A photograph of a wooden boat filled with salmon, floating on a calm body of water. The boat is in the foreground, and the water extends to a distant shoreline with trees under a clear sky. The entire image has a blue color cast.

# using big data to understand Arctic surface water change

Erin Trochim, PhD

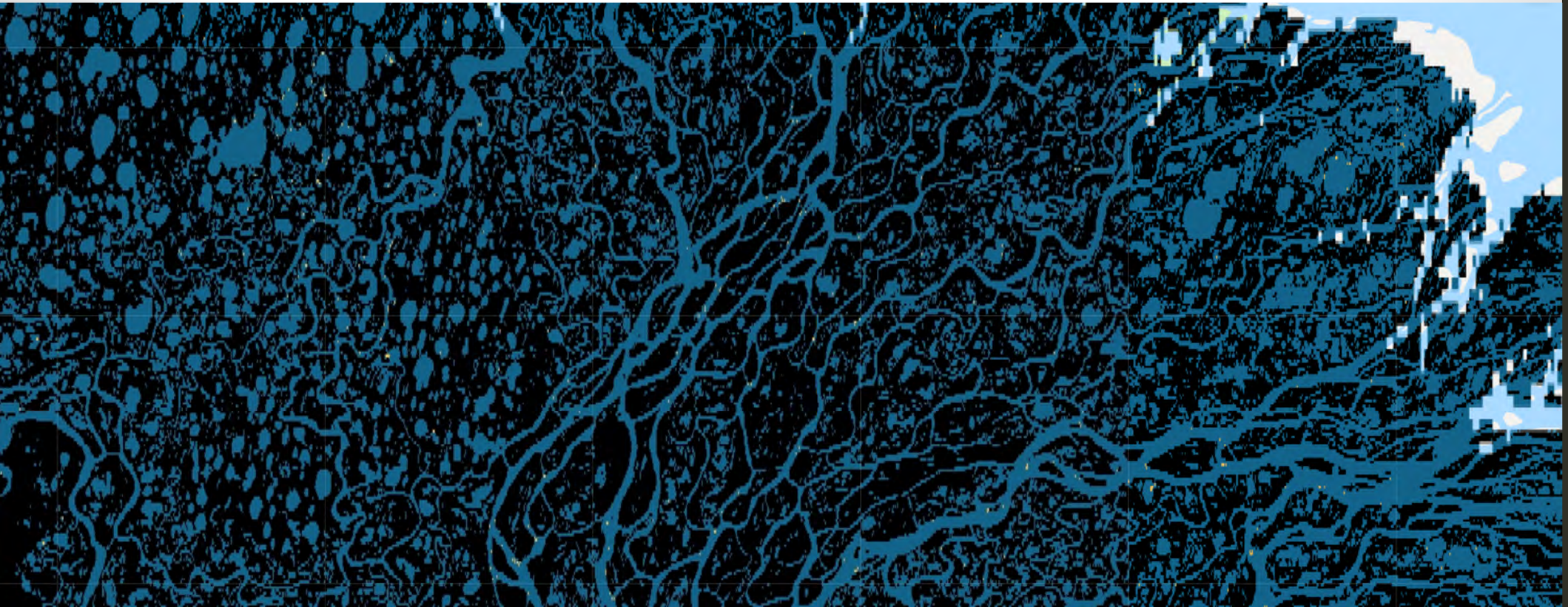
**AK CASO**  
Alaska Climate Adaptation Science Center





surface water is abundant and highly variable in the Arctic  
Understanding distribution and change is critical for local, regional and global processes





big data makes it possible to examine differences in time and space –  
and allows us to understand processes over broad areas

## Policy Implications



## Theoretical Improvements

Better representation of water over time in Arctic environments

## Computational Efficiencies

Improvements in processing speed and data representation

## Communication & Education

Core components of applying and adopting practices in variety of fields

# Integrating Big Data is the new norm for Arctic surface water studies

Scientific questions, research approaches and training must evolve with data availability, improvements in processing and delivery, and application needs

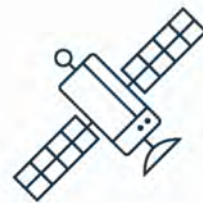


from  
Policy to  
Synthesis  
with  
a detour to  
Hard-core  
Science  
and  
Big Data



## Meet Earth Engine

Google Earth Engine combines a multi-petabyte catalog of satellite imagery and geospatial datasets with planetary-scale analysis capabilities and makes it available for scientists, researchers, and developers to detect changes, map trends, and quantify differences on the Earth's surface.



Satellite Imagery

+



Your Algorithms

+



Real World Applications

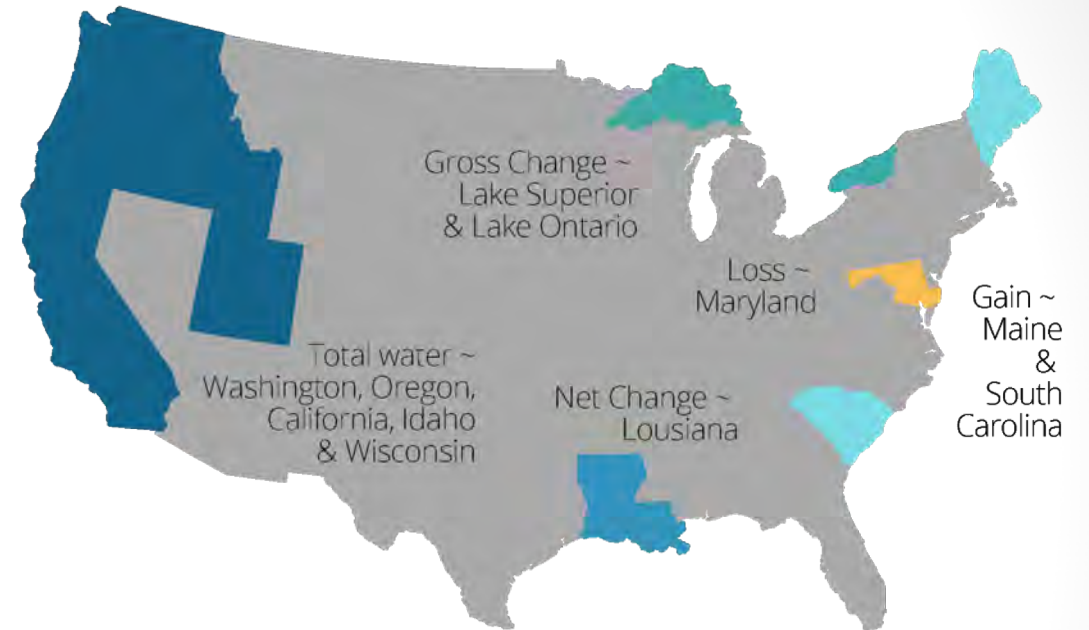
a. Surface water covered a total area of

**1,203,655 km<sup>2</sup>**

IN NORTHERN HEMISPHERE PERMAFROST AREAS FROM 1984-2018



b. Permafrost water areas extrapolated to the United States



bottom-line up-front findings:

in northern hemisphere permafrost

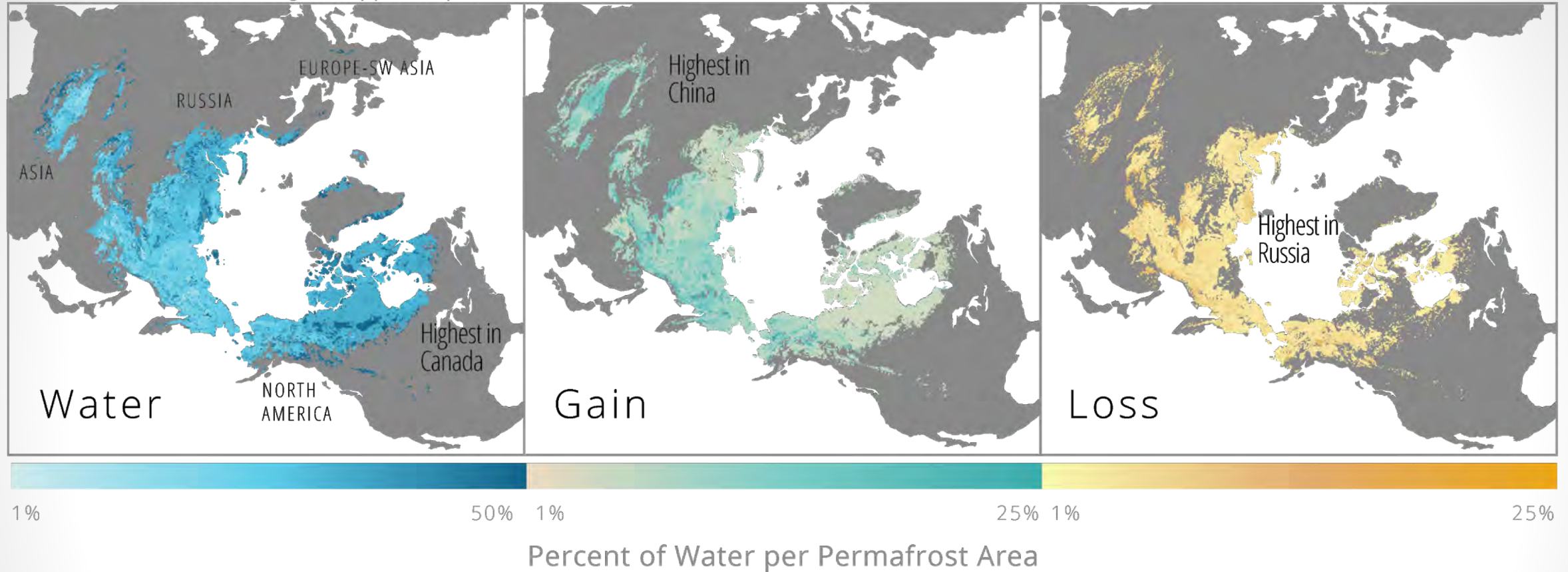
Stable water areas comprised 30% of all global permanent and seasonal water while gains and losses each made up 12% respectively

methods:  
7 separate  
data sets used  
for  
Analysis





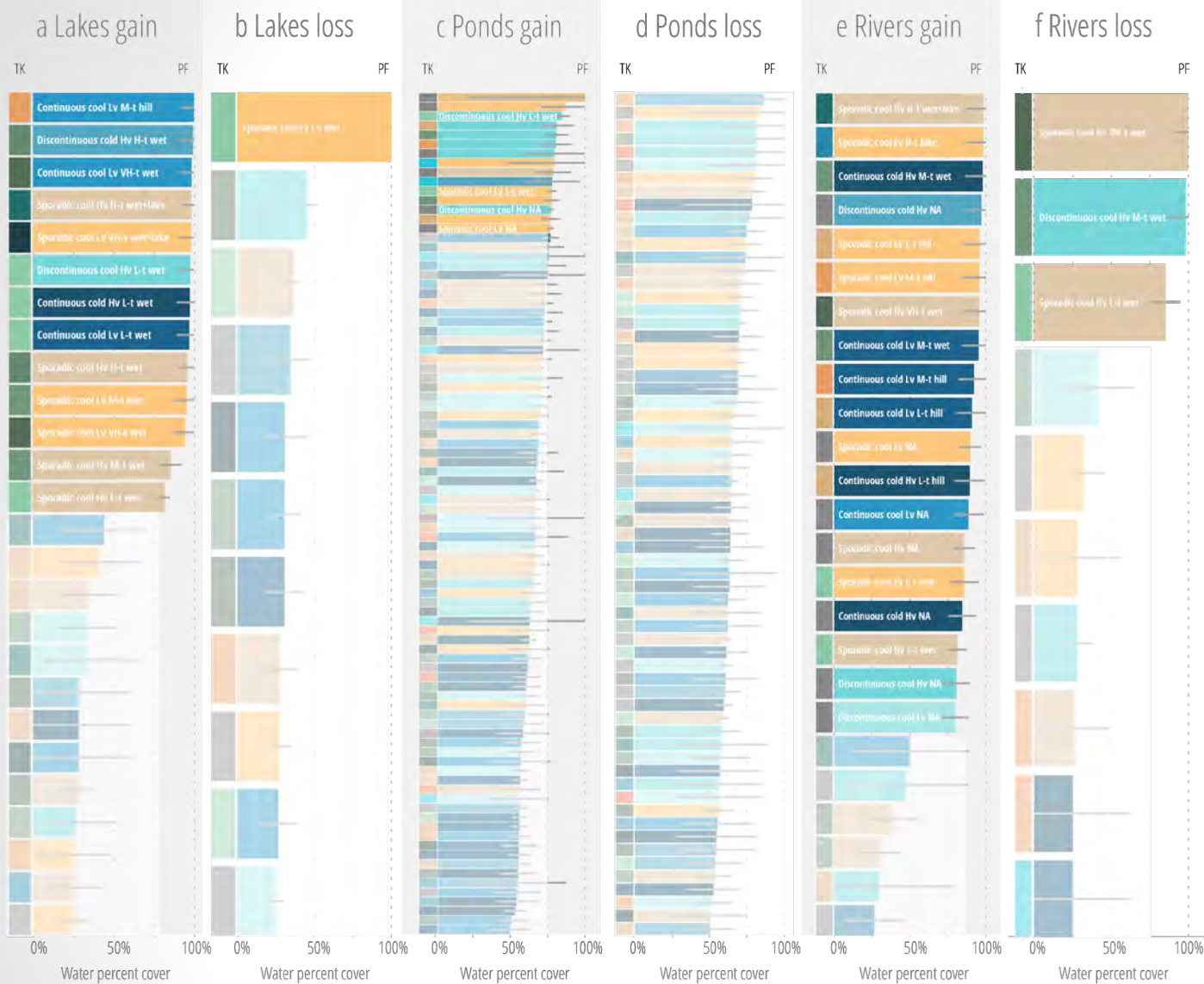
c. Surface water and changes mapped to permafrost areas



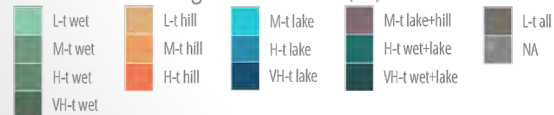
bottom-line up-front findings:

% water not simply correlated to % changes





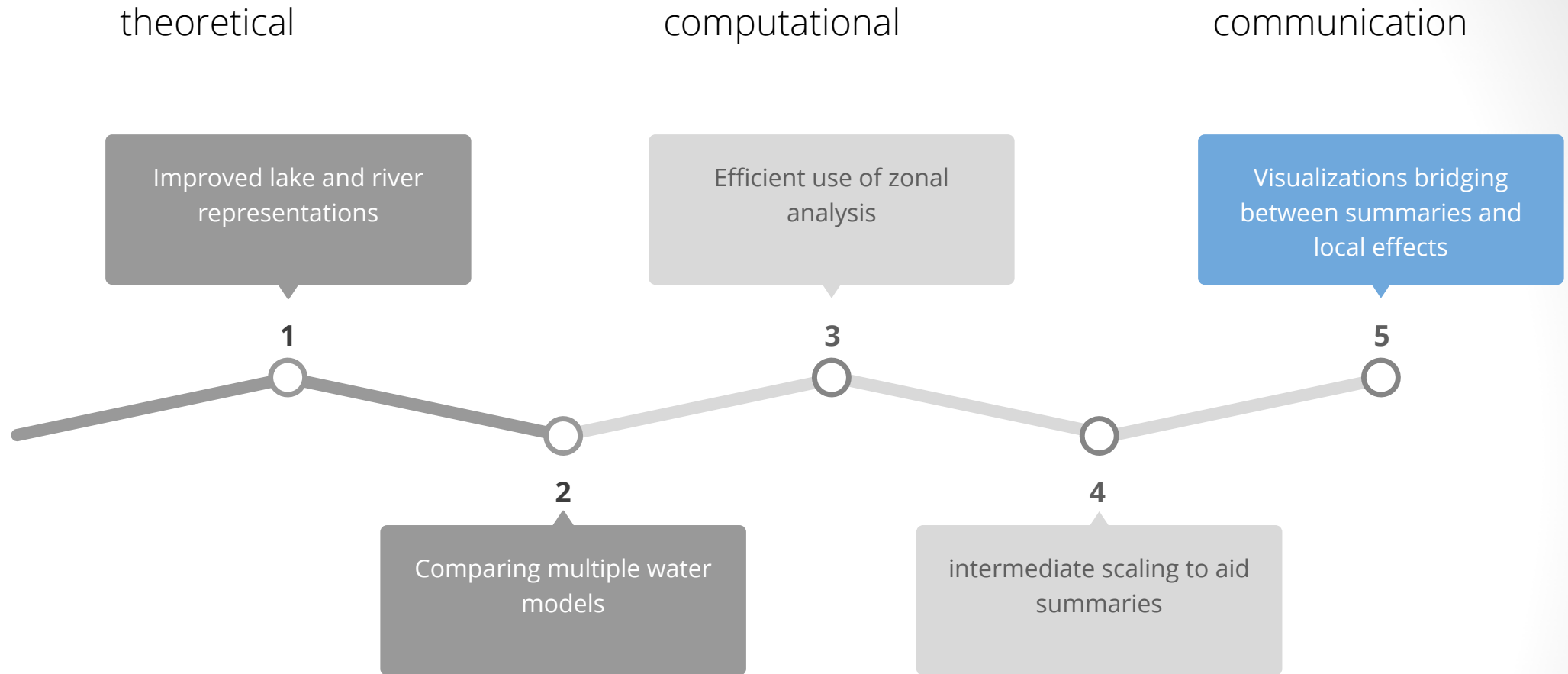
Thermokarst coverage and landform (TK)



Permafrost extent and temperature (PF)



results  
warmer  
temperatures or  
higher ice  
contents  
were not consistently  
associated with higher  
amounts change

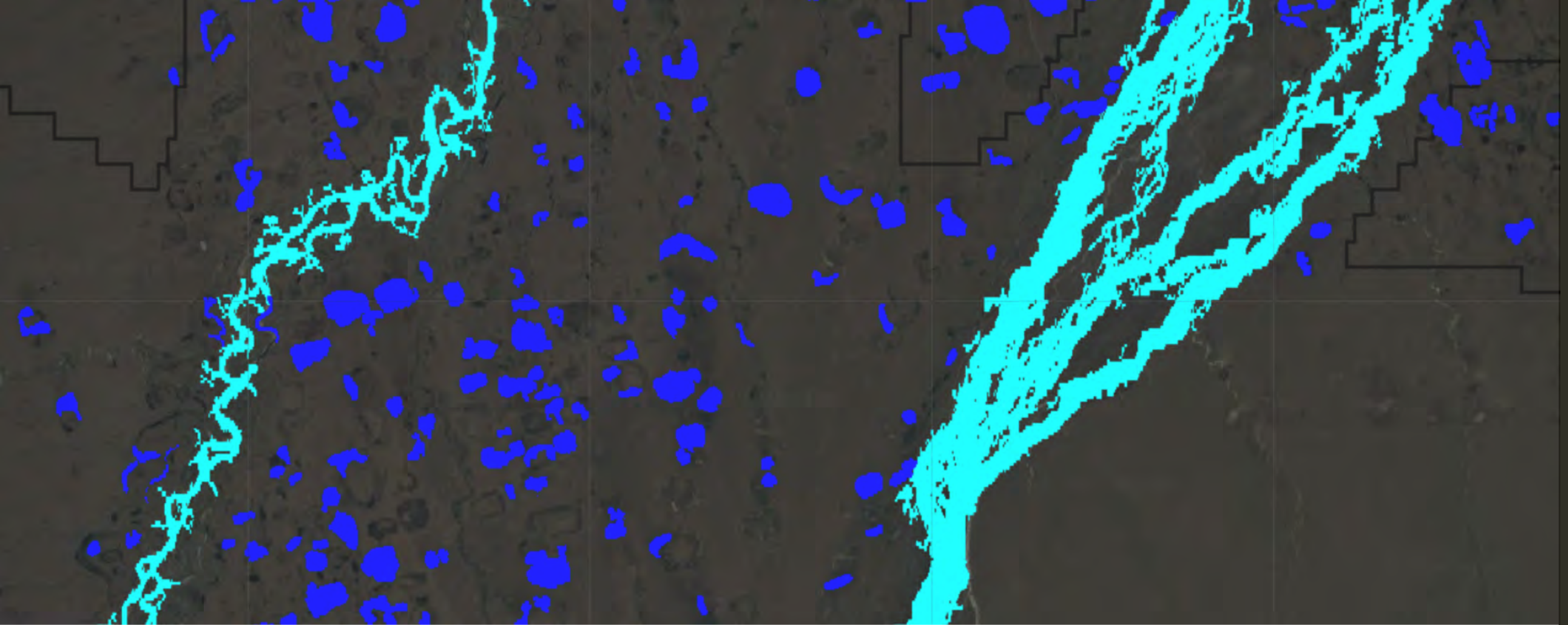


5 keys:

to improve analysis

for differentiating how variability affects surface water over time

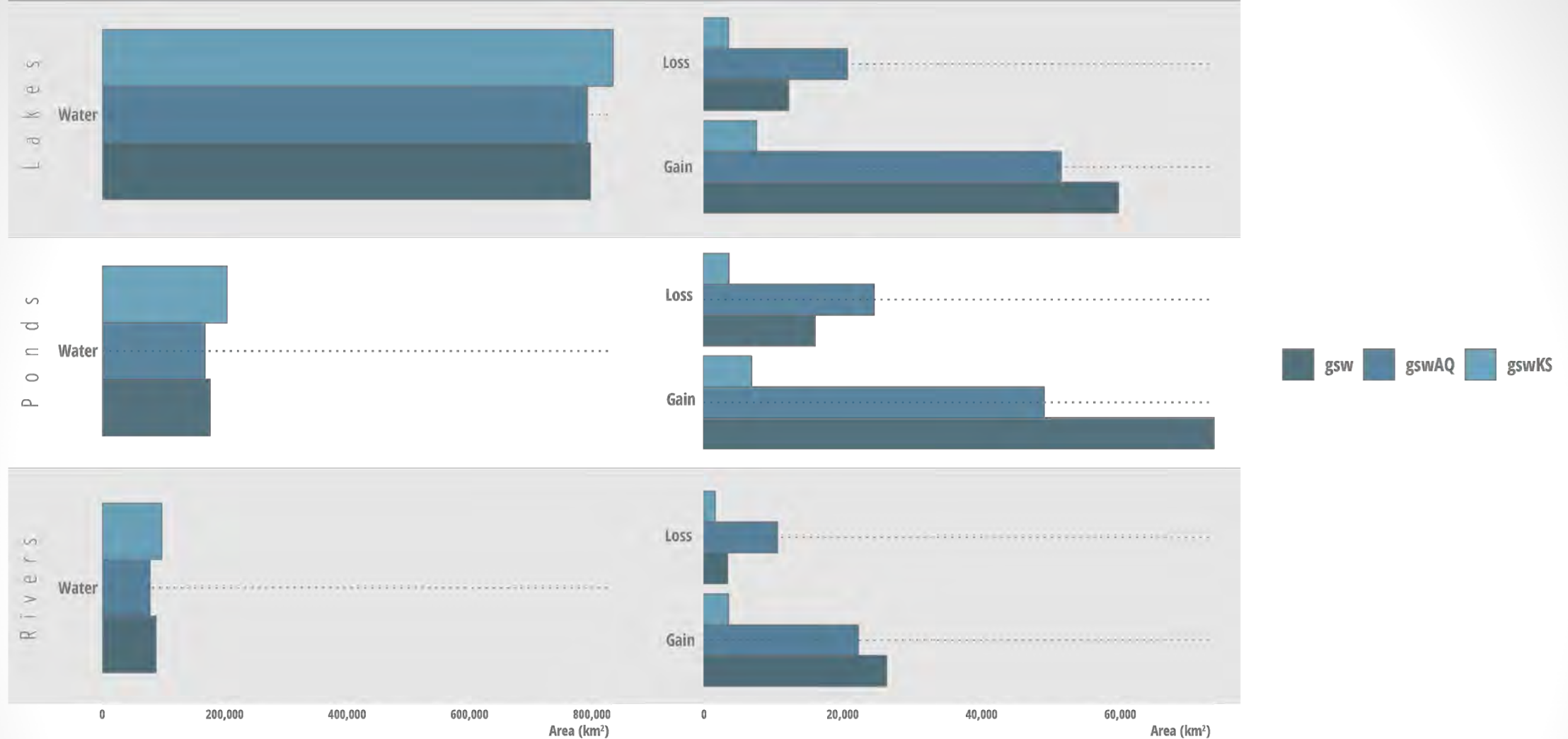




improved lake and river representations

Captured variations by extending average river  
and lakes based on cumulative cost

from maximum water over 35 years

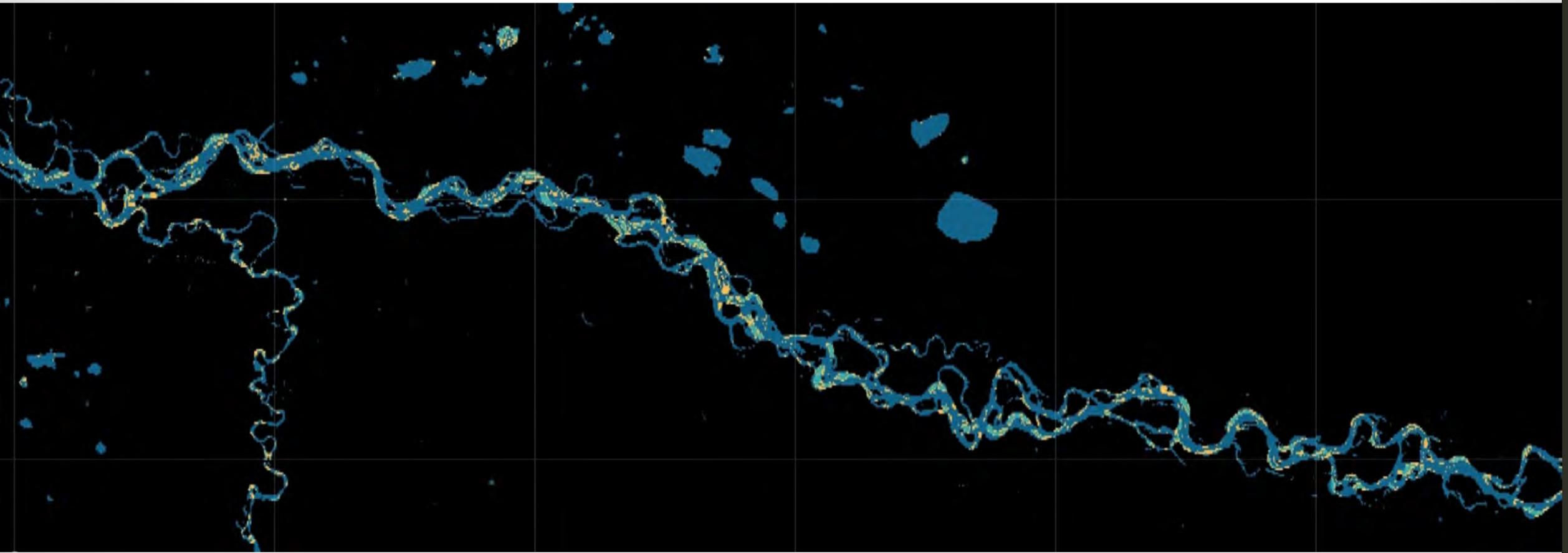


differences in models

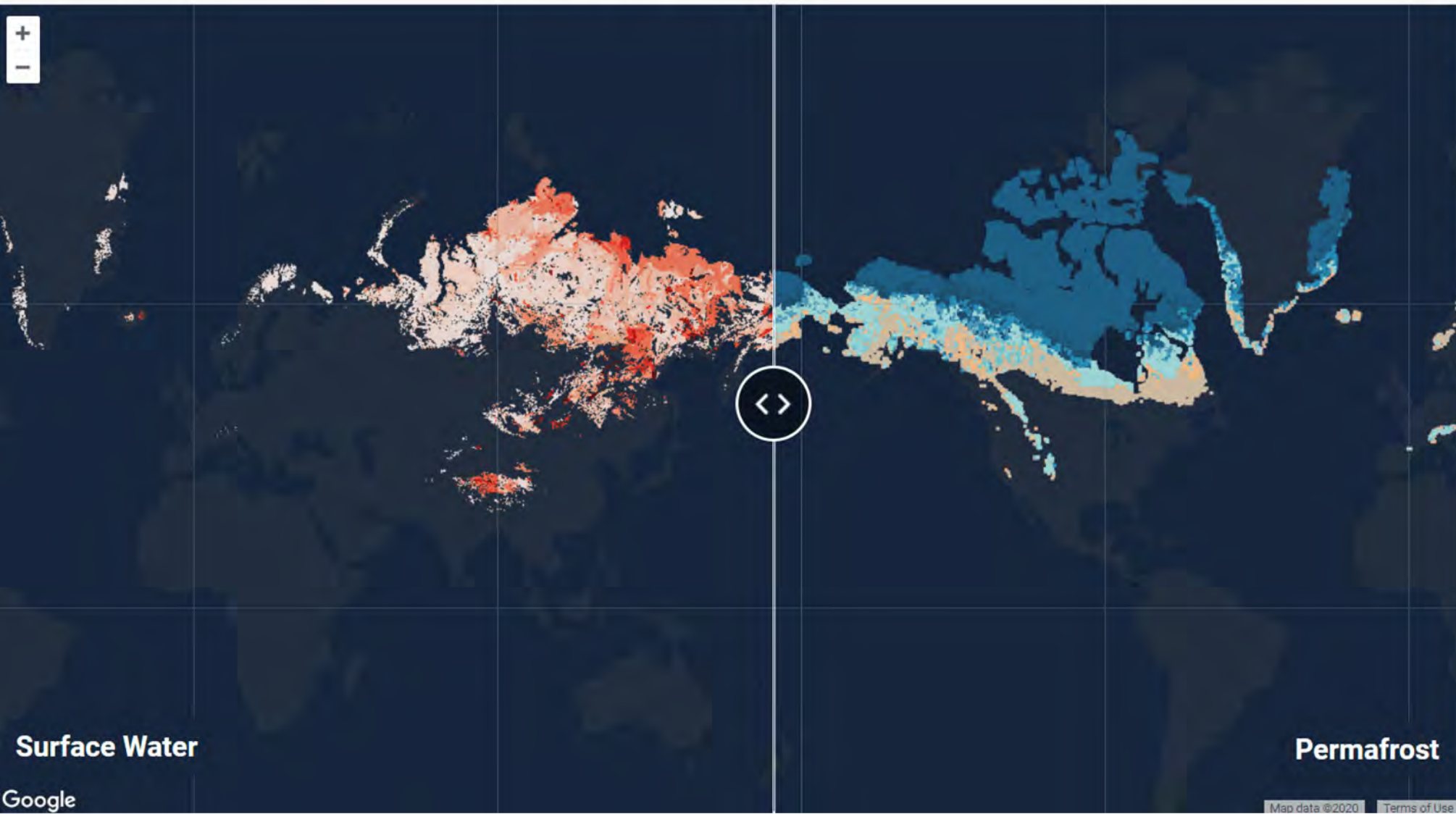
need to be explored, understood and discussed

in order to understand variability





efficient zonal analysis made it possible to be the  
1st to examine all rivers at fine (30 m) scale  
in northern hemisphere permafrost areas



## Permafrost Surface Water Change

1984-2018

Results from analysis of Global Surface Water dataset (Source: EC JRC/Google) characterizing extent and change in northern hemisphere permafrost regions.

For more information see [Trochim et al.](#)

### Map Style

☒ Opacity  0.9

### Visualize Surface Water Layers

#### Legend



### Compare Permafrost Layers

#### Legend

- Sporadic -5 to -2.5 °C ±1 °C
- Sporadic -5 to -2.5 °C ±1 °C
- Sporadic <-5 °C ±1 °C
- Discontinuous -5 to -2.5 °C ±1 °C
- Discontinuous -5 to -2.5 °C ±1 °C

Surface Water

Permafrost

Google

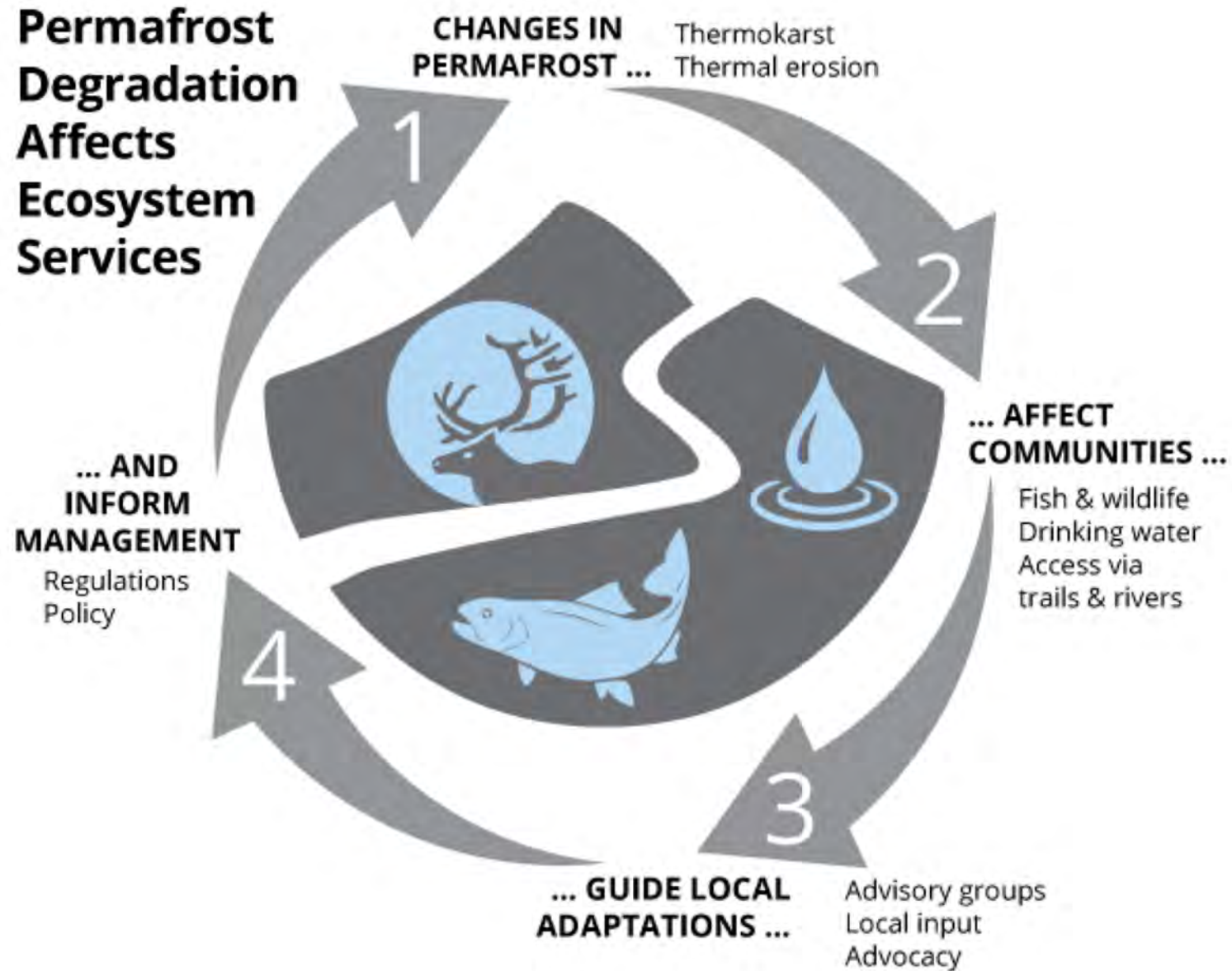
Map data ©2020 Terms of Use







## Permafrost Degradation Affects Ecosystem Services



## Policy Implications



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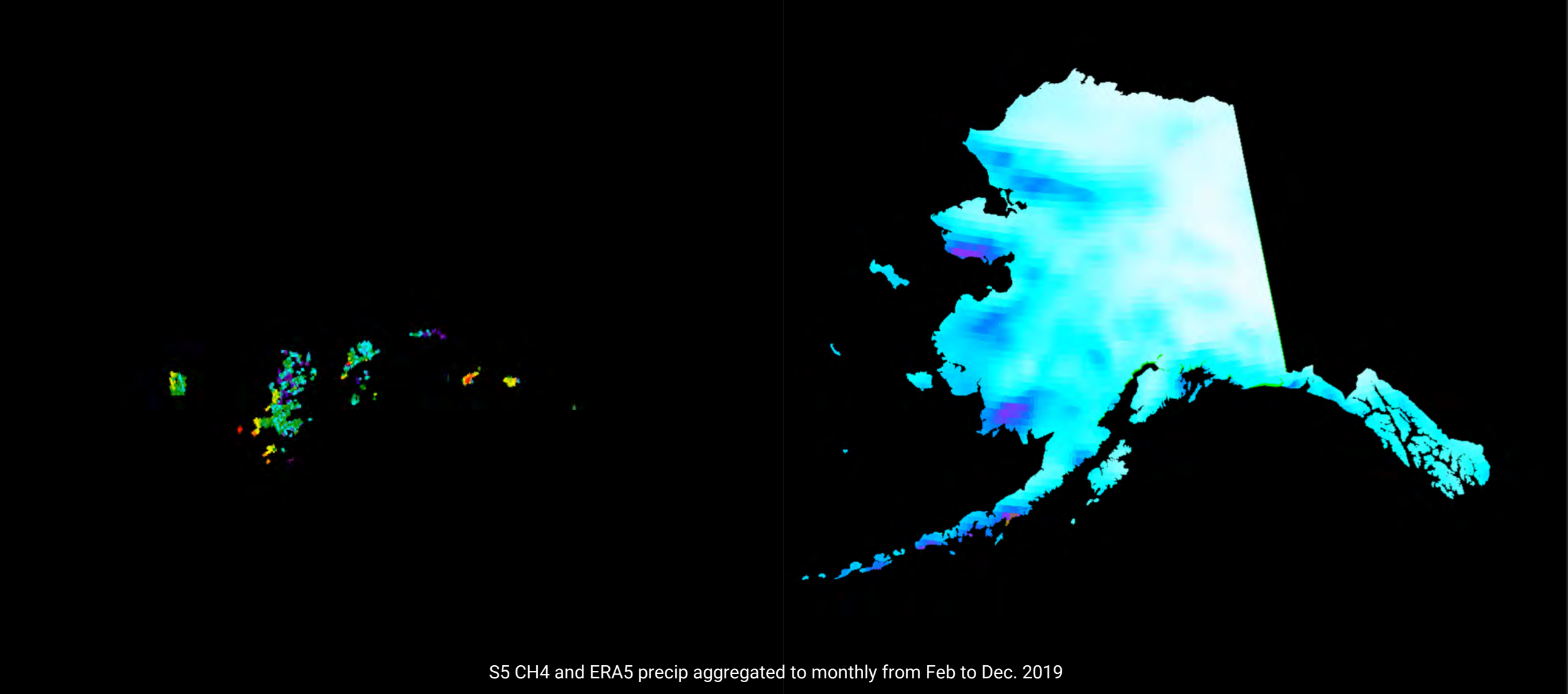
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obvious opportunities to use S5 CH4 and ERA5 precip  
to link drivers and predict relationships

A photograph of a construction site along a body of water. In the foreground, there is a dirt and gravel area. A long, curved retaining wall made of interlocking metal sheet piles runs from the middle ground towards the right. To the left of the wall, a large crane stands on a barge or temporary foundation. Behind the crane is a small, dark wooden building with a corrugated metal roof. The background shows a calm body of water reflecting the sky, with a distant shoreline covered in trees. The sky is filled with soft, white clouds.

# surface water impacts communities and infrastructure

Erin Trochim, PhD  
[edtrochim@alaska.edu](mailto:edtrochim@alaska.edu)