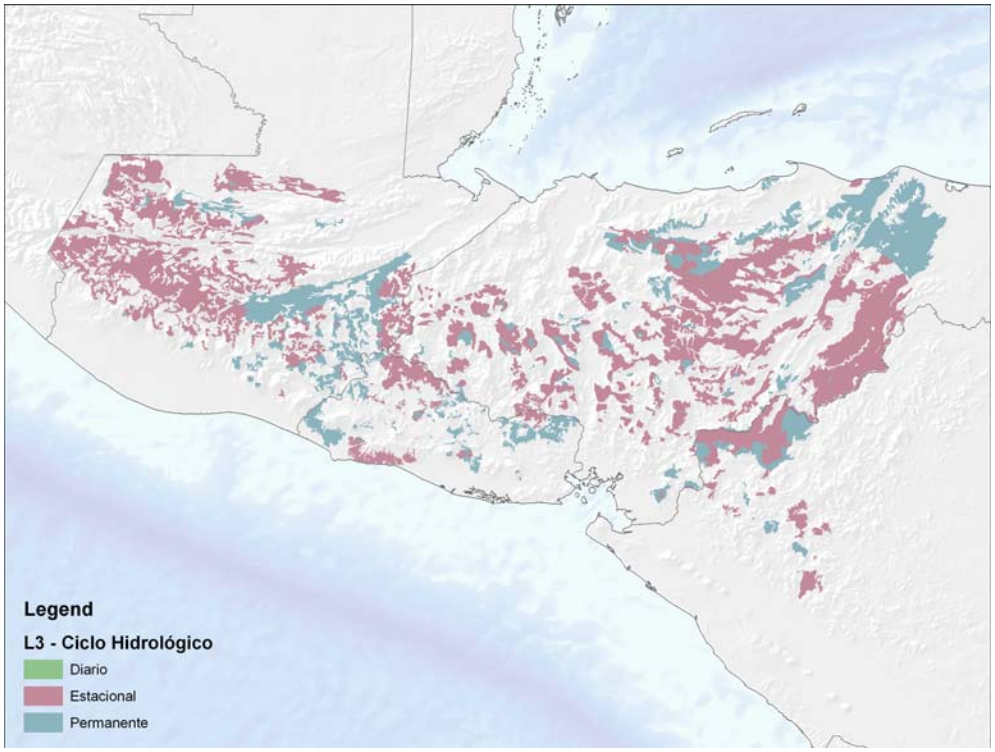
Level 3 of the ETN Terrestrial Standard Format



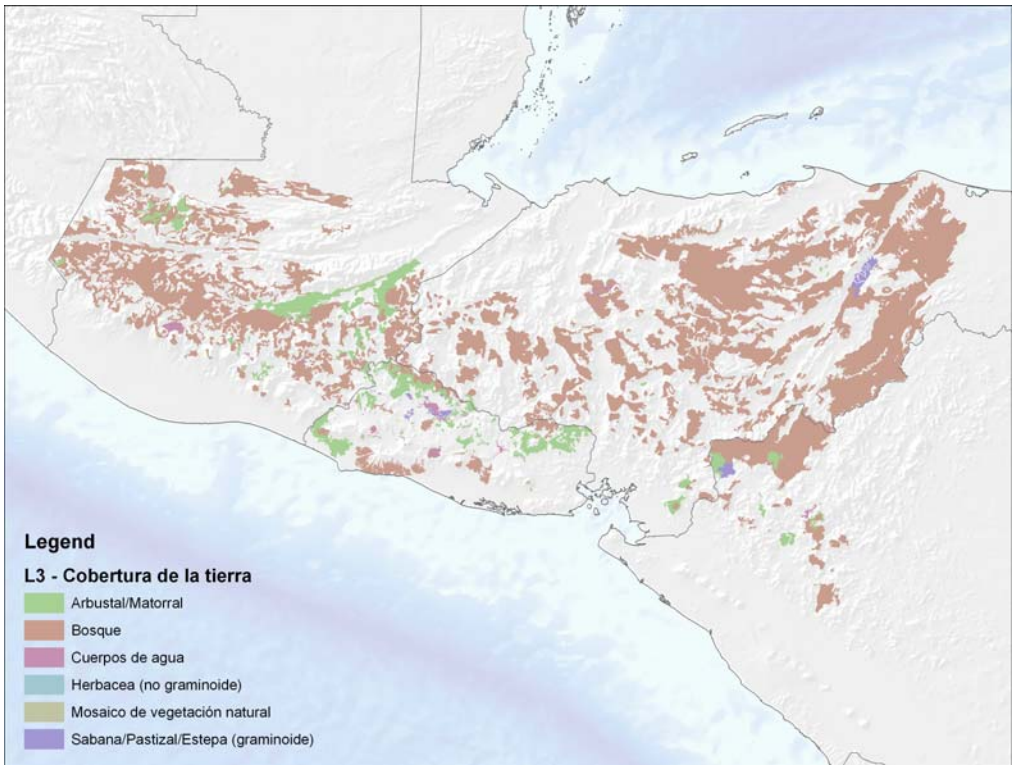
Level 2: Bioclima



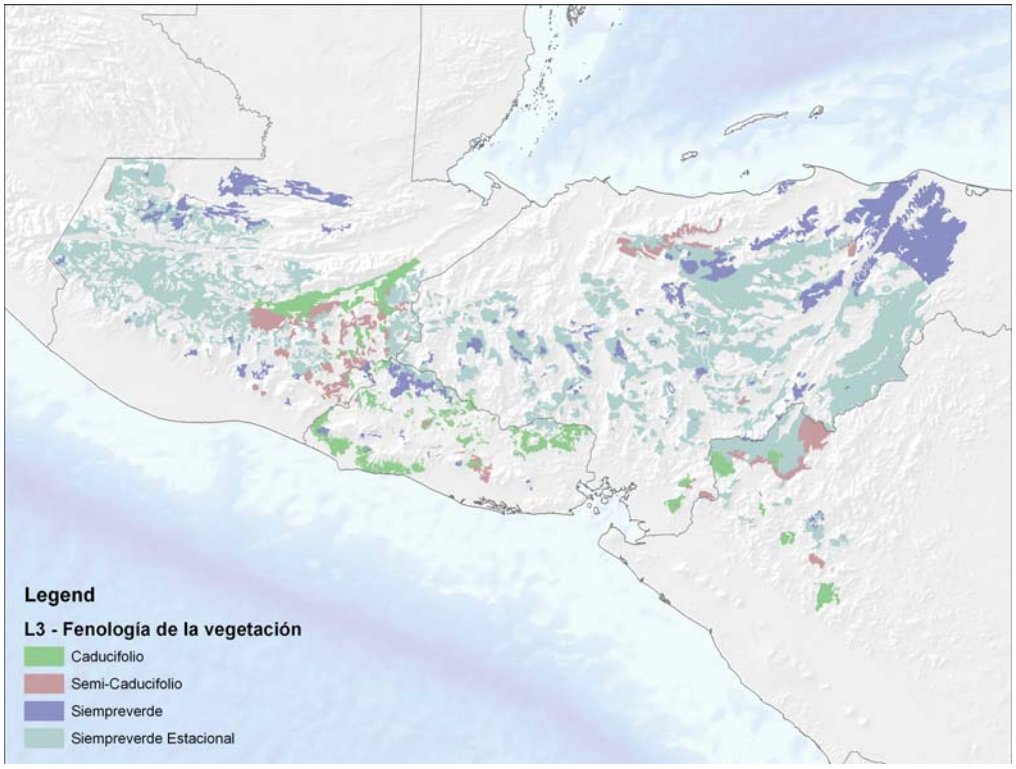
Level 2: Termotipos



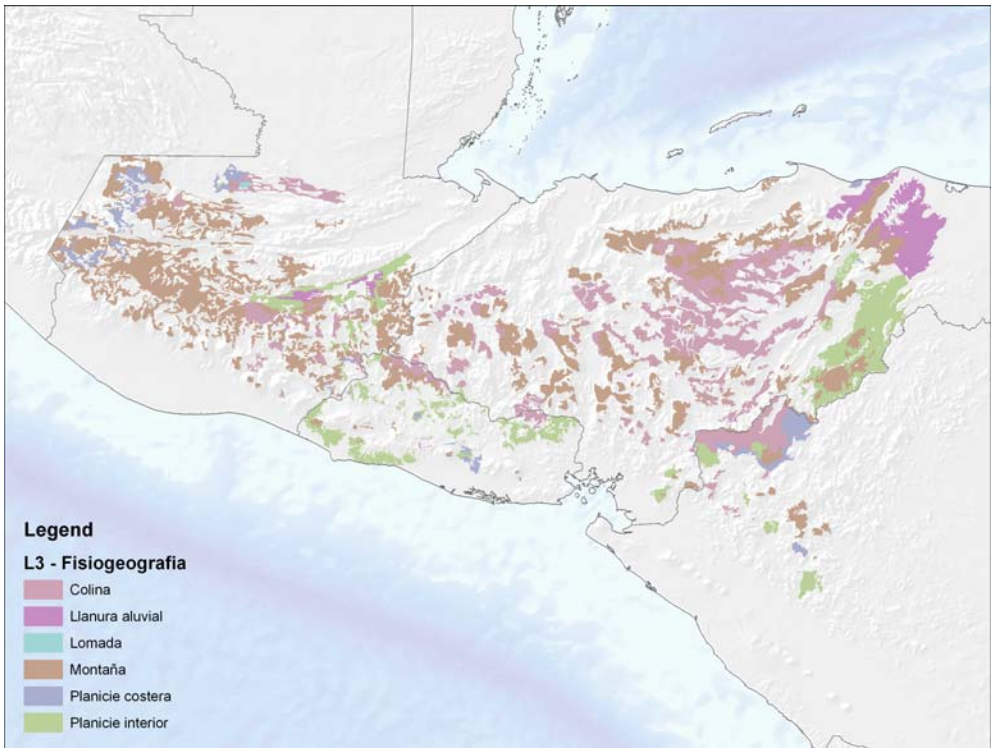
Level 3: Ciclo Hidrológico



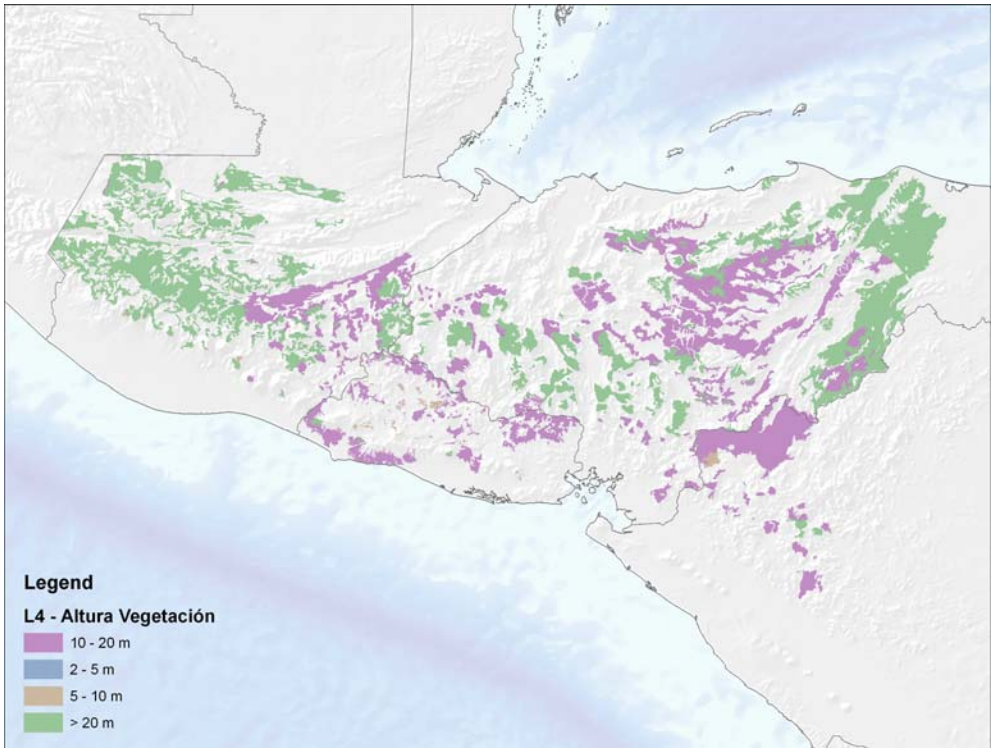
Level 3: Cobertura de la tierra



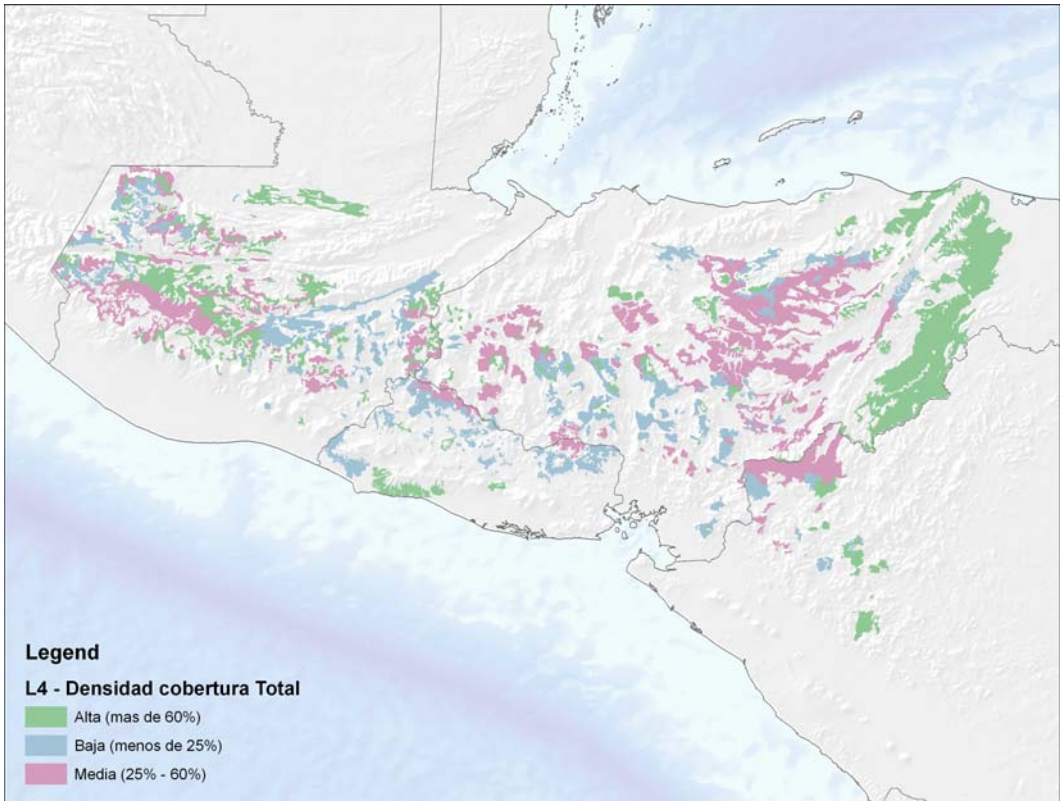
Level 3: Fenología de la vegetación



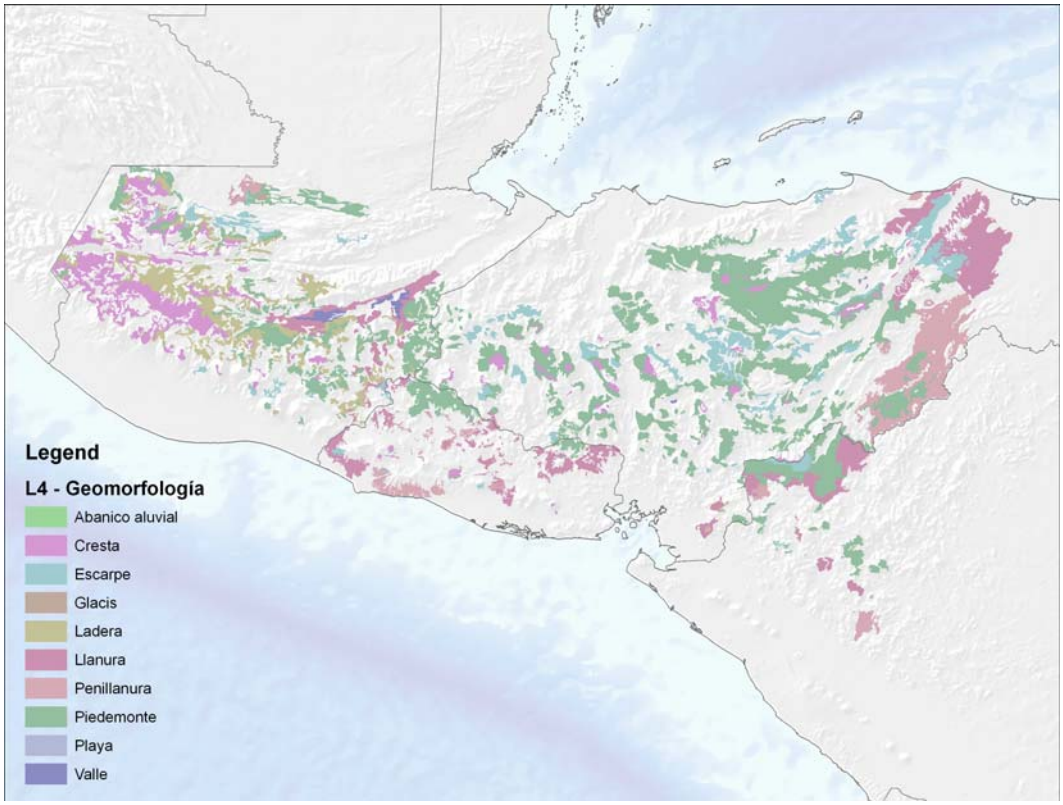
Level 3: Fisiogeografía



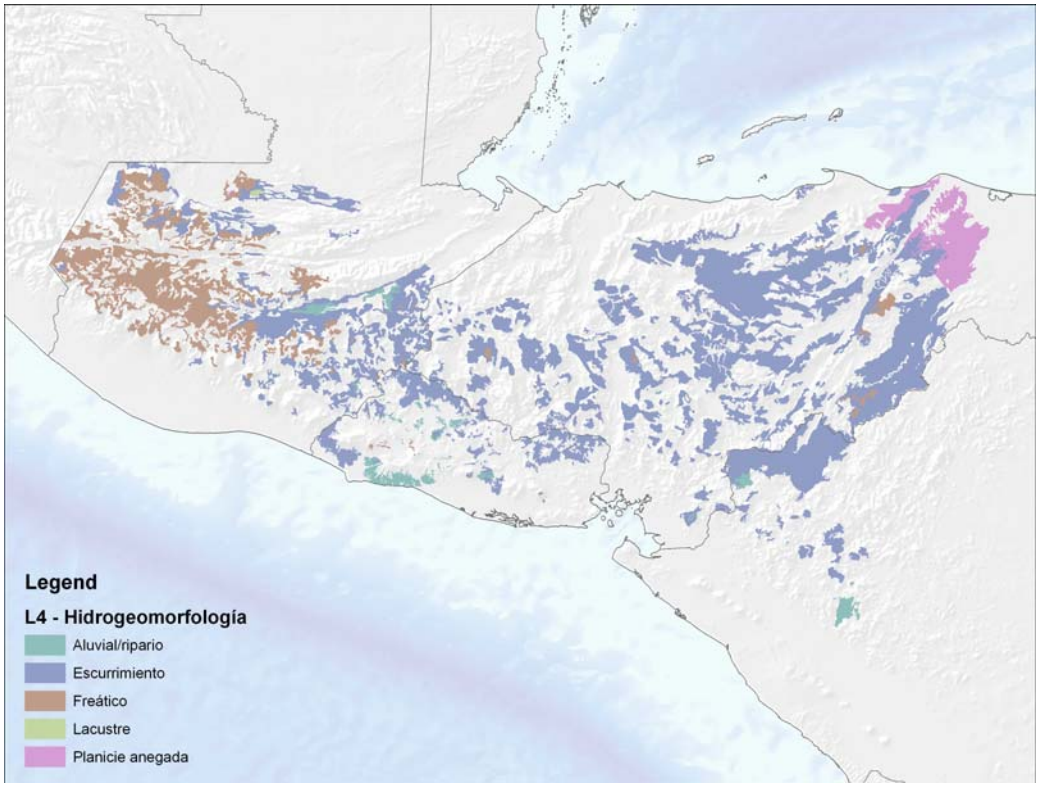
Level 4: Altura Vegetación



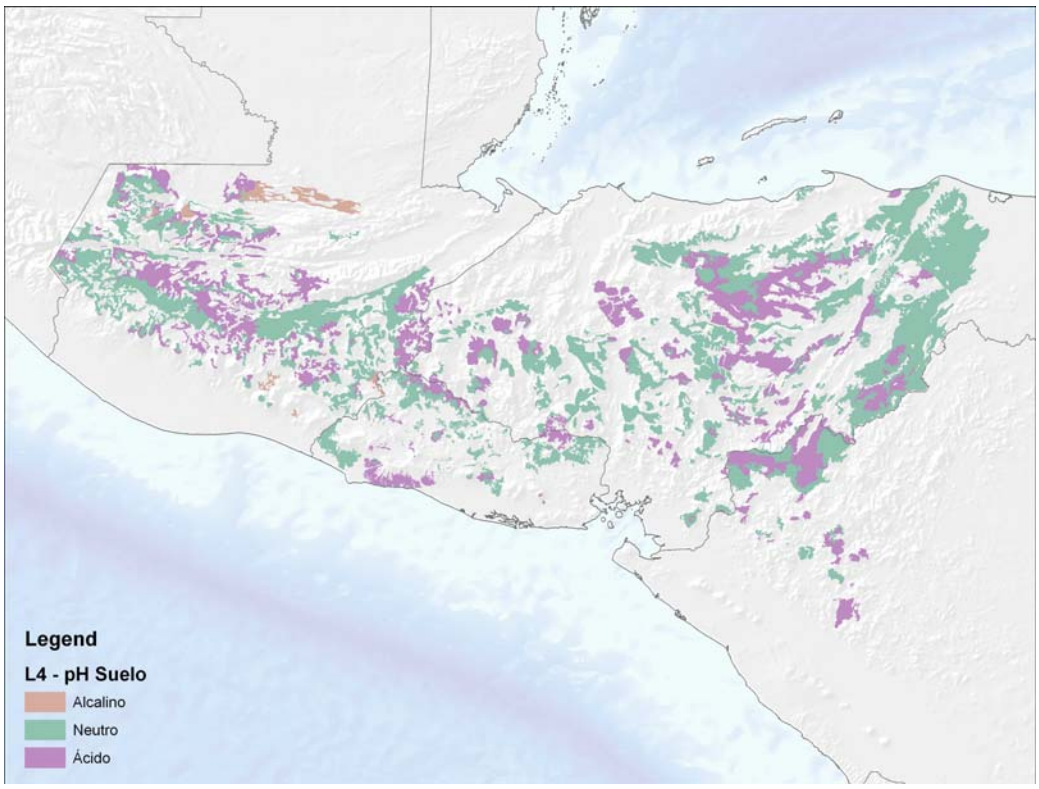
Level 4: Densidad cobertura Total



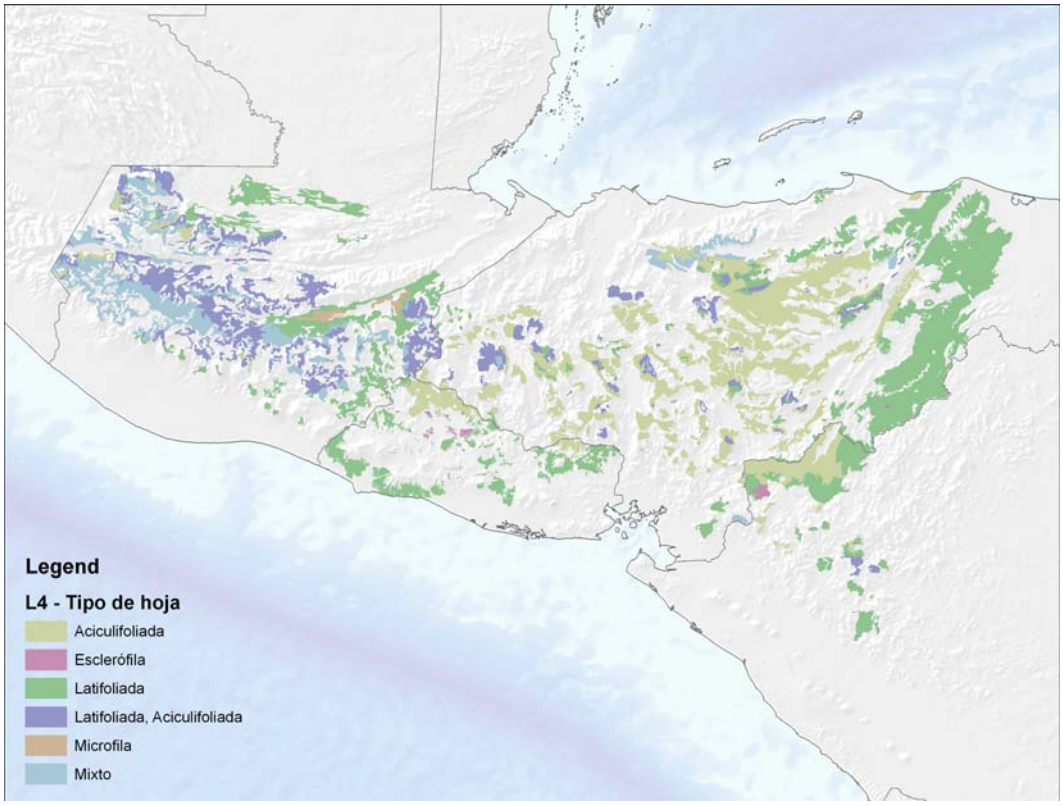
Level 4: Geomorfología



Level 4: Hidrogeomorfología



Level 4: pH Suelo



Level 4: Tipo de hoja

Appendix C: Crosswalk classification for the four levels of the standard format (see attached Excel spreadsheet)