Identification\_Information:

Citation:

Citation\_Information:

Originator:

Canada Centre for Remote Sensing (CCRS)/Canada Centre for Mapping and Earth Observation (CCMEO), Natural Resources Canada (NRCan)

Originator: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO)

Originator: Comisión Nacional Forestal (CONAFOR)

Originator: Instituto Nacional de Estadística y Geografía (INEGI)

Originator: U.S. Geological Survey (USGS)

Publication\_Date: 2024

Title: 2020 Land Cover of North America at 30 meters

Edition: 2.0

Geospatial\_Data\_Presentation\_Form: Raster digital data

Publication\_Information:

Publication\_Place: Ottawa, Ontario, Canada

Publisher: CCRS/CCMEO/NRCan

Publication\_Information:

Publication\_Place: Sioux Falls, South Dakota, USA

Publisher: U.S. Geological Survey

Publication\_Information:

Publication\_Place: Mexico City, México

Publisher: CONABIO

Publication\_Information:

Publication\_Place: San Juan de Ocotán, Jalisco, México

Publisher: CONAFOR

Publication\_Information:

Publication\_Place: Aguascalientes, México

Publisher: INEGI

Publication\_Information:

Publication\_Place: Montréal, Québec, Canada

Publisher: Commission for Environmental Cooperation

Online\_Linkage: <http://www.cec.org/nalcms>

Description:

Abstract:

The 2020 North American Land Cover 30-meter dataset was produced as part of the North American Land Change Monitoring

System (NALCMS), a trilateral effort between Natural Resources Canada, the United States Geological Survey, and three Mexican

organizations including the National Institute of Statistics and Geography (Instituto Nacional de Estadística y Geografía),

National Commission for the Knowledge and Use of the Biodiversity (Comisión Nacional Para el Conocimiento y Uso de la

Biodiversidad), and the National Forestry Commission of Mexico (Comisión Nacional Forestal). The collaboration is facilitated

by the Commission for Environmental Cooperation, an international organization created by the Canada, Mexico, and United States

governments under the North American Agreement on Environmental Cooperation to promote environmental collaboration between the

three countries.

The general objective of NALCMS is to devise, through collective effort, a harmonized multi-scale land cover monitoring

approach which ensures high accuracy and consistency in monitoring land cover changes at the North American scale and

which meets each country’s specific requirements.

This 30-meter dataset of North American Land Cover reflects land cover information for 2020 from Mexico and Canada, and 2021 over the conterminous United States and Alaska. Each country developed its own classification method to identify Land Cover classes and then provided an input layer to produce a continental Land Cover map across North America. Canada, Mexico, and the United States developed their own 30-meter land cover products; see specific sections on data generation below.

The main inputs for image classification were 30-meter Landsat 8 Collection 2 Level 1 data in the three countries (Canada, the United States and Mexico). Image selection processes and reduction to specific spectral bands varied among the countries due to study-site-specific requirements. While Canada selected most images from the year 2020 with a few from 2019 and 2021, the Conterminous United States and Alaska employed mainly images from 2021. The land cover map for Mexico was based on land cover change detection between 2015 and 2020 Mexico Landsat 8 mosaics.

In order to generate a seamless and consistent land cover map of North America, national maps were generated for Canada by

the CCRS; for Mexico by CONABIO, INEGI, and CONAFOR; and for the United States by the USGS. Each country chose their own

approaches, ancillary data, and land cover mapping methodologies to create national datasets. This North America dataset

was produced by combining the national land cover datasets. The integration of the three national products merged four

Land Cover map sections, Alaska, Canada, the conterminous United States and Mexico.

The current version of the North American land cover map (version 2) integrates updated land cover information for the Conterminous

United States, Alaska, and Canada, based on updated national maps provided in February 2024 by the United States Geological Survey

(USGS). Unlike version 1, where the Conterminous United States represented land cover data for 2019, the current version

corresponds to the year 2021. The Canada Centre for Remote Sensing (CCRS) also provided a new land cover map in February 2024.

According to CCRS, the latest update in the land cover time series includes enhancements in mapping mining regions. High-resolution

data, along with supplementary information, was used to verify and improve accuracy in these mining areas and to make minor

adjustments in certain urban locations. These corrections were necessary because some parts of mining regions had been

misclassified as barren land or low vegetation.

At the North American level, the minimum mapping unit remains 5 pixels for all classes in version 2. However, this new version

includes Class 0 (background), which allows pixel patches smaller than 5 pixels that are surrounded by Class 0 to be reclassified

as background. This adjustment helps eliminate isolated pixels or small patches in the sea area that remained after the removal of

the water buffer present in Canada, the Conterminous United States and Alaska. Additionally, this change enables Class 0 to extend

along the coastline when small pixel patches are not primarily bordered by other land class values.

Purpose:

Information on land cover across North America provided by this dataset is valuable for a range of audiences, including

international organizations such as the United Nations Environment Programme, nongovernmental conservation organizations,

land managers, and scientific researchers. The continental scale land cover data generated under NALCMS can be used to

address issues such as climate change, carbon sequestration, biodiversity loss, and changes in ecosystem structure and

function, by helping users to better understand the dynamics and continental-scale patterns of North America’s changing

environment.

The North American Environmental Atlas data are intended for geographic display and analysis at the national and

continental level. These 30-meter land cover data should be displayed and analyzed at scales appropriate

for 1:100,000-scale data. No responsibility is assumed by Natural Resources Canada, Comisión Nacional para el

Conocimiento y Uso de la Biodiversidad, Comisión Nacional Forestal, Instituto Nacional de Estadística y Geografía,

the U.S. Geological Survey, or the Commission for Environmental Cooperation in the use of these data.

Supplemental\_Information:

Natural Resources Canada has North American Land Cover information available online at

<https://open.canada.ca/data/en/dataset/ee1580ab-a23d-4f86-a09b-79763677eb47>

The National Commission for the Knowledge and Use of Biodiversity has North American Land Cover information available online

at <https://www.biodiversidad.gob.mx/monitoreo/cobertura-suelo>

The U.S. Geological Survey has North American Land Cover information available online at [www.mrlc.gov](http://www.mrlc.gov)

The following list describes the display of land cover classification in the .tif file:

Value 1, Temperate or sub-polar needleleaf forest, RGB 0 61 0;

Value 2, Sub-polar taiga needleleaf forest, RGB 148 156 112;

Value 3, Tropical or sub-tropical broadleaf evergreen forest, RGB 0 99 0;

Value 4, Tropical or sub-tropical broadleaf deciduous forest, RGB 30 171 5;

Value 5, Temperate or sub-polar broadleaf deciduous forest, RGB 20 140 61;

Value 6, Mixed Forest, RGB 92 117 43;

Value 7, Tropical or sub-tropical shrubland, RGB 179 158 43;

Value 8, Temperate or sub-polar shrubland, RGB 179 138 51;

Value 9, Tropical or sub-tropical grassland, RGB 232 220 94;

Value 10, Temperate or sub-polar grassland, RGB 225 207 138;

Value 11, Sub-polar or polar shrubland-lichen-moss, RGB 156 117 84;

Value 12, Sub-polar or polar grassland-lichen-moss, RGB 186 212 143;

Value 13, Sub-polar or polar barren-lichen-moss, RGB 64 138 112;

Value 14, Wetland, RGB 107 163 138;

Value 15, Cropland, RGB 230 174 102;

Value 16, Barren lands, RGB 168 171 174;

Value 17, Urban, RGB 220 33 38;

Value 18, Water, RGB 76 112 163;

Value 19, Snow and Ice, RGB 255 250 255.

Bounding box coordinates are included below. However, given the coverage of the data, users may find that corner coordinates are

more useful. The corner coordinates for the continental North America data are: Upper left, Lat 52.76, Long 166.11 E; Upper right,

Lat 61.65, Long -11.99; Lower left, Lat 6.04, Long -138.81; Lower right, Lat 9.56, Long -70.26.

The Commission for Environmental Cooperation (CEC) is an international organization created by Canada, Mexico, and the United

States of America under the North American Agreement on Environmental Cooperation (NAAEC), which came into force at the same time

as the North American Free Trade Agreement (NAFTA). The CEC was established to address regional environmental concerns, help

prevent potential trade and environmental conflicts, and to promote the effective enforcement of environmental law. As of 2020,the

CEC operates in accordance with the Environmental Cooperation Agreement, which entered into force at the same time as the CUSMA/T-

MEC/USMCA trade agreement.

Further information on the CEC is available from

<http://www.cec.org/> or from

Commission for Environmental Cooperation.

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The following references provide additional information on processing methodologies and may be referenced in the

process steps, below.

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Volume 118:83-94.

Time\_Period\_of\_Content:

Time\_Period\_Information:

Range\_of\_Dates/Times:

Beginning\_Date: 2019

Ending\_Date: 2021

Currentness\_Reference: Ground condition

Status:

Progress: Complete

Maintenance\_and\_Update\_Frequency: As needed

Spatial\_Domain:

Bounding\_Coordinates:

West\_Bounding\_Coordinate: 175

East\_Bounding\_Coordinate: -50

North\_Bounding\_Coordinate: 84

South\_Bounding\_Coordinate: 14

Keywords:

Theme:

Theme\_Keyword\_Thesaurus: GCMD Science keywords

Theme\_Keyword: Land Surface > Land Use/Land Cover > Land Cover

Theme\_Keyword: Land Surface > Surface Radiative Properties > Reflectance

Theme:

Theme\_Keyword\_Thesaurus: ISO 19115 Topic Category

Theme\_Keyword: imageryBaseMapsEarthCover

Theme:

Theme\_Keyword\_Thesaurus: None

Theme\_Keyword: Remote sensing

Theme\_Keyword: Land cover

Theme\_Keyword: Landsat

Theme\_Keyword: Reflectance

Place:

Place\_Keyword\_Thesaurus: None

Place\_Keyword: Mid-latitude

Place\_Keyword: Western Hemisphere

Place\_Keyword: Northern Hemisphere

Place\_Keyword: North America

Place\_Keyword: NAFTA

Place\_Keyword: North America Free Trade Agreement

Place\_Keyword: Canada

Place\_Keyword: Mexico

Place\_Keyword: United States

Access\_Constraints: None.

Use\_Constraints:

None. Acknowledgement of Natural Resources Canada, Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Comisión Nacional Forestal, Instituto Nacional de Estadística y Geografía, and the U.S. Geological Survey is required in products derived from these data.

Acknowledgement of the Commission for Environmental Cooperation would be appreciated in products derived from these data.

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Contact\_Organization\_Primary:

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Contact\_Organization: Comisión Nacional Forestal

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State\_or\_Province: Jalisco

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Contact\_Organization\_Primary:

Contact\_Organization: Instituto Nacional de Estadística y Geografía (INEGI)

Contact\_Position: Director of Natural Resources and Environment Information

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State\_or\_Province: Aguascalientes

Postal\_Code: 20270

Country: Mexico

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Point\_of\_Contact:

Contact\_Information:

Contact\_Organization\_Primary:

Contact\_Organization: U.S. Geological Survey

Contact\_Person: Jon Dewitz

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Address\_Type: Mailing and physical address

Address: U.S. Geological Survey, CORE SCIENCE SYSTEMS

Address: 47914 252nd Street

City: Sioux Falls

State\_or\_Province: South Dakota

Postal\_Code: 57198

Country: USA

Contact\_Voice\_Telephone: 1 605 594 2715

Contact\_Electronic\_Mail\_Address: [dewitz@usgs.gov](mailto:dewitz@usgs.gov)

Data\_Quality\_Information:

Attribute\_Accuracy:

Attribute\_Accuracy\_Report:

Alaska:

For Alaska, data were obtained from a stratified random sample of 103 pixels. The procedure was similar to that used for the conterminous United States, and again, agreement was defined as a match between the map label and either the primary or alternate reference label. Strata were defined based on the single-pixel mmu product, but accuracy is for the 5 mmu product. Because of the inherent difficulty in determining accuracy in this remote region, this 2001 accuracy assessment is the only assessment available. All published maps since this are based on this 2001 map with change added and updated. through spectral analysis.

<https://doi.org/10.1016/j.rse.2011.01.020>

Conterminous United States:

NLCD 2021 adds an additional year to the map products produced for NLCD 2019, with a streamlined compositing process for assembling and preprocessing Landsat imagery and geospatial ancillary datasets; a temporally, spectrally, and spatially integrated land cover change analysis strategy; a theme-based post-classification protocol for generating land cover and change products; a continuous fields biophysical parameters modeling method; and a scripted operational system. The overall accuracy of the 2019 Level I land cover was 91%. Results from this study confirm the robustness of this comprehensive and highly automated procedure for NLCD 2021 operational mapping. A formal accuracy assessment has not been conducted for NLCD 2021 Land Cover, NLCD 2021 Land Cover Change, or NLCD 2021 Impervious Surface products. A 2019 accuracy assessment publication can be found here: James Wickham, Stephen V. Stehman, Daniel G. Sorenson, Leila Gass & Jon A. Dewitz (2023) Thematic accuracy assessment of the NLCD 2019 land cover for the conterminous United States, GIScience & Remote Sensing, 60:1, DOI: <https://doi.org/10.1080/15481603.2023.2181143>

Attribute\_Accuracy\_Value: Conterminous United States

Attribute\_Accuracy\_Value: 91.0%

Canada:

The land cover dataset for Canada is produced using observation from Operational Land Imager (OLI) Landsat sensor. An accuracy assessment based on 832 randomly distributed samples shows that land cover data produced with this new approach has achieved 86.9% accuracy with no marked spatial disparities.

Attribute\_Accuracy\_Value: Canada

Attribute\_Accuracy\_Value: 86.9%

Mexico:

No accuracy assessment has been performed by the time this map is being published.

Logical\_Consistency\_Report: No tests for logical consistency have been performed on this dataset.

Completeness\_Report: Data completeness reflects the content of the original Landsat data for Canada, the United States and Mexico.

Lineage:

Source\_Information:

Source\_Citation:

Citation\_Information:

Originator: Canada Centre for Remote Sensing/Canada Centre for Mapping and Earth Observation, Natural Resources Canada

Publication\_Date: 2022

Title: Dataset Landsat Mosaic of Canada 2019-2021

Geospatial\_Data\_Presentation\_Form: Raster digital data assembled from 30m Landsat images

Other\_Citation\_Details: The data were assembled from all available 2019-2021 reasonably cloud-free 30-meter Landsat images

Type\_of\_Source\_Media: Internal file

Source\_Time\_Period\_of\_Content:

Time\_Period\_Information:

Range\_of\_Dates/Times:

Beginning\_Date: 2019

Ending\_Date: 2021

Source\_Currentness\_Reference: Processing dates

Source\_Citation\_Abbreviation: Dataset Landsat Mosaic of Canada 2019-2021

Source\_Contribution: Spatial and attribute information

Source\_Information:

Source\_Citation:

Citation\_Information:

Originator: National Commission for the Knowledge and Use of Biodiversity (CONABIO)

Publication\_Date: 2023

Title: Cobertura del suelo de México a 30 m, 2020, version 1.0

Geospatial\_Data\_Presentation\_Form: Raster digital data assembled from 30m Landsat images

Type\_of\_Source\_Media: Internal file

Source\_Time\_Period\_of\_Content:

Time\_Period\_Information:

Single\_Date/Time:

Calendar\_Date: 2020

Source\_Currentness\_Reference: Processing date

Source\_Citation\_Abbreviation: Mexico land cover map 2020, v1.0

Source\_Contribution: Spatial and attribute information

Source\_Information:

Source\_Citation:

Citation\_Information:

Originator: Instituto Nacional de Estadística y Geografía, INEGI

Publication\_Date: 2020

Title: Red Nacional de Caminos 2020 (National Roads Network 2020)

Geospatial\_Data\_Presentation\_Form: Vector digital data

Online\_Linkage: <https://www.inegi.org.mx/app/biblioteca/ficha.html?upc=889463807452>

Type\_of\_Source\_Media: Online

Source\_Time\_Period\_of\_Content:

Time\_Period\_Information:

Single\_Date/Time:

Calendar\_Date: 2020

Source\_Currentness\_Reference: Publication date

Source\_Citation\_Abbreviation: INEGI 2020

Source\_Contribution: Spatial and attribute information

Source\_Information:

Source\_Citation:

Citation\_Information:

Originator: Canada Centre for Remote Sensing (CCRS)/Canada Centre for Mapping and Earth Observation (CCMEO), Natural Resources

Canada (NRCan)

Originator: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO)

Originator: Comisión Nacional Forestal (CONAFOR)

Originator: Instituto Nacional de Estadística y Geografía (INEGI)

Originator: U.S. Geological Survey (USGS)

Publication\_Date: 2024

Title: 2020 Land Cover of North America at 30 meters

Edition: 2.0

Geospatial\_Data\_Presentation\_Form: Raster digital data

Publication\_Information:

Publication\_Place: Ottawa, Ontario, Canada

Publisher: Canada Centre for Remote Sensing (CCRS)/Canada Centre for Mapping and Earth Observation (CCMEO), Natural Resources

Canada (NRCan)

Publication\_Information:

Publication\_Place: Sioux Falls, South Dakota, USA

Publisher: U.S. Geological Survey

Publication\_Information:

Publication\_Place: Mexico City, México

Publisher: CONABIO

Publication\_Information:

Publication\_Place: San Juan de Ocotán, Jalisco, México

Publisher: CONAFOR

Publication\_Information:

Publication\_Place: Aguascalientes, México

Publisher: INEGI

Publication\_Information:

Publication\_Place: Montréal, Québec, Canada

Publisher: Commission for Environmental Cooperation

Online\_Linkage: <http://www.cec.org/tools-and-resources/north-american-environmental-atlas>

Type\_of\_Source\_Media: Online

Source\_Time\_Period\_of\_Content:

Time\_Period\_Information:

Range\_of\_Dates/Times:

Beginning\_Date: 202001

Ending\_Date: 202012

Source\_Currentness\_Reference: Ground condition

Source\_Citation\_Abbreviation: LandCover2020

Source\_Contribution: Spatial and attribute information

Source\_Information: U.S portion of the map based on combining the National Land Cover Database (Yang et al., 2019) and additional

source data listed below.

Source\_Citation: Yang, L., Jin, S., Danielson, P., Homer, C., Gass, L., Bender, S.M., Case, A., Costello, C., Dewitz, J., Fry, J. and Funk, M., 2018. A new generation of the United States National Land Cover Database: Requirements, research priorities, design, and implementation strategies. ISPRS Journal of Photogrammetry and Remote Sensing, 146, pp.108-123.

Citation\_Information:

Originator: U.S. Geological Survey

Publication\_Date: 20230630

Title: National Land Cover Database (NLCD) 2021 Land Cover Conterminous United States

Edition: The NLCD product is the version dated June 30, 2023

Geospatial\_Data\_Presentation\_Form: Raster digital data

Publication\_Information:

Publication\_Place: Sioux Falls, South Dakota, USA

Publisher: U.S. Geological Survey

Online\_Linkage: <https://www.mrlc.gov/data/nlcd-2021-land-cover-conus>

Type\_of\_Source\_Media: Online

Source\_Information:

Source\_Citation:

Citation\_Information:

Originator: Canada Centre for Remote Sensing (CCRS)/Canada Centre for Mapping and Earth Observation (CCMEO), Natural Resources

Canada (NRCan)

Publication\_Date: 2024

Title: Land Cover Map of Canada for 2020 at 30 meters

Geospatial\_Data\_Presentation\_Form: Raster digital data

Publication\_Information:

Publication\_Place: Ottawa, Ontario

Publisher: Canada Centre for Remote Sensing (CCRS)/Canada Centre for Mapping and Earth Observation (CCMEO), Natural Resources

Canada (NRCan)

Type\_of\_Source\_Media: Internal file

Source\_Time\_Period\_of\_Content:

Time\_Period\_Information:

Single\_Date/Time:

Calendar\_Date: 2020

Source\_Currentness\_Reference: Ground condition

Source\_Citation\_Abbreviation: CCRS 2020

Source\_Contribution: Spatial and attribute information

Source\_Information:

Source\_Citation:

Citation\_Information:

Originator:

Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO)

Originator: Comisión Nacional Forestal (CONAFOR)

Originator: Instituto Nacional de Estadística y Geografía (INEGI)

Publication\_Date: Unknown

Title: Land Cover Map of Mexico for 2020 at 30 meters

Geospatial\_Data\_Presentation\_Form: Raster digital data

Publication\_Information:

Publication\_Place: Mexico City, Mexico

Publisher: Instituto Nacional de Estadística y Geografía

Type\_of\_Source\_Media: Internal file

Source\_Time\_Period\_of\_Content:

Time\_Period\_Information:

Single\_Date/Time:

Calendar\_Date: 2020

Source\_Currentness\_Reference: Ground condition

Source\_Citation\_Abbreviation: CONABIO, CONAFOR, INEGI 2020

Source\_Contribution: Spatial and attribute information

Process\_Step:

Process\_Description:

Canada

Landsat ETM+/OLI scenes were acquired from the U.S. Geological Survey to produce Time series of Canada for period 2009-2021. The processing procedure included re-projection, calibration, cloud/cloud shadow detection, compositing, and additional corrections as described in Latifovic et al. (2015). The approach to create the Land Cover Map of Canada 2015 included the following steps:

1) generating National scale LANDSAT 8 time series data 2016 -2021,

2) generation of training and testing data,

3) generation of Landsat mosaic of Canada July-August circa 2020,

4) land cover change detection for period 2015 – 2020 using deep neural network learning,

5) land cover mapping using Local Optimization Methodology, Latifovic.et al. (2017),

6) change detection 2015-2020 consistency with landcover 2015 and 2020,

7) visual quality control and improvement,

8) cross border Canada-USA consistency,

9) quantitative accuracy assessment

Processing was performed using a tile system to facilitate parallel processing and enable handling and loading data.

Latifovic, R., Pouliot, D., (2005) and Latifovic, R., Pouliot, D., and Olthof, I., (2017) describe the methodology Canada used to produce the Landcover of Canada data included in this data set.

Source\_Used\_Citation\_Abbreviation: Canada ancillary data

Source\_Used\_Citation\_Abbreviation: Dataset Landsat Mosaic of Canada 2019-2021

Source\_Used\_Citation\_Abbreviation: Google Earth

Process\_Date: 2022

Source\_Produced\_Citation\_Abbreviation: CCRS 2020

Process\_Step:

Process\_Description:

Mexico

Mexico’s 2020 land cover map is based on change detection process between 2015 and 2020. Following a methodology defined by the U.S. Geological Survey's. National image mosaics were created using data from the Operational Land Imager (OLI) on Landsat 8, incorporating images from 2018, 2019, and 2020 during the months of June to October. The classification involved the extraction of change polygons from the 2020 mosaic, grouping them in relation to North American ecoregions, and unsupervised classification considering the 15 NALCMS classes existing in Mexico.

To carry out the classification verification processing, a model was used with the conditional function where non-logical changes were eliminated through a matrix where all the combinations of land cover changes that could occur in a period of 5 years were put, using the 2015 coverage map and the polygons classified for the 2020 mosaic. The minimum mappable unit criterion was used, selecting only the polygons greater than 4,500 meters, of which the visual interpretation method was applied to the vectors greater than or equal to 30 hectares.

Subsequently, to improve the product generated by CONABIO, vectors were integrated that indicated changes towards agricultural land and human settlements from a cartography generated by CONAFOR for the states of Tabasco, Chiapas, Yucatán, Campeche and Quintana Roo corresponding to changes in land cover within the period 2016-2020. In addition, edits were made to the map of Mexico to correct problems of overestimation of agricultural zones using the Agricultural Border Series VI SIAP product. With this procedure, agricultural areas classified as tropical pastures were detected in the coverage map of Mexico NALCMS 2015, for which it was decided to classify them as agriculture for the coverage map of Mexico 2020. In the same way, the geostatistical framework of INEGI 2020 was used. and a map on the radiance of lights for the year 2020 in order to eliminate the over-estimation of urban class based on tools for spatial overlapping and generation of areas of influence (buffers) according to the category of human settlement, where 500 meters were applied to urban localities and 250 meters in rural localities.

Finally, a final visual interpretation was made of polygons with change from forests to human settlements, from areas that presented large uniform patterns of change and from areas with non-logical classes according to their geographical location, such as forests to wetlands or bare soils to agricultural areas in high areas.

Source\_Used\_Citation\_Abbreviation: Mexico ancillary data

Source\_Used\_Citation\_Abbreviation: INEGI 2020

Process\_Date: 2022

Process\_Step:

Process\_Description:

The National Land Cover Database (NLCD) primarily uses Landsat imagery for land cover analysis. Starting with NLCD 2019, composite

images were generated instead of individual Landsat scenes, improving automation, reducing latency, and expanding mapping coverage.

The U.S. was divided into 50 blocks for easier processing, and synthetic Landsat imagery was introduced for NLCD 2021.

Landsat composite imagery is generated using a method that calculates per-band median values for valid pixels. "Leaf-on" composites

(from May to September) and "leaf-off" composites (from November to April) were produced for all optical bands from 2000 to 2021,

with annual updates.

Land cover classification for NLCD 2021 was modeled by detecting changes between 2019 and 2021 using various models, including the

Multi-Index Integrated Change Analysis (MIICA) model and time-series methods like TSUN (Time-Series using Normalized Spectral

Distance). These models detected changes in forest cover, water bodies, and cultivated crops.

A post-classification refinement process was employed to ensure consistency between NLCD 2019 and NLCD 2021. Land cover labels were

verified using imagery-based change detection and ancillary data. Refinements were applied to water, wetlands, forests, rangelands,

and agricultural areas, using models designed for each class and type of confusion.

In order to cross-walk NLCD legend classes to NALCMS legend classes a sub-tropical mask for the conterminous United States and a

sub-polar mask for Alaska were required. This mask was necessary to differentiate between temperate and sub-tropical/sub-polar

areas. To generate the initial sub-tropical mask, NLCD was combined with the Landfire Existing Vegetation Type (EVT) data to

identify which EVT classes were considered sub-tropical. This helped define the initial extent of the sub-tropical mask. To

further refine the mask, a combination of Elevation data (NED) Ecoregion boundaries, and PRISM climate data were used to

delineate sub-tropical areas. Lastly, some additional modeling and hand-editing was required to generate the final mask.

In order to differentiate sub-polar and temperate areas in Alaska, a dataset identifying areas of permafrost (AKPermafrost) was

used to identify potential sub-polar regions. Areas of the dataset with values greater than or equal to a permafrost occurrence

greater than 50 percent were considered sub-polar. Some additional localized modeling and hand-editing was required to generate

the final sub-polar mask.

Source\_Used\_Citation\_Abbreviation: United Sates ancillary data

Source\_Used\_Citation\_Abbreviation: LandCover2020

Source\_Produced\_Citation\_Abbreviation: USGS 2020

Process\_Step:

Process\_Description:

To produce the seamless land cover map of North America, the four national land cover map sections (Canada, Mexico, Conterminous United States and Alaska) were reprojected from their national coordinate systems into the WGS 84 Lambert Azimuthal Equal Area projection for the NALCMS map and aligned with a common reference grid for the project. All map sections were merged into a common bounding box and edge matched along the borders. Empty pixels between sections borders were filled using reference data from the previous 2015 Land Cover Map 30-meters. Coastline was defined respecting the terrestrial area (all classes but water) from each national map, water of lagoons, bays, estuaries, or other outlets into the sea were separated from sea water by visual interpretation using an assemblage of various sources. A minimum mapping unit of 5 connected pixels was applied using the "Smart Eliminate" tool developed by the USGS as part of the NLCD project. While the tool allows the exclusion of specific classes (e.g., background) from the minimum mapping unit analysis, all classes, including the background, were considered. This ensures that individual pixels or small pixel patches in sea areas remaining after the water buffer removal are eliminated. North American 2020 Land Cover Map at 30-meters was exported to 8-bit TIFF format, colormap was added based on NALCMS legend color scheme and pyramids were generated to facilitate fast display rendering for final users.

Source\_Used\_Citation\_Abbreviation: Provinces/territories

Source\_Used\_Citation\_Abbreviation: National Cartographic Boundary

Source\_Used\_Citation\_Abbreviation: CCRS 2020

Source\_Used\_Citation\_Abbreviation: USGS 2020

Source\_Used\_Citation\_Abbreviation: INEGI 2020

Source\_Used\_Citation\_Abbreviation: CONAFOR 2020

Source\_Used\_Citation\_Abbreviation: CONABIO 2020

Process\_Date: 2022-2023

Spatial\_Data\_Organization\_Information:

Direct\_Spatial\_Reference\_Method: Raster

Raster\_Object\_Information:

Raster\_Object\_Type: Pixel

Row\_Count: 255000

Column\_Count: 259000

Spatial\_Reference\_Information:

Horizontal\_Coordinate\_System\_Definition:

Planar:

Map\_Projection:

Map\_Projection\_Name: Lambert Azimuthal Equal Area

Lambert\_Azimuthal\_Equal\_Area:

Longitude\_of\_Projection\_Center: -100.00

Latitude\_of\_Projection\_Center: 45.00

False\_Easting: 0.0

False\_Northing: 0.0

Planar\_Coordinate\_Information:

Planar\_Coordinate\_Encoding\_Method: Row and column

Coordinate\_Representation:

Abscissa\_Resolution: 30.0

Ordinate\_Resolution: 30.0

Planar\_Distance\_Units: Meters

Geodetic\_Model:

Horizontal\_Datum\_Name: WGS 84

Ellipsoid\_Name: WGS 84

Semi-major\_Axis: 6378137

Denominator\_of\_Flattening\_Ratio: 298.257

Entity\_and\_Attribute\_Information:

Detailed\_Description:

Entity\_Type:

Entity\_Type\_Label: Land cover classification grid cell

Entity\_Type\_Definition:

Any of the data elements in the 30-meter 2020 North American land cover file

Entity\_Type\_Definition\_Source: North American Land Change Monitoring System (NALCMS) Group

Attribute:

Attribute\_Label: Land cover classification grid cell value

Attribute\_Definition: The value is an indication of the land cover class

Attribute\_Definition\_Source: North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 1

Enumerated\_Domain\_Value\_Definition:

Temperate or sub-polar needleleaf forest. Forests generally taller than

three meters and more than 20 percent of total vegetation cover. This type

occurs across the northern United States, Canada, and mountainous zones of

Mexico. The tree crown cover contains at least 75 percent of needleleaved

species. Land Cover Classification System (LCCS) code: 20134.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 2

Enumerated\_Domain\_Value\_Definition:

Sub-polar taiga needleleaf forest. Forest and woodlands with trees generally

taller than three meters and more than 5 percent of total vegetation cover

with shrubs and lichens commonly present in the understory. The tree crown

cover contains at least 75 percent of needleleaved species. This type occurs

across Alaska and northern Canada and may consist of treed muskeg or

wetlands. Forest canopies are variable and often sparse, with generally

greater tree cover in the southern latitude parts of the zone than the north.

LCCS code: 20229.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 3

Enumerated\_Domain\_Value\_Definition:

Tropical or sub-tropical broadleaf evergreen forest. Forests generally

taller than five meters and more than 20 percent of total vegetation cover.

These occur in the southern United States and Mexico. These forests have

greater than 75 percent of tree crown cover represented by evergreen species.

LCCS code: 20090.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 4

Enumerated\_Domain\_Value\_Definition:

Tropical or sub-tropical broadleaf deciduous forest. Forests generally

taller than five meters and more than 20 percent of total vegetation cover.

These occur in the southern United States and Mexico. These forests have

greater than 75 percent of tree crown cover represented by deciduous species.

LCCS code: 20132.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 5

Enumerated\_Domain\_Value\_Definition:

Temperate or sub-polar broadleaf deciduous forest. Forests generally taller

than three meters and more than 20 percent of total vegetation cover. These

occur in the northern United States, Canada and mountainous zones of Mexico.

These forests have greater than 75 percent of tree crown cover represented by

deciduous species. LCCS code: 20227.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 6

Enumerated\_Domain\_Value\_Definition:

Mixed forest. Forests generally taller than three meters and more than 20

percent of total vegetation cover. Neither needleleaf nor broadleaf tree

species occupy more than 75 percent of total tree cover but are co-dominant.

LCCS codes: 20092, 20090, 20134, 20132, 20229, 20227.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 7

Enumerated\_Domain\_Value\_Definition:

Tropical or sub-tropical shrubland. Areas dominated by woody perennial

plants with persistent woody stems less than five meters tall and typically

greater than 20 percent of total vegetation. This class occurs across the

southern United States and Mexico. LCCS code: 21450-13476.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 8

Enumerated\_Domain\_Value\_Definition:

Temperate or sub-polar shrubland. Areas dominated by woody perennial plants

with persistent woody stems less than three meters tall and typically greater

than 20 percent of total vegetation. This class occurs across the northern

United States, Canada and highlands of Mexico. LCCS code: 21450-12050.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 9

Enumerated\_Domain\_Value\_Definition:

Tropical or sub-tropical grassland. Areas dominated by graminoid or

herbaceous vegetation generally accounting for greater than 80 percent of

total vegetation cover. These areas are not subject to intensive management

such as tilling but can be utilized for grazing. This class occurs across

the southern United States and Mexico. LCCS code: 21669.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 10

Enumerated\_Domain\_Value\_Definition:

Temperate or sub-polar grassland. Areas dominated by graminoid or herbaceous

vegetation, generally accounting for greater than 80 percent of total

vegetation cover. These areas are not subject to intensive management such

as tilling but can be utilized for grazing. This class occurs across

Canada, United States and highlands of Mexico. LCCS code: 21537-12212.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 11

Enumerated\_Domain\_Value\_Definition:

Sub-polar or polar shrubland-lichen-moss. Areas dominated by dwarf shrubs

with lichen and moss typically accounting for at least 20 percent of total

vegetation cover. This class occurs across northern Canada and Alaska. LCCS

codes: 20022-12050, 21454-12212, 21439-3012.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 12

Enumerated\_Domain\_Value\_Definition:

Sub-polar or polar grassland-lichen-moss. Areas dominated by grassland with

lichen and moss typically accounting for at least 20 percent of total

vegetation cover. This class occurs across northern Canada and Alaska. LCCS

codes: 21454-12212, 20022-12050, 21439-3012.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 13

Enumerated\_Domain\_Value\_Definition:

Sub-polar or polar barren-lichen-moss. Areas dominated by a mixture of bare

areas with lichen and moss that typically account for at least 20 percent of

total vegetation cover. This class occurs across northern Canada.

LCCS codes: 21468, 21454-12212, 20022-12050.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 14

Enumerated\_Domain\_Value\_Definition:

Wetland. Areas dominated by perennial herbaceous and woody wetland

vegetation which is influenced by the water table at or near surface over

extensive periods of time. This includes marshes, swamps, bogs, mangroves,

etc., either coastal or inland where water is present for a substantial

period annually. LCCS codes: 42349, 41809.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 15

Enumerated\_Domain\_Value\_Definition:

Cropland. Areas dominated by intensively managed crops. These areas

typically require human activities for their maintenance. This includes

areas used for the production of annual crops, such as corn, soybeans, wheat,

maize, vegetables, tobacco, cotton, etc.; perennial grasses for grazing; and

woody crops such as orchards and vineyards. Crop vegetation accounts for

greater than 20 percent of total vegetation. This class does not represent

natural grasslands used for light to moderate grazing.

LCCS codes: 10037, 10025, 21441, 21453.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 16

Enumerated\_Domain\_Value\_Definition:

Barren lands. Areas characterized by bare rock, gravel, sand, silt, clay, or

other earthen material, with little or no "green" vegetation present

regardless of its inherent ability to support life. Generally, vegetation

accounts for less than 10 percent of total cover. LCCS codes: 6001, 6004.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 17

Enumerated\_Domain\_Value\_Definition:

Urban and built-up. Areas that contain at least 30 percent or greater urban

constructed materials for human activities (cities, towns, transportation

etc.) LCCS code: 5003.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 18

Enumerated\_Domain\_Value\_Definition:

Water. Areas of open water, generally with less than 25 percent cover of

non-water cover types. This class refers to areas that are consistently

covered by water. LCCS codes: 8001, 7001.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Attribute\_Domain\_Values:

Enumerated\_Domain:

Enumerated\_Domain\_Value: 19

Enumerated\_Domain\_Value\_Definition:

Snow and ice. Areas characterized by a perennial cover of ice and/or snow,

generally greater than 25 percent of total cover. LCCS codes: 8005, 8008.

Enumerated\_Domain\_Value\_Definition\_Source:

North American Land Change Monitoring System (NALCMS) Group

Distribution\_Information:

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Distribution\_Information:

Distributor:

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Contact\_Organization: Canada Centre for Remote Sensing/Canada Centre for Mapping and Earth Observation, Natural Resources Canada

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Contact\_Person: Jon Dewitz

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State\_or\_Province: South Dakota

Postal\_Code: 57198-0001

Country: USA

Contact\_Voice\_Telephone: 1 605 594 2714

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Hours\_of\_Service: 0800 - 1600 CT, M - F (-6h CST/-5h CDT GMT)

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Standard\_Order\_Process:

Digital\_Form:

Digital\_Transfer\_Information:

Format\_Name: GeoTIFF

Digital\_Transfer\_Option:

Online\_Option:

Computer\_Contact\_Information:

Network\_Address:

Network\_Resource\_Name:

<http://www.cec.org/tools-and-resources/north-american-environmental-atlas/map-files?field_tool_map_kind_tid=686>

Fees: Gratuit-Free-Gratis

Metadata\_Reference\_Information:

Metadata\_Date: 20240925

Contact\_Information:

Contact\_Organization\_Primary:

Contact\_Organization: Commission for Environmental Cooperation

Contact\_Address:

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Contact\_Organization: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad

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Hours\_of\_Service: 0800 - 1600 (-6h GMT)

Metadata\_Contact:

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Contact\_Organization\_Primary: CONAFOR

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Metadata\_Contact:

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Contact\_Organization\_Primary:

Contact\_Organization: U.S. Geological Survey

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Contact\_Electronic\_Mail\_Address: [dewitz@usgs.gov](mailto:dewitz@usgs.gov)

Hours\_of\_Service: 0800 - 1600 CT, M - F (-6h CST/-5h CDT GMT)

Metadata\_Standard\_Name: FGDC Content Standard for Digital Geospatial Metadata

Metadata\_Standard\_Version: FGDC-STD-001-1998