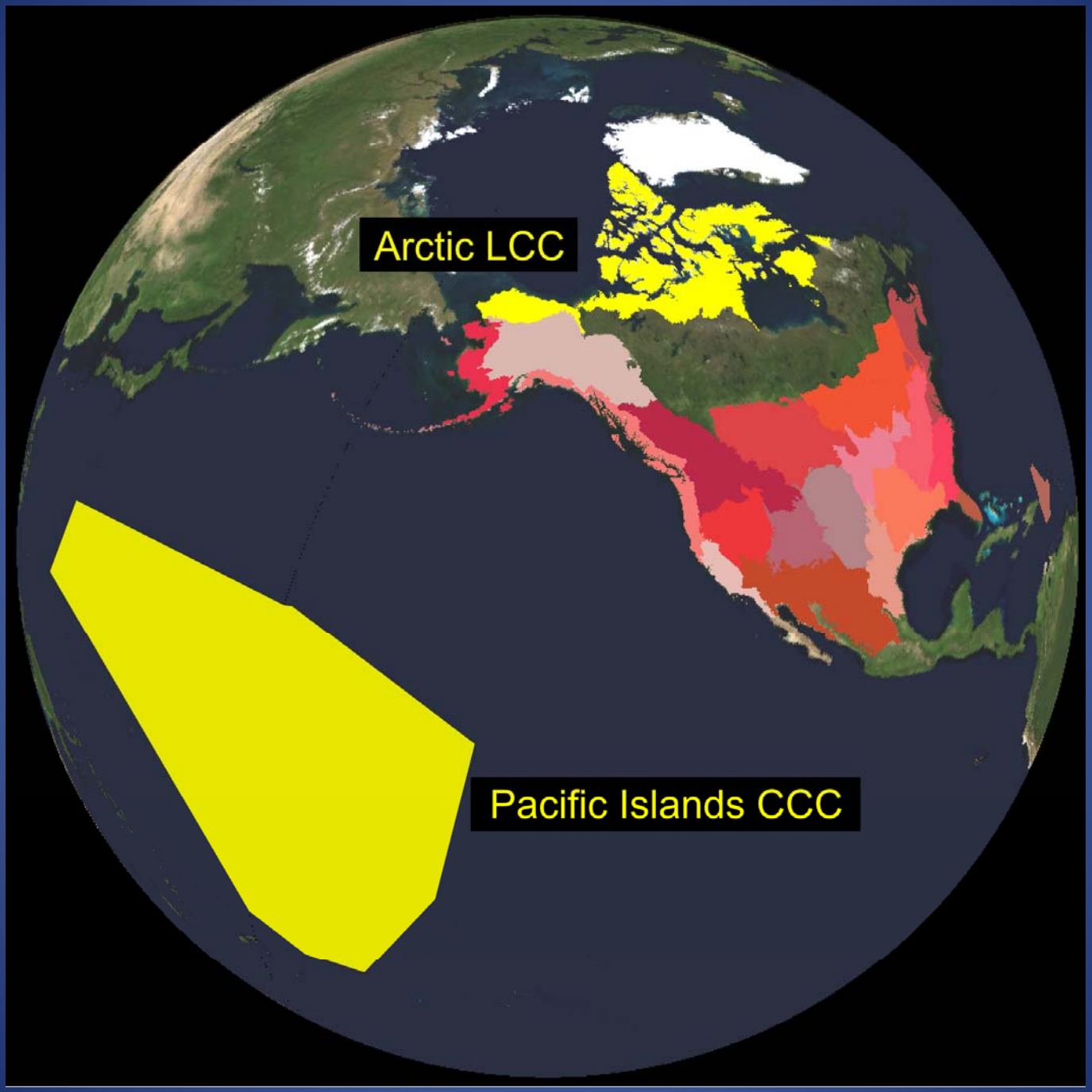
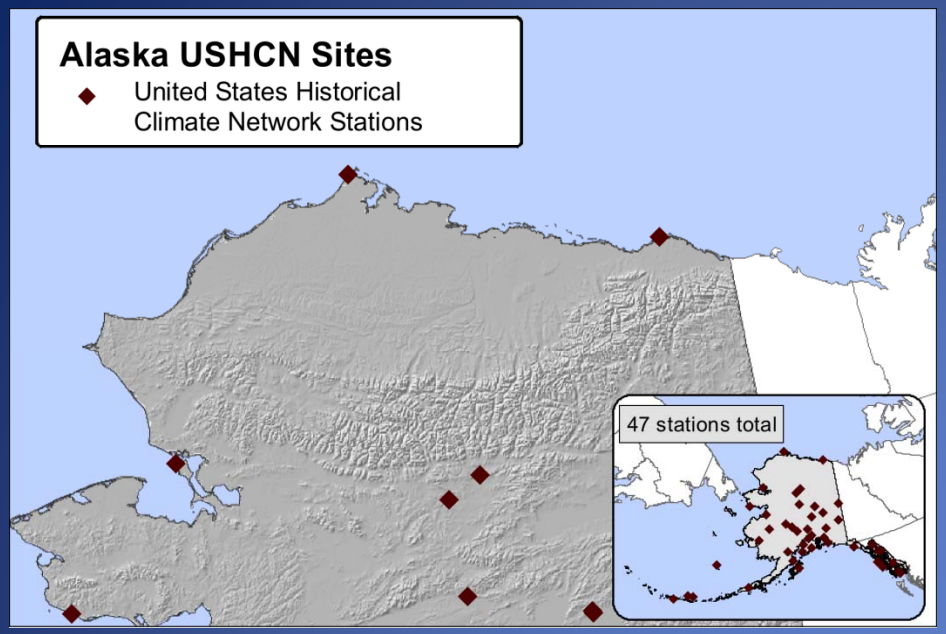
Pacific Islands Climate Change Cooperative

Arctic Landscape Conservation Cooperative

From Tundra to Tropics;

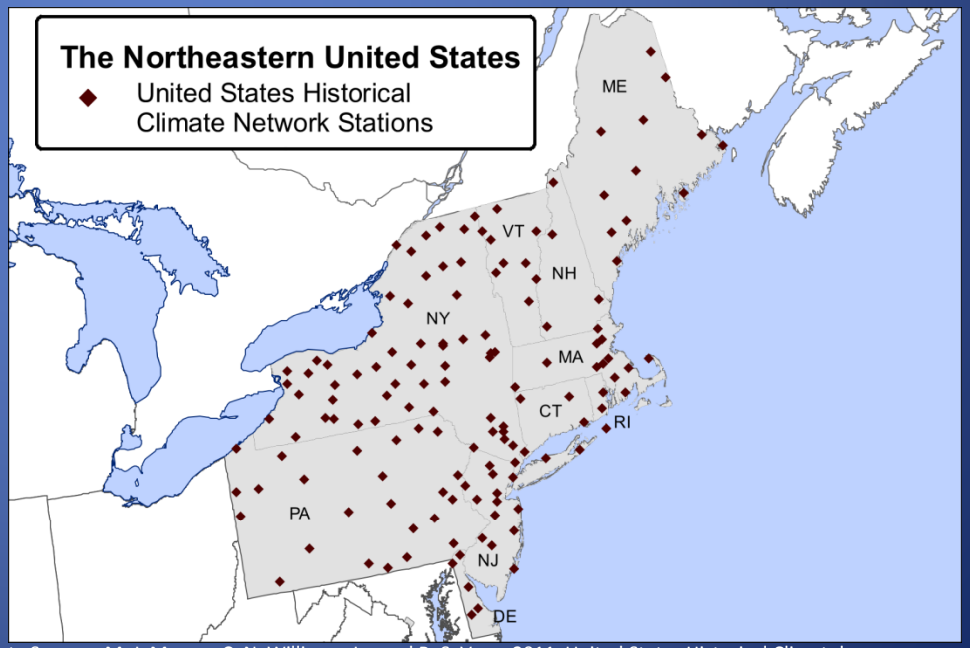
Collaborative Development of Ecological Models in a Data-Sparse Environment


Arctic LCC
Pacific Islands CCC



Data Source: http://climate.gi.alaska.edu/Climate/Networks/USHCN.html

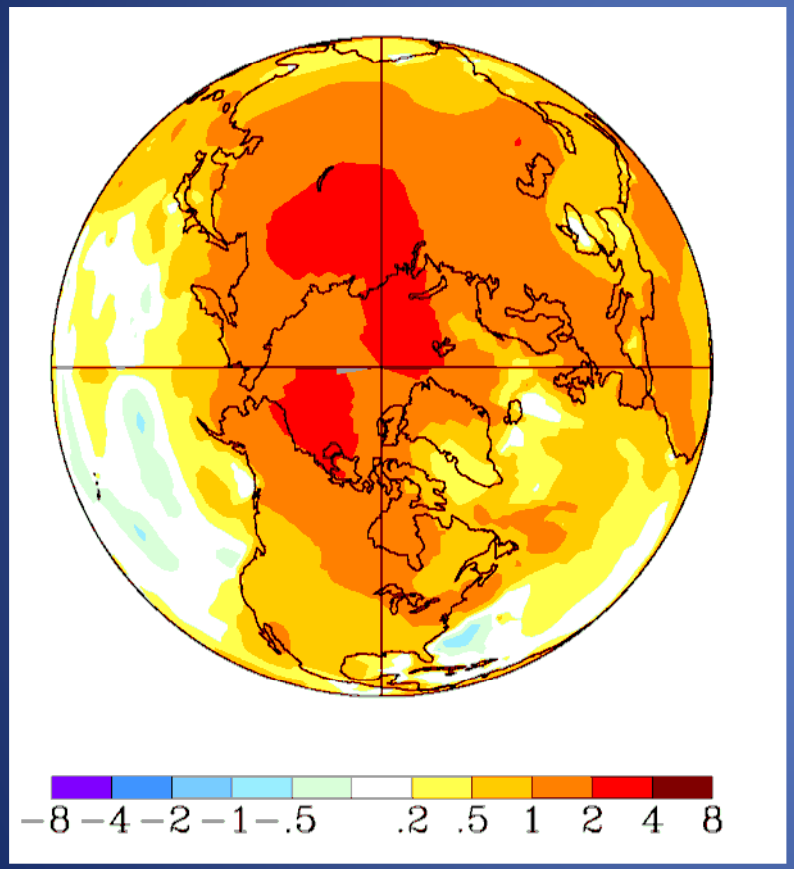
U.S. Historical Climate Network Stations in northern Alaska, compared to Northeast U.S., an area of comparable size.



Data Source: M. J. Menne, C. N. Williams, Jr., and R. S. Vose, 2011. United States Historical Climatology Network Daily Temperature, Precipitation, and Snow Data. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee. Last updated August 2011.

Storm Hits Barrow, Alaska
U.S. Army Corps of Engineers

Historic Temperature



Temperature Change, °C
1958-2008

Temperature Trends

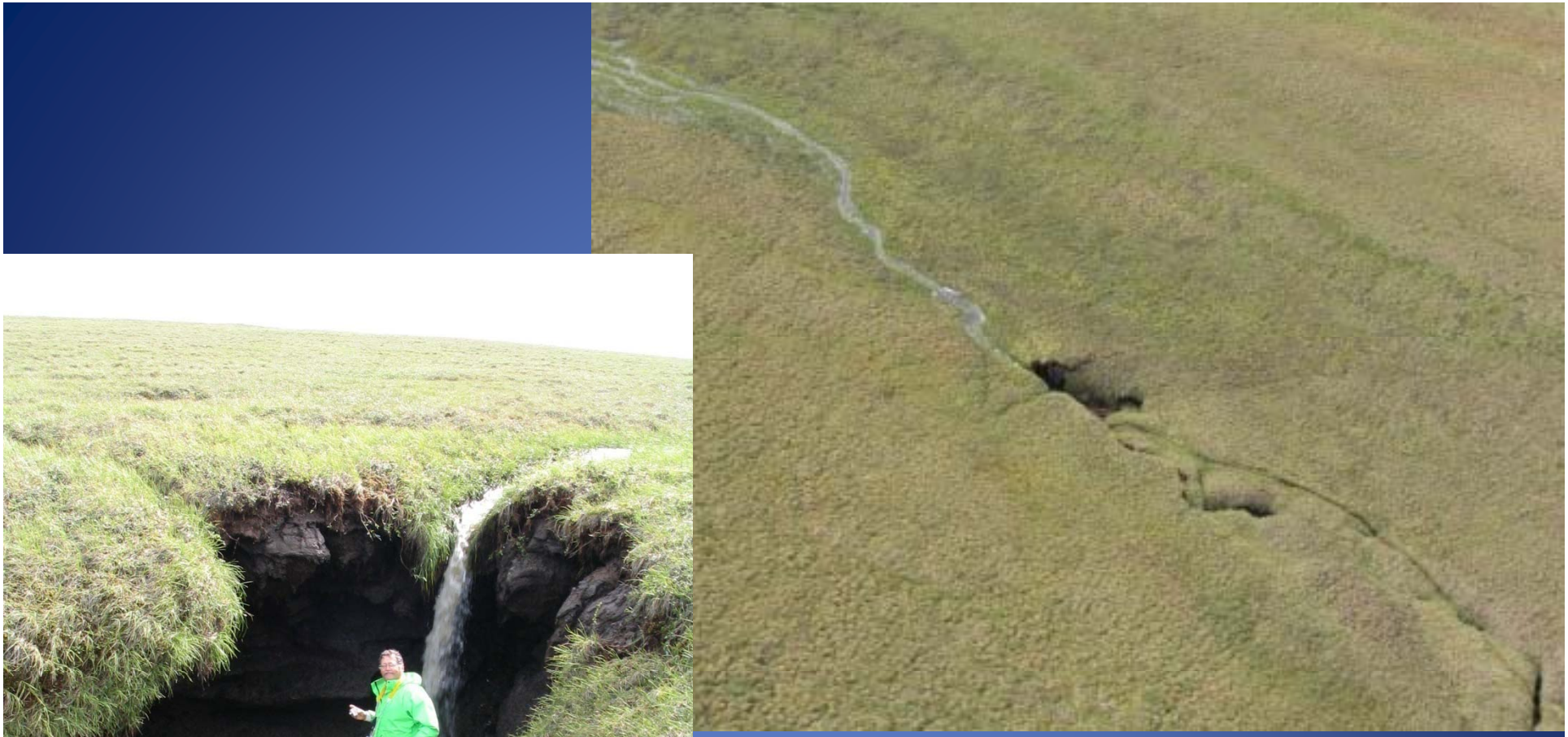
"Lower 48" = 1° F /Century

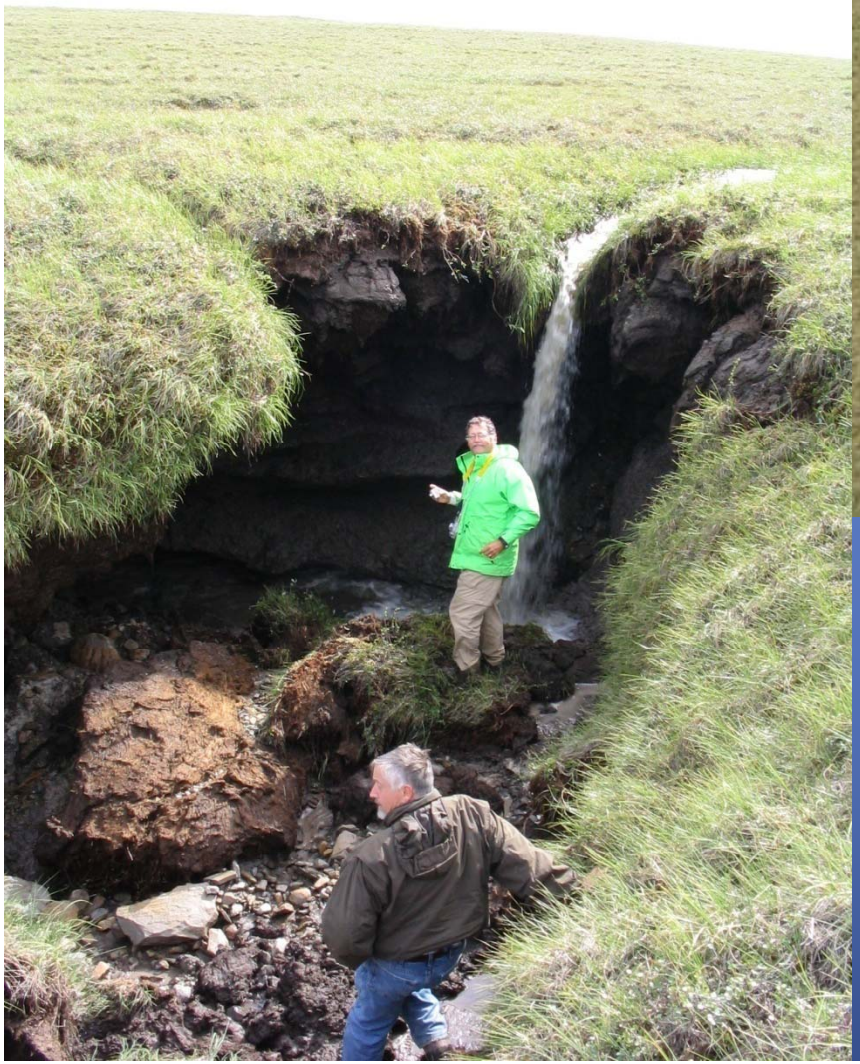
Alaska = 5.2° F /Century*

Barrow = 7.3° F /Century*

*Source: Alaska Climate Research Center

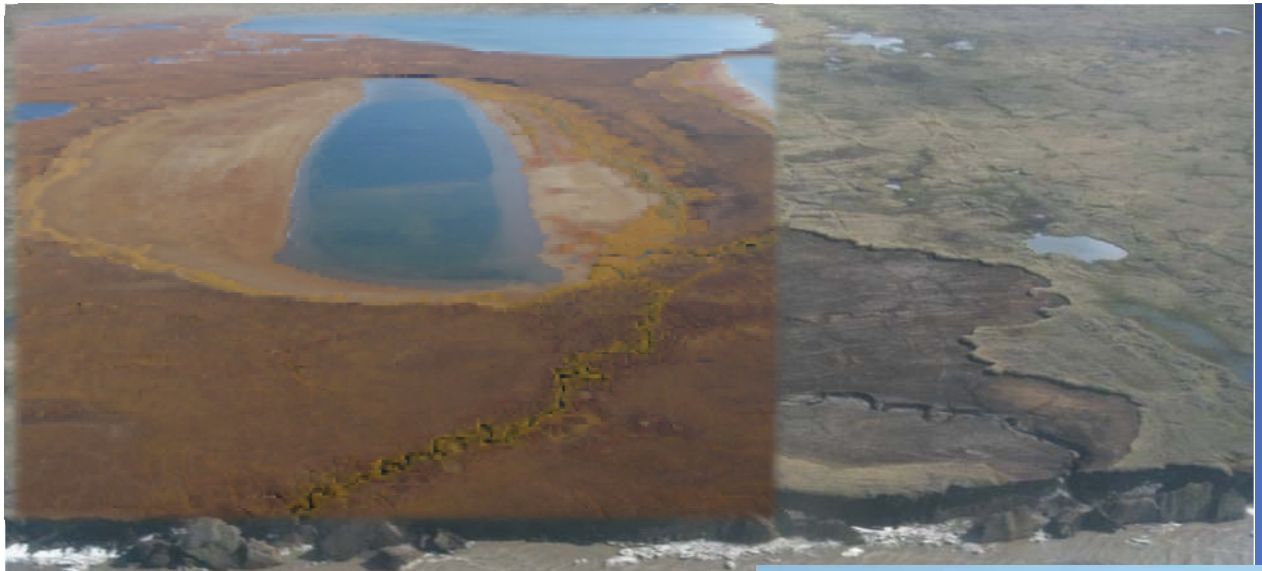
1949-2008 Weather Station Data





Thermokarst

Photos by Michael Goosseff



Changes in Hydrology

Photo by Ben Jones, USGS.

Photo by Doug Kane, UAF.

Impacts of fire in the land of ice

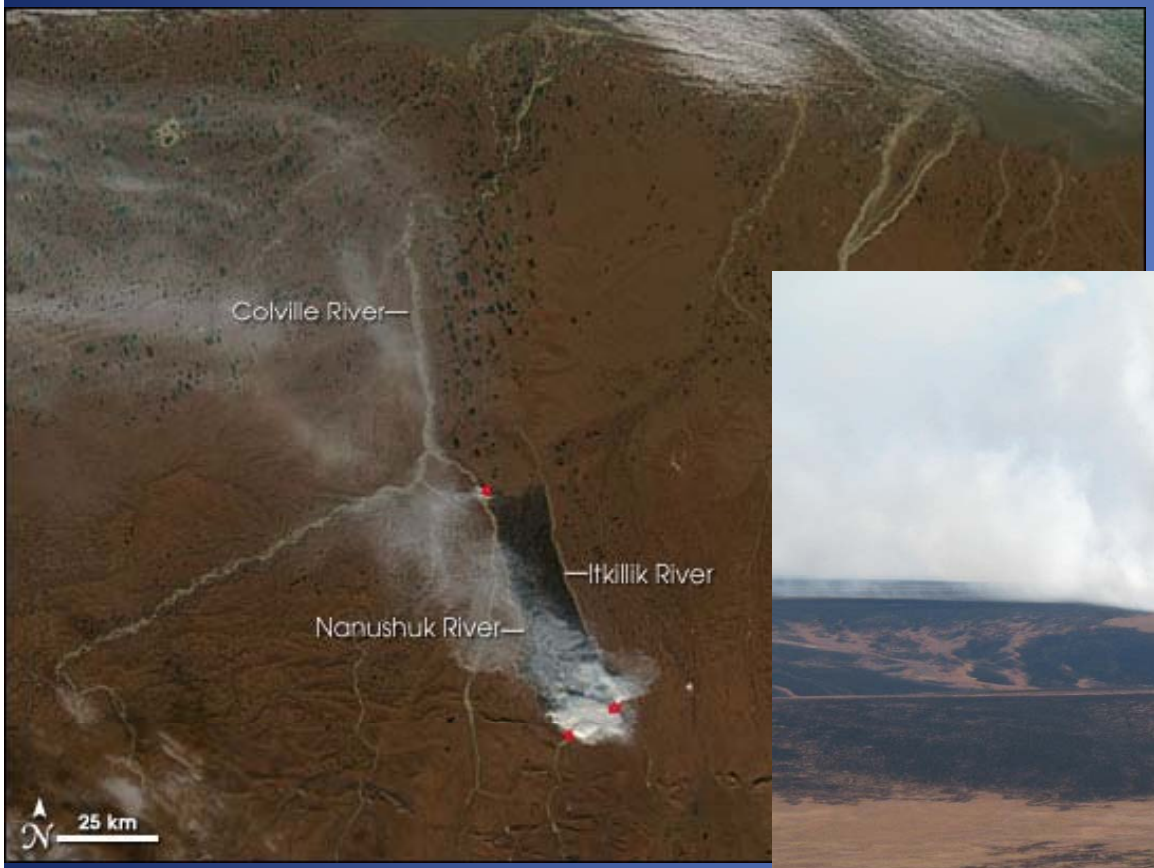
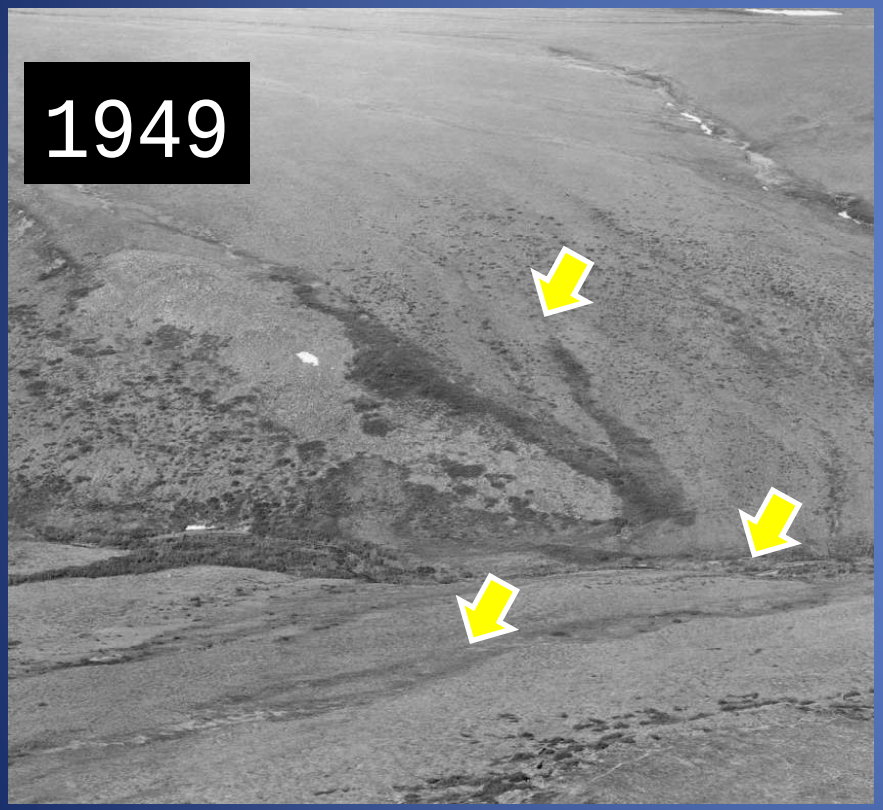
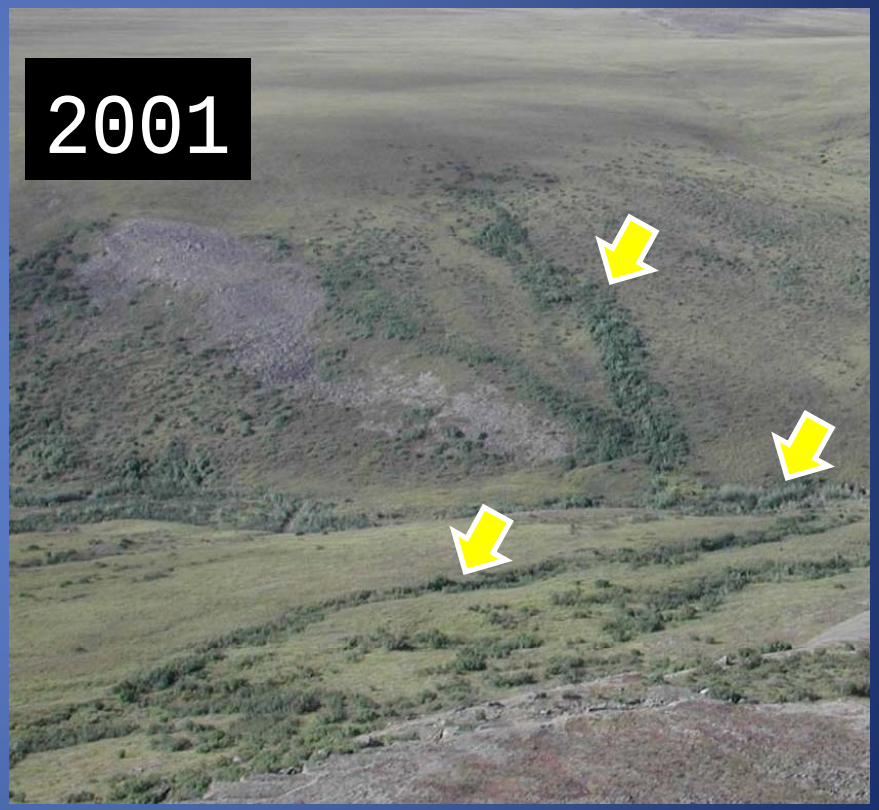


Photo by Ben Jones, USGS.

“Shrubification”





Photos by Matthew Sturm

“Shrubification”

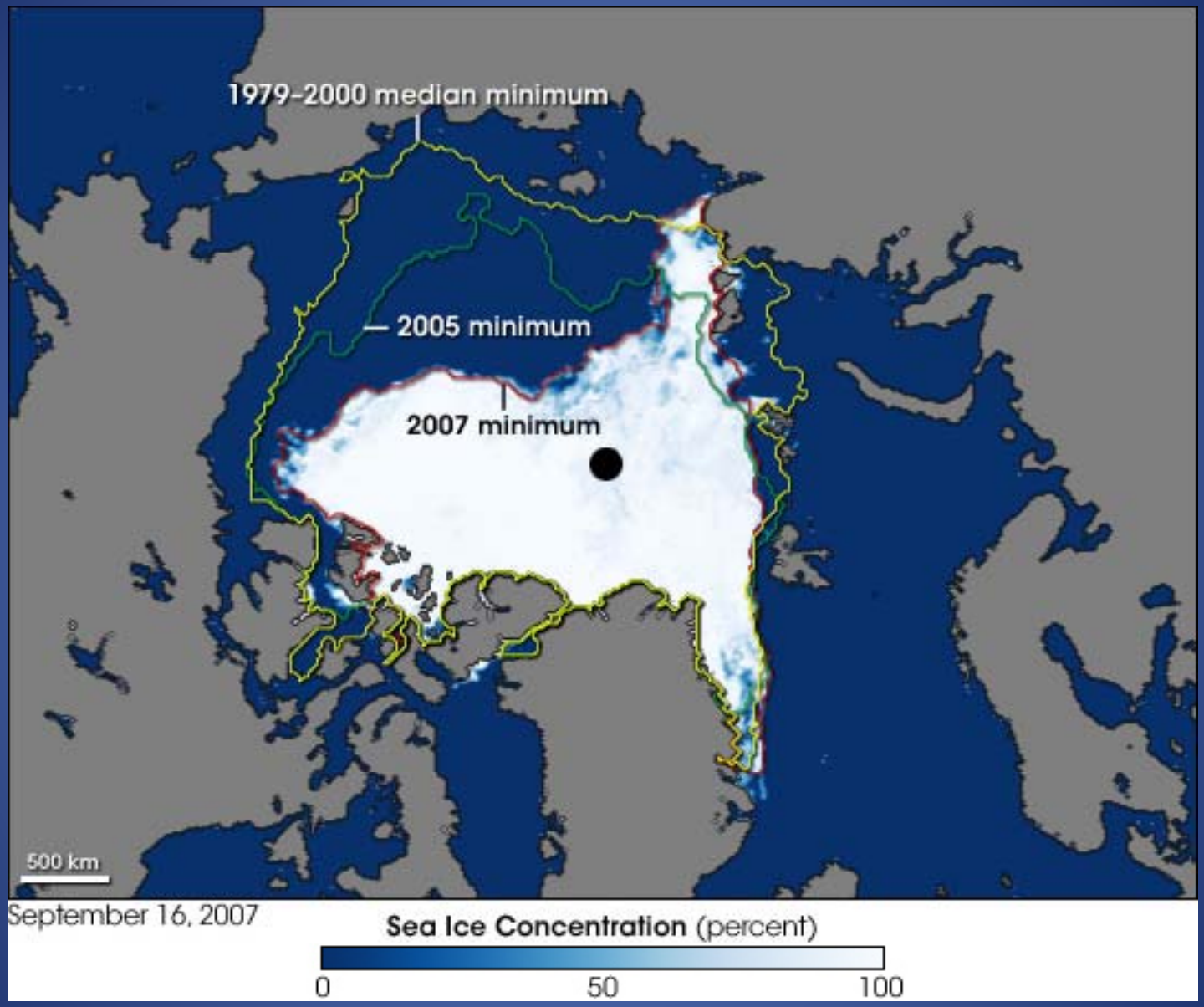
Normal Polygonal Terrain

Future Normal?

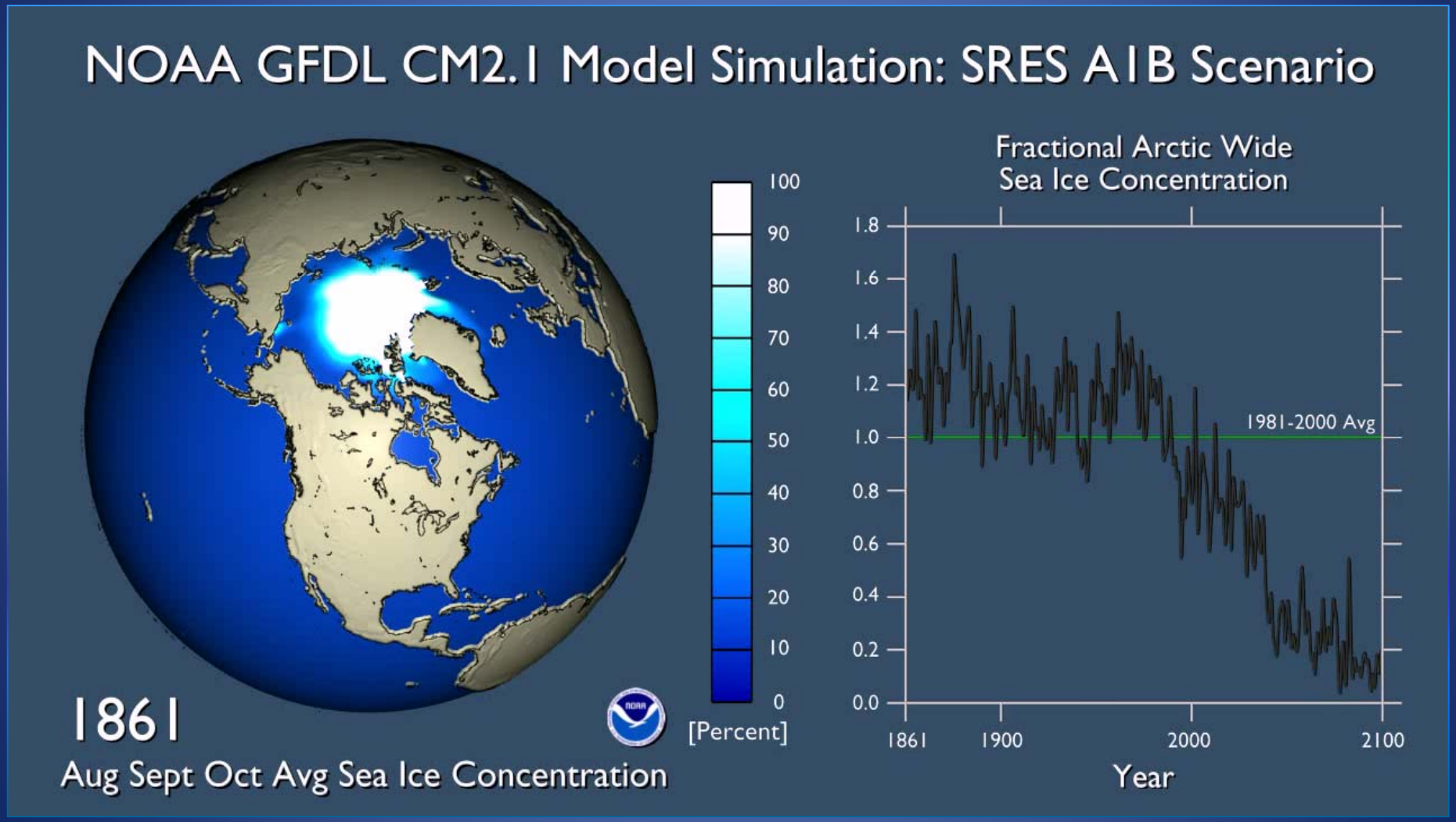
Photo by Torre Jorgenson

375 ppm
+1°C
450-500 ppm
+2°C
> 500 ppm
>+3°C

Hibiscadelphus woodii
Malvaceae
© Ken Wood

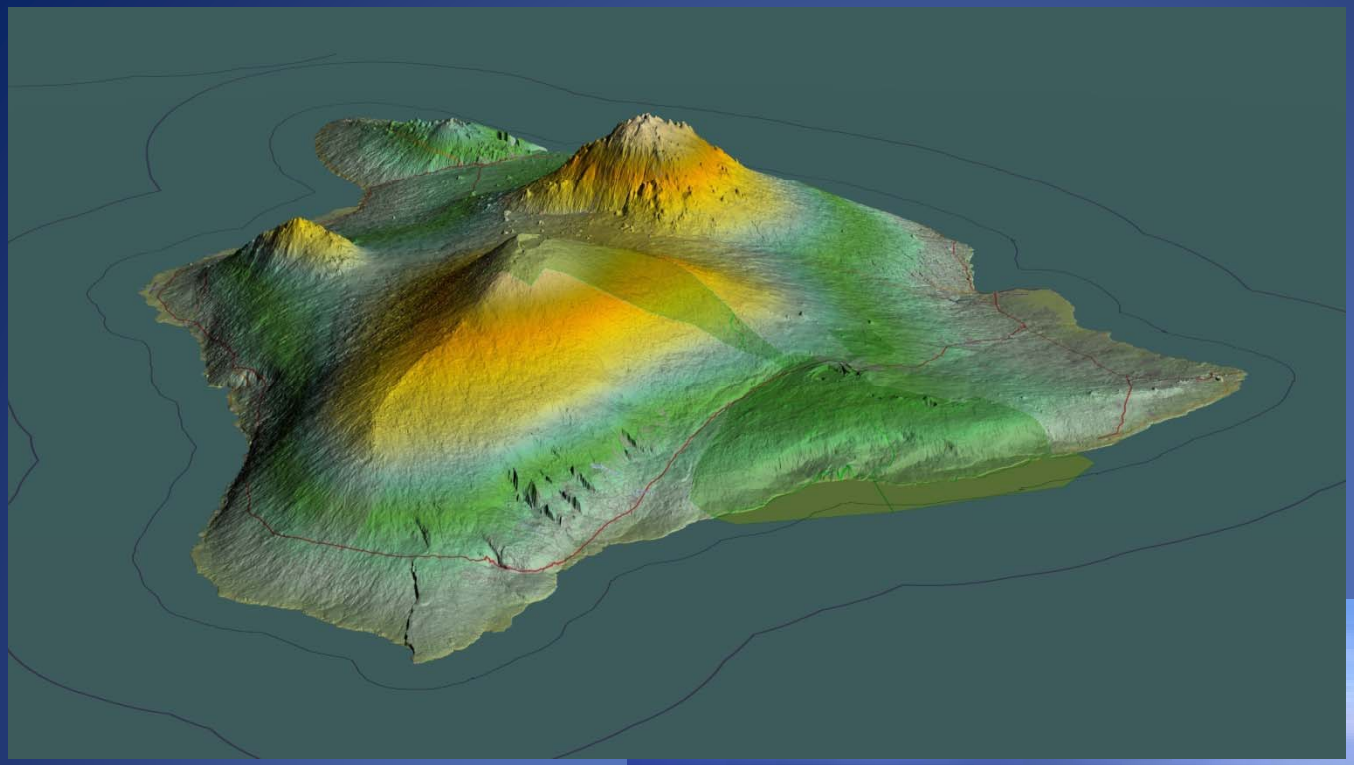

1979-2000 median minimum
2005 minimum
2007 minimum
500 km
September 16, 2007
Sea Ice Concentration (percent)
0
50
100

Sea ice animation – it actually works, yea!



Getty

© Carl Donohue/www.skolaiimages.com

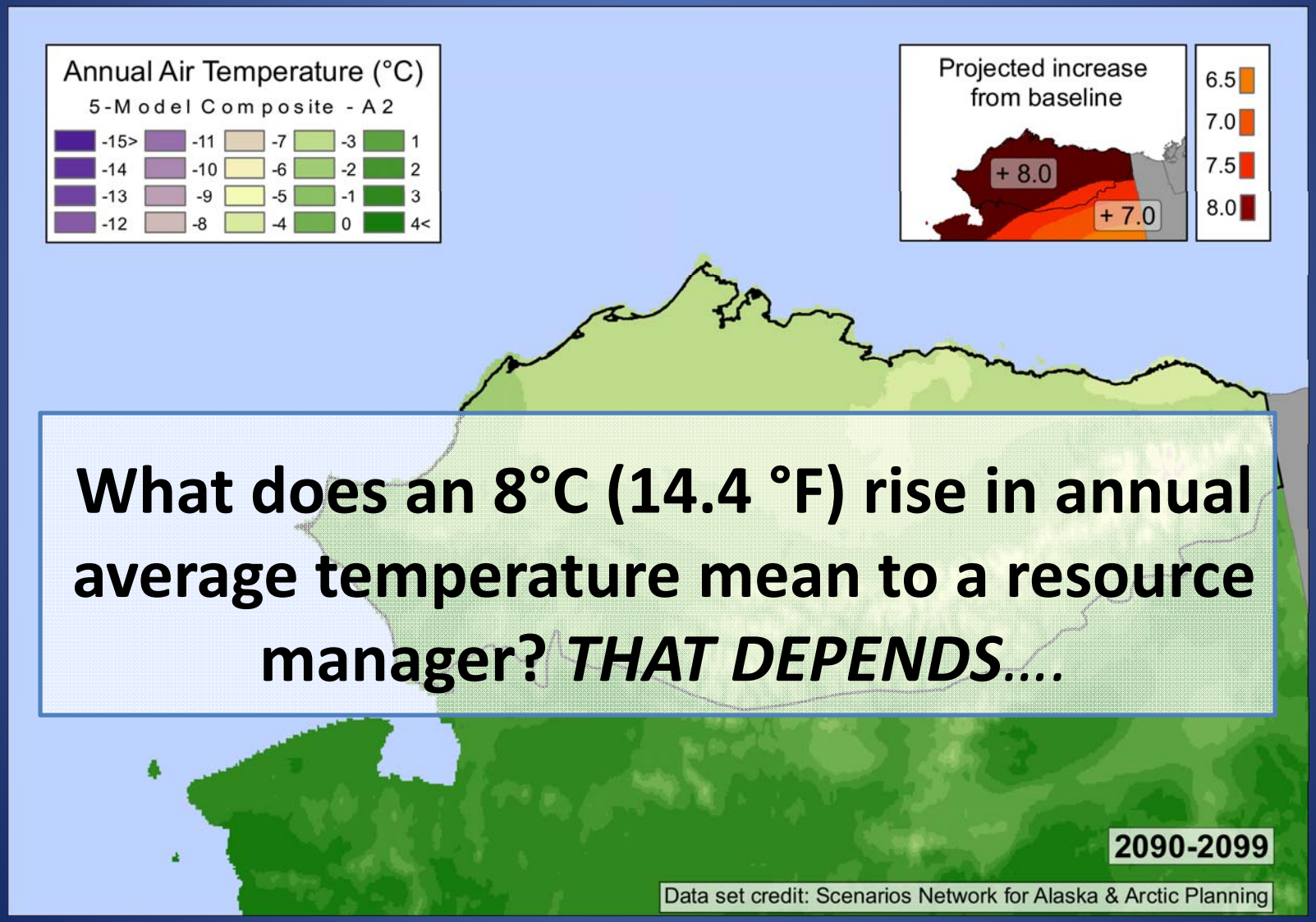


Chukchi Sea
Barrow
Russia
Alaska
Bering Sea
Izembek National
Wildlife Refuge
Cold Bay

Palila: Critically endangered, and reliant upon māmane

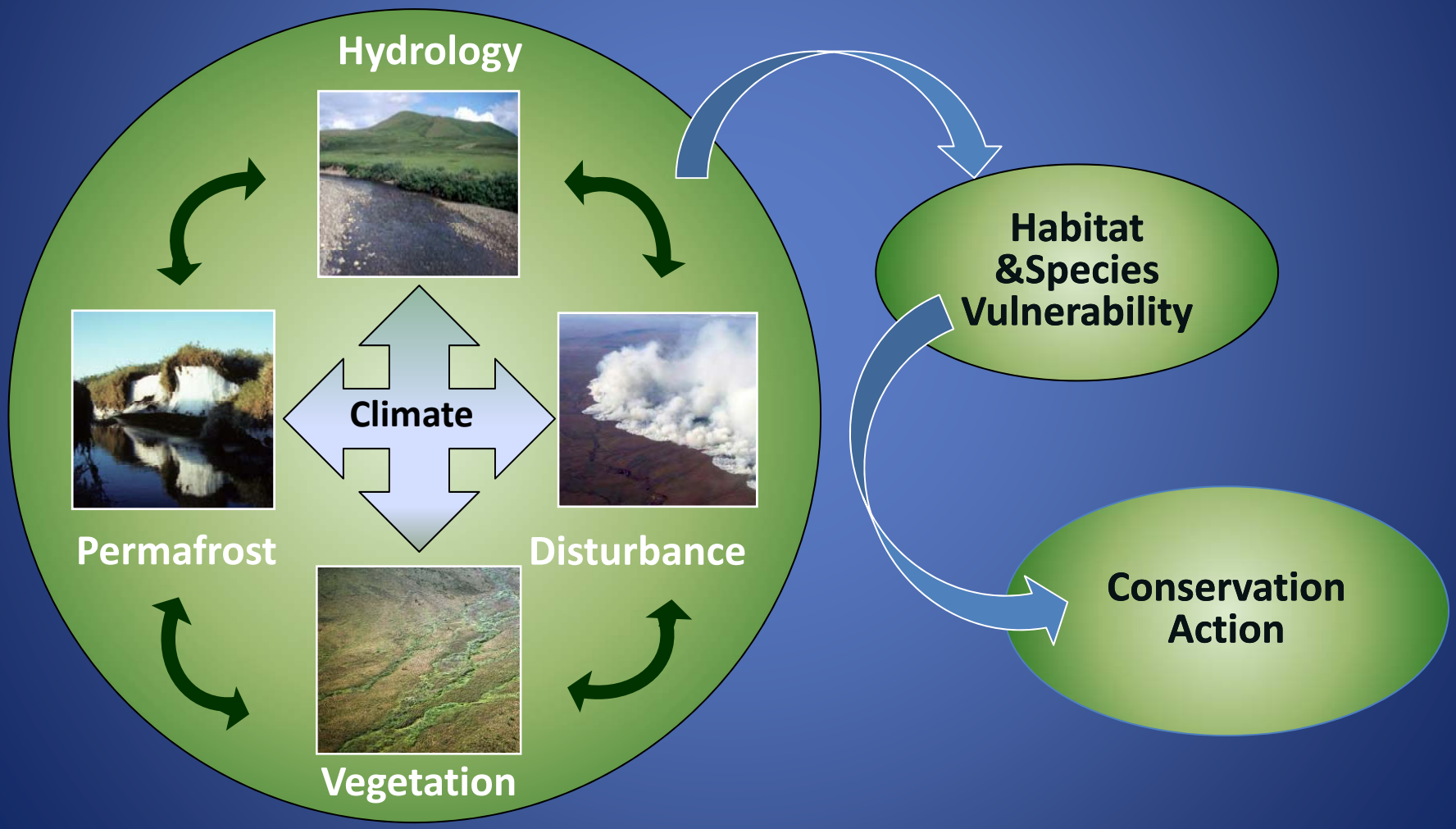
Māmane: Toxic to most critters

The Downscaled Climate Projection Has Arrived – NOW WHAT?

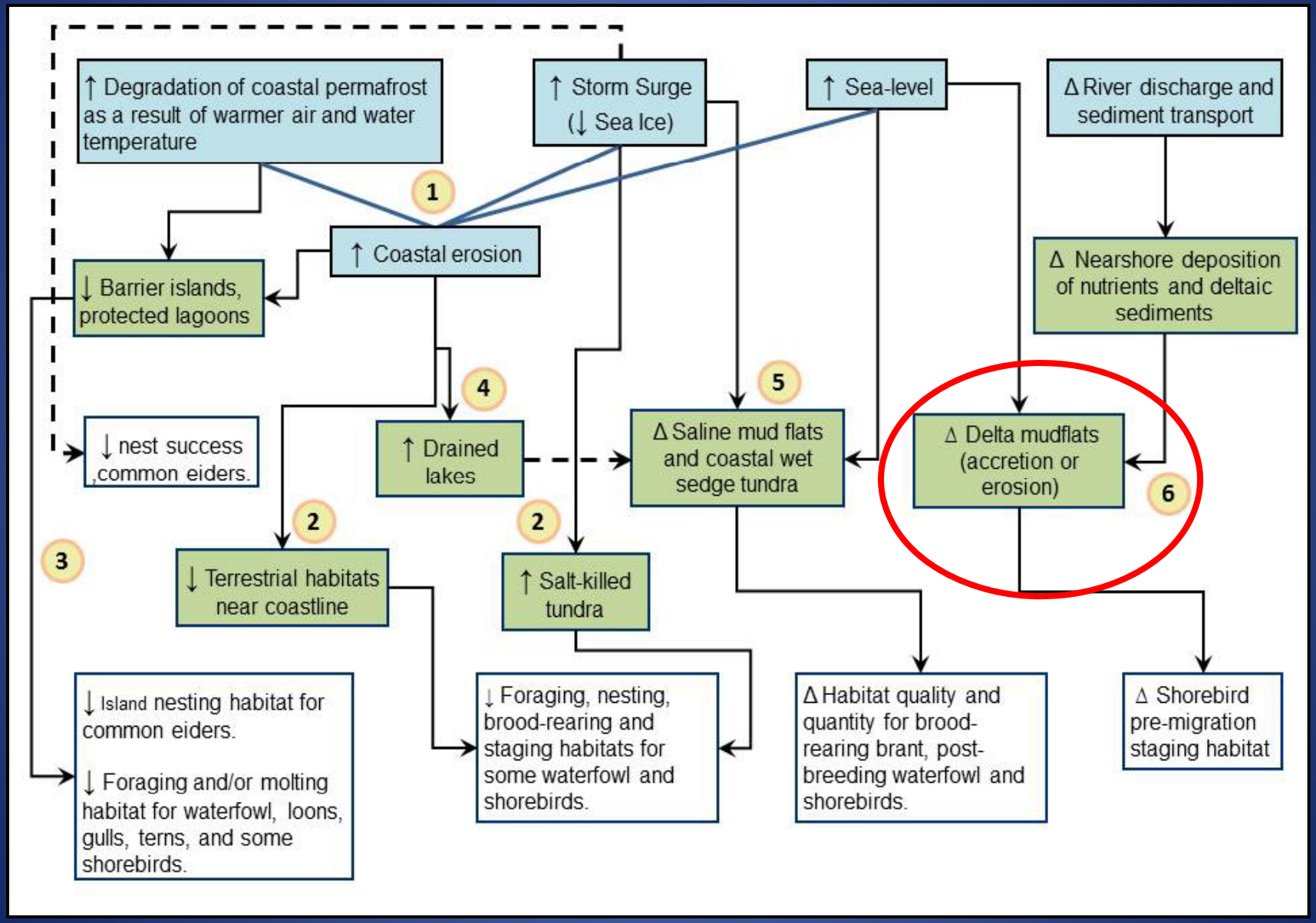


What does an 8°C (14.4 °F) rise in annual average temperature mean to a resource manager? *THAT DEPENDS….*

Ecosystems Response Models – linking climate projections to the needs of resource managers



Conceptual Model



Downscaled GCM Data

ALFRESCO

GIPL-1

Soil Thermal Properties

DOS-TEM

Vegetation type

Burned area

Fire Severity

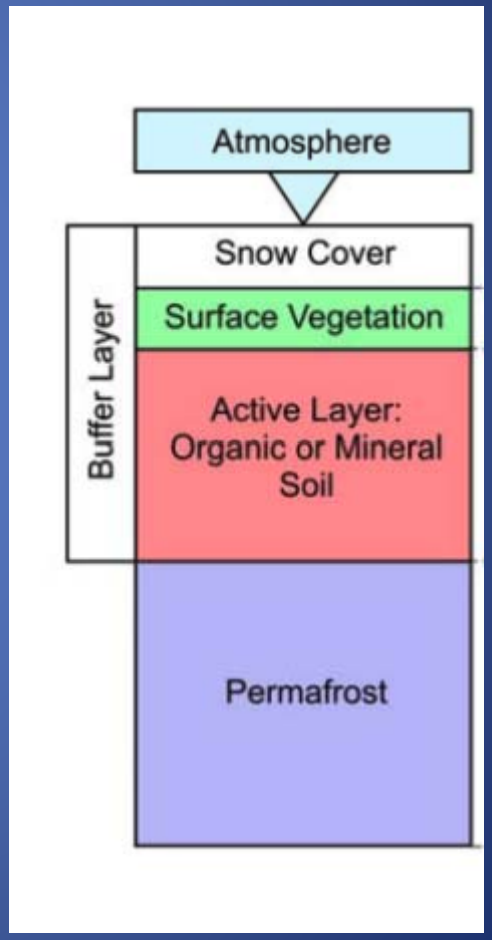
Moss & Organics

Soil moisture

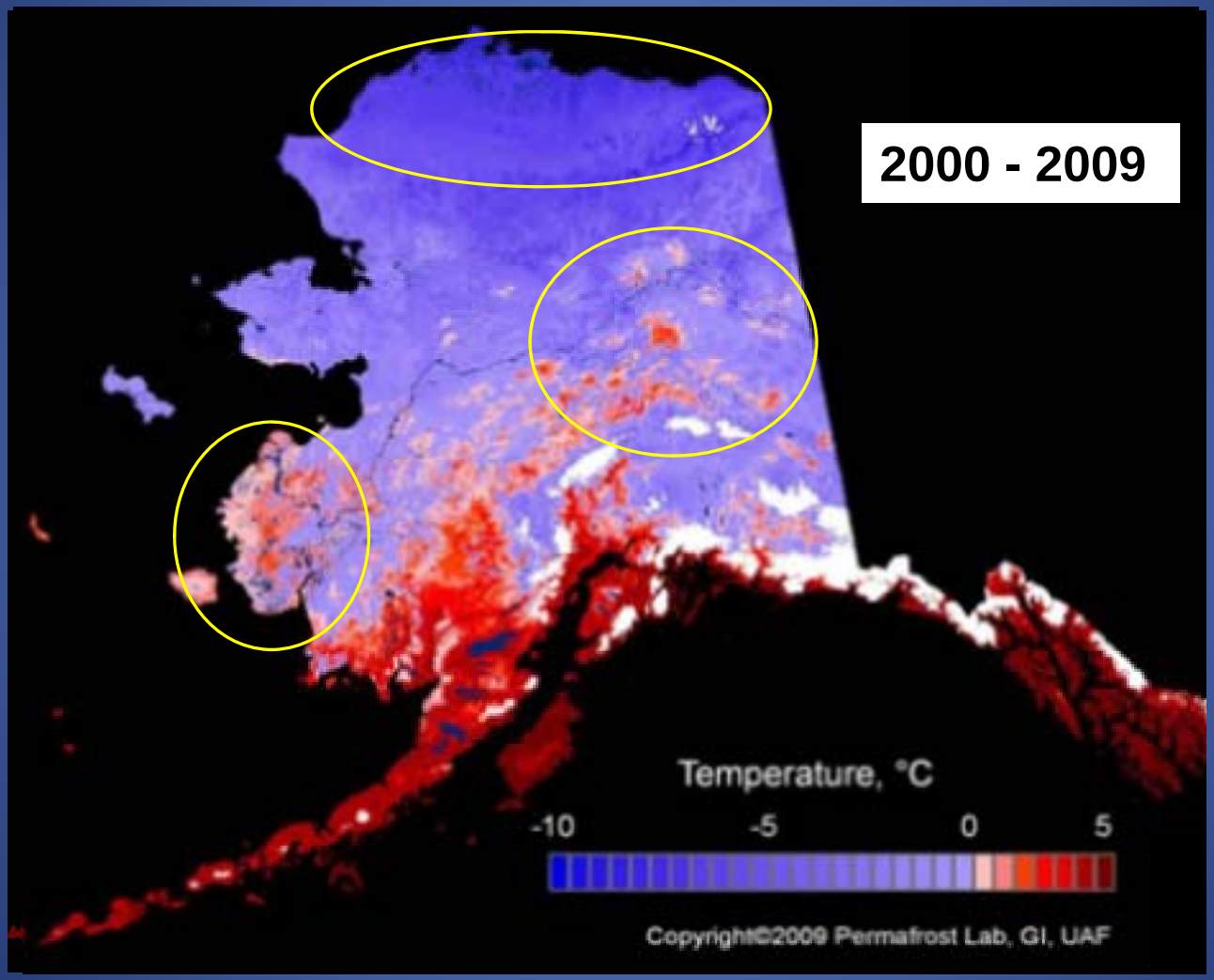
Veg. canopy

Permafrost

Ground Ice

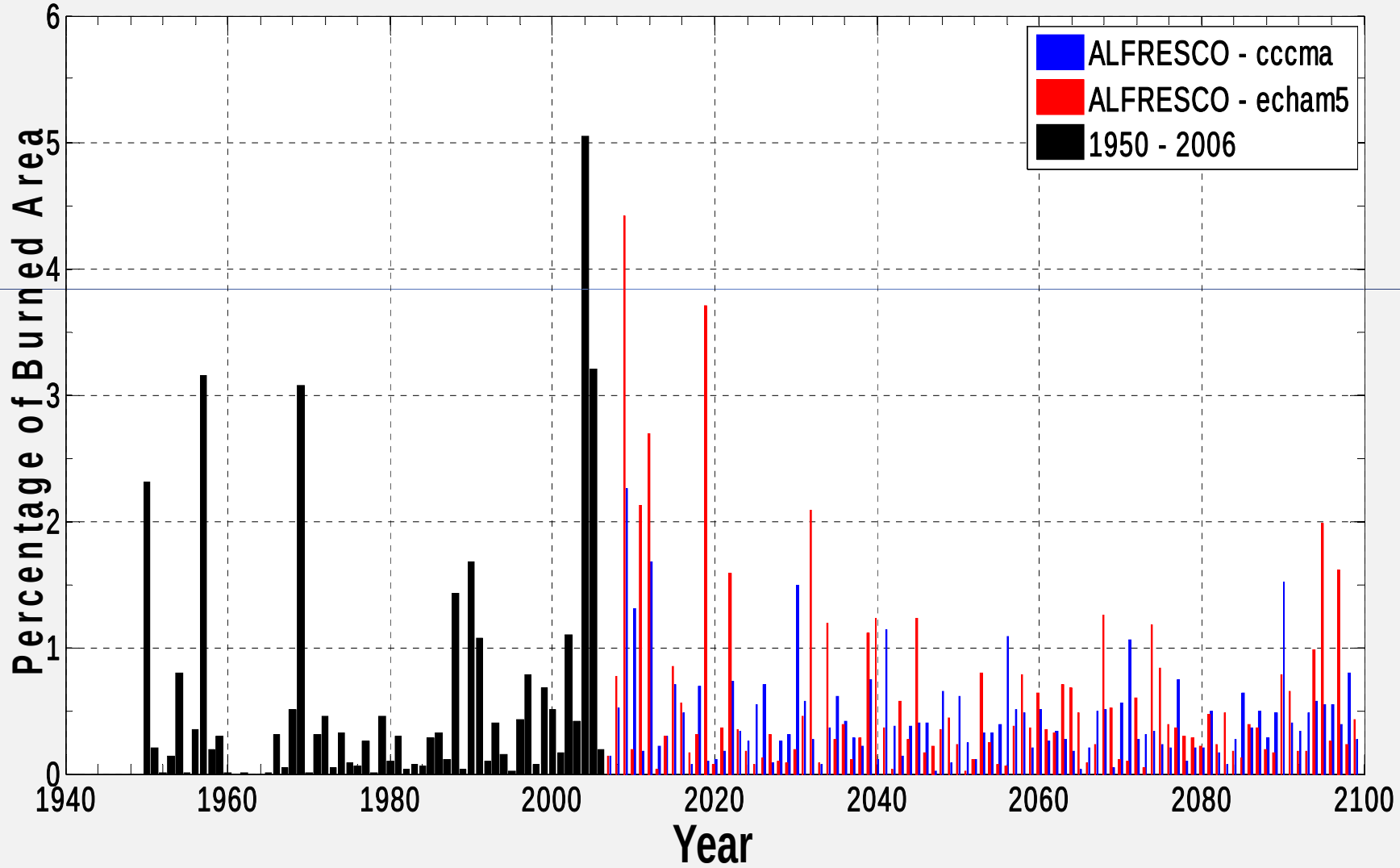


Permafrost Model Alone



Mean Annual Soil Temperature – 1 m Depth

Charring Boreal Forest Forecast



Driven by GCM outputs of CCCMA-CGCM3.1 (CCCMA) and MPI ECHAM5 models (ECHAM5) , A1B emissions scenario.

Pilot Year : Completed in January 2012

- Identified and obtained all variables needed to drive and couple the individual models
- How to modify outputs from one model so that they are meaningful to another model
- How to downscale driving variables
- How to compare similar output variables between models to understand differences and/or uncertainties in these outputs

Phase II Objectives:
4-year Plan

1) Model coupling

To develop and apply a fully **synchronous** coupled model over the Western Arctic integrating important components of an ecosystem model for Alaska including: ***fire, vegetation succession and permafrost dynamics***

2) Tundra fire and treeline dynamics

To evaluate, test and incorporate ***tundra fire and treeline and shrub dynamics into the Alaska IEM***

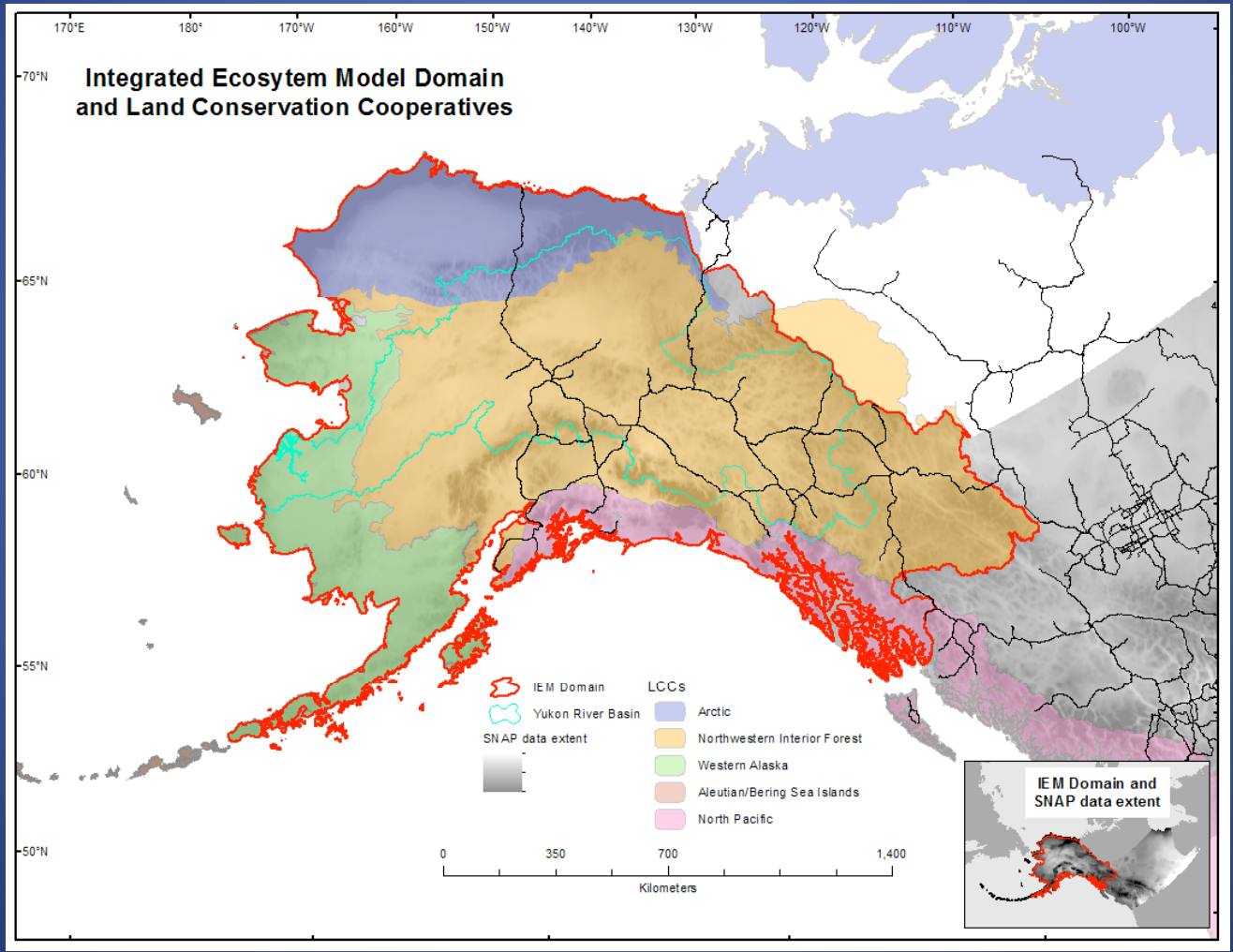
3) Thermokarst dynamics

To develop a conceptual model of ***thermokarst dynamics*** at a landscape scale and to evaluate, test and incorporate thermokarst dynamics into the Alaska IEM

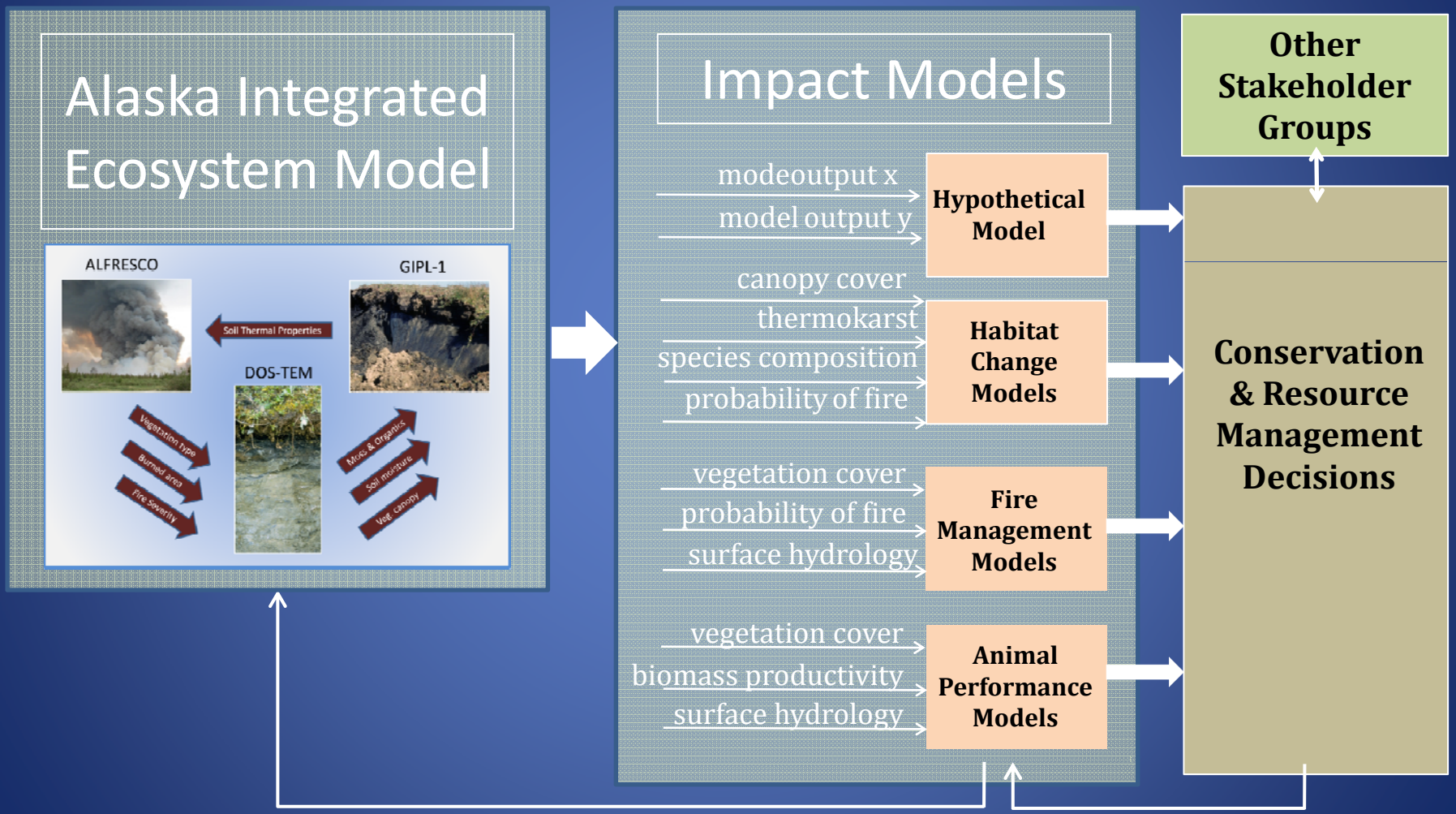
4) Wetland dynamics

To design ***wetland field dynamics*** program to support the Alaska IEM and develop, evaluate, test and incorporate wetland dynamics into the Alaska IEM

Domain and Scale



Links to Management

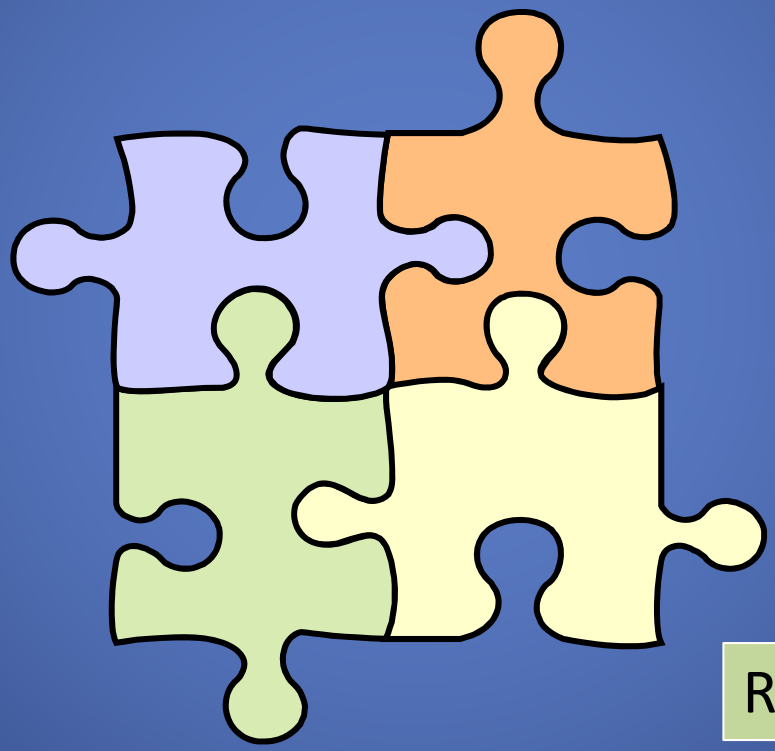


Collaboration Across Disciplines

Terrestrial Ecology

Ecosystem Modeling

Fire Science



Programming

Hydrology

Geophysics

Remote Sensing

Data Management

Collaboration Across Organizations

- Academic departments
- Alaska Climate Science Center
- Arctic LCC
- Western Alaska LCC