



Impacts of Acute Warming on Arctic Flora and Fauna

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Earth2Class Workshops for Teachers

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- Explores the cascade of changes triggered when Arctic vegetation and seasonality are altered
- Response of animal populations to simulated or current climate changes drastically understudied in the Alaskan interior and much of the Arctic

Multi-trophic impacts of climate warming in Arctic tundra: from plants to bugs to migratory songbirds

- Five year (2010-2014) study on the effects that warming-induced increases in shrub abundance and changing seasonality have on migratory songbirds in Alaskan Arctic tundra
- Identify and characterize interactions between shrub dominance and weather to determine how these affect food and shelter availability for migratory songbirds

http://www.ldeo.columbia.edu/~nboelman/Bird_Project/Home.html



Multi-trophic impacts of climate warming in Arctic tundra: from plants, to bugs, to migratory songbirds



http://www.ldeo.columbia.edu/~nboelman/Bird_Project/Home.htm

Project Summary

field notes

The Polar Field Services Newsletter

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Plants, bugs and migratory songbirds (oh my!)



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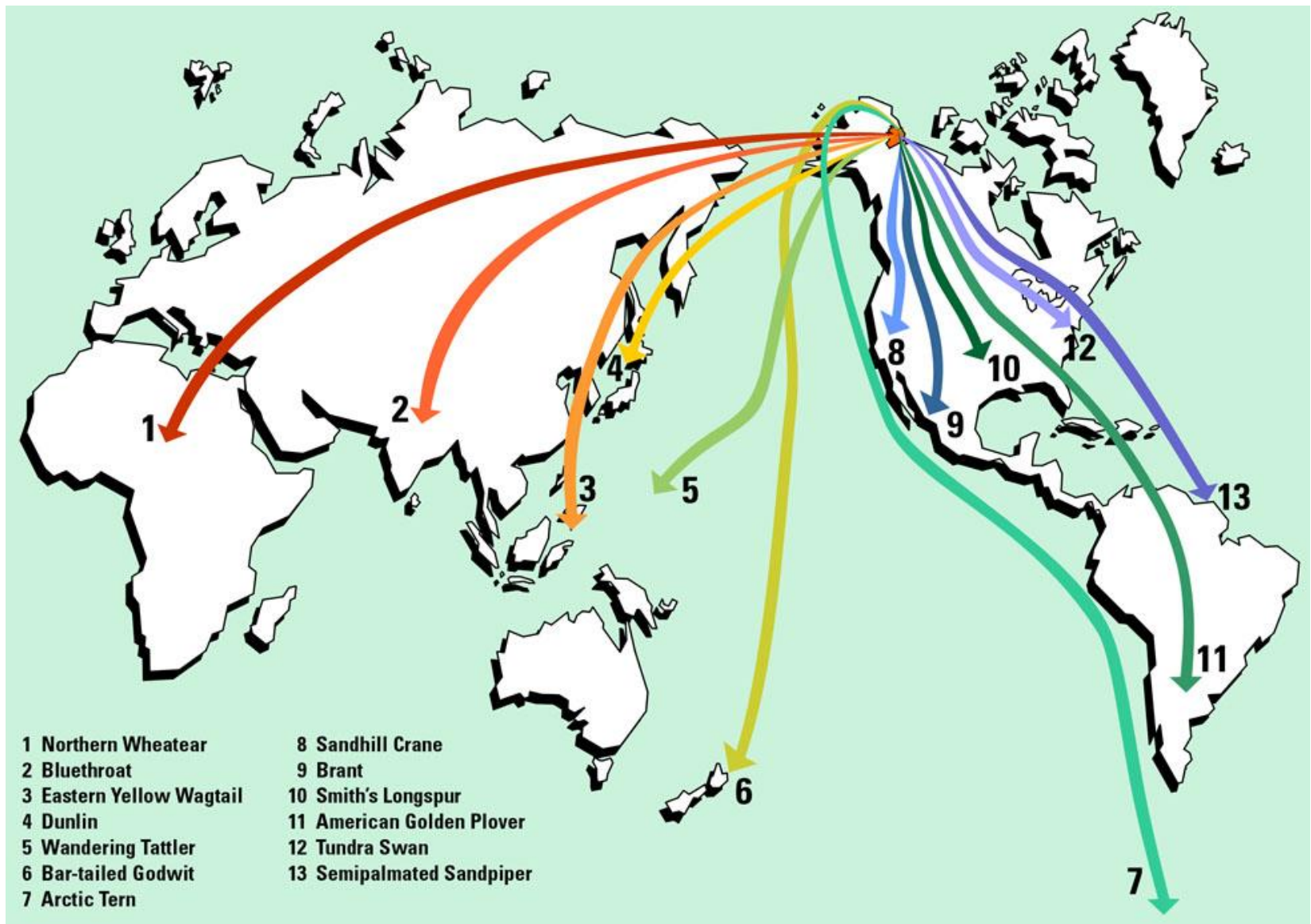
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Arctic Birds

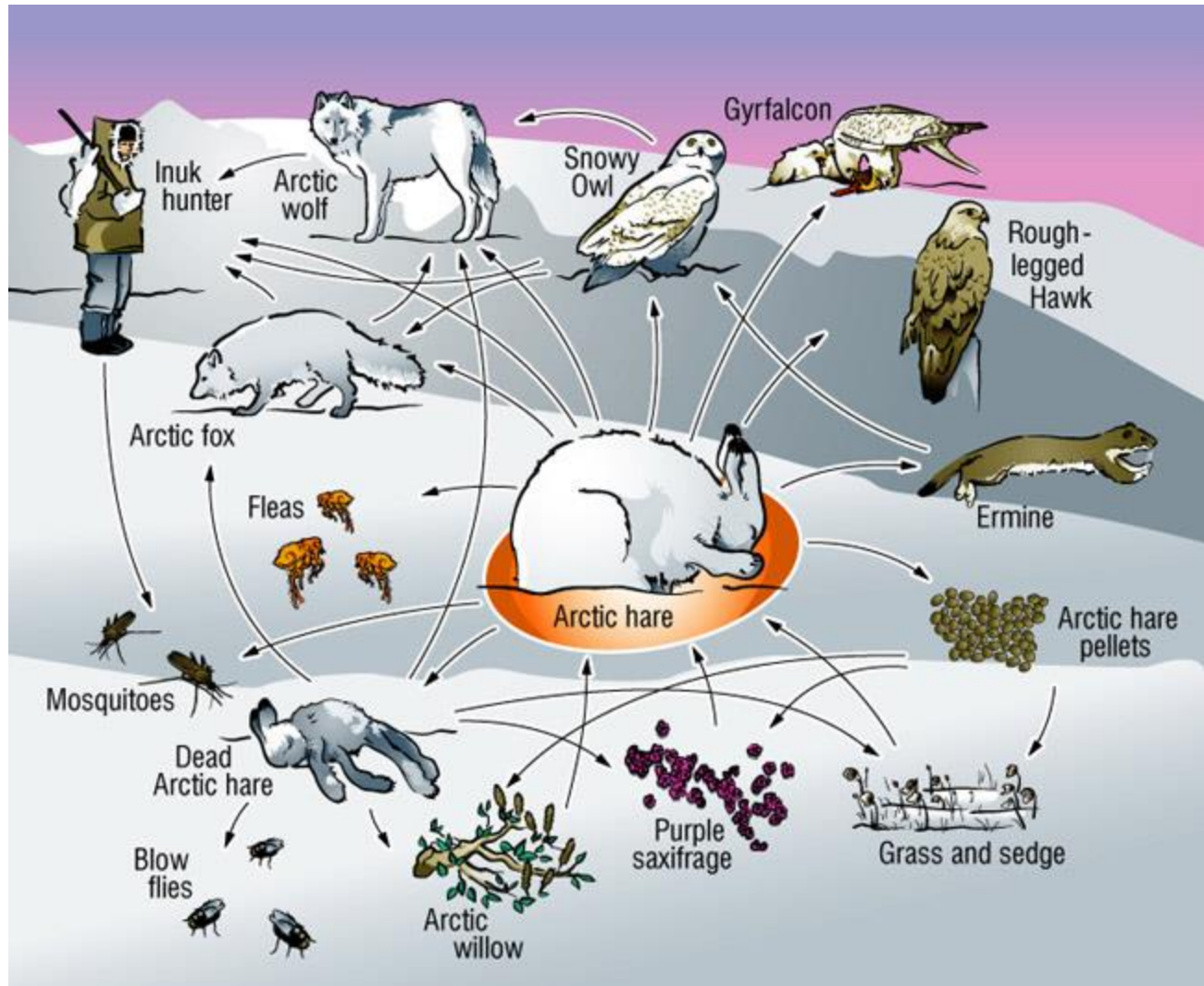


- Seek to determine how reproductive success of populations of two songbirds species respond to variation in both shrub dominance and timing of spring snowmelt
- Measure how these variations affect composition and size of the entire songbird community
- Secondary goal to develop techniques for monitoring bird community attributes via bioacoustic recordings for conducting automated bird community censuses

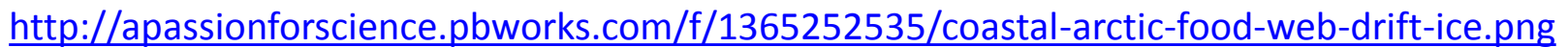


<http://www.fws.gov/alaska/nwr/arctic/images/worldbirdmigration.jpg>

Arctic Food Web



http://nature.ca/ukaliq/images/a196_fw_b_e.jpg





<http://above.nasa.gov/index.html?>



The Institute of Arctic Biology Toolik Field Station (TFS) is a world-renowned Arctic climate change research station located in the northern foothills of the Brooks Range in Alaska at 68° 38' N, 149° 36' W, elevation 720 m. Toolik-based researchers have access to 87,000 acres designated by the Bureau of Land Management as a Research Natural Area. Our location allows scientists access to three major physiographic provinces of Alaska: the Brooks Range, the arctic foothills, and the arctic coastal plain. Toolik Station has been a major location for scientific research in the Arctic since 1975.

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Arctic Long Term Ecological Research Site

at the Arctic LTER

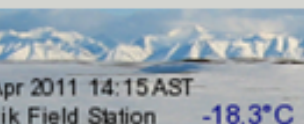
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Welcome to the Arctic Long Term Ecological Research (ARC LTER) site, part of a [network of sites](#) established by the National Science Foundation to support long-term ecological research in the United States. Our [research site](#) is located in the foothills region of the Brooks Range, North Slope of Alaska (68° 38'N, 149° 43'W, elevation 760 m) and is based out of the University of Alaska's [Toolik Field Station](#).

The project is based year-round institute at [The Ecosystems Center](#), Marine Biological Laboratory, Woods Hole, Massachusetts. The Principal Investigator of the Arctic LTER is Gus Shaver while Breck Bowden, Anne Giblin, Chris Luecke and George Kling form an executive committee and direct the four main components of the research including groups focused on tundra, streams, lakes, and landscape interactions. ([Arctic LTER personnel](#))



The long-term goal of Arctic LTER project is to understand and predict the effects of environmental change on arctic landscapes. To achieve this goal the Arctic LTER studies the ecology of the surrounding tundra, streams, and lakes. We hope to gain an understanding of the controls of ecosystem structure and function through long-term monitoring and surveys of natural variation of ecosystem characteristics, through experimental manipulation of ecosystems for years to decades and through synthesis of results and predictive modeling at ecosystem and watershed scales.

The arctic region has warmed significantly over the past 30 years and arctic lands and freshwaters are already changing in response. The changes include a general "greening" of the arctic landscape, changes in species distributions and abundance, and changes in geophysical and biogeochemical processes and cycles at local and regional scales. Recently it has become apparent that climatic warming in the Arctic is accompanied by dramatic changes in disturbance regime, including disturbances related to thawing of permafrost, a surprising increase in wildfire, and changes in the seasonality and synchrony of ecosystem processes. These disturbances have important feedbacks on climate as well as

AMS Earth's Climate System

- <http://www.ametsoc.org/amsedu/ecs/home.html>



Earth's Climate System

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***American Meteorological Society***

# Climate Change Report 2007

[http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr\\_spm.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf)

## **Observed changes in climate and their effects**

**Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level**

- **Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.**



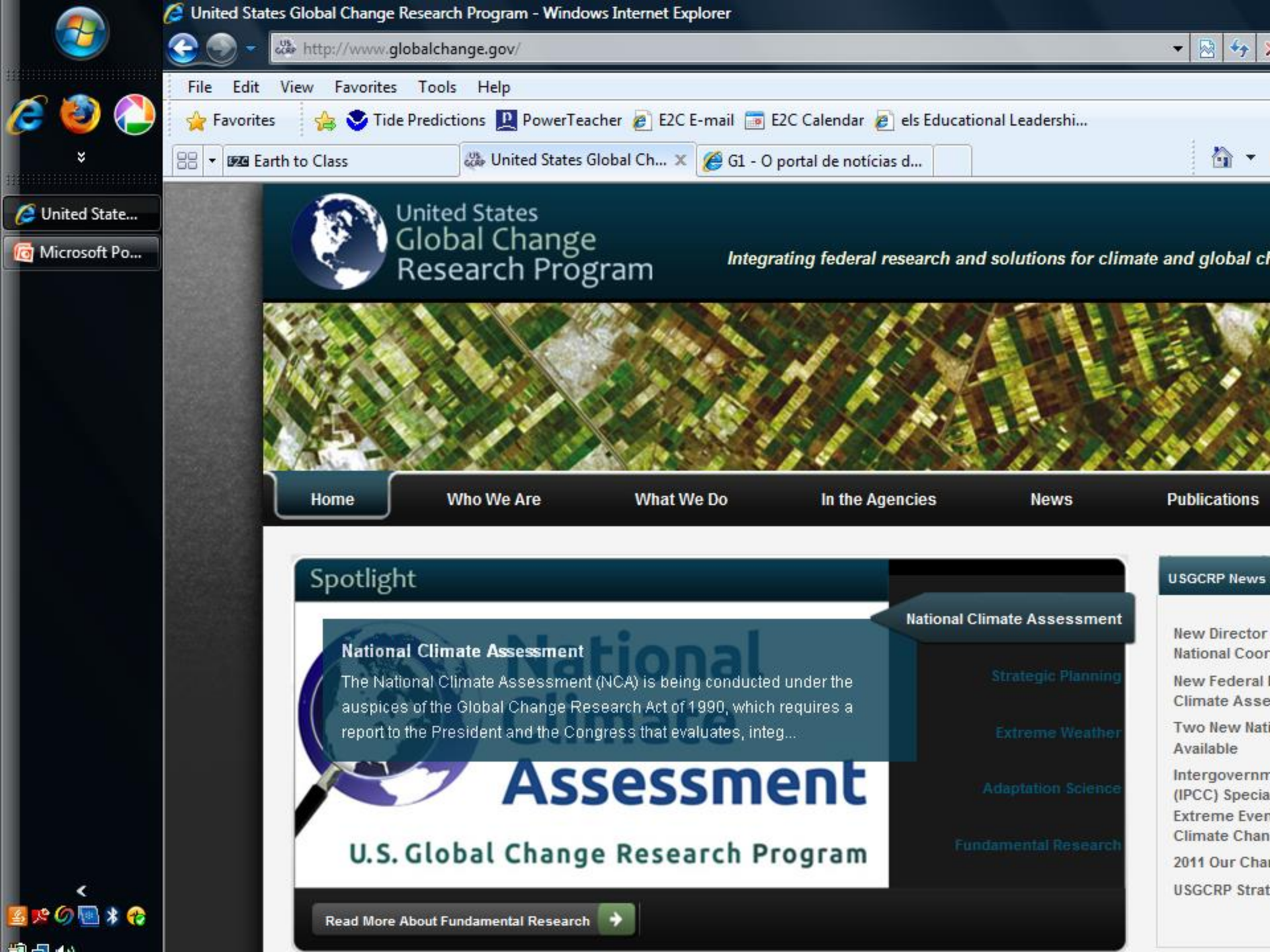
# Causes of Change

- **Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004**
- **Global atmospheric concentrations of CO<sub>2</sub>, methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years.**

- **Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations.**
- **It is likely that there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica)**

# **Projected climate change and its impacts**

- **There is high agreement and much evidence that with current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades.**
- **Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century**



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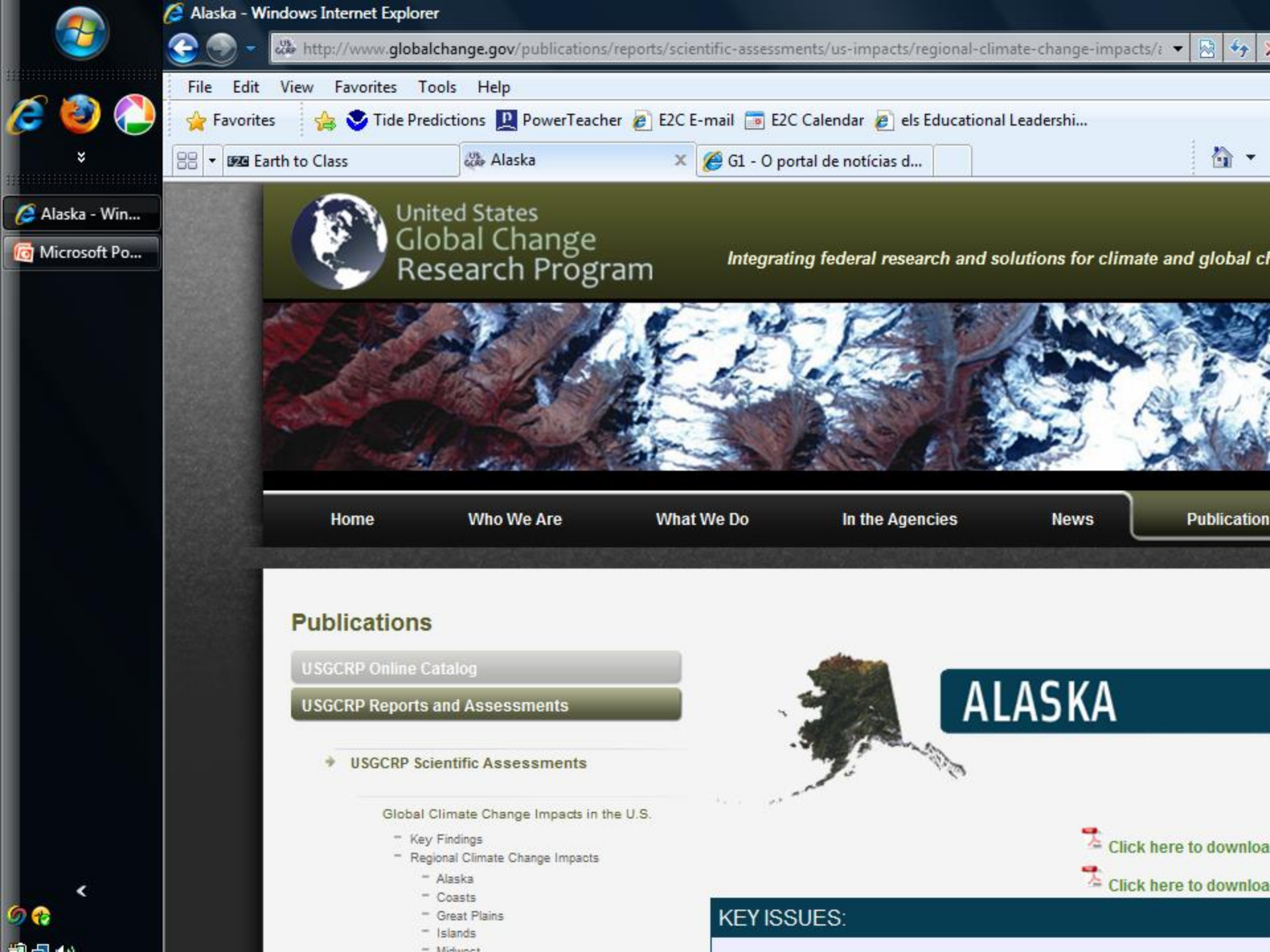
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