Tongass Climate Change Vulnerability Assessment
Phase I – Resource Inventory and Prioritization
Summary report

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The future climate in the Tongass National Forest will likely be different than both what we see now, and what we have seen in the past. A changing climate in southeast Alaska influences social, ecological, and economic systems that interface with the environments managed by the USFS. The long-term nature of climate change and the complexity of social-ecological interactions with those changes result in considerable uncertainty. Uncertainty is a common feature in natural resource planning, and considering alternative future scenarios is a useful way to plan in the face of uncertainty. In order to better prepare the Tongass for what the uncertain future might hold in terms of climate change in Southeast Alaska, the US Forest Service and the University of Alaska Fairbanks (UAF) have begun a three-phase vulnerability assessment. The purpose of this assessment is to provide a quantitative assessment of how vulnerable Tongass resources might be to climate-related changes in Southeast given a range of future climate scenarios.

Phase 1 was completed in May, 2012. The goals of phase I were to (1) develop accurate climate projections for the region, and (2) identify and prioritize key resources in the Tongass (salmon, hydropower, etc.) affected by climate change. Phase II will evaluate the impacts of climate on priority resources identified during phase I. Phase III will quantify sensitivity of each resource under alternative climate scenarios. Information from this three-phase assessment will inform decision-makers and foster an adaptive planning process to help manage critical social, ecological, and economic resources. This report summarizes results from phase I.

Methods

Climate Projection Development

The Scenarios Network for Alaska and Arctic Planning (SNAP) at UAF was responsible for developing climate projections for the Tongass based on the best-performing global climate models (GCMs) for Alaska. Climate models are simplified versions of reality that use mathematic equations to represent how the climate functions because of several atmospheric, land, and oceanic factors. These models behave differently under different scenarios (i.e., different assumptions about possible futures). SNAP uses three scenarios commonly employed by climate modelers based on assumptions about future greenhouse gas emissions; the primary driver of recent climate change. These scenarios are referred to as B1, A1B, and A2. As the scenarios are defined, projected future climate changes most under the A2 emissions scenario, and least under B1. B1 assumes reduced emissions in the future because of cleaner and more efficient technologies. A1B assumes moderate emissions into the future with a balance between fossil fuel and alternative cleaner technologies. A2, essentially a scenario of maintaining the status quo, assumes increased emissions with a rapidly growing human population mainly dependent on fossil fuels. The current trajectory of our planet is A2. For more details, please visit the SNAP website (http://www.snap.uaf.edu/).

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GCMs are available at coarse spatial resolutions (roughly 94 km pixels). Therefore, SNAP downscaled climate projections to be more useful to decision makers at the regional or watershed spatial scales. Using local weather station data and information on the influence of variables such as elevation, slope, and coastlines, SNAP created climate projections in and around the Tongass at resolutions of 800x800m (Alaska) and 2kmx2km (Canada). Projections for temperature, precipitation, freeze date, thaw date, and growing season length have been developed for the Tongass National Forest and surrounding area. Freeze date refers to the date that the temperature midpoint drops below 0° C (32° F). Thaw date refers to the date that the temperature midpoint rises above 0° C (32° F). Growing season refers to the number of days between thaw and freeze date. Monthly, seasonal, and decadal climate projections are available for all climate variables from years 1900 to 2100 (download at http://www.snap.uaf.edu/data.php).

Workshop

Through a collaboration of SNAP, USFS, Alaska Coastal Rainforest Center (ACRC), and Alaska Center for Climate Assessment and Policy (ACCAP), a 1.5-day stakeholder workshop was organized to meet three goals: (1) identify social, ecological, and economic resources in and around the Tongass vulnerable to climate-related changes, (2) using a set of climate scenarios, discuss how climate change may impact these resources, (3) prioritize a list of candidate resources for a more detailed analysis during phases II and III of the vulnerability assessment (Workshop Agenda attached, Appendix 1). A diverse group of roughly 30 participants and 10 observers were invited by the Tongass National Forest to help meet these goals (See Appendix 3 for a list of affiliations). Climate modeling experts gave presentations during the morning session of the first day of the workshop to provide an overview of the 3-phase process (Scott Rupp), vulnerability assessment framework (Paul Duffy), climate change projections for the Tongass (Todd Brinkman), and climate science uncertainty (Steve Gray). The remainder of the workshop focused on facilitating group discussion among participants and observers.

The first task given to the participants was for them, as a single group, to create an initial working resource list that included all social, ecological, and economic resources within the management realm of the Tongass that were perceived to be vulnerable to climate change. We did not want to limit what participants considered an important Tongass resource. Therefore, we did not provide participants with instructions on what should or should not be considered a resource. Also, we did not provide participants with a categorical scheme, scale, or relevant level of specificity (Ex. salmon vs. fish) when stating resources. Participants were asked to consider the following questions when compiling the resource list: (1) How likely is the resource to be impacted by climate change and related environmental change? (2) If the resource is impacted by climate change, how severe are the consequences? Participants were then divided into smaller groups to discuss the thoroughness of the list (e.g., determine if something important was missing) and better organize the list (e.g., eliminate redundancies). Individual groups provided summary reports of their discussions to the other groups. Lists reported from each groups were compiled into a single list by facilitators.

Again, participants were divided into small groups and given the second task to speculate about the probability that climate change will affect each resource on the list and consider the severity of the consequences if the resource is affected. This process required participants to think critically about the relationship between climate change and each resource, and it fostered the refinement of the list. Individual groups reported on their discussions and facilitators revised the working resource list.

At the end of the first day, individual participants were asked to prioritize the working list using the "dotmocracy" approach (see website for more details http://dotmocracy.org/). Dotmocracy is a method for determining agreement among meeting participants. This technique allowed each participant to provide a vote on whether they agreed or disagreed with each resource being included in the vulnerability assessment using 5-point ranking system (example Dotmocracy sheet attached, Appendix 3). For example, participants were asked if they "strongly agree" (2 points), "agree" (1 point), "neutral" (0 points), "disagree" (-1 point), or "strongly disagree" (-2 points). The number of dots in each category was multiplied by the category score and all categories were summed to get a relative score for each resource (Appendix 3). This process helped prioritize the working resource list.

During the morning session of the second day, a summary of dotmocracy results was reported to participants. Participants were divided into small groups to discuss findings and consider the following questions: (1) Are we acknowledging both short and long-term resource issues? (2) Are we acknowledging community, district, and regional needs? (3) Do we have the appropriate balance among ecological, social, and economic resources? Individual groups reported on their discussions and facilitators refined the resource priority list based on these discussions.

The resulting resource list was voted on one final time with individual participants indicating whether they agreed or disagreed with each resource being included in the prioritized list of resources using the the same 5-point ranking system outlined above. Remote control devices called "clickers" were distributed to each participant to register their vote. As the name of each resource was illustrated on a projector screen, participants reported how they ranked the resource using a button on their clicker. Tricia O'Connor (USFS) provided closing comments on future steps of the 3-phase vulnerability assessment.

Results

Climate Projections

As expected, the rate of climate change in the Tongass depends on the climate scenario used (B1, A1B, A2). However, under all scenarios, the Tongass is projected to warm (Fig. 1) and receive slightly more precipitation (Fig. 2) over the next century. Changes in temperature are expected to result in a longer growing season (Fig. 3), later or no anticipated freeze date (Fig. 3), and earlier or no anticipated thaw date (Fig. 3). All historical (1961-1991) averages and future climate projections (2010-2099) as decadal averages are available for transfer to the USFS in a variety of file formats (e.g., GeoTIFF, pdf, PNG). In addition, SNAP has created charts for every community in and around the Tongass illustrating projections of monthly decadal averages for temperature and precipitation (Fig. 4, download at http://www.snap.uaf.edu/charts.php).

Workshop

The initial working list included 42 Tongass resources (Table 1). At the time of the dotmocracy exercise, the list included 27 resources (Table 2). Dotmocracy results indicated that deer, snow, ice, water, and salmon were top-priority resources. At the time of the final vote using clickers, the list included 30 resources (Table 3). Clicker polling indicated that water, salmon, snow, and ice were top-priority resources.

Discussion & Future Steps

According to the prioritization process, it was evident that water-related resources were top priorities for a vulnerability assessment in the Tongass. Therefore, we anticipate that focusing Phases II and III on potential linkages between climate projections (temperature and precipitation) and changes in hydrology may address many stakeholder concerns. For example, the impact of climate change on snow (pack and line), ice (glaciers melt rate and timing), and rivers (quantity, quality, and timing) may be addressed through development of a climate-driven hydrology model. This indirectly would support projections of change in nutrient cycling which may provide important data to address change in fish (e.g., salmon) and forest habitat (e.g., yellow cedar). Additional focus on specific linkages among climate, culture, and economics also may be warranted. With USFS collaboration, SNAP and ACCAP are prepared to begin pre-proposal work on Phases II and III.

Table 1. Initial working resource list: Participants were asked to help create a complete list of resources vulnerable to climate-related changes in and around the Tongass National Forest.

Resource
•Old growth habitat and associated species •Alpine habitat and associated species •Aquatic habitat •Tidal and estuarine habitat •Ecosystem functions that promote productivity of any kind (economic, ecological) •Landscape connectivity and fragmentation associated with island archipelagos •Unique character of Southeast Alaska landscape. Combination of rural character, ecosystem functions, rural and native working side by side •Nutrient exchange between terrestrial and marine environment •Sitka deer, black bear, mountain goats •Raven, bald eagle •Deer and deer habitat •Berries, goose berries, alders, trees: hemlock, birch, cedar, Yellow cedar specifically •Devil's club, chocolate lilies, fiddle head, Hudson bay tea, berries •Sea cucumber, cedar bark and roots •Invasive species and diseases •All fresh water and marine fish and invertebrates •Important migratory and breeding sites •Distribution, pattern and change of all vegetation types •Plant-animal relationships •Species refuge habitat to protect against extinction •Overall disturbance regimes •Stream flow duration and quality •Adequate fish passage •Sufficient salmon for commercial, charter and subsistence •Water quality and quantity •Snow pack, glaciers •Sport hunting and fishing opportunities, commercial fishing •How will human populations change over time in Southeast communities (migration patterns) •Human resource, rural village people (possible migration, sustainability in rural locations) •Base of food chain - marine, estuarine, terrestrial •Subsistence hunting, fishing and gathering •Recreation use (commercial and non-commercial), winter/seasonal outdoor recreation •Tourists from far away. Highly variable and exotic, rugged landscape (glaciers, trees, rocks, ice) •Eco-tourism, cultural-tourism •Eagle crest skiing •Atmospheric monitoring. Need to maintain long term record of environmental monitoring •Renewable energy, hydropower storage •Energy development •Job opportunities •Funding opportunities for monitoring and research •Co-management opportunities that are inclusive of traditional ecological knowledge •Mineral extraction

Table 2. Results from the dotmocracy exercise. For each resource, participants reported to what extent they agreed or disagreed with each of the following resources being on the list for a vulnerability assessment. A five-point ranking system was used (strongly agree = 2, agree = 1, neutral = 0, disagree = -1, strongly disagree = -2). The score column represents sum of participants' votes (Appendix 3).

Resource	Score
Deer & Deer habitat	28
Snow, ice, water	28
Snow pack glaciers	27
Water quality, quantity, timing	24
Wild Salmon Systems	23
Hydropower	23
Yellow cedar	19
Nutrient exchange	16
Wild Alaska Food	16
Insects & disease	15
Tidal & estuarine habitat	13
Cultural & indigenous resources	12
Berries	11
Carbon	11
Renewable energy	11
Alpine habitat	10
Bears	9
Subsistence plants	8
Old Growth Habitat	8
Invasive Species	8
Community infrastructure	7
Tourism	6
Recreational use	6
Migratory and breeding sites	0
Jobs in the woods	0
Landscape connectivity	-4
Physical access to resources	-6

Table 3. Clicker polling results: A revised dotmocracy list was voted on using electronic clickers. Similar to the dotmocracy exercise, a five-point ranking system was used. For each resource, participants reported to what extent they agreed or disagreed with each of the following resources being on the list for a vulnerability assessment. A five-point ranking system was used (strongly agree = 2, agree = 1, neutral = 0, disagree = -1, strongly disagree = -2). The score column represents sum of participants' votes (Appendix 3).

Resource	Score
Water Quality, Quantity and Timing	37
Wild Salmon Systems	34
Snow, Ice and Water	32
Snow Packs and Glaciers	28
Alaskan Livelihood, Cultural Integrity and Economic Opportunity	23
Hydropower Storage and Energy	20
Tidal and Estuarine Habitat	19
Cultural and Indigenous Sustainability	18
Nutrient Exchange (Interaction Among Environments)	17
Insects, Disease and Parasites	16
Wild Alaska Food	13
Yellow Cedar	11
Community Resilience and Human Well Being	11
Invasive Species	10
Subsistence Plants	9
Deer and Deer Habitat	8
Community Infrastructure	4
Carbon	4
Renewable Energy	3
Migratory and Breeding Sites	2
Disturbance Ecology	2
Contaminants (air/water)	1
Alpine Habitat	0
Old Growth Habitat	-1
Berries	-1
Canopy Ecology	-2
Recreational Use	-4
Bears	-8
Outburst Floods	-10
Landscape connectivity	-14
Physical Access to Resources	-21

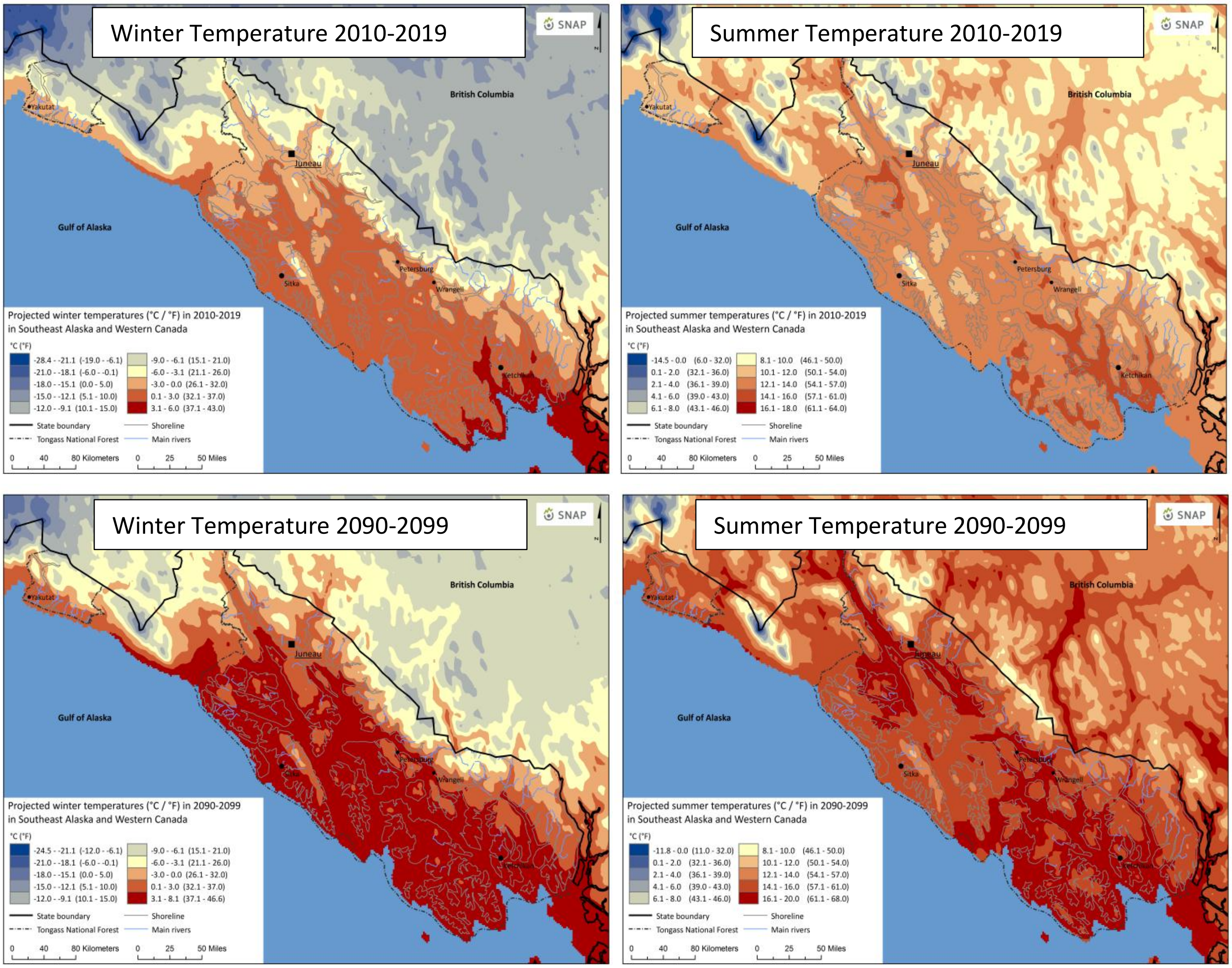

Figure 1. Decadal means (2010-2019 & 2090-2099) of winter and summer temperature projections in and around the Tongass National Forest.

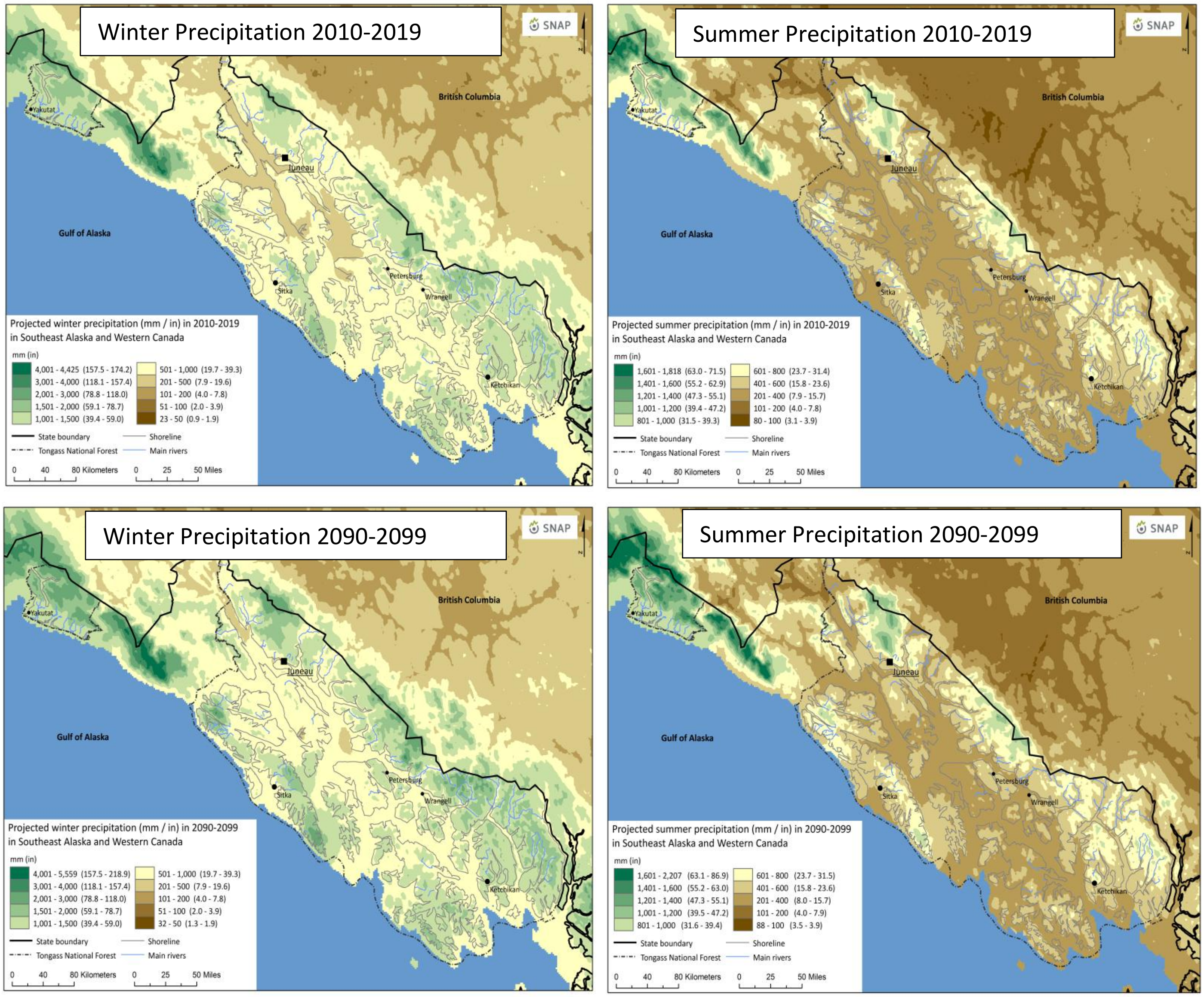

Figure 2. Decadal means (2010-2019 & 2090-2099) of winter and summer temperature projections in and around the Tongass National Forest.

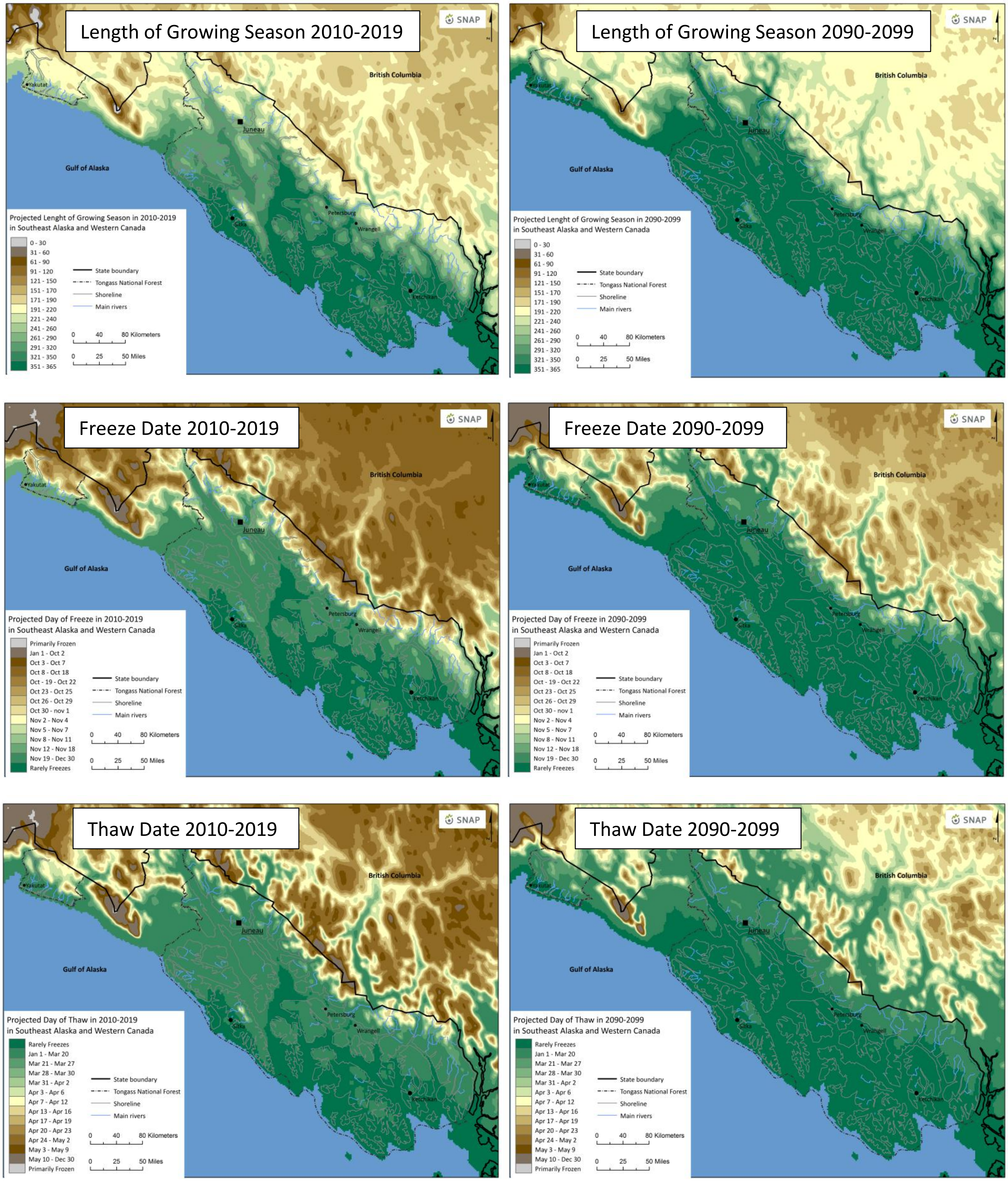

Figure 3. Decadal means (2010-2019 & 2090-2099) of length of growing season, freeze date, and thaw date in and around the Tongass National Forest.

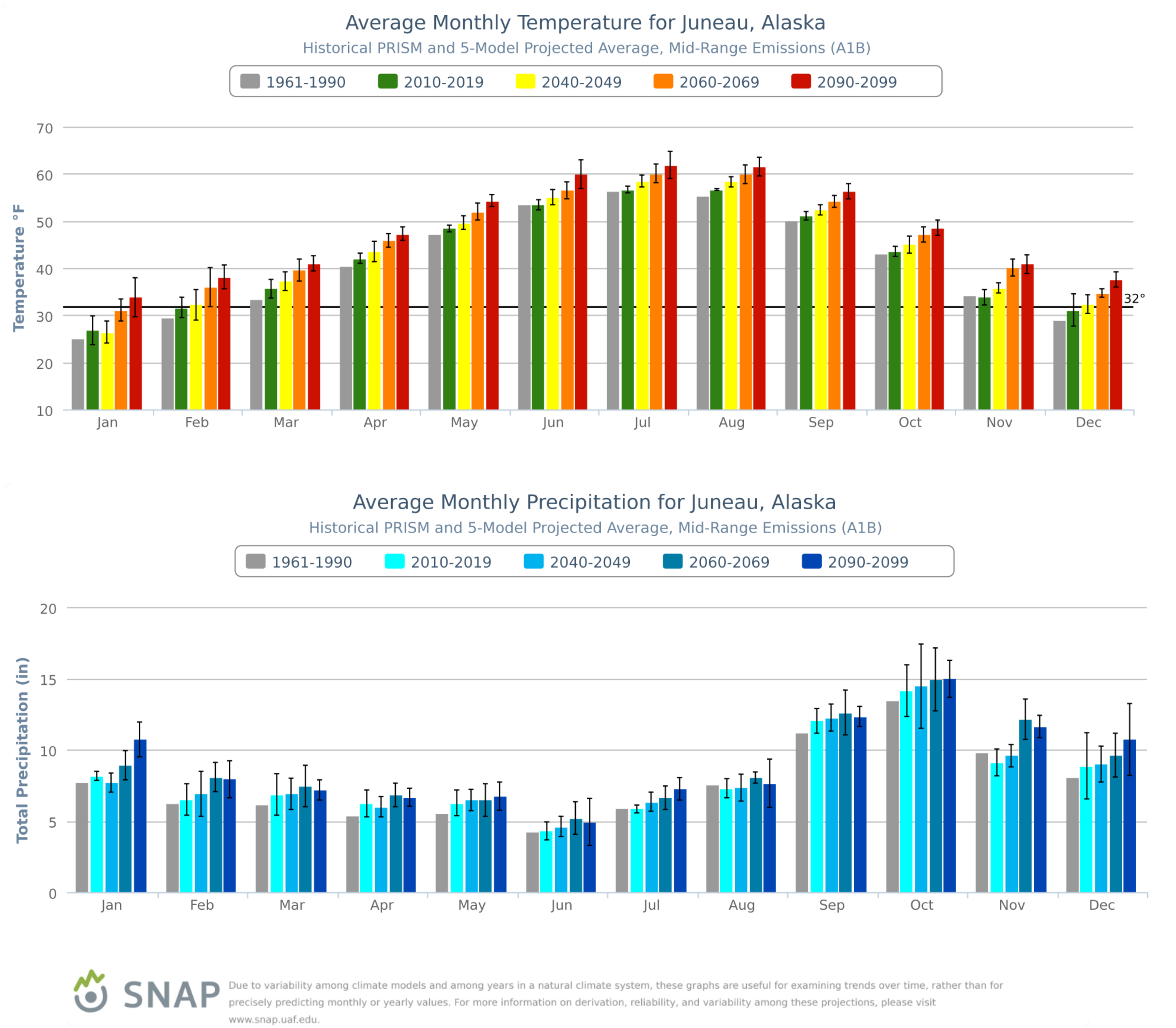

Figure 4. Example of a community chart for the Juneau, Alaska showing monthly temperature and precipitation projections using the A1B scenario.