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Alaska Building Science News

COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF ALASKA FAIRBANKS

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The Alaska Building Science News is a joint publication of the Alaska Building Science Network and Cooperative Extension Service, Office of the Energy Specialist. It is edited by Richard D. Seifert. Any letters, opinions and responses to the articles should be directed to Seifert either by e-mail rdseifert@alaska.edu, phone (907) 474-7201, or fax at (907) 474-5139.

The purpose of Alaska Building Science News is to bring timely building science information to Alaskans in order to improve the quality and durability of the housing stock in Alaska as well as save energy and maintenance expenses for homeowners.

We hope that ABSN Newsletter will become a mainstay in your information menu in the future. If you would like to receive ABSN's newsletter electronically, please let us know by e-mail and we will save cutting the trees and using the paper. This newsletter can be found on our website: http://www.uaf.edu/ces/faculty/seifert

NEW SOLAR DESIGN MANUAL

Rich Seifert

The past winter, I have been working on the publication of a new edition of the *Solar Design Manual for Alaska*. This new manual will have much-improved chapters on all of the important solar design issues for Alaska, including solar technology, solar active water heating, passive solar design and photovoltaics. All of these chapters have been substantially revised and updated, and a new emphasis has been placed on building toward the ultimate sustainable housing — the zero-net-energy housing ideal — for Alaska. It has been a rewarding experience to bring the former solar design manual, last updated in 2005, into the new decade with the focus on what is the optimum housing design idea for the future.

The manual includes new assessments of the financial feasibility and optimal sizing for active solar water heating for many of the major communities around the state. These assessments, generated by the computer program F-chart, focus on whether or not it is an easily achievable goal, with 64 square feet of solar collector, to get more than 50 percent of your annual hot water from solar energy in Alaska. This is the threshold above which you qualify for

Continued on back page

INSIDE THIS ISSUE

A VISIT TO THE FOX PERMAFROST TUNNEL

Rich Seifert

There has been a permafrost tunnel north of Fairbanks near Fox since the mid-1960s. It is one of the most fascinating and peculiar features of the "scientific underground" in the Fairbanks area. The tunnel is a unique collaboration between the U.S. Army Cold Regions Research and Engineer Lab, the U. S. Bureau of Mines and the University of Alaska Institute of Northern Engineering. It was built to test mine drilling equipment as well as to see what permafrost looks like in place, underground, in a known permafrost area. In the 40+ years since the permafrost tunnel was first dug, many changes have taken place. Some expansion of this permafrost science lab has taken place, and many safety precautions have been added to the underground passage that constitutes the main permafrost tunnel.

I had the opportunity to visit it in late April. I have lost count of how many times I've been out there in my 40-year career in Alaska. The experience is always amazing to me, and I marvel at the unique features that one can witness. For instance, at several places through the main walkway, which is about 80 yards long, there are signs of a log or a bison femur from the Pleistocene era, often with descriptions indicating how old these relics are. One bison bone was 14,000 years old and a piece of wood was 30,000 years old. Above this are layers of ice and silt deposited by wind and water over the thousands of years through which you travel by descending into the permafrost tunnel. At its lowest point you are about 50 feet underground, and that is where the oldest material lies. Photo 1 shows the walkway near the entrance. This lighted, raised walkway is quite visible. It is mesh steel and you can walk on it without stirring up the fine, very dry dust that would otherwise fill the air for the first 20 yards or so of the entrance. The overhead portion of the tunnel is reinforced with steel I-beams to keep it from caving in. That is the only reinforced area.

Photo 1. The steel mesh walkway near the entrance.

Photo 2. The entrance to the tunnel is built into the side of the hill.

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Another feature of the permafrost tunnel is, of course, that it has to be refrigerated. You enter through a very small door (Photo 2) that is built right into the side of the hill. One must wear a hard hat and a heavy coat; I actually wore bunny boots on the day I visited because the temperature is kept at just about the mean average temperature of Fairbanks, about minus 3°C., or 25°F.

Photo 3 is illustrative of the amazing kinds of discoveries and insights you can get touring the permafrost tunnel. As you pass along the upright walls of the tunnel you large ice formations imbedded in the walls. The one shown here is

Photo 3. An ice lens inside the permafrost tunnel. Striations in the ice are layers of silt formed during many annual freeze/thaw cycles.

called an ice lens, and you can see that its shape is broad at the top and trends down in a sort of funnel shape toward the bottom (this is a flash photograph and I apologize for the beads of water on the camera lens, which are shown in the image, but they are caused by the fact that it was raining when we entered the permafrost tunnel and I didn't realize that the camera had water spots on it). Notice the striations in the ice; these are deposits of silt that were formed year after year as this ice lens built up from annual freeze-thaw cycles. Each of the striations indicates a year of freezing and expanding of the ice lens. The cross sectional area in this image is about three feet. It doesn't look that wide, but it is. Imagine what would happen if you built your house above something like this lens of ice and over time the huge lens thawed; you would have a gaping hole underneath your house that would be very likely to cave in and cause what is known as a thermokarst. A thermokarst is a hole in the ground caused by heating and melting of the permafrost. The great insight of visiting the permafrost tunnel is that you can see why permafrost causes the problems it does if you build on it. Melting the ice is a key factor in building failure, and *not* melting the ice is the key factor in building successfully on permafrost.

One of the additional things I learned on the tour is that there will be a new permafrost tunnel drilled in 2012 parallel to the existing permafrost tunnel at nearly the same site. This new tunnel will make a U-turn in the back, at the deepest part of the tunnel, to connect with the old permafrost tunnel. This project is being sponsored by the Institute of Northern Engineering and the National Science Foundation. It is a very timely upgrade of the permafrost tunnel and its new purpose will primarily be to monitor the scientific changes that are occurring in the soil and, consequently, in the permafrost. So, once again Fairbanks and UAF are leading the way with interesting research that is very relevant to our local conditions.

ABSN NEWSLETTER GOES GREEN

We are pleased to announce that the ABSN newsletter is going to be delivered electronically. This is both an economic and green move. Please let us know your e-mail address, so that we can send you future newsletters. Contact Sara Burley at sburley@alaska.edu and she will get you signed up for electronic issues.

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TWO RIVERS SCHOOL PHOTOVOLTAIC SOLAR SYSTEM DEDICATION

Rich Seifert

On March 26, 2010 I was invited to attend the dedication of a photovoltaic panel at the Two Rivers Elementary School east of Fairbanks on the Chena Hot Springs Road. I have had a long association with this school and I know several of the teachers. This was an opportunity to see the really wonderful affection that the students have for their teachers and principal, and for a member of their community who bought the solar collector for them to study and learn from. That local parent and solar benefactor is the musher and businessman Sonny Lindner. Sonny attended this dedication on the morning of March 26, which is still early spring here in Fairbanks. However, that didn't daunt the students, teachers or the other attendees. The event was held outside, like a school assembly. Several people made short presentations and, of course, there was a dedication and "thank you" to Lindner for his kindness and interest in supporting the school's science program and his awareness of energy in general — an awareness that inspired him to purchase this photovoltaic panel. Lindner is an example to many communities and business people in Fairbanks and throughout Alaska. This kind of benevolence to the community and to our schools is a model for us all. To further thank Lindner, one of the students read a book titled simply "The Important Book" in honor of the event. Here is what she read:

Solar benefactor Sonny Lindner with Principal Dana Evans at the dedication of the solar panel.

The new photovoltaic panel at Two Rivers Elementary School on Chena Hot Springs Road.

> *The important thing about the sun is that it gives us everything we need to live. It keeps us warm, it keeps our world revolving around it, it keeps us from freezing and it gives us vitamin D. But the important thing about the sun is that it gives us everything we need to live. The important thing about solar power is that it can be used for other schools, stores and houses. It helps us use less energy, it keeps our air clean, it can give electricity to our community and it keeps more plants alive for us to use. But the important thing about solar power is that it can be used for other schools, stores, and houses. The important*

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thing about Sonny Lindner is that he has given us an opportunity to study for our future. He cares about our community, he cares about our planet and he understands how and why we need to learn about solar energy. But the important thing about Sonny Lindner is that he has given us an opportunity to study for our future.

This book was created for you from the interviews of all Two Rivers K-8 students and written by Ms. Sims K-1 class. Thank you for your generous donation to our future.

It was a wonderful, uplifting event to be part of and I wanted to share it with all our readers. It shows what can be done with elementary schools and how wonderful the response is. May this photovoltaic panel serve that community for 50 years. It certainly has the potential to do so.

HOUSE AND SENATE ADVANCE ENERGY EFFICIENCY LEGISLATION

Washington, D.C., May 6, 2010: Today both the U.S. House of Representatives and the U.S. Senate moved forward on legislation to improve energy efficiency in the United States. The House passed a new program called "Home Star" that will help homeowners reduce their energy bills through energy efficiency investments and at the same time help our struggling economy by providing jobs for construction workers. On the Senate side, the Energy and Natural Resources Committee reported on a set of amendments that adopt new consensus minimum efficiency standards on a variety of products.

The House bill establishes a new program that provides grants to homeowners for weatherizing their homes. Two paths are provided: a "silver star" path that has $250–$1,500 incentives for a variety of specific energy saving measures, up to a maximum of $3,000 per home, and a "gold star" path that provides incentives of $3,000–$8,000 per home for comprehensive packages of energy-saving measures (incentives increase as energy savings increase).

The American Council for an Energy-Efficient Economy (ACEEE) estimates that this bill will generate over 160,000 jobs and reduce consumer energy bills by more than $1 billion annually.

The Senate bill adopts consensus minimum efficiency standards on residential air conditioners, furnaces and heat pumps, pole-mounted outdoor lights (e.g., street lights), drinking water dispensers, hot food holding cabinets (used to serve food in hospitals) and hot tubs. ACEEE estimates that after these standards have been fully implemented, they will save about as much energy annually as is now consumed by the state of Nebraska.

"Recent events at the Deepwater Horizon rig in the Gulf of Mexico and the Upper Big Branch mine in West Virginia show some of the significant human and environmental costs associated with our traditional energy sources," noted Steven Nadel, Executive Director of ACEEE. "We are happy to see both the House and Senate advancing legislation that will reduce the need for these traditional energy sources by promoting our cheapest and cleanest energy resource — energy efficiency," he continued.

The House effort has been led by Representatives Peter Welch (D-VT), Edward Markey (D-MA) and Vern Ehlers (R-MI). The Senate effort has been led by Senators Jeff Bingaman (D-NM), Lisa Murkowski (R-AK), and Robert Menendez (D-NJ).

About ACEEE: The American Council for an Energy-Efficient Economy is an independent, nonprofit organization dedicated to advancing energy efficiency as a means of promoting economic prosperity, energy security and environmental protection. 2010 marks ACEEE's 30th anniversary as an organization. For information about ACEEE and its programs, publications and conferences, contact ACEEE, 529 14th Street N.W., Suite 600, Washington, D.C. 20045 or visit aceee.org.

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Alaska Regional Climate Projections

Who We Are

SNAP -The Scenarios Network for Alaska Planning is a network linking university researchers with communities and resource managers. Through collaborative partnerships involving data sharing, research, modeling, and interpretation of model results, SNAP addresses some of the complex challenges of adapting to future conditions.
CES – The Cooperative Extension Service was established by the US Congress as the educational outreach component of the national land grant university system – in Alaska, the University of Alaska Fairbanks. They conduct research and provide educational outreach statewide.
ACCAP - The mission of the Alaska Center for Climate and Policy is to assess the socio-economic and biophysical impacts of climate variability in Alaska, make this information available to local and regional decision-makers, and improve the ability of Alaskans to adapt to a changing climate.

Planning for Change

Background

Alaskans are faced with many new challenges. Rising energy costs have impacted the costs of food and other services as well as fuel prices. Changes in temperature and moisture can trigger profound landscape-level changes such as sea level rise; changing patterns of storms, flooding, or fire; and different migration routes, breeding patterns, or survivorship of fish and wildlife.

Everyone -- from engineers to wildlife managers to farmers – will need to take economic change, social change, and climate change into account when planning for the future, in order to avoid costly mistakes. Planning requires objective analysis – including clear explanations of the uncertainty inherent in all forms of forecasting.

Together, SNAP ACCAP and CES can provide a variety of services that may help you in meeting your community planning needs.

SNAP climate projections

Projections are based on global models used by the Intergovernmental Panel on Climate Change (IPCC), using a moderate scenario (A1B). Results from the five models that perform most accurately in Alaska and other northern regions were downscaled using local data.

Climate Change by Region

Introduction

The following graphs are provided as examples of climate change projections for communities around the state. Each graph shows mean monthly temperatures **(°F)** or mean monthly precipitation **(inches)** for three periods: 1961-1990 (actual historical data), 2041-2050, and 2091-2100 (projections). Note that graph scales differ by region.

Statewide trends

In general, temperatures and precipitation are expected to increase across all regions. Temperature increases are predicted for every month, and increases are expected to continue throughout the century. The growing season is likely to increase statewide. Note that precipitation alone does not predict ecosystem moisture limitations. Increased plant growth and increased evaporation due to higher temperatures may more than offset the additional precipitation, resulting in drier soils.

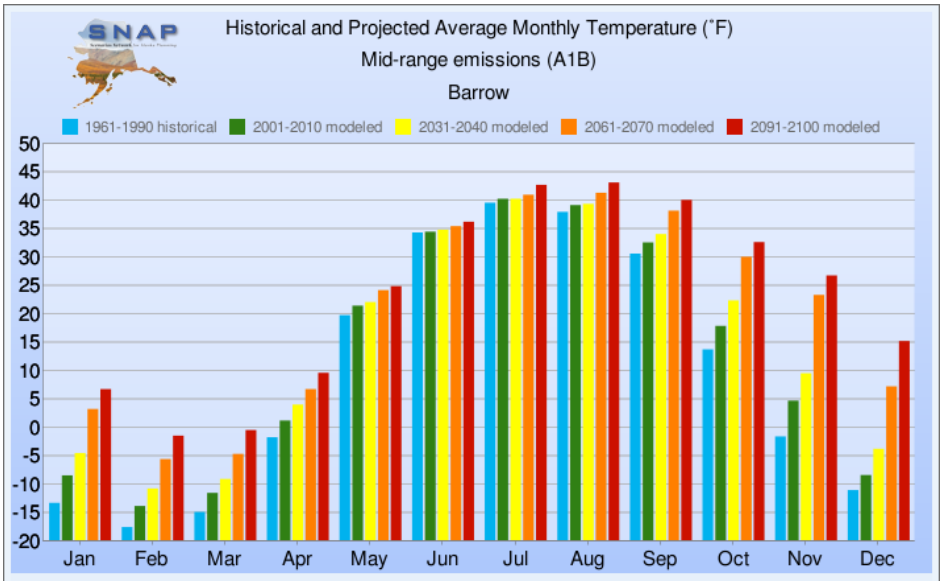
Uncertainty

While values are based on the best available models, they are estimates only. There is variation among the five models used, and annual variation within each model. In general, uncertainty is higher for precipitation than for temperature, particularly for dry regions where small differences can represent large percentage changes. Interpretation of the impacts of temperature and precipitation change adds additional uncertainty.

Contact Us

- ***To learn more about climate projections and how your agency or community can become a SNAP collaborator, visit the SNAP website: www.snap.uaf.edu or contact: Dr. Nancy Fresco: nlfresco@alaska.edu 907-474-2405***
- ***For additional information about climate change in Alaska, visit the ACCAP website: http://www.uaf.edu/accap or contact Dr. Sarah Trainor: accap@uaf.edu 907-474-7878***
- ***For more information about Cooperative Extension services through UAF: http://www.alaska.edu/uaf/ces***

North Slope and Northwest coast



This graph shows average values from projections from five global climate models used by the Intergovernmental Panel on Climate Change. Due to variability among models and among years in a natural climate system, such graphs are useful for examining trends over time, rather than for precisely predicting monthly or yearly values. For more information on the SNAP program, including derivation, reliability, and variability among these projections, please visit www.snap.uaf.edu.

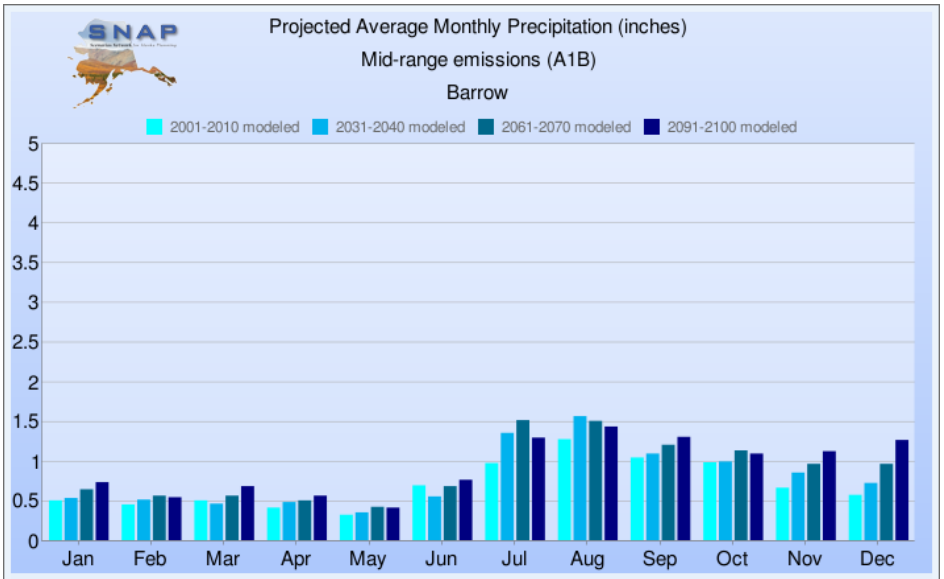
For some coastal communities, erosion is by far the most pressing issue. Loss of sea-ice and thawing of frozen ground along coastlines allows for greater wind and water erosion, especially during severe storms. Warming oceans and melting glaciers increase ocean volume, causing sea level rise. A combination of erosion and sea level rise may necessitate community relocation in some cases.

Loss of sea-ice is also impacting habitat for arctic species and affecting subsistence activities.

Significant temperature change is predicted, particularly in fall and winter months. Note that in Barrow, June temperatures are projected to rise only 2-3° this century, but October-March temperatures are projected to increase by 20-25°
Warmer temperatures and a longer growing season are already causing an increase in shrub cover in the tundra, and higher evapotranspiration is likely to cause drying of some soils and wetlands. Shifting treeline and changing hydrology are likely to lead to species shifts and habitat loss for some arctic species, particularly those with narrow habitat requirements or restricted ranges. New species assemblages may become predominant and conditions change, particularly in western coastal areas.

Thunderstorms may also become more frequent. Shrub cover, drying, and lightning together may result in higher fire incidence.

Warmer winter temperatures and lower water availability may impact the manner in which heavy industry can operate on the North Slope.



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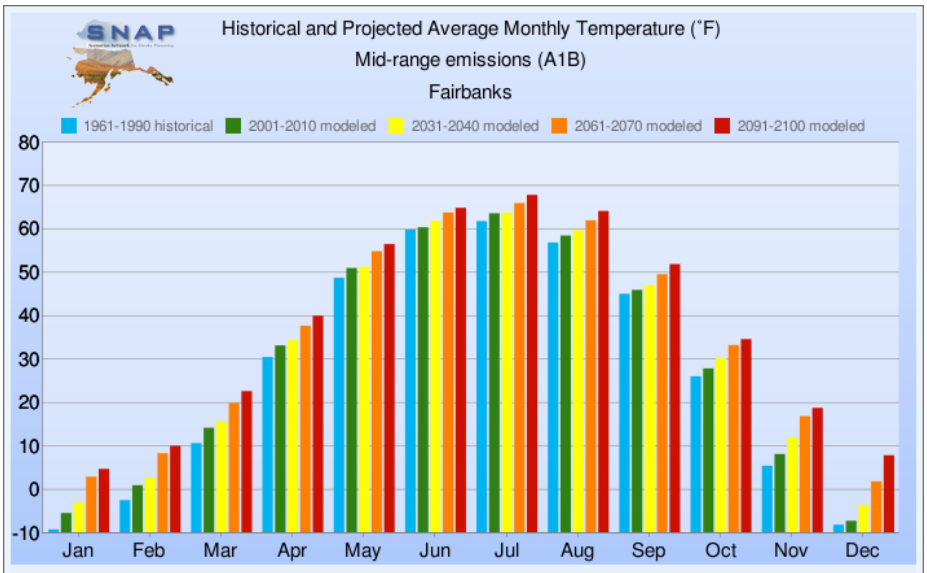
Interior



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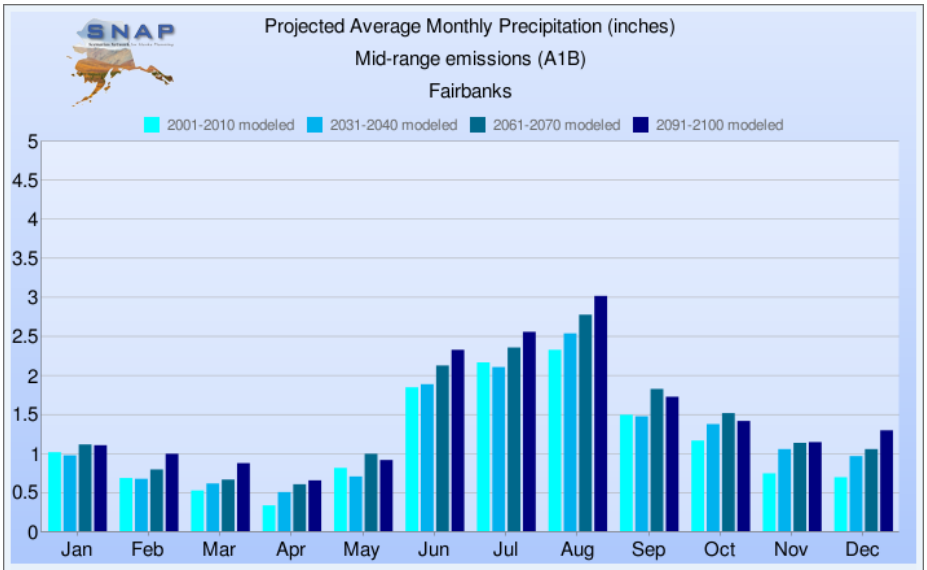
In central Alaska, changes in fire patterns are likely to have significant impacts on ecosystems. Fires may become more frequent and more intense due to drying soils. Note that little or no increase in precipitation is expected in spring (May), and that shorter winters may mean less snowpack even with higher overall precipitation.

Winter temperatures are projected to increase by as much as 15° by 2100. Insect outbreaks may spread north into the boreal forest as winter conditions become warmer, since cold winters are often the population-limiting factor for insects such as the spruce bark beetle.

Permafrost is currently discontinuous in the Interior. With increased temperatures, permafrost thaw may affect roads, pipelines, buildings, and other infrastructure, as well as wetlands and other wildlife habitat.

Changes in fire, hydrology, and permafrost as well as warmer winter temperatures are likely to cause species shifts, particularly an increase in deciduous tree species as compared to more fire-prone spruce. These vegetation shifts may in turn change the composition and frequency of wildlife species dependent upon them for food and cover.

A significantly longer growing season may have a positive impact on agriculture in the Interior, allowing for longer-season crops and reduced need for greenhouses. However, this more favorable growing environment may also allow for more invasive plants to enter the region. The migration of spruce northward and upward in elevation and lodgepole pine into the Interior is likely.



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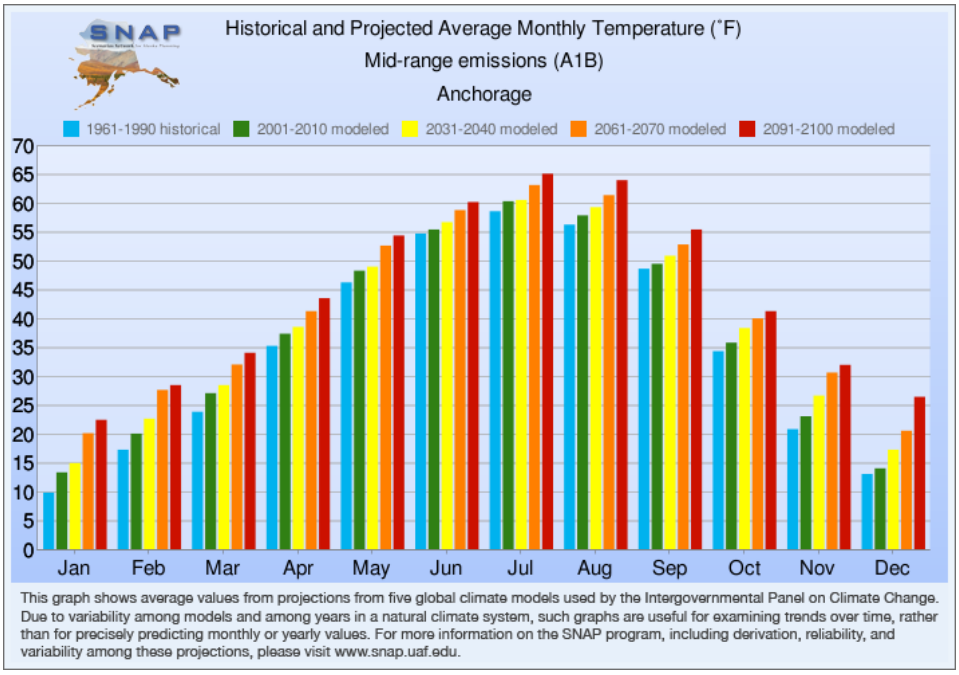
South Central

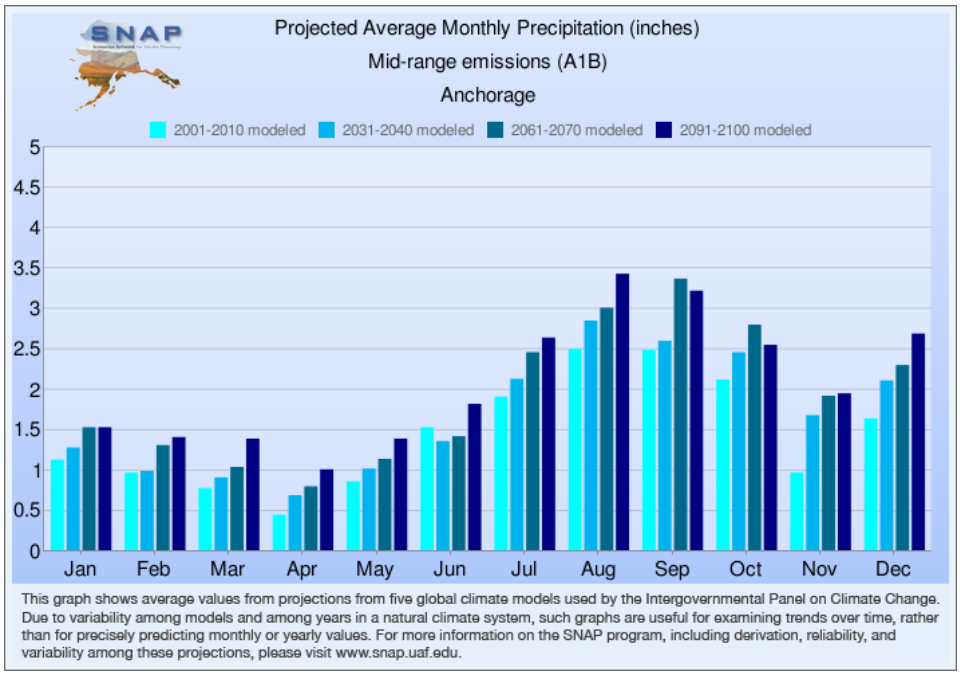


In south central Alaska, warming temperatures and associated drought stress may increase invasive species and other species shifts, including the incidence of insect outbreaks. Warmer weather, drying, and insect-killed trees may also increase the incidence and severity of forest fire.

Note that mean temperatures in Anchorage are projected to rise from well below freezing in November and March to slightly above freezing, with corresponding increases in December-February. Shorter milder winters may allow for greater survival of pest species that have been naturally excluded previously, as was the case with recent bark beetle outbreaks in this region. Milder winters are also expected to result in less snowpack, since a higher percentage of shoulder season precipitation would occur as rain. Winter thaw events and rain on snow events may become more frequent, with associated impacts to wildlife species that are reliant on snow cover or impacted by formation of an ice layer.

Species shifts may negatively impact ecosystem function and subsistence activities. However, longer growing seasons and milder winters may expand the agricultural potential of this region, allowing greater success for long-season annual crops as well as for fruit trees and other perennials.

In coastal areas, storm severity may increase, with associated risks from flooding and erosion.



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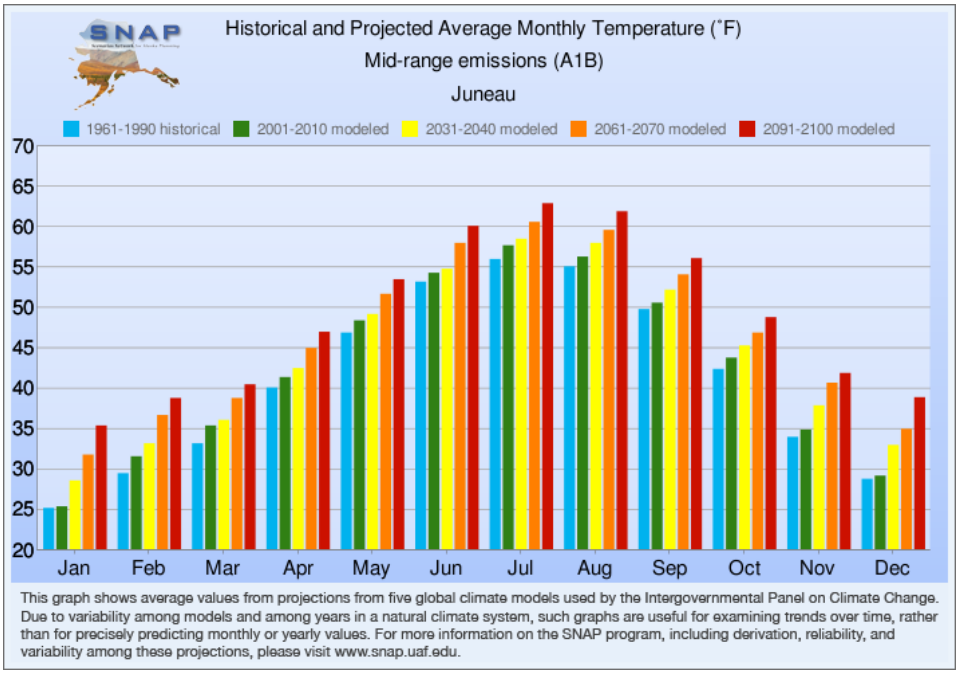
Southeast

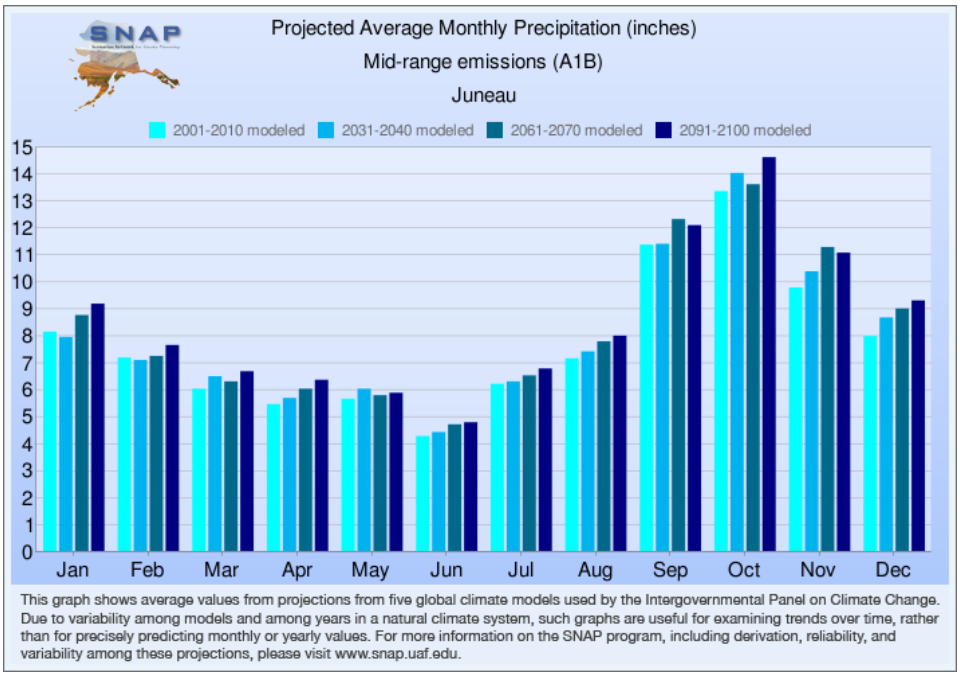


Changing ocean temperature, invasive species, erosion and storms may impact the fishing industry in southeast Alaska. However, since fisheries in other parts of the world may be impacted also, it is hard to predict the relative competitiveness of Alaska fisheries.

Tourism is a major source of revenue in southeast Alaska, and longer and warmer summers may benefit this industry. However, our models predict relatively modest increases in temperatures during the May-September season, and larger changes from October to April.

Although high precipitation has generally prevented forest fire from being a major driver in southeast Alaska in the past, warming and drying of soils may increase fire risk over the coming decades.

Our models suggest that below-freezing temperatures and snowfall will become increasingly rare in this region, at least at low elevations. Note that mean winter temperatures in Juneau are projected to rise from below freezing to well above freezing in the next few decades, potentially leading to little or no snowpack except at the highest elevations. Lack of snowpack is likely to affect species dependent on snow cover. This change will also affect hydrologic cycles, since winter runoff is likely to increase and less snowpack will be available to feed spring runoff. This changing hydrology may impact human water uses and anadromous fish.



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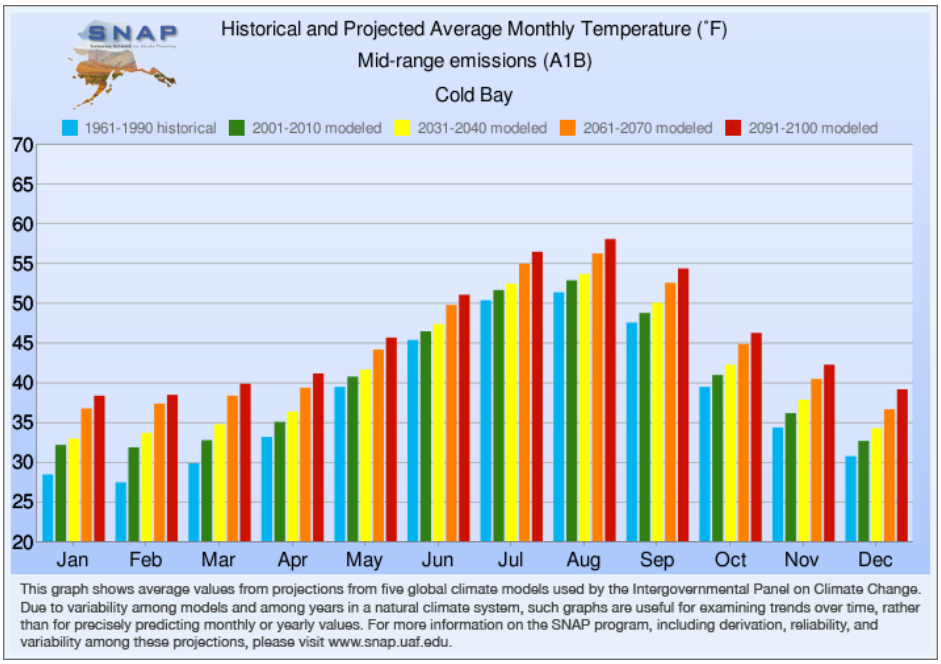
Southwest/Aleutians



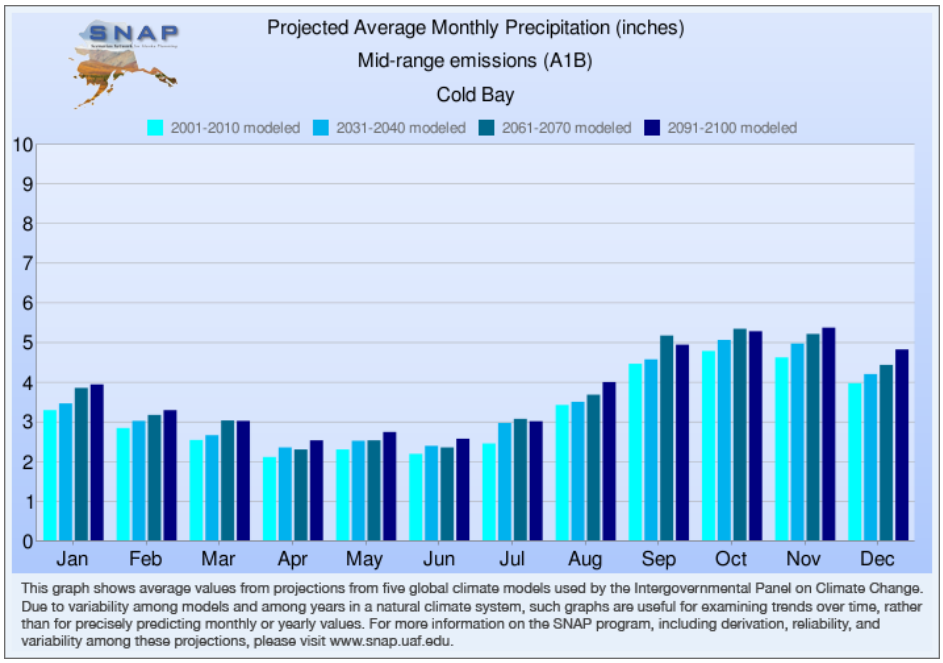
Increased incidence and severity of storms are likely to be of concern in Southwest Alaska.

As a result of sea level rise and storm surges, erosion may also be a problem. However, because these coastal areas are historically free of sea ice they will probably not experience the more extreme erosion of more northern regions.

In many parts of the Aleutians, decreased (or completely absent) snowfall may occur as mean winter temperature rise above freezing. Lack of hard frost may also drive species shifts and allow invasive species to encroach, although more remote islands may be less susceptible than other parts of the state due to the effects of island biogeography. In fact, it's possible that in some cases species shifts may not occur as rapidly as needed to keep up with changing climate conditions.

Tree line will continue to move westward as wet tundra areas dry and become occupied by the westward movement of the boreal forest.

Warming ocean temperatures are altering the Bering Sea ecosystem, impacting fish, marine mammals, and birds.



The chart tool used to create these graphs is available for 353 communities statewide, and can be found at www.snap.eud.edu

Sample questions and groups to contact

- How can we plan for climate change? *SNAP, CES, ACCAP*
- What are the specific climate projections for our community? SNAP
- How might climate change impact natural resources, businesses, and infrastructure? *SNAP*
- Are there energy programs, gardening programs, or products we can produce? *CES*
- Can we develop an educational program on climate change? *CES, SNAP, ACCAP*
- Can our community monitor the efficacy of emission reduction efforts? *CES*

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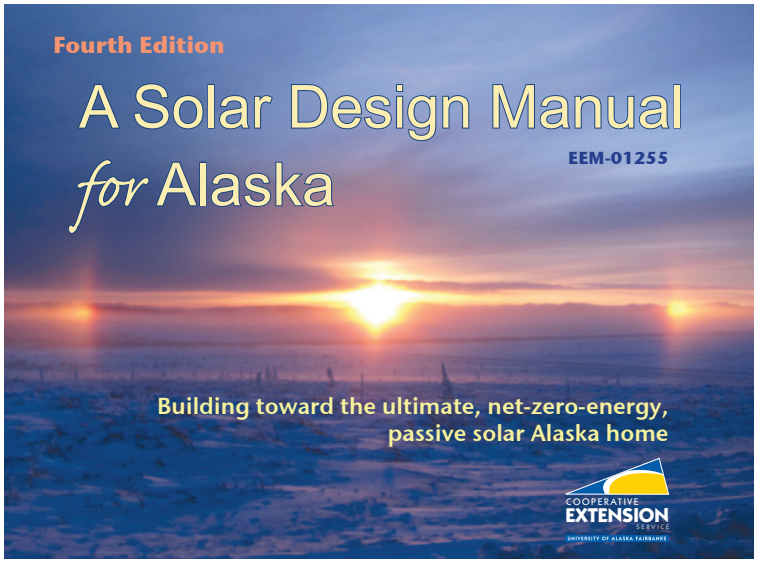
Passive Solar Design, continued from page 1

a 30 percent federal tax break. The manual includes suggested optimal insulation levels and the number of solar south-facing passive windows one might design for in order to achieve the ultimate passive solar design for Alaska.

This new manual will be the text for a new series of educational workshops aiming to demonstrate the best direction and most efficient way to build a structure to maximize the potential for low energy consumption and high renewable solar energy use. As in the past, the new manual will be available on the website www.alaskasun.org. Hopefully, the manual price will be listed on the website by the time this newsletter is released.



The newly updated manual will be available soon at www.alaskasun.org.

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