Summary of Expected Climate-Related Change in Southeast Alaska

Parameter	Change to date (if no info, then current condition)	Projected Change	Direction and range of change expected in the future	Confidence	Map
Mean Annual Temperature	Mean annual temperature increase: +0.8°C from 1943 – 2005 (NOAA)	Approximate mean annual temperature increases for a high greenhouse gas emissions scenario: +0.5°C – 3.5°C by 2050 +2.0°C – 6.0°C by 2100 (SNAP; Wolken et al. 2011)	Mean annual temperatures are expected to increase with the highest rate of increase seen in winter months. Northern mainland showing greatest change and southern island provinces exhibiting the least change.	High >95%	SNAP Map Tool Maps 1-3
Temperature – Extremes		Projected changes in extreme temperature events: 3-6 times more warm events; 3-5 times fewer cold events by 2050. 5-8.5 times more warm events; 8-12 times fewer cold events by 2100. (NPS; Timlin & Walsh, 2007)	Northern mainland showing greatest change and southern island provinces exhibiting the least change.	High >95%	
Temperature – Summer		Approximate mean summer temperature increases for a high greenhouse gas emissions scenario: +0.5°C – 2.0°C by 2050 +2.0°C – 5.5°C by 2100 (SNAP)	Mean summer temperatures are expected to increase. Northern mainland showing greatest change and southern island provinces exhibiting the least change.	High >95%	SNAP Map Tool Maps 4-6
Temperature – Winter	Mean winter temperature increase: +1.1°C from 1943 – 2005 (NOAA)	Approximate mean winter temperature increases for a high greenhouse gas emissions scenario: +1.0°C – 3.5°C by 2050 +3.5°C – 6.0°C by 2100 (SNAP)	Mean winter temperatures are expected to increase at an elevated level compared to other seasons. Northern mainland showing greatest change and southern island provinces exhibiting the least change.	High >95%	SNAP Map Tool Maps 7-9

Parameter	Change to date (if no info, then current condition)	Projected Change	Direction and range of change expected in the future	Confidence	Map
Mean Annual Precipitation	Mean annual precipitation increase: +6.6cm (10%) 1943 – 2005 (NOAA)	Approximate mean annual precipitation increases for a high greenhouse gas emissions scenario: +5% - 15% by 2050 +15% - 35% by 2100 (SNAP)	Mean annual precipitation is expected to increase with the highest rate of increase seen in winter and fall months.	Uncertain	SNAP Map Tool Maps 10-12
Precipitation – Extremes		Projected changes in extreme precipitation events: Change of –20% to +50% by 2050 Change of –20% to +50% by 2100 (NPS)		Uncertain	
Precipitation – Summer		Approximate mean summer precipitation increases for a high greenhouse gas emissions scenario: +5% - 10% by 2050 +10% - 20% by 2010 (SNAP)	Mean summer precipitation is expected to increase.	Uncertain	SNAP Map Tool Maps 13-15
Precipitation – Winter	Mean winter precipitation increase: +6.6cm (+10%) 1943 – 2005 (NOAA)	Approximate mean winter precipitation increases for a high greenhouse gas emissions scenario: +5% - 15% by 2050 +25% - 35% by 2010 (SNAP)	Mean winter precipitation is expected to increase at an elevated level compared to other seasons.	Uncertain	SNAP Map Tool Maps 16-18
Precipitation as Snow	Mean winter snowfall decrease: -40.6cm (-18%) 1943 – 2005 (NOAA)	-119.1 cm to -77.4 cm Current (1961-90) to 2080 (Shanley et al. In review)	Precipitation as snow is expected to decrease, highest rate of decrease at low elevations where the average temperature is projected to be above freezing year round.	High	

Parameter	Change to date (if no info, then current condition)	Projected Change	Direction and range of change expected in the future	Confidence	Map
Snow Day Fraction		Snow day fraction is decreasing with few average monthly temperatures at low elevations projected below freezing by 2050. Average monthly temperatures are expected to be above freezing for all twelve months of the year in coastal temperate regions by 2100. (SNAP)	Snowline will move up slope and lower elevations will receive little to no snow by 2100.	High >95%	
Water Quality					
Temperature		Approximate river and stream temperature change: +1°C - 3°C by 2050 +2°C - 4°C by 2100 (Kyle & Brabets 2001)	River and stream temperatures are expected to increase.	High >90%	
pH		Increased pH levels in the ocean are expected as global temperatures rise and runoff into oceans increases.	pH levels expected to increase.		
DO		Increasing temperatures correlate to decreasing DO in streams and Oceans.	DO levels expected to decrease.		
Nutrients/metals		Increased mercury and other heavy metal concentrations are associated with increasing temperatures, increased precipitation, and decreased precipitation as snowfall. (Blais et al. 1998; Leitch et al. 2007)	Heavy metal concentrations are expected to increase.	Uncertain	
Other Spatial layers					
Infrastructure map					

Parameter	Change to date (if no info. then current condition)	Projected Change	Direction& Range of Change Expected in Future	Confidence	Map
Salmon Stream Use		Changes in summer water temperatures	Response will be highly variable and dependent on watershed. **Surface water sources** • Could be more or less favorable to growth & survival of juveniles depending on the amount of change & current temperatures **Ground water sources** • Increases in water temperature likely to be less than predicted for surface water systems. Likely to be minor effects of increased temperatures **Glacial water sources** • No change in summer water temperatures until glacial source disappears. If glacial smelt begins earlier and extends longer, then conditions for juveniles in main channel may be reduced.	High	
		Changes in winter water temperatures	Response will be highly variable and dependent on watershed. **Surface water sources** • Could result in increased rates of development of eggs, which could lead to fry emerging smaller & earlier. • This in turn, could result, in an extended growing season for juveniles, & potentially change from 2 year old smolt to a one year old smolt. • Also, could change time of ocean entry by smolts. **Ground water sources** • Water temperatures not likely to change, & if do will likely be small changes. These streams are warmer in winter than surface water systems so changes will not be as pronounced	Moderate	
		↑ summer flows	Could be more habitat available in floodplain type channels.	High	
		↑ winter flows	Could be more juvenile habitat available, particularly in floodplain type channels May lead to increased bedload movement & scouring of redds • Could be exacerbated if returning adults are smaller as a result of decreased ocean productivity (smaller fish have shallower redds) • Could be minor if flow can spread out across floodplain	Moderate	

Southeastern Park Units

Climate Variable	Projected Change by 2050	Projected Change by 2100	Confidence	Source
Temperature	+2°C ±1.5°C	+4°C ±2°C	>95% chance of increase	IPCC (2007); SNAP/UAF
Precipitation (rain and snow)	Increased precip (10%-20%), possible decrease in winter snow	Increased precip (20%-40%), possible decrease in winter snow	High uncertainty in timing of snowmelt	AMAP/SWIPA; SNAP/UAF
Freeze-up Date	5-10 days inland; freezeup may not regularly occur in coastal areas	10-20 days inland; freezup may not regularly occur in coastal areas	>90%	SNAP/UAF
Length of Ice-free Season (rivers, lakes)	7-10 days inland; freezeup may not regularly occur in coastal areas	14-21 days; freezeup may not regularly occur in coastal areas	>90%	IPCC (2007); SNAP/UAF
River and Stream Temps	1–3°C	2–4°C	>90%	Kyle & Brabets (2001)
Length of Growing Season	increase of 10–20 days	increase of 20–40 days	>90%	IPCC (2007); SNAP/UAF
Sea Level	3–24 inches	7–72 inches	>90% chance of increase	IPCC (2007)
Water Availability (soil moisture = precip minus PET)	decrease of 0–20+%	decrease of 10–40+%	>66%; varies by region	SNAP/UAF; Wilderness Society
Relative Humidity	0% ±10% increase or decrease	0% ±15% increase or decrease	50% = *as likely as not*	SNAP/UAF
Wind Speed	2–4% increase	4–8% increase	>90% chance of increase	Abatzoglou & Brown
Pacific Decadal Oscillation (PDO)	Uncertain effect of atm circulation anomalies on Alaska's climate	Uncertain effect of atm circulation anomalies on Alaska's climate	High degree of natural variation	Hartmann & Wendler (2005)
Extreme Events: Temperature	3-6 times more warm events; 3-5 times fewer cold events	5-8.5 times more warm events; 8-12 times fewer cold events	>95%	Abatzoglou & Brown; Timlin & Walsh (2007)
Extreme Events: Precipitation	Change of –20% to +50%	Change of –20% to +50%	*Uncertain*	Abatzoglou & Brown
Extreme Events: Storms	Increase in frequency/intensity	Increase in frequency/intensity	>66%	Loehman (2011)

Source: http://www.nps.gov/akso/nature/documents/SEAK_Drivers.pdf

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Potential Anticipated Effects of Climate Change on Hydrological Parameters in SE Alaska

	Watershed Type			
	Glacial	Clear Water		
Potential Impacts of Climate Change		Snow	Transitional	Rain
Altered stream flows				
Summer				
Timing	Earlier	No change	Lower earlier in year	None
Magnitude	Higher	No change	Lower	None/lower
Winter				
Magnitude	No change	No change	Higher & more variable	None[1]
Altered water temperatures				
Summer	No change	No change	Higher	Warmer
Winter		Warmer?	Warmer	Warmer
Annual Thermal Regime[2]	Colder	No/little change	Warmer	Warmer
Channel Response				
Floodplain	Intact: have more water in summer Altered: increased scouring in summer	No/little impacts	Intact: have more water in winter Altered: increased scouring in winter	Variable relative to assumptions about precipitation timing & magnitude
Constrained	No/little impacts	No/little impacts		

Source: G. Reeves, 2013

[1] This depends on the assumptions about changes in precipitation
[2] Number and timing of degree days accumulated