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Drivers and Impacts of Environmental Change in the Yukon-Kuskokwim Delta, Alaska

(Frost-01)

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Dr. Ann Fineup-Riordan (CEC)

Torre Jorgenson (AK Ecoscience)

Matt Macander (ABR)



above.nasa.gov @NASA_ABoVE



Project Team and Institutional Collaborations



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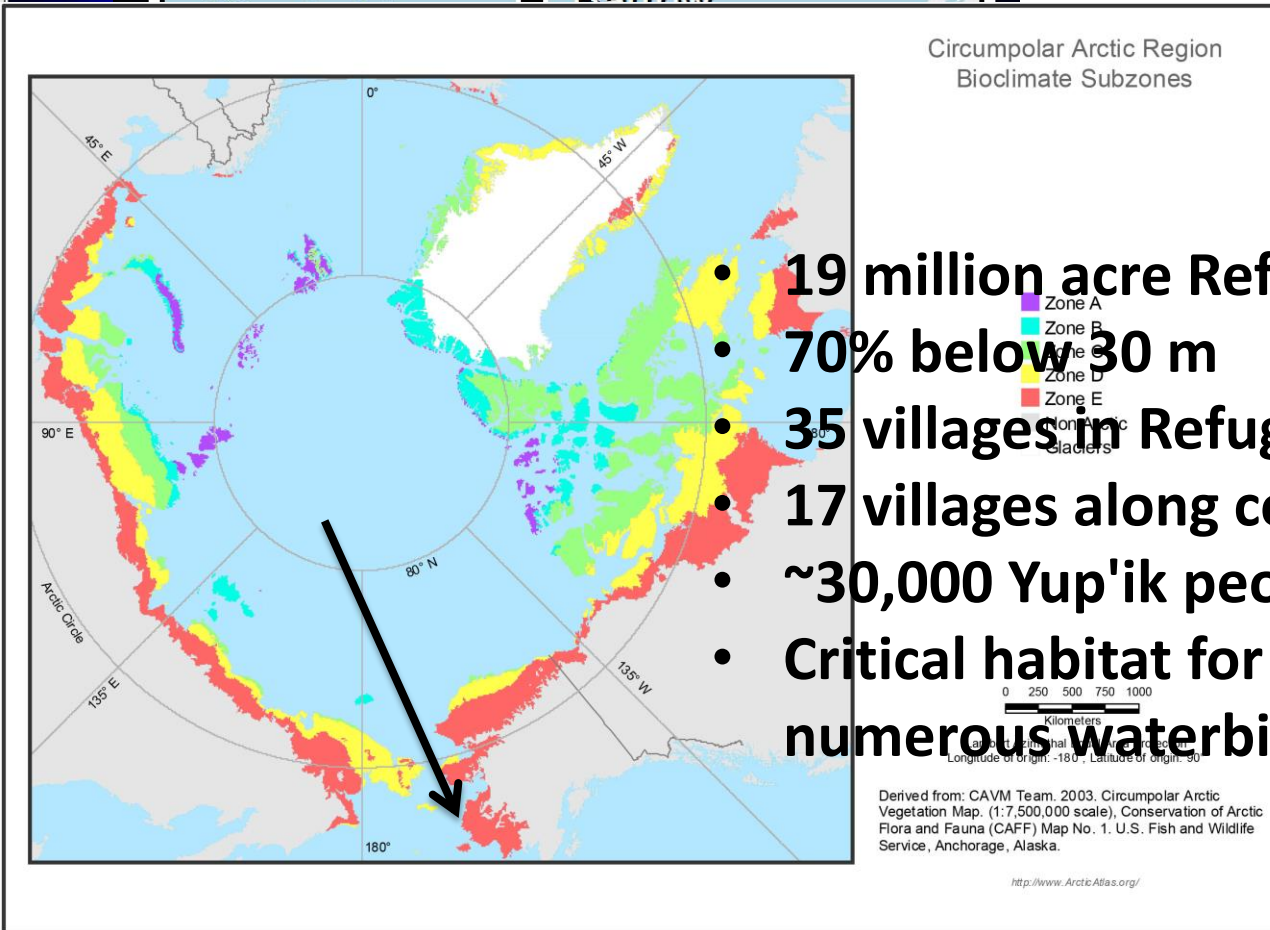
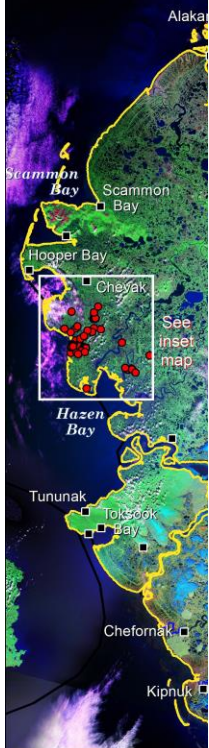


Matt Macander
Remote Sensing
ABR

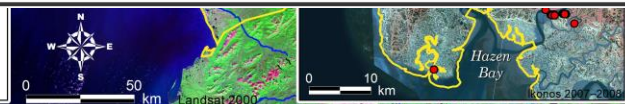


Joel Reynolds
Science Coordinator
Western AK LCC

YK Delta ecoregion

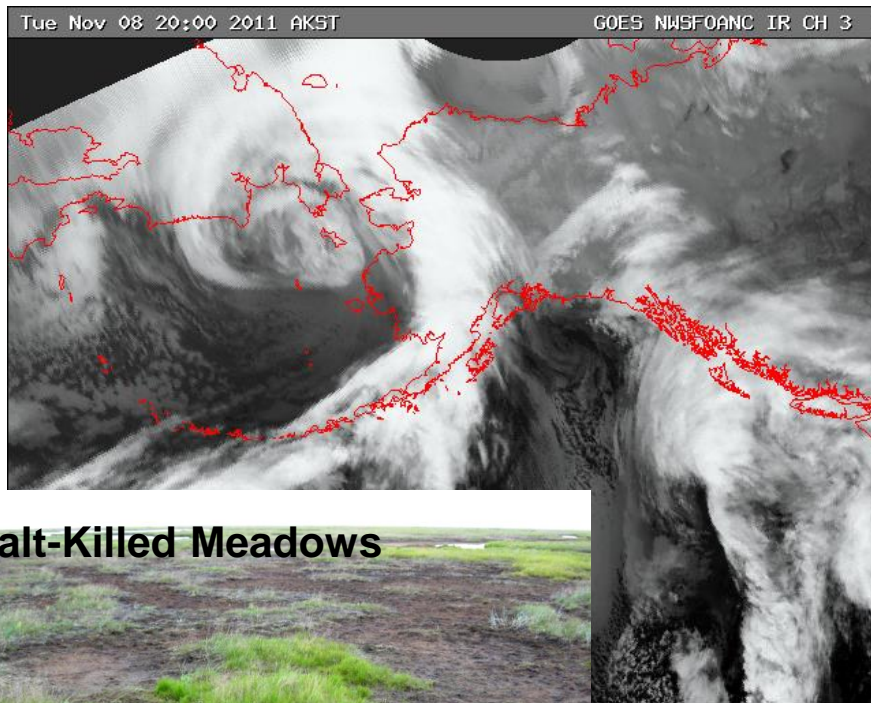


- Long-term Plot
- Y-K Delta Ecoregion
- Yukon Delta NWR



Vulnerability to Climate Change

Storms and Sea Level Rise



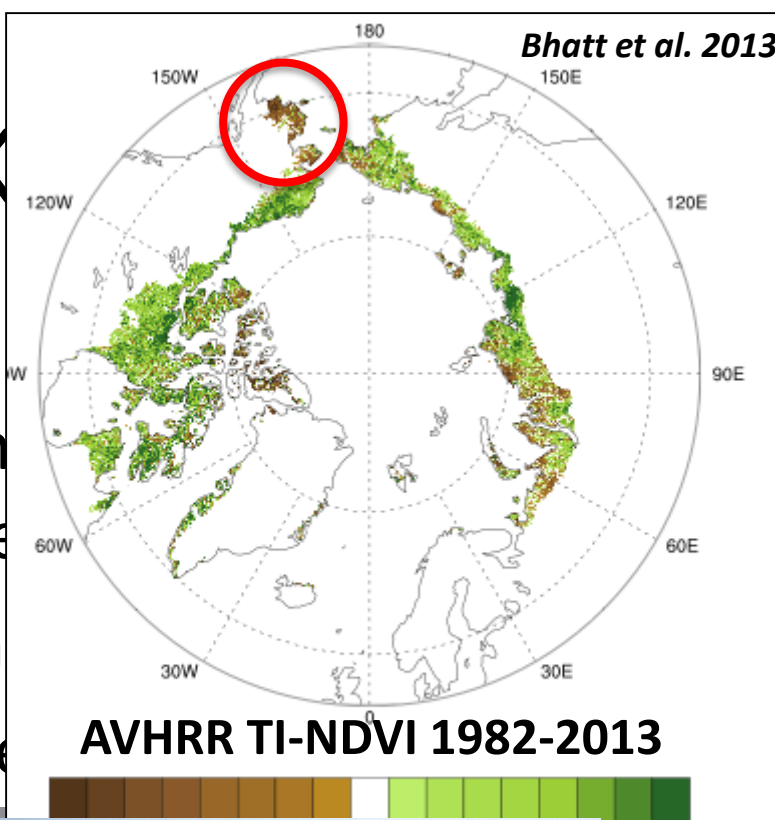
Permafrost Thaw



YK

ns

- One of the most important tundra biomes
- Large human population
- Underrepresented



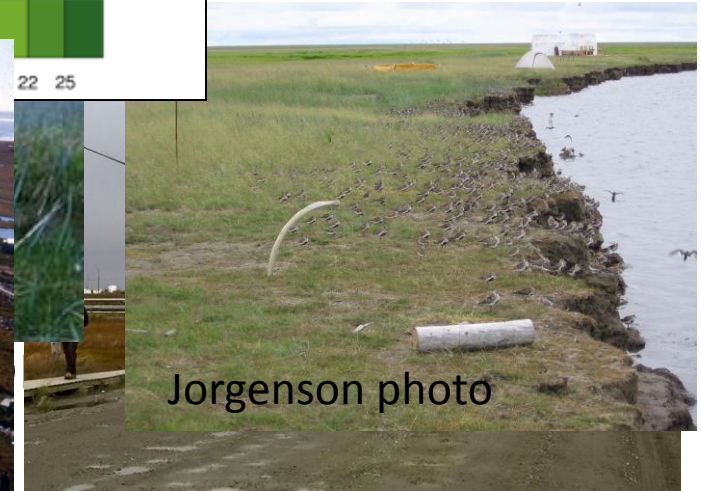
of the arctic
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USGS photo



Frank Keim photo



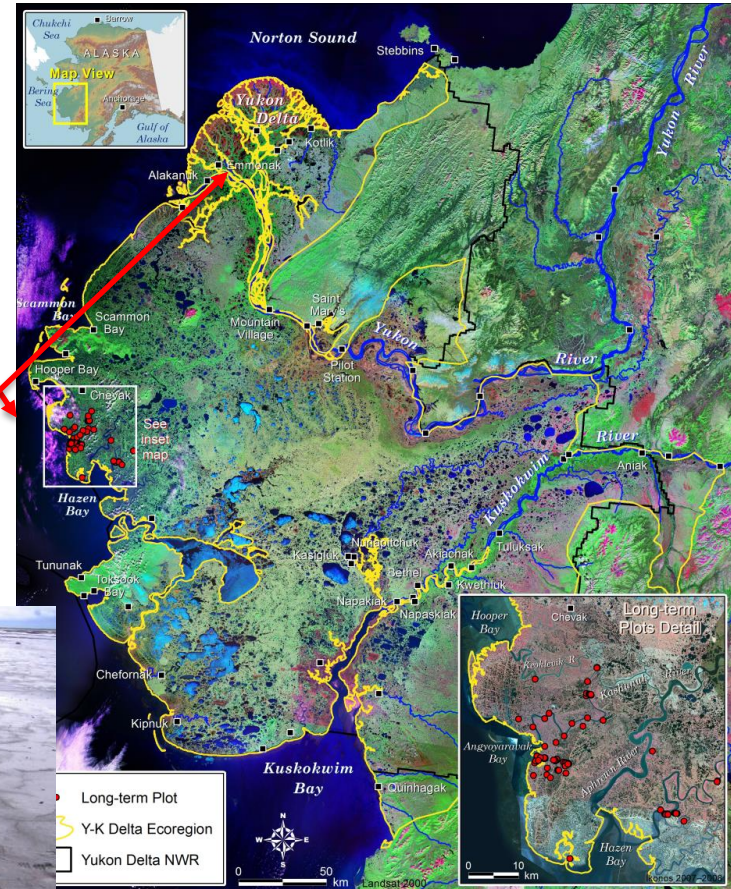
Jorgenson photo

Science Questions & Objectives

- Tier 2 Science Questions addressed
 - How are Y-K flora and fauna responding to change?
 - How are disturbance regimes changing and what are the impacts?
 - What processes are controlling changes to permafrost?
 - How is change affecting ecosystem services? Adaptations?
- Tier 2 Science Objectives
 - Ecosystem Dynamics
 - Ecosystem Services

Field Studies

- Repeat-sampling of long-term monitoring transects (1994-2016)
 - Vegetation point-intercept
 - Surface elevation
 - Soils, permafrost
- Ground data collection and analysis for Yukon



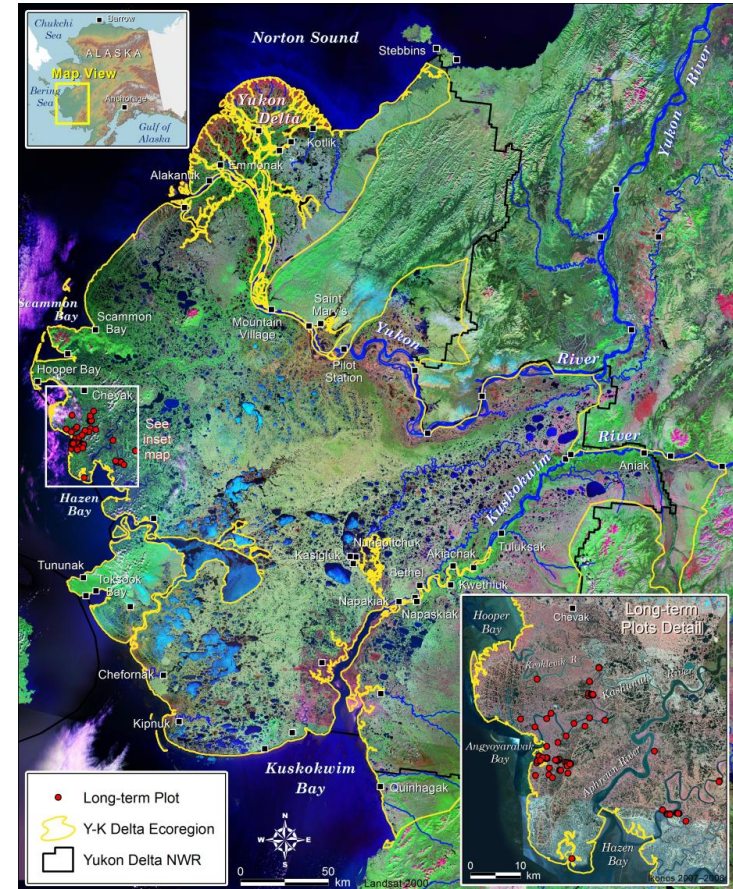
1995



2006

Field Studies

- Y-K Delta Working Group
 - USGS
 - Univ. of Alaska Anchorage
 - WALCC
- Circumpolar Active Layer Monitoring
- Plot data for pre-ABoVE (PI Walker)



Spaceborne Remote Sensing

*Circumpolar
scale*

- AVHRR (1982–present)
- SSM/I sea-ice concentration (1978–present)
- MODIS data products (2000–present)
- Landsat TM/ETM+/OLI (1999–present)
- NGA high-res data archive
 - Excellent new WV02 acquisitions from 2015
 - Anticipate tasking in “shoulder seasons”

Local scale

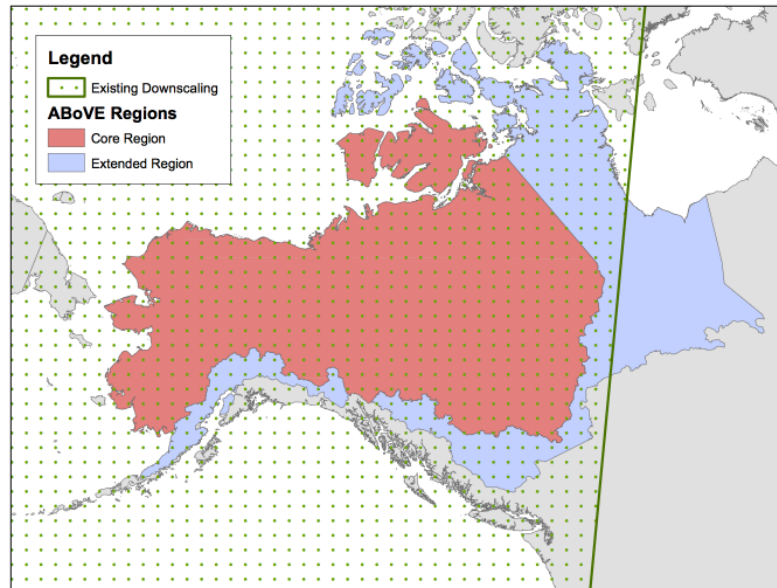
MODIS-scale RS

- Full YK Delta ecoregion + offshore Bering Sea
 - MODIS MaxNDVI time-series
 - Land surface temperature
 - Snow cover
 - Cloud cover
- Corroborate NDVI trends observed by AVHRR
- Linkage with downscaled climate data
 - Temporal trends (temperature, cloudiness)
 - Events/extremes (storms, rain-on-snow events)

Dynamical Downscaling Data: Alaska

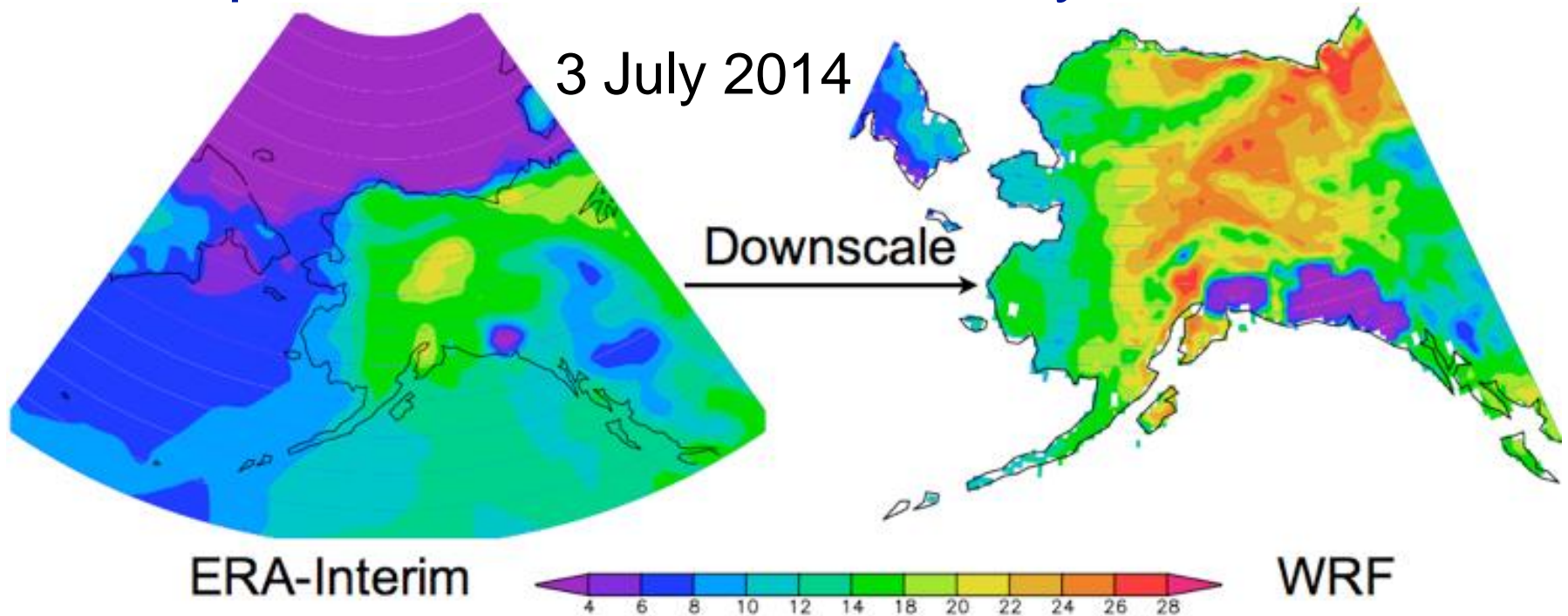
Climate Science Center Project

- Regional Model (Weather Research Forecast Model) over extended Alaska Domain
- Driven by ERA-Interim reanalysis, 1979-2013
- Output netcdf



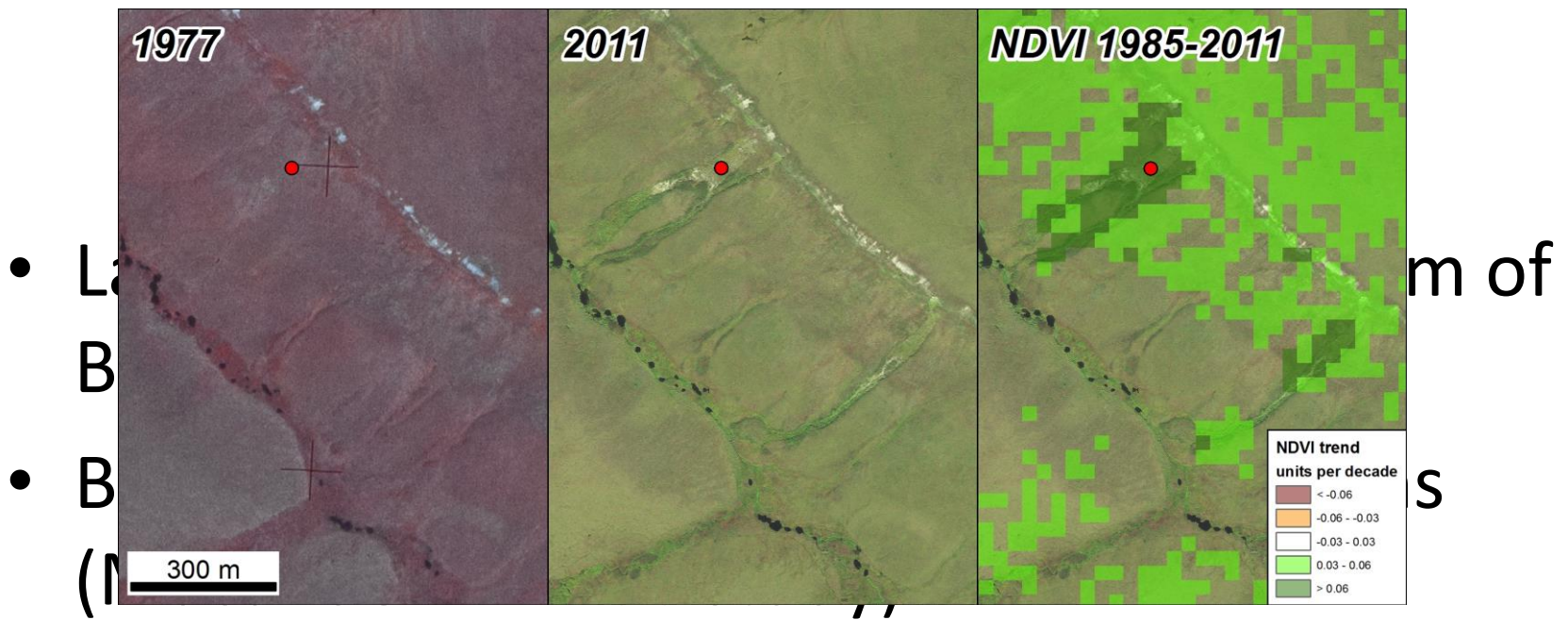
Bieniek et al. 2015

Dynamical Downscaling: Temperatures more Realistically Resolved



Large project to downscale future climate projections. Many parameters available as daily/hourly data!

- Extreme events can be explored
- Variables at surface and other levels

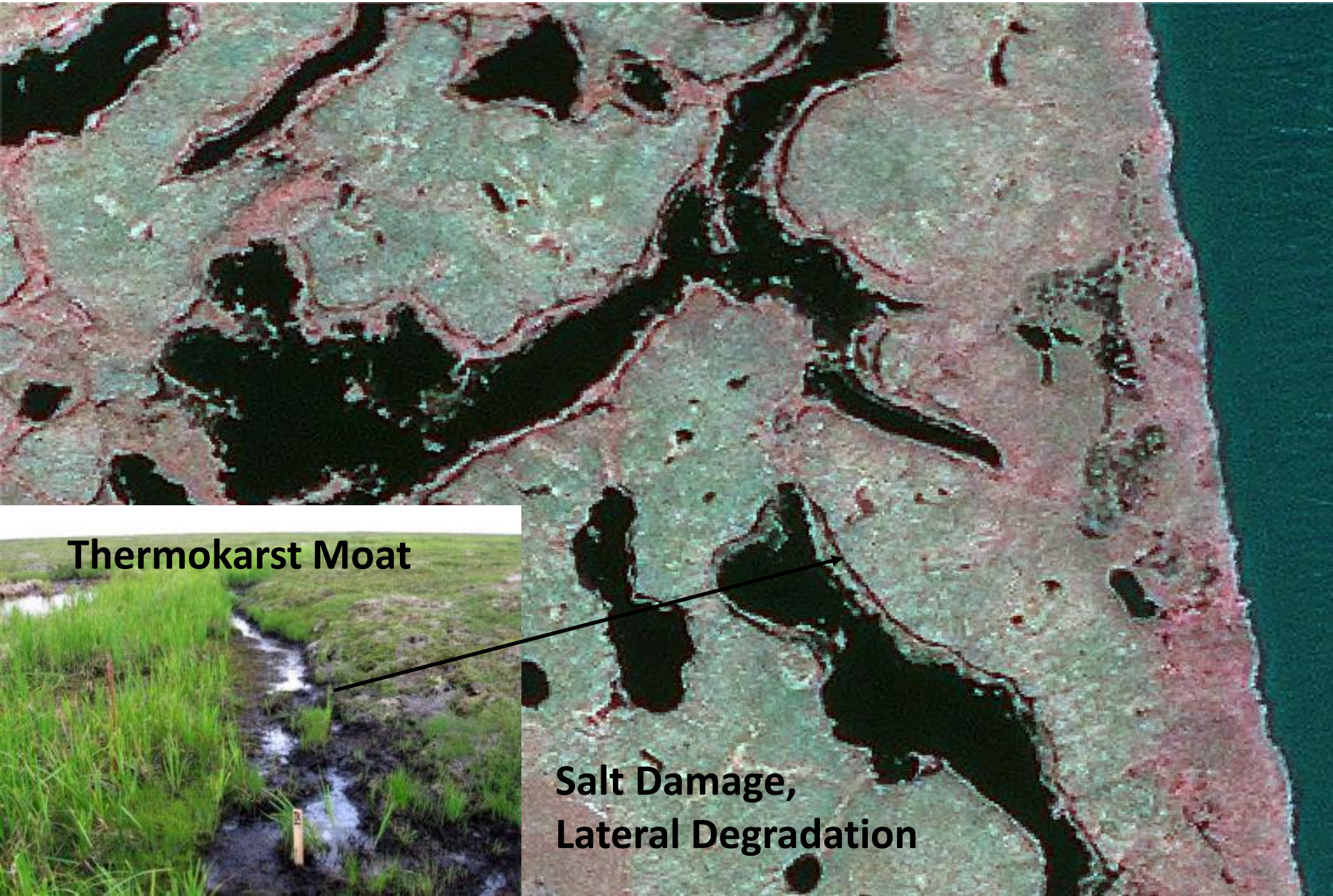


- Spatial context for ecological interpretation
 - Where is the landscape changing? Stable?
 - Long-term change versus “pulses” (e.g., shrubs, salt-kill)
 - Trend analysis informed by in situ monitoring data, historical imagery

Local-scale RS

- Retrospective analysis of high-resolution imagery
 - 1955, 1980s aerial photos
 - Modern high-resolution imagery (NGA)
- Map disturbances near focus villages
 - Chevak (central coast)
 - Emmonak (Yukon Delta)
- Shrub expansion on Yukon Delta
- Recovery after tundra fire

Thermokarst



Thermokarst Moat

**Salt Damage,
Lateral Degradation**

Airborne Remote Sensing

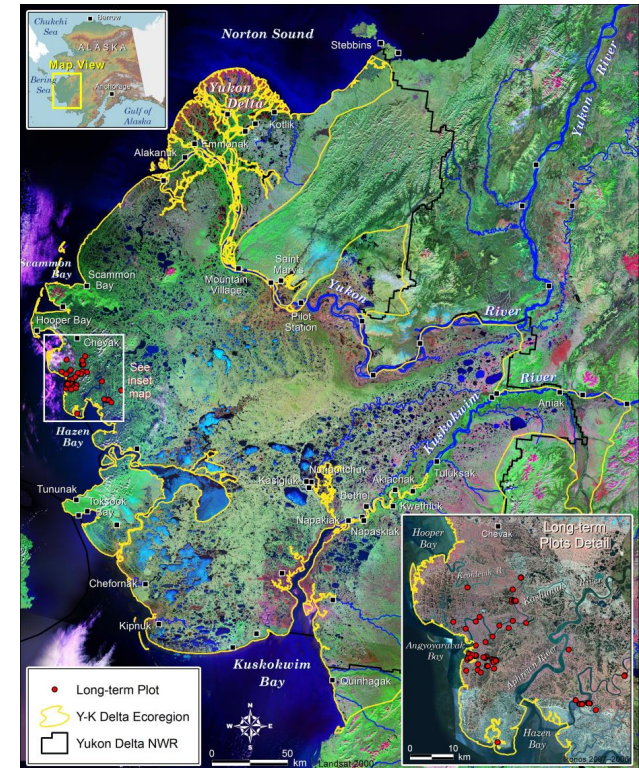
- Existing 2009 Lidar dataset on central coast region
 - Surface elevations (e.g. permafrost plateaus)
- Potential uses for new airborne data
 - Central coast (3DEP proposal)
 - Lidar in Emmonak area (FEMA funding)
 - Hyperspectral
 - Focus on saline/brackish meadows
 - “grazing lawns”

Sociological Approaches

- Advisory meetings timed before field work
 - What are concerns, perceptions, and expectations of YK residents?
 - Chevak (2016)
 - Emmonak (2017)
- Knowledge exchange meetings
 - Chevak (2017)
 - Emmonak (2018)

Geospatial Data Products

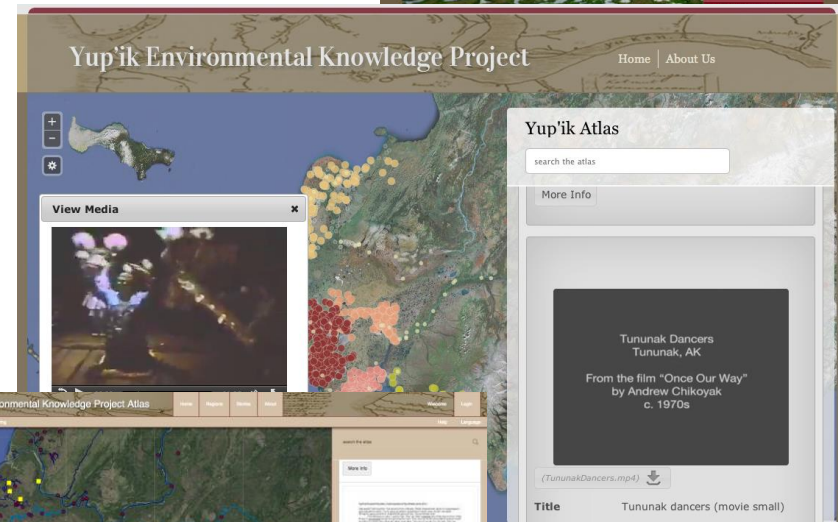
- Downscaled reanalysis
- Trend maps
- Disturbance mapping
- Varied temporal ranges and scales
- Stakeholder / user base
 - YK land managers (tribal gov't, regional corp)
 - USFWS



ELOKA Contribution

ELOKA Mission: To provide data management and user support services to facilitate the collection, preservation, exchange, and use of local observations and knowledge of the Arctic.

- Yup'ik Environmental Knowledge Project/Atlas
- Interactive web mapping application
- Presents geographic, text, audio, video, images along with relationships between content elements
- Supports user contributed content, dialogue



<http://eloka-arctic.org/communities/yupik>

An aerial photograph taken from the perspective of someone on an airplane, looking out over a vast, intricate river delta. The foreground shows the underside of the aircraft's wing and a portion of the fuselage. Below, a wide river winds through a landscape of brownish-green marshes and wetlands. The river branches out into numerous smaller channels and oxbow lakes, creating a complex, maze-like pattern. The sky is overcast and hazy, with soft light filtering through the clouds. The overall scene is a dramatic and detailed view of a natural waterway system.

Questions?