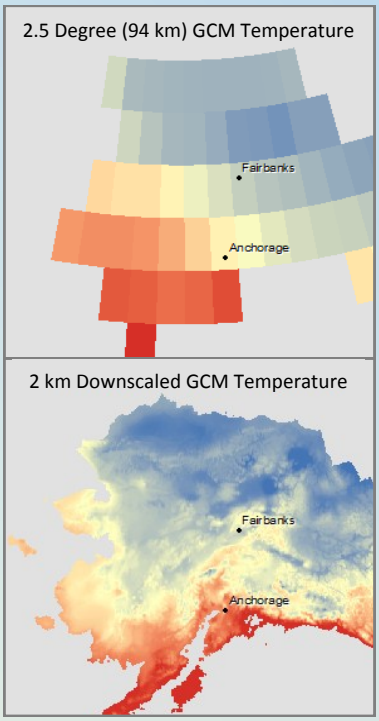
Alaska Climate Downscaling Workshop

≻ Bringing Together Policy and Research ≺



2011 Downscaling workshop

An ever-growing body of scientific evidence confirms that climate change is occurring and that it will likely continue into the foreseeable future. The impacts of climate change are already being observed throughout Alaska across many different sectors. Planning for these changes is in progress, but could be improved with better coordination between the climate science and management communities.

The Alaska Climate Downscaling Workshop, organized by the DOI Alaska Climate Science Center (AK CSC) and the University of Alaska - Fairbanks (UAF) and facilitated by the Institute of the North, was convened April 28-29, 2011, to:

- Develop and improve communication between managers and scientists
- Provide information about climate projections & downscaling techniques
- Identify and prioritize user requirements and research directions
- Recommend research and services to meet user needs

Researchers presented information on Alaska climate, data downscaling, global and regional climate modeling, and the results of a pre-workshop survey of attendees. Most of the workshop was devoted to facilitated discussions where attendees identified the most pressing climate questions and needs and recommended actions to meet them.

FAQ 1 What is downscaling?

The climate models used in IPCC reports, known as coupled atmosphere-ocean general circulation models (AOGCMs), are complex and require considerable computing resources. For practical reasons such as cost and time, they are typically run at coarse spatial scales. The models in the last IPCC report had an average resolution of approximately 2.5° longitude by 2.5° latitude. In Alaska, this corresponds to a grid cell of about 175 by 90 miles. However, many users of climate data need information at much finer scales.

Downscaling is a general term describing a variety of techniques that combine coarse scale climate projections with other information to better understand climate change at scales relevant to policy, planning and management. There are two types of downscaling: statistical and dynamical. Statistical downscaling methods merge the changes projected by climate models with the spatial details of observed climate. Dynamical downscaling involves driving a higher-resolution regional climate model with projections from an AOGCM.

Assessing climate change impacts in Alaska

Workshop participants identified the following broad areas of concern and climate data needs in Alaska:

Areas of Concern:

- Perceived mismatch between the type and spatial scale of climate data needed and what is available.
- Lack of guidance in identifying and accessing the most appropriate climate data to meet user needs.
- Questions about how best to integrate uncertainty into assessments of climate change impacts.
- Insufficient baseline data hinder efforts to meet user needs in terms of data quality and spatial resolution.
- Lack of information about developing and downscaling climate projections can lead to unrealistic expectations.

Climate Data Needs:

- High-resolution coastal zone and marine climate data & projections.
- Greater availability of high spatial and temporal resolution climate data and projections.
- Better characterization of changes in extreme events and an analysis of the risk factors associated with them.
- Production of climate indices for Alaska, such as length of dry and wet spells, growing season length, incidence of heavy precipitation events, and occurrence of extreme heat and cold.
- Readily available dynamically downscaled climate projections.

Attendees of the 2011 Downscaling workshop identified general and specific challenges to climate science in Alaska.

Recommendations

Continued communication and collaboration between research and managers would better meet Alaska's needs, lead to more holistic project development, limit unnecessary replication of work and allow for cost sharing and leveraging of funds.

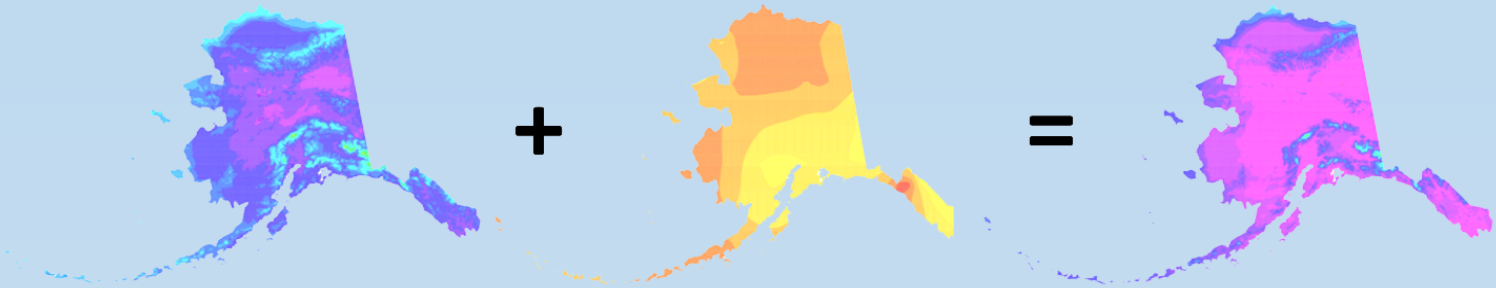
Research Needs:

- Inventory currently available data.
- Describe additional data, monitoring and studies needed to meet user needs.
- Characterize the current capacity for providing downscaled climate products and desired information services.
- Identify gaps in the current capacity and ways to meet those needs.
- Compare statistical and dynamical downscaling products.
- Perform additional model evaluation.
- Incorporate social science research into local needs.
- Develop research coordination networks to improve collaboration.

Information Services:

- A best management practices document for the use of climate projections that provides information on:
  - ◊ appropriate uses of climate data and projections,
  - ◊ common methods for evaluating and incorporating uncertainty,
  - ◊ characteristics of downscaling methods with regard to assessing climate impacts,
  - ◊ timelines, technical requirements and financial costs associated with different downscaled climate products.
- Web-based distribution to serve data and information for diverse audiences.
- A more formalized process for requesting value-added data or products developed/tailored for a specific need.
- Community education and outreach about climate change and climate change impacts to improve grassroots involvement in management.

The Delta method: An example of statistical downscaling



$OBS_{historical}$ + $(GCM_{future} - GCM_{historical})$ = FUTURE

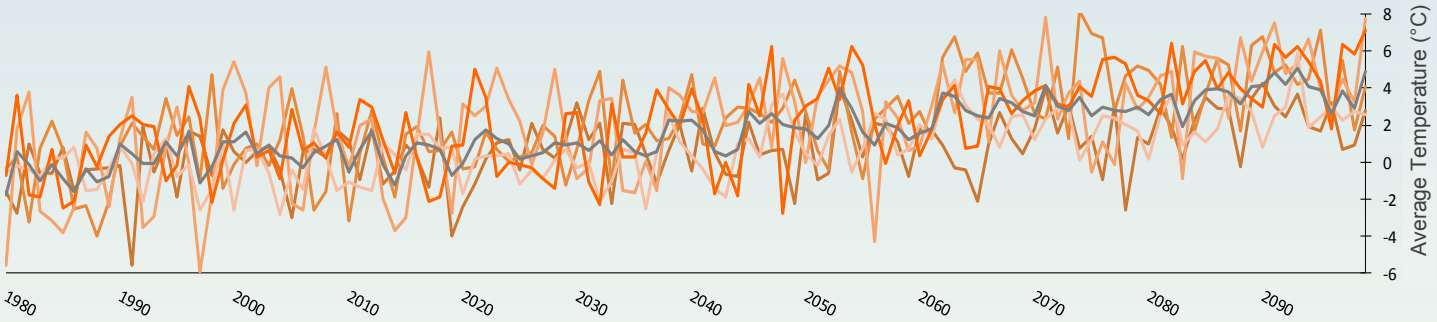
The delta method, a popular statistical downscaling approach, involves overlaying changes projected by a global circulation model (GCM) on observed climate data.

FAQ 2 What kind of downscaling—statistical or dynamical?

There are technical and practical pros and cons to both downscaling approaches. Deciding which method to use should be based on study requirements – which variables are needed at what temporal or spatial resolution, for how many scenarios – and resources such as budget, time and technical capacity.

In general, statistical techniques are faster and cheaper, so a larger number of possible future scenarios are produced. Since this method requires observed climate data at the desired spatial resolution, it is often practical to downscale only a few variables – usually average monthly temperature and precipitation.

Dynamical downscaling requires running a complex numerical model, which can be more costly and time consuming. It is often used to evaluate fewer scenarios at somewhat coarser spatial resolution. However, dynamical downscaling produces projections for many more climate variables than statistical downscaling, usually at higher temporal resolution. In addition, it can address some questions about changes in fine-scale processes that statistical approaches cannot. The two techniques can also be combined to exploit the strengths of both.



Mean annual temperatures for Alaska projected by five Global Circulation Models (GCMs) under an A1B scenario. The grey line represents the 5-model mean.

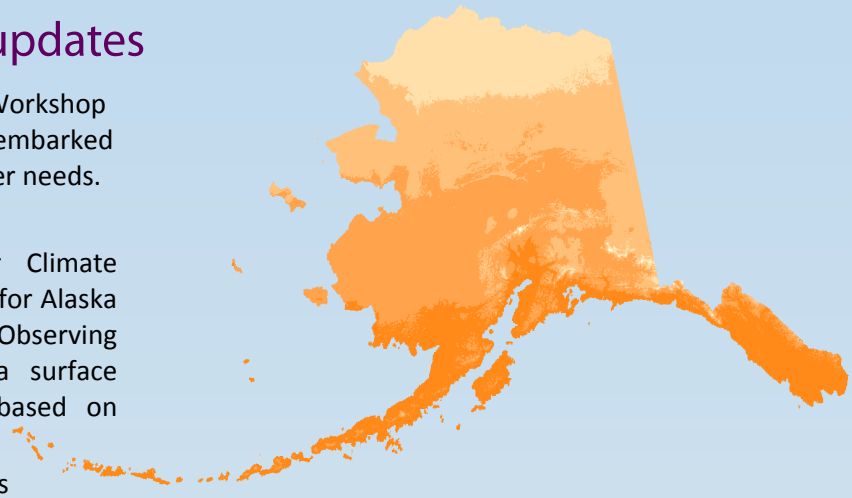
FAQ 3 What is uncertainty?

Understanding the uncertainty of climate projections requires understanding how they are produced and used. A highly abbreviated description of that is:

1. Scenarios are developed to describe an array of future emissions trajectories that seem reasonable, but the actual future is unknown.
2. The scenarios are run through multiple climate models. Each model represents a best attempt at characterizing the earth's climate as we understand it to work, within limits imposed by budget and technology. However, the models are all slightly different and may have different strengths and weaknesses.

When this process is completed, there are a large number of projected future climates that are not identical. Scenarios with higher emissions typically project more dramatic climate change than scenarios with lower emissions. Within each scenario, different models produce slightly different results. These differences are often more apparent when focusing on a particular region than on global averages. There are a number of strategies for dealing with this uncertainty in assessing climate change impacts.

Alaska Climate Science Center updates



In the year since the Alaska Climate Downscaling Workshop took place, the Alaska Climate Science Center has embarked upon several projects designed to meet stakeholder needs. These include:

- Collaborating with the Alaska Center for Climate Assessment and Policy, the Scenarios Network for Alaska and Arctic Planning, and the Alaska Ocean Observing System to develop sea ice, wind and sea surface temperature scenarios for coastal Alaska, based on current climate model projections.
- Supporting University of Alaska-Fairbanks graduate students:
  - ◊ Katrina Bennett, to research changing hydrologic extremes in interior Alaska.
  - ◊ Rick Lader, for an intercomparison and validation study of reanalysis models for Alaska.
- Hiring new researchers and scientists, including:
  - ◊ Postdoctoral researcher Dr. Stephanie McAfee to work on climate model downscaling.
  - ◊ Postdoctoral researcher Dr. Alessio Gusmeroli to work on permafrost hydrology.
  - ◊ A postdoctoral researcher focused on coastal processes.
  - ◊ An ecoclimatologist (applied climate scientist).
  - ◊ Research faculty at UAF to expand dynamical downscaling capacity in Alaska.

For more information on downscaling

More detailed information from the workshop, including presentation materials and recordings of the presentations, are available online at http://csc.alaska.edu/

Additional information about downscaling methods utilized by the Scenarios Network for Alaska & Arctic Planning is available online at http://www.snap.uaf.edu/downscaling.php

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