Climate impacts on Alaska and Yukon hydrometeorology: a modeling effort guided by Indigenous Knowledge

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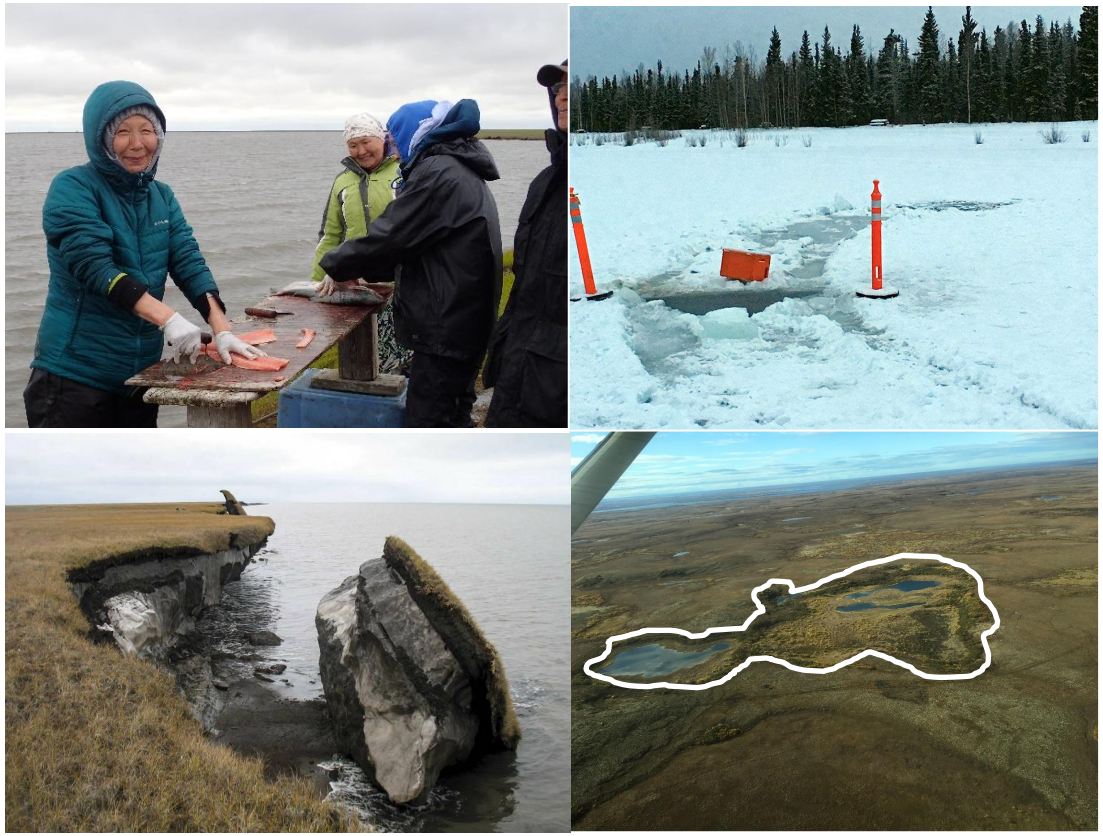
NCAR | RESEARCH APPLICATIONS LABORATORY

Feb 6, 2023, Land Model Working Group

This material is based upon work supported by the National Center for Atmospheric Research, which is a major facility sponsored by the National Science Foundation under Cooperative Agreement No. 1852977.

NSF Navigating the New Arctic Project – The climate impacts on Alaskan and Yukon rivers, fish, and communities as told through co-produced scenarios



- The Arctic is rapidly changing:
  - Large increases in temperature and decreases in sea ice
  - Increases in annual precipitation and rain versus snow amounts
  - Changes in seasonal snowpack
- Indigenous Alaskans heavily rely on the inland river systems for essential subsistence fishing as well as transporting fuels and supplies

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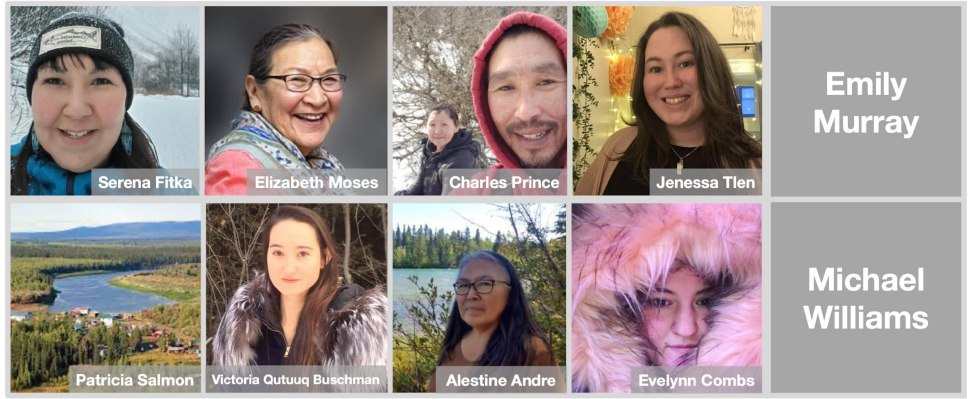
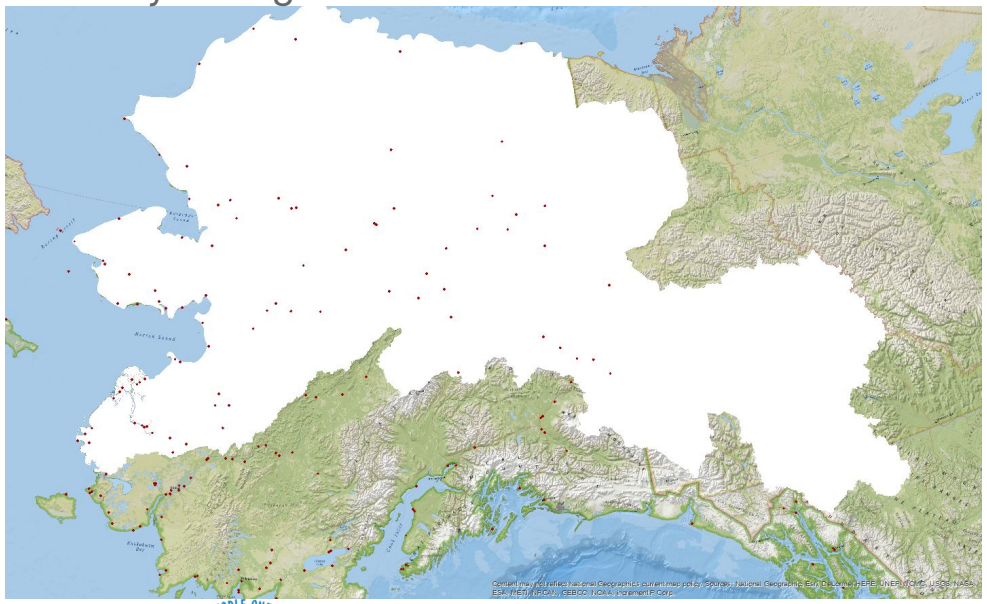
Knowledge co-production with Indigenous Alaskan

- The goal of this project is to strengthen understanding of terrestrial hydrologic change in the Arctic and the potential impacts on rivers, fish and Indigenous communities
  - The goal is tangible to daily lives of Indingeous people
  - Strong collaboration with Indigenous communities and community-based science networks: **Co-production of knowledge**

Indigenous Advisory Council



Federally Recognized Tribes



ONE PEOPLE-ONE RIVER
Yukon River Inter-Tribal Watershed Council
www.yritwc.org

Represents 76 Tribes and First Nations in the Yukon River Watershed

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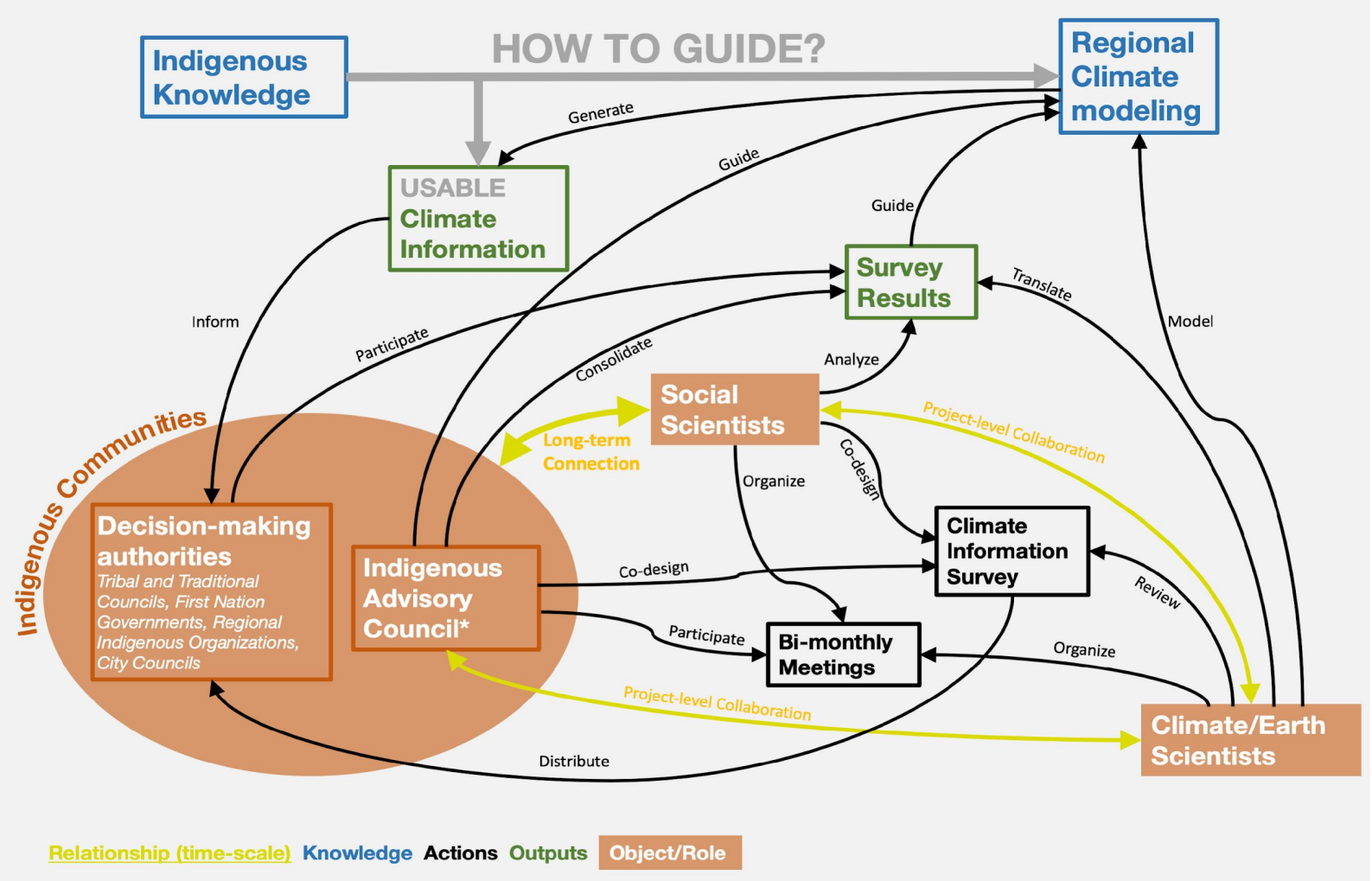
Collaborative mechanisms to support co-production



- Co-production requires involvement of Indigenous communities, social scientist, and climate/earth scientists.
- Long-term connection between social scientists with Indigenous communities laid the foundation for the collaboration

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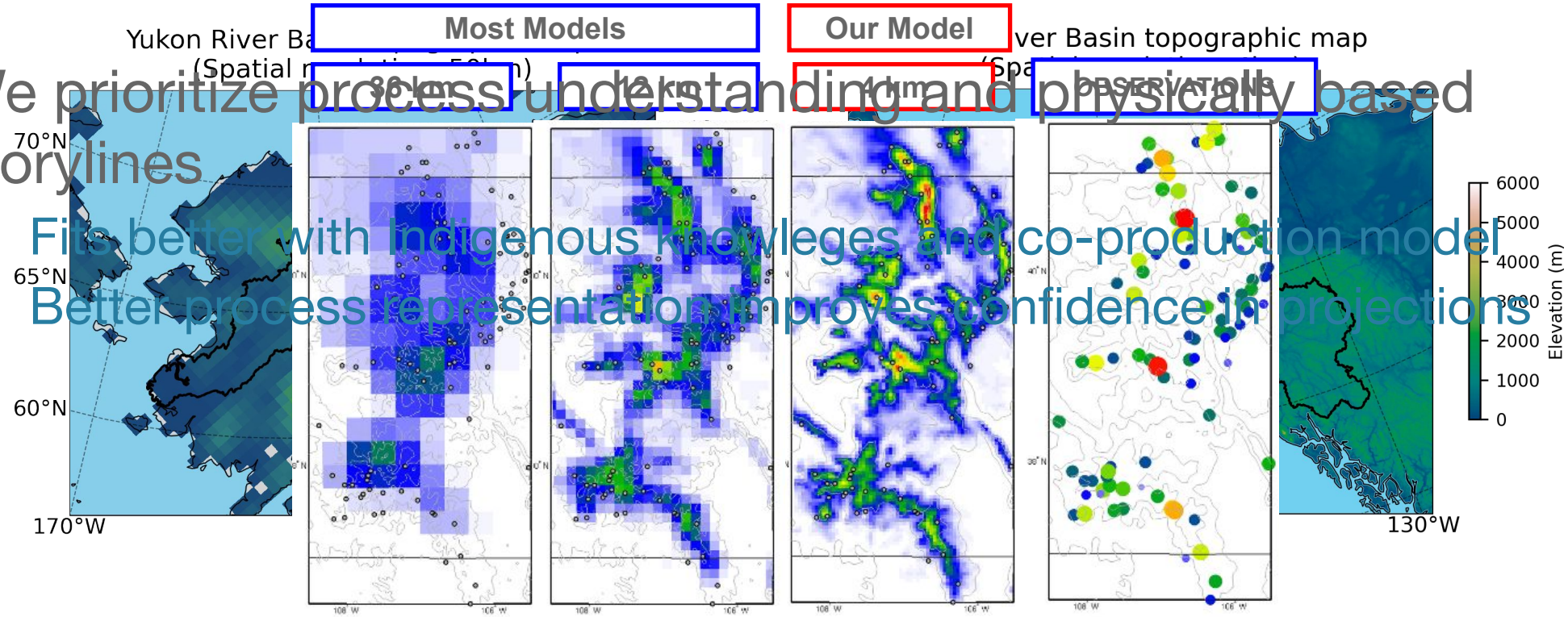
High-resolution regional climate modeling

- Why high-resolution?
  - Discussion with Indigenous Advisory Council
  - It improves many process representations



- We prioritize process understanding and physically based storylines
  - Fits better with Indigenous knowleges and co-production model
  - Better process representation improves confidence in projections

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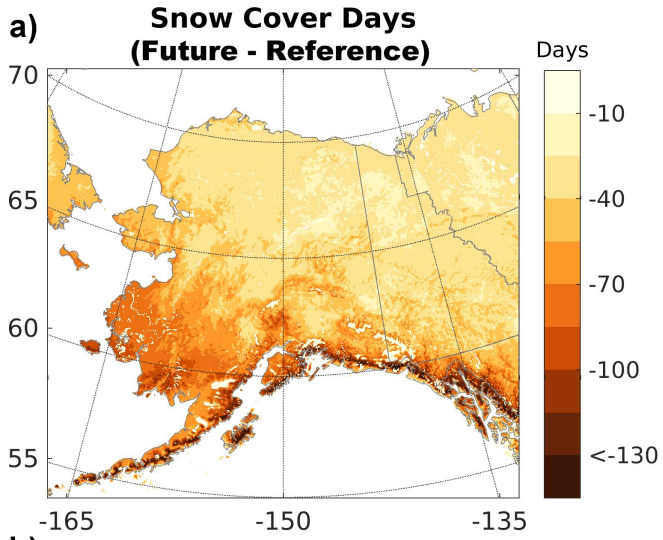
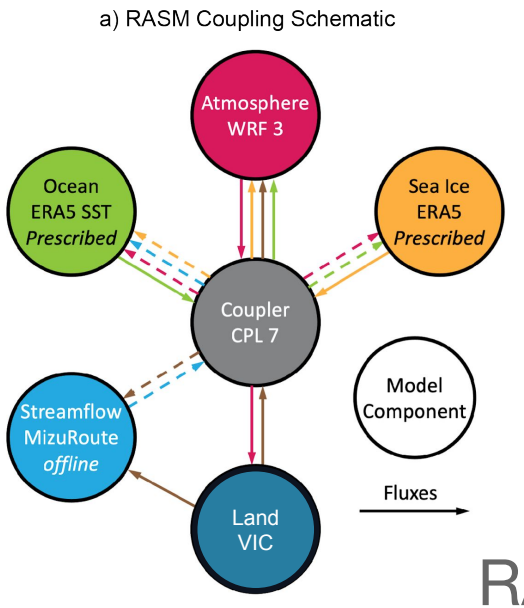
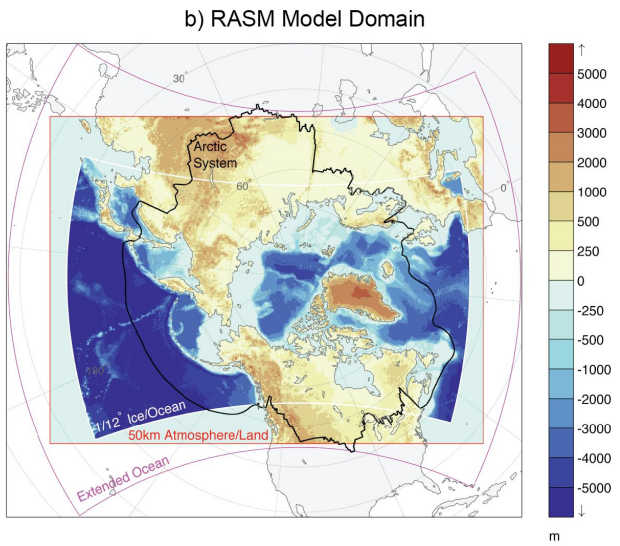
High-resolution atmosphere-land coupled modeling framework

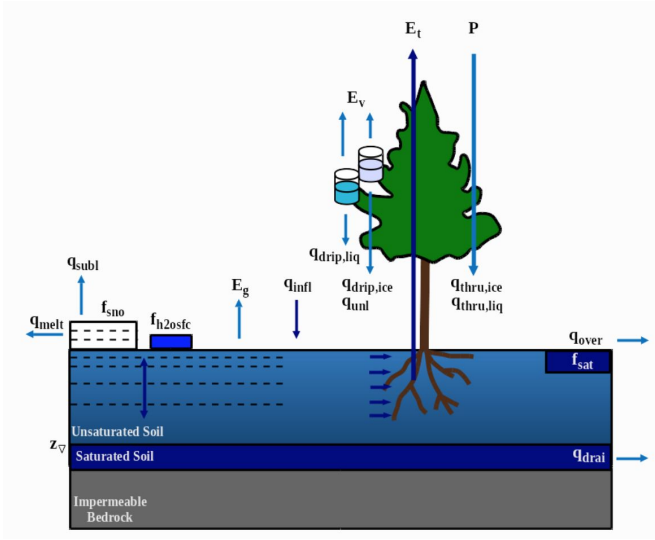
- Climate modeling
  - Regional Arctic System Model (RASM)
  - Community Terrestrial Systems Model (CTSM)
  - High-resolution dynamically downscaled historical and future simulations with routed streamflow



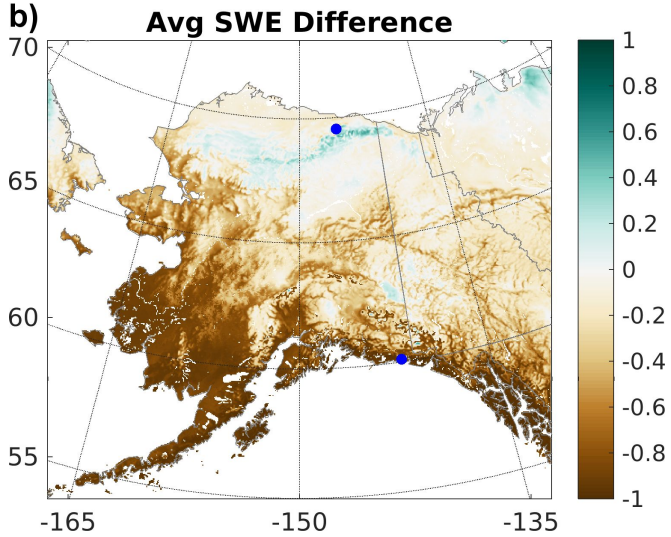




RASM



CTSM



WRF

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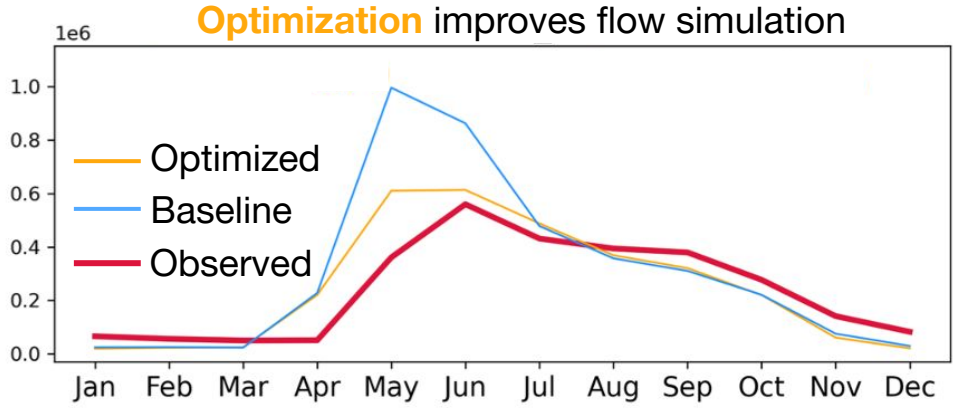
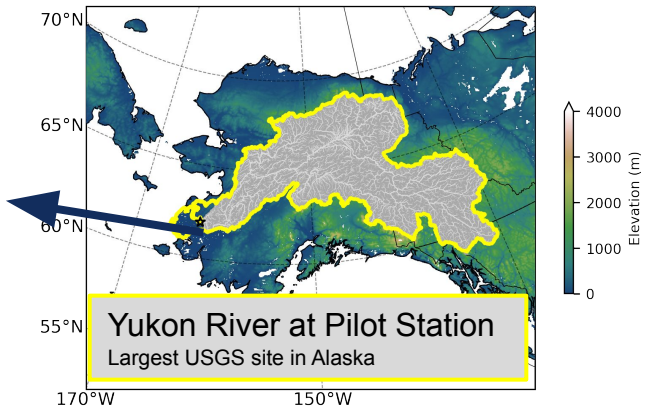
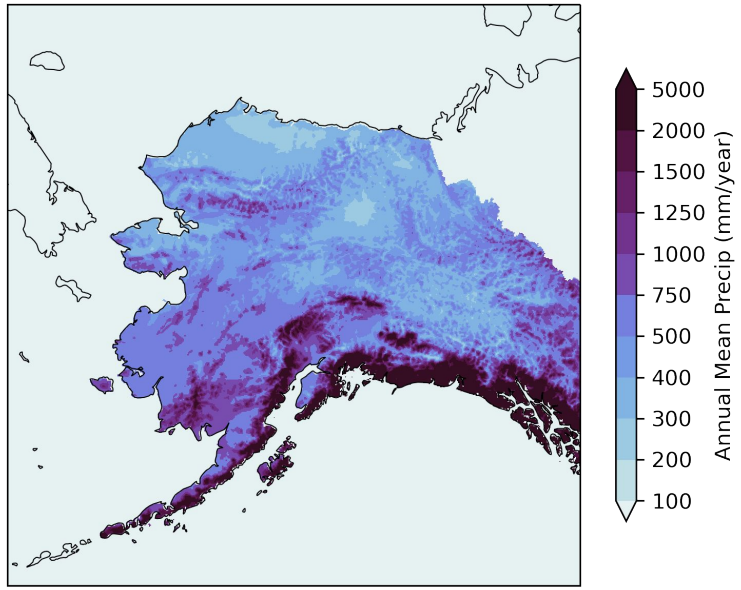
Simulated terrestrial hydrology and hydrometeorology from coupled WRF-CTSM modeling

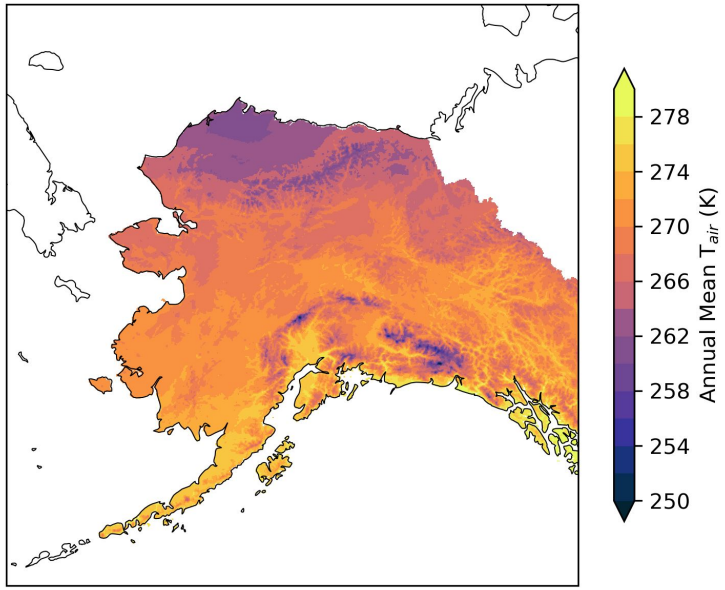




Mean annual precipitation



Mean annual air temperature



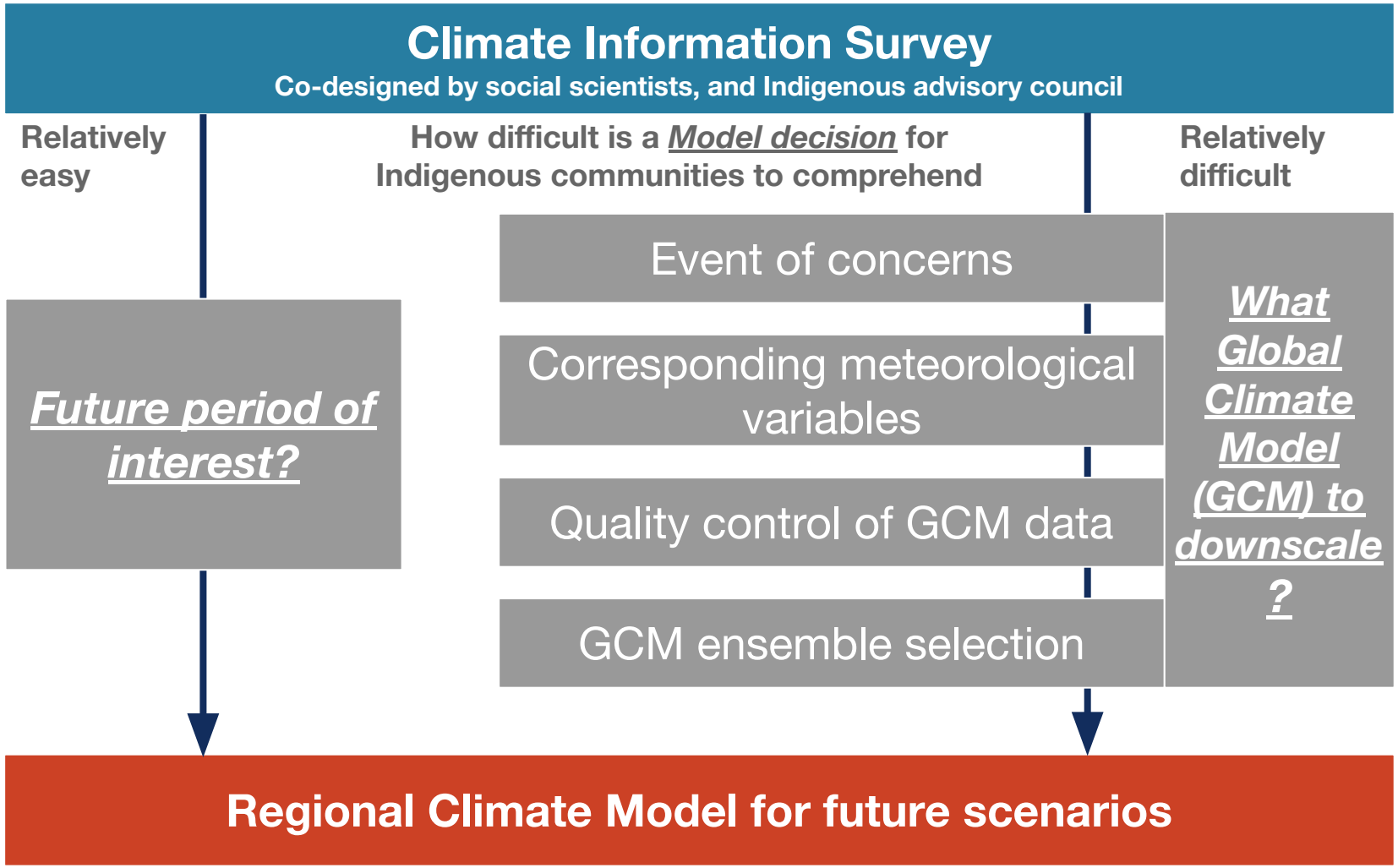
Land surface model

- Developed an optimization workflow for CTSM and focused on river flow and snow

Coupled land-atmosphere models

- Comprehensive evaluation of terrestrial hydrology as well as hydrometeorology, including precipitation, air temperature, E/P ratio, snow fraction, terrestrial snow, streamflow

How do we use Indigenous Knowledge guide the selection of future scenarios?



Climate information survey

- Co-designed by social scientists and Indigenous Advisory Council and reviewed by climate and earth scientists

Comprehensibility of modeling decisions

- Regional climate modeling requires domain knowledge and expertise
- Translation is required for difficult decisions

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Takeaway

- We actively engage Indigenous participation in this project to ensure that Indigenous Knowledge is included, valued and protected. Their knowledge also guided the study design and modeling decisions.
- An optimization workflow is designed for CTSM
  - GitHub page is under construction. Please feel free to contact me if you are interested!
- We will provide this coupled WRF-CTSM climate and hydrology dataset to the community with variables available from sub-daily to monthly from 1990 to 2021.
- Next Steps
  - Kick off the PGW runs this month
  - More high-resolution regional runs (Derecho HPC ASD program)

National Science Foundation

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