

4-27-2019

## **Predicting Fish Distributions in Remote Areas Using E-DNA, Satellites and Models**

Jessie Doyle  
*California State University, Monterey Bay*

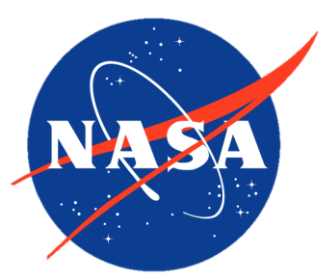
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Doyle, Jessie, "Predicting Fish Distributions in Remote Areas Using E-DNA, Satellites and Models" (2019).  
*CSU Student Research Competition Delegate Entries*. 10.  
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# Predicting Fish Distributions in Remote Areas using E-DNA, Satellites and Models

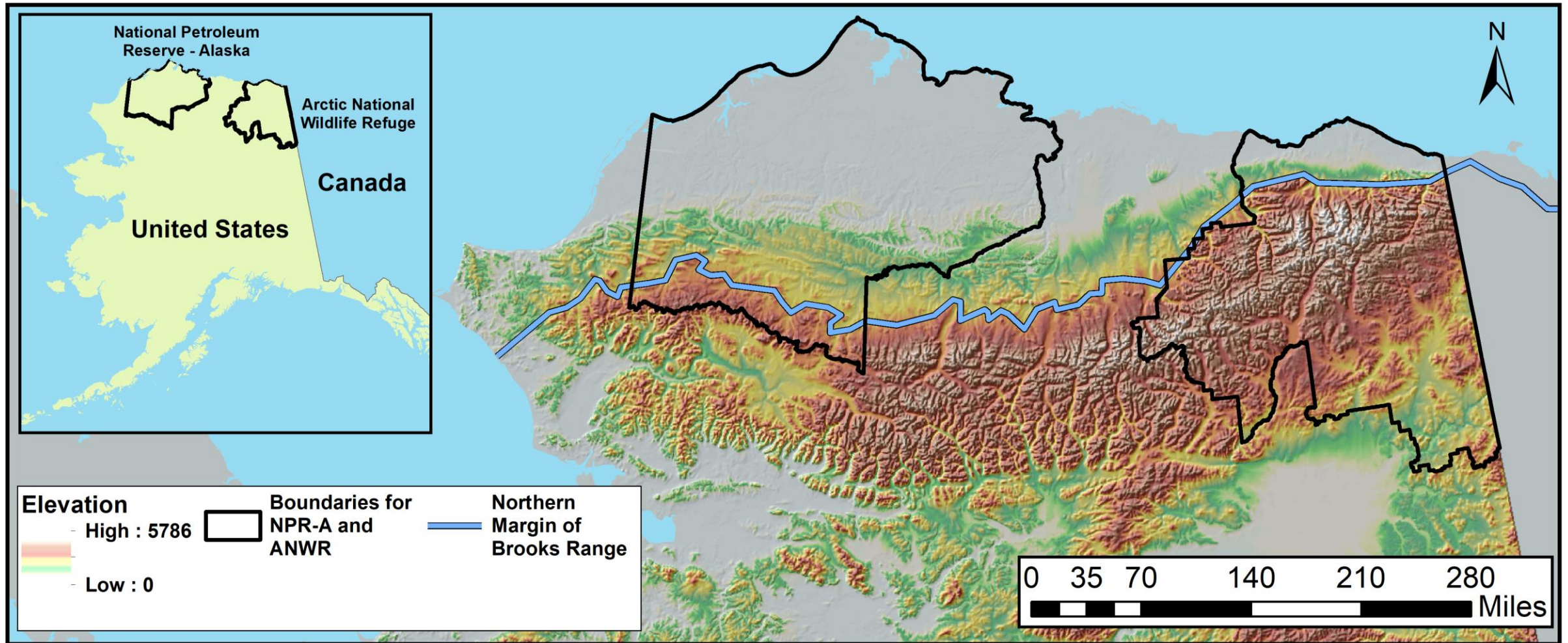
Presentation by Jessie Doyle

PI: Dr. John Olson



California State University  
**MONTEREY BAY**



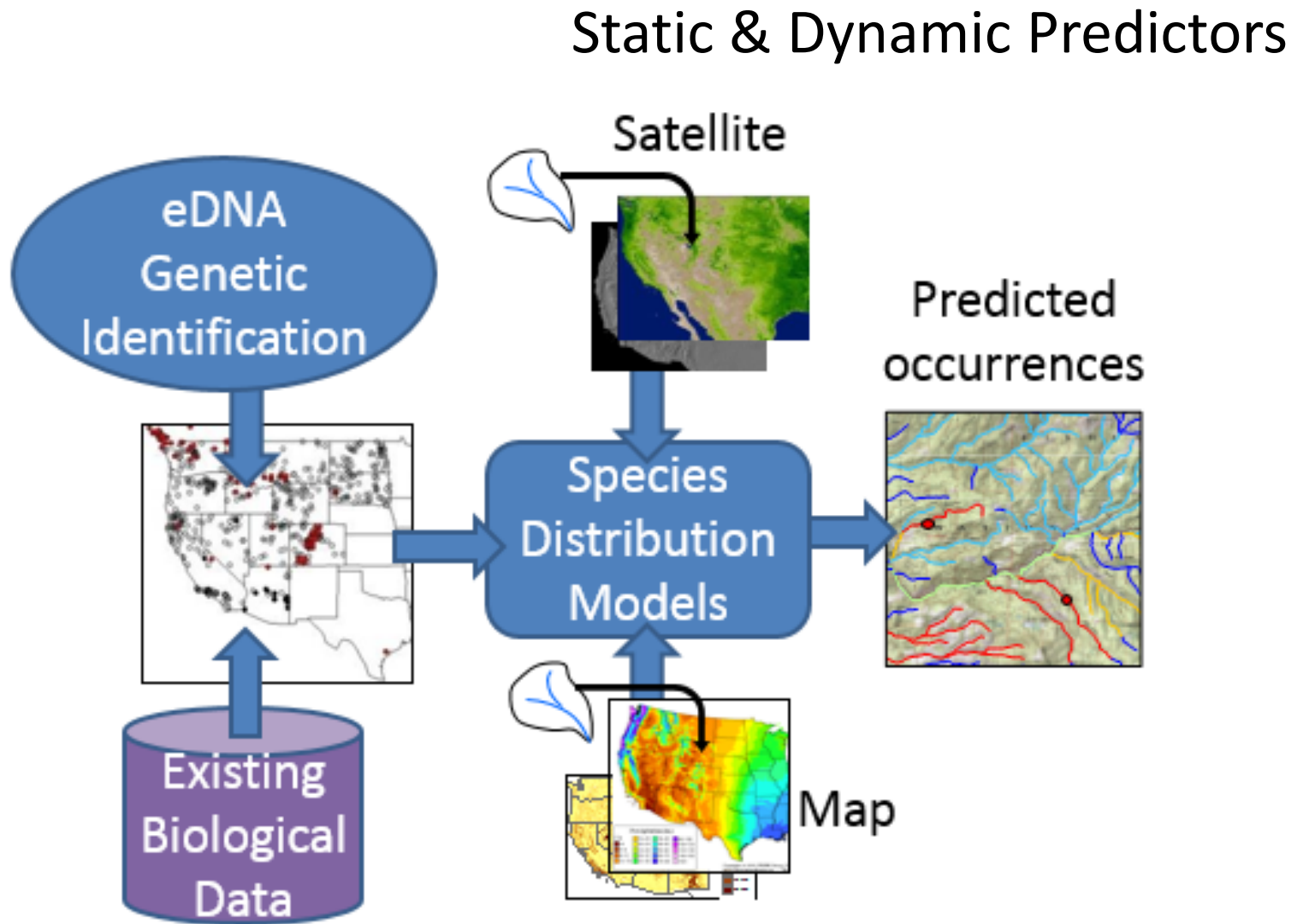
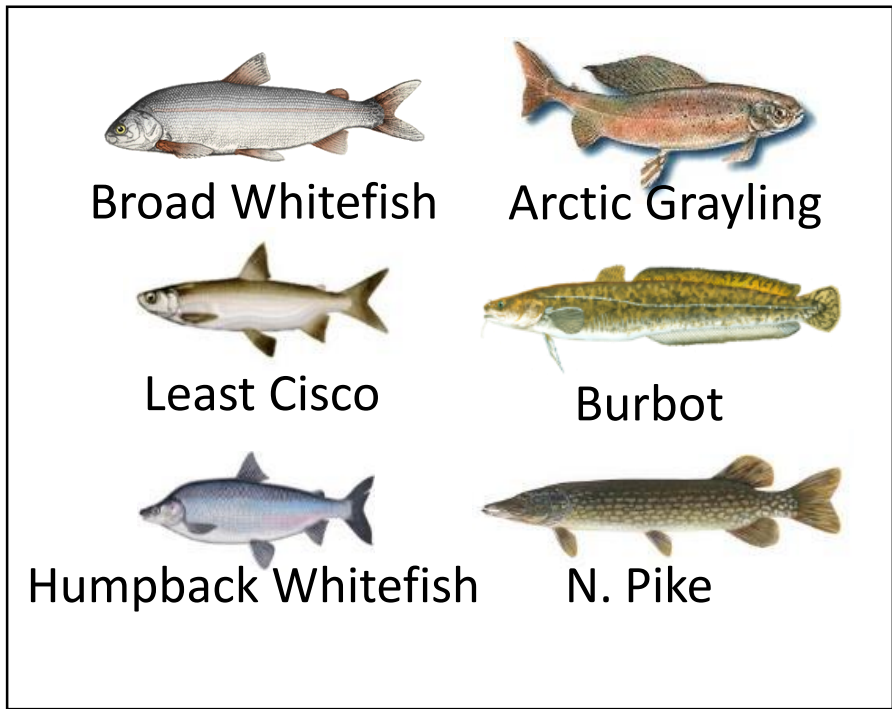


- Goal of our research is to develop predictive fish species distribution maps to help the BLM manage oil and gas development while protecting fish populations



Land Managers Dilemma:  
time/labor intensive, remote location, \$, missing data





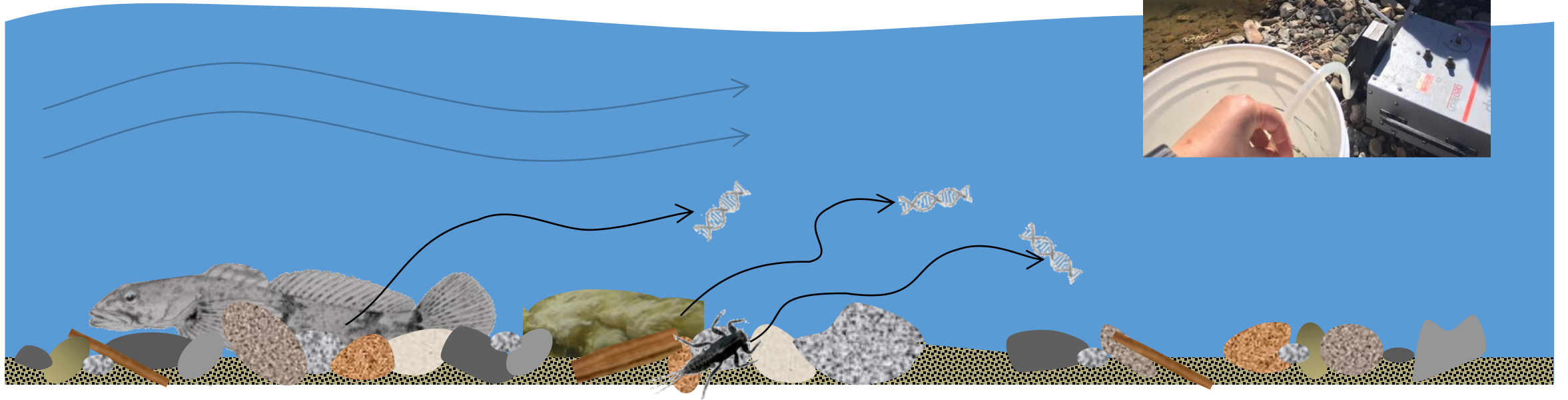
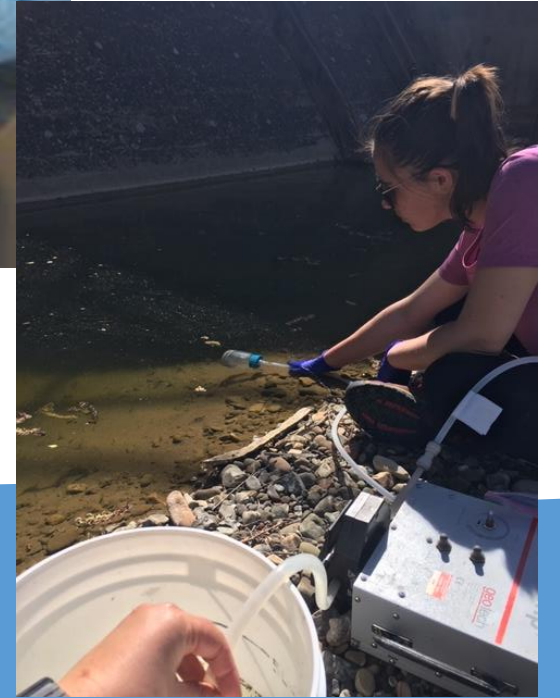
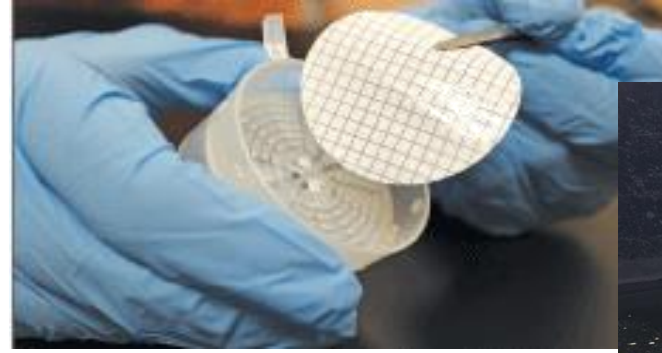
## Stream Characterizations at Landscape Scales - StreamCat

Hill et al., 2016, The Stream-Catchment (StreamCat) Dataset, JAWRA.  
<https://github.com/USEPA/StreamCat>

# Presence & Absence Observations

## Environmental DNA :

- **Detection rates 80-96%**
- **Faster & cheaper sampling (< 60 min, <\$30/sample)**



# Watershed Earth Observations

## Static Predictors

Percent Lakes Unfrozen (SAR)

Drainage Area

Stream Slope

Averages of Dynamic Predictors over Time (Length of Growing Season, ET)

Vegetation Type (Landsat)

Coastline Distance

## Dynamic Predictors

Active Layer Thickness

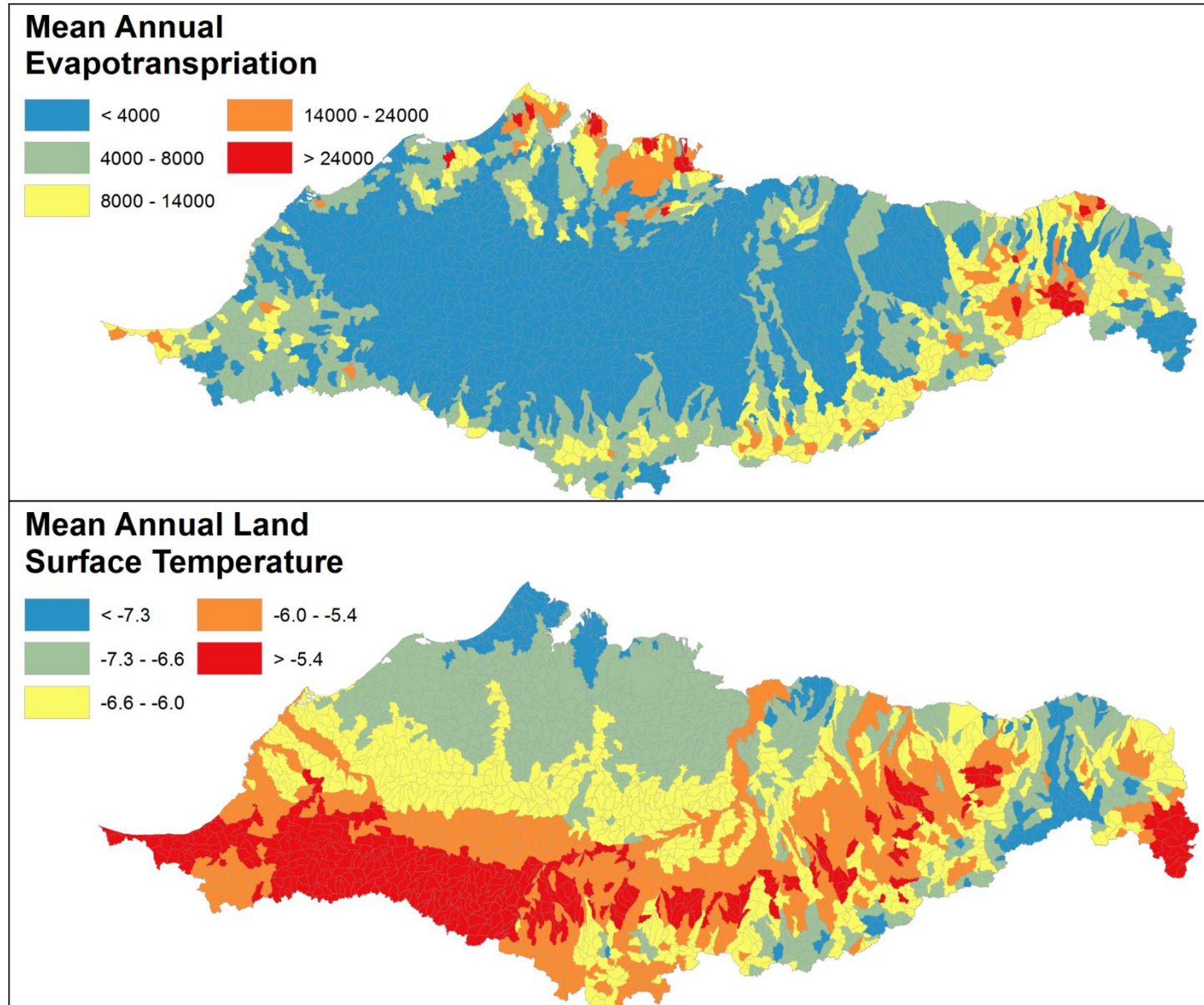
Evapotranspiration (MODIS)

Land Surface Temperature (MODIS)

EVI/GPP (MODIS)

Fire Activity (MODIS)

# NASA's "Moderate-resolution imaging spectroradiometer" (MODIS)







# National Aquatic Resource Surveys

CONTACT US

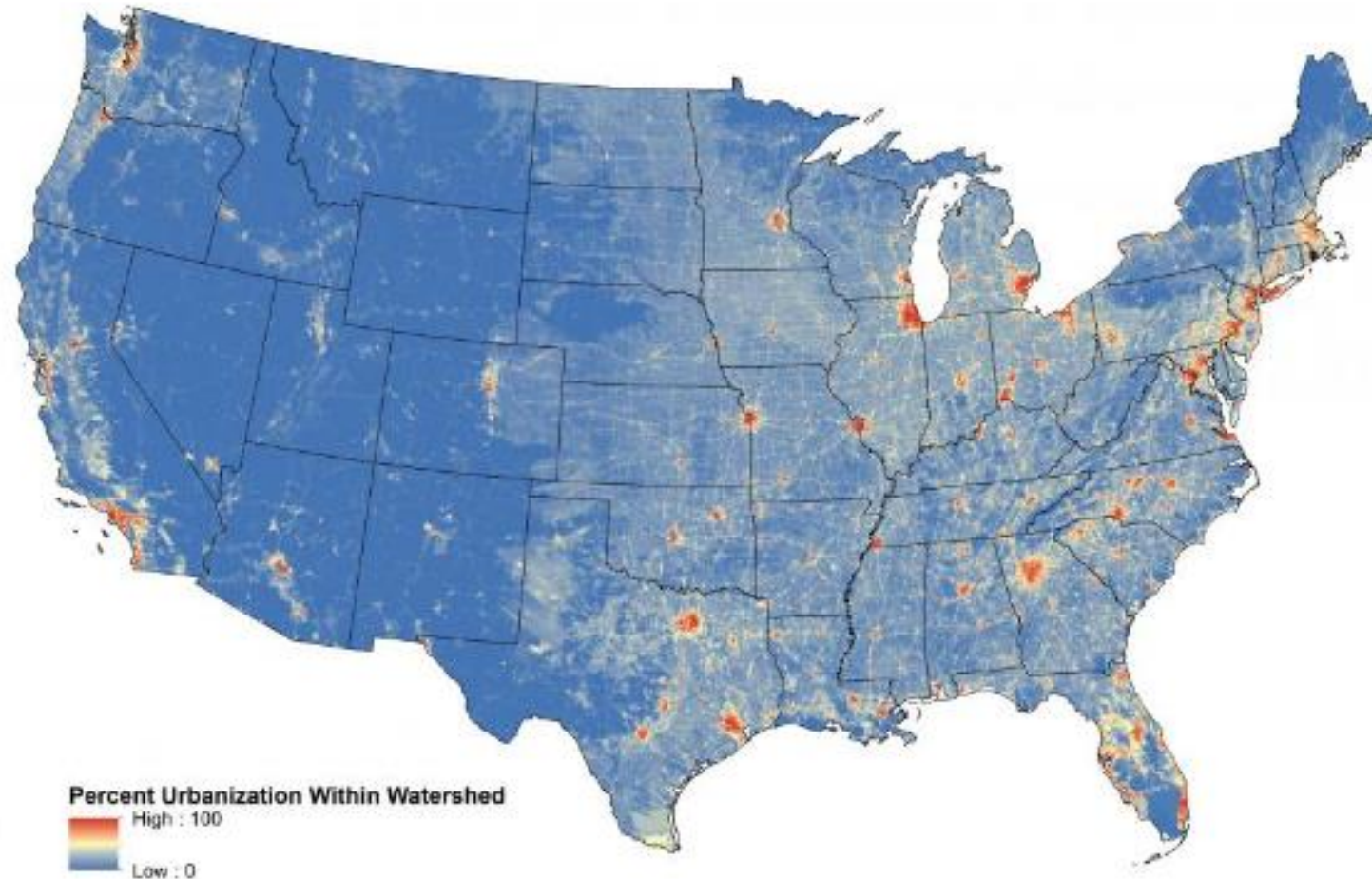
SHARE



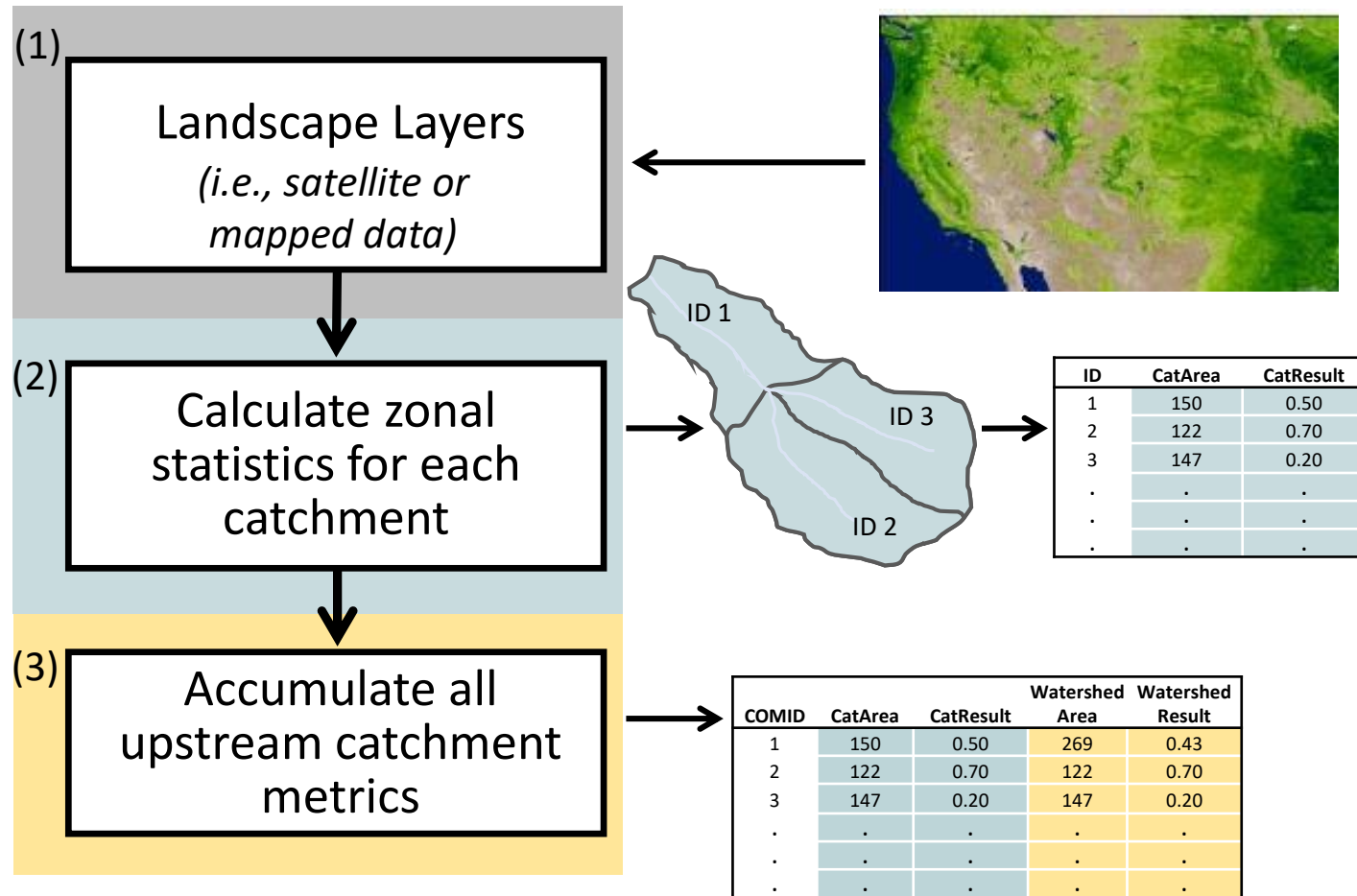
National Aquatic Resource Surveys Homepage

## StreamCat

<https://www.epa.gov/national-aquatic-resource-surveys/streamcat>



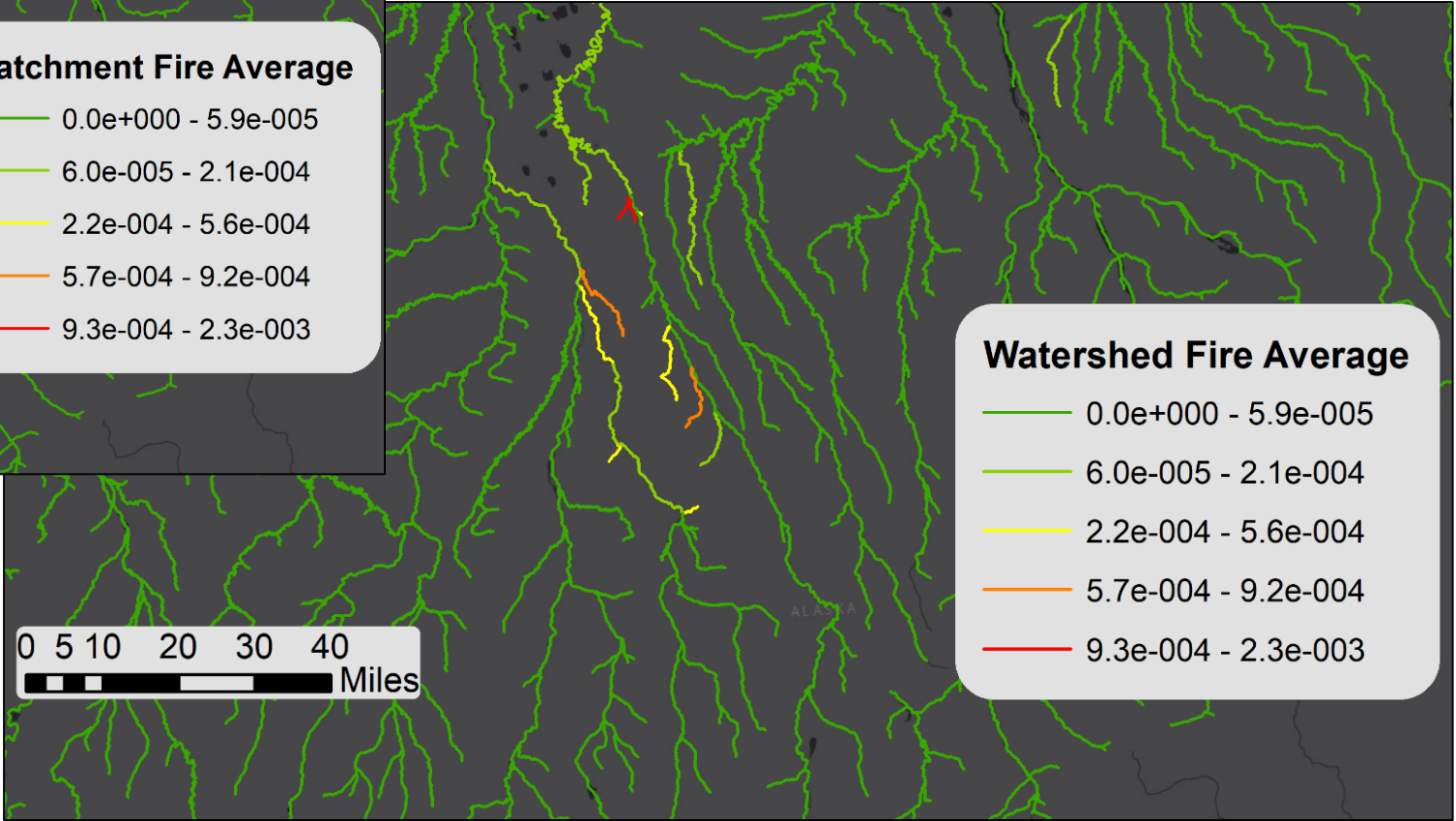
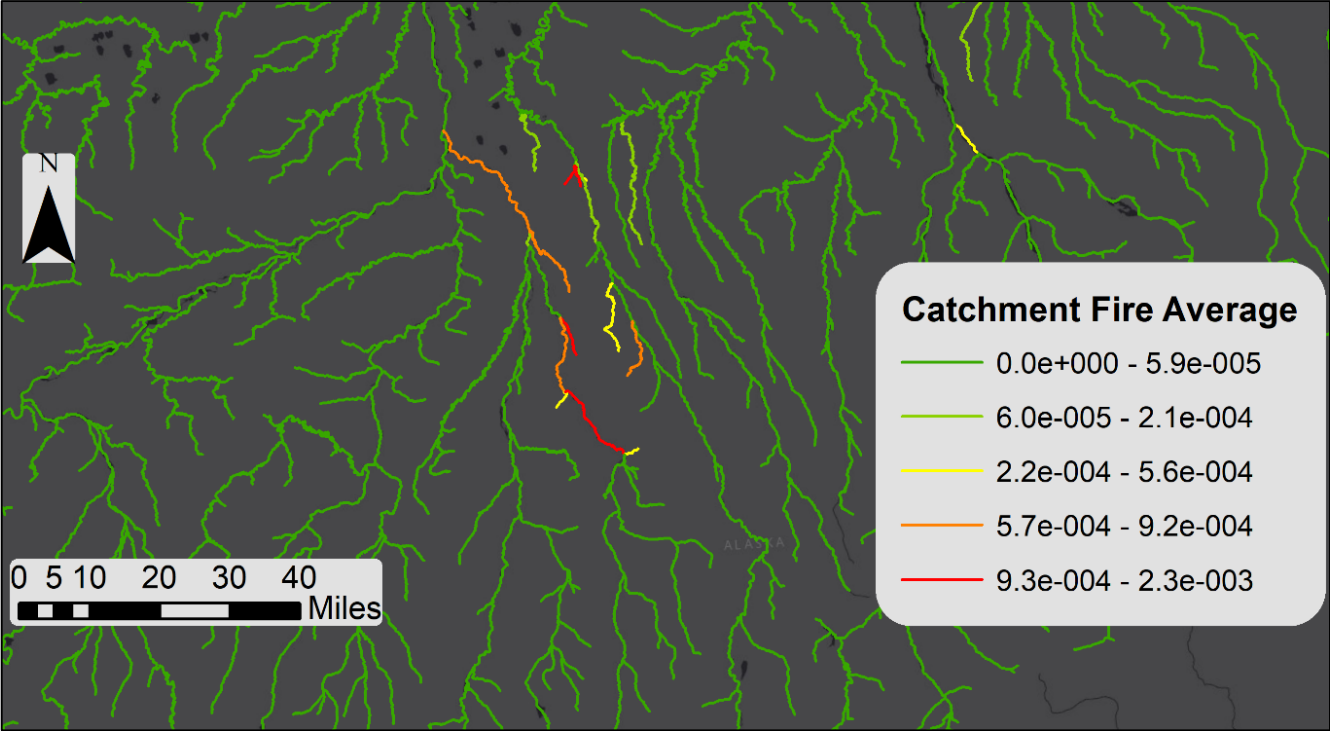
# Stream Characterizations at Landscape Scales - StreamCat



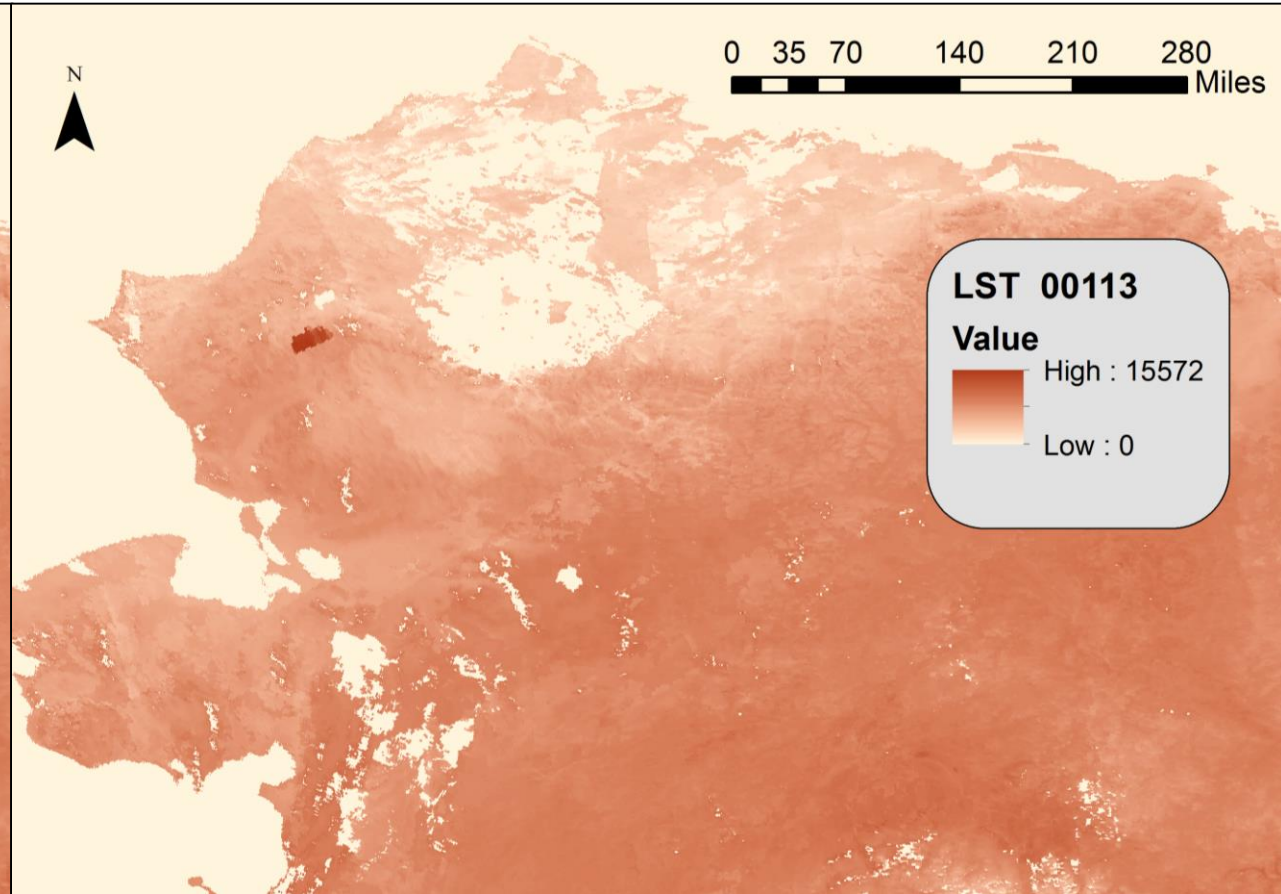
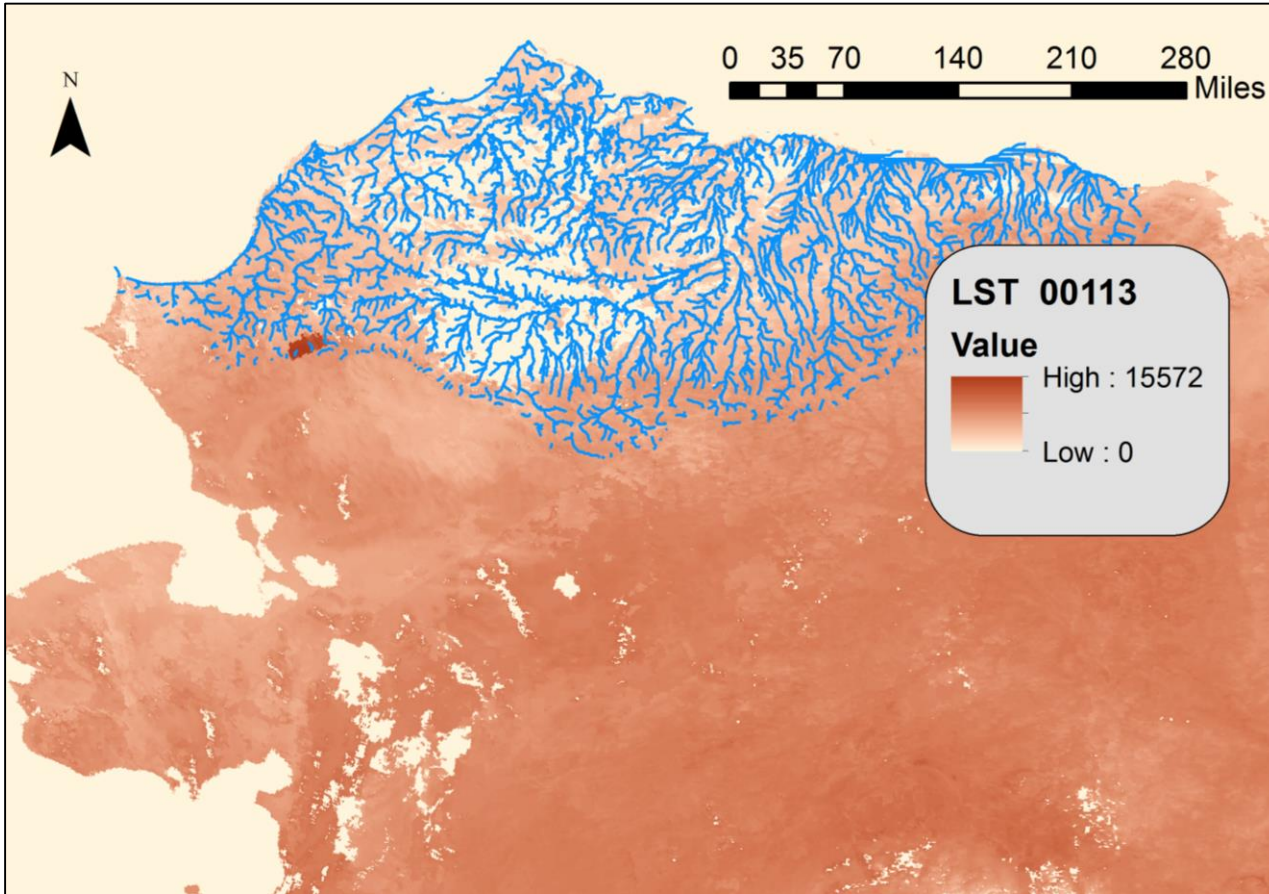
Hill et al., 2016, The Stream-Catchment (StreamCat) Dataset, JAWRA.  
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# Average Fire Index Values - MODIS

- Fire may have more of a local impact
- Watershed level impacts may be diluted



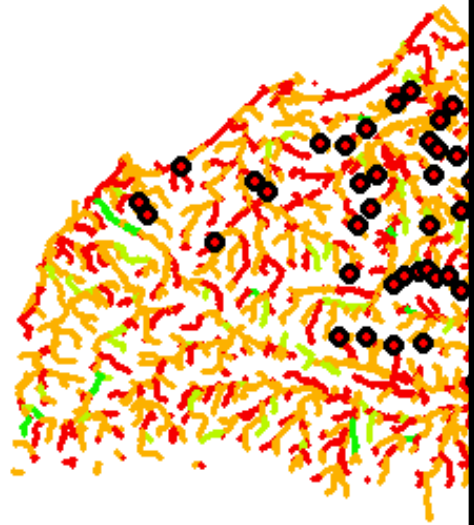
# MODIS Caution of Alaska



# Final Products

## Chinook Salmon (Ots) Model Predictions

EnsembleSimpleAvg



Fish Species	Best Model	AUC
Bering Cisco	PA_Static	0.994
Slimy Sculpin	PA_Dynamic	0.824
Broad Whitefish	PA_Static	0.907
Humpback Whitefish	PA_Static	0.966
Least Cisco	PA_Dynamic	0.924
Alaska Blackfish	PA_Static	0.99
Burbot	PA_Static	0.808
Round Whitefish	PA_Dynamic	0.931
Ninespine Stickleback	PA_Dynamic	0.777



0

500



km

51% - 75%

76% - 100%

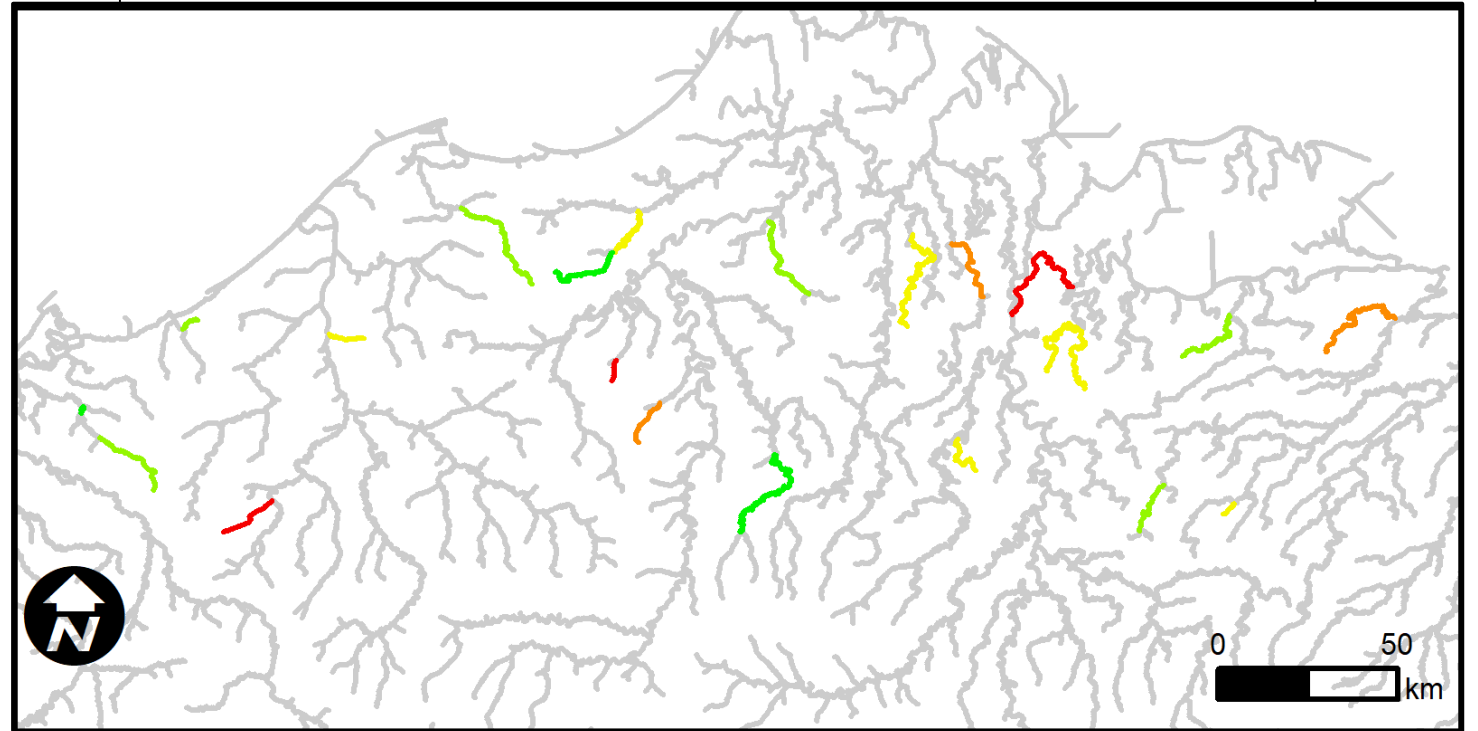
# Species Richness

➔ Sum of all  
Probabilities of  
Detection

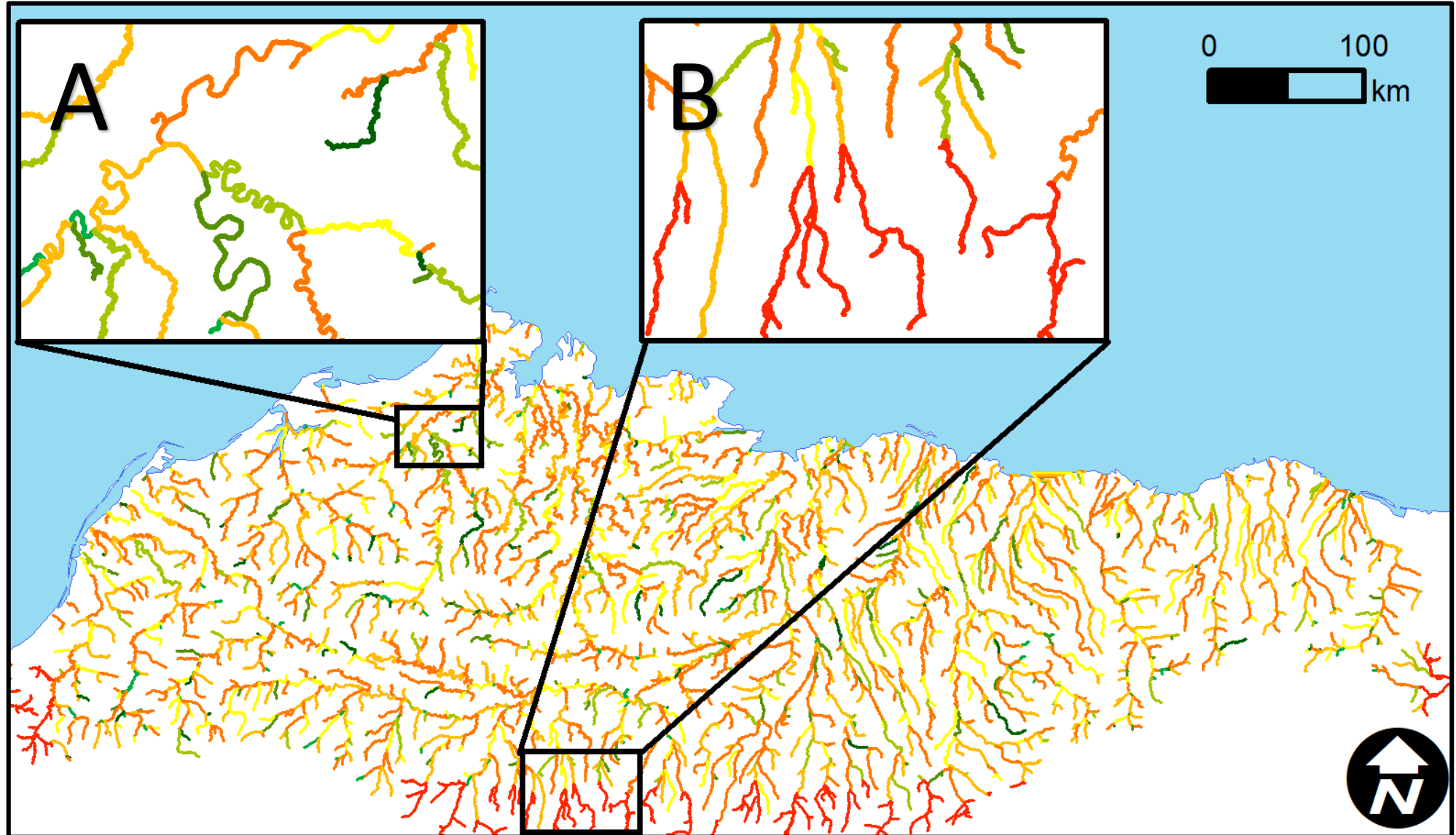
➔ Ex:

$$(0.25 + 0.25 + 0.75 + 0) = 1.25 \text{ richness at COMID } 3147$$

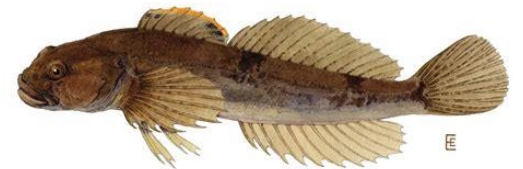
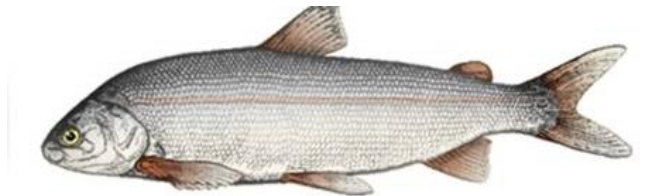
Richness Histogram



# Land Management Application

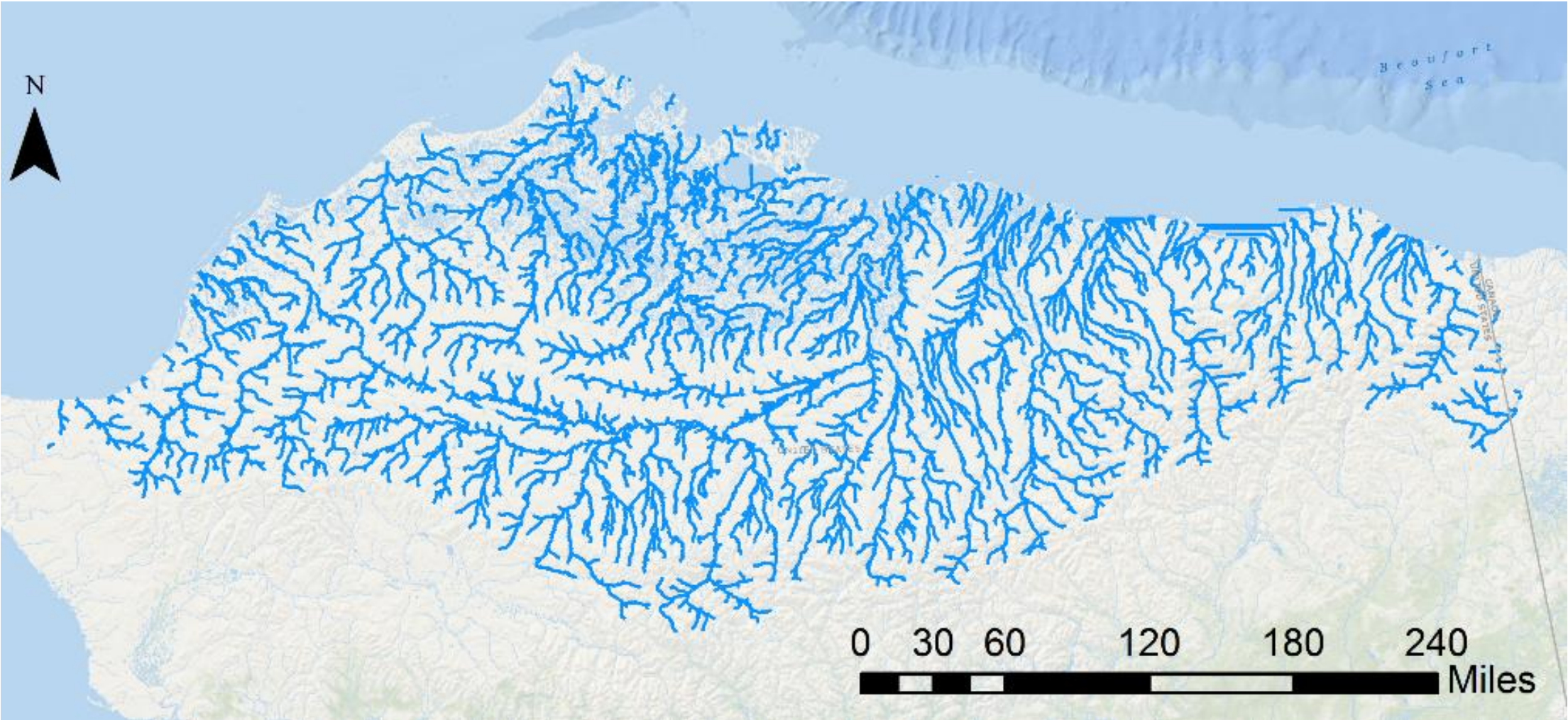
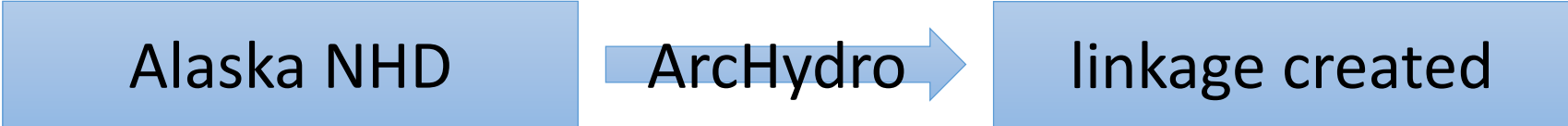


Questions?





# Challenges – StreamCat & NHD plus



```

25 # > Python "F:\Watershed Integrity Spatial Prediction\Scripts\StreamCat.py"
26 # L:\Priv\CORFiles\Geospatial_Library\Data\Project\SSWR1.1B\ControlTables\ControlTable_StreamCat.csv
27 # -----
28
29 import sys
30 import os
31 import pandas as pd
32 # Load table used in function argument
33 #ctl = pd.read_csv(sys.argv[1])
34 ctl = pd.read_csv('D:/GIS/AK/Accumulations/ControlTable_StreamCat.csv')
35
36 # Import system modules
37 from collections import OrderedDict
38 from datetime import datetime as dt
39 import geopandas as gpd
40 #sys.path.append(ctl.DirectoryLocations)
41 sys.path.append('D:/GIS/AK/Accumulations/Scripts')
42 from StreamCat_functions import createAccumulations
43 #####
44 # Populate variables from control table
45 ingrid_dir = ctl.DirectoryLocations.values[1]
46 NHD_dir = ctl.DirectoryLocations.values[3]
47 out_dir = ctl.DirectoryLocations.values[4]
48 numpy_dir = ctl.DirectoryLocations.values[5]
49 interVPU_dir = ctl.DirectoryLocations.values[6]
50 pct_full_file = ctl.DirectoryLocations.values[7]
51 mask_dir = ctl.DirectoryLocations.values[10]
52 #####
53 #inputs = OrderedDict([('10U', 'MS'), ('11U', 'MS'), ('12U', 'MS'), ('13U', 'SA'), ('14U', 'SA'), ('15U', 'SA'), ('16U', 'SA'), ('17U', 'SA'), ('18U', 'CA')])
54 #
55 #
56 #
57 #
58 inputs = OrderedDict([('16', 'GB')])
59
60 totTime = dt.now()
61 interVPUtbl = pd.read_csv(interVPU_dir)
62 if not os.path.exists(numpy_dir):
63     os.mkdir(numpy_dir)
64     makeNumpyVectors(numpy_dir, interVPUtbl)
65 for line in range(len(ctl.values)): # Loop through each FullTableName in control table
66     if ctl.run[line] == 1: # check 'run' field from the table, if 1 run, if not, skip
67         # break
68         print 'running ' + str(ctl.FullTableName[line])
69         accum_type = ctl.accum_type[line] # Load metric specific variables
70         RPU = int(ctl.by_RPU[line])
71         mask = ctl.use_mask[line]
72         appendMetric = ctl.AppendMetric[line]
73         if appendMetric == 'none':
74             appendMetric = ''
75         if mask == 0:
76             mask_dir = ''

```

	1	2
1		DirectoryLocations
2	ingrid_dir	D:/Akdata/Temp-ET/Fire
3	NHD_dir	D:/Akdata/Hydro/NHDPlusV21new
4	out_dir	D:/Akdata/Accumulations/Fire_practice/Allocation_and_Accumulation
5	numpy_dir	D:/Akdata/Accumulations/Fire_practice/npStreamCat
6	interVPU_dir	D:/Akdata/Accumulations/Fire_practice/InterVPU.csv
7	pct_full_file	D:/Akdata/Accumulations/Fire_practice/catFINAL_Clip.dbf
8	StreamCat_repo_dir	D:/Akdata/Accumulations/Fire_practice/Scripts
9	final_tables_dir	D:/Akdata/Accumulations/Fire_practice/HydroRegions
10	mask_dir	D:/GIS/Analysis/StreamCatTest3/QAComplete/buffer
11		
12		
13		
14		
15		

# Water Vapor - MODIS

