Central Yukon REA Geospatial Model Overview

2017-11-15

Background/Overview

The purpose of this document is to provide a high-level document that outlines (not in full detail) the structure and composition of how this REA was completed. This document serves as a 'cliff notes' version for a GIS person to re-trace steps taken by the REA contractor and reviewed by BLM. Further documentation will be released when it becomes available during a full and detailed models QC by the BLM National Operations Center (NOC) REA data team.

Note: All data, maps, and models were published using Esri's ArcGIS version 10.3.1.

This document contains bookmark headings that are accessible through the PDF tools to easily navigate through the document. These bookmarks give a good overview of the structure and components of the REA.

CYR Models Quality Control: Each model within each toolbox was delivered to the BLM from the Alaska Natural Heritage Program (ANHP) who was the primary investigator for the REA. Each model was re-sourced to data/output directories within the BLM network and re-ran by the BLM REA data team in the spring and summer of 2017. Results were compared and issues worked thru to completion. Each model within the CYR REA has been re-sourced, re-ran and results evaluated against delivered products. All models passed this review. For both BLM and external clients who plan to reuse the geospatial models and scripts within these modeling packages, know that the data, maps, and models produced within the REA (with the exception of some restricted data) are publically available through the BLM's Landscape Approach Geoportal. For questions or more information, see the contacts section of this document.

Change Agents

Change Agents (CA) are those features or phenomena that have the potential to affect the size, condition, and landscape context of Conservation Elements. CAs include broad factors that have region-wide impacts such as wildfire, invasive species, and climate change, as well as localized impacts such as development, infrastructure, and extractive energy development.

Abiotic Change Agents (Section C)

Climate

A series of spatial models that assess the relationships between temperature and precipitation; calculating summer warmth index, snow day fraction, date of freeze, date of thaw and climate clusters (cliomes). These parameters are used to derive length of growing season and mean seasonal changes for temperature and precipitation. The analysis employed simulation models to assess current, near-term future, and long-term future climate change.

Permafrost

This toolbox addresses soil thermal dynamics modeling, specifically permafrost modeling and secondary modeling of potential thermokarst. The thermokarst model is based on outputs from the core permafrost model, as well as data on soils and ice content.

Biotic Change Agents (Section D)

Invasive Species

A couple of spatial models that identify historic and long-term waterbodies from National Hydrography Dataset (NHD) that are likely or possibly accessible to floatplanes based on length of the longest axis within regions with highly suitable climate for Elodea spp., based on climate data.

Insect and Disease

A collection of spatial models that calculates the distribution of observed insect- and disease related forest damage, summarizes spatial trends in the relative impact of insect- and disease related forest damage, assesses the status of the four most prevalent host/damage type combinations at five year intervals for the past 15 years, and assesses the near-term and long-term future climate of the CYR ecoregion to severe, regional outbreaks or spruce beetle.

Landscape and Ecological Integrity (Section F)

The authors define Landscape Integrity to include three different descriptions of the landscape: landscape condition, landscape intactness, and potential cumulative impacts. Although they do not present a specific model of ecological integrity, the three metrics of LI can be used to infer key elements of ecological integrity.

Landscape Condition

A group of spatial models that calculate current, near term, and long-term landscape condition. The Landscape Condition Models weight the relative influence of different types of human footprints based on factors such as permanence and the nature of the activity.

Landscape Integrity

A series of spatial models that calculate current, near term, and long-term landscape integrity. For the Central Yukon REA Landscape Integrity is defined to include three different descriptions of the landscape: landscape condition, landscape intactness, and potential cumulative impacts.

Cumulative Impacts

A collection of spatial models that calculate cumulative impacts of the climate, fire, permafrost, development, and invasive species CAs in the Central Yukon study area. Cumulative impacts are the number of significantly changing variables per 5th level hydrologic unit. The cumulative impacts assessment presents a rolled-up dataset of all potential threats to the landscape to identify the locations within the REA that are likely to experience the most amount of change.

Conservation Elements

Conservation Elements (CEs) are defined as biotic constituents (e.g., vegetation classes and wildlife species, or species assemblages), abiotic factors (e.g., soils) of regional importance in major ecosystems

and habitats across the ecoregion, or high biodiversity priority sites (e.g., designated Important Bird Areas). CEs are meant to represent key resources that can serve as surrogates for ecological condition across the ecoregion.

Coarse-Filter Conservation Elements

Terrestrial and Aquatic Coarse-filter CEs include regionally significant terrestrial vegetation classes and aquatic ecosystems within the study area. They are intended to represent the habitat requirements of most characteristic native species, ecological functions, and ecosystem services.

Fine-Filter Conservation Elements

Fine-filter CEs represent species that are critical to the assessment of the ecological condition of the Central Yukon study area for which habitat is not adequately represented by the Coarse-filter CEs. Fine-filter CEs selected for the REA are regionally significant mammal, bird, and fish species.

Terrestrial Coarse Filter (Section G)

Abiotic Change

A collection of spatial models that assess the current and long-term summer warmth index, thermokarst potential and changing permafrost conditions for the regionally important habitat types that share similar vegetation. Seven CEs were selected for analysis: floodplain forest and shrub, lowland woody wetland, upland mesic spruce-hardwood forest, upland mesic spruce forest, upland low and tall shrub, alpine and arctic tussock tundra, and alpine dwarf shrub tundra.

Distribution

A group of spatial models that assess the distribution of the regionally important habitat types that share similar vegetation and biophysical site characteristics, such as permafrost characteristics, surficial deposit, disturbance, and succession. The seven CEs selected for analysis: floodplain forest and shrub, lowland woody wetland, upland mesic spruce-hardwood forest, upland mesic spruce forest, upland low and tall shrub, alpine and arctic tussock tundra, and alpine dwarf shrub tundra.

Insect and Disease

A series of spatial models that assess the percent of surveyed Conservation Elements (CE) area damaged by insect and disease agents (the impacted proportion of the CE). The impacted proportion reflects the relative amount of ecosystem pressure caused by insect and disease agents per CE.

Landscape Condition

A collection of spatial models that assess the current, near-term, and long-term landscape condition for the seven terrestrial coarse filter conservation elements (CE). The seven CEs selected for analysis: Alpine Arctic Tussock Tundra, Alpine Dwarf Shrub Tundra, Floodplain Forest Shrub, Lowland Woody Wetland, Upland Low Tall Shrub Tundra, Upland Mesic Spruce Forest, and Upland Mesic Spruce Hardwood Forest.

Rare Elements

A group of spatial models that assess the distribution potential for unique vegetation communities.

Terrestrial Fine Filter (Section H)

Abiotic Change

A series of spatial models that explore the relationship between several conservation elements and a variety of climate variables over three time periods current, near-term, and long-term. Climate variables explored include: length of growing season, date of spring thaw, mean summer temperature, total winter precipitation, mean spring temperature, mean spring precipitation, mean winter temperature and mean annual ground temperature. The conservation elements explored for Abiotic change for the fine filter include: Dall sheep, Golden Eagle, Swainsons Thrush, Snowshoe Hare, and the American Beaver.

Distribution

A collection of spatial models that assess the distribution of conservation elements using a variety of techniques including: Random Forest and analyzing Alaska Gap Analysis Project models which provide spatial representation of potential habitat distribution for a single species. Conservation elements assessed include: Golden Eagle, Swainsons Thrush, Snowshoe Hare, Caribou and Dall sheep.

Landscape Condition

A series of spatial models that calculates current, near-term, and long-term landscape condition within the distribution of CEs to show the impacts of current and future development. The LCM weights the relative influence of different types of human footprints based on factors such as permanence and the nature of the activity.

Rangifer Forage

A sequence of spatial models that assess migration and movement patterns for Caribou. Caribou generally migrate seasonally in response to forage availability, to access calving grounds, and seek out insect refuges. Caribou typically undergo seasonal migrations between summer calving grounds, mosquito-relief areas and winter foraging sites with migration distances varying amongst herds. Forage quality is derived from the Vegetation Map of Northern, Western, and Interior Alaska.

Waterfowl Habitat

A couple of models that calculates potential number of waterfowl species supported per cell during breeding season. Richness of predicted species habitat was selected as the most appropriate measure for assessing the spatial distribution of primary waterfowl habitat.

Aquatic Coarse Filter (Section I)

Abiotic

A series of spatial models that calculates current (2010s) and long-term Future (2060s) percent cover of permafrost at 1 m depth determined by temperatures at or below 0°C per watershed along stream network.

Distribution

A group of spatial models that create distribution maps of large and small connected lakes. In addition, a synthetic stream network was created to select streams with orders 1 or 2. Finally, a synthetic stream network was created to select streams with order 3 or higher.

Landscape Condition

A series of spatial models that calculate current and long-term mean watershed landscape condition scores along streams and rivers, as well as per 6th level hydrologic unit. In addition, a model selects open contaminated sites catalogued by Alaska Department of Environmental Conservation (ADEC) that are within 500 m of Aquatic Coarse-Filter conservation elements.

Aquatic Fine Filter (Section J)

A collection of spatial models that intersects several Aquatic conservation elements habitats with road crossings. The conservation elements included: Dolly Varden, Chum Salmon, Chinook Salmon and Inconnu.

Table 1. CYR 2013 Management Questions

Abiotic Change Agents (Section C)	
A1	How is climate change likely to alter the fire regime in the dominant vegetation classes and riparian zones?
B1	How is climate change likely to alter permafrost distribution, active layer depth, precipitation regime, and evapotranspiration in this region?
B2	What are the expected associated changes to dominant vegetation communities and CE habitat in relation to altered permafrost distribution, active layer depth, precipitation regime, and evapotranspiration?
C1	How will changes in precipitation, evapotranspiration, and active layer depth alter surface water availability and, therefore, ecosystem function (dominant vegetation classes)?
E1	How is climate change affecting the timing of snow melt and snow onset, spring breakup and green-up, and growing season length?
F3	How are major vegetation successional pathways likely to change in response to climate change, with special emphasis on increased shrub cover and treeline changes?
Anthropogenic Change Agents (Section E)	
Q1	Which subsistence species (aquatic and terrestrial) are being harvested by whom and where is harvest taking place?
U1	Compare the footprint of all types of landscape and landscape disturbances (anthropogenic and natural changed) over the last 20 and 50 years.
U3	How and where is the anthropogenic footprint most likely to expand 20 and 50 years into the future?
Terrestrial Coarse-Filter Conservation Elements (Section G)	
AH1	What rare, but important habitat types that are too fine to map at the REA scale and are associated with coarse- (or fine-) filter CEs that could help identify areas where more detailed mapping or surveys are warranted before making land use allocations (such as steppe bluff association with dry aspect forest)?
G1	Where are refugia for unique vegetation communities (e.g., hot springs, bluffs, sand dunes) and what are the wildlife species associated with them?

G2	Which unique vegetation communities (and specifically, which rare plant species) are most vulnerable to significant alteration due to climate change?
Terrestrial Fine-Filter Conservation Elements (Section H)	
AE1	Where is primary waterfowl (black scoter or trumpeter swan) habitat located?
L1	What are caribou seasonal distribution and movement patterns?
N3	How might sheep distribution shift in relation to climate change?
T1	The introduction of free-ranging reindeer herds to this region has been proposed. What areas would be most likely to biologically support a reindeer herd?
X1	What have the past cumulative impacts of road construction and mineral extraction been on terrestrial CE habitat and population dynamics?
X2	How might future road construction and mineral extraction infrastructure (e.g., both temporary and permanent roads [Umiat, Ambler, Stevens Village], pads, pipeline, both permanent and temporary) affect species habitat, distribution, movements and population dynamics (especially caribou, moose, sheep)?
Aquatic Conservation Elements (Sections I and J)	
W2	How might future road construction and mineral extraction infrastructure (e.g., both temporary and permanent roads, pads, pipeline) affect fish habitat, fish distribution, and fish movements (especially chinook, chum, sheefish)?
V1	How does human activity (e.g., mineral extraction, gravel extraction) alter stream ecology and watershed health (i.e., water quantity, water quality, outflow/stream connectivity, fish habitat, and riparian habitat)?

Contacts:

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