How NDVI time series can inform studies of wildlife migration: An Arctic-centric perspective

David Douglas
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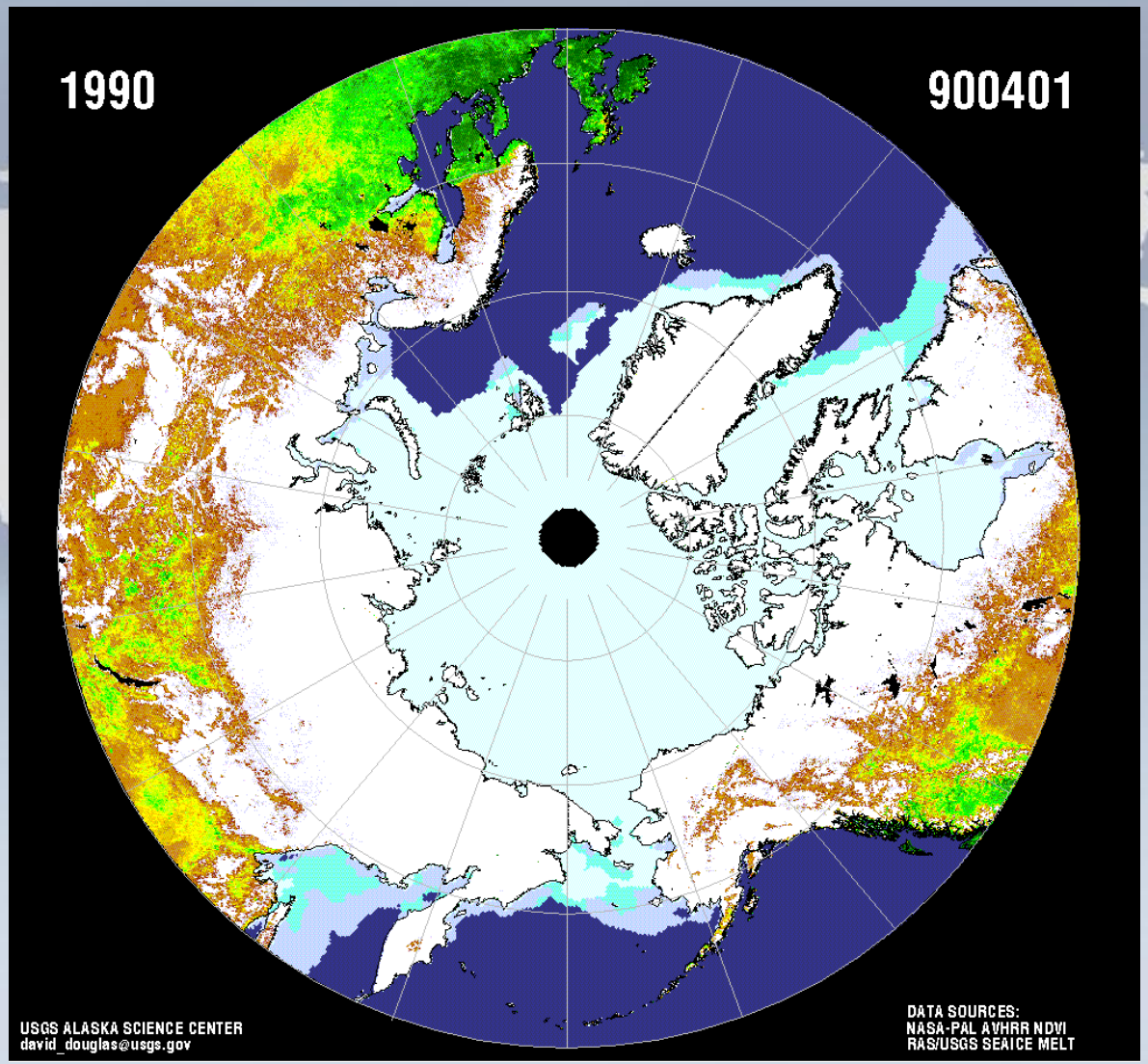
USGS science for a changing world

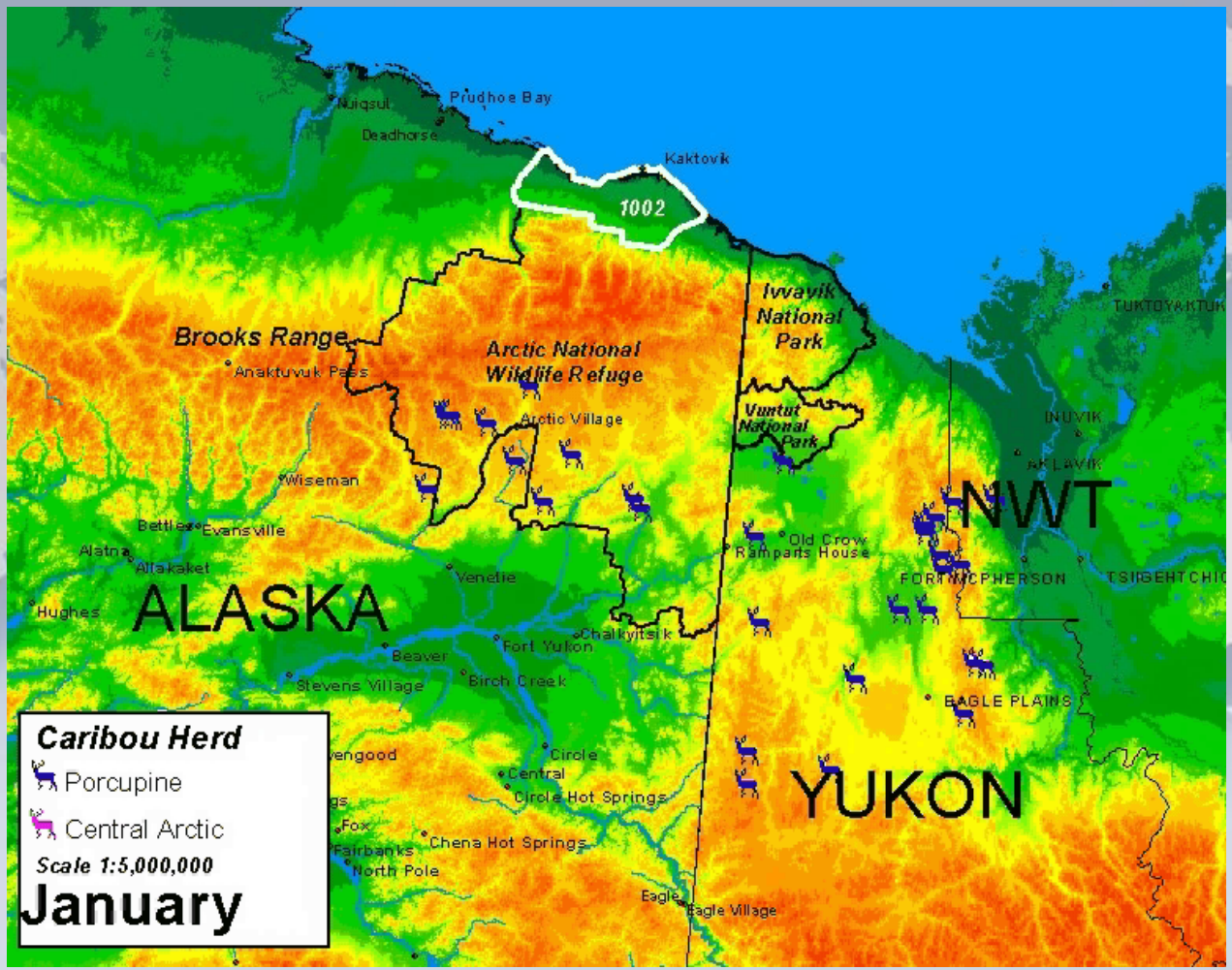
Arctic phenology:

- Abrupt
- Short
- Productive

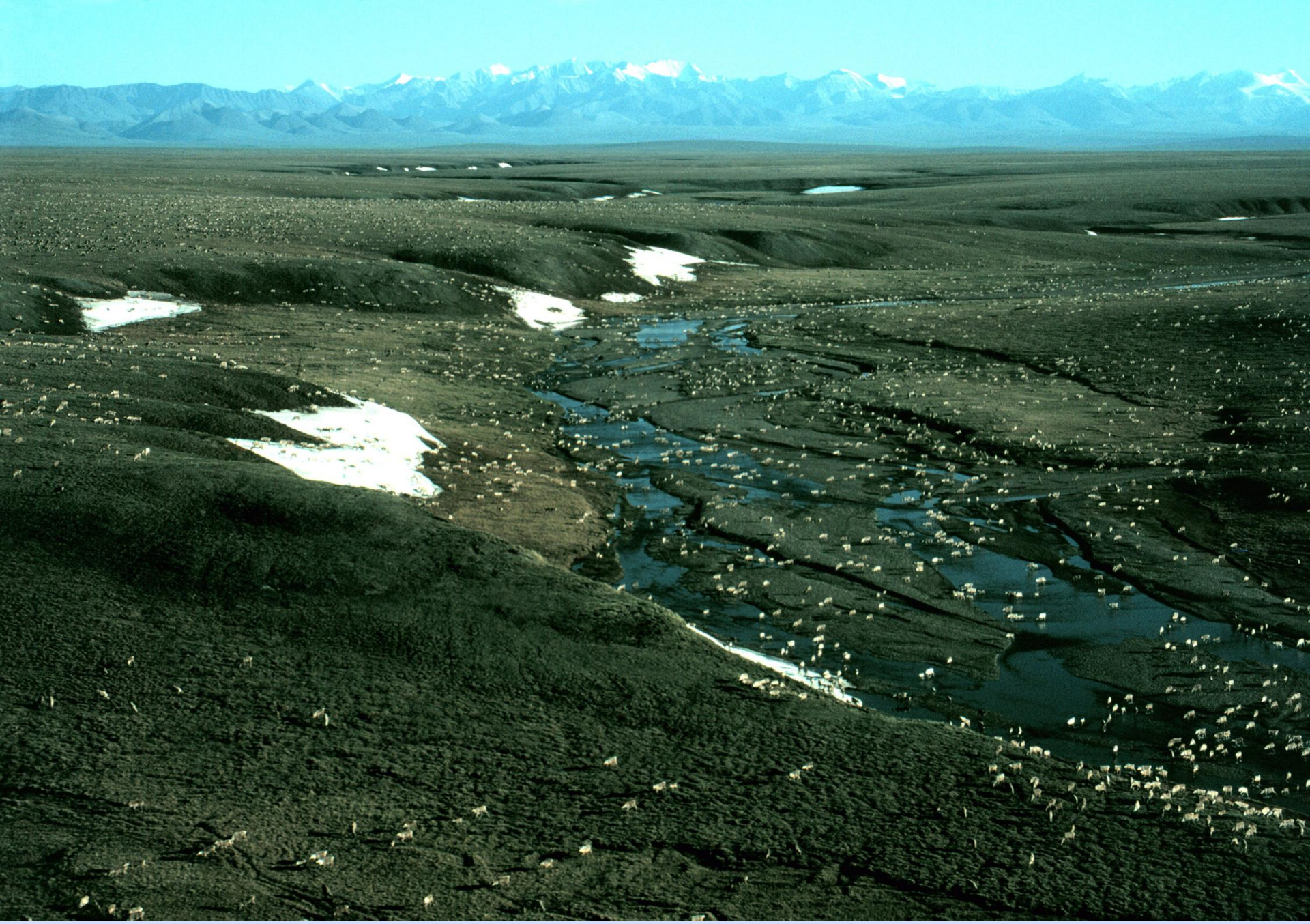


Caribou migration & calving

- When & where?



http://caff.is/carma-interactive-map/maps-and-videos

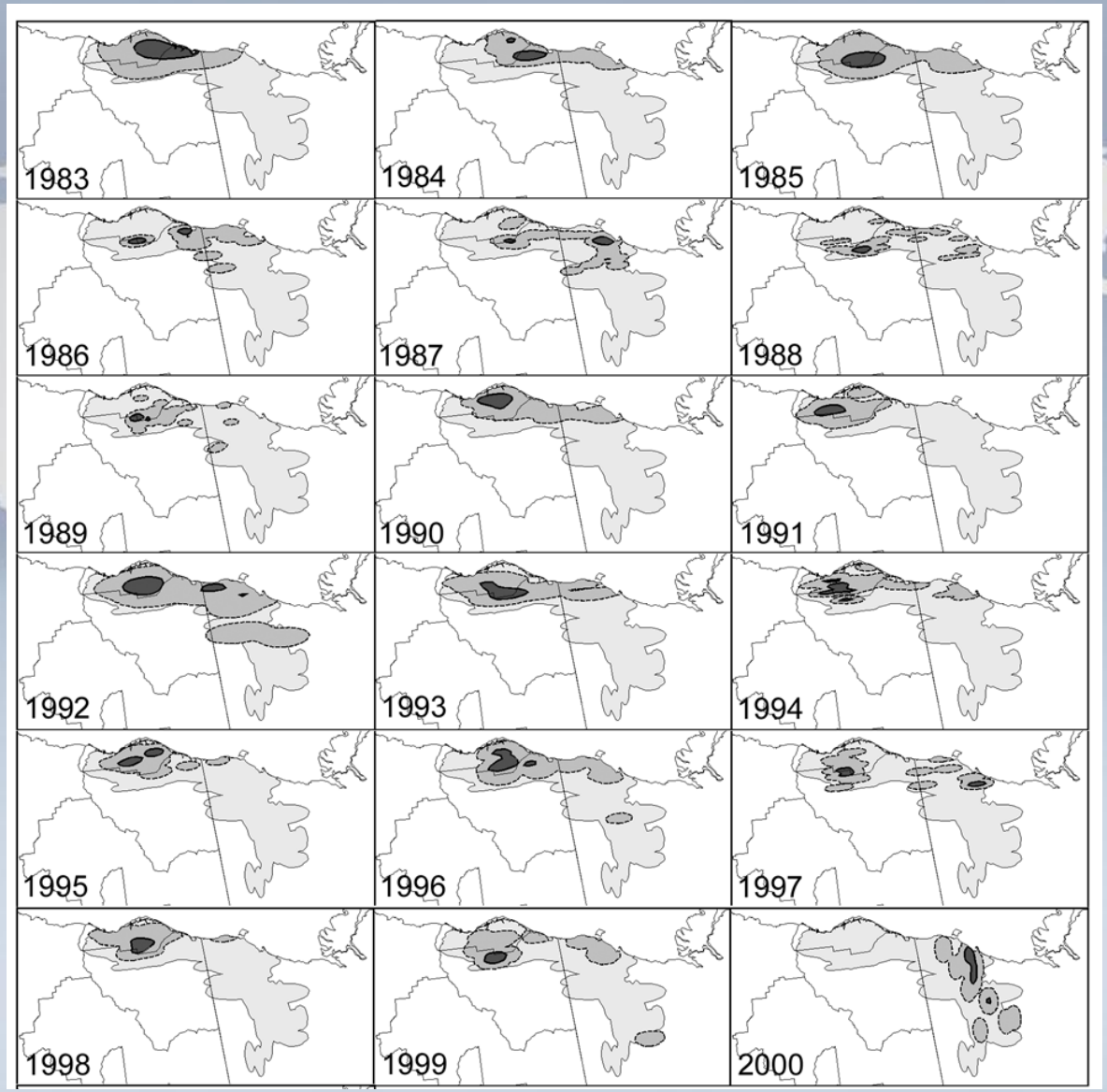


Calving time:

- Early June

Calving location:

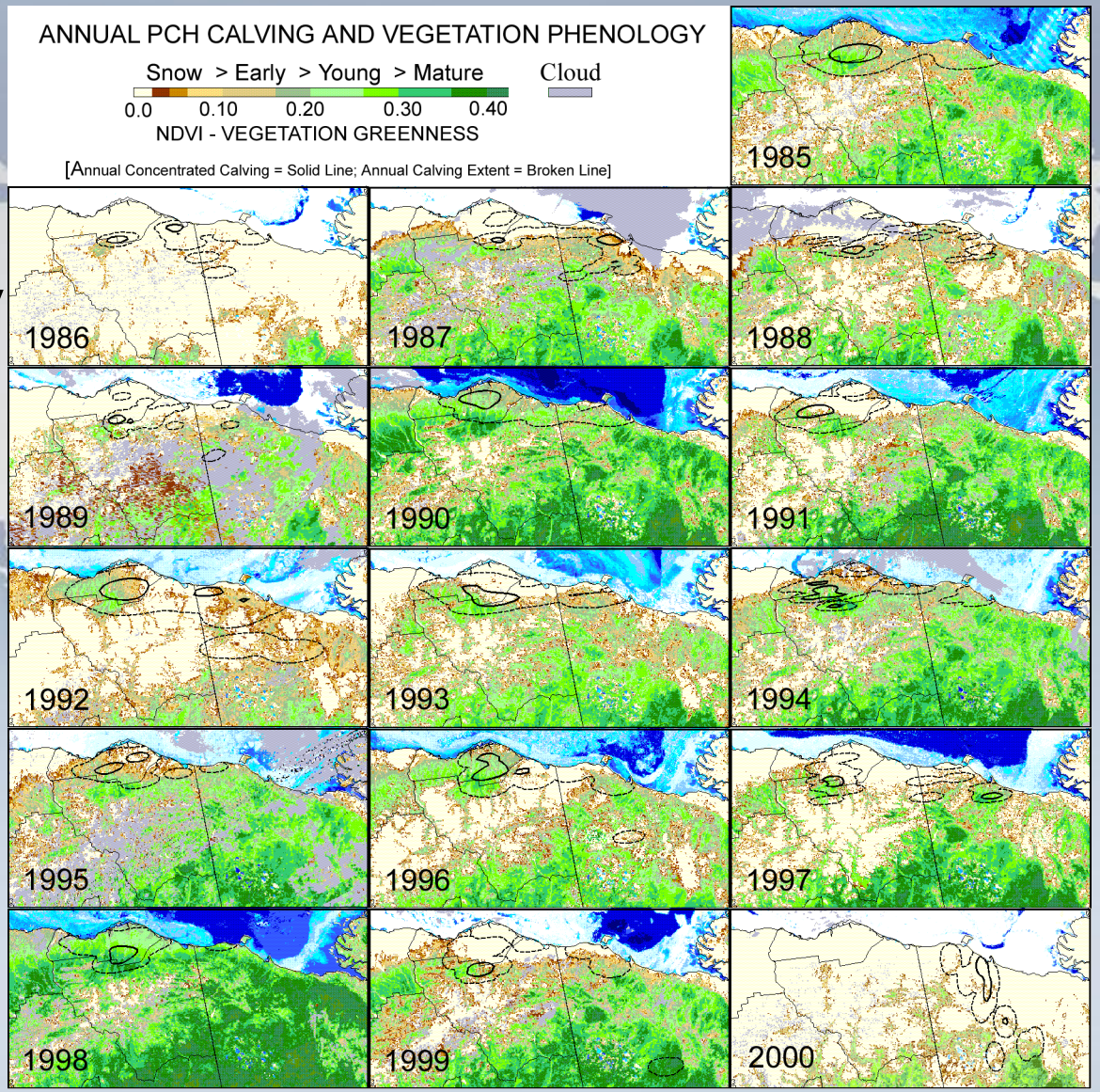
- Varies



Section 3: http://alaska.usgs.gov/BSR-2002/

Calving location:

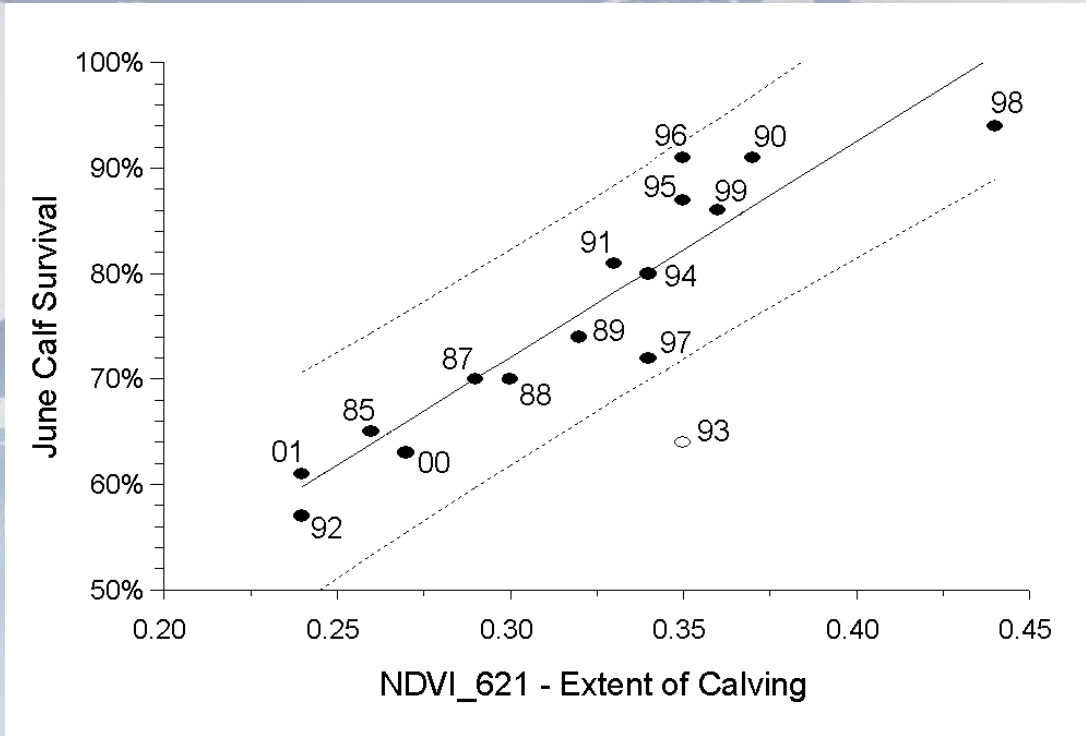
- Varies
- With phenology



Section 3: http://alaska.usgs.gov/BSR-2002/

Calf survival:

- Varies
- With phenology

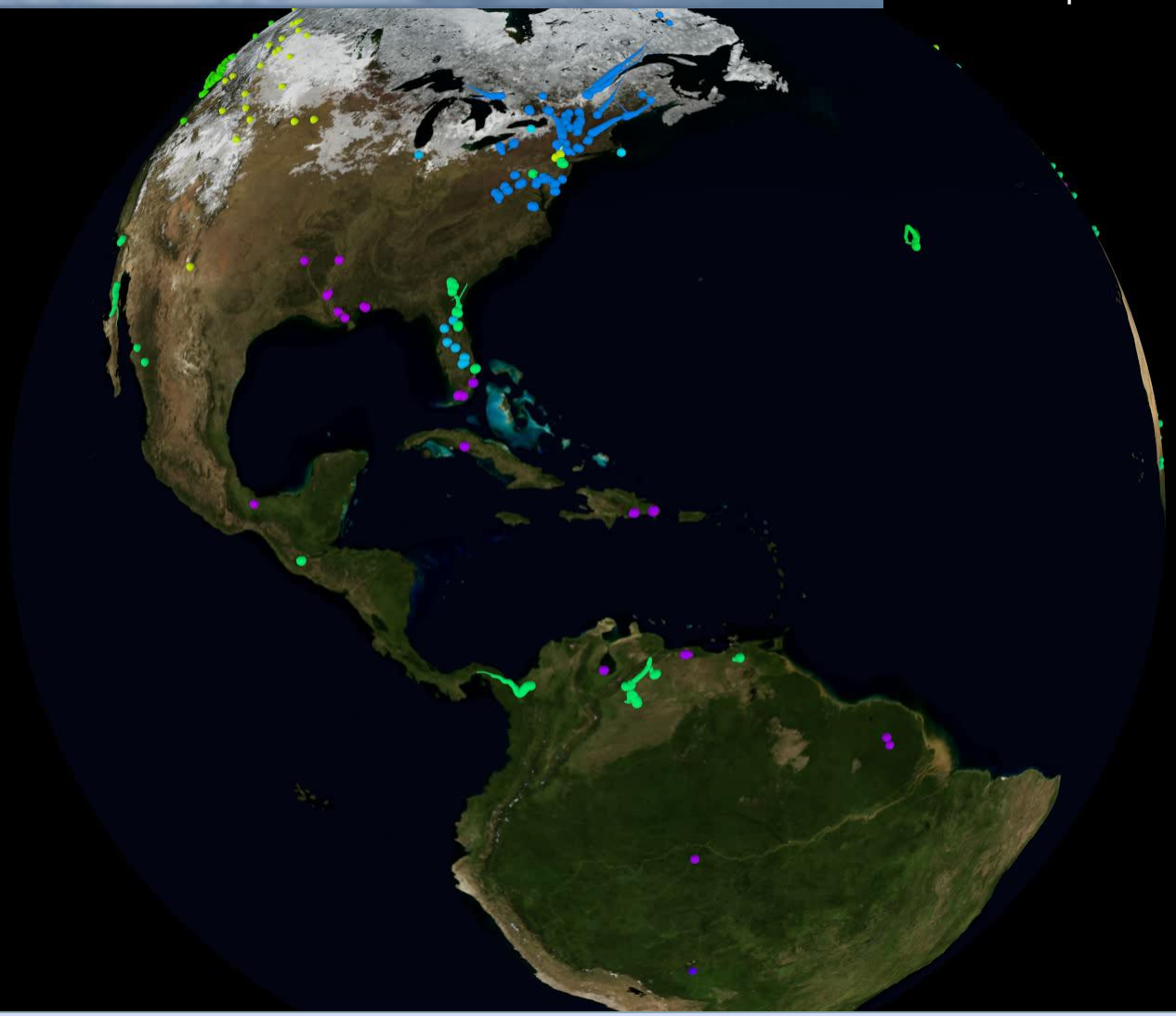


Section 3: http://alaska.usgs.gov/BSR-2002/

MOVEBANK For Animal Tracking Data

MOVEBANK helps animal tracking researchers to manage, share, protect, analyze, and archive their data.

https://www.movebank.org/



01-01

NASA Funded Project 10-BIOCLIM10-0002

"Discovering relationships between climate and animal migration with new tools for linking animal movement tracks with weather and land surface data"

https://www.movebank.org/node/860

PI: Gil Bohrer, The Ohio State University; bohrer.17@osu.edu

Data	Data Source
Tropical Rainfall (TRMM)	NASA http://trmm.gsfc.nasa.gov/
NDVI	USGS (USA only) http://phenology.cr.usgs.gov/get_data_1km.php NASA (global) http://glcf.umiacs.umd.edu/data/gimms/
NCEP Global Reanalysis	NOAA http://www.esrl.noaa.gov/psd/data/reanalysis/
North American Regional Reanalysis (NARR)	NOAA http://www.emc.ncep.noaa.gov/mmb/rreanl/
ECMWF Reanalysis	ECMWF http://www.ecmwf.int/
MODIS Land	NASA https://lpdaac.usgs.gov/
MODIS Ocean	NASA http://oceancolor.gsfc.nasa.gov/
MODIS Snow	NASA http://modis-snow-ice.gsfc.nasa.gov/
Ocean productivity	http://www.science.oregonstate.edu/ocean.productivity/
ASTER GDEM	USGS http://asterweb.jpl.nasa.gov/gdem.asp
SRTM	NASA http://www.cgiar-csi.org/data/srtm-90m-digital-elevation-database-v4-1
GlobCover	ESA http://dup.esrin.esa.it/prjs/prjs68.php
(Population Density Grid)	http://sedac.ciesin.columbia.edu/gpw/global.jsp
OSCAR Ocean Surface Current s	NASA http://www.oscar.noaa.gov/

A topic of growing interest: Ecological Mismatch

PROCEEDINGS OF THE ROYAL SOCIETY B

Proc. R. Soc. B (2011) **278**, 835–842
doi:10.1098/rspb.2010.1778
Published online 22 September 2010

Climate warming, ecological mismatch at arrival and population decline in migratory birds

Nicola Saino[1,*], Roberto Ambrosini[2], Diego Rubolini[1], Jost von Hardenberg[3], Antonello Provenzale[3], Kathrin Hüppop[4], Ommo Hüppop[4], Aleksi Lehikoinen[5], Esa Lehikoinen[6], Kalle Rainio[5], Maria Romano[1] and Leonid Sokolov[7]

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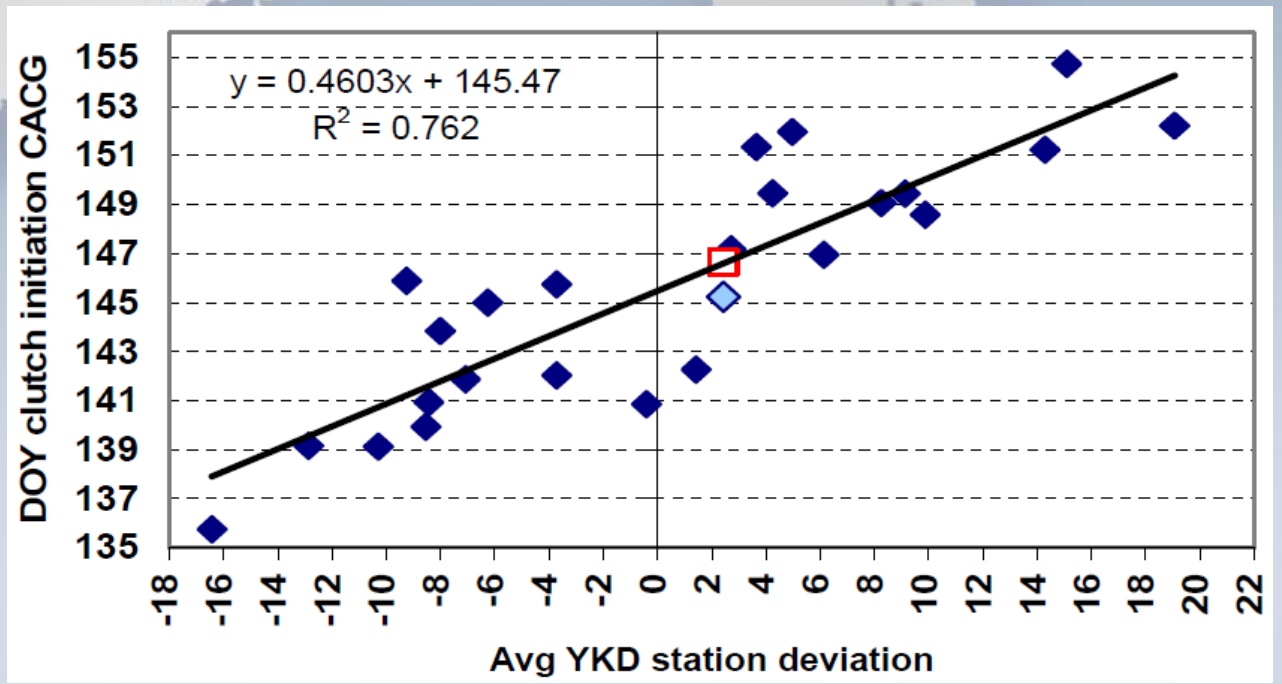
Enhancing scientific problem-solving and discovery through integrated research

The Powell Center provides an environment for cross-disciplinary scientific collaboration. The Center expands U.S. Geological Survey earth system science synthesis research activities by fostering the innovation that results from accumulated knowledge, constructive errors, and the "information spill-over" that emerges from collaborative settings. Working Groups at the Powell Center use existing data to produce new knowledge.

Circumpolar Assessment of Green-Up and Timing of Breeding of Arctic Geese



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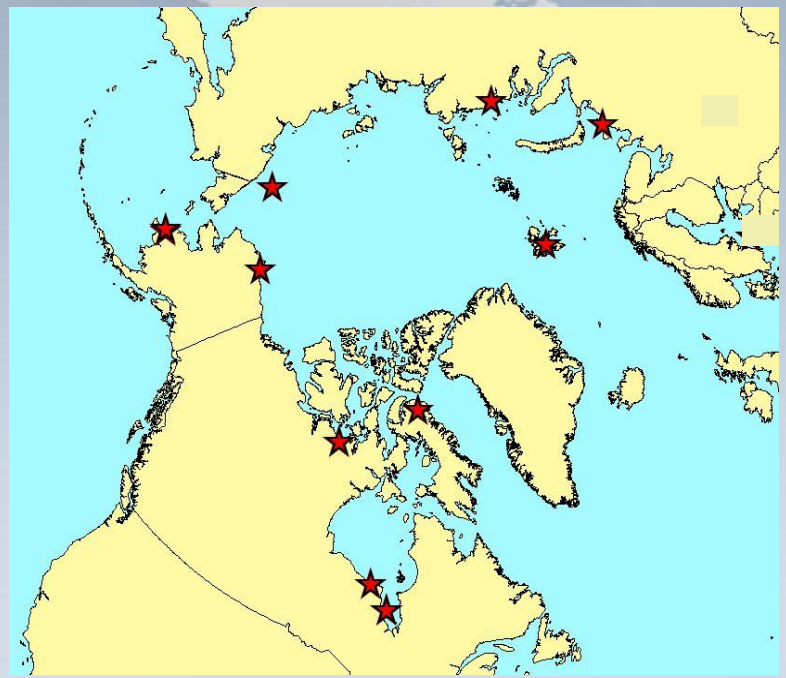
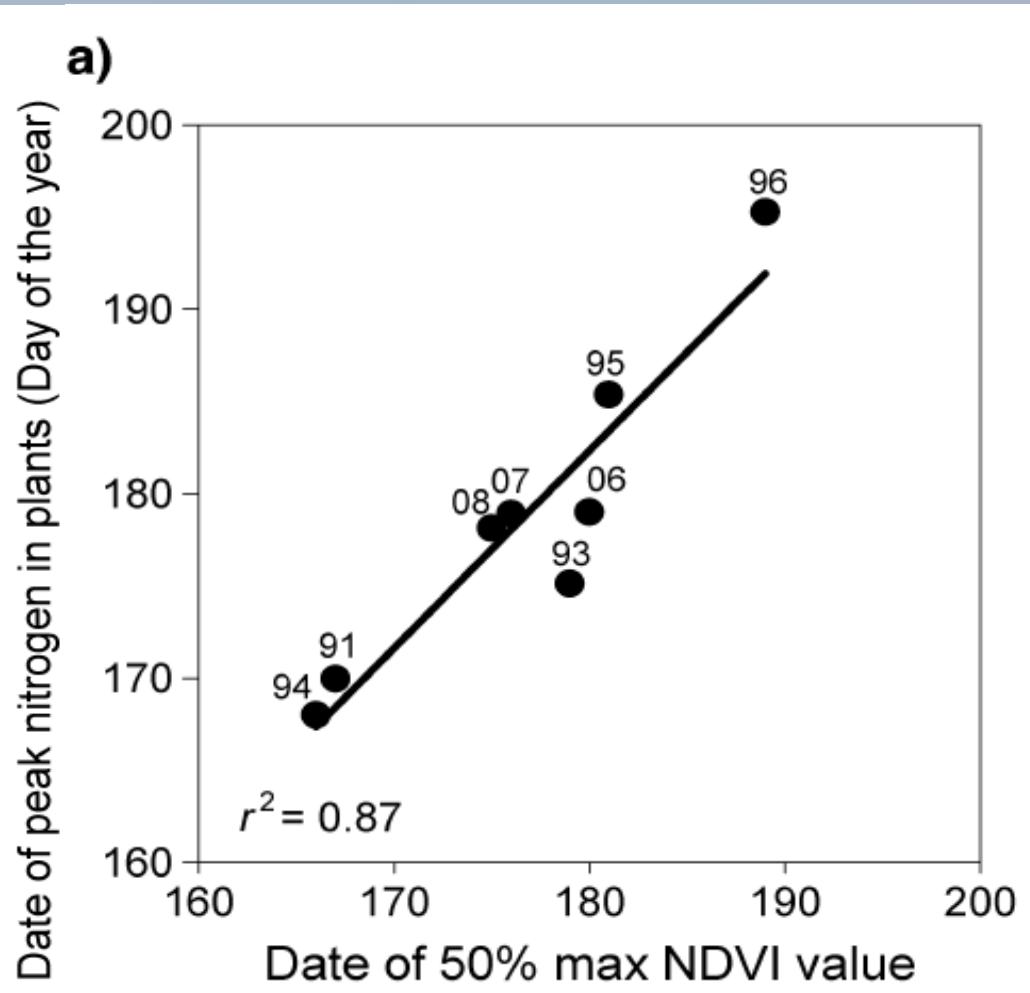
Circumpolar Assessment of Green-Up and Timing of Breeding of Arctic Geese

- 7 goose species
- multiple study sites
- ~300 study years



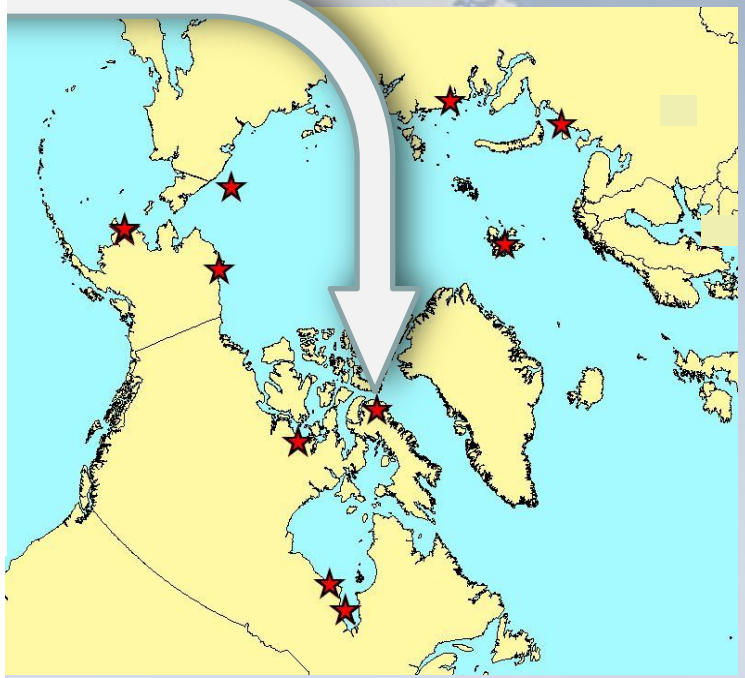
Circumpolar Assessment of Green-Up and Timing of Breeding of Arctic Geese



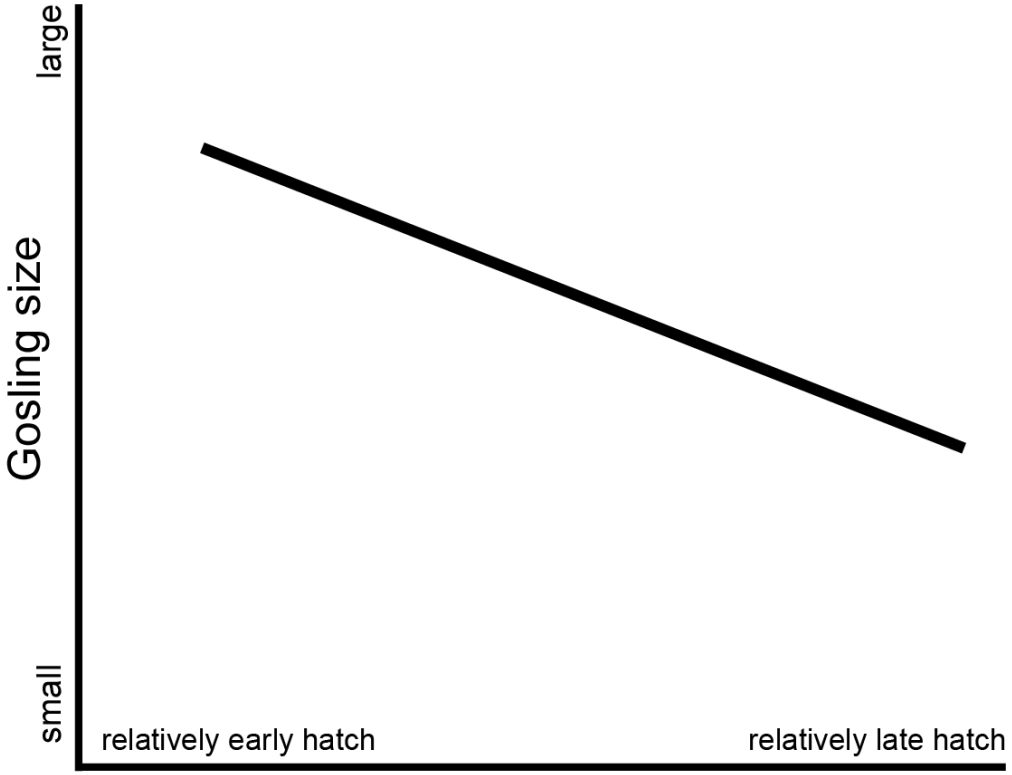
Applied Vegetation Science ■■ (2012)

Broad-scale satellite Normalized Difference Vegetation Index data predict plant biomass and peak date of nitrogen concentration in Arctic tundra vegetation

Madeleine Doiron, Pierre Legagneux, Gilles Gauthier & Esther Lévesque

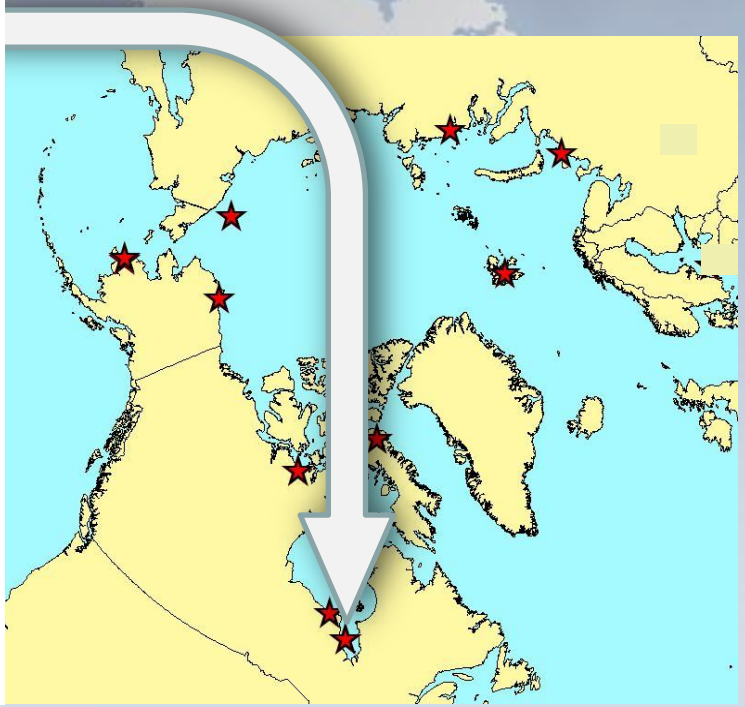


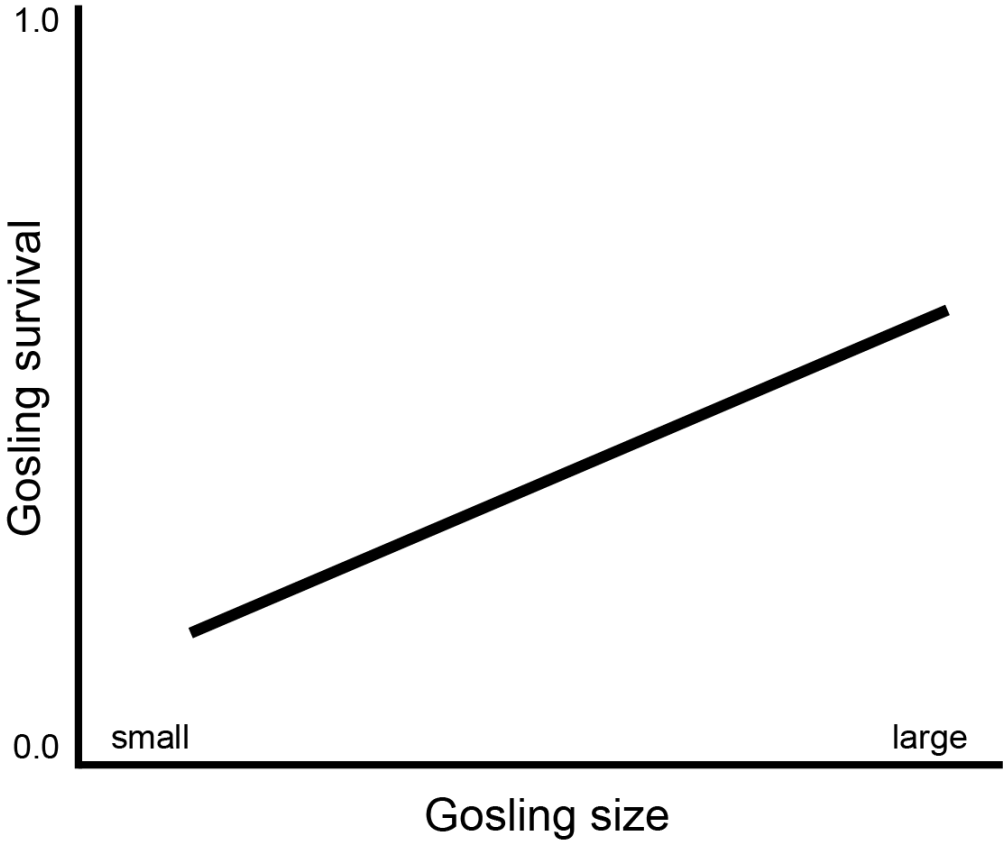
Circumpolar Assessment of Green-Up and Timing of Breeding of Arctic Geese



Hatch timing relative to vegetation phenology

R. W. Brook, Ministry of Natural Resources Ontario, Canada. In prep.





R. W. Brook, Ministry of Natural Resources Ontario, Canada. In prep.

Circumpolar Assessment of Green-Up and Timing of Breeding of Arctic Geese

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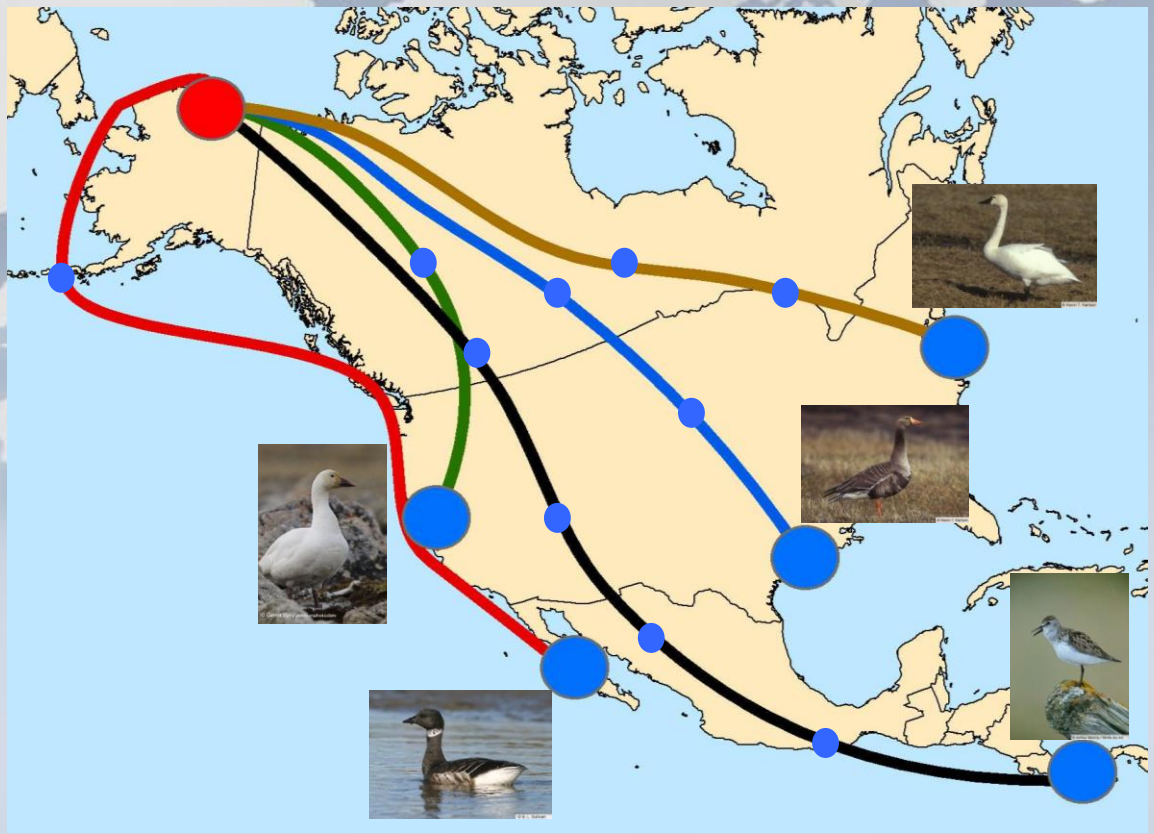
Changing Arctic Ecosystems

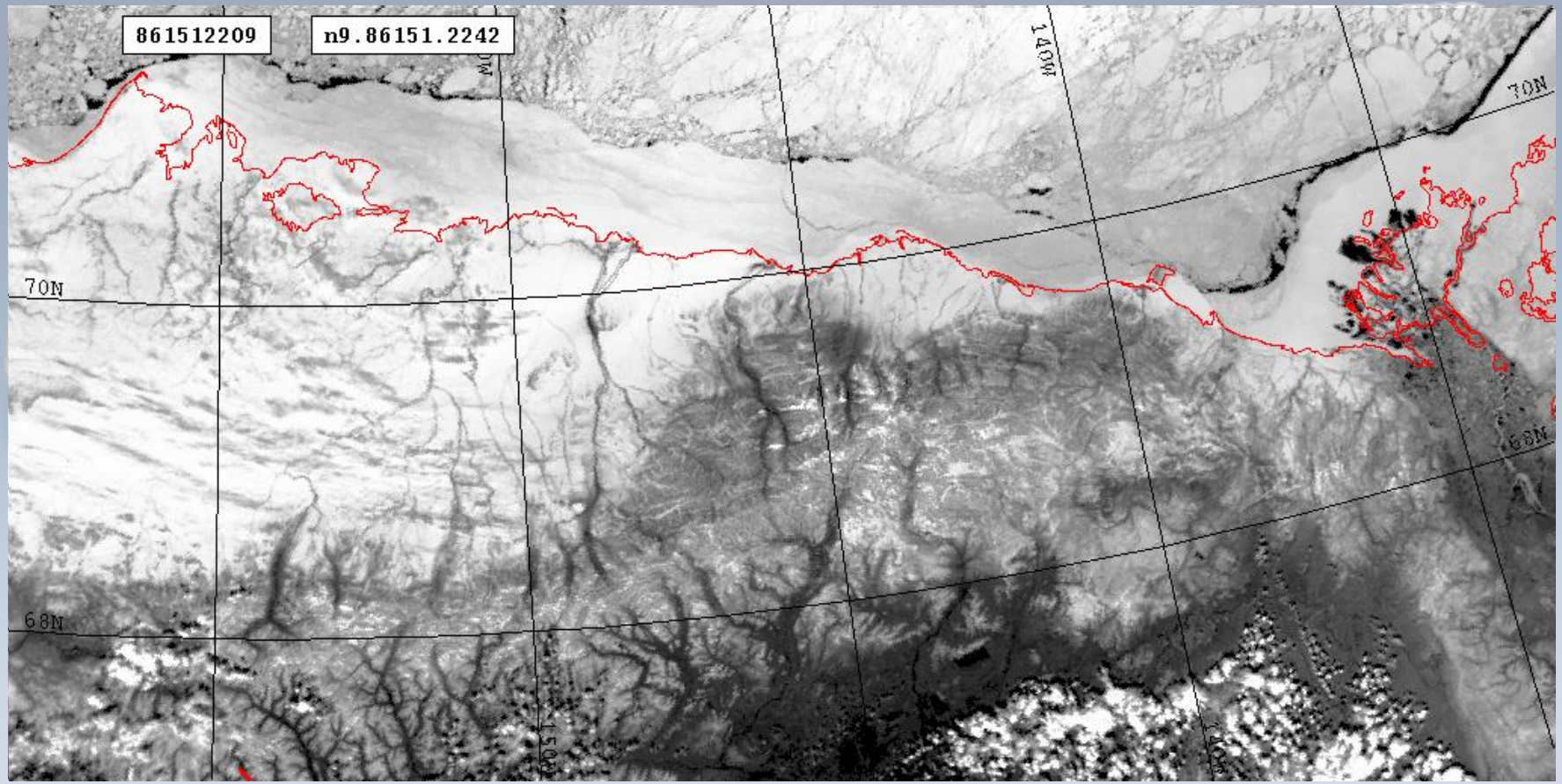
Measuring and Forecasting the Response of Alaska's Terrestrial Ecosystem to a Warming Climate

Factors affecting a species ability to adapt to advancing phenology:

- **Migration distance**
- **Body size**
- **Use of and conditions at stopover sites**
- **Source of nutrients for egg production**



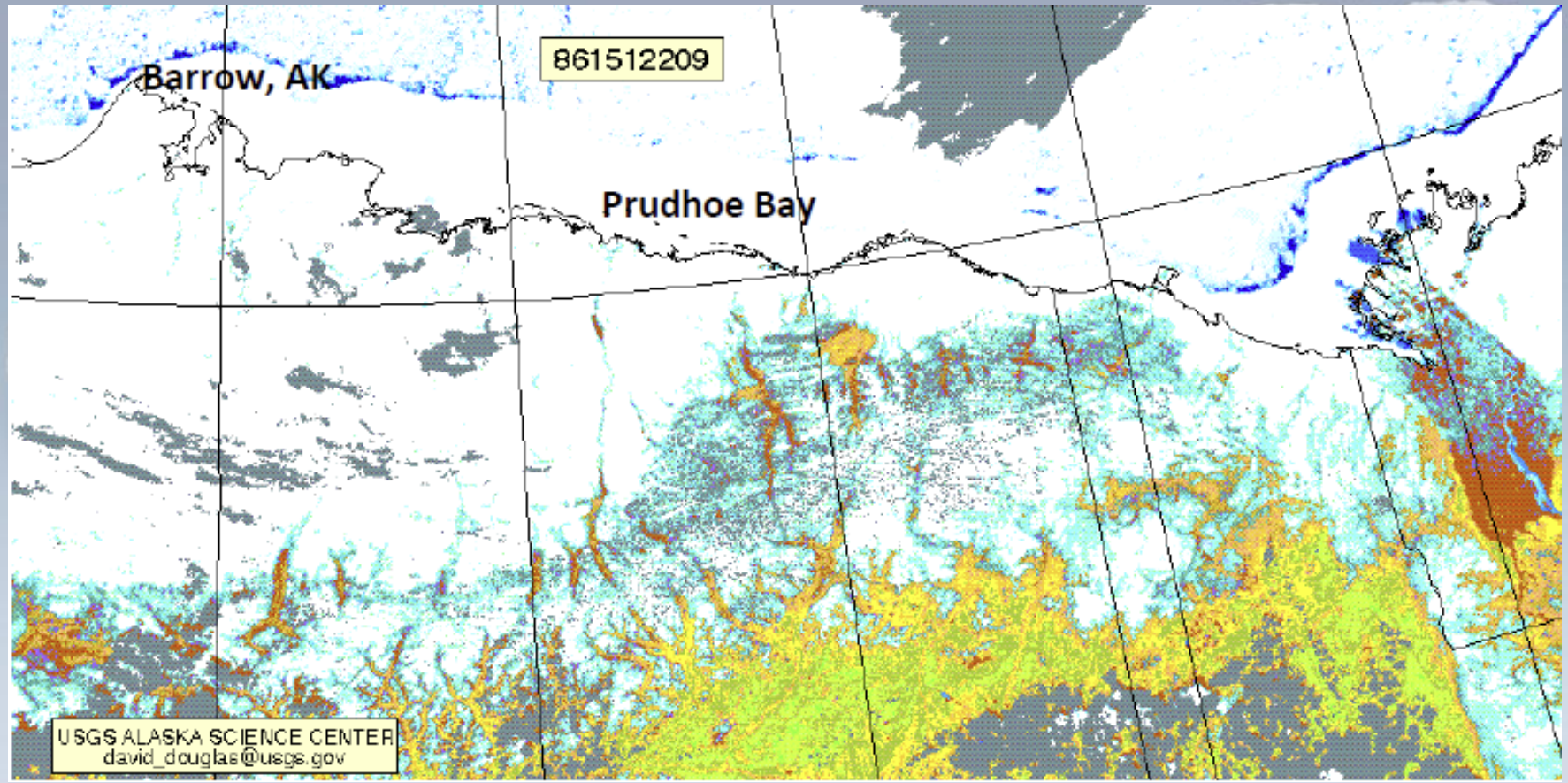
Snow cover presents image processing challenges



AVHRR N9 Ch2, May 31, 1986

Snow cover presents image processing challenges.

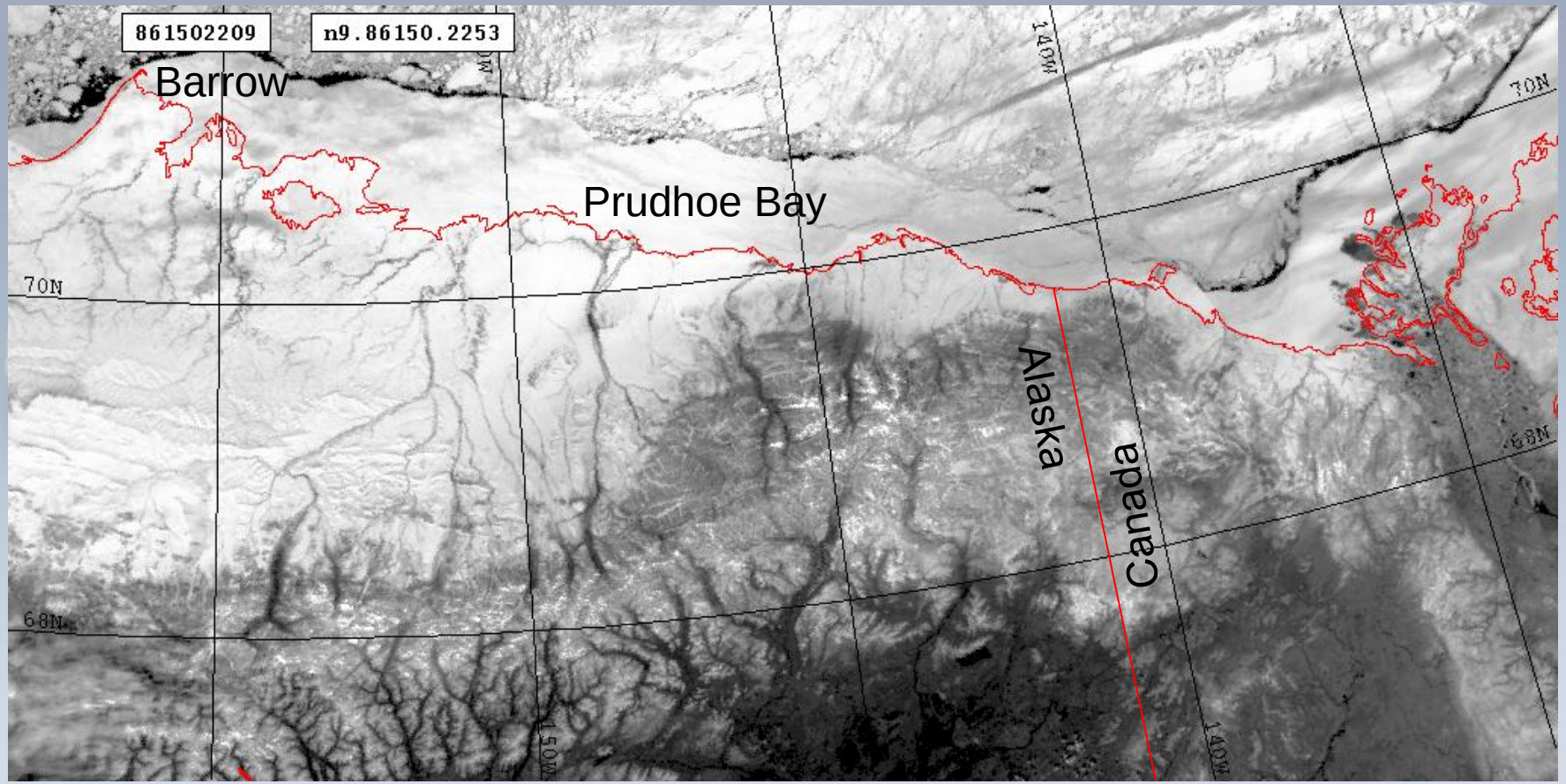
AVHRR N9 NDVI, May 31, 1986



Clouds (gray) based on (Ch3 – Ch4) threshold

BAGLIO, J.V., and HOLROYD, E.W. III, 1989, Methods for operational snow cover area mapping using the Advanced Very High Resolution Radiometer: San Juan Mountains test study. USGS Research Technical Report, USGS/EROS Data Center, Sioux Falls, SD.

Snow cover presents image processing challenges

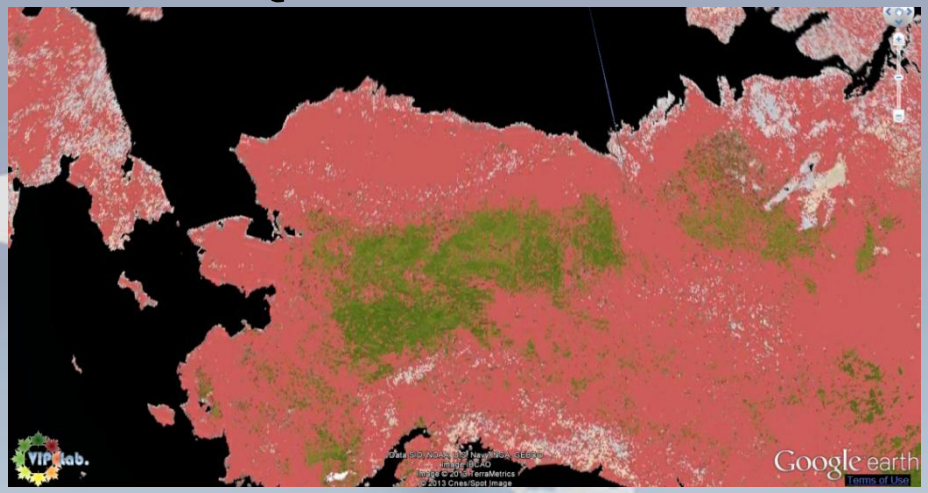


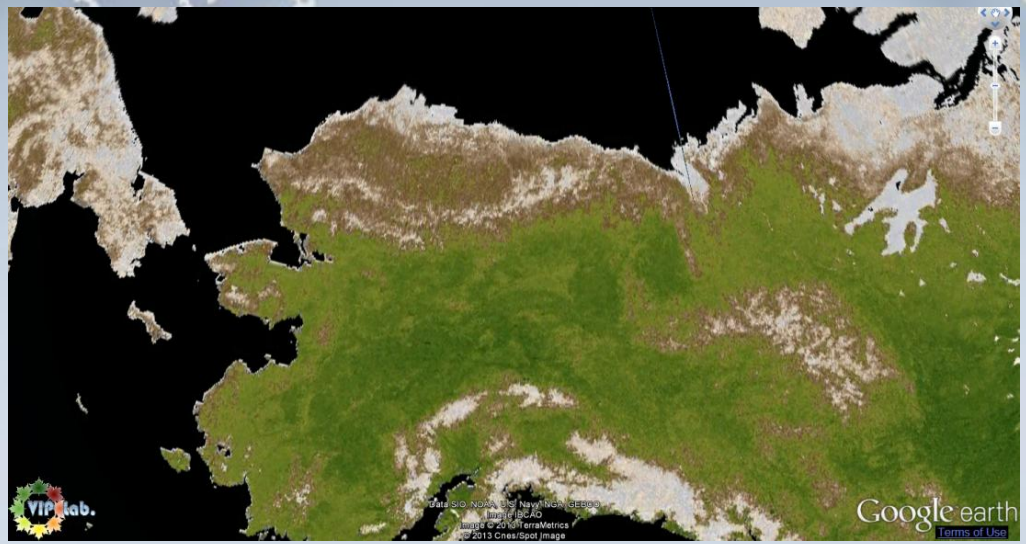
AVHRR N9 Ch2, May 30, 1986

VIP ESDR Version 2: May 30, 1986

Preprocessed Input Data

QA Filtered Data

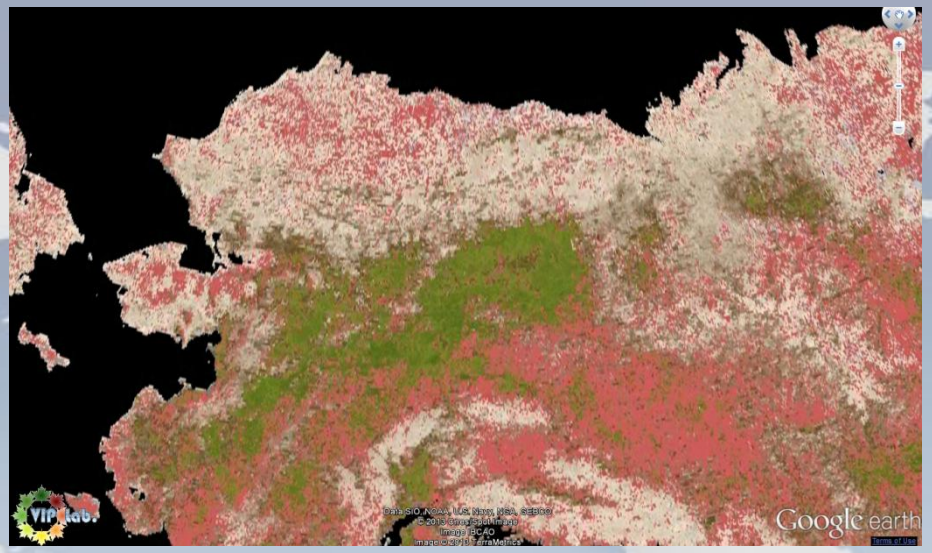




Continuity Gap-filled

VIP ESDR Version 2: May 16-31, 1986

QA Filtered Data



Continuity Gap-filled

VIP ESDR Version 2: May 16-31, 1986 (15-day composite)

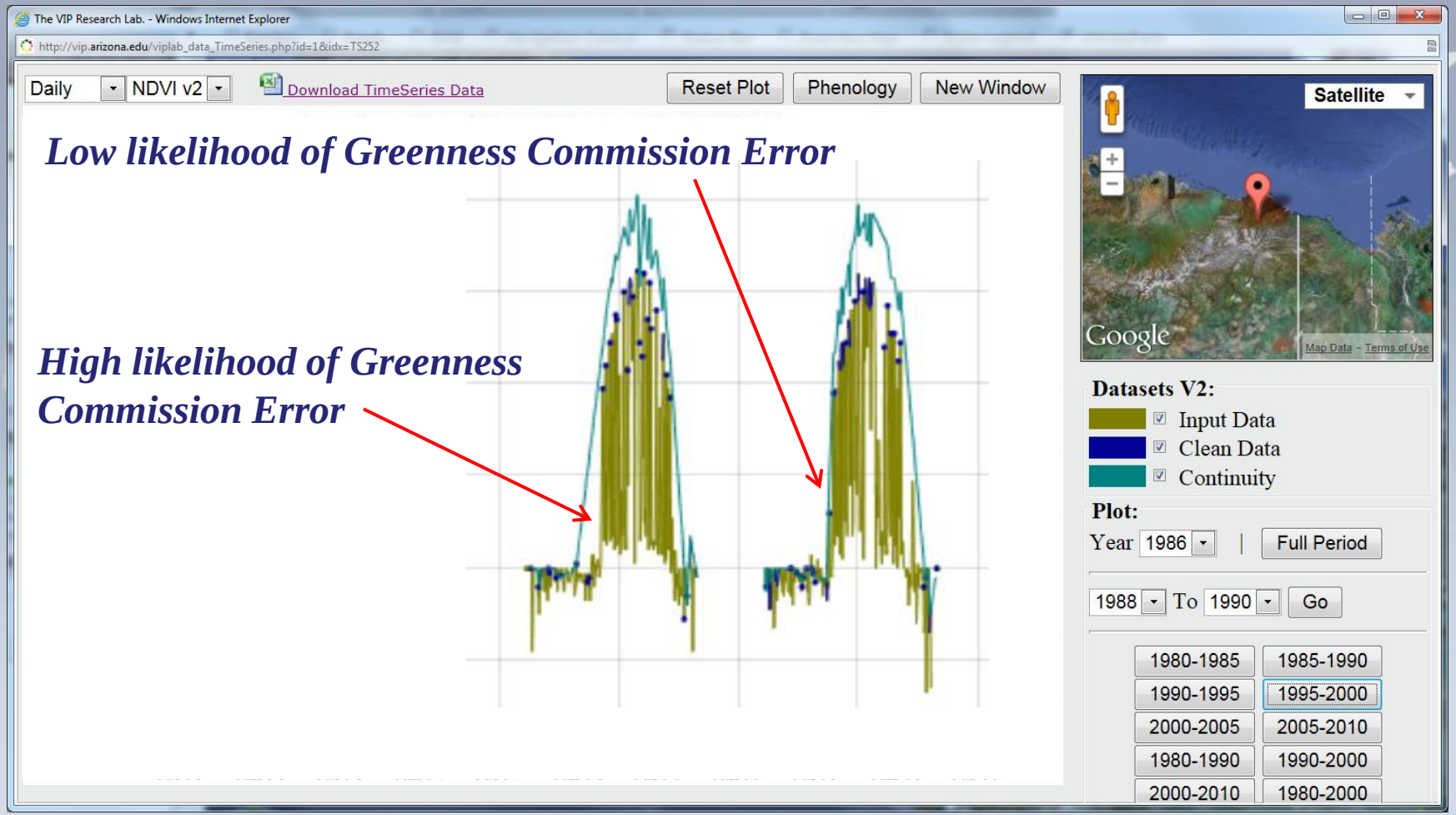
QA Filtered Data

Continuity Gap-filled

"Greenness Commission Errors"

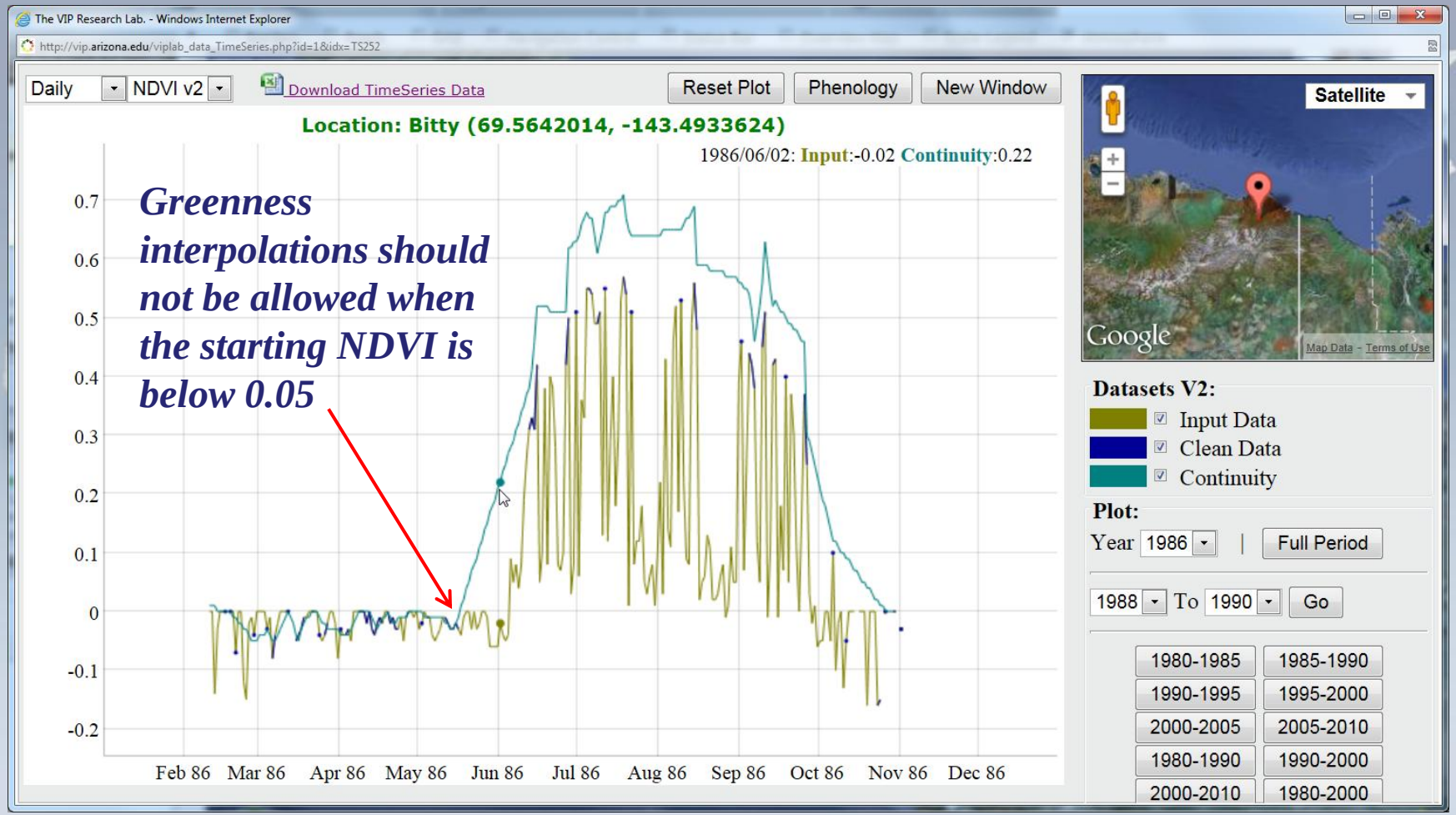
Time series during AVHRR (LTDR) period

Time series during AVHRR (LTDR) period

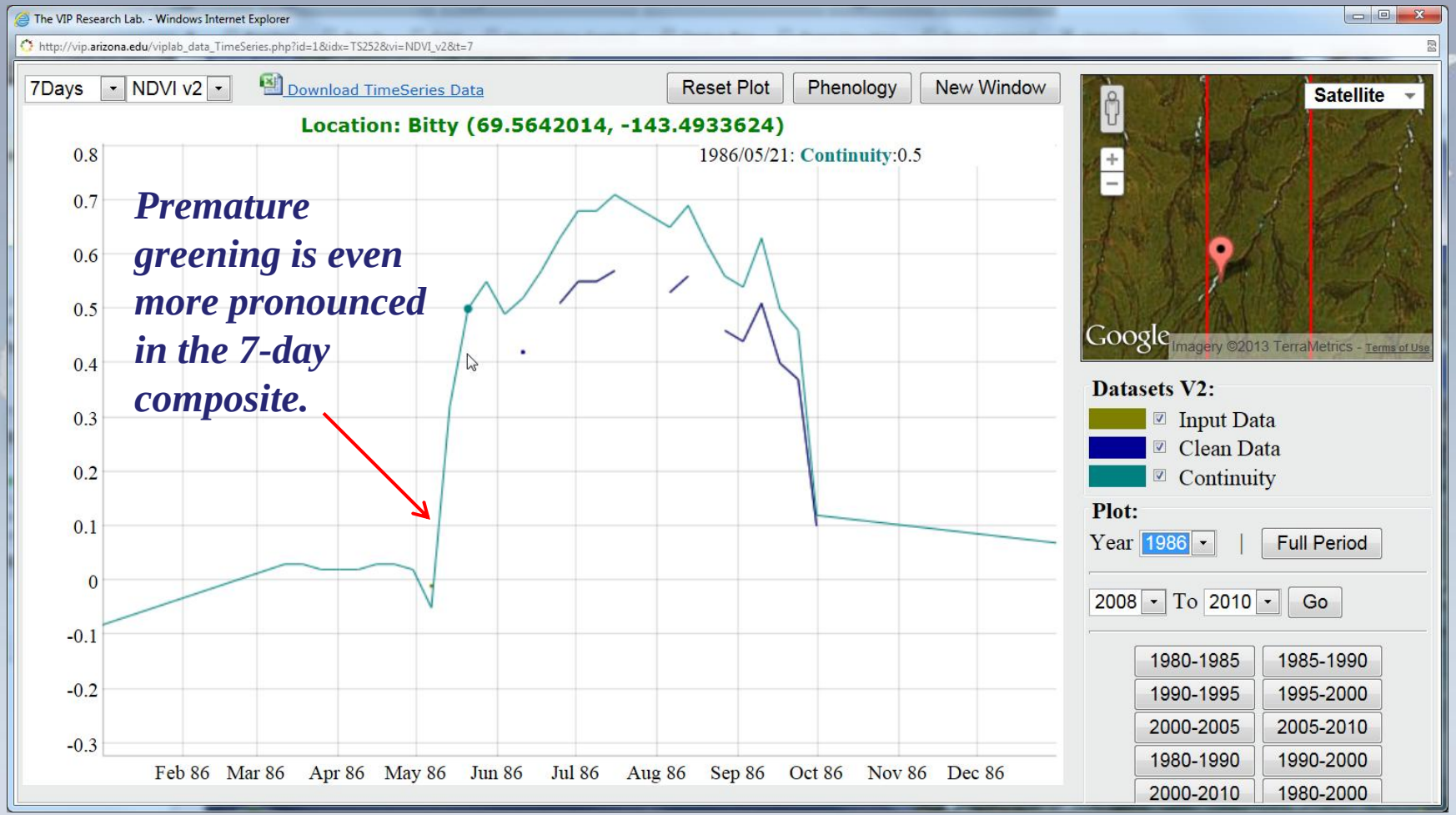


Time series during MODIS period

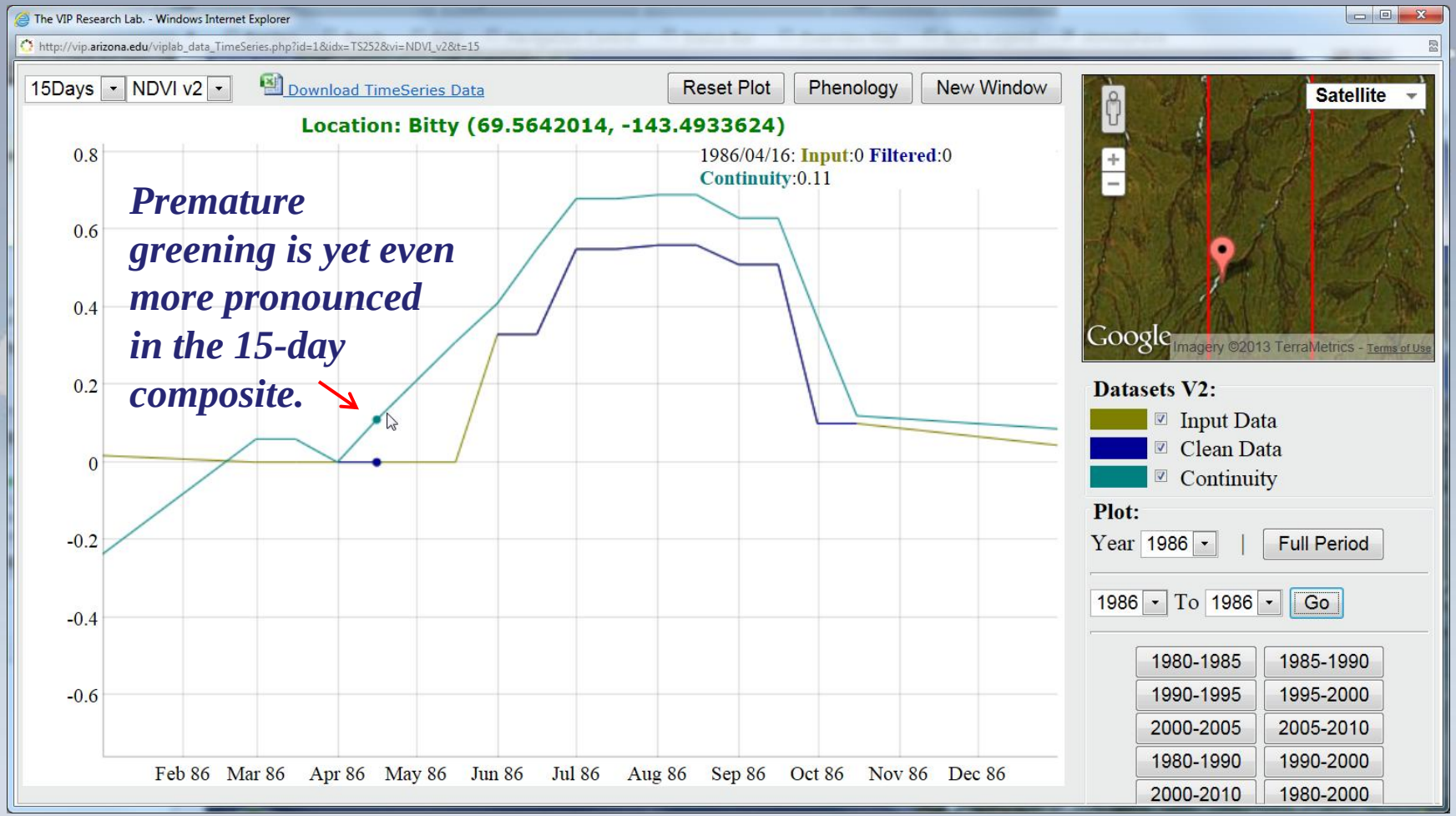
1986 continuity phenology, daily



1986 continuity phenology, 7-day



1986 continuity phenology, 15-day



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