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Ecosystem Functional Type Distribution Map for Mexico, 2001-2014

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Documentation Revision Date: 2019-09-10

Dataset Version: 1

Summary

This dataset provides a map of the distribution of ecosystem functional types (EFTs) at 0.05 degree resolution across Mexico for 2001 to 2014. EFTs are groupings of ecosystems based on their similar ecosystem functioning that are used to represent the spatial patterns and temporal variability of key ecosystem functional traits without prior knowledge of vegetation type or canopy architecture. Sixty-four EFTs were derived from the metrics of a 2001-2014 time-series of satellite images of the Enhanced Vegetation Index (EVI) from the Moderate Resolution Imaging Spectroradiometer (MODIS) product MOD13C2. EFT diversity was calculated as the modal (most repeated) EFT for each pixel.

Also provided are maps of the distributions of synthetic ecoregions (seven and 28 ecoregions) at 0.05 degree resolution that were derived using hierarchical K-means cluster partitioning of assembled and harmonized environmental data related to climate, topography, parent material, soil properties, ecosystem functional attributes, and ecosystem disturbances from across Mexico. Also included in this dataset are estimates of the spatial relationship (i.e., spatial representativeness) between actual and proposed environmental monitoring sites and ecosystem processes. A random forest model was used to estimate the suitability of proposed study sites and of the current distribution of MexFlux sites for adequately monitoring the dynamics of evapotranspiration (ET) and productivity (GPP) across Mexico. The proposed study sites were selected from the seven and 28 synthetic ecoregions.

There are 13 total data files in GeoTIFF (.tif) format: one file with the EFT for each pixel from 2001 to 2014 across Mexico, two files of the distribution of ecoregions, eight files for the representativeness of ET or GPP given the locations of proposed study sites, and two files for the representativeness of ET or GPP given the locations of current MexFlux sites.

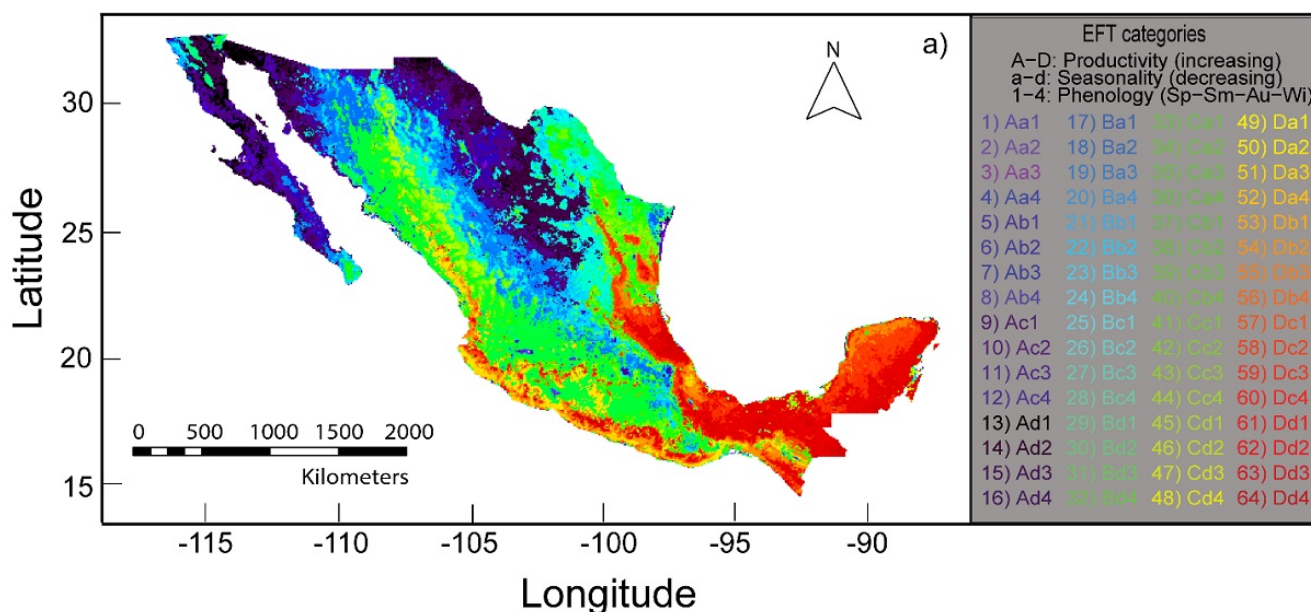


Figure 1. Spatial distribution of 64 ecosystem functional type (EFT) categories across Mexico. For each pixel, the dominant EFT is reported. The description of each EFT is described in Section 2. (Source file: EFT_diversity.tif)

Citation

Villarreal, S., D. Alcaraz-Segura, M. Guevara, and R. Vargas. 2019. Ecosystem Functional Type Distribution Map for Mexico, 2001-2014. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1693>

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1. Dataset Overview

This dataset provides a map of the distribution of ecosystem functional types (EFTs) at 0.05 degree resolution across Mexico for 2001 to 2014. EFTs are groupings of ecosystems based on their similar ecosystem functioning that are used to represent the spatial patterns and temporal variability of key ecosystem functional traits without prior knowledge of vegetation type or canopy architecture. Sixty-four EFTs were derived from the metrics of a 2001-2014 time-series of satellite images of the Enhanced Vegetation Index (EVI) from the Moderate Resolution Imaging Spectroradiometer (MODIS) product MOD13C2. EFT diversity was calculated as the modal (most repeated) EFT for each pixel.

Also provided are maps of the distributions of synthetic ecoregions (seven and 28 ecoregions) at 0.05 degree resolution that were derived using hierarchical K-means cluster partitioning of assembled and harmonized environmental data related to climate, topography, parent material, soil properties, ecosystem functional attributes, and ecosystem disturbances from across Mexico. Also included in this dataset are estimates of the spatial relationship (i.e., spatial representativeness) between actual and proposed environmental monitoring sites and ecosystem processes. A random forest model was used to estimate the suitability of proposed study sites and of the current distribution of MexFlux sites for adequately monitoring the dynamics of evapotranspiration (ET) and productivity (GPP) across Mexico. The proposed study sites were selected from the seven and 28 synthetic ecoregions.

Project: [Carbon Monitoring System \(CMS\)](#)

The NASA Carbon Monitoring System (CMS) is designed to make significant contributions in characterizing, quantifying, understanding, and predicting the evolution of global carbon sources and sinks through improved monitoring of carbon stocks and fluxes. The System will use the full range of NASA satellite observations and modeling/analysis capabilities to establish the accuracy, quantitative uncertainties, and utility of products for supporting national and international policy, regulatory, and management activities. CMS will maintain a global emphasis while providing finer scale regional information, utilizing space-based and surface-based data and will rapidly initiate generation and distribution of products both for user evaluation and to inform near-term policy development and planning.

Related Publication:

Villarreal, S., Guevara, M., Alcaraz-Segura, D. and Vargas, R., 2019. Optimizing an environmental observatory network design using publicly available data. *Journal of Geophysical Research: Biogeosciences*. <https://doi.org/10.1029/2018JG004714>

Related Dataset:

Villarreal, S., R. Vargas, and D. Alcaraz-Segura. 2019. Ecosystem Functional Type Distribution Map for the Conterminous USA, 2001-2014. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1659>

Acknowledgments:

This work was funded by NASA CMS grant 80NSSC18K0173, NASA GEOBON grant 80NSSC18K0446, and ECOPotential H2020 grant 641762.

2. Data Characteristics

Spatial Coverage: Mexico

Spatial Resolution: 0.05 degrees

Temporal Coverage: 2001 - 2014

Temporal Resolution: annual

Study Area: (all latitudes and longitudes given in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Mexico	-118.4	-86	33	14

Data File Information: There are 13 total data files in GeoTIFF (.tif) format:

File Name	Description
EFT_diversity.tif	EFT diversity map, which corresponds to the mode of EFT categories for each pixel from 2001 to 2014 across Mexico
ecoregion_7clusters.tif	map of 7 ecoregions resulting from a K-means analysis
ecoregion_28clusters.tif	map of 28 ecoregions resulting from a K-means analysis
ET_representativeness_7sites.tif	evapotranspiration representativeness of 1 site selected for each of the 7 ecoregions
ET_representativeness_14sites.tif	evapotranspiration representativeness of 2 sites selected for each of the 7 ecoregions
ET_representativeness_28sites.tif	evapotranspiration representativeness of 1 site selected for each of the 28 ecoregions
ET_representativeness_84sites.tif	evapotranspiration representativeness of 3 sites selected for each of the 28 ecoregions
ET_representativeness_MexFlux.tif	evapotranspiration representativeness of sites affiliated with the MexFlux network
GPP_representativeness_7sites.tif	gross primary productivity representativeness of 1 site selected for each of the 7 ecoregions
GPP_representativeness_14sites.tif	gross primary productivity representativeness of 2 sites selected for each of the 7 ecoregions

GPP_representativeness_28sites.tif	gross primary productivity representativeness of 1 site selected for each of the 28 ecoregions
GPP_representativeness_84sites.tif	gross primary productivity representativeness of 3 sites selected for each of the 28 ecoregions
GPP_representativeness_MexFlux.tif	gross primary productivity representativeness of sites affiliated with the MexFlux network

Data File Details

For all GeoTIFF files, the data are categorical, the projection is EPSG 4326, and there is one band.

No data values

No data is represented by **0** for the files *EFT_diversity.tif*, *ecoregion_7clusters.tif*, and *ecoregion_28clusters.tif*.

No data is represented by **255** in all other files.

File Name	Value Range	Details
EFT_diversity.tif	1-64	category of EFT at a pixel (categories defined below)
ecoregion_7clusters.tif	1-7	category of 7 general ecoregions (no category definitions)
ecoregion_28clusters.tif	1-28	category of 28 sub-ecoregions, derived from the 7 ecoregions of <i>ecoregion_7clusters.tif</i> (no category definitions)
XXX _representativeness_#sites.tif	0-1	if ET of GPP is likely represented by the given number of sites, the pixel value will be 1
XXX _representativeness_MexFlux.tif	0-1	if ET of GPP is likely represented by the MexFlux network, the pixel value will be 1

EFT Category Definitions

The file *EFT_diversity.tif* has 64 categories of EFTs. The EFTs are described as follows:

A-D: primary productivity (ascending order)

a-d: seasonality (descending order)

1-4: phenology (spring, summer, autumn, winter)

- Capital letters correspond to the Enhanced Vegetation Index (EVI) annual mean level, ranging from A to D for low to high productivity.
- Lowercase letters show the seasonal coefficient of variation, ranging from a to d for high to low seasonality for carbon uptake.
- Numbers indicate the season of maximum EVI: (1) spring, (2) summer, (3) autumn, (4) winter.

EFT category in <i>EFT_diversity.tif</i>	EFT description
1	Aa1
2	Aa2
3	Aa3
4	Aa4
5	Ab1
6	Ab2
7	Ab3
8	Ab4
9	Ac1
10	Ac2
11	Ac3
12	Ac4
13	Ad1
14	Ad2
15	Ad3
16	Ad4
17	Ba1
18	Ba2
19	Ba3
20	Ba4
21	Bb1
22	Bb2
23	Bb3

24	Bb4
25	Bc1
26	Bc2
27	Bc3
28	Bc4
29	Bd1
30	Bd2
31	Bd3
32	Bd4
33	Ca1
34	Ca2
35	Ca3
36	Ca4
37	Cb1
38	Cb2
39	Cb3
40	Cb4
41	Cc1
42	Cc2
43	Cc3
44	Cc4
45	Cd1
46	Cd2
47	Cd3
48	Cd4
49	Da1
50	Da2
51	Da3
52	Da4
53	Db1
54	Db2
55	Db3
56	Db4
57	Dc1
58	Dc2
59	Dc3
60	Dc4
61	Dd1
62	Dd2
63	Dd3
64	Dd4

3. Application and Derivation

Environmental observatory networks (EONs), like AmeriFLUX and NEON, are organizations that observe environmental factors across multiple study sites. The effectiveness of EON observations to represent the spatial heterogeneity of environmental factors across study sites must be assessed to inform network design. There is a need to optimize resources for large-scale environmental monitoring efforts, especially in developing countries.

These data can be used to identify potential sampling locations or study sites that could maximize the representativeness of an EON to capture targeted ecosystem processes (i.e., carbon and water fluxes) at the national-level.

4. Quality Assessment

Data quality was not specifically assessed.

5. Data Access, Materials, and Methods

Ecosystem Functional Types

Ecosystem functional types (EFTs) are groupings of ecosystems based on their similar ecosystem functioning that are used to represent the spatial patterns and temporal variability of key ecosystem functional traits (e.g., primary productivity, seasonality, phenology of carbon gains). In practice, EFTs are a yearly varying land surface classification based on satellite-derived key ecosystem functional attributes. EFTs were derived from 2001 - 2014 time-series of satellite images of the Enhanced Vegetation Index (EVI, a surrogate of carbon gain dynamics) from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) product MOD13C2 with a spatial resolution of $0.05^\circ \times 0.05^\circ$ across Mexico. Specifically, EFTs were derived from three metrics of the EVI seasonal curve related to the dynamics of terrestrial carbon gains: (1) annual mean as an estimate of primary production; (2) EVI seasonal coefficient of variation as a descriptor of seasonality; and (3) the month of the annual maximum EVI value as an indicator of phenology. The range of values of each EVI metric was divided into four intervals, giving a potential number of 64 EFT categories, and each category is a summary of the information contained in the three EVI metrics for each $0.05^\circ \times 0.05^\circ$ grid pixel. Ecosystem functional type diversity (EFTmode) was calculated as the modal (most repeated) EFT within each pixel throughout the 14-year period.

Ecoregions

To identify ecoregions (i.e., Ecologically Similar Areas) from which to select potential study sites, hierarchical K-means cluster partitioning of assembled and harmonized environmental data related to climate, topography, parent material, soil properties, ecosystem functional attributes, and ecosystem disturbances from across Mexico was used to identify seven ecoregion clusters and 28 ecoregion clusters. The conditioned Latin Hypercube sampling technique was used to choose locations of potential flux sites given the following: a) one site for each of seven ecoregions; b) one site for each of 28 ecoregions; c) two sites for each of 7 ecoregions; and d) three sites for each of 28 ecoregions.

Representativeness

To assess the spatial functional heterogeneity (i.e., spatial representativeness) of proposed study sites and of the current distribution of MexFlux sites for adequately monitoring the dynamics of evapotranspiration (ET) and productivity (GPP) across Mexico, a random forest model was used. In particular, ET and GPP were represented by their annual mean (ET_mean, GPP_mean) and annual coefficient of variation (ET_cv, GPP_cv), as these metrics are known to capture most of the variability of the seasonal dynamics in a time-series of vegetation indexes derived from satellite information.

See the related publication Villarreal et al. (2019) for more information.

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

[Ecosystem Functional Type Distribution Map for Mexico, 2001-2014](#)

Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
- Telephone: +1 (865) 241-3952

7. References

Villarreal, S., Guevara, M., Alcaraz-Segura, D. and Vargas, R., 2019. Optimizing an environmental observatory network design using publicly available data. *Journal of Geophysical Research: Biogeosciences*. <https://doi.org/10.1029/2018JG004714>



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