Including Interior Alaska in the National GHG Inventory (NGHGI)

Meeting IPCC—UNFCCC Guidance on Reporting

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Outline

- Background on the U.S. GHG Inventory

- IPCC and UNFCCC Guidance

- Accounting for Emissions and Removals in Alaska

- Managed Land Analysis

- Options for Improving
  - FIA plot network
  - Interim approaches

- Natural Disturbances
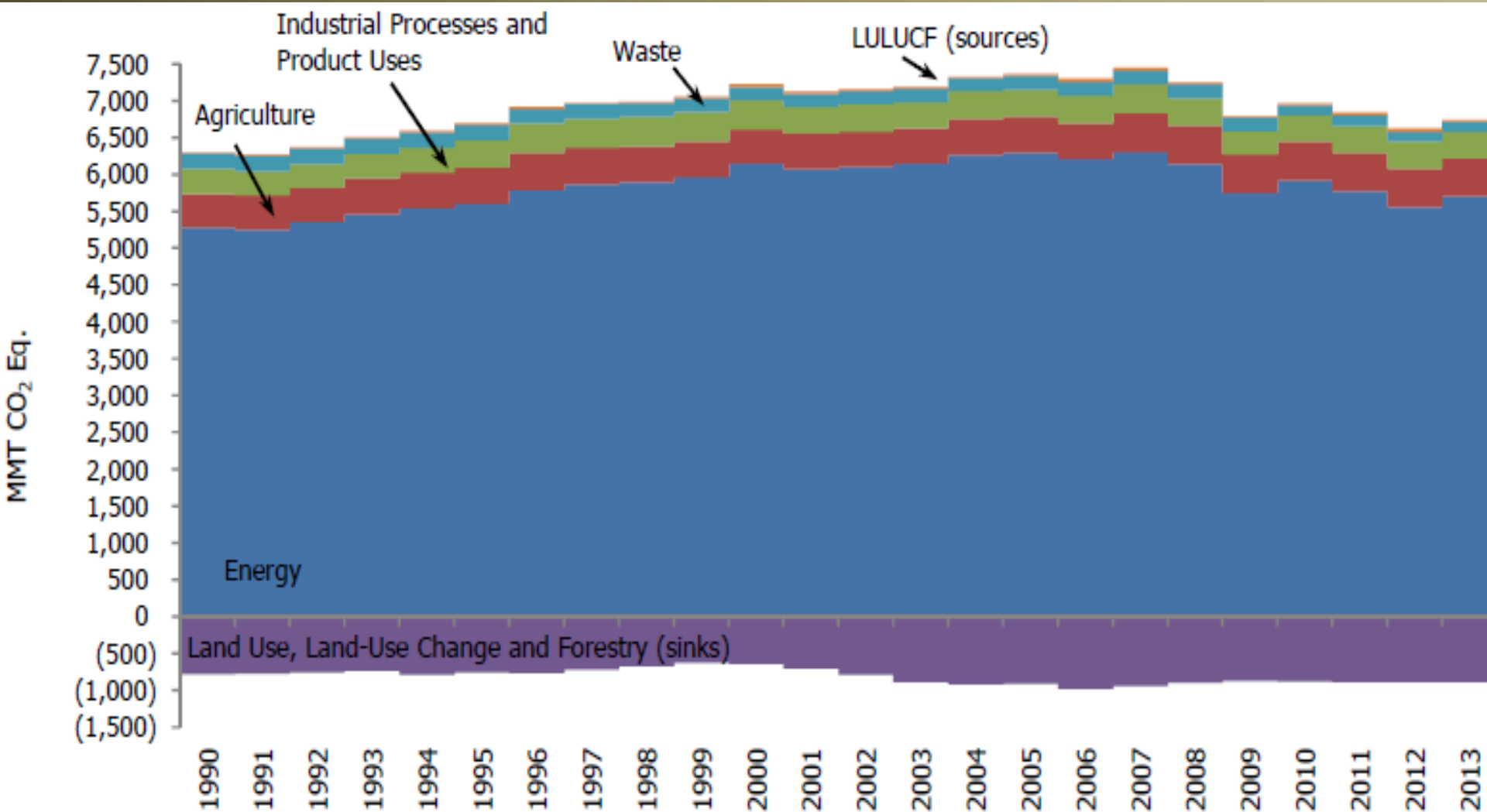
- Future Plans: AK and Beyond

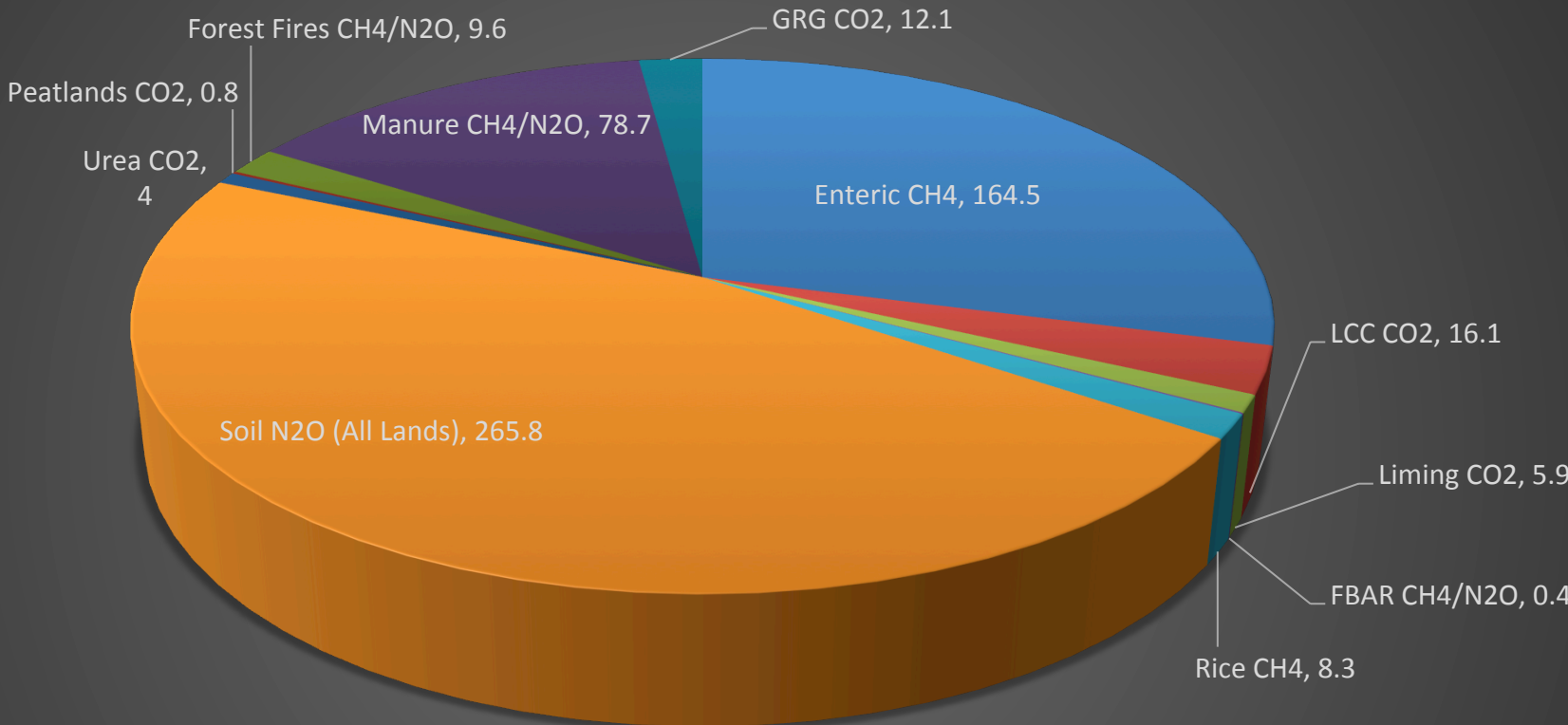# National GHG Inventory (NGHGI)

- Produced annually—due by April 15

- Accounts for anthropogenic GHG emissions and removals over time: 1990 $\Longrightarrow$ Present

- Five methodological chapters
  - Energy
  - Industrial Processes and Product Use
  - Waste
  - Agriculture
  - Land Use, Land-Use Change and Forestry

- Seven primary gases
  - CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3
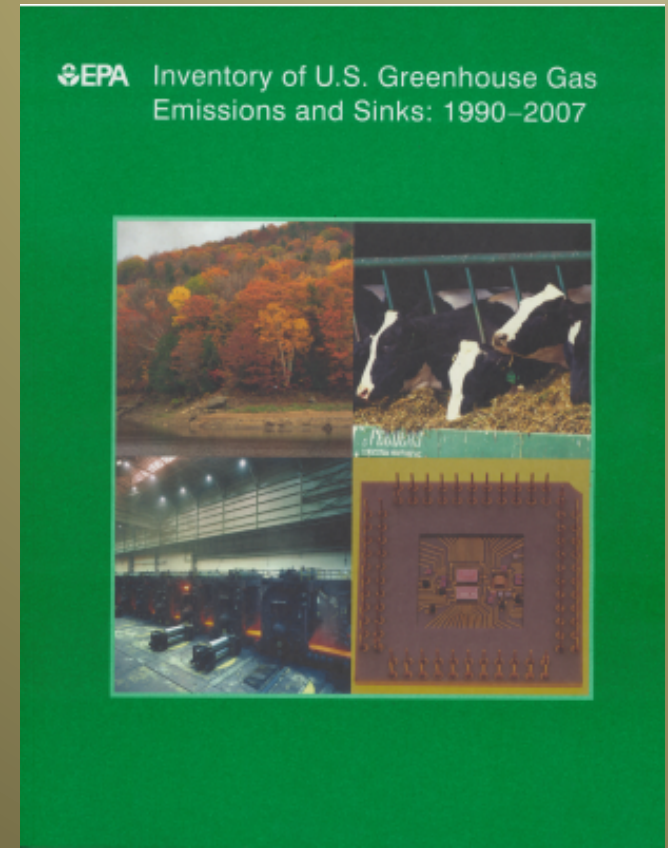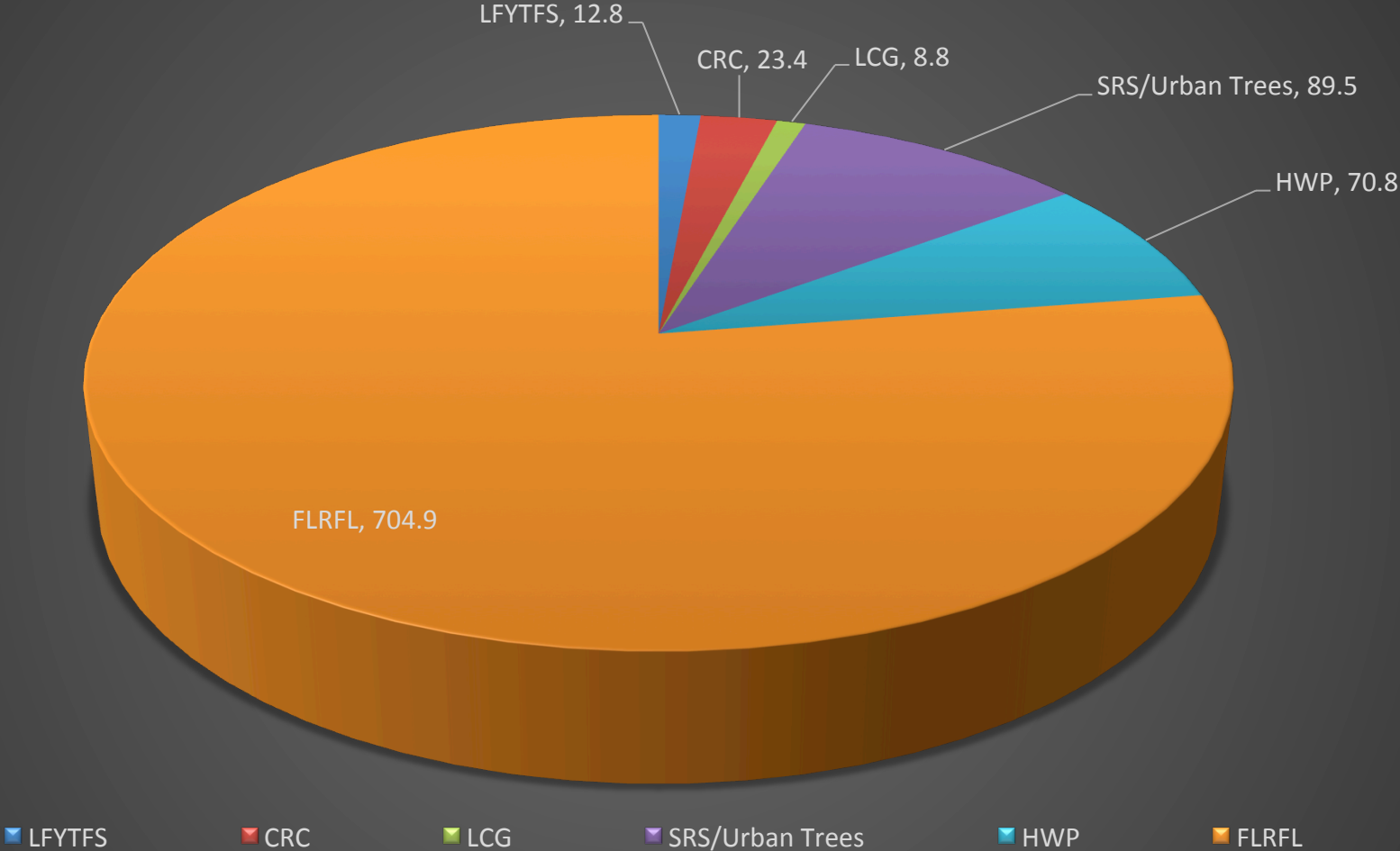
U.S. Greenhouse Gas Emissions and Sinks by Sector: 1990-2013

2013 AFOLU Emissions (MMT CO_2 eq.)

Pie chart: 2013 AFOLU Emissions (MMT CO_2 eq.)

- Forest Fires CH4/N2O, 9.6
- Peatlands CO2, 0.8
- Urea CO2, 4
- Manure CH4/N2O, 78.7
- GRG CO2, 12.1
- Enteric CH4, 164.5
- LCC CO2, 16.1
- Liming CO2, 5.9
- FBAR CH4/N2O, 0.4
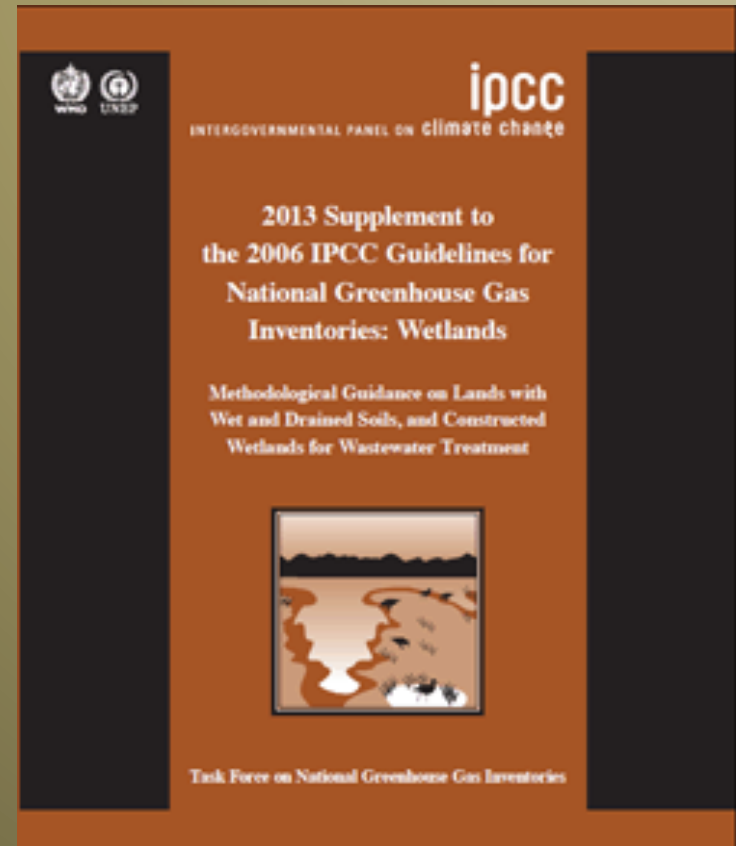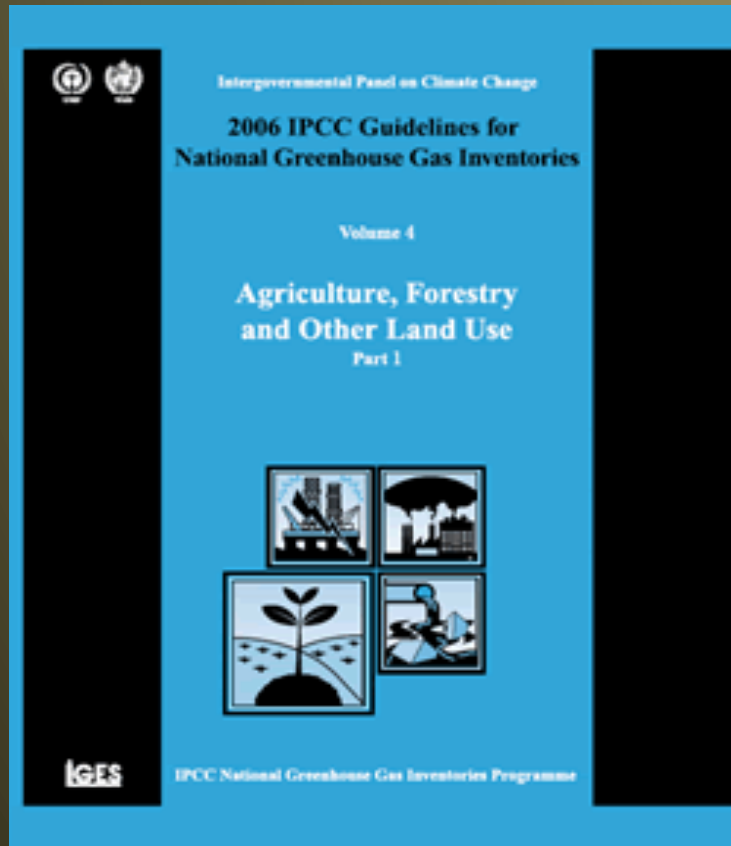- Rice CH4, 8.3
- Soil N2O (All Lands), 265.8

Legend:
- Enteric CH4
- LCC CO2
- Liming CO2
- FBAR CH4/N2O
- Rice CH4
- Soil N2O (All Lands)
- Urea CO2
- Peatlands CO2
- Forest Fires CH4/N2O
- Manure CH4/N2O
- GRG CO2

2013 AFOLU Removals (MMT CO$_2$ eq.)

LFYTFS, 12.8
CRC, 23.4
LCG, 8.8
SRS/Urban Trees, 89.5
HWP, 70.8
FLRFL, 704.9

Legend: LFYTFS · CRC · LCG · SRS/Urban Trees · HWP · FLRFL

IPCC Guidance for AFOLU

- Provides methods for all emissions and removals from Agriculture and LULUCF
- Required for UNFCCC reporting in 2015

- New/updated guidance for wetlands
- Gain experience in use of Supplement and report in 2017

Inventory Quality Indicators and Good Practice Guidance

...neither over nor underestimates so far as can be judged with uncertainties reduced as far as practicable

TCCCA

- **Transparent**
- **Consistent**
- **Complete**
- **Comparable**
- **Accurate**

Inventory

Result

- **Assessed for Uncertainties**
- **Subject to QA/QC**
- **Efficient use of resources**
- **Uncertainties reduced over time**

- **Credible**
- **Reliable**
- **Useful**

UNFCCC Reporting Requirements for Each Category Included in the NGHGI

- Overview
  - Description of source/sink—cause of emission/removal
  - Trends/drivers
  - Emissions/removals in MMT CO_2 eq. and kilotons of gas
- Estimation methodology and activity data
- Uncertainty; Monte Carlo simulation for a 95% confidence interval with lower and upper bounds around the central estimate
- Time series consistency
- QA/QC and verification
- Recalculations Discussion
- Planned Improvements

National Inventory Schedule

- Kick-off Meeting (June)
- Collect Data and Emissions Factors (Summer)
- Prepare Initial Estimates (Fall)
- Develop Draft Report (October)
- QA/QC of Draft Report (November)
- Expert Review Phase (December)
- Address Comments (December-January)
- Public Review Phase (February)
- Finalize Document, Prepare CRF Tables (March)
- Submit to UNFCCC (April 15)

Alaska Represents a Significant Area of Improvement for the NGHGI

The Size of Alaska Compared to European Countries

Current Status

- Only coastal SE/SC Alaska included in FIA plot network
  - Mean net annual non-soil forest C stock change between 2008-2013 is -0.5 MMT C/year
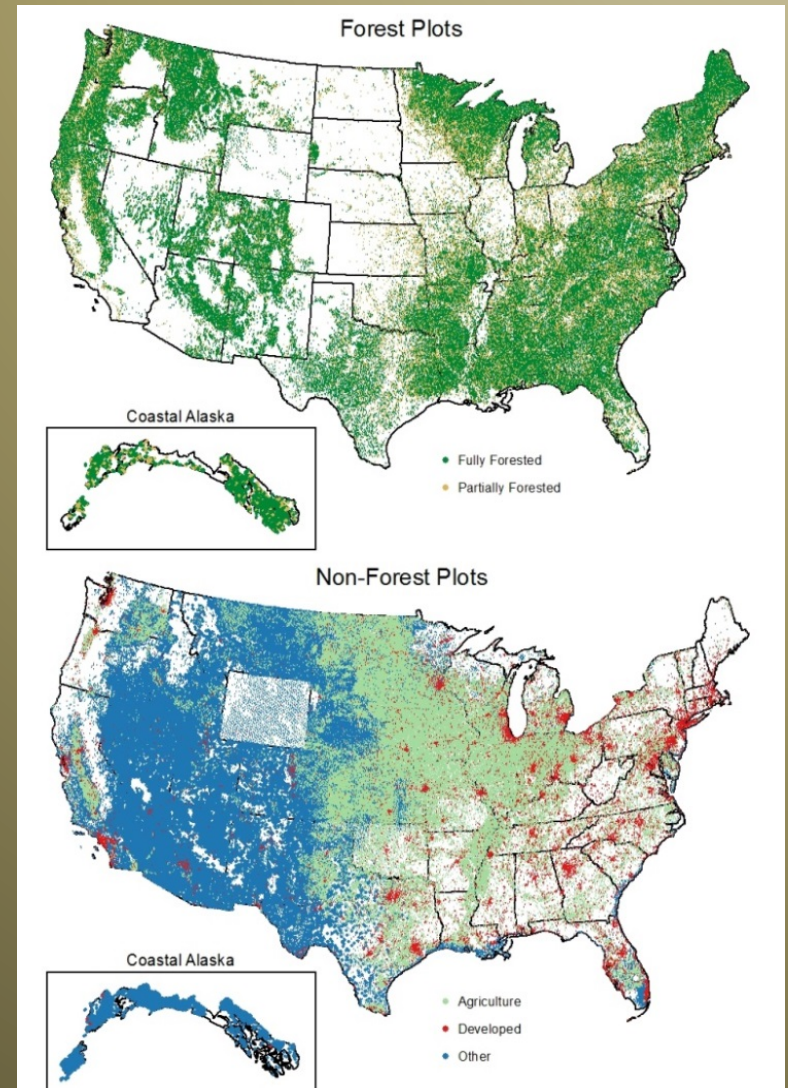
Land Representation

- Complete representation of the land base, categorized into 6 IPCC land use categories
    - Utilize NRI and FIA with NLCD to fill gaps
    - All of Alaska categorized with NLCD

- Separate into managed and unmanaged land
    - Apply managed land definition
    - Under IPCC Guidance "managed" land is a proxy for anthropogenic emissions
    - Note: Wetlands area treated differently

- Identify the land use conversions between lands
    - Lands remain in conversion category for 20 years

- For all 36 LU/LUC categories estimate C stock changes by pool:
    - Above/below-ground biomass
    - Dead wood and litter
    - Soil organic matter
    - Non-CO_2 emissions
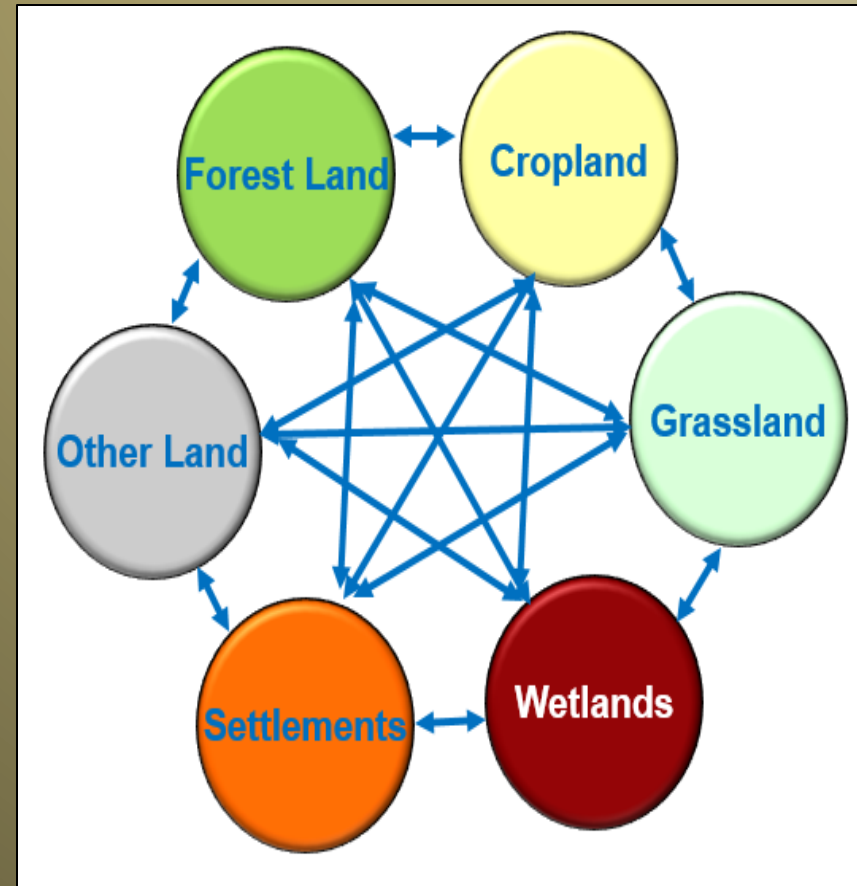
U.S. Specific Managed Land Definition

- *Managed Land*: **Land is considered managed if direct human intervention has influenced its condition.** Direct intervention occurs mostly in areas accessible to human activity and includes altering or maintaining the condition of the land to produce commercial or non-commercial products or services; to serve as transportation corridors or locations for buildings, landfills, or other developed areas for commercial or non-commercial purposes; to extract resources or facilitate acquisition of resources; or to provide social functions for personal, community or societal objectives where these areas are readily accessible to society.

- *Unmanaged Land*: All other land is considered unmanaged. **Unmanaged land is largely comprised of areas inaccessible to society due to the remoteness** of the locations. Though these lands may be influenced indirectly by human actions such as atmospheric deposition of chemical species produced in industry or CO_2 fertilization, they are not influenced by a direct human intervention.

Managed Lands: Criteria

Lands are designated as managed in the conterminous US and Alaska based on the definition provided earlier. In order to apply the definitions in an analysis of managed land, the following criteria are used in combination with available datasets:

- **All Croplands and Settlements**
- **All land with active fire protection**
- **All Grassland if affected by livestock**
- **Lands accessible by roads and/or other infrastructure**
- **Protected lands maintained for recreational and conservation purposes**
- **Lands with active and/or past resource extraction**

US Managed Land Base
(1,000s ha's)

- Includes all 50 states

- Excludes US Territories

- NRI data only goes through 2007

- C stock changes not estimated for entire managed land base:
  - Interior AK
  - HI
  - Federal Grasslands

| Land-Use & Land-Use Change Categories[a]	1990	2005	2009	2010	2011	2012	2013
Total Forest Land	288,964	291,213	292,263	292,399	292,516	292,634	292,751
FF	283,860	278,979	280,844	280,977	281,092	281,207	281,322
CF	1,119	2,656	2,449	2,450	2,450	2,450	2,450
GF	3,434	7,805	7,279	7,280	7,280	7,281	7,281
WF	64	250	257	257	258	258	259
SF	103	362	376	376	376	377	377
OF	383	1,161	1,057	1,059	1,060	1,062	1,063
Total Cropland	170,448	160,107	159,248	159,243	159,238	159,234	159,230
CC	154,527	143,050	143,933	143,928	143,924	143,920	143,916
FC	1,148	688	577	576	576	576	576
GC	13,988	15,216	13,655	13,655	13,655	13,655	13,655
WC	161	199	176	176	176	175	175
SC	438	692	672	672	672	672	672
OC	185	262	236	236	236	236	236
Total Grassland	324,327	321,360	320,666	320,657	320,655	320,652	320,648
GG	313,914	301,823	302,566	302,594	302,627	302,660	302,692
FG	1,615	3,022	2,757	2,755	2,753	2,752	2,750
CG	8,099	14,986	13,912	13,878	13,844	13,810	13,776
WG	238	409	330	329	329	329	329
SG	112	274	267	267	267	267	267
OG	350	846	834	834	834	834	834
Total Wetlands	44,453	44,060	43,441	43,330	43,228	43,126	43,025
WW	43,802	42,545	42,002	41,892	41,792	41,691	41,592
FW	143	397	382	381	380	379	378
CW	132	365	345	345	344	344	344
GW	343	698	664	664	664	664	664
SW	0	10	10	10	10	10	10
OW	32	44	39	39	38	38	38
Total Settlements	38,602	49,676	50,628	50,624	50,621	50,617	50,614
SS	34,060	35,269	36,340	36,337	36,334	36,330	36,328
FS	1,787	6,112	6,090	6,090	6,090	6,090	6,089
CS	1,344	3,633	3,526	3,526	3,526	3,526	3,526
GS	1,353	4,433	4,439	4,439	4,439	4,439	4,439
WS	3	31	30	30	30	30	30
OS	55	200	202	202	202	202	202
Total Other Land	23,225	23,600	23,770	23,765	23,759	23,754	23,748
OO	22,175	21,372	21,470	21,466	21,460	21,455	21,450
FO	182	538	569	569	569	570	570
CO	345	645	703	703	703	703	703
GO	454	903	902	902	902	901	901
WO	67	121	104	104	104	104	104
SO	2	21	20	20	20	20	20
Grand Total	890,018	890,016	890,016	890,017	890,017	890,017	890,017

Managed Land Analysis for Alaska

Croplands and Settlements

- **National Land Cover Database (NLCD) is used to determine cropland and settlements, all of which are considered managed**
- **A 10-km buffer surrounds settlements**

Land Use

■ Managed
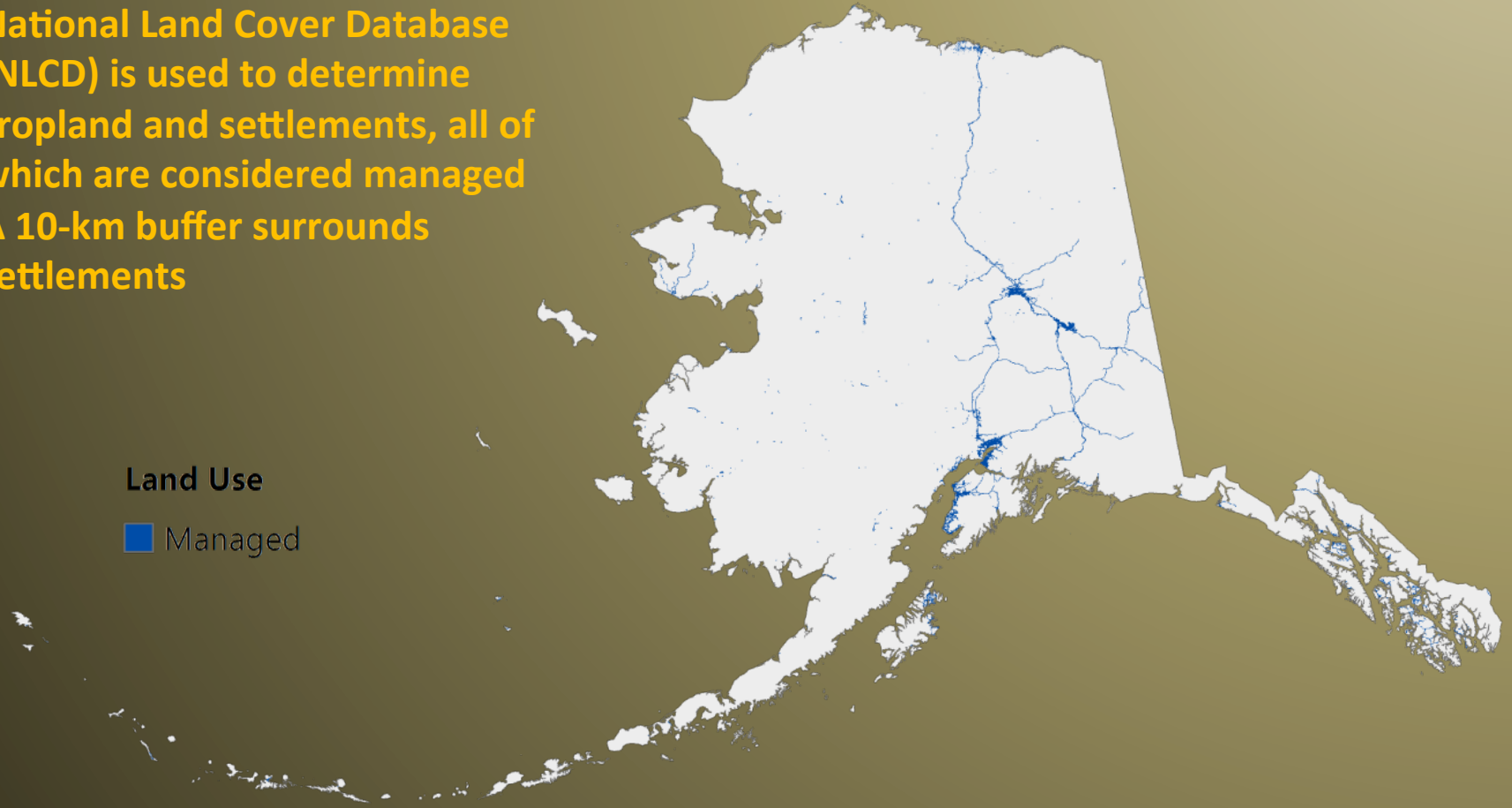
Accessibility: Roads and Train Transportation Corridors

- **Road and train transportation networks based on the ESRI Data and Maps product**
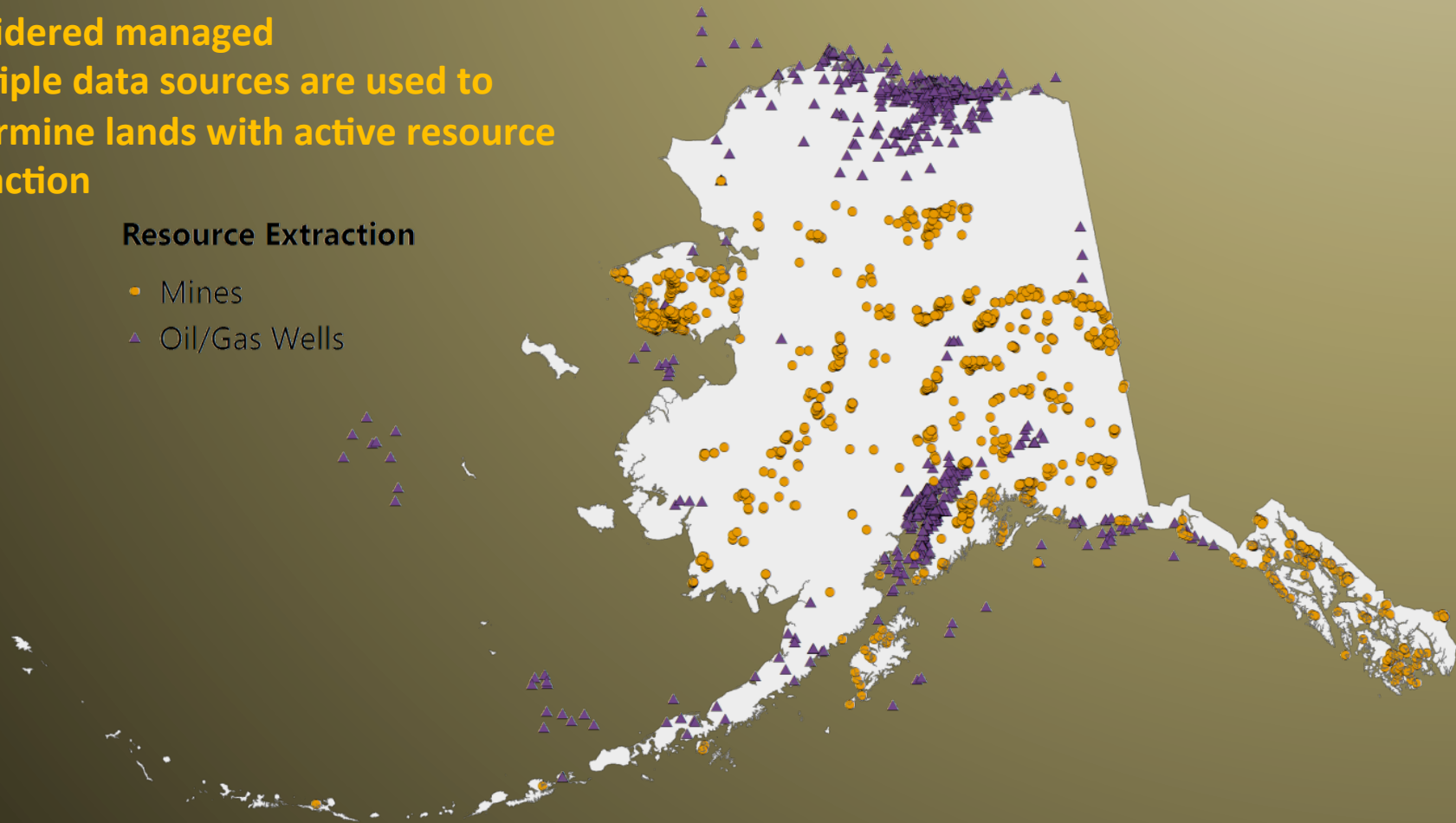- **Includes 10-km buffer**

Transportation

■ Managed

Lands with Active and/or Past Resource Extraction

- **Lands on and near current and past oil/gas wells and mines are considered managed**
- **Multiple data sources are used to determine lands with active resource extraction**

Resource Extraction

- **Managed lands based on resource extraction**
    - **A buffer of 3,300 meters around petroleum extraction**
    - **A buffer of 4,000 meters around mine locations**

Resource Extraction
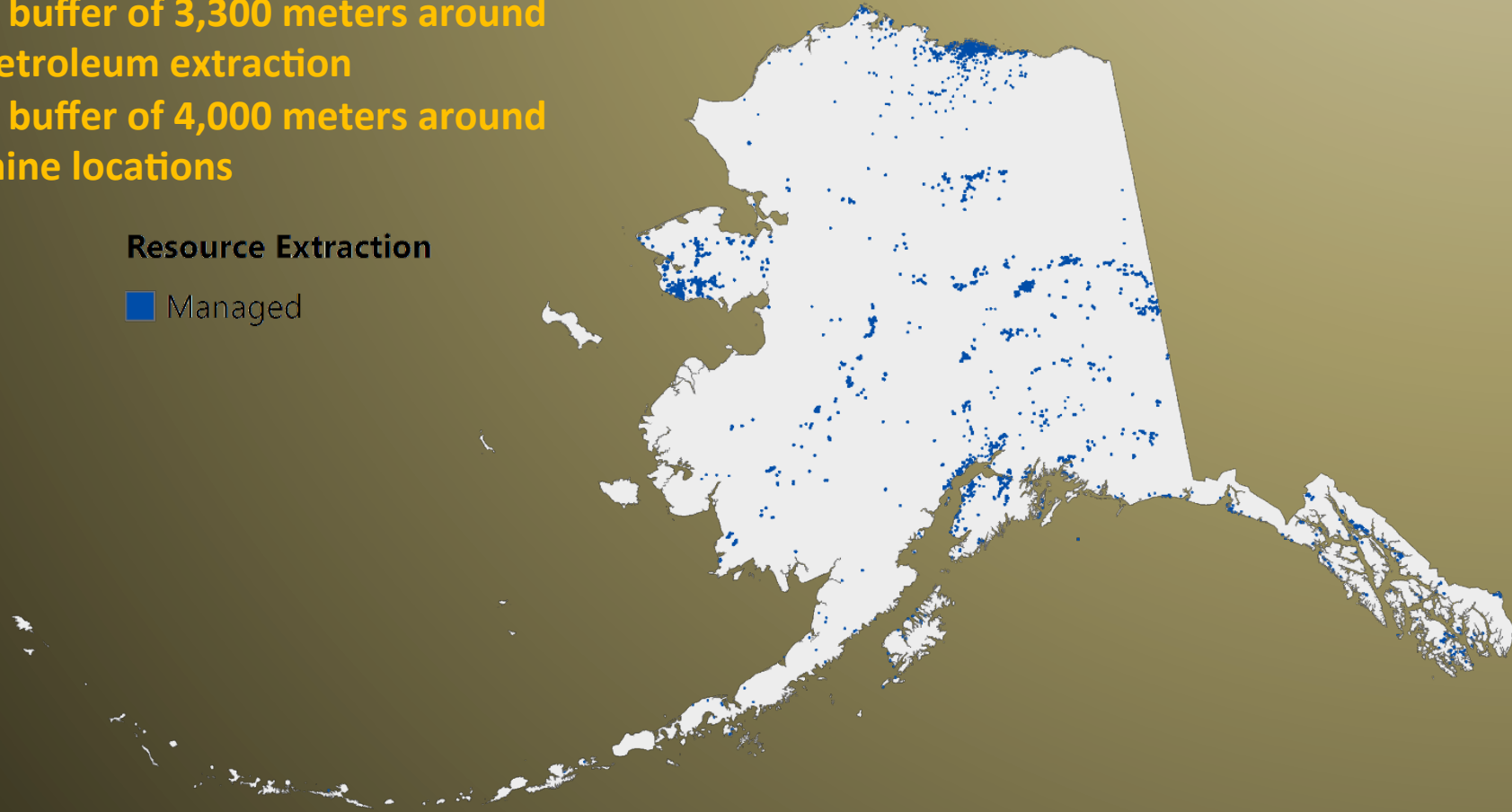
 Managed

All Land with Active Fire Protection

- **The Alaska Interagency Fire Management Plan used to determine which lands have active fire management**
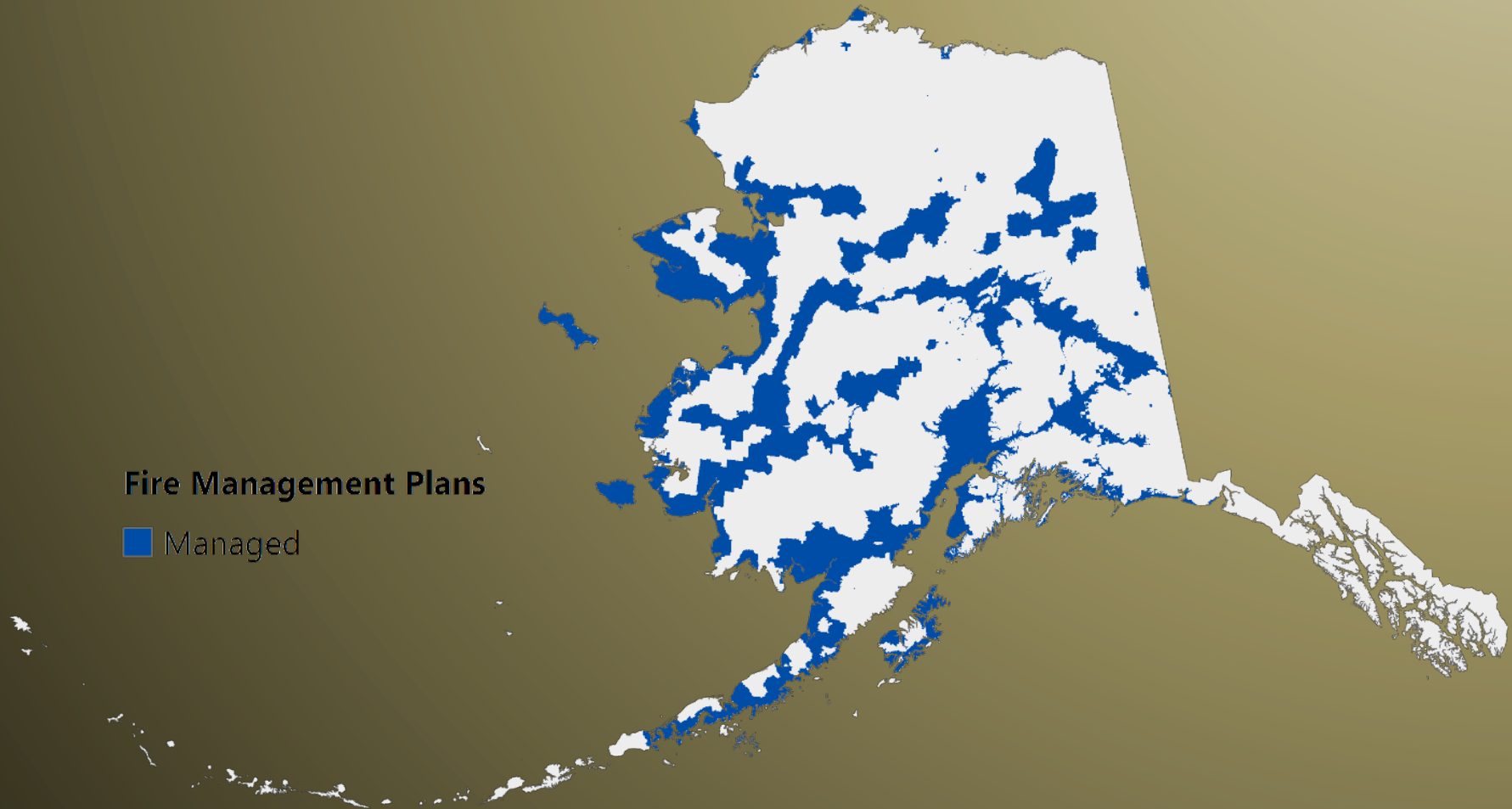- **Active fire management includes those areas identified as critical, full and modified**

Fire Management Plans

- Critical
- Full
- Modified
- Limited
- Unmanaged
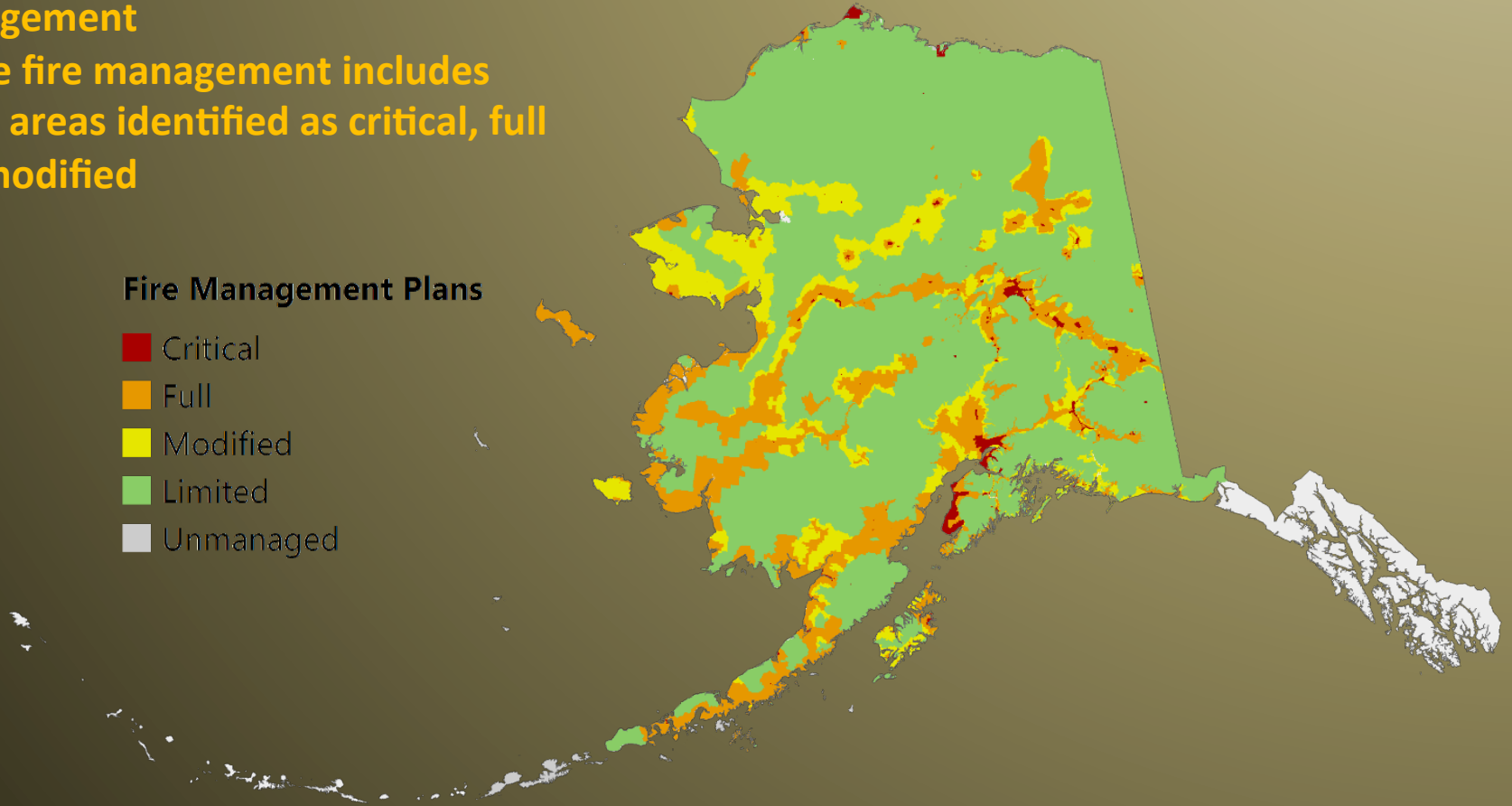
Managed Lands Based on Active Fire Protection

**Fire Management Plans**

■ Managed

Protected Lands Maintained for Recreational and Conservation Purposes

- **The Protected Areas Database (USGS) is used to determine lands used for recreations purposes**

- **Lands protected from development, but subject to suppression of natural disturbance events or extractive uses are considered managed**

Protected Areas
- Ecological disturbance events allowed to proceed
- Ecological disturbance events suppressed
- Subject to extractive or OHV use
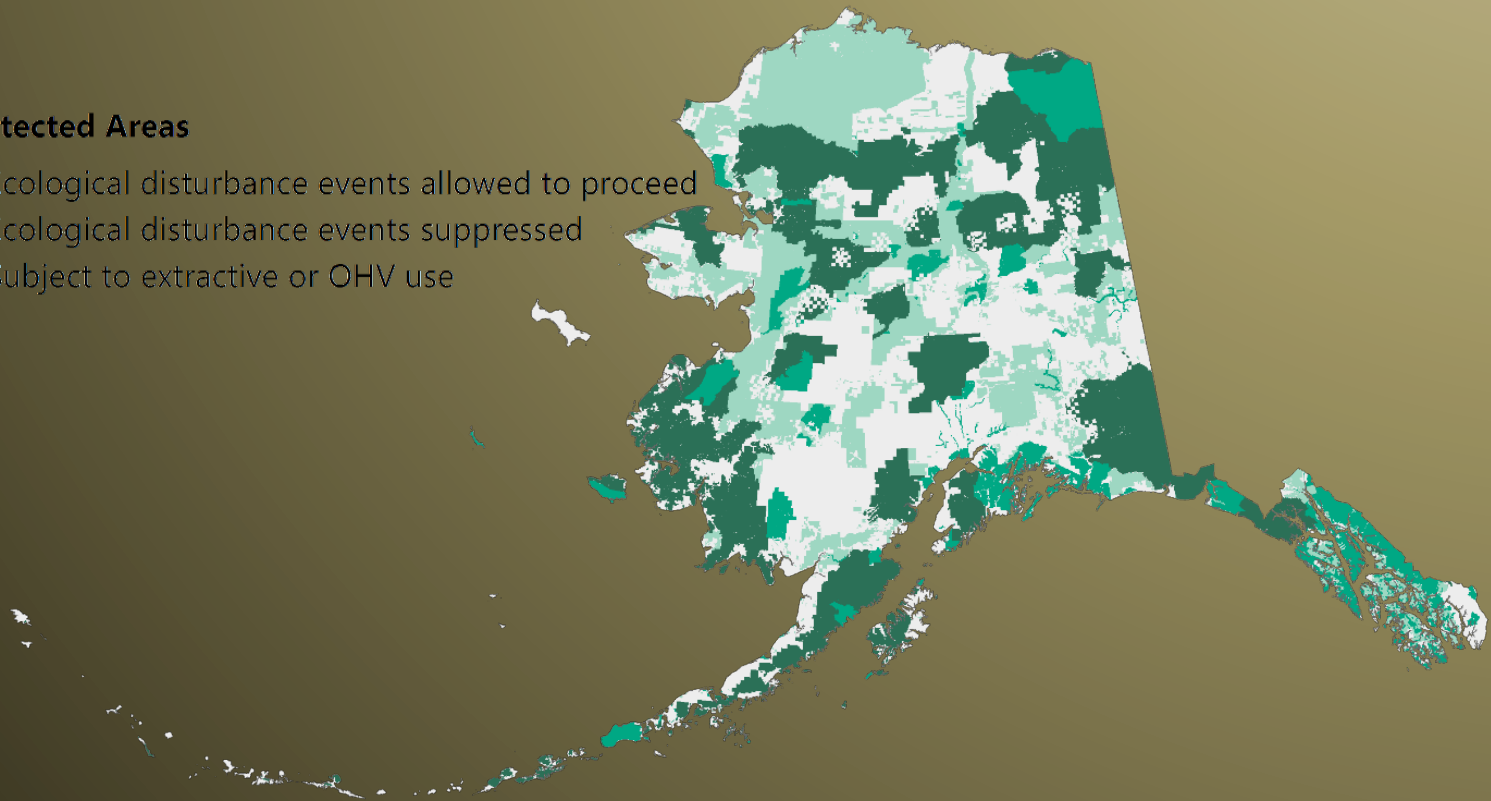
Managed Lands Maintained for Recreational and Conservation Purposes
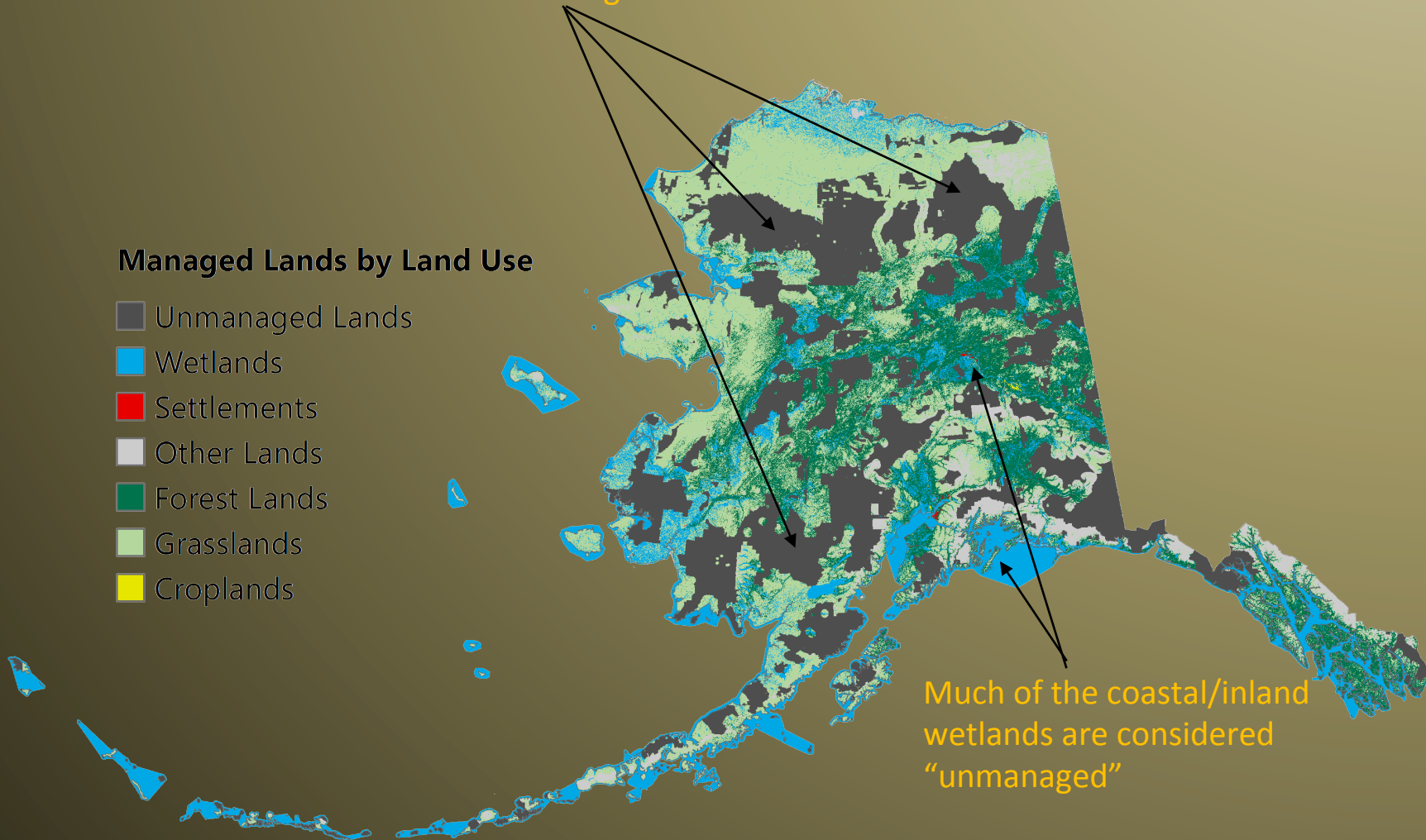
Protected Areas

Managed

Managed and Unmanaged Lands

Significant areas of interior Alaska remain "unmanaged"

Managed Lands by Land Use

- ■ Unmanaged Lands
- ■ Wetlands
- ■ Settlements
- ☐ Other Lands
- ■ Forest Lands
- ■ Grasslands
- ■ Croplands

Much of the coastal/inland wetlands are considered "unmanaged"

# US Managed Lands—Before and After Including Alaska

Land Use Category (Managed)	2012 Submission (2010 values) Land area (000's of hectares)	2015 Submission (2010 values) Land area (000's of hectares)	Change (%) from 2012 to 2015 Submission
Total	785,845	890,017	13%
Forest Land	278,213	292,399	5.1%
Grassland	257,600	320,657	24%
Wetland	26,124	43,330	65%
Cropland	159,095	159,243	--

Towards a Full Accounting of all GHG Emissions and Removals in Alaska

- Long-term implement C stock change
  - FIA plots (reduced density) and remote sensing
- Near-term option
  - Tier 1 IPCC Gain-Loss method
  - Tier 3 remote sensing based approaches

Establish Forest Plots in Combination with Detailed Remotely Sensed Data

- Ground plots at 1/5 coterminous intensity (12,140 vs than 2,400 ha/plot)

- From 5-10 years to include all Alaskan regions

- $20,000/plot, over 4,700 plots

- Stock change estimate in 10-20 years
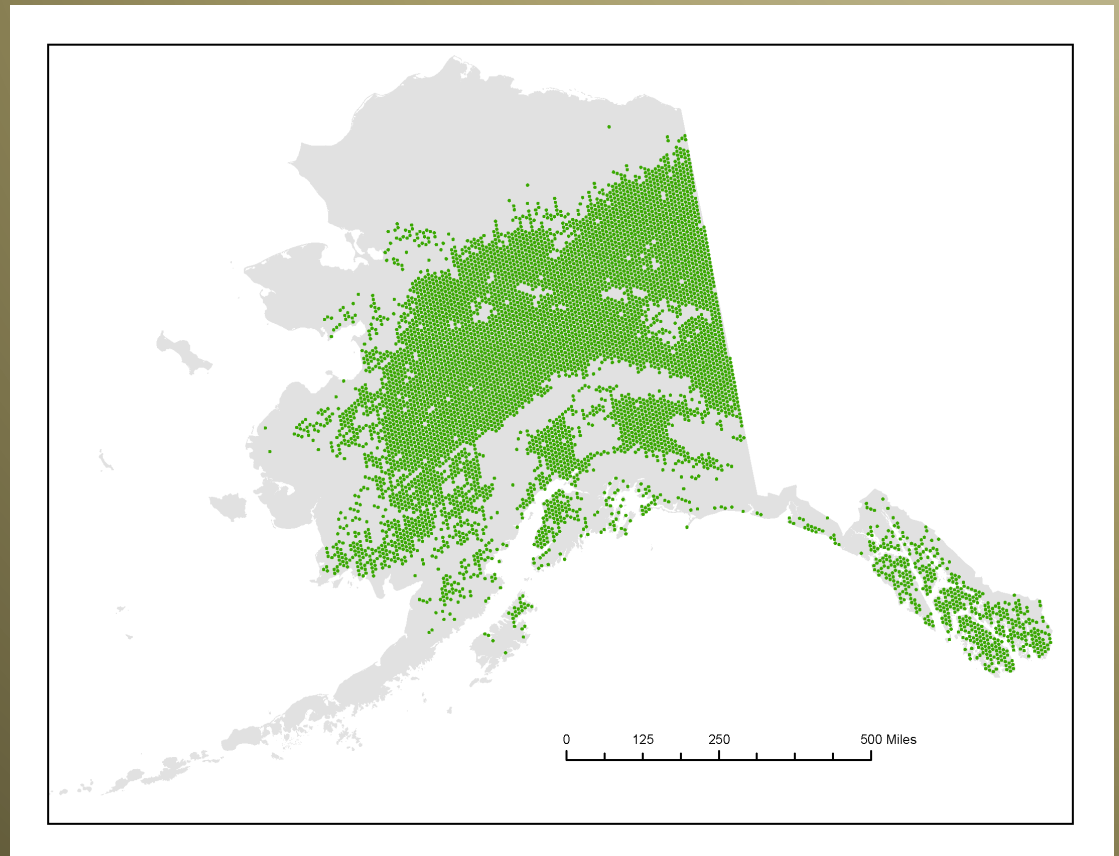
Pilot Project in Tanana Valley Region
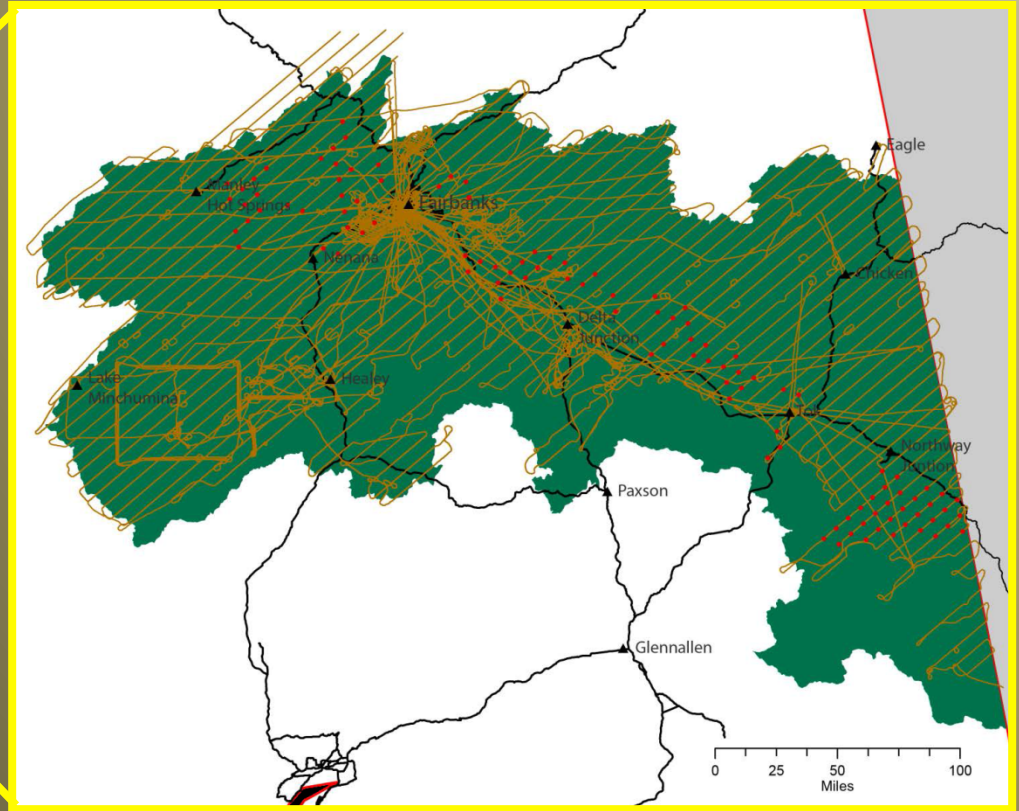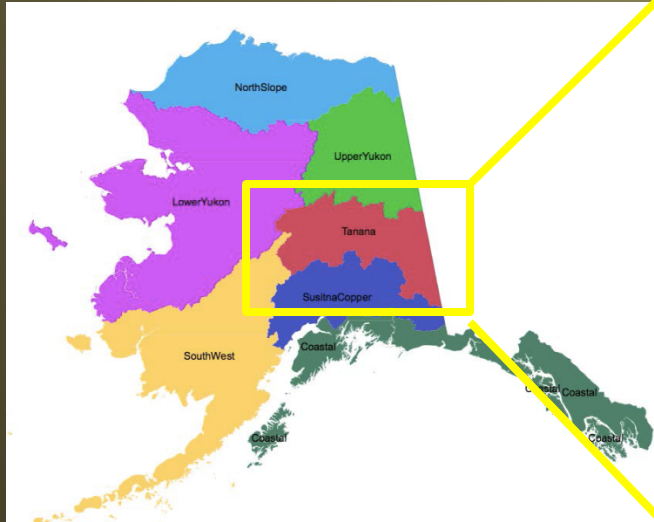
- Study area approximate size of England (135,000 km²)

# Field Crew Work—Logistical Challenges

Unique Challenges Include Detailed Soil and Forest Floor Measurements

- Forest soils are largest C pool in forests
- Soil measurement protocol still being developed

NASA Goddard's G-LiHT System

- LiDAR, Hyperspectral, and Thermal Airborne Imager

- Flight tracks align with forest inventory plots (~100)

- Combine remotely-sensed data with limited in situ plot measurements

- Assess applicability to all of interior Alaska to accurately estimate forest C stocks

- Results expected in ~2 years
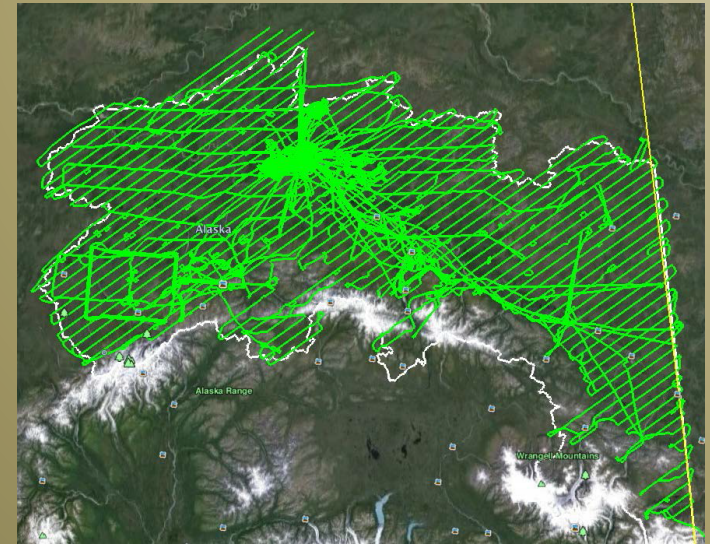
Tanana flight lines

G-LiHT deployed on Piper Cherokee

Short-term: IPCC Biomass Gain-Loss Approach

- Gain-Loss Method: Simple approach to estimate biomass C stock change

$$\Delta C_B = \Delta C_G - \Delta C_L$$

ΔC_B = annual change in carbon stocks
ΔC_G = annual increase in carbon stocks
ΔC_L = annual decrease in carbon stocks

- Could be implemented in 1-2 years; modest cost
- High uncertainty
- Meets UNFCCC reporting requirements—temporarily
- Informs US planning and policy purposes

Alternate Short-Term Approach: Estimate Biomass C stocks with Remote Sensing

- A number of researchers have explored this approach
- Utilize remote sensing tools, informed by in situ and other measurements and allometric equations to estimate biomass C
- Advantages:
  - Relatively low-cost, quickly implemented
  - Attribute cause of biomass C loss (harvest, fire, insect)
  - Assess cause of biomass C gain (growth/regeneration)
- Complete time series can be a challenge
- Sustainability may also depend on available sensors

Natural Disturbances

- Natural disturbances influence GHG emissions on "managed land", but are not directly controlled by anthropogenic activity

- Prominent natural disturbances in Alaska include: wildfire, permafrost melt, floods, droughts and pest/disease breakout

- Results in unexpected and significant impacts on the GHG profile of a country

- Potential to "factor out" being investigated as part of UNFCCC reporting

- The US will be evaluating different options

Future

- Continue to the improve land use management analysis for interior Alaska
- Long Term: Establish in situ-based land survey system capable of tracking land use, land-use conversion, management activities, C stock flux/Non-CO_2 emissions, natural disturbances for all land use types
- Short Term: Evaluate methods for estimating AFOLU emissions across all of Alaska
  - All Land Uses, all C pools and Non-CO_2 emissions
  - Evaluate IPCC default and country-specific methods
  - Establish initial system ~ 2017 Submission
- Improve incrementally over time
- Increase collaboration among USG agencies (USDA, USFS, USGS, NASA) and research community
- Efforts beyond interior Alaska
  - Coastal wetlands
  - Federal grasslands (biomass C)
  - Territories
  - Land use conversion
  - Fires
  - Reservoir CH_4
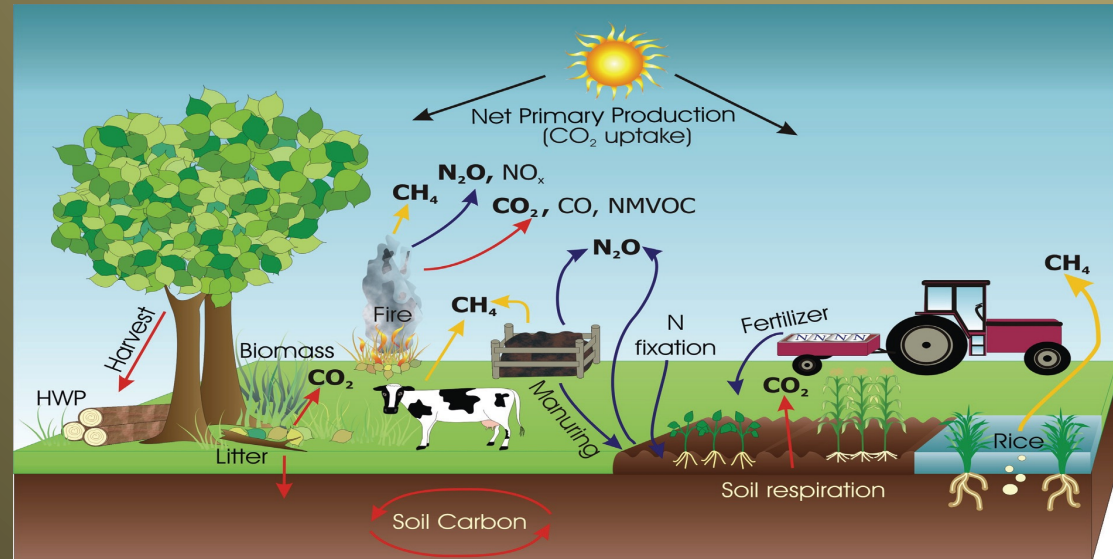
To download a copy of the Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2013:

http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

Thanks for listening!

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